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Securing the Digital Realm

Magic Realism in Indian Culture

Highlights

Protection of Copyright in Brazil

Post-Colonial Literature Context

Discovering Thoughts, Inventing Future

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Artificial Intelligence-Generated Art works: Protection of Copyright in Brazil for Artistic Works used in AI Databases in Light of the U.S. Fair use Doctrine

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Abstract- This study analyzes the applicability of the fair use doctrine in the context of using artistic works in databases for training Generative Artificial Intelligences (AI). It employs bibliographic research combined with a qualitative-quantitative approach to cases filed in U.S. courts concerning copyright issues involving generative AIs. Initially, the discussion centers on the protection of intangible assets and the intensification of the dematerialization of property in the informational society. The study then focuses on identifying the guidelines provided by copyright theories and their compatibility with works generated by Artificial Intelligence (AI).

Keywords: copyright. digital goods. artificial intelligence. database. machine learning. utilitarianism. fair use. changes in private order.

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Artificial Intelligence-Generated Art Works: Protection of Copyright in Brazil for Artistic Works used in AI Databases in Light of the U.S. Fair use Doctrine

Amanda Veríssimo Almeida Vale [α] & Éfren Paulo Porfírio de Sá Lima [σ]

Abstract- This study analyzes the applicability of the fair use doctrine in the context of using artistic works in databases for training Generative Artificial Intelligences (AI). It employs bibliographic research combined with a qualitative-quantitative approach to cases filed in U.S. courts concerning copyright issues involving generative AIs. Initially, the discussion centers on the protection of intangible assets and the intensification of the dematerialization of property in the informational society. The study then focuses on identifying the guidelines provided by copyright theories and their compatibility with works generated by Artificial Intelligence (AI). Finally, it explores the contrast between the use of protected works by AI programs and the American doctrine of fair use, highlighting the utilitarian perspective in this debate and the applicability of this doctrine in Brazilian law. Based on the proposed analysis, the investigation concludes that adopting an extensive interpretation of Brazilian copyright law is more advantageous to facilitate the influx of new contributions from the real world. Consequently, it becomes necessary to analyze the applicability of fair use by Brazilian courts and weigh the arguments for and against considering the creation of databases with protected works as fair use.

Keywords: copyright. digital goods. artificial intelligence. database. machine learning. utilitarianism. fair use. changes in private order.

I. Introduction

The relevance of the discussion about generative AIs is especially evident due to the exponential growth in the amount of data feeding these systems. The report on advances in Artificial Intelligence prepared by Stanford (Brynjolfsson *et al*., 2023, p. 54) revealed that over time, the development of data interpretation parameters showed a regular advance that was particularly pronounced in the 2010s. The complexity of the criteria provided reflects the breadth of tasks that the machine can perform.

In the field of discussions involving copyright protection, as well as in labor rights, the massification of generative AIs had an impact similar to that observed in the early 19th century. On one hand, proponents of the new discovery argue that copyright would be an obstacle to technological advancement and overcoming humanism; on the other hand, the more measured advocates support protecting artists' copyrights to prevent the illicit enrichment of users and the companies owning AI algorithms.

The first position is cautious regarding the protection of the interests of those involved in creative processes. However, this way of framing the issue leads to reasoning about the extent to which individual wills can or cannot override the collective interest. The legal dilemma thus unfolds into a moral problem of a utilitarian nature (Tenório Filho & Mallmann, 2018).

The meaning and scope of the applicability of fair use, in this sense, must be considered from the comparison of favorable and unfavorable perspectives, taking into account the public interest and economic development in conflict. Similarly, the guiding question of this study is presented: what is the applicability of the fair use doctrine in the case of copyrighted works in generative AI databases?[1]

To answer this question, the development of the work will follow three stages. Firstly, to analyze the dematerialization of property in the face of new technologies proposing the virtualization of this doctrine, it will be necessary to outline a brief historical overview of the emergence of intangible asset protection and discuss the greater protection granted to them in the context of the information society based on the lessons taught by Fernando Taveira Jr. (2015, p. 49).

In the second stage, it proposes identifying the guidelines provided by copyright theories by analyzing what guarantees should reach works made by Artificial Intelligence, highlighting the questions raised by Samuelson (2023).

Finally, it seeks to discuss the arguments listed by the doctrine to fit the use of artistic works serving the AI program's database into the fair use criteria. For this purpose, the study draws on the reflections of Tenório

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[1] This study is the result of a monograph originally presented in Brazilian Portuguese by Amanda Veríssimo Almeida Vale, under the guidance of Éfren Paulo Porfírio de Sá Lima, during the Bachelor of Law course at the Federal University of Piauí, Brazil, having been approved with the highest grade by the evaluation committee of the Final Course Work.

Filho and Mallman (2018), in addition to scrutinizing the understandings of the U.S. courts for the application of the doctrine.

To achieve the proposed objectives of this study, which initially employs a primarily qualitative approach, the methodology used was conceptual analysis through bibliographic review, following an analytical path of academic texts, books, legal documents, and jurisprudence. As pointed out by Gil (2017), the stages of the review include preliminary bibliographic survey, source search, note-taking, and final text writing. This methodology is justified given the peculiarities of the guiding problem chosen as the research object.

However, the course of the work is carried out from a qualitative-quantitative approach to the study object. While purely quantitative methodology prioritizes data collection and systematization, "in qualitative research, especially those where a theoretical analysis model is not previously available, it is common to see a back-and-forth between observation, reflection, and interpretation as the analysis progresses" (Gil, 2017, p. 90). In the first stage, this research qualitatively develops the proposed categories to, in the final stage, make a quantitative survey of cases filed in American courts on copyright matters involving generative AIs.

Based on the aforementioned theoretical framework, the article aims to scrutinize the conflict between the phenomenon of creating artistic products by AI and the applicability of copyright law. By the end of the research course, it is expected to analyze the relationship between the AI product and the work that feeds the database, in light of the fair use doctrine criteria.

II. The Dematerialization of Property

In the context of the Information Society, intangible assets gain significant relevance as property gradually loses its material form due to the digitalization of assets (Taveira Júnior, 2015, p. 49). This context involves a paradigm shift where 'liquidity,' as proposed by Zygmunt Bauman (2001, p. 173), points to a scenario in which immaterial objects become the main sources of profit on an ever-expanding scale.

Digital goods can be defined as information stored on electronic devices and the internet. This definition is intentionally imprecise, as it should not only serve as a benchmark for defining the contours of this phenomenon currently but also comprehend present and future innovations. In the current context, it is noted that the phenomenon of the dematerialization of property is closely related to digitalization. This alteration from analog to digital can result from both the transformation of physical documents into electronic files and the direct creation of documents in digital format.

Moreover, the massive circulation of digital goods has been favored mainly by the possibility of greater production and dissemination of content by users and the growing data storage in so-called cloud computing (Taveira Júnior, 2015, p. 55). These circumstances have also made the relationship between technology companies and users of these services more complex.

The deepening of this relationship reveals the user's vulnerability concerning the protection of intangible assets situated in the digital realm. Thus, the internet becomes considered a new field over which Civil Law must focus, especially to correct asymmetry and balance relationships in the digital space. Hence, there arises the need to establish mechanisms to better regulate and manage digital goods.

Indeed, digital goods should also be considered as objects of legal protection. Although part of the doctrine argues that the protection of these goods does not fit within the classic notion of property, it is indisputable that goods of this nature have both property and extra-property value, and thus require regulatory parameters. Currently, digital goods can represent the primary source of income for some users, as profiles and publications on social networks have added value and can be monetarily assessed[2].

In the digital context, the faculties of use and enjoyment prevail, as access coupled with the possibility of sharing proves more valuable than simply holding ownership. For this reason, there is a greater concern with regulating usage licenses rather than ownership itself, demonstrating the importance of "access protection" (Ehrhardt Jr. & Guilhermino, 2015, p. 2).

It is undeniable that the development of the internet has dynamized the process of data transmission, which can take various formats, such as texts, audio, videos, images, or even works protected by copyright. In digital format, it becomes easier for the author to widely disseminate their creations without major obstacles. Conversely, greater exposure also facilitates the unauthorized use of these works, as the internet provides greater ease of access and dissemination of intellectual creations and the emergence of new uses not covered or foreseen by copyright law (Tenório Filho & Mallmann, 2018, p. 68).

From this dynamism arise important implications in the context of creating digital goods through generative artificial intelligence. Since the operation of this type of AI depends on a reference database for "machine training," it is understood that simple access to these materials and data is already sufficient to meet the purpose of feeding the database.

[2] According to Marcos Ehrhardt Jr. and Everilda Guilhermino (2015, p. 2): "an application or an account on a social network can represent a much greater monetary value than a tangible asset."

III. Artificial Intelligence and Copyright Protection

Artificial intelligence is understood as a system developed to perform specific tasks using coordinated algorithms designed to emulate human capabilities. According to the definition provided by the American National Artificial Intelligence Initiative Act of 2020:

> The term "artificial intelligence" means a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments. Artificial intelligence systems use machine and human-based inputs to (a) perceive real and virtual environments; (b) abstract such perceptions into models through analysis in an automated manner; and (c) use model inference to formulate options for information or action (GPO, 2020).

In turn, the European Parliament defines AI as the ability of a machine to display human-like capabilities such as reasoning, learning, planning and creativity (European Parliament News, 2020).

In Brazilian legislation, there is still no specific definition or regulation for this area. However, a commission of jurists was recently established to update the Civil Code in light of the digital revolution, with special concern regarding AI implications (*Senado Notícias*, 2023). There is also a bill in the Senate attempting to establish a regulatory framework for the topic, Project Law No. 5,691/2019 (Brazil, 2019), which outlines guidelines for these systems.

Specifically, generative artificial intelligence differs from other approaches as it is based on a predictive structure of machine "learning." The operation of such systems relies on algorithms of varying complexity levels representing pre-established action chains based on collected data. The quantity and quality of data are significant variables in the resulting product.

Indeed, the AI product may vary drastically depending on the information selected to feed the system. This is because the machine learning technique essentially recognizes patterns in data sets and performs specific tasks "based on its own experience" (Cerri & Carvalho, 2017, p. 298), which is founded precisely on processed data. Using this technique obviates the need for specific programming for each command, as the inserted data are described and the results of their interactions are predicted (Hurwitz & Kirsch, 2018, p. 4). Choosing the data that feeds the system is an essential step to ensure that the results are meaningful and accurate (*idem*, p. 9).

Generative AI algorithms function similarly to human neural networks and are powered by the so-called "Generative Adversarial Networks" (GANs). This technique involves using two types of algorithms: one of a discriminative nature and the other of a generative nature (Goodfellow, 2014, p. 1).

It is evident that applying generative tools allows users to make compositions, including artistic ones, very similar to those of human authorship. For this purpose, these systems are supplied with reference models for the algorithm's "training," necessitating the creation of databases to facilitate data collection and processing.

Thus, the goal is to achieve results close to those stored in the database produced by humans. Given the need to provide a database to enable the operation of AI programs like Stable Diffusion[3], the problem lies in the absence of authorization from the authors of the works whose data are used, who are not even recognized with the right of authorship[4] over the creation nor receive any compensation for the economic benefit derived from the generated work.

Since the reference database with image references is an essential tool for providing new content by the machine, the program may use materials protected by specific licenses, impacting the discussion about the copyright ownership of the AI product.

In this perspective, two systems are highlighted in the context of copyright protection. Typical of Anglo-American law, the "copyright" system of author rights emphasizes the protection of the materiality of the work, with an emphasis on the exclusive right to copy, following the principle "what is worth copying is worth protecting." The French system of "Droit d'Auteur," which has the corollary of protecting the author's figure, influenced the current Brazilian legislation, as evidenced by the personalistic character adopted by Law No. 9,610/98 (Copyright Law or LDA) (Brazil, 1998).

At the international level, the Berne Convention stands out as "the first international and multilateral legal instrument for copyright protection" (Souza, 2006, p. 182), accommodating the two original strands: "copy-right" and "Droit d'Auteur," which coexist internationally nowadays.

