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## Artificial Intelligence in Health Policy – A Global Perspective

By Immanuel Azaad Moonesar & Ruchi Dass

*Abstract- Introduction:* Artificial Intelligence has become the new frontier for digital transformation. For healthcare, AI brings a paradigm shift, powered by increasing healthcare data availability and the rapid progress of analytics techniques globally.

*Objective:* Several hypotheses are set forward to design a policy framework for AI technologies was discussed. This review also suggests a framework that we reflect is a better case involving "responsible AI" and "permission less innovation."

*Methodology:* In this perspective review, AI insights into countries such as the USA, UAE, UK, and the European Union using secondary research.

*Results:* Policy recommendations would impact multiple stakeholders in the value chain. The efficient and responsible use of AI tools would mean culture, data management, technology shifts in the industry, and required up-grading and training professionals for better coordination

*Keywords:* artificial intelligence, privacy laws, future of AI, health policy, responsible AI.

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Immanuel Azaad Moonesar<sup>α</sup> & Ruchi Dass<sup>σ</sup>

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**Results:** Policy recommendations would impact multiple stakeholders in the value chain. The efficient and responsible use of AI tools would mean culture, data management, technology shifts in the industry, and required up-grading and training professionals for better coordination. To achieve the promise AI technology brings in and its efficient use, these policy suggestions will form the policy framework upon which key stakeholders collaborate. The key factors and elements crucial for informing policy with sufficient evidence include collaboration, facilitation, oversight management, quality structure, education, benchmarking and best practices, ethics and accountability and 'responsible AI.'

**Conclusion:** The review can influence policymakers and stakeholders to develop AI and data privacy policies and guidelines across countries globally in healthcare facilities, especially during the current drive towards the future of AI. Future research could investigate the effect of specific variables on healthcare facility users' perceptions that might influence AI use and data privacy.

**Keywords:** artificial intelligence, privacy laws, future of AI, health policy, responsible AI.

## I. INTRODUCTION

In the contemporary era, many governments worldwide shifted its' policy research agenda to understand and assess the uses of social media, e-services, digital transformation, smart cities, open government data, robotics, deep learning, big data, machine learning blockchain, and artificial intelligence. The idiom "artificial intelligence" was first coined by John McCarthy at a famously held workshop at Dartmouth

College, Hanover, USA, during 1956. According to John McCarthy, the father of Artificial Intelligence (AI) defined as "the science and engineering of making intelligent machines," and researchers define AI as the aim to "mimic human cognitive functions." For healthcare, AI is bringing a paradigm shift, powered by increasing healthcare data availability and the rapid progress of analytics techniques. AI generally encompasses of various activities such as machine learning, robotics, and deep learning. For the context of this perspective review, deep learning is where there are artificial neural networks. Secondly, machine learning is making machines that learn from data, such as Automatic Teller Machine cheque readers. And finally, robotics is creating devices and machines that move, such as autonomous vehicles.

AI has become the new edge for digital transformation. Many factors support and drive the fast and powerful evolution of Artificial Intelligence across industries. Most common amongst these are:

Access to sophisticated, fast, and cost-effective computing (processing) tools, hardware, and software and applications,

Availability of large (big) and longitudinal data sets generated by digital efforts worldwide and technologies like IoT.

Availability of open-source coding resources, online communities, users (coders and managers) sharing know-how.

However, many companies are still struggling with real business value, and many Governments are still toying with the idea. In a nutshell, everyone wishes to weigh the risk and reward before committing to such an expensive effort. The AI business risks can around [1, 17, 18]:

- Lack of transparency,
- Bias and discrimination/ social inequality,
- Accountability,
- Privacy and security of data and processes,
- Audit trails,
- Process oversight,
- Legal and regulatory governance, and
- Outcomes leading to mental or physical harm.

Hence, with the growing market potential and interest in AI, it is imperative to develop a thought-through regulatory and legal framework on the adoption

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and use of AI. Several hypotheses are set forward to design a policy framework for AI technologies; the authors will discuss them. This review also suggests a framework that we think is a better case involving "responsible AI" and "permission less innovation."

#### *Size of the problem*

As per the Grand View Research report, The global artificial intelligence market size was valued at USD 62.3 billion in 2020 and is expected to grow at a compound annual growth rate (CAGR) of 42.2% from 2020 to 2027. [1] AI decision-making applications that use algorithmic, neural networks, deep learning, expert and learning systems are used in education, digital imaging, healthcare, manufacturing, robotics, government, supply chain, manufacturing, and production can replace humans for a variety of processes and tasks. This dependency on automated AI-centric systems has raised enormous concern about over-allocating resources towards mitigating AI's most extreme impacts.

## II. UNDERLYING FACTORS

*Regulations:* There is an ongoing global debate on opaque AI systems, data protection regulations, and the lack of transparency on automated data processing. Regulatory approvals and interventions must have access and understanding of concrete definitions; however, the consensus around AI has been broadly worded, an elusive feat, especially in policy discussions. The United Kingdom and the European Union have already implemented AI policies that promote trustworthy AI. Europe has some stringent digital rules that are more strict than HIPAA rules in the US. For example, Article 22 stipulates that citizens cannot be submitted to medical decisions generated by an automated source. [2]NIST's revised data standards have become central to AI policy under the US's Trump order. [3]

*Policy versus Practice:* AI advocates and researchers define AI that highlights its usability, functionality, and process. On the other hand, while designing Policy frameworks, policymakers recognize AI as a tool that should have caution, sensitivity, and prudence like human beings compared to human behavior. Hence, sometimes policies tend to over accentuate concern on the future use of these technologies, ignoring current usability and present-day issues. [4]

*Human Rights:* Advances in technology suggest that industries shall be moving on to a high-level machine intelligence and super-intelligent AI in a few decades. Many recommend it as not safe for humanity. AI may take up a lot of human jobs and work. Although there may be some ambiguity and uncertainty around how jobs and human effort will transition to AI, governments are brainstorming on AI strategy to better prepare systems, users, and processes to minimize negative

impact. There is consideration required to understand the destructive power of AI as well. As suggested by Taddeo & Floridi (2018), there is a pertinent risk that the AI arms race [5] can trigger inadvertent development and AI use. Hence, in addition to Fairness, Accountability, Transparency, and Ethics, human rights serve as a complementary framework for guiding and governing AI and machine learning research and development. [6]

*Governance:* Here, we are taking the example of healthcare as an industry to understand governance-related challenges. Healthcare, as an industry, has established processes and frameworks. The fast pace development and roll-out of AI-related projects may hamper such frameworks. Hence, to maintain such processes and frameworks, an overarching framework must assess and establish potential areas of impact and how regulations may view these changes. Innovation in processes, analysis, and research needs to be developed in the light of maintaining transparency, accountability, and social impact/public interest, as stated in the problem statement above. In addition to these frameworks, it is also essential to develop skill sets amongst the subject matter experts and the user community to plan, assess, and evaluate the best use case of AI for their respective industries.

### III. POLICY RECOMMENDATIONS & IMPLICATIONS



Fig. 1: Recommendations on the AI policy framework

Policy suggestions below would impact multiple stakeholders in the value chain. This is because efficient and responsible use of Artificial intelligence tools would mean culture, data management, technology shifts in the industry, and required up-grading and training professionals for better coordination. To achieve the promise AI technology brings in and its efficient use, these policy suggestions will form the policy framework upon which key stakeholders collaborate. The key factors and elements crucial for informing policy with sufficient evidence include collaboration, facilitation, oversight management, quality structure, education, benchmarking and best practices, ethics and accountability and 'responsible AI.'

Given the risk imposed with the advancement and uptake of AI amongst industries, here are seven high-level recommendations summed up in Figure 1:

**Collaboration:** AI development and implementation should involve multi-stakeholders to collaborate for social, economic, ethical, and legal implications of AI. Public funding should be provided wherever possible to drive mandates for such collaborations nationally and internationally. Collaborations and partnerships should promote knowledge sharing, building access to information, and innovation. Hence, policymakers need to collaborate with AI experts and researchers to design and implement frameworks that facilitate research initiatives and are aligned with the technical practice of AI gapping the divide between policy and practice.

**Facilitation:** Involvement of experts and relevant stakeholders in discussing challenges and possible safeguards against threats. Both Public and Private sectors should pool inappropriate funding for the R&D

efforts pertaining to AI. All parties (regulatory and industry stakeholders) should come together to provide access to resources that help facilitate digitization, building data access, and encouraging incentives like tax credits for both profit and non-profit research that prioritizes transparency and evidence-based validation. Policy frameworks should enable data access by creating a cooperation culture among policymakers, experts, technology users, and the general public.

**Oversight management:** Safety and efficacy of AI are contingent upon well-thought-out risk management approaches and processes to align standards and drive compliance. "What the eye doesn't see, and the mind doesn't know, doesn't exist" [7]. Hence, awareness of possible misuse, abuse, and bias is necessary amongst both researchers and policymakers alike to influence norms, design, and applications, proactively analyzing and flagging potential misuse. The policy framework should highlight all actors- roles, process risks, liabilities, and incentives to highlight opacity, bias, discrimination, inefficiency, and any other negative impact (responsible disclosure).

**Quality structure:** It is vital that stakeholders understand AI risk distribution and liability while using AI tools. An ideal AI structure/ technological framework should support:

Guiding principles of being explainable, transparent (auditable), and fair (unbiased)

And augment human capabilities and maintain human well-being by being safe, ethical, and equitable (human-centric).

Hence quality assurance should be taken into perspective while designing, developing, and deploying AI tools. Policy frameworks also need to match real-world workflows, usability principles, and end-user needs. These AI-driven systems should also solve the redundant, disjointed, and dysfunctions of the technology/ operational systems.

*Education:* In addition to understanding the risk and opportunities of AI, it is also important to realize that an uneven distribution of technology and resources can hamper equitable access to AI resources. Hence, policymakers should influence investments in building AI infrastructure, training personnel, and building an engaging community of users and researchers that help demonstrate AI value leading to voluntary adoption and standards compliance. The education interventions with stakeholder involvement should also encourage keeping these frameworks up-to-date and perceptive to upcoming challenges.

*Benchmarking and Best Practices:* Microsoft, Accenture, and other global companies are members of the Partnership on AI, dedicated to research, discussion, and best practices publication. And the Future of Life Institute has published perhaps the most

comprehensive set of principles called the Asilomar AI Principles, signed by thousands of scientists and others, including Stephen Hawking, Elon Musk, and Dennis Hassabis.

*Ethics and Accountability:* AI adoption will only progress and reach its potential if it is used ethically to protect its users (that is, humans). A digital economic policy has been adopted by almost 40 countries, including the US and the European Union. For private organizations, the personal data protection commission (PDPC), Singapore, proposed a model that guides how ethical principles can be converted into implementable practices as per the World Economic Forum regulations. In 2018, the UK also mandated five principles that could become the basis for a shared ethical AI framework. These include [8]:

Development for common good

Act with fairness and clarity

Preserve data rights and privacy of communities.

AI to help improve citizens' cognitive intelligence alongside artificial intelligence.

Should not be used to destroy or deceive human beings autonomously.

#### IV. RESPONSIBLE AI

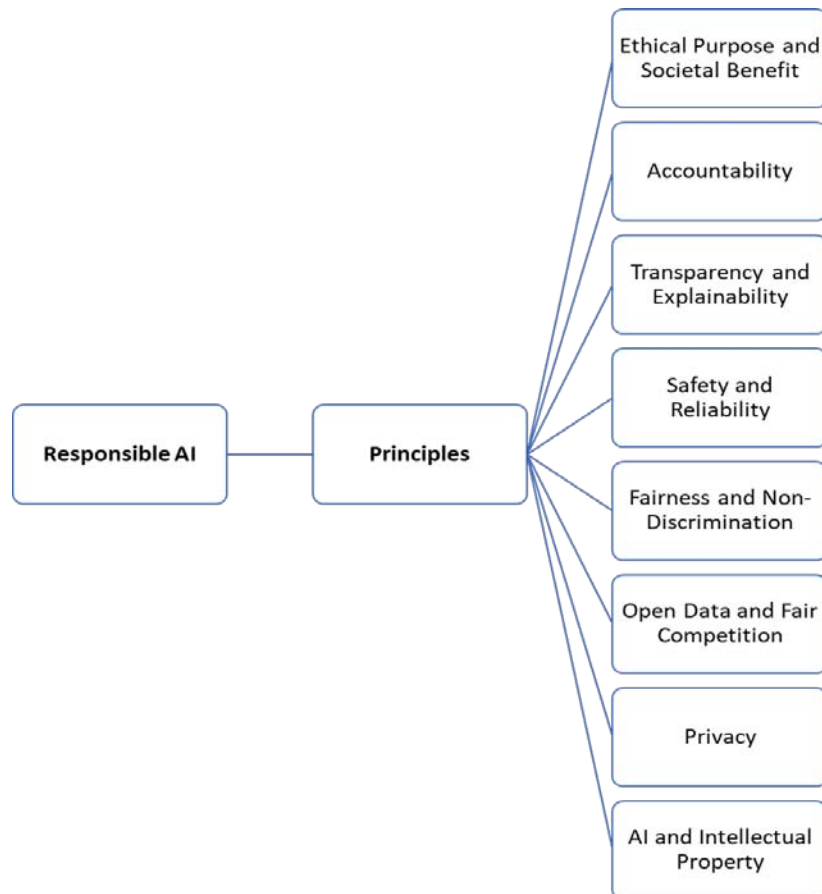


Fig. 2: Responsible AI overarching Principles

Responsible AI is a framework that emphasizes ethical, accountable, and transparent use of AI technologies congruous with human rights, societal norms, user expectations, and organizational values. The overarching eight principles of AI ethics and reliability as adapted from the Responsible AI framework by IT tech law is mentioned in Figure 2. [9]

Independent non-profit bodies like AI-Global [10] are an open platform combining reports, standards, government policies, models, open/available datasets, and open-source software to support affiliates better circumnavigate the AI landscape and directly align and link with the experts who are creating these valuable resources. For instance, the Institute for Ethical AI & Machine Learning is a UK-based research center that conducts highly-technical research into processes and frameworks that support the responsible development, implementation, deployment, and operation of machine learning systems.[11] Many other Data & AI Authorities also emphasize prioritizing ethics in AI and providing practical tools for responsible AI. Others like Certifai [12] work as an AI Risk Scanner application that detects and scores vulnerabilities in any black-box AI model. These application/tools primarily answer the questions around: Explainability- what was predicted and how "x" was predicted?

Fairness- Is it ethical or unfair to a particular group?

Robustness- Can the model be fooled? How robust is the model?

Compliance- Does the design comply with industry regulations?

Governments, private businesses, and non-governmental organizations across the Middle East region are recognizing the shift globally towards AI and advanced technologies. PWC [13] estimates that the Middle East is expected to ensue 2% of the total global benefits of AI in 2030, which is equal to US\$320 billion.

The UAE's national program on Artificial Intelligence aims at enhancing Government performance and efficiency. Recently, the Government of Dubai, Smart Dubai, published Dubai's Ethical AI Toolkit. The toolkit has been created to provide hands-on support across a metropolitan ecosystem. It supports academia, industry, and citizens in understanding how AI systems can be utilized responsibly. It comprises principles and guidelines and a self-assessment tool for developers to assess their platforms. [14] Europe's Communication on Artificial Intelligence, 2018 [15], submitted a report on the implication of AI implementation from the angle of safety and liability. As two-thirds of the value creation by AI contributes to the B2B segment, it is a call for us all researchers, academicians, business owners, governments, and industry leaders to come together and provide due consideration to ethical automation with the use of such technologies.

*Table 1:* Potential Solutions to AI drawbacks and implementation considerations

Drawbacks	Ethical challenge	Implementation considerations
<b>1 AI Black box</b>	<b>Unexplained Predictions</b>	<b>Build Transparency</b>
Though AI algorithms can learn from massive amounts of data and internalize them to make decisions, these algorithms could be a black box to even their creators. [16]	Predictions and decisions without reasons	<ul style="list-style-type: none"> <li>a) Transparent design, Interpretable output- Develop decision or prediction model with its explanation.</li> <li>b) Model Inspection-&gt; Model explanation-&gt;Outcome explanation</li> <li>c) Use what can be explained. Treat self-learning neural networks and solutions with care.</li> </ul>
<b>2 Algorithmic Complexity</b>	<b>Difficult to understand and comprehend the "how?"</b>	<b>Provide adequate training &amp; Validate models</b>
There is more emphasis on models to give smart decisions than ethical ones. Technical secrecy and complexity can be deception	Little understanding or skills around comprehending the algorithm, its functional elements, modus operandi, and relationship across system may blind decision making	Training is required for the end professional to interpret and explicably understand the AI models and the application. Enough test cases (vertical domain) should be run to validate the results of AI.



3 Data quality challenges	Biased data, Biased results	Data collection and processing need to be audited
If data collection is flawed, and the algorithm is narrow or subjective- it can provide biased results that emphasize a stereotype or not take the breadth of factors into account.	Data sets need to be sufficiently large and broad. The smaller size of the data sets can lead to inaccurate or biased results.	High-quality data are essential to train and run an Artificial Intelligence system. These need to be audited so that we can be prevented or detect, report, and neutralize at the earliest.[17]
4 Data Privacy & Cybersecurity	Vulnerabilities introduced in systems can expose private data	a) Accountability, disclosure, and compliance to prevent data theft is the need of the hour b) Robust systems that can withstand adversarial attacks
While introducing AI into systems, vulnerabilities can creep in, leading to data theft.	Cyber intrusion risks Privacy risks Adversarial attacks	Stronger disclosure laws requiring firms to comply to data privacy (data minimization; reporting security and privacy breaches) data protection impact assessments (DPIAs) should be performed before utilizing any personal data.  Neural fuzzing can be used to test large amounts of random input data within the software to identify its vulnerabilities. [18]  Compliance to data privacy regulations (European Union's General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA).

## V. CONCLUSION

The review can influence policymakers and stakeholders to develop AI and data privacy policies and guidelines across countries globally in healthcare facilities, especially during the current drive towards the future of AI. Future research could investigate the effect of specific variables on healthcare facility users' perceptions that might influence AI use and data privacy.

## VI. STATEMENTS

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## REFERENCES RÉFÉRENCES REFERENCIAS

1. Artificial Intelligence Market Size, Trends Analysis Report By Solution (Hardware, Software, Services), By Technology (Deep Learning, Machine Learning), By End Use, By Region, And Segment Forecasts, 2020 - 2027 (Rep. No. GVR-1-68038-955-5). (2020). Retrieved 2020, from <https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-market>
2. Gourraud, P. (2020). Differences between Europe and the United States on AI/Digital Policy: Comment Response to Roundtable Discussion on AI. *Gender and the Genome*, 4, 247028972090710. doi:10.1177/2470289720907103
3. Weber, R. (2019). Lawyers say NIST's revised data standards should be central to AI policy under trump order. *Inside Cybersecurity*, Retrieved from <https://search-proquest-com.lbs.idm.oclc.org/docview/2242766558?accountid=16482>
4. Krafft, P. M., Young, M., Katell, M., Huang, K., & Bugingo, G. (2020). Defining AI in Policy versus Practice. *Proceedings of the AAAI/ACM*

- Conference on AI, Ethics, and Society. doi:10.1145/3375627.3375835
5. Taddeo, Mariarosaria & Floridi, Luciano. (2018). Regulate artificial intelligence to avert cyber arms race. *Nature*. 556. 296-298. 10.1038/d41586-018-04602-6.
  6. Corinne Cath, Mark Latonero, Vidushi Marda, and Roya Pakzad. 2020. Leap of FATE: human rights as a complementary framework for AI policy and practice. In Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency (FAT\*20). Association for Computing Machinery, New York, NY, USA, 702. DOI: <https://doi.org/10.1145/3351095.3375665>
  7. "What the eye doesn't see and the mind doesn't know, doesn't exist."— D. H. Lawrence
  8. AI in the UK: Ready, willing and able? (Rep. No. HL Paper 100). (2019). Retrieved 2020, from Authority of the House of Lords website: <https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf>
  9. Responsible AI Policy Framework (Tech.). (n.d.). Retrieved August 17, 2020, from ITechLaw.org website: [https://www.itechlaw.org/sites/default/files/ResponsibleAI\\_PolicyFramework.pdf](https://www.itechlaw.org/sites/default/files/ResponsibleAI_PolicyFramework.pdf)
  10. Digital economy is next priority: The digital readiness of government ensures business continuity, regardless of the circumstances. (2020). Retrieved from <https://ai-global.org>
  11. The Institute for Ethical AI & Machine Learning. (2020). Retrieved from: <https://ethical.institute>
  12. Cortex Certifai: Evaluate AI models for robustness, fairness, and explainability. (2020). Retrieved from: <https://cognitivescale.github.io/cortex-certifai/>
  13. The potential impact of AI in the Middle East, by PWC. (2020). Retrieved from: <https://www.pwc.com/m1/en/publications/potential-impact-artificial-intelligence-middle-east.html>
  14. [https://www.smartdubai.ae/pdfviewer/web/viewer.html?file=https://www.smartdubai.ae/docs/default-source/ai-principles-resources/ai-ethics.pdf?Sfvrsn=d4184f8d\\_6](https://www.smartdubai.ae/pdfviewer/web/viewer.html?file=https://www.smartdubai.ae/docs/default-source/ai-principles-resources/ai-ethics.pdf?Sfvrsn=d4184f8d_6)
  15. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN>. The accompanying Staff Working Document (2018) 137 (<https://eur-lex.europa.eu/legalcontent/en/ALL/?uri=CELEX%3A52018SC0137>) provided a first mapping of liability challenges that occur in the context of emerging digital technologies.
  16. Davide Castelvecchi, Can We Open the Black Box of AI?, *NATURE* (Oct. 5, 2016) (characterizing "opening up the black box" as the "equivalent of neuroscience to understand the networks inside" the brain).
  17. FRA (2018a); Barocas, S. and Selbst, A. D. (2016). Data quality and artificial intelligence – mitigating bias and error to protect fundamental rights [https://fra.europa.eu/sites/default/files/fra\\_uploads/fra-2019-data-quality-and-ai\\_en.pdf](https://fra.europa.eu/sites/default/files/fra_uploads/fra-2019-data-quality-and-ai_en.pdf)
  18. AlMarzooqi, F. M., Moonesar, I. A., & AlQutob, R. (2020). Healthcare Professional and User Perceptions of e Health Data and Record Privacy in Dubai. *Information*, 11(9), 415. <https://doi.org/10.3390/info11090415>.



