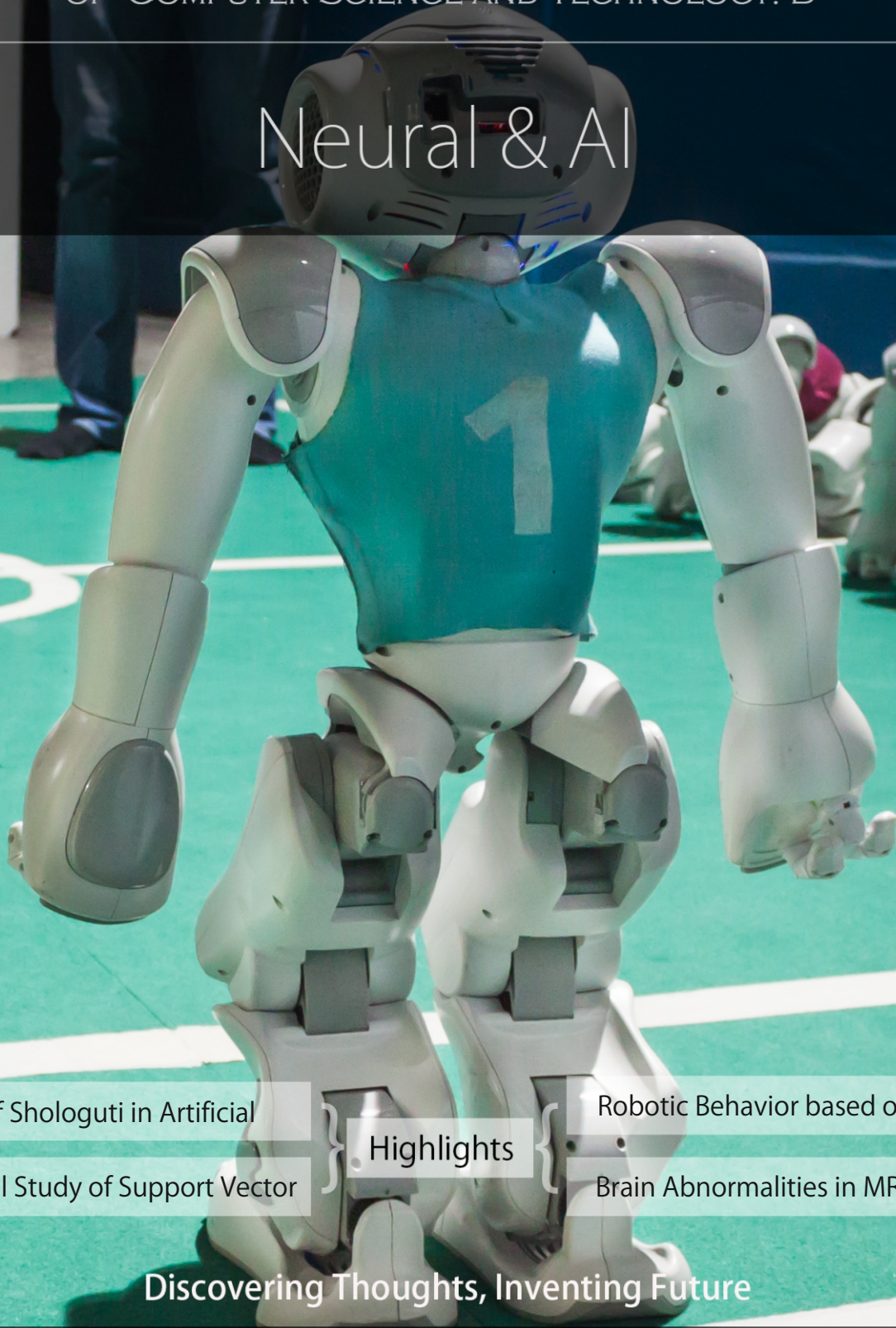


# GLOBAL JOURNAL

OF COMPUTER SCIENCE AND TECHNOLOGY: D

## Neural & AI



Role of Shologuti in Artificial

Analogical Study of Support Vector

Highlights

Robotic Behavior based on Formal

Brain Abnormalities in MRI Images

Discovering Thoughts, Inventing Future

VOLUME 18 ISSUE 2 VERSION 1.0



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NEURAL & ARTIFICIAL INTELLIGENCE

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## Robotic Behavior based on Formal Grammars

By J. L. Briseño, M.A. Jiménez & G. Olague

*Abstract-* Formal grammars, studied by N. Chomsky for the definition of equivalence with languages and models of computing, have been a useful tool in the development of compilers, programming languages, natural language processing, automata theory, etc. The words or symbols of these formal languages can denote deduced actions that correspond to specific behaviors of a robotic entity or agent that interacts with an environment. The primary objective of this paper pretend to represent and generate simple behaviors of artificial agents. Reinforcement learning techniques, grammars, and languages, as defined based on the model of the proposed system were applied to the typical case of the ideal route on the problem of *artificial ant*. The application of such techniques proofs the viability of building robots that might learn through interaction with the environment.

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# Robotic Behavior based on Formal Grammars

J.L. Briseño <sup>α</sup>, M.A. Jiménez <sup>ο</sup> & G. Olague <sup>ρ</sup>

**Abstract-** Formal grammars, studied by N. Chomsky for the definition of equivalence with languages and models of computing, have been a useful tool in the development of compilers, programming languages, natural language processing, automata theory, etc. The words or symbols of these formal languages can denote deduced actions that correspond to specific behaviors of a robotic entity or agent that interacts with an environment. The primary objective of this paper pretend to represent and generate simple behaviors of artificial agents. Reinforcement learning techniques, grammars, and languages, as defined based on the model of the proposed system were applied to the typical case of the ideal route on the problem of *artificial ant*. The application of such techniques proofs the viability of building robots that might learn through interaction with the environment.

**Keywords:** context-free grammars, robotic behavior, intelligent agent, machine learning.

## I. INTRODUCTION

Advances in artificial intelligence (AI) have supported to the development of sciences and disciplines whose influence leads to experimentation and application of new techniques that seek an optimal solution or high performance, depending on the problem that has arisen. The problem of emulating human navigation skills in an environment involves the analysis of behaviors of the humans, which are mapped to cases of robots or humanoids to develop in them mechanisms needed to help find solutions to specific problems. Such mechanisms form the structure of models that encompass interactions between the modules involved in the solution of such a problem. In this paper, the proposed model follows the basic structure defined by Russell and Norvig on learning agents [1]; then considering modules of events and actions that interact with the environment through sensors and actuators. The functionality of such modules lies in the implementation of context-free grammars as a tool for describing and build robotic behaviors. The purpose of this work is to manage behaviors of agents acting within an environment, based on grammars and formal languages. Some work in this direction will be mentioned briefly in the next section. In section 3 the fundamental principles of regular grammars will be addressed; as they are used to describe knowledge about events and actions, as well as determine the language of valid words that define behavior. Section 4 describes the fundamental concepts of grammars, terminology, and reinforcement learning (RL) used in finding the solution on the Santa Fe Trail

problem [2]. The last two sections 5 and 6 show the results and conclusions respectively.

## II. RELATED WORK

In the recent years, few approaches based on formal grammars have been used to learn behaviors in robot navigation problems. Some of these approaches outline the use of bio-inspired mechanisms to build systems with human-like behavior based on spiking neural networks (SNN) [3]; Others that use the RL, Bayesian techniques, and decision trees, rely on human experience and pretend that a robot agent learns to make decisions in generalized models [4], [5]. Otherwise, the ART system [6] considers learning behaviors as a classification problem, and uses a neural network to increase the learning capacity without losing earlier information of other behaviors when they are learning new ones; also integrated audio, and vision models in the current perception of the behavior are observed. Within the first work on behavior and autonomy of robots, in [7] these issues are described based on the representation in nets and using genetic algorithms (GA) as a method to search movements which are learned and generated from the states involved in a net. Regarding the generation of behaviors in [8] are proposed architectures that emulate cortical regions of the human brain which relate modules perception declarative memory, and objectives management. Such modules supported in production systems respond to patterns of information stored on the work memory engaged. In [9], behaviors are in software architecture designed to handle reusable components where each of them has a specific role based primarily on finite state machines (FSM). On the other hand, below the context of using of formal languages for generating robotic behaviors, Manikonda, et al., [10] propose techniques and models with differential equations based on kinetic state machines. In more recent work, Dantam and Stillman [11] formally develop the concept Grammar Movements doing a complete linguistic analysis for robotic control, being very similar some of its specific goals with the particular implementation presented in this article.

## III. FUNDAMENTALS OF LANGUAGES, GRAMMARS AND SYSTEM MODEL

The languages described by formal grammars are of great practical importance in the definitions of programming languages, formalization of the rules of the grammars based on the parsing, simplified

Author <sup>α</sup>: e-mail: briseno@cicese.mx

translations of languages, and applications for pre-processing chains (words). Each language determined by an abstract computing model: finite automaton, pushdown automata, linear bounded automata, and Turing machines, prescribes regular, context-free (CFLs), context-sensitive, and recursively enumerable languages, respectively.

a) *Context-Free Grammars*

A *context-free grammar (CFG)* is a finite set of variables (non-terminals or syntactic categories) where each represents a language. These languages represented by the variables are described recursively each other and regard also primary symbols called terminals. Rules that relate these variables are called productions. Formally a *CFG* is denoted as  $G = (V, T, P, S)$ , where  $V$  and  $T$  are finite sets of *variables* and *terminals* respectively. Each production in  $P$  is of the form  $A \rightarrow \alpha$  where  $A$  is a variable which can be replaced by a chain ( $\alpha$ ) of symbols regardless of the context,  $\alpha$  must be not empty, with symbols of the set  $(V \cup T)^*1$ ,  $S$  is a special variable called *start* symbol. Some common conventions for grammars are a) the capital letters  $A, B,$

$C, D, E,$  and  $S$  denote variables;  $S$  is a start symbol unless it stated in another way. b) The lowercase letters  $a, b, c, d, e,$  *digits*, and *expressions* in "bold" are terminals. c) Capital letters  $X, Y,$  and  $Z$  denote symbols that can be variables or terminals. d) The lowercase letters  $u, v, w,$  and  $z$  denote terminals. e) The lowercase Greek letters  $\alpha, \beta,$  and  $\gamma$  denote strings of variables and terminals. For further explanation on these issues see Hopcroft and Ullman [12].

In this paper, we will define in the next section, *Robotic Behavior Grammar (RBG)* according to the formal description of the *CFG*.

b) *System Model*

Respect to the system model, this paper follows the general concept of a learning agent according to [1] so that the functional mapping defines the relevant modules regarding specific applications addressed by the *RBG*. The model consists of four main components (Figure 1) linking an agent and an environment. The events module tells the element learning how things are happening about a standard fixed performance, in this case, the target's progress of the agent.

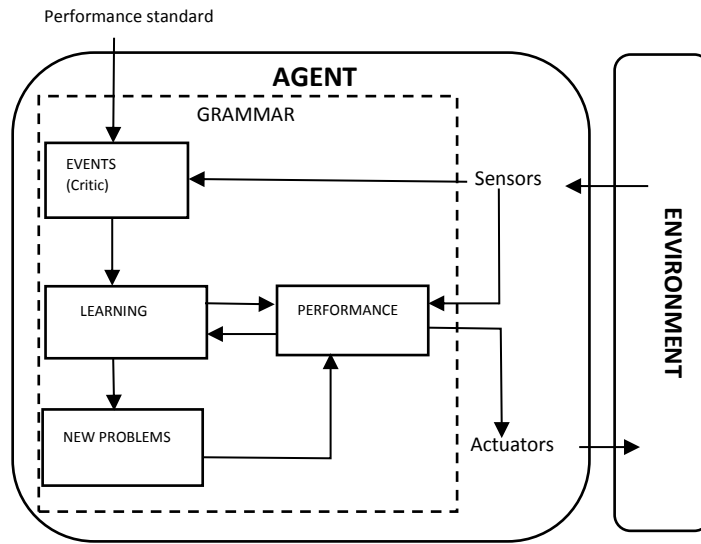


Figure 1: The general model of Robotic Behavior Grammar (RBG).

In the *RBG* model, the *sensors* detect occurrences of *events* in the *environment* which may be a valid event, a non-event, and a repeated event. If a valid event occurs in this *environment*, the *events* module recognizes it as a variable  $V$  corresponding to a fact derivable  $Ed$  then defining it as  $VED$  and verifying that belongs to the set of productions to the derivation of events  $PEd$ . The learning element will process that information to decide whether the "word" (*event or fact*) is valid in the language generated by the grammar used. The performance module then looks for the production

$P$ , which relates an action  $a$ , and a derivate event  $e$  in the set of productions of actions to events  $PEa$ . Thus, an external operation carried out by the actor in the environment is selected. As the event is null when it was not generated or fired any event; or repeated, when the agent is in the same state as a previous one, the expansion of variables continues without affecting the current derivation. The process of the agent's behavior ends when its achieved the goal, or when that means reaches a predetermined time limit. For a more versatile agent, the problems generator module takes the current knowledge and can formulate new rules to new situations or to find particular areas of behavior that are susceptible to improvement.

<sup>1</sup> The asterisk right here indicates the possible set of relationships between variables and terminals involved.

#### IV. TERMINOLOGY AND CONCEPTS

##### a) Grammars

A grammar of robotic behavior  $RBG = (V, \Sigma, P, S)$  define the components as follows:  $V$  is the set of variables  $V = \{VAc, VEa, VEd, Vaux\}$  where  $VAc$  are variables representing complex actions,  $VEa$  are variables representing events or states,  $VEd$  is called a derivation variable of facts, and  $Vaux$  are auxiliary variables.  $S$  is the symbol of the start function, which belongs to the subset  $VEa$ .  $\Sigma$  contains the terminal symbols for the primary actions of the agent. The symbol  $P$  are the productions divided into several subgroups directly related to subsets of  $V$ . These productions are:  $PAC$ , which are productions of complex actions;  $PEa$ , which are productions to select actions for events;  $PEd$  indicating outputs to derivation of events;  $Paux$  indicating auxiliary productions for operations;  $PSEenv$  indicating productions of extension, and  $PSEnuln$  productions of suppression.

