Smartride: The Next-Gen Bus System

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Abstract—Detecting bus overload is important for securing safety and efficiency in public transportation. The proposed system aims to develop an overload detection and alert system for public transit. This study looks at using infrared sensors and passenger counting systems to observe the load levels on the bus in real time continuously. When a bus overload is detected, the data collected from these systems can give an alert to the drivers and control centers. By working in IoT technology, continuous monitoring and immediate response mechanisms are provided, supporting passenger convenience, protecting the bus from wear and tear, and ensuring the buses are managed effectively. Furthermore, the implementation of MQ3 and MQ2 sensors for detecting alcohol intake and smoking by drivers further assists passenger safety. These sensors transmit information about impaired driving conditions, allowing for quick intercession to maintain a secure and healthful environment on the bus. And using the GPS module, the passenger at the next bus stop can be aware of the number of available free seats in the forthcoming bus, and this improves efficiency and planning. The efficient overload detection and driver behavior monitoring systems, Seat Forecasting, collectively provide safer and more reliable bus services, thereby increasing passenger satisfaction and trust.

Keywords: Public Transport Overload Detection, Monitoring Driver Behaviour, Monitoring Real-Time Passengers, IoT in Public Transportation, Alert System.

1 Introduction

In public transportation, ensuring safety will ensure the passenger's satisfaction and trust. Recognizing the importance of this challenge, this study initiates the development of the overload detection and the alert method in public transportation. Detecting the load levels is one of the important goals. In the real-time detection of load levels,

The use of infrared sensors and the passenger counting system is central to this effort. When the sensor detects the overload in the transportation, this system informs or notifies the drivers, and when the driver crosses the overload limit, the information will pass to the nearby control centers. This helps to reduce the potential safety risk. Using IoT technology, the system allows continuous monitoring and immediate response. This is to embellish passenger comfort and safety. Additionally, the integration of MQ3 and MQ2 sensors further augments passenger safety by detecting instances of alcohol consumption. and smoking by drivers Furthermore, the inclusion of MQ3 and MQ2 sensors was used to detect alcohol consumption and smoking by the driver, and these two sensors were used to monitor the driver's behavior. This helps in passenger satisfaction and trust. And using the GPS module, hence it tracks the real-time data, the waiting passenger at the next bus stop can be aware of the number of available free seats in the forthcoming bus, and this improves efficiency and reduces uncertainty.

This approach helps to identify the faulty driving conditions. This maintains the safety and the healthy environment on board the bus. Eventually the combination of effective overload detection and monitoring of the driver behavior networks. This network aims to encourage safer and more reliable bus services. Therefore, increasing the passenger trust and satisfaction in public transportation.

2 Literature Survey

In the existing scenario there is no overload monitoring system in the public transportation system, and also there are no appropriate alcohol detection and smoke sensing systems adopted in the bus [1]. The traditionally available system in other modes of transport is also with low accuracy, and the system maintenance is becoming difficult. There is a new method for detecting the load levels using a non-contact multi-sensor fusion approach. To collect the temperature and sound data from passing trucks, there will be usage of infrared cameras and sound sensors. This data is simplified using Principal Component Analysis (PCA). [2]

Recently, many countries have been facing traffic accidents because of driver behaviour [3]. In that study, they have monitored the driver's behaviors by using various sensors, which are connected to a device with an ODB II port; through that mechanism, the data is sent to the control censer, and thereby, viewing their actions accordingly, the system will predict whether the driver is drunk or smoking while driving, and this testing was done on the Honda Civic to detect 18 dangerous driving behaviors. [4] Smoking causes many health issues. Drivers are smoking while driving; to avoid this, here is a Hear Smoking system that will detect if the person is smoking; it will automatically sense and insist the driver stop smoking [5]. Hear-smoking is a system that detects smoking while driving through the movement of the hand and chest based on their action; the data is processed by CNN, through which the user can detect whether the driver smokes or not. [6].

There is a system to alert the drivers and the authorities about drunk drivers. In the current system, there is a delay in contacting authorities, so the new system uses an alcohol detector to measure the driver's breath. If there is a high alcohol level, an alarm alerts the driver, it displays on the LCD, and it shows warning messages to nearby cars. Also, contact the nearest police station with the drunk driver's location [7].

