

Food Container: Notification System for Goods Depletion

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Abstract

Effective food management in home and small businesses remains difficult, especially for non-refrigerated stored in cabinets or pantries without constant monitoring, which can lead to waste due to spoilage or undetected expiration. This project presented the development of a "Smart Food Container" that integrates various sensors and technologies to provide an efficient goods depletion notification system. It also focuses more on foods that can be placed outside the refrigerator. The key features of the proposed system include continuous monitoring of the goods' weight using a 20kg load cell and HX711 amplifier, measurement of food freshness through temperature & humidity (DHT22), and air quality sensors (MQ-135), and user notification via an OLED display module and a smartphone notification. The system also utilizes IoT technology to transmit the weight and status of the goods to a specified application (Flutterflow), enabling remote monitoring and management of the container's contents. The goal of the proposed "Food Container" was to create a comprehensive and user-friendly solution for monitoring and managing the goods within a container by increasing inventory management efficiency, lowering the risk of goods depletion, and providing useful information about the freshness of the stored items.

Keywords: Smart Food Container, Internet of Things (IoT), Food Spoilage Detection, Inventory Management, Goods Depletion Notification

Introduction

Food insecurity is still a key global issue, frequently because poverty, conflict and climate change cause it. However, inadequate food storage is one frequently overlooked contributor toward this problem. Improper storage conditions can give rise to both the spoilage of perishable goods and contamination, as well as substantial post-harvest losses. This is especially true for regions since they do lack proper infrastructure. According to the Food and Agriculture Organization (FAO) (2021), a large percentage of food waste occurs during storage

and handling stages, reducing the overall availability of consumables. This not only results in economic losses but also diminishes access to safe and nutritious food, particularly in low income communities. Therefore, efficient and smart food storage systems do play a major role in waste reduction, food shelf-life extension, and in the end improvement of food security because they ensure the availability and quality of consumables consistently.

Food containers are necessary to preserve consumables' freshness, quality, and safety (2024). They aid food protection from environmental elements like air, moisture, and pollution and aid prolongation of stored items' shelf life. Food items not in proper storage can easily be contaminated by bacteria, by fungi, or by chemicals. Such contamination may result in food poisoning. This is important not only to consumers' health but also to ensure consumed stored food is of high quality. Moreover, they make it possible to better portion and organize consumables in both domestic and commercial settings, guaranteeing waste reduction and resource efficiency by Ravishanka et al. (2015).

However, utilizing food containers raises a few other issues. These concerns include the amount of items now in the container, when to restock, the condition of the goods, and the mechanism by which the user will be informed to restock. Without these characteristics, the consumer may find themselves in a scenario where the product is entirely depleted or unavailable when they want to use it. An example of a potential problem in an industrial setting is the hotel restaurants' supply chain logistics. While the chefs are the ones that are using the ingredients available inside the hotel to prepare food for the customers, the responsibility for procuring such ingredients falls on the hotel food and beverage manager (2022). This has caused multiple layers of communication to occur between chefs, the head chef, and the food and beverage manager. Due to this, there may be some delay for the information, such as ingredient ordering from the hotel's kitchen, to reach the food and beverage manager. In order to prevent this situation, we can integrate a few electronic sensors within the goods container. This sensor determines the current level of the products as well as notifies the user when quantities are insufficient with tracking of the goods' condition, and also provides user access to consumption and restocking records. This is the basis for the development of Smart Food Container: Notification System for Goods Depletion. Before the products run out entirely, these features ought to be able to assist the consumer in staying vigilant and informed.

Due to the research gap, smart monitoring systems are important for tackling these issues since they offer an autonomous up-to-date information on goods levels, status and information inside the container at the user smartphone. These systems allow for exact goods management, prompt interventions, and proactive decision-making by continually monitoring variables like as goods level, restock and consumption history, and low-level goods alert. The main objective of this project is to design and develop a working storage container which can store various type of item be it perishable goods or non-perishable goods. The container will also be able to alert the user in real-time through application or live view whenever the goods are running out from the decrease in its weight. Throughout the day, it must be able to remind the user to go grocery shopping for the item that is running low.

While recent research has made great strides in smart kitchen tech, a closer look at the literature reveals a clear gap: most existing projects focus heavily on smart refrigerators or

large-scale industrial warehouses. There is a noticeable lack of attention given to everyday, non-refrigerated ambient storage—like the standard pantries and kitchen cabinets used by regular households and small cafes. Furthermore, the few systems designed for ambient storage usually treat inventory tracking and freshness monitoring as completely separate issues. They might track how much an item weighs, or they might test for food spoilage, but they rarely combine the two. This leaves a gap for a unified, low-cost system that handles everything at once. To address this, our project bridges the gap by developing a single, compact IoT container. It uses a synchronized sensor layout to track inventory depletion through weight, detect early biochemical spoilage via gas emissions, and account for external humidity shifts—all while cross-referencing calendar expiration dates on a real-time mobile app.

Literature Review

The positive thing managing food inventory at home or in commercial setting is for saving time, reducing waste and improving kitchen management efficiency (2020). Traditional storage containers usually do not offer any kind of real-time updates or smart feedback. The aim of smart food containers is to solve this problem by integrated technologies like sensors, connectivity, and user notification system.

