A

PROJECT REPORT

ON

"IOT Based Smart Kitchen Wardrobe System"

SUBMITTED IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS OF DEGREE OF

BACHELOR OF ENGINEERING

BY

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2022-23

Certificate

This is to certify that the project entitled **"IOT Based Smart Kitchen Wardrobe System**" is a bonafide work of **"Viraj Dige, Shubham Patil, Pratham Surve"** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of **"Undergraduate"** in **"Computer Engineering"**.

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Project Report Approval for B. E

This project report entitled **“IOT Based Smart Kitchen Wardrobe System”** by **“Viraj Dige, Shubham Patil, Pratham Surve”** is approved for the degree of **Bachelor of Engineering in Computer Engineering**.

Examiners

1._____

2._____

Date:

Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included. We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated orfalsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Viraj Dige

Shubham Patil

Pratham Surve

Date:

Abstract

In today's world, where everything is automated, individuals generally prefer smart devices for daily use instead of manually keeping a tally of every aspect. Inventory Management is the biggest issue for restaurants, family circles, and other food chains. The IoT-based home automation system is developed and can be used in the kitchen wardrobe. Usually, the user is required to manually keep track of the item inventory in a kitchen to make necessary decisions. As a result, it is suggested to use the IoT to manage the grocery items in the kitchen wardrobe. With the help of a wireless system it can be easily achieved. In this project, WLAN is utilized in tandem with Arduino to pay attention to the kitchenware. Furthermore, an easy-to-use UI is provided with use of an Android application to keep track of the inventory remotely.

Keywords: *IoT , Home Automation , WLAN.*

Abbreviations

1. IOT:- Internet of Things
2. WLAN:- Wide Local Area Network
3. WSNs:- Wireless Sensor Network
4. RT:- Response Time
5. DT:- Distance

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Chapter 1
Introduction

Chapter 1
Introduction:

IoT (Internet of Things) based Kitchen Wardrobe Management System is a smart system designed to manage the inventory and storage of food items in a kitchen. It makes use of various IoT sensors and devices to monitor the food items stored in the kitchen wardrobe and provides an effective solution for managing and tracking the inventory. The system ensures the freshness and quality of the stored food items and helps to avoid food wastage. The main objective of this system is to provide an automated solution for managing the kitchen wardrobe inventory, which eliminates the need for manual tracking and monitoring. It provides real-time information on the availability of food items, their quantity, and expiry dates, and sends notifications to the users when a particular item is about to expire. The IoT-based Kitchen Wardrobe Management System is an innovative solution that offers a number of benefits such as efficient inventory management, reduction in food wastage, and cost savings. With the increasing demand for smart and automated solutions in the food industry, this system has the potential to revolutionize the way food items are stored and managed in a kitchen.

1.1 Background

In 2014 Bello and Zeadally, focuses on how two devices in any IOT should communicate intelligently because the quality of the information gathered depends on how smart the devices are. In IoT, different devices work on different network standard, so this can lead to several networks challenges & this cannot be solved by traditional routing protocols. So this paper proposed state-of-the-art routing algorithms, which can help to achieve an intelligent D2D communication in the IoT. In the year 2016 Sun et. Al proposed that one can use IoT to make a network of various connected devise and smart sensors, so that this network can able to remember the past & plan for the future.

1.2 Relevance

Food management is very important in the kitchen these days. In the daily schedule, it is not possible to remember the number of items left in the kitchen and the status of each item.
The kitchen is one of the important places in a house. The safety factor is the main aspect that must be taken into account during the activity in the kitchen.
The main motto of this project is to make a prototype of an **IoT Based Smart Kitchen** using

the **Internet of Things**. The system uses multiple sensors, relays & NodeMCU, ESP8266 Board. We can monitor all the sensor data on **Applications**. We can also send the command from App to control Kitchen Appliances.

1.3 Organization of Report

The material presented in the report is organized into nine chapters. After this introductory chapter 1,

Chapter 2 describes the “Literature Survey” which shows an existing system, proposed system, and the problem statement of the work.

Chapter 3 summarizes the software requirement that would be recommended for the effortless working of the program. The specifications of the program are enlisted in brief.

Chapter 4 explains the plan of the project and a thorough explanation of the resources required and used in the program for the proper working of the programs

Chapter 5 and Chapter 6 represent the infrastructure of the module.

Chapter 7 and chapter 8 represents Implemented System and Result analysis respectively.

Chapter 9 represents conclusion and future scope of the project.

Chapter 2

Literature Survey

2.1 Related Work

In recent years, there has been a growing interest in the development of IoT-based systems for smart home applications, including smart kitchen management systems and wardrobe management systems.[1] Various projects and research studies have been conducted on this topic, including Despite the significant progress in this field, there are still some limitations and challenges that need to be addressed, such as privacy concerns, security issues, and interoperability of different IoT devices.[2] Therefore, the proposed IoT based Kitchen Wardrobe Management System aims to address these limitations by utilizing a secure and privacy-preserving architecture that is compatible with a wide range of IoT devices and technologies.[3]

2.2 Existing System

In embedded system with the advancement in Internet technologies and Wireless Sensors Networks, such monitor the level of the particular container.[4] In this existing system measures some of the parameters, but I can take various parameters which is important in kitchen monitoring system.[5] The previous existing system used GPRS model for network connection and for transferring the data to the server or an application which was very expensive and the rate of data transfer is slow so to overcome this issue we are using wifi module. To make the process faster.[6]

2.3 Problem Statement

The kitchen is an essential part of every household, and managing the kitchen wardrobe inventory is a crucial task. Often, the kitchen staff finds it challenging to keep track of the inventory items and their usage. This leads to overstocking or under stocking of items, which in turn results in wastage of food items and money.

To overcome this challenge, an IoT based kitchen wardrobe management system can be developed. The system will allow the kitchen staff to monitor the inventory levels in real-time and generate alerts when the stock levels reach a certain threshold. The system will also allow the kitchen staff to manage the inventory items efficiently by tracking their usage and placing orders for new items when required. The IoT based kitchen wardrobe management system will consist of various sensors and devices that will collect data on inventory levels, usage, and orders. The system will also have a user interface that will allow the kitchen staff to view and manage the inventory items. The system will ensure efficient inventory management, reduce food wastage, and save costs.

2.4 Summary Table

Table. 2.1 Summary Table

Sr. No	Paper Name	Author Name	Description	Limitations
1	Smart kitchen system based on IOT [1]	Dhanwant Patil	System provides Smart Shopping using Internet of Things (IoT). The abovementioned smart containers are used to collect the data about grocery level. The sensors are connected to each container to track its grocery level.	This paper describes a conceptual design of a smart kitchen cabinet. This system incorporates grocery item identification
2	Kitchen monitoring system using web server [2]	Amita Thakare	This paper describes a conceptual design of a smart kitchen cabinet. This system incorporates grocery item identification	This paper describes a conceptual design of a smart kitchen cabinet.
3	Home Grocery Management [3]	Akshay Pendbhaje	A system is developed and implemented in metro subways of Japan city. A virtual supermarket is built in metro subways in Japan in a way that there are 2d codes of different products.	This paper describes a conceptual design of a smart kitchen cabinet.
4	Design of smart kitchen management system using IOT [4]	Pushpanjali MK Suman R	The system is divided into parts where the sensors are installed. It builds the solution on the idea of a smart refrigerator with built-in processors.	This paper describes a conceptual design of a smart kitchen cabinet.

Chapter 3

Requirement Gathering

3.1 Software and Hardware Requirements

Here we will discuss everything we will need in order to execute. Below we list the necessary

1. Software Requirements:

Arduino IDE

Android Studio

PyCharm

2. Hardware Requirements:

Ultrasonic Sensor

Microcontroller

Arduino-UNO

NodeMCU

ESP8266 Board

Chapter 4
Plan Of Project

4.1 Methodology

The methodology for IoT based Kitchen Wardrobe Management System can be divided into the following steps:

1. **Requirement gathering:** In this step, the requirements for the system are identified by analyzing the problem statement and discussing with stakeholders.
2. **System design:** Based on the requirements, the system architecture and design are created. This includes the selection of appropriate IoT devices, sensors, and communication protocols.
3. **Hardware and software implementation:** The hardware components of the system are selected and integrated with the software components. The software components include the firmware for the IoT devices, middleware for communication, and the application software.
4. **Testing:** The system is tested to ensure that it meets the requirements and is functioning as expected. This includes testing for reliability, usability, and security.
5. **Deployment and maintenance:** The system is deployed and made available to users. Maintenance activities are carried out to ensure that the system continues to function optimally over time. This includes software updates, hardware upgrades, and periodic testing.
6. **Evaluation:** The system is evaluated in terms of its effectiveness, efficiency, and usability. Feedback from users is collected to identify areas for improvement and future enhancements.

Overall, the methodology for IoT based Kitchen Wardrobe Management System involves a systematic approach to designing, implementing, and maintaining a system that can improve the management of kitchen wardrobes.

