Student Monitoring System Of Our Lady Of Fatima University Using Face Recognition

Christopher John Alolor, El Cid John Legaspi, Pedro Legaspi II, John Lloyd Padecio, Alexander Reyes, Arjimson Santiano, Mary Regina B. Apsay, Marissa G. Chua, Florocito S. Camata

Abstract: Face recognition has been one of the most interesting and important research fields in the past two decades. The reasons come from the need of automatic recognitions and surveillance systems, the interest in human visual system on face recognition, and the design of human-computer interface, etc. The rapid development of face recognition is due to a combination of factors: active development of algorithms, the availability of large databases of facial images, and a method for evaluating the performance of face recognition algorithms. The system covers any departments, agencies or companies which require personal identification and security to their employees. The face recognition system covers multiple face photos, matching of faces, head rotations, detects 66 facial feature points (eyes, eyebrows, mouth and nose) and all data are placed in a database. Additional enrolments will be required upon various changes in registered faces. The said system only limits to personal identification which contains certain fields about the registered user, it cannot detect the skin color and age of a person and the system is not a video- based face recognition system. This system does not expect to solve all the issues in face recognition, such as extreme facial expression, wearing on the face, great age discrepancy and extreme lightning condition and without frontal face information.

Keywords: Face Recognition, Image Processing, Luxand FaceSDK, Facial Features

I. Introduction

Face recognition is a very challenging problem and up to date and a bunch of papers have been published to overcome difference factors (such as illumination, expressions, etc.) and achieve better recognition rate, while there is still no robust technique against uncontrolled practical cases which may involve kinds of factors simultaneously including all situations and different applications that face recognition may encounter. Furthermore, the human face is not a unique, rigid object. Indeed, there are numerous factors that cause the appearance of the face to vary. Automatic recognition of people is a challenging problem which has received much attention during the recent years due to its many applications in different fields such as law enforcement, security applications or video indexing. The face recognition system to be proposed is made with the use of Visual Basic 10 (VB 10) and used MySQL as its database which can be accessed with the use of XAMPP. A third party software which is compatible with VB 10 known as Luxand FaceSDK compressed with OpenCV will also be used for facial feature recognition solution. For the experimentation purposes, the researchers used a software called ManyCam so that fiducial points of a face will be clearer.

- *Mary Regina B. Apsay is a Full-time Faculty member of Our Lady of Fatima University. She is taking PHD in Electronics Engineering at Mapua Institute of Technology, Philippines.*
- *Marissa G. Chua is the Program Head of Computer Studies in Our Lady of Fatima Unvieristy. She earned her Masters Degree in Computer Education in AMA Computer University, Philippines.*
- *Florocito Camata is the Internship Coordinator of College of Computer Studies, Our Lady of Fatima University. He is taking his Masters in Information Technology in Technological University of The Philippines, Philippines.*

Although there has always been a need to identify individuals, the requirements of identification have changed in radical ways as populations have expanded and grown increasingly mobile (Introna, 2008). Biometric technologies have emerged as promising tools to meet these challenges of identification, based not only on the faith that “the body does not lie,” but also on dramatic progress in a range of relevant technologies. Face recognition starts with the detection of face patterns in sometimes cluttered scenes, proceeds by normalizing the face images to account for geometrical and illumination changes, possibly using information about the location and appearance of facial landmarks, identifies the faces using appropriate classification algorithms, and post processes the results using model-based schemes and logistic feedback. Face recognition can be divided into two basic applications: detection and verification. In the detection problem, the face to be recognized is unknown and is matched against faces of a data base containing known individuals. In the verification problem the system confirms or rejects the claimed identity of the input face. Although differences may exist, this will address the general problem of face recognition and no particular distinction will be made among the two problems as the challenges and the used techniques are basically the same. Studies by other researchers’ show a lot of similarities and differences particularly in face recognition processes, software tool and database used. A lot of studies have been made but there is no system that has been able to recognize a face not only through live face recognition of a person but also recognition of face through a photograph or a caricature. Currently employed facial recognition systems that compare live people to their photos still have a false negative rate of about 15%. If performance in such controlled situations is so fickle, it seems there is still a lot of work to do before these systems can automatically and accurately pick out faces.

