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IOT-Enabled Multi Sensor Fusion Framework for Real Time Fire Hazard and Gas Leakage Detection

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Abstract: Traditional coaching systems often face challenges such as manual student identification, scattered students may lack proper identification, lack learning resources, limited progress monitoring, and personalization of learning. The project will develop Smart Coaching System that uses ESP32 microcontrollers and RFID to facilitate identification of students, learning resource management, course progress tracking, and mentorship programs. The system uses ESP32 microcontroller as the main controller while RFID identifies students through their RFID cards/tags. An individual RFID card/tag is associated with one student account. In this case, students will use their RFID card/tag to log into their accounts for accessing learning material from web-based portal. The proposed platform will provide easy access to learning resources including study notes, video lecture materials, learning materials, and questions for practice. Furthermore, the platform will help in progress monitoring by noting completed course topics, pending topics, and percentage of course completion. Communication between RFID identification system and web portal will be enabled using wireless communication protocol supported by the ESP32. The above described technology includes RFID identification, embedded processing, wireless communication, and web based learning management. The performance of the proposed system will be analyzed through experiment on detection ability of RFID system, identification response time, progress monitoring, resource accessibility, and communication. Proper system configuration, database management, and experiments

Keywords: ESP32 Smart Coaching System, ESP32 Microcontroller, RFID Technology, Student Identification, Learning Management System, Course Progress Tracking, E-Learning, Mentorship, Web-Based Interface, Internet of Things (IoT).

INTRODUCTION

There are various issues facing the traditional coaching system regarding student identification, management of learning resources, academic progress tracking, and personalized education provision. Traditional methods of manual student identification might take a lot of time and pose various problems with the maintenance of records of students. Notes, video lectures, and practice questions are some of the learning resources that are usually scattered in various systems and make it hard for students to access them [1]. Moreover, there is no good way of progress tracking and topic identification in terms of incompleteness in conventional coaching systems. Utilization of IoT technology into educational systems can help with student identification, resource access, and academic management. Through the use of IoT technology, various physical objects are able to sense and communicate data through the network connection [2].

Within the design of the Smart Coaching System, the ESP32 microcontroller serves as the principal processor and communicator [3]. RFID Reader is utilized for the identification of students based on their RFID cards or tags. Each RFID card includes unique identification data which relates to each particular student's profile within the database of the system [4]. Upon scanning of the RFID card by a student, the identification information is read by the ESP32 and communicated to the web platform in order to get the identification of the student. Verification of the student identification data takes place and access to the learning profile is provided [5].

One of the most important features of the suggested system is the introduction of the web-based learning management portal which is accessible using a laptop or any other compatible device [6]. This platform enables users to have access to learning materials such as study notes, video lessons, learning material and questions. Using Wi-Fi communication, the ESP32 transfers student identification information to the web-based portal [7]. This interface shows the profile of each student, courses, topics completed, topics not yet completed, and completion percentage of all the courses [8]. Students will use this information to evaluate their learning progress and organize their learning activities better. It will include mentorship services aimed at offering personalized learning assistance.

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The primary purpose of this study is to design an inexpensive, efficient, and user-friendly Smart Coaching System employing the ESP32 microcontroller and RFID technology. This smart coaching system intends to make the process of student identification, learning resource management, course progress tracking, and personalized coaching simpler through a web-based interface. The performance of this smart coaching system can be measured by studying the accuracy of RFID identification, response time of student identification, learning resource availability, accuracy of course progress calculation, and WiFi communication. Database setting, testing of the system, and experimentation are essential for ensuring the accuracy and security of the smart coaching system.

