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RFID-POWERED IOT ATTENDANCE MANAGEMENT SYSTEM FOR SCHOOLS AND OFFICES

Dana Ratna Kishor L, Dr G. Satyanarayana, Dr M. Anjan Kumar, Dr B.V. Rama Kumar, T. V. S. Subba Rao

[1,4,5]Assistant Professor, [2]Professor & Head, [3]Professor & Principal,
Department of Computer Science and Engineering,
[1,2,3,4,5]DNR College of Engineering & Technology, Bhimavaram

Abstract- Attendance management is a vital responsibility within educational institutions, including schools, colleges, and universities. Daily student attendance enables teachers to monitor students' activities. It also allows parents to ascertain whether their children are focused on their studies and consistently attend class. Nonetheless, overseeing the daily attendance of thousands of students presents a significant challenge for educators. Conventional methods of recording daily student attendance may lead to inaccuracies and significant manual labor. An RFID-based attendance system effectively addresses these challenges by automating the attendance process, allowing teachers and parents to effortlessly track and monitor students' activities. In addition to managing student attendance, the RFID attendance system can also monitor faculty or staff attendance to streamline the payroll management process.

Keywords: Attendance Management, RFID, Automation, Payroll Management.

I. INTRODUCTION

1. Problem Definition

Conventional techniques for monitoring attendance are laborious, prone to mistakes, and susceptible to manipulation due to paper-based registers. This inefficiency makes a current method necessary and impacts performance evaluation. Our system, which makes use of RFID and IoT, allows for real- time monitoring, automates attendance registration, and has an intuitive user interface. Through improved efficiency, accuracy, and transparency, it successfully tackles these attendance management difficulties.

2. Introduction

Existing techniques for monitoring attendance frequently rely on manual procedures, which causes data management errors and inefficiencies. The need for a dependable and efficient attendance system has grown in importance in places of business, education, and events. The advent of Radio- Frequency Identification (RFID) and Internet of Things (IoT) technologies offers a chance to overcome these obstacles and transform attendance management procedures.

Individuals can be given RFID tags or cards, enabling automated identification and attendance data collection. to different locations. Using RFID and IoT technology together offers a viable way to create a sophisticated attendance tracking system. These technologies can be combined with microcontrollers, like the ESP32, to build a system that is reliable and adaptable and can record attendance properly in a variety of settings. Further improving accessibility is the creation of an intuitive web interface, which enables stakeholders to view attendance data easily from any internet- enabled device.

Considering this, the IoT-based RFID Attendance System project seeks to create a cutting-edge attendance monitoring system by utilizing the capabilities of ESP32 microcontrollers and RFID technology. The project aims to provide a more dependable and efficient alternative to existing attendance management techniques by addressing their flaws and offering automated data recording, remote accessibility via a web interface, and real-time monitoring.

II. LITERATURE SURVEY

A thorough review of the literature survey indicates that attendance management systems are the subject of much attention and research in a variety of contexts, including event management, the workplace, and educational institutions. Traditional attendance tracking techniques have undergone a fundamental transformation thanks to modern technologies, most notably RFID and IoT, which offer creative solutions to age-old problems. According to Gupta et al. (2018), IoT can optimize attendance management procedures by automating attendance tracking, improving accuracy, and enabling real- time monitoring and data analytics. The use of RFID technology for tracking attendance in educational settings is explored in studies by Khan et al. (2019) and Sharma et al. (2020). These studies demonstrate the effectiveness of RFID technology in streamlining student identification and attendance

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recording, which reduces administrative burdens and enhances efficiency.

Meanwhile, because of its smooth interaction with web servers and RFID readers, research by Khan et al. (2021) emphasizes the ESP32 microcontroller's adaptability in IoT applications, particularly in attendance management systems. According to Patel et al. (2017), design principles that improve usability and cross-platform compatibility are important because they highlight the need of user-friendly online interfaces for quick access to attendance data. The integration of IoT and RFID technologies for attendance tracking is the subject of recent research by Choudhary et al. (2022) and Singh et al. (2023), which highlight the advantages of real-time monitoring, automatic data gathering, and remote accessibility.

III.. METHODOLOGY

To determine the fundamental features and performance standards of our IoT-based RFID attendance system, we started the process of establishing the methodology by defining the system requirements and specifications and coordinating them with stakeholder needs. After that, we got to work creating the system's architecture, carefully considering both software and hardware elements, including the web interface and firmware, as well as hardware components like the RFID reader module and ESP32 microcontroller. The goal of this procedure was to guarantee excellent performance and a smooth integration of all components. Determining the data exchange and communication protocols between the web server, RFID reader, and ESP32 was essential to ensuring dependable and effective connectivity in our system.

