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Research Article

Implementation of Deep Learning in the Application of Lecture Attendance System with Face Recognition Technology Based on OpenCV

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Abstract

OpenCV, as an object detection library, is employed as the foundation in the development of a facial recognition system. This system utilizes the Haar Cascade Classifier method embedded in OpenCV for facial detection, providing an efficient approach to identifying individuals. The research is conducted using the Python programming language. The initial stages involve a literature review, followed by data collection necessary for system training. System design incorporates the implementation of the Haar Cascade Classifier method from OpenCV, along with data analysis to comprehend and optimize facial recognition outcomes. After progressing through these stages, the system is tested to evaluate facial features that can reliably identify individuals. The experimental results are expected to offer valuable insights into the development of facial recognition technology using OpenCV, with potential applications across various domains.

Keywords: Attendance, face recognition, Python, OpenCV

INTRODUCTION

The rapid development of technology in the current era has changed the way people interact with the surrounding world. Technological innovations that continue to emerge bring significant changes in various aspects of life, including in the academic world and higher education. Information technology plays a key role in

facilitating academic and administrative processes, and one of the affected aspects is the lecture attendance system.

Student attendance data in lectures has an important value in assessing student integrity and discipline [1]. This attendance data is used by lecturers as a tool to evaluate and provide an assessment of student performance. In addition, attendance data is also used as a basis for evaluating the teaching-learning process in the lecture environment. Therefore, the presence of students in each lecture session is a key element in the success of the educational process.

Although some universities still use traditional methods such as manual signatures or barcodes on Student Identity Cards (KTM) to record student attendance, these methods have proven to be less efficient in supporting the learning process. Phenomena such as "Absenteeism" or TA are often problems that trigger controversy in the world of lectures.

This challenge not only affects students, but also campus administration who face difficulties in managing attendance data and academic administration. Therefore, innovative solutions are needed that are able to overcome this problem and increase efficiency in the process of attendance and processing of student data.

One innovative solution that can be applied is a facial recognition-based attendance system (face recognition). This attendance system uses facial identification as a sign of identity using computerized devices [3]. The concept of computer vision [4] is used to teach computers to understand and interpret images. The implementation of real-time facial recognition [5] makes it easier for users to make attendance and reduces the risk of manipulation of attendance data.

This facial recognition-based attendance system allows students to attend lectures without cheating in the attendance process. The use of this technology also saves time in taking attendance. Therefore, in order to overcome the challenges mentioned above, this study aims to design a more effective attendance system by applying deep learning-based facial recognition methods using OpenCV. Problems that may be encountered in this context include:

1. Inaccuracies of Attendance Data: Traditional methods such as manual signatures or barcodes can be prone to human error or the practice of "Absenteeism," which can result in inaccurate attendance data.
2. Slow Attendance Retrieval Process: The process of taking attendance takes significant time and can disrupt the flow of learning in the classroom.
3. Difficulty in Preventing Data Manipulation: Limitations in traditional attendance methods make it vulnerable to data manipulation by absentee students.
4. Inefficient Attendance Monitoring: Lecturers and administrative staff have to spend a lot of time and effort monitoring student attendance, especially in colleges with large student numbers.

With the implementation of deep learning-based facial recognition technology, it is expected that there will be a significant improvement in student attendance management in the lecture environment. This system will help create a more efficient, fair, and quality academic environment, as well as reduce the negative impact of attendance problems that may arise in the world of lectures.

METHOD

In this research through several stages, namely literature study, dataset development, system development, system testing if, it goes well, documentation and reporting are carried out, if there is an error, system improvements are made back to completion.

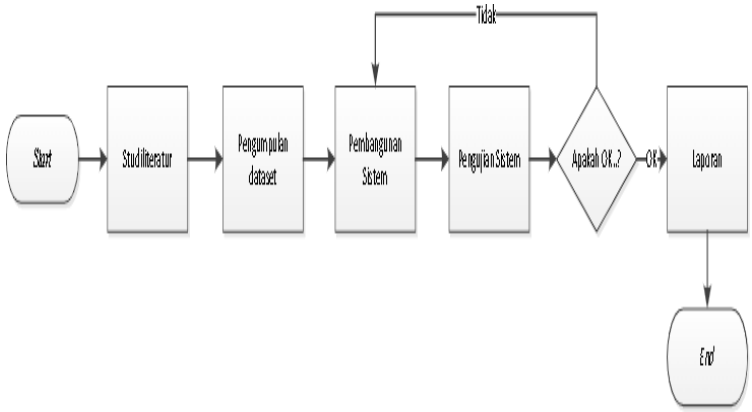
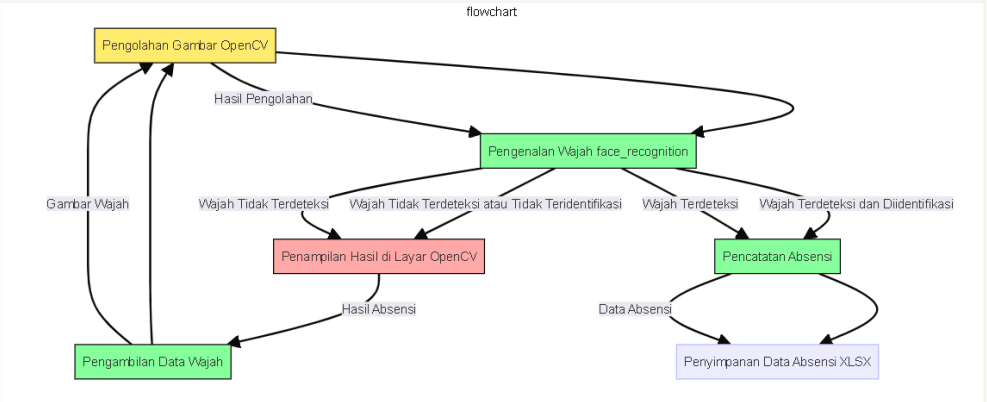


