IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, June 2024

Safety and Security Integrated to Smart School Tracking System using IoT

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Abstract: *To integrate various sensors and actuators within educational environments has paved the way for to the development of Smart School Systems, revolutionizing traditional schooling paradigms. This paper presents a comprehensive approach to designing and implementing a Smart School System using Arduino Uno Board, Fire Sensor, RFID, Servo Motor, and Ultrasonic Sensor technologies. The system aims to enhance safety, security[4], and operational efficiency within educational institutions through the seamless integration of IoT (Internet of Things) devices. The fire sensor component ensures prompt detection of fire hazards, triggering timely alerts and evacuation protocols to safeguard students, staff, and school facilities. RFID technology facilitates automated attendance management and access control, streamlining administrative processes while ensuring accurate tracking of personnel movement. Servo motors enable automated door control mechanisms, enhancing accessibility and security[4] throughout the school premises. Ultrasonic sensors contribute to efficient space utilization and obstacle detection, optimizing navigation within the school environment. The central control unit, powered by the Arduino Uno Board, orchestrates the functionalities of all integrated components, providing administrators with real-time insights and responsive capabilities. This Smart School System [2] represents a transformative solution that prioritizes safety, efficiency, and innovation, fostering an interactive and the conductive learning atmosphere for the students and educators alike.*

Keywords: Smart School, sensors ,IoT , Arduino Uno, RFID , Servo Motor ,Ultrasonic, Motor.

I. INTRODUCTION

In today's technologically driven world, the integration of smart systems has the revolutionized various industries, It including education. The concept of a Smart School System harnesses cutting-edge technologies to creates a safer, more efficient, and interactive learning environment.[1][5]

This system lays the Arduino Uno board[6] that is served as its backbone for integrating components such as fire sensors[8], RFID technology[7], servo motors, and ultrasonic

Sensors. Fire sensors[8] are instrumental in ensuring the safety of students and staff by detecting potential fire hazards and triggering immediate alerts. [4]

RFID technology streamlines attendance management and access control, allowing seamless identification and authentication of individuals within the school premises. Servo motors enable precise control of mechanical systems, facilitating tasks such as automated door control and enhancing security measures. [1]

Additionally, ultrasonic sensors play a crucial role in monitoring occupancy, detecting obstacles, and ensuring safe navigation within the school environment. By combining these components, the Smart School System optimizes operational efficiency, enhances safety protocols, and fosters a conductive atmosphere for learning and collaboration [9].

Overall, the Smart School System[2] exemplifies the transformative power of technology in modernizing educational practices and paving the way for a more connected and innovative approach to learning. In the era of rapid technological advancements, to integrate smart systems into variety of aspects to our lives has to become increasingly prevalent. One such domain that stands to benefit greatly from these advancements is education. The traditional

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educational system is witnessing a transformation with the introduction of smart technologies aimed at enhancing efficiency, safety, and overall learning experience [8] In this context, The implementation of a Smart School System utilizing ArduinoUno board, assembled with other IoT components like fire sensor[8], RFID, servo motor, and ultrasonic sensor.[6]

II. EXISTING SYSTEM

Existing Smart School Systems integrate various technologies to enhance teaching, learning, and administrative processes[2]. These systems typically includes the features such as automated attendance tracking using biometrics[9] or RFID tags[7], interactive with smart class rooms facilitated with their multimedia tools for dynamic teaching methods, and learning management systems (LMS) facilitating online course materials and communication between teachers, students, and parents. They also incorporate parent- teacher communication [5] portals or mobile apps for transparent updates on student progress and school activities. Safety measures are ensured through IoT-enabled surveillance, access control systems, and emergency notification systems.

Additionally, resource management tools optimize energy usage, facility scheduling, and transportation services. Some systems leverage analytics to personalize learning experiences, while others integrate health monitoring technologies[3] to promote student well-being. These combined efforts are aim to creates a secure, efficient, and engaging learning environment within smart schools.

III. PROPOSED SYSTEM

A proposed smart school system would integrate various technological components to streamline operations and enhance the learning experience. The system would feature automated attendance tracking[9] using advanced biometric authentication or RFID technology[7] to improve accuracy and efficiency. Interactive smart classrooms installed with digital whiteboards, projectors, and internet access would enhance immersive and collaborative learning experiences. A centralized learning management system (LMS) would serve-as-a hub for managing course materials, assignments, and communication between teachers, students, and parents. Dedicated parent-teacher communication[5] portals or mobile apps would provide real-time updates on student progress, attendance[9], and school events, fostering greater transparency and engagement. Safety and security[4] measures would include IoT-enabled to surveillance cameras, access- control systems, and emergency notification systems to ensure the well-being of students and staff. Resource management tools would optimize energy usage, facility scheduling, and transportation services, contributing to cost savings and environmental sustainability. Personalized learning pathways based on data analytics would cater to individual student needs and enhance learning outcomes. Additionally, health monitoring technologies[3] could be integrated to promote student wellness and provide timely support. This comprehensive smart school system aims in creating conductive and innovative learning environment, that motivates students to succeed with evolving technology in the digital era.

