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OF COMPUTER SCIENCE AND TECHNOLOGY: D

Neural & AI

Enhancing Facial Recognition

Identification of Anesthesia Stages

Highlights

Logistic Regression Approach

Backpropagation Neural Network

Discovering Thoughts, Inventing Future

GLOBAL JOURNAL OF COMPUTER SCIENCE AND TECHNOLOGY: D
NEURAL & ARTIFICIAL INTELLIGENCE

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CONTENTS OF THE ISSUE

Utilization of 3-D Models for Enhancing Facial Recognition over Various Angles

By Jovan Toroman

Abstract- Aalgorithms for facial recognition PCA (Principal component analysis) encounter a dramatic performance decline when analyzing photos taken from various angles. As part of this research, a 3-D model was utilized for the sake of improving abovementioned performance. This model enables us to convert an image of somebody's face, which was taken from a specific angle to another face. Model was tested using biometric database created on Belgrade University. Picture rotation according to model was performed before comparing with the specimen pictures from the database. Results of this study have shown accuracy in regards to biometric verification, where identification percentage has been drastically improved.

Keywords: biometrics, face recognition, 3D graphics, eigen face.

GJCST-D Classification: I.5.2

UTILIZATIONOF3-DMODELSFORENHANCINGFACIALRECOGNITIONOVERVARIOUSANGLES

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Utilization of 3-D Models for Enhancing Facial Recognition over Various Angles

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Abstract- Aalgorithms for facial recognition PCA (Principal component analysis) encounter a dramatic performance decline when analyzing photos taken from various angles. As part of this research, a 3-D model was utilized for the sake of improving abovementioned performance. This model enables us to convert an image of somebody's face, which was taken from a specific angle to another face. Model was tested using biometric database created on Belgrade University. Picture rotation according to model was performed before comparing with the specimen pictures from the database. Results of this study have shown accuracy in regards to biometric verification, where identification percentage has been drastically improved.

Keywords: biometrics, face recognition, 3D graphics, eigen face.

I. Introduction

Face is a specific characteristic of every human being. When interacting with other people, we direct attention to their face. With the help of facial features, we recognize our acquaintances and distinguish them from unknown people. The human brain is pretty good at recognizing faces and is able to make the right decision even in difficult conditions such as poor lighting, aging, wearing glasses, or changing haircuts. Automatically recognizing a person with a computer is an area that is still in development, with numerous challenges that remain to be solved. In laboratory conditions, without external disturbances, modern systems for facial identification have good performance. However, problems such as changes in lighting, viewing angle, and occlusion have a significant impact on the performance of these biometric systems.

Since cameras are becoming cheaper and more affordable, biometric detection and face detection systems have numerous applications in different areas. They are used to identify faces in photos within social networks, detect fraud in voting at elections, control access to different systems, as well as in surveillance systems. In this paper the problem of changing the position of the head on the picture of the face will be considered. This problem is particularly obvious when using comparison algorithms with two-dimensional facial images. In the case where the position of the face in the image in the base differs in relation to the position in the image obtained by the sensor, the algorithm

becomes less accurate. The proposed solution presented in this paper is based on a three-dimensional model. By using a semi-profile image, the program will generate an en face of an image, which will be compared with the real en face images using the Eigenface method.

II. Detection And Facial Recognition

If it is necessary to create surveillance system that would monitor the camera, for example, the arrival of employees to work, it is necessary to solve two closely related problems: face detection and facial recognition. Face detection involves finding the part of the image on which the face is located. The most extensive method for detection is Viola-Jones [1], which works by principle of the difference in the width of the rectangle with the pixels in different shades of gray. This method returns the rectangular area on which the face is located and works best for an end face of an image.

Face recognition includes more than one task:

Identification: For the given image, you need to find the person in the database which the image belongs to, or conclude that the person is not at the base.

Verification: For a given pair <image, person> to confirm whether this image belongs to a person or not.

Segmentation: Divide the number of images into groups by person.

All these tasks are essentially reduced to one: discover if two photographs belong to the same person.

III. Facial Recognition Algorithms

The first recognition algorithms were feature-based, and their principle of operation was to detect all the key elements of the face, such as eyes, eyebrows, bumps, nose and others, in order to measure them on the basis of their dimensions, angles observation, and distances between each other and calculate a set of values that characterize a given face. Usually, about 40 values were considered and, depending on the specific algorithm that used them, i.e. its characteristics and performance, the performed identification would have a certain degree of accuracy. Work [2] belongs to this category. However, this approach has proven to be insufficiently precise, due to the difficulty of accurately determining the characteristics and neglection of the information contained in the texture of the face itself.

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The second groups of algorithms that were later created, and who still hold the primacy in this area, are based on the observation of an entity as a whole. The essence of the way they work is reduced to the existence of a template in the database, and to the comparison of the person who is the subject of identification with the given templates. To date, some algorithms based on this approach have been developed, some of which are very popular and often used.

The first algorithm from this group is the so-called Eigenface algorithm [3]. This algorithm is based on the Principal Component Analysis method. An analysis of the main components is a statistical method for reducing a number of variables that are observed to a smaller number of new variables that we call the main components. The idea is to find characteristic vectors (eigenfaces) of covariance matrix of the sets of pictures of the face we observe, treating each image as a vector in a multi-dimensional space. These characteristic facial vectors can be seen as a set of characteristics that represent the variation between different facial images in the base. Every face in the database is stored as a vector, a corresponding linear combination of these characteristic facial vectors. For comparison of vectors obtained from different faces we can use different methods, such as Euclidean or Mahalanobis distance.

Figure 1: Eigen faces

The implementation of the eigenface algorithm is available in the OpenCV library (Open Source Computer Vision) [4]. OpenCV is an open source library that contains functions for implementing computer vision activities. It was written in programming languages C and C ++, and has support for launching on Windows, Linux and Mac OS X operating systems. OpenCV was used to test the effect of using the proposed model on the accuracy of recognition.

IV. Existing Work In This Field

As for the use of three-dimensional models in the field of face recognition, the most famous work is that of Blanz and Vetter, who used a laser 3D scanner to create a database with 200 people [5]. Then they manually defined the characteristic points for the eyes, nose and mouth. After that, the recognition was done based on the interpolation of the 3D model from the base. Other work was mostly based on face recognition with 3D cameras. In this way, very good results are obtained, but the disadvantage of this approach is that it requires expensive equipment and cannot be applied to ordinary images. Some of the papers in this field are [6] and [7].