Flow Chart

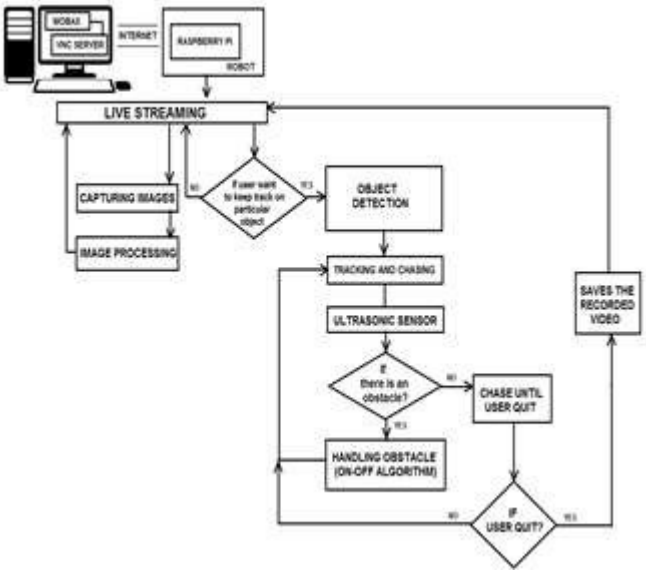

Figure 1: Flow Chart

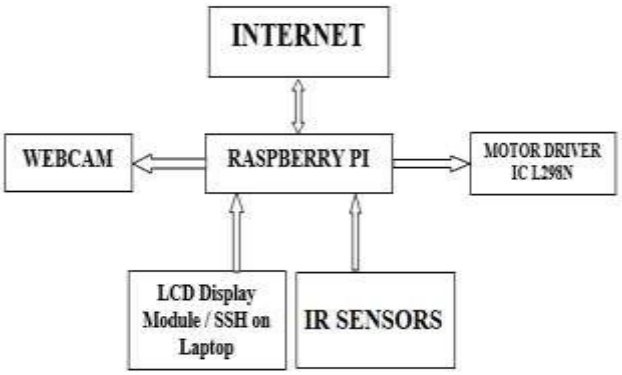

Figure 2: Block Diagram

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Next, we set up the hardware. We carefully put parts together in accordance with the guidelines, setting up connections between the RFID reader module and the ESP32 microcontroller and controlling power and signal transmission to reduce interference with operations. Our firmware development efforts were concentrated on creating firmware for the ESP32 microcontroller that would enable efficient handling of activities related to processing attendance data and seamless interaction with the RFID reader module.

The firmware had important features including data parsing, RFID tag detection, updating attendance records, and web server connectivity carefully developed. Subsequently, extensive testing and debugging methods were carried out to confirm the firmware's dependability and usefulness in a variety of working environments, guaranteeing our RFID Attendance System operates at peak efficiency.

III. EXPERIMENTATION

Hardware and Software Tools Used

- Raspberry-Pi
- Webcam
- DC Motors
- Motor Driver IC L298N
- Ultrasonic Sensors
- LCD Display Module / SSH on Laptop
- Mobax / Putty
- VNC Viewer

A fully customized application was developed for the purpose of video streaming of surveillance system using Raspberry Pi.

Steps followed while achieving this as a first step:

1. **Initialization of the Mobax**

- A basic login page was designed using Mobax to get the user enrolled.
- Once the user gets signed up, a local room layout user could easily switch to whichever locations live video Stream.
- Due to pale user effect and simple design, further UI based development was done to create a user-friendly environment.
- Since VNC Server provides a vast var was done so that the owner of the situations.

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- For this cloud authentication technique several programs enhance the Open CV, PIP, Matplotlib open source.
-

Fig 3: User Interface of Mobax

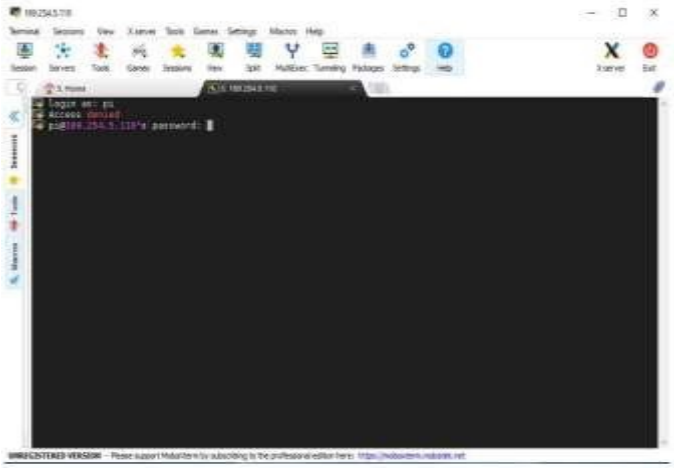

Fig 4: Login page For Mobax

- Dependencies and re vities through VNC server.