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## Usage of Business Analytics and Supply Chain Performance – An Empirical Study of Sri Lankan Apparel Sector

By Lakpura, D.D., Anuththara, K.H.G.M., Hansika, P.P.G.C.N., Fernando, K.E.H.,  
Ranjiva Munasinghe & Madhavika, W. D. N.

**Abstract-** Advances in technology and innovation require companies to embrace these new trends to compete and stay ahead in the business world. In particular, there is a need for companies to incorporate Business Analytics practices within their organizations. Business Analytics consists of two components: Information Systems and Business Process Orientation. This study aims to investigate the impact of the use of Business Analytics on the Supply Chain Performance in apparel companies in Sri Lanka. This research focuses on discussing the objectives developed to achieve the purpose of the study. To achieve this objective, this current study investigates the relationship between the Information System, Supply Chain Performance and the effect of the use of the Information System in the supply chains of Sri Lankan apparel companies. The study uses a quantitative approach. In this study, for quantitative analysis study performs regression analysis and decision tree analysis. This study identifies a positive relationship between the Information System and the Supply Chain Performance. For further future studies, it is advisable to extend this study by examining the performance of medium-and large-scale companies in the country.

**Keywords:** *business analytics, supply chain performance, information system.*

**GJCST-H Classification:** *J.1*



*Strictly as per the compliance and regulations of:*



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## I. INTRODUCTION

Business Analytics (BA) provides a strong foundation for organizations to gain a competitive advantage through 1) cost reduction, 2) improving the operations, and 3) automating business activities, which lead towards the achievement of the organizational objectives. BA methods help to retrieve and analyze large volumes of data, which facilitates strategic decision-making. The adoption of BA practices gradually transforms the current business world (Shao et al., 2018). BA is an umbrella concept, which consists of two components: Information Systems (IS) and Business Process Orientation (BPO) (Trkman et al., 2010). This research intends to study the role of BA and their usage on Supply Chain Performance (SCP) in Sri Lankan apparel companies, examined from the point of view of the company employees. In particular, we focus

on the relationship of IS on SCP. With the advances in technology and innovation, the necessity to incorporate BA practices has increased within the business world in particular; this is true for the Sri Lankan garment industry, where there is a lot of intense pressure and competition (Weeratunge, 2017).

Previously there are several studies conducted in Sri Lanka regarding SCP and its importance towards the country's economy. To the best of our knowledge, there have not been any studies on the role of BA on SCP within the Sri Lankan context. We aim to address this gap with this research.

### a) Problem Statement

The garment industry in Sri Lanka is one of the main contributors to industrial production, foreign exchange earnings, and employment. In 2006, the textile sector was considered the country's key foreign exchange earner: USD 2.97 billion, which was around 45% of the country's export revenues (Weeratunge, 2017). In 2008, the clothing industry contributed 40% of the industrial production of the country and was the largest contributor to the economy with 8% of the Gross Domestic Production (GDP). Recently, Sri Lanka's share of foreign exports has declined due to the GDP. Sri Lanka faced a decline in its total export earnings in 2012. The increase in the trade deficit in 2011 and 2012 is explained by the performance of the export market (Kelegama, 2013). Based on the existing research, the supply chain in the apparel sector faces critical competitive threats in the volatile market. Designs are changing rapidly in the apparel industry, and suppliers use the lawfulness strategy to maintain their competitiveness in the market (Weeratunge, 2017).

The industrial sector of Sri Lanka marked a significant drop of 3.2% in 2019 compared to 2018. The majority of the plunge was accounted from the apparel sector while the other sectors (Agricultural and Rubber Products) managed to retain their performance. The primary reasons identified for this fall are the low-quality of products and the high cost of production (Dheerasinghe, 2009). A decline of 50% is predicted from the apparel sector during the coming quarter due to the global pandemic situation occurred, which led to a pause in operations in the apparel sector. With the

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prevailing situation in the country, it is expected to have an export decline of 30% in 2021 (Rodrigo, 2020). The recent statement released by the Chairman of Joint Apparel Association Forum, A. Sukumaran, states that a 1.5 billion dollars of exports are to contract within the coming months. In 2019, apparel sector records a decline with their contribution. Further, the viral outbreak aroused in 2020 had a significant impact on the country's day-to-day activities. It severely affected the apparel sector operations, which led to a downfall of its performance furthermore.

b) *Scope of the Study*

The scope generalizes the use of BA methods, in particular, IS to increase the efficiency of the supply chain by reducing high costs and improving the quality of manufacturing products relative to the foreign market. The study investigates the relationship between IS and SCP, and its effect on SCP.

c) *Significance of the study*

As highlighted in the introduction, there has not been any work done previously about the use of BA in the Sri Lankan Apparel Industry, which looks at the employee perception of BA. In particular, this study aims to look at the usage of BA in terms of the IS and BPO components and its impact on SCP. As per the third objective developed, this current study examines the relationship of IS on SCP from the perception of employees in depth.

In the Sri Lankan context, apparel manufacturers are exploring new IS to compete with global market competitors in the export sector. A few international academic studies investigated on the usage of IS and its impact on SCP. The findings in these articles lay out the broad and deeper understandings of the effect of IS on SCP and how to improve the supply chain operation. The current literature indicates that supply chains in the garment sector have to face competitive and critical challenges in a very volatile market (Weeratunge, 2017). Apparel companies have rapidly evolved to maintain competitiveness using IS and the new technologies (Weeratunge, 2017). Coordinating IS to manage SCP must result in improving the performance of the supply chain, which deliver (high quality) new choices of garments at a rapid replacement cycle (Kincade et al., 2001). Also, researchers should study how IS has an impact on each SCP area, which leads toward the advancement of the apparel sectors SCP (Trkman et al., 2010). Our research will help assess the role and impact of BA, specifically the IS component, in SCP for Sri Lankan apparel companies.

d) *Research Questions*

Research questions explain and address the purpose of the study;  
 RQ<sub>1</sub> – What is the relationship of employees' perception about the role of IS on SCP?

RQ<sub>2</sub>– What is the employees' perception on the impact of IS on SCP?

e) *Research Objectives*

The objectives developed for the research are as follows:

*Primary Objective*

To determine the overall effect of BA on SCP from the perception of employees in Sri Lankan apparel companies.

*Sub-Objectives*

SO<sub>1</sub> - To determine the relationship of employees' perception about the role of IS on SCP.

SO<sub>2</sub> - To determine the employees' perception of the impact of IS on SCP.

II. LITERATURE REVIEW

a) *Business Analytics*

BA is an application of various advanced data analytical techniques to answer questions or solve problems related to Supply Chain Management (SCM). BA is not a technology, but a set of strategic approaches, organizational procedures, and tools used in combination with each other to gather information, analyze that information and predict the outcomes of the problem as solutions related to the four areas of the Supply Chain Operations Reference (SCOR) Model (Plan, Source, Make, Deliver)(Trkman et al., 2010). Monitoring and optimizing the SCP has been a progressively complex activity. It involves several management processes, such as the selection of measures, the definition of goals, preparation, communication, monitoring, reporting, and feedback. Thus, an approach based on conventional wisdom in the decision-making within the supply chain makes it impossible to manage the use of benchmark or better business practices of the supply chains. Therefore, data analytics becomes the backbone of decision-making in all business practices. Likewise, in supply chain, as accurate decision-making is dependent on large volumes and quantities of external and internal data, facilitated by BA. This ensures and enables the study of gathered data in large capacities (Nyamasege and Oteki, 2015).

b) *Information System*

IS plays a vital role in BA, and IS has an impact on SCP (Ravichandran et al., 2005). Also, companies benefit from the use of IS to increase their effectiveness of cost. However, the implementation of IS should be more closely related to the firm's strategies (Fairbank et al., 2006). Bourgeois (2014) states IS as a set of interlinked components in an operational chain that gathers, processes, stores, and exchange information to support the effective decision-making process, which systems are facilitated through analysis and graphical visualization. Moreover, IS is define as a combination of

compilation, storage, and processing of information and dissemination of information within the organization (Trkman et al., 2010). The processes involved with IS includes various information technologies such as computers, applications, databases, networking networks, the Internet, and mobile devices. Some performs various functions to interact with and to inform people in different operational or social contexts (Boell and Cecez-Kecmanovic, 2015). IS evaluates big data in the company using the systems and is the most efficient tool for improving efficiency and achieving difficult outcomes. The use of IS enhance the capability of the internal information processing of the enterprise.

c) *Supply chain performance*

The reasons for the drop in global exports (and thus of its contribution to the Sri Lankan GDP as a percentage) stated by the past studies are; 1) the quality of the operations and 2) the performance in the supply chain of the companies (Weeratunge, 2017). Competition is high, with exporters needing to deliver high-quality products at lower prices, thus placing a lot of pressure on the operations and SCP (Weeratunge, 2017). According to Cousin's strategic supply wheel model, there are several financial and non-financial factors affecting the SCP of the companies (Cousins et al., 2007). Tracing and improving the performance of a Supply chain has become an increasingly complex task for which BA is one of the current trending solutions. Most of the businesses within the world use BA as a bridge to seek solutions for their problems and investigate new ways to gain a competitive advantage

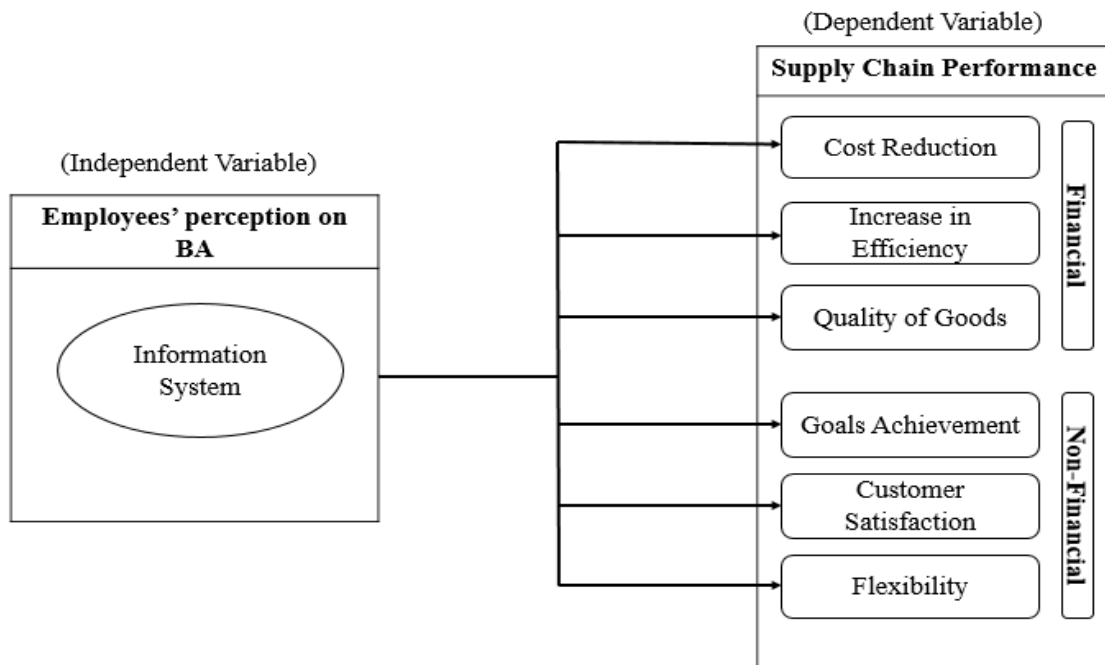
(Flynn et al., 2016). According to the globally conducted studies, a positive relationship is observed and analyzed between BA and SCP (Trkman et al., 2010). BA can help with the following factors (Wachira, 2013; Lee et al., 2007; Neely et al., 1995; Agus, 2011; Khan et al., 2020):

- Reducing the cost of production
- Improving the Quality of the products
- Achieving Organizational Goals
- Increasing the (operational) efficiency
- Addressing issues about customer satisfaction
- Improving the flexibility of the operations

BA improves the quality of the supply chains through proper integration and collaboration. BA deployment enables the management of large volumes of data (Mithas et al., 2011), thus allowing to make the supply chain activities within the company more productive and effective. BA facilitates knowledge sharing and strategic decision-making, which reduces the operational cost and helps in identifying the proper market trends of the industry (Hedgebeth, 2007).

III. CONCEPTUALIZATION FRAMEWORK

The conceptualization framework describes the research objectives by interpreting the interaction between BA and SCP with their dimensions derived from past literature. BA functions as an independent variable, while SCP acts as a dependent variable. The BA dimension is IS, and SCP has six dimensions, which include efficiency, goal achievement, cost reduction, flexibility, product quality, and customer satisfaction.



Source: Authors' Compilation

Figure 1: Conceptual Framework

#### IV. HYPOTHESES

The hypotheses tested in this study are;

H<sub>1</sub> - There is a relationship between employees' perception on IS and SCP.

H<sub>2</sub> - There is an impact from BA on each dimension of SCP from employees' perception.

#### V. DATA AND METHODOLOGY OF THE STUDY

This research study used a deductive approach since the study constructed hypotheses at the beginning. The sample consists of eight key players out of the thirteen key players listed in the apparel sector in the EDB report published in the Industry Capability Report in January 2020. This current study uses the total number of supply chain professionals in each sample company in deciding the number respondents for the data collection. The design proceeds with both quantitative based on primary and secondary data sources. The study conducted surveys for the data collection. Due to the current Covid-19 pandemic situation, the questionnaire sent via e-mail to the respondents. The Krejcie and Morgan sampling technique facilitated in selecting the number of respondents of each sample company. The study utilized SPSS version 25 and R software for quantitative data evaluation.

The study began with a pilot study to assess the reliability and validity of the data collected. Therefore, the study used Cronbach's Alpha in achieving this purpose. The application of the decision tree analysis, the regression analysis in the research achieved the quantitative analysis objectives. The study conducts binary logistic regression since the data obtained are categorical and ordinal. The dependent variable related questions are categorical, that is, "Yes or No" questions. Therefore, the responses are categorical. Independent variables consist of symmetrical one to five Likert scale questions. It consist of ordinal responses. The Likert scale degrees are as follows;

- 1 -> Extremely Disagree
- 2 -> Disagree
- 3 -> Neutral
- 4 -> Agree
- 5 -> Extremely Agree

#### VI. RESULTS AND DISCUSSION

##### a) Decision Tree Analysis

The decision tree analyses the best predictor of the independent variable IS, with each question inside the six dimensions of the SCP. Binary regression analysis measures the impact of IS on SCP. The rattle () package in R software performed the decision tree analysis. Figure 2 shows the best predictors resulted from the decision analysis;

Dimension	Best Predictor
IE1	IS2
IE2	IS2
IE3	IS5
IE4	IS5
QG1	IS2
QG2	IS4
QG3	IS1
QG4	IS6
CR1	IS3
CR3	IS1
CR4	IS5

Dimension	Best Predictor
GA1	IS6
GA2	IS2
GA4	IS5
F1	IS4
F2	IS4
F3	IS4
F4	IS4
CS1	IS4
CS4	IS1

Figure 2: Best Predictors of IS and SCP Dimensions

Figure 3 shows the survey questions developed by the authors for the current study by using the past researches as the foundation in collecting perceptions for the study.

Variable	Dimension	Question
Dependent (SCP)	IE1	Reduced lead time in manufacturing
	IE2	Improve Resource Planning ability
	IE3	Increase operational efficiency
	IE4	Increased efficiency of distribution planning
	QG1	Quality of goods delivered has improved
	QG2	Decreased supplier rejection rate
	QG3	Market share has increased
	QG4	Increased ability to respond to and accommodate new
	CR1	Decreased operational cost per operational hour
	CR2	Inventory carrying out cost has decreased
	CR3	Improve Cost effectiveness of products
	CR4	Total cost of distribution, including transportation and handling
	GA1	Profitability has increased
	GA2	Return on investment has increased
	GA3	Market share has increased
	GA4	Our company can quickly introduce new products, new
	F1	Has a higher flexibility of service systems to meet particular
	F2	Increased flexibility in operational plans
	F3	Adjust delivery capacity/ capability and quickly respond to
	F4	Improve responsiveness to changing market needs
CS1	Improvement of rapid handling of customer complains	
CS2	Our company can quickly modify products to meet our major	
CS3	Our company has an outstanding on time delivery records to	
CS4	Our company provide a high level of customer's services to	
Independent (IS)	IS1	Organization's Information System Currently support t the
	IS2	Organization's Information System currently support s the order
	IS3	Information System support s the distribution management
	IS4	The Information System currently supports the process (Make)
	IS5	The Information System support this process (Source)
	IS6	Information System currently support t the demand management

Figure 3: The Survey Questions of the IS and SCP Dimensions

b) Relationship between IS and SCP

This (RQ<sub>1</sub>) research objective discusses and explains the perception about the employees on the relationship between IS and SCP with use data collected for the study by conducting the chi-square test. The

Chi-square test determines the significant relationship between the dependent and independent variables described in the conceptual context.

H<sub>1</sub> - There is a relationship between employees' perception on IS and SCP.

Table 1: Significance level between IS and SCP Dimensions

Variables	Significance value (P- value)
IS1-IE	0.002
IS2-QG	0.007
IS3-CR	0.001
IS4-GA	0.000
IS5-F	0.000
IS6-CS	0.000

The alpha value in determining the significance is 0.05. If the Significant coefficient is less than the standard significant coefficient, which is the P-value, the hypothesis is true and if the coefficient result is higher than the standard significance value, then the observation is false.

**IS1-IE**

According to the chi-square test allocation, the p-value of IS and IE is 0.002. It concludes that the relationship between IS and IE is significant, since the p-value between IS and the selected question (IE) through the decision tree is smaller than the alpha value of 0.05. This concludes that the organizations IS currently supports the supply chain process, and it significantly increased the efficiency of the supply chain of the company.

**IS2 – QG**

The p-value of IS and QG is 0.007. Therefore, there is a significant relationship between IS and QG since the p-value of IS and the selected question (QG) is lesser than the alpha value of 0.05. The organizations IS currently supports the order commitment process, and it is significantly increases the quality of goods produced in the company.

**IS3 – CR**

The P-value between IS and CR is 0.001, which is lower than the standard alpha P-value therefore, there is a significant statistical relationship between IS and cost reduction in the supply chain. In other words, the proper distribution management within the production with the use of IS reduces the supply chain cost.

**IS4 – GA**

0.000 is the P- value between IS4 and GA; this is lower than the alpha value. Therefore, there is a significant relationship between IS4 and GA. The use of IS will facilitate for the goal achievement of the

company. When the process of making aligns well with IS, the goal achievements boosts as the manufacturing process is organized and integrated with the technology, which prevents the possible faults and risks in the operations.

**IS5 – F**

According to the chi-square test allocation, the P-value of IS and F is 0.000. This concludes a statistical relationship between IS and F since the P-value of IS and the selected question (F) across the decision tree is smaller than the alpha value of 0.05. Finally, we can assume that the IS support source process, and it significantly increased the flexibility.

**IS6 – CS**

According to the chi-square test allocation, the p-value value of IS and CS is 0.000. There is a significant relationship between IS and CS since the P-value of IS and the selected question (CS) across the decision tree is smaller than the alpha value of 0.05. Finally, we can assume that IS currently supports the demand management process, and it significantly satisfy the customers.

All dimensions under SCP are significantly improves with the implementation of IS within the supply chain of the apparel company. Thus in the end, we can accept the first hypothesis that is there is a significant relationship between IS and SCP.

**c) Impact from BA on the Dimensions of SCP**

H<sub>2</sub> - There is an impact from BA on each dimension of SCP from employees' perception.

This (RQ<sub>2</sub>) research objective discusses and explains the findings of the data collected from the survey with the use of binary logistic regression. Further, the objective analyzes how well IS could be used to improve the SCP of apparel companies.

*Table 2:* Results of Binary Logistic Regression – R2

Variables	Omnibus Tests of Model Coefficients	R Square %	Coefficient of the regression (B) %
IS1-IE	0.44	2%	0%
IS2-QG	0.015	1.2%	83.1%
IS3-CR	0.008	1.5%	84.2%
IS4-GA	0.007	1.5%	87.7%
IS5-F	0.000	4.7%	20%
IS6-CS	0.000	6%	78.7%

Binary logistic regression analyzed the impact of independent variables on the dependent variables. This resulted in a positive impact resulted from the independent variable towards each dependent variable through binary logistic regression analysis performed. Omnibus tests of model coefficients interprets that a significant improvement of each dimension of SCP with

the use of IS in the company's supply chain. Further, this model shows a good fit in the data; since R2 in model summary tables of each variable is lying between 0%-100% and is having a higher value; it indicates that the models are a good fit for the data collected. Finally, the regression coefficient implies that when the independent variable (BA) increased by a unit, the



dependent variable (SCP) increased by a unit. The summary table in table 2 indicates the coefficients of regression. Therefore, it concludes that there is an impact on each dimension of SCP from employees' perception of IS, which is the second hypothesis of the study.

