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Smart Linen Hamper and Laundry Monitoring for Hospital Industry

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Abstract

This project creates an efficient and reliable smart linen hamper and laundry monitoring system using IoT. One output from four scale load cells and a HX711 module allows a Smart Linen Hamper system to accurately assess linen load. The mux and HX711module select a combination output channel. This system will monitor linen capacity and alert users via Blynk to avoid overloading. Overloading can degrade washing, resulting in unclean clothes and stressed machine parts, increasing maintenance costs and equipment lifespan. Blynk's real-time tracking improves laundry monitoring. Without it, hospitals waste resources and operate inefficiently. A smart linen hamper and laundry monitoring system with IoT notifications improves hospital laundry management by being efficient, accurate, and proactive. Patients receive better care, hospitals run more efficiently, and physical work diminishes. Administration of laundry by this technology decreases human errors and enhances hospital linen management.

1. Introduction

Hospitals actively clean linens to remove obvious and undetectable stains before patients use them. Some hospital wash room technology are standardized, whereas others are limited [1]. However, hospitals need clean linens to maintain hygiene. This method processes enormous amounts of linen efficiently and continuously. ProLinenCare launders using an 80-kilogram washing machine, depending on capacity and kind [2]. IoT notification-based laundry management has revolutionized laundry monitoring and control in the medical business. This unique solution uses IoT technology to send real-time notifications and increase washing control [3]. Hospital workers must manually conduct linen management due to its challenges. Hospital staff gather, sort, track, and launder linen. Manual operations increase the danger of human error. Inefficient linen loss tracking, unknown location, erroneous amount, and insufficient washing life cycle data make the system inefficient. [4].

2. Materials and Methods

This part explains the underlying processes involved in project work, including the materials, hardware, software, and approaches used. It also provides a full explanation of the smart linen hamper and laundry management system built with IoT technologies. This system's major components include the ESP-32 microcontroller, as well as scale load cells built into the hamper to provide accurate weight measurement and precise linen monitoring. All collected data will be sent to an IoT device and automatically evaluated [5]. The smart linen hamper works perfectly with a laundry management system that uses Blynk apps. Blynk sends out a notification after the washing and drying process is complete, signaling the conclusion of the procedure. The use of Blynk apps improves the comfort of hospital laundry management by allowing remote monitoring and optimizing operational operations.

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2.1 Circuit scale load cell

Fig, 1 illustrates the circuit, scale load cell sensor, and microcontroller, illustrating their integrated operation to provide output. A scale load sensor and a HX711 are used to measure the load. When paired with a scale load cell, the HX711 sensor enables accurate weight measurement and monitoring. To ensure a consistent output, four scale load cells are connected in parallel. This combination is particularly helpful in the context of a smart linen hamper, exhibiting the adaptability of the HX711 sensor and load cell. The circuit scale load cell sensor works well throughout a wide weight range, from 0 to 80 kilogrammes.

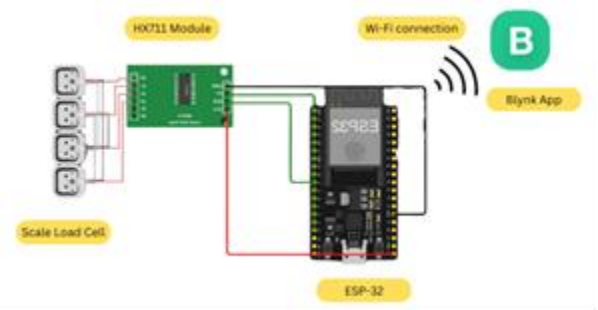

Fig. 1 *Circuit implementation of the proposed system*

2.2 Block diagram

The system's central control unit is an ESP32, which manages a smart linen hamper equipped with a weight sensor, timer, and Blynk integration. The scale load cell sensor, which is supplied by a power source or battery, detects the load inside the hamper and transmits this data to the user via the Blynk app. If the hamper exceeds the weight limit of 80 kg, an alert will be sent. The linen is fed into the machine in predetermined amounts, typically 80 kg, 50 kg, or 36 kg [6]. The timer device monitors wash and dryer cycles and notifies the user via Blynk and email when the cycle is complete. Items are ready for pickup following the wash and dryer cycles. Fig. 2 displays the system as a block diagram, with the ESP-32 acting as the principal microcontroller for programming and system administration.

