Student Attendance using Face Recognition Technology

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***Abstract*—In the world of education, recording student attendance is one crucial element. Student presence record is one of the determinants of student graduation. In almost every education field, attendance records that accurately recorded. The presence of facial recognition technology is one of the solutions used to record student attendance during class meetings. This article discusses the model of student attendance recording that can become part of the campus academic information system. The technologies used in recording student attendance include face recognition technology through Computer Vision and Matlab. This study discusses the system module and the factors that affect the accuracy and performance of the system. This model can be the basis for developing student attendance systems at universities or other educational institutions. This study proves that the process of recording through face recognition has the potential to be applied to educational systems in institutions, both as the primary system or as a support system of an existing system.**

Keywords—face recognition, attendance system, computer vision, student attendance, machine learning.

I. INTRODUCTION

In the world of education, recording student attendance is one crucial element. Student presence record is one of the determinants of student graduation. In almost every education field, attendance records that accurately recorded [1], [2].

With the presence of various information and communication technology capabilities, this has resulted in the development of processes from manual to semi-automatic or automatic. The diversity of existing sensor technologies provides various combinations of processes that have the opportunity to be developed by researchers and developers in various methods, including the method of using the camera [3].

Various methods of recording student attendance are applied by higher education, both manual, semi-automatic, and even by using technology [4]. Different ways of recording student attendance are available and developed at this time; of course, each method has advantages and disadvantages [5].

Examples of the use of technology in this attendance system include RFID [6], social media [7], barcodes, Bluetooth [8], fingerprints[9], and Near Field Communication (NFC) [10]. Various researchers and application developers have implemented this attendance system application. With various sensor technologies, attendance systems can be developed in various forms.

The presence of facial recognition technology is one of the solutions used to record student attendance during class meetings [2], [11]. This technology uses face capture through cameras and object protection systems that make up human faces [12]. This system then discusses each face's object, then each item is predicted with a list of verified-faces in the library of student's faces.

This study discusses the model of face recognition applied to student participation systems in tertiary institutions.

The facial recognition technology model applied to the college attendance system can be one solution for universities to use attendance systems on each campus.

II. RELATED STUDY

Computer Vision is Digital Image Processing [13]. So that computers can see an object like humans know an object [14]. Thus, the machine can recognize an item, make decisions, take action, and count the number of objects [15].

Through Computer Vision [16], computers learn existing data and learn by themselves, so machines can see like humans see things [2]. Through this ability, humans use computers in various activities that observe and pay attention to objects until finally, the machine use to the next level, including student attendance systems in the learning process with their lecturers.

The presence and development of an accelerated Graphics Processing Unit (GPU) [17], machine learning has become one of the emerging technologies lately [18], especially the use of fixed and moving images for various processes needed by humans and their developers.

One of the technologies used is deep systematic learning [19], [20]. The wide scope of deep learning is growing, making this technology popular in information processing through natural language processing, including capability extraction and visualization processes.

Deep Learning technology has an excellent ability to handle processes related to face recognition, including its application to Computer Vision. One of the capabilities used

is in terms of classifying objects in an image, known as Convolutional Neural Networks (CNN) [21], [22].

The detection of objects in the form of images continues to grow, including the presence of various alternatives such as the success of the regional proposal method and the R-CNN [23].

III. METHOD

This research conduct at the Universitas Pembangunan Nasional "Veteran", Yogyakarta. The basis of information and knowledge base on the study of various kinds of literature sourced from multiple journals.

The study stages are based on the concept of the System Development Life Cycle (SDLC) (see Fig. 1). These stages include Communication, Planning, Modeling, Construction, and Deployment [24].

At the communication stage, a process is carried out to understand the needs of the attendance system. The planning stage is a step related to preparing various related steps so that the system can be implemented. The modelling stage is the stage for creating a model based on the things that have been planned. The Construction Phase is the technology phase built, including hardware, software, and supporting infrastructure. Meanwhile, the deployment stage is the application of the system so that it can be used properly.

The system developed using Computer Vision to utilize capabilities to automate tasks related to the human perspective, namely capturing faces, analysing, searching, and recording assigned tasks.

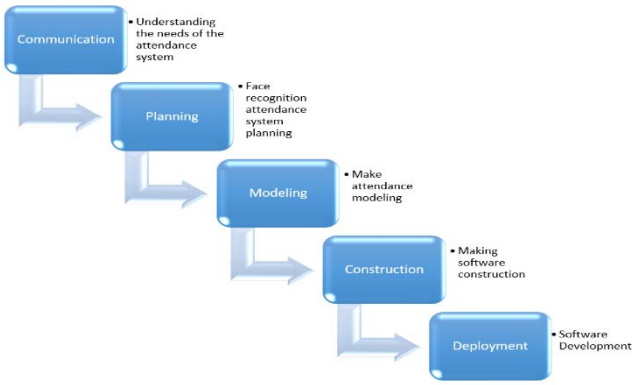

Fig. 1. Life Cycle of Waterfall Software Development in the student attendance recording system using face recognition

Thus, the system built through this model has the potential to replace the existing manual system. The manual process becomes an automatic attendance recording system, including enriching research and studies from a technological perspective in applying student attendance recording systems.