Smart Containers for Food Storage in Refrigerators Several techniques involve to development of smart containers were proposed in the past. One of the technique is show at Tadigadapa et al., (2022) research. This project focus on solving problem of leftover food waste by developing a smart container which will track the time the food been stored in refrigerator. Based on the time the food has been in refrigerator, the smart container will send the reminder when the food has been stored for too long thus motivating consumption before it reaches the expiry date. Figure 1 showed that the development of smart containers integrated with FX-29 compression load cell, Adafruit TSL 2561 light sensor, button, buzzer and Raspberry Pi 3B as its microcontroller. The function of this are to manage and monitor food storage in refrigerators effectively. The application in this project was designed by using the Massachusetts Institute of Technology (MIT) App inventor. The system function focuses mainly on the load sensor when it detects load and light sensor in which during the refrigerator door are opened. When the food was put inside the smart container which was equipped with load cell on the bottom, the 48 hours countdown will start. If the food is not disturbed in the 48 hours countdown, when the fridge is opened in which the light sensor detects the light from within the refrigerator, the system will send the reminder by beeping through the buzzer or by sending message through the dedicated app like figure 2. As for the partially consumed food that was placed in the smart container prior, there is a button which will allow the timer to continues from previous session rather than resetting the timer, thus providing the cumulative time the food has been in smart container. However, there are drawbacks, such as the need for a steady power source because Raspberry Pi modules take a lot of energy and battery solutions only have a short operating duration (about 24 to 48 hours), which may be unpleasant in normal home environments.

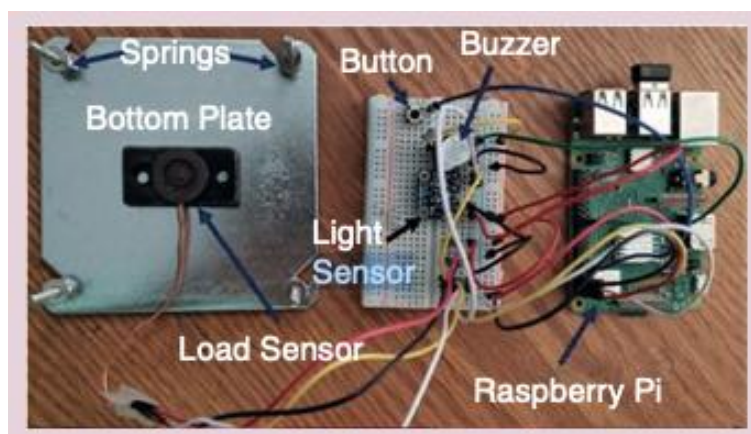
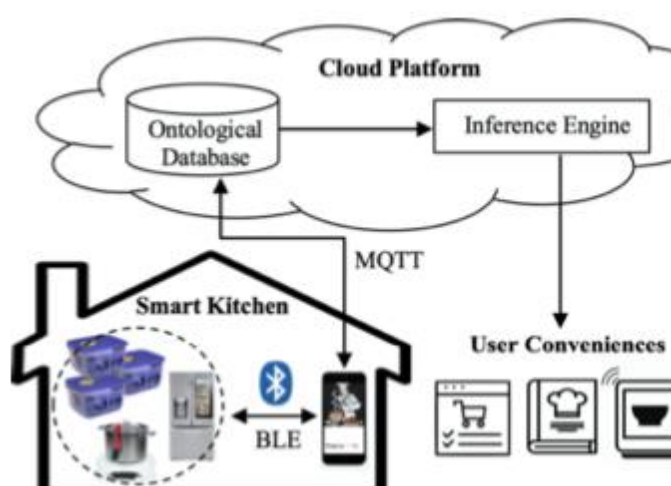


Figure 1 The component used in the project



1.
2. Figure 2 The user interface of application



3.
4. Figure 3 Architecture of TupperwareEarth

The research conducted by Zhou et al. (2022) introduces an IoT-based intelligent system for kitchen management, focusing on both physical and cognitive convenience. It helps more in keeping food fresh and organised. These containers have built-in food spoilage detection through sensors (e.g., humidity, temperature, gas) that can monitor. This means the system alerts users when food is due to expire; they are therefore less inclined to waste it. Then it also gives recipe recommendations based on available inventory and cognitive load reduction via a voice-controlled assistant (Tuppy). Figure 3 showed that how architecture of TupperwareEarth.

In tests, people using TupperwareEarth finished cooking faster and found it easier, especially those who are not confident in the kitchen. The test used a two-sample paired t-test to compare the meal preparation time between the conventional method and the TupperwareEarth-assisted method with Bonferroni correction. Table 1 summarises the results of the analysis, including the mean decrease in time and the 95% confidence interval.

Table 1

Comparison of Average Preparation Time

5. Participants group	6. Average Preparation Time(s)		7. Decrease in Time(s)
8.	9. Conventional	10. Tupperware Earth	11.
12. Expert Cooking Skills	13. 61.1	14. 44.5	15. 16.6
16. Non-Expert Cooking Skills	17. 91.8	18. 42.8	19. 49.0
20. Expert SKA	21. 62.2	22. 40.2	23. 22.0
24. Non-Expert SKA	25. 82.9	26. 45.2	27. 37.7
28. All Participants	29. 76.4	30. 43.63	31. 32.81

* SKA - Smart Kitchen Appliances

Existing literature by Mansor et al. (2023) focuses on solving several issues that are present in inventory management systems, which include unreliable tracking, imprecise data, restricted visibility, overstocking or understocking, documentation faults and deficient interaction due to the manual inventory management approach. The approach used to counter this problem is by using an IoT-based inventory management system connected to a cloudbased platform which allows for automated tracking. The system developed will use a load cell and NodeMCU as its microcontroller, which will be available to be accessed through the ThingSpeak application, such as shown in Figure 4. This system will also be able to generate data history and stock status and will be able to send notifications when the certain threshold has been reached by the system. One major benefit of this design is the provision of error-free, online updates regarding the data, which can easily be accessed by an online platform. Using NodeMCU enables WiFi communication, which improves the overall efficiency and affordability of the system.