IV. IMPLEMENTATION

The Smart School System is proposed to the optimize safety, security, and efficiency in educational settings by integrating various sensors and actuators with the Arduino Uno board[6]. Fire sensors strategically placed throughout the school detect any signs of smoke, flames, or rising temperatures, triggering immediate alerts and initiating evacuation procedures through the Arduino Uno board[6]. RFID technology[7] is employed for automated attendance management and access control. Each student and staff member is provided with an RFID tag or card, which is scanned by RFID readers installed at entry points and classrooms. This data is processed by the Arduino Uno board to monitor attendance and regulate access to restricted areas. Servo motors enable automated door control, enhancing accessibility with hands-free operation. The Arduino Uno board coordinates servo motor activation based on inputs from RFID readers[7] and ultrasonic sensors. Ultrasonic sensors monitor occupancy and detect obstacles in real-time, providing valuable data on room usage and ensuring safe passage within the school premises. Acting as the central control unit, the Arduino Uno board processes sensor data, executes control algorithms, and communicates with external systems for monitoring and alerting. By seamlessly integrating these components, the Smart School System transforms traditional

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educational environments into modern, interconnected spaces prioritizing safety, efficiency, and innovation, they fostering a dynamic learning experience for students and educators.

4.1 RFID using RFID Tags to take Attendance student login Connection

What are the components we connected, we take components Arduino uno Board, Bread Board, RFID, Display.
First we put RFID in Bread Board and then take arduino uno board and take 7 male to male Jumper wires to

Step 1: Connect arduino uno board to RFID sensor connect through jumper wires

- SDA to 10,
- SCK to 13,
- MOSI to 11,
- MISO to 12,
- GND to GND,
- RST to 9 and 3.3V to 3.3V.

Step 2: LCD Display to connect Arduino uno to take Female to male connect

- GND to GND ,
- VCC to 5V ,
- SDA to A4 and SCL to A5.

Step 3: And then to give the power connection

So that Arduino uno board can take 5V battery to connect External Power Supply or Alternative USB plug to PC.

4.2 Ultrasonic Sensor using Automated Door Control System Connection

The Components taken Arduino uno, Servo motors , Ultrasonic sensor and 5V battery power supply.
First we connect ultrasonic sensor to arduino uno by taking

- 4 jumper wires Female to Male wires and then Connect
- VCC to A0 ,
- Tr1g to pin -9 ,
- Echo to pin 8 and GND to GND .
- Servo motor connect to Arduino uno Connect PWM to pin 7 ,
- positive to 3.3V and negative to GND and then connect 5v battery to Arduino uno.

4.3 Fire sensor with water pump automatic using safety Purpose

- VCC (positive) pin is Connected to the IR sensor to the positive end of the power supply.
- Ground GND(negative) pin from the IR sensor is connected to ground terminal of the power connection .
- Connect the OUT pin present in the IR sensor to a digital input pin on the microcontroller.
- Connect the VCC pins of their fire sensor to the positive end side of the power supply.
- GND pin present in the fire sensor of the Ground terminal of the power supply.
- Connect the OUT pin in the fire sensor to another digital input pin on the microcontroller.
- Connect the positive side of their water pumping motor to a suitable power supply.
- Ground GND the negative terminal of their water pump motor to the ground terminal to give the power supply.

DOI: 10.48175/IJARSCT-19041

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4.4 Flowchart :

