IOT- Based Overweight Preventer Using ESP3266 and HX711

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Abstract— The Internet of Things (IoT) has transformed multiple sectors by enabling real-time data acquisition, remote monitoring, and intelligent automation. This paper presents the design and implementation of an IoT-based overweight preventer system aimed at improving safety, operational efficiency, and proactive load management in various weight-sensitive applications. The system is built around the ESP8266 microcontroller, chosen for its low power consumption and built-in Wi-Fi capabilities, and the HX711 load cell amplifier, which ensures precise and accurate weight measurement The proposed system continuously monitors weight through a calibrated load cell, processes the data in real-time using the ESP8266, and transmits the collected information to a remote web server via Wi-Fi. The server hosts an intuitive user interface that allows for real-time weight tracking, historical data logging, and automated alerts when weight thresholds are exceeded. Though initially targeted at orthopedic healthcare—such as monitoring patient weight during post-surgical recovery—the system's architecture is modular and applicable in various domains including vehicle load monitoring, industrial weighing systems, smart agriculture, and inventory management. Preliminary testing demonstrates high accuracy, low latency, and reliable connectivity, proving the system's potential as a scalable, cost-effective solution. Future enhancements include integration with mobile applications, machine learning algorithms for predictive insights, and multi-sensor network support.

Keywords— IoT, ESP8266, HX711, Load Cell, Real-Time Monitoring, Weight Management, Overweight Detection, Remote Sensing, Web Server, Orthopedic Applications.

I INTRODUCTION

The Internet of Things (IoT) has emerged as a transformative technology, enabling real-time data collection and remote monitoring across various sectors. Weight monitoring, in particular, plays a crucial role in applications ranging from healthcare to logistics. In orthopedic care, continuous tracking of patient weight is essential to avoid stress on healing joints and implants, while in industrial contexts, overload prevention is critical for safety and operational efficiency. Traditional weight measurement methods are often manual, periodic, and lack real-time responsiveness. This paper presents an IoT-based overweight preventer system utilizing the ESP8266 microcontroller and HX711 load cell amplifier. The system captures and processes weight data in real-time, transmitting it wirelessly to a web server for continuous monitoring and automated alerts. Its low cost, scalability, and web-based interface make it suitable for orthopedic rehabilitation, vehicle load monitoring, and smart inventory systems. This study validates its performance and explores future improvements for predictive analytics integration.