However, this design has a major disadvantage involving total dependence on a steady internet connection for constant online monitoring. Another con is that the weight capacity of the load cell reduces its utility for a large-scale operation. In this design, the role of the load cell is to serve as the key sensor for detecting the variations in weight, and the amplified signal is obtained from the HX711 interface. The NodeMCU is critical for facilitating wireless operation of the system.

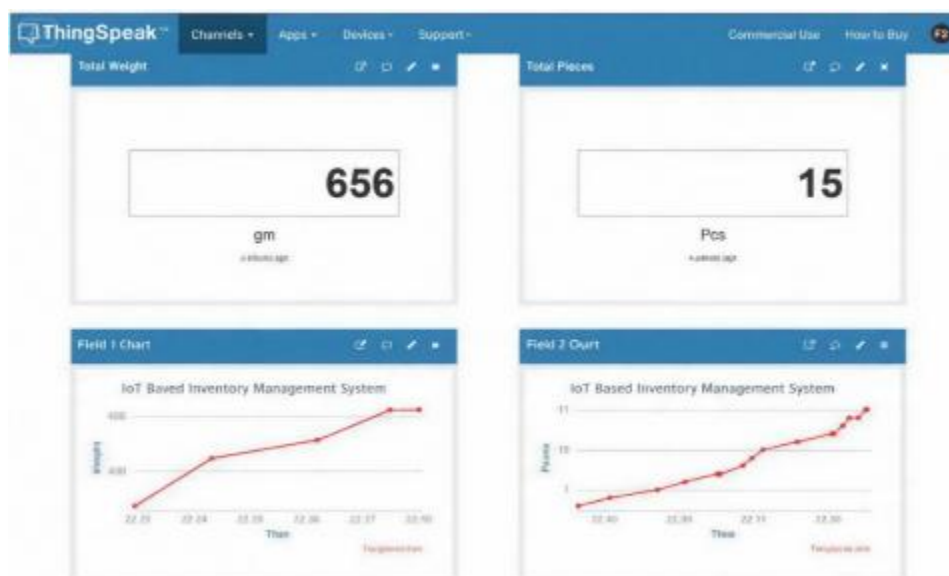


Figure 4 ThingSpeak display for fifteen sample

When looking at these existing systems as a whole, it becomes clear that current smart-kitchen research is split into very specific niches, as summarized in Table 2. Projects like Tadigadapa (2022) or Zhou et al. (2022) are specifically designed just for refrigerators. This means they rely heavily on cold-storage conditions or tracking when the fridge door opens to function properly. On the other side of the spectrum, generalized inventory tracking systems like Mansor et al. (2023) do a great job tracking weight, but they completely ignore the biological reality of food decay by leaving out environmental and gas metrics entirely.

Our proposed Smart Food Container bridges these gaps. Instead of focusing only on cold storage or simple dry-goods counting, our system explicitly targets ambient, non-refrigerated pantry setups. On top of that, it pulls together three distinct data streams that are usually kept completely separate in previous studies: live weight tracking, environmental telemetry, and gas-based spoilage detection. By packing this synchronized layout into a single, low-power ESP32 ecosystem, our work offers a comprehensive, all-in-one solution that fills a clear void in the existing literature (2024).

Table 2

Comparison of the Proposed Smart Food Container with Existing Systems

32. Study / System	33. Storage Focus	34. Weight Tracking	35. Temp/Humid	36. Gas / Spoilage Sensing	37. Main Limitation Solved by Our Work
38. Tadigadapa [6]	39. Refrigerator	40. Yes	41. No	42. No (Uses light/timer)	43. High power consumption; restricted to cold

					environ ments.
44. Zhou et al. [7]	45. Refrigerat or / General	46. No	47. Yes	48. Yes	49. Lacks physical weight tracking for exact depletio n alerts.
50. Mans or et al. [8]	51. Industrial / General	52. Yes (Lo ad Cell)	53. No	54. No	55. Strictly for dry inventor y; cannot detect bioche mical spoilage .
56. Propo sed Syste m	57. Ambient (Pantry/C abinet)	58. Yes (20 kg Loa d Cell)	59. Yes (DHT22)	60. Yes (MQ- 135)	61. None (Integra tes all element s into a low- power, ambient solution).

Methodology

This chapter will review the steps of the methodology which will include the implementation and development of this project. The design used in research must include the functionality, safety and reliability to help in ensuring the product that was developed will meet the user needs and industry standards (2022, 2024). The Food Container: Notification System for Goods Depletion will utilizes the NodeMCU ESP32 as a microcontroller unit to collect data from various sensors like a load cell with HX711 amplifier for weight measurement, MQ-135 for air quality detection, and DHT22 for temperature and humidity. The system's architecture allows it to process sensor data, display it locally on an OLED screen, while simultaneously sending the information to a cloud-based platform (Tago.io) for real-time monitoring and remote access.

