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Attendance Management System Using Face Recognition

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Abstract: *Attendance Monitoring is a common daily activity in Schools, Colleges, Workplaces and Managed Workplaces. It involves an Attendance gathering entity, a physical storage and the attendees. This task of manual Acquisition of attendance data is often tedious and hectic as well as time consuming assuming the limited Workplace time frame. Living in an age of automated machines, it is only feasible that this task be automated as well. This Project deals with using facial data of students for attendance detection systems and using a digital database to store the record with a functional User Friendly UI to be able to view it. This is achieved using A host Computer, A Raspberry Pi with camera hardware as well as a webpage to display the attendance data The data is shared between Pi and the host laptop to manage the detected faces. The data gathering is done via a trained model through the host laptop and is used via the Pi camera to detect the faces and create the digital database. The impacts of the projects will be profound since it will save time and effort of skilled individuals as well as prevent the massive paper wastage that follows manual attendance monitoring. It will also help in ease of access in the attendance of data and allowing the users to monitor their attendance themselves. This also allows for storage of massive data for longer periods of time for future use and reusing the same systems later also conserving the costs and materials.*

Keywords: Raspberry Pi, Attendance Monitoring System, Voila-Jones, Facial Recognition

I. INTRODUCTION

Face recognition is a technique of biometric recognition. It is considered to be one of the most successful applications of image analysis and processing. Maintaining the attendance is very important in all the institutes for checking the presence of students. The face recognition approach is for the automatic attendance of students in the classroom environment without student's intervention. This attendance is recorded by using a camera attached in the classroom which captures images of students, detect the faces in images and compare the detected faces with the student database and mark the attendance. The facial recognition process can be divided into two main stages: processing before detection where face detection and alignment take place (localization and normalization), and afterwards recognition occur through feature extraction and matching steps.

A general statement of the problem of machine recognition of faces can be formulated as follows: given still or video images of a scene, identify or verify one or more persons in the scene using a stored database of faces.

Face detection and face direction estimation are important for face recognition. In personal identification with surveillance cameras, for example, it is necessary to detect the face whose size, position, and pose are unknown. the images used in this project have some degree of uniformity thus the detection algorithm can be simpler first, the all the faces are vertical and have frontal view; second, they are under almost the same illuminate condition.

1.1 Detailed Problem Definition

To Design a System that allows for real time detection of Faces using OPENCV while considering the challenges of identification of faces without manual intervention and allows for data monitoring in a viable digital format that can be transferred.

1.2. Justification of Problem

Computer vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human

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visual system can do. Computer vision tasks include methods for acquiring, processing, analysing and understanding digital images, and extraction of high-dimensional data from real world in order to produce numerical or symbolic information. Mainly computer vision with the theory behind artificial systems that extract information from images.

Raspberry pi hardware will be used as a 24/7 monitoring camera to detect and analyze the facial features and log in the attendance when necessary. Pi will also be used to create a database containing the records of certain people and log the time and id as well as it will be wirelessly connected to the Host computer which can further recieve the records from the shared storage and use it to generate UI content.

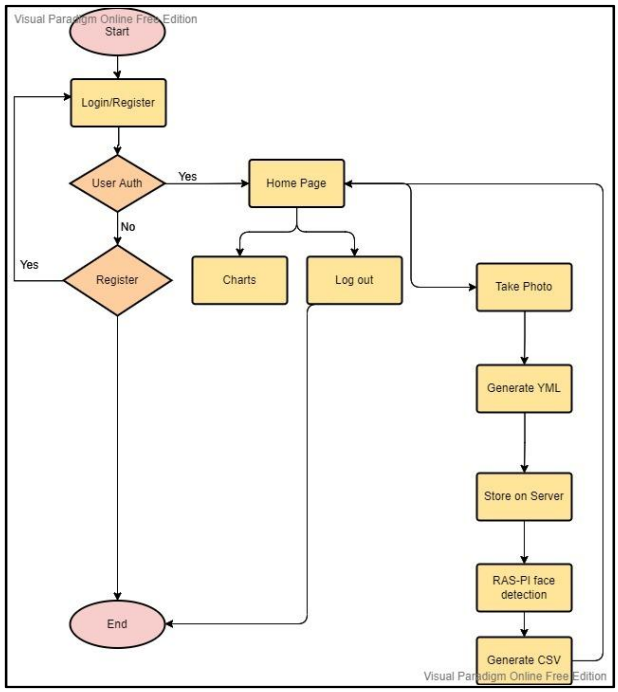
Django is a high-level Python web framework that enables rapid development of secure and maintainable websites. Built by experienced developers, Django takes care of much of the hassle of web development, so you can focus on writing your app without needing to reinvent the wheel. It is free and open source, has a thriving and active community, great documentation, and many options for free and paid-for support.

