Online ISSN : 0975-4172
Print ISSN : 0975-4350
DOI : 10.17406/GJCST

Global Journal

of Computer Science and Technology: C

Software & Data Engineering

Review on Software Defined

Efficient Texture Recognition

Highlights

Protein and Other Biomedical

Mobile Application Development

Discovering Thoughts, Inventing Future

VOLUME 19 ISSUE 1 VERSION 1.0

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Volume 19 Issue 1 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: Open Association of Research Society
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Editorial Board

Global Journal of Computer Science and Technology

Dr. Abdurrahman Arslanyilmaz

Computer Science & Information Systems Department
Youngstown State University
Ph.D., Texas A&M University
University of Missouri, Columbia
Gazi University, Turkey
Web: cis.ysu.edu/~aarslanyilmaz/professional_web

Dr. Chutisant Kerdvibulvech

Dept. of Inf. & Commun. Technol.,
Rangsit University
Pathum Thani, Thailand
Chulalongkorn University Ph.D. Thailand
Keio University, Tokyo, Japan

Dr. Sukhvinder Singh Deora

Ph.D., (Network Security), MSc (Mathematics),

Masters in Computer Applications

Dr. Sotiris Kotsiantis

Ph.D. in Computer Science, University of Patras, Greece
Department of Mathematics, University of Patras, Greece

Dr. Ramadan Elaiess

Ph.D.,

Computer and Information Science

Dr. Manpreet Singh

Ph.D.,
(Computer Science)

Nicla Romano

Professor in Cellular and Developmental Biology;
Cytology and Histology; Morfogenesis and Comparative Anatomy

Dr. Muhammad Abid

M.Phil,
Ph.D Thesis submitted and waiting for defense

Dr. K. Venkata Subba Reddy

Ph.D in Computer Science and Engineering

Loc Nguyen

Postdoctoral degree in Computer Science

Faisal Mubuke

M.Sc (IT), Bachelor of Business Computing, Diploma in Finanicial services and Business Computing

Jiayi Liu

Physics, Machine Learning,
Big Data Systems

Dr. Yuanyang Zhang

Ph.D in Computer Science

Asim Gokhan Yetgin

Design, Modelling and Simulation of Electrical Machinery;

Finite Element Method, Energy Saving, Optimization

Anup Badhe

Bachelor of Engineering (Computer Science)

Dr. S. Nagaprasad

M.Sc, M. Tech, Ph.D

Contents of the Issue

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 19 Issue 1 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Enabling Researchers to Make their Data Count

By Ajit Singh

Department of Computer Science Patna Women's College

Abstract- Over the last years, many organizations have been working on infrastructure to facilitate sharing and reuse of research data. This means that researchers now have ways of making their data available, but not necessarily incentives to do so. Several Research Data Alliance (RDA) working groups have been working on ways to start measuring activities around research data to provide input for new Data Level Metrics (DLMs). These DLMs are a critical step towards providing researchers with credit for their work. In this paper, I describe the outcomes of the work of the Scholarly Link Exchange (Scholix) working group and the Data Usage Metrics working group. The Scholix working group developed a framework that allows organizations to expose and discover links between articles and datasets, thereby providing an indication of data citations. The Data Usage Metrics group works on a standard for the measurement and display of Data Usage Metrics. Here I explain how publishers and data repositories can contribute to and benefit from these initiatives. Together, these contributions feed into several hubs that enable data repositories to start displaying DLMs. Once these DLMs are available, researchers are in a better position to make their data count and be rewarded for their work.

Keywords: *crossref; research data count; citation; DLM; RDA; scholix; researcher; datasite; DOI, working group.*

GJCST-C Classification: *E.m*

Strictly as per the compliance and regulations of:

Enabling Researchers to Make their Data Count

Ajit Singh

Abstract- Over the last years, many organizations have been working on infrastructure to facilitate sharing and reuse of research data. This means that researchers now have ways of making their data available, but not necessarily incentives to do so. Several Research Data Alliance (RDA) working groups have been working on ways to start measuring activities around research data to provide input for new Data Level Metrics (DLMs). These DLMs are a critical step towards providing researchers with credit for their work. In this paper, I describe the outcomes of the work of the Scholarly Link Exchange (Scholix) working group and the Data Usage Metrics working group. The Scholix working group developed a framework that allows organizations to expose and discover links between articles and datasets, thereby providing an indication of data citations. The Data Usage Metrics group works on a standard for the measurement and display of Data Usage Metrics. Here I explain how publishers and data repositories can contribute to and benefit from these initiatives. Together, these contributions feed into several hubs that enable data repositories to start displaying DLMs. Once these DLMs are available, researchers are in a better position to make their data count and be rewarded for their work.

Keywords: crossref; research data count; citation; DLM; RDA; scholix; researcher; datasite; DOI, working group.

I. Introduction

Researchers who want to build on published research can reuse existing data to arrive at new conclusions. In addition, linking scholarly literature and data leads to increased visibility, discovery and retrieval of both literature and data, facilitating reuse, reproducibility and transparency. In a digital world where data can be more easily shared and documented, scholarly literature and its underpinning data are increasingly seen as inseparable.

At the same time, while the importance of data sharing is accepted, there are essential questions that still require an answer. For example, why should authors go through the effort of documenting and publishing datasets, if their career depends on the publication of articles and if there is no standard for metadata and basic attribution information around data? Several RDA projects are underway to provide answers to these questions by creating a framework to measure data reuse in a standardized fashion.

Finding the right way to measure the impact of shared data is crucial if research data is to be included as one of the scholarly outputs used for research evaluation. The current meritocratic system in academia relies heavily on the publication of scientific results in recognized academic journals, supported by an internantional editorial board and peer review system. The most commonly used metric to measure the impact of a publication is counting the number of times it receives a citation from other publications that are also peer reviewed and published in recognized journals.

The temptation to use the same metrics for data, and measure citations of datasets in articles, is certainly strong. However, the interaction and impact of research data is more complex than that. The very definition of what a citation for data is fuzzier than the equivalent for articles.

In this paper, I describe how the outputs of two RDA working groups (WGs), the Scholix WG and the Data Usage Metrics WG, can be used to assess data reuse and make data usage statistics and citations available. I will first outline how data repositories and publishers can expose article-data links using Scholix approaches and data usage metrics following the new code of practice for research data. I will then explain how they can consume this information to make DLMs available and help researchers get credit for their work.

II. Data Citation

a) *Scholix: aggregating article-data links to count data citations*

The goal of the Scholix WG was to establish a high-level framework for exchanging article-data links. It aimed to enable an open information ecosystem to understand systematically what data underpins literature and what literature references data.

The Scholix WG addressed this problem. Its goal was to improve the links between scholarly literature and research data as well as between datasets, thereby making it easier to discover, interpret, and reuse scholarly information. The Scholix initiative offers:

1. A universal, global framework that enables information about the links to be exchanged technical guidelines that specify how the interoperability framework works.
2. A common conceptual model, an information model, and open exchange protocols.
3. A community that discusses, develops and applies these specifications.

Within the Scholix framework:

Data repositories, journals, and others provide information about the links between literature and data that they hold to community 'hubs' such as OpenAIRE,

Author: Assistant Professor, Department of Computer Science Patna Women's College, Patna-800001 Bihar, India.
e-mail: ajit_singh24@yahoo.com

Crossref and DataCite (with Crossref and DataCite working on a shared infrastructure). This supports and respects existing community-specific practices and the existing means of exchanging this information.

The community 'hubs' – which are natural places to collect and exchange information about the links between literature and data – commit to a common information model for exchanging the links that they hold and an agreed open exchange method enables this to occur.

The conceptual model (Figure 1) is about the link between two objects, such as a journal article and the underpinning data. Rather than describing in detail the properties of each of the two objects, the conceptual model focuses on the relationship between the objects. It also enables a record of who asserted the link and who made the link available.

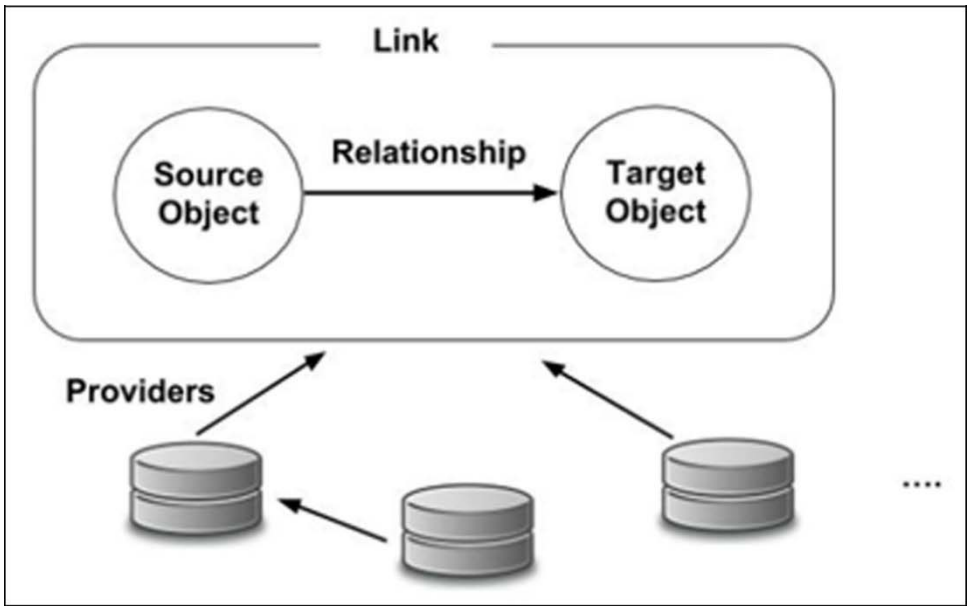

Figure 1: Scholix information model. Providers contribute links by sharing information about the source object (article or dataset), target object (article or dataset) and the nature and direction of the relationship.

b) Contributing data citations: publishers

As mentioned in the previous section, within the Scholix framework organizations contribute information through community hubs. The majority of scholarly publishers work with non-profit organization Crossref to share metadata about publications. These metadata records include comprehensive information about the items being registered, and increasingly include links to related scholarly artifacts such as data, software, protocols, and reviews.

As can be seen in Figure 2, Crossref provides two paths to registering data citations: references and relations. Relations are a way to associate related digital objects with each other through metadata. A publisher can register metadata with Crossref explicitly linking a dataset to a journal article. References are formal citations (such as would be provided in a bibliography) and are a type of relation but are provided separately within Crossref metadata.

Crossref members should deposit data citations as references if:

- The data citation includes a DataCite DOI
- They include data citations in their reference lists (recommended) Crossref members should deposit data citations as relations if:
- They want to capture specific relation types (e.g. is Supplemented By) beyond 'references'
- They are not able to supply data citations as references

In 2019 Crossref will be expanding citation support to allow publishers to explicitly identify data citations in line with the data citation roadmap for scientific publishers (Cousijn et al. 2018). This will allow for deposition of data citations with all types of persistent identifiers as references.

c) Contributing data citations: data repositories

Many data repositories actively curate and keep track of which articles are using the datasets they host. This is valuable information that is currently not always available to other organizations in the data community. For data repositories that use DataCite DOIs, the DOIs and accompanying metadata are registered with

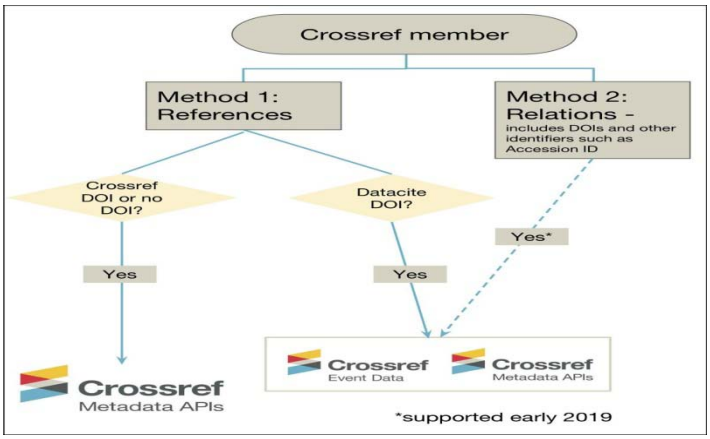

Figure 2: Depositing Data Citations with Crossref. Publishers can deposit data citations following two different methods: references or relations.

DataCite. Therefore, information about any journal publications related to a dataset can be included in the metadata records that are sent to DataCite. This additional information should follow the DataCite metadata schema which is aligned with the Scholix metadata schema (Burton et al. 2017b).

When these elements are added to the metadata that is registered with DataCite, the information about the links will automatically become openly available.

d) Contributing data citations: institutional repositories

For data centers that do not assign DataCite DOIs to datasets, OpenAIRE is currently the best place to deposit article-data links. Institutional repositories can export metadata descriptions of their datasets with links to articles as Dublin Core records or as Scholix records and register with OpenAIRE's Scholexplorer Service (Burton et al. 2017c) as a data source. Scholexplorer will bulk collect metadata records from the reposi-tory APIs; Scholexplorer is compatible with the OAI-PMH protocol or REST search APIs that allow collection of all records with a paging system (collecting by means of several calls) and with "last date of indexing" (incremental approach). Scholexplorer will then enrich its graph of article-dataset links with the ones collected from the repository, de-duplicate when necessary, and expose all links as Scholix records via APIs on behalf of the registered repository. All links exported by OpenAIRE carry provenance information about the data sources that provided the links (more than one source may have provided the same link), to ensure visi-bility of the contributing repositories and provide a degree of trust to the consuming services. OpenAIRE asks the database to display the Scholix logo on their website and indicate that it is harvested by Scholexplorer.