Materials And Methods

A proposal of Smart Coaching System using ESP32 and RFID technology entails the following components: ESP32 Microcontroller, RFID reader, RFID cards/tags, Wi-Fi Network and Learning Management Platform (LMP). An ESP32 microcontroller is the primary processing and communication component of this project [13]. The RFID reader recognizes the students by reading the RFID cards assigned to them. These cards have unique identification numbers associated with each student in the database. Once a student uses an RFID card, the ESP32 reads the identification information and communicates with the LMP through the Wi-Fi network to confirm his/her identity [14]. Following successful identification, students are allowed access to the learning materials in form of study notes, video lectures, other learning resources and practice questions. This system keeps track of the academic progress by tracking the completed and remaining subjects and calculating the percentage of overall completion of the course. A mentorship component is included in the system that helps in personal guidance of the learner. The programming of the ESP32 microcontroller will be done using the Arduino Integrated Development Environment (IDE). The LMP will control the student profiles, educational resources, and progress data. The LMP will show student information, courses, learning resources, progress information

.System Design And Implementation

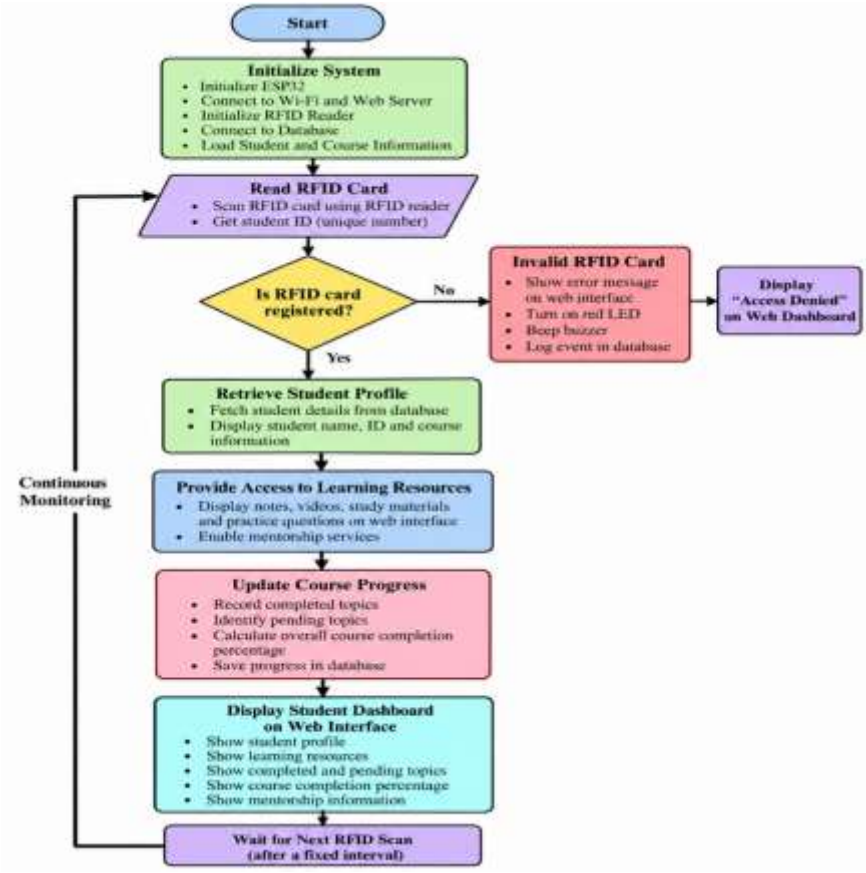
The Smart Coaching System is designed by integrating the ESP32 microcontroller, an RFID reader, RFID cards, Wi-Fi connection, and web-based learning management portal. An RFID reader is connected with the ESP32 through a compatible communication interface. Upon powering up the system, the ESP32 connects to the RFID reader and makes a Wi-Fi connection. Each learner has their own RFID card having a distinct identification number that is associated with a particular student profile in the database. When the student uses his/her RFID card to scan, the identification data is read by the ESP32 and sent to the web-based portal for authentication. Once identification has been made successfully, the student profile is accessed and educational materials, courses, academic performance, and mentoring services are accessible to the learners.

Web-Based Monitoring

The ESP32 is connected to the web learning management system using the Wi-Fi connection. In the website, student identification data, learning material, available courses, academic progress, and mentor information is displayed through the dashboard of the website. The study notes, video tutorials, practice questions, and other learning materials can be accessed from a single platform by the students. It shows the completed and ongoing topics and calculates the percentage of the course completion based on the learning activities recorded. It minimizes the dependency on manual identification of the students and disperse learning materials. The learning information of the student can be accessed using the web-based interface from a laptop or any other compatible computer.

