Development of a Lecture Attendance Registration System Based on Facial Recognition*

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Abstract
The paper deals with the development of a registration system based on facial recognition to be used in the educational process, using which it will be possible to register and record the attendance of both students and professors at lectures. Based on the data recorded by the system, it will be possible to conduct lectures and monitor student attendance, which is one of the important tasks of an educational institution.

Keywords
Facial recognition, Attendance system, lecture, students.

1. Introduction

Along with the rapid development of modern technologies, the demand for them in all spheres of human activity is increasing. This is because the level of introduction of modern technologies in this or that field determines their effective and successful activity.

Today, education is one of the most important and responsible areas. In which the introduction and use of modern techniques and technologies are vital.

Educational institutions are trying to develop management systems based on modern technologies, with the help of which they will be able to effectively solve various tasks in the process of activity.

One of the important tasks of educational institutions is to register and monitor attendance at lectures. The task of recording attendance is generally an actual task for both educational and other institutions.

To solve the mentioned problem, educational institutions use different approaches, but they are also characterized by other shortcomings, which reduce the validity of accounting.

Due to the urgency of the attendance registration task, the goal of our topic is to develop a face recognition-based attendance registration system. which will give us the means to record both the professor-teachers' conducting/not conducting the lecture and the duration of the conducted time, as well as the student's attendance/non-attendance at the lecture and the duration of the attendance time. This will allow us to maximize the validity of the registration and reduce the costs associated with registration.

The novelty of the research lies in the proposal of a new approach to attendance registration and the development of a software system for its implementation.

2. Current approaches to recording attendance at lectures

Different approaches are used to record attendance at lectures, including:

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- Accounting for the delivery of a lecture by a human, which is routine work, and due to subjective factors, the validity of recorded data is very low. Using the traditional registration journal by the lecturer to record the student's attendance at the lecture. This approach to recording students' daily attendance can lead to errors and waste a lot of time.
- Cards system [1,4] - This refers to the development of a system that allows the use of electronic cards to record attendance at lectures, both for lecturers and students. For this, all of them must have a specially made electronic card. The disadvantages of this type of approach are: increased costs caused by the production of cards, since their production requires a certain amount of money, in case the card is lost, the lecturer and the student will not be able to attend the lecture, the low reliability of registration, since one student can register several students to attend the lecture using their cards, so that the said students were not in the educational institution.
- Use of biometric system [2,3,8,9,10] - biometric identifier has an undoubted advantage compared to other approaches, as far as: it is impossible to steal, it is impossible to forget, it is impossible to transfer to another person, it is convenient and comfortable, it is more reliable. In the educational process, biometric technology can be used in different ways. But the biometric system also has some drawbacks: in the case of a large number of students at the lecture, the time to identify them will increase significantly, which may lead to queues at the biometric identification device, a student or lecturer may register with the biometric identification device but not attend the lecture.

Considering the shortcomings of the approaches listed above, it can be said that it is still not possible to record attendance at the lecture as valid as possible.

Therefore, we aim to propose a new approach, which involves the development of a lecture attendance registration system based on facial recognition.

3. Methodology

Our proposed methodology is based on the face recognition task, through which it will be possible to identify the student. Facial recognition is based on a convolutional neural network.

A convolutional neural network is a type of neural network that uses at least one of its strands to perform convolutional operations. A convolution is an operation on two real-valued functions.

Convolutional neural networks [5,6,7] are deep learning algorithms used for image analysis and facial recognition. The way CNN works is that it divides images into layers, where each layer represents a complex feature. The first layer is responsible for finding simple patterns like the contours of objects or the shapes of objects, while the inner layers try to find more complex parts like eyes, a nose, or even the same face.

The whole process starts with a convolutional layer, where the inserted photo is divided into smaller parts, each part passing through different filters, also known as cores. These filters help us to capture and identify low-level properties. The convolutional layer then goes through a RELU (Rectified Linear Unit) nonlinear activation function [5,6], which can detect more complex patterns. And the ultimate solution comes out of the binding layer, where the layers are reduced in size and the key information is stored, making the neural network more efficient and adaptable to the pattern recognition problem.