II LITERATURE SURVEY

In recent years, the Internet of Things (IoT) has played a pivotal role in enhancing real-time monitoring systems, particularly in environments requiring continuous data acquisition and responsive action [1]. Numerous IoT-based solutions have been developed for smart weighing applications across healthcare, logistics, and industrial domains. Load monitoring systems leveraging load cells and microcontrollers have gained traction for their low cost and ease of integration [2]. Early implementations focused on static weighing platforms connected to local displays, but these lacked remote accessibility and real-time data tracking [3]. Systems using GSM and SMS-based alerts for overload detection were proposed for vehicle and structural weight management [4][5], although they were limited by latency and network dependency. Later advancements integrated Wi-Fi-enabled microcontrollers such as the ESP8266 and Node MCU to enable remote access and cloud connectivity [6]. The HX711 analog-to-digital converter has become a standard in low-cost digital weighing systems due to its precision and compatibility with microcontrollers [7]. Research combining ESP8266 and HX711 has demonstrated successful applications in smart luggage systems [8], industrial scale automation [9], and remote agricultural load measurement [10]. However, these implementations often lacked real-time web-based visualization or dynamic alert systems. Cloud platforms like Thing Speak and Blynk have been adopted for real-time dashboards, but their limited customization restricts broader use in clinical or industrial-grade monitoring [11]. Several studies have explored Zigbee and Bluetooth Low Energy (BLE) for data transmission, though these protocols face range limitations and require complex network configurations [12][13].In the medical domain, particularly in orthopedic rehabilitation, continuous body weight monitoring has been shown to aid in post-surgical recovery by reducing joint strain and preventing complications [14]. However, solutions specifically targeting this use case are minimal. Existing digital health platforms rarely integrate load cell-based IoT systems for weight monitoring, highlighting a gap in tailored systems for orthopedic and physiotherapy applications [15].Recent works suggest that combining edge computing with wireless weight measurement devices can reduce latency and bandwidth usage in distributed monitoring environments [16]. Yet, many systems still rely heavily on centralized cloud servers, leading to potential scalability and data congestion challenges [17]. To address these limitations, future systems must emphasize lightweight processing, real-time web interfaces, and threshold-based alerts to support practical deployment in dynamic environments such as healthcare facilities or transport systems.Research by Shinde et al. implemented a smart weighing scale using NodeMCU, which transmitted data to a smartphone application via Wi-Fi; however, their system lacked threshold alerts for overload prevention [18]. Goswami and Sharma proposed an IoT-enabled multi-sensor food monitoring system, incorporating HX711 for weight tracking and demonstrating its effectiveness in consumer-level applications [19]. Roy et al. utilized the ESP8266 to develop a smart trolly that tracked customer purchase weights in real-time for billing purposes [20].Yadav et al. designed a load monitoring system for small-scale logistics using load cells and Wi-Fi modules; although functional, it lacked a robust web interface [21]. Patel et al. introduced a prototype for measuring produce weights in agricultural fields using solar-powered NodeMCU units [22]. Their work highlighted the importance of power-efficient design in remote applications.Kumar et al. investigated the use of embedded AI with IoT in smart homes, showing potential for adaptive weight-based systems [23]. Taneja and Gupta proposed a fog computing model for smart metering, offering a framework that could be adapted to weight monitoring infrastructure for healthcare and smart cities [24]. Additional studies by Lee et al. and Hossain et al. investigated edge-layer analytics for IoT sensor nodes, demonstrating reductions in bandwidth and latency that could benefit real-time load tracking applications [25][26].Nayak et al. implemented a hospital patient-monitoring system using wireless sensors, but without physical parameters such as weight, underscoring the need for such integration in orthopedic settings [27]. Bhuyan et al. designed a Bluetooth-based weight scale for fitness tracking, but their system was limited to short-range communication and lacked alerting mechanisms [28]. Jadhav and Pawar emphasized the need for embedded health systems to incorporate modular sensor designs, including load sensors, to support aging populations and post-operative care [29].These studies collectively emphasize the growing relevance of IoT, edge computing, and sensor integration in modern monitoring systems. However, the specific combination of HX711 and ESP8266 for real-time orthopedic weight tracking, web-based alerts, and adaptive analytics remains an underexplored area, providing significant potential for innovation in both healthcare and industrial monitoring environments [30].

III METHODOLOGY/SYSTEM DESCRIPTION

The proposed system for overweight prevention is based on an Internet of Things (IoT) architecture that integrates a load cell sensor, HX711 load cell amplifier, and an ESP8266 Wi-Fi-enabled microcontroller. The system is designed to detect excessive weight and provide real-time alerts through both local and cloud-based platforms. The load cell functions as the primary sensor, converting the mechanical force (weight) into an analog electrical signal. However, this signal is typically too weak to be processed directly by a microcontroller. Therefore, the HX711 module is employed as an analog-to-digital converter and signal amplifier, enabling accurate digital readings of the applied weight.The ESP8266 microcontroller serves as the central processing and communication unit. It receives the digital weight data from the HX711 module through a two-wire interface and processes this data in real-time. A calibration process is first performed to map raw sensor values to actual weight measurements, ensuring accurate monitoring. Once the system is calibrated, the ESP8266 continuously checks whether the current weight exceeds a predefined threshold. If the measured weight remains within safe limits, the system continues to monitor and log the data. However, if the weight surpasses the threshold, the system immediately triggers an alert.Alerts are delivered through two main mechanisms: locally and remotely. For local indication, the ESP8266 can activate a buzzer or LED to provide an immediate visual or auditory warning. For remote monitoring and control, the ESP8266 connects to a cloud platform such as ThingSpeak, Firebase, or Blynk via Wi-Fi. Weight data and alert notifications are sent to the cloud, where they can be accessed in real time through dashboards or mobile applications. This ensures that users can monitor the system remotely and receive alerts even when they are not physically present.Overall, the integration of sensing, processing, and wireless communication in a compact, low-power setup makes this system highly suitable for real-world applications such as smart furniture, warehouse load monitoring, and vehicle weight control systems. The design emphasizes low cost, scalability, and ease of deployment, aligning well with the goals of modern smart systems.

