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Automatic Students Presence System Based on Face Recognition Using Surveillance Camera

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Abstract

Today, implementation of information technology has expanded to various fields including education. Implementation of information technology in education has evolved from the most basic systems to complex systems. In education, there are much research about Implementation of information technology, start from technology itself to user impact and society. The biometric presence system is one of the implementations of technology that has implemented in several government and private institutions. Biometric presence systems besides using fingerprints can also use faces. Presence systems using faces require simple hardware such as digital cameras and integrated systems. Face based presence usually uses a camera that is directly attached to a presence device, and the face must be directly in front of the camera. The face will be recognized using surveillance cameras to replace ordinary presence cameras. A face detection system added to support the initial process in face recognition. Presence using this surveillance camera will be tested in a study room at the Universitas Pembangunan Nasional "Veteran" Jawa Timur, and will be analyzed about the accuracy and precision of the system. Based on the experiments that have been done, face recognition performance is 72.40%. This accuracy is included in the medium category. This result is still not optimal. The optimization process needs to be done in future research, by analyzing system weaknesses, modification of facial recognition methods, and pre-processing techniques for face data.

Keywords: biometric , face detection, face recognition, student presence, surveillance camera

INTRODUCTION

Today, the use of technology has expanded to various fields including education. The use of technology in education has evolved from the most basic systems to complex systems. Researchers who develop information technology excellence applicative in the field of education are also increasingly, seen from the increasing number of research results and applications that have been utilized in the field of education, including academic information systems which are often found as information systems to provide information in the form of values, attendance lists and various academic matters. The implementation and results of research in the form of hardware and a combination of hardware and software have been utilized in the field of education including as a practicum medium such as for example robotic devices, as well as supporting facilities and infrastructure such as parking systems, and Presence systems.

Presence systems using biometrics are now widely found in various government and private institutions. The presence system that often found is presence that uses fingerprints, faces, or a combination of both. Presence using fingerprints requires a special tool to read fingerprint biometrics from each individual who will attend. Presence using

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fingerprints in addition to using special hardware also requires software that must match the hardware used. Unlike the presence of fingerprints, the presence of using faces requires simpler hardware. The hardware used in face-based presence is a camera that integrated with a faces detection system. The detached face will recognized by using a recognition system based on the face data that has been stored. Cameras used in face attendance systems can vary and do not require specific specifications, while detection systems and facial recognition systems are systems that based on algorithms that are not bound to certain hardware. Face attendance systems can said to be more flexible than fingerprint attendance systems.

Facial presences often found in various government and private institutions, even personal computer systems (laptops) can integrated with facial recognition systems to open or activate systems in the personal computer. Research on the fast face detection process framework and high detection rates has been propose using the introduction of a new image representation called Integral Image that allows the features used by detectors to be calculated very quickly (Viola, 2017). Simple and efficient classification machines have been build using the AdaBoost (supervised learning) learning algorithm that has been use to select a small number of potential visual features (Freund, 1999). In classifying cascades that allow to quick separate images and backgrounds so that the algorithm becomes more efficient (3, 4, 5). Face detection algorithms continue to be developed and can be embed in personal computers with the ability to be simple equipped with a simple camera, and with an unlimited background with a success rate of 97.62% (Gonzales, 2010).

Face recognition is a stage that carried out after the detection of faces in a photo frame. The face that has detected next will be a matching process with the face data that has been stored previously. Information about the owner of the face can displayed based on the data that has been stored. An approach to the detection and identification of human faces presented, and done, approaching a real-time face recognition system that tracks the subject's head and then recognizes people by comparing facial characteristics to the data of people in the database. This approach treats the face as a two-dimensional recognition problem. Face image projected into the feature space ('face space') which is the best and encoded variation between known face images. Face space defined by 'eigenfaces', which are eigenvectors of facial sets (Turk, 1991). An eigenspace manifold used to represent faces from different poses, so that better results can obtained (Graham, 1998). PCA (Principal Component Analysis) and LDA (Linear Discriminant Analysis) can also used in a face recognition system (Zhao, 2002). Research on facial recognition in various lighting has been carried out and created a new framework in the face recognition process (Zhi, 2002).

Presence systems using the face are currently used to recognize faces one by one, and usually a face attendance system like this is installed in an institution for employee or staff attendance. In a higher education institution, in the learning process the majority of student attendance systems still use manual systems by signing printed attendance sheets. In attendance activities in class like this are very vulnerable to fraud which is known as "absenteeism". If using biometric attendance individually it will hamper learning activities because biometric presence must be done one by one for all students present in a class with a minimum capacity of 40 students.

