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

Global Journal

of Computer Science and Technology: D

Neural & AI

Propagation Neural Network

Schedulers Operating Systems

Highlights

Unconstrained Arabic Scene

Distributed Mobility and Elements

Discovering Thoughts, Inventing Future

VOLUME 19 ISSUE 1 VERSION 1.0

Global Journal of Computer Science and Technology: D
Neural & Artificial Intelligence

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Volume 19 Issue 1 (Ver. 1.0)

Open Association of Research Society

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Contents of the Issue

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

Industry 4.0 – Robots with Distributed Mobility and Elements of AI

By D. Avishay, V. Pavlov, G. Pavlova, B. Petrov & N. Dimitrov

Abstract- Robots artificial intelligence elements, which are a product and means of the Fourth Industrial Revolution, are a factor in the future development of the world's society. The present article proposes building a strategy for the future development of robotics by laying the principle of appropriately distributed mobility and functionality based and corresponding artificial intelligence. This principle corresponds to the millennial history of the Earth living beings evolution. The autors introduce new concepts such as kinematic, technological (professional) and structural-functional intelligence. It analyzes the connectivity of the internet, cyber-physical systems. There are three approaches proposed for design development: biological, engineering (industrial) and hybrid.

GJCST-D Classification: *I.2.9*

Strictly as per the compliance and regulations of:

Industry 4.0 – Robots with Distributed Mobility and Elements of AI

D. Avishay [α], V. Pavlov [σ], G. Pavlova [ρ], B. Petrov [ω] & N. Dimitrov [¥]

Abstract- **Robots artificial intelligence elements, which are a product and means of the Fourth Industrial Revolution, are a factor in the future development of the world's society. The present article proposes building a strategy for the future development of robotics by laying the principle of appropriately distributed mobility and functionality based and corresponding artificial intelligence. This principle corresponds to the millennial history of the Earth living beings evolution. The autors introduce new concepts such as kinematic, technological (professional) and structural-functional intelligence. It analyzes the connectivity of the internet, cyber-physical systems. There are three approaches proposed for design development: biological, engineering (industrial) and hybrid.**

I. Introduction

The many traits characterize the Fourth Industrial Revolution. The most significant of them is the massive transfer of intellectual activity and decision making toward the information systems. "Machine to Machine" communication (M2M) becomes increasingly desirable. Humans reduce their physical and mental activity in the industry. Most functions of the man are monitoring, logistic and maintenance activities, as well as high-level management [1, 2]. In this connection, the global network represented by the Internet of Things (IoT) plays a significant role. The global wireless network allows "smart" devices to connect to each other and be remotely controlled by a set of rules beforehand installed into a controller. Another significant feature of the Fourth Industrial Revolution (Industry 4.0) is the structural and functional flexibility of production, which contributes the collaborative work of robots with Humans in one job (work position). This collaboration also increases the flexibility in organizing the technological sequence in production.

The robot is one of the tools that support human activity in the modern industry inside of it (implementation of the auxiliary, technological and transport operations) and outside of it (investigation of the surrounding environment, space research, medicine, military action, etc.). If we consider the robot as "smart" device and make an analogy between robot and human brain, then only the short-term memory will remain in the robot's physical body, and the contextual dependence of memory and long-lasting memory itself will be exported to a cloud environment. The short memory will provide the robot's functionality, its collaboration, and continuation of the operation in case of a longer cut off of the cloud services. The more "intelligent" the robot is concerning its decision capabilities, the more cloud power will be needed to perform complex computational tasks such as image processing, voice recognition, data comparison and making high latency decisions. Information about current states of the system obtained by various sensors needs to be saved in the cloud continuously. The unified system controls the rational application of a certain logic and how to use the reserves with greater precision. Cyber-Physical Systems (CPS) play a significant role in this direction. Although these generalized activities are exported „out“ of the objects, robots need sufficient movement and intelligent behavior to perform their functional tasks qualitatively.

The question arises on how to create a robot that meets these conditions and has sufficient kinematic, communicative and intellectual capabilities. Nature, in that perspective, is an inexhaustible source from which humankind has gained experience and knowledge for its development. It is entirely possible that the principles sought are set in the organs and actions of humans and animals. For a person, the presence of (natural) intellect to a different degree is acceptable. In other living beings, even at the lowest level, functions like nutrition, survival and reproduction, are ensured by the necessary intellect level. Copying of Nature is a direction for the development of Biological Inspired Robots, whose achievements at this point are modest, both in terms of kinematic and intellectual capabilities.

The movement is an important factor for biological individuals in search of food and survival. The control of kinematic and dynamic movement is enshrined in robotics before the advent of the microprocessor control (electronic age of robotics), of course with insufficient quantity and quality. The second characteristic – intellect in technique could be replaced by artificial intelligence (AI), and it has significant achievements but is still not enough developed. It is noteworthy that the blasts of its application exceed the needs of robotics (R). The third component - "nutrition" - in the technique corresponds to the energy and the means for its transformation. For now, robotics rely heavily on electric one.

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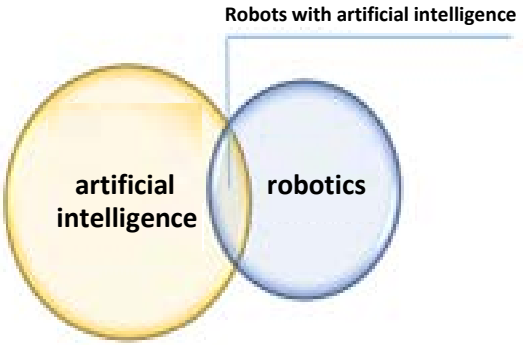
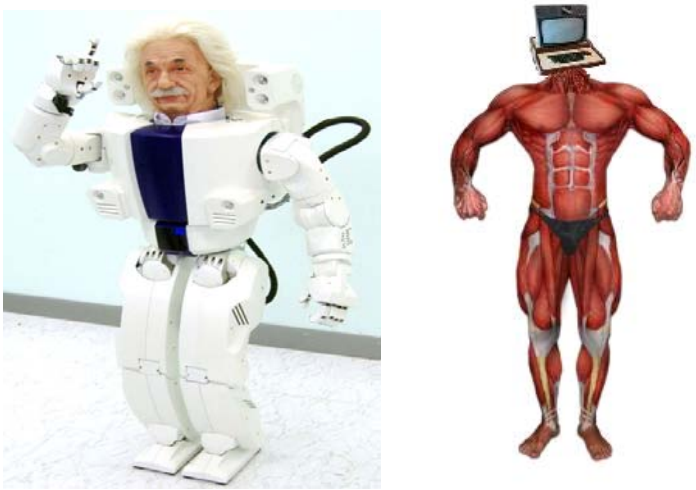


Fig. 1: Integration between artificial intelligence and robotics

Artificial intelligence is a broad concept and is used to solve a wide range of tasks. Robots, as a product and means of production, also perform a wide range of tasks with the necessary and sufficient requirements without the necessity of thinking and reasoning. The robot performs its task at the level of the intellect of the programming person with the constraints of a machine. It is not necessary everywhere and for all the robots to have "intelligence" to perform their tasks properly in production conditions. In Fig. 1 is shown the cross-section AI and R.

The section 'robots with artificial intelligence' is not homogenous. There is diversity in the combination of kinematic possibilities and intellect. This is clearly illustrated in living nature, but there are some examples in the industry. Figure 2 ilustrates the border situations of integration between kinematic capabilities and AI. A very limited in kinematic abilities robot is equipped with an extremely intellectual "head" (Fig. 2a) [8]. A counter solution (Fig. 2b) is a body with high mobility and aesthetic appearance with a primitive computer illustrating low intellect. Obviously, at this stage, it is impossible and inappropriate to fully seek a complete engineering analogy with the biological. The question of modern robot design is to find out how many and how to allocate the degrees of freedom (active and passive) and according to the functional purpose to determine the necessary intellect. This approach excludes robots from fundamental research.



(a) (b)

Fig. 2: Nonconformity of integration between intlligence and motion avilities

a) Limited „mechanics "with super intelligence
b) Super „mechanics "with slimited intelligence

II. The Robot – Product and Means of Industry 4.0.

In science fiction novels (Karel Chapek, Isaac Asimov, etc.) the robot is described as a mean which replaces the man in hard and unattractive work (iron man). Of course, there have been other fantasies, but robotics would not get its prosperity unless it becomes an effective means of production. Even the first industrial applications of intelligent robots (UNIMATE, 1962, VERZATRAN, 1964) reveal the great possibilities of production automation. It is primarily due to the flexibility

provided by microprocessor control. According to the authors of this study, this is defined as an "electronic era" in robotics. Very soon the robots ware applied in many other fields - medicine (surgery, rehabilitation, prosthesis), space and ocean exploration, military and police activities, etc.

All these robots carry the features of industrial ones, which do manipulations with material objects in a given place and move men to it. Industry robots, stationary or mobile, also require new abilities concerning motion as well as management and behavior capabilites. Robotic industries and robotic technologies give a new look to the industry. Logically, all the advances in engineering and technology at a current stage reflect in the robot's qualities, as they are an industrial product that integrates top scientific achievements. That is why a robot is a machine that looks for new, more rational tasks and ways for their intelligent performing.

In fact Industry 4.0 will change not only the production itself but also the products part of which are the robots, both for industrial and research applications. Those advanced machines can help companies accelerate the digital transformation needed to improve their productivity, innovation and quality by consistently lowering the operation and production costs. The new Industrial revolution relies highly on the digital connectivity between objects in the production plant and so-called digital twins. Those digital avatars and models will help design better and intelligent products, simulate their behavior prior production and analyze their lifecycle in a much more predictive manner. Data-driven design approach and the connectivity of the product with the manufacturer through its lifecycle will make the foundation of those insights the digital factories will consist of machines, robots and sensors so interconnected that they could “feel/predict” the future bottlenecks and failures. This is where the Internet of Things in manufacturing comes in place. The information generated by those interconnected devices will lead to a huge amount of data (Big Data) which should and must be managed.

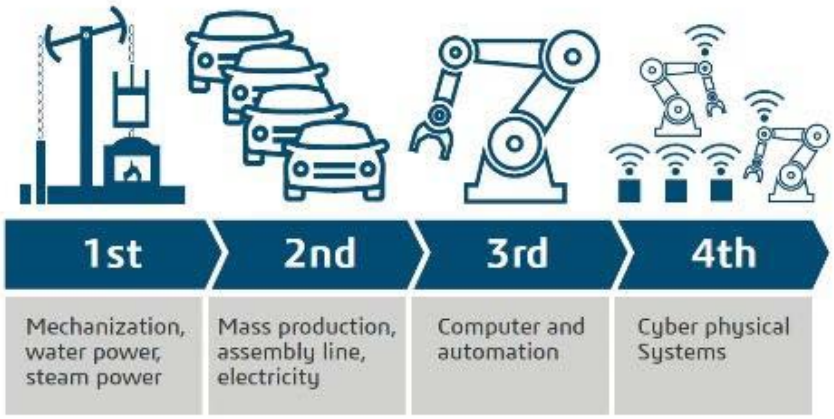


Fig. 3: Key technologies representing the industrial revolutions [9]

Based on the above-said robots will not only be part of the new industrial revolution but also they will be better in every aspect. Their design, connectivity, quality, processing and sensing will supersede everything so far because of the implementation of new technologies every day. The most interesting idea is that their intelligence will be adaptive based on the environment.