Experimental Evaluation

The Smart Coaching System can be analyzed within the context of experimental testing to investigate its functionality, effectiveness, and reliability. In the process of experimental testing, the following will be taken into consideration: RFID card identification, accuracy of identifying the registered students, verification response time, Wi-Fi connectivity reliability, accessibility of learning materials and progress tracking. Both registered and non-registered RFID cards will be tested several times in order to determine if the system is able to correctly identify the students authorized to use the platform and reject the unauthorized ones. Tests will be performed to make sure that all the necessary information about student profiles, study materials, completed topics, pending topics and percentage of course completion is provided on the web platform.



Results

The suggested Smart Coaching System involves using an ESP32 microcontroller, RFID reader, Wi-Fi communication, and web-based learning management platform for providing automated student recognition and learning process monitoring. The system is supposed to recognize the students by using RFID cards and retrieving their profiles from the database. The web-based interface will offer access to various educational materials like study notes, video lectures, test questions, and other learning resources. It will also show the list of finished topics, unfinished topics, and percentage of

the course that is completed by students. The mentorship function is intended to offer individualized help in education. The use of Wi-Fi communication allows ESP32 to exchange information about identification with the web-based system. Thus, the proposed design offers an example of how RFID identification, embedded processing, wireless communication, and web-based learning management can be combined within one educational platform. Experimental analysis is needed in order to check identification response time, accuracy of recognition, quality of communication, and efficiency of database updates.

Discussion

The suggested Smart Coaching System incorporates RFID technology identification, embedded systems processing, wireless communication, and web-based learning management systems to make education more accessible and monitor academic achievements. With the help of RFID reader and RFID cards of each student, the system seeks to make student identification easier. ESP32 is responsible for processing information related to student identification using RFID and communicating with the web-based system via Wi-Fi technology. Moreover, the system provides mentorship services.