The use of IS in the supply chains facilitates to increase the efficiency, improve the quality of goods, reduce the cost in the supply chain, for higher and effective goals achievement, improve flexibility, and to improve customer satisfaction. The favorable impact on these dimensions shows an improvement in the supply chain of apparel companies. Since IS is a dimension of BA, a tool used to measure BA, it concludes a higher SCP with the use of BA within the supply chains. This facilitates the improvement in SCP while turning the declining nature of exports to a boost in the exports.

Through the achievement of each sub-objective and answering all the research questions, at the end achieves the primary-objective, that is to determine the overall employees' perception about the role of BA on SCP among the Sri Lankan large-scale apparel companies. There is a positive perception on the role of BA on SCP. Adding more to it, the use of BA in the supply chain has a positive relationship. The use of BA increases the SCP of the organization through increasing the efficiency, reduction in cost, improving the quality standard of the goods produced, which are the financial dimensions of SCP. The non-financial aspects lead to the improvement of SCP as well, and they are improved goals achievement, customer satisfaction, and flexibility.

## VII. SUMMARY AND DISCUSSION OF FUTURE RESEARCH

As an umbrella concept, BA helps to improve the SCP of apparel firms in Sri Lanka. Based on the analysis undertaken in Sri Lanka using eight sample companies from the thirteen apparel companies identified in the industrial report published by EDB at the end of January 2020. The sample consists of key players in the apparel industry in Sri Lanka. The Integration allows companies to increase their production and productivity, contributing to success in the supply chain of firms. The current study is a discussion on the effect of IS on SCP in detail. Quantitative analysis is used to test the hypotheses and to achieve the objectives set for the current study on the basis of the hypotheses and objectives set for the present study. This quantitative analysis discusses and shows the use of IS had a positive effect on SCP. It also concludes an improvement in performance by integrating the supply chain with BA. The authors suggest further research to determine the efficiency of the supply chain by using medium and small apparel firms in Sri Lanka as a whole.

Further, to explore whether BA could even improve SCPs in other sectors.

## REFERENCES RÉFÉRENCES REFERENCIAS

1. Agus, A. (2011) Supply Chain Management, Supply Chain Flexibility and Business Performance. *Journal of Global Strategic Management* [online], v.1(5), pp.133-134. Available at: <https://doi.org/10.20460/jgsm.2011515818>. [Accessed: 21st June 2020].
2. Anderson, E. W., Fornell, C. & Lehmann, D. R. (1994) Customer Satisfaction, Market Share, and Profitability: Findings from Sweden. *Journal of Marketing* [online], v.58(3), pp.53-66. Available at: <https://doi.org/10.2307/1252310>. [Accessed: 20th June 2020].
3. Ambe, I. (2014) Key Indicators for Optimizing Supply Chain Performance: The Case of Light Vehicle Manufacturers in South Africa. *Journal of Applied Business Research* [online], v.30(1), pp. 277-289. Available at: <https://doi.org/10.19030/jabr.v30i1.8301>. [Accessed: 06th July 2020].
4. Bickman, L. (2000) Summing Up Program Theory. *New Directions for Evaluation* [online], v.2000(87), pp.103-112. Available at: <https://doi.org/10.1002/ev.1186>. [Accessed: 15th May 2020].
5. Boell, S. & D. Cecez-Kecmanovic (2015) What Is An Information System? [online], [Accessed: 20th September 2020].
6. Bolstorff, P. & Rosenbaum, R. (2003) Supply Chain Excellence: A Handbook for Dramatic Improvement Using the SCOR Model. [online], v.3. Available at: <http://www.bptrends.com/publicationfiles/07-03%20BR%20Supply%20Chain%20Excel%20-%20Bolstorff.pdf>. [Accessed: 05th July 2020]
7. Burt, D. N., Petcavage, S. D. & Pinkerton, R. L. (2010) Supply Management, 8th edn, The McGraw-Hill Companies, Inc. [online], pp. 1-641. Available at: [https://Studydaddy.Com/Attachment/34724/20160719135653supply\\_Management\\_\\_David\\_N\\_Burt.Pdf](https://Studydaddy.Com/Attachment/34724/20160719135653supply_Management__David_N_Burt.Pdf). [Accessed: 05th July 2020].
8. Bronzo, M., De Resende, P. T. V., De Oliveira, M. P. V., McCormack, K. P., De Sousa, P. R. & Ferreira, R. L. (2013) Improving Performance Aligning Business Analytics With Process Orientation. *International Journal of Information Management* [online], v.33(2), pp.300-307. Available at: <https://doi.org/10.1016/j.ijinfomgt.2012.11.011>. [Accessed: 06th September 2020].
9. Berisha-Shaqiri, A. (2014). Management Information System and Decision-Making. *Academic Journal of Interdisciplinary Studies* [online], v.3, Available at: <https://doi.org/10.5901/ajis.2014.v3n2p19>. [Accessed: 20th September 2020].
10. Beamon, B. M. (1999) Measuring Supply Chain Performance. *International Journal of Operations & Production Management* [online], v.19(3), pp. 275-

292. Available at: <https://doi.org/10.1108/0144357910249714>. [Accessed: 07th April 2020].
11. Chang, W. J. (2014) Market Orientation and Business-to-Business, A Meta-Analysis Perspective. *Int. J. of Services Technology and Management* [online], v.20, pp. 123-148. Available at: <http://doi.org/10.1504/IJSTM.2014.06356>. [Accessed: 20th September 2020].
  12. Dheerasinghe, R. (2009) Garment Industry in Sri Lanka Challenges, Prospects and Strategies. *Staff Studies* [online], pp.33. Available at: <https://doi.org/10.4038/ss.v33i1.1246>. [Accessed: 01st March 2020].
  13. Flynn, B. B., Koufteros, X. (2016) On Theory in Supply Chain Uncertainty and Its Implications for Supply Chain Integration. *Journal of supply Chain Management* [online], v.52 (3), pp. 3-27. Available at: <https://doi.org/10.1111/jscm.12106>. [Accessed: 22nd January 2020].
  14. Fish, L. (2011) Supply Chain Quality Management. *Supply Chain Management - Pathways for Research and Practice*, Dilek Onkal, Intech Open [online], pp.25-43. Available at: <https://doi.org/10.5772/19973>. [Accessed: 19th June 2020].
  15. Fawcett, S., Osterhaus, Magnan, G., Brau, J. & Mccarter, M. (2007) Information Sharing and Supply Chain Performance: The Role of Connectivity and Willingness. *Supply Chain Management: An International Journal* [online], v.12(5), pp. 358-368. Available at: <https://doi.org/10.1108/13598540710776935>. [Accessed: 05th July 2020].
  16. Gunasekaran, A., Patel, C. & McGaughey, R. E. (2004) A Framework for Supply Chain Performance Measurement. *International Journal of Production Economics* [online], v.87, pp. 333-347. Available at: <https://doi.org/10.1016/j.ijpe.2003.08.003>. [Accessed: 19th June 2020].
  17. Hedgebeth, D. (2007) Data-Driven Decision Making for the Enterprise: An Overview of Business Intelligence Applications. *VINE* [online], v.37, pp.414-420. Available at: <https://doi.org/10.1108/03055720710838498>. [Accessed: 07th March 2020].
  18. Javied, T., Rackow, T. & Franke, J. (2015) Implementing Energy Management System to Increase Energy Efficiency in Manufacturing Companies. *Procedia CIRP*, v.26, pp.156-161. Available at: <https://doi.org/10.1016/j.procir.2014.07.057>. [Accessed: 04th June 2020].
  19. Kelegama, S.(2013) Export Sector in Sri Lanka: Issues and Challenges. [PowerPoint Slides]. Retrieved from Institute of Policy Studies of Sri Lanka [online], Available at: [https://www.ips.lk/wp-content/uploads/2017/06/xeport\\_nce.pdf](https://www.ips.lk/wp-content/uploads/2017/06/xeport_nce.pdf). [Accessed: 03rd June 2020].
  20. Khan, H., Sadat, S. M. & Kamboj, H. (2020) Factors Affecting Customers' Satisfaction of Online Shopping- Evidence From Kabul, Afghanistan. [online], v.22, pp.11-17. Available at: <http://doi.org/10.9790/487X-2205041117>. [Accessed: 05th July 2020].
  21. Kincade, D. H., Vass, D. & Cassill, N. L.(2001) Implementation of Technology and Relationships to Supply Chain Performance: Apparel Manufacturers' Perspectives. *The International Review of Retail, Distribution and Consumer Research* [online], v.11(3),pp.301-327. [Accessed: 17th January 2020].
  22. Kleverlaan, M. (2008) Supply Chain Performance. *Journal of Operations Management* [online], v.25(1), pp.9-35. Unpublished. [Accessed: 20th February 2020].
  23. Lee, C. W., Kwon, I.-W. & Severance, D. (2007) Relationship between Supply Chain Performance and Degree of Linkage Among Supplier, Internal Integration, and Customer. *Supply Chain Management: An International Journal* [online], v.12 (6), pp.444-452. Available at: <https://doi.org/10.1108/13598540710826371>. [Accessed: 04th March 2020].
  24. Mithas, S., Ramasubbu, N. & Sambamurthy, V. (2011) How Information Management Capability Influences Firm Performance. *MIS Quarterly* [online], v.35, pp.237-256. [Accessed: 07th March 2020].
  25. Neely, A., Platts, K. (1995) Performance Measurement System Design: A Literature Review and Research Agenda. *International Journal of Operations and Production Management* [online], v.15 (4) pp. 80-116. Available at: <https://doi.org/10.1108/01443579510083622>. [Accessed: 10th January 2020].
  26. Negash, S. & P. Gray (2008). *Business Intelligence. Handbook on Decision Support Systems 2* [online], pp. 175-193. [Accessed: 20th September 2020].
  27. Nigel, S., Chambers, S., Harland, C., Harrison, A. & Johnston, R. (1995) *Operations Management*, London, Pitman Publishing. 1st edn, [online], [Accessed: 19th June 2020].
  28. Nyamasege, O. & Oteki, E. (2015) Effect of Supplier Relationship Management on the Effectiveness of Supply Chain Management in the Kenya Public Sector. *International Journal of Managing Value and Supply Chains* [online], v.6, pp.25-32. [Accessed: 07th March 2020].
  29. Ravichandran, T., Lertwongsatien, C. & Lertwongsatien, C. (2005) Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective. *Journal of Management Information Systems* [online], v.21, pp.237-276. Available at: <https://doi.org/10.1080/07421222.2005.11045820>. [Accessed: 07th March 2020].
  30. Rodrigo, P. (2020) Covid - 19 has taken its toll on Sri Lanka clothing sector. *Just-Style: Apparel Sourcing Strategy* [online], Available: [© 2021 Global Journals](https://www.just-</a></li>
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- style.com/analysis/covid-19-has-taken-its-toll-on-sri-lanka-clothing-sector\_id138909.aspx. [Accessed: 04th June 2020].
31. Sehgal, V. (2011) Supply Chain as Strategic Asset: The Key to Reaching Business Goals. [online], pp. 1-325. Available at: <https://doi.org/10.1002/9781118269176>. [Accessed: 07th August 2020].
  32. Sahay, B. S. & Ranjan, J. (2008) Real Time Business Intelligence In Supply Chain Analytics. *Information Management & Computer Security* [online], v.16(1), pp.28-48. Available at: <https://doi.org/10.1108/09685220810862733>. [Accessed: 22nd June 2020].
  33. Shao, B., Shi, Z., Choi, T. & Chae, S. (2018) A Data-Analytics Approach To Identifying Hidden Critical Suppliers In Supply Networks: Development of Nexus Supplier Index. *Decision Support Systems* [online], v.114, pp.37-48. Available at: <https://doi.org/10.1016/j.dss.2018.08.008>. [Accessed: 10th January 2020].
  34. Shepherd, C. & Gunter, H. (2006) Measuring Supply Chain Performance: Current Research and Future Directions. *International Journal of Productivity and Performance Management* [online], v. 55(4), pp.242-258. Available at: <https://doi.org/10.1108/17410400610653219>. [Accessed: 18th April 2020].
  35. Sun, Z., Strang, K. D. & Firmin, S. (2017) Business Analytics-Based Enterprise Information Systems. *Journal of Computer Information Systems* [online], v.57(2), pp.169-178. Available at: <https://doi.org/10.1080/08874417.2016.1183977>. [Accessed: 06th September 2020].
  36. Suchanek, P. & Kralova, M. (2015) Effect of Customer Satisfaction on Company Performance. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* [online], v.63(3), pp.1013-1021. Available at: <https://doi.org/10.11118/actaun201563031013>. [Accessed: 30th March 2020].
  37. Taber, K. (2017) The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education* [online], pp.1-24. Available at: <https://doi.org/10.1007/s11165-016-9602-2>. [Accessed: 21st August 2020].
  38. Trkman, P., McCormack, K., Oliveira, M. & Ladeira, M. (2010) The Impact of Business Analytics on Supply Chain Performance. *Decision Support Systems* [online], v.49, pp.318-327. Available at: <https://doi.org/10.1016/j.dss.2010.03.00>. [Accessed: 07th March 2020].
  39. Wachira, R. (2013) Supplier Relationship Management and Supply Chain Performance in Alcoholic Beverage Industry in Kenya [online], [Accessed: 08th February 2020].
  40. Weeratunge, R. A. D. D. (2017) Role of Supply Chain Management (SCM) in Strategic Competitiveness: A Literature Review on Apparel Sector in Sri Lanka. *International Journal of Scientific and Engineering Research* [online], v.8(6), pp.495-506. [Accessed: 14th July 2020].





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## MyVote - An Effective Online Voting System that can be Trusted

By Harshitha B & Veerabhadra Swamy N.S

*Abstract-* In a country where leaders are elected by the people, election, and the process of electing play a crucial role. Every citizen of a country has the “right to vote”. There are different ways of casting a vote and electing an individual. With such a large population, the country needs its own effective and secure voting system. The voting system has made drastic changes from traditional paper ballot voting to current electronic voting and now the online voting system. Advancements in the new system eliminate the drawbacks of the previous system. This paper proposes a new online voting system that provides every individual to cast a vote securely and effectively irrespective of the location.

*Keywords:* booth officer, EVM, EPIC.

*GJCST-H Classification:* H.4



*Strictly as per the compliance and regulations of:*





# MyVote - An Effective Online Voting System that can be Trusted

Harshitha B<sup>α</sup> & Veerabhadra Swamy N.S<sup>σ</sup>

**Abstract-** In a country where leaders are elected by the people, election, and the process of electing play a crucial role. Every citizen of a country has the “right to vote”. There are different ways of casting a vote and electing an individual. With such a large population, the country needs its own effective and secure voting system. The voting system has made drastic changes from traditional paper ballot voting to current electronic voting and now the online voting system. Advancements in the new system eliminate the drawbacks of the previous system. This paper proposes a new online voting system that provides every individual to cast a vote securely and effectively irrespective of the location.

**Keywords:** booth officer, EVM, EPIC.

## I. INTRODUCTION

The election, or the voting should be simple, secure, and robust so that any individual can easily enjoy the freedom of voting. The system should be transparent and intelligible so that voters and candidates can accept the results of the election. Manual intervention should be avoided, which leads to manipulation of the system and electing a wrong leader. A secure voting system should have the following criteria: **Authenticity:** Our proposed system concentrates on authenticity of a voter by checking with the EPIC number, name, and phone number of an individual. If any one of these information is correct, then the voter is identified as an authenticated person and is allowed to vote. Since voting is the secret process, voters should be the highest priority to make the voting process fair.

**Security:** Security is the primary factor in any online system. Security should prevent the duplication of votes. Un- authenticated person should be filtered in the early stages itself. In the proposed system, the booth officer is responsible for providing security by eliminating duplicate, fake voters.

**Usability:** The election/voting should be simple, easy, and understandable by every individual regardless of age, disability. Our system is usable and friendly since all the verification and validation are carried out by the booth officer, and the voter can simply cast a vote.

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**Time and cost:** The voting process should be simple and easy. It should not be tedious and cumbersome. The voter should enjoy the election. Our system is less time consuming, since all the information is already in the database and only verification is carried out at the time of voting. It reduces time.

## II. EXISTING SYSTEM

The voting is the right of every citizen. Vote confirms our right as citizens to elect the leaders of the government. The voting is the most effective way to express the right of every individual. The voting system records the votes of the people, and the results should be accurate and unbiased.

### a) Paper Ballot Voting System

The paper ballot system is the initial and traditional system of voting. In this system, the votes were cast by means of the papers in which the voter used to vote by marking the ballot paper with a rubber stamp, the voter then folds the ballot paper and put it in the ballot box, which is kept safe in the eye of allotted officers.

#### i. Advantages of the Paper Ballot Voting System

**Simplicity:** The Paper Ballot is easy to understand since the procedure is easy. The voter just has to put the mark in the box next to the name of the candidate.

**Eliminates duplicate votes:** Since each voter is given only one chance to vote, this eliminates duplicate votes.

**Less costly:** The system is very much affordable than the electronic system as the major requirements are only paper and the ballot box.

**No fear of technological errors:** The paper ballot voting included no electronic device. Hence there is no fear of hacking, fraud, replacement of parts, and errors in the election process.

#### ii. Disadvantages of The Paper Ballot Voting System

**Time Consuming:** As only one person can vote at a time, it is very time consuming, and a slow process.

**Results of the voting are delayed:** The results of election cannot be declared immediately since all the ballot boxes should be collected at one specific location, and then the counting should start.

### b) Electronic Voting Machine (EVM)

Instead of ballot boxes, electronic voting machines were introduced. This machine has a control

unit and a ballot unit. The ballot unit has 16 candidate buttons, and if any of them is unused, they are covered with a plastic masking tab inside the unit. An EVM can record a maximum of 3840 votes. It is not possible to vote more than once by pressing the button again and again. As soon as a particular button is pressed, the vote is recorded for that particular candidate and the machine gets locked. As soon as the last voter has voted, the polling officer will press the close button. After that EVM will not accept any votes.

i. *Disadvantages of Electronic Voting System EVMs Systems Lack Transparency:* A voter cannot observe the process inside the machine and must blindly trust that the votes are registered.

*Vulnerability to Fraud:* If people have knowledge and access to machines, one can take out the memory card that stores the votes and can replace it with another card, which can affect a huge number of votes.

*Power:* An electronic machine mainly works on battery power. In remote places where electricity is the major issue, EVM fails to operate and the entire process is disturbed.

*Cost:* The cost of the system is a major concern. It consists of a unit which is expensive, and also if damaged, the cost of repair is more and irrecoverable.

### III. PROPOSED ONLINE VOTING SYSTEM

MyVote is an online voting system, which is a simple, understandable and secure way to cast a vote. In the proposed system, the voter simply has to cast a vote by pressing a vote button. All the votes will be stored in a database. Before the election, all the details of voters are available in a database. In order to vote, the voter should be registered first. On the Election Day, the booth officer will validate the voter either by the EPIC, name or phone number. If the voter has the EPIC, it gives us the details of the voter. If the voter provides any other id proof such as Adhar, then the voter is verified by name, and other details such as district, constituency, and so on. Once the details are entered, we can retrieve the details of the voter, which can be verified against the id proof of the voter. The main objective of the proposed system is identifying properties that a secure and trusted online voting system must satisfy to eliminate duplication.

#### a) Step 1: The Voter Verification and Validation

For the proposed system, the voter has to first register as a voter either online or by filling the application form. Once he is registered as a voter, all the details will be stored in a database. At the time of election, the booth officer will verify the id and cross check the voter's details. The verification can be done by entering voter's EPIC, name or phone number by the booth officer. The information retrieved after entering voters' information will be validated by the booth officer.

Only registered and valid voters are allowed to vote. There is no need for physical identity, provided the name of the voter should be in a voters list.

