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EMPOWERMENT IN : IOT-BASED GROCERY STOREMANAGEMENT SYSTEMS

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Abstract—The research introduces an innovative approach to grocery inventory management, utilizing advanced sensor technologies for accurate and efficient monitoring.Using cutting-edge sensor technology for precise and effective monitoring, the research presents a novel method for managing supermarket inventories. The laborious chore of manually supervising grocery stores led to the creation of a sensor-based smart supermarket management system. This technology transforms conventional inventory procedures by fusing ultrasonic sensors, and an ESP-32 microcontroller to create an intelligent network. The automatic sensing of foodstuff levels within containers is the core idea. Fixed-size containers with built-in ultrasonic sensors allow for exact content level measurement from the top of the container. Weight sensors evaluate the availability of items within these containers in real time. These sensors gather data, which is processed by ESP-32 micro controllers to create a smooth Wi-Fi connection to the internet.This makes it possible for customers to get real-time warnings if a product's weight drops below certain criteria. The application of this technology has several advantages. First off, it greatly lessens the requirement for a large workforce at supermarkets, which saves operating expenses. Furthermore, it enhances the consumer experience by reducing the likelihood of stock shortages and guaranteeing product availability. Additionally, the system minimizes waste through effective inventory management, supporting environmental sustainability.

Keywords: Internet of Things, Blynk Cloud, Web Application, Ultrasonic Sensor, ESP-32, Smart Grocery Management, Inventory Monitoring.

I. INTRODUCTION

The Internet of Things (IoT), also referred to as the Internet of Everything or Network of Everything, represents a network formed by integrating physical items or "things" with sensors, software, and connectivity. Each innovation aims to enhance people's lives in some manner. In this era of rapid technological advancement, novel concepts and prototypes emerge daily, gradually infiltrating various aspects of our daily routines. As we embrace digitization, our lifestyles and habits become increasingly intelligent by the day.

One innovative solution that reimagines the grocery shopping process is the Smart Grocery Management System. Manual handling of goods can be cumbersome, especially in our fast-paced world where time is a luxury. Amidst hectic schedules, individuals often struggle to monitor their grocery levels, particularly in large urban centers where domestic responsibilities may be challenging to juggle. Unnoticed expiration of supermarket items can disrupt meal planning and healthy eating habits, leading to frustration. Moreover, remembering to create a grocery list, go shopping, and wait in line at checkout counters adds to the complexity.

In response to these challenges, an intelligent grocery management system has been devised. Utilizing the ESP32 microcontroller and ultrasonic sensors, this system revolutionizes the way we monitor and replenish household groceries. Smart sensors are employed to monitor the quantity of grocery products at regular intervals, transmitting data regarding quantity and status to a server. If the received data falls below a predetermined threshold, the user is promptly notified via a dedicated mobile application.

The system's core functionality revolves around level measurement using an ultrasonic sensor, seamlessly integrated with the ESP32 microcontroller for WiFi connectivity. This ensures real-time interaction with the user via the internet. Leveraging technologies such as the Internet of Things (IOT), online applications, cloud computing, and the ESP32 microcontroller, this innovative solution

enhances both the shopping experience and inventory management. By combining these components harmoniously, it exemplifies a paradigm shift in grocery retail, showcasing how sensor-based solutions can revolutionize conventional retail procedures, ensure timely replenishment, minimize waste, and ultimately enhance consumer satisfaction**.**

II . LITERATUREREVIEW

The paper "Smart grocery management system using internet of things" Chetal S. Patil[2]. The proposed system in this plug-in uses the sensing and inbuilt Wi-Fi capabilities of the Edison board to connect to the cloud. This system informs the user when the levels of groceries are low. It gives the live details of groceries in the container. Future work for smart grocery systems is that we can directly place orders through an Android application on our smart phones.

The paper "IOT In Home Grocery Management " Akshay Pendbhaje et al[4]. Proposed a system using load cells to measure the grocery weight and a Raspberry Pi microcontroller board that tracks the availability of groceries in the kitchen. It also searches for better options from e-commerce sites with lower prices to order the product and displays the list on the user's Smartphone, from which the user can order and procure those items.

The paper "A Smart Kitchen Automation and Grocery Management System using IOT "K.Sakthisudhan[11], S. Mohanraj [8].This system provides Smart grocery level management using Internet of Things (IOT). The smart containers which are incorporated with sensors are used to collect the data about grocery level in it. This data is stored in the cloud platform accordingly with the help of Wireless protocol.