This project will use various sensors as inputs, which will load a cell paired with an HX711 amplifier as a weight scale, an MQ-135 as a gas detection sensor, and then a DHT22 as a temperature and humidity sensor. A load cell and HX711 amplifier will be used to measure the weight of goods stored inside the container. A MQ-135 and DHT22 will be used to monitor the condition inside the storage in which the goods are being kept (2020). The main component in this project is NodeMCU ESP32 as a process. It functions as a central controller

in an IoT embedded system. It is very useful for managing a variety of processes in real-time systems since it has a dual-core CPU, several GPIO (General Purpose Input/Output) pins, and integrated Wi-Fi and Bluetooth capabilities, see Figure 5.

Then, this project has three outputs to the final result or response of the system after processing the input data. The OLED display provides immediate visual feedback to users near the device. The cloud application functions to store and visualize sensor data online (2020). Lastly, Flutterflow app provide portable access for users through smartphones, supporting real-time monitoring and alerts on the go. Because of this, there will be two main algorithms: one will be used to determine the weight of the goods and the other to monitor the condition inside the container.

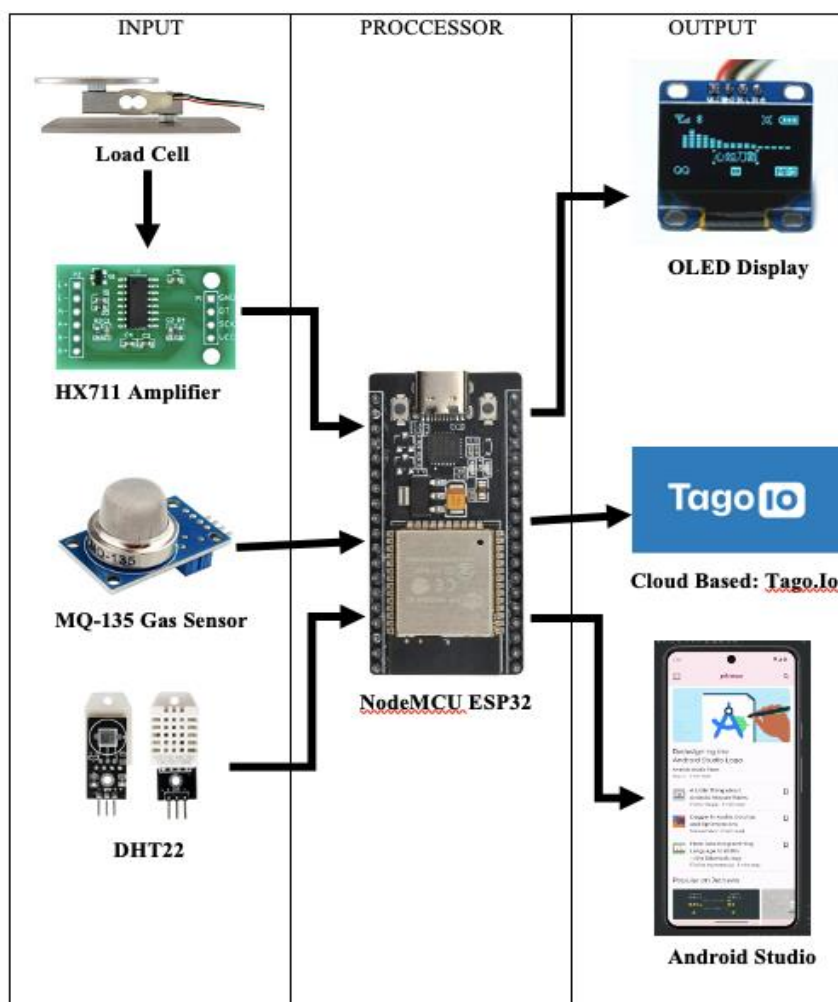


Figure 5 Block Diagram of Hardware Design

The flowchart in figure 6 lays out how the IoT-based smart container actually works to keep track of food and stop it from going to waste. When you turn it on, the system boots up its Wi-Fi connection along with a few key sensors: a load cell, a DHT22, and an MQ-135, while showing the connection status right on the built-in OLED screen. Once it's online, the system runs four monitoring tasks side-by-side and shoots all the data up to the Tago.io cloud. Basically, it tracks the food's weight to alert you when you're running low, checks the ambient

temperature and humidity, measures air quality to warn you if spoilage gases go over 10ppm, and compares the current date to the expiry date so it can push a notification to your phone when food is two days away from spoiling.

The Smart Food Container system is expected to provide real-time monitoring of food inventory by accurately tracking the weight of stored items using a 20kg load cell. The weight data should be displayed both on the OLED screen attached to the container and through a mobile application, allowing users to view the information conveniently. When the weight of any item drops below a predefined threshold, the system is designed to send a depletion alert via the Flutterflow app, reminding the user to restock. In addition to weight monitoring, the system is also expected to track environmental conditions within the container. Using the DHT22 and MQ-135 sensors, it should measure temperature, humidity, and air quality to help determine food freshness (2022).

The mobile application will display live sensor data, including weight and environmental readings, along with alerts and possibly a basic history log of previous measurements. Sensor data is expected to be transmitted to the Tago.io cloud platform, allowing for remote access and visualization on both web and mobile interfaces. The overall interface, both on the OLED and the mobile app, is intended to be user-friendly, clear, and responsive for ease of use (2020). The system should deliver accurate readings with minimal error (e.g., + 2%) and ensure that alerts are triggered promptly when thresholds are reached. Ultimately, this system aims to enhance users' awareness of their food inventory, helping to reduce food waste, prevent over-purchasing, and support better grocery planning.