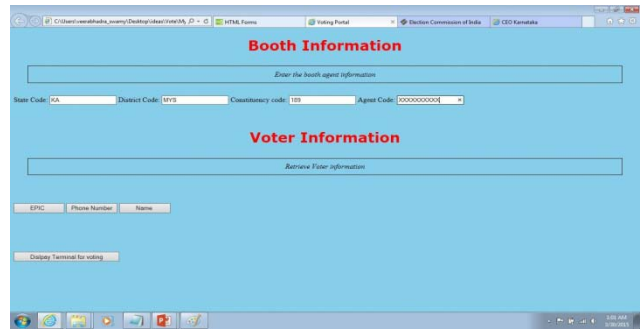


Figure 1: Home Page of MyVote

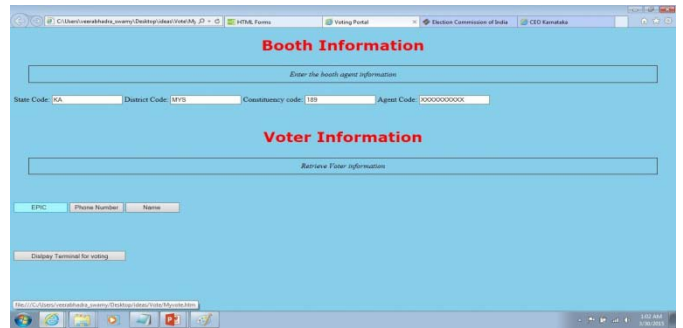


Figure 2: The voter is verified by EPIC

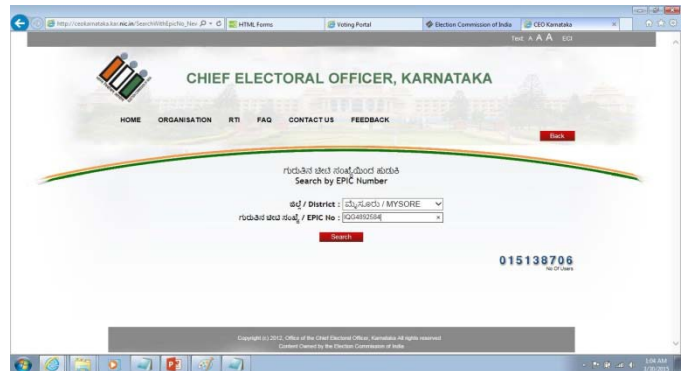


Figure 3: Display details of voter

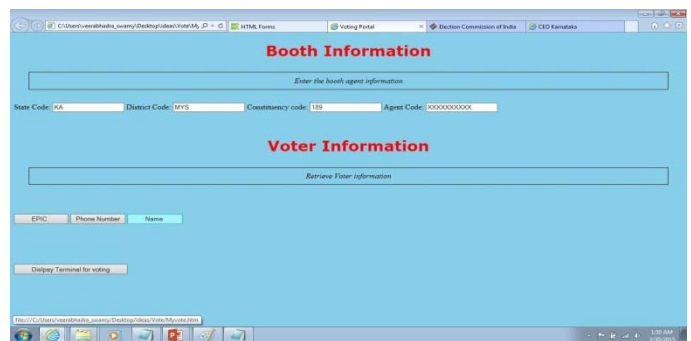


Figure 4: Voter verification by name

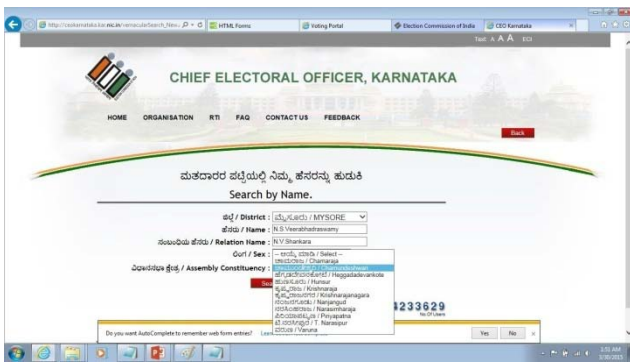


Figure 5: Enter details such as district, name, and constituency



Figure 6: Displays voter details

b) Step 2: Retrieve Constituency of voter

After verification of the voter, the Booth officer can retrieve the constituency of the voter by entering details such as state code, district code, constituency code and polling station code. From this the voter gets to know the information about the candidates in their constituency and the voter can vote without any confusion.

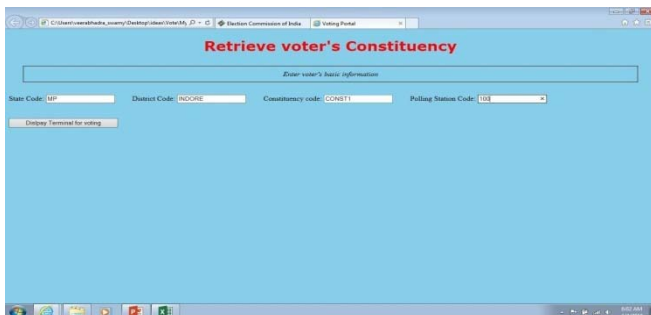


Figure 7: Voter constituency is displayed

c) Step 3: Casting Vote

In this step, the actual voting takes place where the voters cast their votes. Once the details are verified against the proof provided by the voter, the booth officer can submit the "display terminal for voting" button. Finally the voter is displayed with a terminal which consists of candidate names and the voter can now cast a vote. The vote is successfully accepted and is saved in a vote database which is further used for counting and statistics.

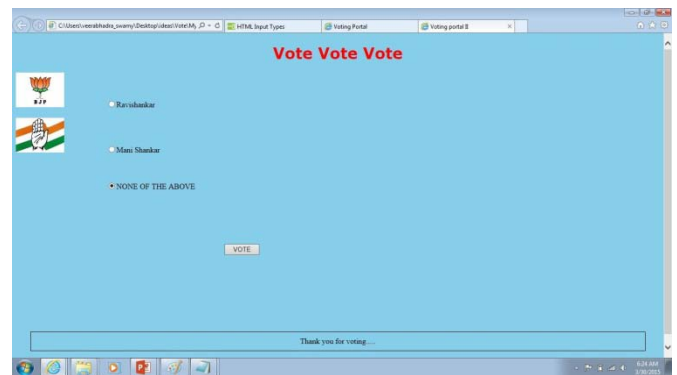


Figure 8: Voting terminal

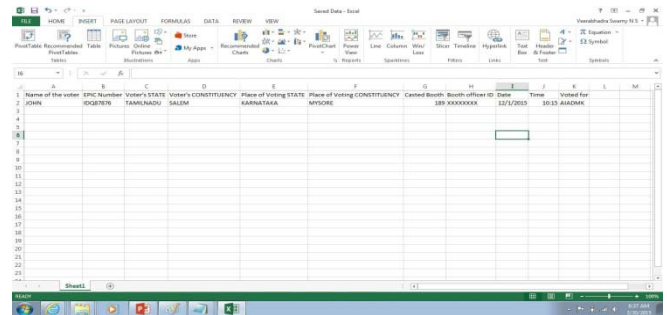


Figure 9: Database that store votes

d) Advantages of Proposed System

**Availability and Feasibility:** If the voter has photo id and address proof, he can vote from anywhere in India and if kiosks are set up overseas, even NRIs can cast their vote in the embassy offices. Kiosks can be set up in DC offices which are governed by the central government. For example: On the day of voting in MP, a person from MP can walk into the DC office in Mysore and cast a vote.

**Cost:** Physical transportation of the voting machines from one place to another can be eliminated, which in turn eliminates the cost of transportation. The cost involved in training people every time, before the election process can also be reduced. Also the cost spent on the EVMs can be nullified.

**Results are not delayed:** As the data resides on the central database, the results of the voting can be announced without any delay.

IV. CONCLUSION

In a country where democracy is by the people, every individual vote is to be considered valuable. Due to various reasons in the manual and electronic voting system, the valuable votes cannot be effectively discharged. This paper therefore introduces an online voting system, which enables the voter to cast his/her vote in a trusted environment. Also since the validation and the verification is done by the booth officer at the time of election, fake or proxy voting can be eliminated. The setup cost for setting up the central server for this system is considered to be huge, but later only involves

system is considered to be huge, but later only involves the maintenance cost. Also the voters need to be educated on the system before voting. The proposed system can be considered as replacement to EVMs, the major change involves replacement of the EVMs with the computers. Since the EVMs are costlier one can reduce the cost spent on the machines.

### REFERENCES RÉFÉRENCES REFERENCIAS

1. Aggelos Kiayias An Internet Voting System Supporting User Privacy acsac.org,2006
2. Ankit Anand, Pallavi Divya, An Efficient Online Voting System, IJMER, vol-2, Issue4, July-Aug 2012.
3. Dr.Aree Ali Mohammed, Efficient E-voting Android Based System, IJARCSSE, vol 3, Issue11, Nov 2013.
4. Mohammad Malkawi, Modeling and Simulation of a Robust e-Voting System, IBMIA, vol 8, 2009.





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## AROGYA Intelligent Health Care Application

By Kannangara A.S., Rathnayaka W.G.P.N., Ranasinghe R.A.K.D.  
& Halmillawewa C.A.

*Sri Lanka Institute of Information Technology*

**Abstract-** People of today pay less attention to their daily diet due to their busy lifestyles. Therefore, there is a great tendency to contract chronic non-communicable diseases. Furthermore, the lack of nutritious meals and daily exercise causes chronic non-communicable diseases in people with no age difference. In our first part, we developed to predict specialization in cardiology using symptoms. However, when we refer to a doctor, we must at least know what specialist should know based on their symptoms. In addition, there is a problem with the recipe. If the pharmacist has misread the prescription given by the doctor, patients can receive bad medications, leading to terrible side effects and even death due to careless writing by the doctor. As a solution, an application function can be proposed that will be developed in the project and the function should be able to improve the readability and intelligibility of the patient with prescription drugs. Therefore, the patient always knows the prescribed medications through the application to avoid the problem mentioned above. According to the 2016 pharmaceutical magazine, there are cholesterol and diabetic patients suffering mainly from chronic non-communicable diseases in Sri Lanka.

*GJCST-H Classification: J.3*



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## I. INTRODUCTION

Human health is main part of the life. The meaning of health has evolved over time. From the biomedical perspective, early definitions of health focused on the issue of the body's ability to function; health was viewed as a normal functioning state which could be interrupted from time to time by illness. Also, in current era, people too much busy with their works. Because of that, people are suffering with non-communicable chronic diseases [7]. According to the Pharmaceutical Journal of Sri Lanka 2016 [7], there are Hypertension 48.5%, Diabetes mellitus 45.3% and Ischemic Heart disease 29.4%. Proposed application based on non-communicable chronic diseases. First part mainly based on heart diseases. Because the heart diseases area is wide in the medical world. There are

many categories based on heart diseases named blood vessel diseases, coronary artery disease; heart rhythm problems (arrhythmias); and heart defects born with (congenital heart defects), among others[8]. Also, Cardiovascular disease usually refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina), or a stroke. Other heart conditions, such as those that affect muscle, valves, or heart rate, are also considered to be forms of heart disease. Other part based on cholesterol, diabetic and blood pressure. Cholesterol is a chemical compound that the body needs as a building block for cell membranes and hormones like estragon and testosterone. The liver produces about 80% of the body's cholesterol and the rest comes from food sources such as meat, chicken, eggs, fish, and dairy products. Plant-based foods do not contain cholesterol [9]. Cholesterol divided in to three parts known as High-density lipoprotein (HDL), Low-density lipoprotein (LDL) and very low-density lipoprotein(VLDL). There are levels known as VLDL < 40 mg/dL, LDL < 160 mg/dL, HDL >= 45mg/dL, Triglycerides < 150 mg/dL.

## II. METHOD

### a) Data sets

#### i. Heart disease prediction model

The data set that we used in this research, is used various researchers for their research purpose. We get it the web site called kaggle.com[10].This dataset was used in this research designing for heart disease diagnosis for machine-learning-based system. This heart disease related dataset has a sample size of 4240 patients, 16 features.

#### ii. Prediction for future cholesterol level model

The data set that we used to predict cholesterol level is a created data set by me. This data set used in this research for predict cholesterol level for future six months suing time series analysis. This cholesterol level related dataset has a sample size of 20 months of one patient.

#### iii. Model for diet plan

I created dataset to similar medicine using SPC guidelines. Because there is no dummy, data set to this part. In that case, I met a doctor and created a sample dataset to create the model.

To predict the diabetic level and cholesterol levels part we got the dummy data using [https://www.kaggle.com/ website](https://www.kaggle.com/website).

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iv. Give an idea of the prescription

Collected cholesterol prescription as an image data set and created a stranded dataset.

b) Data processing

There is feature called education. That one is not related to the heart disease. Therefore, we drop that feature. During the cleaning, remove null values. Some null values fill with the mean value of the feature and get a value, which will increase the efficiency. In the prediction of the diabetic and cholesterol level part, started to create the model using jupyter notebook. First, imported necessary libraries and added the dataset. Also dropped the unnecessary data column in the data set.

c) Methodology of the Proposed System

i. Heart disease prediction model

The proposed system developing with the aim to classify whether people should channel cardiology or not. One of the popular machine learning classifiers logistic regression used for classification of this system. Logistic regression is the one of best classifier to get binary value output. The methodology of the proposed system structured into four stages including (1) preprocessing of dataset, (2) feature selection, (3) machine learning classifiers, and (4) classifiers' performance evaluation methods. Figure 1 shows the framework of the proposed system.

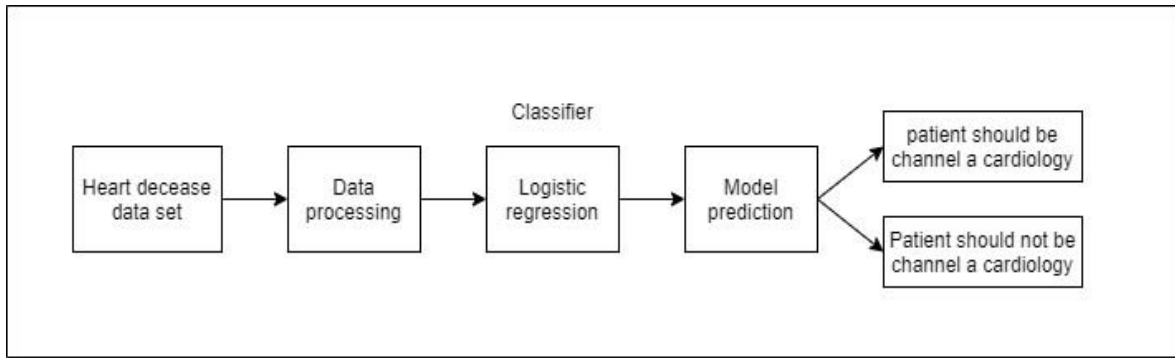


Figure 1

**Logistic Regression:** A logistic regression is a classification algorithm [27–29]. For binary classification problem, in order to predict the value of predictive variable  $y$  when  $y \in [0, 1]$ , 0 is negative class and 1 is positive class. It also uses multi classification to predict the value of  $y$  when  $y \in [0, 1, 2, 3]$ .

In order to classify two classes 0 and 1, a hypothesis will be designed and threshold classifier

output is at 0.5. If the value of hypothesis, it will predict  $y = 1$  which mean that the person has heart disease and if value of, then predict  $y = 0$  which shows that the person is healthy.

Hence, the prediction of logistic regression under the condition is done.

Logistic regression sigmoid function can be written as follows:

$$h\theta(x) = g(\theta^T X),$$

where  $g(z) = 1/(1 + x^{-z})$  and  $h\theta(x) = 1/(1 + x^{-z})$ .

Similarly, the logistic regression cost function can be written as follows:

$$J(\theta) = \frac{1}{m} \sum_{i=1}^m \text{cost}(h\theta(x^{(i)}), y^{(i)}).$$

My ratio is 80-20. 80% data will train and 20% will be test. Import confusion matrix to represent the false positive, false negative, true positive and true negative.

ii. Prediction for future cholesterol level model

This proposed system developing to predict a cholesterol level for about 6 months of future and store

patient past data records of cholesterol level. The time series is one of the popular machine learning prediction algorithms. In time series analysis have one variable at that time. There have an independent variable and a dependent variable. Time series prediction is a form of data mining that predicts future behaviors by analyzing historical data.

The objectives of a time series prediction,  $t$  is estimated value of  $x$  and  $\hat{x}[t+s]=f(x[t],x[t-1],\dots,x[t-N])$ ,  $s>0$  is called the horizon of prediction. Figure 2 shows

the prediction of a time series using auto regression integrated moving average (ARIMA-model) [11].

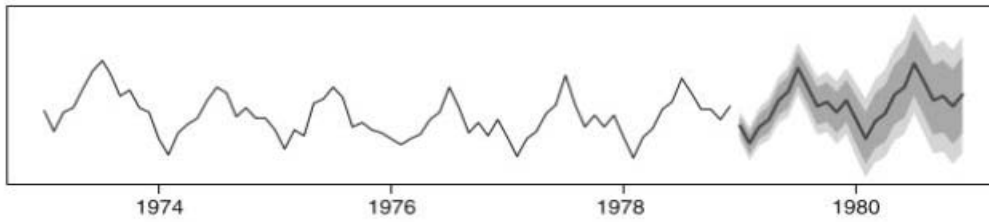


Figure 2

The way a Simply Moving Average is calculated is that it takes the subset of the data mentioned in the moving average model description, adds together the data points, and then takes the average over the subset of data. It can help identify the direction of trends in your data and identify levels of resistance wherein business or trading data. [12]

Forecasting is one of the most relevant tasks when working with time-series data. You can forecast with a simple moving average, another moving average model called 'Autoregressive Integrated Moving Average' is popular for fairly accurate and quick forecasting of time series. The Autoregressive Integrated Moving Average, or ARIMA model, is a linear function that is used for predicting future data points based on past data. ARIMA combines the models the past data points to determine future points to the linear regression model on an independent variable to predict the dependent variable. Because of ARIMA's using past data, a longer series is preferable to get results that are more accurate. [13]

iii. Model for diet plan

In decision tree classification data model have two main types known as classification tree and regression tree. This is a non-parametric supervised learning method [1]. In this data model, predict the value of the target variable in the data set by learning simple decision rules. In classification, tree outcome was yes/no type. Those decision variables are categorical or discrete. Also, it known as binary recursive partitioning. However, regression tree is taking continuous values or real numbers [2]. There are many different algorithms but in here, mainly used ID3 (Iterative Dichotomies 3) algorithm [3] invented by Ross Quinlan. Simple meaning of this is greedy search via the space of possible branches without no reverse. It is built top-down from a root node and create subsets using similar values. This is known as homogenous [4]. ID3 algorithm used entropy (figure 3) to appraise the homogeneity of the data set.

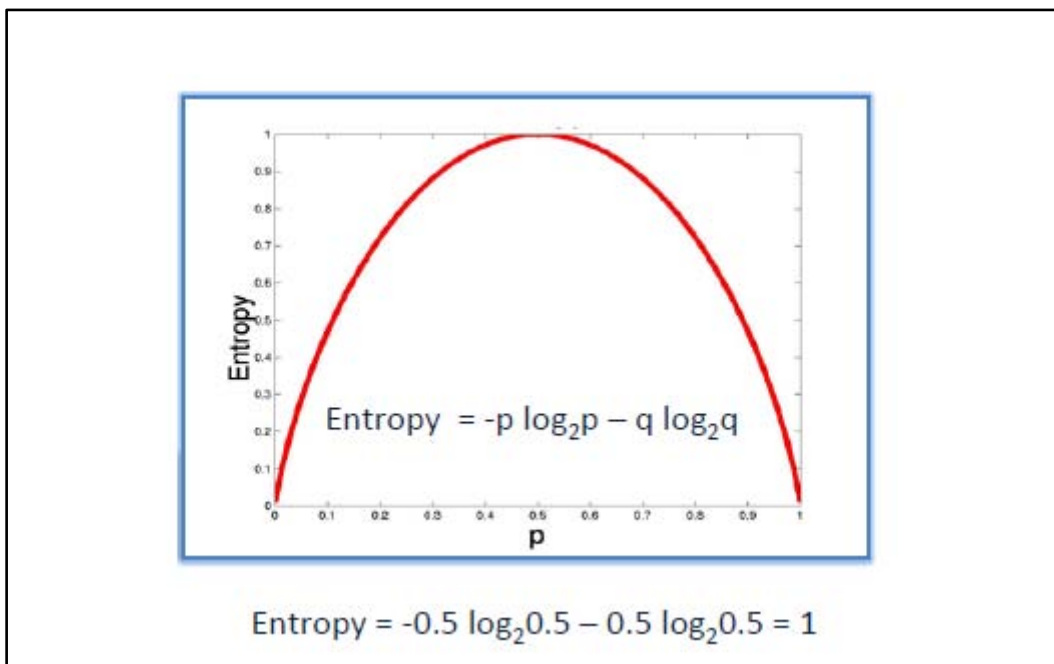


Figure 3



Entropy using the frequency table to calculate the decision tree within two types. First, one is for one attribute (Figure 4). Second, one is for two attributes

(Figure 5). There are two formulas for above mention types.

$$E(S) = \sum_{i=1}^c -p_i \log_2 p_i$$

Figure 4: Calculation for one attribute

$$E(T, X) = \sum_{c \in X} P(c)E(c)$$

Figure 5: Calculation for two attributes

In the similar medicine part, created a histogram to overview the dataset. Finally checked the accuracy of the dataset.

In the cholesterol and diabetic part, create the ranges to diabetic level and cholesterol level. Then created a pie chart to get an idea of the data set. Checked the null values in the dataset. If there were null values, get the mean value of the data column and replaced to the null values. Next, create a histogram to the age column and reading levels. Finally checked the accuracy of the dataset. Next created the meal plan to the reading ranges above mentioned.

iv. Give an idea of the prescription

First recognized of handwritten medical forms. For that, I used Lexicon Driven Word Recognizer

Algorithm [5]. All lexicon entries are treated as detached words and matched the input word image as containing handwriting to recognize in word model-based recognition. Lexicon entry is the best top choice of this. To develop this model, we created word recognition methodology (Figure 6). Segments are matched against individual characters without using any contextual information in character model-based recognition. In addition, we used Latent Semantic Analysis [6] to compute the relationship between the context of words and terms to a semantic category.

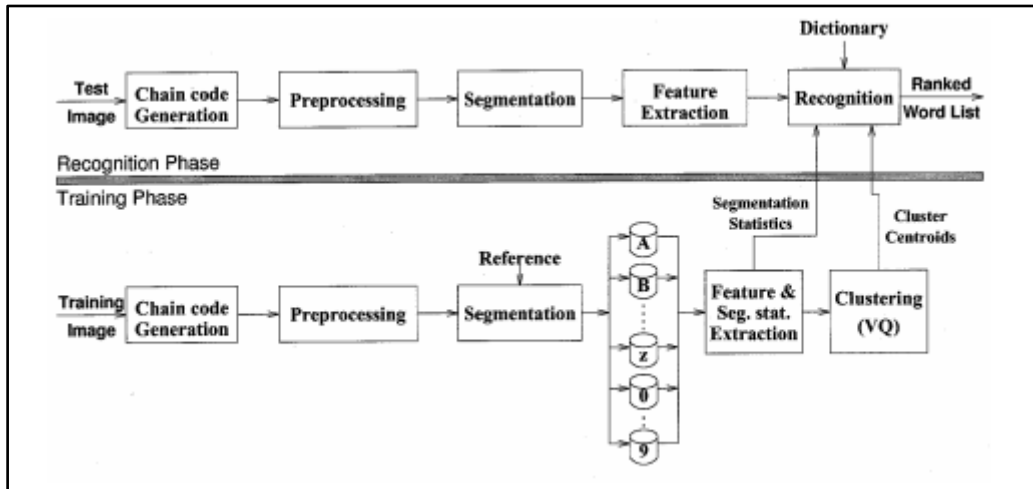


Figure 6

### III. RESULTS AND DISCUSSION

a) Heart disease prediction model

This section of the paper involved the discussion on the classification model and outcome. First, we checked the performance of machine learning algorithm that I used called logistic regression. All

computations were performed on an Intel(R) Core™ i7 - 7500U CPU @3.5 GHz PC.