The paper "Sensor Based Industrial Kitchen Foodstuffs Monitoring System "Sowndarya Palanisamy [11] proposed a framework that will assist the client in getting the appropriate administration of our grocery store. The client no longer needs to stress over constantly observing the ingredients. The sensors are connected to an Arduino microcontroller. These sensors collect the data and store it in the Things Speak cloud framework via a microcontroller and Wi-Fi module. Future work for a smart basic food item framework utilizing IOT is an easily understandable framework for clients.

The paper " IOT Based integrated smart home automation system " Eng. N. Satheeskanth[8] , Marasinghe S.D , R.M.L.M.P Rathnayaka .This paper presents the complete design of an IoT based sensing and monitoring system for a smart home automation. This system use NodeMCU-ESP8266 microcontroller board for wireless communication, to provide the user with remote control of various appliances within their home and to store the data in the server.

The paper "Smart Grocery Monitoring System using Smart Sensors and IOT " Loveleen kaur [13], Shreya Shah , Muskan Gupta , Rashmi Bhadoriya . This system helps users by keeping a track of grocery items and reordering them whenever required all by itself. The basic idea is to detect thegrocery levels in the container and intimate the user through notification whenever required. The system consists of smart sensors and micro controllers and is connected to the internet via Wi-Fi, Which helps it to communicate with the user? A smart grocery management system is a smart andNew way of grocery shopping that redefines the approach toward grocery shopping.Javed et al. in "The Development Of IoT Enabled Household" describe a camera-enabled system to detect the product by scanning their bar codes and weight sensors and if the product's weight is below a threshold level the user is intimated

III . ALGORITHM AND MATERIALS

Algorithm

A typical grocery management system that makes use of IOT includes the following elements:

A microcontroller/ ESP-32 to gather data from sensors and manage cloud.

Arrange of sensors to track the level of grocery in the container.

Cloud will save the data gathered via sensor. Via mobile application, user will get update about grocery time to time.

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The fundamental procedures in the following algorithm describe a Smart Grocery Management System utilizing IOT:

1. Set up the microcontroller/ ESP-32, together with attached sensors and actuators.
2. Start a loop monitor the sensors generated data continuously and gather data.
3. Transfer the gathered data to a cloud, server or mobile application.
4. Use the cloud server or mobile app to process and analyze the data to look forany anomalies.

- **Ultrasonic Sensor:**

This sensor gauges the content levels within a fixed-size container using ultrasonic waves. An RFID tag associated with the container defines its size and the product it contains.An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity**.**

- **ESP 32:**

ESP32 is a chip that provides Wi-Fi and Blutooth connectivity for embedded devices It is low cost and highly versatile microcontroller used for various applications which include wireless communication, IOT (Internet of things) devices, home automation, robotics, embedded systems.

- **Internet Connectivity (Wi-Fi):**

The system is connected to the internet via Wi-Fi. This connectivity enables the system to send notifications to users whenever the weight of a product falls below the predefined threshold level.

JAVASCRIPT:

One programming language that is crucial to web development is JavaScript, particularly when it comes to making interactive web apps. JavaScript is used in the following ways while creating web-based platforms: UI Development: It enables web applications to be updated in real time using data that is received in real time from ESP-32 and the cloud. JavaScript facilitates the handling of real-time data.

PHP:

PHP is a server-side programming language that is free and open-source that can be used to make apps, websites, CRMs, and more. It is a general-purpose language that is extensively used and may be integrated into HTML

XAMPP SERVER:

XAMPP is an open-source, cross-platform web server solution stack package that combines Apache HTTP Server, MariaDB (MySQL), PHP, and Perl into a convenient, all-in-one package. Designed for

local development and testing purposes, XAMPP simplifies the setup of a web server environment on Windows, macOS, and Linux systems. It offers developers a quick and easy way to create a local server environment for building and testing web applications before deployment to a production server. With its pre-configured components, XAMPP provides a straightforward solution for those looking to develop websites or web applications in a local environment without the hassle of individually installing and configuring each component.

ESP-32:

The ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. It offers various modules like ESP32-WROOM-32, ESP32-SOLO-1, ESP32-WROVER-IE, and more, each with specific features and capabilities1. The ESP32 chip provides Wi-Fi and Bluetooth connectivity for embedded devices, making it ideal for IOT applications. It features a single core Tensilica Xtensa LX6 microprocessor, with newer models like the ESP32-C and -S series incorporating both single and dual-core variations using a Risc-V CPU model. The ESP32 is commonly used in mobile devices, wearable tech, and IOT applications, offering scalability and adaptability.