III. Data Usage Metrics

a) Standards for data usage metrics

Following the Scholix initiative and the related work of the RDA Data Citation WG, it was clear that there are broader metrics for data that the community needs to address. With the Scholix working group focusing on the relationships between articles and datasets and the Data Citation Working Group addressing challenges related to dynamic data citation, there was a need for a working group to define usage for data. The Data Usage Metrics WG started in Ocyober' 2018 and focuses on metrics that reflect usage of research data. The group is working to build a comprehensive list of use cases that covers the spectrum of types of 'usage metrics' that may apply to research data, build a recommendation for community guidance on what types of usage metrics should be applied at the data and repositories levels, and drive adoption of usage metrics across the research landscape. Specifically, the working group is aimed at outlining the barriers to adoption of data-level-metrics standards and current implementations of usage metrics across the data repository landscape. These conversations, surveys, and findings will aid in defining recommendations for types of data and associated metrics that repositories should be considering. The group works closely with the Make Data Count project and leverages the COUNTER code of practice for research data (mentioned below).

b) Contributing data usage metrics

This first release of the Code of Practice for Research Data specifically targets research data usage. The recommendations are aligned as much as possible with the COUNTER Code of Practice Release 5 for the major categories of e-resources (journals, databases, books, reference works, and multimedia databases).

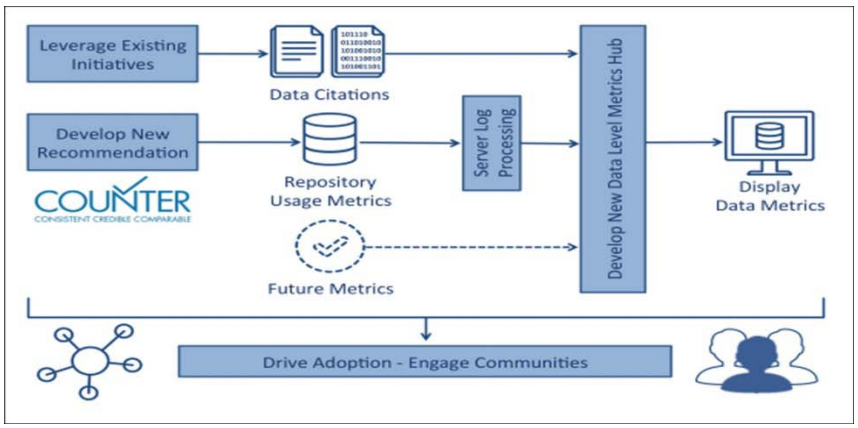

Figure 3: Framework of the Make Data Count project. Repositories process log files against the new Code of Practice and these processed files feed into the same hub as the article-data links collected following the cholix framework. All this information is made openly available to the community so organizations can develop and display DLMs.

and mainly concern views and downloads – called investigations and requests in the Code of Practice. Many definitions, processing rules and reporting recommendations apply to research data in the same way as they apply to other resources. The Code of Practice for Research Data enables the reporting of usage statistics by different data repositories following common best practices, and thus is an essential step towards realizing usage statistics as a metric available to the community to better understand how publicly available datasets are being reused.

IV. Consuming Data Usage Statistics and Citations

The citations and usage statistics contributed by data repositories and publishers are made openly available to the community via APIs. Crossref and DataCite developed Event Data, a shared underlying infrastructure that holds (among other things) all citations that are contributed as part of article and dataset metadata. Crossref and DataCite each have their own API through which they make these citations available.

- Services such as Scholexplorer retrieve data citations from the Crossref Event Data service using this Scholix API endpoint: http:/api.eventdata.crossref.org/v1/events/scholix.
- Scholexplorer combines this information with the citations that are provided to OpenAIRE.
- Views and downloads processed against the COUNTER Code of Practice are sent to DataCite and any repos-itory or research data service can consume usage statistics for a given dataset DOI from an Event Data Query API provided by DataCite (https://support.datacite.org/docs/eventdata-guide). The API combines citations and other events into one API call.

V. Conclusions

Measuring data (re)use and the development of DLMs are crucial if data is to become a first-class research output. Both the Scholix and Data Usage Metrics WGs are making significant contributions in this area by developing clear guidance on how to collect and share data usage statistics and article-data links. Whereas the Scholix WG has reached the end of two very successful 18 month working group terms, the Data Usage Metrics only just started and will continue the work on DLMs and the adoption thereof.

In this paper, I described how data repositories and publishers can contribute to and participate in these initiatives. The openness of the systems developed offers an infrastructure for collaboration using accepted standards. Community organizations, publishers, data repositories, and service providers can rely on common guidelines and standards to share (re)use information they collect about datasets. The most important next step is for as many organizations as possible to standardize usage counts and contribute usage and citations to the open infrastructure hubs.

Acknowledgements

I would like to thank the Co-ordinator cum Editor, IQRC Journal, Patna Women's College, Patna, IND.

References Références Referencias

1. Bierer, B, Crosas, M and Pierce, H. 2017. Data authorship as an incentive to data sharing. N Engl J Med, 376. DOI: https://doi.org/10.1056/NEJMsb1616595
2. Borgman, C. 2012. The conundrum of sharing research data. Journal of the American Society for Information Science and Technology, 63: 1059–1078. DOI: https://doi.org/10.1002/asi.22634

3. Burton, A, et al. 2017a. The Scholix Framework for Interoperability in Data-Literature Information Exchange. D-Lib Magazine, 23(1/2). DOI: https://doi.org/10.1045/january2017-burton
4. Burton, A, et al. 2017b. Scholix Metadata Schema for Exchange of Scholarly Communication Links. Zenodo. DOI: https://doi.org/10.5281/zenodo.1120265
5. Burton, A, et al. 2017c. The data-literature interlinking service: Towards a common infrastructure for sharing data-article links. Program, 51(1): 75–100. DOI: https://doi.org/10.1108/PROG-06-2016-0048
6. Cantu-Ortiz, F. 2017. Research Analytics: Boosting University Productivity and Competitiveness Through Scientometrics. Boca Raton: CRC Press. DOI: https://doi.org/10.1201/9781315155890
7. Cousijn, H, et al. 2018. A data citation roadmap for scientific publishers. Scientific Data, 5. DOI: https://doi. org/10.1038/sdata.2018.259
8. Fenner, M, et al. 2018. Code of practice for research data usage metrics release. PeerJ Preprints, 6(e26505v1). DOI: https://doi.org/10.7287/peerj.preprints.26505v1
9. Kratz, J and Strasser, C. 2015. Making data count. Scientific Data, 2. DOI: https://doi.org/10.1038/sdata.2015.39
10. Make-Data-Count. 2018. Implementing the COUNTER Code of Practice for Research Data in Repositories. Github. Available at: https://github.com/CDLUC3/Make-Data-Count/blob/master/getting-started.md [Last accessed 30 August 2018].
11. Mongeon, P, et al. 2017. Incorporating data sharing to the reward system of science. Aslib Journal of Information Management, 69: 545–556. DOI: https://doi.org/10.1108/AJIM-01-2017-0024
12. Piwowar, H and Vision, T. 2013. Data reuse and the open data citation advantage. PeerJ, 1(e175). DOI: https://doi.org/10.7717/peerj.175
13. Rauber, A, et al. 2016. Identification of Reproducible Subsets for Data Citation, Sharing and Re-Use. TCDL Bulletin, 12(1).
14. Silvello, G. 2018. Theory and practice of data citation. JASIST, 69(1): 6–20. DOI: https://doi.org/10.1002/ asi.23917

This page is intentionally left blank

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 19 Issue 1 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Past before Future: A Comprehensive Review on Software Defined Networks Road Map

By W. Rankothge

Abstract- Software Defined Networking (SDN) is a paradigm that moves out the network switch's control plane (routing protocols) from the switch and leaves only the data plane (user traffic) inside the switch. Since the control plane has been decoupled from hardware and given to a logically centralized software application called a controller; network devices become simple packet forwarding devices that can be programmed via open interfaces. The SDN's concepts: decoupled control logic and programmable networks provide a range of benefits for management process and has gained significant attention from both academia and industry. Since the SDN field is growing very fast, it is an active research area. This review paper discusses the state of art in SDN, with a historic perspective of the field by describing the SDN paradigm, architecture and deployments in detail.

Keywords: *software defined network (SDN), review.*

GJCST-C Classification: *H.3*

Strictly as per the compliance and regulations of:

Past before Future: A Comprehensive Review on Software Defined Networks Road Map

W. Rankothge

Abstract- Software Defined Networking (SDN) is a paradigm that moves out the network switch's control plane (routing protocols) from the switch and leaves only the data plane (user traffic) inside the switch. Since the control plane has been decoupled from hardware and given to a logically centralized software application called a controller; network devices become simple packet forwarding devices that can be programmed via open interfaces. The SDN's concepts: decoupled control logic and programmable networks provide a range of benefits for management process and has gained significant attention from both academia and industry. Since the SDN field is growing very fast, it is an active research area. This review paper discusses the state of art in SDN, with a historic perspective of the field by describing the SDN paradigm, architecture and deployments in detail.

Keywords: software defined network (SDN), review.

I. Introduction

Three components of the network architecture are control plane, data plane, and management plane [1]. The control plane carries control traffic (routing protocols) and is responsible for maintaining the routing tables. The management plane carries administrative traffic and is considered a subset of the control plane. The data plane bears the user traffic that the network exists to carry. It forwards the user traffic based upon information learned by the control plane. In a conventional network, all these three planes are implemented in the firmware of routers and switches.

Software Defined Networking (SDN) is a new paradigm that moves out the network switch's control plane from the switch and leaves only data plane inside the switch [2]. Since the control plane is decoupled from hardware and given to a logically centralized software application called a controller, network devices become simple packet forwarding devices that can be programmed via open interfaces. The SDN's concepts: decoupled control logic and programmable networks provide a range of benefits for the network management process. They include centralized control, simplified algorithms, commoditizing network hardware, eliminating middle-boxes and enabling the design and deployment of third-party applications.

The promise of SDN has gained significant attention from both academia and industry. The Open Network Foundation (ONF) is an industrial driven organization, founded in the year 2011 by a group of network operators, service providers, and vendors to promote SDN and standardize the OpenFlow protocol [3]. Deutsche Telekom, Facebook, Google, Microsoft, Verizon and Yahoo are among the founders. Currently, ONF has around 95 members including several major vendors. The OpenFlow Network Research Center (ONRC) was created by the academia with a focus on SDN research [4]. Since the SDN field is growing very fast, it is a very active research area. This review paper discusses the state of art in SDN, with a historic perspective of the field by describing the SDN paradigm, architecture and deployments in detail.

Author: Sri Lanka Institute of Information Technology Sri Lanka.
e-mail: windhya.r@sliit.lk

II. SDN History

The idea of programmable networks and decoupled control logic has a story of years. The history of SDN goes back to 1980s [5]. This section provides an overview of four technologies which helped SDN to evolve.

a) Central network control

In earlier days telephone networks were using in-band signaling where the data (voice) and the control signals are sent over the same channel. The resulting networks were always complex and insecure. In 1980s, AT&T separated data and control planes of their telephone network and introduced the concept of "Network Control Point" (NCP) [6]. The idea was to separate voice and control, and the control resided on NCP. NCP allowed operators to have a central network-wide vantage point and directly observe the network-wide behavior. Elimination of in-band signaling lead to independent evolution of infrastructure, data, and services where new services were able to be introduced to customers easily. So NCP was the origin of the SDN's concept: separating control and data plane, and to have centralized control over the network [5].

b) Programmability in networks

In the mid-1990s, DARPA research community introduced "Active Networks" with the idea of a network infrastructure that would be programmable for customized services [7]. There were two main approaches: user programmable switches, with in-band data transfer and out-of-band management channels and capsules, which were program fragments that carried in user messages. Program fragments would be interpreted and executed by routers [8]. A Cambridge project in the year 1998, Tempset developed

programmable, virtualizable switches called switchlets [9]. Switchware project of Penn, introduced a programmable switch and a scripting language to support switchlets [10]. Smart Packets, research by BBN was focused on applying the active networks framework to network management process [11]. The Open Signaling project of Columbia, introduced NetScript, a language to provide programmable processing of packet streams [12] [13]. Pro- grammable switches accelerated the innovation of middle- boxes (firewalls and proxies) which are programmed to per- form specific functions. Providing programming functions in networks and compose these functions together were the legacy of active networks for SDN [5].

c) Network virtualization

Network virtualization is the representation of one or more logical network topologies on top of the same infrastructure. It separates the logical infrastructure from underlying physical infrastructure. There are many different instantiations such as Virtual LANs (VLANs), network testbeds and VMWare. In the Switchlets, the control framework has been separated from the switch and allowed virtualization of the switch [9]. In the year 2006, VINI provided a Virtual Network Infrastructure to support different experiments on virtual topologies using a single infrastructure [14]. VINI used the concept of separating control and data planes, and its control plane was a software routing protocol called XORP, which allowed to run routing protocols on virtual network topologies. VINI's data plane "Click" provided the appearance of the virtual network topolo- gies to experimenters. In the year 2007, CABO, a network infrastructure, separated the infrastructure and services to allow service providers to operate independently [15]. The concepts of separating services from infrastructure, using multiple con- trollers to control a single switch and exposing multiple logical switches on top of a single physical switch were the legacy of network virtualization for SDN [5].

d) Control of packet switched networks

With the above evolution of network technologies, the separation of control was needed for rapid innovation of networks. Since the control logic is tied to hardware, it was easier to modify the existing control logics of the telephone network. Having a separate control channel made it possible to have a separate software controller and could easily introduce new services to the telephone network. Software controllers also allowed operators to have a centralized network-wide vantage point and directly observe the network-wide behavior of the telephone network. With these motivations, packet switched networks also tried to separate the control plane from the data plane. There are four main ways that packet switched networks achieved separation of control: separate control channel, in- band protocols, customizing the hardware in the data plane and open Hardware [5].