V. Software Description

The image rotation program is written in the C ++ programming language. The OpenGL API allows the use of hardware acceleration when plotting the model through direct communication with the graphics card.

A free head model was downloaded from the Internet [8]. The model is represented by a series of points in the space, a series of triangles and a series of texture coordinates. Each point in the space is arranged by the triplet (x, y, z), where x, y and z are the coordinates of the point along the corresponding axes. The triangles consist of three points in space. A set of texture coordinates is of the same size as a series of points, with each point corresponding to one coordinate of the texture. The texture coordinates are arranged in pairs (u, v) where u and v are textures along x and y-axes, respectively.

This model is placed on the picture by placing the eye and nose points on the model and the face from the image. This is achieved by scaling and translating the model. Also, it is important to rotate the model so that the angle of the model is equal to the angle under which the face of the image stands. Rotation is performed using the transformation matrix, as shown in Figure 2. If we represent a point as a matrix whose rows are values x, y and z, by multiplying this matrix with the transformation matrix we obtain the coordinates of the point.

$$Mx(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\theta) & -\sin(\theta) \\ 0 & \sin(\theta) & \cos(\theta) \end{bmatrix} \quad \text{Rotacija oko X ose}$$

$$My(\theta) = \begin{bmatrix} \cos(\theta) & 0 & \sin(\theta) \\ 0 & 1 & 0 \\ -\sin(\theta) & 0 & \cos(\theta) \end{bmatrix} \quad \text{Rotacija oko Y ose}$$

$$Mz(\theta) = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{Rotacija oko Z ose}$$

Figure 2: Transformation matrices for rotation

Then the picture is "glued" to the model. This will be done by changing the texture coordinates of the model so that each pair (u, v) takes the values of the transformed point (x', y', z') so that u = x and v = y.

When gluing an image to a model, the problem of hidden surfaces is created. This problem is easily shown on an example of a cube (Figure 3): the blue, red and green sides are visible and can be filled with texture. The other three sides are concealed. So in the face model as well, there are surfaces that are hidden and they are fulfilled using the principle of the mirror image. In order to see which surfaces are hidden, we will check the order of the triangle points: if they are counterclockwise, then it's a hidden surface. The program memorizes for each triangle whether it is hidden or not during gluing of the texture. Also, for each point of the model we will determine the point that is symmetric to it in relation to the x axis. The symmetric point is chosen so that the sum (sx + x) + (sy-y) + (sz-z) is minimal.
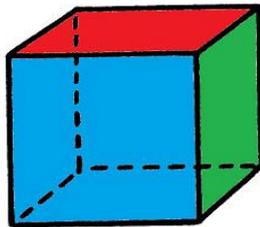
Figure 3: Hidden surfaces problem

When the image is glued to the model, the model rotates back into the flat position using transformations for the negative value of the angle for which we rotated during installation. Then using the OpenGL function, we plot the model on the screen. For each triangle, we will pass three points in the space and the corresponding texture coordinates, whereby the coordinates of the texture of the symmetric point will be passed to the hidden triangles. The next step is to copy the graphics card buffer into memory and memory to the hard disk in bitmap format. The entire transformation process is shown in Figure 4.
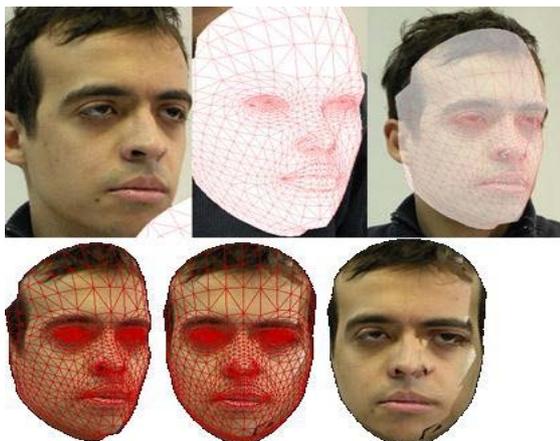
Figure 4: Transformation process

In the processed images, the border between the areas that were hidden and other surfaces are visible. This limit would not be visible if the light came frontally, or if the lighting was normalized.

Figure 5: Original "en face" picture

The resulting images will be further aligned using the funnel [9], which will improve the results and allow more valid comparison of the results.

VI. Results

All tests were conducted on a database with 34 persons from the Faculty of Organizational Sciences [10]. The database contains images of persons under different angles in similar lighting conditions, photographed twice in six months. For the creation of the database, the en face images from the first period were used. Then, three tests with images from the second period were performed: en face images, semi-profile images and program-generated en face images by processing semi-profile images images (from now on referred to as "returned"). The accuracy of the verification process can be seen using ROC (Receiver Operating Characteristics) curve in Figure 6.
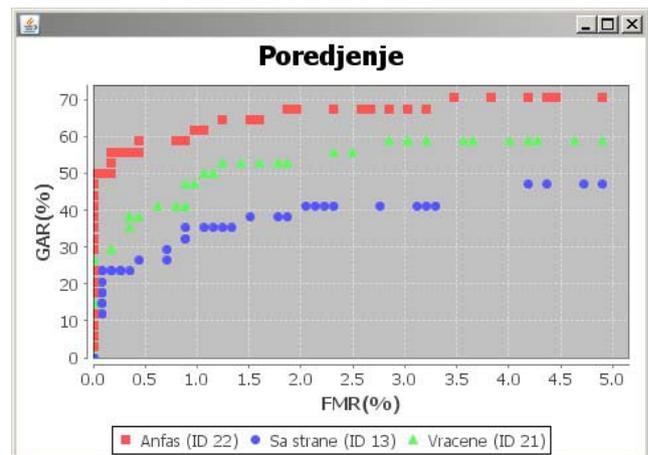
Figure 6: Verification - relation of GAR and FMR

The identification process gave the following results: En face images showed the best performance, which was expected. Twenty-two persons were successfully identified (65%). Semi-profile images showed a significant decline in the performance of the algorithm - only 13 people were identified (38%). Returned images gave better results than semi-profile images, but worse than en face images. As many as 21 people (62%) were identified, which is only one person less than the en face image.

VII. Conclusion

Rotation of images using a three-dimensional model in the initial phase of the study showed good results. Research conducted on a biometric database collected at the Faculty of Organizational Sciences has shown that this approach contributes to the precision of the biometric system. These results encourage us to continue improving the proposed solution.

For now, the process of attaching the model on the picture is done manually, which means that it is necessary for a person to be present in order for the system to work. In the following versions of the program, the program should independently determine the position and angle of the head so that the system becomes automated. This automation would enable more intensive testing on larger databases.

