Facial Recognition System Implementation for Managing Techniques of Student Attendance

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Abstract: Face recognition stands as a paramount cornerstone of biometric technology, wielding immense power across a spectrum of applications. Its prowess in security, authentication, identification, and a plethora of other advantages is beyond dispute. This technological marvel, with the finesse to autonomously identify or verify individuals within digital images or video frames, extracted from dynamic video clips, is a force to be reckoned with facial recognition systems, in their diverse manifestations, share a common modus operandi: they meticulously scrutinize selected facial features in a given image, juxtaposing them with a vast database of stored visages. But it's not limited to mere scrutiny; it's revolutionizing the attendance-taking process, an area notorious for its time-consuming nature, especially when carried out by administrators.

The primary objective of this automated attendance system is audacious: to seamlessly identify multiple faces in real-time, specifically tailored for educational institutions. Daily, it captures, compares, and updates the attendance records of students by scrutinizing images captured via cameras and contrasting them with the preloaded database under the administrator's custody. As the designated meeting time arrives, the system springs into action, capturing live video shots and subjecting them to the rigors of face detection and recognition techniques. Those students who meet the recognition criteria are swiftly marked as present, and their attendance records are enriched with timestamp and course identification. And for situations where students are tardy or absent, the administrator retains the power to manually adjust their attendance status. This system heralds a new era of efficiency and accuracy in the realm of attendance management.

Keywords: Face recognition, digital image, video frame, real-time environment, recognition techniques

1. Introduction

Maintaining attendance is very important in all the educational institutes for checking the student's interest in attending. In this regard, every educational institute has its own system. Some use the document to write a name and ID or attendance roll call or signature technique manually to attend. In these approaches, however, students must wait for a long time before they quit the class or before they begin the lecture. There are several biometric systems available, but the key authentications in all the techniques are the same. Each biometric system consists of an enrollment process in which a person's specific characteristics are recorded in the database and then there are identification and verification processes. These two processes compare the biometric feature of a person with a previously stored template captured at the time of enrollment. Biometric templates can be of many types like Fingerprints, Eye Iris, Face, Hand Geometry, Signature, Gait, and voice.

For the automatic attendance of students in the classroom environment without lecturer intervention, our system uses the face recognition strategy. Face recognition consists of a four-stage face recognition technique to automatically register students in the classroom. Faces in the image are first discovered, and then these detected faces are compared to a verified dataset and taking attendance information, in addition most lecturers have a significant number of students, and it is hard to keep taking or tracking all their absence. Facial recognition is commonly used in many institutions to take attendance of a significant number of students. There are many errors that could occur during this process, including misidentification and self-recognition. Lecturer can control the errors and correct it.

The main motivation for this study was the slow and inefficient traditional manual attendance systems. So, why not make it automated fast and much efficiently. This article intends to help administrators to the acceleration of the attendance process in an easy way by record students' faces recognizing technology.

The main intention of this study is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide convenience to the institution. In this paper, an application will be developed which can recognize the identity of each individual and eventually record down the data into a database system. Apart from that, an excel sheet is created which shows the students attendance and is direct mailed to the faculty.

2. Literature Review and Background of Related researches

The problem of using a single SVM classifier is to detect the entire face pattern with comparing different types of image features in this context, present and evaluate a new method for reducing the number of features, and discuss practical issues such as SVM parameterization and training data selection. The second part of the paper describes a component-based method for face detection consisting of a two-level hierarchy of SVM classifiers. On the first level, component classifiers independently detect components of a face, such as the eyes, the nose, and the mouth. On the second level, a single classier check whether the geometrical configuration of the detected components in the image matches a geometrical model of a face. Some related works for face Recognition and participation in the takedown, along with the benefits and drawbacks of each method.

Automated Attendance Management on Face Recognition,

This system is basically based on face detection and recognition algorithms, automatically detect the student when he enters the classroom and marks the attendance by recognizing him. Because LBPH outperforms other algorithms with a better recognition rate and low false-positive rate the system is based on this algorithm however the face detection and loading training data processes are just a little bit slow. The system uses SVM and Bayesian as a classifier because they are better when compared to distance classifiers. The workflow of the system architecture is when a person enters the classroom his image is captured by the camera at the entrance. A face region is then extracted and pre-processed for further processing.