The first approach of a separate control channel for packet switched network came from the Internet Engineering Task Force (IETF) with the protocol "FORCES" in the year 2003 [16]. The FORCES redefined the network device's internal architecture by separating the control element (CE) from the forwarding elements (FE). The CE executes control and signaling functions and uses the ForCES protocol to instruct FEs on how to forward packets. The FEs forwards packets according to the instructions given by the CE. Each FE has a Logical Function Block in its data plane which enables the CE to control the FEs' configuration and used to process packets. The communication between FEs and CE are achieved by the FORCES protocol. The protocol works based on a master- slave model; FEs are slaves and CE is the master. Even though the FORCES architecture separated the control plane from the data plane, both the planes were kept in the same network device and was represented as a single entity. However, the FORCES required standardization, adoption and deployment of new hardware.

The second approach was to use existing protocols as control channels to send control messages to FEs, and it was called in-band protocols. With the Routing Control Platform (RCP) in the year 2004, each autonomous system in the network had a controller in the form of an RCP [17]. An RCP computed the routes on behalf of routers and, it used existing routing protocols to communicate routes to routers. The limitation with this approach was, the control process was constrained by what the existing protocols can support.

Customizing the hardware in the data plane, supported a wide range of applications in the control plane. In the year 2007, Ethane presented a network architecture for enterprise networks, which used a centralized controller to manage policies and security in a network [18]. Ethane directly enforced a single, network policy at an element called "Domain Controller." A Domain controller computes the flow table entries that should be installed in each of the enterprise switches based on access control policies defined at the Domain Controller. OpenWrt, NetFPGA, and Linux built custom switches to sup- port the Ethane protocol. However, they required new hardware deployments that support Ethane protocol.

The solution was the last approach, to use a method that can operate on existing routing protocols, and did not require customized hardware [19]. It is called open hardware and in the year 2008, the OpenFlow project started with this concept [20] [21]. OpenFlow took the capabilities of existing hardware and opened those capabilities, such that standard control protocols could control the behavior of that hardware.

e) OpenFlow

The OpenFlow network has been deployed in academic campus networks initially [20] [21] and today more than nine universities in the US have deployed OpenFlow networks [22]. OpenFlow has gained significant attention from both academia and industry as a strategy to increase the functionality of the network, but at the same time reducing costs and hardware complexity. The OpenFlow architecture consists of three modules: a Flow Table in each switch, a Secure Channel that connects the switch to a remote control process (called the controller) and the OpenFlow Protocol [20] [21] as shown in Figure 1.

The forwarding device (OpenFlow enabled switch/router) has one or more flow tables. A flow table consists of flow entries, each of which determines how packets belonging to a flow will be processed and forwarded. Flow entries are stored according to their priorities. A flow table entry consists of three main fields [23] and shown in Figure 2.

- Match fields (information found in the packet header): used to match incoming packets
- Counters: used to collect statistics for the particular flow (number of received packets, number of bytes and duration of the flow)

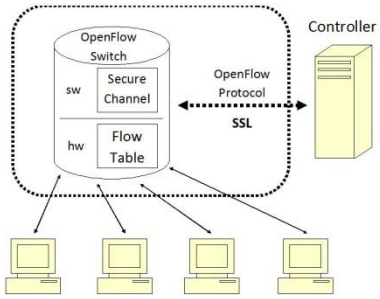

Fig. 1: OpenFlow Architecture [20]

A set of instructions, or actions, to be applied upon a match; they dictate how to handle matching packets. The actions include dropping the packet, continuing the matching process on the next flow table, or for- ward the packet to the controller over the OpenFlow channel.

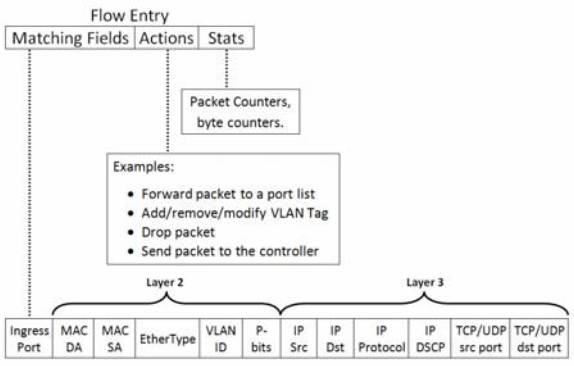

Fig. 2: OpenFlow Flow Table Entry [23]

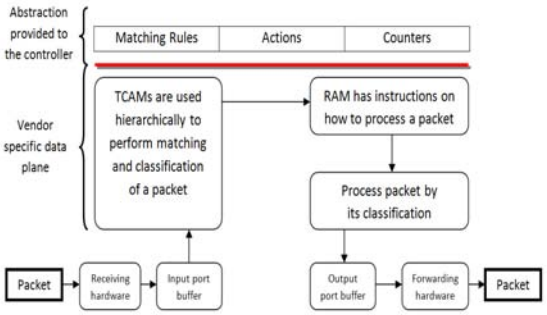

Fig. 3: High-level description of how an OpenFlow switch processes a packet

An OpenFlow enabled switch/router has the capability of forwarding packets according to the rules defined in the flow table. Figure 3 shows a high-level description of how an OpenFlow enabled switch/router processes a packet. Internally, a switch uses Ternary Content Addressable Memory (TCAM) and Random Access Memory (RAM) to process each packet [24]. When a packet arrives at the OpenFlow enabled switch/router, packet header fields are extracted and matched against the matching fields of the first flow table entries. If a matching entry is found, the switch applies the appropriate set of instructions associated with the matched flow entry. If a matching entry is not found, depends on the instructions defined by the table-miss flow entry, the switch will take action. To handle table misses, every flow table must contain a table-miss entry which specifies a set of actions to be performed when no match is found for an incoming packet [23]. Figure 4 shows a low-level description of how an OpenFlow switch processes a packet.

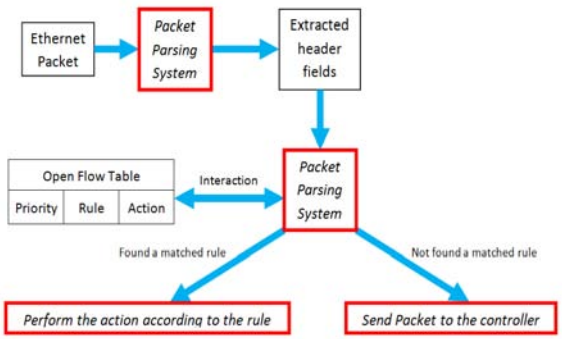

Fig. 4: Low-level description of how an OpenFlow switch processes a packet

The communication between the controller and switch is achieved through the OpenFlow protocol [20] [21]. It defines a set of messages that is exchanged between the controller and a switch over a secure channel. Using the OpenFlow protocol, a controller can add, update, or delete flow entries from the switch flow

tables reactively (in response to a packet arrival) or pro-actively.

The OpenFlow specifications have different versions [23] and the first version was the OpenFlow version 0.2.0 released in March 2008. OpenFlow version 1.0, which is the most widely deployed version was released in December 2009. A switch which supports OpenFlow specification 1.0.0 uses 12 header fields in the Ethernet header and payload of the Ethernet packets are coming into the switch. The header fields include: Ingress port, Ethernet source address, Ethernet destination address, Ethernet destination address, Ethernet type, VLAN priority QoS, IP source address, IP destination address, IP protocol, IP type of service bits, TCP/UDP source port and TCP/UDP destination port. A packet is matched to a flow entry in the flow table by using one or more header fields of the packet.

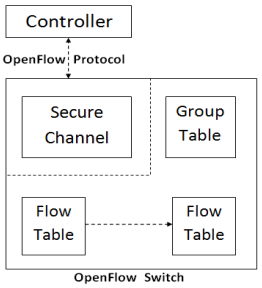

Fig. 5: Main components of the OpenFlow 1.1.0 switch

In the OpenFlow 1.1.0 specification, instead of a single flow table, a switch contains several flow tables and a group table. Figure 5 shows the main components of the OpenFlow

1.1.0 switch with multiple flow tables. Three extra fields (Metadata, MPLS label and MPLS EXP traffic class) have been added to the header fields with OpenFlow 1.1.0. The metadata field acts as a register which can be used to pass information between the tables as the packet traverses through them. The Multi-Protocol Label Switching (MPLS) fields are included to support MPLS tagging. Since there are multiple flow tables available in the switch, the processing of a packet entering the switch is changed. The flow tables in the switch are linked together using a process called "pipeline processing." When the packet first enters the switch, it is sent to the first flow table to look for the flow entry to be matched. If there is a match, the packet gets processed there. If there is another flow table that the particular flow entry points to, the packet is then sent to that flow table. The process is repeated until a particular flow entry does not point to any other flow table. The flow entries in the flow tables can also point to the group table. The group table is specially designed to perform operations that are common across multiple flows. The OpenFlow 1.1.0 also replaced actions with instructions. In OpenFlow 1.0.0 an action could be to forward the packet or to drop it, as well as processing it normally as it would be in a regular switch. Instructions are more complex and they include modifying a packet, updating an action set or updating the metadata.

The OpenFlow 1.2.0 specification was released in De- cember 2011 and it included support to IPv6 addressing. Matching could be done using the IPv6 source and destination addresses. With OpenFlow 1.2.0 specifications, a switch could be connected to multiple controllers concurrently. The switch maintains connections with all the controllers. Controllers can communicate with each other. Having multiple controllers facilitated load balancing and faster recovery during a failure. The OpenFlow 1.3.0 specification was released in June 2012. It included features to (1) control the rate of packets through per flow meters, (2) have auxiliary connections between the switch and the controller and (3) add cookies to the packets sent from the switch to the controller. Table I shows a summarization of OpenFlow specifications.

Table I: Comparison of OpenFlow Specifications

Specification	1.0.0	1.1.0	1.2.0	1.3.0
Widely deployed	Yes	No	No	No
Flow tables	One	Multiple	Multiple	Multiple
Group tables	No	Yes	Yes	Yes
MPLS matching	No	Yes	Yes	Yes
Group tables	No	Yes	Yes	Yes
IPV6 Support	No	No	Yes	Yes
Simultaneous communication	No	No	Yes	Yes

III. SDN Architecture

In SDN, the control plane is decoupled from the hard- ware data plane and given to a software application called a controller. The controller is the core of an SDN network and it lies between network devices and applications [25] [26]. This section gives a brief introduction to the SDN architecture. SDN architecture is shown in figure 6 and it includes: SDN Controllers, Southbound Interfaces, and Northbound Interfaces [25].

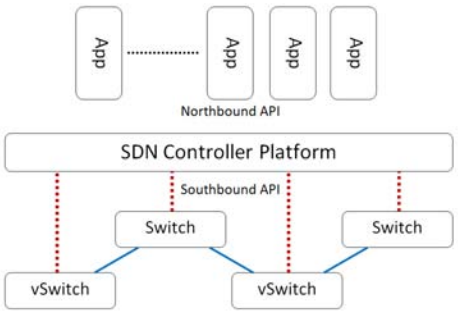

Fig. 6: SDN Architecture

a) SDN controller

The controller is as an operating system for the network that provides a uniform and centralized view

point to the network (network operating system) [27]. While a computer operating system provides read and write access to various resources, a network operating system provides the ability to observe and control a network. The network operating system which is referred to as the controller here after, does not manage the network, but it provides a programmatic interface which can be used to implement applications to perform the actual management tasks. SDN controllers presents two possible behaviors: reactive and proactive [28].

When the controller behaves reactively, it listens to switches passively and configures routes on-demand. The first packet of each new flow, received by a switch (flow request) triggers the controller to insert flow entries in each switch of the network [28]. Every new flow introduces a small delay because of the additional set-up time. Also with the hard dependency of the controller, if a switch losses the connection to the controller, the switch will not be able to forward packets of new flows. When the controller behaves pro-actively, it pre-populates a flow table for each switch. So it has zero additional flow set-up time because the forwarding rules are already defined [28]. With this approach, if the switch loss the connection with the controller, it will not disrupt traffic. However, the proactive approach requires the controller to know the traffic flows in advanced to configure the paths before it is used. Current controllers are implemented to facilitates both approaches. The Controller behaves reactively in the initial state of the network and, after getting to know the network it starts to behave pro-actively.

b) Southbound Interfaces

The southbound interfaces allow switches to communicate with the controller. The OpenFlow protocol is the most popular implementation of the southbound interface. OpenFlow 1.3.0 and above provide optional support for encrypted Transport Layer Security (TLS) communication and a certificate exchange between the switches and the controller for secure communication [23]. The OpenFlow protocol consists of three types of messages.

1) Controller-to-switch messages: Sent by the controller: The Features messages are used to request information on switch capabilities, while configuration messages are used to set or query configuration parameters. Evermore, modify state messages are used to specify, modify or delete flow definitions. The Read state messages are used to retrieve information like counters from the switch and the Role request messages are used to set or query the state of the OpenFlow channel when the switch is connected to multiple controllers. Finally, the Packet out messages are used to send a packet back to a switch for processing after a new flow is created.
2) Asynchronous messages: Sent by the switch: The Packet-in messages are used to inform the controller about a packet that does not match an existing flow. The Flow Removed messages are used to inform the controller that a flow has been removed because of its time to live parameter or inactivity timer has expired. Finally, the Port status messages are used to inform the controller of a change in port status or that an error has occurred on the switch.
3) Symmetric messages: Sent by both the switch or the con- troller: The Hello messages exchanged between the controller and switch on startup, and the Echo messages are used to determine the latency of the controller-to-switch connection and to verify that the controller-to-switch connection is still operative. The Error messages are used to notify the other side of the connection of problems. Finally, the Experimenter messages are used to provide a path for future extensions to OpenFlow technology.