The model of the face to which texture is mapped is rigid and unchanging, which would be appropriate if all people had the same face shape, which is obviously not the case. It should be possible to modify the model each time a person is mapped in order for the model to fit as good as possible to the person to be mapped. Change parameters could be used to recognize the face in addition to or instead of a PCA algorithm.

Also, it would be possible to extend the application's performance in terms of solving the problem of lightening normalization.

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Employee Satisfaction of Academics in Sri Lanka: A Logistic Regression Approach

By D. P. N. P. Dias, T. M. J. A. Cooray & Wasantha Rajapakse

University of Moratuwa

Abstract- This study has mainly focused on the use of multinomial logistic regression in predicting employee satisfaction of the academics in Sri Lankan universities. A questionnaire was used to gather data from acdemics and it is prepared to collect demographic data and eight main factors. Demographic factors were analyzed with multinomial logistic regression, and it resulted in three elements namely, sector, salary, and gender. Before examining the main factors in the questionnaire, a reliability analysis was done. Factors were analyzed with multinomial logistic regression and resulted in different models and the best model out of all is presented in this paper. By comparing the models with R-squared values, goodness-of-fit statistics and residuals, the best model was obtained. This study revealed thatfitting of the abilities and knowledge with the job, ability to use the full potential in work, superior behavior and freedom are significant factors in predicting employee satisfaction of academics in Sri Lankan universities.

Keywords: employee satisfaction, multinomial logistic regression, demographic data, academics.

GJCST-D Classification: J.1

EMPLOYEESATISFACTIONOFACADEMICSINSRILANKAALOGISTICREGRESSIONAPPROACH

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Keywords: employee satisfaction, multinomial logistic regression, demographic data, academics.

I. Introduction

A high-quality academic staff is the cornerstone of an effective educational system. Therefore, it is essential to pay attention to satisfaction of the academic members. A positive and healthy university structure results in increased academic staff's job satisfaction. A good university atmosphere will not only increase the employee satisfaction of academic staff, but it will at the same time develop the learning environment. The employee satisfaction is affected by internal and external motivating factors such as the supervisor behavior, co-worker behavior, and the individual success or failure in their work (Lane, 2008).

Academic staff is essential and the most vital component in the process of achieving the mission and vision of an educational institute (Kodithuwakku, 2017). Because academic staff members are the first line of contact with students and require complex work in an increasingly demanding environment (Tai, 2014). To meet the relevant standards of education, the academics need an environment that allows them to work freely without problems. According to

(Rashid, 2011), satisfaction has been extensively studied in the management literature due to its importance to the physical and mental wellbeing of the employee. Therefore it is essential to determine the factors affecting academic staff members' satisfaction. Also this will be useful to recognize that, which factors should be maintained by an institute/university to increase the employee satisfaction.(Perkins, 1973) Proposed that university lecturers fulfill three major functions, namely teaching, researching and administration and management. Consequently university lecturer satis-faction is related to the functions of higher education. According to (Mueller, 2008) there are two types of job satisfaction which are based on the feelings of employees regarding their jobs. The most studied is global job satisfaction, which in dicates the overall feelings of employees about their jobs. The second type of job satisfaction is job facet satisfaction, which refers to feelings about specific job attributes, such as salary, benefits, and co-worker behavior. This questionnaire can measure above mentioned both types of job satisfaction.

When it measures employee satisfaction, most of the variables that are going to collect are categorical variables. Therefore this analysis involves categorical data analysis. Most of the previous researches in the same context have used some of the statistical techniques which are not much applicable in categorical data analysis. If researchers use un suitable mathematical models, that could lead to bias and misconception of research findings. One of the most common mistakes in a predictive model is to use statistical variable selection algorithms to identify causes.

Therefore this research used advanced analysis technique such as multinomial logistic regression. The method used for the study is the multinomial logistic regression in predicting employee satisfaction. This method is well apposite in scenarios when there is a categorical dependent variable.

II. Literature Review

Different statistical methods such as descriptive statistics, chi-square, linear regression, multilevel modeling, and ordinal regression techniques have been commonly found in the literature to analyze satisfaction questionnaires to study satisfaction about various explanatory variables. These methods investigate the

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association between the explanatory variables and the outcome variable. Some of the previous researches which have used different statistical techniques are reviewed below.

a) Multinomial Logistic Regression

Several types of research which have used multinomial logistic regression in measuring employee satisfaction are reviewed below.

In (Tahir, 2010), Multinomial Logistic Regression is used to model Employment Satisfaction at higher education institutions of Lahore Pakistan. Data had collected from 145 educators. The data was analyzed using Multinomial Logistic Regression models. (Yousra H. AL JAZAIRY1, 2014) Aims to assess the influence of professional and personal characteristics on job satisfaction among dental assistants. Multinomial logistic regression was used to determine the relationship between overall job satisfaction and other variables.

Multinomial logistic regression is also used to measure the stress levels of the employees. (Nor Amira Mohamad, 2016) Has used a multinomial logistic regression model to model the stress level among secondary school teachers in KubangPasu District, Kedah. (Prasad, 2016) Has also reported the results of their investigation on causes of occupational stress, coping strategies adopted and their relationship with the teachers' performance in CBSE affiliated school teachers in and around Hyderabad. (Madhu, 2012) Examines the factors that affect work stress among the employees in the manufacturing industries in Kerala, India. They have identified that seven factors affect the work stress of the employees. All the above researches reviewed are carried out in India.

To measure the customer satisfaction multinomial logistic regression is used. (Satyakama Paul, 2014) Has developed a model for predicting after sales customer satisfaction using multinomial logistic regression insights from a South African car company.

b) Employee Satisfaction

Following are some of the past researches that have been done in the employee satisfaction domain.

Researches were carried out to measure the employee satisfaction of the academics. (Rajapakshe, 2007) Determines the perception of organizational climate has a significant effect on the job performance of some academics in Thailand. This study has used MANOVA and descriptive statistics for the analysis process. The same questionnaire was used in this study, because of the reliability of the factors in that. Another study has been carried out in the higher education sector and (Oshagbemi T., 1997) investigated job satisfaction among university professors. In here cluster analysis was used.

(Hagedorn, 1994) Examined the satisfaction of academic staff using various variables, including salary, perceived support from colleagues, satisfaction with administration, enjoyment of student interaction and stress levels. In here it has used Importance Satisfaction model, which is not much related to a statistical background.