1. GENERAL OBJECTIVES

This study aims to develop a face recognition system that can identify the data/ information of a registered person using a special face feature of detecting and recognizing a

face in real time and in a photo or a caricature and also for security purposes that can be embedded in some hardware wherein it is also applied in a Student Monitoring System for experimental purposes

1.1 Specific Objectives

The study sought to accomplish the following objectives

1. Designing a recognition system for face.
2. Creating a database for the storage of the information of the user.
3. To evaluate the system.
4. To conduct a testing and debugging of the face recognition system .
5. To implement the face recognition system to a particular area of interest.
6. To introduce the use of Luxand FaceSDK to students and other programmers.

6.1 Statement of the problem

To prove that the development of a Student Monitoring System of Our Lady of Fatima University using Face Recognition is reliable and user friendly the following questions are answered.

Research Question 1: *What is the demographic profile of the respondents in terms of Age, Gender & Student Status?*
Research Question 2: *What is the performance of the Face Recognition System?*
Research Question 3: *How do the respondents evaluate the Face Recognition System?*
Research Question 4: *Is there any significant relationship between the performance and the respondents' evaluation of the Face Recognition System?*

HYPOTHESIS

In relation to the previous, the following hypothesis is postulated:

H_0: *There is no significant relationship between the performance and the respondents' evaluation of the Face Recognition System.*

SCOPE AND LIMITATIONS

The system covers any departments, agencies or companies which require personal identification and security to their employees. The face recognition system covers multiple face photos, matching of faces, head rotations, detects 66 facial feature points (eyes, eyebrows, mouth and nose) and all data are placed in a database. The system can be used in real time for it is user friendly and it is easy to use for it is generated and can be modified for general areas of interest. The system can be used for security purposes and personal identification and the system comes with a tutorial on how to use it and how to install the software and hardware needed to be able to run the face recognition system successfully. Additional enrollments will be required upon various changes in registered faces. The said system only limits to personal identification which contains certain fields about the registered user, it cannot detect the skin color and age of a person and the system is not a video- based face recognition system. This system does not expect to solve all the issues in face recognition, such as extreme facial expression, wearing on the face, great age discrepancy and extreme lightning condition and without frontal face information. The system is also not 3D- based, it can only recognize one face at a time and it does not include dual biometric security.

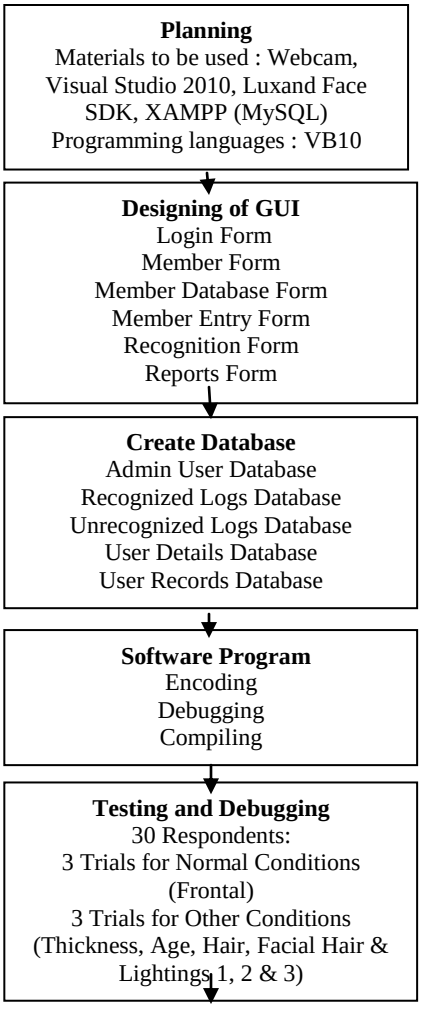
6.2 Significance of the study

This section states the importance of the study in this field, and how the people concerned will benefit from the proposed system.

Broad Areas- including social networking, security, law enforcement, cell phone applications and in odd places that you might not expect. With this, the users will be able to gain personal satisfaction and experience with the use of this kind of system.
Commercial Applications - they will be able to use and modify this system with the way they want it to work, this can be used to boost and upgrade their advertising and it can also be used to help and satisfy their growing number of customers.
Future Researchers- they will be able to use this study as a guide wherein this can be there stepping stone on making a more advanced face recognition system in the near future.