It is observed that Copyright Law has a hybrid, dual, or "*sui generis*" legal nature. The author is recognized with two bundles of rights. One concerns moral or personal rights (strictly personal) enshrined in Article 24 of the LDA. These act as bonds that unite the author or creator to the intellectual work, protecting the rights inherent to their personality. They arise with the creation of the work, produce perennial effects, and aim to maintain the bond with the created work. On the other hand, there are property rights detailed in Article 29 of

[3] About this program, the Stanford Report points out: "Stable Diffusion is trained on existing images created by humans and gives no credit or acknowledgment, leaving open questions around the ethical use of image generators." (Maslej *et al., op. cit.,* p. 77).

[4] "The property right manifests in two dimensions: a positive and a negative. The first one refers to the claim to mention the author's name. The second one establishes the right to react to violations committed." (Ascensão, *opcit*, p.141).

the mentioned law, relating to the economic exploitation of legally protected works.

The "Droit d'Auteur" doctrine in its genesis in French law sought to protect creations of the spirit. Thus, the intention was to provide legal support to the author's inspiration as well as the novelty and originality of the created work. In this sense, creativity is considered the main raw material of Copyright Law. Similarly, Leandro Macedo Poli (2008, p. 112) argues that "it is precisely in the creative character of the work that the justification for copyright protection lies."

Indisputably, with the disruptive model proposed by AI, it is necessary to align the Copyright Law theory with new modalities of intellectual work production without, however, interrupting technological development. In the context of generative technologies, the discussion takes on specific contours, and the controversy revolves around the potential violation of copyright due to the program's ability to provide new works similar to those contained in the database used.

In this regard, it is noteworthy that Article 7, item XIII of the LDA provides for the protection of databases provided that "by their selection, organization, or disposition of their content constitute an intellectual creation." However, paragraph 2 of the aforementioned article clearly states that "this protection does not prejudice any copyrights subsisting with respect to the data or materials contained therein." Thus, the copyrights of materials contained in compilations remain in force independently of the database protection itself.

When using pre-existing references in programs applying generative technology, the works generated by the algorithm may reference some protected creation. Therefore, it is necessary to analyze what link is established between the generated work and the one contained in the database from the perspective of investigating a possible violation of the rights of the artists whose works comprise the reference database used by the AI.

In an attempt to answer the question about the possible violation of copyrights by the machine, Beatriz Bugallo Montaño (2022) argues that if the influence of other people's works on the human author's creation is not considered misuse, then composing the database for training the algorithm should be understood similarly, that is, merely as a "source of inspiration." According to the author, the method used by the machine also differs from derivative works. Indeed, subparagraph "g" of item VIII of Article 5 of the LDA states that derivative works result from the transformation of an original work. In this sense, they correspond to the reproduction, modification, and incorporation of a work to generate a new creation distinct from the original and with its own individual content.

Given the presented innovations, doctrinal discussions arise about AI's creative potential, and there seems to be resistance to granting such rights to the machine. Commenting on the topic, the U.S. registration authority defined that only those works using AI as a mere tool, necessarily requiring human author control, are entitled to copyright protection (United States of America, 2017, p. 68-69).

In another perspective, the problem seems more complicated when considering an unprecedented AI product developed by an AI system with a higher degree of autonomy. In other words, different analysis should be considered when the operator merely provides generic parameters for the production of results over which there is no human control, as in these cases, the machine's role is not merely to obey commands and instructions given by the user.

Restricting the discussion to the context of generative artificial intelligence, copyright protection must also be discussed from the angle of the works used for algorithm training. For some artists, the use of art without consent is an absolute violation of both property and moral rights over the work.

An action is pending in the U.S. courts filed by artists whose works were improperly used as a training base in an AI program (Stable Diffusion Litigation, 2023). The plaintiffs argue that the use of their creations for this purpose was not consented to, exacerbated by the lack of means to allow artists to opt-out of the database.

As noted, AI, although it develops unprecedented products, will provide results similar to pre-existing works, which are somehow ready to compete in the market with the arts used as training data for the algorithm[5].

In contrast to the artists' plea, it is argued that the use of works is solely to develop and train the algorithm, thus fitting within the so-called fair use. This doctrine, by defining parameters that make the authorization of authors for the use of the work unnecessary, seeks to expand the range of hypotheses for the use of protected material without causing a violation of the creators' rights.

IV. The fair use Doctrine Applied to the use of Artistic Works by Artificial Intelligence Programs

According to Jeremy Bentham (1974), the most relevant objective is to maximize happiness by safeguarding individuals' pleasure over pain. Utility, in general terms, would be characterized as something that brings happiness and avoids suffering, this being the maxim to be sought by citizens and legislators (Tenório Filho & Mallmann, *op. cit.*, p. 62). Later, to reconcile individual rights with utilitarian ethics, John Stuart Mill (2000) proposes a theory of fundamental

[5] "Algorithms can be used to create forgeries of existing artworks or to create works that resemble a specific style or artist, which can lead to a devaluation of the art market and a loss of consumer confidence." (Varella, 2023).

rights that mitigates the effects of utilitarian calculation, allowing the articulation between a democratic regime and minimal State intervention, ensuring individual freedom.

The utilitarian thought rejects the notion of natural right, as the goal is to reduce the notions of justice and moral action to calculable precepts, which is why it is incompatible with pre-established aspects. Thus, natural law is replaced by the mentioned idea of utility as the justifying element of law-making. Applying these concepts to the aspect analyzed in the present study, Alves and Pontes (2009, p. 9872) explain:

> According to the utilitarian theory, the authors' right corresponds to a prerogative granted to creators so that they can commercially exploit their creation exclusively for a temporary period, justified as an incentive instrument for intellectual creation and authors' remuneration. The natural law theory, on the other hand, is based on the argument that the author has a property right over their work, which is inherent to the creation itself, because it would ensure ownership over the fruit of their labor.

According to the authors, John Locke opposes the utilitarian trend and argues that the author's right should be perpetual, as it holds a moral and personal dimension (Alves & Pontes, 2009, p. 9879). Thus, the work deserves exclusive protection for representing the intellectual labor of its creator. The exclusivity prerogative is seen as an instrument to encourage intellectual production and consequently the authors' remuneration. However, when analyzing copyright legislation under the utilitarian argument, the public utility of disseminating intellectual works to the community is considered, as opposed to the real and commercial monopoly of these works.

In an attempt to align the individual interests involved in copyright protection with the public utility of disseminating protected content, the fair use doctrine, typical of American law, emerges, aiming to limit copyright protection according to some criteria discussed below.

The fair use theory resulted from jurisprudential consolidation in Section 107 of the "Copyright Act" (United States of America, 1976) after a series of decisions intended to establish broad access to works as a way to achieve cultural development and technical-scientific progress without, however, generating risks to the interests of copyright holders.

The purpose of fair use in preventing copyright protection from making all forms of a work's use unfeasible aligns with the utilitarian discussion related to public interest and cultural, economic, and technological development. Thus, fair use defines some criteria for weighing these interests, among which are: (i) the purpose of the use; (ii) the nature of the protected intellectual work; (iii) the amount and substantiality of the portion used; and (iv) the level of harm to the work's author in the market.

These parameters were created in the paradigmatic case "Folsom vs. Marsh" (C.C.D. Mass 1841), in which the applicability of the fair use doctrine was discussed. The dispute involved the copyright of George Washington's writings belonging to the editors who filed the action. The controversy arose from the copying of several excerpts from this text in the creation of a biographical work of the president. In the end, the court found that the defendants' conduct constituted a violation of copyright, noting that use cannot be tolerated when essential parts of the work are used to substitute the original work, as this would discourage future creators. Based on these criteria, it is seen that the fair use theory better adheres to specific uses that include criticism, commentaries, news reporting, research, and classroom teaching (United States of America, 1976, p. 20).

In this perspective, a functionalization of legal institutions – in this specific case, property – is observed in line with the contributions of the Italian philosopher Norberto Bobbio (2007). According to the author, the law also incorporates a promotional function, providing means of inducing and incentivizing certain behaviors, in addition to the roles traditionally attributed to the structure within the legal order. However, Brazilian legislation does not prioritize the incentive for the author's creativity but rather privileges the property aspect related to the work.

In this line, Brazilian copyright law demonstrates a strong protective character and gives little relevance to the weighing of the exclusivity right in face of collective interests, despite the Federal Constitution (CF), in its Article 5, item XXIII, being explicit in determining the observance of the social function of property. Article 46 of the LDA[6] outlines a list of limitations to copyright. The

[6] Article 46. The following do not constitute copyright infringement: I - the reproduction: a) in the daily or periodic press of news or informative articles published in daily or periodical newspapers, mentioning the author's name if signed and the publication from which they were transcribed; b) in daily or periodical newspapers of speeches delivered in public meetings of any nature; c) of portraits or other forms of representation of the image made on commission when carried out by the owner of the ordered object, without opposition from the person represented or their heirs; d) of literary, artistic, or scientific works for the exclusive use of the visually impaired, provided that reproduction is non-commercial and made using the Braille system or other procedure in any medium for these recipients; II - the reproduction of small excerpts for private use of the copier, provided it is done by them without intent to profit; III - the citation in books, newspapers, magazines, or any other means of communication of passages from any work for study, criticism, or controversy, to the justified extent for the intended purpose, indicating the author's name and the source; IV - the collection of lessons in educational establishments by those to whom they are directed, provided that publication is prohibited without prior and express authorization from the lecturer; V - the use of literary, artistic, or scientific works, phonograms, and radio and television broadcasts in commercial establishments exclusively for demonstration to customers, provided that these establishments sell the media or equipment that allow their use; VI - the theatrical representation and musical performance when carried out in the family environment or exclusively for educational

concessions made by the Brazilian legislator are insufficient as they cannot cover all situations.

Nonetheless, it is observed from the reading of the items of the mentioned article that the legislator's central concern was to allow use as long as it falls under non-commercial use hypotheses – except for items III and VIII – and is permissive regarding educational and informative use.

According to Schirru (2020, p. 157), the interpretation applied to the list of limitations should be considered extensive, as it enables the incidence of the fair use doctrine under national legislation.

In Brazil, the Superior Court of Justice (STJ) permits the use of some protected works without authorization, provided that the "Three-Step Rule" requirements (Brazil, 2011) established in the Berne Convention are met. This theoretical orientation relates to the interpretation of copyright limitations and outlines criteria for the flexibility of copyright protection: (i) the use must fit special cases; (ii) the use must not conflict with the normal exploitation of the original work; and (iii) no unjustified harm must be caused to the legitimate interests of the right holder. However, it is notable that the criteria established by this theory are quite generic and imprecise, which demonstrates that the fair use doctrine offers a better approach to this issue.

Finally, shifting this discussion to the scope of this investigation, a survey is conducted on the justifications and arguments both for and against the application of the fair use doctrine to the use of protected artistic works to supply the image databases of generative AI programs.

a) Favorable Arguments for Applying Fair Use

In the U.S., providing new images through applications has been the subject of legal actions based on allegations of plagiarism and art theft from the images that comprise the database. According to the litigants, the "Stable Diffusion" program, launched by Stability AI, "contains unauthorized copies of millions – and possibly billions – of copyrighted images." In their plea, these artists claim that these copies were made without the authors' knowledge or consent.

According to Pamela Samuelson (2023), an argument used by developers, in contrast to the artists' allegations, is that the technology's use does not focus on the artistic creation itself. Instead, the interest lies in the underlying data of the artworks. From this perspective, databases would function merely as raw material for computational purposes.

It is widely accepted that copyright protection concerns the original expression. Therefore, if the object of interest is considered to be limited to the data and not the work itself, it would be possible to classify the formation of databases for algorithm training solely as data mining, which is widely accepted as fair use.

The practice of data mining consists of recognizing patterns over a large amount of data based on large-scale computational analysis[7]. Even though the analyzed material is protected by copyright, the predominant understanding has been that this purpose would be covered by fair use. This is because the use of "text data mining" (TDM) allows for the discovery of new knowledge from the organization of existing knowledge. As it serves scientific and educational purposes, this has been the understanding of American courts regarding data mining (Krista L. Cox, 2015).

When confronted with the criteria proposed by fair use, the applicability of the mentioned doctrine for data mining cases is observed as follows: (i) regarding the purpose and character of the use, courts understand that the transformative nature of the use prevails, and it is demonstrated that the creation of a database differs in purpose, character, expression, and meaning from the material from which it is extracted; (ii) regarding the amount and substantiality of the portion used, it is understood that making copies of the entire work for analysis purposes was necessary; otherwise, it would be impossible to perform effective data mining, thus even if it involves substantial copying of the work, it is considered reasonable since the work is not used as an expression; and (iii) regarding the market impact, given its highly transformative nature, it is unlikely that using the work in databases will generate adverse impacts for the original from a market perspective.