In (Ceylan, 2009), they have used different statistical techniques such as reliability analysis, factor analysis, correlation analysis and regression analysis. They have used the Kaiser-Meyer-Olkin (KMO) test, and Bartlett's Test of Sphericity to measure the adequacy of the data. Eventually, they have obtained a model for Employee Satisfaction. In (Aguilar, 2009) also, they have used Regression Analysis and reliability analysis. Same as in (Ceylan, 2009) they have derived a regression model for employee satisfaction and here it has considered more independent variables.

In (Welly, 2014), to collect the data it had used the Job Descriptive Index (JDI) Questionnaire which has been used to evaluate job satisfaction. Data is analyzed with Descriptive Statistics which has contributed to identifying mean value for each independent variable and dependent variable. The results had indicated that the employees are being neutral about their job satisfaction. In (Dziechciarz-Duda, 2005), it has used multivariate analysis and clustering techniques which are the same approach as (Oshagbemi T., 1997). Using these methods, it has clustered the employees into three categories.

To measure the satisfaction levels of higher education teachers (M. Bojadjiev, 2015) has carried out a study. This study had issued a questionnaire to all teachers at a Higher Education Institute in Taiwan. Reliability analysis is carried out, and it has determined which quality attributes must be improved to raise employee satisfaction.

In (Kodithuwakku, 2017), the study is carried out to measure the employee satisfaction of the academics in government and private universities in Sri Lanka.This study has used both primary and secondary data. This study has used statistical techniques such as student's t-tests and one-way ANOVA tables though it is suitable to use techniques related to categorical data analysis. This analysis had not gone through profound statistical analysis.

Most of the researches reviewed above are related to employee satisfaction. Some of them have used linear regression analysis, and some have used very light statistical methods such as student's t-test, ANOVA and MANOVA, which are not much appropriate to use with ordinal dependent variables.

After reviewing the literature, the following factors were considered as factors affecting employee satisfaction.
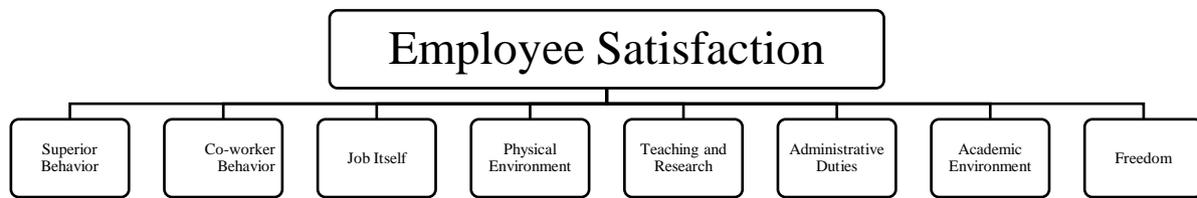
Figure 1: Factors affecting Employee Satisfaction

III. Methodology

a) Research Design

This study is survey research, and it is based on the data collected through the questionnaire. To analyze the data, different statistical methods were used. The unit of analysis is an academic from a Sri Lankan University.

b) Population and Sample

In this context, the population is all the university academics in government and private both sectors in Sri Lanka. There are seventeen state universities, nine Institutes and seven Post Graduate institutes available in the Tertiary Education system in Sri Lanka. Currently, there are 15 government universities in Sri Lanka. All these government universities employ around 5440 permanent university lecturers in all the universities according to "Sri Lanka University Statistics – 2016" (University Grants Commission, 2016). Still, there is no record on the number of academics in the private sector. However, the sample of the data should be composed of data from government and private universities both.

c) Data Collection

When collecting the elements for the sample, haphazard sampling was used. It is a non-probability sampling technique. With this sampling technique elements are selected in an aimless and assume that the population is homogeneous. The rationale for using this sampling method is due to lower cost, speedy data collection, and availability of population selection. Data collection was done from December 2017 to January 2018. 1116 questionnaires were distributed among academics in all private and government universities in Sri Lanka, and only 260 responses were received. Out of all 260 responses, only 230 could be used for the analysis process due to incompletely filled questionnaires. Hence the response rate was around 23.3% which is a slightly small value.

d) Questionnaire Design

For this research, the initial stage was to design the questionnaire. It was prepared based on previous research and specifically (Rajapakshe, 2007) has considered. This consists of some demographic data and also it covered different areas such as Superior behavior, co-worker behavior, the job itself, physical environment, teaching and research, administrative duties, academic atmosphere, and freedom. Collected demographic data include age, gender, academic rank, sector, the field of lecturing, years of service, salary, distance to work location, and number of research papers published. The Questionnaire consists of six questions to measure employee satisfaction. There are altogether 47 questions to measure these eight factors. Cronbach's alpha is used to determine the reliability, or internal consistency, of a set of variables. In other words, Cronbach's alpha is one way of assessing the strength of that consistency (Dennick, 2011). According to the results, except supervisor behavior, all the other factors have a positive Chronbach's alpha value. To measure supervisor behavior there are five questions, and there are negatively related questions and that can be the reason to obtain negative values for the chronbach's alpha. Therefore to overcome this problem two questions from supervisor behavior were re-coded. Once the first and third questions are recoded, Cronbach's alpha was again calculated, and the resulting value was 0.812 which is an acceptable value. It indicates that now the items in superior behavior are internally consistent.

e) Data Analysis Methods

To analyze data, Multinomial Logistic Regression was used. Logistic regression assumes that the dependent variable is a stochastic event and a dependent variable describes the outcome of this stochastic event with a density function (a function of cumulated probabilities ranging from 0 to 1). A binary logistic regression model is taken into account,and regression coefficients are estimated to predict the probability of the outcome of interest. Equation (1) shows a function of the probabilities results in a linear combination of parameters is,

$$\ln\left(\frac{prob\,(event\,)}{1-prob\,(event\,)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \quad \text{q. (1)}$$

The component in the Left-hand side is called as a logit. The coefficients in the logistic regression model indicate how much the logit changes based on the values of the independent variables.

There are five scalar measures of model fit: (1) Deviance; (2) McFadden's; (3) Cox and Snell Pseudo; (4) Nagelkerke Pseudo and (5) Test of Parallel Lines. There is no convincing evidence that selection of a model that maximizes the value of a given measure necessarily results in a model that is optimal in any

sense other than the model having a bigger (or smaller) of that measure (Long & Freese, 2001). However, the residual analysis was also used to measure the goodness of fit of the model.