##### b) Generating behaviors

The RBG can generate behaviors using grammars derivation process, which depends on the different subsets of variables and productions. Those behaviors lead to executing routines that rely on the expansion of production rules. For example, a variable that can be expanded in many different ways, unless there are certain conditions, will always be extended by the same production rule. Whenever is expanded a variable, and a new terminal symbol appears, a corresponding primary action for such a symbol will run. Derivation default will be leftmost derivation, which guarantees a particular order in the process that generates behaviors.

##### c) Learning

Reinforcement learning (RL) is the method considered in this work. With this method, the robotic agent learns to select an action from several of them possible involved in a particular state. With reinforcement learning the agent seeks to learn an optimal policy  $\pi$ , which for some state  $s$ , recommend an action  $a$  that helps the agent to meet its goal. For this process is performed a mapping between the elements of the grammar of behaviors and RL. The reinforcement learning process was carried out using standard algorithms, once are identified states, actions and a control policy for a grammar of behaviors (in this case the RBG). Note that transitions, utilities, and the learning, tend to vary depending on the problem. In an  $RBG = \{V, \Sigma, P, S\}$ , the productions of the subset  $PEa$  (member of the set  $P$ ), have the form  $Ex \rightarrow Ai$  where  $Ex$  is a variable that represents an event, and belongs to the subset  $VEa$ ,  $Ai$  is a variable (where  $i=1,2,\dots,n$ ) representing an action which belongs to the subgroup  $VAc$ . The purpose of the agent is to learn a policy  $\pi$ :

$S \rightarrow A$ , such that it dictates the next action  $at$  to be executed when the agent is in a state  $st$ , ie,  $\pi(st)=at$ .

Using that policy to generate the most significant utility it's found one way to specify which strategy to use. An arbitrary policy  $\pi$  from a random initial state  $st$  defined the cumulative value  $V \pi(st)$  according to the equation:

$$V(st) \equiv \sum \gamma^i r_{t+i} \quad (1)$$

where  $r_{t+i}$  indicates the sequence of generated rewards, which starts at a state  $st$  as a result of using a policy  $\pi$  for selecting actions. The formula (1) indicates that starting in state  $st$  and then implementing the actions recommended by the policy  $\pi$ , the sequence of rewards is obtained [13]. The parameter  $\gamma$  (*gamma*) defined by an assignment of values between 0 and 1, is known as the discount factor, and it indicates the preference between immediate rewards on future rewards. The smaller the value of  $\gamma$ , future rewards will be less significant for the agent. In general, it's intended that the agent learns a policy that maximizes  $V \pi(s)$  for all states  $s$ . This procedure is called optimal policy, given by

$$\pi^* \equiv \operatorname{argmax} V \pi(s), (\forall s) \quad (2)$$

#### V. DEVELOPMENT AND IMPLEMENTATION

##### a) Grammar for the passage of Santa Fe

It will describe the design and implementation of the RBG based on the context of the problem of *artificial ant* in the particular instance Santa Fe Trail [2]. The aim of the *ant* is eating all the food (cells in black), running all the way, in the shortest possible time; the stage in which the artificial *ant* acts is a 32x32 grid of squares (cells), as shown in Figure 2. Its considered the ant as being the agent that starts in the box at the left upper corner (0,0) facing right and has the following limitations: partially observable environment (only can see the place in which it is) and will have three basic actions:

- Move a unit forward.
- Rotate 90 degrees clockwise.
- Rotate 90 degrees counterclockwise.

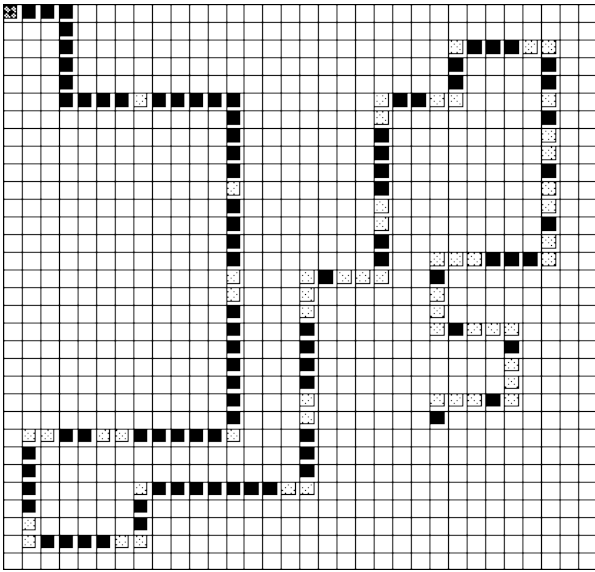


Figure 2: The artificial ant on the Santa Fe Trail problem

The path is irregular and consists of 89 pieces of food, which can be placed consecutively or separated by jumps. Jumps can vary but follow specific patterns, which are: jumps in a straight line, single and double; jumps corner, individual, double (how a horse moves in chess) and triples. The *artificial ant* (Agent) will do the corresponding derivations of the *RBG* after the completion of the algorithm of Figure 3. In this algorithm, the implied grammar will define the events that the agent will receive. Are defined the actions as production rules, and they are explained by a control policy which will select the step to take when an event happens.

The Agent can do three necessary actions, which in the grammar through the terminal symbols (*f*), (*r*), (*l*), could represent movement toward the front, turn right 90°, and turn left 90°, respectively. When through the derivation process a new terminal symbol has been adding to the string, the necessary action that corresponds with that terminal symbol will run. From basic movements, are formed complex actions which belong to the subset of productions *P<sub>Ac</sub>*. When is generated an event, will be selected any of these productions (rules). In the case of agent *RBG* = (*V*,  $\Sigma$ , *P*, *S*), its components are defined as follows:

$$V = \{VAc, VEa, VEd\} \quad P = \{PAc, PEa, PEd, PSEev1\}$$

$$S = \{[START]\} \quad \Sigma = \{(r), (l), (f)\}$$

$$VAc = \{[ROT RIGHT], [ROT LEFT], [FORWARD]\}$$

$$VEa = \{[START], [ROT 360], [WALL INFRONT], [FOOD], [NO FOOD]\}$$

$$VEd = \{[EVENT]\}$$

$$PAc = \{[ROT RIGHT] \rightarrow (r)[EVENT][ROT RIGHT], [ROT LEFT] \rightarrow (l)[EVENT][ROT LEFT], [FORWARD] \rightarrow (f)[EVENT][FORWARD]\}$$

$$PEd = \{[EVENT] \rightarrow [START] \mid [ROT 360] \mid [WALL INFRONT] \mid [FOOD] \mid [NO FOOD]\}$$

$$PEa = \{[START] \rightarrow [ROT RIGHT] \mid [ROT LEFT] \mid [FORWARD], [ROT 360] \rightarrow [ROT RIGHT] \mid [ROT LEFT] \mid [FORWARD], [WALL INFRONT] \rightarrow [ROT RIGHT] \mid [ROT LEFT], [FOOD] \rightarrow [ROT RIGHT] \mid [ROT LEFT] \mid [FORWARD], [NO FOOD] \rightarrow [ROT RIGHT] \mid [ROT LEFT] \mid [FORWARD]\}$$

$$PSEev1 = \{[ROT RIGHT] \rightarrow \epsilon, [ROT LEFT] \rightarrow \epsilon, [FORWARD] \rightarrow \epsilon\}$$

Note that will use square brackets and parentheses to frame a variable or a terminal, respectively.

### The RBG algorithm

1. Start
2. Selecting actions
3. Execution of complex action
4. Running basic action
5. Check for event generated
6. Deletion and / or extension of variables
7. Derivation of events. The event is valid?

Yes. ↑ 2

No. ↓ 8

8. Derivation leftmost. Is it produce an action?

Yes. ↑ 4

No. ↓ 8

Figure 3: The general flow of grammar robotic behavior (RBG)

### b) Transitions, frequencies and utilities in the Reinforcement Learning (RL)

It will treat a nondeterministic transition function in the implementation of reinforcement learning. That is, when is required to do something to a state, the result will not always be the same, i.e., it hold a probabilistic transition  $Pr = (s, a, s')$ , which means the chance of going to the state *s'* by acting *a* from the state *s*. This function is unknown to the agent and, to approximate such function, it will use a table of frequency (*TF*) defined as:

$$TF [s, a, s'] = TF [s, a, s'] + 1$$

That is, for each time it's tried the pass from state *s* to *s'* using the action *a*, it will be adding 1 to the entry table that corresponds to such movement. Just as transitions between states occur, the utility function it presents in a non-deterministic way. Then, it's used a table of utilities (*TU*) to get updated as does the table of frequencies but, the difference is that it's updated *TU* only if the agent finds food in the new state *s'*. That is,

$$TU[st, at, s't+1] \leftarrow TU[st, at, s't+1] + Ct+1$$

iff  $s't+1$  contains food, otherwise

$$TU[st, at, s't+1] \leftarrow TU[st, at, s't+1] - 0.5$$

Where  $Ct+1$  is the number of boxes with food that the agent found at time  $t + 1$ .

i. *Q-Learning Function*

Since a strategy (policy) is required to show the best action for each state, a function is then used to recommend the optimal movement for that state when using frequency tables and utilities. It needs to update a Q-table using,

$$Q[s, a] \leftarrow updateQValues(s, a), \forall(\text{state-action pair } (s, a))$$

Where, *updateQValues* ( $s, a$ ) is a call to a function in the algorithm of Figure 4. If it's updated the table Q, it is possible to get simply the optimal policy, which, for a state  $s$ , is given by the following expression:

$$\pi^*(s) \leftarrow \max_a[s, a], (\forall(a), \forall(s))$$

During the execution of the algorithm, where defined values of 10 for the size of an epoch (times that it's repeated the journey), and values of 400 for the time limit permissible (necessary actions allowed) before concluding such a period.

The resulting policy guides the agent to find the 89 pieces of food on the Santa Fe path, and this policy it's represented by a string of integers, where each number represents the index of the optimal action for any state.

---

```

Algorithm updateQValues(s,a)


---


FUNCTION updateQValues(s, a)
INPUT: state-action pair(s, a)
var n ← 0
var total ← (times repeated of the pair(s, a))
var count ← 0
Repeat for all events s'
  var c ← TF(s, a, s')
  if c = 0? then
    n ← n + (UT[s, a, s'] * (c/total))
    count ← count + 1
if count > 0? then
  OUTPUT: (n/count)
if count ≤ 0? then
  OUTPUT: 0
    
```

---

Figure 4: Auxiliary function for the updating of the table Q(s, a)

For example, for a numerical policy 3 3 1 3 1 wherein, the mapping corresponding with each production rule that belonging to subset PE takes the form:

$$[E] \rightarrow [A1] \mid [2] \mid [A3] \mid \dots [Ax]$$

and knowing that the policy is  $\pi^*([E]) = n$  where  $n$  indicates the  $n$ -th optimal action to follow for such an event  $[E]$ , then the resultant learned control policy (3 3 1 3 1) for the agent can be rewritten, as follows:

$$\begin{aligned} \pi^*([START]) &= 3 \\ \pi^*([ROT\ 360]) &= 3 \\ \pi^*([WALL\ INFRONT]) &= 1 \\ \pi^*([FOOD]) &= 3 \\ \pi^*([NO\ FOOD]) &= 1 \end{aligned}$$

## VI. RESULTS AND CONCLUSIONS

The software implemented to meet results to the issues raised in this paper can be found in <ftp://ftp.cicese.mx/pub/divFA/ciencomp/brisenol/> where its possible to download the software, and all the necessary information to verify the algorithmic implementation of the agent's behavior. The Santa Fe Trail problem has also been addressed based on other algorithms applicable to machine learning, such as genetic algorithms (GA). The last option, although not described in this paper, was also considered in the experimental runs for comparative purposes. It's possible to see, in Figure 5, that the reinforcement learning algorithm of the RBG found an effective strategy after the sixth attempt in about 13 seconds to get all the foods.

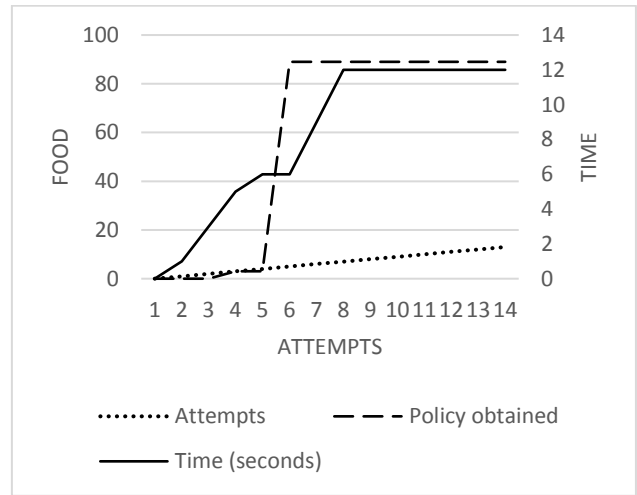
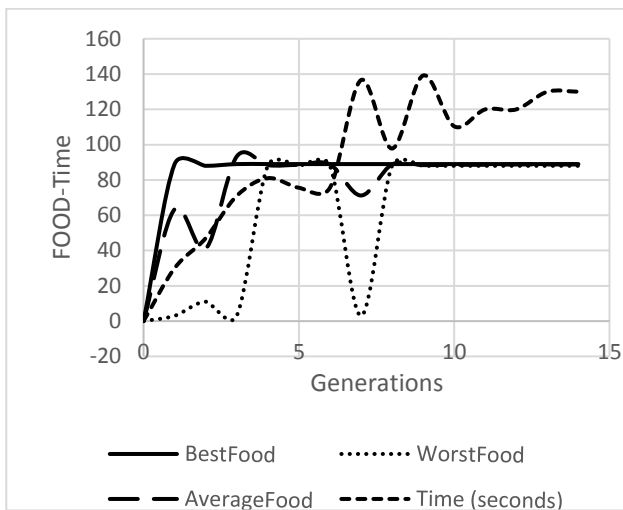


Figure 5: Performance of the Reinforcement Learning Algorithm to learn the best policy based on the Robotic Behavior Grammar applied to the Santa Fe Trail problem

On the other hand, the RBG implemented with Genetic Algorithms, in Figure 6, describes the performance of the best individual, the average individual, the worst individual, and the convergence of them after the eighth generation, between 100 to 140 seconds. The above proves a better performance when it's used the Reinforcement Learning technique according to the procedure described in section 5.