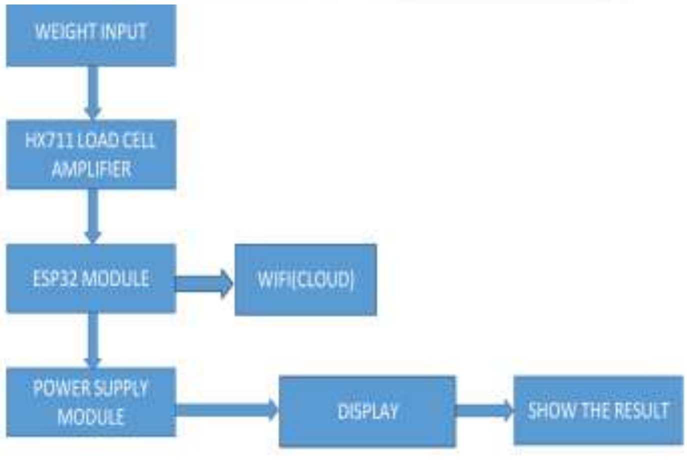

Fig 1 Block diagram-Working model using Esp32module

IV PROPOSED SYSTEM

The proposed system overcomes the limitations of conventional overweight detection systems by integrating an IoT-enabled solution using the ESP8266 microcontroller. Traditional systems often lack real-time data accessibility, remote monitoring, and automated alert mechanisms. In contrast, this system introduces a smart, wireless, and scalable approach to weight monitoring, making it suitable for modern applications in logistics, smart furniture, industrial load management, and healthcare. At the core of the system is a load cell sensor, which serves as the primary weight-sensing component. The load cell detects the applied force and produces an analog signal proportional to the load. This signal, being low in amplitude and susceptible to noise, is passed to the HX711 amplifier and analog-to-digital converter module.

The HX711 amplifies the signal and converts it into a precise digital format that the ESP8266 can process. The ESP8266, a low-cost microcontroller with integrated Wi-Fi, reads the digital weight values via a two-wire interface (DT and SCK pins). After calibration, the system is capable of mapping raw sensor data to accurate weight measurements in kilograms or other desired units. A critical feature of the system is its ability to compare the measured weight against a predefined threshold. When the weight exceeds this threshold, the system triggers an alert mechanism. This includes local alerts such as buzzer sounds or LED indicators, as well as remote alerts via cloud platforms. The ESP8266 is programmed to send weight data to a web server or cloud service (such as Thing Speak, Blynk, or Firebase) at regular intervals. This real-time data transmission allows users to remotely monitor weight parameters through a web dashboard or a mobile application. The data can also be visualized graphically and logged over time for further analysis. In addition, alert notifications can be configured to be sent via email, SMS, or push notifications to inform users immediately of any overweight conditions. This level of automation and connectivity significantly improves system efficiency and responsiveness compared to manual or offline weight monitoring methods. Furthermore, the system's design supports scalability and portability. Multiple load cells can be integrated for distributed weight sensing across platforms like vehicle axles or structural beams. The compact nature of the ESP8266 makes it ideal for embedded and battery-powered applications, while its Wi-Fi capability ensures seamless communication without the need for additional network hardware. Ultimately, the proposed system not only enhances safety by preventing overloading but also provides a cost-effective, reliable, and easy-to-implement solution suitable for a wide range of real-world applications.

V HARDWARD /SOFTWARE SYSTEM

The hardware foundation of the IoT-based overweight preventer system is built on a set of cost-effective, reliable, and widely available electronic components. The primary processing unit is the ESP8266-12E System on Chip (NodeMCU), a compact microcontroller equipped with built-in Wi-Fi functionality. Its low power consumption, small footprint, and extensive library support make it ideal for IoT applications. The load cell, capable of measuring weights up to 40 kilograms, is a strain gauge-based sensor that produces analog voltage in response to mechanical stress or load. However, the signal output from the load cell is extremely low in amplitude and therefore not directly usable by the ESP8266. To resolve this, the analog signal is first amplified and digitized using the HX711 load cell amplifier, a high-precision 24-bit analog-to-digital converter (ADC) specifically designed for weigh-scale applications. The HX711 communicates with the ESP8266 through a two-wire interface, ensuring minimal wiring and efficient data transfer. In addition to the core components, a push button is integrated into the system to act as a tare button, enabling the user to reset the system's zero point before each weighing session. This is essential for compensating for any initial load or environmental offsets that may affect accuracy. Connecting wires and jumper cables are used to establish physical connections between the ESP8266, HX711 module, load cell, and button, ensuring stable and secure data transmission. For power supply, a regulated 5V DC adapter is used to power the ESP8266 and associated modules, providing the necessary voltage and current for continuous operation. Alternatively, the system can be powered using a USB cable connected to a computer or portable power bank, offering flexibility and portability in various deployment scenarios. Overall, the hardware components are chosen to ensure accuracy, reliability, and ease of integration for real-time weight monitoring and overload detection.