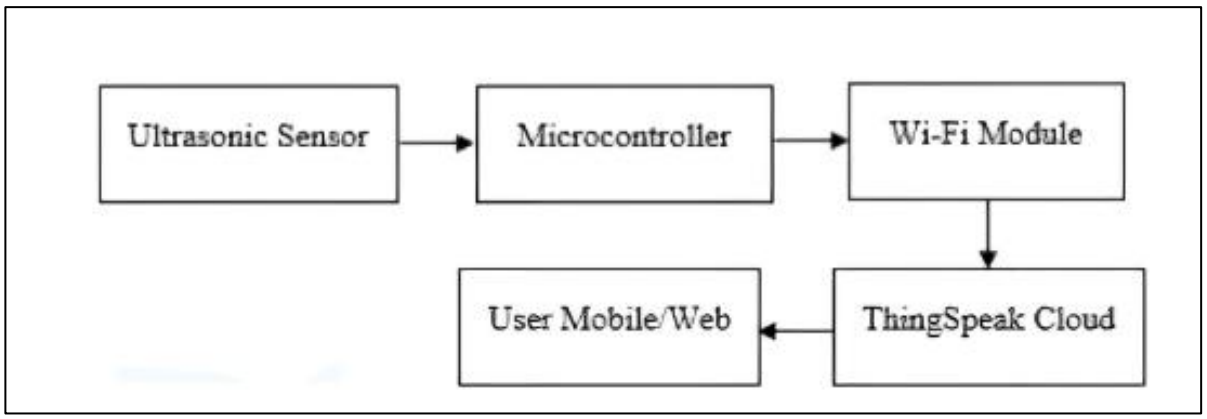

Figure 4.1 . Methodology

4.2 Project Plan (Gantt chart)

A Gantt chart, commonly used in project management, is one of the most popular and useful

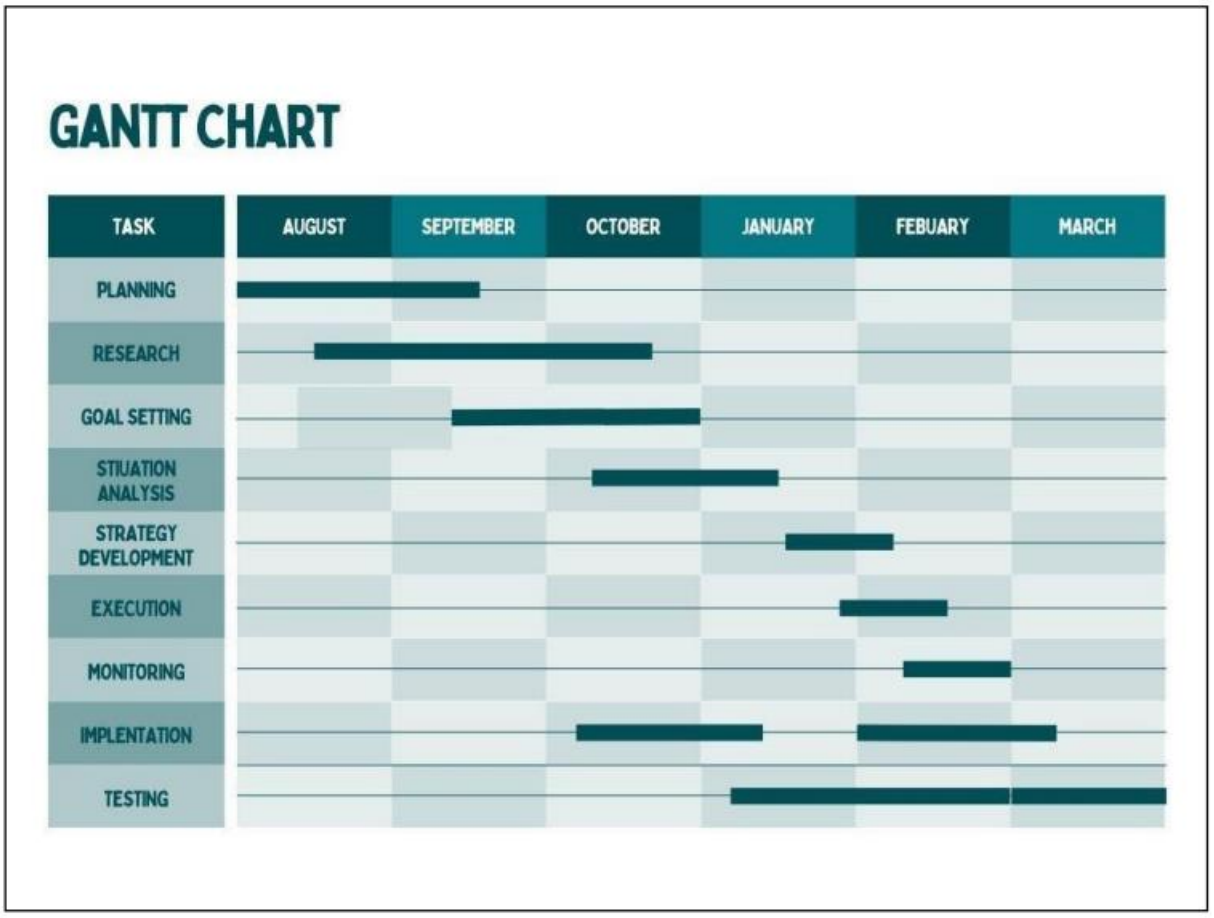

Figure 4.2: Gantt chart

4.3 Proposed System

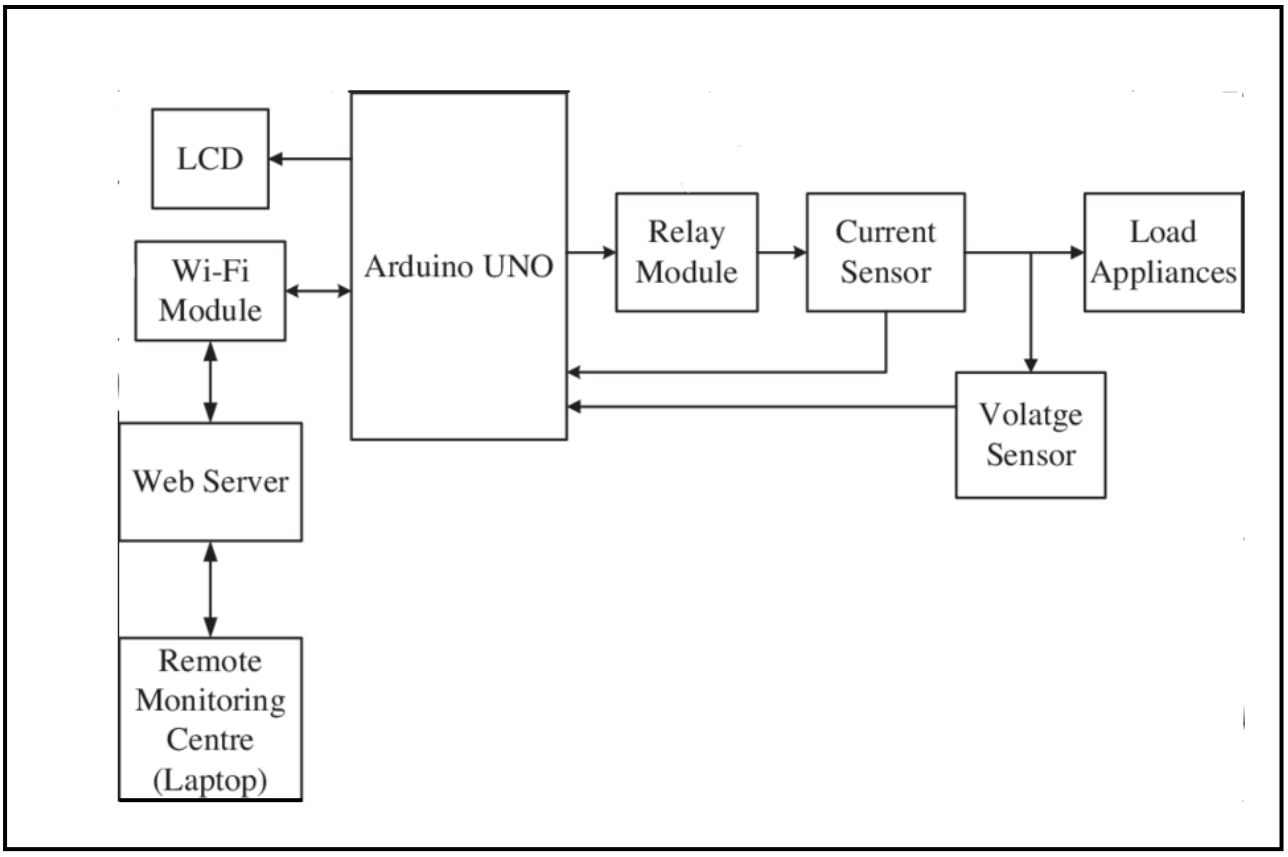

Figure 4.3: Proposed System

The proposed system for IoT-based Kitchen Wardrobe Management System is designed to provide an efficient and convenient way to manage the kitchen wardrobe. It is an innovative solution that uses the Internet of Things (IoT) technology to automate the process of inventory management and make it more efficient. The system consists of a set of ultrasonic sensors that are installed in the kitchen wardrobe. These sensors detect the presence of objects and send the data to a microcontroller. The microcontroller processes the data and sends it to a cloud server through a Wi-Fi module. The cloud server stores the data and provides access to the user interface. The user interface is a web-based application that can be accessed from any device with an internet connection. It displays the inventory status of the kitchen wardrobe in real-time and allows the user to add, remove or update items in the inventory. The system also sends notifications to the user when the inventory is running low or when an item is about to expire.