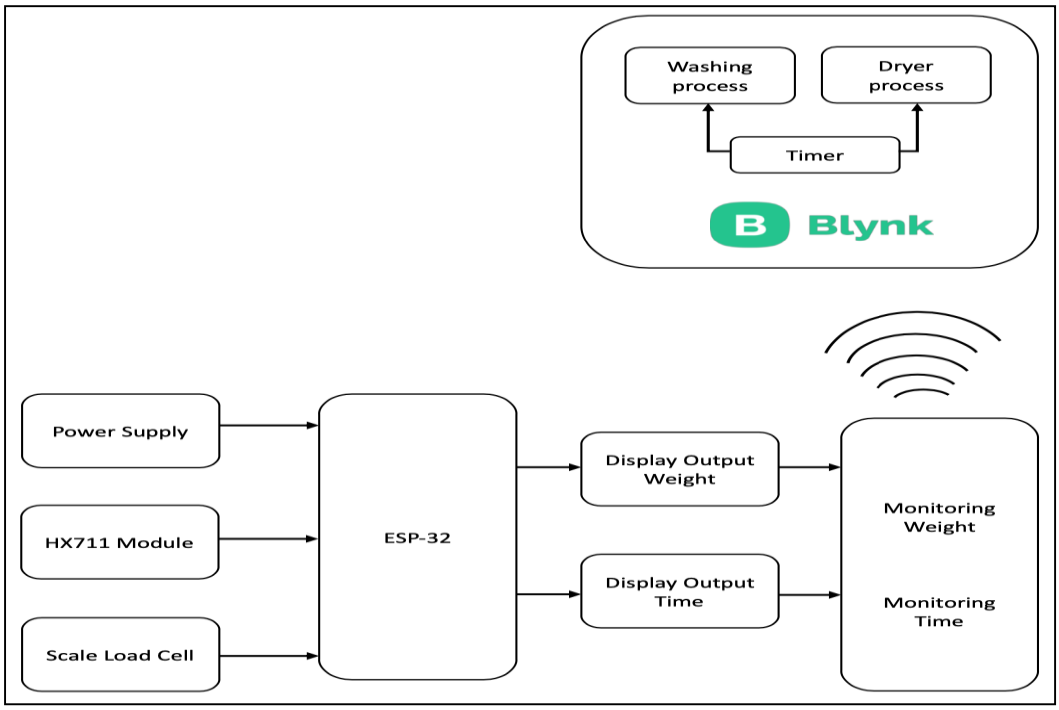

Fig. 2 *Block diagram of smart linen hamper and laundry management*

2.3 Flowchart

Fig. 3 displays an intelligent process flowchart that guides users through the completion of a project in smart linen hamper and laundry monitoring. This flowchart displays the project's sequential tasks. The flowchart displays key stages in the process, from weighing linens, clothing, and other items to beginning the washing process. A scale load cell sensor accurately measures the load, and the Blynk app displays it in the smart linen hamper. The

washing and drying operations commence, each lasting 30 minutes, as indicated by the Blynk display. Figure 3 demonstrates the sequential and timed nature of the washing and drying processes. After completing both activities, the user receives a brief message via the Blynk app and email telling them that the procedure has been finished.

