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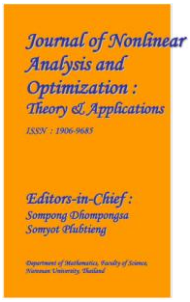


PYTHON BASED SMART SCHOOL BUS MONITORING AND SECURITY SYSTEM

Dr. S. VARA KUMARI Department of Electronics & Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Eluru (Dt)-521212
U. SHIVA KUMAR REDDY Department of Electronics & Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Eluru (Dt)-521212
T. KAVYA Department of Electronics & Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Eluru (Dt)-521212
Y. SINDHURA Department of Electronics & Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Eluru (Dt)-521212
T. VAMSI KRISHNA Department of Electronics & Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Eluru (Dt)-521212

Abstract:
The "Smart School Bus Monitoring and Security System" paper offers a comprehensive solution to enhance the safety and security of students during their school bus commute. The project integrates various advanced technologies to create a robust system. A Python-installed PC equipped with a camera and OpenCV is employed for real-time face recognition of students as they board and disembark from the school bus. Upon recognizing a student's face, the system triggers an automated email notification to alert parents, ensuring peace of mind for caregivers. In addition to student recognition, the system incorporates alcohol detection capabilities for the driver. If the driver is found to be under the influence of alcohol, the bus's ignition system will remain locked, preventing the bus from starting. Simultaneously, an email notification is dispatched to the school administration, allowing immediate action. Furthermore, the system enhances student safety by implementing accident detection and fire detection mechanisms. In the event of an accident or fire, automatic email alerts are sent to the school administration, enabling swift responses to emergencies. This project represents a significant advancement in ensuring the safety and security of students during their school bus commute, promoting proactive monitoring and immediate responses to critical situations.

Keywords:
Arduino, LCD, Gas sensor, Python installed PC, MEMS sensor, Camera

1.Introduction

Notwithstanding to the fact that punctuality is a discipline to be inculcated since the school days, there will be situations where we bound to fail at it. Such is the case with getting on time to board the school bus. In case of the student being in a class below five, it would be mandatory for the parents to pick them up from the school once they descend from the bus. Likewise, having a sound transportation service is inevitable for an educational institution which would aspire to reach even the roots of the country. In order to make all these wishes come true, we have designed a system which would provide the complete status of school students to the school management. Our proposed system tracks the live location, the speed, list of students on the bus with minimal cost. The school management and parents can continuously monitor the bus which will ensure the student’s safety while picking up and dropping off. GPS module continuously tracks the geographical coordinates of the bus and uploads that onto the firebase database through the Wi-Fi available in the microcontroller. This data can be accessed by the parents as well as management through a mobile application that gets the latitude and longitude from the database and plots it on a map. GPS (Global Positioning System) and Google maps are used for navigation and display services respectively. The proposed system notifies the parent when the

particular student is recognized by the face recognition module. The microcontroller sends his/her unique ID to the firebase and the notification will be sent to that particular parent. The proposed system also allows parents to notify if their ward is absent from the school so that driver need not wait for the particular student at the stop. The research undertaken by National Highway Traffic Safety Administration in the USA notes that when comparing the number of fatalities of children aged 5 to 18 years during normal school transportation hours, school buses are 87 times safer than private cars. Headlines like “Girl dies in bus tragedy” from the May 18, 2010 issue of the Peninsula newspaper in Qatar seem to be repeated several times every year in different places of the world. Thus, the proposed system will notify the parents if their children have reached the school safely and continuously monitors the school bus.

2.Proposed system

The proposed method for the "Smart School Bus Monitoring and Security System" project involves the integration of advanced technologies to ensure the safety and security of students during their school bus commute. A Python-installed PC, equipped with a camera and OpenCV, will be employed for real-time face recognition of students as they board and disembark from the school bus. Upon successful recognition, automated email notifications will be sent to parents, providing them with real-time updates on their child's journey. Additionally, the system will incorporate alcohol detection capabilities for the driver; if the driver is found to be under the influence of alcohol, the ignition system will remain locked, and an email notification will be dispatched to the school administration. Furthermore, the project enhances student safety through accident and fire detection mechanisms, triggering immediate email alerts to the school administration in the event of emergencies. This comprehensive system represents a significant advancement in school bus monitoring and security, ensuring real-time monitoring, automated responses, and proactive safety measures for students.