Classroom Attendance System Using Facial Recognition System,

This system aims to introduce a new approach to identify a student using a face recognition system in the classroom environment, i.e., the generation of a 3D Facial Model. This study is to attempt to provide an automated attendance system that recognizes students using face recognition technology from an image/video stream to record their attendance in lectures or sections and evaluating their performance accordingly.

Implementation of Attendance Management System using SMART-FR,

The authors of this system describe the Raspberry Pi module that used for face detection & recognition. The camera will be connected to the Raspberry Pi module. The student's attendance will be sent to their parents using GSM technology. The System performs managing students with Open CV and raspberry pi module that is interfaced with fingerprint device.

3. Research Methodology

A system development methodology refers to the framework that is used to structure, plan, and control the process of developing an information system. A wide variety of such frameworks have evolved over the years, each with its own recognized strengths and weaknesses. One system development methodology is not necessarily suitable for use by all systems. Each of the available methodologies is best suited to specific kinds of projects, based on various technical, organizational, project and team considerations.

System Development Life Cycle (SDLC) is a process used by the system industry to design, develop and test high-quality systems. The SDLC aims to produce high-quality software that meets or exceeds customer expectations,

reaches completion within times and cost estimates [4] [5]. In this system, will be used Python as a front side programing language and design the database by using SQLite. Once the software is complete, and it is deployed in the testing environment, the testing team starts testing the functionality of the entire system. During this phase, QA and testing team may find some bugs/defects, which they communicate to developers. The development team fixes the bug and sends it back to QA for a re-test. This process continues until the software is bug-free, stable, and working according to the business needs of that system. Once the software testing phase is over and no bugs or errors left in the system then the final deployment process starts. Based on the feedback given by the project manager, the final software is released and checked for deployment issues if any.

The methodology to apply this paper is extreme programming, which is one of the most important software development frameworks of agile models. It is used to improve software quality and responsive to customer requirements.

3.1 Methodology Prototype

A prototype is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from. It is a term used in a variety of contexts, including semantics, design, electronics, and software programming. A prototype is designed to test and trial a new design to enhance precision by system analysts and users. Prototyping serves to provide specifications for a real, working system rather than a theoretical one as shown on Fig.1. In some workflow models, creating a prototype (a process sometimes called materialization) is the step between the formalization and the evaluation of an idea.
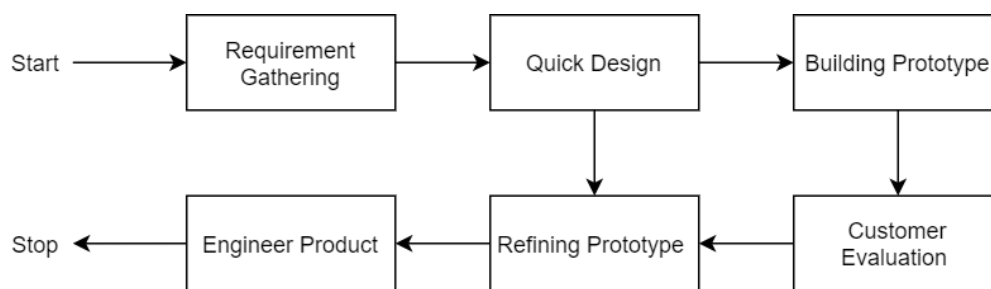

Figure 1 - Prototype Software Life Cycle Model

The prototype format section is based on the structural thinking of the float sketch of the system, so it will be less complicated to be understood in the coding process. This phase will put into effect the interface plan of a machine regardless of functions.

In this phase, it is a procedure of implementing the coding according to the functions of the machine into the last version of the prototype that is developed. Each of the machine modules will be developed according to specification and architectural design.