2. Research methodology

2.1 System Design



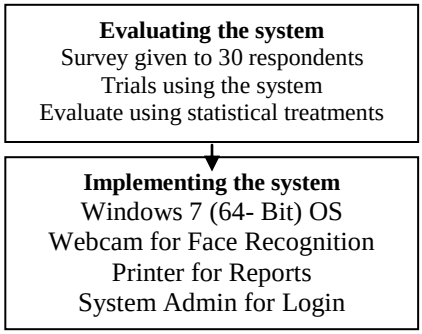


Fig. 1. *System Design*

2.1.1 Planning

The development of the project includes the usage of the Student Monitoring System of OLFU using Face Recognition. The researchers used Visual Basic 10 and Luxand FaceSDK to develop the interface and used MySQL as the database engine.

2.1.2 Designing of Graphical User Interface

Interpretation of the study has been made before the coding of the system. This is how the system in general should be implemented. The designing and creating of User Interface was done using Visual Basic 10 & Luxand FaceSDK. Visual Basic 10 offers easier methods to create a well- designed graphical user interface in each forms. Designing the face recognition system is varied through the right selection and optimization for what is necessary for implementation of the system. Creating the right design for the system will be able to add up to the face recognition technology as long as it is appropriate and applicable.

Fig. 2. Main Window

This is the Main Window of the Student Monitoring System using Face Recognition.

Fig. 3. *Student Registration*

This is the Registration page of the system for the students. This will allow students to fill in the required fields.

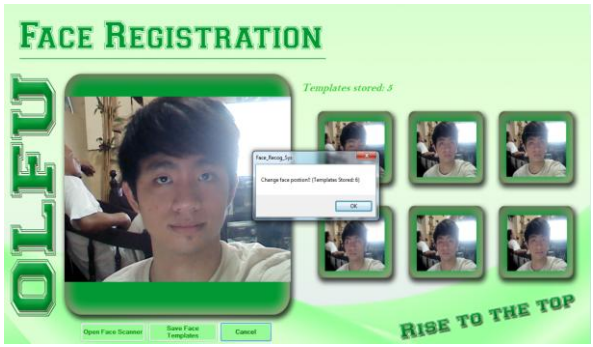


Fig. 4. *Saving Face Templates*

Students will be required to save six (6) different face templates so that users will be enrolled in the system's database and for them to be recognized.

Fig. 5. *Recognized User*

Users that will be recognized by the system will result in showing that user's details. Recognition of the face will also be placed in the database.

Fig. 6. *Unrecognized User*

Users that will not be recognized by the system has the option to use an alternative log- in if they really are registered in the system. They have to just input their username and password to access their account.

