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Cloud-based Attendance System using Facial Recognition, GPS and Session Timings

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ABSTRACT: Attendance systems are integrated systems that play an important role in the record-keeping of an individual's presence or absence. Depending on the organization, the attendance of individuals determines each individual's overall productivity and efficiency. Facial recognition systems have played a major role in security & privacy authentication procedures. The superior quality cameras and the resulting images are major factors that make authentication possible. The acquired attendance record becomes more and more perfect as the number of proxies goes down. On other hand, the Global Positioning System (GPS) provides us with the real-time location of required devices and their corresponding individuals. All the records also require a database management service. There are existing attendance systems that store the records using QR schemes, RFIDs, Biometrics, Iris detection, Facial recognition and so on. This Cloud-based attendance system intends to incorporate session timings, facial recognition and a Global positioning system to reduce proxy attendance.

KEYWORDS: Cloud-based attendance system, Facial recognition, Global Positioning System, Session timings, RFIDs

1. INTRODUCTION

1.1. Overview

In this era where computerization and motorization have taken over almost every sector, the use of pen and paper to take attendance seems like a very unviable option. The implementation of a cloud-based attendance system can work wonders for any organization. According to a study, Comparing the parts of courses that used the electronicattendance monitoring system to the portions of courses that did not use the electronic attendance monitoring system, there is a considerable difference in each of the three courses, History 101, History 102, and Math 102. The findings show that deploying an electronic attendance tracking system can improve undergraduate students' academic progress.[1] The main purpose of a cloud-based attendance system would be to provide a record with minimum proxy attendance and organize the acquired records in a well-managed form. The major factors that should be considered to minimize proxy attendance are the Verification of an individual's identity, the Verification of an individual's location and the time spent by an individual in that particular location (refers to figure 1).

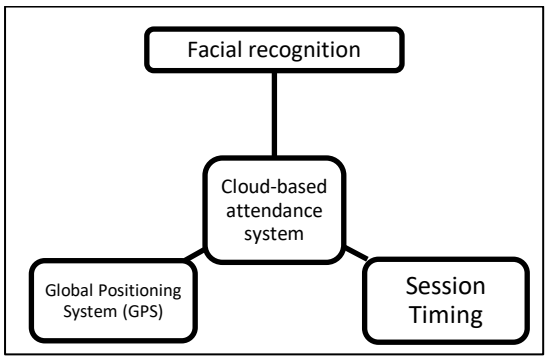

Figure1. Major factors for the attendance system

Incorporating face detection systems will help us verify and authenticate the identity of individuals at a high-security level. Many companies like Apple, Samsung, and Facebook have been using face detection systems for identity verification and authentication. The AWS has Amazon Rekognition which can detect faces in images and videos.

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Amazon Rekognition provides us with data about facial landmarks like the position of the eyes, lips, and nose in animage or a video. A face in one image can be compared to faces found in another image. Amazon Rekognition can give us the per cent confidence score for the images with faces on them [2]. The use of facial detection in a cloud-based attendance system can certainly improve the quality and authenticity of the records. The use of the Global Positioning System (GPS) can provide us with the location of individuals in real time. This allows us to assure the presence of a particular individual in that location at that particular time. The location data of an individual can be faulty if they are present within a certain distance of our designated location. So, to avoid this, we will be using the concept of session timings. Session timings record the period that an individual spends in that location. For example, A teacher can create a session at the beginning of the class and all the students can log in to that session. After that, the system allows face detection later on, when the session timing is above a certain time. So as a whole, we get our Cloud-based attendance system which uses face detection for identity authentication, Global Positioning System (GPS) for location verification and session timings for validating the presence in that location for a particular period.

1.2. Problem Statement

Statement 1:

• The old system of taking attendance through pen and paper is very tedious and time-consuming for both teacher and student. It is also prone to human error and manipulation.

• The American Payroll Association (APA) estimates that businesses without automated timekeeping have a payroll mistake rate of up to 8%. [3]

• Despite risks like Government compliance and financial loss, one in three businesses continue to use manual timekeeping techniques, according to a 2011 Aberdeen Group analysis.[3]

Possible solution: Creating a system which consumes much less time and is less prone to errors.

Statement 2:

• The accessibility of the attendance records is very limited and requires manual calculations. • So, an individual needs to calculate the attendance of each attendee every time the record is needed.

• Although paper-based time and attendance tracking is initially straightforward, processing a large volume of records makes it more difficult.

Possible solution: Creating a system which can automatically keep track of the attendance of individuals.