The Border Gateway Protocol (BGP), a well-known core Internet routing protocol is used by Juniper Network's in their SDNs [29]. The controller uses BGP as a control plane protocol and leverage NETCONF (an IETF network management protocol) as a management plane protocol to interact with physical routers, switches and networking services like firewalls. This approach enables SDN to exist in a multi vendor environment without requiring infrastructure upgrades. OpenFlow does not address the issue of the controller inter-operability and requires physical changes to the network, so Juniper is introducing BGP to be the standard of the SDN. Extensible Messaging and Presence Protocol (XMPP) which was originally developed for instant messaging and online presence detection is also emerging as an alternative SDN protocol [30]. XMPP can be used by the controller to distribute control plane information to the server endpoints because XMPP manages information at all levels of abstraction down to the flow, not only to network devices.

c) Northbound APIs

The southbound interfaces allowed controller - switches communication and provided basic operations to access the network system. But they could not retrieve complex information from the switches and therefore programming the network to perform high-level tasks (load balancing, implementing security policies) was difficult. Also, it was difficult to perform multiple independent tasks (routing, access control) concurrently using the south bound interfaces. So the northbound interface, a programming interface that allows applications to program the network with higher level abstraction [25] [26] was introduced. Developers can use the northbound interface to extract information about the underlying network and to implement complex

applications such as path computation, loop avoidance, routing, and security. Additionally, northbound interface can be used by controllers to communicate with each other to share resources and synchronize policies. The North- bound interface offers vendor in-dependability and ability to modify or customize control through popular programming languages. Unlike southbound interfaces, there is no currently accepted standard for northbound interfaces and they are more likely to be implemented depending on the application requirements.

IV. SDN Development Tools and Frameworks

The concept of decoupling control plane from the data plane allows SDN to facilitate network evolution and innovation by introducing new services and protocols easily. This section gives an overview of currently available tools and environments for developing services and protocols with SDN.

a) SDN controller platforms

Many controller implementations are available for SDNs and a suitable controller can be selected by considering the programming language and performances of the controller [31] [32] [33]. The popular controller platforms include ovs [23], NOX [27], POX [34], Beacon [31], Maestro [35], Trema [36] Ryu [37] and Floodlight [38]. Table II shows a comparison of the SDN controller platforms according to their general details and Figure 7 (taken from [31]) shows a comparison of the performances of SDN controller platforms.

The current standard for evaluating SDN controller performance is Cbench. The Cbench simulates OpenFlow switches and operates in either throughput or latency mode. In through- put mode, each of 64 emulated switches constantly sends as many Packet In messages as possible to the controller, ensuring that the controller always has messages to process. Evaluation tests have been run on Amazon's Elastic Computer Cloud using a Cluster Compute Eight Extra Large instance, containing 16 physical cores from 2 x Intel Xeon E5-2670 processors, 60.5GB of RAM, using a 64-bit Ubuntu 11.10 VM image. Figure 7 shows Cbench throughput mode results using controllers with a single thread. Beacon shows the highest throughput at 1.35 million responses per second, followed by NOX with 828,000, Maestro with 420,000, Beacon Queue with 206,000, Floodlight with 135,000, and Beacon Immediate with 118,000. Both Python-based controllers run significantly slower, POX serving 35,000 responses per second and Ryu with 20,000.

Table II: General comparison of SDN controller platforms

Name	Language	License	Original authors	Can Extend	Currently active	Notes
Ovs	C	OpenFlow license	Stanford/ Nicira	No	No	A reference controller, act as a learning switch
NOX	C++	GPL	Nicira	Yes	Yes	Event-based
POX	Python	GPL	Nicira	Yes	Yes	Event-based
Beacon	Java	GPL	Stanford	Yes	Yes	Web Interface, Regression test framework, Event based and Multi-thread based
Maestro	Java	LGPL	Rice	Yes	No	Multi-thread based
Trema	Ruby, C	GPL	NEC	Yes	No	Emulator and Regression test framework
Floodlight	Java	Apache	Big switch	Yes	Yes	REST APIs, Supports multi-tenant clouds

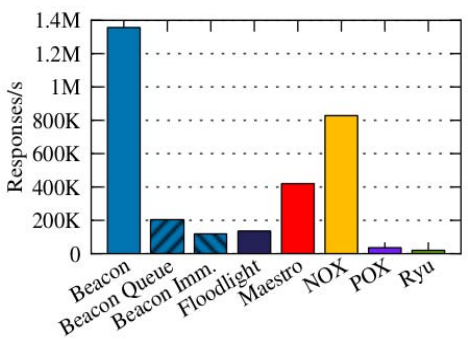

Fig. 7: SDN Controller Platforms Performances Comparison [31]

b) SDN software switch platforms

With SDN, the switch architecture has become very simple, because it is left only with the data plane. It has reduced functions of switches and introduced concepts of software switch implementation and switch virtualization. The result was rapid innovations in software switch platforms. The software switch platforms can be used to replace the firmware of physical switches that do not support SDN. The popular software switch platforms include Open vSwitch [23], Pantou/OpenWRT [39] and ofsoftswitch13 [40]. Table III shows a comparison of the SDN software switch platforms.

c) Native SDN switches

As explained at the beginning of the paper, the promise of SDN has gained significant attention from many network de- vices vendors. One clear evidence of industry strong commitment to SDN is the availability of OpenFlow enabled commodity network hardware. Hewlett-Packard, Brocade, IBM, NEC, Pronto, Juniper, and Pica8 have introduced many OpenFlow enabled switch models. Table IV shows a partial list of native SDN switches.

d) SDN languages

SDN programming languages are used for higher level abstraction of programming for network management. They consist of high-level abstractions for querying network state, defining forwarding policies and updating policies in a consistent way [41]. SDN languages is an area of very active research and several languages have been proposed and are still under development. Table V shows a classification of different SDN languages.

The FatTire [42] allows programmers to declaratively specify sets of legal paths through the network and fault tolerance requirements for those paths. The FatTire compiler takes programs specified regarding paths and translates them to OpenFlow switch configurations. Since the backup paths are configured with those programs, responding to link failures can be done automatically without controller intervention.

The Nettle [43] was originally designed for programming OpenFlow networks. Using the discrete nature of Functional Reactive Programming, Nettle can capture control messages to and from OpenFlow switches as streams of Nettle events. The Nettle model messages from switches with a data type SwitchMessage and commands to switches with a data type SwitchCommand. A Nettle program is a signal function (SF) having an input carrying switch messages from all switches in the network and output carrying switch commands to any switches in the network, SF (Event SwitchMessage) (Event SwitchCommand).

The Flow-based Management Language (FML) [44] comes with high-level built-in policy operators that allow or deny certain flows flowing through a firewall or provide quality of service. If network forwarding policy falls into the space of policies that can be described by an FML program, the code for implementing the policy is easy. But adding new policy operators to the system requires coding outside the FML language. Moreover, a resulting policy decision applies equally to all packets within the same flow and it is not possible to move or redirect a flow as it is processed. So, even though FML provides network operators with a very useful set of SDN abstractions, the programming model, is inflexible.

The Procera [45] is an extension to Nettle, which has been designed to incorporate events that originated from sources other than OpenFlow switches. It supports policies that react to conditions such as user authentications, time of day, bandwidth use and server load. Procera is expressive and extensible, so users can easily extend the language by adding new constructs. The input to the main Procera signal function is a world signal whose instantaneous values have the abstract World type. The output of a Procera program is a signal carrying flow constraint functions. A flow constraint function determines the constraints that are applied to a flow: allow or deny.

Table III: General comparison of software switch platforms

Software switch	Language	OpenFlow Version	Notes
OpenVSwitch	C, Python	V 1.0	Implements a switch platform in a virtualized server environment. Supports standard Ethernet switching with VLANs and access control lists. Provides interfaces for managing configuration state and a method to remotely manipulate the forwarding path.
Pantou/ OpenWRT	C	V 1.0	Turns a commercial wireless router/access point to an OpenFlow enabled switch. OpenFlow is implemented as an application on top of OpenWRT. Pantou is based on the BackFire OpenWRT release and the OpenFlow module is based on the Stanford reference implementation.
ofsoftswitch13	C, C++	V 1.3	A user space software switch implementation. The code is based on the Ericsson's Traffic Lab 1.1 soft switch implementation.

Table IV: Native SDN switches

Switch Company	Series
Cisco	Cisco cat6k, catalyst 3750,6500 series
Juniper	Juniper MX-240,T-640
HP	HP pro-curve 5400zl,8200zl,6200zl,3500zl,6600
NEC	NEC IP8800
Pronto	Pronto 3240, 3290
Dell	Dell Z9000 and S4810
Toroki	Toroki Light switch 4810
Ciena	Ciena Core-director running firmware version 6.1.1
Quanta	Quanta LB4G

The Frenetic language is embedded in Python and comprises two integrated sub-languages: a declarative network query language and a network policy management library. The results of such queries may be used for security monitoring and for decisions about the forwarding policy.

The Flog [46] combines features of both FML and in Frenetic. From FML, Flog uses logic programming as the central paradigm for controlling SDNs. Logic programming fits the SDN domain because SDN programming is table driven collection and processing of network statistics. From Frenetic, Flog uses the concept that controller programs may be factored into three key components: a mechanism for querying network state, a mechanism for processing data learned from queries and a component for generating packet forwarding policies. Flog is designed as an event-driven and forward chaining logic programming language. Each time a networking event occurs, the logic program executes. It can have two effects: generates a packet forwarding policy that is compiled and deployed on switches and generates a state that is used to help the logic program to be executed when the next network event is processed.

The Pyretic system [47] enables programmers to specify network policies, compose them together and execute them on abstract network topologies. The Pyretic's static policy lan-network), and policy combinators, which are used to mix primitive actions, predicates, and queries together to craft so- phisticated policies from simple components. The policies can be composed together in two ways: parallel and sequential. In parallel composition, multiple policies operate concurrently on separate copies of the same packets. In sequential composition, one module operates on the packets produced by another.

e) SDN debugging tools

The emergence of SDN enables adding new network functionalities easily, at the risk of programming errors. Even though the centralized programming model has reduced the likelihood of bugs, the ultimate success of SDN depends on having effective ways to test applications in pursuit of avoiding bugs. There are many SDN debugging tools have been developed and they can be divided into four categories based on the layers they are working with. Table VI shows a classification of different debugging tools according to the layers they are working with.

The NICE [48] is an automated testing tool that can be used to identify bugs in OpenFlow programs though model checking and symbolic execution. It automatically generates streams of packets under possible events and tests unmodified controller programs. The programmer must supply the controller program and the specification of a topology with switches and hosts, to use with NICE. NICE can be instructed by the programmer to check for generic correctness properties (no forwarding loops or no black holes), and optionally application-specific correctness properties. NICE is developed to explores the space of possible system behaviors systematically and checks them against the desired correctness properties. As the output, NICE reports property violations with the traces to deterministically reproduce them.

Anteater [49] is the first design and implementation of a data plane analysis system which can be used to find bugs in real networks. The system detects problems by analysing the contents of forwarding tables in routers, switches, firewalls and other networking equipment. It checks network invariants

Table V: General comparison of SDN Languages

Language	Supports	Type	Based on	Used for
FatTire	Only OpenFlow	-	Regular expressions	Fault tolerant programming
Nettle	Only OpenFlow	Functional	Functional Reactive Programming	Load balancing programming
FML	Only OpenFlow	Logical	datalog	Policy implementation programming
Procera	Any type of hardware	Functional	Functional Reactive Programming	General programming
Flog	Any type of hardware	Logical	datalog	General programming
Frenetic	Any type of hardware	Logical	Query language	General programming
Pyretic	Any type of hardware	Logical	Query language	General programming

Table VI: Classification of SDN debugging tools according to the layers they are working with

Layer	Tools
Application layer	NICE
Data Plane	Anteater
Control Plane	ndb, OFrewind
A new layer between Data Plane and Control Plane	VeriFlow

(connectivity or consistency) that exist in the data plane. Violations of these invariants are considered as a bug in the network. Anteater translates the detected high-level network invariants into instances of boolean satisfiability problems (SAT). Then checks them against network state using an SAT solver. And finally, if violations have been found, it reports counter examples.

The ndb [50] is a prototype network debugger inspired by gdb (a popular debugger for software programs). It implements two primitives useful for debugging a SDN control plane: breakpoints and packet back-traces. A packet back-trace in ndb allows the user to define a packet breakpoint (an un-forwarded packet or a packet filter). Then it shows the sequence of for- warding actions seen by that packet leading to the breakpoint.

OFRewind [51] allows SDN control plane traffic to be recorded at different granularities. Later they can be replayed to reproduce a specific scenario, giving the opportunity to localize and troubleshoot the events that caused the network anomaly. It records flow table state via a proxy and logs packet traces and aids debugging via scenario re-creation. The VeriFlow [52] is a SDN debugging tool which finds faulty rules issued by SDN applications and prevents them from reaching the network and causing anomalous network behavior. VeriFlow operates as a layer between the controller and the devices, and checks the validity of invariants as each rule is inserted. To ensure a real-time response, VeriFlow introduces new algorithms to search for potential violation of key network invariants: availability of a path to the destination, absence of routing loops, access control policies or isolation between virtual networks.

Other than the SDN debugging tools which were described earlier, there are two SDN troubleshooting simulators: STS (SDN Troubleshooting Simulator) [53] and OpenSketch [54]. STS [53] is a SDN troubleshooting simulator which is written in python and depends on POX controller [34]. It simulates the devices of the network to allow operators to easily generate test cases, examine the state of the network interactively and find the exact inputs that are responsible for triggering a given ment architecture, which separates the measurement data plane from the control plane. In the data plane, OpenSketch provides a simple three-stage pipeline (hashing, filtering, and counting). They can be implemented with commodity switch components and support many measurement tasks. In the control plane, OpenSketch provides a measurement library that automatically configures the pipeline and allocates resources for different measurement tasks.

f) SDN emulation and simulation tools

The Mininet [55], the Emulab and the ns-3 [56] are popular emulation and simulation Tools used with SDN. Mininet [55] is an emulation environment which creates a complete network of hosts, links, and switches on a single machine. It creates virtual networks using process-based virtualization and network namespaces (features available in Linux kernels). In Mininet, hosts are emulated as bash processes running in a network namespace. So any code that would run on a Linux server can be run within a Mininet "Host". The Mininet "Host" has its private network interface and can only see its own processes. Switches in Mininet are software-

based OpenFlow switches. Links are virtual ethernet pairs, which resides in the Linux kernel and connect emulated switches to emulated hosts. Mininet is useful for SDN interactive development, testing, and demonstrations. SDN prototypes in Mininet can be transferred to hardware with minimal changes for real-time execution.