This paper proposed a system that can automatically attend using surveillance cameras. The camera will be installed in front of the class in an area that can reach all parts of the class. Furthermore, by using a face detection system, the camera will mark the part of the frame from the captured image which is the face of students in a class. The process is continued with an introduction to the face that has been detected so that it will automatically be kept a record that the student is present in the class with a specific course and time.

It is expected that this system can replace manual attendance so that teaching and learning activities become more effective because the presence process is not interrupted, and more efficient because the system will directly store student data that is present in a class with a specific course and time.

METHODS

Digital image

An image is a combination of points, fields, and colors to be created from physical or human objects. Images can take the form of two-dimensional images, such as paintings, photographs and three-dimensional shapes, such as statues. In this era, images are very well known for painting. Early theory suggests that humans begin to create

images about their daily lives, usually those that become their clots. With these images, they believe that they will help them in more hunting. However, these images are very influential to get the attention of others, even to pass through the niche.

The image was first created around 35,000 years ago. At that time, human creation increased as more paintings were created. Archaeologists call this period a creative explosion. The cave painting was first discovered by Maria, the daughter of an amateur archaeologist named Marcelino De Sautuola in 1879, in the form of a group of long-extinct Aurochs (a type of bull (England: Ox) that had long gone extinct) in the Altamira cave, northern Spain. One of the most famous images is a picture in the cave of Lascaux, France in 1940. The cave walls are shown with pictures of mammoths, bison, wildebeest and horses. There are also cave paintings found in 1969 in front of the cave near Twyfelfontein, Namibia, about 30,000 years. And paintings in the Chauvet cave, southwest France, were discovered in 1994 and reached 31,000 years.

The painting or drawing is made using materials such as charcoal, lime, coal, and others. One technique that is well-known for making prehistoric images by ancient humans is to install hands on the walls of the cave, then spray it with chewing leaves or colored mineral stones. The colors are mostly red, brown, yellow and black that can be made from mining materials, with a mixture of blood and animal fat. Figure 1 is a picture of a famous monalisa painting.

Figure 1. Image of Painting Monalisa.

Images or images have evolved along with the development of human civilization. The shape is no longer just a painting like prehistoric times. Now there are photos, images produced by capturing light on a medium that has been coated with light-sensitive chemicals or digital sensors, then there are films, moving images. Even with the existence of technology, the evolution of images only revolves around painting, sculpture, photographs and film. The medium used began to vary, from those originally using canvas, can now use paper to the digital form. However, the image function will also not change, as a symbol of what you want to communicate. Image or image is a tool that humans use to convey messages to other people.

Generally digital image is an image stored in digital media. Digital image is a two-dimensional image that is stored and can be processed using a computer as a digital device. Digital images on digital media are stored in a matrix containing real and complex values that are represented in a particular set of bits. An image can be defined as a function of f (x, y) measuring M lines, and N columns, where x and y are spatial coordinates, and the amplitude f at the coordinate point (x, y) is called the intensity or gray level of the image at that point.

If the value of x, y, and the overall amplitude value is finite (limited) and discrete value then it can be seen that the image is a digital image. Digital images can be used using a matrix in the following form.

$$f(x,y)=\begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1,N-1) \end{bmatrix}$$

The value of a slice between rows and columns (at the position of x, y) is called picture elements, pels, or pixels. The term pixel / pixel is most often used in digital images (Putra, 2010).

Figure 2. Digital imaging tools.

Digital images are images formed by digital devices. Figure 2 is a number of examples of digital devices that can produce a digital image. Digital images are formed by digitizing. Image digitalization is a process for converting sensed objects obtained by sensors into digital images. Image digitalization consists of two processes, namely: sampling and digitizing intensity. Sampling is the process of taking a discrete value of coordinates (x, y) by passing an image through a grid (gap). Quantization is a process of grouping the value of gray level continuous image into several levels or it can also be said as a process that divides the gray scale (0, L) into G level level expressed by an integer price (integer), can be written as follows: G = 2m where G is a gray degree and m is a positive integer (Putra, 2010).