These steps are repeated several times on the substrate to detect more complex patterns. Finally, the join layer is reduced to a one-dimensional vector and goes to the solid layer where the image is classified based on its properties and previous layers.

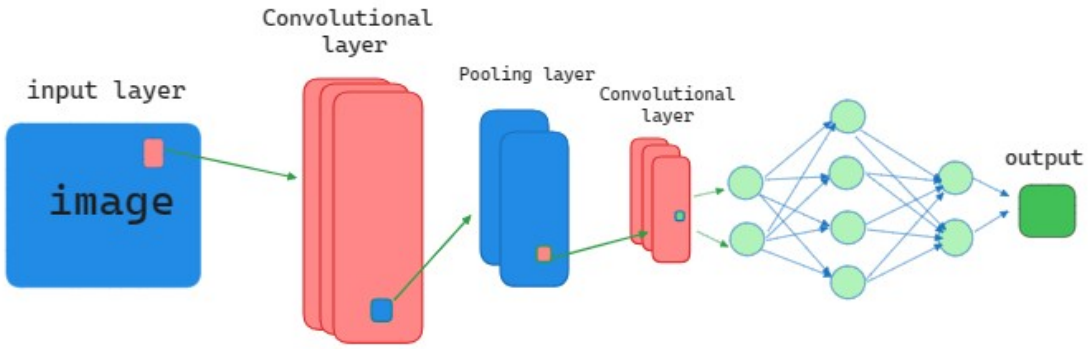

Figure 2. Convolutional neural networks

The proposed face recognition method includes the following Stages:
Stage 1. Reading the image in real-time
Stage 2. Face detection
Stage 3. Encoding the detected face and storing it in an array
Stage 4. The array obtained as a result of encoding is compared to the photos of students registered in the database, which is recorded in the database by means of the array obtained as a result of the encoding of the user's image, which occurs at the stage of registration.

4. System architecture

The lecture attendance registration system based on facial recognition is implemented in a client-server architecture, the system software consists of two applications:

1. Facial recognition application.
2. System Administrator Application.

The functional structure of the system is presented in Figure 1:

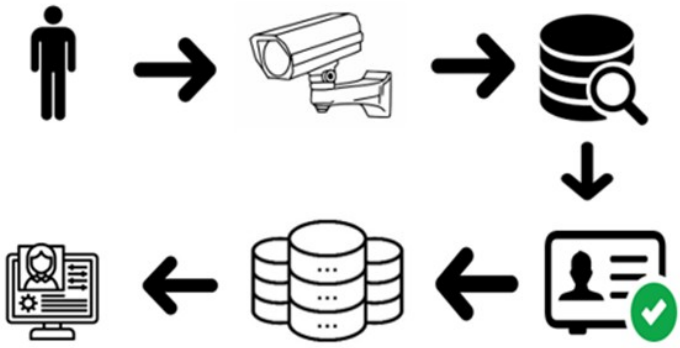

Figure 1. Functional structure of the system

The facial recognition application registers the attendance of students and professors at lectures, all users (students, lecturers) are obliged to go through the registration through the video camera after the start and end of all lectures. The result is that the corresponding user is identified in the database, attendance is registered and attendance time is counted. The mentioned face recognition approach is implemented using opencv and face_recognition libraries.

Using the system administrator's desktop application, the database is fully managed, which means: adding and managing faculties, adding and managing specialties by faculties, adding and managing training courses according to specialties, adding and managing lecturers, adding and managing students, adding and managing groups of student, changing and managing the lecture schedule based on which the attendance at the lecture should be recorded, preparation of the attendance reports at the lecture.