2.1.3 Software Programming

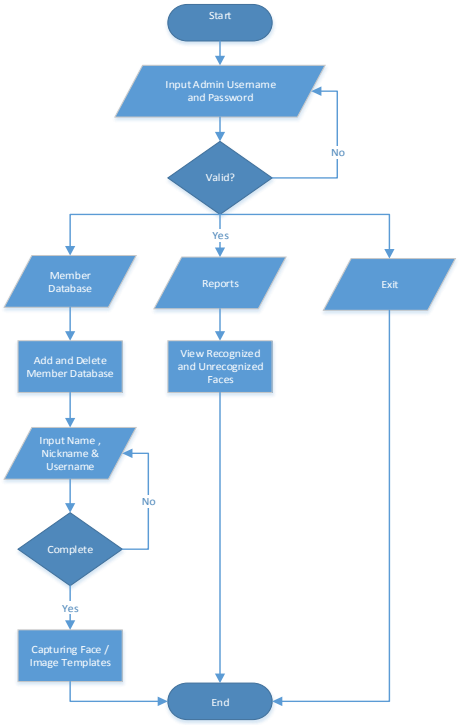


Fig. 7.0 *Flow Chart of Admin Log- In*

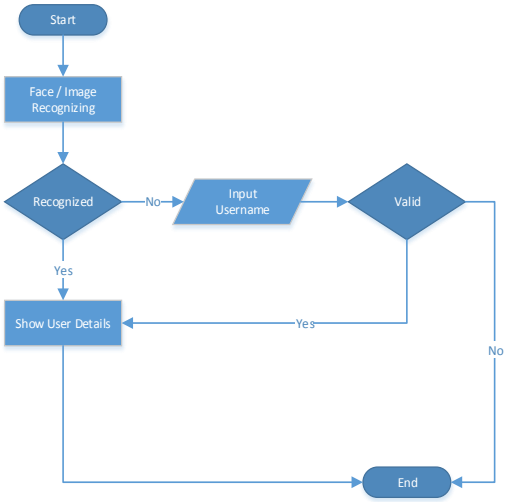


Fig. 8.0 *Flow Chart of Face Recognition*

2.1.4 Database Creation

The researchers used MySQL to store processed information. MySQL is easy to use and it has a big storage. This database is also open-source that will help the researchers lessen the financial costs of the researchers as well as for the future researchers. The database consists of tables for Admin User, Recognized Logs, Unrecognized Logs, User Details and User Records.

2.1.5 Testing and Debugging

The system was tested by thirty (30) students of Our Lady of Fatima University, Quezon City Campus, particularly the students of the College of Computer Studies. Debugging of the system was done upon errors encountered.

2.1.6 Evaluating the System

Gathered Data were analyzed using statistical technique and in order to have systematic collection, presentation, analysis, and interpretation of the data.

2.1.7 Implementing

For demonstration purposes the study was implemented using the Student Monitoring System using Face Recognition. This is implemented using Visual Basic 10 with Luxand Face SDK. MySQL is used as the database and the system is implemented in Windows 7 OS (64- Bit)

3. RESULTS AND DISCUSSIONS

4.1 Demographic Profile

Table 1
Frequency and Percentage Distribution of the Respondents According to their Demographic Profile

Demography	Frequency (f)	Percentage (%)
1.1 Age		
17- 18	4	13.33%
19- 20	13	43.33%
21- 22	8	26.67%
23- 24	5	16.67%
Total=	**N= 30**	**100%**
1.2 Gender		
Male	21	70%
Female	9	30%
Total=	**N= 30**	**100%**
1.3 Student Status		
Regular	23	76.67%
Irregular	7	23.33%
Total=	**N= 30**	**100%**

From the data gathered regarding the age of the respondents, it shows that majority of the respondents belong to the age range of 19-20 (f= 13, %= 43.33%) followed by the age range of 21-22 (f= 8, %= 26.67%), then by the age range of 23-24 (f= 5, %= 16.67%) and lastly, the age range of 17-18 (f= 4, %= 13.33%). The data gathered from the respondent's gender shows that majority of the respondents are Male (f= 21, %= 70%) while Female (f= 9, %= 30%) has the least number of respondents. The data also shows the student's status of each respondent. Majority of the students are Regular students (f= 23, %= 76.67%) while the Irregular students (f= 7, %= 23.33%) has the least number of respondents.

4.2 Performance of the System

Table 2
Performance of the System towards the Respondents

	Trials	Recognized	Not Recognized	Accuracy	Verbal Interpretation
Normal Condition	1.1 Frontal				
	Trial 1	30	0	100%	Excellent
	Trial 2	28	2	93.33%	Very Good
	Trial 3	28	2	93.33%	Very Good
	2.1 Thickness				
	Trial 1	29	1	96.67%	Excellent
	Trial 2	30	0	100%	Excellent
	Trial 3	28	2	93.33%	Very Good
	2.2 Age				
	Trial 1	28	2	93.33%	Very Good
	Trial 2	28	2	93.33%	Very Good
	Trial 3	29	1	96.67%	Excellent
	2.3 Facial Hair				
	Trial 1	30	0	100%	Excellent
	Trial 2	28	2	93.33%	Very Good
	Trial 3	29	1	96.67%	Excellent
	2.4 Hair				
	Trial 1	27	3	90%	Very Good
	Trial 2	28	2	93.33%	Very Good
	Trial 3	27	3	90%	Very Good
	2.5 Lightning 1 (Summer Filter)				
	Trial 1	28	2	93.33%	Very Good
	Trial 2	29	1	96.67%	Excellent
	Trial 3	29	1	96.67%	Excellent
	2.6 Lightning 2 (Winter Filter)				
	Trial 1	29	1	96.67%	Excellent
	Trial 2	30	0	100%	Excellent
	Trial 3	30	0	100%	Excellent
	2.7 Lightning 3 (Black & White Filter)				
	Trial 1	29	1	96.67%	Excellent
	Trial 2	29	1	96.67%	Excellent
Other Conditions	Trial 3	30	0	100%	Excellent
			Overall=	95.83333333%	Very Good