Fig 5: VNC server activation page idealization of the VNC

- Further VNC server activation, authentication and login page for the authorized user is created and can be operated by using VNC server application.

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Fig 6: VNC sever login and Authentication

2. Image Processing

- Further VNC server is used for controlled and secured access of the application by authorized user for detection and capture and reading of images
- The UI screen for remote monitoring includes space for dynamic display of detected parameters that are to be fetched from VNC server for reading of images.
- Images of working environment for detection of hazardous situations. Also, repositories were added to build a customized zoomable images from Web cam.
- Different switches, buttons and analog slide bars are laid for controlling the environment from a remote location. For this purpose, internet connectivity should be enabled for further requirements.

Fig 6: Input Code and Output Window

3. Video Capturing

- Now several frames‟ images are captured and joined together to form a video. Now according to the controls given by the authorized user and live streaming video is observed by the authorities using internet.

4. Object Detection and Tracking

- We can also detect and track a specific-colored ball using OpenCV library of python language.
- It will first detect the particular-colored ball whose HSV is mentioned in the code and make a circle around that ball by calculating the diameter of the ball. We have used imutil library of python language for that.
- Then it will track the ball by as it moves around the video by using its preceding positions as it moves. Here it will user x-y graph plot and store previous position of ball and make a tail which is following the ball‟s path. We have handled importing necessary packages and used dequeue to append and delete the locations of the ball.
- In the end it will also save the video which it has captured for future analysis.

Algorithm for Object Detection and Tracking

- We have used dequeue which is a data structure similar to list with superfast append and delete to maintain a list of past „n‟ (x,y)-locations of the object in the video stream. With this we can draw “contrail “of the object as it is being tracked.
- First, we give access of webcam through the switch statement and enable the web cam simultaneously. Cv.VideoCapture() function call is made to capture the video
- Another argument we will give is buffer, which is the maximum size of dequeue which maintains the list of previous coordinates of object “deque(maxlen=args["buffer"])”.
- We have taken the lower and upper boundaries of specific color in HSV color space. The color boundaries will allow us to detect the specific color in livestream video.
- Then we start for loop which will continue until we press “q” key (which means quit).
- Make a call to the read method of the camera pointer which will return 2 tuples. First one is a Boolean which tells us if the frame captures is successful or not. Second one is the video frame itself.
- In case if the frame is not successfully read then it will break the for loop and move to end of the cade to exit and show the error.
- We have handled the actual localization of the object in the livestream by making the call to “cv.inRange”. we first give lower HSV boundaries and then upper HSV boundaries.

- The we have made a call “cv.findContour” to detect the object and cv.grab_contours() for tracking purpose. Simultaneously we will initialize the (x,y) coordinate of the object to make contrail further.
- We will calculate the radius of the object using cnts() as it will return the centroid of the object. With this we make call to method cv.circle() to make a circle around the object. The we start looping over each position of centroid of the object. Provided that both coordinates are valid then we have called "int(np.sqrt(args["buffer"] / float(i + 1)) * 2.5)” to compute the estimated size of the object and make a circle around it.
- Finally cv.imShow() call is done to show the object detection and tracking.

IV. FUTURE SCOPE

We see a lot of exciting opportunities to improve our RFID attendance system, which is based on the Internet of Things. A crucial area of attention is security. We may greatly strengthen the system's defences against unwanted access or tampering by incorporating biometric authentication and putting encryption mechanisms for RFID data transmission into place. Furthermore, deeper insights into attendance patterns and connections may be possible with advanced analytics capabilities, such as machine learning techniques, opening the door to predictive analysis and customized recommendations. A full view of attendance records and streamlined data synchronization would be provided by integration with HRMS and SIS, or student information systems. In addition, the creation of mobile applications with geolocation features could enhance accessibility and precision by enabling users to obtain attendance data while on the go and confirm attendance based on physical presence.

V. CONCLUSION

In this paper a RFID Attendance System, which is based on the Internet of Things, is a noteworthy progression in the field of attendance management technology. It provides several advantages, such as increased efficiency, improved accuracy, real-time monitoring, and accessibility. The initiative solves long-standing issues with conventional attendance tracking techniques by utilizing IoT and RFID technology, opening the door for more efficient organizational operations.

During this project, we have created a solid system that can collect attendance automatically, provide real-time updates, and provide convenient online access to attendance data. Although there are many drawbacks to the project, such as the difficulty of the initial setup, the RFID's limited range, and its reliance on internet access, these can be overcome with proper design, execution, and continuing maintenance.

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