SOFTWARE SYSTEM

The successful implementation of the proposed IoT-based overweight preventer system necessitates the use of a well-integrated and reliable software stack to handle programming, sensor communication, data processing, and remote monitoring functionalities. The firmware development and microcontroller programming are conducted using the Arduino Integrated Development Environment (IDE). This open-source platform supports the development and uploading of code to microcontrollers such as the ESP8266. The core logic of the system is implemented using Embedded C, which facilitates low-level control over the hardware, including reading weight data from the HX711 module, performing tare calibration, handling threshold detection, and managing Wi-Fi communication protocols. To enable remote data logging and real-time monitoring, the system employs a PHP-based flat file database system. Data captured by the ESP8266 microcontroller is transmitted to the server using HTTP POST requests. The server-side application, written in PHP, is responsible for receiving these requests, extracting the weight data, and appending it to a structured flat file format such as .txt or .csv. This approach provides a lightweight and efficient method for data storage, particularly suitable for small- to medium-scale applications where complex relational databases are unnecessary. The entire server application is hosted using a local development server environment, specifically Easy PHP or XAMPP, which offer bundled solutions containing Apache HTTP Server, PHP engine, and optional database tools. These platforms allow the developer to simulate a web server on a local machine, thereby enabling browser-based access to the stored data without requiring a live internet server. The server interface is designed to display real-time weight readings and status indicators, such as whether the load exceeds the predefined threshold. This architecture enables end-users to monitor system performance and receive timely alerts regarding potential overweight conditions. Moreover, the modularity and openness of the software design allow for future scalability, such as integrating more advanced features like cloud data storage, mobile push notifications, and advanced analytics using external APIs. Overall, the chosen software tools and architecture ensure seamless communication between hardware and the web server, delivering a responsive, accessible, and user-friendly experience in real-time overweight detection and prevention scenarios.

VI CONCLUSION

This study successfully presents an IoT-based overweight preventer system developed using the ESP8266 microcontroller and a 40Kg load cell. The system is designed to efficiently measure weight, process sensor data, and wirelessly transmit the information to a remote web server for real-time monitoring. The integration of the HX711 load cell amplifier ensures high-precision data conversion, enabling accurate weight measurements. Additionally, the tare function implemented through the push button further enhances the system's ability to deliver precise readings by eliminating potential offsets and calibrating the sensor before each measurement. The results obtained from the implementation indicate that the system is highly accurate and reliable for detecting overweight conditions. By leveraging the Wi-Fi capability of the ESP8266, the system offers the advantage of remote monitoring, thereby providing operational flexibility and allowing users to access weight data from anywhere, in real time. This makes the system ideal for applications in various sectors such as industrial monitoring, vehicle weight management, smart infrastructure, and logistics, where preventing overloading is critical for safety, efficiency, and compliance with regulations. The software architecture, including the use of the Arduino IDE for embedded programming and PHP-based server technology for data handling, ensures a robust and scalable platform. Data transmission through HTTP POST requests allows seamless integration with web interfaces, enabling easy data visualization and the provision of timely alerts when weight thresholds are exceeded. The ability to display real-time and historical weight data provides valuable insights for decision-makers, enhancing operational efficiency and reducing the risk of overloading. Moreover, the modular and cost-effective nature of the proposed system makes it suitable for future enhancements, including the potential for cloud-based storage, mobile notifications, and the incorporation of advanced analytics. The system's flexibility also makes it adaptable to various scales, from small applications to large-scale industrial systems. Furthermore, the ability to integrate multiple sensors opens the door for expanding its capabilities to monitor multiple points simultaneously, such as in the case of vehicle axles or heavy equipment load management .In conclusion, the IoT-based overweight preventer system provides a reliable, scalable, and cost-effective solution for weight monitoring, demonstrating significant potential in improving safety, optimizing resource use, and enhancing operational management in a variety of industries. The success of this project lays the groundwork for future research and development in the area of IoT-enabled smart monitoring systems, with the potential to revolutionize how overweight conditions are prevented and managed in real-time.

VII REFERENCE

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