Chapter 5
Project Analysis

5.1 Use case Diagram

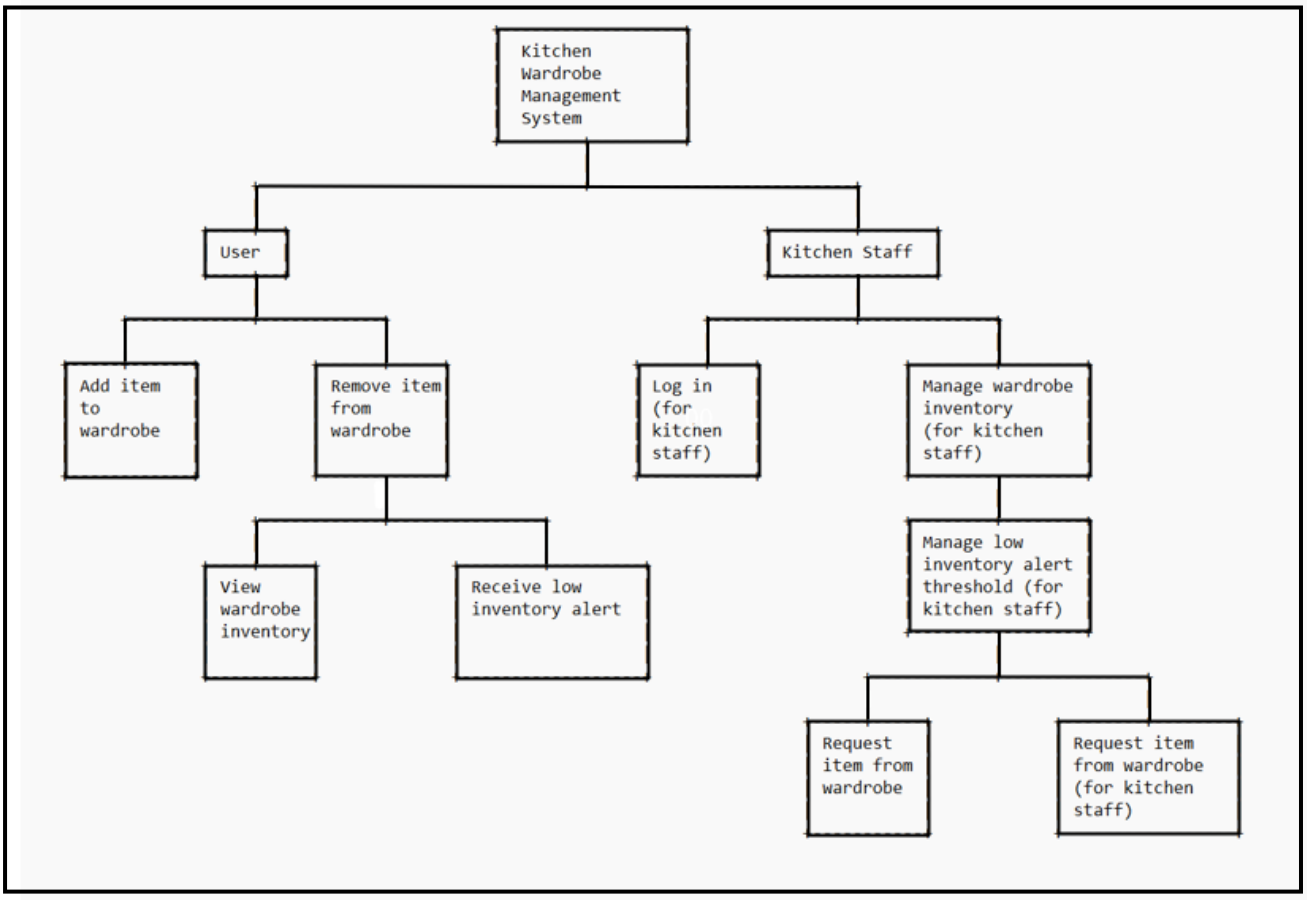

Figure 5.1: Use case diagram

In this use case diagram, there are two types of users: the regular user and the kitchen staff. The regular user can perform actions like adding or removing items from the wardrobe, viewing the inventory, and receiving low inventory alerts.

The kitchen staff can perform additional actions such as logging in and out, managing the inventory, and adjusting the low inventory alert threshold. Both types of users can request items from the wardrobe.

This use case diagram provides an overview of the system's functionalities and the actors involved in it.

5.1.1 Use Case Document

1 Use Case Name: Add Item to Wardrobe Actors: Kitchen Staff Brief Description: This use case describes how the kitchen staff adds a new item to the kitchen wardrobe.

2 Preconditions:

   a. The kitchen staff has logged into the system.
   b. The kitchen wardrobe is connected to the system.

3 Basic Flow:

   a. The kitchen staff selects the "Add Item" option from the system menu.
   b. The system prompts the kitchen staff to enter the details of the new item, such as item name, quantity, and location in the wardrobe.
   c. The kitchen staff enters the details and clicks the "Add" button.
   d. The system verifies the entered details and adds the new item to the wardrobe inventory.

5.1.2 Use case Analysis:

1. Use case: Add Item to Wardrobe Actors: User (Kitchen Staff) Description: This use case describes how the user (kitchen staff) adds an item to the wardrobe.

2. Preconditions:
   User must be logged in
   The wardrobe must have free space for the item

3. Basic Flow:
   i. User selects the "Add item to wardrobe" option.
   ii. System prompts the user to enter the item details (name, quantity, etc.).
   iii. User enters the item details.
   iv. System checks if there is enough space in the wardrobe.
   v. If there is enough space, system adds the item to the wardrobe and updates the inventory.
   vi. If there is not enough space, system notifies the user that the wardrobe is full.

5.2 Activity Diagram

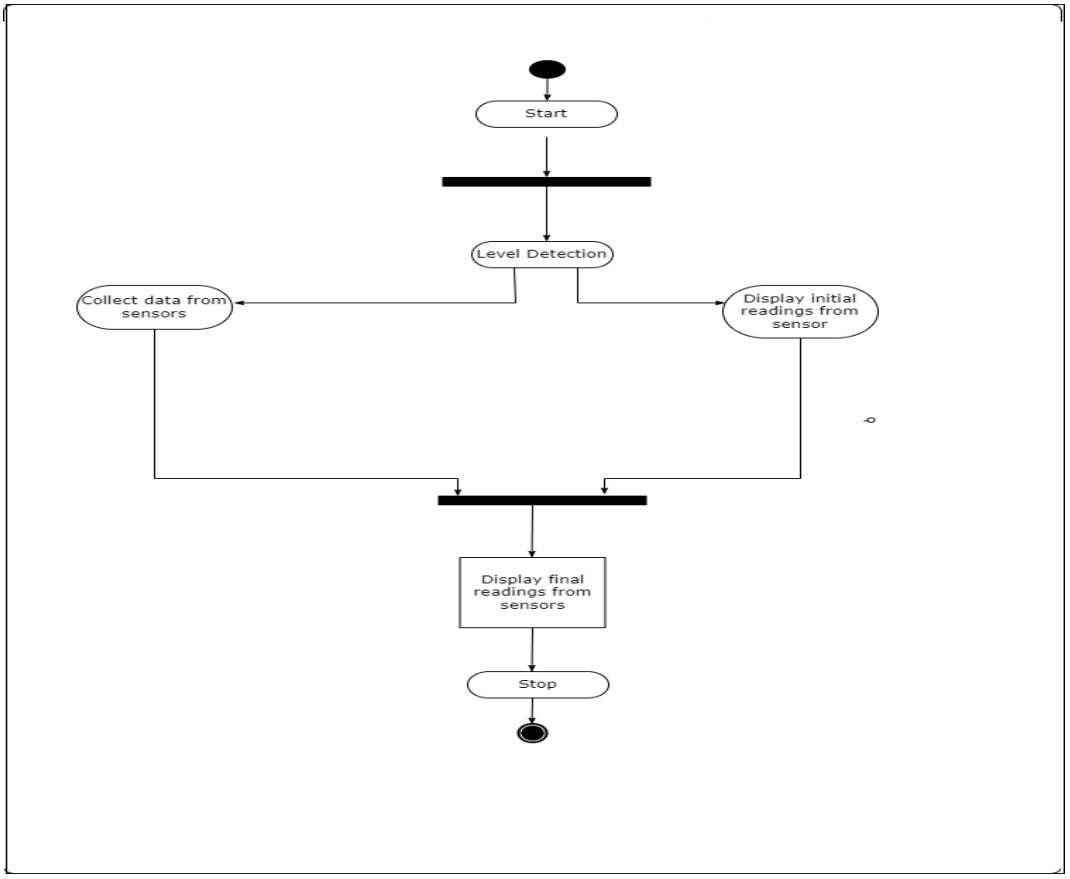

Figure 5.2: Activity Diagram

The above activity diagram for the IoT based Kitchen Wardrobe Management System shows the sequence of activities performed by the user to manage the kitchen wardrobe inventory using the system. The process begins when the user logs into the system with their credentials.

After logging in, the user has the option to either add an item to the wardrobe or view the current inventory. If the user chooses to add an item, they will be prompted to enter the details of the item, including its name, quantity, and category. The system will then add the item to the inventory.

If the user chooses to view the inventory, the system will display a list of all the items in the wardrobe along with their respective details. The user can then select a specific item from the list to view its details or edit its information.

If the user chooses to edit an item's information, they will be prompted to enter the updated details. The system will then update the item's information in the inventory.

The user also has the option to request an item from the wardrobe. To do this, they select the option to request an item and provide the necessary details, such as the item's name and quantity. The system will then send a notification to the kitchen staff to fulfill the request.

Finally, if the user wants to log out of the system, they can select the option to do so, and the system will end the session.