4. Data Analysis and Design

In the research process, the first activity is to review the current system and to consider the criteria and domains of the new system. Equally significant are both activities, but the first activity acts as the basis for supplying the functional requirements and then successfully developing the proposed scheme. It is more difficult to understand the properties and specifications of a new system and involves innovative thinking and it is also difficult to understand the existing system, and confusion of the current system can lead to deviation from the solution. In this way, an application can be established that does not meet the requirements of the educational institute, but rather demonstrates a degree of consistency with the educational institute's potential needs. The aim of a windows application is to complete the development of an analysis model or device requirement specification. The review is a technological task that defines the windows application data and functional specifications. As noticed on Fig.2, the student comes in front of the camera to take a picture of his face and which is then saved in the database with the student's personal data such as name and ID to make the system able to recognize the student's face with his name and next time, the administrator

can prepare automatically by making the student look in front of the camera, and the student's face will be recognized by comparing the previously recorded image and the attendance will be taken directly. The administrator can at any time register new students with the ability to view, search, or edit the attendance record. He will also be able to view, edit or delete the data of students previously registered in the database, and he can also generate and print the reports for attendance records.
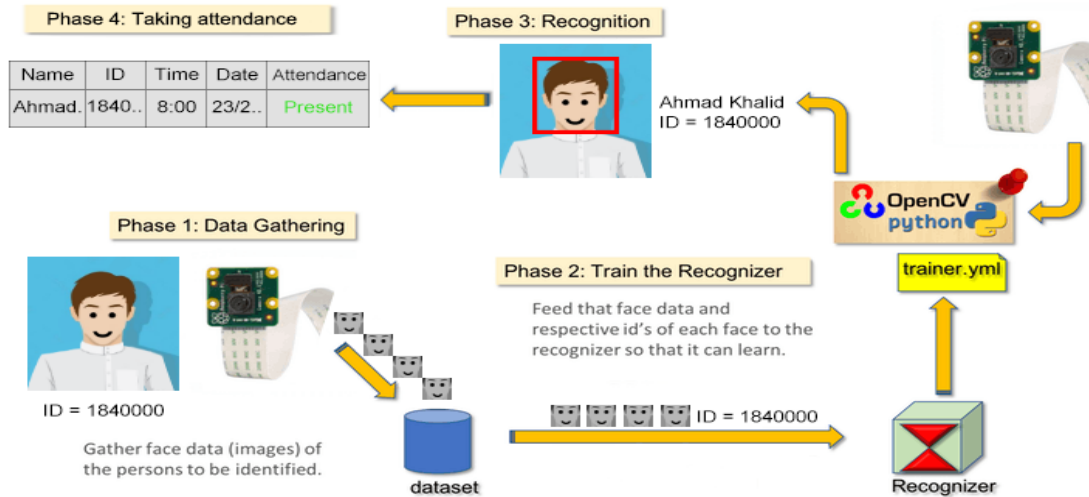
Figure 2 - Analysis Phase

A sequence diagram in Figure 3, for the system Administrator shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are sometimes called event diagrams or event scenarios.
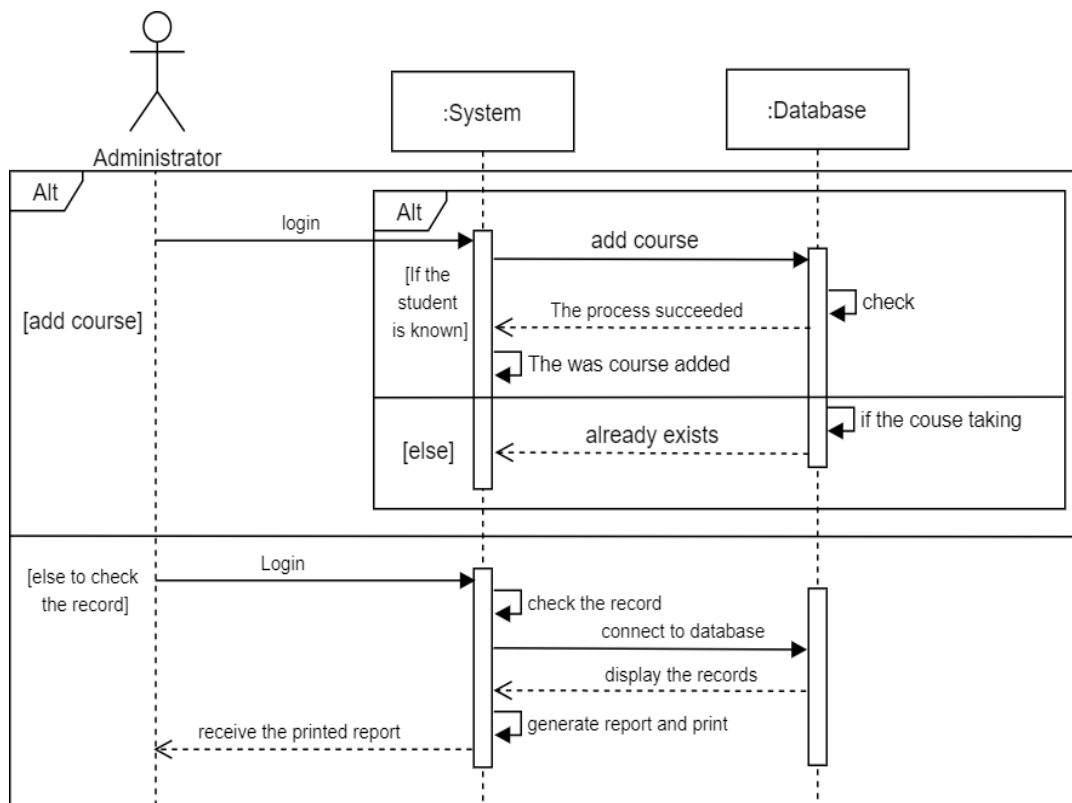
Figure 3 - Face Recognition Sequence Diagram- Administrator