The Emulab [57] is a network emulation testbed which includes a network facility and a software system. Emulab is widely used by computer science researchers in the fields of networking and distributed systems and it support OpenFlow. So currently it is used also used for SDN research works. The primary Emulab installation is run by the Flux Group, part of the School of Computing at the University of Utah. The ns-3 [56] is a discrete event network simulator for internet systems. It is based on C++ and Python and widely used for research and educational use. Since ns-3 provides support for OpenFlow, it can be used to emulate SDNs.

g) SDN virtualization tools

The OpenFlow has opened the control of a network for innovation, but only one network administrator can do experiments on the network at a time. If there is a way to divide, slice or replicate network resources, more than one network administrator can use them in parallel to do experiments. Actions in one slice or replication should not negatively affect other, even if they share the same underlying physical hardware. SDN Virtualization concepts have been introduced to achieve these goals.

The FlowVisor [58] is a special purpose OpenFlow controller that allows multiple researchers to run experiments independently on the same production OpenFlow network. It uses a new approach to switch virtualization, in which the same hardware forwarding plane is shared among multiple logical networks, each with distinct forwarding logic. FlowVisor acts as a middle layer between the underlying physical hardware and the software that controls it. It is implemented as an OpenFlow proxy that intercepts messages between OpenFlow switches and OpenFlow controllers. The AutoSlice [59] devel- ops a transparent virtualization layer (SDN hypervisor) which automates the deployment and operation of vSDN topologies. In contrast to FlowVisor, AutoSlice focuses on the scalability aspects of the hypervisor design. AutoSlice monitors flow level traffic statistics to optimize the resource utilization and to mitigate flow-table limitations. With the distributed hypervisor architecture, Autoslice can handle large numbers of flow table control messages from multiple tenants.

In a virtual machine environment, moving applications from one location to another without a disruption in service is called Live virtual machine (VM) migration. SDN applications can reside and rely on multiple VMs. So migrating individual SDN VMs, one by one, may disrupt the SDN applications. So the LIME [60] design migrate an ensemble: the VMs, the network, and the management system to a different set of physical resources at the same time. LIME uses the SDN concept of separation between the controller and the data plane state in the switches. LIME clones the data plane state to a new set of switches, transparent to the application running on the controller. And then incrementally migrates the traffic sources.

The RouteFlow [61] provides virtualized IP routing over OpenFlow capable hardware. It is composed with a OpenFlow Controller application, a server, and a virtual network environ- ment. The virtual network environment rebuild the connectivity of the physical infrastructure and runs IP routing engines. The routing engines generate the forwarding information base (FIB) according to the routing protocols configured. An ex- tension of RouteFlow [62], discusses incorporating RCPs [17] in the context of OpenFlow and SDN. It proposes a controller centric networking model with a prototype implementation of an autonomous system-wide abstract BGP routing service.

V. Final Remarks

SDNs have emerged in the last decade as a very active research domain, gaining significant attention from both academia and industry. This survey discussed the state of art in SDN, with a historic perspective of the field by describing the SDN paradigm, architecture and deployments in detail.

We first introduced the concepts and definitions that enable a clear understanding of SDNs. The idea of programmable networks and decoupled control logic has been around for many years and the history of SDN goes back to the early 1980s. Central network control, programmability in networks, network virtualization and control of packet switched networks were the four main supporting technologies which helped SDN to evolve. The survey was extended by exploring the OpenFlow project and the standardized SDN architecture. Standard SDN three tier architecture includes: SDN controller, southbound APIs and northbound APIs. For a broader scope, the pa- per detailed the tools and frameworks associated with SDN development in the categories of SDN controller platforms, SDN software switch platforms, native SDN switches, SDN languages, SDN debugging tools, SDN emulation/simulation tools and SDN virtualization tools.

Acknowledgment

I would like to thank Prof. Jorge Lobo, Prof. A. Russo, Dr. Frank Le, Dr. C. Makaya and Prof. H. Ramalhino, who collaborated in all my SDN related research work [63], [64], [65], [66], [67], [68].

References Références Referencias

1. J. Menga, "Ccnp practical studies: Layer 3 switching," 2003. [Online]. Available: http://www.ciscopress.com/articles/article.asp?p=102093
2. H. Kim and N. Feamster, "Improving network management with software defined networking," IEEE Communications Magazine.
3. "Open networking foundation," 2011. [Online]. Available: https://www.opennetworking.org/about/onf-overview
4. "Open networking research center (onrc)," 2011. [Online]. Available: http://onrc.net
5. N. Feamster, "Sdn course," 2013. [Online]. Available: http://https://www.coursera.org/course/sdn
6. J. J. Lawser, LeCronier, and at el., "Stored program controlled network: Generic network plan," Bell System Technical Journal, 1982.
7. D. L. Tennenhouse, J. M. Smith, and at.el, "A survey of active network research," IEEE Communications Magazine, 1997.
8. D. Wetherall, "Active network vision and reality: lessons from a capsule-based system," ACM Operating Systems Review, 1999.
9. J. E. van and at el., "The tempest: A practical framework for network programmability," IEEE Networks Magazine, 1998.
10. J. M. Smith, D. J. Farber, and at el., "Switchware: Accelerating network evolution," Tech. Rep., 1996.
11. B. Schwartz, A. W. Jackson, and at el., "Smart packets: applying active networks to network management," ACM Transactions on Computer Systems, 2000.
12. Y. Yemini and S. D. Silva, "Towards programmable networks," in IEEE International Workshop on Distributed Systems: Operations and Management, 1996.
13. A. T. Campbell, I. Katzela, and at el., "Open signaling for atm, internet and mobile networks," Computer Communication Review (ACM SIGCOMM), 1998.
14. A. Bavier, N. Feamster, and at el., "In vini veritas: Realistic and con- trolled network experimentation," Computer Communication Review, 2006.
15. N. Feamster, L. Gao, and J. Rexford, "How to lease the internet in your spare time," ACM SIGCOMM, 2007.
16. A. Doria, J. H. Salim, and at el., "Forwarding and control element separation (forces) protocol specification," RFC 5810, 2010.
17. M. Caesar, D. Caldwell, and at el., "Design and implementation of a routing control platform," in NSDI 2005.
18. M. Casado and M. J. F. at el., "Ethane: Taking control of the enterprise," Computer Communication Review (ACM SIGCOMM), 2007.
19. H. J. S. X. Wang Z., Tsou T. and Y. X., "Analysis of comparisons between openflow and forces draft-wang-forces-compare- openflow-forces." [Online]. Available: http://tools.ietf.org/html/draft- wang-forces-compare-openflow-forces-01
20. N. McKeown, T. Anderson, and at el., "Openflow: enabling innovation in campus networks," ACM SIGCOMM, 2008.
21. T. A. Limoncelli, "Openflow: a radical new idea in networking,"ACM Queue - Performance, 2012.
22. "Openflow current deployments," 2012. [Online]. Available: http://www.openflow.org/wp/current-deployments/
23. "Openflow switch specification 1.4.0," Open Networking Foundation, Tech. Rep., 2013.
24. T. Santhanam, "Cisco support community: Cam vs tcam," 2011. [Online]. Available: https://supportforums.cisco.com/docs/DOC-15833
25. M.-K. Shin, H.-J. Kim, and K.-H. Nam, "Software-defined networking (sdn): A reference architecture and open apis," in ICTC 2012.
26. M. S. Jonathan and J. F. David, "The open sdn architecture - big switch networks," Tech. Rep., 2011.
27. N. Gude, T. Koponen, and at el., "Nox: towards an operating system for networks," ACM SIGCOMM 2008.
28. F. M. Fernandez, "Comparing openflow controller paradigms scalability: Reactive and proactive," in AINA 2013.
29. S. Johnson, "Border gateway protocol as a hybrid sdn protocol," 2012. [Online]. Available: http://searchsdn.techtarget.com/feature/Border-Gateway-Protocol-as-a-hybrid-SDN-protocol
30. "The role for xmpp as a southbound sdn protocol," 2012. [Online]. Available: http://searchsdn.techtarget.com/feature/The-role-for-XMPP-as-a-southbound-SDN-protocol
31. D. Erickson, "The beacon openflow controller," in HotSDN 2013. [32]A. Tootoonchian, S. Gorbunov, and at el., "On controller performance in software-defined networks," in Hot-ICE 2012.
32. "Controller performance comparisons," 2011. [Online]. Available: http://archive.openflow.org/wk/index.php/ControllerPerformanceComparisons
33. "About pox," 2012. [Online]. Available: http://www.noxrepo.org/pox/about-pox/
34. Z. Cai, A. L. Cox, and at el., "Maestro: A system for scalable openflow control," Tech. Rep., 2010.
35. "Trema openflow controller framework," 2012. [Online]. Available: https://github.com/trema/trema
36. "Ryu : a component-based software-defined networking framework," 2012. [Online]. Available: http://osrg.github.io/ryu/
37. "Floodlight is an open sdn controller," 2012. [Online]. Available: http://floodlight.openflowhub.org/

38. "Pantou: openflow 1.0 for openwrt," 2011. [Online]. Available: http://www.openflow.org/wk/index.php/Open-Flow 1.0 for OpenWRT
39. "ofsoftswitch13," 2011. [Online]. Available: https://github.com/CPqD/ofsoftswitch13
40. N. F. et al, "Languages for software-defined networks," IEEE Communications Magazine, 2013.
41. M. Reitblatt, M. Canini, and at el., "Fattire: Declarative fault tolerance for software-defined networks," in HotSDN 2013.
42. A. Voellmy and P. Hudak, "Nettle: Functional reactive programming of openflow networks," in International Conference on Practical aspects of declarative languages, 2011.
43. T. L. Hinrichs, N. S. Gude, and at el., "Practical declarative network management," in Proceedings of the 1st ACM Workshop on Research on enterprise networking, 2009.
44. A. Voellmy, H. Kim, and N. Feamster, "Procera: A language for high- level reactive network control," in HotSDN 2012.
45. N. P. Kaia, J. Rexford, and D. Walker, "Logic programming for software-defined networks: Flog," in ACM SIGPLAN Workshop on Cross-model Language Design and Implementation, 2012.
46. C. Monsanto, J. Reich, and at el., "Composing software defined networks," in USENIX Conference on Networked Systems Design and Implementation, 2013.
47. M. Canini, D. Venzano, and at el., "A nice way to test openflow applications," in USENIX conference on Networked Systems Design and Implementation, 2012.
48. H. Mai, A. Khurshid, and at el., "Debugging the data plane with anteater," in ACM SIGCOMM 2011.
49. N. Handigol, B. Heller, and at el., "Where is the debugger for my software-defined network?" in HotSDN 2012.
50. A. Wundsam, D. Levin, and at el., "Of rewind: enabling record and re- play troubleshooting for networks," in USENIX conference on USENIX annual technical conference, 2011.
51. A. Khurshid, W. Zhou, and at el., "Veriflow: verifying network-wide invariants in real time," in HotSDN 2011.
52. "Sdn troubleshooting simulator (sts)," 2013. [Online]. Available: http://ucb-sts.github.com/sts/
53. M. Yu, L. Jose, and R. Miao, "Software defined traffic measurement with opensketch," in USENIX Symposium on Networked Systems Design and Implementation, 2013.
54. B. Lantz, B. Heller, and N. McKeown, "A network in a laptop: rapid prototyping for software-defined networks," in ACM SIGCOMM Workshop on Hot Topics in Networks, 2010.
55. T. R. Henderson, M. Lacage, and G. F. Riley, "Network simulations with the ns-3 simulator," in ACM SIGCOMM Workshop on Hot Topics in Networks, 2008.
56. "Emulab - network emulation testbed home," 2013. [Online]. Available: http://www.emulab.net/
57. R. Sherwood, M. Chan, and et al., "Carving research slices out of your production networks with openflow," ACM SIGCOMM 2008.
58. Z. Bozakov and P. Papadimitriou, "Autoslice: automated and scalable slicing for software-defined networks," in CoNEXT Student 12.
59. E. Keller, D. Arora, and at el., "Live migration of an entire network and its hosts," in HotNets-XI 2012.
60. M. R. Nascimento, C. E. Rothenberg, and at el., "Virtual routers as a service: the routeflow approach leveraging software-defined networks," in Future Internet Technologies, 2011.
61. C. E. Rothenberg, M. R. Nascimento, and et al, "Revisiting routing.
62. W. Rankothge, J. Ma, F. Le, A. Russo, and J. Lobo, "Towards making network function virtualization a cloud computing service," in IEEE IM 2015.
63. W. Rankothge, F. Le, A. Russo, and J. Lobo, "Experimental results on the use of genetic algorithms for scaling virtualized network functions," in IEEE SDN/NFV 2015.
64. W. Rankothge, F. Le, and at el., "Optimizing resources allocation for virtualized network functions in a cloud center using genetic algorithms." in IEEE TNSM 2017.
65. W. Rankothge, F. Le, J. Lobo, and at el., "Data modelling for the eval- uation of virtualized network functions resource allocation algorithms." in arXiv:1702.00369.
66. J. Ma, W. Rankothge, C. Makaya, C. Morales, F. Le, and J. Lobo, "An overview of a load balancer architecture for vnf chains horizontal scaling," in IEEE IFIP CNSM 2018.
67. J. Ma, W. Rankothge, C. Makaya, C. Morales, and at el, "A compre- hensive study on load balancers for vnf chains horizontal scaling." in arXiv:1810.03238.