IV . LITERATURE SURVEY:

Sr No	Author	Paper title	Method Used	Limitations
1.	M.Chaiyaporn .al	Smart Shelf for Smart Kitchen an Internet of things initiative	The layout and functionality of the sensor-based Smart Shelf, which can gauge the variety of supermarket goods that are available.	A drone delivery system that utilizes the grocery shopping list the system generates can be integrated into the smart kitchen.
2.	C. S. Patil .al|	Smart Grocery Management System Using Internet of Things	When grocery store inventory is low, this technology notifies users in advance. It provides real-time information on the grocery store levels within the container.	We can directly place orders for the smart grocery system by using an Android application on our phones in the future.
3.	A.Pendbhaje.al	IOT In Home Grocery Management	This method that offers an improved way to handle machine-to-machine and human-to-machine interaction.	It did little more than place the orders and suggest scanning the barcode.
4.	S.Rezwan.al	IOT Based Smart Inventory Management System for Kitchen Using Weight Sensors, LDR, LED, Arduino Mega and Node MCU (ESP8266) Wi-Fi	In addition to lowering costs, large-scale production will make the design more appealing to customers.	The goal of the product is to improve its usability so that the greatest number of users can use SKI without any problems.

		Module with Website and App		
5.	B.Nagaria.al	IOT Based Inventory System for Stock Management	The cloud monitor displays a line chart that provides broad data insights. One can evaluate a real-time advancing line chart for The cloud monitor displays a line chart that provides broad data insights. Line chart that advances in real time Its capable of being load cell examined. the cell of load.	We had only produced one prototype load cell. Similar methods may also be used to develop many load cell prototypes for different grocery items in the kitchen.
6.	K.Shakthisudhan. al	" A Smart Kitchen Automation and Grocery Management System using IOT	This work is being done on a smart shopping system that grocery businesses and residences may use.	We link the system to the store owner's cloud so that deliveries may be made right to our door without even requiring us to visit the store.
7.	T.Manikandan .al	Home Groceries Management System Using IOT	Four load cells on the integrated smart kitchen shelf allow it to weigh four supermarket items at once and relay the results.	In order to transport groceries, the smart kitchen appliances may be directly connected to supermarkets and grocery stores and combined with drone delivery services.
8.	S.Palanisamy.al	Sensor Based Industrial Kitchen Foodstuffs Monitoring System	The Arduino micro controller is linked to the sensors. These sensors gather data, which is then saved in the Thing Speak cloud framework using an ESP8266 wifi module and a microcontroller.	A clever framework for basic food items that makes use of IoT is one that is affordable and simple for clients to comprehend. It does more than simply help become organized for grocery shopping.
9.	L.Kaur.al	Smart Grocery Monitoring System using Smart Sensors and IOT	A number of intelligent sensors are used in this system to track the amount of groceries. The user can rearrange the item with only one click after receiving a notice to that effect.	This will send a reminder to the consumer to repurchase the product and alert the firm each time the product is set to expire.

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V . PROPOSED SYSTEM

The architecture for the grocery store management system is shown in the diagram above. The user's phone will be connected to the cloud and device of system, and the grocery will be monitored using various firmware sensors. The UV sensor will be detect the level is going downward notice will be delivered to the user. In order to decide whether or not fill the grocery in container sensor's reading are satisfactory, the system will signal that the grocery to end and will convey this information to the user.