**Figure 6:** Performance of the Genetic Algorithm to learn the best individual based on the Robotic Behavior Grammar applied to the Santa Fe Trail problem

The results showed that formal grammars are a possible method to represent and generate behavior of agents (robots) that interact with an environment. Besides, the techniques of machine learning, as in this case reinforcement learning, can help in the derivation process of the productions involving these grammars, so the agent can optimally meet your goal. In future work, it is considered to include grammars induction techniques to automate the capture of grammars applicable to unforeseen circumstances or in cases of dynamic environments.

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## Analogue Study of Support Vector Machine (SVM) and Neural Network in Vehicle's Number Plate Detection

By Jyoti Kapasiya & Vishal Jayaswal

**Abstract-** Recognition of vehicles has always been a desired technology for curbing the crimes done with the help of vehicles. Number imprinted on plates of cars and motorbikes are consist of numerals and alphabets, and these plates can be easily recognized. The uniqueness of combination of characters and numbers can be easily utilized for multiple purposes. For instance, fines can be imposed on people automatically for wrong parking, toll fee can be automatically collected just by recognizing the number plate, apart from these two there may be several numbers of uses can be accommodated.

Computer vision is comprehended as a sub space of the computerized reasoning furthermore software engineering fields. Alternate ranges most firmly identified with computer vision are picture handling, picture examination and machine vision. As an exploratory order, computer vision is apprehensive with the counterfeit frameworks that concentrate data from pictures and recordings.

**Keywords:** data encryption, machine learning, beural network, support vector machine.

**GJCST-D Classification:** 1.5.1



*Strictly as per the compliance and regulations of:*



# Analogical Study of Support Vector Machine (SVM) and Neural Network in Vehicle's Number Plate Detection

Jyoti Kapasiya <sup>α</sup> & Vishal Jayaswal <sup>σ</sup>

**Abstract-** Recognition of vehicles has always been a desired technology for curbing the crimes done with the help of vehicles. Number imprinted on plates of cars and motorbikes are consist of numerals and alphabets, and these plates can be easily recognized. The uniqueness of combination of characters and numbers can be easily utilized for multiple purposes. For instance, fines can be imposed on people automatically for wrong parking, toll fee can be automatically collected just by recognizing the number plate, apart from these two there may be several numbers of uses can be accommodated.

Computer vision is comprehended as a sub space of the computerized reasoning furthermore software engineering fields. Alternate ranges most firmly identified with computer vision are picture handling, picture examination and machine vision. As an exploratory order, computer vision is apprehensive with the counterfeit frameworks that concentrate data from pictures and recordings. The picture information can take numerous structures, for instance, segmentations of videos, taken from several cameras.

This thesis presents a training based approach for the recognition of vehicle number plate. The whole process has been divided into three stages i.e. capturing the image, plate localization and recognition of digits over the plate. The characteristics of HOG have been utilized for training and SVM has been used for adopted for classifying while recognizing. This algorithm has been checked for more than 100 pictures.

*General Terms:* ITS, NPR, SVM, ANN, ML.

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## I. INTRODUCTION

At present, Indian vehicle registration number pattern starts with two characters representing state, followed by two digit code representing the transport office, followed by one or two character representing series of registration, followed by a four digit number indicating the serial number within the series like: UP15 EB 1234. Further, the registration scheme for union territory is slightly different. Union territory region registration number pattern has two characters region code, taken after by an arrangement code like 2M implying second arrangement for motorbikes and 14C connoting fourteenth arrangement for private autos and so forth.

*Author α:* PG Student, Department of Computer Science & Engineering, MIET Meerut, India. e-mail: jyoti.kapasia@gmail.com

*Author σ:* Assistant Professor, Department Computer Science & Engineering, MIET Meerut, India. e-mail: vishal.jayaswl@miet.ac.in

The union territory region registration patterns are like: DL 6C 2108. However, in India the size of number plate, font style and font sizes are not standardized. In some cases vehicles are frequently employed directly or indirectly in a wide variety of criminal and fraudulent activities. Conventional methods of investigation for involvement of vehicles in crimes and frauds is, either by deploying a very large police task force or aerial pursuit of criminals using helicopters, are largely cumbersome, expensive and ineffective. Further, the traditional system [1] of investigation depends on the human eye witness by law enforcers which is inadequate. In fact, in recent years, it is noticed growing reluctance or unwillingness by individuals to cooperate with the police for one or the other reason. Such a conventional system is an inefficient system and takes long time for investigation thus leading to cover the offence.

The development of Intelligent Transportation system has grown rapidly over the last two decades with the progress of the computer vision technologies. PC vision is the science and advancement of machines that see and get it. As an exploratory order, computer vision is apprehensive with the counterfeit frameworks that concentrate data from pictures and recordings. The picture information can take numerous structures, for example, video groupings, sees from different cameras and so forth. Computer vision is comprehended as a sub space of the computerized reasoning furthermore software engineering fields. Alternate ranges most firmly identified with computer vision are picture handling, picture examination and machine vision.

Major applications of computer vision are: Surveillance systems, Gestures understanding, Sign Language understanding, Face Recognition, Road Monitoring, Biometrics, Planetary Exploration, Industrial Inspection, Autonomous Driving, Robotic Control, Medicine, Docking, Military, Remote Sensing, Automatic perusing of information or data from archives, Objects Recognition and so on. The other important area of computer vision application is open for research is Automatic Reading of Number plates from vehicles. The need to comprehend the development of vehicles in our country's roadways is turning out to be more essential, since the development of cleared streets, confronted numerous issues with approaches to record vehicular



development. Not just this data is required for appropriate configuration of roadways; additionally new intelligent transportation systems (ITS) require constant learning of activity development to be successful. In the midst of current years, sharp transport frameworks are contained 16 sorts of advancements based systems. These systems are separated into savvy base frameworks and clever vehicle frameworks. PC vision and character acknowledgment calculations for Number Plate Recognition (NPR) Systems are utilized as centre modules for keen infrastructure frameworks like freeway, vehicle tracking, involvement in crimes, movement of suspicious vehicle, attack by terrorists, arterial management and electronic payment systems for traffic surveillance. NPR is one of the form of automatic vehicle identification. NPR utilizes picture handling techniques to recognize vehicles by their number plates. Presently vehicle plays a major role in transportation and requires an appropriate vehicle administration system.

## II. REVIEW OF LITERATURE

In this Paper [1] programmed distinguishing proof of vehicle turns out to be more functional in numerous applications with the quick improvement of an open transportation system. The system consequently recognizes a vehicle by perusing the number plate information from a picture or a video. The Automatic number plate recognition system is utilized distinguish the number plate under different perilous conditions like stormy, foggy climate impacts, low differentiation situations, objects like the number plate out of sight, and on a level plane tilted number plate. Diverse image processing methodologies, strategies, and calculations are utilized to construct programmed number plate recognition system technique to identify a number plate range from a picture or a video.

This paper [2] presents a training based approach for the recognition of vehicle number plate. The complete procedure has been segmented into 3 steps i.e. capturing the number plate's image, localization of plate and recognition of digits imprinted on the plate. HOG characteristics have been utilised for the purpose of training and SVM is deployed for the segmentation yielding in around 99% accuracy while recognising. The algorithm has been checked for more than 100 number plate pictures.

This work [3] developed completely unique methodology for the recognition of vehicle registration plate. The proposed method uses horizontal projection profile and Hough transform. Firstly, the extraction process of number plate from a given input image is located, then performed segmented the plate characters independently and applied template matching by using template data set for recognition of plate characters. Moreover, it is certain to be around 96% for the mining of plate area, 95% for partitioning optical character's

recognition unit correct, producing the whole system performance better than the current system. The time taken to identify a plate, is between 5 and 15 seconds which is relatively lesser than existing taken time which is more than 30 sec. Apart from this, the location of the vehicle can be accurately traced in GPS enabled cars.

In this Paper [4], This research paper is deals with the topic of Automatic Number Plate Recognition (Identification)(ANPI) utilizing application of Android OS, as of now there is not any image processing tool available on the standard Android mobile phone that could do this job. So, ANPI using Android application gives so many merits like higher identification performance, less consumption of resources, and less computational difficulty. In early researches, many researchers have utilized a great quality computer and high camera with high resolution quality to deploy the ANPR [1] system. In this work, the improving the performance of ANPR algorithm on inadequate hardware of Android phone is shown. By optimization of ANPR, many merits could be attained, like; higher identification accuracy, less consumption of and less computing complexity.

In this research paper [5], we've discussed the photograph processing method to put into effect the computerized toll collection with a purpose to lessen congestion and fraudulent behaviour on the toll checkpoints. In addition we have mentioned the working of the proposed device together with the smart card implementation and the automated deduction of the toll from the car owner's bank account. The proposed system will assist in lessen the human intervention at the toll collection areas. The motive of this research paper was to improvise the toll series in addition to put into effect a gadget for smartcard users as clever playing cards is being utilized by many human beings with the intention to keep away from bodily coins.

In this paper [6], we propose an automatic and mechanized license and number plate recognition (LNPR) system which can extract the license plate number of the vehicles passing through a given location using image processing algorithms. No additional devices such as GPS or radio frequency identification (RFID) need to be installed for implementing the proposed system. Using special cameras, the system takes pictures from each passing vehicle and forwards the image to the computer for being processed by the LPR software. Plate recognition software uses different algorithms such as localization, orientation, normalization, segmentation and finally optical character recognition (OCR). The resulting data is applied to compare with the records on a database. Experimental results reveal that the presented system successfully detects and recognizes the vehicle number plate on real images. This system can also be used for security and traffic control.

In this Paper [7], the growing affluence of urban India has made the ownership of vehicles a necessity. This has resulted in an unexpected civic problem - that of traffic control and vehicle identification. Parking areas have become overstressed due to the growing numbers of vehicles on the roads today. The Automatic Number Plate Recognition System (ANPR) plays an important role in addressing these issues as its application ranges from parking admission to monitoring urban traffic and to tracking automobile thefts. There are numerous ANPR systems available today which are based on different methodologies. In this paper, we attempt to review the various techniques and their usage. The ANPR system has been implemented using template Matching and its accuracy was found to be 80.8% for Indian number plates.

With the growing number of vehicles, finding a car park is a serious issue today for a large number of students and faculty at Educational Institutions. Most of the car parks are managed manually by security guards who do not keep a track of the number of vehicles entering and exiting the premises. Hence, the vehicle driver have to keep circling the car park in order to find a vacant slot leading to a wastage of time, not to mention the anxiety and frustration of the driver. The absence of the security guards may also lead to vehicle thefts.

In this Paper [8], automatic Number Plate Recognition (ANPR) system is an important technique, used in Intelligent Transportation System. ANPR is an advanced machine vision technology used to identify vehicles by their number plates without direct human intervention. It is an important area of research due to its many applications. The development of Intelligent Transportation System (ITS) provides the data of vehicle numbers which can be used in follow up, analyses and monitoring. ANPR is important in the area of traffic problems, highway toll collection, borders and custom security, premises where high security is needed, like Parliament, Legislative Assembly, and so on. Real time NPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads. Since every vehicle carries a unique license plate, no external cards, tags or transmitters need to be recognizable, only license plate.

### III. BASIC THEORY

One of the challenges in development of vehicle number plate recognition system is to outline models that work across a large variety of environments. A need for a model that detect, segment by combining features in real time is essentially required. Prior methodologies produced for discovery, division and acknowledgment of vehicle number plate experiences a few factors, for example, the division procedures not appropriate for constant applications and few issues like identification of perfect representation number plates, location of

situated number plates are not tended to. These requirements in NPR (Number Plate Recognition) system motivated us to take up research in NPR system to explore few approaches/solutions required in building generic NPR system.

Toll booths in India generally employ a purely visual system of vehicle classification. However this causes a huge loss of revenue to the firms operating the tollbooths due to rampant malpractices and discrepancies. To keep a tab on the operators some tollbooths employ a system using fibre optic sensors to automatically classify a vehicle in the background and tally the results with the manual entries. However this system is expensive complicated and requires high maintenance. We aim to study the various systems that can be used to replace such a system with a cheaper and efficient alternative. To keep a tab on the operators some tollbooths employ a system using fibre optic sensors to automatically classify a vehicle in the background and tally the results with the manual entries. However this system is expensive complicated and requires high maintenance. We aim to study the various systems that can be used to replace such a system with a cheaper and efficient alternative.

However the social scenario in India is significantly different due to problems such as poverty, unemployment as well as a considerably lower respect for rules. This makes it unfeasible to go for a completely automatic tollbooth. The industry requires an automatic vehicle classification system in India not to reduce or eliminate human intervention or labour, but to ensure that human intervention does not cause any financial malpractices. The industry requires a system that runs in the background and merely keeps a cross-check on the manual.