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 19 Issue 1 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A Review of Mobile Application Development in the Agile Software Development Environment

By Neyole Misiko Jacob

Jomo Kenyatta University of Agriculture and Technology

Abstract- With the ever changing dynamic environment in mobile devices, mobile software applications need to cope with some particular performance environment that include the limited resources, high autonomy requirements and market regulations among other constraints [1]. To provide a software development process that responds to these challenges, adoption of Agile methodology that follows an iterative approach to build software rapidly where the entire software development lifecycle is brok en down into smaller iterations helps to minimize overall risks. This allows software projects developed though agile methodologies to be easily modified rapidly to meet the users/customers' requirements. This paper assesses the development of mobile applications in the agile software development environment.

Index Terms: *agile development environment, mobile applications, mobile-D.*

GJCST-C Classification: *K.6.3*

Strictly as per the compliance and regulations of:

A Review of Mobile Application Development in the Agile Software Development Environment

Neyole Misiko Jacob

Abstract- With the ever changing dynamic environment in mobile devices, mobile software applications need to cope with some particular performance environment that include the limited resources, high autonomy requirements and market regulations among other constraints [1]. To provide a software development process that responds to these challenges, adoption of Agile methodology that follows an iterative approach to build software rapidly where the entire software development lifecycle is brok en down into smaller iterations helps to minimize overall risks. This allows software projects developed though agile methodologies to be easily modified rapidly to meet the users/customers' requirements. This paper assesses the development of mobile applications in the agile software development environment.

Index Terms: agile development environment, mobile applications, mobile-D.

I. Introduction

According to Sommerville [2], software processes are categorized as either plan-driven or agile processes. Plan- driven processes involves all process activities being planned in advance and progress is measured against the devised plan. Agile processes on the other hand, involves planning that is incremental and is much easier to change the process to reflect changing customer requirements. A mix of both processes in SE is important as each comes with its values necessary for product development. As Boehm and Turner [3] discuss, each approach is suitable for different types of software. Generally, SE need to find a balance between plan-driven and agile processes [2]. Spataru [4] established that agile methods are good approaches towards mobile application development coined together with end-user inclusion in the lifecycle, performance testing of components and adoption of software product line principles.

II. The Concept Agile Software Development

Corrall et.al [1] stated that mobile software development and applications need to cope with a particular execution environment that have limited resources, high autonomy requirements, market regulations, and many other constraints. There is need for developers to therefore to employ the agile development which is an umbrella term for several iterative and incremental software development methodologies [5]. According to Sriram and Saji [6] a development methodology has a direct relationship with managing project complexity. It accompanies and has implications for usability, maintainability, adaptability, reliability and portability of the software being developed.

In the late 1990's, agile methodologies became dominant to address some shortcomings of traditional methodologies like heavy documentation, lack of productivity, reliability and simplicity [7]. Agile alliance, in response to more process driven traditional methodologies, stresses upon people, communication and customer priorities [8]. Also, different agile methodologies has exhibited flexibility to working within constraints, without demanding major upfront investments, while being adaptable to changing market conditions [9].

The fundamentals of agile methodology namely the incremental and iterative development methods required the researchers to work on the principle of separating design, implementation and testing [10]. To date the most popular agile methodologies include Extreme Programming (XP), Scrum, Crystal, Dynamic Systems Development Method (DSDM), Lean Development, and Feature-Driven Development (FDD) [5] have been employed in software development giving software products that are versatile and more robust to the market. Sriram and Saji [6] cited a document by Nerur & Balijepally [11] on the main characteristics of agile development methodologies stating that the main characteristics of agile development methodologies include more autonomy, decision-making discretion and adaptive understanding, have a theoretical background, which is consistent with problem framing, problem solving approaches in architecture and strategic management. This main characteristics indicate that agile methodologies provide the designers with greater opportunities to develop software products that reliable.

III. Plan-Driven and Agile Development

Software processes can be categorized as either plan - driven or agile processes. According to [2], Plan -driven are processes where all of the process activities are planned in advance and progress is measured against this plan. In comparison to agile

Author: Jomo Kenyatta University of Agriculture and Technology.
e-mail: Jneyole434@gmail.com

processes, Sommerville [2] indicates that in agile planning is incremental and it is easier to change the process to reflect changing customer requirements. Each approach is therefore suitable for different types of software. Good practice as discussed by Boehm and Turner [3] is that there is need to find a balance between plan-driven and agile processes.

Software processes are complex and, like all intellectual and creative processes, rely on people making decisions and judgments [2]. In line with this, software processes can be improved by process standardization where the diversity in software processes across an organization is reduced. Through this, there is improved communication and a reduction in training time, and makes automated process support more economical. Standardization is important first step in introducing new software engineering methods and techniques and good software engineering practice.

According to Mudasir Kirmani [12], agile methodology follow an iterative approach to build software rapidly where the entire software development lifecycle is broken down into smaller iterations. The iterations helps to minimize overall risks allowing a software development project be easily modified on the upfront and strictly maintaining the project schedule and budget. I all this the software product is delivered on time and according to the budget that it was initially proposed on.

Inspite of the agile methodology being iterative, the methodology has some limitations [6]. Such as dependence on run-time tacit knowledge rather than more documented information, lack of traceable and proved implementation guidelines for mission critical projects, lack of adequate support for repetitive and large scale projects and team requirement of highly talented, self- motivated individuals with a high degree of implementation freedom [7].The resulting software product/ project developed using agile methodologies are dependent mainly on organizational factors like customer commitment, decision time, team location and composition, corporate culture and people factors like competency and self-motivation [13].

According to Andrei C. Spataru [4] the main argument against agile methods is the asserted lack of scientific validation for associated activities and practices, as well as the difficulty of integrating plan - based practices with agile ones. In order to address various concerns, several methodologies within the agile category have evolved Abrahamsson et al. [14] identifies ten of them as truly agile. They include: - SCRUM, PP, ASP, FDD, XP, DSDM, Crystal, AM and ASD. For mobile software development, agile methods represent a relatively new approach to software development [4].

IV. Agile Project Management

According to Beck et al. [8] Agile alliance, in response to more process driven traditional methodologies, stresses upon people, communication and customer priorities. Rajagopalan and Mathew [6] indicated that agile software development methodology has a direct relationship with managing project complexity. According to Martin et al. the customer plays a very important role in agile projects with key responsibilities to drive the project, interact constantly with business users and provide requirements and participate in retrospection to test the intermediate deliverable and its compliance [15]. However, at times the customer may fail to keep these practices or be consistent due to the dynamic nature of development projects.

In solving this, the customer's role is essentially not played by a single person but there are pseudo roles assumed by different people to drive the project effective conclusion. Known by role labels such as the technical liaison, negotiator, and customer coach, skill specialists for designer, tester and quality facilitator [6]. Chow et al. [16] Identified factors that can serve to guide in the selection of agile methodologies for projects in organizations with specific characteristics. Project success or failure in agile methodologies are guided by six key dimensions of agile methodologies with specific attributes to guide selection of a specific methodology. They include: - delivery strategies, software engineering techniques, team capability, project management process, team environment and customer involvement [6].

V. Agile Methods in Mobile Software Development

According to Spataru [4] mobile applications market is currently undergoing rapid expansion. He further asserts that mobile platforms continue to improve in performance as the users' need for a wide variety of mobile applications increases. Software development for mobile platforms comes with unique features and constraints. The development environment and the technologies that support the software are different compared to "traditional" settings. Abrahamsson et al [17] identified important distinguishing characteristics to be a high level of competitiveness, necessarily short time-to-delivery and added difficulty in identifying stakeholders and their requirements.

Due to substantial differences in the environment and in platform specifications, mobile application development requires a suitable development methodology. Usually the mobile software released in an uncertain and dynamic environment with high levels of competition. Development teams face the challenge of a dynamic environment, with frequent

modifications in customer needs and expectations. Abrahamsson [18] states Technological constraints apply to mobile platforms in the form of limited physical resources and rapidly changing specifications. There is need to focus on agile methods and their suitability for mobile application development. Agile methods for mobile software development emphasize the adaptability of enterprises to a dynamic environment [19]. The unique features of agile methods derive from the list of principles found in the Agile Manifesto [20].

Smart mobile devices like cellphones and tablets are a key target for software products and services [1]. Consequently, software applications for the smart devices is receiving greater attention by companies' individuals and business enterprises globally. Along with the features and computing power offered by these mobile equipment, mobile software applications (apps) bear the big challenge of performing satisfactorily in a heterogeneous and resource- limited environment [12] that demands high availability, efficient performance and short response time while delivering value to the end user.

In the mobile ecosystem mobile software development rapidly requires updates and developments to meet the diverse customer requirements against a universe of constraints that exist on mobile environments namely evolving and inherent. The evolving constraints include current limitations that will be solved in the future by the evolution in technology, resources, bandwidth and coverage. Inherent constraints on the other hand are those intrinsic to mobile platforms, since they are part of the operational condition of the system and will not be solved in the near future [1]. These constraints should be taken into account by developers to determine the practices to relieve them as means of non-functional requirements.

Wasserman [21], indicated that mobile applications development are similar to software engineering for other embedded applications. However, the mobile applications development present s ome additional requirements that are less commonly found if compared to traditional software applications [12]. Boehm and Turner [22] identify fundamental concepts to agile development such as: simple design principles, a large number of releases in a short time frame, extensive use of refactoring, pair programming, test - driven development, and seeing change as an advantage. Abrahamsson, et al. [23] mention that an agile development method is incremental, cooperative, straightforward and adaptive.

Along the agile methodology, a new development methodology specifically tailored for mobile application development, called Mobile-D, is presented [17]. The method is based on agile practices, drawing elements from well- established agile methods such as Extreme Pro gramming and Crystal Methodologies and also from the heavier Rational Unified Process [24]. The Rational Unified Process is explained from a practical point of view in [25]. Practices associated to Mobile-D include test-driven development, pair programming, continuous integration, refactoring, as well as software process improvement tasks. The methodology serves as a basis for this work, and will be further detailed in the following section [26].

The Mobile-D process should be used by a team of at most ten co-located developers, working towards a product delivery within ten weeks. The Mobile-D methodology of the agile method comprises five phases: Explore, Initialize, Productionize, Stabilize, and System Test & Fix. Each of these phases has a number of associated stages, tasks and practices. The complete specifications of the method are available in [27].

One issue with the mobile-D method is that the well-known practices adopted by the Mobile-D process do not account for the performance of components under development, either at design time or during coding [4]. To address the issue integration of performance testing activities in the lifecycle, more specifically extending the Test-Driven Development practice with performance aspects is mentioned.

VI. Conclusions

The importance of projection completion JIT cannot be over emphasized, with the use of the agile methodology in mobile software development, it introduces end -user feedback support, application categories and software product lines principles. The Mobile-D presents more of the ideal characteristics. Since the methodology was improved in aspects such as the inclusion of performance testing in the lifecycle. The ever dynamic changing environment of the mobile devices, software developers for mobile applications must be up to the task to develop software apps that meet this limitations and still satisfy the user needs. The different agile methodologies have demonstrated flexibility to working within constraints, without demanding major upfront investments, while being adaptable to changing market conditions [9].

References Références Referencias

1. L. Corral, A. Sillitti and G. Succi, Agile Software Development Processes for Mobile Systems: Accomplishment, Evidence and Evolution, Verlag Berlin Heidelberg: Springer, 2013.
2. I. Sommerville, "Requirements Engineering," in Software Engineering, 10th Edition, Boston, Massachusetts, Pearson Education, Inc, 2016, pp. 82-84.
3. B. Boehm and R. Turner, Balancing Agility and Discipline: A Guide for the Perplexed, Boston: Addison-Wesley, 2003.