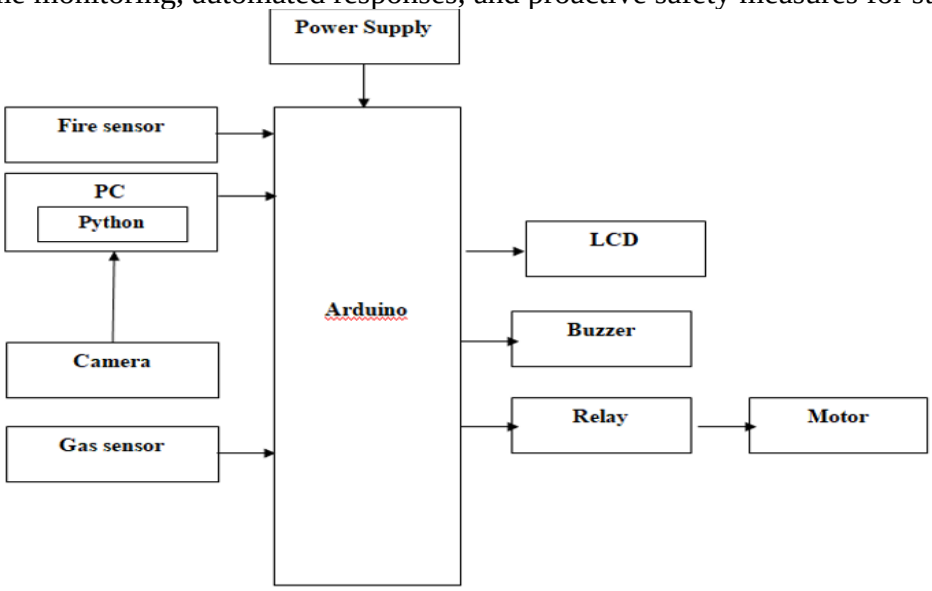


Figure.1.BLOCK DIAGRAM OF PROPOSED SYSTEM

2.1 Hardware description

2.1.1 Introduction to Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It consists of a microcontroller that can be programmed to sense and control objects in the physical world. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. They are used for a variety of purposes, including creating interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino boards come in various shapes and sizes, each with its own set of features and capabilities. Some of the most popular Arduino boards include:

Arduino Uno: The Uno is one of the most popular Arduino boards. It features a microcontroller, digital and analog input/output pins, USB connection, and a power jack.

Arduino Mega: The Mega is similar to the Uno but with more digital and analog input/output pins, making it suitable for larger projects that require more I/O.
Arduino Nano: The Nano is a compact board with similar features to the Uno but in a smaller form factor, making it ideal for projects with space constraints.
Arduino Due: The Due is based on a more powerful microcontroller than the Uno, making it suitable for projects that require more processing power.
Arduino Leonardo: The Leonardo is similar to the Uno but with built-in USB communication, making it easier to interface with computers.
In addition to the hardware, Arduino also provides a software development environment that allows users to write, compile, and upload code to their Arduino boards. The Arduino IDE (Integrated Development Environment) is a simple yet powerful tool that is used to write code in the Arduino programming language, which is based on Wiring, and upload it to the board.
Overall, Arduino is a versatile platform that is used by hobbyists, students, and professionals alike to create a wide range of projects, from simple blinking LED lights to complex robotics projects. Its ease of use, coupled with its affordability and flexibility, has made it one of the most popular platforms for electronics prototyping and experimentation.

2.1.2 Features of the Arduino

Arduino boards come with a variety of features that make them suitable for a wide range of projects. Some of the key features of Arduino boards include:
Microcontroller: Arduino boards are equipped with a microcontroller, which is the brain of the board. The microcontroller is responsible for executing the program and controlling the inputs and outputs of the board.
Digital Input/Output Pins: Arduino boards come with a number of digital input/output (I/O) pins that can be used to connect the board to external devices such as sensors, LEDs, and motors. These pins can be configured as either inputs or outputs, allowing the board to read data from sensors or control external devices.
Analog Input Pins: In addition to digital I/O pins, Arduino boards also feature analog input pins that can be used to read analog signals from sensors. These pins allow the board to measure variables such as light intensity, temperature, and sound level.
PWM (Pulse Width Modulation) Pins: Some Arduino boards come with PWM pins, which can be used to generate analog-like signals. PWM is often used to control the brightness of LEDs or the speed of motors.
USB Connection: Arduino boards feature a USB connection, which allows them to be connected to a computer for programming and serial communication. The USB connection also provides power to the board, eliminating the need for an external power source.
Power Jack: Arduino boards come with a power jack that can be used to connect an external power source, such as a battery or a wall adapter. This allows the board to be powered independently of the USB connection.
Reset Button: Arduino boards feature a reset button that can be used to restart the board and re-run the program.
Integrated Development Environment (IDE): Arduino boards are programmed using the Arduino IDE, which provides a simple and intuitive interface for writing, compiling, and uploading code to the board.
Open-Source: Arduino is an open-source platform, which means that the hardware designs and software libraries are freely available for anyone to use and modify. This has led to a large community of Arduino users who share their projects and collaborate on new ideas.
Overall, Arduino boards are versatile and easy-to-use platforms that are ideal for beginners and experienced makers alike. Their combination of features, affordability, and flexibility make them a popular choice for a wide range of projects, from simple blinking LED lights to complex robotics applications.