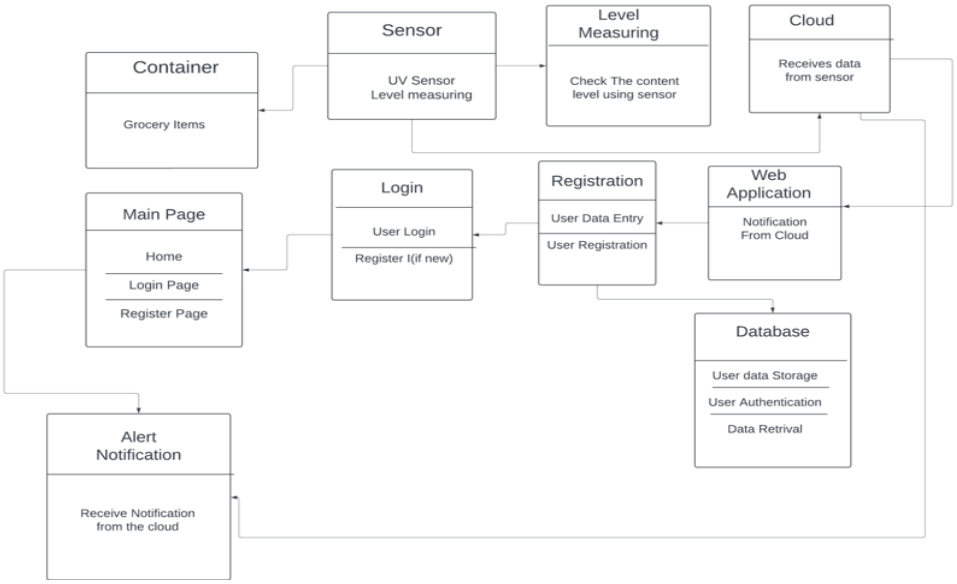

Fig no. 2.1 System Architecture

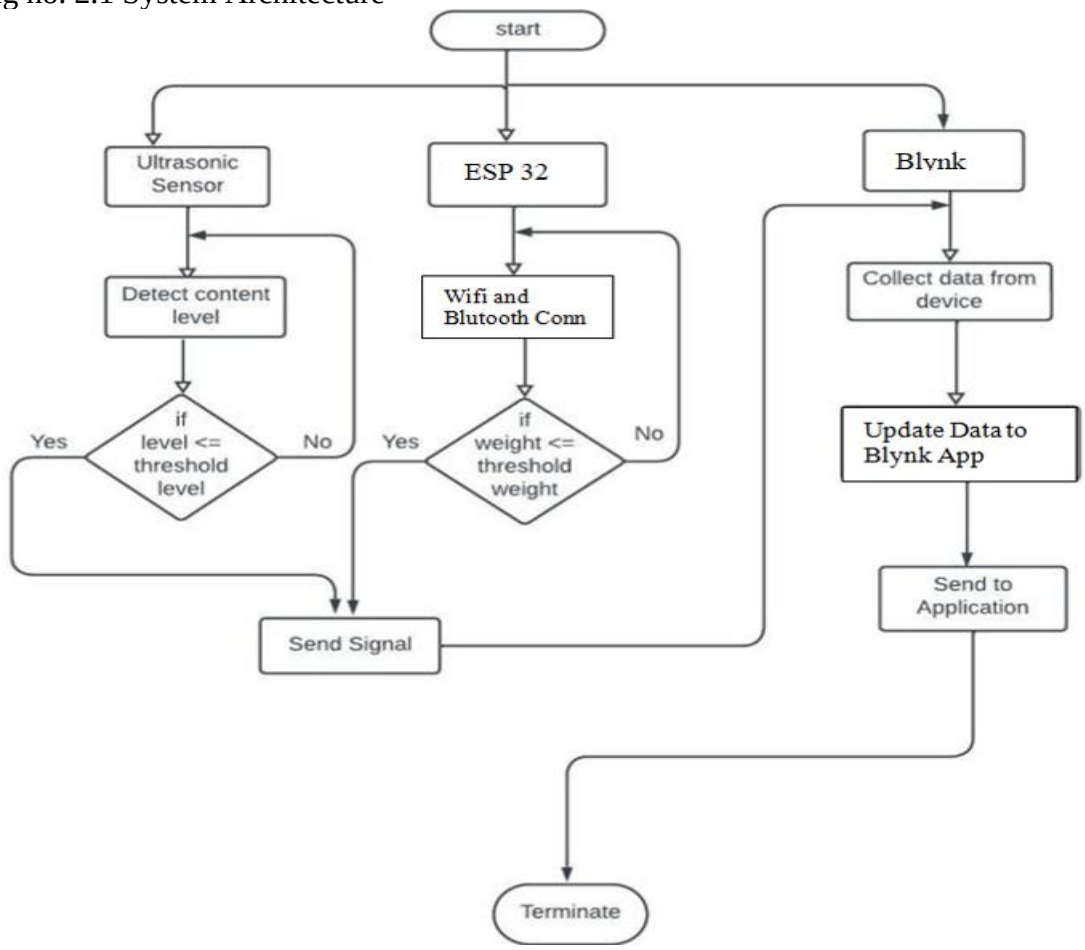

Fig no. 2.2 Data Flow Diagram

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VI . PIN DIAGRAM

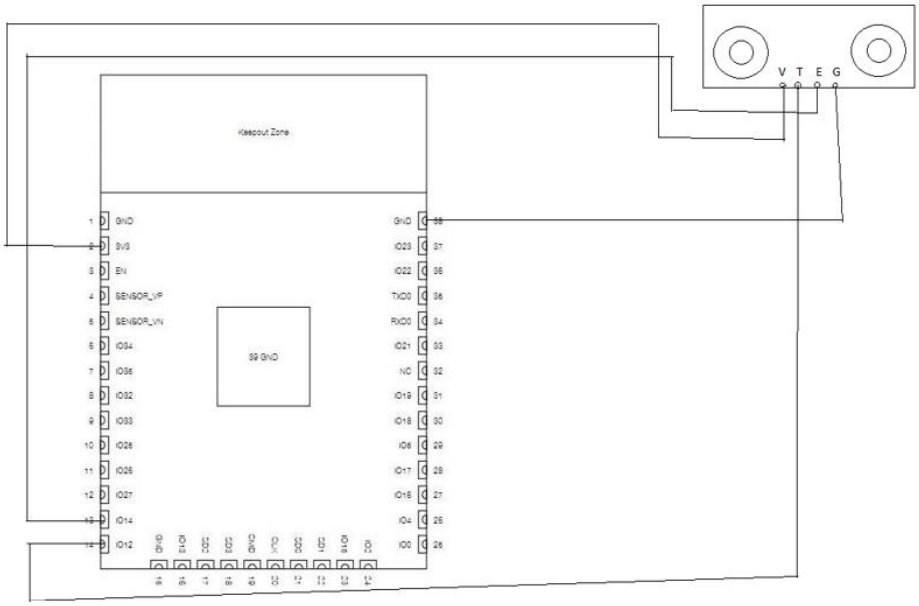

Fig no. 3.1 Pin Diagram

VII . MODELSELECTION

Waterfall Model

The waterfall model is a methodical, organized, and linear approach to the software development process. Requirements analysis, system design, development, testing, deployment, and maintenance are some of its discrete stages. Before going on to the next step, each one must be finished, with little to no overlap. The waterfall approach is appropriate for projects with well specified requirements and few anticipated changes during development because it places a strong emphasis on careful planning and documentation up front. In contrast to more iterative approaches, it may not be as adaptable to modifications made later in the project lifetime.

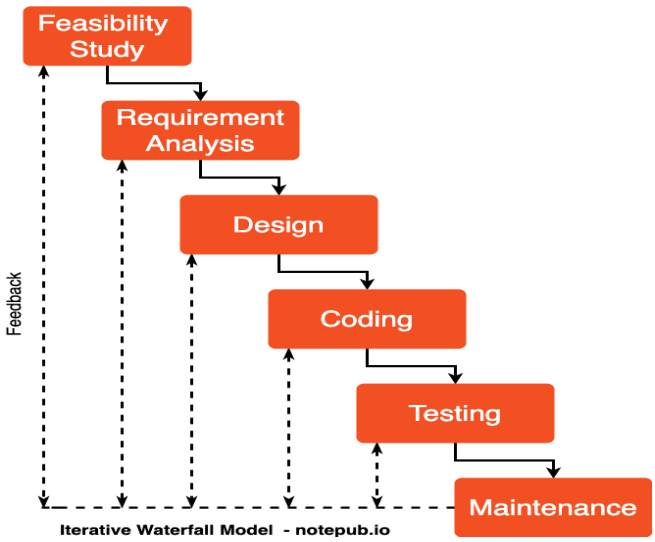

Fig no. 4.1 Waterfall Model

Feasibility Study:

This phase's primary goal is to ascertain whether developing the program would be technically and financially feasible.

The process of doing a feasibility study include analyzing the issue and coming up with creative solutions. These many related outcomes are broken down based on their advantages and disadvantages. A fashionable result is selected, and the next stages are completed in accordance with this plan.

Conditions

Phases of condition analysis and specification The goal of the demand analysis and specification step is to accurately ascertain the client's circumstances and appropriately record them. There are two distinct conditioning in this period.
collecting and analyzing demand Initially, the customer provides all requirements for the program, and those requirements are then examined. The goal of the analysis section is to eliminate gaps (a deficient demand is one in which certain factual circumstances have been overlooked) and contradictions (an inconsistent demand is one in which some requests conflict with one another).
require details A software demand specification (SRS) document contains the proof for these atomized criteria. The SRS document acts as a contract between the visitors and the development platoon.Any future disagreement between the guests and the inventors can be settled by examining the SRS document.

Design Phase

This phase's goal is to transform the SRS conditions into a format that can be decoded using a computer language. It comprises the whole software armature in addition to thorough and high-position design. In conclusion, the goal of this stage is to transform the SRS conditions into a format that can be further rendered in a computer language.

Perpetration and unit testing

In this stage, the design is put into practice.However, if the SDD is full, all the information requested by software innovators is provided in it, thus the perpetration or rendering process goes more smoothly.

Integration and System Testing

Soon after they have been unit tested and decrypted, various modules can be integrated. The integration of vibrant modules is done gradually in a number of ways. Preliminarily designed modules are introduced to the partially integrated system and the accompanying system is tested at each stage of integration. System testing is done on the completed, functional system once all of the modules have been successfully tested and integrated.

System testing consists of two different kinds of testing conditioning as described below

nascence testing

nascence testing is the system testing performed by the development platoon.

Beta testing

System testing by a group of amiable visitors is known as beta testing.Acceptance examination The client conducts acceptance testing following software delivery to decide whether to accept or reject the product.