IV. Results And Analysis

This section presents an analysis of the data using multinomial logistic regression. Questionnaire extracts demographic factors and factors which affect employee satisfaction. Those main factors include superior behavior, co-worker behavior, the job itself, physical conditions, teaching and research, academic environment and freedom. Initially, the demographic factors are analyzed with multinomial logistic regression.

a) *Multinomial Logistic Regression Analysis of Demographic Factors and Employee Satisfaction*

The demographic factors collected are age, gender, academic rank, sector, the field of lecturing, years of service, salary, distance to work location and number of research papers published. Multinomial logistic regression is applied to find the relationship between demographic factors and employee satisfaction.

Since there are six questions to measure employee satisfaction, to form one dependent variable, the mode of all the six variables was taken. Employee satisfaction was modeled with the demographic factors using multinomial logistic regression, and the following result was obtained.

Table 4.1: Model Fitting Information for the model between employee Satisfaction and Demographic Factors

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Degrees of Freedom	Significance
Intercept Only	207.804			
Final	139.256	68.548	24	.000

Table 4.1 gives the model fitting information and significance value is 0.000. It is less than 0.05, and it indicates that the model is significant at 5% level of significance.

Table 4.2: Pseudo R-Square the model between employee Satisfaction and Demographic factors

Cox and Snell	.261
Nagelkerke	.286
McFadden	.125

According to Table 4.2, Nagelkerke R-square value is 0.286. Therefore the model can explain 28.6% of the variation of the dependent variable.

Table 4.3: Likelihood Ratio Tests and Significance of the parameters

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Degrees of Freedom	Significance
Intercept	139.256[a]	.000	0	.
Sector	156.528	17.272	4	.002
Salary	168.672	29.417	16	.021
Gender	149.908	10.652	4	.031

According to Table 4.3, all the predictors, sector, salary, and gender are significant, because all these demographic factors have significance values less than 0.05. Therefore they are all significant at 5 % level of significance. It can be concluded that sector, salary and gender have a vital effect on employee satisfaction. In this context, the sector indicates whether the employee is either from private or government sector.

Table 4.4 gives the correct classification rate for the multinomial logistic regression model. According to the table, the overall correct classification rate is 60.8%. Observed and predicted frequencies for the model are given in Appendix II. It can be seen that, for most of the categories, predicted and observed percentages are approximately the same. Pearson residuals are also included in this table, and all those values are less than

2, and therefore it can be concluded that the model fits the data well.

Table 4.4: Correct Classification Rate of the model

Observed	Predicted					
	1	2	3	4	5	Percent Correct
1	0	0	1	10	0	0.0%
2	0	0	3	17	0	0.0%
3	0	0	6	28	0	17.6%
4	0	0	3	132	0	97.8%
5	0	0	0	27	0	0.0%
Overall Percentage	0.0%	0.0%	5.7%	94.3%	0.0%	60.8%

b) *Multinomial Logistic Regression Model for Employee Satisfaction*

After the reliability analysis, the main factors in the questionnaire were analyzed with multinomial logistic regression. After obtaining different models with employee satisfaction, the best model was obtained with four independent variables. Table 4.7 gives the model fitting information for the multinomial logistic regression model between employee satisfaction and main factors. According to the table, chi-square value is significant at the 5% significance level.

Table 4.7: Model Fitting Information for the model between employee Satisfaction and main factors

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Degrees of Freedom	Significance
Intercept Only	450.665			
Final	271.590	179.075	64	.000

According to Table 4.8, Nagelkerke R-square value is 0.596. Therefore the model can explain 59.6% of the variation of the dependent variable.

Table 4.8: Pseudo R-Square the model between employee Satisfaction and main factors

Cox and Snell	.543
Nagelkerke	.596
McFadden	.324

According to Table 4.9, four factors are significant, namely Q12, Q31, Q32, and Q83. All these factors have significance values less than 0.05 and therefore it can be concluded that all those factors are significant at 5% level of significance. These factors include freedom, superior behavior and the job itself. The questions that have become significant are listed in Table 4.10.

Table 4.9: Likelihood Ratio Tests and Significance of the parameters

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Degrees of Freedom	Significance
Intercept	271.590[a]	.000	0	.
Q12	315.921	44.330	16	.000
Q31	301.166	29.576	16	.020
Q32	323.125	51.535	16	.000
Q83	340.914	69.324	16	.000

One of the significant factors includes the behavior of the superior. Both of the next two factors are from the job itself and it indicates that fitting of the abilities, and knowledge with the work is a significant factor in employee satisfaction. Further, the ability to use the full potential in the work is another significant factor in predicting employee satisfaction. Another key factor that has become significant is the freedom of the lecturer.

Table 4.10: Significant items in the questionnaire

Question	Question in the Questionnaire	Factor
Q12	I believe that my superior is selfish	Superior Behavior
Q32	My job fits my abilities and knowledge	Job Itself
Q31	I can use my full potential in my job	Job Itself
Q83	I am allowed to give lectures in other Universities	Freedom

Table 4.11 gives the correct classification rate for the multinomial logistic regression model. According to the table, the overall correct classification rate is 67.7%. Pearson residuals for the model are given in Appendix. It has found that, for most of the categories, predicted and observed percentages are approximately the same. Pearson residuals are also included in this table, and all those values are less than 2, and therefore it can be concluded that the model fits the data well.

Table 4.11: Correct Classification Rate of the model

Observed	Predicted					
	1	2	3	4	5	Percent Correct
1	6	1	0	3	1	54.5%
2	1	5	0	13	1	25.0%
3	1	3	9	19	2	26.5%
4	1	4	3	121	7	89.0%
5	1	0	1	12	14	50.0%
Overall Percentage	4.4%	5.7%	5.7%	73.4%	10.9%	67.7%

V. Conclusion

This study was conducted to evaluate and determine the main factors affecting employee satisfaction of academics in Sri Lanka. Multinomial logistic regression is used to analyze demographic factors and all 7 factors namely superior behavior, co-worker behavior, the job itself, physical conditions, teaching and Research, administrative duties, academic environment and freedom against the employee satisfaction. All these seven factors were measured by 37 questions included in the questionnaire. Results obtained from the analysis can be incorporated to improve the employee satisfaction of the Sri Lankan academics in future. Findings obtained from the analysis indicated that, out of all the demographic factors, sector, salary and gender were significant factors when modeling employee satisfaction with multinomial logistic regression. According to the model, sector, salary and gender can explain 28.6% of the variation of the employee satisfaction. As suggested by (David Bernal, 1998), this study also confirms that salary is related to employee satisfaction. (Shihadeh, 1994) Have found out of that, women are more satisfied with their job than men and that indicates that there is a relationship between employee satisfaction and gender. This study is able to confirm the result that employee satisfaction is associated with gender.