When analyzing the nature of the copied material, it is observed that in cases where the analyzed data were underlying works with greater copyright protection, i.e., works with creative – and not functional – character, courts did not place much importance on this factor[8], considering it neutral in most cases or moderately unfavorable to fair use applicability.

Additionally, to feed the algorithm training database, the application used the LAION dataset, a collection of data created by a German non-profit

purposes in educational establishments, without any profit intent; VII - the use of literary, artistic, or scientific works to produce judicial or administrative evidence; VIII - the reproduction in any work of small excerpts of pre-existing works of any nature or of entire works when it comes to plastic arts, provided that reproduction is not the main purpose of the new work and does not prejudice the normal exploitation of the reproduced work nor cause unjustified damage to the legitimate interests of the authors.

[7] The European Directive 2019/790 of April 17, 2019, defines it as "any automated analytical technique aimed at analysing text and data in digital form in order to generate information which includes but is not limited to patterns, trends and correlations;" (European Parliament, 2019).

[8] This reasoning derives from the courts' understanding that the mere recontextualization of a protected work from an expressive context to another context is sufficient to apply fair use. According to Matthew Sag (2023), there were similar judgments in the U.S., such as in the case Bill Graham Archives v. Dorling Kindersley Ltd., 448 F.3d 605, 609-610 (2d Cir. 2006), where the use of rock promotional posters to illustrate a biography had a different context from the original use for which it was created.

organization. LAION ("Large-scale Artificial Intelligence Open Network") is a database containing 5.85 billion images accompanied by texts, conceived by volunteers (The Batch, 2023) to democratize research (Beaumont, 2022).

In this sense, it seems reasonable to assume that the fair use doctrine would adhere to this modality, as the dataset's primary objective was to foster the development of machine learning model research in a public character.

Based on this reasoning, using images to create the database would fall under the fair use doctrine, considering the scientific-educational nature associated with the formation of this database. Applying AI would allow for the reuse of incorporated data, and the new works would promote scientific progress. However, a different analysis should be given when these data are used to train programs with profitable purposes.

b) Unfavorable Arguments for Applying Fair Use

Applying fair use to supply training data for generative AI is indeed quite controversial. Although databases such as LAION were created for research and technology development purposes, itis notable that platforms like Midjourney and LensAI use this technology to generate marketable digital goods. In other words, these platforms subvert the use of images to serve their profit-making purposes.

The LensAI application requires a monetary payment from the user for avatars to be generated. Similarly, Midjourney requires a subscription plan for the service to be provided. Thus, the purpose becomes purely commercial, which is a use not covered by the scope of fair use.

The main argument used to support the artists' plea refers to the market impact resulting from that use. According to a testimony given by artist Karla Ortiz when discussing AI and copyright before the U.S. Senate Judiciary Subcommittee on Intellectual Property:

> [...] It is bad enough that this is being done without our consent, without any credit being offered, or without any compensation, but worse still, we are now forced to compete against these Generative AI models that were built upon our own work. No human being can outcompete a Generative AI model, due to the economies of scale: an AI is low cost and can generate a massive volume of “good enough” products especially compared to a single artist (United States of America, 2023).

Similarly, Samuelson (2023, p. 66) notes that these systems can produce results more quickly and economically than human authors, and AI results are generally of sufficient quality to be competitive in the market compared to human authors' works. This means that there is a non-trivial potential for market substitution. At this point lies the greatest controversy regarding using artworks to train algorithms. Generative AI technology threatens artists' opportunities to compete in the market, causing a loss of income based on an exploitation structure of works whose use was neither consented to nor credited. There is not even any form of compensation, as noted by the litigants.

Regarding the market impact of applying fair use, it is also necessary to highlight the potential emergence of a market for creating specific licenses to authorize works to be included in such databases[9]. If the decision is to simply apply fair use, these licenses will become obsolete, causing significant losses to this market niche, which is another factor that should be weighed in deciding the case.

It is important to consider the separation between the database used and the generative AI system itself. However, if there is an infringement in the used database, Pamela Samuelson (2023b, p. 70) points out that courts may understand that the AI use is also "contaminated," which would automatically transfer the infringement to these systems.

Even though there is an evident separation between merely creating a database and the generative AI system, Pamela Samuelson suggests that U.S. courts might apply the same understanding to both hypotheses – as noted, the courts have been understanding fair use in data mining cases – so it will be up to the plaintiffs to "distinguish."

Finally, it is important to consider that there are solid arguments on both sides. However, it should be emphasized that the applicability of the fair use doctrine depends on the specific case analysis to weigh the interests involved in particular cases, which has not yet been analyzed by the courts.

V. Conclusion

The meaning and applicability of fair use for supplying digital art databases must consider not only public sphere interests for technology dissemination and development but also private sphere interests represented by the authors' property rights. The investigation demonstrated that it is possible to list arguments both for and against fair use application.

Due to the immediate functionality extraction of protected digital goods through simple sharing, the importance of regulating access protection was concluded, as this faculty is currently more relevant than the condition of effectively owning a particular good.

Throughout the investigation, the conflicting interests involved in using artworks in databases serving generative AI training were analyzed, which proved to be

[9] Pamela Samuelson (2023b, p. 82) observes that the Copyright Clearance Center should explore the opportunity to organize licenses for the use of protected works by generative AIs, given that licensing markets have already emerged in various contexts of disruptive technologies. In this regard, the author points out that the judiciary has considered the threat to existing or potential markets, as in the case of the Napster and TVEyes applications.

a utilitarian issue. On one hand, there is the collective interest for technology to be improved and enhanced; on the other, there are the moral and property interests of the work creators.

To frame the debate, different viewpoints on the issue were discussed. One stance argues that the use does not incur any violation, as it would be analogous to the human inspiration process. According to this perspective, if the influence of others' works on the human author's creation is not considered misuse, then composing the database for algorithm training should be understood similarly. This perspective suggests there is no direct use of the contained arts but rather the processing and treatment of the data underlying them to define solutions by the algorithm.

In parallel, the artists' perspective argues that using works for machine learning is improper due to the similarity between AI products and the works contained in the database. In these terms, the necessity of artist authorization for such use was discussed in light of the argument that AI programs appropriate the databases compiling the works without crediting or compensating the authors.

In the end, the study compared different understandings of machine learning techniques. Some authors merely treat it as data mining, while others argue that it involves the exploitation of the work itself.

The cases analyzed highlighted that AI program developers seek to apply fair use in database formation by considering the use purpose and the work portion used. On the other hand, for the artists whose works are included as parameters, the market impact caused by using their work seems more relevant.

From the developers' perspective, the purpose of use to be considered is the development of machine learning techniques for technology progress, which would easily adhere to fair use. There are databases organized solely for research purposes, such as LAION; however, the study highlighted that some platforms use databases like this to provide new images that users pay for, thus subverting the research purpose compatible with fair use.

It is undeniable that producing new artistic works on a simple user command impacts the authors' income. Generative AI technology threatens artists' opportunities to compete in the market, causing income loss based on an exploitation structure of works whose use was not consented to and without remuneration for the artists. However, this argument is difficult to prove, as there is no way to precisely identify the copy of a specific original work in the AI result. In any case, it was concluded that fair use application requires specific case analysis, which has not yet been judged by the court where the action was filed.

Regarding the application of the fair use doctrine in Brazil, it was found more advantageous to extensively interpret the limitations to copyright protection provided in Brazilian legislation, aiming to cover new hypotheses arising in the real world.

Although the claim of the authors, whose works are included in AI training databases, is legitimate for the recognition of their rights, it is technically difficult to prove these claims. This demonstrates that the ideal solution to the problem would be to regulate permission oversight by authorities. Such regulation would allow artists to consent to the use of their works and receive financial compensation for their valuable contribution to generative AI systems.

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An Enhanced Method to Detect Hand Key-points in Single Images using Multiview Bootstrapping

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Abstract- Hand key point detection is crucial for facilitating natural human-computer interactions. However, this task is highly challenging due to the intricate variations stemming from complex articulations, diverse viewpoints, self-similar parts, significant self-occlusions, as well as variations in shapes and sizes. To address these challenges, the thesis proposes several innovative contributions. Firstly, it introduces a novel approach employing a multi-camera system to train precise detectors for key points, particularly those susceptible to occlusion, such as the hand joints. This methodology, termed multiview bootstrapping, begins with an initial key point detector generating noisy labels across multiple hand views.

Keywords: convolutional neural network, key point detector, density network with a single gaussian model, mixture density network, degree of freedom.

GJCST-G Classification: ACM Code: I.4.8

Strictly as per the compliance and regulations of:

An Enhanced Method to Detect Hand Key-points in Single Images using Multiview Bootstrapping

Mohammad Hasan [α], Montasim Al Mamun [σ] & Abid Hasan [ρ]

Abstract- Hand key point detection is crucial for facilitating natural human-computer interactions. However, this task is highly challenging due to the intricate variations stemming from complex articulations, diverse viewpoints, self-similar parts, significant self-occlusions, as well as variations in shapes and sizes. To address these challenges, the thesis proposes several innovative contributions. Firstly, it introduces a novel approach employing a multi-camera system to train precise detectors for key points, particularly those susceptible to occlusion, such as the hand joints. This methodology, termed multiview bootstrapping, begins with an initial key point detector generating noisy labels across multiple hand views. Subsequently, these noisy detections undergo triangulation in 3D utilizing Multiview geometry or are identified as outliers. These triangulations, upon re-projection, serve as new labeled training data to refine the detector. This iterative process iterates, yielding additional labeled data with each iteration. The thesis also presents an analytical derivation establishing the minimum number of views necessary to achieve predetermined true and false-positive rates for a given detector. This methodology is further employed to train a hand key point detector tailored for single images. The resultant detector operates in real-time on RGB images and exhibits accuracy on par with methods utilizing depth sensors. Leveraging a single-view detector triangulated over multiple perspectives enables markerless 3D hand motion capture, even amidst complex object interactions.

Keywords: convolutional neural network, key point detector, density network with a single gaussian model, mixture density network, degree of freedom.

I. Introduction

Hand pose estimation stands as a pivotal topic in computer vision, finding myriad applications across human-computer interaction, augmented/virtual reality, and gaming. These applications typically necessitate hand segmentation, articulated hand pose estimation, and tracking. Although recent advancements in body pose estimation [1], [2] can aid in hand detection and segmentation using human body hand joint features, articulated hand pose estimation from monocular RGB images remains a challenging endeavor on several fronts. This complexity arises due to the diverse configurations of human hands, which possess over 20 Degrees of Freedom (DoF). Moreover, hands, being smaller than the body, often occupy only a fraction of the image when the entire body is visible. Additionally, hand key points frequently encounter occlusion from other parts of the same hand, the opposing hand, or other body regions.

At present, deep learning techniques demonstrate the highest level of performance in human body pose estimation. This task involves estimating the articulated pose of the body, akin to hand pose estimation. However, body pose estimation generally proves to be less challenging. This is primarily because the body is typically upright, reducing the complexity of the problem. Additionally, occlusions pose a less frequent and less severe issue in full-body images compared to hand images. Our study delves into deep learning methods designed for hand pose estimation, particularly those employing holistic articulated pose estimation. While pixel-wise pose estimation methods exist, they may be impractical for real-time applications due to their slower processing speed. Moreover, such approaches often fail to leverage crucial holistic hand features due to their focus on individual pixels.

In this study, our focus lies on RGB-based articulated hand pose estimation, a preference rooted in the widespread availability and straightforward deployment of standard color cameras in comparison to depth cameras. Our contribution targets the problem of partial hand pose estimation within individual RGB image frames, with key points of interest including the wrist and fingertips for each digit: thumb, index finger, middle finger, ring finger, and little finger.

We introduce a novel RGB benchmark dataset designed specifically for estimating hand keypoints and conduct evaluations to offer quantitative assessments of current state-of-the-art methods for this task. This dataset encompasses hand gestures alongside keypoint annotations, particularly emphasizing gestures involving rhythmic hand movements. Our motivation stems from the potential utility of tasks involving such movements for cognitive assessments, particularly when integrated with activities involving whole-body motion [3]. There exists a growing need for computational methods aimed at automatically computing various physical performance metrics, thereby enhancing the

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accuracy and efficiency of human-made assessments. Articulated hand pose recognition assumes a critical role in recognizing and evaluating physical exercises incorporating hand gestures. In Section 4, we delve into the selected hand gestures, elucidating the associated physical exercise tasks and underscoring the significance of articulated hand pose estimation in assessing performance within those tasks. Recognizing rhythmic movements for rapid sequential hand gestures poses additional challenges due to the speed and complexity of the motion. Furthermore, the hand's potential orientation variability and dexterity compound the difficulty in estimating and tracking finger positions.

