Development of Hospital Central Sterilization System with Eigenface Method

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Abstract. The sterilization center is one of the important links for infection control and plays a role in suppressing the incidence of infection. Sterilization is very important especially for surgical instruments, especially nowadays the development of surgical procedures and the complexity of medical equipment. In addition, hospitals as health care providers attempt to prevent the risk of infection for patients and hospital personnel. This study aims to develop tools/systems that can minimize the spread of infection with the use of facial recognition for a location that potentially infects people without Self Protective Equipment (APD). Facial recognition method developed by research is Eigenface Method. Eigenfaces are methods that use a set of eigenvectors in image processing for human face recognition. The created eigenfaces will appear as bright and dark areas arranged in a particular pattern. This pattern is how different facial features are selected to be evaluated and assessed. There will be a pattern to evaluate the symmetry, if there is a facial hair style, where the hairline is, or evaluation of the size of the nose or mouth. Other Eigenfaces have patterns that are less easily recognizable, and eigen surface shadows may look very little like faces. This method is expected the system/tool can provide a good introduction to the person/person who is allowed or not allowed access a particular room. So the purpose of the research will be achieved to suppress the extent of infection and present the Central Sterilization System that can be widely used in the hospital.

Keywords— ***hospital, sterilization center, eigenface, face recognition***

1. Introduction

Nosocomial infections or Hospital Acquired Infection (HAI) is an infection acquired in hospital by a patient who was admitted for a reason other than that infection. An infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility (WHO, 2002). The incidence of nosocomial

infections is one of indicators of hospitalization services at the hospital. According to the Decree of the Minister of Health No. 129 of 2008 about Hospital Minimum Service Standards, the standard incidence of nosocomial infections is ≤ 1,5%. To achieve these standards, it is necessary to control the infection in the hospital.

The sterilization center is one of the important links to control and reduce the incidence of infection (Banu & Subhas, 2013). Sterilization is a process to make an object or space sterile by destroying all types of microorganisms, including destroying the most heat-resistant microorganisms, that is bacterial spores (Fardiaz, 1992). Sterilization is very important especially for surgical instruments, especially when the operating procedures are growing and the complexity of medical equipment, a centralized sterilization process is needed so that the overall process becomes more efficient, economical and patient safety is guaranteed.

Hospitals as health care institutions manage to prevent the risk of infection for patients and hospital staff. To gain this achievement, it is necessary to control infection in the hospital (De Fátima et al., 2014)(Sangthong et al., 2005)(Group et al., n.d.). So this study aims to develop tools / systems that can minimize the spread of infection by using facial recognition for locations that have the potential to infect people without Personal Protection Equipment (PPE).

The face recognition method developed by the research is the Eigenface Method. Eigenface is a method that uses a set of eigenvectors in image processing for human face recognition (Kurniawan, Wicaksana, & Prasetiyowati, 2017). The created eigenfaces will appear as bright and dark areas arranged in a certain pattern. This pattern is about different facial features are chosen to be evaluated and assessed. There will be a pattern to evaluate symmetry, such as the style of the facial hair, the hairline, or the evaluation of the size of the nose or mouth. Other eigenfaces have patterns that are difficult to recognized, and the shadow of eigen surface maybe less visible as a face (Turan, n.d.). This method is expected to provide a good introduction to people who are allowed or not allowed to access certain rooms so that the purpose of the research will be achieved.

2. Research Methods

This research method consists of several stages, such as literature review, data collection, parameter identification and data processing, application development, results and discussion, conclusions and recommendations.

1. Literature Review
   Literature review is carried out to collect information from several references related to the issues to be discussed. Theories related to research problems are used as a basis for processing data. At this stage, identification and problems formulation will be conducted which will be the objectives of the research. Problem formulation to be examined based on the background of the problem.
2. Data Collection
   This stage is carried out by collecting data by observation using device. Then, this data is used as the basis for establishing the Knowledge Base of the system, this is because the method used by the system requires initial data, the initial data (face image) is used as a system parameter to recognize faces.
   This research used 100 facial images consisting of 5 people and each person takes 20 facial images as sample. Facial images are taken with different expressions and positions and use additional accessories such as glasses and masks. In this study, accessories also included medical masks and caps. Figure 1 is the example of a face database that is used for face recognition. All images are in same size and equivalently.

Fig.1 Face Database

3. Parameter Identification and Data Processing
This stage is conducted to identify the parameters used to recognize faces and this stage will be associated with the method used by the research. The first step in eigenface is to convert images vector form and calculate the mean. Second step is to normalize vectors using equation 1. Equation 2 and 3 is used to form the convariance matrix. The next step is to process the test results data.

$$\Phi_i = \Gamma_i - \Psi \quad \text{... (1)}$$

$$A = [\Phi_1, \Phi_2, .., \Phi_m] \quad \text{... (2)}$$

$$C = \frac{1}{M}\sum_{n=1}^{M} \Phi_n \Phi_n^T = AA^T \quad \text{... (3)}$$

4. Application Development
Application development carried out by research based on the initial testing stages of algorithm accuracy on research data. If the resulting accuracy is high / more than 90%, the research will use the algorithm as the core of modeling applications for face recognition. Applications will be developed using a prototyping approach. This method is chosen to ensure that applications are developed according to the necessity. This development method provides a wide space for users to provide suggestions in the development process.