The figure 7 show how the Food Container System Architecture works. The system begins by collecting data from several sensors. Load sensors measure the weight of stored items, the DHT22 sensor detects temperature and humidity, and the MQ-135 sensor monitors air quality. The ESP32 microcontroller, which is the central processing unit, receives all the sensor data. The ESP32 processes this data and sends it to the cloud platform (Tago.io) for real-time storage and remote access. From the cloud, the information is displayed on two outputs: an OLED screen for local monitoring and a mobile application created using Android Studio for remote access. This setup allows users to receive live updates and alerts about their food inventory directly on their phone or through the container's display.

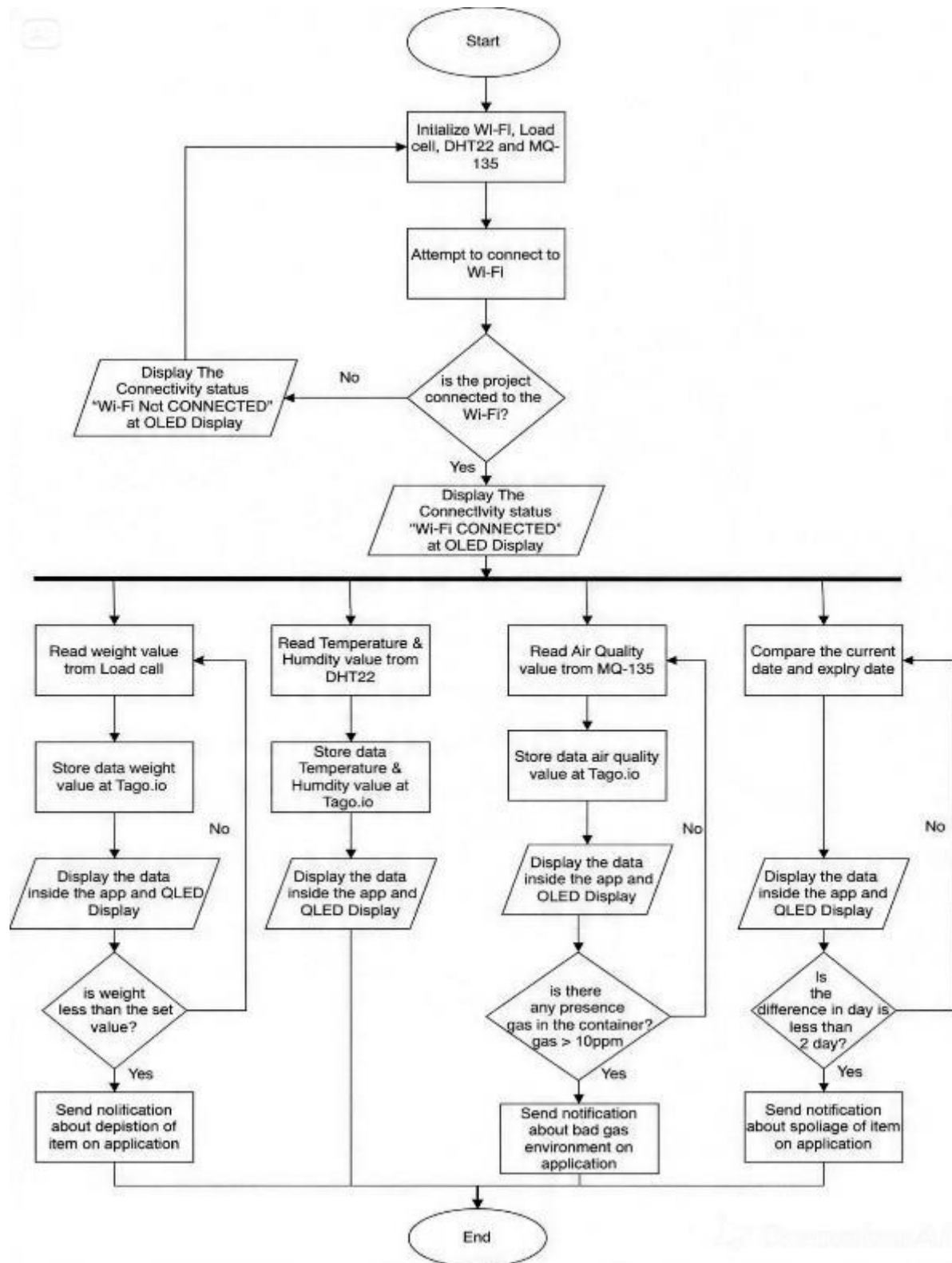


Figure 6 Flowchart Food Container system

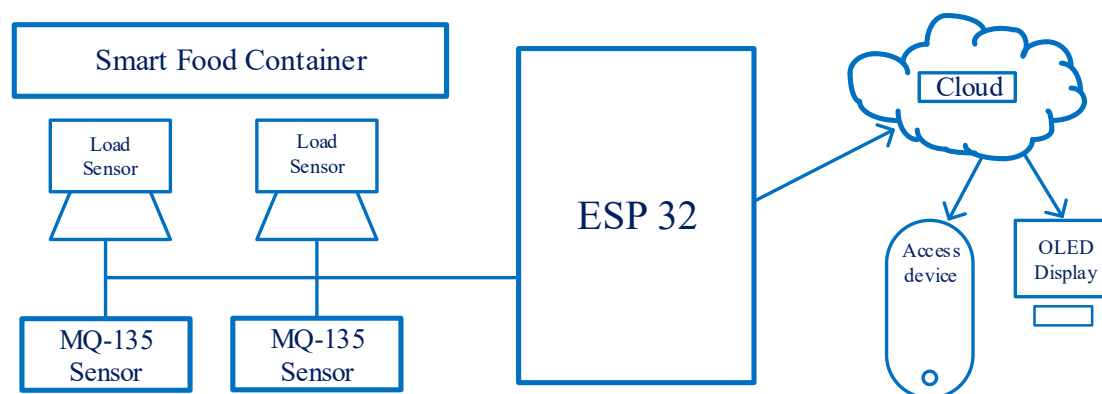


Figure 7 System Architecture

The Smart Food Container system's whole hardware simulation configuration is shown in the figure 8. It incorporates key elements, such as the ESP32 microprocessor, which interfaces and exchanges data with numerous sensors. It has an OLED display for output visualisation, a DHT22 sensor for temperature and humidity, a MQ-135 gas sensor for detecting spoiling gases, and a HX711 module with load cell for weight measurement (2019). Additionally, the ESP32 facilitates wireless connectivity, which permits the data to be sent to an Android Studio-developed mobile application. Real-time feedback and seamless sensor data collecting are made possible by the wiring and configuration. When fully functional, the system is expected to display sensor readings on the OLED screen and send alerts to the user via a mobile application when thresholds (e.g., gas level, low food weight, or high humidity) are exceeded. This setup reflects the expected result where all sensors work in synchronization to monitor food quality and quantity efficiently.