As already stated, the system using fibre optics inherently possesses a large number of problems apart from the main concerns of high cost and maintenance. Although an IR curtain system reduces the cost significantly, it is still quite expensive and cheaper alternatives are desired. As almost all the tollbooths employ cameras for security purposes, it was felt that the feasibility of a system using IP cameras should be tested.

In most recent couple of years, ANPR or tag acknowledgment (LPR) has been one of the valuable methodologies for vehicle observation. It is can be connected at number of open spots for satisfying a portion of the reasons like movement wellbeing implementation, programmed toll content gathering [1], auto stop framework and Automatic vehicle stopping framework. ANPR calculations are for the most part separated in four stages:

- i. Vehicle picture catching
- ii. Number plate recognition

- iii. Character division
- iv. Character acknowledgment

The initial step i.e. to catch picture of vehicle looks simple yet it is very critical assignment as it is exceptionally hard to catch picture of moving vehicle continuously in such a way, to the point that none of the segment of vehicle particularly the vehicle number plate ought to be missed. By and by number plate discovery and acknowledgment preparing time is under 50 ms in numerous frameworks. The achievement of fourth step relies upon how second and third step can find vehicle number plate and separate each character. As there is the request of unmanned tag acknowledgment (LPR) framework, and the advancement of computerized cameras and machine vision calculations made conceivable programmed LPR. Clearly the programmed LPR framework ought to have couple of blunders. The framework is identified with verifications, making charges, and law authorizations which are not tolerant to blunders. Some LPR frameworks accomplished palatable correctnesses in limited conditions, and late examinations are endeavouring to expand the acknowledgment exactnesses and to decrease the confinements. Most programmed LPR frameworks comprise of tag confinement (LPL), character division (CS), and character acknowledgment (CR) modules as appeared in the figure given below.

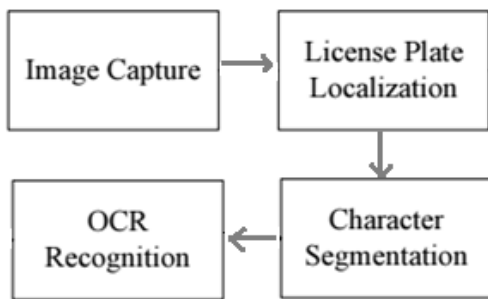


Fig. 1: Architecture of the License Plate Recognition system.

#### IV. PROPOSED METHODOLOGY

The proposed method replaces the traditional SVM with a more advance technique which incorporates the information provided by HOG Features with the computational power of Neural Networks.

The classifier is trained by using a 8-bit BMP image containing a list of alphabets. The alphabets are easily separated by computing their contours. Each position is assigned a label. The contours are fed to a HOG Descriptor which calculates its features. The new data and their labels are fed to a Neural Network. The network is expected to coverage before 5000 iterations.

One by one, images are feed to the model. The images must be cleaned before they are passed. First we need to identify the number plate inside the image. If there is no number plate, the algorithm waits. When a

number plate is detected, its contours are detected and it is separated into different sections. HOG features of each section are computed separately and they are feed to the classifier one at a time. The final predictions by the model are printed.

In our approach the data is thoroughly tested and trained to perform and act better on various types of low or high quality images. These measures have been adopted to make this technique rigorous to work in better in every situation without comprising the quality of the results. The steps taken in testing and training are described below step by step in the upcoming text.

##### a) Testing

The image is captured of the vehicle and then after analysis takes place on that image to detect the number plate of that vehicle. After identifying number plate, contours of the segmented characters are detected. Later in this procedure HOG feature is calculated for each contour. Then after the characters of the number plate are predicted using classifier.

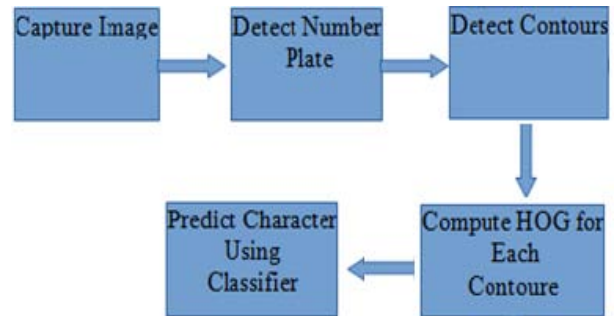


Fig. 2: Testing Procedure of Custom Neural Network Training.

The data is trained to act and work as it promises rigorously. First of all, in this process the image of the alphabet is loaded into the system later in this stage the contours of the characters are computed. Then-after the each contour is named. After labelling the each and every contour the HOG feature of all contours are computed. After calculating the HOG feature of each contour, the classifier is prepared to segment the character, using Neural Network.

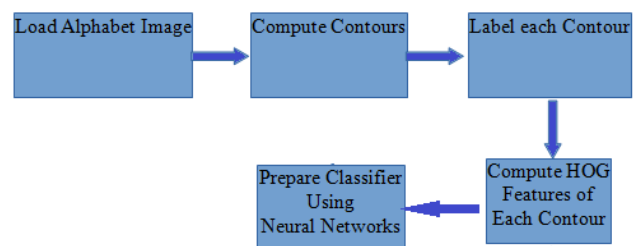


Fig. 3: Training Procedure of Custom Neural Network.

Neural network is parallel computing approach; this technique is used to provide the intelligence to a

computing device. The main aim is to produce a system to carry out several computing jobs faster than the classical systems. Neural network can be defined in easy terms as capability to learn, memorize and generalize, prompted research in algorithmic modelling of biological neural systems.

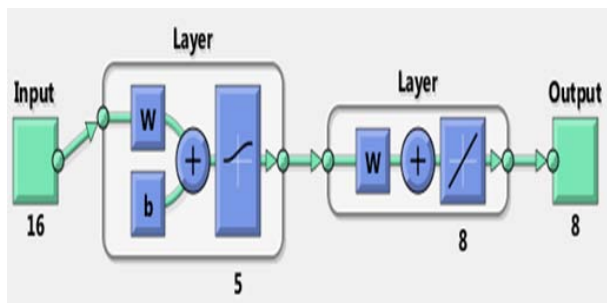


Fig. 4: Custom Neural Network of Proposed Method  
Work Flow of Proposed Method.

- First of all the pre-processed images are fed into the system.
- The images that are converted from RGB to Greyscale images, then after normalization is applied for noise-removal; this is done for image enhancement and then these enhanced images are called pre-processed images.
- Plate region extraction takes place, in this step the image area other than number plate is discarded.
- After extracting the number plate region, the inversion of the localized plate is applied, after inversion of that region characters are appeared.
- Then-after segmentation is applied on each number and character to separate each and every number clearly.
- In this step HOG feature is extracted from segmented numbers and characters to properly recognise the number plate.
- Now, extracted features are recognized with the help of trained data.
- In this step, the characters are recognized with help of Neural Network, and the exact numbers are provided as output.
- Parameters i.e. Accuracy and Execution Time are calculated.
- These parameters are compared with existing SVM classifier, which proves that neural network technique is way better than SVM.s

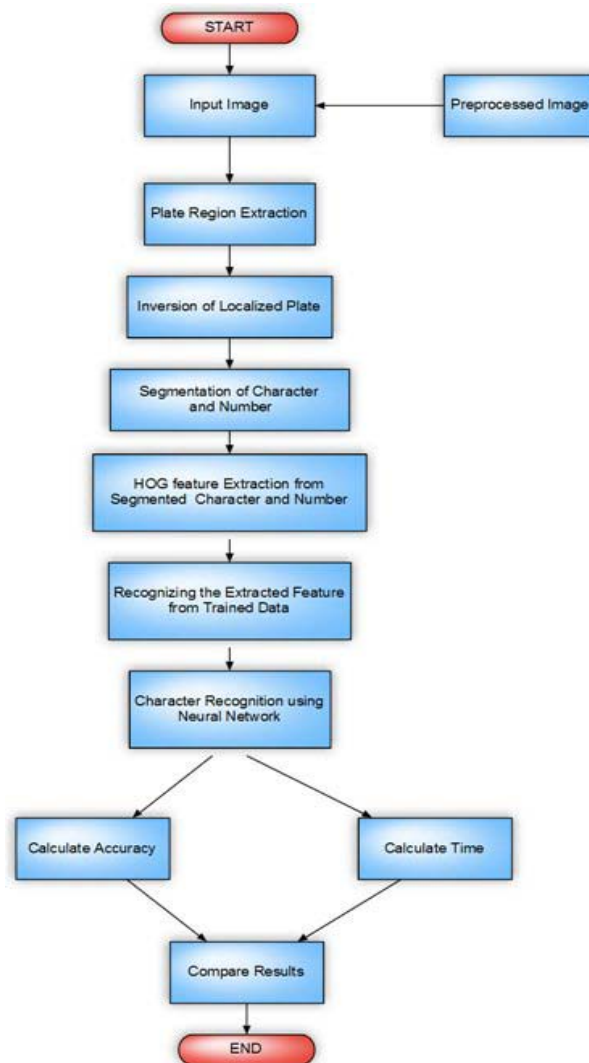


Fig. 5: Flowchart of Proposed Method.

## V. EXPERIMENTAL RESULTS

Several sample images have been utilized for this research procedure and to discover the outcomes. The information for image were extremely dimensional, and several attributes have been considered finally, on the basis of necessities. The image is tested using MATLAB and processed it with SVM Classifier and Artificial Neural Network one by one and outcomes are compared of both technologies.

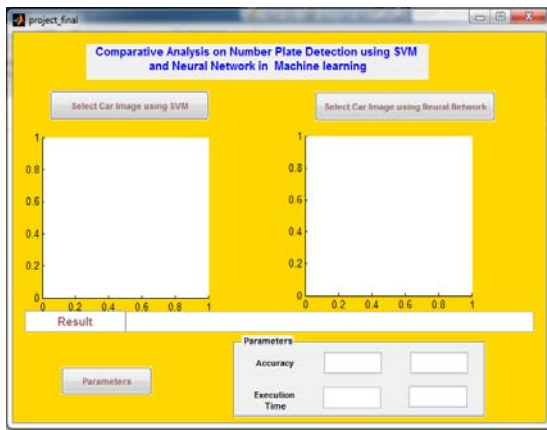


Fig. 6: GUI in Command Window.

This is command window to load, analyze and compare the results of images after running with SVM and ANN as well. Results are compared on 2 parameters accuracy of the result and total time taken to execute the image from start till end.

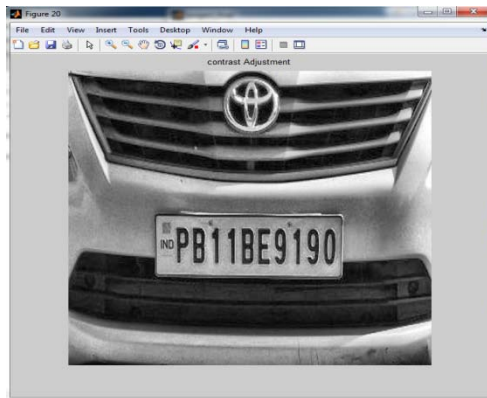


Fig. 7: Image after browsing with the SVM.

In the Figure 3, shown above, this is the preprocessed enhanced image which is browsed to detect the number plate with greyscale effect after that character and number will be segmented in separate images to detect the number plate recognition.



Fig. 8: Preprocessed Image after plate localization in SVM Classifier.

The above Fig 4, After the enhancement of the image only number and character are shown and all the part of image is blacked after that the only part of number plate is cropped.



Fig. 9: Cropped Image after plate localization.

After the contrast adjustment for number plate. The plate is cropped after that character and number are segmented in separate images to recognize the number plate.



Fig. 10: GUI with results after detection of number plate using SVM.

In Fig 7, This is the GUI of code where we're running the code to detect the number plate after the running the first part of code which is using SVM classifier to recognize the number plate. The Result is showing that number plate is detected and also showing the processed image in which character and number are circled for recognition. And in this image parameter are showing in terms of accuracy and execution time. Accuracy is approximately 96% and execution time approximately 20 seconds. Now, we run the other part of the code for comparison.

Now we'll repeat the same procedure but this time the technology will be Neural Network with ML(Machine Learning).

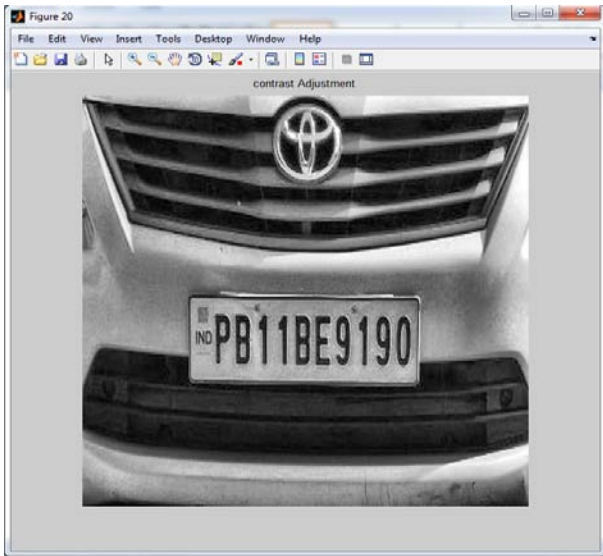


Fig.11: Histogram of Encrypted Image when after running Modified AES.

In the Figure 8, this is the preprocessed enhanced image which is browsed in proposed method to detect the number plate using neural network with greyscale effect after that character and number are segmented in separate images to detect the number plate recognition.



Fig.12: Preporcessed Image after plate localization in neural network.



Fig.13: Preporcessed Image after plate localization in neural network.

As shown in the Fig 4.11, After the contrast adjustment for number plate. The plate is cropped for neural network after that character and number are

segmented in separate images to recognized the number plate.

After this the parameters of Neural networks were analysed and compared in terms of accuracy and time taken to execute the whole process.