Figure 1 research flow chart.

RESULT AND DISCUSSION

Dataset collection



In this study, the dataset used used facial data from Medan State University students majoring in computer science class of 2022 class b which was taken directly by the application and could be manually imported. Then stored in the database. The file is stored in the database in jpg format with a grayish level of 256 pixels.

System Planning

1. Face Data Capture: The system starts by retrieving face data from a camera connected to a computer. The camera will take pictures of the student's face at certain time intervals. Any facial image taken will be considered as input.
2. Image Processing: Images captured by the camera must be processed before facial recognition can be performed. This image processing is included in the preprocessing step. This image processing includes:
    - Convert images from color format (BGR) to RGB format.
    - Face detection in images using OpenCV technology. OpenCV technology allows identification of positions (coordinates) and facial features in images.
    - Image size adjustment to increase recognition speed and reduce computational load.
3. Face Recognition: Once the image has been processed, the facial recognition algorithm will be executed. In this implementation, face_recognition library is used to facilitate facial recognition. This algorithm will compare the faces

detected in the image with the faces already in the database. The result is a list of possible student names corresponding to the detected faces. This algorithm considers the unique characteristics of the face, such as the distance between the eyes, the shape of the lips, and so on.

4. Attendance Logging: If a face is detected and identified with a certain match rate (for example, more than 90% matches), the system records the student's attendance corresponding to the recognized name. The attendance data recorded will include the student's name, attendance time, and attendance date. This recording can be done in a data table that will be used to create attendance reports.
5. Attendance Data Storage: The attendance data recorded in the previous step will be saved in Excel file format (XLSX). To do this, the xlsxwriter library is used to generate an Excel file that records all student attendance in class. This file will have a table structure with columns that include the student's name, attendance time, and attendance date.

System Implementation

After going through the next stage of system design is system implementation. System implementation is the final part of the system design that has been built where this stage is also a testing program.

A. Form Menu Utama

The main menu form serves to access all commands contained in the application. In this form there are several menus, namely the Data File Menu which contains submenus of the import menu of images from directories, imput images from direct cameras, face detection and exit menus. The appearance can be seen in the following picture:

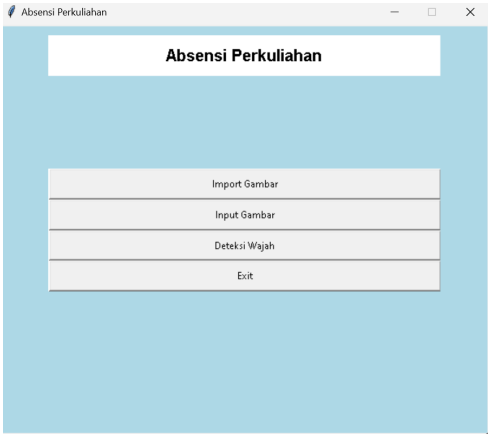


Figure 3 : . Main Menu Form

B. Image input form or take a picture from the camera

The login form serves as a way to take user pictures directly from the camera of the device used. The display of the image input form can be seen in the following picture:

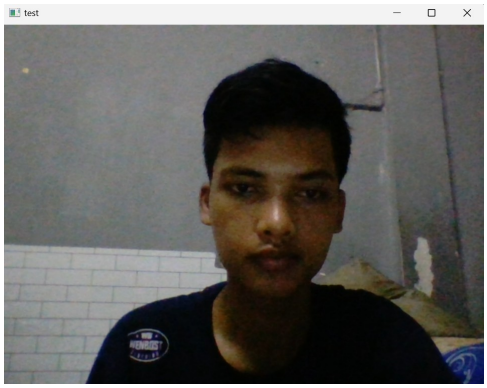


Figure 4 : . Image input form

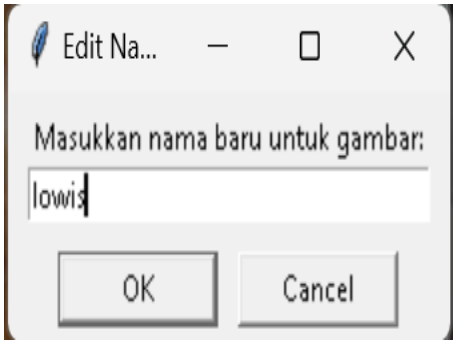


Figure 5 : . Edit Name

Then to take a picture, press the Space and Esc keys to exit. When the space key is pressed, we will proceed to the next form, namely edit the photo name in jpg format, then press the ok button to save.

C. Form Import Gambar

This form functions to import pre-existing images from the directory of the device used. The appearance can be seen in the following picture:

Gambar 6 : . Form import gambar

D. Face detection form

This form is the camera view when it detects the user's face. When the detection is recognized, a successful timesheet message will appear: + (the name of the face of the person detected) in green while if the face fails to be detected, an unknown message will appear with red writing. The appearance can be seen in the following picture:

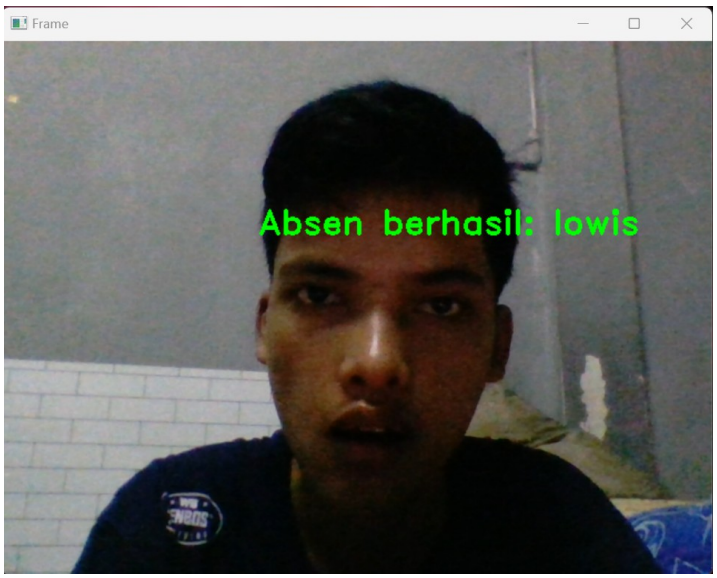


Figure 7 : . Face detection

E. Form Output

This form is a display of attendance data recorded in Excel file format (XLSX). This file will have a table structure with columns that include student names, attendance times, and attendance dates as below:

	Nama	Waktu	Tanggal
2	afif		
3	fauzan		
4	isaac		
5	jonathan		
6	mirza		
7	glenn		
8	bryan		
9	joel		
10	ade		
11	zikri		
12	fikri		
13	enrico		
14	wira		
15	louders		
16	faris		
17	jibran		
18	rizky		
19	rafli		
20	rendy		
21	lowis	20:55:42	28/11/2023
22	intan		
23	dewi		
24	radiatun		
25	rahma		
26	yusiva		
27	nur rizkah		
28	erika		
29	nurra		
30	siti ananda		
31	ronasip		
32	deswita		
33	khaira		
34	dita		
35	eli		
36	azura		
37	syafirah		
38	juraidah		

CONCLUSION

Based on the exploration and detailed stages in the development of attendance systems with facial recognition technology using Python and OpenCV, here are some conclusions that can be drawn:

1. Effectiveness of Using Face Recognition Technology: The implementation of facial recognition technology using OpenCV and Python in this attendance system proves its effectiveness in identifying and recording student attendance automatically. This can increase the efficiency of the attendance process in the educational environment.
2. Application of Face Recognition Algorithm: Through the application of facial recognition algorithm, the system can recognize students' faces accurately and responsively. The use of face_recognition and OpenCV libraries makes it easier to

implement these algorithms, ensuring reliable results in real-time facial recognition.

3. Advantages of OpenCV Technology: OpenCV makes a major contribution in the detection and processing of facial images. Its ability to change image formats, detect faces, and preprocess is a key factor in the success of this system.
4. System Design and Implementation Stages: The stages of system design, including facial data retrieval, image processing, facial recognition, attendance recording, and attendance data storage, have been successfully implemented. Each stage produces outputs that correspond to the purpose of the system.
5. Flexibility and Wide Application: This system has wide application potential in various fields, especially in attendance management in educational institutions and institutions that require automatic recording of attendance. Its flexibility allows integration with other hardware and software.

Thus, this conclusion reflects that attendance systems with facial recognition technology using Python and OpenCV provide effective and efficient solutions in attendance management, with wide application potential in various contexts.

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