5. Results

5.1. The system software

The software of the system presented in the paper is developed on the .NET platform, and the system database is designed in the MySql database management system. The database relationship diagram is presented in the figure below:

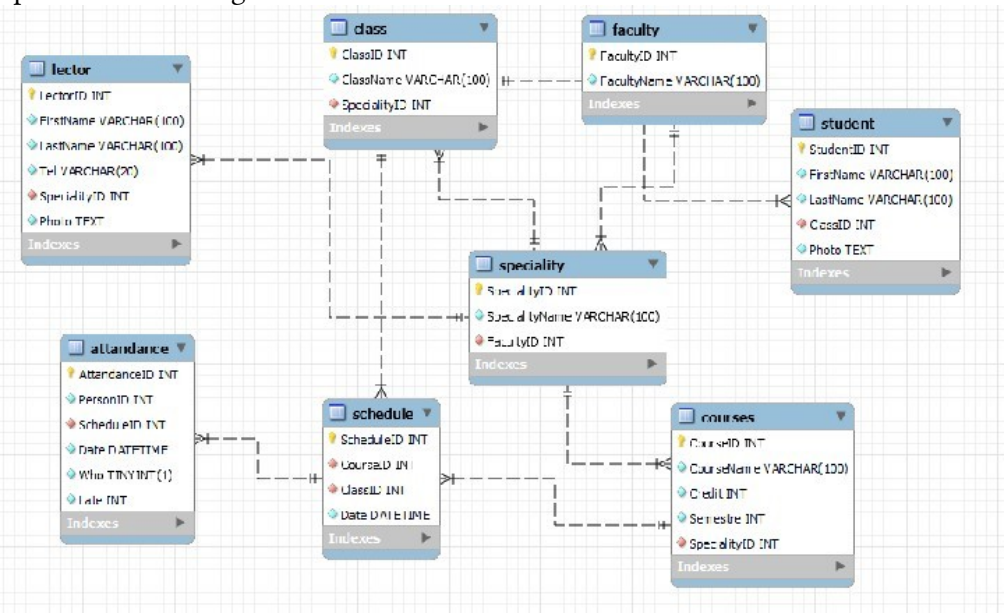

Figure 1. Database relationship diagram

To consider some parts of the software's user interface, the image (Figure 3) below shows the main form of the desktop application:

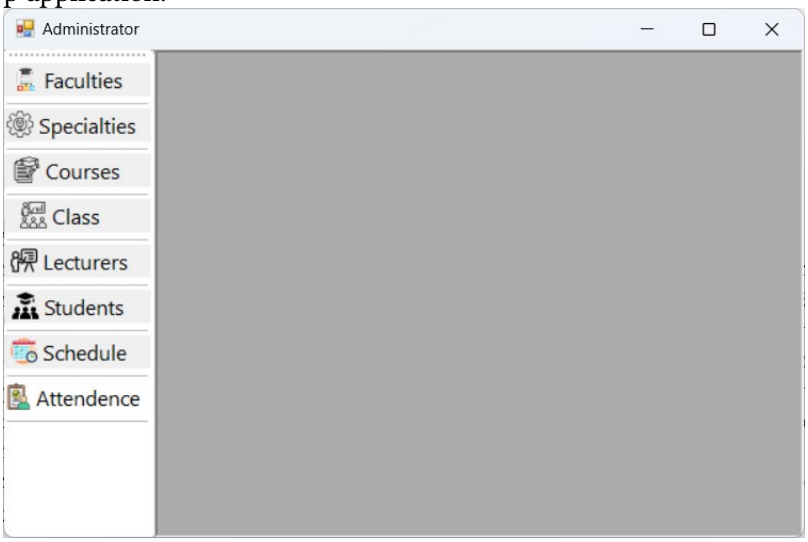

Figure 3. Main form

The image (Figure 4) below shows the form of adding and managing specialties by faculties:

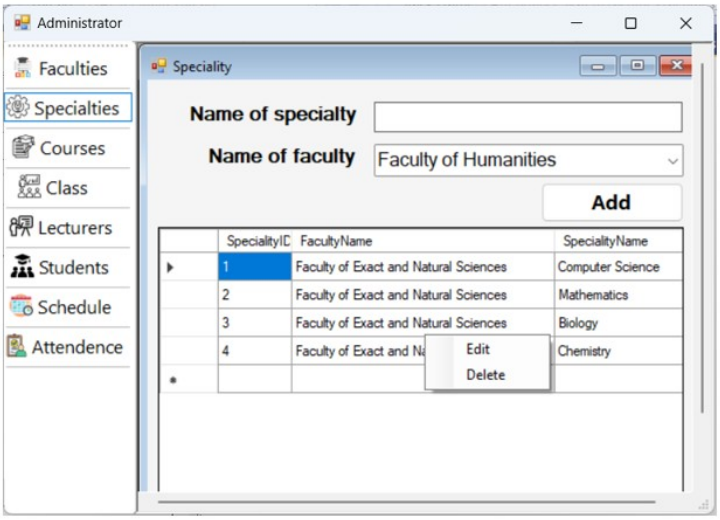

Figure 4. Specialties

Below is a picture(Figure 5) of how to add and manage courses according to specialties:

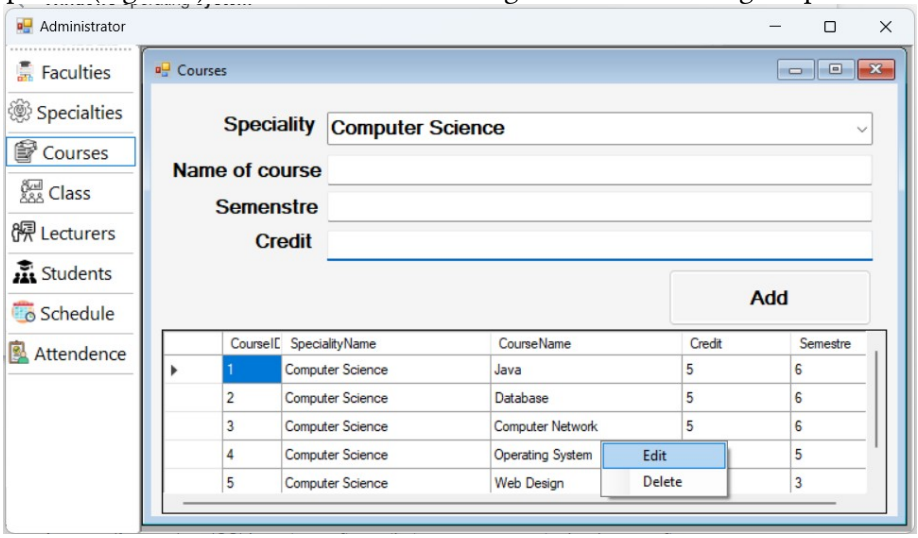

Figure 5. Courses

The image (Figure 6) below shows the form of adding and managing students, through which the registration of students is carried out, the photo is uploaded to the database along with other necessary data during the registration of students, which is used to identify the student. The student's image is stored in the database as an encoded array of float:

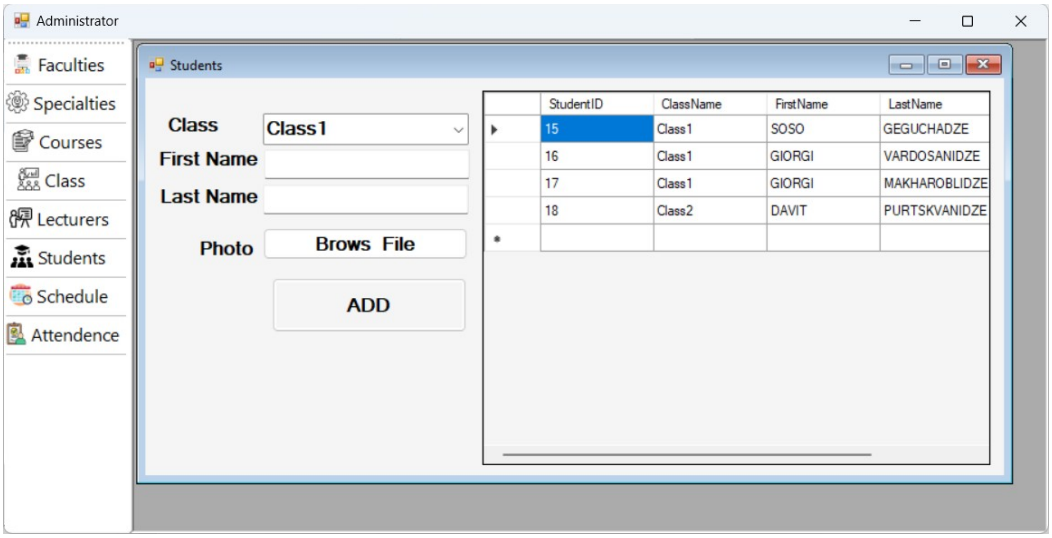

Figure 6. Students

The form (Figure 7) below provides for the creation of a lecture schedule by faculty, specialty, and course, using which lecture attendance is counted:

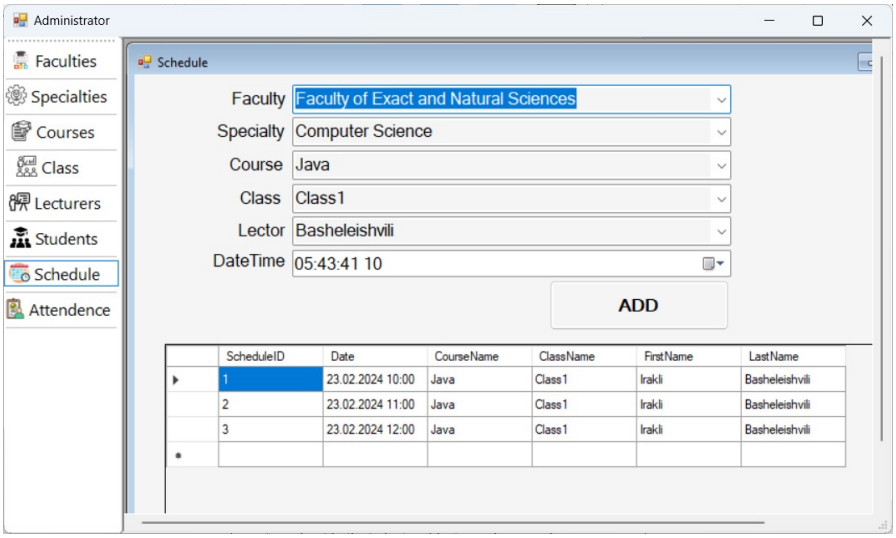

Figure 7. Lecture schedule

In the image (Figure 8) below, we can see a form of attendance tracking that allows us to get information about both student and lecturer absences. In a more specific way, we can say:

- Set a time for both the teacher and the student to arrive and leave the classroom.
- Determine the list of students in a particular course who missed the lecture.
- Determine the list of students in a particular course who attended the lecture.
- Determine how long a particular student has attended a particular course.
- Export data to PDF and XLXS files when needed.