The activity diagram is another important diagram in UML to describe the dynamic aspects of the system; Figure 4 illustrates these aspects for the teacher's tasks.
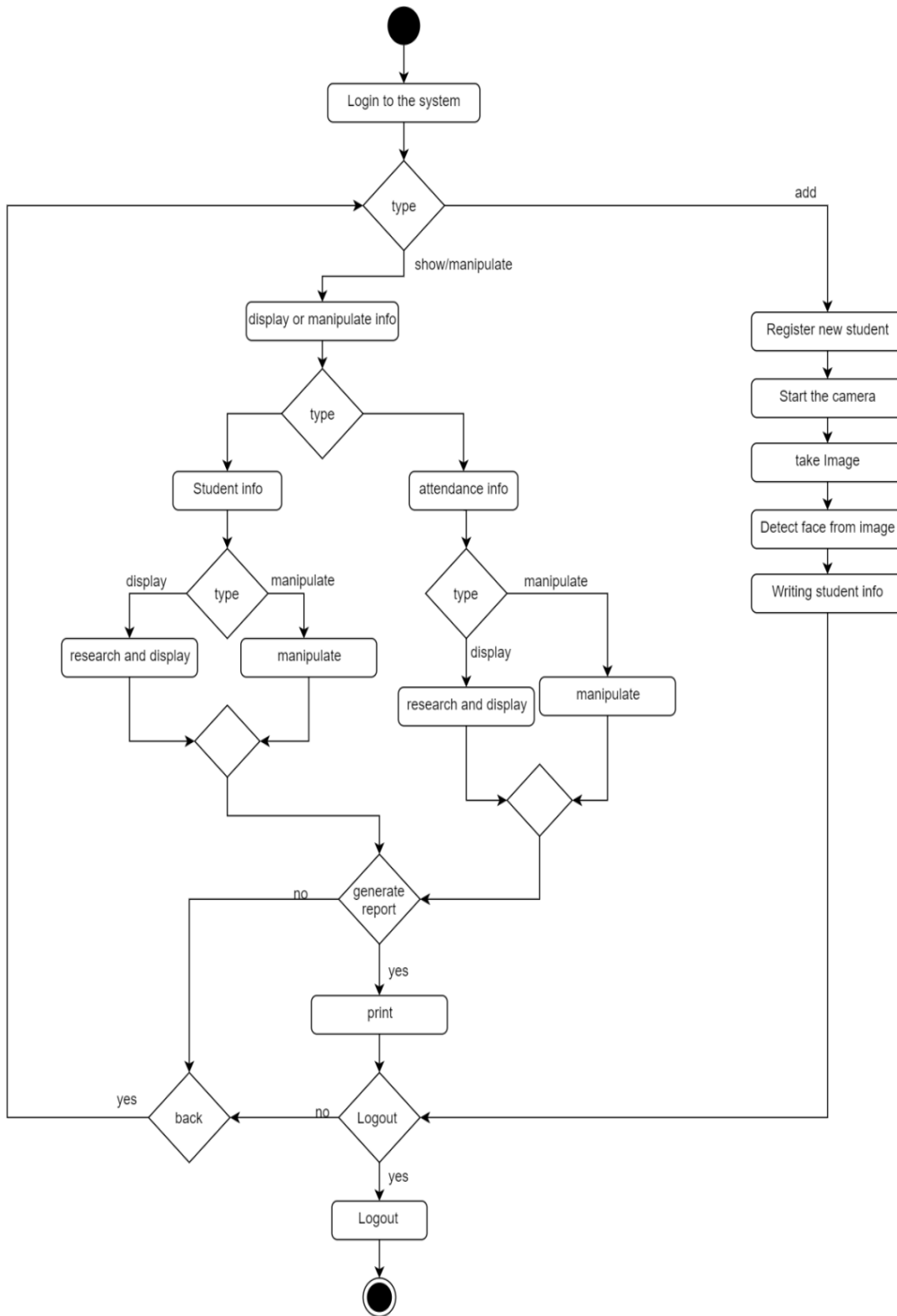
Figure 4 - Face Recognition Activity Diagram- Teacher