Before the analysis of the main factors, internal consistency of each factor was tested with the Cronbach's alpha and except the first factor (Superior behavior) all other factors gave positive values. When it is tested with superior behavior, it gave a negative value for Cronbach's alpha and therefore in order to make it internally consistent two questions were re-coded and it resulted in an acceptable Cronbach's alpha value which shows that all 5 items in superior behavior are internally consistent. Reliability analysis is used in many researches.

Multinomial logistic regression resulted in a model for employee satisfaction with four factors. This model has shown that, superior behavior, job itself and freedom are significant factors in predicting employee satisfaction. That is, this analysis has found that, fitting of job with abilities and knowledge, use of the employer's full potential in the job, superior's behavior and freedom are significant factors in the model. This model was evaluated with R-square values, residuals,

percentage of correct prediction and significance of parameter estimates. However, the R-square value is 59.6% for this model and therefore it indicates that this model is explaining 59.6% of the variation of the dependent variable.(Rajapakshe, 2007) Has found that co-worker's behavior, job itself and freedom are significant factors on employee satisfaction. Therefore it shows that there is a slight difference between the results of this study and the results of (Rajapakshe, 2007). But most of the significant factors in this study were much similar to (Rajapakshe, 2007).

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

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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.

Keywords: artificial intelligence. design, game, extinct, shologuti.

GJCST-D Classification: I.2.1

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Strictly as per the compliance and regulations of:

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

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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.

Keywords: artificial intelligence. design, game, extinct, shologuti.

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.

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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)
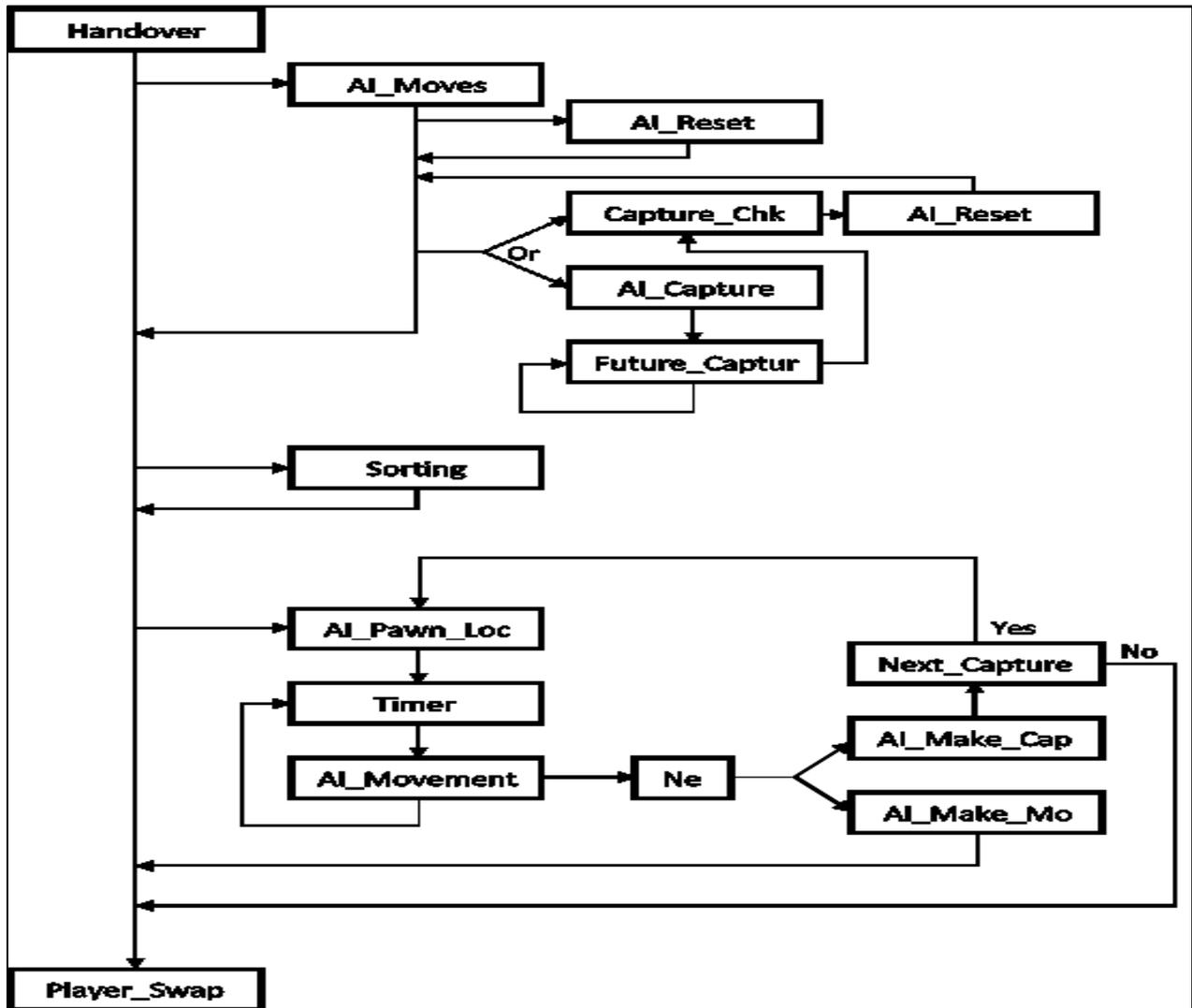
Fig. 1: PvAI Algorithm Workflow

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 points[x,0,z]=current position

Step 4: For every current position
Check every adjacent positions value

Step 5: If value of current adjacent position is = 0
Set points[x,1,z] = current adjacent position
Call Capture_Check(points[x,0,z], points[x,1,z])
z=z+1, AI_Reset()

Step 6: If value of current adjacent position is 1
Call AI_Capture with parameter points[x,0,z] and 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 | ai0 = a0, ai2 = a2 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 points set points[x,2,z] = points[x,2,z] – 4;

Step 3: Else Set points [x,2,z] = 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 points set points[x,2,z] = points[x,2,z] + 10;
Set points[x,1,z] = Third Position
Call Future_Capture with parameter 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 recourses 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 short technique and ascends the best move based on the points assigned during previous function operation.

viii. *AI_Pawn_Loc*

AICsp is usually set as the first starting point and AICep 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 AICsp and AICep. This function then finds out the X & Y coordination for both the AICsp and AICep positions and put them in SPx, SPy, EPx and EPy accordingly. Then it starts the timer function.