The Paper is Further Organized as Follows: In Section 1, we discuss Introduction; in Section 2, we discuss Literature Review; Section 3 describes Methodology; in Section 4 we describe Implementation; in Section 5, we discuss our experimental Result & Analysis.

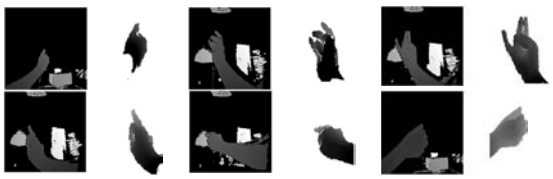
II. Literature Review

Early research in hand pose estimation initially focused on utilizing RGB data, as demonstrated by Rehg and Kanade [4] who explored applications in vision-based Human-Computer Interaction (HCI). Many of the early methods were fragile, relying on the fitting of intricate 3D models with strong priors, such as principles from physics or dynamics [5], employing multiple hypotheses [6], or utilizing analysis-by-synthesis techniques [7]. These approaches often relied on visual cues like silhouettes, edges, skin color, and shading, which were tested in controlled environments with limited poses and simple movements. Wang and Popovic's method managed to alleviate some of these limitations but necessitated the use of a specialized colored glove. Similarly, multiview RGB methods often rely on fitting complex mesh models (e.g., [1], [3]), achieving impressive accuracy but typically only under highly controlled conditions.

Following the advent of readily available depth sensors, research emphasis shifted towards single-view depth-based hand pose estimation, leading to a proliferation of depth-based methods. These approaches can broadly be categorized into generative methods [8], discriminative methods [9], or hybrid methods [1], [10], [11]. A recent example of a hybrid method by Sharp et al. [10] has showcased practical performance across a wide spectrum, though challenges persist in scenarios involving interactions between hands or hands and objects. Discriminative and hybrid strategies for depth-based hand pose estimation heavily rely on synthetic data. Oberwerger et al. [12], for instance, employ feedback loops to generate synthetic training data for hand pose estimation, driven by similar principles as our work, albeit focusing on generating depth images. Moreover, the semi-automatic data annotation scheme outlined in [13] shares a similar motivation; however, our approach utilizes multi-view geometry and key-point detection to offer automated supervision.

Discriminative methods, particularly those reliant on deep architectures, necessitate extensive annotated training datasets. While synthesizing such datasets for depth maps is comparatively straightforward, generating them for RGB poses significant challenges due to the complexity of rendering, demanding photorealistic appearance and realistic lighting. Multiview bootstrapping presents an approach that facilitates the generation of large annotated datasets using an initially weak detector. This process, in turn, facilitates the development of the first real-time hand key-point detector for RGB images in real-world settings. When the pose parameters involve joint locations, the pose estimation task can be likened to detecting key points from input images, thereby sharing similarities with other vision problems such as facial landmarking, 6D Object Detection, and human body pose estimation. Of these, hand pose estimation encounters similar challenges to human body estimation, which has witnessed significant advancements in the past decade [14].

(a)



(b)

Fig. 1: Depth images captured by Intel Real Sense SR300 [Intel] and cropped hand areas. (a) images captured in third-person viewpoints; (b) images captured in first-person (ego- centric) viewpoints.

Both models aim to represent articulated objects with numerous degrees of freedom and account for self-occlusions. However, hand pose estimation presents distinct challenges due to intricate variations stemming from high Degrees of Freedom (DoF) articulations, diverse viewpoints, self-similar components, significant self-occlusions, and variations in shapes and sizes.

The CPM (Convolutional Pose Machines) is a convolutional neural network designed for human pose estimation using single 2D human pose estimation datasets like MPII, LSP, and Frames Labelled in Cinema

(FLIC). This model utilizes CNNs for human pose estimation, with its primary innovation lying in the utilization of a sequential convolution architecture to capture both spatial and texture information. This architecture comprises multiple stages within the network, each undergoing supervised training to prevent gradient vanishing in deep networks. Initially, the original image serves as input, while subsequent stages use the feature map from the previous stage. This approach aims to integrate spatial information, texture information, and central constraints. Additionally, employing multiple scales to process the input feature map and response map within the same convolutional architecture ensures both accuracy and consideration of the distance relationship between key points of each human skeleton.

The overall structure of the CPMs is depicted in Figure 2, where "C" and "MC1, MC2" denote different convolution layers, and "P" represents various pooling layers. The "Centre map" denotes the central point of the human body image, used for aggregating response maps to the image centers. The "Loss" function reflects the minimum output cost, consistent with subsequent figures.

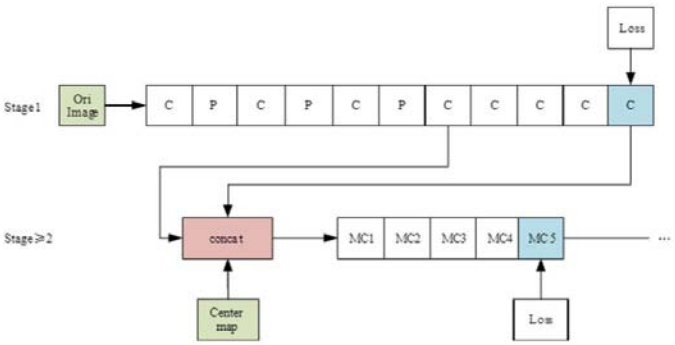


Fig. 2: The overall structure of the convolutional pose machines.

The initial phase of the CPMs comprises a fundamental convolutional neural network (indicated by white convolutions), tasked with directly generating response maps for each key point of the human skeleton from input images. The entire model encompasses response maps for 14 key points of the human skeleton and an additional background response map, resulting in a total of 15 layers of response maps. The network architecture remains consistent across stages≥ 2. In subsequent stages, a feature image with a depth of 128, derived from stage 1, serves as input. This input undergoes fusion through a concept layer, integrating three types of data: texture features, spatial features, and center constraints (wherein the center point of the human body image aggregates the response maps to the image centers).

III. Methodology

This technique essentially involves a learning process conducted through a Multiview system. In our everyday experiences, we observe objects from various angles, each presenting a different shape. Developing computer vision algorithms for camera networks necessitates an understanding of the relationships between images of the same scene captured from different viewpoints. A strategy employed in this regard entails utilizing a multi-camera system to train detailed detectors for keypoints vulnerable to occlusion, such as hand joints. This approach, termed Multiview Bootstrapping, unfolds as follows: initially, an initial keypoint detector generates noisy labels across multiple hand views. Subsequently, these noisy detections undergo either 3D triangulation using Multiview geometry or are flagged as outliers. The resulting reprojected triangulations serve as new labeled training data to refine the detector. This iterative process repeats, yielding additional labeled data with each iteration.

a) Dataset

We present the Hand Keypoint Dataset (HKD), containing annotated RGB images captured while participants engage in rhythmic finger movements. Our dataset comprises 782 color image frames collected from four distinct participants, constituting a novel benchmark dataset for hand Keypoint detection and/or tracking from RGB images. The dataset includes original frames annotated with key points, as well as annotated cropped frames loosely centered around the hand's centroid in the frame. Annotations cover six hand keypoints: W (wrist), TT (tip of the thumb), IT (tip of the index finger), TM (tip of the middle finger), TR (tip of the ring finger), and TL (tip of the little finger). Additionally, the dataset includes annotations for the hand centroid location in the original RGB frames. During data collection, participants executed rapid sequential finger gestures outlined in Section 3, performing these movements thrice with varying hand orientations relative to the camera. The dataset encompasses hand movements from four participants (two male, two female), with annotations manually conducted by two annotators utilizing a standardized annotation toolkit developed by our team.

Additional details of our Dataset,

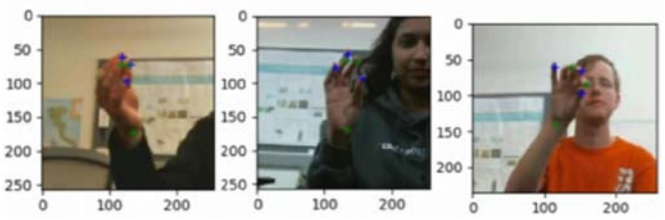


Fig. 3: Example annotations of cropped images from HKD dataset.

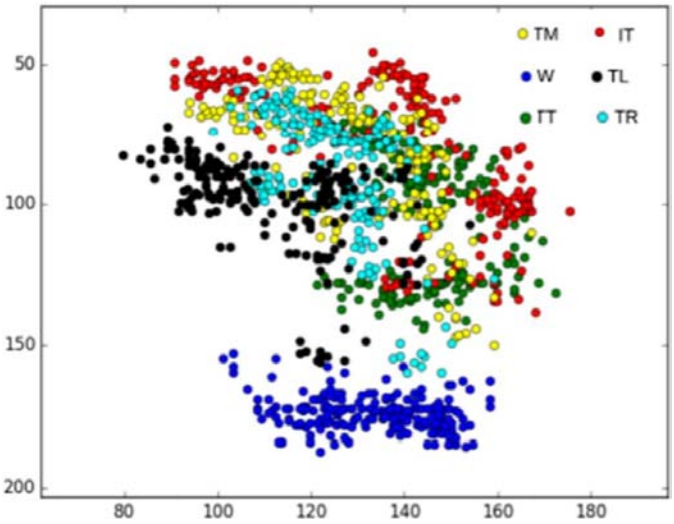


Fig. 4: Variance of hand key points of Subject1 in HKD.

b) Proposed Method

We configured our network module and dataset using OpenCV, along with prototext and caffemodel files. Subsequently, we processed an RGB image containing a hand. The process of detecting keypoints resembles identifying notable points on the hand, akin to human hand joints. We established 22 points to pinpoint hand keypoints and established pairs of keypoints to connect specific points, akin to a human skeleton. Once this method localizes all the keypoints, we depict the skeleton by drawing lines between the pairs and represent the keypoints as circles. Ultimately, we present the output, showcasing the detected keypoints and skeleton.

IV. Implementation

We implement the procedure outlined in the preceding section to ascertain the hand's pose and individuate the five fingers individually. Employing the Multiview Bootstrapping method, we detect all 22 keypoints, proceeding to estimate the hand's pose based on these detected keypoints. Ultimately, we categorize the five fingers independently, marking the culmination of our implementation.

a) Image Preprocessing

Initial image processing is undertaken to ready it for primary processing or subsequent analysis. In this stage, we begin with an image and reduce its dimensions through resizing. Initially, we determine the original height and width of the provided image, calculating the aspect ratio accordingly. Following this, we establish a default height of 368 pixels, while the width is determined based on the aspect ratio and height. The width is computed as the product of the aspect ratio and height. For processing with the Multiview Bootstrapping method, four image parameters are required: batch size, channel, height, and width. Utilizing OpenCV and its "blobFromImage" function, we amalgamate all necessary information required for the network.

b) Localize Keypoints

The result consists of 22 matrices, each representing the Probability Map of a keypoint. To pinpoint the precise keypoints, we initially resize the probability map to match the dimensions of the original image. Subsequently, we identify the keypoint's location by detecting the maximum value within the probability map, achieved through the minmaxLoc function in OpenCV. We then illustrate the detected points on the image, labeling them with corresponding numbers. Specifically, the wrist is denoted by point 0, while points 4, 8, 12, 16, and 20 signify the tip points of each finger.

c) Estimate Hand pose

We define pairs of key points as like joint on human hand. We define 20 pose pairs to connect the detected keypoints. The pose pairs are like,