The attendance page can only appear for the teacher as it is illustrated on Fig.5 to take student attendance and refresh the dataset also; if the teacher camera does not work the attendance will be takin by a manual process to upload the picture.
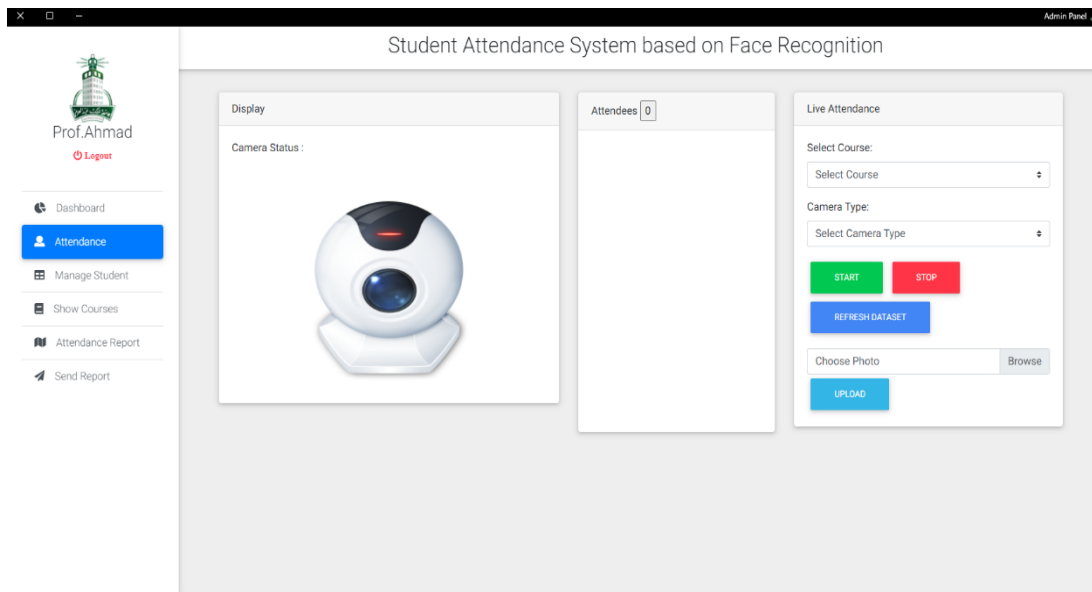
Figure 5 - The Attendance Page