5.3 Class Diagram

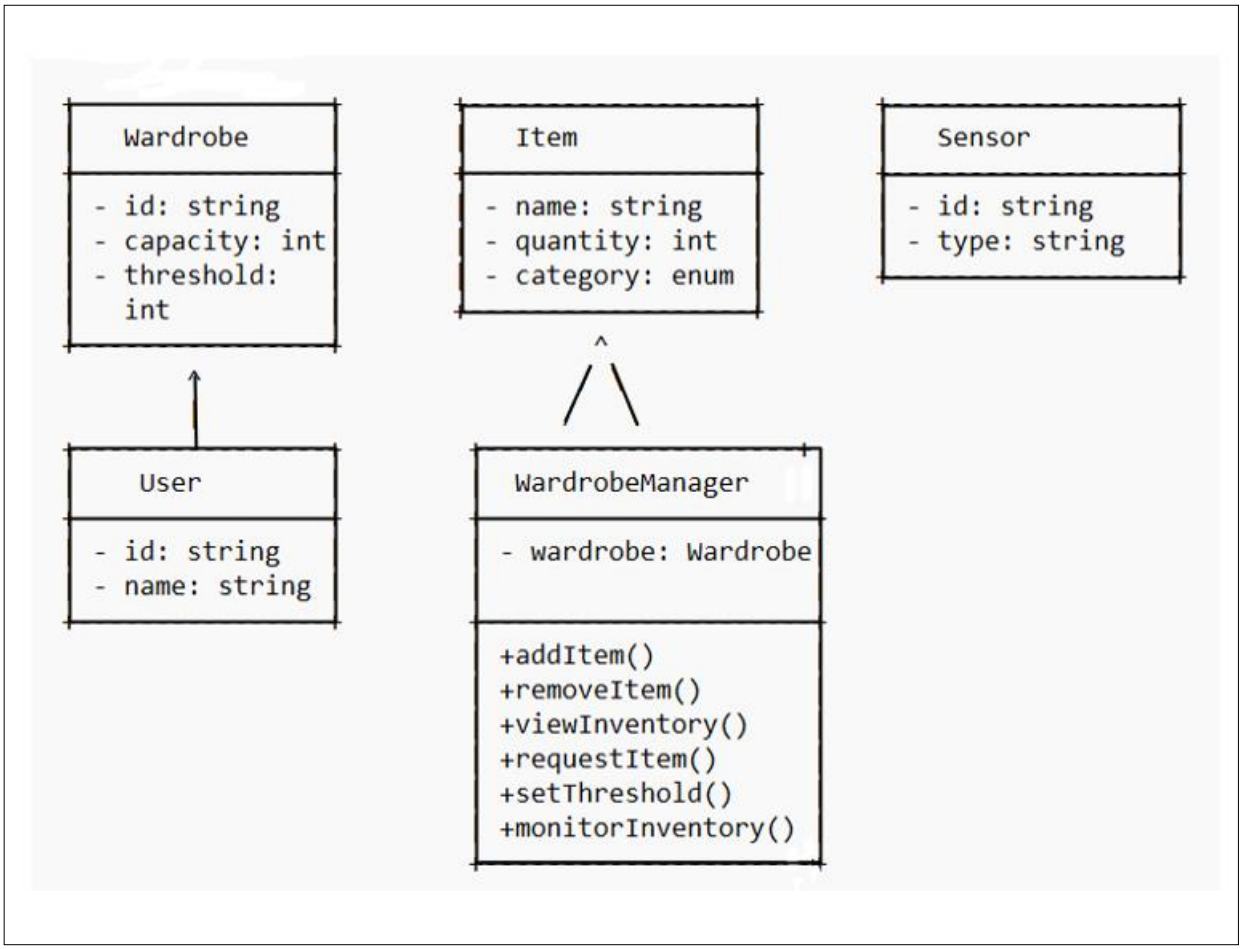

Figure 5.3 Class Diagram

The class diagram for IoT based Kitchen Wardrobe Management System represents the static structure of the system. It shows the classes, their attributes, and the relationships between them.

In the class diagram for IoT based Kitchen Wardrobe Management System, we have the following classes:

User: Represents a user of the system who can access the kitchen wardrobe and manage its inventory.

Item: Represents an item that can be stored in the kitchen wardrobe. It has attributes like name, quantity, and expiry date.

Kitchen Wardrobe: Represents the kitchen wardrobe entity, which has a collection of items.

Sensor: Represents the sensors that are installed in the kitchen wardrobe to monitor its inventory and send data to the system.

Inventory Alert: Represents the class responsible for generating alerts when the inventory level of any item goes below a certain threshold.

Notification: Represents the notification class, which sends alerts to the user when the inventory level of

any item goes below a certain threshold.

Database: Represents the database that stores all the data related to items, inventory levels, and alerts.

IoT Device: Represents the IoT devices used to access the system and manage the kitchen wardrobe inventory.

The relationships between the classes are as follows:

1. User has a relationship with Kitchen Wardrobe, as the user can access and manage the kitchen wardrobe inventory.
2. Kitchen Wardrobe has a composition relationship with Item, as the items are a part of the kitchen wardrobe entity.
3. Kitchen Wardrobe has an association relationship with Sensor, as the sensors are used to monitor the inventory levels of the kitchen wardrobe.
4. Inventory Alert has an association relationship with Kitchen Wardrobe, as it needs to access the inventory levels to generate alerts.
5. Notification has a dependency relationship with Inventory Alert, as it is dependent on the alerts generated by Inventory Alert to send notifications.
6. IoT Device has an association relationship with User, as the user can access the system using IoT devices.
7. IoT Device has an association relationship with Sensor, as the sensors are installed in the kitchen wardrobe and are used to collect data.
8. The class diagram for IoT based Kitchen Wardrobe Management System provides a high-level overview of the system, its entities, and their relationships. It is a critical tool for understanding the static structure of the system and for designing the software architecture.

5.4 Sequence Diagram

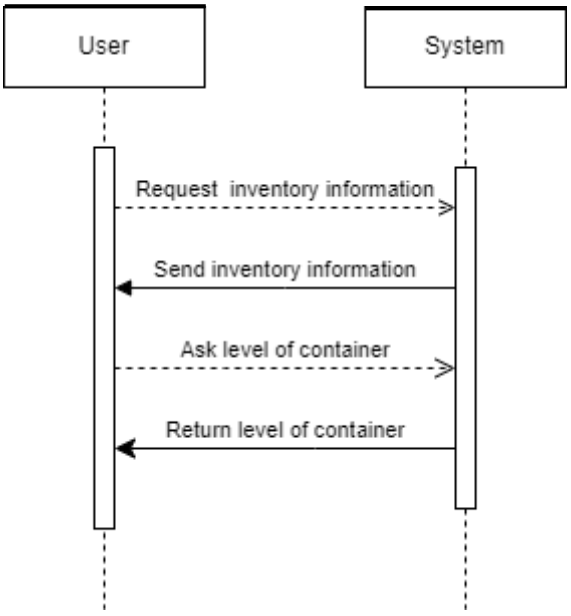

Figure 5.4 Sequence Diagram

The sequence diagram depicts the interactions between different objects in the IoT-based Kitchen Wardrobe Management System. It shows the sequence of messages and method calls exchanged between the objects involved in the system.

The sequence diagram starts with the user requesting to log in to the system. The user object sends a login request to the kitchen staff object, which is responsible for authenticating the user's credentials.

Once the user is successfully logged in, the user object sends a request to view the wardrobe inventory to the kitchen staff object. The kitchen staff object then retrieves the inventory data from the wardrobe inventory object and sends it back to the user object.

If the user wants to add a new item to the wardrobe inventory, the user object sends a request to the kitchen staff object to add the item. The kitchen staff object then adds the item to the wardrobe inventory object and sends a confirmation message back to the user object.

If the wardrobe inventory reaches a low inventory threshold, the wardrobe inventory object sends an alert message to the kitchen staff object. The kitchen staff object then sends a notification message to the user object to inform them of the low inventory status.

Finally, if the user wants to request an item from the wardrobe inventory, the user object sends a request message to the kitchen staff object. The kitchen staff object then retrieves the requested item from the wardrobe inventory object and sends it back to the user object.

Chapter 6
Project Design

6.1 Data Flow diagram

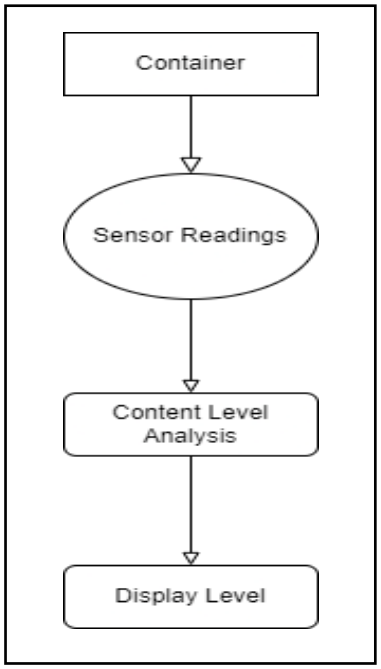

Figure 6.1.1 DFD Level 0

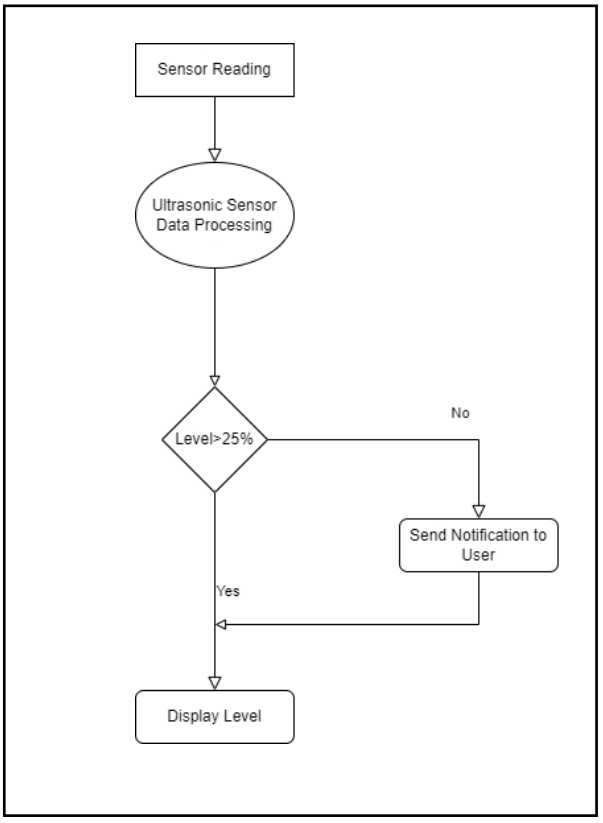

Figure 6.1.2 DFD Level 1

The data flow diagram (DFD) for IoT-based Kitchen Wardrobe Management System illustrates the flow of data in the system, including inputs, processes, and outputs. It is a graphical representation of the system's data flow that shows how data moves through different stages of the system.

In this system, the primary inputs are the sensor data from the IoT devices, which are processed by the system to generate alerts and notifications for the users. The users can also request items from the wardrobe, which is recorded in the system's database.