In conclusion, this stage is very important as the success of the testing process determines the final product's quality. More precise outcomes, less expenditures associated with conservation, and happier attendees are all benefits of a better event.

Operation and conservation phase

The most crucial stage of a software life cycle is conservation. Of the overall effort required to produce a complete software, sixty percent is devoted to conservation. Three different kinds of conservation exist.

Remedial conservation This kind of conservation is done to make up for crimes that were overlooked when the product was being developed. The preservation of perfection Based on the client's desire, this kind of conservation is done to improve the system's functionality. Adaptive preservation When porting software to a new environment, such as a new computer platform or operating system, adaptive conservation is typically required. To sum up.Every stoner must carry out conservation once the program has been supplied, installed, and used by the client.

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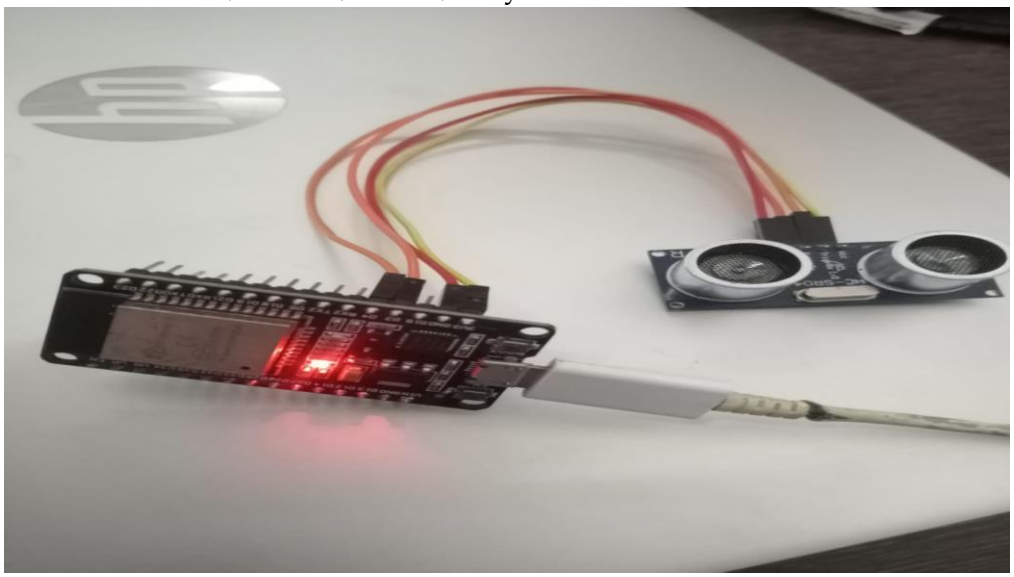
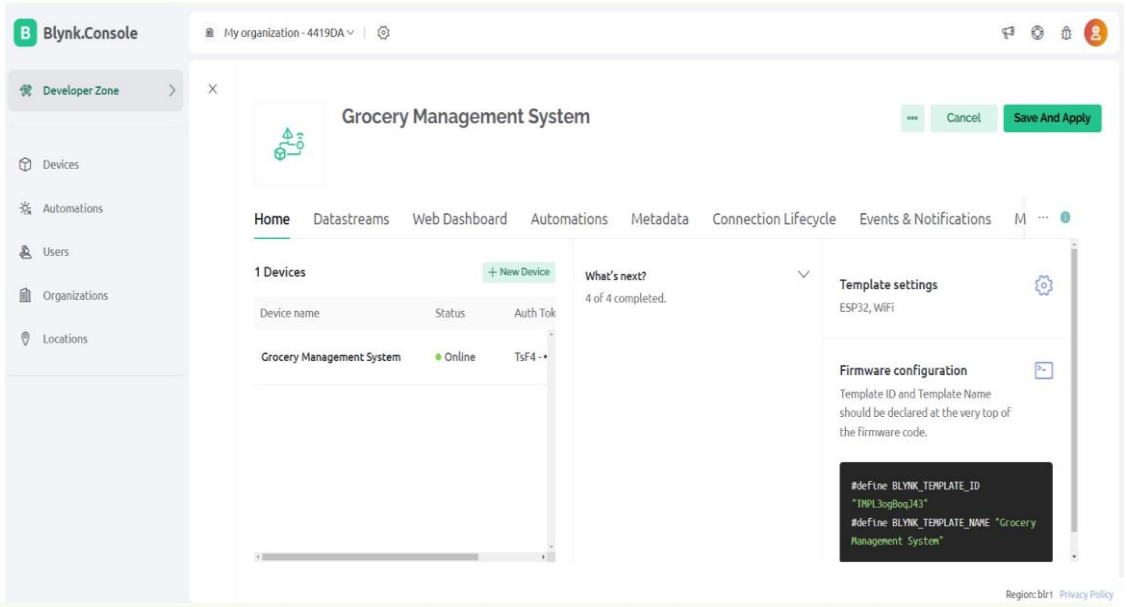
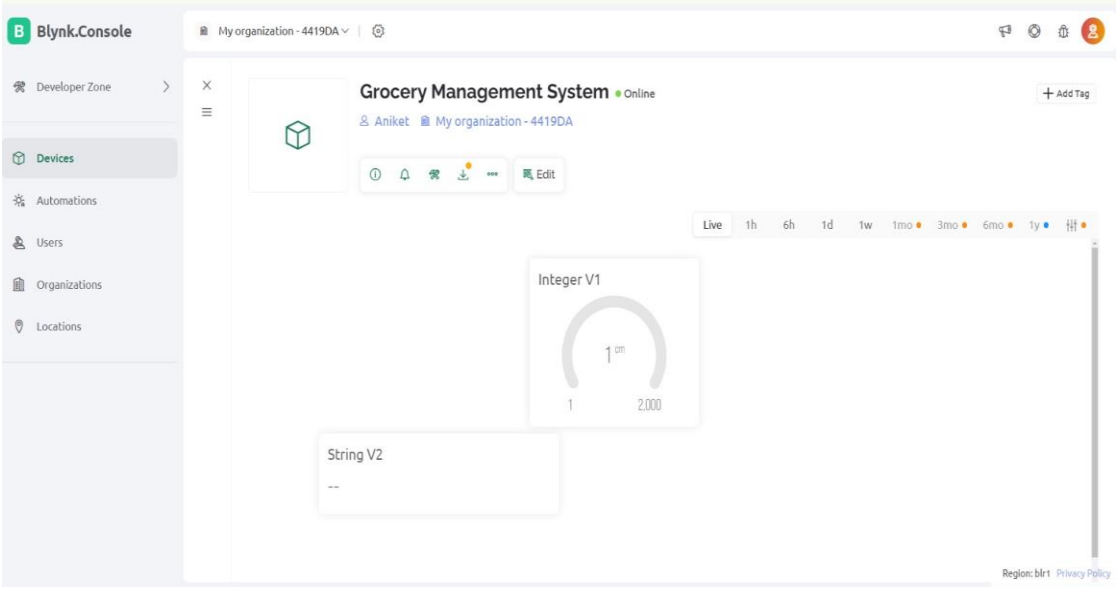