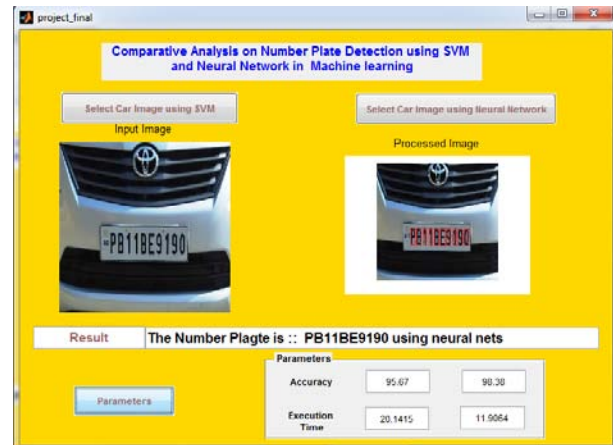


Fig.14: GUI with results after detection using neural network.

This is GUI of code where we running the code to detect the number plate after the running the second part of code which is using neural network to recognize the number plate. The Result is showing that number plate is detected and also showing the processed image in which character and number are circled for recognition. And in this image parameter are showing in terms of accuracy and execution time. Accuracy is approximately 99% and execution time approximately 12 seconds. Now, it is obvious to say that neural network technique is better than SVM by analysing the above results.

a) Result

As it can be seen in the table 1 below and table 2 shown below that there is a big upgrading between both parameters. Neural Networks method is superior to the SVM technique as there is great improve in accuracy and total time taken to execute. In Neural Network method the execution time has been slashed by half. So it can be said that the Neural Network technique will give a huge improvement to the Image number plate detection technology.

Table 1: Analogy between SVM and ANN

Parameters	Using SVM Classifier	Using Neural Network
Accuracy	95.67 %	98.38 %
Execution time	20.141	11.9064

## VI. CONCLUSION

Recognition of vehicles' number plate has always been in high demand as this technique is very vital to curb the incidents that were implemented by using car or motorbike. In this comparative study the two methods for plate recognition have been discussed so far. The two methods SVM and neural network some steps are common like pre-processing and normalization which are employed to improve the image quality to attain better and fast results. In neural network method, the method has been trained on more than 100 images so that the technique could work faster and accurate. The neural network method has been tested with several pictures, which resulted in good parameter factors.

Now this technique has begun to be used in some countries like- Germany, Canada and Dubai. And it helped them a lot to fight with rising graph of crime rate. This methodology has been applied at toll plazas to collect the toll fee, imposing the fine on people who violate the traffic rules or park their cars at an unauthorized space.

Although, many more researches are being done in this area but that are not up to the mark which could deal with real life problems. But this neural network technique is fulfilling the demands of real life situation, as it has been thoroughly tested and trained. The aim of this research is to deal with real life problems and deal with them without any hustle. Though, OCR is not a new technique but this research field is still not researched as it should have been. The benefits of this technique are enormous and can help to solve several problems if integrated with other techniques.

## VII. FUTURE SCOPE

The enhancements which can be introduced in this approach are – this analysis will be able to deal with videos and fast moving vehicles as well. As a future work of this approach the idea may be to enlarge suggested technique to include different language or to make this system language independent.

Following are the various possibilities which can be done in future.

1. This technique can be extended to be language independent character recognition system, as right now this system is working only with English alphabets and numbers. And we're working on the method which could identify Hindi language too.
2. Cursive character identification: There is great requirement for a recognition system which is capable of identifying cursive manuscripts and scripts as- Palm Leaves. Because this can actually avoid typing and font encoding as well.
3. Apart from this method can be made capable of recognising number from a live video.

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## The Role of Shologuti in Artificial Intelligence Research: A Rural Game of Bangladesh

By Samia Nawshin & Mohd. Saifuzzaman

*Daffodil International University*

**Abstract-** Shologuti has three major component: move generation, search and evaluation. Each components are pretty much necessary, though evaluation with its quiescence analysis is the main part which makes each program's play unique. To make this game more striking, most reliable algorithms and its many supporting aids are used here. Main components of the game tree search and pruning are analyzed here and the performance refinements such as aspiration variation search, assists like transposition and history table are compared here.

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**GJCST-D Classification:** *1.2.1*



*Strictly as per the compliance and regulations of:*



# The Role of Shologuti in Artificial Intelligence Research: A Rural Game of Bangladesh

Samia Nawshin<sup>α</sup> & Mohd. Saifuzzaman<sup>σ</sup>

**Abstract** Shologuti has three major component: move generation, search and evaluation. Each components are pretty much necessary, though evaluation with its quiescence analysis is the main part which makes each program's play unique. To make this game more striking, most reliable algorithms and its many supporting aids are used here. Main components of the game tree search and pruning are analyzed here and the performance refinements such as aspiration variation search, assists like transposition and history table are compared here.

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## I. INTRODUCTION

Shologuti is very famous and popular game in Bangladesh and some of the Indian regions. It actually a checker type game which basically played between two players. So from that view, it can be called as a rural version or innovation of chess. The local people play this game for passing their leisure period even sometimes they arrange tournament of this game. Generally the board of this game is very simple like the people can draw it in table or ground and use stones, dry branch or a small piece of cane as pawns. After drawing, two players take their place at the opposite direction of the board with their 32 guti's altogether of which everyone try to achieve opponent's sixteen beads. After placing 16 pawn from the edge of the board, the game starts by making a move on the empty space. The pawn can move right, left, forward, backward and crosswise where each opponents actually try to take or occupy others pawns. If any player's pawn can cross opponent's pawn, then the pawn will be out of the board. After that, only that pawn has the ability to have a bonus move if that pawn can find out opponents pawn can be crossed over. By this process, which player can take or capture all the pawns of opponents, he or she will be the winner.

Now a days, computer has become a part of our life and almost everyone like to play game in it. This led us to develop this attractive game of Shologuti. Due to lack of well-designed boards in market, city's people can't play it or don't even actually well known about the game. So, the problem can be solved by developing this game with an attractive UI. After designing the basic part of this research [16], we are intended to push artificial

intelligence part in this program to make it more fascinating.

## II. LITERATURE REVIEW

In general, this research cover the literature review from different sources which is targeted various aspect of designing game, installation & learning.

Whitby et.al [1] concerned in his research about the creation of a game installation and a reviewed a case study to test the game. Coleman et.al [2] described the initiatives they took to develop & design a game for improving their skills. Symborski et.al [3] & Martey et.al. [5] also showed the game development and design strategy guided by experimental test and evaluation. Sethi et.al [4] described "Don't just play a game, design a game & build a game and improve your programming skills". Amory et.al [9], Cheng et.al [10] & Dondlinger [12] developed a game which is actually a part of social & mental development. Schrier et.al [11] designed a game which was filled with moral scenarios & moral choices. Nergiz et.al [13] & Strzalkowski et.al [14] described the experiences from the implementation of a computer game development that it could help a student to improve in problem solving, the application of previously learned knowledge, the utilization of independent learning and learning by doing.

Then Reidl et.al. [15], Thune et.al. [16], Nasr et.al. [17] and Harrison et.al. [18] described in their research that Artificial intelligence has long been an important part of game design and development practices. Treanor et.al. [19], Eladhari et.al. [20] and Magerko et.al. [21] identified design patterns for AI in games like AI-based games put AI in the foreground of the player experience in their research.

After that, we (Nawshin et.al. [22]) developed and reviewed the development part of Shologuti in our research document where we wanted to describe and analyze a computer based game (Player vs Player) which will help our culture to save an extinct rural game.

So, in extension, we are intended to use more interesting algorithms to develop the AI vs player environment which will increase the performance to make this game more accurate, unique and enjoyable.

In the coming chapters we will discuss about system architecture of the developed game in Chapter III, Chapter IV deals about the physical implementation and results and finally Chapter V shows us the conclusion.

*Author α σ:* Lecturer, Dept. of CSE, Daffodil International University, Dhaka, Bangladesh. e-mails: samia@daffodilvarsity.edu.bd, saifuzzaman.cse@diu.edu.bd

### III. SYSTEM ARCHITECTURE

To explain the entire system as well as the game, an effective architectural system needs to be designed. This section will represent the basic design part. The control flow of the program among various functions is shown using a single flowchart. Each function in the program is well defined and their pseudo codes are given for better understanding of the program. This section contains Control flow diagram, Function description and Pseudo code which will represent a clear understanding about move generation, search and evaluation part of this game.

#### a) Control flow diagram

PvAI Algorithm Workflow in fig 1 shows the entire execution sequence of functions in the program. In this program, two players can play continuously that is PvP (Player vs. Player) which is already developed [16]. In this game, a single player can also play by a good contribution of AI.

#### b) Function description

##### i. Handover

Handover is the starting function for AI part of the game. When the player complete his turn handover function is called. First of all this function clears the array named points to make it ready to use again. Then it calls AI\_Moves, Sorting, sets up AICsp (the starting position of AI's best move) and AICep (the ending position of AI's best move) based on the sorting and finally AI\_Pawn\_Loc.

Pseudo code:

Step 1: Clear array "Points"

Step 2: Call AI\_Moves ()

Step 3: Call Sorting()

Step 4: Set

AICsp = points[0,0,0]

AICep = points[0,1,0]

Step 5: Call AI\_Pawn\_Loc(AICsp, AICep)

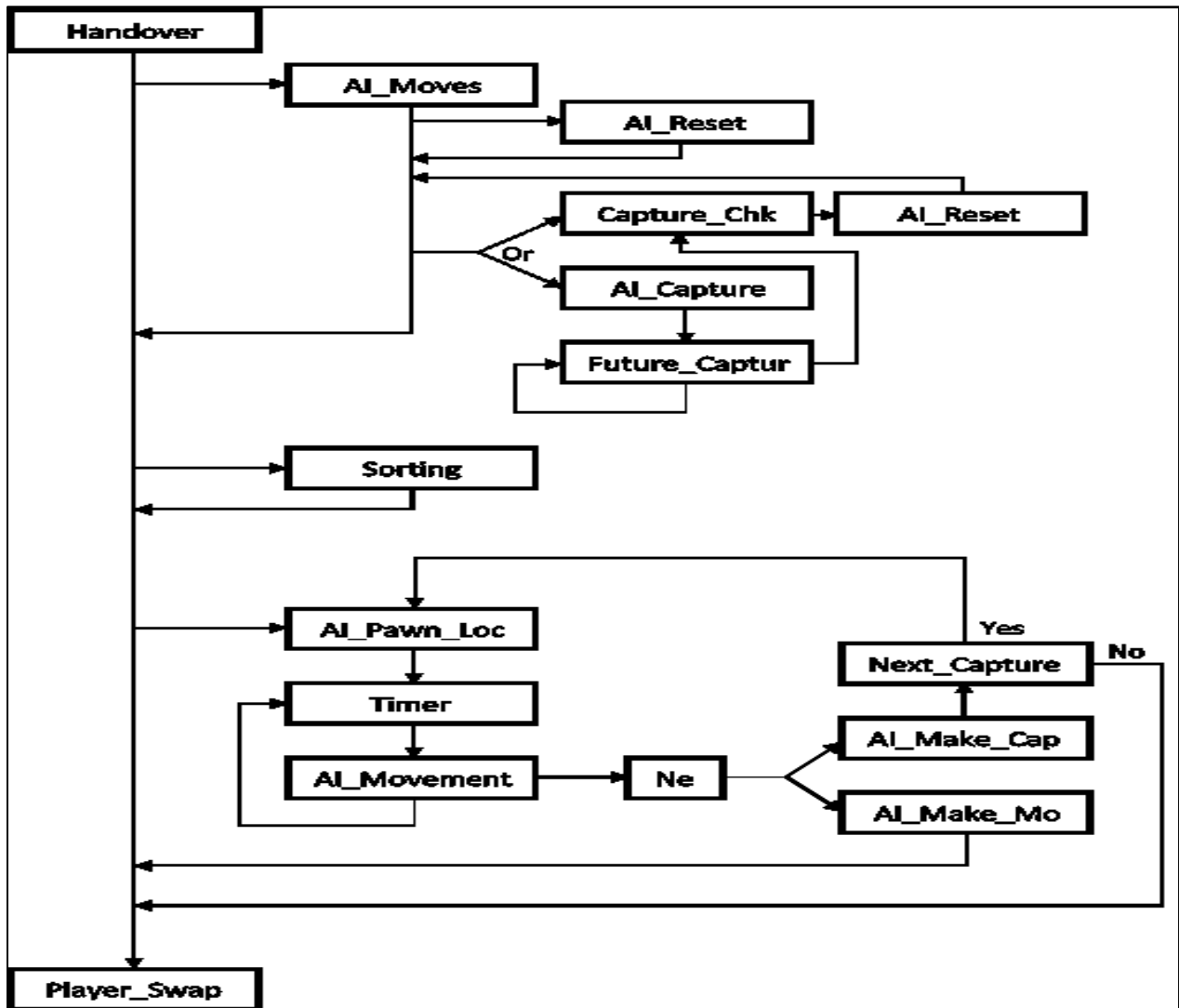


Fig. 1: PvAI Algorithm Workflow

ii. *AI\_Moves*

*AI\_Moves* function along with some other functions acts as the mini-max mechanism of the game. This function particularly focuses on each available AI's pawns adjacent positions. First it checks for all the available pawns on the board and store them in the array. Then takes a pawn each time, and searches its adjacent positions. Checks each adjacent positions value. If the value is 0 (represents open position). It stores that position as possible end point on array and calls *Capture\_Check* with parameter as that position. If the adjacent position is 1 (represents enemy pawn), it calls *AI\_Capture* function with parameter of starting position and that position. The function ends when each adjacent position for each pawn is calculated and points are distributed.