The DFD consists of several levels each level with its own set of processes and data flows. At level 0, the system's main components are the IoT devices and the kitchen wardrobe. The ultrasonic sensor in the wardrobe detects the inventory level and sends the data to the system.

At level 1, the system's processes are broken down into sub-processes. The inventory level data is processed by the system to generate alerts and notifications for the users. The users can also request items from the wardrobe, which is recorded in the system's database.

At level 2, the system's processes are further broken down into sub-processes. The user authentication process verifies the user's credentials before allowing access to the system. The inventory management process updates the inventory database based on the requests and notifications received.

Overall, the DFD for IoT-based Kitchen Wardrobe Management System provides a comprehensive view of the system's data flow and processes, which helps in understanding the system's functionality and identifying any potential issues.

6.2 Flow Chart

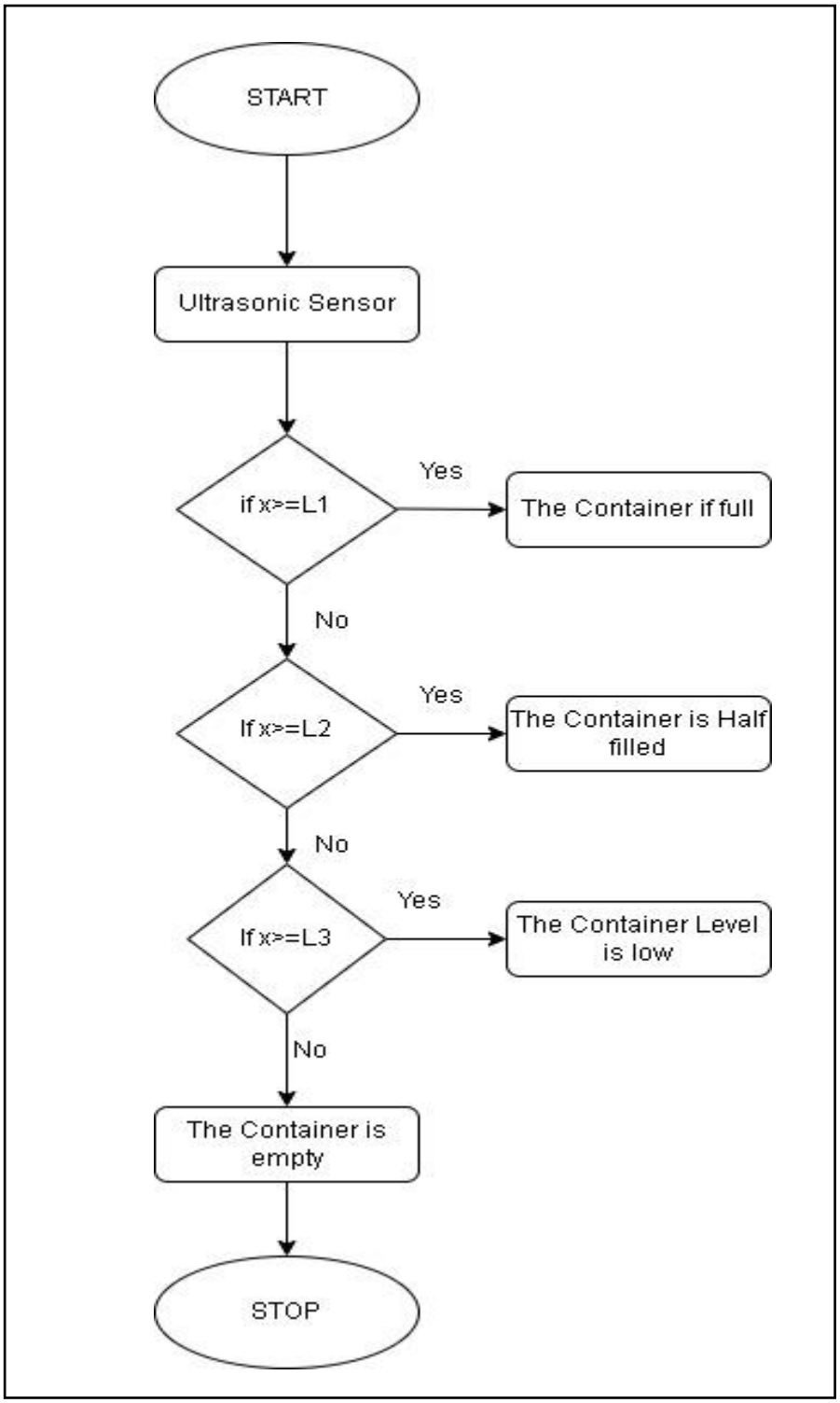

Figure 6.2 Flow Chart

A flowchart is a diagrammatic representation of a process or system that uses symbols, shapes, and arrows to illustrate the flow of steps in a particular order. The flowchart for the IoT based Kitchen Wardrobe Management System represents the different stages of the system's functioning. The flowchart starts with the initialization stage and ends with the termination stage. In between, it shows the different stages that are part of the system's functioning.

The flowchart starts with the initialization stage, where the system is set up for use. The next stage is the login stage, where users are required to log in before they can access the system's features. Once the user logs in, they can choose from a range of features, including adding items to the wardrobe inventory, viewing the inventory, managing the inventory, and requesting items from the wardrobe.

If the user chooses to add an item to the wardrobe inventory, they will be prompted to input the details of the item, including its name, quantity, and type. The system will then check if the item already exists in the inventory, and if it does not, it will add the new item to the inventory.

If the user chooses to view the inventory, the system will display the details of all items in the inventory. The user can then choose to filter the items based on their type or other criteria.

If the user chooses to manage the inventory, they will have the option to set a low inventory alert threshold. The system will then monitor the inventory levels and send an alert if the threshold is reached.

If the user chooses to request an item from the wardrobe, they will be prompted to input the details of the item they require, including its name and quantity. The system will then check if the item is available in the inventory, and if it is, it will mark the item as reserved and notify the user. The flowchart ends with the termination stage, where the user logs out of the system..

Chapter 7
Implemented System

7.1 System Architecture

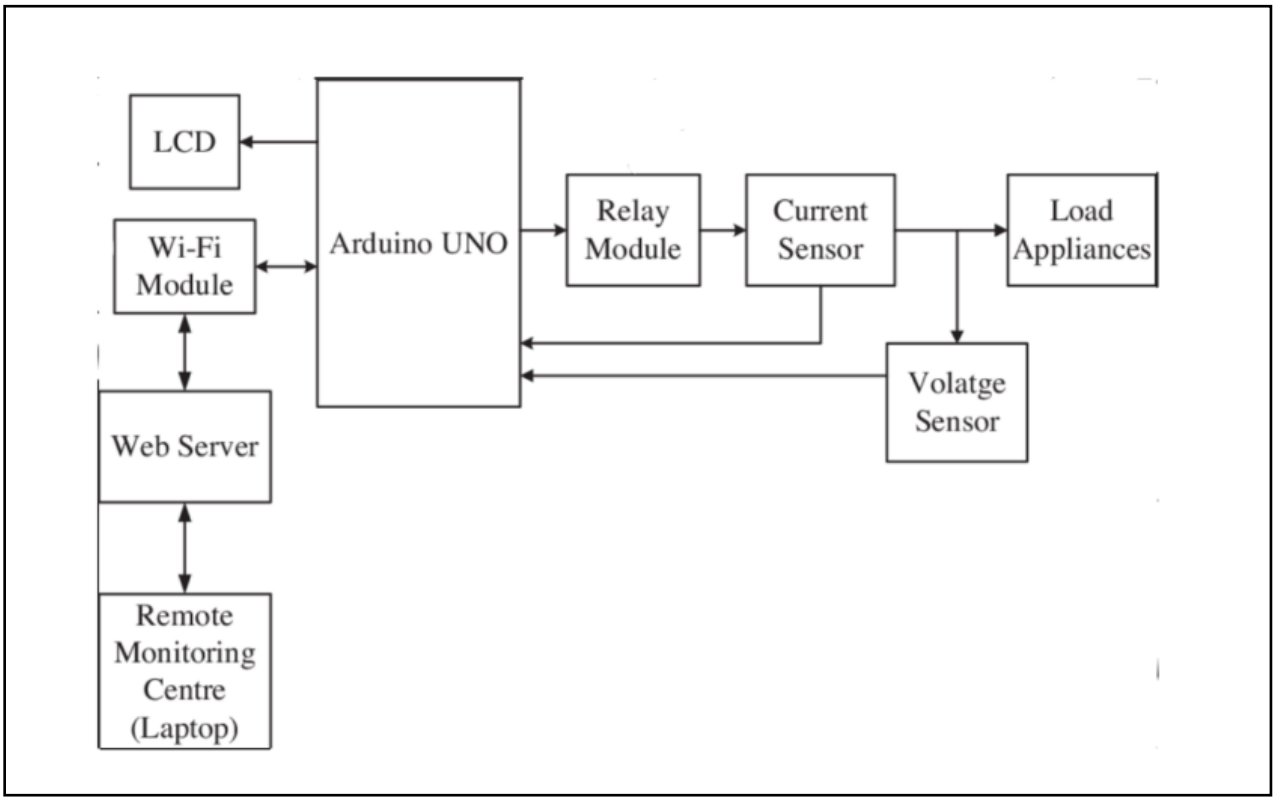

Figure 7.1: System Architecture

The system architecture for IoT-based Kitchen Wardrobe Management System would typically include the following components:

1. **Sensors:** Ultrasonic sensors or weight sensors can be used to detect the quantity of items present in the kitchen wardrobe. Ultrasonic sensors are a type of distance sensor that uses ultrasonic sound waves to measure the distance between the sensor and an object. In the context of IoT-based Kitchen Wardrobe Management System, ultrasonic sensors can be used to detect the distance between the shelves of the wardrobe and the items stored on them. The sensor emits a high-frequency sound wave that bounces off the item and returns to the sensor. The time it takes for the sound wave to return to the sensor is used to calculate the distance.