III. Robots with Elements of Artificial Intelligence

The integration between two relatively autonomous and dynamically developing areas - robotics and artificial intelligence, provokes new qualities and possibilities for application of robotised systems in production [3]. The role of the artificial intelligence in information processing and making adequate decisions from the robot's "sensory organs" (engineering analogs of the biologic species - vision, hearing, speech, smell, etc.), is especially crucial. Due to this integration will be created "thinking (smart)" robots, analogs of human [4,5] or other living beings.

The robots perform technological, support and transport operations in the industry, and that is why the requirements for intelligent behavior are limited. Together with the technological machinery, equipment, and other auxiliary equipment, they form the structural building of a production, which is subordinate to the type of organization, functional requirements for productivity and quality of the produced product. Three are qualities that distinguish industrial robots with artificial intelligence from conventional ones. They possess kinematic (intelligent movement), technological (intelligent action) and structural and functional (collaborative) intellect.

Therefore, hardware and software are needful for artificial intelligence at this stage for: robots movement (mostly auxiliary operations) with the necessary "kinematic intelligence" that optimizes movement in terms of the basic kinematic parameters -

position, trajectory, velocity, acceleration and makes possible a Collaborative Work between robots, as well as between robots and people at one workplace without conflict situations. Robots which perform technological operations (welding, painting, cutting, etc.) must have "technological intelligence", i.e., to have the possibility to change their behavior with acceptable deviations in the technological conditions to keep the quality. In practice, the possibility of cognitive mutuality in the production of technological or auxiliary operations is stimulated. These capabilities allow concentration of operations at one workstation and this way the workspace could become smaller and transport time could be reduced, resulting in increased productivity and quality improvement. Kinematic Intelligence primarily associates with the use of "knowledge base". The task is solvable with the proper training of the robots and the people who will work together.

Development of robots with artificial intelligence, at the present stage, is characterized by one principle - "the more, so much more", i.e., more degrees of freedom and greater possibilities of artificial intelligence. However, the creation of a "super robot" that is applicable everywhere and for everything is not expedient and even is less effective.

IV. Robots with Appropriately Distributed Mobility and Corresponding Intelligence

a) Biological approach for robot design (Biological Inspired Robots)

Nature has created a wide variety of mobile creatures with great opportunities to move in an undefined environment on the surface of the earth, with the ability to overcome barriers of different character and location. The complete movement on the surface of the ground with the ability to overcome obstacles can achieve by a sufficient number and appropriately located controllable and passive (not controllable) degrees of freedom in the body. Such examples in nature are snakes and worms. The other extreme is the realization of complete movement through a sufficient number of limbs (feet) with necessary degrees of freedom, and the body is rigid (stationary) that does not change its shape during the movement. There are many examples of insects, turtles, and so on.

The most widespread in the living environment are the cases when the mobile creatures have mobility in the body that favors control behavior during the movement, overcoming and obstructing obstacles. The distribution of degrees of freedom between the body and extremities is biologically resolved in terms of the number, the location of the axes, the type of joints as well as concerning the functions of the relative displacement values. Here it is essential to pay attention to the spine and its extension (neck, tail), to the ends of the legs - grasping parts of the hands, foot of the feet. In these places are concentrated a large number of degrees of freedom (active and passive), specific joints and vertebrae, driving schemas, and use other features, but in modern robotics they are limited.

In the mobile robotics, the problem of the total number of degrees of freedom and their distribution between body and legs at this stage has no reasoned and functionally motivated solution. There is evidence of a minimum number of degrees of freedom for full movement in terms of the trajectory (geometry) of the displacement. The minimum number of active degrees of freedom is a prerequisite for the maximum energy efficiency of the robot in the currently used motor devices. The future development cannot be done only in this direction, as functional requirements are increasing.

But in the nearest future, it could not be possible to develop an algorithm that uniquely determines the total number of degrees of freedom of the robot and the way of their distribution between the body and the legs. For now, it is clear that the introduction of biological analogies should be functionally justified, while this can remain a subject of interest for research projects.

Another is the issue when it comes to the prosthesis. The achievements of robotics in prosthesis are not only for limbs and joints but also for other human organs.

b) Engineering (industrial) approach to design robots

This approach could be summed up as a search for a solution to perform one or a group of functional tasks with minimal but sufficient kinematic and intellectual capabilities which, under the same conditions, ensure low cost, energy consumption, reliability, and easy maintenance. It is known that the technique uses wheels, chains, cylindrical hinges and linear joints that have proven properties and have no analogs in animals. They are successfully applied to stationary and mobile robots. Wheels, chains, cylindrical hinges and linear joints, that have proven properties and do not have analog in animals, are successfully applied to stationary and mobile robots.

For industrial stationary robots, simple rotational and translational movements are used, which could be realized respectively in cylindrical and prismatic joints. The number and mutual arrangement of the axes are determined by the principles of complete translation and orientation of the manipulated objects. It is well known that three elementary moves are necessary for complete replacement and its combinations are: RRR, RRT, RTR, TRR, RTT, TRT, TTR, and TTT (R-rotation, T-linear translation).

Orientation is most often done by three rotations but replacing one of them with a translation for entering details into machine gripping devices. The use of more than six manageable degrees of freedom is related to

serving more than one workstation and/or enhancing obstruction abilities. Wide is the number and combinations in capturing matte objects that are the ultimate effector of this class of robots. They range from one (a range of specialized grippers) to those of the human gripper (not only interesting for robots but also prosthetics).

Spherical hinges, knee and scissors are successfully fabricated and applied in prosthetics but are not used in robots yet, due to the difficult drive and control of a group of axles by conventional engines.

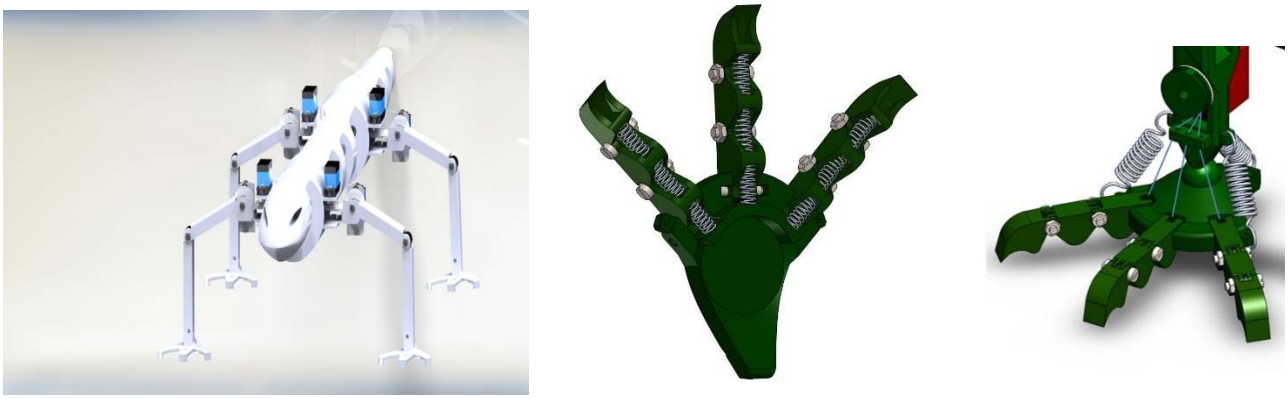
Using 3D technologies to create non-disassembled joints close to those of biological ones using two-component materials - one with a low friction coefficient - a cartilage analog and another one with high mechanical strength - a bone analogue will probably achieve significant novel results. The printing also allows execution as an assembled unit without using of additional fasteners. If applicable, individual vertebrae for operative replacement could be used. For robots, significant changes will occur when this technology combines with artificial muscles.

c) A hybrid approach

This design approach is applied nowadays but limited. And now, the industrial robotics searches for analogies with the human hands, and the walking robots - with legs of humans and other animals, but there is still more differences than a similarity to the original. The differences are many, but the most important of them is that the robots have a significantly smaller number of degrees of freedom. Today's design capabilities are compelled at every degree of freedom to provide the necessary drive (electric motors, power cylinders transmissions), which leads to a series of unfavorable problems.

A substantial reserve in this direction is in the combination of active (derived from controllable motors) and passive (translations caused by external force factors, most often realized through elastic deformations) degrees of freedom. The dependable movements, when one engine moves two or more units with a predefined ratio of the displacement, are also a reserve of increased mobility with a smaller number of motors.

One example [6], [7] of combining active and passive degrees of freedom into a lizard analog robot (Fig. 4.a) shows satisfactory results. The vertebral column has five vertebrae, the tail - three and the neck – two and each of them allows 4+2 (a little move along the horizontal axis and a little rotation along the vertical axis) 6 degrees of freedom. Passive movements caused by surface unevenness are realized at the expense of spring deformations, and the active movements (spine, tail and neck rotation relative to a vertical axis to realise a curve corresponding to the gait) are obtained from a controllable motor, located in the pelvis belt using threaded/wire mechanisms.



(a) (b)

Fig. 4: Mobile robot a lizard analog

a) general view b) adaptive foot

Each of the legs (Fig. 4.b) has two controllable and one dependable degree of freedom. The feet are connected to the last unit of the leg by a spherical joint and springs, and the three fingers have three cylindrical hinges that have a defined position by the springs. When the robot moves in uneven terrain they adapt to it, by improving the contact through a driven motor and wire mechanisms operating the motion of each of the "fingers".

Most of the details are made by 3D printing, which allows for much free of constraints design approach, although the elementary base (motors, springs, wire mechanisms, etc.) impose engineering design conditions and constraints. The application and development of the 3D technology and the specific element base for robots will be resulting in the creation of much more realistic biomimetic robots which will lead to changes in the design and engineering techniques.

V. Conclusion

The word robot begins to cover its true content, externally to look like to its prototype (human, animal, bird, etc.) and has the qualities to perceive, analyze and act according to the terms of reference and the specific conditions. External features are a product of development of technology and elementary basis, and behavior is formed by adequate discernment of the environment by methods and means of artificial intelligence. An essential milestone for effective development is the metering of the need for movement and intelligent behavior in performing certain tasks. Overdose of any of the two movements or intellect leads to low efficiency for the industry. Searching for the best match must be the basic rule for the development of science-applied projects.

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

Sub-Sampling Approach for Unconstrained Arabic Scene Text Analysis by Implicit Segmentation based Deep Learning Classifier

By Saad Bin Ahmed, Zainab Malik, Muhammad Imran Razzak & Rubiyah Yusof

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Abstract- The text extraction from the natural scene image is still a cumbersome task to perform. This paper presents a novel contribution and suggests the solution for cursive scene text analysis notably recognition of Arabic scene text appeared in the unconstrained environment. The hierarchical sub-sampling technique is adapted to investigate the potential through sub-sampling the window size of the given scene text sample. The deep learning architecture is presented by considering the complexity of the Arabic script. The conducted experiments present 96.81% accuracy at the character level. The comparison of the Arabic scene text with handwritten and printed data is outlined as well.

Keywords: *sub sampling, MDLSTM, deep learning, Implicit segmentation, unconstraint.*

GJCST-D Classification: *I.2.6*

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Keywords: sub sampling, MDLSTM, deep learning, Implicit segmentation, unconstraint.

I. Introduction

The research on unconstrained scene text recognition is gaining momentum for few years. The text separation always been a cumbersome task because the presence of other objects in an image. Although text provides information and guide in a situation having strange environment. It is essential to investigate about nature of a text appeared in a scene image so that it may provide meaning for someone. But the unconstrained scripts like the Arabic poses a huge challenge to deal with the complexities of language itself in the presence of other image degrading properties. The normal way to tackle with the problem of Arabic scene text classification, we usually disintegrate the part of an image into smaller units and investigate each one individually. Each Arabic character has four variations concerning its position appeared in a word i.e., a character can appear in isolation, at first, middle or at last position in a word. To overcome these implicit challenges, there are numerous techniques proposed recently [1, 5, 7, 8], which presented various feature extraction or classification techniques.