*Pseudo code:*

*Step 1:* Call *AI\_Reset()*

*Step 2:* Set  $x=0$

*Step 3:* For every position on the board

Set  $z=0$

Set  $\text{points}[x,0,z]=\text{current position}$

*Step 4:* For every current position

Check every adjacent positions value

*Step 5:* If value of current adjacent position is = 0

Set  $\text{points}[x,1,z] = \text{current adjacent position}$

Call *Capture\_Check*( $\text{points}[x,0,z]$ ,  $\text{points}[x,1,z]$ )

$z=z+1$ , *AI\_Reset()*

*Step 6:* If value of current adjacent position is 1

Call *AI\_Capture* with parameter  $\text{points}[x,0,z]$  and  $\text{points}[x,1,z]$

$z=z+1$ , *AI\_Reset()*

*Step 7:*  $x=x+1$

iii. *AI\_Reset*

*AI\_Reset* function is very important function for the AI part of the game. To calculate and distribute points to each possible moves to evaluate the best move, we have to manipulate the variables that represents pawn on the board. But original variables can't be manipulated directly or the game would become a chaos. So a dummy board or replica is needed. This function replicates the board and lets the needed change happen for calculation. This provides with the ability to calculate using the same info as the board but not change it in the process.

*Pseudo code:*

- Copy every positions value to similar AI variables |  $ai_0 = a_0$ ,  $ai_2 = a_2$  etc.

iv. *Capture\_Check*

This function is the first function that sets points as the mini-max mechanism. This function checks if an AI pawn is moved to a new position, is there any chance that it would be captured by an enemy pawn or not. If there is a chance the pawn may be captured, this will

subtract 4 points from the array for that move. If not, it will add three points into it.

*Pseudo code:*

*Step 1:* Check for each possible enemy capture for this move.

*Step 2:* If there is a possible enemy capture

Set  $\text{points}[x,2,z] = \text{points}[x,2,z] - 4$ ;

*Step 3:* Else Set  $\text{points}[x,2,z] = \text{points}[x,2,z] + 3$ ;

Call *Future\_Capture* with parameter  $[x,1,z]$

v. *AI\_Capture*

This is another function of the mini-max mechanism. This function takes the starting and the adjacent enemy position and checks for the third position's value to be 0 (represents open location). If the 3rd position is open, it adds 10 points in the array and calls *Future\_capture* function with the 3rd position as parameter.

*Pseudo code:*

*Step 1:* Get starting and capture position from *AI\_Moves*

*Step 2:* If the third position on the line is open

Set  $\text{points}[x,2,z] = \text{points}[x,2,z] + 10$ ;

Set  $\text{points}[x,1,z] = \text{Third Position}$

Call *Future\_Capture* with parameter  $\text{points}[x,1,z]$

vi. *Future\_Capture*

This function is used to detect any possible bonus capture moves. As per Sholo-Guti rules, a player can make several capture moves at a time with a single pawn if possible. If possible it adds 5 points to the array for that move, and recurses using the future endpoint for this bonus move. The recursion continues till there is no more bonus moves possible and then calls the *Capture\_Check* function with the parameter of captured location (FSP) and ending position (FEP) it gets at the final recursion.

*Pseudo code:*

*Step 1:* Set FSP = null & FEP = null

*Step 2:* Check if any capture move is possible

*Step 3:* If possible,

Set FSP = Capturable enemy pawn position

Set FEP = Next open position on the line

Call *Future\_Capture* with parameter FEP

*Step 4:* If not,

Call *Capture\_Check* with parameter FSP and FEP

vii. *Sorting*

After the mini-max part is done, the array is full with each possible move and their respective points. The array then is sorted. Firstly the best move for each pawn is sorted out and brought to the top, i.e.  $z=0$  of the array. And then the best move between all the pawns is sorted and brought to the beginning column i.e.  $x=0$  of the array. After this process the first column of first page of the array holds the best moves starting position, ending position and its points. The array is

string type array so to manipulate numeric value. After this the control returns to handover function.

*Pseudo code:*

- Sorts the array using Bubble sort technique and ascends the best move based on the points assigned during previous function operation.

#### viii. *AI\_Pawn\_Loc*

AI\_Csp is usually set as the first starting point and AI\_Cep is set as first ending point on the array by the function Handover. In case of multiple capture, this function is called again using modified AI\_Csp and AI\_Cep. This function then finds out the X & Y coordination for both the AI\_Csp and AI\_Cep positions and put them in SPx, SPy, EPx and EPy accordingly. Then it starts the timer function.

*Pseudo code:*

*Step 1:* Get AI\_Csp, AI\_Cep

*Step 2:* Set

SPx = X Co-ordination of AI\_Csp  
SPy = Y Co-ordination of AI\_Csp  
EPx = X Co-ordination of AI\_Cep  
Epy = Y Co-ordination of AI\_Cep

*Step 3:* Start timer function

#### ix. *Timer*

Timer function is used to recurse a function after a fixed time. Each time timer is activated it calls AI\_Movement function till SPx = EPx and SPy = Epy. When the condition is met, timer stops and calls function Next.

*Pseudo code:*

*Step 1:* Call AI\_Movement()

After certain time till SPx = EPx and SPy = Epy

*Step 2:* Stop timer, call Next()

#### x. *AI\_Movement*

AI\_Movement function is responsible for the movement of AI pawn. It detects which pawn to move from and to where and which direction. It increases or decreases SPx & SPy by 4 each and moves the pawn to new SPx & SPy, time till it matches EPx & Epy. This creates the movement of AI's pawn.

*Pseudo code:*

*Step 1:* If SPx < EPx

SPx = SPx + 4

Else

SPx = SPx - 4

*Step 2:* If SPy < Epy

SPy = SPy + 4

Else

SPy = SPy - 4

#### xi. *Next*

After the mini-max mechanism and sorting happened, AI has the best move to make. Timer function moves the pawn to the desired position but the

value of the board has to change. AI\_Make\_Move, AI\_Make\_Capture functions make that happen. After these functions are called and executed, the control again returns to next function and player swap function is called to swap the program control to the pvp part of the game for player to make his move. And the game progresses.

*Pseudo code:*

*Step 1:* Call AI\_Make\_Move(AI\_Csp, AI\_Cep)

*Step 2:* Call AI\_Make\_Capture(AI\_Csp, AI\_Cep)

*Step 3:* Call Player\_Swap()

#### xii. *AI\_Make\_Move*

AI\_Make\_Move function is used to change the value in board when AI makes a normal move.

*Pseudo code:*

*Step 1:* Move pawn from AI\_Csp position to AI\_Cep position

*Step 2:* Set AI\_Cep positions value as AI\_Csp positions value

*Step 3:* Set AI\_Csp positions value as default 0.

#### xiii. *AI\_Make\_Capture*

AI make capture function is used when AI makes a capture move. It sets AI\_Cep positions value as AI\_Csp positions value. And AI\_Csp positions value is set as default 0. The position in between value is set as default 0. Captured pawn count is increased by 1 and enemy pawn count is decreased by 1. Then the function calls Next\_Capture function using parameter AI\_Cep.

*Pseudo code:*

*Step 1:* Move pawn from AI\_Csp to AI\_Cep

*Step 2:* Hide pawn between AI\_Csp and AI\_Cep

Count enemy pawn = pawn - 1

*Step 3:* Call Next\_Capture using parameter AI\_Cep

#### xiv. *Next\_Capture*

Next\_Capture function checks each adjacent position of AI\_Cep position for enemy pawn, if found, it checks if capture move is possible. If possible it sets AI\_Csp as AI\_Cep, AI\_Cep as new ending position, and calls function AI\_Pawn\_Loc using these parameter. This process keeps repeating till there is no more capture move possible. And returns control to function next.

*Pseudo code:*

- If any more capture possible

Set

AI\_Csp = AI\_Cep

AI\_Cep = Ending Position

Call AI\_Pawn\_Loc() using parameter AI\_Csp and AI\_Cep.

#### IV. IMPLEMENTATION AND RESULTS

##### a) Selecting the Game Type

When the game starts if it detects a previously saved game, the game is loaded with previously saved properties. If not, a window shows up like this and asks the player to select a game type, either a PvP or PvAI.

Fig. 2. is the screenshot of Selecting the Game Type.

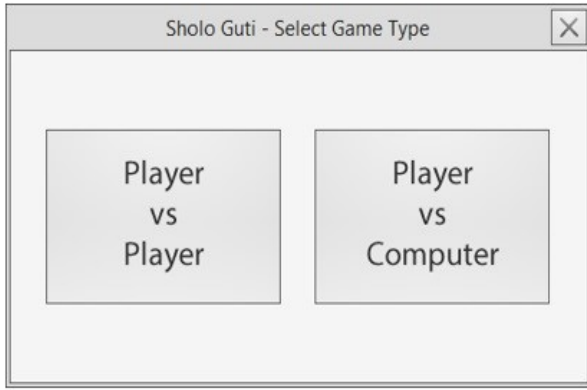


Fig.2: Selecting the Game Type

##### b) Player vs. Computer

If the player selects to play a new game of PvAI, the board is loaded with pawns set in their default starting position and then the player gets to play the first move always. When a move is made by the player, AI will take a move automatically. Fig.3. is the screenshot of Player vs. Computer.

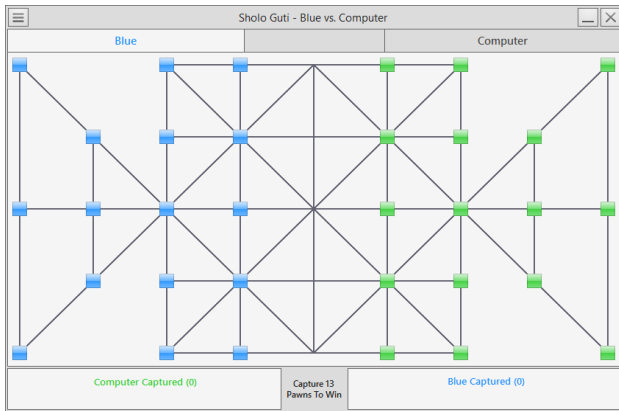


Fig. 3: Default Board - Player vs. Computer

##### c) Pawn Movements

###### i. Player Pawn

If the player selects a pawn of his own, then possible moves are shown in the board in Yellow and Red. Yellow color represents normal movable positions and Red color represents capturable positions on the board. Fig.4. is the screenshot of Pawn Movements of Player Pawn.

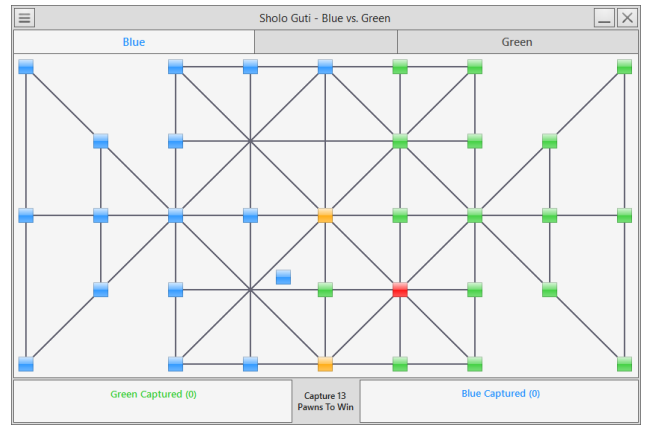


Fig. 4: Pawn Movements - Player Pawn

###### ii. AI Pawn

When a move is made by the user AI will make a move to best possible location among all of its own pawn and after making a move AI will hand over the game to the player.

If there is any capture move possible AI will take that move. And then if another capture is possible with that pawn again, AI will take that move too and will be looking to capture more pawns with that pawn if possible. Else, AI will hand over the game to the player. Fig.5. is the screenshot of Pawn Movements taken by AI Pawn.

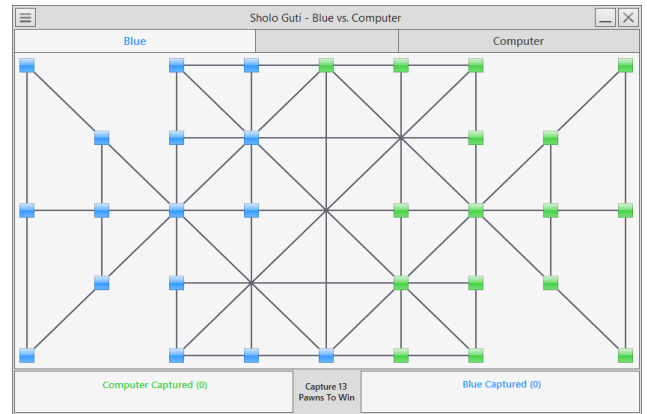


Fig. 5: Pawn Movements – AI Pawn

##### d) Drop-Down Menu

On top left of the UI there is a button which shows a dropdown menu if clicked. The menu has different options and submenus to customize game properties. Fig.6. is the screenshot of the game window with Drop-Down Menu.



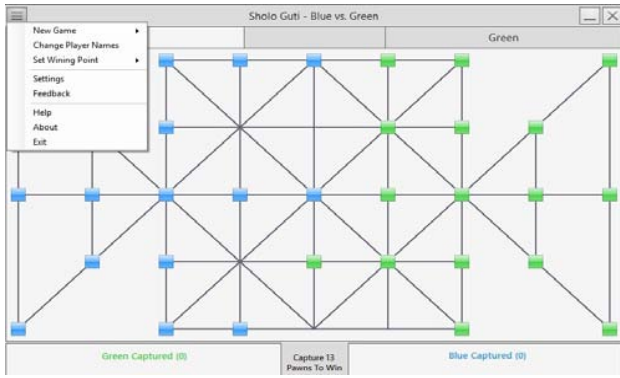


Fig. 6: Drop-Down Menu

e) *New Game*

On dropdown menu there is a submenu named as “New Game” which contains two options to start a new game, “Player vs. Player” and “Player vs. Computer”. On the click to one of those menu option specific game starts with default board. Fig.7. is the screenshot of how to create a new game.