Statement 3:

• In the case of educational institutions, the pen-andpaper attendance system is less transparent and can only be accessed by the teacher. So, if a student wants to know his/her attendance status, he/she needs to consult the teacher. This leads to unnecessary consumption of time for both teacher and student.

Possible solution: Creating a system which can display the attendance status of individuals maintaining their private data.

Statement 4:

• The use of biometric scanners with inbuilt facial recognition is seen in use these days. These are devices that must be installed in each room where a session going to happen. So, an organization may need hundreds of devices which are very expensive, if they were to implement this facility.

Possible solution: Using the individual's devices like Mobile phones and laptops for face recognition and location verification.

II. RELATED WORK

The fast-paced development of machine learning and artificial intelligence has influenced many people to be interested in this field. Some of the existing systems related to an electronically functioning attendance system are discussed below with their limitations.

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2.1. Existing systems and their limitations

System 1: Attendance System using Facial Recognition and Geolocation, IJRTE, May 2019.

This system uses Geolocation and Facial Recognition features to produce an attendance system. It has used technologies like AWS Face Rekognition, DiUS WebApp and AWS S3. The application workflow of this project starts with the verification of the location. After the individual's location is verified, it verifies the identity using facial recognition. This system seems to be perfect as it addresses the location and identity of the individual.

Limitation of System 1:

This system may fail to differentiate the location of a student if he/she is not inside the classroom. This can grant students with present status in the records whereas, in reality, they may just be standing outside the classroom. Similarly, some students may leave the classroom once the location is verified. This can give them proxy attendance.[7]

System 2: Enhancement of QR code Student's Attendance Management System using GPS, IOSR-JCE, 2019.

This system mainly incorporates a QR code and Global Positioning System (GPS) to complete the attendance process. The process includes verifying the location of individual students at first. As the location verification is done, students are required to scan the QR code for a particular session and get their attendance. The final record is then saved in a database which can be accessed at any time in the future.

Limitation of System 2:

The QR code verification can be a problem while identifying the individual's identity. Even if a student is not present in the session, another student who is present can use the device of the student who is not present to scan the QR code. This way absent students can easily get proxy attendance. This decreases the quality of attendance records and increases the proxy.[8]

System 3: Contactless Attendance System using Smart Phone and Raspberry Pi QR-AES256, IJERT, 2022.

This system incorporates Raspberry Pi, a Camera Module and a GSM module for requesting information movement. The facial data is inputted using the camera module and Raspberry Pi and GSM module is used for identity verification. This system utilizes extra hardware components to complete the attendance process.

Limitation of System 3:

The use of external hardware devices can be taken as a very expensive setup for educational organizations with more than hundreds of classrooms. The total cost after setup and regular maintenance can be seen as its major limitation. [9]

2.2 Proposed system

The Cloud-based attendance system will incorporate session time tracking, Global Positioning System (GPS) and Facial recognition to address all the limitations of the existing systems. The final system can be operated using individual devices like laptops or mobile phones. This is a cost-effective and time-saving system which will store all the attendance records and produce desired statistical reports.

III. PROPOSED SYSTEM

As shown in the flowchart in figure 2, an individual will open his/her laptop or smartphone and go to the homepage of the web application. After redirecting the user to the attendance page, the webpage will ask permission to access the device's location. If the person doesn't allow the permission, the verification process will not initiate; hence attendance will not be marked. After the user grants permission, the webpage will capture the real-time location of the person's device. After that, the admin will generate a session with a unique identity number where the individuals are required to log in. If the person logged in is not in the location from which the session id is generated, then the first phase of the verification will not be passed; the person will be redirected to the homepage showing a message "You are not in the classroom, Attendance cannot be done". If the person's location matches the classroom's location, session timing starts. When the session timing reaches its limit, then the webpage will use the webcam to take a picture of the user. The captured image is then sent to Amazon Rekognition to obtain the find-print of the image. Once the find-print of the image is obtained then it is compared with the find-prints from the database. If any of the image's face-print matches more than 90% with the current image's face-print, then the student will get an attendance. If the face print doesn't match with any of the face-print saved in the database, then the webpage will display the message "Not Recognized, TRY AGAIN!!!" and again opens the webcam and captures the image. This process is repeated until the find-print is

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matched. Once the student gets the attendance, it will be saved into the Amazon RDS Database. Encase of any technical difficulties, manual attendance can be given directly by the admin.