In the processed system through this study, the CNN detector used is the face pattern recognition method. The CNN method library used comes from Matlab 2019.

Matlab is a numerical computational environment and includes in the fourth-generation computer programming language.

Matlab capabilities used in this method are mainly in the object detection framework, including image manipulation, data function plotting, algorithm implementation, and user interfaces.

The programming language used is to detect image-based objects, using R-CNN as a detector. R-CNN or Regions with Convolutional Neural Networks is one of the object detectors used in deep learning, mainly related to convolutional neural network areas.

IV. RESULTS AND DISCUSSION

The concept applied in this study show in Fig. 2. This study provides a solution to the process of recording the presence of lectures with face recognition methods using Computer Vision, both with deep learning and the use of Convolutional Neural Networks and Raster R-CNN Matlab.

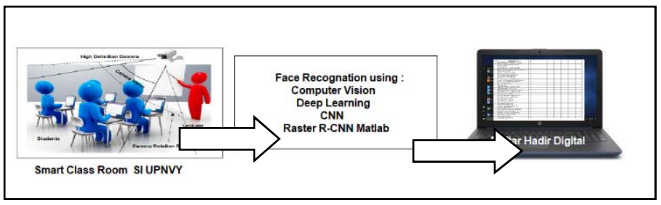

Fig. 2. The design of attendance recording systems using Computer Vision

In developing a student attendance recording system during lectures by utilizing face recognition technology, at least four modules prepared, starting from the face taking the module, training module, camera module, and attendance module. This stage present Fig. 3.

Implementation of the system is carried out by recording each student's data, then conducting training data and testing with functions in the CNN library. When the accuracy is above 90%, the system is used in the student attendance process, as in prototype experiments conducted in class.

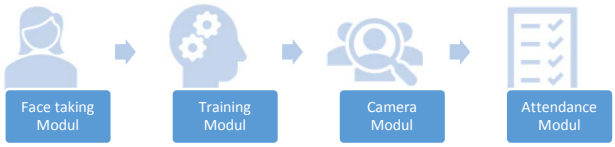

Fig. 3. Modules for face recognition on student attendance systems

In the system of recording the presence of students through the introduction of human faces as objects, there is an initial stage process that works to record human faces that are used as objects, namely the faces of students—this collection of face images stored in the library (Fig. 4).

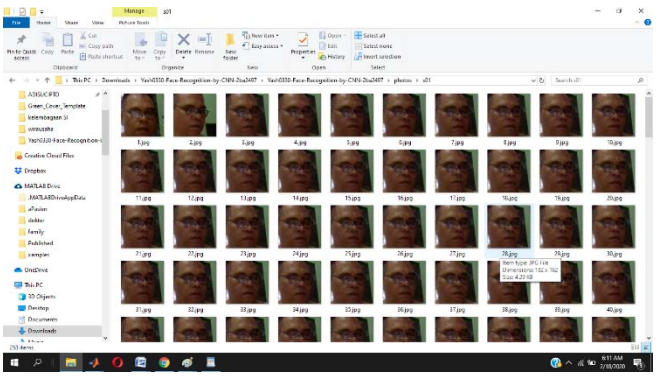

Fig. 4. Library of face images that will be recognized by the system

This image library that used as a source during the face initiation process sought by the system. If found, their

attendance recorded in the student attendance system. The more images taken and stored in the library will increase the level of accuracy of the system in human face recognition from the tests carried out.

The gallery image requires sufficient space. The storage capacity is an issue to consider here. The capacity used is directly proportional to the number of images stored in the library. The higher the resolution used will help with more precise prediction results. Likewise, with the number of images used as a library, the more images that become references will help the system have higher accuracy in predicting students' faces.

The second stage is the training module, which is the algorithm and completeness module related to the system's process to train itself to recognize the faces of students based on data stored in the library.

The code compiled in the training module provides steps about the processes carried out in the system. Programs that are made through effective and efficient algorithms will help the program to run correctly.

One part of the facial swallowing logic is as follows:

```
img = imread(student_face_file);
[img, face] = cropface(img);

%face value is 1 when it detects face in image or 0
if face == 1
  img = imresize (img, [227 227]);
  predict = classify (newnet, img);
end
```

In the above program logic, the image is first stored in memory. Furthermore, the images in this memory are identified only by the face, namely by cropping the human face if it is found. If a face is found that face is predicted.

Next is the Camera Module. This module recognizes human faces and looks for faces in the library of faces that previously trained.