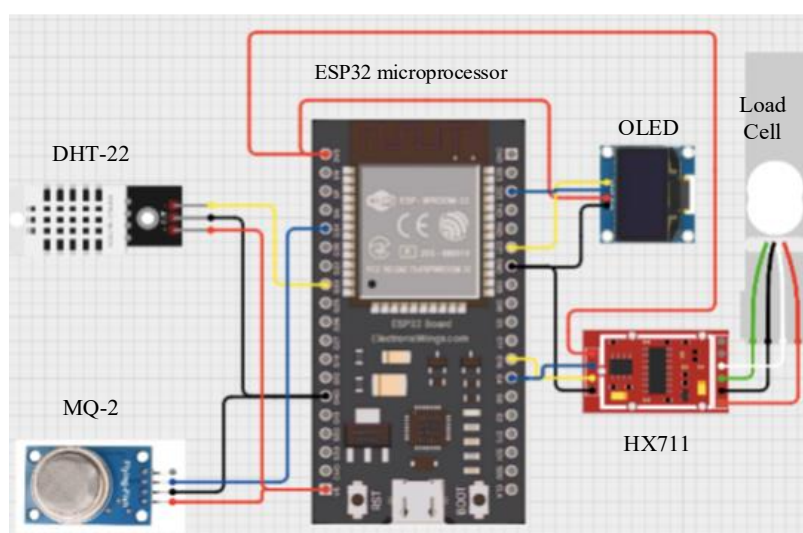


Figure 8 Circuit simulation

Results and Discussions

The Food Container System was designed in such a way that the system can provide real-time alerts depending on the predefined levels of weight and gas concentration (2024). The alerts were intended to notify the user of the status of the food in the container regarding normal

functionality, low stock, and food spillage. Status of the food in the container regarding normal functionality, low stock, and food spillage. During the testing of the system, the system was able to provide alerts regarding three different statuses of the food in the container: Normal Status, Low Stock Status, and Spoilage Status. If the system measured an appropriate value of the food in the container, the system did not send an alert regarding normal functionality of the system in the container.

In the Low Stock scenario, the notification was sent when the weight indicated by the HX711 load cell was less than the set limit. The notification indicated the user that the stock was running low and that it was time to refill. The weight notifications were sent at the recommended values, which indicated the accuracy of the HX711 sensor in detecting the stock levels like table 3.

Table 3

Weight-Based Condition

62. Weight Percentage (%)	63. Condition	64. Description
65. $\leq 20\%$	66. Low Stock	67. Food quantity is below the predefined threshold and requires restocking
68. $> 20\%$	69. Normal	70. Food quantity is within the acceptable range

In Spoilage detection, the MQ-135 gas sensor was applied to detect gas emitted during food spoilage. A warning message on food spoilage was sent out as soon as the gas level exceeded the spoilage level. The warning message signaled to the user that the food could not be safe to eat. The data from the gas sensor matched the indicator of spoilage through smell, hence indicating that MQ-135 performed its function properly like table 4.