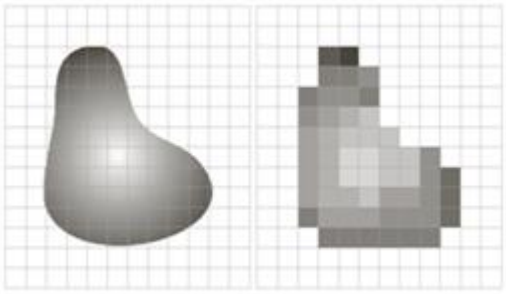

Figure 3. Digitalization of continuous object

Digital image storage sampled with N x M (N rows and M columns, as in previous posts) pixels and quantized to 2m level gray level requires memory: M x N x m. For example, an image measuring 512 × 512 with 256 gray degrees requires a memory of 512 x 512 x 8 bits = 2,048,000bit. representation of gray digital image (grayscale) which is the result of the digitization process (Putra, 2010).

Face Detection and Recognition

Face detection is computer technology used in various applications that identify human faces in digital images (Frischholz, 2017). Face detection also refers to the psychological process in which humans find and present to the face in a visual scene (Lewis, 2003). Face detection can be considered as a special case of object-class detection. In object-class detection, this task is to find the location and size of all objects in an image that belong to the given class. Examples include the upper torso, pedestrians and cars.

The face-detection algorithm focuses on frontal human face detection. This is in line with image detection where a person's image fits little by little. Images match the image store in the database. Each face change feature in the database will cancel the matching process. Trusted face-detection approaches are based on genetic algorithms and eigen-face techniques (Zhang, 2007). Result of face detection can be seen in Figure 4.

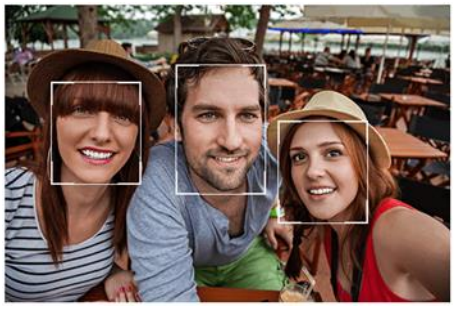

Figure 4. Face mark of image.

The human face plays an important role in our social interactions, conveying people's identities. Using the human face as a key to safety, biometric face recognition technology has received significant attention in recent years because of its potential for a wide variety of applications in both law enforcement and non-law enforcement. Examples of face recognition as shown in Figure 4.

Compared to other biometric systems using fingerprints / palms and irises, face recognition has different advantages due to its non-contact process. Face images can be captured remotely without touching the person being identified, and identification does not require interacting with that person. In addition, face recognition serves a deterrent goal because face images that have been recorded and archived can then help identify someone.

Face recognition can be used as a presence system because by using face data, someone who does attendance is enough to show his face to the camera that is used as a tool to capture the digital image of the face. The face of the person will then be introduced based on the data contained in the database. After the data is validated, the system will provide a notification message as a notification that the system has recognized the person's face. research on face recognition has developed very rapidly.

Over the past decade, NEC has concentrated on developing facial recognition methods in the framework of biometric security systems and now applies face recognition technology to other markets. NEC's Face Recognition technology achieved the highest performance evaluation at the Face Recognition Seller Test (FRVT) 2013 conducted by the US National Institute of Standards and Technology (NIST). In addition, NEC technology took first place for the third consecutive time after the 2009 Multiple Biometric Grand Challenge (MBGC 2009) and 2010-2011 Multiple Biometrics Evaluations (MBE 2010-2011).

In this research, face recognition is used to replace the manual student attendance process. The process of face recognition is done by capturing facial images using surveillance cameras installed in front of the class. The case study in this research was in the environment of UPN "Veteran" East Java precisely in the Study Program of Informatics Engineering.

Proposed Algorithm

The face database in this paper is a collection of facial image files from active students at a university. Each student will take his face picture 5 times with different shooting angles. So that if there are 200 students, 1000 face data will be obtained. The face image will be carried out by the face detection process using the same algorithm as when doing face detection processes from surveillance camera images (figure 5). Cropping will automatically be done to get the facial segment of the student concerned. Facial segmentation results will be saved as a dataset.

