

MUHAMMAD AL-XORAZMIY NOMIDAGI
TOSHKENT AXBOROT TEXNOLOGIYALARI
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The importance of student image recognition programs in education management

Azimov Bunyod,
Department of artificial intelligence,
Tashkent university of information technologies
named after Muhammad al-Khwarizmi
Tashkent, Uzbekistan

Ahmadaliyev Boburjon,
Doctoral student,
Tashkent university of information technologies
named after Muhammad al-Khwarizmi
Tashkent, Uzbekistan

Abstract— Currently, the use of artificial intelligence systems to prevent human errors is developing day by day. The automated method of determining attendance by face recognition using intelligent systems is of great importance. I implemented this using the Python program. In addition, I tested the method of using the wavelet method to increase the accuracy and reliability of this system in test control. I explained the software sequence (algorithm) of implementing this process and my thoughts on using the necessary libraries.

Keywords— Digital technologies, Traditional education, Intelligent system, Python programming language, Python libraries.

1. INTRODUCTION

Using the Python programming language, we can create complex applications or platforms that help us create a student image recognition program for the educational process. This is very useful for creating opportunities for step-by-step, reliable and effective management of the educational process.

We have developed the necessary tools for creating programs in the Python programming language (import sys, os; from datetime import datetime; import cv2 import pandas as pd; from PyQt5.QtCore import QThread, pyqtSignal, Qt; from PyQt5.QtGui import QImage, QPixmap; from PyQt5.QtWidgets import QMainWindow, QApplication, QPushButton, QMessageBox, QLineEdit, QLabel, QTextEdit; from deepface import DeepFace; import sqlite3; import threading) We got acquainted with the libraries, if we are using the Pycharm program, we will need to download these libraries from the Settings section of the Project:python program, and then go to Python. interpreter, libraries for the version of the required Python program are loaded, for this the active window and the + button in the name are clicked. the necessary libraries are written and the Install Package button is clicked. Of course, our device must be active on the network. The integration of the wavelet method in managing group attendance via student image recognition offers a robust and efficient solution for modern education systems. By combining image processing with machine learning, this approach enhances the accuracy and reliability of attendance tracking while automating routine administrative tasks.

Key Aspects of Wavelet-Based Image Recognition in Attendance The wavelet transform allows the decomposition

of facial images into different frequency components, making it easier to identify critical features like edges and textures. This is particularly useful for distinguishing between students in a group setting. In real-world scenarios, classroom environments can produce noisy data due to lighting variations, occlusions, or low-resolution images. Wavelet transforms efficiently reduce noise while preserving essential features for accurate recognition. Wavelet-based compression reduces the size of facial image data, enabling real-time processing and storage efficiency without compromising the recognition quality. Wavelet-transformed images can be integrated with machine learning models like Convolutional Neural Networks (CNNs) or Support Vector Machines (SVMs) to enhance the classification and identification of students. By applying wavelet techniques to video streams captured via classroom cameras, the system can identify students present in real-time, marking attendance without manual intervention

2. RELATED WORKS

Havelsan A.Ş. Konya and Ana Jet Üs K.ığı, in their article “Student Recognition and Student Activity Detection through Real-Time Image Processing”, tested the success of face recognition and head pose estimation using the UPNA Head Pose database and the most successful results were recorded as a result of the tests. Face recognition was achieved with a recognition rate of 98.95% using the Local Binary Patterns method. In the main part of SECS, face detection from the real-time images taken from the camera, facial landmarks extraction, face recognition, head pose estimation, and student engagement classification processes are carried out.

In addition to these, if the student is not far from the camera and the eye area can be properly determined with image processing, eye aperture is also calculated to increase the success of student engagement classification. This parameter is added optionally in order for the program to be used in e-learning environments.