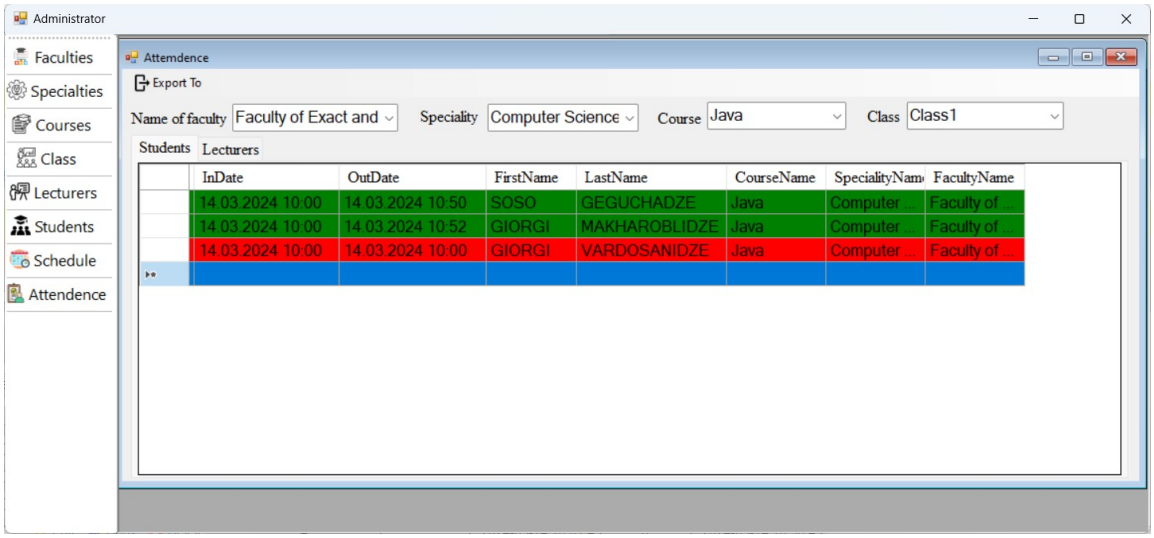

Figure 8. Attendance form

A facial recognition application consists of a single form with a simple interface that captures a student or lecturer with a camera, recognizes his or her face, and checks it in the database, as a result of checking in the database, if the student or lecturer in question is identified, his or her attendance at the lecture is registered and the time of entering the lecture is recorded in the database. Figure 9 below shows a case of the identification of a student. Figure 10 of the below shows that the student could not be identified.

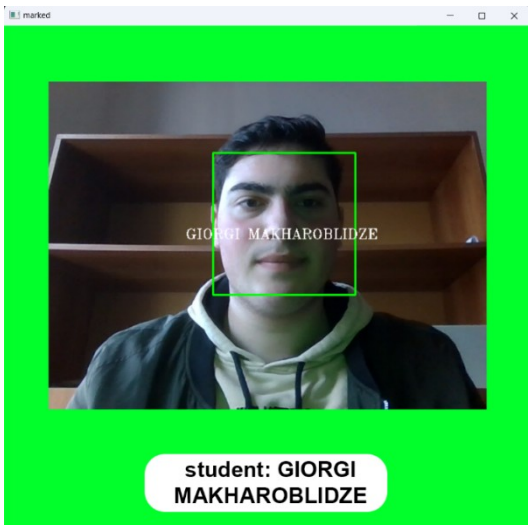

Figure 9. Recognized face

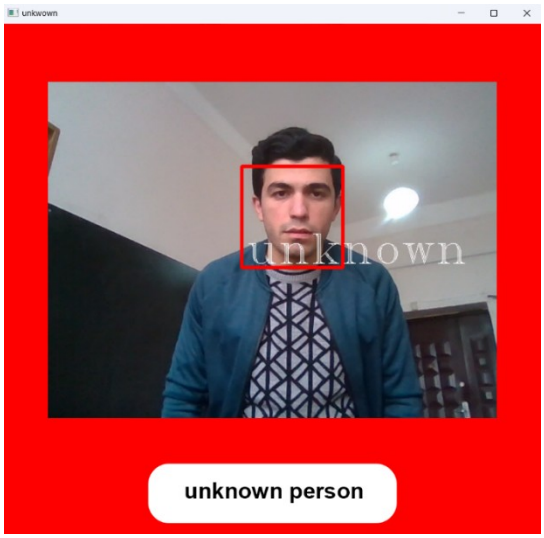

Figure 10. Unknown person

5.2. Experiment

To evaluate the efficiency of the system proposed in the paper, we experimented. We experimented on a computer with an amd R5 processor and 16GB of RAM. At the time of experimenting, we had 30 students registered in the database. At the time of experimenting, we identified and registered 15 students. The average time it took the system to recognize each student was 0.967 milliseconds.

6. Conclusion

Within the research framework, a lecture attendance registration system based on facial recognition has been developed, allowing us to monitor lectures attendance in real-time.
Using the system, it is possible to analyze the attendance of lecturers and students based on recorded data.

7. References

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