The nature of unconstrained Arabic script prompt researchers to suggest implicit segmentation approaches to deal with the complexity of under discussion script. To deal with the representation of the same character appears to be extreme difficult task to address. In this way, manual segmentation also proves to be a laborious work. We are looking for such type of solutions which proved good results on cursive scripts. This particular complexity of Arabic script prompts to suggest implicit segmentation techniques. The other important aspect of cursive scripts is to consider the context. In Arabic every character appearance depends on the previous character, in this way learning the context of current character is crucial. There are some solutions suggested by recent research to tackle with the variability of characters with context learning approaches as proposed in [9, 10, 11]. The most prominent context learning approach specifically used for unconstrained cursive text research is Long Short Term Memory (LSTM) networks [4].

By keeping in view the complexity associated with the cursive script, it is assumed that if scene image disintegrates into smaller parts then consider their feature values individually and assemble them together in one unit before applying the language model. For the cursive script like Arabic we require more detailed features of given patterns so that we may scrutinize and learn the pattern. Therefore, there is a need to look for such classification model which does not only learns the patterns from right to left or left to right but also from top to bottom and bottom to top. To address the problem above, this paper is proposing an adapted Multidimensional Long Short Term Memory (MDLSTM) networks [12]. The implicit segmentation approaches are more accurate and less error prone in comparison to those approaches defined explicitly. The parts of a given image are considered by the convolutional neural network (ConvNets) using implicit segmentation approach. As nature of ConvNets make it as instance learner, but there is a need to learn the context of a given sample in this way history of learned pattern play a role. Therefore, this paper is proposing deep learn- ing MDLSTM network because of its strong ability to learn sequence-based on the context. The Connectionist Temporal Classification (CTC) is used as a probabilistic model to map the learned sequences against corresponding ground truth [13]. By using CTC, explicit segmentation and modeling language is avoided. The performance of proposed MDLSTM network architecture is evaluated on Arabic scene text images. The EASTR-

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42k dataset used for proposed work which covers various aspects of scene text images. The dataset contains 14, 000 segmented Arabic scene text images.

Arabic like languages share the same writing style i.e., from right to left. Arabic like scripts categorized into two forms i.e., joiner and non-joiner. The characters that appear as a joiner may join predecessor or successor character in a word, its mean these characters can appear as first, middle or at final position in a word. Whereas, non-joiner characters may appear in isolation or as the last character in a ligature. As mentioned earlier every character has option to appear on any of the four locations i.e., initial, middle, final or an isolated position. As far as Arabic scene text is concerned, it is relatively difficult to deal with the complexity of joined and non-joined characters. In camera captured text images, there are other numerous factors to concentrate on so that we may extract the text with high precision. There are numerous factors like illumination, an angle of a text, font size, appearance and clarity of a text pose a challenge for researchers to recognize Arabic scene text.

II. Related Work

There are various feature extraction and classification approaches has been proposed for detection and recognition of Latin and cursive scripts like Chinese in natural scene images [6, 14, 15]. The text in natural scene images not only represent the pattern information but also it exhibits semantic information which shows some meaning in real applications. This paper is presenting unconstrained character recognition in natural images having Arabic text in focus. By reviewing recent year's research, there is an impression that not enough work has been presented on Arabic text recognition in natural scene images. Although some substantial work have been reported which we summarized in this section.

One of the recent work on Arabic scene text is represented by [16]. They proposed Convolutional Recurrent Neural Network (CRNN) approach to evaluate the performance of their own gathered dataset and two publicly available video text datasets i.e., ALIF [17] and ACTIV [18]. They gathered 500 Arabic word images appeared in natural images. They categorized their experiments into character, word and line recognition. They reported very good accuracy on screen rendered video text datasets. The achieved 98.17% on character recognition, 79.67% accuracy on word recognition and 67.08% line recognition accuracy while on their own gathered dataset they achieved 69.55% and 39.25% accuracy on character and word recognition respectively.

Another paper on deep learning based isolated Arabic scene character recognition is presented by [7]. They proposed deep convolutional neural net- work (ConvNets) architecture for recognition of Arabic characters appears in natural scene images. The features extraction and classification were per- formed through ConvNets. As there is not any benchmark dataset available for Arabic text in natural images they prepared dataset by their own which covers approximately every variation of each character. The experimental settings were empirically adjusted on 3 x 3 and 5 x 5 filter size with learning rate 0.5 and 0.005 by keeping the stride value 1 and 2. They identified 27 classes and save each character image with five orientations in different angles. In this way they identified 2450 images as the train set while 250 character images were used to evaluate the performance of their proposed algorithm. They reported 0.15% error rate on their proposed architecture.

The Arabic scene text dataset is proposed by [3]. They collected free Arabic text appeared in an unconstrained environment. They clicked 364 images having Arabic text. The images were segmented into 1280 cropped words. They also segmented acquired Arabic text into 374 characters. The major drawback of their proposed dataset is lack of applicability details.

The recent work on recognition and establishing a connection of moving Arabic text appeared in the video is presented by [19]. They developed dedicated OCR for the purpose to recognize low-resolution news captions in video images. They prepared dataset from Aljazeera news programs. They used connection method approach based on insertion operation, voting processing and substitution using minimum likelihood edit distance between two successive news frames for the purpose to connect text. Their proposed method is for automatic language translation and also helpful in reducing OCR errors caused by truncated characters. Their dataset was disintegrated into the train and the test set by using 453 video frames. They reported 96.78% accuracy through f-measure using bi-gram sequence.

III. Learning Architecture

a) Feature Extraction by ConvNets

The natural images have characteristics of representing the image details at the same level, meaning that representation of text in a natural image would seems at the same energy level as the other objects in an image. As we are dealing with text specifically so we were looking such a technique by which we can focus on text only in a natural image. The arbitrary size of

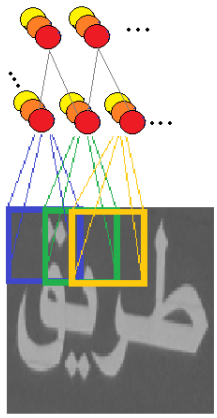


Figure 1: Convolutional Feature extraction

an input image is taken into account and normalized it with fixed 150 150 pixel size by considering the aspect ratio according to the image size. After that image is converted into gray scale. The 8 8 window is used to detect features of an image and make a feature map. This helps in considering each part of an image and focused on most relevant features of the corresponding image. At each point where the feature detector stops it takes a mean of involved pixels and write it over feature map at (1, 1) position. For the next move, the feature detector will move one pixel right and perform the same process again until the end of first row. After operating on first row feature detector window will move one step down to the second row and start the same process. In this way whole image will be filtered through feature detector window and update in feature map. The feature map contains a large amount of features in relevance to single image. Let's assume a small patch x x y, then array of convolved pixels will be represented as,

$$f_{convolve} = \eta(r - x + 1) * (c - y + 1) \quad (1)$$

The features f are obtained by taking mean η of contributed pixels r, c appears in feature detector window. The feature values write on the feature map from (1,1)(1,2)(1,3)....(143,143). Further explains the idea that feature map is mapping 143 features computed by applying mean pooling strategy. There considered 143 feature points corresponding to the given image. These extracted features are now ready to pass them to classifier.

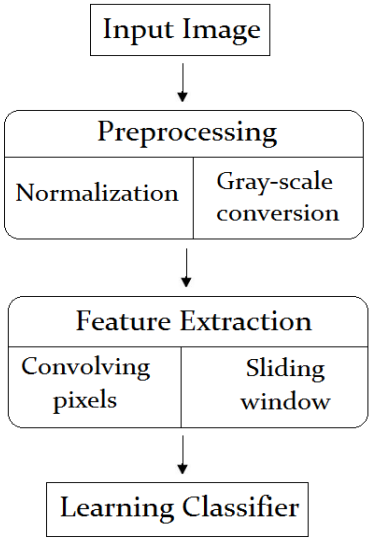


Figure 2: The flowchart of proposed idea

b) Multidimensional LSTM classifier for Arabic Scene text

The LSTM has effectively applied on a number of problems where data is correlated and sequence is important to learn. The correlation of data may be represented by single or multidimensional axis. The LSTM is a technique under RNN approach where unlike RNN the data can be modeled into multidimensional vector in addition to the single axis. The Arabic script recognition is a classic example of sequence learning tasks where context is important to learn. The representation of each character depends on the previous character and so on. Unlike Latin, the Arabic script written in joining style which complicate the recognition process. The ConvNets can prove to be the good choice to learn the different segments of handwritten samples which require a lot of manual pre-processing. Moreover, it cannot produce good results when the problem is large and where context learning is important.

The idea of multidimensional LSTM is to replace the single memory block of LSTM with the number of memory blocks according to dimensions. The input is delegated to hidden layers where the input data is processed by LSTM memory blocks in each dimension. In MDLSTM the self-connection of LSTM cell is controlled by n self-connection with n dimension and n forget gates. The cell activation values were forward to gates by peephole connections. The input gate in a memory block connected to all previous cells and in all dimensions. This will help to learn the sequential pattern of learning. The forget gate connected to cell c of all dimensions with different weights. This helps in determining how much previous computation takes part in all dimensions with reference to the current cell's computation. This type of setup is very important for Arabic script recognition where each character has four

variations according to the position in a word, moreover the character segmentation is also extremely difficult.

The MDLSTM is considered as ideal architecture for learning the sequential problems more efficiently and effectively. Most of the recently reported work on Urdu and in Arabic script recognition as explained in [2] proposed MDLSTM for learning the complex patterns and reported state-of-the-art results. The details about MDLSTM network architecture can be explored in Graves et al. paper [12].

IV. Hierarchical Subsampling based Cursive Document and Scene Text Recognition

The adapted hierarchical MDLSTM architecture based on sub-sampling of hidden layers approach is proposed for Arabic scene text.

The hierarchical subsampling usually applies where the data volume is too large and complex. The hierarchical subsampling based LSTM architecture includes input layer, an output layer and multiple self-connected hidden layers. The output of each level in the hierarchy is represented as input to the level up and so on. The input sequences were subsampled by predetermined window width. The hierarchical subsampling of RNN based networks follows the same structure as defined for ConvNets. The potential of sub-sampling approach was scrutinized by investigating the performance through 3 layer architecture which incorporates 20, 40, 60, 80, 100 and 120 hidden memory block sizes.