In many of the places, due to weak legal enforcement, vehicles are overloaded beyond the legal limits, which leads to damage to the roads, economic losses, many accidents, higher fuel consumption, and environmental pollution. To avoid these issues, the Regional Transport Office (RTO) created an effective way to manage issues by counting the incoming and outgoing passengers [8].

The existing system uses a Wi-Fi-based system to estimate the passenger counter. The data on passenger count is used to help them to plan a better transport system [9].

Considering the bad behavior of the driver, the location of the car is planned according to the model at full speed. The mKdV equation is derived from the perturbation method. These play an important role in the change of transportation. [10]

The Internet of Things (IoT) simplifies automation by utilizing various sensors to detect and alert us about issues. By IoT technology, if the vehicle is overloaded, the WiFi weight sensor will detect it; if the overload is ignored, then it alerts the user or owner or the corresponding authority to take necessary action.

3 Existing System

Existing bus overloads were trusted in basic sensors and physical methods, which may miss the accuracy and may lead to some potential risk. Manual control by the drivers and the conductors may lead to human error. Basic sensors might miss the current data and will provide inaccurate ones, and the detection of the overload will be delayed [11]. Overall, the existing systems may not be efficient in overload detection, and it is not much safer for the passenger on the bus. [12-13]. IoT based information transferring is best suited for many applications [14-17].

4 Proposed System

However, the proposed system combines some advanced technologies with the use of infrared sensors and passenger counting for continuously monitoring load levels in the bus. This makes it possible for the fast detection of the load levels and quick alerts to the drivers and the control center. And also, the integration of the sensors to monitor the driver's behavior, like alcohol consumption and smoking detection. And The GPS module allows for real-time monitoring that displays the available free seats to the waiting passengers. Hence, for counting the available vacant seats, we can do this using the sensors. For displaying the available vacant seats to the forthcoming bus stop, there will be the usage of a GPS module. Overall, the proposed system provides an efficient solution for maintaining the safety of public transportation and improving passenger satisfaction and trust and reduces uncertainty.

5 Block Diagram

Fig. 1, shows the block diagram of the proposed system. It consists of various parts like a microcontroller, infrared sensor, alcohol detection (MQ-3 sensor), gas detector (MQ-2 sensor), GSM module, GPS module, LCD display, and buzzer.