   Ultrasonic sensors have several advantages for use in the Kitchen Wardrobe Management System. They are relatively inexpensive and easy to install. They are also non-intrusive and do not require physical contact with the items being measured.

2. **Microcontroller:** A microcontroller can be used to interface with the sensors and perform the necessary computations for the system to function. In an IoT based Kitchen Wardrobe Management

System, microcontrollers are an important component. Microcontrollers are small computer chips that contain a microprocessor, memory, and input/output peripherals. They are used to control various aspects of the system, including the sensors, actuators, and communication modules. In the Kitchen Wardrobe Management System, the microcontroller is responsible for controlling the ultrasonic sensors that detect the presence of items in the wardrobe. The microcontroller receives the data from the sensors and processes it to determine if an item is present or not. It also controls the communication modules that transmit the data to the cloud server.

3. **Connectivity:** The microcontroller can be connected to the internet using protocols such as Wi-Fi, Bluetooth, or Zigbee to communicate with the server. Connectivity is a crucial aspect of the IoT-based Kitchen Wardrobe Management System as it enables communication between various components of the system. In this system, there are three main types of connectivity:
   Sensor Connectivity: The sensors used in the system, such as the ultrasonic sensors, are connected to the microcontroller through wired or wireless interfaces. The microcontroller reads the sensor data and processes it to make decisions about the wardrobe inventory.
   Internet Connectivity: The microcontroller is connected to the internet using a Wi-Fi module or a GSM module. This allows the system to send inventory data to a cloud server and receive commands from a remote user interface.
   User Interface Connectivity: The user interface is typically a mobile application or a web application that allows the user to view the wardrobe inventory, request items, and receive alerts. The user interface communicates with the cloud server using an internet connection.

4. **User Interface:** A web or mobile-based user interface can be provided to the user to view the inventory levels and request for items.
   The user interface for IoT based Kitchen Wardrobe Management System is the front-end of the system that provides a platform for the users to interact with the system. It includes all the components that the user interacts with, such as screens, buttons, forms, and other input and output components.
   The main objective of the user interface is to make the system user-friendly and easily accessible for the users. It should be designed in such a way that users can easily navigate through the system, access the required information and perform the desired actions.

5. **Notifications:** The system can also send notifications to the user in case of low inventory levels or when an item is requested.

There can be several types of notifications such as low inventory alerts, item requests, item addition or removal alerts, and system error notifications. These notifications can be sent through various mediums such as SMS, email, or mobile application notifications.

The system can be designed to automatically send notifications to the kitchen staff and the system administrators based on certain pre-defined rules and thresholds. For example, if the inventory of a particular item falls below a certain threshold, the system can automatically send a low inventory alert notification to the kitchen staff and the system administrators. Similarly, if a user requests a certain item, the system can send a notification to the relevant kitchen staff member to fulfill the request.

7.2 Sample code

First interface:

```
//Include the library files
#include <LiquidCrystal_I2C.h>
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

//Initialize the LCD display
LiquidCrystal_I2C lcd(0x27, 16, 2);

char auth[] = "";//Enter your Auth token
char ssid[] = "";//Enter your WIFI name
char pass[] = "";//Enter your WIFI password

BlynkTimer timer;

// Define the component pins
#define trig D7
#define echo D8
#define LED1 D0
#define LED2 D3
#define LED3 D4
#define LED4 D5
#define LED5 D6
#define relay 3

//Enter your tank max value(CM)
int MaxLevel = 20;

int Level1 = (MaxLevel * 75) / 100;
int Level2 = (MaxLevel * 65) / 100;
int Level3 = (MaxLevel * 55) / 100;
int Level4 = (MaxLevel * 45) / 100;
int Level5 = (MaxLevel * 35) / 100;

void setup() {
  Serial.begin(9600);
```

```
  lcd.init();
  lcd.backlight();
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);
  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);
  pinMode(LED3, OUTPUT);
  pinMode(LED4, OUTPUT);
  pinMode(LED5, OUTPUT);
  pinMode(relay, OUTPUT);
  digitalWrite(relay, HIGH);
  Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);

  lcd.setCursor(0, 0);
  lcd.print("Water level");
  lcd.setCursor(4, 1);
  lcd.print("Monitoring");
  delay(4000);
  lcd.clear();

  //Call the functions
  timer.setInterval(100L, ultrasonic);
}

//Get the ultrasonic sensor values
void ultrasonic() {
  digitalWrite(trig, LOW);
  delayMicroseconds(4);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);
  long t = pulseIn(echo, HIGH);
  int distance = t / 29 / 2;

  int blynkDistance = (distance - MaxLevel) * -1;
  if (distance <= MaxLevel) {
    Blynk.virtualWrite(V0, blynkDistance);
  } else {
    Blynk.virtualWrite(V0, 0);
```

```
}
lcd.setCursor(0, 0);
lcd.print("WLevel:");

if (Level1 <= distance) {
 lcd.setCursor(8, 0);
 lcd.print("Very Low");
 digitalWrite(LED1, HIGH);
 digitalWrite(LED2, LOW);
 digitalWrite(LED3, LOW);
 digitalWrite(LED4, LOW);
 digitalWrite(LED5, LOW);
} else if (Level2 <= distance && Level1 > distance) {
 lcd.setCursor(8, 0);
 lcd.print("Low");
 lcd.print("      ");
 digitalWrite(LED1, HIGH);
 digitalWrite(LED2, HIGH);
 digitalWrite(LED3, LOW);
 digitalWrite(LED4, LOW);
 digitalWrite(LED5, LOW);
} else if (Level3 <= distance && Level2 > distance) {
 lcd.setCursor(8, 0);
 lcd.print("Medium");
 lcd.print("      ");
 digitalWrite(LED1, HIGH);
 digitalWrite(LED2, HIGH);
 digitalWrite(LED3, HIGH);
 digitalWrite(LED4, LOW);
 digitalWrite(LED5, LOW);
} else if (Level4 <= distance && Level3 > distance) {
 lcd.setCursor(8, 0);
 lcd.print("High");
 lcd.print("      ");
 digitalWrite(LED1, HIGH);
 digitalWrite(LED2, HIGH);
 digitalWrite(LED3, HIGH);
 digitalWrite(LED4, HIGH);
 digitalWrite(LED5, LOW);
```

```
  } else if (Level5 >= distance) {
    lcd.setCursor(8, 0);
    lcd.print("Full");
    lcd.print("      ");
    digitalWrite(LED1, HIGH);
    digitalWrite(LED2, HIGH);
    digitalWrite(LED3, HIGH);
    digitalWrite(LED4, HIGH);
    digitalWrite(LED5, HIGH);
  }
}

//Get the button value
BLYNK_WRITE(V1) {
  bool Relay = param.asInt();
  if (Relay == 1) {
    digitalWrite(relay, LOW);
    lcd.setCursor(0, 1);
    lcd.print("Motor is ON ");
  } else {
    digitalWrite(relay, HIGH);
    lcd.setCursor(0, 1);
    lcd.print("Motor is OFF");
  }
}

void loop() {
  Blynk.run();//Run the Blynk library
  timer.run();//Run the Blynk timer
}
```

Chapter 8
Result Analysis

8.1 Result Analysis

Result analysis for IoT-based Kitchen Wardrobe Management System involves analyzing the performance of the system to evaluate its effectiveness and efficiency. The analysis can be done through various metrics such as accuracy, response time, throughput, and user satisfaction.

Accuracy refers to the correctness of the system in detecting the inventory levels of the items in the kitchen wardrobe. The accuracy of the system can be calculated by comparing the actual inventory levels with the ones reported by the system. A high accuracy rate indicates that the system can be relied on to accurately detect inventory levels.

Response time refers to the time taken by the system to detect the inventory levels and send notifications to the users. A low response time indicates that the system is efficient in detecting inventory levels and notifying users promptly.

Throughput refers to the number of inventory detections and notifications that can be processed by the system per unit time. A high throughput rate indicates that the system is capable of handling a large volume of inventory detections and notifications.

User satisfaction refers to the level of satisfaction of the users with the system's performance. This can be measured through surveys or feedback from users.

Overall, the result analysis of the IoT-based Kitchen Wardrobe Management System should demonstrate that the system is accurate, efficient, and effective in detecting inventory levels and notifying users in a timely manner, which can lead to improved inventory management and user satisfaction.

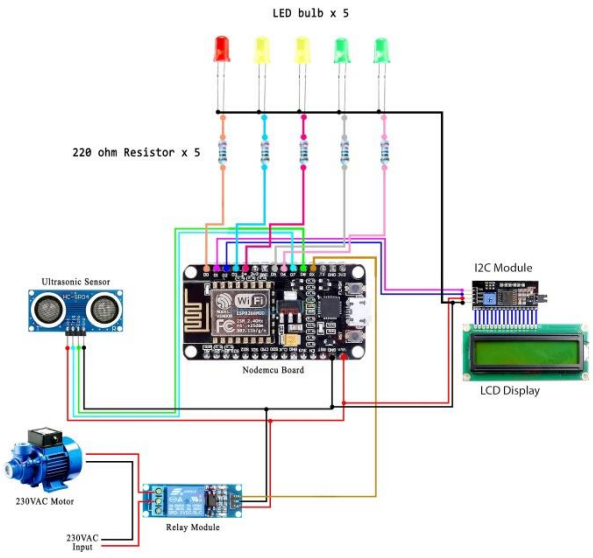

Figure 8.1: Circuit Diagram

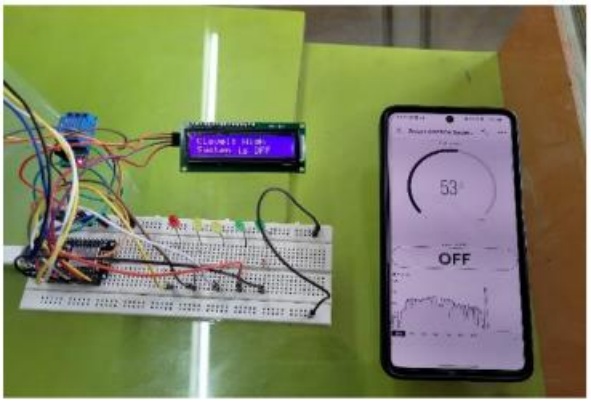

Figure 8.2: SKWMS Model

The Arduino IDE and the Blynk programmed are used in this configuration. Software developed by Arduino is called the Arduino IDE. The creation of numerous Arduino programming procedures using this application. [4]. Both the Arduino board and the ESP8266-01 are programmed using the serial monitor in the Arduino IDE. The web server for the ESP32 Cam. It is an application and webserver for building Internet of Things projects. It contains a function that enables you to maintain tabs on your possessions. It's easy to use because it simply addresses visual and graphic issues. A recording memory card slot on this machine can be utilized for security purposes in the future.