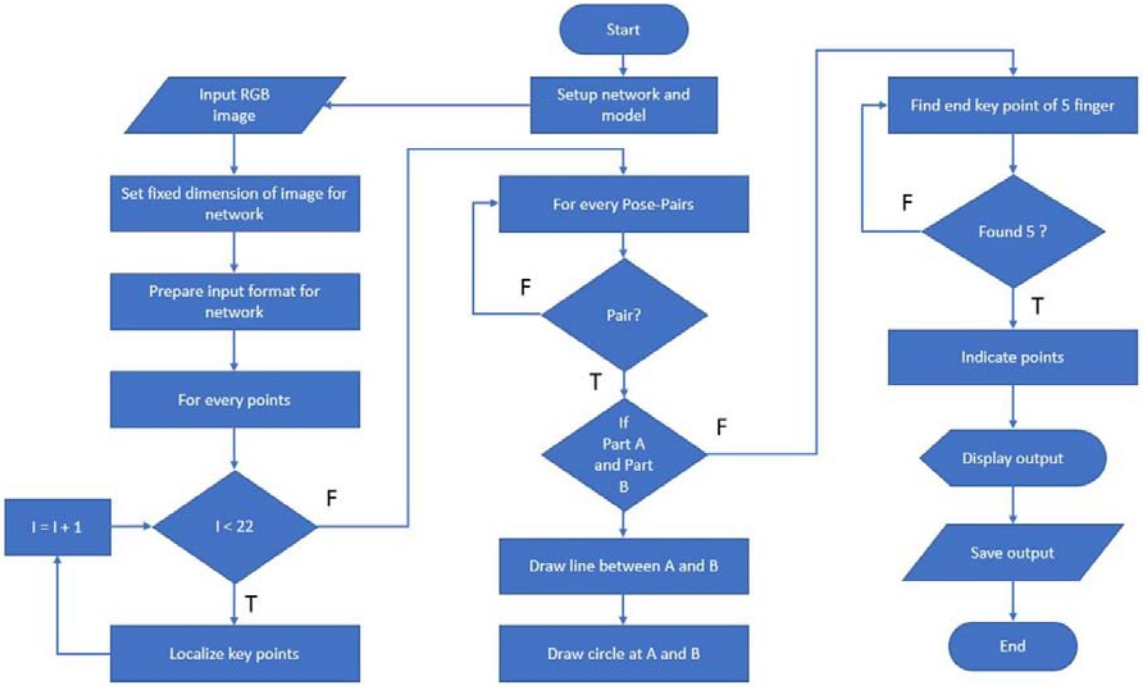


Fig. 5: Flowchart of proposed methodology

[[0, 1], [1, 2], [2, 3], [3, 4],
[0, 5], [5, 6], [6, 7], [7, 8],
[0, 9], [9, 10], [10, 11], [11, 12],
[0, 13], [13, 14], [14, 15], [15, 16],
[0, 17], [17, 18], [18, 19], [19, 20]]

We will use the detected points to get the skeleton formed by the key points and draw them on the image.

d) Finger Classification

We noticed that all the fingers start from 0 point and end with 4, 8, 12, 16, 20 respectively. When the detectord_i {ifiϵ[0…4]} It is indicating as number 1 finger, When, d_i{ifiϵ[0,5…8]} It is indicating as number 2 finger, When, d_i{if i ϵ [0, 9…12]} It is indicating as number 3 finger, When d_i{ifiϵ[0,13…16]} It is indicating as number 4 finger, When, d_i{ifiϵ[0,17…20]} It is indicating as number 5 finger. So, we need to identify the pixel value of the needed points and indicate with the indexing number.

e) Visualization

The visualization of the image is facilitated by a function within the OpenCV module. Utilizing OpenCV, we display our outcome. Specifically, we employ distinct colors for individual fingers and denote each finger with a straight line originating from the top of the image, accompanied by an index.

V. Result and Analysis

None of the existing hand pose estimation datasets we evaluated were suitable for our intended application: encompassing general, real-world images depicting everyday hand gestures and activities. Consequently, we manually annotated two publicly available image collections: (1) The MPII Human Pose dataset [18], sourced from YouTube videos curated specifically to portray ordinary human activities, and (2) Images from the New Zealand Sign Language (NZSL) Exercises conducted by Victoria University of Wellington [2], featuring individuals using NZSL to narrate stories. We opted for the latter dataset due to its diverse range of hand poses, resembling those encountered in conversational contexts, which are less prevalent in the MPII dataset.

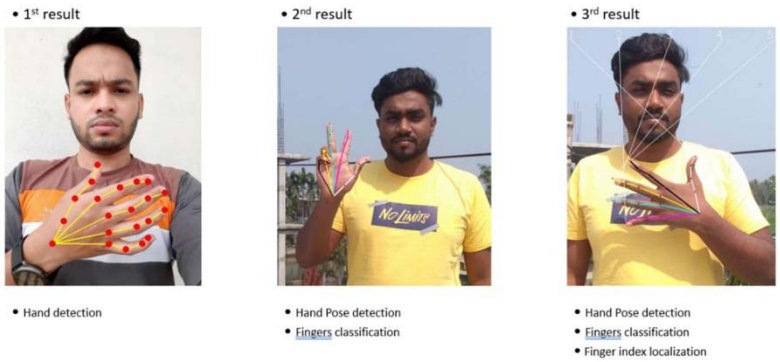


Fig. 6: Expected result after successful implementation.

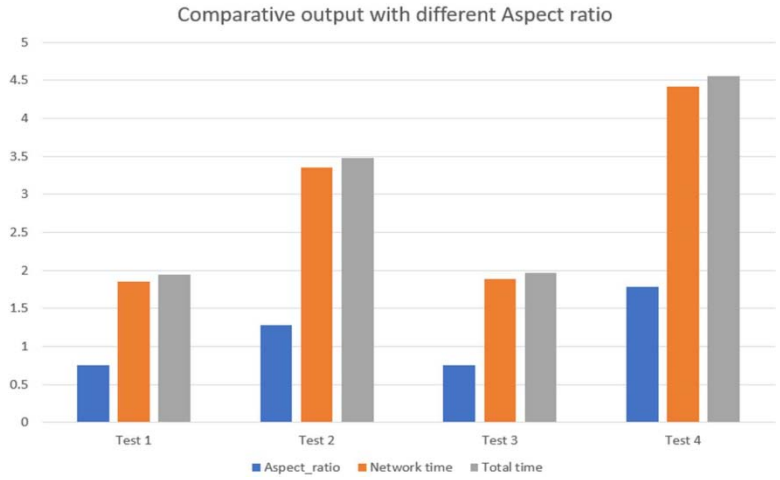


Fig. 7: Comparative output with different Aspect ratio

a) Robustness to View Angle

We assess the enhancement in the detector's resilience to varying viewing angles by gauging the proportion of outliers during 3D reconstruction. To establish ground truth, we meticulously scrutinize our most accurate 3D reconstruction outcome, selecting only frames that are correctly reconstructed. We define the view angle in terms of azimuth φ and elevation θ relative to a stationary hand positioned at the origin. From an intuitive perspective, angles where $\varphi = \{-180, 0, 180\}$ (providing a direct view of the palm or backhand) are deemed easier due to reduced self-occlusion. Conversely, angles at $\varphi = \{-90, 90\}$ offer a side view of the hand, from the thumb to the little finger or vice versa, resulting in increased occlusion. Similarly, angles at $\theta = \{90,-90\}$ present a view from the fingertips to the wrist, and vice versa, representing the most challenging perspectives. We contrast the initial iterations of the "Mix" detector, which swiftly adapt to diverse viewing angles. This comparison is visualized as a heatmap, wherein hand detections are binned based on the azimuth and elevation of each example. The percentage of outliers is determined by considering all examples falling within each bin.

b) Comparison to Depth-based Methods

We evaluate the effectiveness of our method using a publicly available dataset curated by Tzionaset al.. While numerous datasets are commonly employed for assessing depth-based methods, many lack corresponding RGB images or have annotations that are solely applicable to depth images. Datasets containing RGB images with precise manual annotations are scarce; therefore, the dataset provided by [18] aligns best with our method's evaluation requirements. Employing the 2D Keypoint detector "Mix 3" on the RGB images from the dataset, we analyze sequences featuring single-hand motion, hand-hand interaction, and hand-object interaction. For direct comparison, we utilize the average pixel errors in keypoint locations as outlined in Table 1. It's noteworthy that the referenced method relies on a sophisticated 3D hand template, utilizing depth data and tracking, resulting in several seconds of processing time per frame. In contrast, our approach achieves comparable performance in single-hand and hand-object scenarios using only per-frame RGB detection, capable of real-time operation with GPU acceleration. Performance diminishes in hand interaction scenarios, where our detector may erroneously identify occluding hands. Simultaneous detection of joints on both hands would offer

advantages in such cases, rather than treating each hand independently as our current approach does.

c) Summery

We assessed Multiview bootstrapping by implementing Algorithm 1 using three initial detectors. All three detectors adhere to the architecture outlined in Sect. 4, but are trained on three distinct sets of initial training data T0: (1) "Render": a preliminary collection of synthetically generated images of hands, totaling approximately 11,000 examples, (2) "Manual": manual annotations extracted from the MPII and NZSL training sets discussed earlier, and (3) "Mix": a fusion of rendered data and manual annotations. For Multiview bootstrapping, we utilized images from the Panoptic Studio dataset [8]. Specifically, we employed 31 HD camera views and four sequences featuring hand motions, leveraging the provided 3D body pose [8] to estimate occlusions and bounding boxes for hand detection. During bootstrapping iterations, frames were discarded if they exhibited an average number of inliers < 5 or an average reprojection error > 5, with a detection confidence threshold of $\lambda=0.2$. Throughout the process, we manually discarded no more than 15 incorrectly labeled frames. It's important to note that the detector requires a bounding box surrounding the hand to predict the keypoints. Therefore, for optimal results, the hand should be positioned close to the camera or cropped using a hand detector before being inputted to the network. Additionally, the provided code is designed to detect only one hand at a time; however, it can be easily adapted to detect multiple hands by utilizing the probability maps and implementing certain heuristics.

VI. Conclusion and Future Works

This paper introduces two advancements: (1) the inaugural real-time hand Keypoint detector demonstrating practical utility in uncontrolled RGB video settings; and (2) the pioneering markerless 3D hand motion capture system, capable of reconstructing intricate hand-object interactions and musical performances autonomously. We ascertain that extensive training sets can be constructed through Multiview bootstrapping, enhancing both the quality and quantity of annotations. Our approach can be applied to generate annotations for any Keypoint detector susceptible to occlusions (e.g., body and face). The creation of a large annotated dataset often poses a significant bottleneck for numerous machine learning and computer vision tasks, and our method offers a means to refine weakly supervised learning by leveraging Multiview geometry as an external source of supervision. As a prospective avenue of exploration, enhancing the method's robustness to discern between right and left hands, optimizing the algorithm, and implementing it in real-world problem-solving scenarios would facilitate the development of even more comprehensive datasets that closely mirror real-world capture conditions.

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Securing the Digital Realm: Navigating Cyber Threats, Risks, and Resilience

By Jai Bhortake

Abstract- The internet connects us, empowers us, but also exposes us. This paper explores the wild world of cybersecurity, uncovering its challenges and successes. It sheds light on the internet's dual nature, exploring its vast global impact and susceptibility to various threats, while also acknowledging the swift advancements in hacking techniques. The paper contrasts different perspectives on cybersecurity, focusing on the enhanced security potential offered by specialized cloud computing services. Highlighting the pressing need for cybersecurity, it addresses the increasingly sophisticated cyber threats, including cyber terrorism and espionage, posing significant hurdles for government and business networks. It also delves into the motives and methods of cyber criminals, ranging from profit-driven hackers to state-sponsored groups, showcasing their tactics such as social engineering and phishing. Providing guidance for effective cybersecurity, the paper emphasizes risk assessments, strong authentication methods, education, and compliance with security standards.