Table 4

Gas Sensor Condition (MQ-135)

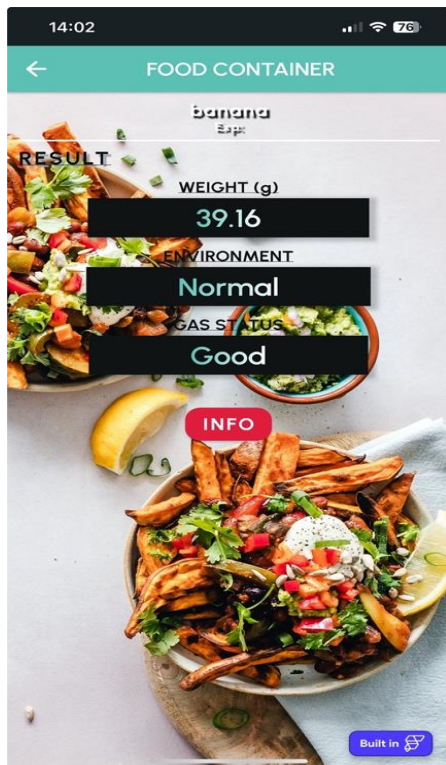
71. Gas Sensor Value (Adjusted)	72. Condition	73. Description
74. ≤ 80	75. Good	76. Food still fresh
77. 81 - 150	78. About to Spoil	79. Food starting to spoil
80. > 150	81. Spoilt	82. Food already spoiled

The mobile application interface of the Food Container System in figure 9 depicts clear and organized information about the food stored inside a container. The designed outputs can be easily understood, making it possible for users to track the food without technical knowledge. The top of the interface has the food name section, which will provide information on the kind of food monitored at the moment; this would help in quickly noticing the content of the container. Below it is the current weight output of the food in grams. This is automatically fed into the output from the sensor readings that give the user changes in food quantity over time. The environment output describes storage conditions inside the container in simple descriptive labels to give, at one glance, whether the internal environment is suitable for food storage. In the same manner, the gas status output supplies the user with freshness information regarding food from gas detection by translating sensor data into understandable status labels informing users about the condition of their food (2023). An INFO button is also provided in order for the user to access more information about the selected food item. The

interface will use appropriate text, colour contrast, and logical arrangement of sections so that all output can be easily seen and read. All the outputs update automatically every 10 seconds, thus the user will be able to get almost real-time information concerning food weight, storage environment, and freshness status. This continuing update enables the dynamic monitoring and makes sure that the information displayed can represent the latest sensor readings. In all, the interface of the mobile application provides necessary information in a way that is user-friendly and efficiently allows for monitoring of the Food Container System.

Finally, the output of this project will be the Food Container System in figure 10, which is specifically designed to constantly track the food in real time, thus helping the users to maintain the freshness of the food and efficiently manage the stock of the food on hand. The Food Container System combines hardware and software to detect spoilage and low stock of food. The hardware part is basically a physical container fitted with a weight sensor that can estimate the remaining food quantity, a gas sensor to find out whether the food has gone bad by analyzing the gas it emits, and a humidity and temperature sensor to detect the environment. All of these sensors are connected to an ESP32 microcontroller, which constantly receives and processes sensor data, compares the readings against predetermined thresholds, and communicates the result to a mobile application.

The software part of Food Container System has a mobile app which displays real-time data from the sensors and food information. There are a number of screens in this app, see figure 11. They include a dashboard screen, food input screen, monitor screen, and information screen (2020). The users can input food information, which entails food name and expiration dates. Additionally, the system continuously displays weight values, humidity levels, temperature values, and data from the gas sensor. With predefined threshold values, the app gives a clear interpretation of the above values in relation to food freshness levels, which may be normal or low inventory, fresh or drying food, among others.



83.
84.

85. Figure 9: Real-Time Output

86.



87.
88.

89. Figure 10: Food Container hardware

90.

Our food container system is modular, portable, and energy-efficient. It takes IoT tech out of the lab and puts it to work solving major real-world problems: cutting down on food waste, tracking food safety, and managing inventory automatically. The next step is to make it even more versatile. Future updates will introduce customized profiles for different food types, multi-container syncing, and standalone battery power.