Figure 8.3: Readings

Figure 8.4: Graph of SKWMS

In the android mobile application, which can be used to make the wardrobe smarter, the user can access and scrutinize information about the most recent grocery buying plan and the number of items that need to be bought. If the product level in the receptacle is low and the amount exceeds the cutoff level, the product is added to the purchasing list and the user is informed via the mobile application. The user's automatic shopping list is created by the Android app. When the shopping list is finished, the Android application will send a push notice to the user. If necessary, the user can also update the shopping list. screenshot of the notification that the user receives via a mobile application.

Chapter 9
Conclusion And Future Scope

9.1 Conclusion

In conclusion, the IoT-based Kitchen Wardrobe Management System is an effective solution for managing kitchen inventory. The system utilizes sensors to detect and monitor the inventory levels of kitchen items in real-time. This information is then transmitted to a microcontroller which processes the data and sends alerts to the user interface to notify the user of low inventory levels. The system also provides an intuitive user interface that allows users to view and manage their kitchen inventory. Through the development and testing of the system, it was found to be an effective tool for managing kitchen inventory, reducing waste, and saving time and money. The use of ultrasonic sensors provided accurate and reliable data, and the connectivity options allowed for easy integration into existing networks. Overall, the system offers a practical and efficient solution for kitchen inventory management.

Future work can be done to expand the functionality of the system, such as integrating with smart home systems or implementing predictive analytics to forecast inventory needs. Additionally, further testing can be done to evaluate the system's performance in various kitchen environments and under different conditions.

9.2 Future Scope

Integration with Voice Assistants: One future scope could be to integrate the system with voice assistants like Amazon Alexa or Google Assistant. This would enable users to manage their wardrobe items using voice commands, making the system more user-friendly.

Mobile Application: Developing a mobile application for the system could be another future scope. This would allow users to manage their kitchen wardrobe items from their smartphones, making it more convenient and accessible.

Machine Learning and Artificial Intelligence: Implementing machine learning algorithms and AI in the system could help predict the usage patterns of the kitchen wardrobe items and optimize inventory levels accordingly.

Integration with Recipe Applications: The system could be integrated with recipe applications to provide users with real-time recommendations for items that are running low and need to be restocked.

Smart Refrigerator Integration: Integrating the system with smart refrigerators could enable the system to automatically suggest ingredients or items that need to be restocked based on the recipes the user is planning to cook.

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Thanking You,

Viraj Dige

Shubham Patil

Pratham Surve

Appendix I: List of Publication

Journal

1. Viraj Dige, Shubham Patil, Pratham Surve, Nikita Saindane, “IOT Based Smart Kitchen Wardrobe System”, International Journal of Scientific Research in Engineering & Management, April 18-2023, Volume 07, Issue-04 2023, DOI-10.55041, ISSN-2582-393. [Status : Accepted]

Appendix II: Published Paper

Smart Kitchen Wardrobe System Based on IoT

Real Time Monitoring of Kitchen through IoT

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***Abstract*—In the modern world, People generally prefer using smart devices for everyday chores rather than physically recording every detail in a world where everything is automated. Restaurants, families, and other food networks struggle with the serious problem of controlling and monitoring the food record. The kitchen closet is where the Internet of Things-based home management system was developed and put to use. Making choices and physically keeping track of the groceries in a kitchen is required. Therefore, it is advised to handle the grocery products in the kitchen pantry using the Internet of Things. It was made possible by cellular networks, mobile devices, and the internet. In this project, Nodemcu is used in conjunction with the brand-new Live Video Analysis technique to keep an eye on the products in the kitchen. There is also an Android app that offers the user a user-friendly interface.**

Keywords— IOT, Smart Kitchen, Live Video Analytics, Grocery, Kitchen wardrobe .

I. Introduction

The Internet of Things (IoT) has altered daily life and is currently a hot button issue in marketing and public discourse. The Internet of Things (IoT) has become a significant technology with applications in numerous sectors and has sparked a revolution [1]. The Internet of Things (IoT) is a platform made up of intelligent devices combined with communication, sensing, and processing technologies that work together and concurrently to create a setting in which intelligent services can be offered to end users. IoT refers to a network of real-world objects that are electronically interconnected and used by organisations to sense, monitor, and communicate. To enable efficient supply chain planning, management, and collaboration, the supply chain enables flexibility, transparency, monitoring, and information exchange. Both the nation and people have benefited from it in a number of ways.

This Every item a kitchen needs is in the kitchen wardrobe, especially the groceries. The products that are available in the kitchen are managed by this smart kitchen wardrobe [1]. This is accomplished by keeping an eye on all of the grocery items in each container [2]. The grocery items in a kitchen may be in a variety of shapes, such as solids, liquids, or powders. Each item is kept in its appropriate container. Depending on how often we use these grocery items, their level may decrease. Each product may be used differently each day. The products should be purchased and restocked if the level drops. Monitoring of all the products is included in this smart kitchen wardrobe. and level every day, regardless of the container or form, and alerting the user that a certain product's level is low and that it needs to be purchased before it further drops .The following elements must be preserved in the suggested system to model a better kitchen wardrobe. keeping an eye on where each product is located in the container

- Maintain daily monitoring and detection of the quantities of groceries in each container.
- When a product level falls below a threshold, alert the user so they can make another purchase and restock the container with the appropriate products.

This "Smart Kitchen Wardrobe" android application is made to alert the user to the products that need to be purchased. Products are added to a list when their level drops below and then rises above the threshold level. As a result, the user receives notification via this application about the list of products that reach the threshold level. Thus, the user is informed through the mobile application that the automatic shopping list has been prepared. Our system uses the Internet of Things (IoT) to offer the user smart shopping [5].The database, or cloud platform, stores the product levels and its placement within each container. This is an ongoing process that happens every day. The data includes the total number of products, those that must be purchased, and how much must be purchased of the frequently used products. Additionally, the product's location will be tracked. Through our mobile application or through IoT, you can view this information.

The product levels and the position of the product in each container is stored in the database i.e., cloud platform. This is a continuous process, which takes place daily. The information includes the quantity level of all products, products which need to be bought and the amount need to be bought for the frequently used products. And also the location of the product will be monitored. This information can be viewed through our Mobile application, through IoT. During shopping it is enough to just carry the mobile phone, which clearly shows the shopping list details. Thus android mobile application prepares the shopping list for the user.

II. Related Works

A. *Aware Home with Smart Kitchen Cabinet:-*

The Smart Kitchen Cabinet lists the items that are currently in the kitchen. The weight of the product inside the jar, which is equipped with an RFID tag for location identification, is measured by a sensor installed in the kitchen cabinet. Every time the product is placed or removed, the weight is updated in the database. When the product quantity reaches a predetermined level based on usage, an automated shopping list is generated [1]..

B. *Smart Kitchen Automation and Grocery Management System using IOT:*

Smart phones and smart systems can add a new layer to how we conduct everyday activities such as banking, shopping, and other tasks. The "smart grocery system," a smart and innovative way of food shopping, acts as our assistant and redefines how we go about doing our shopping. The internet of Things (IoT) may be designed to integrate transparently and seamlessly for a diverse set of end systems. It does, however, provide free access to specific informational subsets for a digital service event.

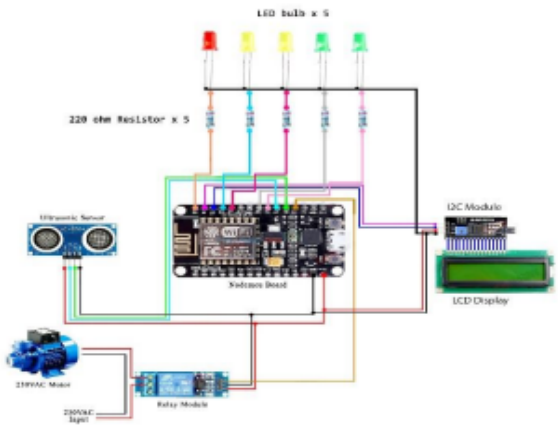
An improved method for machine to machine and human to machine communication is the Internet of Things. It is a technology that assigns each living and non living object a special identification number. M2M, also known as machine to machine communication, is the process of multiple machines talking to one another or transferring data straight to one another without the need for human interaction or human to human or human to machine conversation. The concept of smart technology first emerged in 1982. Everything that has connectivity to networks, electronics, sensors, software, actuators, and actuators can communicate with one another, transmit signals, and then take the necessary choices and actions. [6]. Women now labour in a variety of industries and are primarily responsible for household chores. They must keep up with some unseen tasks, such as maintaining a supply of groceries and other quickly consumed items at home, without which it would be impossible to complete important tasks like cooking, washing, etc.

C. *Smart Kitchen Cabinet for Aware Home*

Any innovation or improvement should aim to make life easier and more comfortable for people. The phrase "smart homes" has become more popular in recent years as a result of the potential use of Internet of Things (IoT) for home automation. However, the IoT's primary emphasis right now is on managing various household activities. The majority of IoT-based solutions being suggested do not concentrate on the kitchen, which is a key area of the home where a lot of data is actually present and needs to be updated frequently..