4. A. C. Spataru, Agile Development Methods for Mobile Applications, Edinburgh: University of Edinburgh, 2010.
5. VersionOne, "Agile 101 General Learnings," VersionOne Company, 30th July 2017. [Online]. Available: https://www.versionone.com/agile-101/. [Accessed 20th August 2017].
6. S. Rajagopalan and S. K. Mathew, "Choice of Agile Methodologies in Software Development: A Vendor Perspective," Journal of International Technology and Information, vol. 25, no. 1, pp. 39-56, 2016.
7. J. Cho, "A hybrid software development method for large-scale projects: rational unified process with scrum," Issues in Information Systems, vol. 10, no. 2, pp. 340-348, 2009.
8. K. Beck, M. Beedle, A. Cockburn, W. Cunningham, M. Fowler, J. Grenning, J. Highsmith, A. Hunt, R. Jeffries, J. Kern, B. Marick, R. C. Martin, S. Mellor, K. Schwaber, J. Sutherland, D. Thomas and B. A. van, "The agile manifesto," 2014. [Online]. Available: http://agilemanifesto.org/. [Accessed 20th August 2017].
9. A. H. Mohammad, T. Alwada'n and J. A. Ababneh, "Agile Software Methodologies: Strength and Weakness," International Journal of Engineering Science and Technology (IJEST), vol. 5, no. 3, pp. 455-459, 2013.
10. C. Larman and V. R. Basili, "Iterative and incremental development: A brief history," Computer, vol. 36, no. 6, pp. 47-56, 2003.
11. S. Nerur and V. Balijepally, "Theoretical reflections on agile development methodologies," Communications of the ACM, vol. 50, no. 3, pp. 79-83, 2007.
12. M. M. Kirmani,"Agile methods for mobile application development: A comparative analysis," International Journal of Advanced Research in Computer Science, vol. 8, no. 5, pp. 1200-1206, 2017.
13. V. Vinekar, C. W. Slinkman and S. Nerur, "Can agile and traditional systems development approaches coexist? An ambidextrous view," Journal of Information systems management, vol. 2, no. 3, pp. 31-42, 2006.
14. P. Abrahamsson, N. Oza and M. T. Siponen, "Agile Software Development Methods: A Comparative Review1," in Agile Software Development, Berlin, Heidelberg, Springer, 2010, pp. 31-59.
15. A. Martin, R. Biddle and J. Noble, "XP customer practices: A grounded theory.," in Agile Conference, AGILE'09 -IEEE, 2009.
16. T. Chow and D. B. Cao, "A survey study of critical success factors in agile software projects," Journal of Systems and Software, vol. 81, no. 6, pp. 961-971, 2008.
17. P. Abrahamsson , A. Hanhineva, H. Hulkko, T. Ihme, J. Jäälinoja and M. Korkala, "Mobile-D: an agile approach for mobile application development," in Conference on Object Oriented Programming Systems Languages and Application; Companion to the 19th annual ACM SIGPLAN, Vancouver, 2004.
18. P. Abrahamsson, "Agile Software Development of Mobile Information Systems.," in Advanced Information Systems, Berlin, 2007.
19. O. Salo, Enabling Software Process Improvement in Agile Software Development Teams and Organisations, Helsinki: VTT, 2006.
20. Agile Alliance, "Agile Software Development Manifesto. Retrieved from Manifesto for Agile Software Development," Agile Alliance, 2001. [Online]. Available: http://agilemanifesto.org/. [Accessed 01st September 2017].
21. A. I. Wasserman, "Software engineering issues for Mobile application development.," in proceedings of the FSE/SDP workshop on figure of software engineering research, FoSER, New Mexico, USA.AC., 2010.
22. B. Boehm and R. Turner, Balancing Agility and Discipline: A Guide for the Perplexed, USA: Addison-Wesley, 2003.
23. P. Abrahamsson, O. Salo, J. Ronkainen and J. Warsta, "Agile Software Development Metods: Review and Analysis," in VTT Electronics., 2002.
24. K. Beck and C. Andres, Extreme Programming Explained: Embrace Change (2nd Edition), USA: Addison-Wesley Professional, 2004.
25. P. Kroll and P. Kruchten, The Rational Unified Process Made Easy: A Practitioner's Guide to the RUP, USA: Addison-Wesley Professional, 2003.
26. A. C. Spataru, Agile Development Methods for Mobile Applications, Edinburgh: University of Edinburgh, 2010.
27. VTT Electronics, "Portal of Agile Software Development Methodologies," VTT Electronics, 2006. [Online]. Available: http://virtual.vtt.fi/virtual/agile/mobiled.html. [Accessed 01st September 2017].

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 19 Issue 1 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Protein and Other Biomedical Entity Name

By Md. Arif Rizvee, Md. Ashfakur Rahman Arju
& Saifuddin Mohammad Tareque

Abstract- Protein and other biomedical entities such as a gene, chromosome names are key elements in bioinformatics. Identifying them individually from the pdf file is very challenging. Because a text pdf document can contain lots of information, identifying them is not so much easy task. So the main focus in our project is converting the pdf file to humanreadable text file then we will have to find the gene and other entities from the GENIA tagger website database. Using natural language processing GENIA tagger will give us the name of all the protein, gene, and other biomedical entity name. After identifying them, we will save it to database. Then we will visualize the related data.

Keywords: tagging protein, gene, and other biomedical entities, natural language processing, GENIA tagger, data visualization.

GJCST-C Classification: J.3

Strictly as per the compliance and regulations of:

Protein and Other Biomedical Entity Name

Md. Arif Rizvee [α], Md. Ashfakur Rahman Arju [σ] & Saifuddin Mohammad Tareque [ρ]

Abstract- Protein and other biomedical entities such as a gene, chromosome names are key elements in bioinformatics. Identifying them individually from the pdf file is very challenging. Because a text pdf document can contain lots of information, identifying them is not so much easy task. So the main focus in our project is converting the pdf file to human-readable text file then we will have to find the gene and other entities from the GENIA tagger website database. Using natural language processing GENIA tagger will give us the name of all the protein, gene, and other biomedical entity name. After identifying them, we will save it to database. Then we will visualize the related data.

Keywords: tagging protein, gene, and other biomedical entities, natural language processing, GENIA tagger, data visualization.

I. Introduction

Protein and other biomedical entity name are used in various biomedical and other bioinformatics-related research. So we will have to work hard to identifying the entities. In text- based literature protein and other biomedical name are tagged with other text. Identifying such entities from text file is very difficult. So we will have to use any scientific approach to solve the problem. Natural language processing is a system which can be used to solve the problem. Using natural language processing we will extract the required info from a text file. We use 'GENIA tagger' database to extract the information from the pdf file and get our required biomedical name. Then we will use these names to make a relation between them and visualized them.

II. Related Work

Many researches are introduced in the field of biomedical and bioinformatics by using data extraction technique. All the work is currently done by text reading system. It is not possible to get the accurate data from manually text extraction technique. As a result protein and other

Biomedical entities are not possible to find out correctly. So it is huge drawback of these types of a research field. In the research we have tried to find out the protein, and gene name which is about 70%-80% correct.

Author α σ ρ: e-mails: arif25-627@diu.edu.bd, Muhammad25-631@diu.edu.bd, saifuddin25-630@diu.edu.bd

III. Our Proposed Work

In the research we try to identify the tagging problem and find a solution related to this type of work. Our work will follow the below procedure.

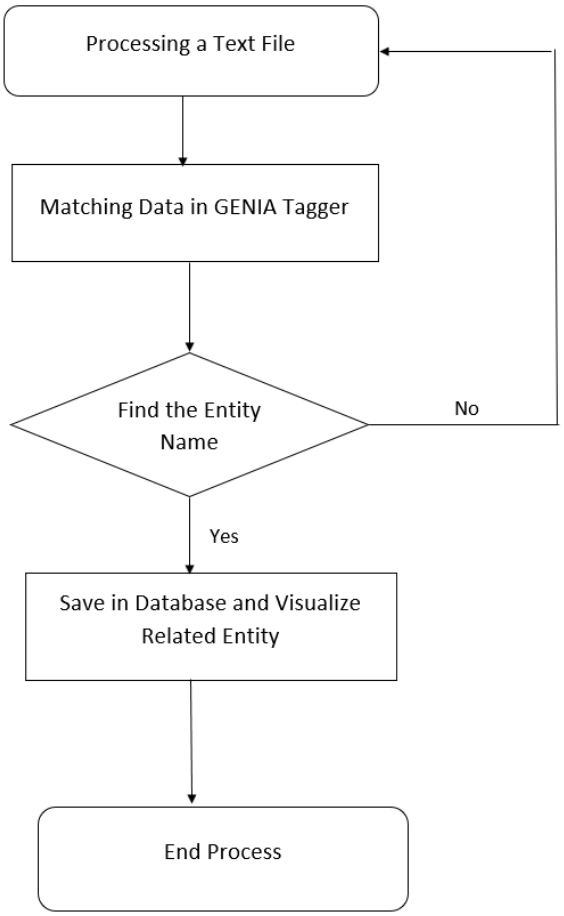

Fig. 1: Tagging & Visualize Protein and Other Biomedical Entity Name

IV. Conversion of PDF Files to Text File

Pdf to text file conversion is looks complex task, but we can convert it easily with the use of the algorithm and other tools.

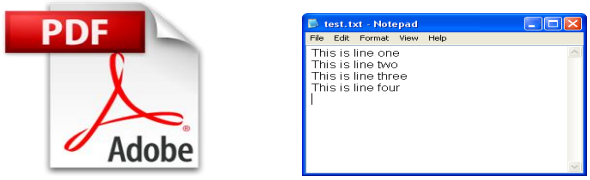

Fig. 2: Conversion of Pdf to Text File

V. Text-based Approach using Natural Language Processing

For our project work, we will have to work on the natural language based text extraction system, which will identify which type of the data is in the text file. Moreover, we can find out the required data and another type of system approach to find that entity. The natural language based system will help us on the text file to find out the necessary information for the system fulfillment of the data. By using this system, we can find out protein and its related entity.

VI. Using Genia Tagger for Data Extraction

GENIA tagger is a website that will help to find out the natural language based system for the protein name tagging from the text; we will use this website for the relevant data search. Moreover, we will use this information in the desired data analyze technique [5]. We also use these type of system for our data processing system [6].

VII. Data Tagging

First we will keep the data in the text file. These data will help us in accessing the information [7][8].

Protein name contains an acronym abbreviating the species name, e.g. Protein human growth hormone (hGH)/protein, but long-form human protein IGF-II / protein /long-form. Protein entities share common terms; there may be only one name entity that can be easily tagged. We tag such name as a protein. Long-form protein CSN subunits 4 /protein, 5,6 /long-form. Assessment of v2 the results on intercoder reliability using the revised guidelines are much better.

protein name contains an acronym abbreviating the species name , e.g . Protein human growth hormone (hGH) /pro- tein , but long-form human protein IGF-II / protein /long-form . protein entities share common terms , there may be only one name entity that can be easily tagged . We tag such an entity as a protein, while the list of enti- ties together are tagged as a long-form, e.g . Long-form protein CSN subunits 4 /protein, 5, 6 /long-form . Assessment of v2 The results on inter-coder reliability using the revised guidelines are much better . We present results for F-measure

Fig. 3: Data Tagging in a Text File

VIII. Tagging Performance with other Documents

GENIA tagger performance is better than other biomedical websites. GENIA tagger is trained in Wall Street Journal corpus, PennBioIE corpus so it performs well in various types of medical data.

Table I: Genia Tagger Comparison with Other Documents

	Wall Street Journal	GENIA corpus
A tagger trained on the WSJ corpus	97.45%	85.34%
A tagger trained on the GENIA corpus	78.4%	95.67%
GENIA tagger	94.67	97.45

IX. Retrieving Data and Save Database According to the Related Entity

We will have to save data according to the text file which we will get from GENIA tagger website. Then we will able to visualize them.

	id	entity_name	entity_tag
Edit Copy Delete	1	protein_complex	gene_promoters
Edit Copy Delete	2	La-related protein 6	LARP6
Edit Copy Delete	3	Haptoglobin- protein	HPR
Edit Copy Delete	4	Parathyroid Protein	HHM

Fig. 4: Saving Related Entity to Database

X. Data Visualization

After retrieving the data, we will analyze all the entities which are related to each other. We will categorize them according to the protein, gene, chromosome various entities. Then we will visualize

them according to their category so that we will able to know which data are the same group[10][11].

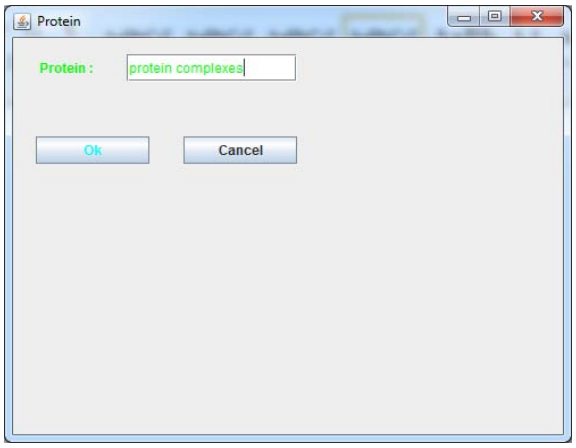

Fig. 5: Searching Related Protein Name

XI. Named Entity Recognition Performance

Our pdf file contains lots of entity of Protein, DNA, RNA, Cell Line, and Cell Type. Genia tagger provides us the flowing the final performance on the evaluation set is as follows [12].

Table II: Genia Tagger Performance

Entity Type	Recall	Precision	F-Score
Protein	75.89	68.89	90.89
RNA	72.56	65.56	67.34
DNA	69.34	73.78	78.90
Cell Line	63.56	85.35	76.34
Cell Type	56.78	65.45	82.98
Overall	73.45	68.67	78.79

XII. Conclusion

Natural Language Processing is a way to find out the similar relational data from a text or document. We try find out related protein and other biomedical entity name and visualize them. Our research makes the system fruitful for the data analysis process.

References Références Referencias

1. Jenny Rose Finkel and Christopher D. Manning, "Nested Named Entity Recognition"
2. Beatrice Alex, Barry Haddow and Claire Grover, "Recognizing Nested Named Entities in Biomedical Text", June 29 - 30, 2007
3. J¨org Tiedemann, "Improved Text Extraction from PDF Documents for Large-Scale Natural Language Processing", 2014
4. Matthew Lease, Eugene Charniak, 'Parsing Biomedical Literature'
5. Firat Tekiner, Yoshimasa Tsuruoka, Jun'ichi Tsujii, "Highly scalable Text Mining - parallel tagging application", Soft Computing, Computing with Words and Perceptions in System Analysis, Decision and Control, 2009. ICSCCW 2009. Fifth International Conference on IEEE, Famagusta, Cyprus.
6. Anni R. Codena Serguei V. PakhomovbRie K. Andoa Patrick H. Duffyb Christopher G.Chute, "Domain-specific language models and lexicons for tagging", Journal of Biomedical Informatics, December 2005.
7. Qian Wang , Huijun Xue , Siqi Li, Ying Chen, Xuelei Tian, Xin Xu, Wei Xiao, Yu Vincent Fu,"A method for labeling proteins with tags at the native genomic loci in budding yeast", Journal pone, May 1, 2017
8. Robert J. Latour, "Tagging methods and associated data analysis ", 2013
9. Ning Kang, Erik M.van MulligenJan, A.Kors, "Comparing and combining chunkers of biomedical text", 2010.
10. Jahiruddina, Muhammad Abulaisha, Lipika Dey, "A concept-driven biomedical knowledge extraction and visualization framework for conceptualization of text corpora", 2010.
11. Vivek N. Bhatia, David H. Perlman, Catherine E. Costello, and Mark E. McComb, "Software Tool for Researching Annotations of Proteins (STRAP): Open-Source Protein Annotation Software with Data Visualization", Journal of Biomedical Informatics, December 2009.
12. Jeffrey P Ferraro, Hal Daumé, III Scott L DuVall , Wendy W Chapman Henk Harkema, Peter J Haug, "Improving performance of natural language processing part-of-speech tagging on clinical narratives through domain adaptation", Journal of the American Medical Informatics Association, Volume 20, Issue 5, 1 September 2013.