From the data gathered regarding the performance of the system, the evaluation has been divided into two categories, (1) Normal Condition & (2) Other Conditions. The Normal Condition is evaluated upon the saved face templates of each respondent and then testing it in the Face Recognition System three times. Trial 1 got a 100% accuracy rated as 'Excellent' while both Trial 2 and Trial 3 got 93.33% rated as 'Very Good.' The next category in the table, (2) Other Conditions, consist of different sub-categories: thickness, age, facial hair, hair and three kinds of lightning. These are possible changes that may affect in recognizing faces and are done using different applications so that experimentation can be applied to the respondent's faces. In the category of thickness, Trial 2 got the highest accuracy of 100% rated as 'Excellent', followed by Trial 1 having 96.67% rated also as 'Excellent' and Trial 3 only having 93.33% having a rating of 'Very Good.' In the category of Age, Trial 3 got the highest accuracy of 96.67% rated as 'Excellent' followed by Trials 1 and 2 both having 93.33% rated as 'Very Good.' In the category, Facial Hair, Trial 1 got the highest accuracy of 100% rated as 'Excellent', while Trial 3 got the next highest accuracy of 96.67% rated also as 'Excellent' while Trial 2 only got 93.33% which is rated as 'Very Good.' In the Hair category, the highest accuracy is garnered in Trial 2 having the accuracy of 93.33% rated as 'Very Good' while both Trials 1 and 3 had 90% rated also as 'Very Good.' In the next category, Lightning 1, Trials 2 and 3 got the same accuracy of 96.67% rated as 'Excellent' while Trial 1 only got 93.33% that rated as 'Very Good.' In the Lightning 2 category, Trials 2 and 3 also had the same garnered accuracy of 100% rated as 'Excellent' while Trial 1 got 96.67% rated as 'Excellent.' In the last category, Lightning 3, Trial 3 got the highest accuracy of 100% rated as 'Excellent' while both Trials 1 and 2 got also rated as 'Excellent' but only garnered the accuracy of 96.67%. The overall accuracy of the system is 95.83% which is equivalent to 'Very Good' in terms of verbal interpretation.

4.3 Evaluation of the System

Table 3
Evaluation of the System by the Respondents in Terms of User- Friendliness and Speed

	α = 0.05	Degree of Freedom (df)= 29		
Face Recognition	**Computed Value**	**Critical Value**	**Decision**	**Conclusion**
Frontal	-0.12356	± 0.355	Accept H_0	Insignificant
Thickness	-0.20386	± 0.355	Accept H_0	Insignificant
Age	-0.13676	± 0.355	Accept H_0	Insignificant
Facial Hair	0.08737	± 0.355	Accept H_0	Insignificant
Hair	0.339168	± 0.355	Accept H_0	Insignificant
Lightning 1	-0.10575	± 0.355	Accept H_0	Insignificant
Lightning 2	0.089234	± 0.355	Accept H_0	Insignificant
Lightning 3	0.040864	± 0.355	Accept H_0	Insignificant

The above table shows how the respondents evaluated the system in terms of its User- Friendliness and Speed. In the User- Friendliness category, the System's Navigation got a Weighted Mean of 3.57 rated as 'Outstanding', the System Design got a Weighted Mean of 3.77 that is also rated as 'Outstanding' while the Operation of the System only got 3.4 Weighted Mean that is rated 'Very Good.' The Grand Mean of the User- Friendliness category is 3.58 which is equivalent to a Verbal Interpretation of 'Outstanding.' The next category is Speed, the table above shows that the speed in storing faces got a Weighted Mean of 3.64 that is rated as 'Outstanding' and the speed in recognizing faces got a Weighted Mean of 3.7 that is also rated as 'Outstanding.' The Grand Mean of the Speed category is 3.66 which is also equivalent to a Verbal Interpretation of 'Outstanding.'