The teacher can manage the students and show data by selecting course, also able to search specific student by his ID as shown on Fig.6.
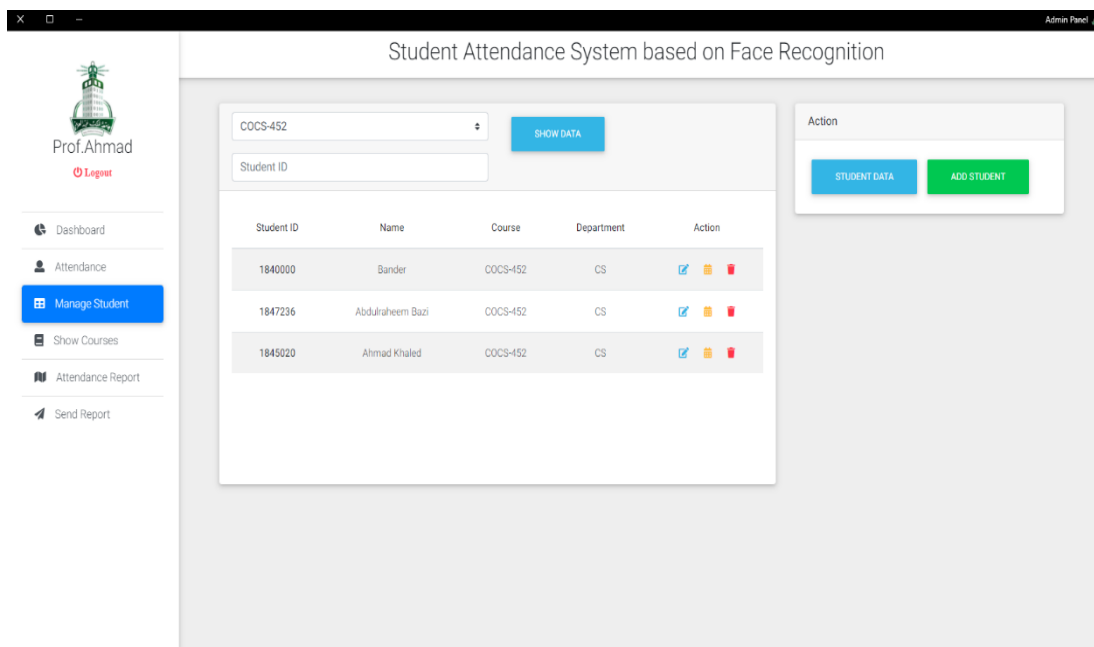
Figure 6 - Manage student

Here on the next phase on Fig.7, the teacher can add new student by complete the information as attendance report page for teacher and admin.
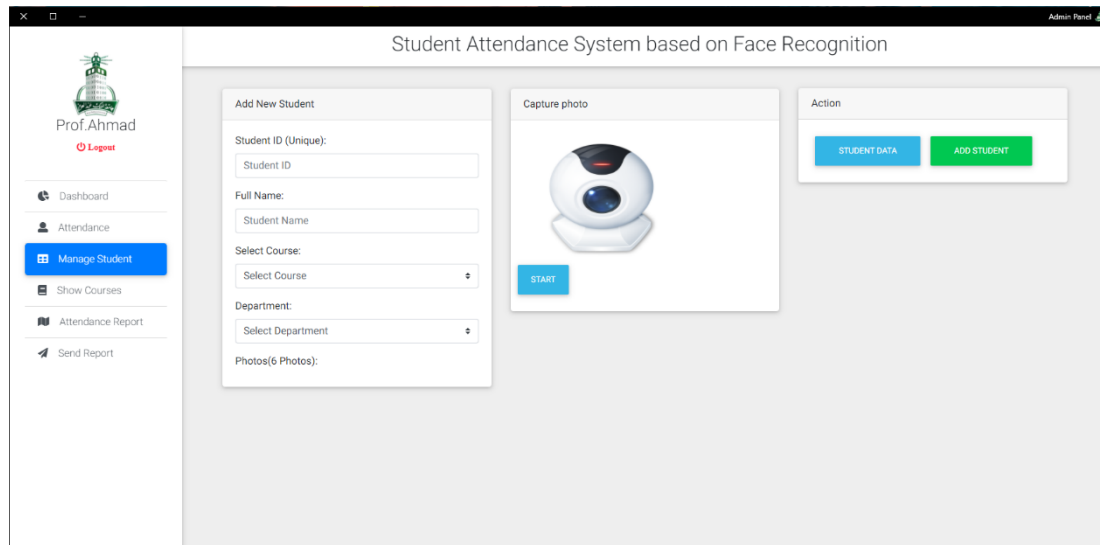
Figure 7 - Add New Student