The flow diagram of the main module of SECS software is shown in . The methods used in the flowchart in the figure are as follows. Histogram of oriented gradients were used for face detection, local binary patterns for face recognition, PnP for head pose estimation, and SVM for classification.[1]

The wavelet method is an effective and widely used technique in image recognition. This approach is particularly useful for analyzing and identifying features in complex structured images. Below is a detailed overview of its key aspects and applications. Wavelet transforms provide a

powerful framework for multi-scale analysis, enabling the decomposition of images into various frequency components. This facilitates precise identification of edges, textures, and patterns while also supporting tasks like image compression and noise reduction.[2]

3.1. METHODS (OPTIONAL)

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3.2. FORMULATION OF THE PROBLEM

Using surveillance cameras for attendance recognition reduces the need to interrupt classes and minimizes unnecessary time consumption, thereby contributing to improved teaching efficiency and enhanced educational quality.

3.3. ALGORITHM FOR SOLVING THE PROBLEM

1. The process begins with a surveillance camera installed in the classroom, which continuously monitors the students.
2. The camera captures real-time images of students during the lesson.
3. The captured images are processed to enhance quality by reducing noise and compressing the data for faster analysis.
4. Advanced algorithms identify individual faces from the pre-processed image. This step isolates the required regions for recognition.
5. The system matches the detected faces with the existing database to identify students accurately.
6. Once the students are recognized, their attendance is logged automatically into the system.
7. The system compiles the attendance data into a report, which can be accessed by teachers and administrators for analysis.

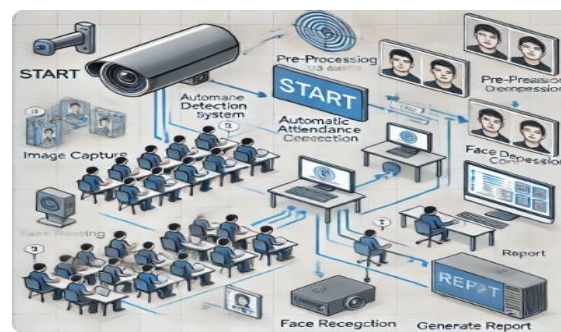


Figure 1. Algorithm for the process

The entire process ensures accurate and efficient attendance tracking, eliminates manual errors, and provides valuable insights into student engagement without disrupting the learning environment.

3.4. RESULTS OF SIMULATION MODELING

It is also possible to use the Terminal to install libraries, for this the name of the required library is written in the Terminal window as follows: `pip install PyQt` This command installs the module of our library and the functions related to this library work. After installing the libraries, we can proceed to the process. In this process, we will need to write the program code and get the students' pictures. The photo obtained through the images downloaded to the database is compared and the data is sent to the required department.

In our Libraries program, we can recall:

In the program, we put the pictures of distance education students in our dataset folder for testing and integrated it using the above code.

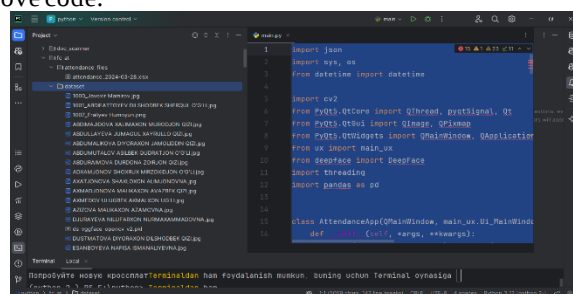


Figure 2. A folder with students' pictures.

3.5. THE OBTAINED RESEARCH

By taking a picture of a student, the data "hemis id": [id], "Student": [name], "Date": [date_time] are entered in the dataset. The information is sent to the Journal.xls file and attendance is determined.

