Vehicle Overloading Challan and Alert System

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***Abstract*— Maintaining road safety and regulatory standards in the quickly changing transportation world of today requires strict adherence to vehicle load restrictions, insurance regulations, and outstanding challans. We offer the "Real-time Vehicle Overload Alert, Insurance Verification, and Chala Status Monitoring System" an inventive solution that makes use of Arduino microcontroller technology to meet this pressing requirement. In order to precisely determine the weight of passing cars, this system uses sophisticated load sensors that are placed strategically along roads. An automatic GSM alarm is sent to the appropriate authorities as soon as a vehicle surpasses its weight limit, allowing for fast intervention and guaranteeing compliance with traffic safety laws. The system uses RFID receivers in addition to load monitoring to provide thorough confirmation of each vehicle's compliance status. In order to identify any outstanding challans or holes in insurance coverage, it seamlessly cross references against databases. The vehicle's current RFID card is smoothly integrated with this real-time verification process, which expedites record keeping and guarantees immediate access to vital compliance data. Our solution provides a thorough and proactive method of improving traffic safety and legal compliance by combining these elements. In addition to offering real- time insights, the smooth integration of load sensors, Arduino microcontrollers, GSM technology, and RFID verification makes it possible to monitor vehicle compliance effectively and precisely, greatly lowering the risk of accidents and legal infractions. We hope that this project will help create a more secure and controlled transportation environment, which will ultimately result in fewer collisions, safer roads, and better traffic control in general**

Keywords: **Load sensors, Arduino Microcontroller, GSM, RFID reader, Power Supply, Display module**

I. INTRODUCTION

Real-time weight monitoring is emphasized in studies on vehicle overload detection systems in order to keep overloaded cars off the road. The usage of IoT devices for traffic data gathering and safety measures is investigated in research on smart transportation systems. Automated insurance verification systems improve traffic safety and legal compliance by utilizing data analytics and RFID technologies. Challan monitoring systems track and handle pending violations using RFID Among the most significant concerns with classical electronic voting systems is electronic voting systems is that they are built on cards and database administration. For data accessibility and integrity, effective data administration and storage including the usage of RFID cards is crucial.

Alert systems based on GSM have been used for emergency notifications and vehicle monitoring. Automation in traffic management is thought to increase traffic efficiency, minimize human error, and optimize resource allocation. It is often known how important road safety and compliance are to lowering accident rates and preserving a smooth traffic flow. The capabilities of the suggested system are greatly increased by technological developments in sensors, microcontrollers (like Arduino), and the Internet of Things. Recurring themes include cost savings and efficiency, with automation lowering labor expenses and opening the door to higher revenue through better enforcement. By combining several technologies and approaches, the project tackles current issues in road safety and traffic management while also keeping up with current research trends.

II. LITERATURE REVIEW

IoT-based solutions for accident alerts and vehicle overloading detection are suggested in a number of research articles. In "IOT BASED VEHICLE LOAD BALANCING & ACCIDENT DETECTION," Ashwini Gulhane et al. (2019–2020) created a system that uses vibration and load sensors, a webcam, and an Android app for administrator notifications. Similarly, in their work "Vehicle Overloading Detection and Protection using Raspberry Pi and IOT Application," Mr. Shardul Singh Gurjar and Dr. Ravi Mishra (2019) concentrated on detecting overloading by utilizing a Raspberry Pi to calculate payload against regulatory limitations. Mohamed Abdulwahab Mortada et al.

"An IoT Monitoring Design System of Road Overload Vehicles Based on Raspberry Pi," published in 2020, describes a low-cost IoT wireless monitoring system that detects overload, takes pictures, and stores data using a Raspberry Pi and camera. In "Design and development of automatic vehicle overload control system," Bhagwat Dayal & Gezahegn Tibebu (2022) focused on developing a load cell-based automatic overload control system for trucks. Dharmadurai P. Leon et al.

load cells and an IoT system with a fuel cutoff mechanism in "AVOID OVERLOADING IN TRUCK USING IOT WITH FUEL CUTOFF," published in 2021, to stop trucks from overloading. In "Design of overloading detection systems on vehicles using adruino," M Z Rohim et al. (2021) created an Arduino- based system for overload detection and alarms in real time. Last but not least, in "Vehicle Overloading: A Review," Anusha Gaira et al. (2020) offered a thorough analysis of the current vehicle overloading detection techniques and the issues they raise.