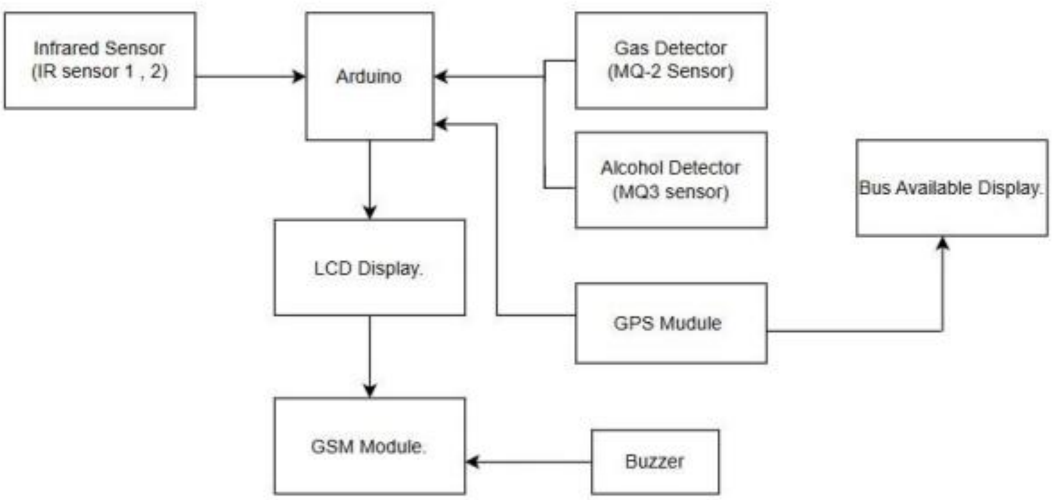


Fig. 1. Block Diagram

The microcontroller acts as the heart of the proposed system; it is connected with various sensors like the MQ-3 alcohol sensor and the MQ-2 smoke sensor. These sensors detect the presence of alcohol and smoke; based on the data gathered from all the connected sensors, the controller processes the information and sends it to the authority through the GSM module attached to the controller. The system also consists of an LCD display and a buzzer for providing the awareness information to the passengers. And there is another system to continuously monitor the number of available free or vacant seats in the transport and send the relevant information to the digital display at the next stop, and this helps the passenger to decide whether to board or wait for the next bus. Sensors (IR, alcohol, gas) continuously monitor the atmosphere and communicate data to the controller. In addition to that, the proposed system also continuously monitors the passenger count through IR sensors; if the predefined seating capacity of the transportation system is exceeded, overloading will be detected, and it will start to provide an alarm through the affixed buzzer. If overloading is not addressed within a stipulated time period of 5 minutes, then the overloading information will be sent to the concerned authority to take necessary action.

6 Circuit Diagram

Fig. 2, shows the circuit connection of the proposed method; it consists of a controller, sensors, a GSM module, a GPS module, an LCD, and a buzzer. Sensors like MQ-2 and MQ-3 are fixed in front of the driver with a distance of 10 inches. IR sensors are affixed at the incoming and outgoing passenger paths of the transportation system.

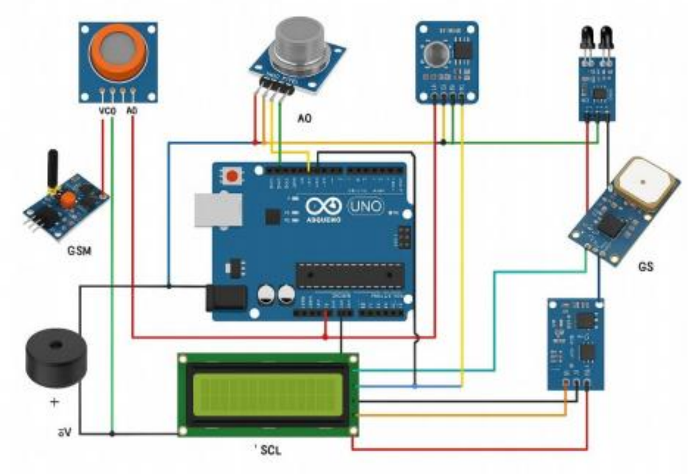


Fig. 2. Circuit Diagram

When a passenger gets into the bus, the counter in the system will increase the count by 1; if the passenger gets down from the bus, it decrements its count by 1. If the passenger count is within the prefixed value, the system works fine; otherwise, the system provides a signal to the buzzer and provides an alert regarding overloading in the bus. According to the Indian public transportation bus system, the average seating capacity is 60; by considering single-deck buses, the passenger capacity varies between 60 and 120. By taking an average weight of 70 to 80 kg per passenger, the proposed system's overloading capacity is determined. Thus, the proposed system detects overloading and the state of the driver monitoring and seat forecasting. The main intention of this method is to provide safety to the passengers without any compromise.

7 Working in Different Modes

The proposed system operates in different modes of operation, like overload detection and driver behavior monitoring, and provides alerts to the authority. The overall experimental setup of the proposed system is shown in Figure 3.

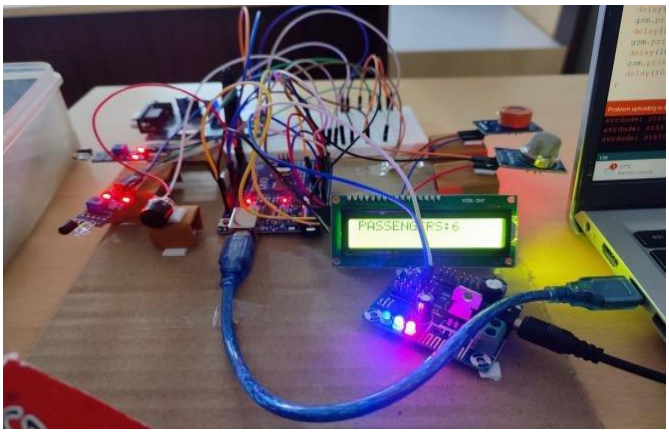


Fig. 3. Experimental Setup

7.1 Overload Detection

In this mode, IR sensors are used to take the number of passengers that are inside the bus. There are two paths in the bus, where one should be dedicated for passenger in and another one should be dedicated for passenger out; at each path IR sensors are fitted, and their outputs are given to a counter that accounts for the passengers in and out data. If that data exceeds its preset value, the system alerts the driver and conductor by ringing the buzzer as an alarm; if they fail to match the loading capacity of the bus as per the predefined value within the next 5 minutes, the information about the bus and overloading capacity details will be sent to the corresponding authority to take necessary action.

