EFFICIENT CLASSROOM MONITORING USING INTERNET OF THINGS

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DOI : https://www.doi.org/10.56726/IRJMETS47452

ABSTRACT

The "IoT-Based Classroom Attendance Monitoring System" is a project designed to automate recording student attendance in a classroom setting. This system employs IoT modules, specifically IR sensors and NodeMCU, to accurately count the number of students entering and exiting a classroom. The captured data is transmitted to the Firebase Realtime Database for storage and retrieval. The project also utilizes the Angular framework to create a user-friendly frontend for accessing attendance records stored in Firebase. "The 'Efficient Classroom Monitoring' (ECM) is a project designed to automate recording student counts in a classroom setting. This system employs IoT modules, specifically IR sensors and NodeMCU, to accurately count the number of students entering and exiting a classroom. The captured data is transmitted to the Firebase Realtime Database for storage and retrieval. The project also utilizes the Angular framework to create a user-friendly frontend for accessing count records stored in Firebase. The ECM also monitors the temperature and light intensity in the class by using a lux sensor and humidity/temperature sensors, which help to turn on and off the lights and fans in the classroom as required. The project is implemented in various stages. It includes establishing the connectivity between the NodeMCU and sensor modules, which include IR sensors, temperature sensors (DHT11), and lux (light intensity) sensors. The next stage involves establishing connectivity with Firebase for the NodeMCU by connecting it to the internet through Wi-Fi. Then, the next stage is creating the frontend application using Angular and connecting it with Firebase to render the data sent by the IoT module."

Keywords: Analysis, Internet Of Things, Monitoring, ECM, Firebase.

I. INTRODUCTION

In educational institutions, monitoring student attendance plays a pivotal role, serving multiple purposes that are indispensable for the efficient functioning of these establishments. Manual attendance tracking, the traditional method employed for decades, is not without its shortcomings. It consumes valuable time and resources while leaving the classroom for inaccuracies. To address these challenges and embrace the possibilities of modern technology, this project is dedicated to the implementation of an automated attendance monitoring system, leveraging the Internet of Things (IoT). "Efficient Classroom Monitoring," abbreviated as ECM, is a comprehensive project meticulously crafted to streamline and enhance the process of tracking student attendance within a classroom environment. At its core, this system leverages cutting-edge IoT (Internet of Things) technology, specifically incorporating IR (Infrared) sensors and the versatile NodeMCU platform, to meticulously monitor the ingress and egress of students, ensuring a precise headcount. The project is implemented in various stages. It includes establishing the connectivity between the NodeMCU and sensor modules, which include IR sensors, temperature sensors (DHT11), and lux (light intensity) sensor. The next stage involves establishing connectivity with Firebase for the NodeMCU by connecting it to the internet through Wi-Fi. Then, the next stage is creating the frontend application using Angular and connecting it with Firebase to render the data sent by the IoT module. The data collected from these sensors is seamlessly relayed to the firebase Realtime Database, and securely stored. "Efficient Classroom Monitoring," abbreviated as ECM, is a comprehensive project meticulously crafted to streamline and enhance the process of tracking student attendance within a classroom environment. At its core, this system leverages cutting-edge IoT (Internet of Things) technology, specifically incorporating IR (Infrared) sensors and the versatile NodeMCU platform, to meticulously monitor the ingress and egress of students, ensuring a precise headcount. The data collected from these sensors is seamlessly relayed to the Firebase Realtime Database, where it is securely stored and readily
accessible for future retrieval. To facilitate user-friendly access to this invaluable attendance data, the ECM project seamlessly integrates the Angular framework, which empowers the creation of an intuitive and responsive frontend interface. Beyond attendance monitoring, ECM extends its capabilities to maintain a comfortable learning environment. It actively monitors key environmental factors, such as temperature and light intensity, utilizing lux sensors and humidity/temperature sensors. This data is crucial for dynamically controlling classroom conditions, such as the automated adjustment of lighting and fan systems in response to prevailing conditions. The ECM project unfolds in several well-defined stages. Initially, it involves establishing the seamless connectivity between NodeMCU and various sensor modules, encompassing IR sensors, temperature sensors (DHT11), and lux sensors. Subsequently, the project progresses to establish a robust connection between NodeMCU and the Firebase platform through Wi-Fi, enabling real-time data transmission. The final stage encompasses the development of a sophisticated frontend application using Angular, which seamlessly interfaces with Firebase to render the data transmitted by the IoT module. This frontend application is thoughtfully designed to be user-friendly and responsive, offering a consistent experience across a spectrum of devices, from desktop computers to mobile devices. In summary, the ECM project not only offers efficient attendance monitoring but also prioritizes user experience by delivering a user-friendly interface. It ensures a conducive learning environment through real-time environmental monitoring, thereby promoting an ideal and responsive educational setting.