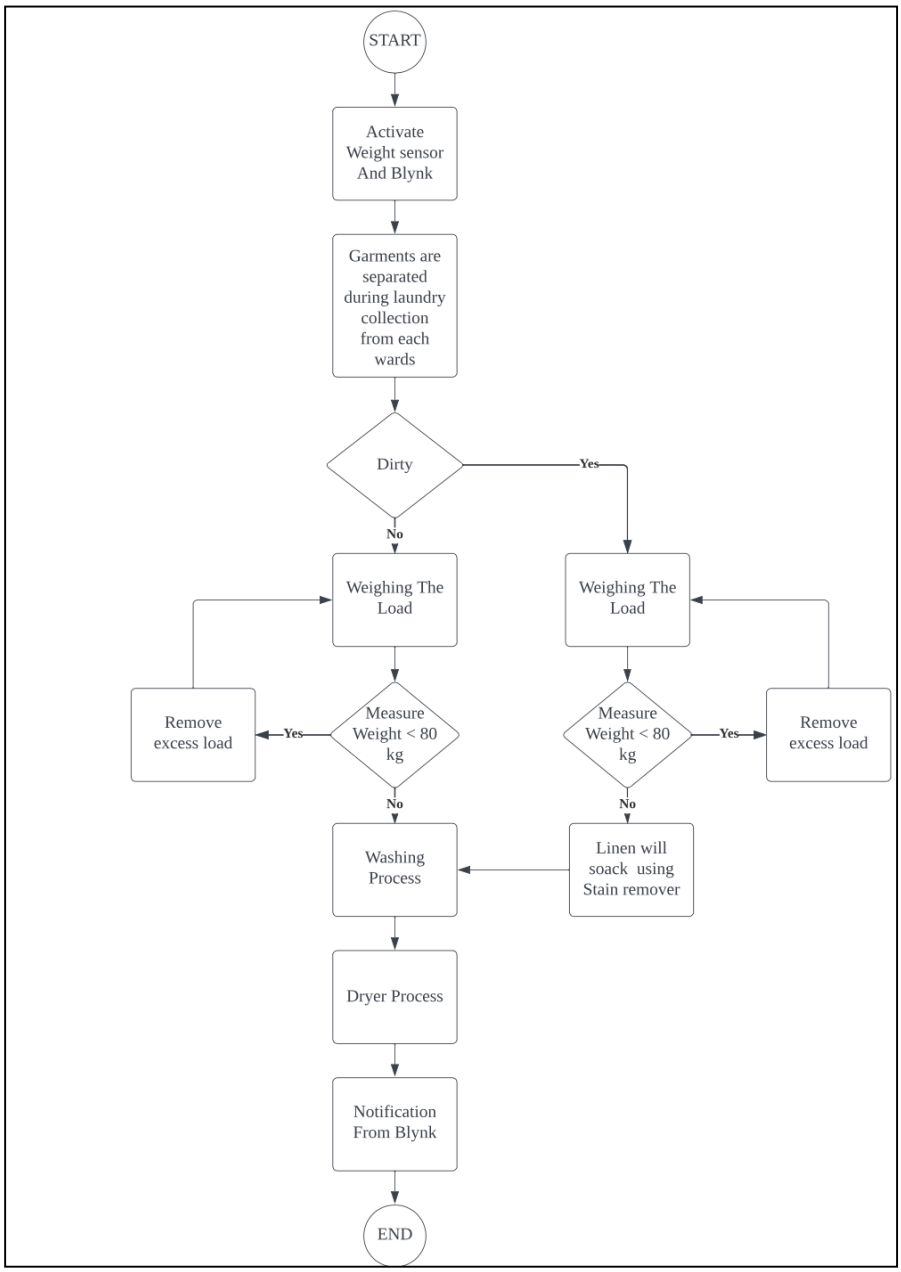

Fig. 3 *The flowchart of smart linen hamper and laundry management*

3. Results and Discussion

The results and discussion section looks into the preliminary findings obtained from constructing a smart linen hamper and laundry management system in hospitals using IoT Notification. The statistics presented come from various stages of the product development process. This section provides for categorization according to aims, chronological chronology, case groupings, experimental configurations, or any other logical sequence judged appropriate for a thorough study and analysis of the collected results.

3.1 Smart linen hamper

Fig. 4 depicts the ESP32 microcontroller, which serves as the project's key component and measures load using the human scale load sensor and the HX711 sensor. The ESP32 is linked to a HX711 module, which, when combined with four 200kg scale load cells, correctly measures weight.

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Fig. 4 *Hardware design of smart linen hamper (left) top view (right) bottom view*

3.2 Testing system

The testing procedure given in the results and discussion section establishes a systematic approach to undertaking a complete analysis of the research. To ensure relevance to the goals of each exam, rigorous data collection processes are implemented. The analytical criteria are established, allowing for a systematic examination of findings, the identification of trends, and the evaluation of various experimental configurations.