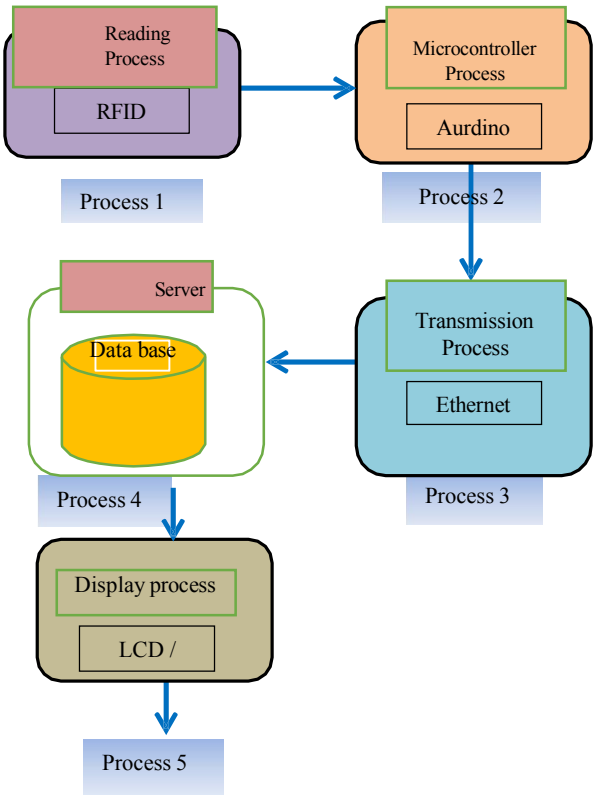

Fig1 : FlowChart

4.5 Components used:

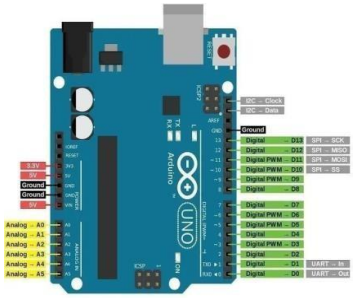

Fig 2: Arduino Uno Board

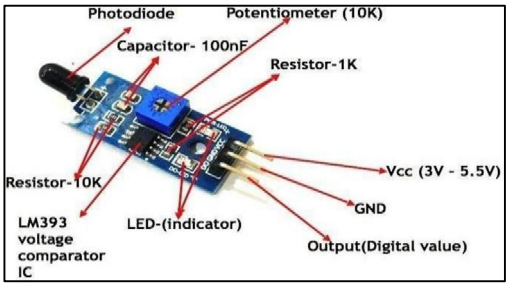

Fig 3: Fire Sensor

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Fig 4: Ultrasonic Sensor

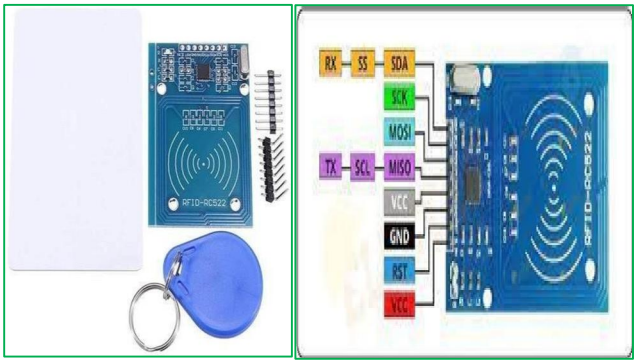

Fig 5: RFID And RFID Tag

4.6 Final Outcome:

4.6.1 Attendance tracking and operations management

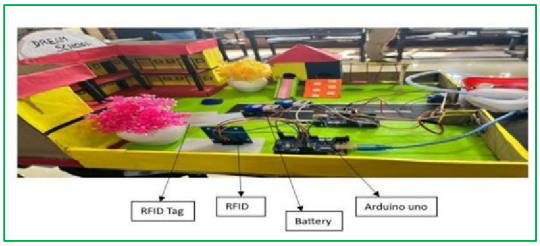

Figure 6: (RFID Sensor working image)

4.6.2 Safety and Security[4] integrated with Operations

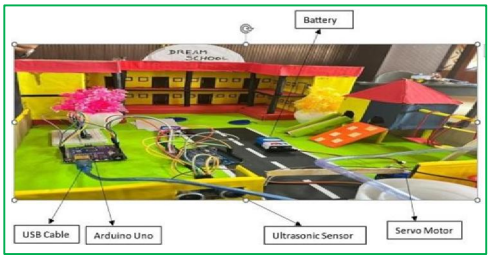

Figure 7: (Ultrasonic Sensor using Servo Motor working image)

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V. CONCLUSION

In conclusion, the Smart School System, incorporating Arduino Uno Board, Fire Sensor, RFID, Servo Motor, and Ultrasonic Sensor, represents a significant advancement in modernizing educational environments. By seamlessly integrating these technologies, the system enhances safety protocols, automates administrative tasks, and fosters an interactive learning atmosphere. The real-time fire detection[8] capabilities of the fire sensor ensure prompt response to potential hazards, while RFID technology facilitates efficient attendance management and access control. Additionally, servo motors enable automated door control mechanisms, enhancing security[4] and accessibility. Ultrasonic sensors contribute to efficient space utilization and obstacle detection, further optimizing the school environment. Centralized control through the Arduino Uno Board provides administrators with comprehensive oversight and responsive functionalities.

As for future-work, they are present numerous opportunities for further enhancement and expansion of the Smart School System. Firstly, incorporating advanced analytics and machine-learning algorithms can enable predictive maintenance and proactive safety measures based on historical data analysis. Secondly, integrating biometric authentication systems alongside RFID technology can further enhance security and accuracy in access control. Additionally, exploring energy-efficient solutions and renewable-energy sources can contribute to sustainability efforts within the school environment. Furthermore, enhancing the system's scalability and interoperability with other IoT devices can broaden its applicability and adaptability to evolving educational needs. Lastly, fostering collaboration with educational researchers and stakeholders can facilitate the continuous refinement and optimization of the Smart School System to meet the ever- changing demands of modern education.

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