I get the mark 87% as the result of the accuracy score. Precision score, recall score, f1 score and the confusion metrics would be as follows.

```
In [24]: print('Accuracy Score : ' + str(accuracy_score(y_test,y_pred)))
print('Precision Score : ' + str(precision_score(y_test,y_pred)))
print('Recall Score : ' + str(recall_score(y_test,y_pred)))
print('F1 Score : ' + str(f1_score(y_test,y_pred)))
from sklearn.metrics import confusion_matrix
print('Confusion Matrix : \n' + str(confusion_matrix(y_test,y_pred)))
```

```
Accuracy Score : 0.8702830188679245
Precision Score : 0.8
Recall Score : 0.10084033613445378
F1 Score : 0.17910447761194032
Confusion Matrix :
[[726  3]
 [107 12]]
```

Figure 7

I used grid search for increase my accuracy after the training and testing the data. Accuracy score increased by 0.1%.

```
[ ] accuracy=accuracy_score(y_test,y_pred) |
accuracy
0.8714622641509434
```

Figure 8

b) Prediction for future cholesterol level model

For the cholesterol prediction section, we used the performance of time series analysis to predict future cholesterol levels. The result of selecting time series

analysis, inputs of cholesterol levels are used to convert to log scale and giving a plot graph and showing prediction line for six months. Other than that in that graph shows the confidence level of prediction

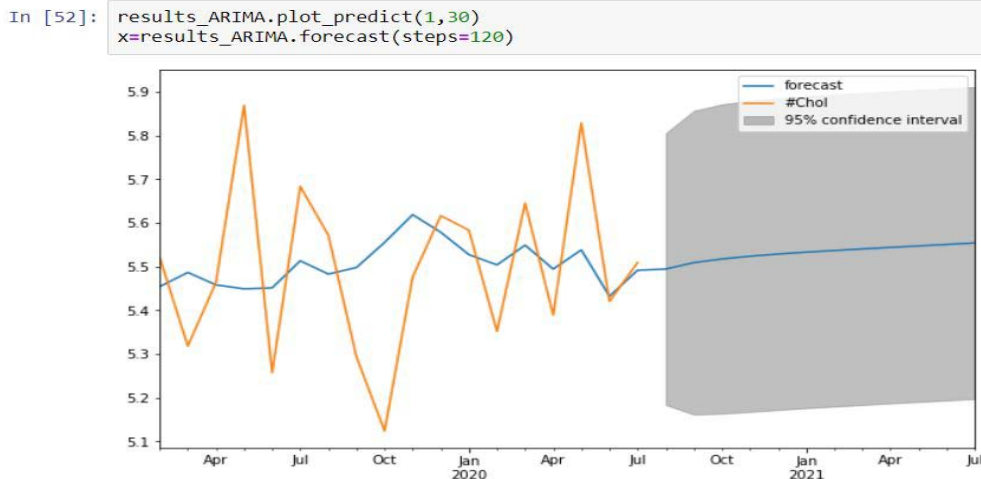


Figure 9

c) Model for diet plan

In the cholesterol level and diabetic level, get the 90% as accuracy score. Also, predict the result of the data set. As we expected, predict data was the same as the actual data (Figure7).



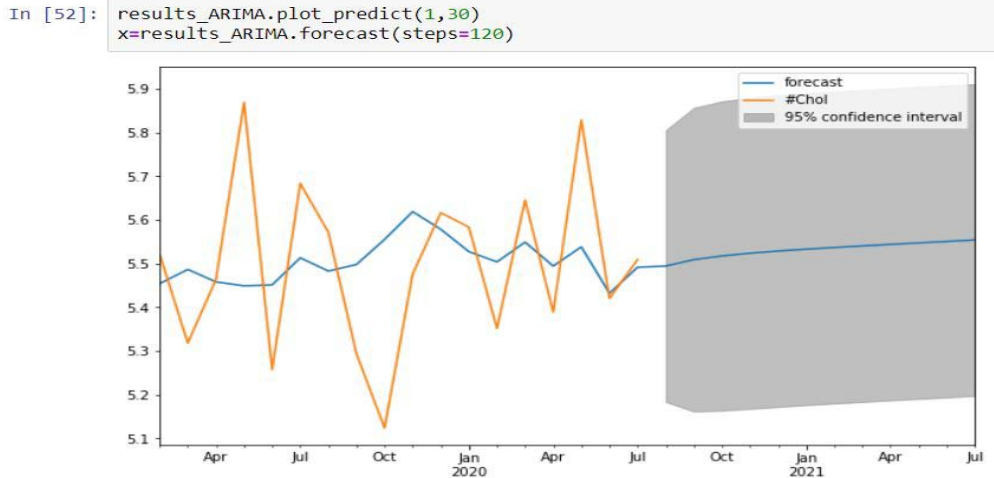


Figure 10

d) Give an idea of the prescription

In the handwriting recognition of the prescription part, get an example to give the result.

Selected a random word as 'word'. Matched the word between a sample image and lexicon entry 'word' (Figure 8).

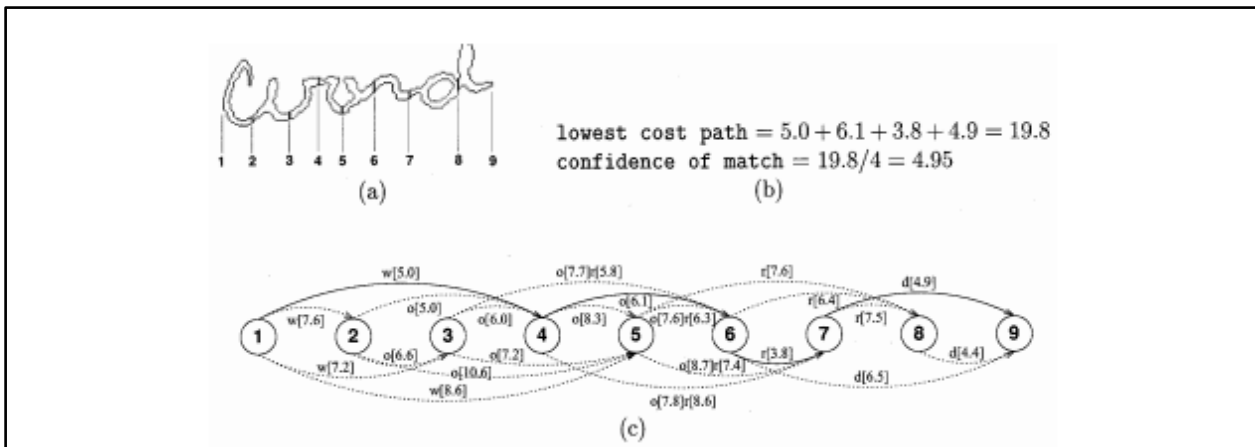


Figure 11

In the first part, it shows segment point of the image. There are 9 points. Second part is the confidence of the match word. Final part is matching the paths and confidences. For this result will be as the expected one.

#### IV. CONCLUSION

In this research, we try to implement a model for predict heart disease; predict cholesterol and diabetic levels for best meal plan using machine learning algorithm. We train and test model for using given data set. In predict heart disease, part, its accuracy score is 87% up to now. For that, we used logistic regression for classification. In predict cholesterol and diabetic levels for best meal plan part, its accuracy score is 90%. For that, we used Decision tree for classification.

Researchers can increase accuracy level of the model. However, there are numbers of algorithms to

classification. We will perform more experiments to increase the performance of these predictive classifiers for heart disease prediction by using others feature selection algorithms and optimization techniques. If someone follow the heart disease prediction, you all can use different data set and can be use other algorithms for classification. If researchers can implement hybrid model using many algorithms. We think it is also new era of this heart disease prediction model.

In cholesterol level prediction section, we try to implement a model of predict cholesterol level for about six months for future. We train and test model for predict cholesterol level using given dataset and get prediction line and confidence area.

Researchers can develop this model for other diseases and they can try to develop this system using other algorithms and techniques. If someone trying to follow cholesterol level prediction, you can try to get a

very smooth line using another way for stationarity. If researchers implement this using more algorithm, that also a new thing for cholesterol prediction model.

In prescription reading via image, processing is a big challenge for us. However, using Lexicon Driven Word Recognizer Algorithm, it simplifies the model work. Use of variable duration in word recognition process improved performance.

### ACKNOWLEDGEMENT

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### REFERENCES RÉFÉRENCES REFERENCIAS

1. Brownlee, J., 2016. Parametric and Nonparametric Machine Learning Algorithms. [online] Machine Learning Mastery. Available at: <https://machinelearningmastery.com/parametric-and-nonparametric-machine-learning-algorithms/#:~:text=underlying%20mapping%20function,-Nonparametric%20Machine%20Learning%20Algorithms,form%20from%20the%20training%20data>.
2. Chakure, A., 2019. Decision Tree Classification. [online] Medium. Available at: <https://towardsdatascience.com/decision-tree-classification-de64fc4d5aac>
3. En.wikipedia.org. 2020. ID3 Algorithm. [online] Available at: [https://en.wikipedia.org/wiki/ID3\\_algorithm](https://en.wikipedia.org/wiki/ID3_algorithm)
4. Saedsayad.com. n.d. Decision Tree. [online] Available at: [https://www.saedsayad.com/decision\\_tree.htm#:~:text=Decision%20Tree%20%2D%20Classification,decision%20nodes%20and%20leaf%20nodes](https://www.saedsayad.com/decision_tree.htm#:~:text=Decision%20Tree%20%2D%20Classification,decision%20nodes%20and%20leaf%20nodes)
5. Pdfs.semanticscholar.org. 1997. A Lexicon Driven Approach to Handwritten Word Recognition for Real-Time Applications. [online] Available at: <https://pdfs.semanticscholar.org/9dde/54b4c73b866cde5bdc013ba0de8cf72ee003.pdf>
6. Google Books. 2011. Handbook Of Latent Semantic Analysis. [online] Available at: [https://books.google.lk/books?hl=en&lr=&id=JbzCzPvzpmQC&oi=fnd&pg=PP1&dq=Latent+Semantic+Analysis&ots=aN03G2P0HE&sig=aQIXfzinenum39EpoSmmEwc5R-s&redir\\_esc=y#v=onepage&q=Latent%20Semantic%20Analysis&f=false](https://books.google.lk/books?hl=en&lr=&id=JbzCzPvzpmQC&oi=fnd&pg=PP1&dq=Latent+Semantic+Analysis&ots=aN03G2P0HE&sig=aQIXfzinenum39EpoSmmEwc5R-s&redir_esc=y#v=onepage&q=Latent%20Semantic%20Analysis&f=false)
7. N. Wijekoonand L. Shanika, "Adverse drug reactions and associated factors in a cohort of Sri Lankan patient with non-communicable chronic diseases", ResearchGate.net, 2016. [Online]. Available: [https://www.researchgate.net/publication/307545534\\_Adverse\\_Drug\\_reactions\\_and\\_associated\\_factors\\_in\\_a\\_cohort\\_of\\_Sri\\_Lankan\\_patients\\_with\\_non-communicable\\_chronic\\_diseases](https://www.researchgate.net/publication/307545534_Adverse_Drug_reactions_and_associated_factors_in_a_cohort_of_Sri_Lankan_patients_with_non-communicable_chronic_diseases)
8. Mayo Clinic staff, "Heart disease -Symptoms and causes", Mayo Clinic, 2018. [Online]. Available: <https://www.mayoclinic.org/diseases-conditions/heart-disease/symptoms-causes/syc-20353118>
9. R.Charles Patrick Davis and Benjamin Wedro, "What Is Cholesterol? HDL and LDL Ranges and Diet", Medicine Net, 2016. [Online]. Available: [https://www.medicinenet.com/cholesterol\\_management/article.htm#why\\_is\\_high\\_cholesterol\\_dangerous](https://www.medicinenet.com/cholesterol_management/article.htm#why_is_high_cholesterol_dangerous)
10. Kaggle.com. 2020. Framingham Heart Study Dataset. [Online] Available at: <https://www.kaggle.com/amanajmera1/framingham-heart-study-dataset> [Accessed 17 July 2020].
11. <https://www.springer.com/gp/book/9789812874108>
12. <https://algorithmia.com/blog/introduction-to-time-series>
13. A. M. De Silva and P. H. W. Leong, Grammar-Based Feature Generation for Time-Series Prediction, Springer, Berlin, Germany, 2015.
14. <https://machinelearningmastery.com/time-series-forecasting/>
15. <https://towardsdatascience.com/the-complete-guide-to-time-series-analysis-and-forecasting-70d476bfe775>



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## A Review of Contact Tracing Approaches for Controlling COVID-19 Pandemic

By Md. Tanvir Rahman, Taslima Ferdaus Shuva, Risala Tasin Khan  
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**Abstract-** The year 2020 will always be in the history of mankind due to the deadly outbreak of COVID-19. Many people are already infected around the world due to the spreading of this novel coronavirus. The virus mainly replicates through close contacts, so there are no other alternatives than to keep social distance, use proper safety gear, and maintain self-quarantine. As a result, the growth of the virus has changed the lifestyle of every individual to a great extent. It is also compelling the Governments to dictate strict lock-downs of the highly affected areas, impose work-from-home approaches where applicable, enforce strict social distancing standards, and so on. Some of the countries are also using smartphone-based applications for contact tracing to track the possibly infected individuals. However, there is a lot of discussion around the world about these contact tracing applications and also about their architecture, attribute, data privacy, and so on. In this paper, we have provided a comprehensive review of these contact tracing approaches in terms of their system architecture, key attributes, and data privacy. We have also outlined a list of potential research directions that can improvise the tracing performance while maintaining the privacy of the user to a great extent.

**Index Terms:** corona virus, contact tracing, pandemic.

**GJCST-H Classification:** J.3



AREVIEWOFCONTACTTRACINGAPPROACHESFORCONTROLLINGCOVID19PANDEMIC

*Strictly as per the compliance and regulations of:*



RESEARCH | DIVERSITY | ETHICS

# A Review of Contact Tracing Approaches for Controlling COVID-19 Pandemic

Md. Tanvir Rahman<sup>α</sup>, Taslima Ferdous Shuva<sup>σ</sup>, Risala Tasin Khan<sup>ρ</sup> & Mostofa Kamal Nasir<sup>ω</sup>

**Abstract-** The year 2020 will always be in the history of mankind due to the deadly outbreak of COVID-19. Many people are already infected around the world due to the spreading of this novel coronavirus. The virus mainly replicates through close contacts, so there are no other alternatives than to keep social distance, use proper safety gear, and maintain self-quarantine. As a result, the growth of the virus has changed the lifestyle of every individual to a great extent. It is also compelling the Governments to dictate strict lock-downs of the highly affected areas, impose work-from-home approaches where applicable, enforce strict social distancing standards, and so on. Some of the countries are also using smartphone-based applications for contact tracing to track the possibly infected individuals. However, there is a lot of discussion around the world about these contact tracing applications and also about their architecture, attribute, data privacy, and so on. In this paper, we have provided a comprehensive review of these contact tracing approaches in terms of their system architecture, key attributes, and data privacy. We have also outlined a list of potential research directions that can improvise the tracing performance while maintaining the privacy of the user to a great extent.

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## I. INTRODUCTION

The World Health Organization (WHO) has declared COVID-19 as a public health emergency of international concern (PHEIC) on January 30, 2020 [1, 2] and also a pandemic on March 11, 2020 [3]. According to the Coronavirus disease (COVID-19) Situation Report (by WHO) on 11 July 2020, the total number of confirmed cases was 12322395 globally and among them, 556335 was deceased [4]. To defend this virus, there should be rapid identification and forced quarantine of the infected persons, determination of every other individual with whom they have had close contacts, and the locations where the infected person has visited in recent days [5]. For that reason, many countries have already developed different contact tracing apps to track infected persons and zones [6].

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These apps are designed to counterpart contact tracing by using location data acquired from GPS (Global Positioning System) and Bluetooth sensor [7]. Through these applications, it is possible to detect whether a user has been exposed to any COVID-19 positive person or not. Although Bluetooth based solutions for contact tracing are found alluring and being used in developed countries e.g., Singapore, South Korea, etc., there are some negative impacts as it may hamper one's privacy [8, 9]. Besides, any intruder may impersonate and steal valuable information while using the Bluetooth based application. Here, the above-stated solution requires Smartphones to operate. But according to [10], only 24% of people in India use a smartphone. As a result, the BLE (Bluetooth Low Energy) based solutions will not be appropriate for a list of countries. To address these limitations, the authors of [11] have proposed a solution where the contact tracing can be accomplished by geo location data from mobile-cellular networks. It is also explained that more than 200% of probably infected persons can be identified as only the cell phone network will be used to measure the location [11]. The only limitation of the approach is that the people have to carry the cell phone with them. Besides these contact tracing apps, few countries like China, France, and South Korea are thinking about the CCTV surveillance technology with image processing. According to Reuters, China has already given an unprecedented glimpse into how to extensively use surveillance cameras to check people's movement [12]. In France, when the lockdown was eased, they monitored every individual by video surveillance cameras [13]. South Korea has been widely admired for its management of the outbreak and spread of coronavirus disease. In South Korean cities, there are over 8 million closed-circuit cameras and that is one camera per 6.3 people [14]. These cameras were heavily used to track the persons who came in near proximity to the infected person. CCTV cameras can work as an investigation tool for detecting various types of content and events, including motion detection, facial recognition, crowd, and so on [15]. The footage can be used for 'video analytics' by which the contact tracing technique will be more convenient [16]. Apart from these approaches, in some of the countries QR code is used as a medium of contact tracing. People are encouraged to keep the unique QR code with them all the time. Whenever a person is using any public property, s/he is



scanning the QR code first and by doing so it becomes easy to track every individual.

According to the different proposed approaches and implementations by a list of countries, there are mainly three technological aspects that cover the domain of contact tracing applications. These aspects are BLE (Bluetooth Low Energy) based approach, Geo-location-based approach, and QR Code based approach. In this paper, we have provided a detailed comprehensive review of these approaches in terms of their architecture, feature, and the privacy of the user.

The rest of the paper is organized as follows: Section II emphasizes the review of Contact Tracing applications used by different countries, section III focuses on the classification of the contact tracing applications, section IV shows the comparison among the different contact tracing approaches, and the conclusion and future work is discussed in section V.

## II. CONTACT TRACING APPS USED BY DIFFERENT COUNTRIES

With the alarming spread of COVID-19, researchers around the world are rushing to develop new methods, applications, services, or systems for contact tracing [17]. The purpose of these applications is to identify and notify the persons who were in close contact with a COVID-19 carrier. As a result, many countries are using different contact tracing applications for the safety of the inhabitants. The details of the contact tracing application implemented by a list of the countries around the world are outlined as follows:

### a) Singapore

The government of Singapore has released a mobile phone application titled "TraceTogether" to assist health officials to track down their exposures after an infected individual is identified [18]. The working principle of the application is very simple. The application mainly shares a code to nearby devices where the same app is installed. Both of the devices store the encrypted code in it. When the two users pass by, the application uses the Bluetooth Relative Signal Strength Indicator (RSSI) readings between the devices to estimate the closeness and duration of the meeting. These acquired data (proximity and duration information) are stored on both of the users' phone for 21 days. If a user is found COVID-19 positive, the activity and contact log for the last 14 days are analyzed. Singaporean government made it compulsory to install this app which results in an installation of about 17% of their total population [19]. As this app uses Bluetooth based approach to operate, it required public acceptance as there were privacy-related issues [20].

### b) China

China has also launched an application titled "Health Code" [21]. The app collects several information

about the user such as work address, residential information, contact number, passport number, national identity number, symptom, travel history, and so on. Once submitting the required data, verification will be done via the 'QR Code' which will be sent to the mobile phone. The QR Code can contain either red, green, or amber color code, and depending on the color code the user will be considered risky or risk-free. Users with red color code will be considered risky and will undergo government quarantine or self-quarantine for 14 days, users with amber code will go to quarantine for 7 days but users with green code are considered to be risk-free. The main drawback of this app is if a person intentionally provides wrong information about traveling history or symptoms, he/she might get a green code and affect more people [21].

### c) Canada

For contact tracing, Canada has adopted a "test, trace, and isolate" strategy [22]. In Canada, a contact tracing app named "ABTraceTogether" was launched by the Province of Alberta on May 1, 2020, [23]. Users can voluntarily download the app for tracing and notifying users who may have been exposed to COVID-19 carrier. The public health officials of Alberta Health and Alberta Health Services (AHS) use this application to supplement manual contact tracing. "ABTraceTogether" is also a Bluetooth technology-based application which tracks user's mobile device. It generates an anonymous log of other app users with whom the device user has been in contact. Here the mobile devices exchange Bluetooth-enabled secure encrypted tokens when they are in close contact. The logged data that is collected by Bluetooth proximity is anonymized and encrypted, and does not reveal users' identity [23].