Together, these publications describe a variety of Internet of Things (IoT)-based systems that use sensors, microcontrollers, and mobile apps for real-time monitoring and notifications in order to detect vehicle overloading and accidents. These initiatives, which seek to improve safety and stop infrastructure damage, frequently struggle with controlling environmental conditions, maintaining reliable connectivity for their alarm systems, and attaining dynamic load sensing accuracy.

III. IMPLEMENTATION OF THE SYSTEM

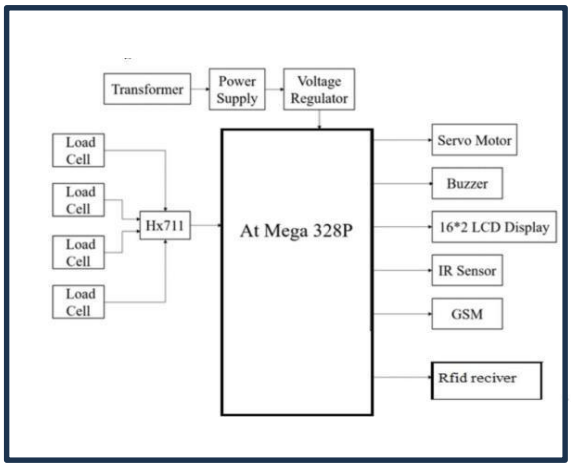


Fig. 1 Block diagram of the proposed system

The block diagram for the Vehicle Overloading challan and alert system includes Transformer, Power Supply, Volatage Regulator, Load Cell, Buzzer, H6117(24 bit ADC), Microcontroller, GSM, Display, RFID reader, RFID Vehicle Card.

Transformer: An essential part of the system, the transformer's primary function is to reduce the high mains voltage to a level that is safe and suitable for the electronic components that are included into the system. The transformer guarantees that the entire system functions within safe electrical parameters by scaling down the voltage. This procedure is crucial for protecting the electronic component and averting possible system harm likely to manage voltage requirements for powering high-energy components.

Power Supply: The power supply, which gives the electronic components a steady and controlled power source, is essential to the system's operation. It is in charge of making sure that a steady and dependable power supply is available to power the many system components. The load cell, microprocessor, and other essential parts depend on this steady power source to function dependably and continuously. It serves as a defense against any malfunctions brought on by variations in voltage or anomalies in the power supply.

Voltage Regulator: A crucial component that guarantees the voltage sent to the load cell stays steady despite variations in the mains voltage is the voltage regulator. Because it ensures that the load cell receives a constant voltage supply, its regulating function is crucial. Road safety is greatly enhanced by the steady voltage, which is essential for precise weight readings and the trustworthy identification of vehicle overloads.

Load cell: One of the most important sensors in the system is the load cell. It is in charge of determining the vehicle's load weight. The information produced by the load cell is essential for figuring out whether a car is overloaded and is essential to the system's capacity to improve traffic safety. Achieving the project's objectives depends on the load cell's accuracy and precision.

Buzzer: An essential component of the system's alarm system is the buzzer, an auditory alerting device. The buzzer is activated and emits a

characteristic sound or alarm when the system determines that a vehicle is overloaded. Because it functions as an instantaneous, on-site alarm mechanism, this auditory input is an essential component of the system. When an overload scenario arises, the buzzer's loud and noticeable design guarantees that the proper authorities or personnel are notified right away, allowing for timely and suitable action to reduce safety hazards.

H6711(24 bit ADC): The load cell's analog output signal is converted into a digital format by the H6711, a 24-bit analog-to-digital converter (ADC) built within the system. Because it makes it possible to measure the weight of the vehicle's load precisely and accurately, this conversion procedure is crucial to the system. By converting the analog output of the load cell into a digital signal, the H6711 makes sure that the microcontroller of the system can process and understand the data effectively. Accurate weight readings and overload detection are made possible by the 24-bit ADC's high precision and resolution.

Atmega328P: As the system's central processing unit (CPU), the ATmega328P acts as its "brain." It is essential to managing and coordinating the system's overall functioning. Data from several sources, such as the load sensor, RFID reader, and GSM modem, must be gathered and managed by the microcontroller. Because of its adaptability and programmability, it is essential to the system's efficient operation. The system's response to changing situations, such overload detection, is ensured by the microcontroller's ability to interpret. data and execute commands. It also enables the timely execution of particular activities, like sending alerts or setting off alarms.