Keywords: *IT security, internet of things (IOT), cybersecurity.*

GJCST-G Classification: *ACM Code: K.6.5*

Strictly as per the compliance and regulations of:

Securing the Digital Realm: Navigating Cyber Threats, Risks, and Resilience

Jai Bhortake

Abstract- The internet connects us, empowers us, but also exposes us. This paper explores the wild world of cybersecurity, uncovering its challenges and successes. It sheds light on the internet's dual nature, exploring its vast global impact and susceptibility to various threats, while also acknowledging the swift advancements in hacking techniques. The paper contrasts different perspectives on cybersecurity, focusing on the enhanced security potential offered by specialized cloud computing services. Highlighting the pressing need for cybersecurity, it addresses the increasingly sophisticated cyber threats, including cyber terrorism and espionage, posing significant hurdles for government and business networks. It also delves into the motives and methods of cyber criminals, ranging from profit-driven hackers to state-sponsored groups, showcasing their tactics such as social engineering and phishing. Providing guidance for effective cybersecurity, the paper emphasizes risk assessments, strong authentication methods, education, and compliance with security standards. It stresses the importance of encryption, backups, and response plans as shields against evolving threats like malware, phishing, DDoS attacks, and vulnerabilities in IoT devices. Going beyond immediate disruptions, the paper examines the broader consequences of cyber-attacks, forecasting their impact on geopolitics, societal trust, and the ever-evolving threat landscape. It also analyses hacking tools, their functionalities, ethical implications, and legal repercussions, culminating in a comprehensive cyber risk evaluation. Ultimately, the paper reaches a pinnacle by advocating a holistic approach and pioneering strategies to confront cyber insecurity. It places significant emphasis on the paramount need for public awareness, fostering cultural shifts towards cyber hygiene, embracing ongoing technological advancements, fostering collaborative endeavours, and deeply integrating ethical considerations to forge a resilient and safeguarded digital future. This paper stands as an indispensable asset, guiding all stakeholders in navigating the intricate landscape of cybersecurity within our progressively interconnected world.

Keywords: IT security, internet of things (IOT), cybersecurity.

I. Introduction

Cybersecurity refers to safeguarding internet-connected systems, encompassing hardware, software, and data, against cyber-attacks. It spans cyber and physical security, both crucial for enterprises to ward off unauthorized access to data centres and computerized systems. Security, aiming to maintain data's confidentiality, integrity, and availability, falls within the domain of cybersecurity. The internet has dramatically shrunk the world while exposing us to diverse and challenging influences. Security measures developed rapidly, yet the realm of hacking evolved even faster. In an age defined by digital dependence, where the internet's tendrils reach every corner of life, a critical battle is waged in the shadows. This is the fight for cybersecurity, where the very fabric of our interconnected world hangs in the balance. Awareness, cultural shifts, technological advancements, inter-continental collaboration, and a steadfast commitment to ethical considerations are the pillars upon which a more secure future rest. This comprehensive exploration serves as a compass, guiding everyone through the complex maze of cybersecurity in a world where yesterday's solutions may not suffice for tomorrow's threats.

II. Necessity of Cyber Security

The scope of cybersecurity operations involves shielding information and systems from various formidable cyber threats, each taking diverse forms. Keeping up with cybersecurity strategies is challenging, especially in governmental and enterprise networks. These threats often target a nation's secretive, political, or military assets, posing a considerable challenge. Common threats include:

1. *Cyber Terrorism:* Innovative use of information technology by terrorist groups to further political agendas, often manifesting as attacks on networks, computer systems, and telecommunication infrastructures.
2. *Cyber Warfare:* Nation-states employing information technology to infiltrate another nation's networks for causing damage. Acknowledged as the fifth domain of warfare, cyber warfare attacks, typically executed by well-trained hackers supported by nation-states, compromise valuable data, degrade communications, or disrupt vital services.
3. *Cyber Espionage:* The practice of using IT to illicitly acquire secret information, often for strategic, economic, or military advantage. Employing cracking techniques and malware, cyber espionage aims to gain critical data without permission.

The boundless web of connectivity that defines our world, while catalysing remarkable progress, also casts a dark shadow: the burgeoning threat landscape

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of cybercrime. These silent predators lurk in the digital ether, poised to inflict chaos on individuals, businesses, and even nations. This stark reality underscores the critical need for robust cybersecurity measures, a veritable digital shield against the ever-evolving arsenal of malicious attacks. Firstly, cybersecurity stands as the sentinel guarding our sensitive information, mitigating the insidious risks of data breaches, financial losses, and shattered reputations. It meticulously upholds the CIA triad – the holy trinity of data protection – ensuring the confidentiality, integrity, and availability of our digital assets, a cornerstone of trust in the contemporary world. But the need for robust defences extends far beyond protecting personal data. Our very way of life rests upon the interconnected foundation of critical infrastructure – from the pulsating arteries of smart energy grids to the life-saving veins of healthcare systems and the intricate web of financial networks. A single breach in these vital systems can trigger cascading disruptions, crippling daily life and jeopardizing national security. Cybersecurity, therefore, is the fortified wall protecting the critical infrastructure upon which our societies stand. On the global stage, the battle against cyber threats transcends national borders. Espionage, cyber warfare, and other nefarious activities lurk in the shadows, seeking to destabilize nations and compromise sensitive information. Robust cybersecurity becomes, then, a shield for national resilience, bolstering international cooperation in the face of an ever-shifting battleground.
In essence, cybersecurity is essential to safeguarding the digital realm and ensuring the continued functionality, safety, and reliability of our interconnected world.

III. Cybercriminals

Cybercriminals are individuals or groups that engage in illegal activities using computer systems, networks, or digital devices. They operate with the intent to exploit vulnerabilities, access sensitive information, or cause harm for financial gain, personal motives, or to disrupt operations.

a) Types of Cyber Criminals

White Hat Hackers: Aso known as ethical hackers, are individuals who use their technical skills to identify and address security vulnerabilities in systems, networks, or applications. They typically operate with the permission of the system owner and aim to improve cybersecurity by proactively finding and fixing weaknesses. White hat hackers often work in roles such as security professionals, penetration testers, or consultants. Their activities contribute to strengthening defines against cyber threats and enhancing overall security posture.

Black Hat Hackers: Black hat hackers are individuals who exploit security vulnerabilities in systems, networks, or applications for personal gain or malicious purposes. They may engage in activities such as stealing sensitive information, disrupting services, deploying malware, or conducting other illegal actions. Black hat hackers are commonly associated with cybercrime and may operate individually or as part of organized cybercrime groups. Their actions pose significant risks to individuals, organizations, and society as a whole, leading to financial losses, data breaches, and other adverse consequences.

Grey Hat Hackers: Grey hat hackers occupy a middle ground between white hat and black hat hackers. These individuals may engage in hacking activities without explicit authorization but without malicious intent. Grey hat hackers may discover vulnerabilities in systems and networks and choose to expose them to the system owner or the public, sometimes without permission. While their actions may not be inherently malicious, they still operate outside the boundaries of legal and ethical hacking practices. Grey hat hackers blur the lines between ethical and unethical behaviour, raising questions about the appropriateness of their actions.

Script Kiddies: Script kiddies are individuals who lack advanced technical skills but use pre-existing tools, scripts, or malware to launch cyber-attacks. They typically rely on readily available resources and exploit known vulnerabilities without fully understanding the underlying technology. Script kiddies often engage in low-level, opportunistic attacks, such as website defacements, DDoS attacks, or spreading malware. While their impact may be less severe compared to more skilled hackers, script kiddies can still cause disruptions and damage to individuals and organizations, highlighting the importance of basic cybersecurity measures.

State-Sponsored Actors: Nation-states or government-affiliated groups engaging in cyber espionage, cyber warfare, or other cyber activities to advance political, economic, or military objectives.

b) Motivations Behind Cyber Crime

Cybercriminals pursue various motives, with financial gain standing as a primary incentive. Many engage in illicit activities to reap monetary benefits, targeting sensitive financial information, executing fraudulent transactions, or resorting to ransomware attacks for extortion. Another motivation involves espionage and information theft, where individuals seek to gather sensitive data for competitive advantage, espionage purposes, or political motives. Additionally, some cybercriminals embrace hacktivism, using cyber-attacks to advocate for social or political causes. This may involve defacing websites, disrupting services, or leaking sensitive information to advance ideological goals. Lastly, a subset of cybercriminals aims at causing disruption and chaos, with the intent of damaging systems, services, or critical infrastructure. This group

pursues its objectives for ideological reasons or personal satisfaction, adding an element of unpredictability to the motives behind cyber threats.

c) *Techniques Used*

1. *Social Engineering:* Manipulating individuals to divulge confidential information.
2. *Exploiting Vulnerabilities:* Leveraging weaknesses in software, networks, or systems.
3. *Phishing and Spoofing:* Deceptive techniques to trick users into revealing sensitive data.

IV. Types of Cyber Security Threats

1. *Malware:* Malware refers to malicious software designed to infiltrate, damage, or gain unauthorized access to computer systems.

Types:

Viruses: Programs that replicate themselves by attaching to other programs or files and can cause damage or spread throughout a system.

Ransomware: Encrypts files or systems and demands payment to restore access, often causing significant disruptions or financial losses.

Trojans: Disguised as legitimate software, these programs enable unauthorized access or perform harmful actions on the victim's system.

Spyware: Secretly gathers information about a user's activities without their consent.

2. *Phishing:* Phishing involves deceptive attempts to trick individuals into revealing sensitive information, often via fraudulent emails, websites, phone calls or messages.

Types:

Spear Phishing: Targeted phishing attacks customized for specific individuals or organizations.

Whaling: Targets high-profile individuals like executives or CEOs for sensitive information or financial gain.

3. *DDoS Attacks (Distributed Denial of Service):* DDoS attacks overwhelm a system, network, or service with excessive traffic, rendering it inaccessible to legitimate users.

Types:

Volumetric Attacks: Floods networks with high volumes of traffic to consume bandwidth.

Application Layer Attacks: Targets specific applications or services, exhausting server resources and causing service disruption.

4. *Man-in-the-Middle (MitM) Attacks:* In MitM attacks, an attacker intercepts communication between two parties without their knowledge.

Types:

Session Hijacking: Unauthorized access to an active session between two users.

SSL Stripping: Forces communication to occur over unencrypted channels, allowing attackers to intercept data.

5. *IoT-Based Attacks:* Exploitation of vulnerabilities in Internet of Things (IoT) devices to gain unauthorized access or cause disruptions.

Types:

Botnets: Compromised IoT devices controlled by attackers to conduct large-scale industrial attacks.

V. Hacking Tools

Hacking tools encompass various categories that aid in unauthorized access, manipulation, or exploitation of computer systems and networks. These categories include Vulnerability Scanners, identifying system weaknesses for potential entry points, and Exploitation Frameworks that automate vulnerability identification and exploitation, allowing unauthorized access. Password Crackers decipher passwords through various techniques to breach systems, while Packet Sniffers and Spoofers intercept and analyse network traffic for data capture or identity spoofing. Remote Access Tools (RATs) enable surreptitious remote control of systemsand Steganography Tools conceal information within files to evade detection. These tools possess functionalities that automate processes, empowering attackers, even those with limited technical expertise, to execute sophisticated attacks, elevating risks to systems and networks. Some tools facilitate anonymity, making it challenging for law enforcement to trace attacks, while others exploit known vulnerabilities, underscoring the importance of regular system updates and patch management for prevention. Despite some legitimate uses for security testing or network administration, misuse of these tools for unauthorized access or malicious activities constitutes illegal actions, contributing to the perpetual evolution and sophistication of cyber threats. Also, Advancements in hacking have birthed SQL injection tools and exploit kits, exploiting vulnerabilities in web applications or operating systems with surgical precision. These instruments, capable of manoeuvring through intricate databases or pinpointing specific system flaws, pose substantial threats to organizations globally. As technology progresses, the menacing arsenal expands to include, social engineering kits, capitalizing on human susceptibility, employ psychological manipulation to coerce individuals into divulging confidential data or performing actions detrimental to cybersecurity.

VI. Consequences of Cyber Attack

Cyber-attacks can yield far-reaching and multifaceted consequences, impacting individuals, businesses, governments, and societies at large. Beyond immediate disruptions, the consequences extend into financial, reputational, and societal realms,

and future perspectives suggest these impacts may intensify. Immediate Consequences: Initially, a cyber-attack can lead to severe disruptions. It can paralyze systems, leading to downtime and financial losses for businesses. Data breaches compromise sensitive information, potentially exposing personal or financial details of individuals, leading to identity theft or financial fraud. Ransomware attacks encrypt critical data, demanding hefty payments for decryption, causing operational standstills. Moreover, Distributed Denial of Service (DDoS) attacks cripple online services, rendering them inaccessible to users.