Table 1: Selected Parameters during training the network

Parameters	Values
Input block size	4×1
Hidden block size	4
Subsample sizes	6 and 20
Hidden sizes	2,10 and 50
Learn rate	1×10^{-4}, 1×10^{-3}
Momentum	0.9
Total network weight	732863

The network learning is based on the empirically selected parameters. The prime objective is to look for appropriate parameters that provide low error rate in comparison. The parameters detail along error rates and overall training time is provided in Table 1. The Arabic word assorted from the scene text initially pre-process to the standard size of 70 by keeping the aspect ratio. The feature map is prepared by convolving the extracted features from given image through filter window. The convolution process

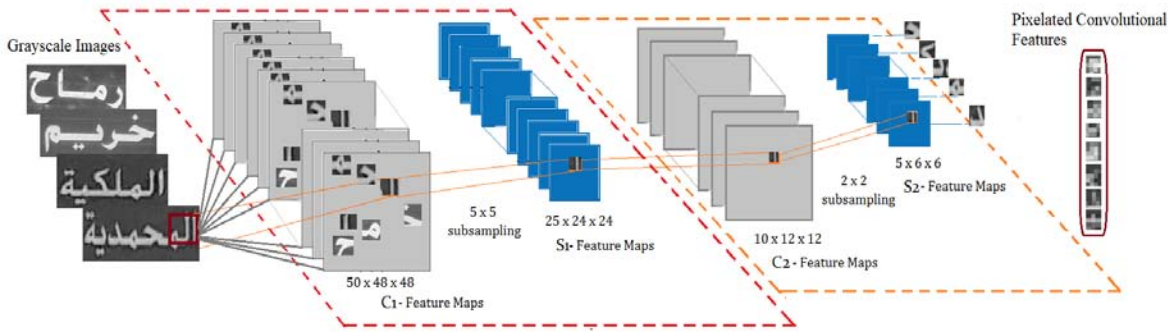


Figure 3: Arabic scene text feature extraction by convolutional pixelate method

is similar as presented in section ?? for handwritten Urdu text as depicted in Figure 3. Here, the gray scale values of convolved pixels are passed to classifier by following a specific input size as sketched in Figure 4.

In each feature map, every neuron is mapped according to small 5 $\times$ 5 region of an input image. The connection from input image to hidden layer is established through local receptive field called a filter size. Each neuron in a layer shares the same bias value. As single feature map does not cover the intensive features, therefore the process is further delegated to have a variety of features against each given image. A feature map is defined by its share weight and a bias value; mathematically this relation can be represented as follows in equation 2,

$$\alpha\left(d + \sum_{e=0}^{4}\sum_{f=0}^{4} W_{e,f} A_{j+e,k+f}\right) \quad (2)$$

whereas, α is neural activation sigmoid function while d is a shared value of bias. We,f represents filter or kernel weight which depends on filter size whereas, A represents the input activation at point (x,y).

The extracted features by ConvNets are converted into raw pixels and are given to MDLSTM architecture with corresponding ground truth as presented in Figure 4. The complex nature of Arabic script prompts to proposed a hierarchical subsampling architecture of MDLSTM for learning purpose. The proposed experiments are based on the subsampling architecture which is divided into two main categories. As a first evaluation, the experiments were performed having 3 and 5 layers architecture. Each layer incorporate 20, 40, 60, 80, 100 and 120 hidden LSTM memory block. The three-layer architecture is defined by number of hidden memory units at every three layers. The input is subsampled by 6 6 and 2 9 window size. The deep learning architecture is designed by defining the data into layer wise manner. The same process is applied on five layer architecture.

The second variation of experiments performed by defining the same pa- rameters as experimented by [12, 20]. [12] proposed their solution on hand- written Arabic character recognition while [20] presented the same idea on printed Urdu character recognition using similar parameters. The same pa- rameters and network structure are deliberately to compare the performance of handwritten, printed and scene text Arabic script recognition as shown in Figure 4. All activation functions in sub-sampling layers are feed forward tanh layers, whereas hidden layers are fully connected in all dimensions. The MDLSTM network collapse all processing into one dimensional CTC layer having 40 classes including a blank label which predict the output symbol. All activation functions in sub-sampling layers are feed forward tanh layers, whereas hidden layers are fully connected in all dimensions. The MDL-

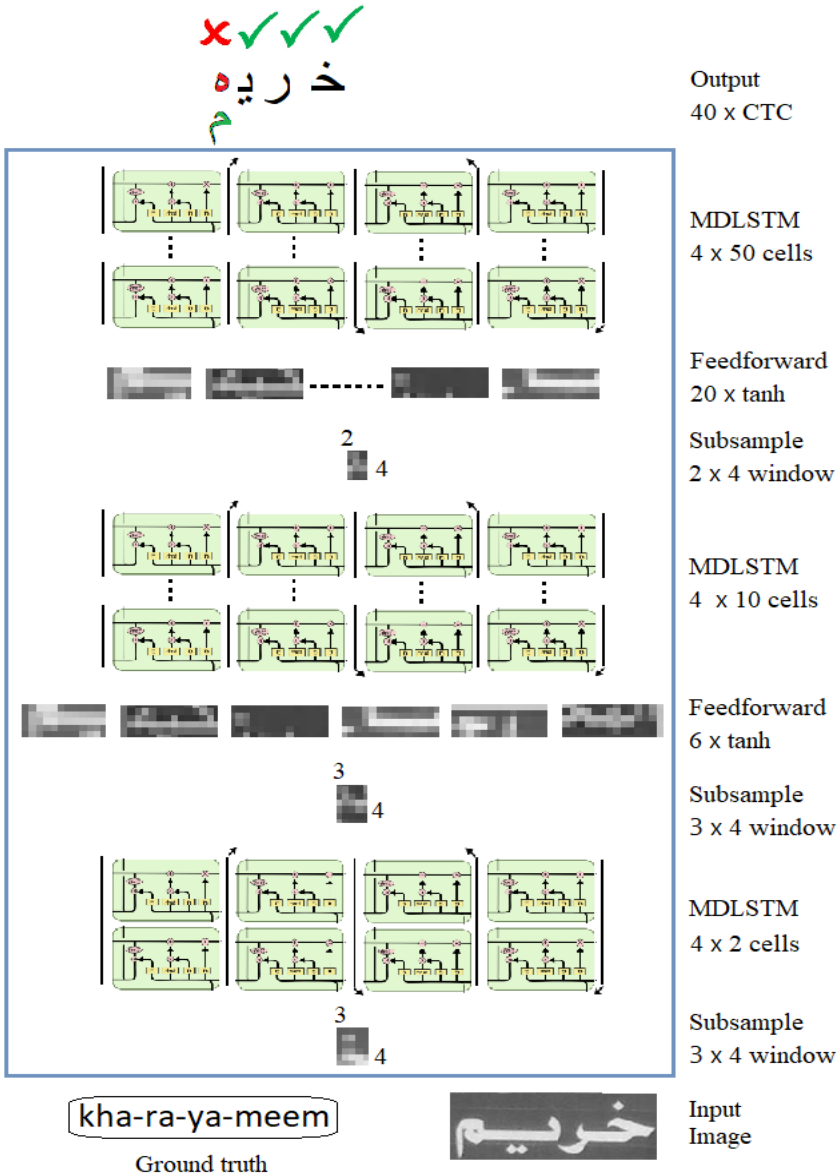


Figure 4: Hierarchical sub-sampling approach. As indicated in the output the character 'meem' (in green) not recognized by the network.

Table 2: Selected Parameters during training the network

Parameters	Values	Training/ Validation Error	No. of Epochs	Time/Epoch (minutes)
Subsample window	6×6	0.86/ 0.83	317	40
	2×9	0.94/ 0.92	299	34
Hidden memory units	20,60,100, 120	Best(0.97/0.95)	461	29
	-	Worst(17.28/15.74)	248	53
Learning rate	1×10^{-4}	0.80/ 0.82	319	48
	1×10^{-5}	0.96/ 0.98	406	51
Momentum	0.9	-	-	-
Total network weight	475723	-	-	-

STM network collapse all processing into one dimensional CTC layer having 40 classes including a blank label which predict the output symbol. The performance was evaluated on various settings of proposed architecture as summarized in Table 2.

The performance comparison of said approach on handwritten, synthetic and scene text is detailed in Table 3. The offline and online handwritten Arabic is experimented by [12].

They presented their work in ICDAR 2009 handwriting competition. As presented in Table 3, they proposed hierarchical architecture. Later [20] used the same architecture by changing little bit in parameters like hidden memory blocks. Moreover, they experimented their work with MDLSTM networks. The details about their implementation can be found in their manuscript [20]. The presented approach on scene text using the hierarchical sub-sampling achieved benchmark accuracy in terms of Arabic scene text recognition.

a) Experimental Analysis

The experiments were conducted into manifold with various settings. The experimental settings were apparently outlined on the basis of architectural manipulation and parametric details. Following are the details of conducted experiments.

Table 3: Performance comparison of hierarchical subsampling on handwritten, synthetic and scene text Arabic script with pre-determined architecture.

Category	Epochs	Hidden Units	Output layer	Weights	sub-sample window	LSTM Dimension	Accuracy (%)
Online Handwritten Arabic [12]	85	20, 60, 180	CTC	423,926	[1],[2],[2]	1-DLSTM	95.70
Offline Handwritten Arabic [12]	91	4, 20, 100	CTC	550,334	[4,3],[4,2],[4,2]	2-DLSTM	95.70
Printed Arabic [20]	398	2, 10, 50	CTC	551,405	[4,3],[4,2],[4,2]	MDLSTM	98.25
Arabic Scene Text	406	20, 60, 100, 120	CTC	475,723	[4,3],[4,2],[4,2]	MDLSTM	96.81

1. The number of hidden layers were considered to investigate the performance of learning architecture.
2. The number of memory blocks at each layers using subsampled input.
3. The performance is explored by empirically selected learning rates.

As discussed earlier, that proposed network delegate the processing of MDL- STM network's learning to hidden layer units. The proposed method was evaluated on 3 and 5 hidden layer architecture.

At first, with three-layer architecture, each layer has 20. Then, by following same hidden layer architecture, each layer has 60 LSTM memory blocks and so on. Ultimately, with hidden layers size 3 and 5, the network was evaluated with each 20, 60, 100 and 120 LSTM memory blocks. Consequently, there are 8 experimental settings for each proposed architecture based on number of hidden layers as detailed in Table 4.

For the activation of the input and output unit used tanh whereas, function was used for gate's activation. The CTC layer has 38 output nodes for 37 input characters including one extra blank node. The 38 character input includes Arabic characters and numerals. All hidden layers in proposed architecture are fully connected to each other. The 3 hidden layer architecture was initially proposed where each layer was subsampled at first to 20 LSTM memory blocks. The performance was evaluated later on 40, 60, 80, 100.

Table 4: Details of performed experiments on 3 hidden layer architecture

Subsample size	Experiments	Hidden units/layer	Learning rate	Word Recognition Error(%)	Character Recognition Error (%)
6×6	Exp-1	20	1×10^{-4}	0.49	0.40
	Exp-2	60	1×10^{-4}	0.24	0.19
	Exp-3	100	1×10^{-4}	0.17	0.13
	Exp-4	120	1×10^{-4}	0.20	0.17
2×9	Exp-1	20	1×10^{-5}	0.55	0.51
	Exp-2	60	1×10^{-5}	0.33	0.23
	Exp-3	100	1×10^{-5}	0.09	0.06
	Exp-4	120	1×10^{-5}	0.24	0.16

Table 5: Details of performed experiments on 5 hidden layer architecture

Subsample size	Experiments	Hidden units/layer	Learning rate	Word Recognition Error(%)	Character Recognition Error (%)
6 × 6	Exp-1	20	1×10^{-4}	0.62	0.54
	Exp-2	60	1×10^{-4}	0.53	0.42
	Exp-3	100	1×10^{-4}	0.11	0.10
	Exp-4	120	1×10^{-4}	0.43	0.34
2 × 9	Exp-1	20	1×10^{-5}	0.59	0.48
	Exp-2	40	1×10^{-5}	0.31	0.24
	Exp-3	100	1×10^{-5}	0.19	0.12
	Exp-4	120	1×10^{-5}	0.22	0.14

The units defined in subsampled layers were also fully connected. The performance in hidden units were delegated backward to main hidden layers and the calculation of subsample layer was incorporated in the gradient descent of next hidden layer with learning rate 1 10−4 and then on 1 10−3 and momentum 0.9 which is selected after observing the trend from another cursive text analysis using MDLSTM. The training on each experiment was stopped after observing no significant improvement on performance for 30 epochs. Table 4 5

represent the details about number of epochs consumed for each experiment while the size of the hidden layer was 3 and 5. The learning rate and number of hidden sub-sampled layers on convolutional features are impacting the learning performance of training network. The output is presented in Figure 5. The recorded accuracy is 95.8% calculated by Levenshtein distance measure at character level as indicated in Table 6.