3.2.1 Testing prototype smart linen hamper

Testing the hardware, as shown in Fig. 5, is essential to ensure the proper functioning of the smart linen hamper system before implementation in the hospital. The scale load cell sensor, which is placed beneath the board, is crucial for optimal operation. This sensor accurately determines the weight of the linens in the hamper. A calibrated scale load cell is an essential component in precision weighing systems because it translates applied force into an electrical signal, allowing the weight of an item to be accurately calculated. The calibration of a weighing scale is changing and setting the scale to provide accurate and exact measurements. The HX711 sensor's analog-to-digital converter turns analogue measurements into electronic signals that may be transferred between analogue and digital systems [7]. According to Fig. 6, the Blynk has a weight of 10 kg and a price of RM 49.99 for normal linen, while unclean linen costs RM 69.99 per kilogram. The Blynk program enhances the user experience by showing a clear and easily accessible representation of recorded weights, enabling effective load monitoring. The adoption increases the efficiency and accuracy of monitoring and managing hospital linens, clothes, towels, bed sheets, and other laundry items.

Fig. 5 *Testing system prototype smart linen hamper*

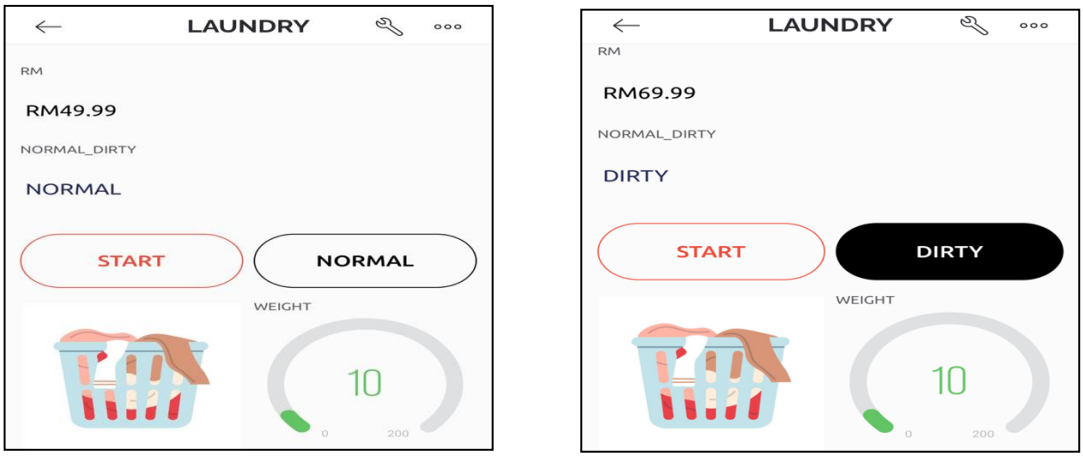

Fig. 6 *Display Blynk application (left) Price Normal Linen (right) Price Dirty Linen*

In Fig. 7, the Blynk application displays a warning that the smart linen hamper has surpassed its maximum capacity of 80kg. The Blynk program, which is specifically built for this purpose, warns users when the entered weight surpasses the 80kg threshold, ensuring timely notification that the hamper has reached its maximum capacity.

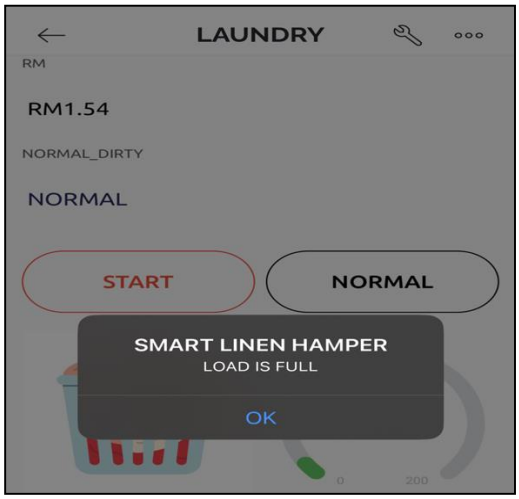

Fig. 7 *Alert from Blynk application*

Table 1 shows data on the functionality of a smart linen hamper and laundry management system. The sensor system of the smart linen hamper was tested with a prototype to determine its performance under various load weights. The device uses a scale load cell sensor that can measure weights ranging from 0 to 80 kg. When the weight reaches its maximum capacity of 80kg, the Blynk app provides an indication that the hamper is full. The Blynk program allows users to simply track the load status.