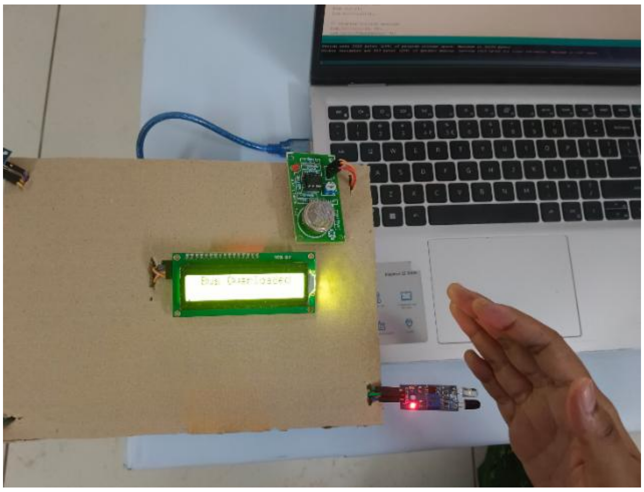


Fig. 4. Overload Detection

Fig. 4, shows the overload detection of the proposed prototype system. This system detects and counts the passengers inside the bus, if the passenger count is more than the pre-set value of the passengers the system will send alert to the nearby Traffic Division, which helps to enhance the passenger's safety. Fig. 4, shows the alert information send to the traffic division.

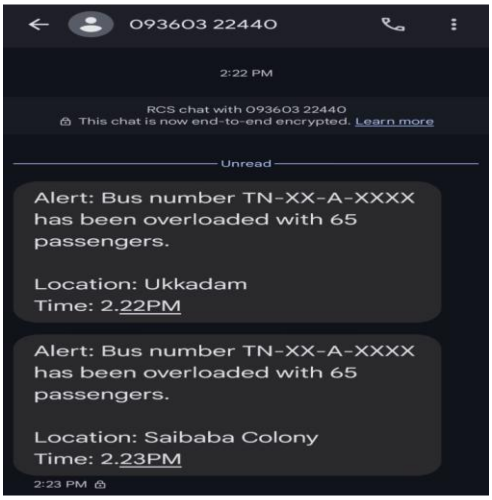


Fig. 5. Alert Information

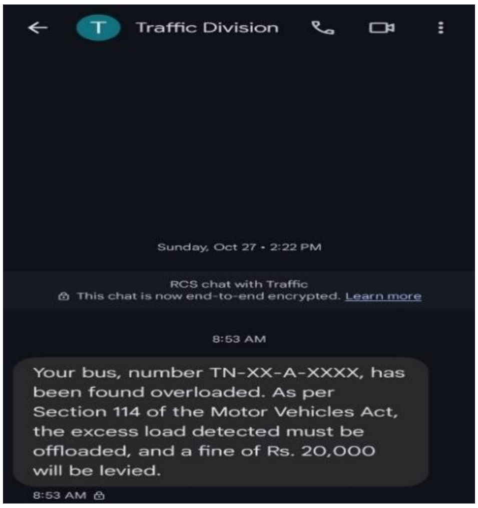


Fig. 6. Penal Notice Message

If the particular bus repeats the overload several times here, it is taken that more than three times, the corresponding bus will be penalized. This notice of information will also be sent to the bus owner. Fig. 6, shows the notice information received by the bus owner from the traffic maintenance division.

7.2 Driver Behaviour Monitoring

In this mode, II driver’s smoking and liquor intake will be monitored. The MQ2 sensor is used to do smoke detection; if the driver is smoking while driving, this sensor will automatically sense and send its corresponding information to the bus owner. Similarly, the MQ3 sensor is used to detect the liquor intake of the driver. This sensor is affixed within 10 inches of the driver. If any liquor intake is detected, the sensor will automatically send the information to the bus owner primarily, and then if it continues, the information will be sent to the traffic maintenance division for further action. Based on the seriousness of the problem, as per legal record, actions will be taken for the benefit of the passenger. Figures 7 and 8 show the information sent to the authority regarding smoke detection while driving.