Long-Term and Future Consequences: Looking ahead, the consequences of cyber-attacks are expected to evolve and amplify. As technology becomes more embedded in daily life, the potential for larger-scale disruptions looms larger. The rise of interconnected devices through the Internet of Things (IoT) introduces vulnerabilities on a broader scale, leaving critical infrastructure, smart cities, and essential services susceptible to cyber-attacks. Future attacks could target autonomous vehicles, healthcare systems, or smart grids, posing significant risks to public safety and security. As our dependence on digital infrastructure and data intensifies, the financial ramifications of cyber-attacks are poised to spiral upwards. A successful breach can inflict not just immediate costs of recovery and remediation, but also long-term damage to business continuity, market shares, and investor confidence. The eroded trust in the wake of even minor leaks can linger, impacting customer loyalty and brand reputation, potentially hampering profitability and competitive advantage for years to come. Beyond impacting individual businesses, cyber threats pose a significant risk to international stability and security. Nation-states increasingly resort to cyber warfare or espionage, weaponizing sophisticated tools and techniques to gain strategic advantages or sow discord. This digital arms race is further fuelled by the growing sophistication of attacks, often employing AI or machine learning algorithms that can inflict widespread damage and unintended consequences, potentially escalating geopolitical tensions and undermining international cooperation. Furthermore, the ever-escalating sophistication of cyberattacks, fuelled by the burgeoning power of AI and machine learning, leaves cybersecurity professionals scrambling to stay ahead of the curve. Cyber-attacks aren't mere inconveniences; they're tremors prefiguring an earthquake in the foundations of trust, stability, and security. Neglecting these warnings won't just inflict financial wounds on businesses, but cast a dark spell of instability across the globe, leaving us navigating a transformed landscape sculpted by the digital storm. Evolving tactics and tools, constantly morphing like digital chameleons, demand a constant arms race of innovation and adaptation. It's a stark call to action: fortify our defences, collaborate globally, and embrace ethical considerations before the tremors escalate into an irreversible quake.

a) A Multi-Layered Approach to Cyber Risk Assessment

Globally, businesses invest around 12% of their IT budgets in cybersecurity, prioritizing fortified network segmentation and encryption to protect sensitive data. Human defence, often underestimated, involves training and awareness to mitigate social engineering attacks, reducing the average cost per breached record to $164, as revealed by IBM's report. Despite these efforts, breaches persist, leading to reactive strategies like forensic investigations and data recovery, costing up to $30,000 per incident. Neglecting cybersecurity proves costlier; breaches incur heavy fines, legal expenses, and damage customer trust. The Ponemon Institute estimates an average breach cost of $4.24 million, highlighting the immense financial impact compared to preventive measures. Hence An in-depth examination of various methodologies is paramount to comprehend-sively address the dynamic cyber threat landscape. One key aspect involves Threat Intelligence Gathering, employing data analytics, honeypot deployments, and threat feeds to meticulously map the evolving threat landscape. This includes characterizing known malwares, phishing campaigns, and ransomware variants, with a strategic focus on emergent threats such as zero-day vulnerabilities and sophisticated supply chain attacks. Following this, the process of Vulnerability Assessment and Penetration Testing becomes crucial, integrating automated vulnerability scanners and manual penetration testing techniques to identify and map exploitable weaknesses across systems, networks, and applications. The analysis encompasses scrutinizing misconfigurations, insecure coding practices, outdated software dependencies, and ineffective security protocols, providing insights into the likelihood of successful exploits and their potential impact. Quantitative Risk Analysis will add another layer, utilizing frameworks like Monte Carlo simulations and attack trees to model potential cyber incidents and their cascading effects. This comprehensive approach will involve estimating the likelihood of attacks, quantifying financial losses (including potential ransom demands and regulatory fines), assessing reputational damage, and evaluating service disruptions. Furthermore, a vital component is the Cybersecurity Posture Evaluation, where the maturity of cybersecurity measures is assessed through a data-centric approach. Leveraging security information and event management (SIEM) systems and incident response logs, organizations can analyse their effectiveness in detecting, responding to, and recovering from cyberattacks. This data-driven evaluation will enable the identification of gaps in existing controls, facilitating informed decisions to

prioritize investments in cybersecurity infrastructure and personnel.

b) Strategies for Safeguarding Cyber Environments

Maintaining effective cybersecurity involves a comprehensive approach encompassing various strategies and practices to safeguard digital assets and systems. Firstly, organizations should undertake thorough risk assessments, identifying critical assets, potential threats, and existing vulnerabilities within their networks. This helps in prioritizing security measures effectively. Implementing strong authentication methods, such as multi-factor authentication (MFA), and enforcing the principle of least privilege ensures heightened login security and restricts user access to only necessary resources, minimizing potential damage from compromised accounts. Regular software updates and patch management are crucial components of cybersecurity maintenance. Timely application of security patches and updates across all systems, software, and applications helps address known vulnerabilities and mitigate potential risks. Deploying firewalls to monitor and control network traffic plays a pivotal role in preventing unauthorized access and filtering malicious content.

Moving away from the traditional perimeter-based security model, we should be implementing these new security measures like the Zero Trust Architecture which assumes no implicit trust, requiring strict verification of every user and device accessing the network. It involves continuous authentication, encryption, and micro-segmentation to limit access and reduce the attack surface. Harnessing the power of Artificial Intelligence (AI) and Machine Learning (ML) is crucial in identifying anomalies, detecting patterns, and predicting potential threats. These technologies enable the development of adaptive security systems capable of learning and evolving to counter new attack vectors. With the widespread adoption of cloud services, robust cloud security measures are imperative. This includes encryption, access controls, multi-factor authentication, and continuous monitoring of cloud environments to mitigate risks associated with data breaches or unauthorized access. The proliferation of Internet of Things (IoT) devices presents new challenges. Strengthening IoT security involves robust authentication mechanisms, regular updates and patching, encryption of data in transit and at rest, and network segmentation to isolate IoT devices from critical systems. Embracing automation in cybersecurity streamlines incident response, threat detection, and vulnerability management. Also, Adherence to regulatory frameworks like GDPR, CCPA, or the current industry-specific standards is vital.

Ensuring effective cybersecurity encompasses a comprehensive approach that extends beyond technological advancements. Central to this strategy is the imperative need for a digitally literate population. Future research outlines the integration of cybersecurity education into primary curricula, accompanied by VR simulations of cyberattacks to enhance awareness. Block chain technology will emergeas a cornerstone, offering an unreachable ledger that guarantees data security by ensuring the integrity and immutability of sensitive information. Complementing this, self-healing infrastructure, drawing inspiration from biological systems, autonomously repairs vulnerabilities, significantly mitigating cyber threats. However, the evolution of defence mechanisms goes beyond technological prowess due to the looming threat of quantum computers to traditional cryptography. Established cryptographic methods like RSA and ECC face vulnerability to Shor's algorithm, highlighting the need for Quantum Resistant Cryptography (QRC) as a formidable defence. QRC, founded on intricate principles of lattice-based cryptography, coding theory, and multivariate cryptography, leverages problems that even the most powerful quantum computers cannot solve, safeguarding current digital infrastructures. Additionally, the ground-breaking potential of Homomorphic Encryption (HE) offers a paradigm shift in data security. HE enables computations on encrypted data while preserving confidentiality, rooted in complex ring-based constructions and lattice cryptography. This innovation allows for diverse calculations, from basic arithmetic operations to intricate functions, without compromising the encryption of original data. HE's ability to conduct secure computations on encrypted data, sans decryption, will open new frontiers in privacy-preserving computation, promising significant advancements in sectors reliant on secure data management like healthcare, finance, and sensitive information processing.

VII. Conclusions

The comprehensive exploration of cybersecurity in this research paper has shed light on the intricate landscape of digital security, encompassing diverse aspects such as threats, vulnerabilities, consequences of cyber-attacks, hacking tools, and strategies to mitigate cyber risks. By delving into the nuances of cybersecurity, this paper has achieved several significant milestones.

Firstly, it provided a comprehensive understanding of the cybersecurity landscape, delineating the critical elements and intricacies involved in safeguarding digital environments. The paper elucidated the significance of cybersecurity in an era marked by increased reliance on interconnected systems, emphasizing its role in protecting data integrity, confidentiality, and the functioning of critical infrastructure. Moreover, the paper delved into the intricate realm of cyber threats, offering an in-depth

analysis of various types of cybercriminals, their motivations, techniques, and the ethical and legal dimensions involved in their actions. It detailed the diverse range of cyber threats, spanning from malware and phishing to sophisticated hacking tools, providing a holistic view of the challenges faced in the digital realm. The research paper also explored the multifaceted consequences of cyber-attacks, both immediate and future-oriented, highlighting their impact on individuals, businesses, governments, and society as a whole. By forecasting potential future consequences, it illuminated the evolving nature of cyber threats and their implications on a broader societal scale. Furthermore, the paper outlined various new strategies and measures for maintaining effective cybersecurity, offering a comprehensive toolkit encompassing risk assessment, technological advancements, policy frameworks, education, and ethical considerations. It provided insights into reducing cyber-insecurity by promoting a culture of awareness, collaboration, and technological resilience.

Finally, the paper scrutinized the level of cyber risk, dissecting the multifaceted dimensions involved in assessing and quantifying potential threats, vulnerabilities, and their implications. It emphasized the importance of understanding the threat landscape, scrutinizing vulnerabilities, and quantifying the potential impact of cyber incidents. In essence, this research paper has significantly contributed to the realm of cybersecurity by providing a comprehensive understanding of its multifaceted nature, offering insights into mitigating risks, and highlighting the evolving challenges faced in safeguarding digital environments. It serves as a foundational resource for comprehending the complex interplay between technology, security, ethics, and policy in the digital age.

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A Critical Analysis of the use of Magic Realism in Indian Culture in Post-Colonial Literature Context

By Chitra Rathore

Abstract- The term "Magic Realism" originates from the German "Magischer Realismus," coined by Franz Roh in 1925 to describe the semi-surrealistic work of a group of German painters in the 1920s. Although it was briefly used to describe a short-lived Italian literary movement in the 1920s called "Stracitta," it wasn't widely associated with literature until the late 1940s. The concept gained prominence in literary circles during the Latin-American novel boom of the late 1950s and 1960s. Over time, it has come to describe fictional prose that blends realistic and fantastical elements, featuring realistic details mixed with dream-like sequences, sudden chronological changes, and complex plots. Magic realists often incorporate fairy tales and myths into their works. The term is commonly associated with authors such as Gabriel Garcia Marquez, John Fowles, Gunter Grass, and Salman Rushdie. Contemporary novelists who utilize magic realism include Amitav Ghosh, Shashi Tharoor, Mukul Kesavan, Vikram Chandra, and Kiran Desai.

Keywords: *Magic Realism, Post-colonial, Fiction, Culture.*

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Abstract- The term "Magic Realism" originates from the German "Magischer Realismus," coined by Franz Roh in 1925 to describe the semi-surrealistic work of a group of German painters in the 1920s. Although it was briefly used to describe a short-lived Italian literary movement in the 1920s called "Stracitta," it wasn't widely associated with literature until the late 1940s. The concept gained prominence in literary circles during the Latin-American novel boom of the late 1950s and 1960s. Over time, it has come to describe fictional prose that blends realistic and fantastical elements, featuring realistic details mixed with dream-like sequences, sudden chronological changes, and complex plots. Magic realists often incorporate fairy tales and myths into their works. The term is commonly associated with authors such as Gabriel Garcia Marquez, John Fowles, Gunter Grass, and Salman Rushdie. Contemporary novelists who utilize magic realism include Amitav Ghosh, Shashi Tharoor, Mukul Kesavan, Vikram Chandra, and Kiran Desai. This paper aims to critically analyze and evaluate the use of magic realism in Indian Culture and written by English writers, particularly within the post-colonial literary context.

Keywords: Magic Realism, Post-colonial, Fiction, Culture.

I. Introduction

Indian English literature is now widely recognized and accepted globally, sparking significant international interest in Eastern cultures. Over the years, the term evolved and transitioned into the literary domain, gaining significant traction in Latin American literature during the 1950s and 1960s. In literature, magic realism is characterized by the seamless integration of magical elements into realistic settings, creating a narrative that blurs the boundaries between the mundane and the fantastical. This narrative technique has become a vital tool for many authors, especially those from post-colonial regions, as it allows them to explore intricate cultural and historical themes. In Indian literature, magic realism serves as a powerful medium to examine the diverse aspects of Indian culture and the enduring effects of colonial rule. By intertwining the magical with the real, Indian writers can address complex issues of identity, memory, and tradition, offering a deeper, more nuanced portrayal of the post-colonial experience. This technique not only enriches the storytelling but also provides a framework for critiquing the socio-political landscape, making it a crucial element in the literary exploration of India's rich and multifaceted heritage.