The Website is created with capability to login as Student or Teacher and the records are displayed accordingly to each type of user record i.e. (Data Hiding from unnecessary entities). The website is hosted and contains the Charts and displayed attendance for the users to view and for teachers to be able to export the attendance data.

SMB is a network file and resource sharing protocol that uses a client-server model. SMB clients such as PCs on a network connect to SMB servers to access resources such as files and directories or perform tasks like printing over the network.

II. SYSTEM DESIGN

2.1 System Architecture



- The key features include a website where students/teachers can register and view their attendance
- Take photo allows the system to acquire images of students which is used by algorithm to recognise them .
- Yml file is generated which is stored on server
- Raspberry Pi has camera module and is present in classrooms
- CSV file is generated and displayed on the website

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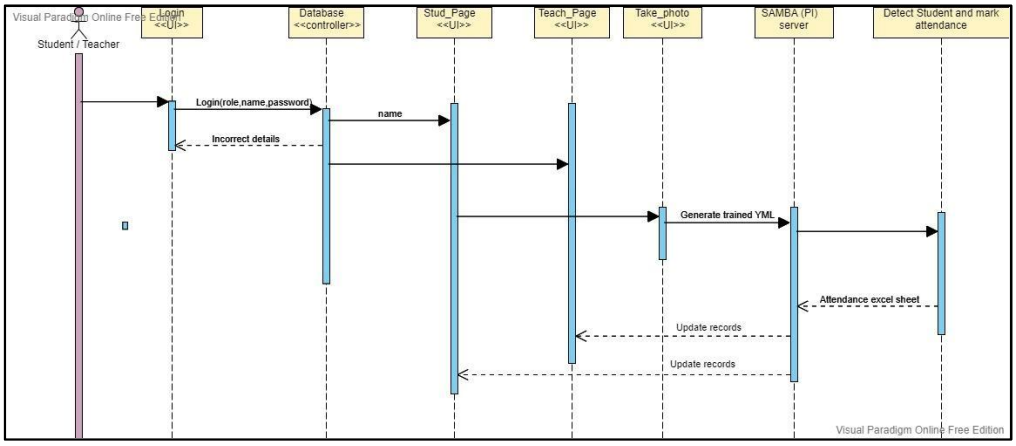
2.2 Sequence Diagram



- A sequence diagram is a type of interaction diagram because it describes how—and in what order—a group of objects works together. These diagrams are used by software developers and business professionals to understand requirements for a new system or to document an existing process.
- Students and Teachers can login on the website
- Database authenticates based on password and username
- User name should always be unique
- Maximum functionality of the project can be handled via home page
- Take photo feature allows the system to get photos of the user to generate YML file for algorithm
- Take photo is only a feature for Students
- YML once generated is stored on the server
- Raspberry Pi works asynchronously and sends CSV of attendance
- Attendance is displayed on the website

2.3 Class Diagram

A class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. There are seven modules in the project namely:

1. Student/teacher login
2. Home page
3. Take photo
4. Charts
5. Server
6. Raspberry Pi
7. Attendance CSV

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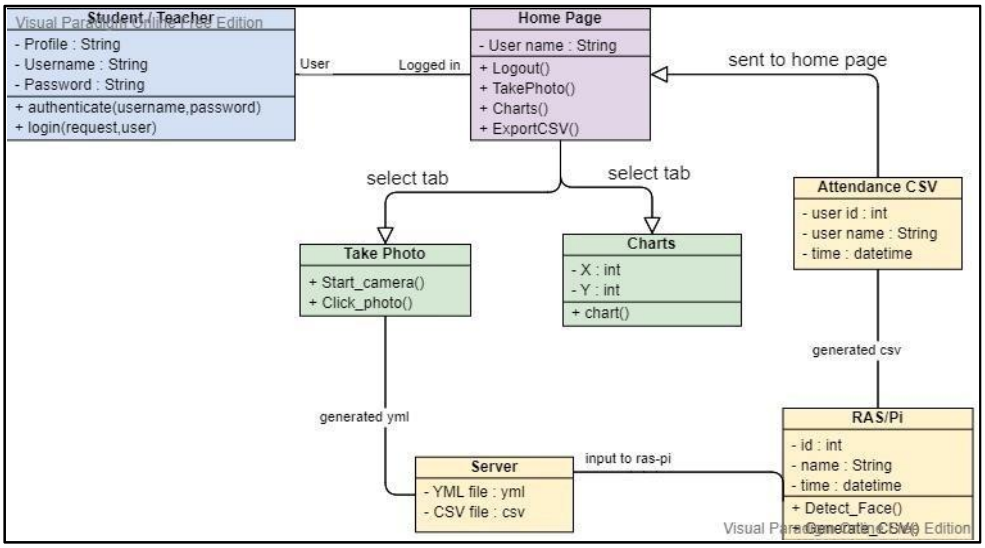
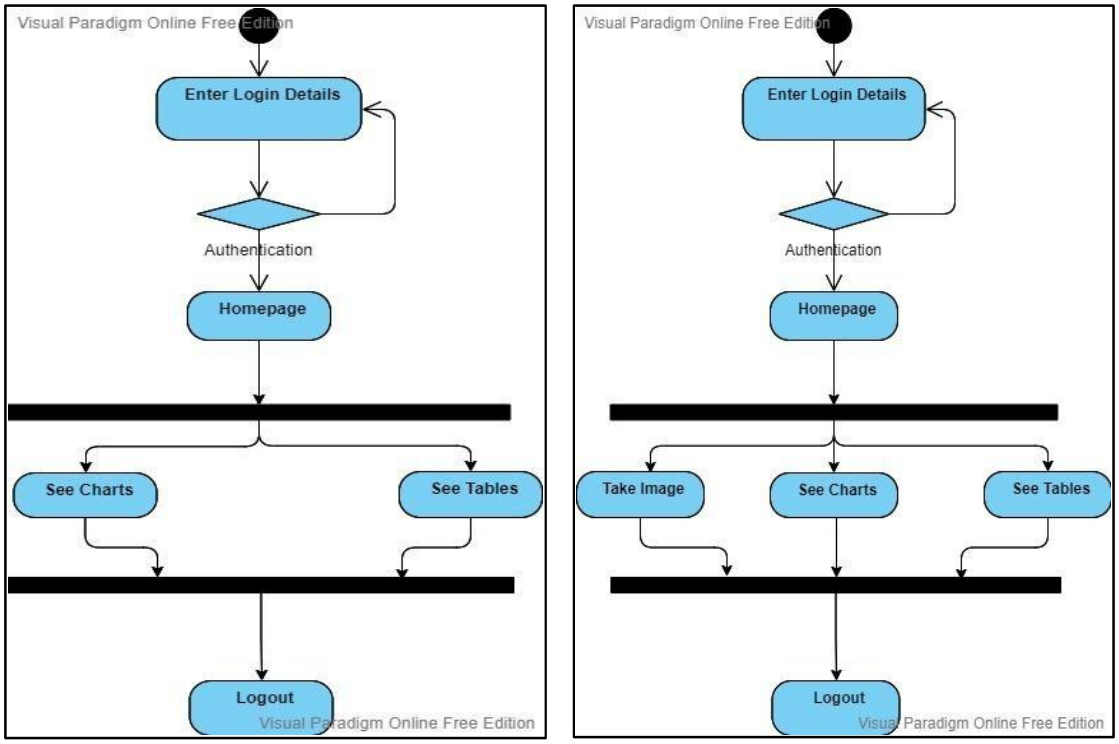


2.4 Activity Diagram



- Activity diagrams are graphical representations of workflows of stepwise activities and actions] with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational processes (i.e., workflows), as well as the data flows intersecting with the related activities.
- Students and Teachers can login using their credentials.
- After successful login user is redirected to home page.
- Here user can check the attendance

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- Take photo feature allows the system to get photos of the user to generate YML file for algorithm
- Take photo is only a feature for Students
- Log out button allows the user to exit the system

III. Methodology Used For Implementation

There are two major system flows in the software development section as shown below:

- The creation of the face database
- The process of attendance taking

Both processes mentioned above are essential because they made up the backbone of the attendance management system. In this section, the process of both flows will be briefly described.

3.1 The Creation of the Face Database

The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process which will be discussed in later section. In the process above, a YML file is created to aid the process of image labelling because there will be more than one portrait stored for each student, thus, in order to group their portraits under the name of the same person, labels are used to distinguish them. After that, those images will be inserted into a recognizer to do its training. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student's portraits to ensure the training is done as minimum as possible.