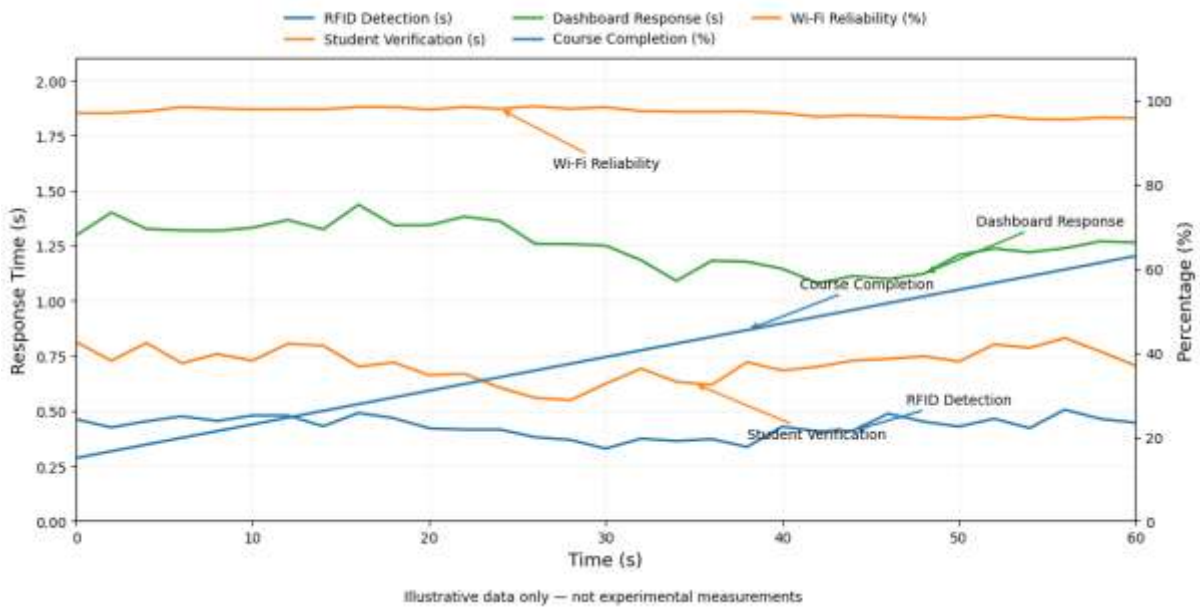


Fig. 2 Real-Time Student Identification and Academic Progress Monitoring

The major components of the suggested system are student dashboards based on the web that show details of the student identification number, list of courses available, educational sources, finished topics, unfinished topics, and course completion rates. The use of the dashboard permits students to track their academic activities and educational sources in one place. Wi-Fi communication helps the ESP32 send student RFID identification data to the web-based portal. The web-based site serves as an interface that can be used to track student progress and manage educational sources. However, the success of the portal will depend on the Internet connection, database accuracy, reliable communication, and proper web application.

The efficiency of the system could also depend on the following factors: the RFID reading range, the precision of card detection, network disruptions, database response time, and the identification process in general. It is important to set up the RFID readers correctly, provide good networking, and properly manage the database to ensure stable system functioning. More testing should be conducted to measure the accuracy of identification, the response time, availability of the resources, and the precision of the progress calculation in different environments. Further

experimentation will reveal the shortcomings of the system and enhance its performance.