Display: The system's display component acts as a user interface, giving users visible access to pertinent data, like the vehicle's weight. It is an essential component of the system's feedback and user interaction system. Users, operators, or authorities may readily monitor and confirm the weight of the load on the vehicle thanks to the display's capacity to present weight measurements and status information in a human- readable format. The system's goals of improving road safety and compliance.

GSM Module: The main purpose of the GSM module, a communication device built into the system, is to allow the system to notify the owner of the vehicle or authorized authorities via SMS when an overloaded vehicle is identified. This ability to communicate guarantees that the matter can be addressed quickly and appropriately. The module enables real-time warnings and notifications by connecting the system to the cellular network. One essential component that improves the system's capacity to react to overloading situations and uphold traffic safety is its capacity to send messages and data via GSM (Global System for Mobile Communications) technology.

RFID Reader: An essential part of the system is the RFID reader, which reads the RFID tag on the car's registration document. The entrance point for obtaining and accessing crucial vehicle-related data is this reader. Here, RFID technology plays a key role in improving compliance and expediting data verification procedures. The reader's capacity to read the RFID tag facilitates quick and precise data retrieval, which helps the system verify the insurance status and car registration. Reducing the need for manual verification and increasing the general effectiveness of administrative procedures depend on this feature.

Vehicle RFID card: An essential component of the system's data management and verification procedures is the vehicle RFID card, which is a data storage card. The system can access and validate the stored data by using the RFID reader to read the RFID tag on this card. This data storing technique offers a dependable and effective way to verify important vehicle details while also enhancing the system's data accessibility and openness. The system's capacity to accomplish precise data verification and expedite administrative procedures is improved by the use of RFID technology for vehicle information storage.

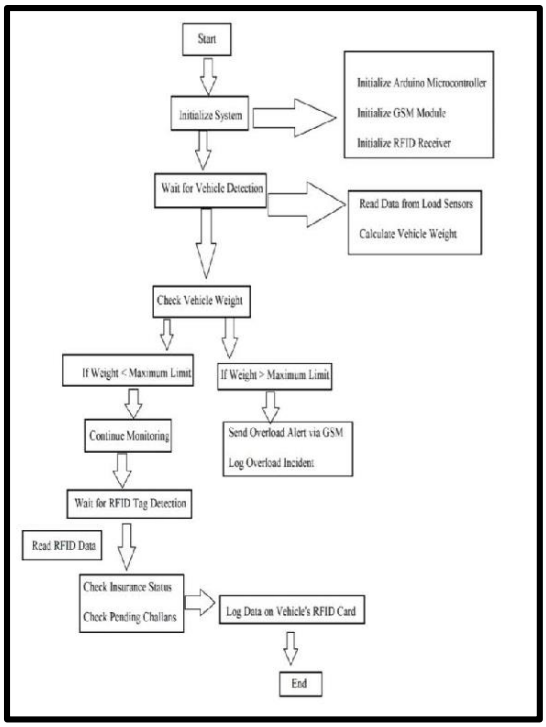


Fig. 2 Flowchart of Vehicle Overloading Challan and Alert System

Using components based on microcontrollers, the flowchart shows how an autonomous vehicle monitoring and management system operates. The Arduino microcontroller, GSM module, and RFID receiver are among the important hardware components that are initialized at the start of the system. After initialization, the system reads data from load sensors to determine the vehicle's weight after waiting for vehicle detection. The car continues to be monitored and waits for the RFID tag to be detected if its weight is within the permitted range. It reads the vehicle's RFID data after detecting it, verifies the insurance status, and looks for any outstanding challans.

After that, this information is recorded on the car's RFID card. Before moving on to the RFID verification and data logging procedures, the system files the overload occurrence and sends an overload alarm through the GSM module if the vehicle weighs more than the allowed amount. The procedure improves the effectiveness of traffic control and vehicle monitoring by guaranteeing adherence to weight restrictions and the validation of legal papers.

System Initialization: The first step in the procedure involves turning on and configuring the Arduino microcontroller, GSM module, and RFID receiver so they are prepared for data processing and communication.

Vehicle Detection Phase: The system waits for a vehicle to be detected after initialization. The system measures the weight of the vehicle after detecting it by reading data from load sensors positioned on the platform or on the road.

Weight Verification: Using the load sensor data, the system determines the vehicle's weight and determines if it is within the permitted maximum limit.

The system continues to monitor the car continuously and waits for the vehicle's RFID tag to be detected if its weight is within the limit.