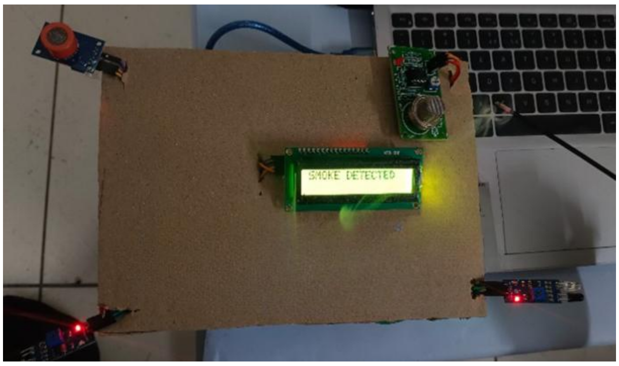


Fig. 7. Smoke detection

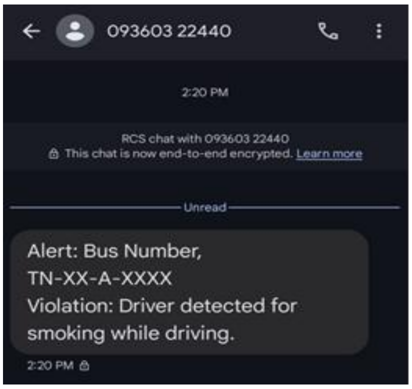


Fig. 8. Smoke detection information

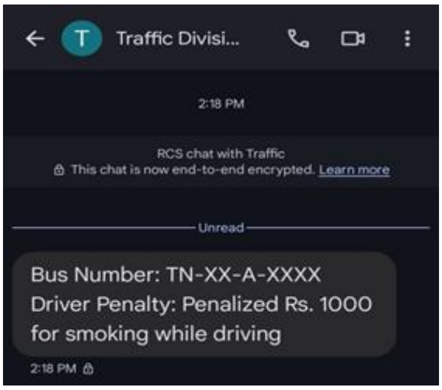


Fig.9. Penalty for smoking

Fig. 9, shows the information sent by the traffic maintenance authority to the bus owner. If the traffic rules are violated even after the information is sent to the owner, if no longer predictive measures are taken by the owner, it will leverage into a penalty, and its corresponding information will be sent to the owner.

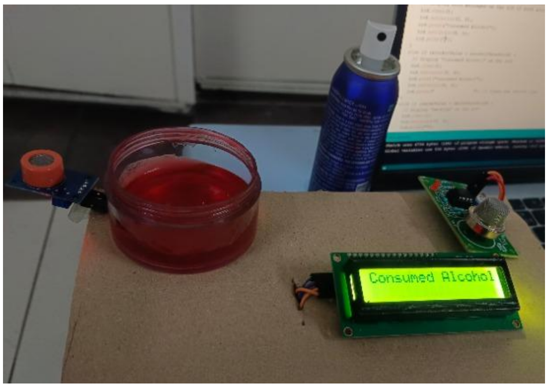


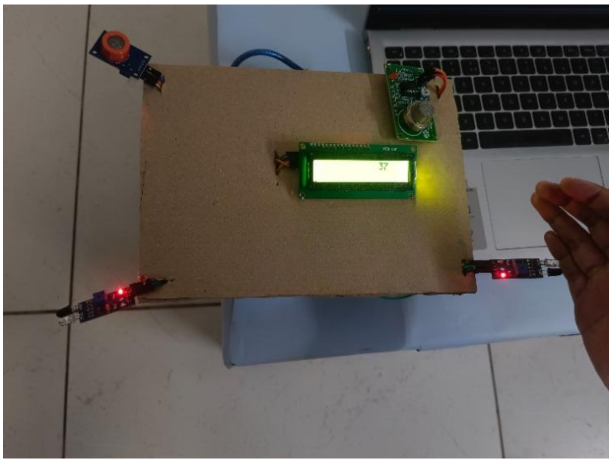
Fig. 10. Alcohol Detection

Fig. 11. Penalty for Drunk and Drive

Fig. 10, shows the alcohol intake detected by the proposed system. Fig. 11, shows the penalty information received by the bus owner for the driver's liquor intake. Similar to smoke detection, liquor intake information will also be sent to the bus owner.