3.1 Technologies used

HTML, CSS, JavaScript, React.js & Node.js: Frontend of the web application is built using the three basic tools i.e., HTML, CSS and JavaScript along with React to optimize the user interface, whereas Node.js is used to build the server-side scripts. React is also used while implementing face recognition using Amazon Rekognition. Scripting for capturing images from the web application to triggering the Lambda function is done using React.

Amazon RDS: It is the Amazon service where all the user's data is stored. It is attached to the Amazon EC2 instance. When the web application running on top of the Amazon EC2 instance gets any data from the user then it gets directly updated in the database created in the Amazon RDS. A separate database is also created in the Amazon RDS to store the data related to face recognition while using Amazon Rekognition.

Amazon EC2: Services like Apache and SQL servers are installed in an EC2 instance and the web application is hosted on it. Amazon EC2 service provides high availability and durability to the web server. Database from Amazon RDS is attached to the Amazon EC2 instance to store all the user's attendance and other data.[6]

GeoApify: It is an API that is used to access the exact location of a user in real-time. The Geoapify platform streamlines map development and geospatial analytics applications. The accuracy of Geoapify is very high as it can differentiate between a distance of 10-20 meters.

Amazon Rekognitition: Rather than going through the process of learning and finding all the algorithms, and their working process, we are using Amazon Rekognition it is a service that offers computer vision to any app so it can analyse videos and images and perform various things out of it [2]. The craziest thing is that we don't have to worry about how it works in the back end. It does make use of the best computer vision and machine learning algorithms to achieve what we want. And we are simply using this feature just like a function call in our code and we can achieve face recognition features from just one function call. When an image is captured, it is stored in the Amazon S3 Bucket from where Amazon Rekognition uses those images to make their face print and store it in the Amazon RDS as shown in Figure 3. [4]

Amazon Lambda Function: It is a way of building a serverless backend for the application. So, for the same reason, we have created a lambda function. Whenever a new image is uploaded into this s3 bucket we can create a trigger such that it triggers this particular lambda function so, that the new image is uploaded to the s3 bucket this lambda function will be triggered and executed. Inside this lambda function is where we have written the logic to populate the index of the amazon recognition so whenever a new image is uploaded to the bucket the lambda function is going to take that image it's going to analyse it and it's going to create something known as a faceprint and save this faceprint into the database created in Amazon RDS [5].

Apache Web Server: It is used to host the web application. The Apache Web server will be hosted on top of an EC2 instance. As Amazon EC2 service is a highly available, durable and scalable service, installing Apache Web Server on top of it will give us a highly available, durable as well as scalable web server.

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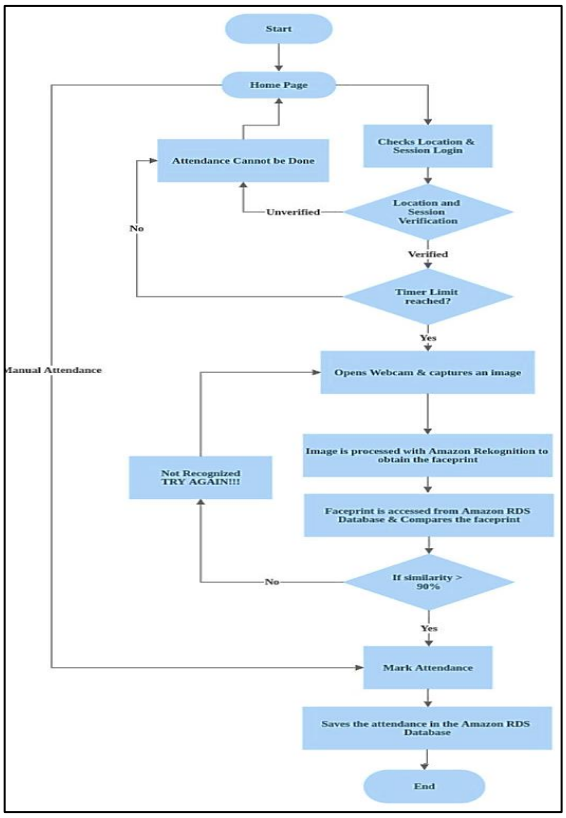