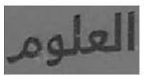
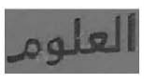
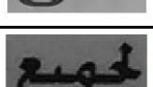
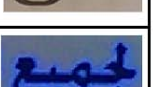
Results	Recognized output	Ground Truth	Gray-scale Image	Original Image
2 - Substitutions	الملوه	العلوم		
1 - Substitution 3 - Deletions	جاهة	الجامعة		
	أرمادا	أرمادا		
3 - Deletions	و	زبون		
	الخارجية	الخارجية		
	الوطنية	الوطنية		
1 - Susbtitution	المى	الى		
	لجميع	لجميع		
	حريق	حريق		
1 - Substitution 1 - Insertion	حبرير	جرير		
2 - Substitution 3 - Insertions	العمألبية	العناية		

Figure 5: Observed scene text recognition output, the original input images were rescaled and converted into gray-scale. The output was mapped with ground truth. The green color symbols at output show insertions, whereas, deletions are presented in red color.

Table 6: Details of performed experiments on 5 hidden layer architecture

Error type	Test set Error
Deletions	43.75
Substitutions	41.91
Insertions	30.24

V. Conclusion and Discussion

The nature of Arabic script is extremely complex and cursive. To under- stand the Arabic word, there is a need to investigate the characters involved in predicting a word. The representation of characters is a considerable is- sue, because every character has four possibilities to occur in a word. The constraint of character's position make it difficult for any type of segmentation technique to correctly determine the characters by any specified technique. Therefore, there is always a need to look for implicit segmentation techniques that counter such complications associated to Arabic scripts. As Arabic script is a context-based language, hence context learning classifiers are suitable for learning purpose. The presented architecture for scene text analysis depicted good results. The obtained results exhibit that if there is a precise and relevant feature provided to learning network then it could pro- duce realistic results even on the intrinsic scripts. Experimental evaluation has also explained in detail which tells the learning trend and recognition accuracy at word and character level of Arabic scene text.

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

Identification of Anesthesia Stages from EEG Signals using Wavelet Entropy and Back Propagation Neural Network

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Abstract- This study focuses on entropy based analysis of EEG signals for extracting features for a neural network based solution for identifying anesthetic levels. The process involves an optimized back propagation neural network with a supervised learning method. We provided the extracted features from EEG signals as training data for the neural network. The target outputs provided are levels of anesthesia stages.

Wavelet analysis provides more effective extraction of key features from EEG data than power spectral density analysis using Fourier transform. The key features are used to train the Back Propagation Neural Network (BPNN) for pattern classification network. The final result shows that entropy-based feature extraction is an effective procedure for classifying EEG data.

Keywords: *EEG, artificial neural network, back propagation, anesthesia.*

GJCST-D Classification: *I.5.1*

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Ahmed Abdal Shafi Rasel

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Keywords: EEG, artificial neural network, back propagation, anesthesia.

I. Introduction

Human Brain is the core processing unit which controls the functionality of the whole body. The human brain is a complex structure of billions of neurons. Our brain cells produce pulses and vibrations. This electrical activity of our brain is one of the most signifying factors in understanding how the brain functions. EEG (Electroencephalogram) signals of the brain can be used to monitor neural activities [1]. EEG records electrical activity over areas of the scalp. The brain produces different electrical waves over different levels of consciousness of the brain.

In the past, EEG signals were analyzed using traditional methods[2]. However, the diversity of the EEG signal could not be possibly mapped by using the linear analytical procedure. So later came techniques like Fourier transform were used for analyzing power spectral density and frequency components. Wavelet decomposition is a much better tool for analyzing EEG signals which provide signal denoising. Because of the transient characteristic of EEG data, a wavelet is a more effective analytical tool in this case.

Wavelet entropy is perhaps one of the most defining factors to consider when analyzing the level of consciousness of the human brain. Suppression in EEG signals could mean possible loss of responsiveness over a period [3]. So for anesthesiological applications, wavelet entropy of EEG signals could be considered as an important factor.

Anesthesia is a medical process extensively used in hypnosis, analgesia, muscle relaxation, etc. So the necessity to maintain the transparent, precise and consistent level in a medical coma is of much importance in the biomedical world. EEG has drawn much attention as a clinical monitoring tool for anesthesiological applications.

Also, there is a need for sophisticated analysis of EEG signals in the field of medical diagnoses like brain tumor identification or characterization of epileptic seizures. Several pathological or cognitive events can be diagnosed in the EEG spectrum.

II. Literature Review

EEG signals were first recorded in 1924. Since then, the analysis of this signal has been a developing interest. EEG signals are much complex with a multitude of frequencies and patterns.

Neuro-physiologists have defined distinct frequency bands and corresponding physiological activities in EEG signal. Traditionally used linear systems of EEG analysis proved to be inept in modeling such a dynamic system like brain [2]. Then with the advent of non-linear signal processing techniques like Fourier transform were used. However, Fourier transform does not provide efficient analysis of non-stationary signals like EEG. Since then wavelet is an excellent tool for analyzing EEG data [4].

a) Wavelets & Entropy Measures

For analyzing transient signals, wavelet decomposition is the most popular choice. A wavelet is wave-like oscillations of limited duration. Wavelet transforms an existing signal into another form by translation and dilation [5].

Entropy provides the average unpredictability of a random variable which is equal to the information content in a composite signal [6]. Claude Shannon was the first one to come up with the definition of entropy. That's why Shannon's entropy is mostly used in finding entropy of a given discrete signal.

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Table 2.1: Different definitions of EEG frequency band divisions

Frequency Bands (in Hz)	Characteristics
$0 \leq \delta 1 \leq 1.9$	Delta, δ (<4Hz):slow brain activity preponderant Only in deep sleep stages of normal adults,otherwise,they suggest pathologies
$2 \leq \delta 2 \leq 3.4$	
$3.5 \leq \theta 1 \leq 5.4$	Theta, θ (4-8 Hz): appears during drowsiness and sleep in normal adults, otherwise high theta activity in awake state suggests abnormal and pathological conditions
$5.4 \leq \theta 2 \leq 7.4$	
$7.4 \leq \alpha 1 \leq 9.9$	Alpha, α (8-14 Hz): appears during relaxed and mentally inactive awakeness.Amplitude mostly <50 μV, and appears most prominent in occipital area
$9.9 \leq \alpha 2 \leq 12.4$	
$12.5 \leq \beta 1 \leq 17.9$	Beta, β (14-30): present in front central region with less amplitude than alpha rhythms.Enhanced by expectancy states and tension.
$18 \leq \beta 2 \leq 23.9$	
$24.0 \leq \beta 3$	
	Gamma, γ(>30): have high frequency band and usually not of clinical and psychological interests, and therefore often filtered out in EEG recordings.

Shannon entropy *H* is given by the formula

$$H=-\sum p_i \log_b p_i$$

Where p_i is the probability of character number *i* showing up in a stream of characters.

Besides, Shannon's Entropy measurement several other entropy measurements are there such as Log Energy Entropy (LogEn) and Threshold Entropy Measurement.

b) Characteristics of Anesthesia

Anesthesia is a temporary state of unconsciousness. [7] [8] Anesthesia is used in medical procedures for lack of pain and muscle relaxation to enable medical intervention in human bodies. Anesthesia thus has several different levels. Anesthesia levels correspond to the level of consciousness. [9] [10] [11]

The different phases of anesthesia levels include induction, the excitement phase, surgical anesthetic stage, and an overdose. Each of these stages affects the EEG signal in different ways. [12] [13] [14] In our work we have assumed five levels of anesthesia ranging from 1 to 5 each corresponding to anesthesia levels in an ascending manner.

c) The outcome of Literature Survey

Analyzing EEG signals using a traditional linear methodology or even conventional Fourier transform does not give complete information of signal's characteristics. Wavelet analysis on such diverse transient signal components is too quite troublesome for getting efficient features [15]. That is why using wavelet entropy could provide the expected value of information from a given signal. But to characterize EEG signals to the point of making it an analyzing factor in identifying anesthetic stages like induction, exciting stage, surgical anesthesia, and overdose, we need the use of artificial intelligence. Using feed-forward neural network with back propagation could provide the much-needed pattern recognition in the EEG spectrum for identifying the level of consciousness.

III. Methodology

In this work, we have used organized EEG data where each EEG signal is mapped to the level of anesthesia stages. We grouped our data into 300 samples of EEG signal in the matrix. Each signal is of 250 Hz and has a duration of 10s.

a) Key Feature Selection

The approach of obtaining a key feature from EEG data is the most crucial part. The whole procedure is based upon the fundamental concepts mentioned in chapter 2. Firstly, the obtained EEG signals are loaded in the wavelet toolbox for analyzing. The signals are denoised using the created m-function written in the Matlab. After Denoising signals we need to extract features from those signals. We have chosen entropy measurements as our characterizing feature for EEG data.

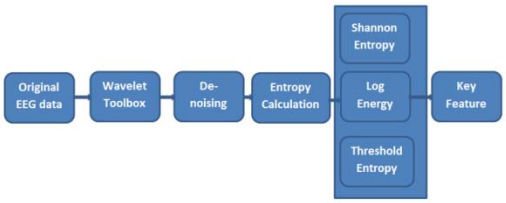

Figure 3.1: Procedure of Extracting Key Feature

We have calculated three entropy measurements which are Shannon's Entropy which is the most basic and common one, the log energy entropy which is an excellent feature for analyzing EEG data and threshold entropy with a threshold value of 0.2. These entropy measurements are used as training features for the neural network.

Figure 3.1 shows the step by step approach in extracting feature from the EEG data

b) Wavelet Parameters

In the process of denoising the EEG signals, we have used discrete Meyer wavelet as mother wavelet. Choosing mother wavelet depends upon symmetry, the speed of convergence, orthogonality and regularity of

the wavelet. We are dealing with 1-D EEG signals which are band-limited. Since Meyer wavelets match any band-limited signal very well [16], we have chosen 'dmey' as our mother wavelet. The discrete 'meyer' wave also shows infinite regularity [17]. However other mother wavelets can also be used.

c) Wavelet Entropy Calculation

Wavelet entropy is a measure of the unpredictability of information content. It shows the degree of order or disorder in an energy spectrum. Therefore, wavelet entropy can provide useful information about the underlying dynamic process associated with the signal.

The wavelet entropy is used as the key feature of our EEG data analysis. We have used three entropy measurements namely the Shannon Entropy, log energy entropy and the threshold entropy.

The Shannon entropy is given by the formula:

$E1(s_i) = s_i{}^2 \log si^2$so

$E1(s) = -\sum \; s_i{}^2 \log s_i{}^2$

The log energy entropy [18] can be calculated as such:

$$E3(s_i) = \log s_i{}^2$$

$$E3(s) = -\sum_i \log s_i{}^2$$

The threshold entropy is computed by:
E4(si) = 1 if |si| >p and 0 elsewhere so,
E4(si) = #{i such that |si | >p} is the number of time instants when the signal is greater than a threshold p.

d) Pattern Recognition Network

The acquired key features are concatenated with one another for providing multi-layer input in the pattern recognition network. Also, each entropy measure can be given separately into the input layer. In both cases additional factors like age of the patient etc. can be added for multi-layer input data in the pattern recognition network. [19] [20]

Choosing the number of hidden layer in the pattern recognition network is a critical decision. The target vector contains a value within range 1 to 5. The higher the level of anesthesia, the higher the target values. The target value is compared with the output vector in the output layer. The comparison is used to compute the mean squared error (MSE). The error is propagated backward to adjust weights and biases of the neural network. MSE value gradually decreases over the training phases. [17]

IV. Result and Analysis

Here we present the results of our works and the analysis of our findings.