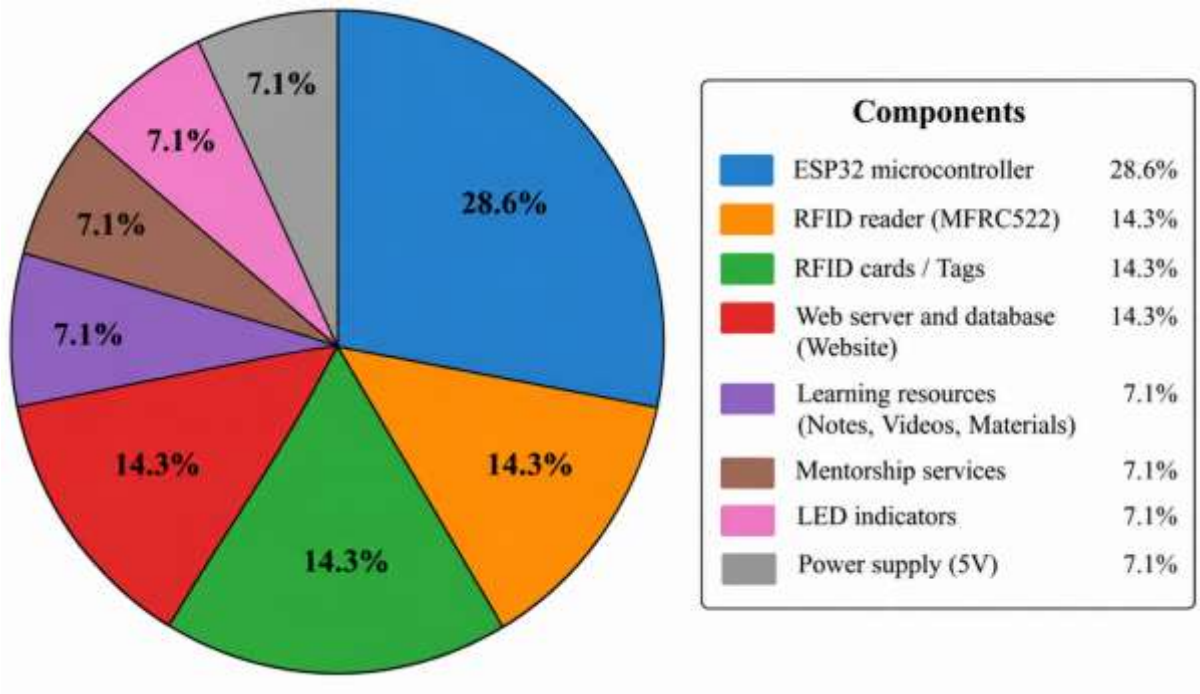


Fig. 3 Component-Wise Distribution of the Proposed Smart Coaching System

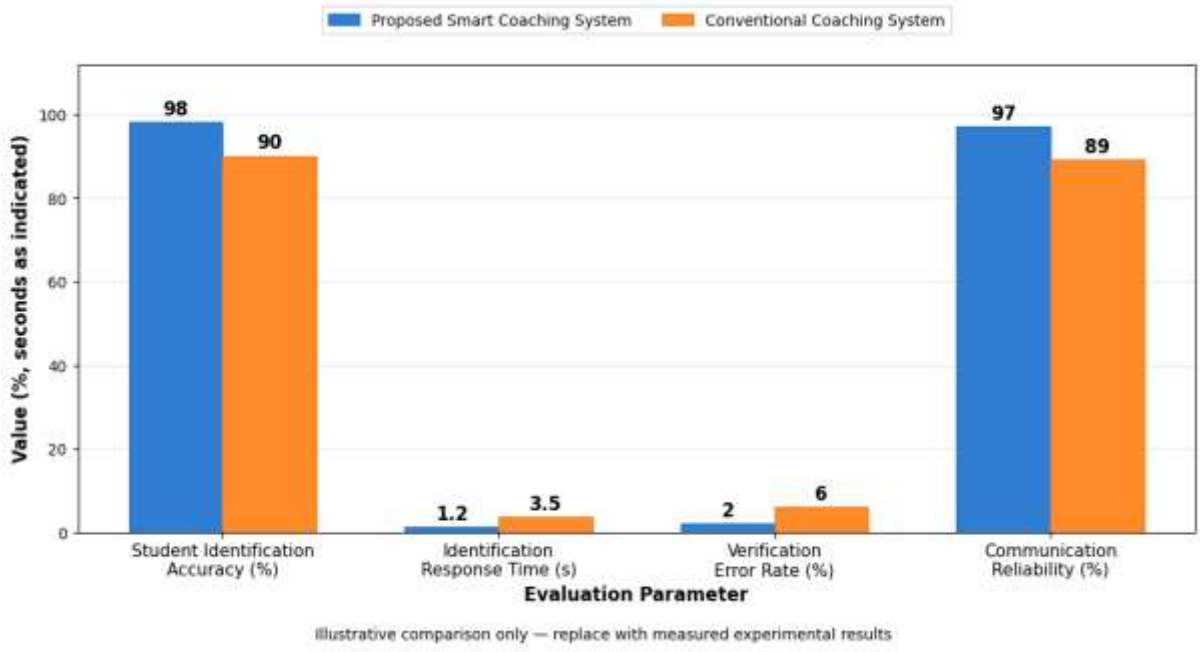


Fig. 4 Performance Comparison of Student Identification and Learning Management

CONCLUSION

The Smart Coaching System that has been suggested by employing the ESP32 and RFID technologies seeks to enhance identification of students, learning resources, academic progress tracking and mentoring services through the use of a central web-based platform. This system involves the use of ESP32 microcontroller, RFID reader, RFID cards, Wi-Fi communication, and database management for automation of identification and provision of personalized educational services. Each individual student will be provided with an RFID card that has been tagged to their personal profile so that the system can fetch the profile information once the individual has been successfully identified. Through the web-based platform, learning materials such as study notes, video lectures, quiz questions, among others will be available and completed topics and percentages of completing the courses will be known.

A web-based dashboard would provide an easy-to-use platform for the students to have access to academic information, track their learning process, and get mentoring through a single platform. The system under discussion incorporates embedded processing, wireless communication, RFID technology, and web-based learning management system in a cost-effective and user-friendly educational application. Possible future improvements of the system may include the integration of mobile applications, automatic attendance control, personalized learning advice based on AI technology, performance analysis, and cloud storage for the database security. More experiments are needed to estimate the accuracy of RFID identification, system reaction time, database reliability, and the quality of Wi-Fi communication.

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