Figure2. Application Flowchart

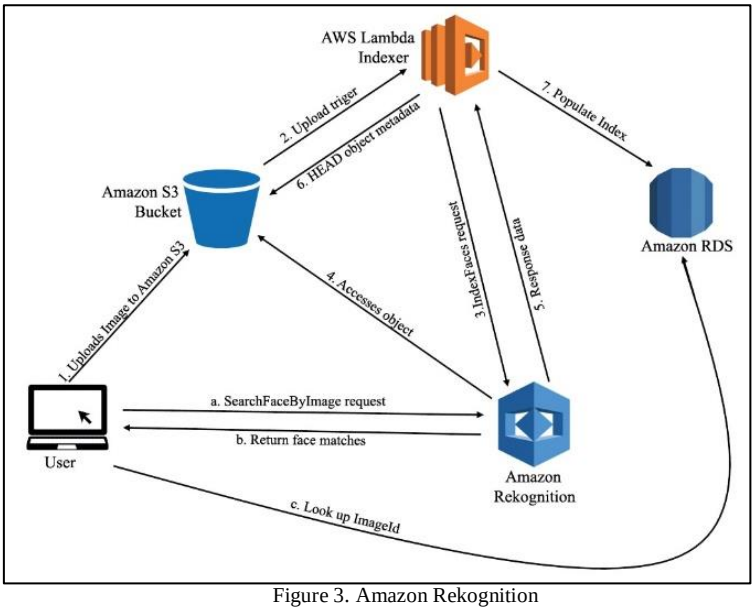

Figure 3. Amazon Rekognition

IV. IMPLEMENTATION OF AMAZON REKOGNITION AND GEOAPIFY

Amazon Rekognition is known to be highly accurate and 99.99% error-free. It can detect the features of a face in an image. Face landmarks such as the position of eyes, nose and lips can help to detect emotions. As the face data of individuals is added, it provides us with a per cent confidence score for each face. This will later determine the accuracy with which it can match the database image [11]. Then GeoApify accuracy is measured by setting the longitude and latitude coordinates for different classrooms. The system will automatically detect the coordinates while the admin generates a session in the web app. The application will verifywhether the device logged in to that session is present in the same coordinate or not [12].

GeoApify intends to make Location Intelligence technologies available for everybody. They provide APIs and components for customer maps to build location-aware apps.

By getting the user's location we can determine where the user is located in his/her time zone. So, the integration of GeoApify in our system allows us to see whether the student is present in the desired location or not. For this, we can implement the following method in our code.

Method name - HTML Geolocation API (navigator. geolocation)

We need to create three functions to use GeoApify, the first function's name is getLocation which gets the current location of the individual. Here, a Get request is made by our web app to Geoapify. Then a corresponding response is returned for the request as shown in Figure 4.Another function's name is watchLocation. This function will try to match the default saved location of the system with the individual's location. If the two locations match, the work will further proceed.The Final function's name is handleError. This will handle errors when a request made is not available or if any suspicious activity is found. It will prevent the system from loading the site.

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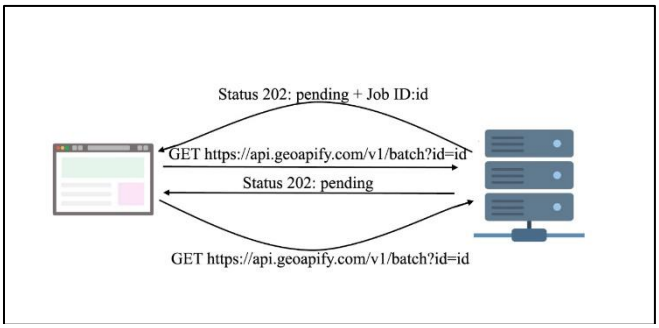

Figure 4. GeoApify function working process [12]

V. Conclusion and Future Work

This paper proposed a cloud-based attendance system using some methodologies like Face detection, GPS and session timing. We used the GPS-based system to track the student's location using the coordinates within the classroom. By using face recognition, we can authenticate the identity of any user easily. It is a cost-effective model which does not require any external hardware components. This attendance system has been designed and improvised to prevent proxy attendance and human errors. Our attendance system will also provide statistical reports of the attendance reports stored in the database. In this way, we have proposed an efficient, cost-saving, time-saving and highly accurate cloud-based attendance system.Some possible future scopes for our web application can be as follows:

- The later development of our web application can include increased accuracy, speed, and security.
- We can improvise our system by adding a retinal scan and 3D scan of the face to identify the person accurately.
- We can also include the statistical reports of attendance of each individual available for them through the web app.
- We can also upgrade our plans in Amazon Web Services (AWS) from free tier to paid tiers to prevent latency.
- We can make a mobile application with the same functionality.
- We can further develop features that can provide us with time schedules for sessions, session alerting alarms and so on.

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