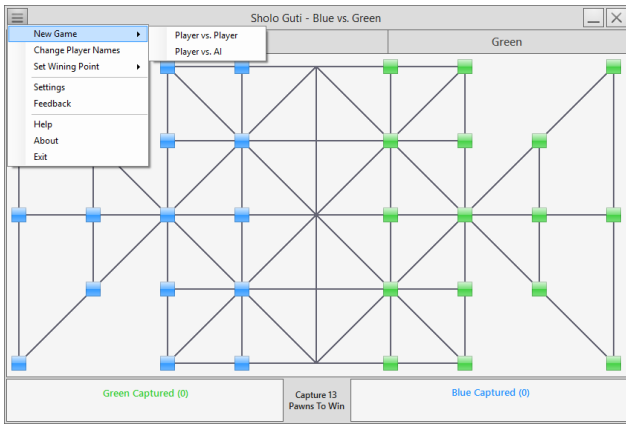


Fig. 7: New Game

f) *Setting Wining Point*

On dropdown menu there is a submenu named as “Set Wining Point”. On the hover to this control, it shows five different numbers. Clicking on any of them sets particular value. Which indicates how many pawns have to be captured by users/computer to win the current game. Fig.8. is the screenshot of how to set wining point on a game.

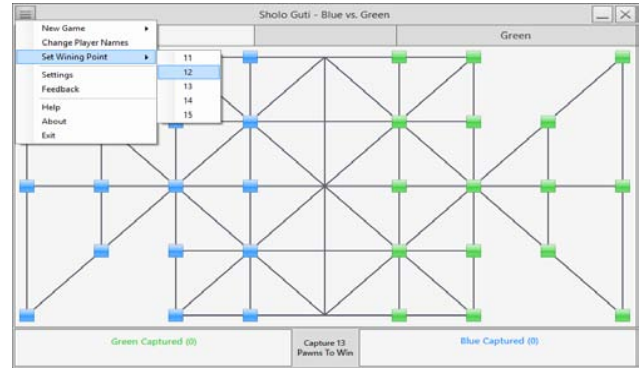


Fig. 8: Setting Wining Point

g) *Wining the Game*

When the specified numbers of pawn is captured by player/ computer, a message box appears on the screen showing the winners name on it. And then another message box is showed up if the player/players wants to start a new game on the current game mode. Fig.9. is the screenshot of what happens when a game is won by the AI and fig.10. is the screenshot of what happens when a game is finished.

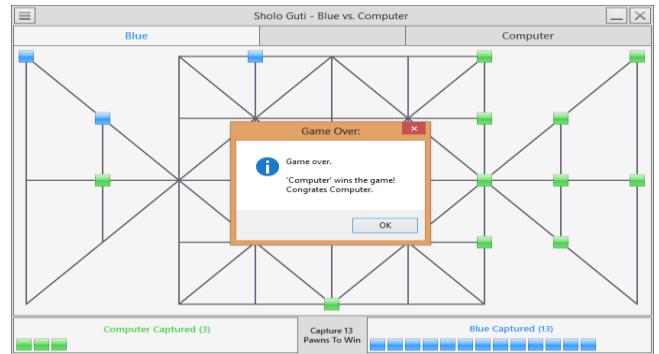


Fig. 9: Wining the Game – Game Over

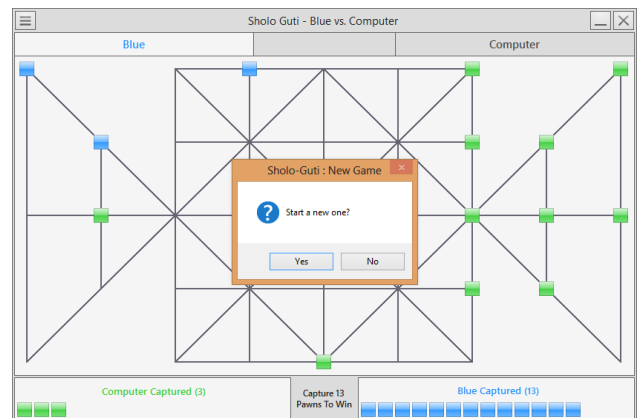


Fig. 10: Wining the Game – New Game

h) *Save & Exit*

When the close button on the top right is pressed or “Exit” is clicked from the dropdown menu, a message box appears to ask player if he wants to save



the current game to play it later from the current state. If the button "Yes" is clicked then the game will be saved with current properties. And user can play the game from that saved state when he runs the game next time. Fig.11. is the screenshot of what happens when a close button is pressed during the gameplay.

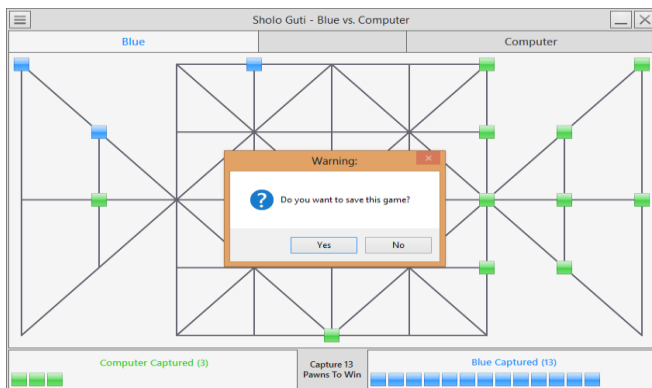


Fig. 11: Save & Exit

## V. CONCLUSION

Different person thinks in different way. This game is developed from a specific point of view and analysis. For developing or designing this game, many problems or difficulties actually came out. So there is a chance that the problems can be solved in a much more easy way by using advanced techniques.

### a) Challenges to overcome

It is true that the development environment is totally unpredictable. Many things went wrong while working on the real project. Firstly, any well-defined structure of the game haven't found. Secondly, Some problems arose while developing the system like creating database cost us more time fetching data from database for this a three dimensional array is used instead of using database. Finally, faced some problem in .NET platform but managed to fix it all.

### b) Future scope

We need to apply more algorithms in future to make it more efficient and effective. In future this research can be enhanced into a more intelligent system.

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## Texture Feature Abstraction based on Assessment of HOG and GLDM Features for Diagnosing Brain Abnormalities in MRI Images

By Sudheesh. K. V & L. Basavaraj

*Vidyavrdhaka College of Engineering*

**Abstract-** The brain tumors are increasing rapidly among the younger generation. The survival of the subject can gradually be increased if the tumors are detected at early stages. Magnetic Resonance Imaging (MRI) is an important technique in detecting the tumors. The images are corrupted by random unwanted information, complicating the automatic feature extraction and the analysis of clinical data. Many methods are existing in present day to remove the unwanted information from the images. Automatic classification is essential because it reduces the cause of human error and where the accuracy is not affected. The work emphasizes on removal of noises from the MRI using the hybrid KSL technique which is the combination of Kernel, Sobel and low pass filter. Features are the properties which describe the whole image. Features from these images are extracted using shape, texture and intensity based techniques. The feature extracted are HOG and GLDM.

**Keywords:** *histogram of gradient, gray level difference method, feature extraction.*

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Sudheesh. K. V <sup>α</sup> & L. Basavaraj <sup>σ</sup>

**Abstract-** The brain tumors are increasing rapidly among the younger generation. The survival of the subject can gradually be increased if the tumors are detected at early stages. Magnetic Resonance Imaging (MRI) is an important technique in detecting the tumors. The images are corrupted by random unwanted information, complicating the automatic feature extraction and the analysis of clinical data. Many methods are existing in present day to remove the unwanted information from the images. Automatic classification is essential because it reduces the cause of human error and where the accuracy is not affected. The work emphasizes on removal of noises from the MRI using the hybrid KSL technique which is the combination of Kernel, Sobel and low pass filter. Features are the properties which describe the whole image. Features from these images are extracted using shape, texture and intensity based techniques. The feature extracted are HOG and GLDM.

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## I. INTRODUCTION

Imaging technique in biomedical field has helped the doctors in depicting the inner parts of the body for easier diagnosis. It also has helped doctors to make keyhole surgeries for reaching the particular interior parts without really opening too much of the body. X-ray is a beam produced by a tube which contains X-ray by sending through the body. This had helped doctors in investigating the subject very detailed manner. But the drawback from this was when the subject was x-rayed many times there was some side-effects. CT scanner, Ultrasound and Magnetic Resonance Imaging have overcome x-ray imaging by making easier way for doctors. Technique of imaging using ultra-sound utilizes high frequency band sound waves which will be in terms of megahertz range that are reflected in imaging. The technique is usually diagnosis of fetus in pregnant women. It can be used to image the breast, muscles, tendons, abdominal organs, heart, arteries and veins. But it provides less information when compared to techniques such as CT or MRI. Powerful magnetic fields and radio waves which produce detailed interior information of body are used in Magnetic resonance imaging technique. MRI is one of the improvised technique in medical imaging which has proven to be a

*Author α:* Vidyavrdhaka College of Engineering, Mysuru, India.  
e-mail: sudheesh.vce@gmail.com

*Author σ:* ATME College of Engineering, Mysuru, India.  
e-mail: basavaraj.atme@gmail.com

successful tool in the realizing the human brain. The abundant information provided by this concerning of the soft tissue and anatomy of brain has improved the quality of diagnosis and its treatment.

The not involving the introduction of instruments into the body is the important advantage of this technique. MRI scan is not only meant for brain also utilized for examining any part of the body including the injuries due to sports, problems related to musculoskeletal, vessels of heart and blood can be analyzed. Internal organs, brain and spinal cord and bones and joints. Results obtained can be provide ample amount of information for treatment, planning for further and shows how effective the previous treatment was. MRI scan include a special methods that ensures extra information to physician. An intracranial neoplasm (brain tumor) happens when undesirable cells form within the brain. There are mainly malignant or cancerous tumors and benign tumors or noncancerous tumors. Malignant tumors are the tumors which are caused due to inflammation in other parts of the body. In malignant, primary tumors which start within the brain and secondary tumors which will be spreading from other body parts known as brain metastasis tumors. Benign tumors are tumor cells which grow in brain. They grow very slow where as malignant cells grow very rapidly. Brain tumors has the symptoms determined on the amount of the brain involved. Some of the symptoms are headaches, problem with vision, seizures, vomiting and mental changes. Cause of most brain tumors is usually unknown. The common type in children is a malignant medulloblastoma. Anticonvulsant medication used for treatment of seizures. Primary brain tumors originate in your brain. They can develop from the brain cells, nerve cells and glands.

## II. BACKGROUND STUDY

### a) Preprocessing

Removing noise from signal or image is the main aim of pre-processing. Photography field uses Pre-processing because an image is degraded which needs to be enhanced so that it will printed as required. Getting back a high quality magnetic resonance image medical for diagnosing is crucial where it injures the subject more if the machines are passing high level

Magnetic resonance sound for taking an image. Noise will be introduced to image at the time acquisition or during the transmission. The corruption rate in an image is decided by its quantification. Noises sources for an image are:

- i. Environmental conditions may affect the sensors which are used for imaging.
- ii. Inadequate light levels and sensor temperature produce the unwanted information in an image.
- iii. Transmission channel interruption cause noise generation.

**b) Feature Extraction**

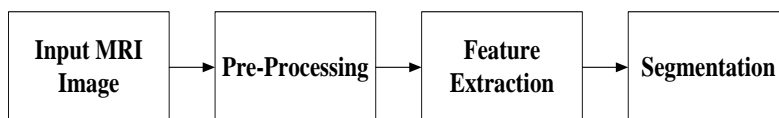
Dimensionality reduction is known as feature extraction. When input is large enough to be processed by an algorithm and it is having an impression to emphasize the quality redundant. This input information will be made to appear into a decreased few features. Features extracted are picked up and expected features set will extract the appropriate information from the input which will perform the desired task being reduced instead of the full size input.

Extracted features from an image are the properties that elaborates the full image. The aim is to reduce the original information set by measuring certain

features. Generally feature extraction can be classified as Shape based, Texture based and Intensity based. Circularity, shape, irregularity, area, perimeter etc. are the commonly used shape features. Intensity features are mean, median intensity, variance, standard variance, skewness and kurtosis. Commonly used texture features are contrast, sum of square variance, correlation, entropy, energy, homogeneity. Wavelet transform is used in the modern feature extraction method for MRI as the WT supplies localization in both spatial and spectral domains. Wavelet transform can be decomposed into different levels. Middle frequencies information is provided by decomposition coefficients. These information has excellent usage for image segmentation. The features extracted from wavelet coefficients are combined and applied as input to the segmentation stage. The work mainly concentrates on extracting the features like histogram of gradient and grey level difference method.

**III. METHODOLOGY**

A system comprises of pre-processing of input image, feature extraction and segmentation of the image. The block diagram representation for various steps carried out in this work is depicted in the Figure 1.



*Fig.1:* Block diagram of Proposed Methodology

**a) Image Acquisition**

The input MRI image is acquired by using MRI scan technology. The image acquisition is a difficult task as the image needed from the scanner is of an important organ of the body and once if it is damaged curing those damages is difficult. The user positions his body on the scanner. The user will go through high magnetic resonance imaging so that the machine captures the image in a proper manner. Then collect the images through the help of MRI scanning centers. The scanner produces the images 5mm slice thickness whose resolution varies from 256X256 to 958X958. One of the T2 weighted brain MRI image (normal and abnormal) considered in the database.

**b) Brain MRI Image Preprocessing**

The MRI image can be seen as a combination of many noises such as salt and pepper, speckle noise, Rican noise, Gaussian and so on. To improve the information present in the image and remove associated noises pre-processing techniques are used. In this proposed algorithm we use a hybrid technique known as KSL technique. KSL filtering algorithm is the combination of kernel, sobel and low pass filter. Kernel

filter is applied on to the MRI image, where kernel matrix is applied to each pixel in the image. Various kernel filters are used to remove different types of noises. This provides LPF and HPF using a kernel. Next pass the output obtained through sobel filter which does the work of 2-D spatial gradient measurement on an image.