An overload alarm is instantly transmitted to a specified authority or database via the GSM module if the vehicle's weight surpasses the limit. The overload occurrence is also recorded for documentation purposes and maybe for the purpose of imposing sanctions.

RFID Tag Processing: The system reads the RFID data, which usually includes vehicle-specific information, when the vehicle weight falls below the maximum limit and the RFID tag is identified

Verification of Insurance and Challans: The system verifies the vehicle's insurance status and any outstanding challans (traffic fines) after reading the RFID data. This is crucial to guarantee that the car complies with all applicable laws and traffic laws.

Data Logging: For future reference and tracking, all pertinent data, such as weight, insurance status, and challan data, is recorded onto the vehicle's RFID card. Process End: The system completes the logging and monitoring procedure, preparing to start the cycle over for the subsequent vehicle that is detected.

IV. RESULT AND DISCUSSIONS

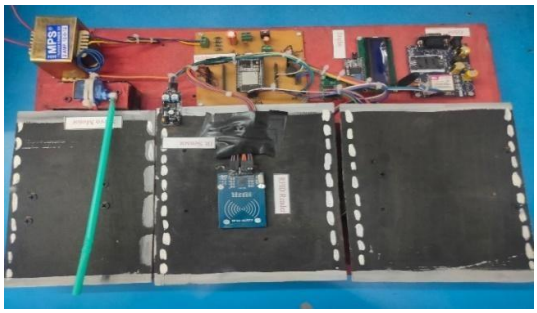
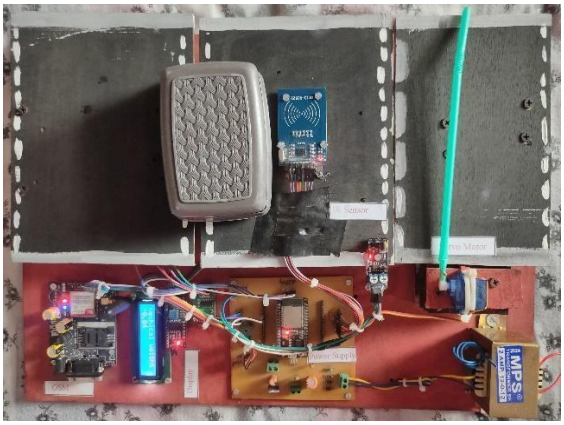
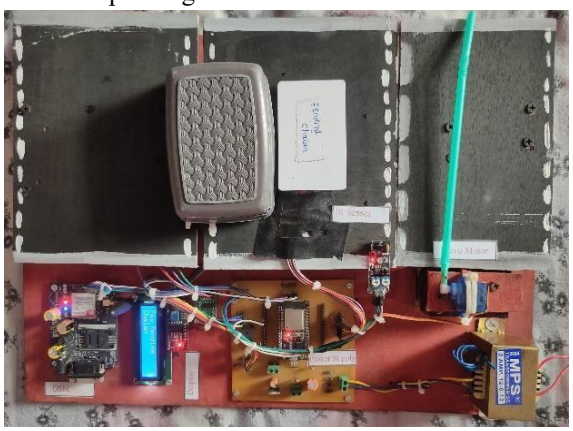


Fig. 3 Fanal Result

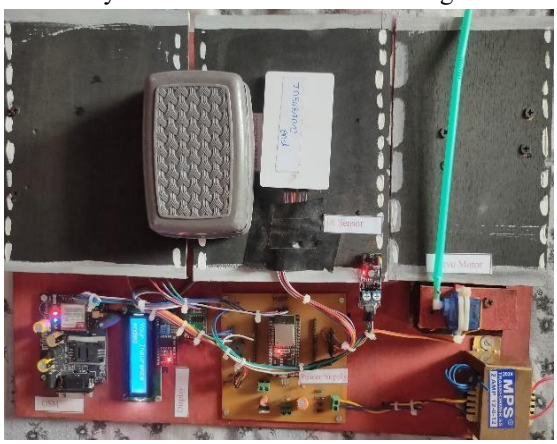
When system displays the weight:
The system is actively measuring and displaying the vehicle's current weight on the LCD screen when the display indicates the weight. The process starts here, when the car crosses the weighing platform and the machine records its weight. The system's current focus is on precisely determining the vehicle's weight without rendering any conclusions or issuing challans. Both the driver and the monitoring staff receive real- time weight information from it, which is crucial for making subsequent decisions about overloading or compliance.