VIII . RESULTS





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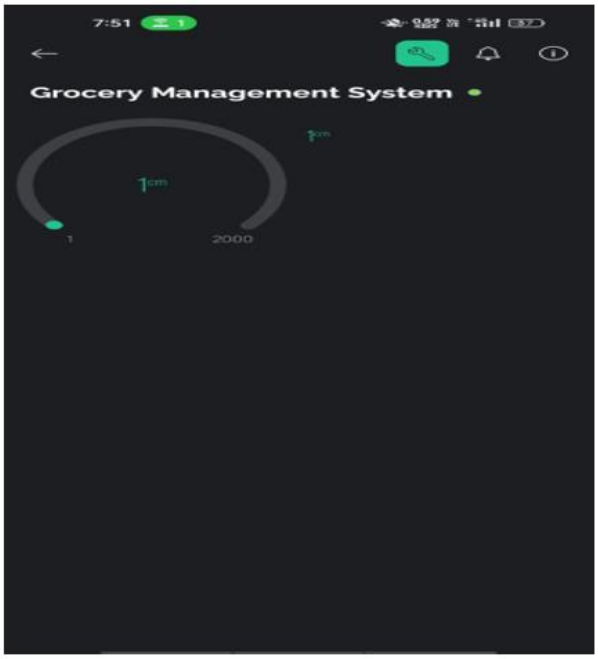