The original signals are denoised using discrete 'Meyer' wavelet at level 5.

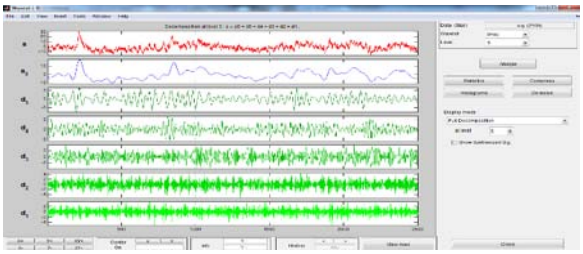

Figure 4.1: Wavelet decomposition of the noisy signal

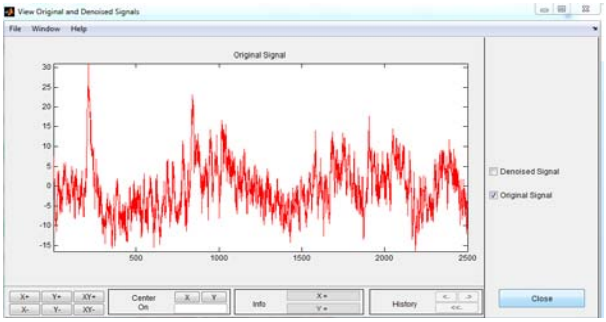

Figure 4.2: Original Noisy Signal

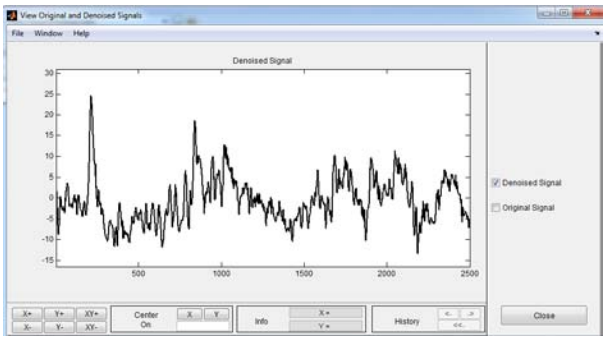

Figure 4.3: Denoised Signal

However before denoising the noisy signal, wavelet decomposition has to be done. Figure 4.1 shows the decomposition of the EEG signal at level 5 using 'dmey'. The signal is then denoised choosing from various threshold methods.

Figure 4.2 shows a noisy EEG signal and Figure 4.3 shows a denoised EEG signal.

Then the entropy value is computed from the denoised signal. The Shannon Entropy, Log Energy Entropy and Threshold Entropy values are used as the feature for the next phase of classification.

We choose a pattern recognition network with four input layers, four hidden layers, and one output layer. We have tested the neural network with distinct numbers of hidden layers, and the optimized number is chosen to be four.

The performance of the pattern recognition network is quite satisfying. We have given Shannon's entropy, log energy entropy, and threshold entropy as the feature values for the target data which was used to train the neural network.

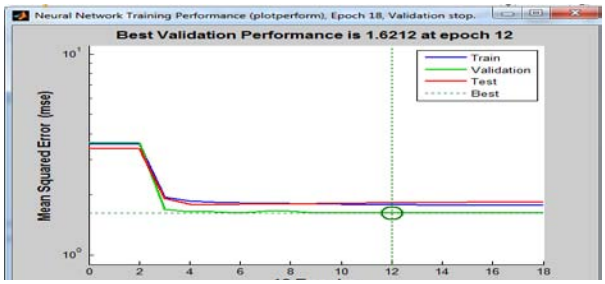

Figure 4.4: Performance Graph

So finally we can see that the pattern recognition network is very efficient in recognizing patterns in the EEG signals for different anesthesia stages.

V. Conclusion

This paper elucidates an approach in analyzing EEG signal with the goal of identification of anesthesia levels. Wavelet entropy calculation shows how this highly diverse non-linear EEG signals can be simply measured. The work depicts a suitable method by combining wavelet entropy and artificial neural networks for classifying transitions in the EEG signals under anesthesia.

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

An Integration of Deep Learning and Neuroscience for Machine Consciousness

By Ali Mallakin

Abstract- Conscious processing is a useful aspect of brain function that can be used as a model to design artificial-intelligence devices. There are still certain computational features that our conscious brains possess, and which machines currently fail to perform those. This paper discusses the necessary elements needed to make the device conscious and suggests if those implemented, the resulting machine would likely to be considered conscious. Consciousness mainly presented as a computational tool that evolved to connect the modular organization of the brain. Specialized modules of the brain process information unconsciously and what we subjectively experience as consciousness is the global availability of data, which is made possible by a non modular global workspace. During conscious perception, the global neuronal work space at parieto-frontal part of the brain selectively amplifies relevant pieces of information. Supported by large neurons with long axons, which makes the long-distance connectivity possible, the selected portions of information stabilized and transmitted to all other brain modules. The brain areas that have structuring ability seem to match to a specific computational problem. The global workspace maintains this information in an active state for as long as it is needed. In this paper, a broad range of theories and specific problems have been discussed, which need to be solved to make the machine conscious. Later particular implications of these hypotheses for research approach in neuroscience and machine learning are debated.

GJCST-D Classification: *I.2.6*

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Abstract- Conscious processing is a useful aspect of brain function that can be used as a model to design artificial-intelligence devices. There are still certain computational features that our conscious brains possess, and which machines currently fail to perform those. This paper discusses the necessary elements needed to make the device conscious and suggests if those implemented, the resulting machine would likely to be considered conscious. Consciousness mainly presented as a computational tool that evolved to connect the modular organization of the brain. Specialized modules of the brain process information unconsciously and what we subjectively experience as consciousness is the global availability of data, which is made possible by a non modular global workspace. During conscious perception, the global neuronal work space at parieto-frontal part of the brain selectively amplifies relevant pieces of information. Supported by large neurons with long axons, which makes the long-distance connectivity possible, the selected portions of information stabilized and transmitted to all other brain modules. The brain areas that have structuring ability seem to match to a specific computational problem. The global workspace maintains this information in an active state for as long as it is needed. In this paper, a broad range of theories and specific problems have been discussed, which need to be solved to make the machine conscious. Later particular implications of these hypotheses for research approach in neuroscience and machine learning are debated.

I. Scientific View and Definition of Consciousness

One of the difficulties with the study of consciousness is the lack of a universally accepted definition. Another struggle is that empirical scientists must deal with questions, which has no quantitative answer, and responses can touch upon unscientific subjects. The very act of thinking demonstrates the reality of one's existence and consciousness, which viewed as an individual's awareness of its internal states as well as the events in the surrounding environment. Recent research on consciousness has focused on understanding the neuroscience behind our conscious experiences. Some investigators have used brain scanning technologies to seek out specific brain modules or neuronal networks that may link to different conscious events[1,2]. Two major theories of consciousness, which will be discussed further through this paper, consist of integrated information and global workspace theories. The first attempts to look at consciousness by learning more about the physical processes that motivate our conscious experiences[3]. This theory attempts to create a measure of the integrated information that forms consciousness and reveals that the level of integration represents the quality of an organism's consciousness. It explains the nature and source of consciousness and claims that consciousness is identical to a particular type of information, which requires physical realization, not merely functional, and which can be measured mathematically according to the Φ metric. The second theory suggests that we have a memory bank from which the brain draws information to form the experience of conscious awareness[4]. While integrated information theory focuses more on identifying whether an organism is aware, the global workspace theory offers abroader approach to understanding how consciousness works. My motivation to have useful models in artificial consciousness is toward the design of communication technology that is convenient in everyday human activities.

There is a long way to go in our understanding of consciousness as investigators continue to explore the different bases of consciousness such as the physical, social, cultural and psychological influences that contribute to our conscious awareness. Consciousness defined as a state of awareness which features apprehensiveness, subjectivity, experience through sensory perceptions, the state of wakefulness, the sense of ego, and the control of the mind with knowledge of thought processes [5-7].Other most essential attributes of consciousness are curiosity and creativity, which could be a factor that distinguishes humans from other earth beings[8,9].Intelligence is also another fundamental aspect of brain requirement and consciousness, which some beliefs like consciousness it is a property of a physical mind, not a metaphysical phenomenon[10]; however, not a sufficient condition for creativity [11]. Apart from humans, other earth beings also show certain levels of creativity[12]. In defining consciousness, the problem emerges from attempts that try to explain it in purely physical terms. That is why psychology and quantum mechanics have been integrated to challenge the materialistic view of consciousness [13].

Recent advances in artificial intelligence (AI) have revived the possibility that machines would

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eventually mimic all the brain's abilities, including consciousness. Deep learning networks, inspired by neuroscience, have led to the creation of artificial neural networks (ANN) that can even occasionally surpass human capacity [14,15]. These types of the network without having biophysical properties of real neurons have several neurobiological features, including nonlinear input-output functions, layers with converging projections, and modifiable synaptic weights. Advances in computer field now allow such networks to operate on complex problems with capacity that previously was a privilege of a real brain. Computations implemented by current deep-learning systems that correspond mostly to non conscious processes in the human brain, although it often considered as the highpoint of the brain and something impossible to achieve by machines, in this paper is claimed to be otherwise. This paper reviews the previous studies and much of what we know about how brains generate consciousness, what are the relationships among conscious, subconscious and non conscious brains and how these findings can be used in advance artificial intelligence. This paper reviews specific existing models of consciousnesses and presents the approaches that make a machine more conscious. Besides, it discusses the role and relationship between quantum mechanics (QM) and remote viewing (RV). This relationship between quantum non locality and conscious or subconscious brain functions is essential, as quantum processes in biological phenomena are becoming more apparent. Further, it discusses non-local consciousness or remote viewing (RV) as an application of consciousness that permits a viewer to describe details regarding a target that is inaccessible to the ordinary senses.

II. Current Theories for Machine Consciousness

There are various models of machine consciousness, each with certain strengths and limitations. Machine consciousness was classified earlier into four groups [16], and later to five categories based on recurring matters on the fundamental issues that are most fundamental to consciousness[17]. The most recent classification includes a global workspace, information integration, an internal self-model, higher-level representation, and attention mechanisms[17]. Although various models presented, the creation of an intelligent machine has not been much less successful due to the computational issues and the inability to explain the application of high-level cognitive algorithms in terms of neuro-computational processing[18]. Mechanistic theory of consciousness hypothesizes that how a brain with an attention schema may have subjective awareness[19]. In the attention schema theory, consciousness viewed beyond philosophy, towards developing basic properties that can engineer into machines. It is considered an essential part of the brain responsible for data processing where conscious is an internal model of attention. Supporters of this theory claimed that the attention schema theory provides a possible answer to the puzzle of subjective experience by which the brain computes a simplified model of the process and the current state of attention which is the basis of subjective intelligence[20].