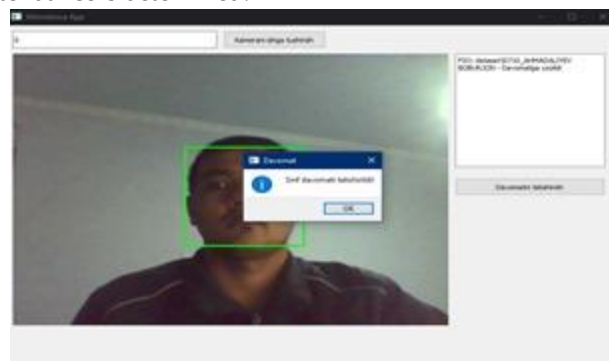


Figure 3. Search and identify by the view taken by the camera.

4.1. RESULTS

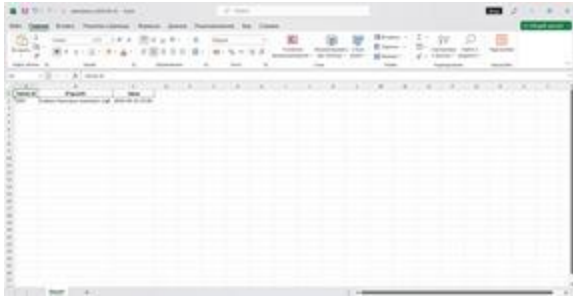


Figure 4. Sending the detected data to Jurnal.xls.

4.2. DISCUSSION

An automatic attendance system in education that leverages image recognition plays a vital role in tracking student attendance and monitoring their impact on the learning process. This system not only ensures accurate attendance tracking but also contributes significantly to the overall quality of education by optimizing time management and reducing administrative workload.

Key Advantages of Automatic Attendance Systems

Automatic attendance systems provide a range of benefits, including:

Improved Lesson Quality: These systems offer insights into real-time student participation without disrupting the learning process, thus enhancing the quality of lessons.

Non-Intrusive Monitoring: Operating passively, the system allows teachers and students to focus on teaching and learning without interruptions.

Enhanced Learning Environment: By promoting accountability and minimizing human error in attendance tracking, the system creates a positive impact on the learning experience.

The Role of Devices in Image Recognition

The effectiveness of an automatic attendance system heavily relies on the quality of devices used for image recognition. High-performance surveillance cameras are essential for capturing clear and accurate images of students in various classroom settings. Key factors to consider when selecting such devices include:

Resolution: High-resolution cameras ensure clear images of facial features, enabling accurate recognition.

Frame Rate: Higher frame rates allow smooth and consistent monitoring, especially in dynamic classroom environments.

Lighting Adaptability: Cameras with advanced sensors perform well under varying light conditions, ensuring consistent image quality.

Wavelet Transform in Image Processing

The wavelet transform method is a powerful tool in image processing that enhances the performance of image recognition systems. It is particularly effective in:

Image Compression: Wavelet transforms reduce image sizes without significant quality loss, decreasing storage requirements and accelerating data processing.

Noise Reduction: Wavelet techniques remove unwanted noise, improving the accuracy of facial recognition algorithms.

Efficient Feature Extraction: Multi-resolution analysis allows systems to focus on key facial features, boosting recognition precision.

For instance, the Haar wavelet transform is widely used in face recognition algorithms. It divides images into smaller regions and performs analysis at different resolution levels, making it ideal for real-time applications.

Practical Implications for Educational Systems

Combining reliable hardware with advanced image processing techniques, such as wavelet transforms, ensures the efficient operation of automatic attendance systems. This approach offers:

Time Savings: Teachers can dedicate more time to teaching rather than administrative tasks.

Data Analytics: These systems generate valuable data for analyzing student participation and attendance trends.

Scalability: With efficient image compression and processing, the system can handle large-scale applications in schools, universities, and training centers.

5. CONCLUSION

Automatic attendance detection systems, supported by robust image recognition devices and wavelet-based image processing techniques, represent a transformative approach in modern education. These systems simplify attendance tracking, improve lesson quality, and foster a learning-focused environment. By adopting advanced technologies, educational institutions can significantly enhance teaching and learning experiences, paving the way for a more efficient and effective education system.

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