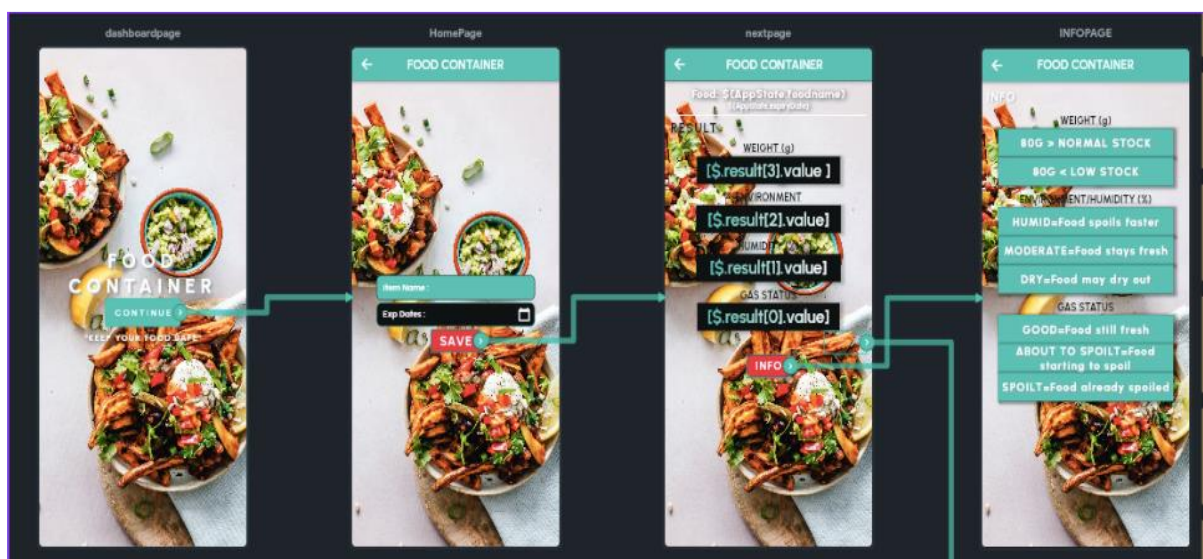


Figure 11 Flow Interface Mobile Application

Conclusion and Recommendations

Overall, this project has successfully achieved its main goals by designing and building a functional Smart Food Container System. By integrating different hardware components with a NodeMCU ESP32, the system provides a practical way to monitor food conditions and send real-time updates. The testing phase proved that all three sensors work well together. The MQ-135 gas sensor successfully caught the early signs of food spoilage by tracking gas emissions before any physical smell or mold appeared. At the same time, the HX711 weight sensor accurately monitored the weight inside the container, making it easy to track food levels and detect shortages instantly. To keep the data reliable, the DHT22 humidity sensor monitored the internal environment, ensuring that changes in the food's condition weren't just a side effect of ambient humidity shifts.

The system remained stable throughout testing, even though there were minor fluctuations in the readings depending on the specific type of food stored. The data from these sensors updated continuously and sent instant alerts to the mobile app whenever the gas or weight levels crossed the set safety limits. This setup gives users a clear, user-friendly way to check their food status remotely and take action before things go to waste. Because the project uses affordable, standard components, it has great potential for commercialization. It could easily be manufactured as a standalone smart storage box or as a small add-on module for existing kitchen cabinets. Ultimately, this system offers a low-cost, efficient solution to help everyday households and small shops manage their inventory and reduce food waste.

To enhance system accuracy and operational stability, future development should focus on integrating multi-modal sensing technologies—such as ultrasonic or optical sensors—alongside a dynamic software classification framework that automatically calibrates alert thresholds based on specific food profiles.

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References

- United Nations Environment Programme. (2021). Food Waste Index Report 2021. UNEP.
- Jeronimo Martins. (2024). Food is energy: How it powers the human body. Feed Magazine.
- Biji, K. B., Ravishankar, C. N., Mohan, C. O., & Gopal, T. K. S. (2015). Smart packaging systems for food applications: A review. *Journal of Food Science and Technology*, 52(10), 6125–6134.
- Lacalle, E. (2022). What are the duties and responsibilities of a hotel food and beverage manager? Mews.
- Prajwal, A., Vaishali, P., Payal, Z., & Sumit, D. (2020). Food quality detection and monitoring system [Paper presentation]. 2020 IEEE International Students Conference on Electrical, Electronics and Computer Science.
- Tadigadapa, A. (2022). Smart containers for food storage in refrigerators. *IEEE Potentials*, 41(3), 29–34.
- Eom, S., Zhou, H., Kaur, U., Voyles, R. M., & Kusuma, D. (2022). TupperwareEarth: Bringing intelligent user assistance to the “Internet of Kitchen Things.” *IEEE Internet of Things Journal*, 9(15), 13233–13249.
- Mansor, M. N., Talib, N. A. A., Saidi, S. A., Mustafa, W. A., & Zamri, N. F. (2023). Arduino IOT based inventory management system using load cell and NodeMCU. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 32(3), 12–25.
- Theo, D., Theresia, C., & Hariandja, J. R. O. (2022). Perancangan smart food container dalam sektor rumah tangga dengan pendekatan desain interaksi. *Jurnal INTECH Teknik Industri Universitas Serang Raya*, 8(2), 133–142.
- Naveed, S., Janani Sri, R., & Prasad, B. (2024). IoT-enhanced hostel inventory management system for seamless resource monitoring and control [Paper presentation]. Third International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS).
- Selvan, D. T., Manikandan, T., Vaidhyanathan, R., Vigneshvaran, B., & Nandalal, V. (2020). Home groceries management system using IOT. *International Journal of Psychosocial Rehabilitation*, 24(5), 2741–2746.
- Kumar, P., Raj, R., Saini, R., & Mishra, S. (2020). IOT based pantry management system. *Journal of Emerging Technologies and Innovative Research (JETIR)*, 7(8), 123–127.
- Sonwani, E., Bansal, U., Alroobaea, R., Baqasah, A. M., & Hedabou, M. (2022). An artificial intelligence approach toward food spoilage detection and analysis. *Frontiers in Public Health*, 9, Article 800342.
- Prajwal, A., Vaishali, P., Payal, Z., & Sumit, D. (2020). Food quality detection and monitoring system [Paper presentation]. 2020 IEEE International Students Conference on Electrical, Electronics and Computer Science.
- Budoyo, Y. D. S., & Andriana, A. D. (2019). Sistem IoT timbangan digital menggunakan sensor load cell di UD. Pangrukti Tani. *Jurnal Teknik Informatika Universitas Komputer Indonesia*, 8.
- Mounika, M., Adithya, T., Padmakumar, V., Saikumar, S. S., Chittiboyina, G. R., & Arjun, D. (2024). Smart container for leftover food tracking for packed and unpacked food. *Engineering Proceedings*, 66(1), 50.
- Preethichandra, D. M. G., Gholami, M. D., Izake, E. L., O'Mullane, A. P., & Sonar, P. (2023). Conducting polymer based ammonia and hydrogen sulfide chemical sensors and their suitability for detecting food spoilage. *Advanced Materials Technologies*, 8(4), Article 2200841.

Mulay, O., Bhalerao, M., Bhamare, S., Gaikwad, V., & Nalavade, K. (2020). IoT based food inventory tracking system for domestic and commercial kitchens. International Journal of Innovations in Engineering Research and Technology [IJIERT], 7(4).