Consciousness made by the application of ANN may be better explained by exploring the designs that allow the human brain to generate consciousness, then transferring those understandings into computer algorithms. The aim is to study aspects of the cognitive neuroscience of consciousness that may be pertinent for learning machines. Consciousness given by brain capacity seeks to understand its relationship to our objective world. It states the relationship between a cognitive system and a specific object of thought, such as a mental representation. Conscious information becomes globally available to us, which gives us the ability to recollect, act upon it, and speak about it. Having the data in mind among the immense range of thoughts that can become conscious at a given time, only the ones that are universally available constitute the content of consciousness of an objective world. In another hand, consciousness scan be reflexive or spontaneous, in such a way that the cognitive system can monitor its processing and obtain information about itself in a self-referential manner. This self-examination ability of consciousness is commonly known as meta-cognition, which is having self-awareness and the ability to conceive and make use one's knowledge and abilities[21].Some suggested that global and reflexive consciousnesses may constitute independent dimensions of conscious computations. Both can overlap physical substrates, and in the brain, both depend on the prefrontal cortex[22]. Theoretically, the two may come apart as there can be global consciousness without reflexive consciousness, such as when reportable processing is not accompanied by accurate meta-cognition, or reflexive consciousness without global one, such as when a self-monitoring operation unfolds without being consciously reportable [23]. Sepertae computations can be performed before we consider their synergy. Furthermore, many estimates involve neither of these two conscious and therefore called unconscious. What we pursue is a satisfying scientific theory of consciousness that predicts under which conditions any particular physical system, whether it is a complex network of neurons or electronic circuit board has awareness experience. Moreover, we need to investigate what makes the quality of experiences different and if they have a specific function. Such a theory will allow us to conclude which systems will experience anything. Experience has shown that without an approach that brings testable

predictions, any speculation based on our intuition would not be reliable.

III. The Relationship among Conscious, Subconscious and Unconscious Minds

Sigmund Freud psychoanalytic theory presented in the early twentieth century has retain edits hold on the shaping of views regarding the doctrine of the human mind despite the new advancements. Neuroscience has identified the physical brain mechanisms underlying subjective processes. Following those breakthroughs, consciousness could then be seen as a computational property associated with a certain level of information processing. Three computational levels may be distinguished based on our conscious, subconscious or unconscious mind. It is estimated that just 10% of the cognitive function is made up of conscious thought, which can direct our focus and able us to envision what is not real. Our subconscious is the storage point of recent memories, which needed for quick recall and holds current information that we use every day. The unconscious mind is where our memories and past experiences reside and include memories that have been repressed and those that have been merely consciously forgotten. The unconscious brain continually communicates with the conscious mind via the subconscious, which provides us with the meaning of our interactions with the world. It breathes through feelings, emotions, thoughts, sensations, and dreams. At unconscious mind algorithms process symbols blindly and, apparently without any awareness. For instance, our visual system blindly and unconsciously processes the images. By this mean, many of the brain's unconscious computations are rational computations, and unexpectedly any machine that attempts towards objectivity would be submitted to similar human-like deceptions.

Above the unconscious processing level, two higher levels of information processing are defined that correspond to primary and secondary consciousness [24]. The first level known as conscious access, which is a selective attribution of a piece of information, selected for its relevance and became the focus of additional processing. Second, is conscious self-representation, in which the cognitive system shows one or several representations of its knowledge, for instance, it may know what it is currently focusing on, or it made an error. Consequently, the system not only commits its resources to a specific piece of information but also recognizes that it knows. The assumption is that this self-knowledge is represented in the same format as the knowledge of other individuals, which allows this information to be shared with others[25,26].

Those definitions made it entirely possible to study consciousness experimentally. The experimental approach may proceed with identifying a minimal experimental paradigm that allows to contrast visible and invisible stimuli [27,28]. Then, carefully quantify the subject's introspection, which is recognizing what it known. Self-examination defines the conscious of subjective perception and must, therefore, be recorded alongside other objective measures of brain activity. The capacity to report a piece of information to oneself or other scan be the next phase of the study, in which this sense of consciousness that is called report ability can be distinguished from other concepts such as attention, watchfulness, or self-consciousness. The last can be the use of modern neuro-imaging tools to compare the behaviors and brain activity patterns evoked by reportable and unreportable stimuli, thus uncovering the signatures of consciousness.

IV. Specific Signatures of a Brain Consciousness

Further study of consciousness in the human brain reveals that although subliminal stimuli can induce considerable activity in many human minds, conscious perception is associated with a set of specific signatures. The first sign is amplification and access to the prefrontal cortex, in which a conscious image is amplified and gains access to higher levels of representation, particularly in prefrontal and parietal cortices. Next would be tracing the propagation of conscious and unconscious images that shows unconscious activity can be strong in the cortex, yet perish in a brief time within higher cortical areas. This conscious image is amplified in a non-linear manner, in an event known as global ignition.

Nevertheless, in a short period brain activity becomes more stable when the stimulus is conscious than when it is not [29].This conscious ignition is accompanied by increased in bidirectional exchanges of information in the human brain. During a conscious episode, the cortex activates at greater distances, and correlations of brain signals demonstrate this. The brain can spontaneously generate its patterns of circulated activity with constant changes, even in the absence of stimuli[30]. This resting state activity can partially predict the content of consciousness. Finally, neurons in prefrontal and anterior temporal cortex fire to a specific concept and do so only when the corresponding word or image is presented consciously. This activity acted as a signature of conscious perception and known as the all-or-none law that applies to the firing of neurons[31].

The findings of brain-specific signatures and explanation of generic consciousness are compatible with the Global Neuronal Workspace (GNW) hypothesis, which tries to address the serious question of the function of consciousness[27,28,32].Consciousness appears to be required for specific operations, and it is not just a mere epiphenomenon. Subliminal information

is temporary, but conscious knowledge is stabilized and available for long-term thinking. Consciousness converts the incoming data and reduces it to a form that can be reported or stored, while unconscious processes compute with an entire probability distribution, and consciousness samples from it through the subconscious mind. Consciousness is also involved in routing information to other processing phases, which allows us to perform random chains of operations [33].

V. Machine Consciousness Should be Self-Organizing

The phenomenon of consciousness may require a self-organizing system, similar to the brain's physical structure, which current machines lack this critical feature. Adaptive self-organizing mechanisms can be designed to be as sophisticated as the human brain; however, at the moment we require a mathematical theory of computation for these types of system. Perhaps it's true that only biological machines can be sufficiently creative and flexible. That may suggest start working on engineering new biological structures that are or can become conscious. Conscious as a useful aspect of brain function likely to be helpful to a design of artificial-intelligence devices. Certain computational features can be considered, which if they are implemented, the resulting machine would be likely to be considered conscious, or at least more aware than what is currently available. The first to be considered is a workspace for global availability, the act of selecting and making a piece of information accessible for processing and decision-making by the whole system. Global availability highlights or draws attention to information that remained unconscious until that moment. Even though the brain possesses specialized modules that operate non-consciously and are dedicated to specific tasks, it also maintains a global neuronal workspace, where accurate information is selected and shared across all modules. According to the GNW hypothesis, consciousness evolved to break this modularity. The GNW can extract relevant information from virtually any brain module, and make it available to the entire organism, in which the prefrontal cortex appears to act as a central information sharing device. The information presents in this global workspace at any given time is known as conscious. Machines may benefit from a similar architecture for flexible information sharing, capable of broadcasting to the entire system a potentially relevant piece of information. It would be interesting to pursue this idea in the context of present-day machine-learning algorithms, which can make the best use of the broadcasted information. Another feature for a conscious machine is its inherent abilities: a database that contains a list of its apps, the kind of knowledge they possess, what goals they can fulfill, how fast can operate, and how likely they should be corrected.

A conscious machine should know when it is wrong or when it is uncertain about something. In the human brain, this corresponds to meta-cognitive knowledge that has been linked to the prefrontal cortex. In several ways, a computer could be equipped with similar functionality. Primarily, it could be equipped with statistical programs that do not just give an answer, but also compute the probability that this answer is correct. Subsequently, it can have an error-detection system, similar to the brain's error-negativity, which continually compares the current activity with prior expectations and instinctively reacts if the current behavior is likely to be wrong. Finally, this error detection device could be attached to a corrective mechanism that allows the system to continually looks for alternative ways to get the correct answer.

Another point which may be unique to humans is the ability to represent self-knowledge and have a theory of mind, which allows us to model other accounts and to use this knowledge to maximize the usefulness of information that we can provide to them [34]. Additional attributes that should be considered include producing a machine with a consciousness that has qualities, instincts, and creativity. Also, states of consciousness that can change experiences such as emotions and expression scan be considered. Current machines often lack such significance and a device that could simulate its user's mind would undoubtedly provide more relevant information. Algorithms that handle such recursive representations of other accounts are currently being developed [35,36].On the other hand, certain human behaviors such as creativity and a sense of freedom, which do not appear to come from logic or calculations, cannot be found in machines.

Another viewing platform on consciousness comes from quantum theory, which is one of the most in-depth theories of physics. According to the orthodox Copenhagen Interpretation, consciousness and the physical world are balancing aspects of the same reality. When a person observes some aspect of the physical world, that person's conscious interaction causes a noticeable change. Since this theory takes consciousness as a given and not derived from physics, the Copenhagen Interpretation may be considered as a phenomenon that exists by itself, while it requires brains to become real. This view was popular with the pioneers of quantum theory such as Niels Bohr, Werner Heisenberg, and Erwin Schrödinger. A well-known example of this is the paradox of Schrödinger's cat, in which a cat is placed in a situation that results in it being equally likely to survive or die – and the act of observation itself is what makes the outcome inevitable.

The opposing view reveals that consciousness emerges from biology, just as biology itself emerges from chemistry which, in turn, arises from physics. This less broad concept of consciousness agrees with the neuroscientists view that the processes of the mind are

identical to states and operations of the brain. It also coincides with a more recent interpretation of quantum theory motivated by an attempt to rid it of paradoxes, the Many Worlds Interpretation, in which observers are a part of the mathematics of physics.

VI. Particle and Consciousness Entanglements

Since the past few decades, quantum processes in the brain have been given attention to explain consciousness and its enigmatic features. As functional quantum processes in biology are becoming more and more apparent, recent evidence suggests that quantum non locality occurs in conscious and subconscious brain functions. Remote viewing (RV) is a mental ability that allows a viewer to describe or give details about a target that is inaccessible to normal senses [37,38]. For example, a viewer might be asked to specify a location in a different part of the world, which a reviewer has never visited; or a viewer might be asked to describe an event that happened long ago without being said anything about the target. Therefore, RV deals directly with target information processed by human consciousness. QM deal with particles such as electrons and photons, in which the concept of particle entanglement refers to local measurements on a particle that will instantaneously interact with an entangled particle, without considering the distance and how far apart the particles are [39].QM and RV both involve entanglement, in which particle entanglement can be described in QM and consciousness entanglement in RV. Entanglement in non-quantum or classical version arises in situations where we have partial knowledge of the state of two systems. In QM entanglement, the quantum information is encoded in such a way that none of the two qubits (quantum bit: unit of quantum) carries any clear information on its own as all of the data is encoded in their joint properties. Such entanglement is one of the counter-intuitive features of QM and leads to its inconsistencies. Consciousness entanglement in the RV process refers to the local intentions by a viewer on target information that will instantaneously interact with entangled target information, no matter how far apart the viewer and target are. For the viewer, the entangled experience is the target. RV experimental result shows that nonlocal precognitive connections are, in fact, part of our reality. Our memory fits with the simple linear model of time as the only reality based on our accepted experience. While the non-linear QM model has not been experimentally verified in physics laboratories, RV precognition experimental data support the notion of backward through time motion. Therefore, non-local interactions may also involve general aspects of space-time described by the theory of relativity.