### d) South Korea

South Korea is one of the fewest countries in the world that has almost defeated COVID-19 most effectively. In South Korea, the first confirmed cases were reported on 20th January 2020 and within March 6, 2020, the number of deceased was 42 including 6284 cases which indicates a flattening in the curve of affected and death [24]. For controlling the spread, the Government of South Korea imposed mandatory quarantine to the travelers who departed from other countries in recent times. During their quarantine state, the travelers were forced to install and use a self-diagnosis app through which they updated their health status regularly so that the Government can get informed whether any of them is a potential carrier of COVID-19 or not [25]. The drawback of this tracing process in violation of private data as the collected data were shared among many authorities such as police, health insurance, government agencies, health care professionals, and others [26].

e) *Australia*

The Australian Federal Government launched a contact tracing application titled "COVIDSafe" on April 26, 2020 [27]. Like previous applications, it also uses Bluetooth technology to record contact between users. Although it has shown a significant effect on tracing COVID-19 positive people in Australia it is already facing a lot of debate because of its transparency and privacy issues [27].

f) *France*

Like many European countries, the French government introduced a contact tracing app, titled "StopCovid". It works using Bluetooth technology and provides data privacy, protection, and transparency [28].

g) *Germany*

The German Federal government has launched a "BLE" (Bluetooth Low Energy technology) based application "Corona-Warn-App" on June 16, 2020 [29]. There are no major privacy concerns as the-App has been designed with a special focus on privacy from the beginning.

h) *Indonesia*

Indonesian Ministry of Information and Communication (MOCI) launched a mobile application called "PeduliLindungi" which uses Bluetooth and GPS (Global Positioning System) both. Users register and share their locations during their traveling. This app traces whether they were in contact with COVID-19 patients or not. While it traces someone entering crowds whom they are calling "COVID-19 red zones", the application alerts the user [30].

i) *Poland*

The Polish Government has launched two applications titled "Kwarantanna domowa" and "ProteGO Safe Safe". The "Kwarantanna domowa" uses geolocation and face recognition technology to ensure the quarantine of relevant people. The app is designed to track whether COVID-19 patients are in quarantine or roaming around. The app will time to time ask for selfies from the app user to ensure his location and thus using image processing and geological data will ensure spreading the virus by limiting patients' movement [31]. Poland govt. using another app "ProteGO Safe Safe", which uses Bluetooth short-range radio. This technology is also being used by Apple and Google to securely exchange keys among the smartphones who have been near to each other [32].

j) *South Africa*

For tracking COVID-19 patients South African app Covi-ID has worked with a different approach by using QR codes. The working principle of the app is providing each user with a QR code after his/her registration in the app. While registering the app, the

user needs to provide his information on being COVID-19 positive or negative. He/she then get a QR code that needs to be scanned while he/she travels by vehicles or enters any public place like shopping malls, educational institutions, etc. Whenever the user gets to know about his being COVID-19 positive he updates the status in the app and it alerts all the vehicles and places he visited previously [33]. Thus, each time the QR code is being scanned the geo-location of the user can be located for further tracking the individual. Their identification is being checked using blockchain [34].

k) *India*

The Indian government has made it compulsory to install an app named "Aarogya Setu" for the government employees to control the spread of COVID-19 [35]. This application uses BLE (Blue-tooth Low Energy) and GPS (Global Positioning System) both for tracking COVID-19 infections. By Bluetooth, it checks whether a user has been exposed to (within six feet of) any COVID-19 positive patients or not. And using geological location information, the app determines whether the current location of the user belongs to one of the infected areas or not.

l) *Switzerland*

"Swisscovid" is the most popular app for contact tracing in Switzerland. It is also a Bluetooth based application which needs smartphones with the users to track COVID-19. While two devices come in close contact, they exchange random IDs that remain on the phone for the next 14 days before automatically delete. It is more likely the other BLE based apps like German's "Corona-Warn-App" or France's StopCovid" [36]. Like lots of BLE-based other applications, it was accused of a large set of problems including false-positive attack, cryptography weakness, and so on [37].

m) *Pakistan*

Under the supervision of the Ministry of IT and Telecommunication, the Pakistan government has developed an app named "COVID-19 Gov PK" for raising awareness among citizens about COVID-19. The app needs to access the user's geo-location during the installation time of installation [38].

Netherlands, Turkey, UAE, UK, U.S. also using different contact tracing apps for controlling the spread of COVID-19. So, from the described scenario, we can conclude in a point that most of the countries around the world are using applications that are mainly BLE (Bluetooth Low Energy) GPS (Global Positioning System) based.

### III. CLASSIFICATION OF CONTACT TRACING APPLICATIONS

Numerous contact tracing applications are already implemented in some of the countries around the world and some others are proposed by the

researchers. Most of these applications are smartphone-based which require Bluetooth while some other approaches do not require any smartphone at all rather any cellphone would work. Even in some

scenarios, the QR code is considered to be the only solution. As a result, the applications can be classified or categorized based on some technical aspects as follows:

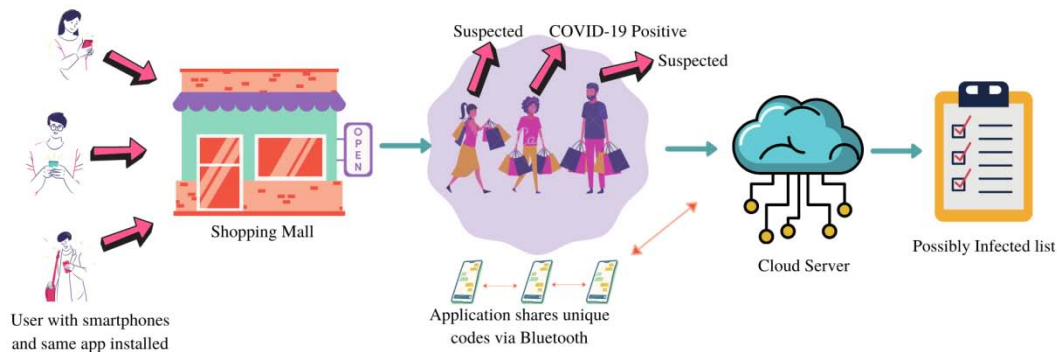


Fig. 1: Summarized steps in Bluetooth based Contact Tracing approach

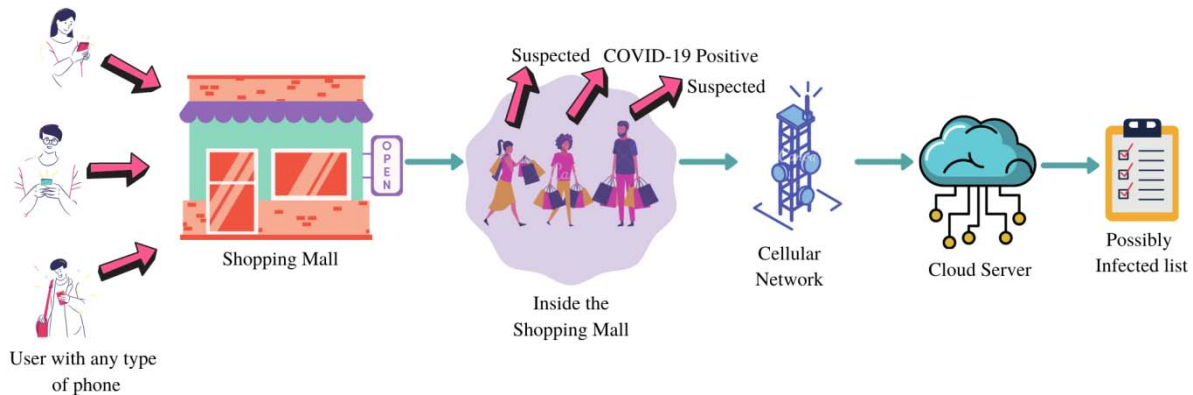


Fig. 2: Summarized steps in Geo Location based Contact Tracing approach

a) Bluetooth Based Approach

In Bluetooth based approach, firstly the user has to install the application. Then if the user passes at near proximity with a COVID-19 carrier (who also had installed the same application previously on his/her phone), the application can record the data and show the intensity of risk. The summarized steps are as follows:

- Step 01: Miss. A, Mr. B, Mr. C, and so on installs the application and keeps the Bluetooth turned on
- Step 02: Miss. A, Mr. B and Mr. C visit the nearest shop
- Step 03: The applications share unique codes when Miss. A, Mr. B, and Mr. C were in close proximity
- Step 04: Mr. B is tested as COVID-19 positive
- Step 05: Miss. A and Mr. C is on the suspected list
- Step 06: Any application user can check whether he or she was in close proximity with any COVID-19 carrier or not

Fig. 1 shows the summarized steps of Bluetooth based Contact Tracing approach. From the figure, a list

of people is going to a shopping mall. But previously all of them have installed the contact tracing application on their smartphone. All of them are also keeping the Bluetooth of their smartphone turned on. Now, at any point inside the shop, they were in close proximity to one another. At that time, the application shares a unique code with one another. These data are also synchronized with the server. Later on, it is found that one of them is COVID-19 positive. As a result, the other two people also lie in the suspected list. Here, the suspected list was generated with the help of a shared code by Bluetooth.

b) Geo-location Based Approach

In the Geo-location-based approach, the location data of the COVID-19 carrier will be collected from the SIM (Subscriber Identity Module) operator rather than any installed application. The main advantage is that to trace the COVID-19 carrier, no user application is needed. But in this approach active government support is required. The summarized steps are as follows:

- Step 01: Miss. A, Mr. B, and Mr. C visit the nearest shop with their mobile phone (any type of mobile phone that is connected to a cellular network)
- Step 02: Mr. B is COVID-19 positive
- Step 03: Miss. A and Mr. C is on the suspected list
- Step 04: The location points (latitude and longitude) of Mr. B for the last 7 days are also collected from the cellphone operator.
- Step 05: These location points are considered as red points
- Step 06: The red points are sent to all other cellphone operators to collect the list of all possibly infected individuals.

Fig. 2 illustrates the summarized steps of the cellphone network-based Contact Tracing approach. From the figure, a list of people is going to a shopping mall. But in this approach, the end-user does not need to install any kind of application in his/her phone and even the phone does not need to be a smartphone rather any kind of mobile phone with an active SIM card will work. Here, the location data of the user will be collected from the cell phone network and synchronized with the server.



Fig. 3: Summarized steps in QR Code based Contact Tracing approach

c) QR Code Based Approach

In this approach, the people are monitored via QR code. People are instructed to keep a unique QR code with them all the time for example when a user is using a public bus or entering a shopping mall and so on. in this approach, it is also instructed that even if the user has no smartphone, the QR code must be printed in hard copies. QR code scanner will be everywhere so that people can scan their QR code and do the necessary things. The summarized steps are as follows:

- Step 01: Miss. A, Mr. B, Mr. C, and so on acquires the QR code from the authority
- Step 02: Miss. A, Mr. B, and Mr. C visit the nearest shop by scanning the QR code
- Mr. B is tested as COVID-19 positive
- Miss A and Mr. C is on the suspected list
- Any application user can check whether he or she was in close proximity with any COVID-19 carrier or not

Fig.3 shows the summarized steps of the QR code-based Contact Tracing approach. From the figure, a list of people is going to a shopping mall. Before that, all of them has got their unique QR code from the authority. These QR codes will be used when any person will use any public property for example public bus, public toilet, etc. Before entering the shopping mall, all of them have shown the QR code to the scanner. If any person at that shopping mall was found COVID-19 positive, then all others will be at risk.

IV. COMPARATIVE ANALYSIS

At this point, we want to provide a comprehensive analysis of the strengths and limitations of Bluetooth based Contact Tracing, Geo-location based Contact Tracing, and QR Code based Contact Tracing as follows:

Table 1: Comparative Study of Strength and Limitation of Different Contact Tracing Approaches

Approach	Major Strength	Major Limitation
Bluetooth Based	<ul style="list-style-type: none"> <li>• Bluetooth operates effectively at close range</li> <li>• Anonymous code is used for each device</li> <li>• No cellular data is needed for the application to operate</li> </ul>	<ul style="list-style-type: none"> <li>• The person has to carry a phone</li> <li>• The phone must be a smartphone with a Bluetooth sensor</li> <li>• User's privacy may be hampered as any unwanted access can be possible through Bluetooth</li> <li>• The user is bound to install the application hence or otherwise the</li> </ul>



		<p>approach won't work</p> <ul style="list-style-type: none"> <li>• This approach can generate false-positive results. For example, there can be a wall in between two persons inside a building.</li> </ul>
Geolocation Based	<ul style="list-style-type: none"> <li>• The mobile phone of the user can be of any type. For example, it can be a smartphone or it can be a very simple button phone with no touch screen and Bluetooth and other sensors</li> <li>• Mass people do not need to install any type of application</li> <li>• There is no chance that the location data is inaccurate if the real user of the mobile is carrying it</li> <li>• Less amount of false negative issue</li> </ul>	<ul style="list-style-type: none"> <li>• The person has to carry the cellphone</li> <li>• If someone carries other's cellphone, then this process won't work</li> <li>• At different levels of a building, the geo-location approach detects the location points as the same</li> </ul>
QR Code Based	<ul style="list-style-type: none"> <li>• Appropriate for poor countries where people have limited access to mobile phones (Printed QR Codes)</li> <li>• There is no technological dependency. Any type of person can use it.</li> <li>• From the users perspective, it works in an offline perspective</li> </ul>	<ul style="list-style-type: none"> <li>• May produce false-positive results while determining close contact among infected and healthy individuals</li> <li>• This approach is fully dependent on the will of the mass people as the physical distance is not measured in the process rather the process-aware the people about the fact</li> </ul>

From Table 1, it is clear that none of the approaches is bullet-proof. Each of the approaches has its strengths and limitations. From the users' perspective, there will be some privacy-related issues for each of the contact tracing approaches. For the Bluetooth based approach, it is highly probable that any intruder may gain some improper access to the device of a person and steal valuable information which is irrecoverable. Although the Bluetooth based approach shares encrypted code among devices, even then it may run into some attack through Bluetooth. On the other hand, when the location data of the person is collected from the cellular network, it is less attack prone. So, the data privacy of the user is preserved in the Geo-location-based approach when compared to Bluetooth based Contact Tracing. Lastly, the QR code is applicable to the under-developed countries where very limited people have mobile phones. In this approach, it is instructed that the person should keep the QR code all the time if the soft copy is not possible then in hard copies. So, there is no chance of privacy-related issues for the people.

## V. CONCLUSION

The novel Coronavirus can only be controlled via safety measures. Contact Tracing approaches are one of the most important and beneficial precautions that can be utilized to trace the spread of the disease. It is expected that most of the adults around the world have a mobile phone of any type. In our research, we

have found that all of the implemented and proposed contact tracing approaches can be categorized into three segments based on technological aspects such as Bluetooth based Contact Tracing, Geo-location based Contact Tracing, and QR code-based Contact Tracing. We can obviously predict that these available contact tracing approaches can play a vital role in defeating the pandemic. We have also analyzed the approaches and found that there should be more research related to platform-independent contact tracing, there can be any physical device or sensor for this inside the smartphone or wearable. Apart from hardware changes, researchers may focus on Artificial Intelligence-based algorithms for contact tracing solutions.

## REFERENCES RÉFÉRENCES REFERENCIAS

1. Farhana K M (2020), Knowledge and Perception towards Novel Coronavirus (COVID-19) in Bangladesh. SSRN. <https://dx.doi.org/10.2139/ssrn.3578477>
2. WHO (2020) Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). [https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)). Accessed 27 November 2020.



3. WHO (2020) WHO Director-General's opening remarks at the media briefing on COVID-19. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>. Accessed 27 November 2020.
4. WHO (2020) Coronavirus disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>. Accessed 27 November 2020.
5. Raskar R et al (2020) Apps gone rogue: Maintaining personal privacy in an epidemic. arXiv. <https://arxiv.org/abs/2003.08567>
6. Ahmed N et al (2020) A Survey of COVID-19 Contact Tracing Apps. *IEEE Access*. 8:134577-134601. <https://doi.org/10.1109/ACCESS.2020.3010226>
7. Chan J et al (2020) Pact: Privacy sensitive protocols and mechanisms for mobile contact tracing. arXiv. <https://arxiv.org/abs/2004.03544>
8. Sonn J W (2020) Coronavirus: South Korea's success in controlling disease is due to its acceptance of surveillance. <https://theconversation.com/coronavirus-south-koreas-success-in-controlling-disease-is-due-to-its-acceptance-of-surveillance-134068>. Accessed 27 November 2020.
9. Kaptchuk G et al (2020) How good is good enough for COVID19 apps? The influence of benefits, accuracy, and privacy on willingness to adopt. arXiv. <https://arxiv.org/abs/2005.04343>
10. Statista (2020) Smartphone ownership rate by country 2019. <https://www.statista.com/statistics/539395/smartphone-penetration-worldwide-by-country/>. Accessed 27 November 2020.
11. Rahman M T et al (2020) An Automated Contact Tracing Approach for Controlling Covid-19 Spread Based on Geolocation Data from Mobile Cellular Networks. *IEEE Access* <https://doi.org/10.1109/ACCESS.2020.3040198>
12. Cadell C (2020) China's coronavirus campaign offers glimpse into surveillance system. <https://www.reuters.com/article/us-health-coronavirus-china-surveillance/chinas-coronavirus-campaign-offers-glimpse-into-surveillance-system-idUSKBN2320LZ>. Accessed 27 November 2020.
13. BBC (2020) Coronavirus France: Cameras to monitor masks and social distancing. <https://www.bbc.com/news/world-europe-52529981>. Accessed 27 November 2020.
14. Zastrow M (2020) Coronavirus contact-tracing apps: can they slow the spread of COVID-19? <https://www.nature.com/articles/d41586-020-01514-2>. Accessed 27 November 2020.
15. O'dea S (2020) Number of smartphone users from 2016 to 2021. <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/>. Accessed 27 November 2020.
16. Ashby M (2017) The Value of CCTV Surveillance Cameras as an Investigative Tool: An Empirical Analysis. *European Journal on Criminal Policy and Research*. 23:441-459. <https://doi.org/10.1007/s10610-017-9341-6>
17. O'Neill P H (2020) A flood of coronavirus apps are tracking us. Now it's time to keep track of them. <https://www.technologyreview.com/2020/05/07/1000961/launching-mittr-covid-tracing-tracker/>. Accessed 27 November 2020.
18. Cho H et al (2020) Contact Tracing Mobile Apps for COVID-19: Privacy Considerations and Related Trade-offs. arXiv. <https://arxiv.org/abs/2003.11511>
19. Bay J et al (2020) Bluetrace: A Privacy-Preserving Protocol Forcommunity-Driven Contact Tracing Across Borders. [https://bluetrace.io/static/bluetrace\\_whitepaper-938063656596c104632def383eb33b3c.pdf](https://bluetrace.io/static/bluetrace_whitepaper-938063656596c104632def383eb33b3c.pdf)
20. Trivedi A et al (2020) WiFiTrace: Network-based Contact Tracing for Infectious Diseases Using Passive WiFi Sensing. arXiv. <https://arxiv.org/abs/2005.12045>
21. Hua J & Shaw R (2020) Corona Virus (COVID-19) "Infodemic" and Emerging Issues through a Data Lens: The Case of China. *Int. J. Environ. Res. Public Health*. 17:2309. <https://doi.org/10.3390/ijerph17072309>
22. Austin L M et al (2020) Test, Trace, and Isolate: COVID-19 and the Canadian Constitution. Osgoode Legal Studies Research Paper. <https://ssrn.com/abstract=3608823> or <http://dx.doi.org/10.2139/ssrn.3608823>
23. Alberta (2020) AB Trace Together. <https://www.alberta.ca/ab-trace-together.aspx>. Accessed 27 November, 2020.
24. Shim E et al (2020) Transmission potential and severity of COVID-19 in South Korea. *International Journal of Infectious Diseases*. 93: 339-344. <https://doi.org/10.1016/j.ijid.2020.03.031>.
25. Ko H et al (2017) Structure and enforcement of data privacy law in South Korea. *International Data Privacy Law*. 7(2):100-114. <https://doi.org/10.1093/idpl/ix004>
26. Rousan N A & Najjar H A (2020) Data Analysis of Coronavirus CoVID-19 Epidemic in South Korea Based on Recovered and Death Cases. *Journal of Medical Virology*. <https://doi.org/10.1002/jmv.25850>
27. Greenleaf G and Kemp K (2020) Australia's 'COVIDSafe App': An Experiment in Surveillance, Trust and Law. *University of New South Wales Law Research Series* 999. <https://ssrn.com/abstract=3589317>
28. Dillet R (2020) France releases contact-tracing app StopCovid | TechCrunch. <https://techcrunch.com/2020/06/02/france-releases-contact-tracing-app->

- stopcovid-on-android/. Accessed 27 November 2020.
29. Made for Mind (2020) Loved or loathed? How Germany's coronavirus tracking app is faring. <https://www.dw.com/en/loved-or-loathed-how-germanys-coronavirus-tracking-app-is-faring/a-53959165>. Accessed 27 November 2020.
  30. Abrahams N et al (2020) Contact tracing apps: A new world for data privacy. <https://www.nortonrosefulbright.com/en-us/knowledge/publications/d7a9a296/contact-tracing-apps-a-new-world-for-data-privacy>. Accessed 27 November 2020.
  31. Bartoszko A (2020) Accelerating Curve of Anxiousness: How a Governmental Quarantine-App Feeds Society with Bugs. *Journal of Extreme Anthropology*. 4(1):E7-E17 <https://doi.org/10.5617/jea.7861>
  32. Koper A (2020) Poland rolls out privacy-secure coronavirus tracking app. <https://www.reuters.com/article/us-health-coronavirus-poland-tech/poland-rolls-out-privacy-secure-coronavirus-tracking-app-idUSKBN23G208>. Accessed 27 November 2020.
  33. Kriesch A (2020) South African app aims to slow spread of COVID-19 in developing nations. <https://www.dw.com/en/south-african-app-aims-to-slow-spread-of-covid-19-in-developing-nations/a-53447346>. Accessed 27 November 2020.
  34. Sawant N (2020) AAROGYA SETU: whether we like it or not, the app is here to stay, but it's still riddled with privacy issues that need strong answers. <https://www.firstpost.com/tech/news-analysis/aarogya-setu-whether-we-like-it-or-not-the-app-is-here-to-stay-but-its-still-riddled-with-privacy-issues-that-need-strong-answers-8348131.html>. Accessed 27 November 2020.
  35. FOPH (2020) Coronavirus: SwissCovid app and contact tracing. <https://www.bag.admin.ch/bag/en/home/krankheiten/ausbrueche-epidemien-pandemien/aktuelle-ausbrueche-epidemien/novel-cov/swisscovid-app-und-contact-tracing.html>. Accessed 27 November 2020.
  36. Dehaye P. & Reardon J. (2020) SwissCovid: a critical analysis of risk assessment by Swiss authorities. arXiv. <https://arxiv.org/abs/2006.10719>
  37. Moitt-PK (2020) Application developed to deal with coronavirus. <https://moitt.gov.pk/NewsDetail/NjQ3NWQyMDMtYTBIYy00ZWU0LWI2YjctYmFmMjk4MTA1MWQ0>. Accessed 27 November 2020.
  38. Ministry of Information Technology and Telecommunication, Application Developed to Deal with Coronavirus. <https://moitt.gov.pk/NewsDetail/NjQ3NWQyMDMtYTBIYy00ZWU0LWI2YjctYmFmMjk4MTA1MWQ0>. Accessed 27 November 2020.