4.4 Significant Relationship

Table 4.1
Significant Relationship between the Performance and Evaluation of the Respondents on the System in Terms of User- Friendliness

User-Friendliness	Weighted Mean	Verbal Interpretation	Standard Deviation
1.1 System Navigation	3.57	Outstanding	0.679
1.2 System Design	3.77	Outstanding	0.504
1.3 Operation of the System	3.4	Very Good	0.724
GRAND MEAN=	**3.58**	**Outstanding**	
Speed	**Weighted Mean**	**Verbal Interpretation**	**Standard Deviation**
2.1 Storing	3.64	Outstanding	0.556
2.2 Recognizing	3.67	Outstanding	0.661
GRAND MEAN=	**3.66**	**Outstanding**	

The above table shows that using the formula, Pearson's r with α= 0.05 and having a Degree of Freedom= 29 to see if there is a relationship between the performance and respondents' evaluation of the system in terms of user-friendliness, every decision resulted into accepting the Null Hypothesis (H_0). The critical value of every conditions of the Face Recognition is ± 0.355 where in the Computed Values of Frontal (-0.12356), Thickness (-0.20386), Age (-0.13676), Facial Hair (0.08737), Hair (0.339168), Lightning 1 (-0.10575), Lightning 2 (0.089234) and Lightning 3 (0.040864) are correlated coefficient values which are either negative or positive and are all less than or greater than the Critical Value of ± 0.355. This result all the conclusions to be 'Insignificant' where in there is no significant relationship between the performance and evaluation of the respondents on the system's user-friendliness.

Table 4.2
Significant Relationship between the Performance and Evaluation of the Respondents on the System in Terms of Speed

	α = 0.05		Degree of Freedom (df)= 29	
Face Recognition	**Computed Value**	**Critical Value**	**Decision**	**Conclusion**
Frontal	-0.21108	± 0.355	Accept H_0	Insignificant
Thickness	-0.12162	± 0.355	Accept H_0	Insignificant
Age	0.044499	± 0.355	Accept H_0	Insignificant
Facial Hair	-0.12162	± 0.355	Accept H_0	Insignificant
Hair	0.180009	± 0.355	Accept H_0	Insignificant
Lightning 1	-0.06216	± 0.355	Accept H_0	Insignificant
Lightning 2	0.42498	± 0.355	Reject H_0	Significant
Lightning 3	0.07978	± 0.355	Accept H_0	Insignificant

The table shows that using the formula, Pearson's r with α= 0.05 and having a Degree of Freedom= 29 to see if there is a relationship between the performance and respondents' evaluation of the system in terms of speed, every decision resulted into accepting the Null Hypothesis (H_0) except for the condition, Lightning 2. The critical value of every conditions of the Face Recognition is ± 0.355 where in the Computed Values of Frontal (-0.21108), Thickness (-0.12162), Age (0.044499), Facial Hair (-0.12162), Hair (0.180009), Lightning 1 (-0.06216) and Lightning 3 (0.07978) are correlated coefficient values which are either negative or positive are all less than or greater than the Critical Value of ± 0.355 except for the condition of Lightning 2 (0.42498) where in it is greater than the given Critical Value. This result all the conclusions to be 'Insignificant' where in there is no significant relationship between the performance and evaluation of the respondents on the system's speed except for Lightning 2 where in its conclusion resulted to 'Significant' which means that this kind of lightning gives a significant relationship to the system's performance and the respondents' evaluation of system's speed.

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

4.1 Summary of Findings

4.1.1 Demographic Profile

Upon consideration of the data gathered and presented, several discussions have been made from this research. Respondents for this research, randomly selected, came from the College of Computer Studies in Our Lady of Fatima University, Quezon City Campus. The sample size for this research is only thirty (30) students. Majority of the respondents are male with the female group having the least number of respondents. Ages ranging from 19 to 20 years old have the majority number of respondents and ages ranging 17 to 18 years old have the least. Majority of the respondents randomly selected also are Regular students disregarding what year level they are at.