VII. Neuroscience and Consciousness

Consciousness is qualitative and coherent, in which for each conscious experience some qualitative entities have that experience and each piece of this conscious experience fits precisely into a global picture of our world [40]. As conscious experience depends on brain activity; therefore, neuroscience has an extensive contribution in explaining consciousness. Except for neuroscience, no other area can provide so much information and advances concerning consciousness, which focuses on the neural correlates of consciousness. Considering that not all neural correlates are explanatory, so identifying the correlates is the first step in the neuroscience of consciousness. A thorough study of consciousness through neuroscience requires that we understand the relevant neural properties at the right level of analysis. Understanding of consciousness will unquestionably emerge from neuroscience but cracking its mysteries will need the knowledge and discoveries of many other scientific disciplines. To understand the connection between brain activity and consciousness, we need to focus on neurons, study computational and spiritual models, and conduct a theoretical analysis. Here we will focus on identifying such principles by considering the activity of neurons. The effort is to address how neural properties may determine when a state is conscious and how they may explain what the content is of that conscious. As a phenomenal consciousness is not reducible to either of these cases, there is a limitation to empirical explanations of phenomenal consciousness as empirical explanations are fundamentally either structural or functional.

Explanation of consciousness remains in the neural action that presents conscious contents and the unknown element that changes a state with that content from unconsciousness to consciousness. A variety of theories can describe generic consciousness that offers a need for the presence of higher-level neural properties necessary or adequate for the consciousness of a given state. Global Neuronal Workspace is one of these theories, which suggests access into the neural workspace is essential and sufficient for a state to be consciousness. In contrast, supporters of Recurrent Processing Theory believe that frequent processing in sensory areas is necessary and enough for perceptual consciousness, and therefore admission to the Workspace is not necessary. In Higher-Order Theories, seem the presence of a higher-order state connected to prefrontal areas of a brain is necessary and sufficient for a phenomenal experience. Subsequently, recurrent processing in sensory areas or access into the workspace is not necessary. At last Information Integration Theories consider a form of integration of information as essential and adequate parts for a state to be conscious.

Most neuroscientists instead of explaining the existence of consciousness in the biotic domain, try to explain generic consciousness by identifying neural properties that can turn consciousness on and off and by determining the neural representational basis of conscious contents. Modern neuroscience of consciousness attempts to explain consciousness by focusing on neural correlates of consciousness (NCCs) that is an essential initial step in understanding consciousness[41,42]. Talk of correlates is deep-rooted in the neuroscience of consciousness, so one must remember that the goal is to find the subset of neural correlates that are explanatory, in answering particular questions. Neuroscientific theories that contribute to explaining specific and generic consciousness further discussed here. We realize that there are limits to neural explanations of consciousness, precisely because of the explanatory gap [43].The reference to neural correlates here means neural explanatory correlate of consciousness.

The theories discussed here provide higher level neural properties that are necessary or sufficient for generic consciousness of a given state. The first is global neuronal workspace theory that is tied to the access of the brain architecture and assumes perceptual, aide-mémoire, attentional, valuational and motoric functions of a cortical structure, which involves workspace neurons with long-range connections linking arrangements. The global workspace in neural terms defined as long-range workspace neurons within different systems that can constitute the workspace, but they should not necessarily identify within the workspace. A subset of workspace neurons becomes the workspace when they exemplify specific neural properties. What determines which workspace neurons constitute the workspace at a given time is the activity of those neurons given the subject's current state. The workspace then is not a rigid neural structure but a rapidly changing neural network, typically only a proper subset of all workspace neurons. This theory can also provide an account of phenomenal consciousness in addition to access consciousness. As imaging data can be obtained that reveal widespread activation when consciousness is present, it can predict widespread activation of a cortical workspace network as it correlates with phenomenal conscious experience[44]. As we track phenomenal consciousness by access in the introspective report, therefore, widespread activity during reports of conscious experience correlates with both access and phenomenal consciousness. However, this correlation cannot state whether the observed activity in a report is the basis of phenomenal consciousness or access consciousness.

Other theories such as Recurrent Processing Theory has a different explanation and ties perceptual consciousness to recurrent activity in sensory areas and processing independent of the workspace, with emphasizes on properties of first-order neural representation as explaining consciousness. It claimed that repetitive processing is necessary and sufficient for consciousness [45-47]. This theory focuses mainly on the visual sensory modality, it argued to apply to all of the senses, and further, it distinguishes conscious and unconscious information. These distinctions were made along the lines of different types of processing that happen within the visual cortex and include the feed forward, locally recurrent, and globally recurrent types. Recurrent processing occurs where sensory systems are highly interconnected and involve feed forward and feedback connections.

The well-known Lamme's theory of recurrent processing identifies four stages of normal visual processing that consist of: I) In superficial feed forward processing stage visual signals are directed locally within the optical system; II) In deep feed forward processing step visual signals have traveled further forward and they can influence action; III) In superficial recurrent processing phase information has traveled back into former visual areas, leading to local, repetitive processing; IV) During widespread intermittent processing information activates extensive regions [45-47]. Based on this theory recurrent processing is necessary and adequate for consciousness. Therefore, the visual state is conscious once a specific intermittent processing state attains the suitable visual circuitry. Consequently, the global neuronal workspace embraces that recurrent processing at Stage 4 is necessary for consciousness while the recurrent processing theory holds that repetitive processing at Stage 3 is sufficient. Base on this difference, recurrent processing theory affirms phenomenal consciousness without access by the global neuronal workspace. Each approach has its answer, which is different from the other, one requiring access but then the other denying it. The organizational challenge in testing for the presence of phenomenal consciousness independently of access remains a hurdle for both theories.

Higher-Order Theory reveals that one is in a conscious state if and only if one relevantly represents oneself as being in such a state [48,49]. It can be described by a conscious visual state of seeing an object if and only if one appropriately represents oneself being in that visual state. This higher-order state by representing the first-order state that represents the world results in having the first order state that is conscious. The justification for such theories is that if one is in a visual state but not aware of that state, then the visual state would not be conscious. Consequently, to be in a conscious state, one must be aware of it and represent it [50]. Higher-order theories tie high-order representations with activity in prefrontal cortex, which is assumed to be the area with the required higher-order representations. On certain higher-order theories, one can be in a conscious visual state even without any

visual system activity, as long as one represents oneself as being in that state.

Empirical tests of the higher-order theory against other accounts show the need to study the prefrontal cortex of a brain [51]. Based on the higher-order theory, lesions to prefrontal cortex should affect consciousness; therefore, testing the prefrontal cortex for consciousness is necessary [52]. Against higher-order theories, recent studies claim that patients with surgically removed prefrontal cortex maintain preserved perceptual consciousness [53], which gives support to recurrent processing theories, therefore, deem that prefrontal cortical activity is not necessary for consciousness.

At last, Integrated Information Theory emphasizes on the concept of integrated information to explain generic consciousness, and it assumes consciousness needs a grouping of elements within a system that has physical cause-effect power upon one another[54-56].It postulates that any conscious system must possess three properties, which include: I) The existence of consciousness advocates a system of mechanisms with a specific cause-effect power. II) The organizational nature of consciousness suggests that its mechanical elements within a system must have the ability to combine and that those combinations have cause-effect power. III) Since consciousness is informative; it must specify or differentiate one experience from others.

This theory claims that consciousness is identical to a certain kind of information, in which its realization requires physical, not merely functional integration, which can be measured mathematically according to the Φ metric. In principle, it proposes the Φ metric to quantify consciousness and attempts to explain the nature and source of consciousness by incorporating that the system carries integrated information if the useful informational content of the whole is greater than the sum of the informational content of the parts. If there is no partitioning where the summed informational content of the parts equals the whole; then the system carries integrated information, and it has a positive value for Φ. Intuitively, the interaction of the components adds more to the system than the parts acting alone.

This theory attempts to bring a balance by preserving the cartesian intuitions that experience is immediate, direct and unified, but on the other hand, it takes neuroscientific accounts of the brain for an understanding of what the nature of a physical system must be to be conscious [57].The methodology of the most developers of this theory that are neuroscientists involves characterizing the primarily subjective nature of consciousness and postulating the physical traits necessary for a system to realize it. The theory claims that these predictions agree with observations of the brain's physical realization of consciousness; therefore, once the brain does not present the necessary attributes, it does not create consciousness. Encouraged by these predictions, it generalizes its claims beyond human consciousness to animal and artificial consciousness. Since it identifies the subjective experience of consciousness with objectively measurable dynamics of a system, it can be measurable in principle, and consequently, proposes the Φ metric to quantify consciousness [58]. Recent new studies present more novel and practical methods to estimate Φ from high-density EEG that can apply to different states of consciousness. The investigation of the EEG properties corresponding to Φ metric enables to gather information on large-scale network correlates of various states of consciousness [59,60].

VIII. Conclusion

This paper attempts to gather and present the features necessary to produce a machine consciousness with a more human-like experience for artificial systems. If the essential computational features that conscious brains possess and currently lack in machines can be implemented, then artificial systems that appear natural would be possible. In addition to the interpretation of consciousness as a metaphysical phenomenon, this paper presents its concrete definition based on the models and biological study of conscious brains. Here the author compared the various existing models of consciousness to highlight the essential and distinct features of what makes the machine aware. Even though, the definition of consciousness very much equals a biological perspective; the proposed machine consciousness is entirely computational and includes various phenomenological characteristics of consciousness. Based on the models and features presented in this paper, the organization of machine consciousness is a functional property and progressively approximated by incorporating features such as a workspace for global information sharing, up to date self-knowledge, statistical programs, error detection systems, and theory of mind, which the latter allows modeling other minds and use this information to maximize the usefulness of data. Also, machine consciousness needs to be an emerging phenomenon as the development of the human brain indicates that functional units such as prefrontal and anterior temporal cortex are responsible for the emergence of consciousness. As the central administration that controls and coordinates all processes, whether conscious or sub conscious is necessary for developing consciousness, the machine model of consciousness should mimic the biological systems functionally and retains a distinct architecture and basic algorithm for implementing consciousness. The conscious machine with its proposed features might be neither complete nor practically feasible at present; however, it should guide building models of conscious machines in the future.

We may not need to wait and see if computers become conscious as the design of more complicated computers has not yielded any satisfactory result. Instead, we may need to be more foresighted and proactively integrate machine consciousness in the new design processes to have immediate benefit from its function.Interesting philosophical and empirical studies can be done, which involve other fields in addition to computer sciences such as humanities, divinity, natural sciences, and psychology as an empirical science. It may be more useful to design a machine in a way that it concludes it has consciousness and can prove this conclusion. This intelligent machine then can use its self-model to regulate its data flow and understand the actions of others.

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

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

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

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

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

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

It is mandatory to read all terms and conditions carefully.

Auxiliary Memberships

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

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

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

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

The Institute will be entitled to following benefits:

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

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

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

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

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

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

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

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

The following entitlements are applicable to individual Fellows:

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

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

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

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

Other:

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

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

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

Note :

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

"

Preferred Author Guidelines

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

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

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

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

Before and during Submission

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

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

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

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

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

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

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

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

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

Changes in Authorship

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

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Appealing Decisions

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

Acknowledgments

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

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Preparing your Manuscript

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

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

Manuscript Style Instruction (Optional)

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

Structure and Format of Manuscript

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

A research paper must include:

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

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

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

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

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

Format Structure

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

All manuscripts submitted to Global Journals should include:

Title

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

Author details

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

Abstract

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

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

Keywords

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

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

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

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

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

Numerical Methods

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

Abbreviations

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

Formulas and equations

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

Tables, Figures, and Figure Legends

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

Figures

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

Preparation of Eletronic Figures for Publication

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

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

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

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium 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

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ISSN 9754350