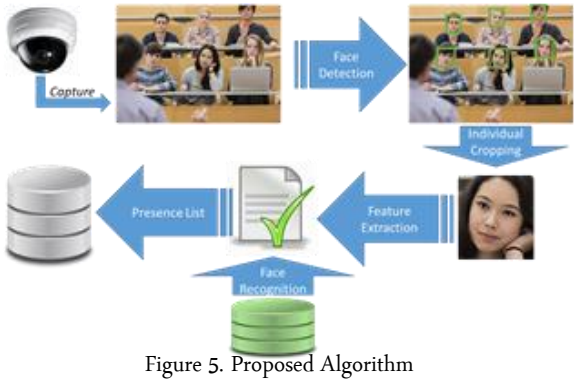

Figure 5. Proposed Algorithm

This paper uses images taken with surveillance camera devices. The camera will be placed right in the middle of the front of the class or in line with the position of the blackboard where the student will look. The camera used must have enough resolution to take pictures clearly from the front of the class to the back of the class. Auxiliary cameras are also installed on the left and right side of the class right in the middle of the class length line. The three cameras will take pictures randomly, each time ten times, so as many as 30 images are obtained in a class. Image taking is done when the lecturer gives direction / material so that the picture can be obtained when almost all students in the class direct their foresight.

The images that have been obtained will be sent to the server for processing. The first process that is done is the face detection process. The result of face detection is a segmented face image, and is temporarily stored in the hard drive. In this case there will be more than one face image for one type of face, this is necessary for the face recognition process because the face recognition process will get better results when using data with a greater variety of image angle taking. Each face image will be compared to the entire database of faces stored. Face images in a database that has the highest similarity value with the face being compared will be considered as an object (student). The identity of the identified students will be recorded in the attendance list of the class concerned.

RESULT AND DISCUSSION

The system in this paper was built using high-level programming languages. A high-level programming language is a language that has an easy-to-understand interface design, such as text controls or buttons. In high-level programming languages can also display images and graphics so that the system built in this research the interaction between the user and the system is done on the media form in which there is control to provide action and process input. The results of the process output are also displayed in the form interface. System interface to process data analysis as shown in Figure 6. In Figure 6, you can see the load camera button to connect to the camera in front of the class leading to students in the class. After the image appears in the video control, the analyzing button can be clicked to do the image retrieval process which is then performed with the face search process by using a face detection algorithm.

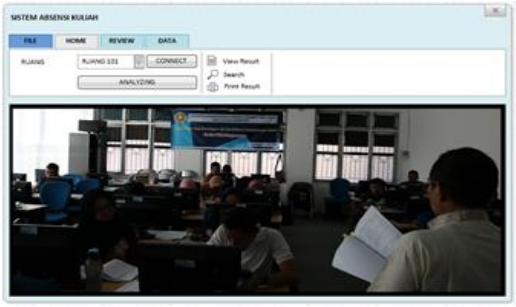

Figure 6. Interface of system

The results of the face detection process will be displayed in the same control form, with markers as shown in Figure 7. The results of the individual face detection process can be seen through the review menu. In the first year of this research the review menu can be used to automatically calculate the number of faces found in the image. The review menu also displays the results of segmentation of the face image. The segmentation face image is then automatically counted. The number of faces found in the image is considered as the number of students in the class. The system results also display a list of names in accordance with the face image that was successfully detected.

Evaluation in this paper begins with preparing test data which is image data taken by using a surveillance camera. The test data is then analyzed using the interface that has been built. The results of face detection will be analyzed in plain view by calculating the number of errors made by the system. Types of system errors include marked areas that are not faces, and failure to recognize areas that are faces. The results will be compared to the real conditions at the time the data was taken. For example, as shown in Figure 5, there are some errors that occur in the face detection process. The average error value obtained shows that the system has been able to recognize the face area, and system errors occur due to the influence of factors outside the system including the camera resolution factor, and the condition of the student when the image was taken.

Figure 7. Example of Face Detection Result

CONCLUSION

The topic of this research focuses on the implementation process of face detection and face recognition algorithms to support the process of recording student attendance lists in a lecture. The device used is a digital camera device to carry out data collection processes, and surveillance camera devices for attendance data collection processes. From the analysis of system outputs that have been carried out, the following conclusions are obtained. The system has been running and is able to detect facial areas in digital images. Research has been successfully carried out with the creation of a system that is able to detect the number of students who are in a class in certain lecture hours using a camera with face detection methods. The results of the face detection process are strongly influenced by several factors: light, camera resolution, camera position, and the conditions of students in the class.

Based on the experiments that have been done, face recognition performance is 72.40%. This accuracy is included in the medium category. This result is still not optimal. The optimization process needs to be done in future research, by analyzing system weaknesses, modification of facial recognition methods, and pre-processing techniques for face data.

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