Also the teacher can see the student's attendance and download the report file. This report will be as excel file as shown on Fig.8.
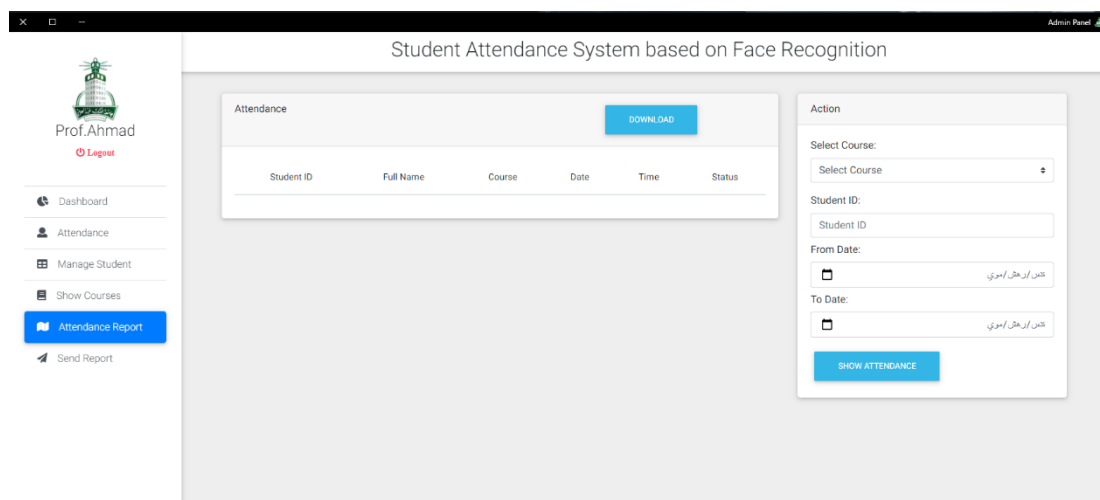
Figure 8- Attendance Report Page

This part, along with the benefits of the proposed method, offered a brief overview of the analysis-design data model. By highlighting the functional and non-functional specifications of the proposed framework, software requirements and system implementations are presented. In addition, the program case diagrams and definitions, sequence diagrams, operation diagrams, device design, and database design for the proposed system were illustrated. It eventually provided the graphical user interface template for the project.

5. System Implementation

All criteria have been gathered, examined, and comprehended in terms of architecture design, user-friendly interface, and the structure of the functions that are coded into the system, which improves the system's ability to operate well and deliver the best results. The functional requirements that were mentioned earlier were used to implement this system.

The steps of execution in the process development of the system ensure that the system meets the software requirements specified in the earlier stage. The coding operations that are part of the process implementation must adhere to the specifications that were created during the design phase. The PyCharm software was utilized in the system's development, which gives all the tools needed to create apps, web forms, and even graphical user interfaces in a single, expandable platform. It was used also PyCharm to manage, connect to a database, build a virtual environment, and access the command line.

The system was then implemented, and each program or part of the system was individually tested. The various units were integrated, and system testing took place. Also, it was decided to develop a website UI and used HTML 5, CSS. Moreover, the system was connected in Python using the sqlite3 module. Use the following steps to connect to SQLite import sqlite3 statement imports the sqlite3 module in the program. Using the classes and methods defined in the sqlite3 module can communicate with the SQLite database. As samples of the implementation, it will divide the code into three parts for python, javascript, and HTML.

Python Part sample
Camera.py

```python
import cv2


class VideoCamera(object):
    def __init__(self):
        self.video = cv2.VideoCapture('http:192.168.0.2:4747/video')

    def __del__(self):
        self.video.release()

    def get_frame(self):
        success, image = self.video.read()

        ret, jpeg = cv2.imencode('.jpg', image)
        return jpeg.tobytes()
```

SceneChangeDetect.py

```python
import cv2
import math
class sceneChangeDetect:
    mean_previous = 0
    sum_frame = 0

    def detectChange(self, img):
        gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
        blur = cv2.GaussianBlur(gray, (5, 5), 0)
        edges = cv2.Canny(blur, 100, 150, apertureSize=3)
        mean_now = edges.mean()
        self.sum_frame = (self.sum_frame + mean_now) / 2 + 4
        sub = math.sqrt(abs(mean_now ** 4 - self.mean_previous ** 4) + 100)
        ##print("sub is "+str(sub))
        ##print("sum is "+str(self.sum_frame))
        self.mean_previous = mean_now

        if sub > self.sum_frame:
            return True
        else:
            return False
```