2.1.3 Arduino Pinout

- Arduino Uno is based on an AVR microcontroller called Atmega328. This controller comes with 2KB SRAM, 32KB of flash memory, and 1KB of EEPROM. The Arduino Board comes with 14

digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16 MHz frequency crystal oscillator is equipped on the board. The following figure shows the pinout of the Arduino Uno Board

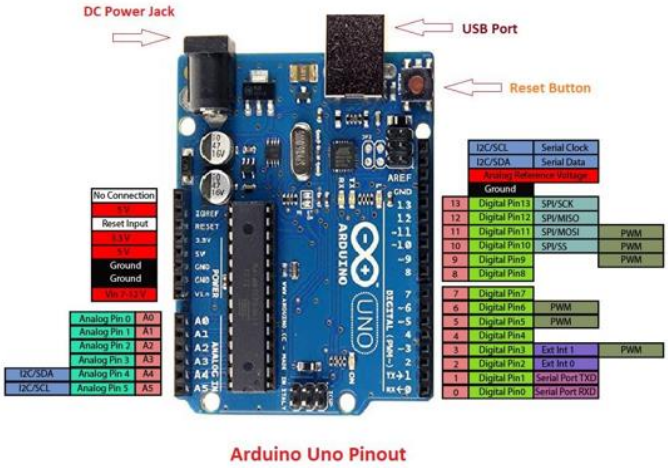
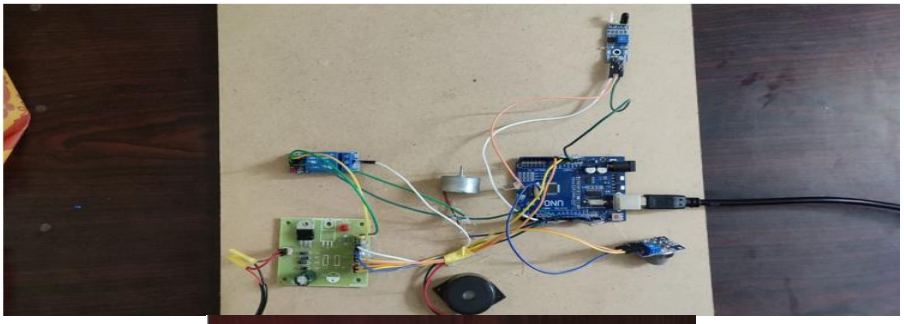
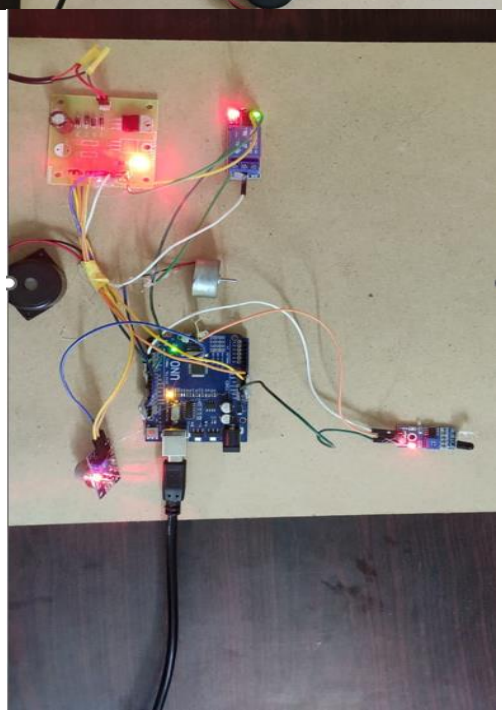


Figure.2. Arduino UNO Pinout diagram

3.Results and Discussion





4.Conclusion

The Smart School Bus Monitoring and Security System represents a significant step forward in enhancing the safety, efficiency, and transparency of student transportation services. Throughout the development and implementation phases, our team focused on addressing key challenges faced by school administrators, parents, and students alike, aiming to create a comprehensive solution that meets the diverse needs of all stakeholders involved in the school bus ecosystem. At its core, the system serves as a proactive measure to mitigate risks and ensure the well-being of students during their daily

commute to and from school. By providing real-time location tracking, emergency alerts, and surveillance capabilities, it empowers school authorities and parents with the tools they need to respond swiftly and effectively to any incidents or emergencies that may arise along the bus route. This proactive approach to safety not only instils confidence in parents but also fosters a culture of accountability and responsibility among drivers and school staff. Moreover, the system goes beyond basic tracking and security features by incorporating advanced functionalities such as route optimization, driver behaviour monitoring, and attendance tracking. These capabilities not only streamline operational processes but also contribute to cost savings, resource optimization, and overall efficiency gains for school transportation departments. By leveraging data analytics and reporting tools, administrators can identify areas for improvement, optimize routes, and make data-driven decisions to enhance the quality and reliability of student transportation services.

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