7.3 Passenger Count Detection

In this mode, it shows the available passengers actually inside the bus; the proposed system consists of two infrared sensors (IR) to track the passenger count. There are two paths in the bus for the purpose of inlet and outlet; one should be dedicated to inlet and the other should be dedicated to outlet. The inlet IR sensor increments the passenger count, and the outlet IR sensor decrements the count based on its human detection. The actual number of passengers inside the bus can be readily monitored by the bus conductor at the time. Figures 12 and 13 show the passenger monitoring system before and after the arrival and departure of the passenger.



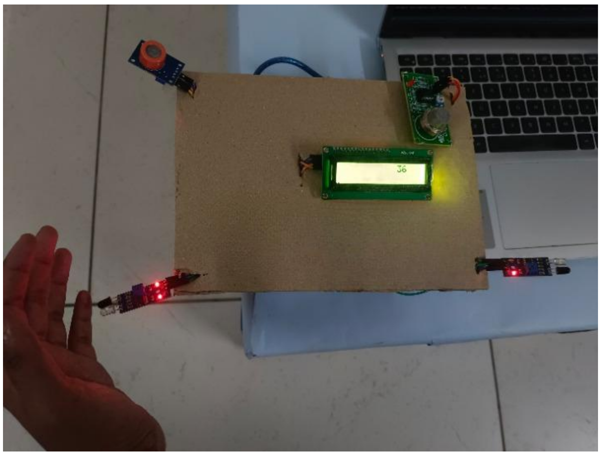


Fig. 12. Passenger Increment

Fig. 13. Passenger Count Decrements

7.4 Real-Time Seat Availability

In this mode, it shows the available free seats inside the bus; the proposed system consists of a GPS module. It is connected with the passenger counting sensor and the display. With the help of the passenger counting sensors, we can know the availability of the free seats in the bus, and the GPS module enables real-time tracking. The available vacant seats data is sent to the forthcoming bus stop.

8 Comparison of Existing and Proposed System

Table 1. Comparison of existing and proposed system based on different aspects.

Aspect	Existing	Proposed System
Over load detection	Relies on basic sensors and manual control, leading to delays and inaccuracies.	Uses advanced infrared sensors and passenger counting for real-time overload detection.
Accuracy	May miss current data and provide inaccurate readings.	Ensures continuous and accurate monitoring, enabling faster detection of overloads.
Human Error	Manual control by drivers and conductors increases error risks.	An automated system reduces human intervention, minimizing errors.
Driver Behavior Monitoring	No monitoring for driver behavior like alcohol consumption or smoking.	Integrates sensors to detect unsafe driver behaviors for enhanced safety.
Safety and Risk	Less efficient in ensuring passenger safety, leading to potential risks.	Provides real-time alerts and continuous monitoring, improving overall safety.
Seats Forecasting	No real-time data or information on bus seat availability, leading to inefficient boarding.	Using the GPS module and on-board sensors for providing the real-time seat availability and updating the data in the forthcoming stops reduces wait times and improves overall passenger experience.

Table 1, shows the feature comparison existing and proposed methodology based on different aspects.

9 Conclusion

Public transport is a primary means of transportation that is commonly accessed and opted for by most of the people. In the case of public transportation, detecting bus overload is important for security, safety, and effectiveness in transportation. The aim of our project is to detect bus overload and create an alert system to ensure the safety of the passengers in public transportation. In this proposed prototype, infrared sensors are used to continuously count the passenger count, from which the load levels on the bus are checked at present. When the overload is detected in the bus, it gives an alarm sound, and when they cross the limits, it gives the alert message to the nearby control centers. and a GPS module for real-time tracing systems for the free seats availability. Continuous monitoring and immediate response mechanisms are provided by the IoT technology, and this technology is used for protecting the bus from wear and tear and ensuring the safety of the bus. The information from the sensors about impaired driving conditions, from which the quick interactions are a mode for a secure and healthful environment on the bus. The overload detection, driver behavior, and seat forecasting are the efficient monitoring systems that collectively provide safer and more reliable bus services, thereby increasing passenger safety, trust, and satisfaction.

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