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## A Study on Finding the Factors, Hindering the use of Digital Wallets among Youth in Developing Countries

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**Abstract-** A digital wallet or eWallet is a mobile base software application that securely persists consumer's payment information and passwords for numerous payment methods. By using an eWallet, users can complete their transactions easily and quickly with technologies such as Quick Response (QR) and near-field communications (NFC). In the modern world, people use digital wallets to engage in financial and non-financial activities using the internet. It stores physical financial instruments digitally and provides high availability to convenience to the user. Typically, to facilitate high security to those financial assets, in the digital wallet of the user, and to maintain reliability and availability, mobile application developing organizations follow different authorization mechanisms. Problem prevailing in a developing country similar to Sri Lanka is the less use of digital wallets in day to day transactions. The final outcome of the research will be to find the factors which affect the use of digital wallets in Sri Lankan students who study in western province universities.

**Keywords:** eWallet, digital wallet, UTAUT-3, Unified theory of acceptance and use of technology – 3, user adoption, behavioral intention.

**GJCST-H Classification:** H.1



*Strictly as per the compliance and regulations of:*



# A Study on Finding the Factors, Hindering the use of Digital Wallets among Youth in Developing Countries

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**Abstract-** A digital wallet or eWallet is a mobile base software application that securely persists consumer's payment information and passwords for numerous payment methods. By using an eWallet, users can complete their transactions easily and quickly with technologies such as Quick Response (QR) and near-field communications (NFC). In the modern world, people use digital wallets to engage in financial and non-financial activities using the internet. It stores physical financial instruments digitally and provides high availability to convenience to the user. Typically, to facilitate high security to those financial assets, in the digital wallet of the user, and to maintain reliability and availability, mobile application developing organizations follow different authorization mechanisms. Problem prevailing in a developing country similar to Sri Lanka is the less use of digital wallets in day to day transactions. The final outcome of the research will be to find the factors which affect the use of digital wallets in Sri Lankan students who study in western province universities. The advantage of finding the mentioned factors is to help eWallet developers to enhance their products to attract and on-board more customers. The eWallet developers can think about these measures when developing a solution and use it to promote the application. Further, when developers create an optimal solution, the consumer of eWallets will be highly benefited with an efficient financial application.

**Keywords:** eWallet, digital wallet, UTAUT-3, Unified theory of acceptance and use of technology – 3, user adoption, behavioral intention.

## 1. INTRODUCTION

Information systems and processes in the Corporate environment are rapidly evolving and often subjected to digitalization [1]. In a digital era, more focus is driven towards innovations in financial processes. Organizations in third world countries like Sri Lanka are following a traditional method of transaction settlement [2]. Studies say that Sri Lankans use their debit cards/account pass books to withdraw their money and use physical cash for their daily expenses and the percentage use of new applications such as mobile cash and online banking has been less than 01% and comparatively insignificant [2]. Employees in the country who have an educational level of GCE Advanced Level

and above display a contrast in the previously stated behavior in handling their expenses due to the increase of computer literacy. As per Computer Literacy Statistics – 2018 (First six months) Department of Census and Statistics Sri Lanka, a person (aged 5-69) is considered as a computer literate person if he/she could use a computer on his/her own. For example, even if a 5 years old child can play a computer game then he/she is considered as a computer literate person [6]. The statistic also demonstrates that the computer literacy of individuals who have an educational level of GCE Advanced Level and above, is 70% [6]. They tend to use digital banking; wallets and they follow a minimal use of physical cash. Mobile wallets have numerous advantages for the customer as well as the merchant and the most significant benefits are the time saved and the ease of use.

Mobile wallets are one of the prepaid payment instruments [7]. Further, it is a digital alter-ego of the physical wallet [12]. Digital Wallet is a mobile application which allows it's consumers to perform electronic financial transactions, just as they hold her physical wallet with cash, debit cards, credit cards, pre-paid cards driver's license, transportation passes etc. Digital wallets allow the user to carry almost everything that a physical wallet does.

At the initial stage of introducing digital wallets to the consumers, banking industry researchers predicted that mobile wallets would rapidly replace consumer's use of cash and plastic cards. The mobile wallets haven't exactly taken off as per the prediction. Consumers are interested in using the mobile wallets, but the reality is that mobile wallets still need improvements to convert into a widespread product. Studies in Sri Lanka shows that embracing or use of digital banking and mobile banking except ATM services by consumers is less than 01% [23]. This percentage is insignificant and Motivation behind this is to find out the preference towards mobile wallets, of a selected sample of consumers in Sri Lanka.

According to the statistics in Tencent 2019 WeChat and AliPay Digital wallets have the highest number of active users which exceeds One Billion users. The next in line is PayPal which has 250 million active users. [1]

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According to a study done on Impact of e-wallets for current generation, [44] following advantages and impact those factors create on current generation is identified.

1. Offers more convenience for many consumers (33.3%)
2. Offer access to new rewards (22.2%)
3. Help you with your Budget (17.8)
4. Can be paid to other services (14.4%)
5. High availability (12.2%)

The statistics showed that Sri Lanka being a developing country has high computer literacy when educated population is considered (GCE Advanced Level or above) and Sri Lankans currently use other latest digital finance services.

## II. LITERATURE REVIEW

As per the world development report background papers, the number of young people is reaching unprecedented levels in most developing countries [52]. In many countries, especially in East Asia and Latin America, youth populations are at or near their peak [52]. Sri Lanka is considered as a developing country and as per the world bank reports on Sri Lanka, it is a lower middle income country with an average per person GDP of USD 3,852 and a total population of 21.8 million.

Since the youth represents the future of a country, behaviour of youth towards technology reflects a country's adoption to the same. The youth population in Sri Lanka is estimated to be around 4.4 million or 23% of the total population based on 2012 statistics.

It is shown that eWallet usage needs specific technological skills or computer literacy. Since mostly educated youth are computer literate, this study will be conducted among the university students in Sri Lanka. Highest number of universities are located in western province of Sri Lanka and in my point of view finding the factors, hindering the use of digital wallets among youth in developing countries will be clearly reflected through the responses of Sri Lankan students, who study in universities located in western province of the country.

### a) eWallet usage in Sri Lanka

The mode of delivering services to the customers by financial institutions has changed over the years and the use of information and telecommunication technologies within the financial industry shows an explosive growth. A Journal by an Indian author Bhagyashri R. Pachpande and Aakash Kamble states that the Senior President of Yes Bank said "Prepaid wallets will increasingly replace cash in the near future. The debit and credit cards will not be replaced, but those instruments will be used for specific requirements and micro transactions". Hence it is known that the digital wallets are gradually replacing the traditional

transaction mechanisms [3]. A study by the Faculty of Management and Commerce, South Eastern University of Sri Lanka shows that there are 25 commercial banks both state and non-state throughout the country [2]. Nearly all the banks in Sri Lanka provide mobile banking applications and some of the Banking and non-banking institutions provide digital wallets as well.

Due to the unavailability of reliable sources to identify the exact number of digital wallet users in Sri Lanka, the total wallet downloads of each wallet application through Google play is considered. Considering the top five digital wallet applications in Sri Lanka, an average will be derived. According to the annual reports of Lanka Pay, there are five main issuer banks/financial organizations which have enabled JustPay. JustPay is one of the latest trends in payment products of LankaPay, which allows consumers to make retail payments upto Rs. 10,000 in value using smart mobile devices by transferring funds from their account(s) to the merchant's account directly [15]. Assuming that the active users will be in the highest downloaded digital wallet apps group of consumers, five sample apps are taken into consideration. The eWallet usage in Sri Lanka is approximately ~ 0.38%.

Using the above derived approximate percentage of wallet usage, the gap between the wallet usage of other eight countries and Sri Lanka is compared below [13].

Table 1: Wallet Usage Gap in Sri Lanka Compared to other countries

Country	Percentage (a)	Gap in Sri Lanka (a)-0.38%
China	47%	46.6200%
Norway	42%	41.6200%
UK	24%	23.6200%
Japan	20%	19.6200%
Australia	19%	18.6200%
Colombia	19%	18.6200%
United States	17%	16.6200%
Singapore	17%	16.6200%

Studies conducted in Sri Lanka by researchers have discovered the issues related to Digital and mobile payments [2]. To identify the factors which affect the usage of digital wallets in Sri Lanka negatively, the famous model namely Unified Theory of Acceptance and Use of Technology (UTAUT-3) will be used.

Studies show that the adaptation of modern technology such as digital wallets, mobile banking, online banking etc other than ATM services in Sri Lanka is less than 1% which is very insignificant compared to the rest of the world [2]. When the low rate of 1% is



considered, it is questionable whether the money invested in Research and Development of latest Finance applications will be beneficial to the community at this time period. Due to some of the factors which discourage Sri Lankan customers to switch from traditional payments to Digital wallets implies that the Sri Lankan Banking and finance platform has a customer base who are not mature enough to seize the services they are ready to render.

b) *A Study of Preference towards the Mobile Wallets Among the University Students in Lucknow City*

“The study says, eWallet was something majority of people in India was not aware a few years back, but its use saw a huge leap in last couple of years with the surge of smart phones, high speed internet connectivity using 3G and 4G and the lucrative offers mobile wallets provide in India [7].” “The stated study was an attempt to discover the preference towards eWallet among the students studying in various universities in a indian city called Lucknow city [7].”

The study says the majority of the students prefer to use an eWallet to make a recharge to their phone (23.15%) followed by paying bills (16.84%) and transferring money (15.78%). Avoiding long queues, independent purchase based on time and place, and paying instantly are the three important factors for the students to opt for mobile wallets in India. The study also states that 44% of those indian respondents strongly agree with the statement that they prefer to use other cashless payments methods also, out of all the respondents, 31.57% strongly agree that they are concerned about transaction safety. Further 40% of students disagree that the cost of data access is high and a similar percentage (40%) of them have no issue in trusting the online vendors.

The study also states that there is no significant association between the gender of the respondent and the opinion regarding the future of mobile wallet fails to reject. Study has discovered that Significant association is there between the age of the respondents and the opinion regarding the future of eWallet.

c) *Factors Affecting Consumer's Choice to use Mobile Wallet to Access m-Commerce Industry in India*

“An eWallet can be defined as the digital alternative of the physical wallet” [50]. It stores the digitized valuables for authorization and uses it accordingly to grant permission for accessing goods [50]. The permission is granted by various forms, ranging from password, QR code, and facial image [50].

In the context of the enormous growth of the m-commerce industry in India, this empirical research was undertaken to determine the factors influencing consumers' choice to use the mobile wallet service. [50]. This paper describes how these factors were determined using Logistic Regression, and Structural Equation Modeling [50].

The Indian mobile wallet market is expected to grow at a CAGR of 140.87% through 2018 [50]. This growth is characterized by the adoption of smartphones, tablets and other mobile technologies. The business model is all about discounts [50]. There is a perception that mobile wallets are more secure than normal wallets [50]. Market players have yet to identify a strategic difference in the product. In India, Paytm is the biggest player [50].

From the data analysis, it is observed that convenience, promotions, direct billing, and prompt service are important, in that they have a significant impact on the dependent variable [50].

d) *A Model of Factors Influencing Consumers Intention to use E-Payment System in Indonesia*

The study indicates that in recent years, electronic commerce (electronic commerce) in Indonesia has grown rapidly [51]. E-commerce has become an opportunity for businesses to increase their sales [51]. Electronic payment (electronic payment) was developed to facilitate e-commerce transactions between the consumer and the seller [51]. In this study, the researcher investigated the consumer's intention to use electronic payment [51]. The proposed research model was developed by extending the Unified Theory of Acceptance and Use of Technology (UTAUT-3) with the culture and perceived safety in the model, to determine the significant factors that influence the acceptance of electronic payment technology [51]. The model proposed in the study is used to investigate the consumer's intention to use the electronic payment system in Indonesia, based on UTAUT-3. He states that the factors of UTAUT-3 have a positive effect on the intention to use the electronic payment system [51].

The research indicates that the UTAUT model is a conceptual model that can be used to discover the factors which influence the user's adoption to e-commerce.

### III. METHODOLOGY

To prove that the Digital wallets have not taken off as expected by the finance apps using community, a study should be conducted. Designing the study in an achievable manner and creating proper hypotheses should be done in the design phase.

I propose the model of factors influencing consumer's intention to use eWallet application in Sri Lanka. The proposed model is based on UTAUT-3 to investigate consumer's intention to use eWallet in Sri Lanka. Much research has been developed and modified based on the UTAUT-3 model to get variables that correspond to the context of their research.

a) *Research Model*

The objective of this study is to identify factors which affect the use of Digital Wallets in Sri Lankans.

Unified Theory of Acceptance and Use of Technology (UTAUT-3) by Farooq et al. (2017) is one of the latest and trending developments in the field of technology acceptance models. It is introduced as a combined or unified model for accepting new information technology based on eight such technology acceptance models. Those models are “Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), , Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB, Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT) [27]”.

The UTAUT-3 model identifies user goal or intention and adaptation as the main dependent variable. [27].

UTAUT-3 has constructs namely “performance expectancy (PE), effort expectancy (EE), social influence (SI), Habit (HB), Hedonic Motivation (HM), Facilitating Conditions (FC), Personal innovativeness in the domain of IT (PI) and Price value (PV)”.

Primarily to identify the factors which affect the use of eWallets in Sri Lankans, a focus group discussion was done with ten individuals who are working in a FinTech company as Business Analysts. The discussion was held for 30 minutes and decided that for the research purpose; most suitable and relevant direct determinants are “Performance Expectancy and Effort Expectancy”. The variables of SI, HB, HM, FC, PI, PV have been taken out due to its irrelevance to the context.

The two independent variables PE and EE are hypothesized to be determining the behavioral intention (BI) and behavior (UB) to the adoption of eWallet.

**Performance Expectancy (PE):** Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance [27].

The user's perception of how e-wallets would improve shopping convenience and efficiency is expected to influence the user's adoption intentions. Previous Studies have confirmed a significant relationship between performance expectations and technology adoption [47].

Therefore, it is hypothesized that;

$H_1$ : PE influence user's behavioral intention to use e-wallet

**Effort Expectancy (EE):** Effort expectancy is defined as the degree of ease associated with the use of the system [27].

Therefore, when a user feels that using an eWallet is easy and does not require physical cash or wallet, then the expectation of the effort becomes a strong predictor of the intention to use eWallet. Empirically, the link between expectation of effort and behavioral intention has been supported by many authors [46,47].

Therefore, it is hypothesized that;

$H_2$ : EE influences a user's behavioral intention to use e-wallet.

**Behavioral Intention to use the technology (BI):** “BI refers to the behavioral preparation to accept, use or embrace a particular technology [46]”.

It is hypothesized that;

$H_3$ : Behavioral intention influences user's adaptation behavior to e-wallet

b) *Measuring Direct Determinants using UTAUT-3 model*

According to the UTAUT-3 conceptual model, the relationship between the direct determinants. Multi-item scales from UTAUT-3 instruments [46].

To measure Direct Determinants quantitative survey methodology will be used, in order to generate answers to the research questions by testing hypotheses. Data was collected using a questionnaire that was distributed through Google forms among the target population.

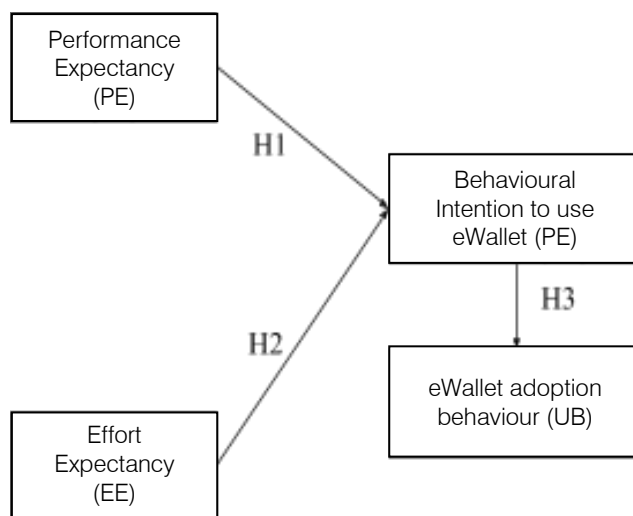


Figure 1: Conceptual Diagram

As the diagram depicts, the independent variables for the research are PE and EE, and the dependent variable is UB.

This model establishes two key determinants of individual eWallet adoption, namely, performance expectancy (PE) and effort expectancy (EE), These factors are mediated by behavioral intention to use (BI) in understanding actual technology utilization behavior (Venkatesh et al., 2012). The extended UTAUT was named as UTAUT-3 with seven significant determinants of IS adoption behavior prediction but for this research only two of the direct determinants will be used.

c) *Research Design*

In this chapter, the process of conducting the research is explained. Deriving the hypothesis, population selection, sample selection and process of gathering data for final data analysis is described.

i. *Null Hypothesis and Alternative Hypothesis*

$H_0$ : Identified factors affects the use of digital wallets in Sri Lankan students who study in western province universities

$H_a$ : Identified factors do not affect the use of digital wallets in Sri Lankan students who study in western province universities.

ii. *Select Population*

“The backbone of the Sri Lankan economy is formed by Small and Medium Enterprises (SMEs) which is an essential sector in a competitive and efficient market” [35]. According to statistics, Sri Lanka has nearly 230,000 business owners or entrepreneurs [34]. As per the 2017 LFS reports there are 300,855 Formal entrepreneurs in the agricultural sector and 279,990 Formal entrepreneurs in the non-agricultural sector [33]. Sri Lankan Government is planning to launch Innovation and Entrepreneurship Strategy in order to improve the existing low number of entrepreneurs and additionally, encourage the new businessmen by supporting financially and mentoring them [34]. Digital wallet usage by business founders is important in order to increase the wallet usage, since consumers cannot use a digital wallet when buying, if the merchant is not using a digital wallet. Hence identifying what a merchant requires through a digital wallet and what consumers expect from a digital wallet is important. In Sri Lanka successful businesses operated mostly by individuals who are graduates or post graduates. Statistics show that 73% of the Founders of Businesses are having a bachelor's degree or above while 40% are from computer science background and 31% are from Business Background [39].

According to the Sri Lanka startup report 2019 the Technical skills and expertise is the factor which affects enabling of successful startups with 69% of impact [39]. As per the Sri Lanka start up report 2019, 33% Sri Lankan Startup Founders are between 25-29 [39]. According to the 2018 Startup Genome Report, the trend has changed in Sri Lanka and most entrepreneurs are the ones who have formal education, experience and whose median age is 39 years [39]. Due to the above stated reasons and existing statistics, in order to conduct the research on Finding the factors which affect the use of digital wallets in Sri Lanka, students who are studying at universities of Colombo District will be considered.

Population of the study comprised of the students studying in undergraduate, postgraduate and Ph.D programs of Western Province universities. According to the Department of Census and Statistics Sri Lanka, western province has the highest computer literacy in the country with 38.6% in 2017 [6].

iii. *Sample*

Since the population size for the study is above 500, a sample will be selected. Individuals will be

selected independently of the other members of the population which will generate a random sample. According to UGC Statistics 2015, Universities and HEIs established under the Universities Act,

Table 2: Total Population

University Program (2015)	Number of Students
Total Undergraduate Admissions	36,582
Total Postgraduate Admissions	14,120
Total State University Students in Western Province	50,702

*Assumptions*

1. Average university admissions are approximately equal to admissions in 2015.

*Exclusions*

1. Private universities are excluded due to unavailability of statistics.

To calculate the sample size, following formula is used,  $n = N * X / (X + N - 1)$ ,

where,

$$X = Z_{\alpha/2} * p * (1-p) / MOE^2,$$

And  $Z_{\alpha/2}$  is the critical value of the Normal distribution at  $\alpha/2$  (e.g. for a confidence level of 95%,  $\alpha$  is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size. Note that a Finite Population Correction has been applied to the sample size formula.