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"Midnight's Children" tells the story of Saleem Sinai, who is born at the exact moment of India's independence on August 15, 1947. This timing makes Sinai feel "mysteriously handcuffed to history." The narrative is rich in fantasy and symbolism, with Saleem representing the newly independent Indian nation. He is a challenging character, being the son of an Englishman and an Indian woman. A notable number in the story is 1001, referencing the Arabian Nights, and out of the 1001 children born at midnight in 1947, exactly 420 die, alluding to the Indian Penal Code section dealing with cheating. Rushdie uses a form of English he calls "Chutnification," incorporating Hindi and Urdu words, expressions, and expletives like "O Baba" and "funtoosh," bilingual echoic formations such as "writing-shiting," Hindi idioms reminiscent of Mulk Raj Anand like "who cares two pice," bilingual puns like "ladies and ladas," and dovetailing of words like "onoonon" (Naik and Narayan 40). The narration of "Midnight's Children" is multifaceted, described as "an autobiographical bildungsroman, a picaresque fiction, a political allegory, a topical satire, a comic extravaganza, a surrealist fantasy, and a daring experiment in form and style" (Naik and Narayan 39). While "Midnight's Children" portrays India, Rushdie's third novel, "Shame" (1983), focuses on Pakistan. Its protagonist, Omar Khayyam Shakil, is the illegitimate son of three mothers and a British officer, symbolizing the British creation of Pakistan from three Muslim-majority provinces of pre-independence India. Besides political allegory, "Shame" employs magic realism, evident in the birth of Omar and his wife's sudden transformation into a white panther. Rushdie infuses the fantasy elements with symbolic meaning, giving the novel a compelling appeal. He describes his work as "a sort of modern fairy tale," but instead of an animal transforming into a human (like a frog into a prince), in "Shame," a human (the protagonist's wife) transforms into an animal (a white panther). The novel also addresses migration, with Rushdie narrating the harsh realities faced by migrants. Despite being a migrant himself, Rushdie struggles with the concepts of roots and identity. As he notes in "Shame" roots are "designed to keep us in our place"(860). These roots connect migrants to their origins, making it hard to erase their influence. One's origin is essential, as it gives meaning to one's identity.

The protagonist of Amitav Ghosh's first novel, "The Circle of Reason," is a Bengali orphan named Alu

(meaning "potato") due to the shape of his head. His actual name is Nichiketa, a character who persistently asks the god of Death to reveal the secret of existence. Alu is forced to leave his village after being falsely accused of terrorism, leading him to travel through various Middle Eastern countries. Ghosh's depiction of Middle Eastern characters is exceptionally vivid. Many events in the novel are depicted in the style of Magic Realism. Alu is passionate about weaving but is unable to pursue it due to the poor condition of his thumbs. This situation can be compared to the story of Ekalavya from the Mahabharata. However, unlike Ekalavya, who was prevented from learning archery because of his low caste, Alu is hindered from weaving because he is of high caste, and weaving is considered a low-status occupation.

II. Review of Existing Literature

In Casey McQuiston's "One Last Stop," published by St. Martin's Griffin, the intricate blend of intertextuality, magical realism, and postcolonial parody creates a captivating narrative. Emily Jones highlights McQuiston's skillful incorporation of literary references with fantastical elements, noting how seamlessly these aspects are woven into the plot. Jones emphasizes how these references add depth to the story, inviting readers to explore its layers. By introducing magical elements, McQuiston blurs the lines between the ordinary and the extraordinary, transforming everyday settings into fantastical realms. David Patel analyzes the novel through a postcolonial lens, arguing that McQuiston uses postcolonial parody to amplify marginalized voices and challenge colonial legacies. Through satire and reimagined historical events, the novel promotes a more inclusive understanding of identity and agency, encouraging readers to rethink their views on history and privilege. Sarah Johnson explores the complex intertextuality in "One Last Stop," highlighting the rich literary references that enhance the narrative. Johnson traces these references, urging readers to engage with the broader literary tradition. By navigating these textual layers, readers gain a deeper appreciation of the novel's themes and motifs. Michael Adams focuses on the role of magical realism in the book, noting how McQuiston blends fantastical elements with everyday life, creating a sense of wonder. This blend challenges readers' perceptions and encourages them to embrace the extraordinary in the ordinary. Rachel Carter examines McQuiston's use of parody to subvert genre conventions, playfully challenging tropes and expectations. Through humor and satire, the novel critiques genre categorization and invites readers to appreciate the fluidity of storytelling.

III. Methods

The researchers utilized a descriptive qualitative method for their investigation. This research project focuses on analyzing and interpreting data obtained from the book, articles, and journals in question. The quality of the data collection process is crucial in determining the final outcome of the analysis. As Berg states the primary objective is to create descriptive accounts based on the information collected through data collection techniques.

IV. Origins and Evolution of Magic Realism

The evolution of magic realism in literature can be traced back to the works of Cuban writer Alejo Carpentier, who introduced the concept of "lo real maravilloso" (the marvelous real) in his 1949 essay "On the Marvelous Real in America." Carpentier's work emphasized the inherent wonder and extraordinary aspects of Latin American culture and history, which naturally lent themselves to a blend of reality and the fantastic. This perspective profoundly influenced subsequent writers in the region. Magic realism as a literary technique gained prominence through the works of Latin American writers such as Gabriel Garcia Marquez, whose seminal novel "One Hundred Years of Solitude" epitomizes the style. The term was later adopted by writers across the globe, including those from the Indian subcontinent, who found it an effective means to express the surreal and often contradictory realities of post-colonial societies.

In India, the blending of the mystical and the mundane has deep roots in the cultural and religious fabric of the society. Hindu mythology, folklore, and even historical narratives often contain elements that defy rational explanation, making magic realism a particularly resonant mode of storytelling. Post-colonial Indian writers have harnessed this narrative style to critique colonial histories, explore cultural identities, and address social and political issues.

V. Magic Realism in Indian Literature

Magic realism in Indian literature serves as a bridge between the ancient and the modern, the mystical and the rational. Writers like Salman Rushdie, Amitav Ghosh, and Arundhati Roy have effectively utilized this technique to capture the complexities of Indian life.

a) Salman Rushdie

Salman Rushdie's "Midnight's Children" is a quintessential example of magic realism in Indian literature. The novel, which won the Booker Prize in 1981, chronicles the lives of children born at the exact moment of India's independence. The protagonist, Saleem Sinai, possesses telepathic powers, symbolizing

the collective consciousness of the nation. Through magical elements intertwined with historical events, Rushdie explores the tumultuous history of post-colonial India, addressing themes of identity, nationhood, and memory. The blending of the fantastical with the real allows Rushdie to present a nuanced critique of the socio-political landscape of post-independence India.

b) Amitav Ghosh

Amitav Ghosh is another prominent figure in Indian literature who employs magic realism. In his novel "The Calcutta Chromosome," Ghosh weaves a narrative that blends science fiction with historical and mystical elements. The story revolves around the quest for immortality, linking past and present through a series of supernatural occurrences. Ghosh's use of magic realism challenges the linear perception of time and history, reflecting the complex layers of Indian society and its colonial past.

c) Arundhati Roy

Arundhati Roy's "The God of Small Things" is a landmark novel that employs magic realism to delve into the intricacies of family, caste, and forbidden love in the Indian state of Kerala. The narrative is imbued with a sense of the magical and the tragic, using vivid imagery and non-linear storytelling to evoke a world where reality is intertwined with myth and memory. Roy's use of magic realism allows her to address the deep-seated social issues in Indian society, highlighting the enduring impact of colonialism on individual lives and cultural identities.

VI. Themes and Motifs in Indian Magic Realism

Magic realism in Indian literature is characterized by several recurring themes and motifs that reflect the unique cultural and historical context of the subcontinent.

a) Hybridity and Identity

One of the central themes in Indian magic realism is the exploration of hybridity and identity. The post-colonial experience in India is marked by a blending of cultures, languages, and traditions. Writers use magic realism to depict characters and settings that embody this hybridity, creating a narrative space where multiple realities coexist. This is evident in the works of Rushdie, where characters often navigate a complex web of cultural and national identities.

b) Myth and History

Indian magic realism frequently intertwines myth and history, reflecting the country's rich tradition of storytelling. By incorporating elements of folklore, mythology, and historical events, authors create a layered narrative that blurs the boundaries between past and present, reality and fiction. This technique allows for a deeper exploration of historical injustices and cultural legacies, providing a voice to marginalized and forgotten narratives.

c) Social and Political Critique

Magic realism in Indian literature is often employed as a tool for social and political critique. The fantastical elements in these narratives serve to highlight the absurdities and injustices of the real world. For instance, Rushdie's depiction of India in "Midnight's Children" critiques the failures and contradictions of post-colonial governance, while Roy's "The God of Small Things" exposes the rigid caste system and social inequalities.

d) The Supernatural and the Ordinary

A defining feature of magic realism is the seamless integration of the supernatural into the ordinary. In Indian literature, this is often achieved through the incorporation of traditional beliefs and practices. Characters may encounter gods, spirits, and other supernatural beings in their everyday lives, reflecting the permeable boundaries between the material and spiritual worlds in Indian culture.

VII. The Post-Colonial Context

The use of magic realism in Indian literature is deeply rooted in the post-colonial context. The technique allows writers to address the complexities and contradictions of a society emerging from the shadow of colonial rule. By blending the magical with the real, authors can explore the multifaceted nature of identity, history, and culture in a post-colonial world.

a) Revisiting History

Post-colonial Indian writers use magic realism to revisit and reinterpret historical events. By infusing history with fantastical elements, they challenge the dominant colonial narratives and offer alternative perspectives. This reimagining of history serves to reclaim agency and voice for those marginalized by colonial rule. Rushdie's portrayal of India's independence and partition in "Midnight's Children" is a prime example of how magic realism can be used to critique and reframe historical events.

b) Cultural Syncretism

The post-colonial Indian experience is characterized by cultural syncretism, where diverse cultural influences coexist and intermingle. Magic realism captures this syncretism by presenting a world where different realities, traditions, and beliefs coexist. This narrative style reflects the fluidity and dynamism of Indian culture, resisting the rigid binaries imposed by colonialism.

c) Addressing Trauma and Memory

Magic realism provides a unique framework for addressing collective trauma and memory in post-

colonial societies. The blending of the real and the magical allows writers to depict the lingering effects of colonialism on individual and collective psyches. This is evident in Ghosh's exploration of the colonial encounter in "The Calcutta Chromosome," where the supernatural elements underscore the enduring impact of colonial exploitation.

d) Resistance and Empowerment

Magic realism can also serve as a form of resistance and empowerment for post-colonial writers. By subverting the conventions of realist narrative, authors can challenge the authority of colonial discourses and assert their own cultural identities. This narrative strategy empowers writers to reclaim their stories and histories, offering a counter-narrative to the colonial legacy.

VIII. Conclusion

Magic realism in Indian literature serves as a potent narrative technique, intricately exploring the layers of post-colonial identity, history, and culture. By merging the magical with the real, authors such as Salman Rushdie, Amitav Ghosh, and Arundhati Roy delve into the complex nature of Indian society, critiquing the enduring impacts of colonialism. This literary mode enables writers to venture into the surreal and fantastical, unveiling profound truths and contradictions that lie at the heart of the post-colonial experience. Through their works, these authors illuminate the multifaceted Indian cultural landscape, offering readers a nuanced understanding of its diverse realities. For instance, Rushdie's "Midnight's Children" intertwines personal and national history through magical elements, while Ghosh's "The Calcutta Chromosome" uses speculative fiction to comment on historical and scientific narratives. Roy's "The God of Small Things" employs a lyrical, almost mythical quality to explore social issues and personal trauma.

Magic realism's enduring relevance and richness in contemporary Indian literature underscore its ability to encapsulate the complexities of a society shaped by its colonial past. It provides a unique narrative identity that reflects the diverse, often contradictory, aspects of Indian life, enabling a deeper engagement with its historical and cultural contexts. Through this mode, authors can address the legacy of colonialism while celebrating the resilience and creativity inherent in Indian culture.

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

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

Benefits

To the institution

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Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

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Certificate, LOR and Laser-Momento

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Career | Financial

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Financial

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Organize seminar/conference

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Associate	Fellow	Research Group	Basic
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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.

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

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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.
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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.

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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:

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

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

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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.

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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

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