Table 1 *Result on a weight load*

Weight in unit kg	Scale Load Cell	Notification Alert
1.38	Detected	Not notified
4.5	Detected	Not notified
10	Detected	Not notified
40	Detected	Not notified
80	Detected	Notified

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Based on Table 2 shows the successful results of the scale load cell sensor, which operates successfully in the weight range of 0 to 80 kilos. The sensor system of the smart linen hamper was tested using a prototype to determine its performance under various load weights and prices. The weight and pricing information for the chosen linen type are provided. Clean (average condition) linen costs RM 5 per kilogram, whereas soiled (extremely dirty) linen costs RM 7 per kilogram. Normal linen is clean and well-maintained, usually cleaned to remove stains, filth, and odors. However, heavily soiled or bloody linen requires professional cleaning. Pre-treatment and soaking are required to clean and use the linen.

Table 2 *Weight price of a specific type of linen*

Weight in unit kg	Scale Load Cell	Price for Normal Linen in Ringgit Malaysia	Price for Dirty Linen in Ringgit Malaysia
1.38	Detected	6.88	9.63
4.5	Detected	22.49	31.51
10	Detected	50	70
40	Detected	200	280
80	Detected	400	560
1.38	Detected	6.88	9.63

3.2.2 Testing laundry management system

In figures show eight button representations for washing and drying procedures on the Blynk Display, each having a 30-minute length. The visual representation depicts the sequential nature of these processes and their periods. Once both processes are completed, a notification is given to the user via the Blynk app. Fig. 8 shows the notification received from the Blynk app verifying the completion of the washing and drying cycles.

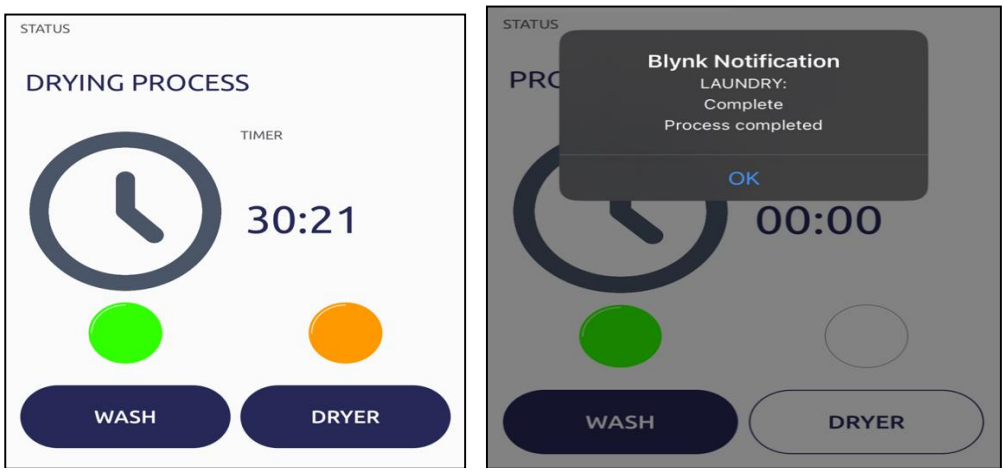

Fig. 8 *Timer (left) washing and dryer process; (right) notification from Blynk*

4. Conclusion

This project intends to create a smart linen hamper and laundry management system that will bring significant benefits in terms of efficiency, accuracy, and convenience. The hospital laundry smart linen hamper is intended to optimize the washing process while providing a high-quality wash for apparel and linens. The concept comprises employing a scale load cell sensor to monitor the weight of linen placed in the smart linen hamper and enabling real-time monitoring via the Blynk app. In addition, the Blynk program has two major processes: washing and drying, each with a 30-minute timer. After finishing either step, the Blynk program can send notifications informing the user that it has been done. The IoT messages provide immediate information and warnings about inventory levels, laundry condition, and replenishment requirements, allowing for proactive decision-making and reducing clean laundry shortages or delays [8]. This significantly enhances operational efficiency in healthcare organizations by streamlining the entire laundry management process and decreasing human errors. This innovation provides the efficient, precise, and proactive administration of laundry goods, revolutionizing how hospitals handle their linen requirements.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the completing of the paper.

Author Contribution

The author attests to having sole responsibility for the following: planning and designing the study, data collection, analysis and interpretation of the outcomes, and paper writing.

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