4.1.2 Performance of the System

When it comes to the performance of the system, different experimentation methods have been used to be able to get how accurate the system's performance is. In the normal condition which is the Frontal view of a face, it showed a result greater than or equal (>=) to 90% that ranges from the rating of Very Good to Excellent. In testing the other conditions that may affect in recognizing a face, different kinds of applications have been used to also determine if the system will still be able to perform its job. Change in face like turning it fat and old, changing of hair style and applying facial hair into the images of the respondents have been done to see if these factors affect in recognizing faces. Change in room lightning has also been tested by applying 3 different types of filters into the images of the respondents. Results from these conditions also resulted a greater than or equal (>=) to 90% of accuracy that ranges from the rating of Very Good to Excellent. Overall performance of the system regarding both Normal and Other Conditions applied in the experimentation of the Face Recognition System is 95.83% which is equivalent to a Very Good remark.

4.1.3 Evaluation of the System

The respondents are the ones who evaluated the system through a survey form given by the researchers. The evaluation of the system is to know of what the respondents/ users think of the system's user- friendliness and speed. The user- friendliness is rated by its navigation, design and operation. Both the system's navigation and design got an 'Outstanding' rating while its operation got only a 'Very Good' rating. The system's user- friendliness got an overall rating of 'Outstanding' having a Grand Mean of 3.58%. In terms of speed, the respondents rated the system in terms of storing and recognizing faces. The respondents both rated the storing and recognizing faces as 'Outstanding' only to differ in its Weighted Mean. The system's speed got an overall rating of 'Outstanding' having a Grand Mean of 3.66%.

4.1.4 Significant Relationship

The above tables show the correlated coefficient values which are either negative or positive but less than or greater than the critical value and that leads the researchers to accept or reject the null hypothesis depending to the computed value. Accepting the H_0 will result an 'Insignificant' conclusion that means that there is no significant relationship between the system's performance and the respondents' evaluation of the system's user-friendliness and speed. Rejecting the H_0 will result a 'Significant' conclusion meaning that there is a significant relationship between the performance and the respondents' evaluation of the system. Table 4.1 showed an 'Insignificant' conclusion to all conditions; this means that there is no significant relationship between the system's performance and the respondents' evaluation towards the user- friendliness of the system. Table 4.2 showed an 'Insignificant' conclusion to all conditions except for Lightning 2 which showed a 'Significant' conclusion that means that this condition shows a significant relationship between the system's performance and the respondents' evaluation of the system's speed. Majority of the results show that the two variables do not affect each other. Even if the performance of the system is 'Very Good', the evaluation of the system could be 'Outstanding.' It may also have the opposite of the output wherein the system's performance is 'Excellent' while the evaluation is 'Very Good.' There could be a chance that the performance and evaluation of the system are different with each other, meaning one variable could be higher or lower than the other variable.

4.2 Conclusions

Based on the findings, the researchers come up with the following conclusions:

1. The findings in the research tell that system is appropriate to be implemented as a biometric to another system or hardware that needs security for the system is accurate and user- friendly. The system not only also stores and recognizes real time faces of people but it can also store and recognize face images as long as the 66 fiducial points are visible through the camera. The system is more accurate if the user will be able to portray exactly one (1) of the six (6) face templates he saved in the system's database with the same room lightning.
2. Different conditions like aging change in face mass and hair style and having facial hair can be factors that may affect in recognizing a person's face. These conditions lessens the accuracy of the system in recognizing the system but due the face recognition system's algorithms, the system can still be able to determine who the person is even if changes affect each of the user's faces. Room lightning is also a factor that may affect in recognizing faces for the room lightning that has been saved in the database can be different from the time the system is going to recognize the user.
3. Finally, the study shows that there is no significant relationship between the system's performance and the respondents' evaluation of the system for both of this variables stand differently from one another. The performance of the system focuses on what the system can do and cannot do while the evaluation only stands for what the users think about the system wherein every user could have a different perspective about the system since everyone thinks differently from one another. Change in the performance of the system.