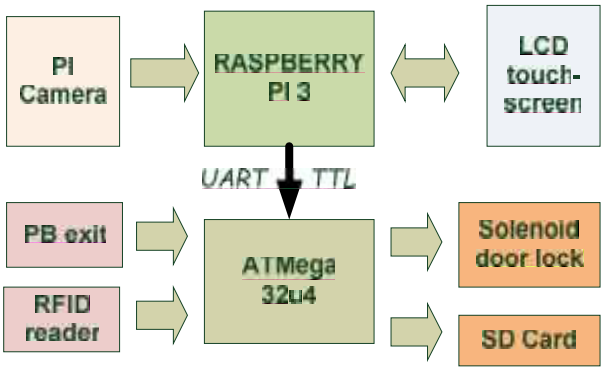

Fig2. System Block Diagram

5. Results and Discussion
   The results produced by the tool are then compared with the results of expert assessors. The equation that comes out shows the value of accuracy possessed by the tool. The method used by the research is Ground Turth.

6. Conclusions And Recommendations
   This stage is the final stage of the research that draws conclusions from the results of the analysis of the discussion and provides suggestions for further research. This stage reviews the implementation of related technology / research, this is carried out to ensure that the research has a novelty contribution to the research fields,

3. Result and Discussion

System testing is carried out with image data taken with various expressions shown in the following figure 3. Tests are carried out in several conditions. The first test is done on the condition of the face without using accesories. The second test is done on the condition of the face wearing a mask. The third test is done on the condition of the face wearing a mask and hat. Based on the test results in the figure above, the system has been able to recognize objects that are indicated by various types of facial expressions and positions. In order to obtain a decision in identifying the image, it is necessary to set a limit value needed for the clarification process. An error analysis is performed from the results of the experiments that have been carried out.

Fig.3 System Testing

The errors analyzed consist of two types of errors, namely False Acceptance Rate (FAR) and False Rejection Rate (FRR). FAR shows an error in recognizing the input image identity, whether it's an error in recognizing the registered image identity or not registered in the training set. FRR indicates an error in rejecting an input image that should be recognizable to become unknown. The value of FAR and FRR is obtained by varying the threshold value used in the classification process. FAR / FRR values and accuracy using several threshold values (T) are shown in the figure 4.

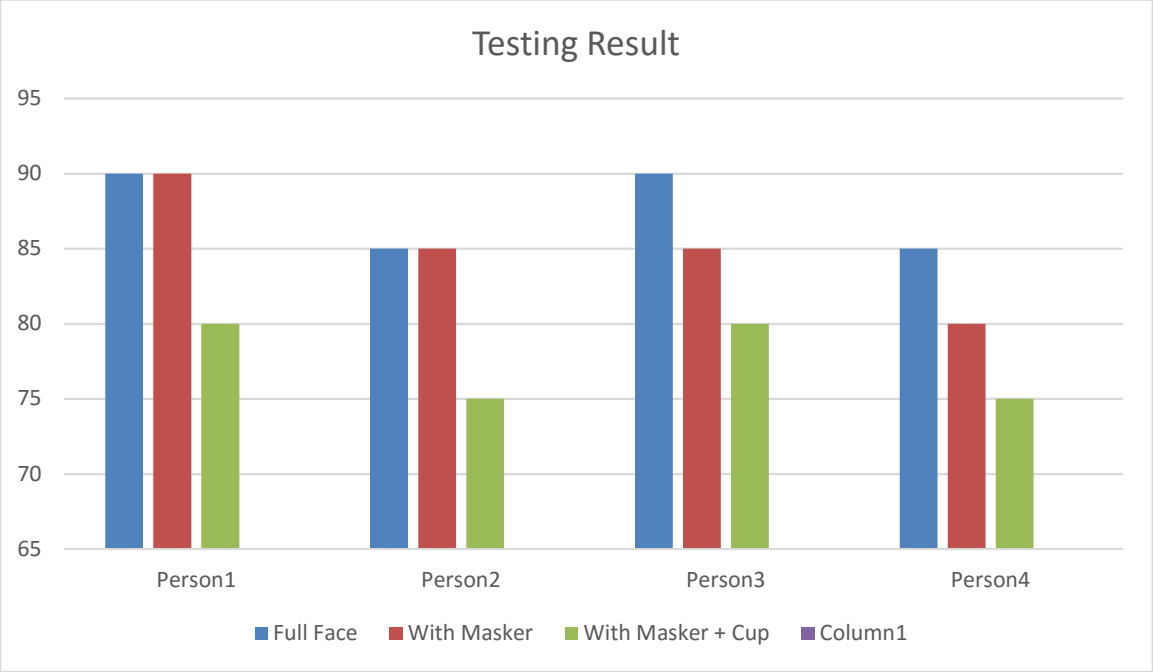

Fig 4. Testing Result

4 people used for testing. Tests are carried out with 20 data collection times for each person. On face recognition without accessories, the average success rate is 87.5%. On face recognition using masks, the average success rate is 85%. On recognition of faces using masks and hats, the average success rate is 77.5%. The whole test has an average success rate of 83.3%.

4. Conclusion

Based on the research that has been conducted, it can be concluded several things.

1. Face recognition with eigenface can be used to identify faces even though objects with different facial expressions and can be used to access in medical rooms.
2. The usage of the eigenface method for facial recognition systems provides good results with an average recognition rate of 83.3%.

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