JavaScript Part
Main.js

```javascript
document.getElementById('sidebar-hide').addEventListener("click",hideSidebar);
function                                                                      hideSidebar() {
  document.getElementById('sidebar').style.display='none';
}
document.getElementById('sidebar-show').addEventListener("click",showSidebar);
function                                                                      showSidebar() {
  document.getElementById('sidebar').style.display='block';
}
eel.get_user_details()(showUserDetails);
function                                                          showUserDetails(userName){
document.getElementById('admin-name').innerText=userName;
}
eel.expose(logout);
function                                                                          logout() {
  alert("Logout                                                          Successfully");
  window.location.href                      =                            'login.html';
}
function                                 show_image()                                   {
  eel.show_image()(setImage);
}

function                              setImage(base64)                                  {
  document.getElementById("qr").src          =                            base64;
}
```

HTLM Part
Dashboard-Admin.html

```html
<!DOCTYPE                                                                    html>
<html                                                                  lang="en">
<head>
  <meta                                                           charset="utf-8">
  <meta          name="viewport"          content="width=device-width,         initial-scale=1,        shrink-to-fit=no">
  <title>Admin                                                          Panel</title>
  <script                        type="text/javascript"                   src="/eel.js"></script>
  <link           rel="shortcut          icon          type="image/ico"        href="img/favicon.ico"/>
  <!--            Font                           Awesome                          -->
  <link                          rel="stylesheet"                   href="css/fontawesome-all.css">
  <!--          Bootstrap            core               CSS              -->
  <link                   href="css/bootstrap.min.css"                     rel="stylesheet">
  <!--            Design                 Bootstrap              -->
  <link                   href="css/bootstrapd.min.css"                    rel="stylesheet">
  <!--        Your        custom        styles       (optional)            -->
  <link                   href="css/style.min.css"                        rel="stylesheet">
  <link                   href="css/Chart.css"                            rel="stylesheet">
</head>

<body                            class="grey                              lighten-3">
<div                                                                class="se-pre-con">
  <img                                                           src="img/loading1.gif">
</div>
<!--Main                                                               Navigation-->
```

```
<header>

<!--                                            Navbar                                            -->
<nav          class="navbar          fixed-top          navbar-expand-lg          navbar-light          white">
   <div                              class="container-fluid                              text-center">
      <span     class="btn"     id="sidebar-show"><i     class="fa-1x     fas     fa-bars"></i></span>
      <h2          style="width:          100%;">Student          Attendance          System          based
         on                              Face                              Recognition</h2>
   </div>
</nav>
<!--                                            Navbar                                            -->

<!--                                            Sidebar                                            -->
<div                    class="sidebar-fixed                    position-fixed"                    id="sidebar">
   <div                    id="sidebar-hide"><i                    class="fas                    fa-times"></i></div>
   <div                                                            class="text-center">
      <div                              class="logo-wrapper                              waves-effect">
         <img                    src="img/lo1.png"                    class="img-fluid"                    alt="">
         <h4                                                            id="admin-name"></h4>
         <a     href="#"     class="text-danger"     style="font-size:     14px;"     onclick="eel.logout();"><i
            class="fas                              fa-power-off">                              Logout</i></a>
      </div>
   </div>
   <div                              class="list-group                              list-group-flush">
```

6. Summary and Conclusions

Because automated attendance systems are more successful than human attendance systems, so automated attendance management system based on hybrid face detection and face recognition approaches is presented. The well-known Haar-cascade Detection in OpenCV is used for face detection and recognition. This increases the overall accuracy of current attendance management systems by automating the tracking of student records, reducing manual labor and pressure on lecturers for accurate attendance marking, reducing the time required for attendance marking while maximizing the time required for actual teaching.

The System Development Life Cycle (SDLC) used in this article as a process to design, develop, and test high-quality systems. It was also used a local server that runs on port 8000. Python, JavaScript, HTML, and CSS are the languages we utilize for development and design.

It is used the SQLite database and explained how to link it to Python. This paper also applied a system testing types. The face detection and loading training data procedures are a little slow. For future improvements, a plan will expand the system features and allow the administrator to fully utilize the system, as well as connect the system to the faculty server.

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