According to the calculations, it is planned to collect 382 responses for the questionnaire to achieve a confidence level of 95% and 5% margin of error.

Gathering of data will be done through conducting an online survey to the selected random sample. Once gathered, the data will be analyzed to create useful information and it will be a quantitative analysis.

#### IV. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

Adopting eWallet and related technologies improves the performance of SMEs. As explained in the research design, university students who have a high level of education have a higher potential for starting SMEs. Identifying the factors influencing e-wallet adoption through the responses of students studying at universities in the Western Province will undoubtedly become a major area of study in strategy and development. management of SMEs. The Western Province is a province which has many business-centric cities and has high computer literacy compared to other parts of the country. Conducting the study for the

selected population using the conceptual model selected, will be beneficial for e-wallet developers and proprietary companies / banks, to focus more on the factors that affect eWallet use, and to provide functionality and features in eWallet, based on these factors.

The questionnaire will consist of three sections; the first section was intended to capture demographics of users; the second section contained items capturing UTAUT-3 statements on a seven-point likert rating scale with end points "strongly disagree" and "strongly agree" [46]. The third section was assigned to capture usage details and experience.

As a contribution to the field of study, the above-mentioned factors can be tested through a pilot test and provide insight to discover a plan to overcome information technology barriers in the implementation of the solution. eWallet in companies.

### REFERENCES RÉFÉRENCES REFERENCIAS

- "Global Online Payment Statistics 2019", Vapulus Blog, 2019. [Online]. Available: <https://www.vapulus.com/en/online-payment-statistics-2019/>. [Accessed: 06- Oct- 2019].
- "Sri Lankan Customers' Behavioural Intention to Use Mobile Banking: A Structural Equation Modelling Approach", Seu.ac.lk, 2019. [Online]. Available: <http://www.seu.ac.lk/jisit/publication/v2n2/paper1.pdf>. [Accessed: 06- Oct- 2019].
- B. Pachpande and A. Kamble, "Study of E-wallet Awareness and its Usage in Mumbai", Journal of Commerce and Management Thought, vol. 9, no. 1, p. 33, 2018. Available: 10.5958/0976-478x.2018.00004.6.
- "El modelo chino que mira Galperín para que ML valga u\$s 30.000 M", El modelo chino que mira Galperín para que ML valga u\$s 30.000M, 2019. [Online]. Available: <https://theworldnews.net/ar-news/el-modelo-chino-que-mira-galperin-para-que-ml-valga-u-s-30-000-m>. [Accessed: 06- Oct- 2019].
- "The rise of digital and mobile wallet: Global usage statistics from 2018", Payments Cards & Mobile, 2019. [Online]. Available: <https://www.paymentscardsandmobile.com/mobile-wallet-global-usa-ge-statistic/>. [Accessed: 06- Oct- 2019]
- Statistics.gov.lk. (2019). Computer Literacy. [online] Available at: <http://www.statistics.gov.lk/education/ComputerLiteracy/ComputerLiteracy-2018Q1-Q2-final.pdf> [Accessed 1 Dec. 2019].
- S. Singh Rana, "A STUDY OF PREFERENCE TOWARDS THE MOBILE WALLETS AMONG THE UNIVERSITY STUDENTS IN LUCKNOW CITY", vol. 04, 2017. [Accessed 1 February 2020].
- L. LTD, "The Island", Island.lk, 2020. [Online]. Available: [http://island.lk/index.php?page\\_cat=article-details&page=article-details&code\\_title=208127](http://island.lk/index.php?page_cat=article-details&page=article-details&code_title=208127). [Accessed: 08- Feb- 2020].
- "Sampath Wepay - by Sampath Bank PLC - Finance Category - AppGrooves: Get More out of Life with iPhone & Android Apps", Appgrooves.com, 2020. [Online]. Available: <https://appgrooves.com/ios/1375437357/sampath-wepay/sampath-bank-plc>. [Accessed: 08- Feb- 2020].
- "Sampath Bank offers customers and non-customers a variety of solutions for bill payments | Daily FT", Ft.lk, 2020. [Online]. Available: <http://www.ft.lk/financial-services/Sampath-Bank-offers-customers-and-non-customers-a-variety-of-solutions-for-bill-payments/42-68259>. [Accessed: 08- Feb- 2020].
- "WePay - Electronic Banking - Personal - Sampath Bank PLC", Sampath.lk, 2020. [Online]. Available: <https://www.sampath.lk/en/personal/electronic-banking/wepay>. [Accessed: 08- Feb- 2020].
2020. [Online]. Available: [https://www.researchgate.net/publication/315619951\\_FACTORS\\_AFFECTING\\_CONSUMER'S\\_CHOICE\\_TO\\_USE\\_MOBILE\\_WALLET\\_TO\\_ACCESS\\_M-COMMERCE\\_INDUSTRY\\_IN\\_INDIA](https://www.researchgate.net/publication/315619951_FACTORS_AFFECTING_CONSUMER'S_CHOICE_TO_USE_MOBILE_WALLET_TO_ACCESS_M-COMMERCE_INDUSTRY_IN_INDIA). [Accessed: 05- Mar- 2020].
- B. Young, "The Rise of Digital & Mobile Wallets: 2020 Global Usage Stats", Merchant Machine, 2020. [Online]. Available: <https://merchantmachine.co.uk/digital-wallet/>. [Accessed: 05- Mar- 2020].
- Lankaclear.com, 2020. [Online]. Available: <https://www.lankaclear.com/assets/images/downloads/annual-reports/file/2017-2018.pdf>. [Accessed: 05- Mar- 2020].
- "LankaClear", Lankaclear.com, 2020. [Online]. Available: <https://www.lankaclear.com/products-and-services/justpay/>. [Accessed: 05- Mar- 2020].
- Play.google.com, 2020. [Online]. Available: <https://play.google.com/store/apps>. [Accessed: 05- Mar- 2020].
- Statistics.gov.lk, 2020. [Online]. Available: [http://www.statistics.gov.lk/samplesurvey/LFS\\_Annual%20Report%202018-f.pdf](http://www.statistics.gov.lk/samplesurvey/LFS_Annual%20Report%202018-f.pdf). [Accessed: 05- Mar- 2020].
- Ugc.ac.lk, 2020. [Online]. Available: [http://www.ugc.ac.lk/downloads/statistics/stat\\_2015/Chapter%203.pdf](http://www.ugc.ac.lk/downloads/statistics/stat_2015/Chapter%203.pdf). [Accessed: 06- Mar- 2020].
2020. [Online]. Available: [https://www.researchgate.net/figure/UTUAT-Conceptual-Model\\_fig1\\_292134289](https://www.researchgate.net/figure/UTUAT-Conceptual-Model_fig1_292134289). [Accessed: 05- Mar- 2020].
2020. [Online]. Available: [https://www.researchgate.net/publication/292134289\\_REVIEW\\_OF\\_STUDIES\\_WITH\\_UTAUT\\_AS\\_CONCEPTUAL\\_FRAMEWORK](https://www.researchgate.net/publication/292134289_REVIEW_OF_STUDIES_WITH_UTAUT_AS_CONCEPTUAL_FRAMEWORK). [Accessed: 05- Mar- 2020].
- "Guerrilla marketing", En.wikipedia.org, 2020. [Online]. Available: [https://en.wikipedia.org/wiki/Guerrilla\\_marketing](https://en.wikipedia.org/wiki/Guerrilla_marketing). [Accessed: 05- Mar- 2020].
- "Consumer adoption of mobile banking in Jordan: Examining the role of usefulness, ease of use, perceived risk and self-efficacy | Emerald Insight", Doi.org, 2020. [Online]. Available: <https://doi.org/>



- 10.1108/JEIM-04-2015-0035. [Accessed: 05- Mar- 2020].
23. Ugc.ac.lk, 2020. [Online]. Available: [http://www.ugc.ac.lk/downloads/statistics/stat\\_2015/Chapter%203.pdf](http://www.ugc.ac.lk/downloads/statistics/stat_2015/Chapter%203.pdf). [Accessed: 06- Mar- 2020].
24. "Statistics – Telecommunications Regulatory Commission of Sri Lanka", Trc.gov.lk, 2020. [Online]. Available: <http://www.trc.gov.lk/2014-05-13-03-56-46/statistics.html>. [Accessed: 05- Mar- 2020].
25. A. Goswami and S. Dutta, "Gender Differences in Technology Usage—A Literature Review", *Open Journal of Business and Management*, vol. 04, no. 01, pp. 51-59, 2016. Available: [https://www.researchgate.net/publication/290475791\\_Gender\\_Differences\\_in\\_Technology\\_Usage-A\\_Literature\\_Review/link/5699eca508aeaa98594c622/download](https://www.researchgate.net/publication/290475791_Gender_Differences_in_Technology_Usage-A_Literature_Review/link/5699eca508aeaa98594c622/download).
26. K. Mutaqin and E. Sutoyo, "Analysis of Citizens Acceptance for e-Government Services in Bandung, Indonesia: The Use of the Unified Theory of Acceptance and Use of Technology (UTAUT) Model", *Bulletin of Computer Science and Electrical Engineering*, vol. 1, no. 1, pp. 19-25, 2020. Available: 10.25008/bcsee.v1i1.3.
27. "Extending the unified theory of acceptance and use of technology (UTAUT) model - IEEE Conference Publication", *ieeexplore.ieee.org*, 2020. [Online]. Available: <https://ieeexplore.ieee.org/document/6014530>. [Accessed: 09- Jul- 2020].
28. Statistics.gov.lk. 2020. Computer Literacy of Sri Lanka. [online] Available at: <http://www.statistics.gov.lk/CLS/> [Accessed 9 July 2020].
29. Finstad, K., 2010. The Usability Metric for User Experience. *Interacting with Computers*, [online] 22(5), pp.323-327. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S095354381000038X>.
30. Usabilitygeek.com. 2020. [online] Available at: <https://usabilitygeek.com/usability-metrics-a-guide-to-quantify-system-usability/> [Accessed 9 July 2020].
31. Sergeev, a., 2020. UI Designer - ISO-9241 Efficiency Metrics - Theory of Usability. [online] *Ui-designer.net*. Available at: <http://ui-designer.net/usability/efficiency.htm> [Accessed 9 July 2020].
32. Measuringu.com. 2020. [online] Available at: <https://measuringu.com/seq10/> [Accessed 9 July 2020].
33. Statistics.gov.lk. 2020. Sri Lanka Labour Force Survey. [online] Available at: [http://www.statistics.gov.lk/samplesurvey/LFS\\_Annual%20Report\\_2017\\_version2.pdf](http://www.statistics.gov.lk/samplesurvey/LFS_Annual%20Report_2017_version2.pdf) [Accessed 9 July 2020].
34. Ft.lk. 2020. [online] Available at: <http://www.ft.lk/mobile/front-page/Govt--to-launch%C2%A0Innovation-and-Entrepreneurship-Strategy/44-651311> [Accessed 9 July 2020].
35. Aeb.wyb.ac.lk. 2020. [online] Available at: [http://aeb.wyb.ac.lk/wp-content/uploads/2018/01/Vo1-1/Kuluppuara\\_chchi.pdf](http://aeb.wyb.ac.lk/wp-content/uploads/2018/01/Vo1-1/Kuluppuara_chchi.pdf) [Accessed 9 July 2020].
36. "Sampath.lk. 2020. Sampath Saviya - Entrepreneur Development - Personal - Sampath Bank PLC." [online] Available at: <https://www.sampath.lk/en/personal/entrepreneur-development/sampath-saviya> [Accessed 9 July 2020].
37. Frimi.lk. 2020. Frimi. [online] Available at: <https://www.frimi.lk/frimi-for-business> [Accessed 9 July 2020]
38. Sdb.lk. 2020. [online] Available at: <https://www.sdb.lk/en/sme/sme-plus> [Accessed 9 July 2020].
39. "Sri Lanka Startup Report 2019 – Slasscom", Slasscom.lk, 2020. [Online]. Available: <https://slasscom.lk/sri-lanka-startup-report-2019/>. [Accessed: 09- Jul- 2020].
40. "S. Subramanian, "Consumer Acuity on Select Digital Wallets", *researchgate.net*, 2020. [Online]. Available: [https://www.researchgate.net/publication/338357685\\_Consumer\\_Acuity\\_On\\_Select\\_Digital\\_Wallets](https://www.researchgate.net/publication/338357685_Consumer_Acuity_On_Select_Digital_Wallets). [Accessed: 09- Jul- 2020].
41. *SurveyMonkey.com*. 2020. A Study On Degree Of Awareness About Mobile Wallet, Its Potential Market In India, Barriers And Drivers To Its Success. *Survey*. [online] Available at: [https://www.surveymonkey.com/r/mobile\\_wallet\\_symbiosis](https://www.surveymonkey.com/r/mobile_wallet_symbiosis) [Accessed 9 July 2020].
42. V. Patel, "Young Consumers' Intention to Use Mobile Wallet Services: An Empirical Investigation Using UTAUT Model", *researchgate*, 2020. [Online]. Available: [https://www.researchgate.net/publication/303685121\\_Young\\_Consumers%27\\_Intention\\_to\\_Use\\_Mobile\\_Wallet\\_Services\\_An\\_Empirical\\_Investigation\\_Using\\_UTAUT\\_Model](https://www.researchgate.net/publication/303685121_Young_Consumers%27_Intention_to_Use_Mobile_Wallet_Services_An_Empirical_Investigation_Using_UTAUT_Model). [Accessed: 09- Jul- 2020].
43. Pande, J., 2019. Cashless Transaction – Mobile Transaction. *SSRN Electronic Journal*, [online] Available at: [https://www.researchgate.net/publication/339253038\\_Impact\\_of\\_mobile\\_wallets\\_o](https://www.researchgate.net/publication/339253038_Impact_of_mobile_wallets_o).
44. Subaramaniam, K., 2020. The Impact of E-Wallets for Current Generation. *Journal of Advanced Research in Dynamical and Control Systems*, [online] 12(01-Special Issue), pp.751-759. Available at: [https://www.researchgate.net/publication/339236716\\_The\\_Impact\\_of\\_E-Wallets\\_for\\_Current\\_Generation/link/5e583914299bf1bdb840a5a9/download](https://www.researchgate.net/publication/339236716_The_Impact_of_E-Wallets_for_Current_Generation/link/5e583914299bf1bdb840a5a9/download)
45. A. Goswami and S. Dutta, "Gender Differences in Technology Usage—A Literature Review", *Open Journal of Business and Management*, vol. 04, no. 01, pp. 51-59, 2016. Available: [https://www.researchgate.net/publication/290475791\\_Gender\\_Differences\\_in\\_Technology\\_Usage-A\\_Literature\\_Review/link/5699eca508aeaa98594c622/download](https://www.researchgate.net/publication/290475791_Gender_Differences_in_Technology_Usage-A_Literature_Review/link/5699eca508aeaa98594c622/download).



46. A. Gurusinghe, "The adequacy of UTAUT-3 in interpreting academicians' adoption to e-Learning in higher education environments | Emerald Insight", Emerald.com, 2020. [Online]. Available: <https://www.emerald.com/insight/content/doi/10.1108/ITSE-05-2019-0020/full/html?skipTracking=true>. [Accessed: 11- Aug- 2020].
47. "An empirical study on the adoption of consumer-to-consumer e-commerce: Integrating the UTAUT model and the Initial Trust model", Research Gate, 2020. [Online]. Available: [https://www.researchgate.net/publication/324676519\\_An\\_empirical\\_study\\_on\\_the\\_adoption\\_of\\_consumer-to-consumer\\_e-commerce\\_Integrating\\_the\\_UTAUT\\_model\\_and\\_the\\_Initial\\_Trust\\_model](https://www.researchgate.net/publication/324676519_An_empirical_study_on_the_adoption_of_consumer-to-consumer_e-commerce_Integrating_the_UTAUT_model_and_the_Initial_Trust_model). [Accessed: 23- Aug- 2020].
48. "Malhotra, Nunan & Birks, Marketing Research: An applied approach, 5th Edition | Pearson", Pearson.com, 2020. [Online]. Available: <https://www.pearson.com/uk/educators/higher-education-educators/program/Malhotra-Marketing-Research-An-applied-approach-5th-Edition/PGM1638972.html>. [Accessed: 17- Oct- 2020].
49. "Payments Bulletin", Cbsl.gov.lk, 2020. [Online]. Available: <https://www.cbsl.gov.lk/sites/default/files/Payments%20Bulletin%202019%20Q1%20Final.pdf>. [Accessed: 21- Oct- 2020].
50. "Factors Affecting Consumer's Choice to Use Mobile Wallet to Access m-Commerce Industry in India. India: Abhilasha Seam\*, Raja Sekhar Reddy\*, Snehil Agrawal\*, Behara Krishna Chaitanya\*, Himanshu Bist\*, Suleman Safdar\*, Pranav Ranjan Patil\*, Purba Halady Rao\*\*", 2020.
51. "A Model of Factors Influencing Consumer's Intention To Use E-payment System in Indonesia", Research Gate, 2020. [Online]. Available: [https://www.researchgate.net/publication/283162078\\_A\\_Model\\_of\\_Factors\\_Influencing\\_Consumer's\\_Intention\\_To\\_Use\\_E-payment\\_System\\_in\\_Indonesia](https://www.researchgate.net/publication/283162078_A_Model_of_Factors_Influencing_Consumer's_Intention_To_Use_E-payment_System_in_Indonesia). [Accessed: 30- Oct- 2020].
52. "D. Lam, "The Demography Of Youth In Developing Countries And Its Economic Implications", Openknowledge.worldbank.org, 2020. [Online]. Available: <https://openknowledge.worldbank.org/handle/10986/9215>. [Accessed: 30- Oct- 2020].
53. "The World Bank In Sri Lanka", World Bank, 2020. [Online]. Available: <https://www.worldbank.org/en/country/srilanka/overview>. [Accessed: 30- Oct- 2020].

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### RECOGNITION ON THE PLATFORM

#### BETTER VISIBILITY AND CITATION

All the Fellow members of FCSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career

Credibility

Reputation

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Career

Financial



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Career

Credibility

Reputation



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Financial

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Credibility

Financial

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## ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.



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Career

Credibility

Exclusive

Reputation



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Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career

Credibility

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Reputation



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Career

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Career

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Reputation

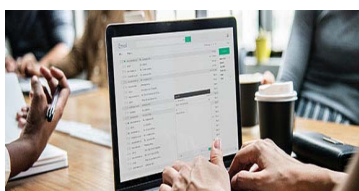
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Career

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ASSOCIATE	FELLOW	RESEARCH GROUP	BASIC
<p>\$4800 lifetime designation</p> <hr/> <p>Certificate, LoR and Momento 2 discounted publishing/year Gradation of Research 10 research contacts/day 1 GB Cloud Storage GJ Community Access</p>	<p>\$6800 lifetime designation</p> <hr/> <p>Certificate, LoR and Momento Unlimited discounted publishing/year Gradation of Research Unlimited research contacts/day 5 GB Cloud Storage Online Presense Assistance GJ Community Access</p>	<p>\$12500.00 organizational</p> <hr/> <p>Certificates, LoRs and Momentos Unlimited free publishing/year Gradation of Research Unlimited research contacts/day Unlimited Cloud Storage Online Presense Assistance GJ Community Access</p>	<p>APC per article</p> <hr/> <p>GJ Community Access</p>



# PREFERRED AUTHOR GUIDELINES

**We accept the manuscript submissions in any standard (generic) format.**

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from <https://globaljournals.org/Template.zip>

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at [submit@globaljournals.org](mailto:submit@globaljournals.org) or get in touch with [chiefeditor@globaljournals.org](mailto:chiefeditor@globaljournals.org) if they wish to send the abstract before submission.

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1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct*, along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s) names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
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Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

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- Findings
- Writings
- Diagrams
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- Illustrations
- Lectures



- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

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2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

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The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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### Acknowledgments

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## PREPARING YOUR MANUSCRIPT

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



### ***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

### ***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



## FORMAT STRUCTURE

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

All manuscripts submitted to Global Journals should include:

### **Title**

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

### **Author details**

The full postal address of any related author(s) must be specified.

### **Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

### **Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

### **Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

### **Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

### **Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

### **Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.





## Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## PREPARATION OF ELETRONIC FIGURES FOR PUBLICATION

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

## TIPS FOR WRITING A GOOD QUALITY COMPUTER SCIENCE RESEARCH PAPER

Techniques for writing a good quality computer science research paper:

**1. Choosing the topic:** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

**2. Think like evaluators:** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

**3. Ask your guides:** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

**4. Use of computer is recommended:** As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

**5. Use the internet for help:** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



**6. Bookmarks are useful:** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

**7. Revise what you wrote:** When you write anything, always read it, summarize it, and then finalize it.

**8. Make every effort:** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

**9. Produce good diagrams of your own:** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

**10. Use proper verb tense:** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

**11. Pick a good study spot:** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

**12. Know what you know:** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

**13. Use good grammar:** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

**14. Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

**15. Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**16. Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

**17. Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

**18. Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**19. Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



**20. Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

**21. Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

**22. Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

**23. Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

### **Key points to remember:**

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

### **Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

### **The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

### **General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



### *Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

### **Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

### **Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

### **Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

#### **Approach:**

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#### **Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

#### **Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

#### **Approach:**

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Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

#### **What to keep away from:**

- Resources and methods are not a set of information.
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- Leave out information that is immaterial to a third party.





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The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

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**Content:**

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- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
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- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

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If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

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- Give details of all of your remarks as much as possible, focusing on mechanisms.
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- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

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Describe generally acknowledged facts and main beliefs in present tense.

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<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
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<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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