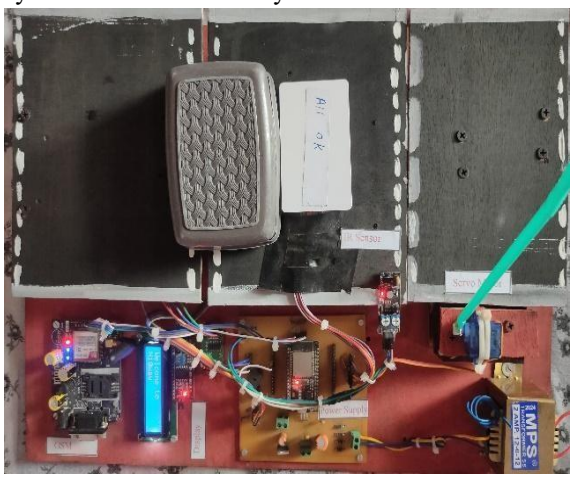
Pending challan condition:
If pending challans are detected by the system, the LCD displays the message "Pay Pending Challan." This suggests that there are unpaid penalties for earlier infractions. Before continuing, the car owner must pay off these outstanding debts. To guarantee prompt payment and enforcement, the GSM module may also notify the car owner or traffic authorities about the pending challan.



End insurance:
The vehicle's insurance has expired or is no longer valid when the system shows "Insurance End" on the LCD. The technology detects that the vehicle is not legally permitted to be driven in this condition in accordance with regulatory standards. A challan is created instantly, and the vehicle owner or the appropriate traffic authorities are probably notified by the GSM module. In order to keep the car from moving forward until the insurance problem is fixed, the servo motor barrier might also stay closed. Before permitting the car to proceed, this guarantees road safety and adherence to insurance regulations.

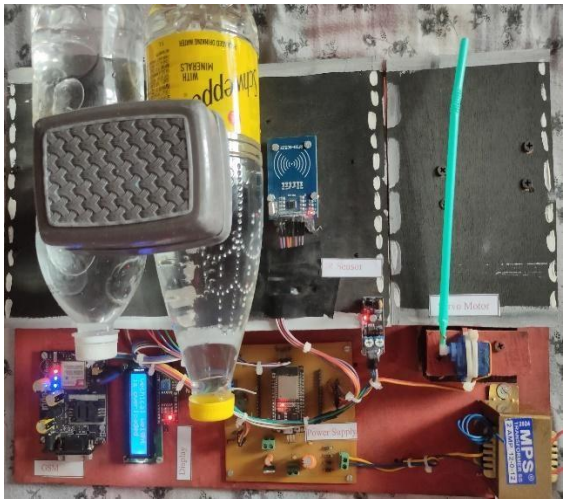


All ok condition:
The LCD shows the message "All OK." when the system determines that the vehicle weight is within the allowed range. The vehicle is permitted to pass without incident in this situation, and no fine or challan is created. The barrier stays open, signifying that the car complies with the weight restrictions and that neither the driver nor the system need to take any more action.



Vehicle overloaded:
The LCD reads "Weight Overload" when the system detects overloading that exceeds the allowable limit. This immediately causes a challan to be generated, informing the driver and the authorities of the infraction. The servo motor may automatically close the barrier to prevent the vehicle from moving until remedial action is done

after the GSM module sends an SMS alerting the driver of the overload.



V. CONCLUSION

One of the most important innovations in contemporary transportation management is the Vehicle Overloading and Alert System. Road safety, vehicle integrity, and public infrastructure are all seriously threatened by overloaded cars. When weight limits are exceeded, this technology offers a real-time way to monitor, identify, and notify drivers or authorities. It guarantees precise and timely alerts by combining technologies like sensors, GPS, and data transfer. It helps enforce legal weight regulations, reducing the chances of road accidents and mechanical failures. The method also helps to keep roads and bridges from wearing out too soon, which reduces maintenance costs and increases the lifespan of infrastructure.

Additionally, the technology helps law enforcement authorities carry out mobility policies in an efficient manner. Fleet operators gain from reduced legal penalties and increased operational efficiency. By allowing drivers to take prompt corrective action, the alert mechanism encourages safer driving and load management techniques. Planning and optimization benefits from integration with data analytics and vehicle tracking solutions. All things considered, the Vehicle Overloading and Alert System encourages conscientious logistics, backs sustainable growth, and helps create safer, more intelligent transportation systems.

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