Filtered image obtained from the sobel output is passed through LPF which is best suited for smoothing of an image. This retains the low frequency information present in an image. The KSL filtering technique for MRI is implemented using Matlab and tested for different kind of images. Kernel matrix is applied to each and every matrix pixel. The kernel has multiplication factors for multiplying to the pixel and its neighbors. As all the values present in the image will be multiplied and each value change with the sum of the products. These filters provide low and high-pass filtered outputs.

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} * [2 \ 2] = (i*1) + (h*2) + (g*3) + (f*4) + (e*5) + (d*6) + (c*7) + (b*8) + (a*9) \quad (1)$$

The Sobel operator does the operation on a 2-D gradient of spatial measurement of an image. Usually it finds the closest gradient magnitude at every point in an input gray-scale image. The edge detector has a pair of 3\*3 convolution masks where one is used to estimate the gradient columns and the other one is used to estimate the gradient of rows. Always convolution mask is smaller than the actual image. The mask has moved on the image, influencing a square of pixels at each time. The Sobel masks are shown

$$G_x = \begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +2 \end{pmatrix} \quad (2)$$

$$G_y = \begin{pmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix} \quad (3)$$

The calculation of the gradient is done by:

$$|G| = \sqrt{G_x^2 + G_y^2} \quad (4)$$

The closest Magnitude can be estimated as:

$$|G| = |G_x| + |G_y| \quad (6)$$

A low pass filter is frequently used as smoothing methods. An image is blended by reducing the dissimilarities between pixel values by providing the average values of nearby pixels. In low pass filters all the high frequencies are being removed off by retaining the low frequencies. An example

$$A = \begin{pmatrix} \frac{-1}{16} & \frac{-1}{8} & \frac{-1}{16} \\ \frac{-1}{8} & \frac{3}{4} & \frac{-1}{8} \\ \frac{-1}{16} & \frac{-1}{8} & \frac{-1}{16} \end{pmatrix} \quad (7)$$

Non-brain tissue has to be eliminated from the MRI images which is performed by skull stripping methods. Non-brain tissues which are removed is a basic step in the processing of brain MR images. This process by default includes some intensity normalization, spatial normalization, and repositioning of the brain, but to a certain extent those can be switched off. The actual skull stripping is a modified version of the

BET algorithm, expanding a spherical surface iteratively until it envelopes the brain. The output can be a skull stripped (masked) brain, the mask itself or different surface formats. Skull-Strip is called by a set of other functions. Therefore no separate block for skull-stripping but options can be adjusted as parts of the respective blocks. It increases the speed and accuracy of diagnosis which is the preceding step in various medical applications. It's been know that removes non-cerebral tissues such a skull, scalp, and dura which will from images of brain. S3 is named after algorithm simple skull stripping which depends on brain anatomy and intensity of image characteristics. It uses intensity adaptive thresholding which helps in increased robustness, morphological operations of the magnetic resonance (MR) images. The value of the threshold is evaluated by adaptively knowledge based in brain MR images database. The performance of S3 algorithm is used to estimate the similarities with three popular algorithms known as brain extraction tool, brain surface extractor, and robust brain extraction using standard validity indices.

### c) Brain MRI Image Feature Extraction

Analysis of the texture of an image is the main role in the medical image segmentation. The basic principles is the use of characteristics regarding text, image and background objects. Features are removed in this processes to identify image, text and background objects by the help of various techniques. Few techniques used for excluding the features from the image are depending on shape of the subject, textures and the intensity based. The simple and straight forward statistical features are used to distinguish objects from one another. Principles depends on observing the image pixel colors for example pixels lighter than from background in gray scale images indicate characteristic pattern of the brain tissues. Intensity of the image having high values the WM, pixels of lesser values are GM and pixels with least values are CSF.

- Histogram of Gradients

Object detection in computer vision and image processing are mainly defined through histogram of gradient. The high intensity features are extracted by this method. Dense means that it extracts features for region of interest and all locations in the image as reflected to only the local neighborhood of key-points like SIFT. This technique counts the availability of gradient orientation of an image in localized portions. This is similar to shape contexts edge orientation histograms. It is uniformly spaced cells of dense grid and this ensures overlapping local contrast for normalization. It will obtains the information of the region by capturing the gradients. It

can be done through making the image into small parts. Each cell which are divided has a particular number of gradient orientation bins. Pixels are bi-linearly interpolated to reduce aliasing. Pixel vote for its orientation bin and for the neighboring orientation bins. Distances of pixels from the centre decides the weights. Depending on the energy across the blocks histograms are normalized. Usually each step size has a cell where in each cell has 4 blocks .Therefore these define four different version of histogram.

- Gray Level Difference Method (GLDM)

The GLDM depends on the availability of two pixels which are having difference in grey level. They are separated by specific displacement is  $\delta$ .

$$\delta = (\Delta i, \Delta j) \quad (8)$$

$$\text{Let } S(i, j) = |S(i, j) - S(i + \Delta i, j + \Delta j)| \quad (9)$$

Consider difference = 2, d = 1 and angle = 00 the element in the matrix is assigned the value of 13 as  $M(2) = 13$ . The algorithm of GLDM is as shown.

- Segmented Image, (d) distance and direction
- Read the Segmented Image (ROI)
- Iterative process for each pixel block window size 7X7
- Select the pixel with passing through parameters d
- Construct the 255 5 matrix in S
- If the selected pixel and consecutive pixels are same, then the position of the selected pixel and d will be replaced by the count in the GLDM matrix
- Repeat the steps 2-6

In the process of texture analysis usually Haralick features are extracted and from those set, algorithms select the reduced features. The statistical texture features of a digital mammogram or the digital image are extracted using this technique. Contrast can be defined as the difference between the high and low intensity levels of the image. The measure of homogeneity of the image is angular second moment. Entropy is correlated to energy. Measure of inverse difference moment is the distribution of elements in the GLDM in diagonal form. Gray level difference method be defined by  $g(n, m)$ . For any given displacement

$$\delta = (\Delta n, \Delta m) \quad (10)$$

Where,  $\Delta n$  and  $\Delta m$  are integers

$$g\delta(n, m) = |g(n, m) - g(n + \Delta n, m + \Delta m)| \quad (11)$$

- Brain MRI Image Segmentation

Neural networks are the networks which are constructed and are used to implement human brain. The main aim of this network is to create a computational device for looking after the brain to perform many tasks faster than the traditional systems.

ANN does various tasks as matching of pattern and classification, optimization function, quantization of vector. ANN is an effective information processing system which is similar as biological neural network characteristics. ANN possesses large number of nodes and neurons. These are inter connected to each other. These neurons and nodes have the capability of modeling the networks of the original brain manages it.

Single layered is defined by taking an element to be processed and combining it with other processing element. A layer indicates a stage going stage by stage means input stage and output stage are linked with each other. These lined environments leads to formation of various network architectures. When a layer of the processing nodes is formed the inputs can be connected to these nodes with different weights, resulting in series of outputs one single node. This is called single layered feed forward network. A multi-layered is defined by the connection of several layers. The input layer receives the input and has no function as of buffering the input signal. The output layered generates the output of the network called the hidden layers. The hidden layers are the inner layers to the network. This has no contact with external environment. The layers may vary from zero to N numbers.

#### IV. EXPERIMENTAL RESULTS

Pre-processing is concerned with predominantly decreasing any variability in the input. The input image for processing is read and shown in Figure 2.

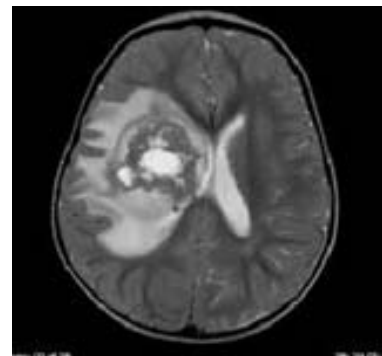


Fig. 2: Input Brain MRI Image

The work proposes a novel filtering approach called as KSL filter which is effective over the Impulse (Salt and Pepper) noise commonly present within brain MRI images. The input MRI Image is first pre-processed by filtering it in three stages namely KSL filtering technique as mentioned earlier. First kernel performs the convolution operation then sobel detects the edges. After detecting the edge the high frequency noise is removed out by passing it through low-pass filter. Figure 3 shows the test image and filtered image using Kernel filter and Figure 4 shows filter output of sobel and Low-Pass filter.

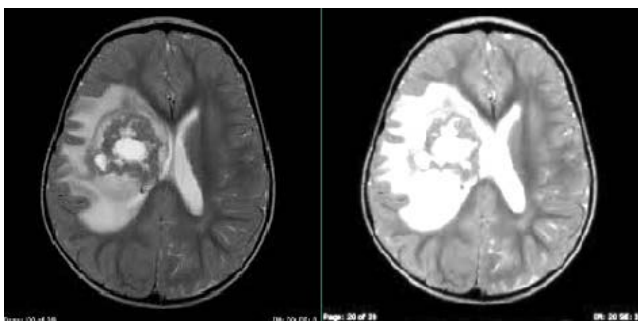


Fig. 3: Query Image and Kernel Filtered Applied image

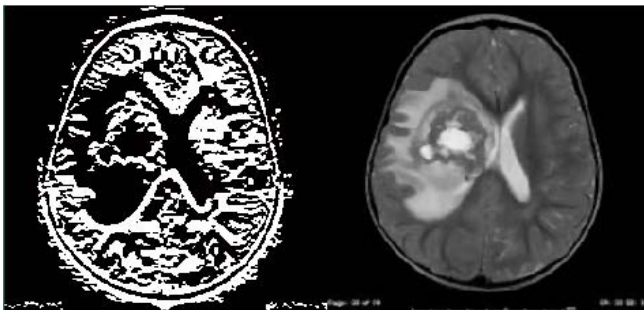


Fig. 4: Sobel Filtered and Low pass Filtered image

The different noise removal algorithms are tested and simulated. Denoising process is carried out for five set of brain MRI images using the different standard impulse lessening filters such as Median mesh (filter), and proposed filtering approach called as Kernel Sobel Low-pass filter. The Table 2 indicates the comparative analysis of performances of different denoising algorithms evaluated using statistical noise parameters such as PSNR, SNR, SSI and MSE.

Table 2: Comparison Analysis of noise removal techniques

Test Images	SNR (KSL)	SNR (MEDIAN)	PSNR (KSL)	PSNR (MEDIAN)
Image 1	26.90	8.19	36.79	28.60
Image 2	30.96	31.23	38.84	29.07
Image 3	28.51	14.63	36.36	29.31
Image 4	22.67	16.59	33.46	30.70
Image 5	25.03	5.18	31.82	28.90

After noise removal the next step is brain image segmentation. But for segmentation of brain image the skull stripping process is a preliminary step. Removal of non-cerebral tissues of the brain is essentially termed as Skull Stripping. The non-cerebral tissues are normally bright and may hamper the segmentation process because MRI images contains patient label (Film Artifacts), noise like salt and pepper noise and skull regions. Hence the direct usage of brain MRI images without skull stripping as a main preprocessing step will affects the accuracy of both segmentation and classification process. Therefore it is necessary to remove the skull region which is not required in the detection of abnormalities. Since morphological

operations is said to give better results than tracking algorithms morphological operations based skull stripping algorithm is explored in this work. Related to the methodology we proposes a pivotal scheme which is to create a mask of the brain which is free from non-cerebral tissues and multiply with the original image to obtain the resultant image free from skull region. The images obtained after opening operation, creation of mask and after skull removal for brain MRI images are as in Figure 5 and the features extracted from the images are HOG and GLDM are as shown in Table 3.



Fig. 5: Skull Striped Image

Table 3: Extracted HOG and GLCM Features

Test Images	Histogram of Gradients Features	Features from Gray Level Difference Method
Image 1	5720	24979
Image 2	10248	27571
Image 3	13949	29589
Image 4	16692	31292
Image 5	18974	32827
Image 6	21025	34345
Image 7	222839	35539
Image 8	24525	36760
Image 9	25910	37906
Image 10	27201	38935

## V. CONCLUSION AND FUTURE WORK

The tumor that is being spread widely have to be identified in prior stages. The tumor which is being captured by MRI scanner in MRI images will provide a wide range of information when compared with the other techniques such as CT scanner, X-ray Scanner. These images are first pre-processed to remove the noise as well as the skull region in the image. Segmentation process is performed to detect the tumor regions.



Features such as GLDM, texture based, HOG is being performed to detect the tumor region.

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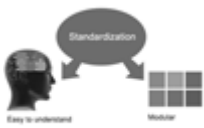
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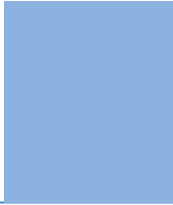
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## AUXILIARY MEMBERSHIPS

### 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).



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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.



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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.

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- 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.
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- 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.
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- • 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](mailto:submit@globaljournals.org) or get in touch with [chiefeditor@globaljournals.org](mailto:chiefeditor@globaljournals.org) if they wish to send the abstract before submission.

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

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2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
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- Writings
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- Printed material
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- Electronic material
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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

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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 ELECTRONIC 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).

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## 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.

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**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.

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**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.

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**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.

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

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

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

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

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

### **Final points:**

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

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

### **The discussion section:**

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

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

### **General style:**

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

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





### *Mistakes to avoid:*

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

### **Title page:**

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

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

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

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

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

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

### **Approach:**

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

### **Introduction:**

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



*The following approach can create a valuable beginning:*

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

#### **Approach:**

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):**

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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.

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*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.
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- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

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**Approach:**

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

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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.

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- 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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<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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