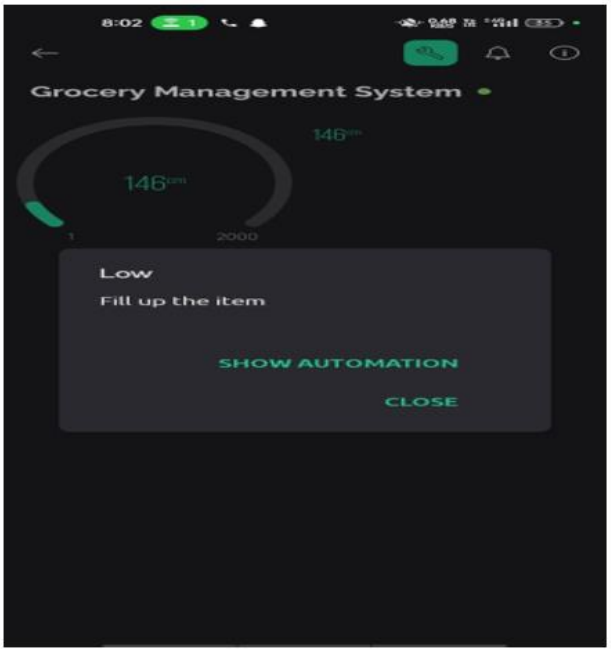

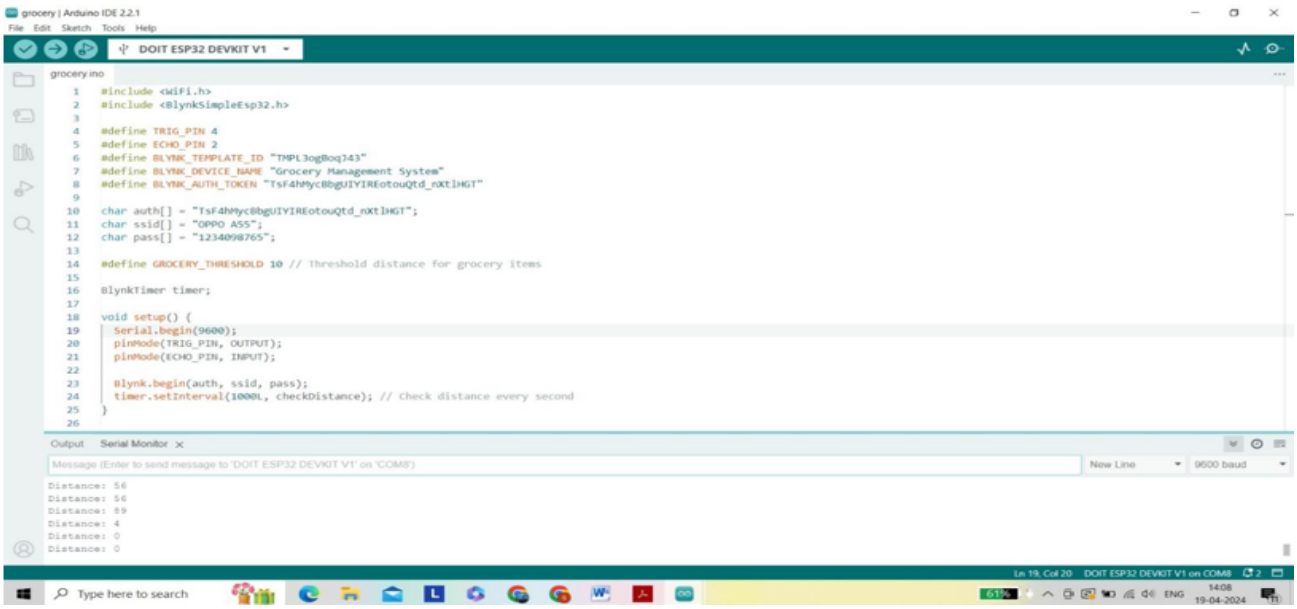

IX . CONCLUSION

After reviewing every study, we conclude that using an ESP-32, an ultrasonic sensor, and a weight sensor module will increase system accuracy and decrease the need for human labor to produce a full record of a supermarket transaction. To ensure accurate inventory monitoring, we want to achieve more exact weight measurements through the evolution of sensor technologies, which is the main emphasis of this study. At the same time, efforts are being made to lower production costs so that a greater variety of shops may more easily access these technologies, and sustainable power solutions are being investigated to limit the environmental effect of IoT devices. The convergence of cutting-edge sensor technologies, cost-effective power solutions, sustainable energy sources, and advanced data science applications will shape grocery store management systems of the future.In order to develop a comprehensive IoT-based grocery store management system (IoT-GSMS) with previously unheard-of precision, efficiency, and sustainability, this research explores the creative integration of various components. Additionally, this study explores the interrelationships between data science and the Internet of Things. The program itself has the ability to place an order once a container becomes empty. All we need to do is choose the range. It will lessen the work that humans do. Additionally,

market owners will benefit more from it.

X .**Future Scope**

Expansion of Sensor Technology: Exploring the use of additional sensor technologies such as RFID or image recognition to further enhance inventory tracking accuracy and enable more detailed product identification.

Blockchain Integration: Implementing blockchain technology to improve transparency and traceability in the supply chain, ensuring the authenticity and quality of products while reducing the risk of fraud or counterfeit goods.

Smart Packaging: Collaborating with food packaging manufacturers to develop smart packaging solutions with embedded sensors or RFID tags that can communicate with the grocery management system to track product freshness and shelf life in real-time.

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