II. METHODOLOGY

System Architecture (Hardware Side):

- Object detection:
  - IR Sensor: An IR sensor, also known as an IR detector or IR receiver, typically consists of an IR-sensitive component, such as a photodiode or a phototransistor. These components are sensitive to infrared radiation. Emission and Reflection: IR sensors can be used in two primary ways: emission and reflection. Emission: In an IoT system, you might use an IR sensor to emit infrared light and then measure how much of that light is reflected. When an object is placed in front of the sensor, it reflects some of the emitted IR light to the sensor. Reflection: Alternatively, an IR sensor can simply detect the IR radiation emitted by objects in its field of view. This is useful for passive infrared motion sensors, which are commonly used in IoT applications to detect motion.

![Fig.1 ESP8266 firebase connectivity](image)
Upon application initialization, it establishes a connection with Firebase, retrieves data from the real-time database, and displays it on the application’s screen. Whenever there’s a change in the values from a NodeMCU device, the Firebase database method is triggered updating the displayed values on the screen accordingly. This mechanism ensures that the application stays in sync with real-time updates from the NodeMCU device via Firebase.

### III. RESULTS AND DISCUSSION

#### 3.1 Result:

- **Fig.2** Application flow with firebase connectivity
- **Fig.3** Firebase Realtime DB data storage
- **Fig.4** Application Result
3.2 Result Testing:
Step 1. Walk-in Detection:
Step 1.1: A change in the right IR sensor state triggers further analysis.
Step 1.2: If no walk-in event is currently active and the new right IR state is low (sensor detects something), a walk-in event is initiated and a timer is started.

Step 2. Walk-in Confirmation:
Step 2.1: If the walk-in timer exceeds the predefined timeout (1500 milliseconds), the event is considered invalid and cleared.
Step 2.2: If both IR sensors indicate opposite states (left low, right high) during the walk-in event, a valid walk-in is confirmed.

Step 3. Walk-in Result:
Step 3.1: The Student count is incremented.
Step 3.2: The updated count and current temperature, humidity, and light level are sent to the Firebase database.
Step 3.3: A confirmation message with the updated count is printed to the serial monitor.

4. Function:
Step 4.1. Walk-out Detection:
Step 4.1.1: Similar to walk-in detection, a change in the left IR sensor state triggers further analysis.
Step 4.1.2: If no walk-out event is currently active and the new left IR state is low (sensor detects something), a walk-out event is initiated and a timer is started.
Step 4.2. Walk-out Confirmation:
Step 4.2.1: Similar to walk-in confirmation, the walk-out event is cleared if the timer exceeds the timeout.
Step 4.2.2: A valid walk-out is confirmed if both IR sensors indicate opposite states (left high, right low) during the walk-out event.

Step 4.3. Walk-out Result:
Step 4.3.1: The Student count is decremented.
Step 4.3.2: Similar to walk-in result, the updated count and current environmental data are sent to the Firebase database.
Step 4.3.3: A confirmation message with the updated count is printed to the serial monitor.

IV. CONCLUSION
The overall project application tracks Student movement and environmental data in a designated area. It uses IR sensors to count people entering and leaving, and sends the updated count along with temperature, humidity, and light level to a Firebase database in real-time. This data allows analysis of occupancy trends and environmental conditions, enabling optimization of space usage, resource allocation, and occupant comfort. The system is robust, utilizing random seed generation and timeouts for accurate data collection, making it a valuable tool for various monitoring and management applications.

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