This page is intentionally left blank

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 19 Issue 1 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A Collaborative Approach for Segmentation of Probe Image for Efficient Texture Recognition

By Divya Mathur & Sandeep Upadhyay

NJR Institute of Technology

Abstract- Image processing methodologies and domain is quite wide and really efficient now days for real time applications. Our work primarily deals with the domain of image segmentation and using segmentation concept, texture recognition has been performed with comparative results and simulations performed over a particular image dataset. The initial work in our proposed work is to perform segmentation on each part image then performing extraction .We have focused on segmentation followed by extraction so that the classification result may not contain much error. The conventional approach has been implemented in this regard first and then the main problem that has been formulated is patch up data pixels together which provide error in getting right and appropriate texture. In order to deal with the problem formulated in the existing work we have proposed a new commuted method in which the extraction and segmentation of image depends on the dynamic threshold set by user.

Keywords: *weka, naïve bayesian.*

GJCST-C Classification: *I.7.5*

Strictly as per the compliance and regulations of:

A Collaborative Approach for Segmentation of Probe Image for Efficient Texture Recognition

Divya Mathur [α] & Sandeep Upadhyay [σ]

Abstract- Image processing methodologies and domain is quite wide and really efficient now days for real time applications. Our work primarily deals with the domain of image segmentation and using segmentation concept, texture recognition has been performed with comparative results and simulations performed over a particular image dataset. The initial work in our proposed work is to perform segmentation on each part image then performing extraction .We have focused on segmentation followed by extraction so that the classification result may not contain much error. The conventional approach has been implemented in this regard first and then the main problem that has been formulated is patch up data pixels together which provide error in getting right and appropriate texture. In order to deal with the problem formulated in the existing work we have proposed a new commuted method in which the extraction and segmentation of image depends on the dynamic threshold set by user.

Keywords: weka, naïve bayesian.

I. Introduction

The world as we all know nowadays is extremely fast paced and extremely machine-driven. Technology has become similar to automation. All this is often as a result of we have a tendency to, humans, have a bent to try to our job quicker and within the most effective method. thus the additional we have a tendency to change, the simpler and quicker our work becomes. Next trend in today's quick dynamical world is medical care. Since this is often the age of computers we would like each data obtainable be digitized and keep within the computers, since they need quicker computing capabilities. however the matter in digitizing world data into digital domain is we'd like to show the pc specifically concerning our involved world information.

Texture affirmation (OCR) is the distinction in physically formed or created substance into an electronic course of action, which can be secured, deciphered and orchestrated by a PC. It can be utilized as a snappy information input framework for a front line PC. Any OCR framework depends upon the running with four key advances:- Texture affirmation (OCR) is the difference in translated or created substance into an electronic plan, which can be secured, deciphered and dealt with by a PC. It can be utilized as a provoke information input procedure for a front line PC. Any OCR framework depends upon the running with four key advances.

II. Background

In certainties, principal Component assessment (pca) can be a technique that might be acclimated change a dataset., extra formally it's far a straight change that picks a front line reference outline for the informational collection specific the fine fluctuation through any projection of the actualities set incorporates lie on the essential hub (at that point called the essential most critical segment), the second quality difference on the second one pivot, et cetera. PCA are often utilized for diminishing dimensionality in a greatly dataset while retentive those attributes of the dataset that make a commitment most to its variance with the guide of expelling the later imperative components (with the asset of an extra or a dreadful parcel considerably less heuristic decision). Those qualities additionally can be the "greatest basic", however this can be not essentially the situation, depending on the applying.

PCA has the forte of being the top notch straight change numerical space that has greatest fluctuation. In any case, this comes at the doubtlessly worth of vast approach call for. Never again like probability direct changes, the PCA does not have an intense and fast arrangement of premise vectors, its premise vectors depend on the data set. expecting 0 exact propose (the observational suggest of the circulation has been subtracted from the information set), the fundamental part American joined conditions of a dataset x are every now and again compute with the asset of finding the Eigen values and eigenvectors of the fluctuation lattice of x, we discover that the eigenvectors with the most basic eigenvalues compare to the measurements which have the most effective correlation inside the dataset. The preparatory estimations ar eventually anticipated onto the diminished vector locale. Look based absolutely acknowledgment exploitation PCA.

Author α σ: Department of Computer Science & Engineering Techno India NJR Institute of Technology, Udaipur.
e-mails: divya.mathurregal@gmail.com, sandeep.upadhyay@technonjr.org

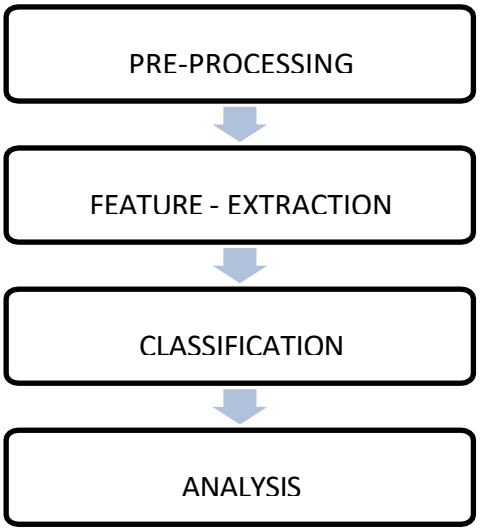

Figure 1.1: Steps for OCR

III. Problem Formulation and Proposed Solution

In comparison of pervious work, our main focus would be on

Proposed Algorithm

Step 1- Take input data set in RGB texture and then perform linearization for making it compatible for the tool.

Step 2- Pre-processing of data set should be performed to implement masking and filtering for getting more accurate results

Step 3- In order to get accurate image segmentation and extraction

Step 4- A maximum threshold is set now for pixel intensity of 30 so that object lower than this pixel vector can be removed in order to provide better visual effects and less distortion in the dataset and texture .

Step 5- Again the linearization of image will be repeated to get the final noise removed image.

Step 6- To provide dynamic dimension to our proposed algorithm we have calculated region attributes of image.

Step 7- Region properties can be calculated using bounding index for better texture recognition.

Step 8- Bounding box plotting is done now for getting exact position and edge color of the input data set.

Step 9- Now final object extraction will be performed using pseudo code like
%% Objects extraction
figure

for n=1:Ne where L and Ne is label connected component
[r,c] = find (L==n); r and c are rows and column feature vectors
n1=imagen(min(r):max(r),min(c):max(c));maximum and minimum feature vectors are calculated to extract each texture.
n is the position of texture and region property attributes.

Step 10- The above steps will be repeated till the last texture is not extracted efficiently.
Step 11- exitr

IV. Simulation and Results

Fig 4.1: Input data\set of car number plate

The figure 1 is just used as in input data set which depicts the car number plate the first module will load this into the tool for pre-processing then the next process will be implemented .the given image is used in implementing the existing work with random approach of setting the threshold value.

Fig. 4.2: Binarization of the input data set

The fig 2 shown above is just the linearization of the input dataset so that it becomes compatible to the

tool to get processed further. The 2 dimensional one is only acceptable in the tool for getting the number of maximum connected components so that we can get that number reduce in the proposed method to get the accuracy improved along with better time complexity and better extraction capabilities. The existing work has randomly set the maximum threshold for the probe image to extract the textures more accurately in the first module of the work .considering the module1 .We have contemplated a new technique with dynamic approach to get the characters on a console window with more accuracy and clarity. Instead of setting the threshold value randomly we have used bounding boxes in the work and proposed algorithm.

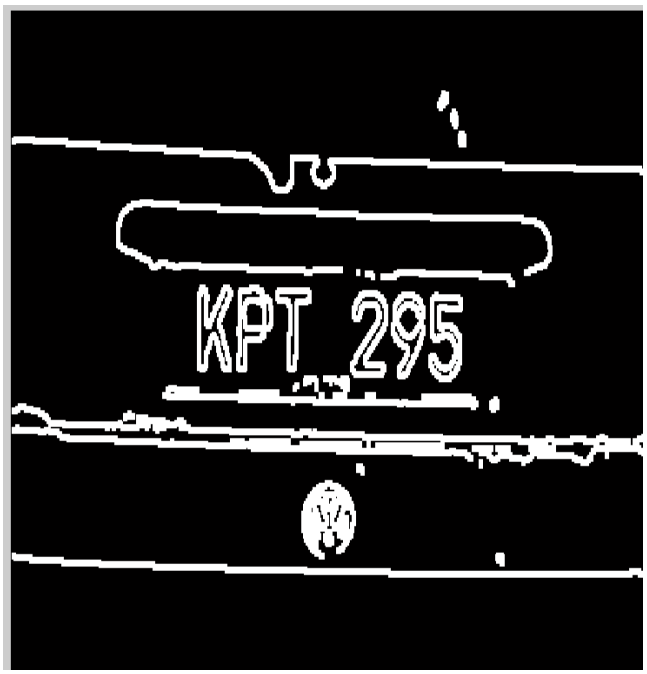

Fig. 4.3: Texture segmentation of the probe image to get content separated

The fig 3 is showing the segmentation of different textures so that the content can be recognized accurately but the existing work has a drawback it can recognize s single character for each time, It will certainly increased the time complexity for each loop and it also requires us to set the random threshold for different character to be recognized. The existing work has randomly set the maximum threshold for the probe image to extract the textures more accurately in the first module of the work. considering the module1

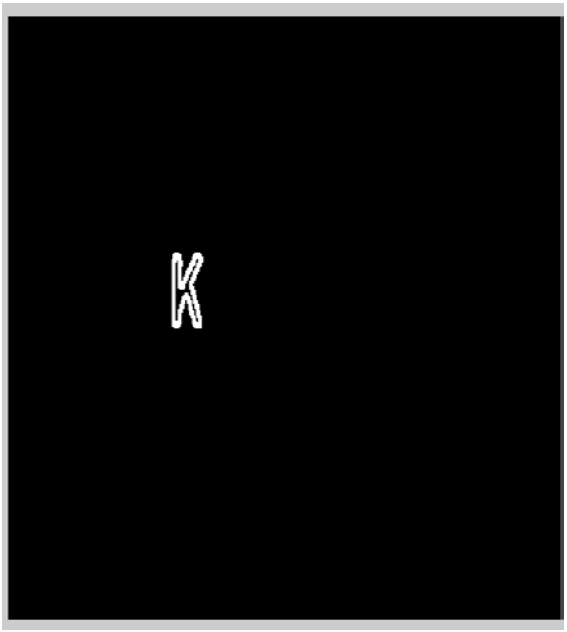

Fig. 4.4: The single texture extracted character by using existing Algorithm

The Fig 4 has depicted the extracted texture which has been performed by using existing work algorithm which was very much random in approach so we can see that only single texture can be recognized at the single time this was one of the drawback of existing work.

V. Conclusion and Future Work

A road accident is something which misshapen with our Image processing methodologies and area is quite extensive and simply efficient now days for real time applications. There are different proposed approach which perform segmentation based texture recognition with on the web and disconnected methodologies with high and low accuracy of in recognition .Our work concentrates around commuted methodologies which incorporates pre-handling of test set first to show signs of improvement precision and afterward examine the output goes under the recognition task. The current work has picked irregular and static methodologies which at times blend information pixel and result in worst precision and poor texture recognition rate.

References Références Referencias

1. Chaudhuri et al., Texture Recognition Systems for Different Languages with Soft Computing, Studies in Fuzziness and Soft Computing 352, DOI 10.1007/978-3-319-50252-6_2,Springer International Publishing AG 2017
2. Debasish Basa, Sukadev meher , “Handwritten Odia Character Recognition”, Presented in the National Conference on Recent Advances in Microwave

Tubes, Devices and Communication Systems, Jagannath Gupta Institute of Engineering and Technology, Jaipur, March 4-5, 2011

3. Rajean Plamondon, Fellow IEEE and Sargur N. Srihari, Fellow IEEE, "On-Line and Off-Line Handwritting character Recognition: A Comprehensive Survey", 1EEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE. VOL. 22, NO. 1. JANUARY 2000
4. G.Vamvakas, B.Gatos, N. Stamatopoulos, and S.J.Perantonis, "A Complete Texture Recognition Methodology for Historical Documents", the Eighth IAPR Workshop on Document Analysis Systems.
5. B.B. Chaudhuri U. Pal M. Mitra, "Automatic Recognition of Printed Oriya Script".
6. Fumitaka KIMURA, Tetsushi WAKABAYASHI and Yasuji MIYAKE, "On Feature Extraction for Limited Class Problem"
7. Supriya Deshmukh, Leena Ragha, "Analysis of Directional Features - Stroke and Contour for Handwritten Character Recognition", 2009 IEEE International Advance Computing Conference (IACC 2009) Patiala, India, 6-7 March 2009.
8. M. Blumenstein, B. K. Verma and H. Basli, "A Novel Feature ExtractionTechnique for the Recognition of Segmented Handwritten Characters", 7th International Conference on Document Analysis and Recognition (ICDAR '03) Eddinburgh, Scotland: pp.137-141, 2003.

Global Journals Guidelines Handbook 2019

www.GlobalJournals.org

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN COMPUTING (FARSC)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSC" title to individuals. The 'FARSC' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

FARSC accrediting is an honor. It authenticates your research activities. After recognition as FARSC, you can add 'FARSC' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSC designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSC title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA).The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.
Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSS members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSS member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The "MARSS" is a dignified ornament which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSC member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

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 or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

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.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

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:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

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

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

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.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

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 though 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:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

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:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

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.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

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.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- 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:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

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.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- 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:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	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
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

save our planet

Global Journal of Computer Science and Technology

Visit us on the Web at www.GlobalJournals.org | www.ComputerResearch.org
or email us at helpdesk@globaljournals.org

ISSN 9754350