Pseudo code:

Step 1: Get AICsp, AICep

Step 2: Set
SPx = X Co-ordination of AICsp
SPy = Y Co-ordination of AICsp
EPx = X Co-ordination of AICep
EPy = Y Co-ordination of AICep

Step 3: Start timer function

ix. *Timer*

Timer function is used to recourse 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(AICsp,AICep)

Step 2: Call AI_Make_Capture(AICsp,AICep)

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 AICsp position to AICep position

Step 2: Set AICep positions value as AICsp positions value

Step 3: Set AICsp positions value as default 0.

xiii. *AI_Make_Capture*

AI make capture function is used when AI makes a capture move. It sets AICep positions value as AICsp positions value. And AICsp 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 AICep.

Pseudo code:

Step 1: Move pawn from AICsp to AICep

Step 2: Hide pawn between AICsp and AICep
Count enemy pawn = pawn – 1

Step 3: Call Next_Capture using parameter AICep

xiv. *Next_Capture*

Next_Capture function checks each adjacent position of AICep position for enemy pawn, if found, it checks if capture move is possible. If possible it sets AICsp as AICep, AICep 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
AICsp = AICep
AICep = Ending Position
Call AI_Pawn_Loc() using parameter AICsp and AICep.

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.
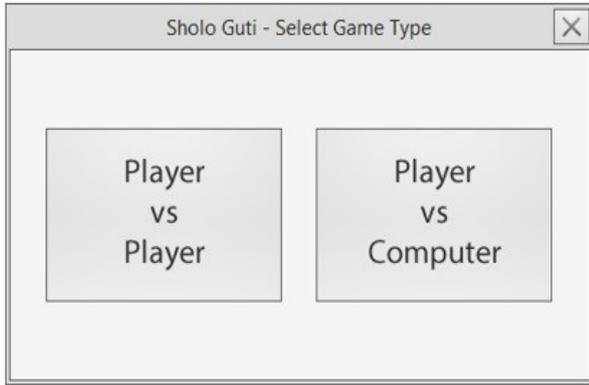
Fig.2: Selecting the Game Type

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.
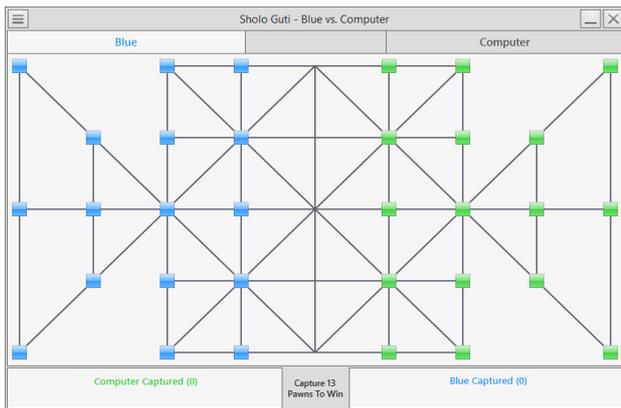

Fig. 3: Default Board - Player vs. Computer

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.
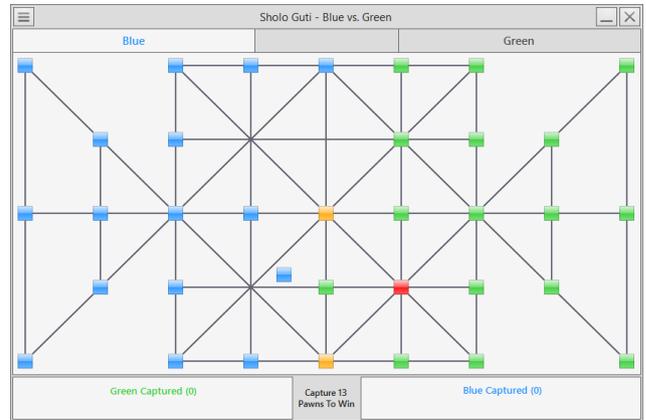
Fig. 4: Pawn Movements - Player Pawn

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.
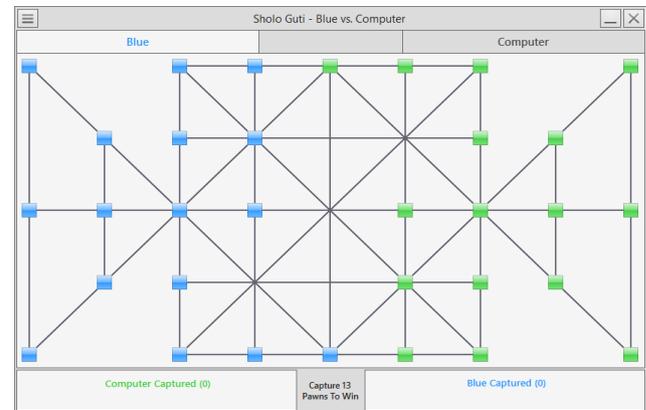
Fig. 5: Pawn Movements – AI Pawn

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.
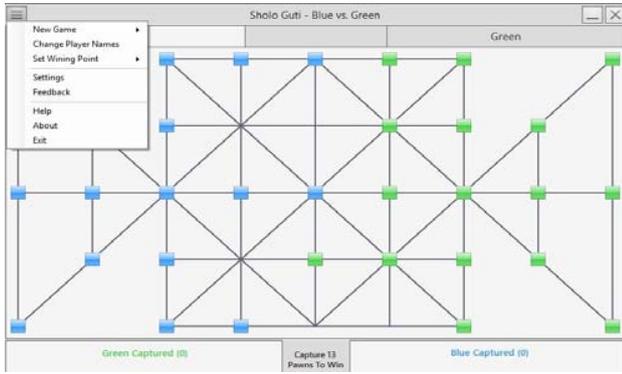
Fig. 6: Drop-Down Menu

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.
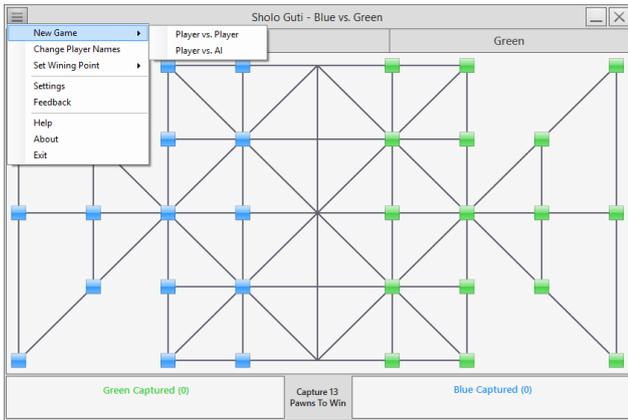