The camera is placed in a strategic location, which is a location that is thought to be able to capture the faces of the students clearly. In a variety of conditions, this position helps to obtain accurate image capture by the system. Also, the lighting system can influence the capture and clarity of images obtained by the camera. Another thing to note about this camera module is related to the resolution of the image capture and the camera's autofocus ability.

Fig. 5. Facial correction and capture of student attendance pictures

If the face found matches the predicted face trained, then the attendance process is carried out—an example of the process in this module, shown in Fig. 5 below.

The process in this camera module is to recognize objects in the shape of faces, then capture faces to be compared with face predictions in the face library that previously initiated.

Face detection in real-time which done during lectures in the classroom. For this, an interface that needed that connects the program Matlab with the equipment. In this case, detection using a camera where scattered in class. Placement of several cameras which done to enhance the accuracy of facial recognition. Besides that, the installation of some angle taking positions also increases the precision of facial pattern recognition.

Accuracy information can also be monitored, especially as a consideration in building and developing systems. This level of accuracy present in Fig. 6.

Before this system was run, the attendance system was manual. Manual data obtained is used for training on the system until the system produces facial recognition. From direct experiments in class comparisons between manual real attendance and those carried out through this system, testing on CNN showed the results of the system training with high accuracy, reaching 99% of the actual data against the predicted data from the students' faces.

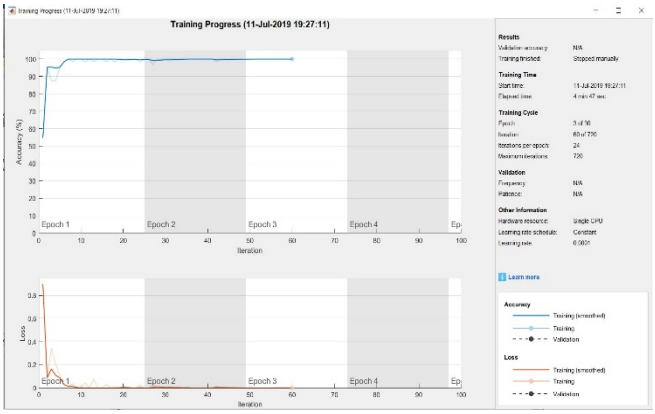

Fig. 6. The level of accuracy of the results of training with the CNN method

The performance of facial recognition technology applied to the attendance system which influenced by various criteria, such as algorithms, completeness of the library, facial recognition aids, camera resolution, processor and memory strength, number of object image libraries that identified.

Of the various cases found at the time of this study, facial recognition technology's accuracy and performance applied to the present system influenced by at least the following three factors, the devices used, the system and logic, and the situation on the ground (Fig. 7).

Accuracy and performance factors for devices are affected by the processor, memory, camera resolution, and network. The system and logic influence by several things. This logic is influenced by how effective the algorithm is used, how the system is built, the quantity, and the quality of object image libraries' availability. As for the field situation, accuracy and performance are influenced by, among others, the available lighting power.

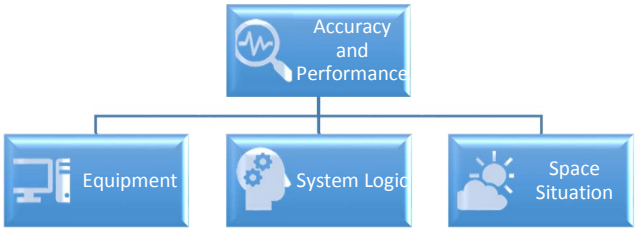

Fig. 7. Factors that affect the accuracy and performance of the face recognition process

The system that tested through the student attendance system during lectures using Matlab, R-CNN, and vission is paperless electronic presence. This system can be developed in determining participation in exams and can also overcome fraud in the presence that has been using the manual method (paper). Likewise, lecturers can determine the value of student attendance in determining the evaluation value automatically for lecturers. Besides reducing the use of time wasted during teaching caused by the attendance process, for meetings that have little face-to-face time, of course, this time issue becomes essential.

The benefits of developing a system through facial recognition sensor technology can increase attendance accuracy and reduce the level of cheating that sometimes occurs through manual absences manipulation.

In a transparent and real-time manner, this system can monitor and control the attendance of lecture activities, and student examinations carried out through this system as the basis for the management of teaching and learning activities.

This study shows that the application of attendance by using a Computer Vision-based application can simplify the student attendance process more easily and is done automatically through a camera.

V. Conclusions

The use of face recognition technology supported by Computer Vision can provide an alternative to record student attendance. The process was carried out by forming four machine learning modules specifically for recording student attendance through student face recognition. The four process modules face taking the module, training module, camera module, and attendance module. The system's accuracy and performance are influenced by various aspects, both from the computer equipment used, the system built, and the space situation.

This study proves that the process of recording through face recognition has the potential to be applied to educational systems in institutions, both as the primary system or as a support system of an existing system.

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