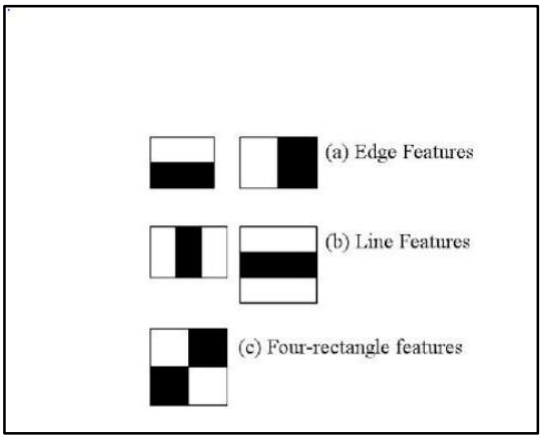
3.2 The Process of Attendance Taking

The Raspberry Pi device will be connected to a camera module and will be present in the class room. The Haar Cascade Algorithm will run on this device and will be trained based on images taken through the website. Once a face is recognized the attendance will be marked automatically and a CSV file will be generated. Students/teachers can check their attendance on the website.

IV. Algorithm

Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, Haar features shown in the below image are used. They are just like our convolutional kernel. Each feature is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under the black rectangle.



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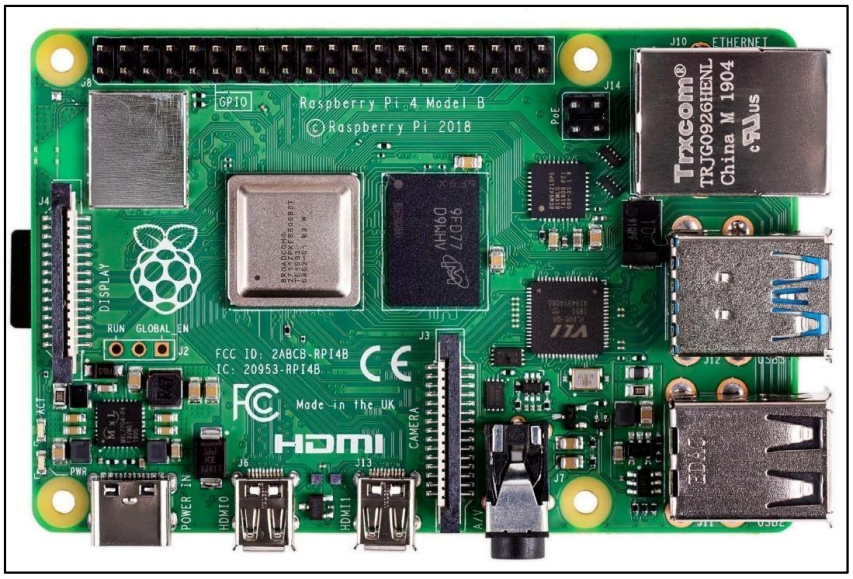
In an image, most of the image is non-face region. So it is a better idea to have a simple method to check if a window is not a face region. If it is not, discard it in a single shot, and don't process it again. Instead, focus on regions where there can be a face. This way, we spend more time checking possible face regions.

For this they introduced the concept of Cascade of Classifiers. Instead of applying all 6000 features on a window, the features are grouped into different stages of classifiers and applied one-by-one. (Normally the first few stages will contain very many fewer features). If a window fails the first stage, discard it. We don't consider the remaining features on it. If it passes, apply the second stage of features and continue the process. The window which passes all stages is a face region.

V. IoT Device : Raspberry Pi

Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems. This product's key features include a high-performance 64-bit quad-core processor, dual display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0,and PoE capability (via a separate PoE HAT add-on). The dual-band wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both cost and time to market



VI. Future Scope

This project is currently identifying people based on facial features and storing their details in a database. It can be further improved to detect objects and classify it in dangerous and non-dangerous category. It can also be tweaked further to recognize suspicious activity and different head/body poses and alert the administrators of nefarious tasks. Features can be implemented later to improve the low light functioning and generate better results Its area of use is currently limited to Schools, Colleges and Workplaces but after improvisation it can also be installed in shops, ATMs and some public places to detect regular ongoers to improve their experience and to protect them from harm. It can also be installed at Construction sites with technology like LIDAR scanners to detect environment AR features and identify if someone might fall and activate safety systems. It can be paired with other technologies like Robots and Trigger based systems to monitor and contact someone according to requirements in a heavily modernized facility for delivery of items, transfer of papers or detection of an injured individual to quickly and accurately dispatch help at the accurate location.

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VII. Conclusion

We have implemented attendance monitoring system using Viola Jones face detection algorithm. With the help of Raspberry pi and SMB protocol ,we have created a real-time hands free attendance taking platform. Website is created to improve the user friendly nature of our project. On this website both students and teacher can keep record of students attendance. Along with this website also shows attendance graphically.

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