4.3 Recommendations

Likewise, there are still limitations are needed to be addressed by the future researchers. Future researchers can reconstruct this type of research to a different kind of system; it can be mobile applications that focuses on security or other stuffs that face recognition can be linked to. The researchers recommend "Luxand Face SDK" as a tool used in constructing the system or application for this is flexible to any types of programming language. It is also recommended that the future researchers extend their experimentation to a more advanced level to be able to measure the maximum potential of their study like in increasing the system's accuracy. But regardless of the limitations, this study can serve as a guide in providing knowledge to pursue in creating a more advanced face recognition system. For companies that are using biometrics, it is also a recommendation for their company to use dual biometrics to be able to secure and verify every record of each employee. This kind of system will be beneficial to employees for they will feel that their working environment is safe and sound. The researchers also recommend Law enforcement agencies to use this kind of system as a "Crime Fighting" tool to avoid crimes and bring safety to their people. This kind of system will be beneficial in their investigations in many ways like for identifying and capturing thieves. This system can also bring privacy to documents that are confidential and only chosen people will be able to view these documents.

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REFERENCES

[1] Chellappa et al (2009), Human and machine recognition of faces: A Survey, Proc. IEEE, vol. 83, no. 5, pp. 705-740.Bahram Shakouri, Soheila khoshnevis Yazdi (2012). The Sustainable Marine Aquaculture. Bowes and Bowes

[2] Martin (2010), Image Processing for Machine Vision, Florida International University, Dept. of Mechanical Engineering, pp. 1-8.

[3] Davies (2009), Machine Vision: Theory, Algorithms, Practicalities (Signal Processing and its Applications Series), Academic Press, pp. 24-28.Colt J., S. Mitchell, G. Tchobanoglous, A. Knight (2004). The environment requirements of fish. Delacorte Press

[4] Freeman (2008), Machine Vision: Algorithms, Architectures, and Systems, Academic Press, Inc. pp. 45-51.Lenntech (2011). Why Dissolved Oxygen is important. David and Charles

[5] Ritter and Wilson (2009), Handbook of Computer Vision Algorithms in Image Algebra, Florida International University, CRC Press, pp. 12-16.

[6] McKenna et al (2009), Real- Time Tracking for an Integrated Face Recognition System, Dept. of Computer Science, Queen Mary and Westfield College, University of London, pp. 1-6.

[7] Bruneli and Poggio (2008), Example- Based Learning for View- Based human Face Detection, I.E.E.E. Int. Conf. Neural Networks, pp. 87-92.

[8] Introna (2008), Facial Recognition Technology: A Survey of Policy and Implementation Issues, New York University, Dept. of Media Culture and Communications, pp. 15-30.

[9] Phillips et al (2010), Focus on Quality: Predicting FRVT 2006 Performance, 8th IEEE International Conference on Automatic Face and Gesture Recognition, Amsterdam, The Netherlands, pp. 17-19.Department of Ecology, Washington. A citizen's guide to understanding and monitoring lakes and streams

[10] Caluyo et al (2011), Wavelet-based Feature Extraction Algorithm for an Iris Recognition System, Journal of Information Processing Systems, Vol.7, No.3, pp. 426-430.U.S Fish & wildlife Service, Arcata. Fish Kills

[11] Wilson et al (2008), Human and Machine Recognition System: A Survey, IEEE, Workshops on Motion, pp. 711-725.

[12] Senior and Bolle (2010), Face Recognition and its Applications, IBM T.J. Watson Research Center, P.O. Box 704, Yorktown Heights, NY 10598, USA, pp. 101-109.Yovita John Mallya (2007). The Effects of Dissolved Oxygen on Fish Growth in Aquaculture

[13] Edwards et al (2011), Interpreting faces using Active Appearance Models in International Conference on Face and Gesture Recognition, number 3, pp. 300–305.John A. Hargreaves and Craig S. Tucker (2002). Measuring Dissolved Oxygen Concentration in Aquaculture

[14] M. Kirby and L. Sirovich (2009), Application of the Karhunen-Lo`eve Procedure for the Characterization of Human Faces, IEEE Transactions on Pattern Analysis and Machine Intelligence, pp. 103–108.

[15] Balasuriya (2010), Frontal View: Human Face Detection and Recognition, Dept. of Statistics and Computer Science, University of Colombo, pp. 20-30.

[16] Russell et al (2011), Face Recognition by Humans: 20 Results all Computer Vision Researchers Should Know About, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, pp. 5-20.

[17] Tolba (2010), Face Recognition: A Literature Review, International Journal of Information and Communication Engineering, pp. 88-95.