Fig. 7: New Game

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.
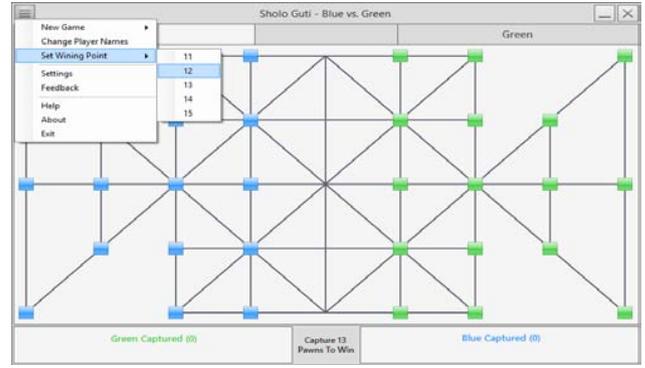
Fig. 8: Setting Wining Point

g) Winning 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.
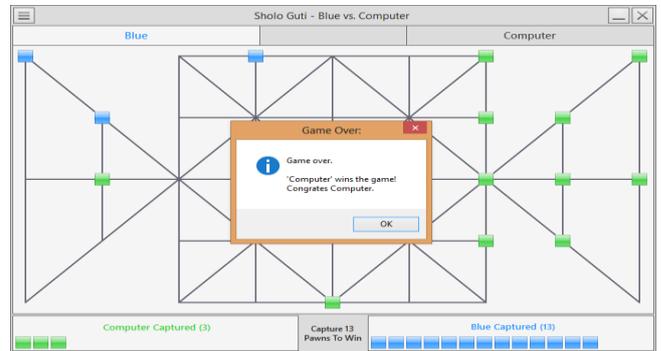
Fig. 9: Wining the Game – Game Over
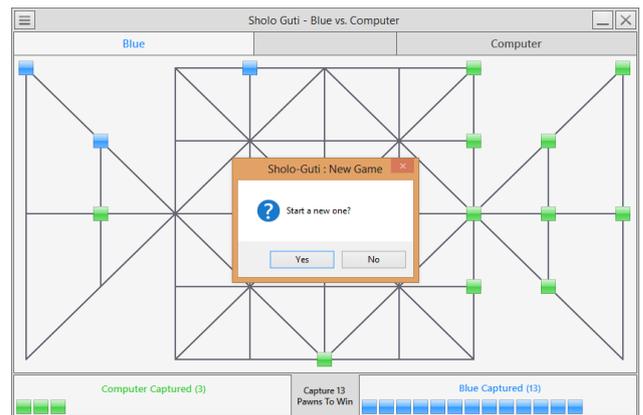
Fig. 10: Wining the Game – New Game

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.
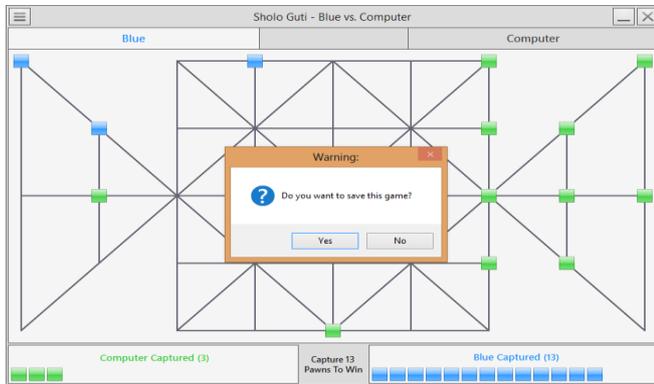
Fig. 11: Save & Exit

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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20

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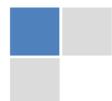
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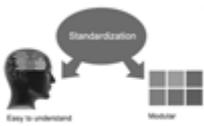
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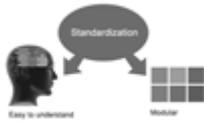
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"
➢ In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.

➢ In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.

➢ In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.
"

Preferred Author Guidelines

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

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

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

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

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

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- Ideas
- Findings
- Writings
- Diagrams
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- Illustrations
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- Printed material
- Graphic representations
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- Electronic material
- Any other original work

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3. Final approval of the version of the paper to be published.

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

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

Acknowledgments

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

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PREPARING YOUR MANUSCRIPT

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

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

Manuscript Style Instruction (Optional)

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

Structure and Format of Manuscript

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

A research paper must include:

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

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

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

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

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

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

All manuscripts submitted to Global Journals should include:

Title

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

Author details

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

Abstract

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

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

Keywords

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

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

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

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

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

Numerical Methods

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

Abbreviations

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

Formulas and equations

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

Tables, Figures, and Figure Legends

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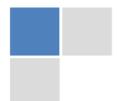
Figures

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

PREPARATION OF ELETRONIC FIGURES FOR PUBLICATION

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

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

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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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.
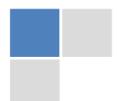
20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

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

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

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

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

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

Final points:

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

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

The discussion section:

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

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

General style:

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

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

Mistakes to avoid:

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

Title page:

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

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

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

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

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

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

Approach:

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

Introduction:

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

The following approach can create a valuable beginning:

o   Explain the value (significance) of the study.
o   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.
o   Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
o   Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

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

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

Procedures (methods and materials):

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

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

Materials:

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

Methods:

o   Report the method and not the particulars of each process that engaged the same methodology.
o   Describe the method entirely.
o   To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
o   Simplify—detail how procedures were completed, not how they were performed on a particular day.
o   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:

o   Resources and methods are not a set of information.
o   Skip all descriptive information and surroundings—save it for the argument.
o   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:

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

What to stay away from:

- o   Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- o   Do not include raw data or intermediate calculations in a research manuscript.
- o   Do not present similar data more than once.
- o   A manuscript should complement any figures or tables, not duplicate information.
- o   Never confuse figures with tables—there is a difference.

Approach:

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

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

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

Figures and tables:

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

Discussion:

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

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

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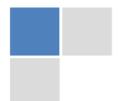
Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- o You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- o Give details of all of your remarks as much as possible, focusing on mechanisms.
- o 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.
- o 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?
- o Recommendations for detailed papers will offer supplementary suggestions.

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INDEX

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