D. *Hardware Configuration*

Through a TCP connection, the NodeMCU Wi-Fi module connects the hardware device to the software. A php script transmits a request for this compartment to NodeMCU when a user refreshes one of the compartments in the cabinet. NodeMCU then sends this request to Arduino through I2C communication, where Arduino executes its operation and retrieves the data. Through the NodeMCU depicted in Fig. 2, the data is transmitted to the database. Update the server's directory with information about the compartments.



The two major categories of groceries are. One can be counted, while the other cannot. We used a weight cell to measure countable goods. Weight is measured by a weight cell. We used LDR/LED to measure countless foods like rice, pulses, tea leaf, sugar, salt, etc. The levels of the groceries stored in the compartment are measured by LDR/LED.

Level measuring techniques are used in eight out of nine sections, and weight measuring techniques are used in one compartment.

E. *Software /userinterface:*

An application has been created specifically for this SKI to allow for remote tracking of the Smart Inventory. Ultrasonic sensors will be used to measure the quantity of ingredients instead of a weight machine. Users of this application can place orders for goods from a partner superstore and track inventory. Whether the purchase has been delivered or not, the user can also view the order history and status. The user can create a list showing how much purchasing has been done over a specified period. The user can also alter the name of a compartment and add or remove cabinets. User will be informed if the amount of groceries in the inventory is equivalent to or less than 10%. The user will also be informed when a purchase is taken and delivered. displays a few SKI website sites as well as a few SKI mobile app views. With the aid of our effort, we also hope to contribute to the development of digital India.

III . PROPOSED WORK

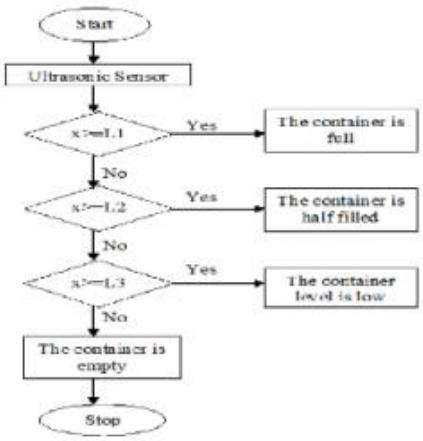
The Proposed System's Smart Kitchen closet is designed to automatically identify a list of containers in the closet holding grocery products such as seasonings and culinary powders. The gadget can determine the quantity of each grocery item in the container. In this elegant kitchen wardrobe, a sensor is perpetually installed. The

sensor monitors the closet's containers, and the quantity of products in each container is recorded. The in-wardrobe night keeps an eye on all of the receptacles. The image of the containers that were captured and processed is used to identify the product amount and present position. This is accomplished through the image capture process.

An image processing toolbox is needed for this operation. This is done by using the MATLAB R2019a programme, which is also known as the image processing toolbox. The camera image is transferred to a computer that is connected to an Arduino board, and then, using the Arduino IDE software, the number of containers and the level of each product inside each container are displayed

on the LCD. The buzzer signals a change in where the product is located in the container. The Internet of Things is used for this process. An Android application is created that alerts the user when a specific product in the container goes below and exceeds the cutoff level. A shopping plan is also immediately generated and sent to the user via the Android mobile program. Three levels of product quantity analysis are performed to determine the level of the product in the container. The fixed threshold level in this instance is the third level, or L3.
Each product is added to the user's shopping list in their mobile application when it reaches that threshold level.

A functional flow diagram of the project's overall process is shown below. The functional flow diagram 1 illustrates what occurs when a certain product reaches a certain quantity level in the Smart Kitchen.



"Product is full in container" is displayed on level L1 of the LCD, "Product is half full in the container" is displayed on level L2, etc.Moreover, the LCD displays "Product is low in the container" along with its quantity measure at level L3, which is the threshold level. The product is immediately added to the user's shopping list once it reaches L3 level.
The main objectives of this project are:
1. To organise all data from the kitchen and offer it through an Android application or on a website in order to produce useful results.
2. All actions directed by a website and an android application.
3. To keep track of and order the necessary kitchen ingredients from the local retailer.
4. To make the kitchen more secure by using stringent security measures to detect unwanted users.
5. Design that is accessible to everyone.

IV . RESULTS AND DISCUSSION

The testing of the proposed SKI is carried out for several weeks. Hardware and software components used in the SKI are given in Table Iand Table II.

Throughout the endeavour, there were a few issues with technical fixes. Making accurate and affordable instruments was difficult. Eventually, this issue was resolved with LDR/LED. In this endeavour, a secure TCP connection must be made between the hardware and server in order for the hardware to update the inventory database. The ESP8266-01 was unreliable, though. There were issues with this, and contact took a very long time. Eventually, this issue was

TABLE I:

SL.	Components	Quantity	Price (USD)
1.	Cabinet	1	48
2.	LDR, LED	24, 8	1.5
3.	Arduino Mega	1	8
5.	Wires		2
6.	9V 2A Power Supply	1	1.5
7.	Battery	1	5
8.	Weight cell	1	10
9.	Others	1	5
		Total	81

TABLE II :

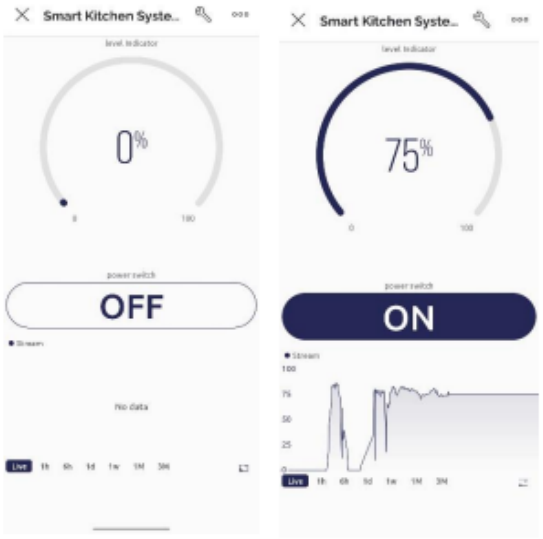
SL.	Required Software
1.	Wires
2.	Android Studio
3.	XAMPP
4.	ATOM
5.	FTP Server

resolved after using NodeMCU (ESP8266) with a stable firmware. The project also included creating an application. Flutter framework was used to create a responsive

application for this smart inventory. Moreover, core PHP is used in the backend part to link the website and smart inventory via NodeMCU. Due to a lack of resources, live notification had an issue. Ajax was used to resolve this issue..

F. Mobile Application

The Arduino IDE and the Blynk programme are used in this configuration. Software developed by Arduino is called the Arduino IDE. The creation of numerous Arduino programming procedures using this application. [4]. Both the Arduino board and the ESP8266-01 are programmed using the serial monitor in the Arduino IDE. The web server for the ESP32 Cam. It is an application and webserver for building Internet of Things projects. It contains a function that enables you to maintain tabs on your possessions.
It's easy to use because it simply addresses visual and graphic issues. A recording memory card slot on this machine can be utilised for security purposes in the future.



In the android mobile application, which can be used to make the wardrobe smarter, the user can access and scrutinize information about the most recent grocery buying plan and the number of items that need to be bought. If the product level in the receptacle is low and the amount exceeds the cutoff level, the product is added to the purchasing list and the user is informed via the mobile application. The user's automatic shopping list is created by the Android app. When the shopping list is finished, the Android application will send a push notice to the user. If necessary, the user can also update the shopping list. screenshot of the notification that the user receives via a mobile application.

Results:

Products / Container	Rice	Wheat flour	Sugar	Biscuits
Container1 (1Kg)	80%	70%	85%	90%
Container2 (500g)	74%	56%	77%	85%
Container3 (5kg)	66%	72%	83%	80%

v ADVANTAGES

1. This project will still function even if the server is down.
2. Demo videos can allow users who are unfamiliar with Android applications or websites to quickly pick them up.
3. Users can call our support team for assistance if they have any technical or equipment issues. The customer service team will be available to consumers around-the-clock, and problems will be resolved in a day.
4. A user-friendly interface that is simple to utilise for the average individual.

VI. FUTURE WORK

Although a prototype has already been created for testing, the product may eventually move into large-scale industrial manufacturing. Production on a large scale will help reduce costs and make the design more appealing to customers. Making the product more user-friendly would enable the greatest possible amount of individuals to use SKI without experiencing any difficulties. Clients will also have the option of placing the chips in their currently installed kitchen cabinets, allowing them to take use of our smart kitchen services without having to make significant alterations to their kitchen. To increase this product's accessibility and use for customers, the SKI team is now planning a partnership with convenience retailers. Collaboration with bKash is also necessary.

Also, cooperation with bKash to streamline the payment process for the goods. The collaboration with bKash will make sure that even for money transactions, customers don't have to deal with any hassles, as the entire idea of SKI was to develop a system that helps users save time and energy. Users who might not be available for cash on delivery transactions can easily purchase groceries through online transactions.

The microcontroller's pin count must be expanded in order to control many sensors with a single microprocessor. Multiplexer can be used to solve the issue. The SKI team will test multiplexers and put them into use in the future. Moreover, SIMS/SKI guarantees that the data supplied by users will be protected and kept private. End-to-End encryption and proper security procedures will be used in the future to protect user data. We intend to continue working on this project and will complete another area of the house in the future. promote the Digital India initiative.
We will totally automate the home and enable phone control with a simple click.

VII. CONCLUSION

With the development of technology and a rapidly expanding modern civilization, it is inevitable that people may not have enough time to complete even the most basic duties. Sometimes it gets more difficult to remember to perform routine tasks like food shopping. They frequently failed to go to the grocery store, make a shopping list, or count how many grocery items they had at home. Smart Inventory Management System (SIMS) might assist them in getting rid of this hassle. Although this system may seem like a high-end item, it is made to be affordable and widely available. After the smart system is built, grocery shopping, even on a regular basis, as well as keeping track of food, become simpler. This technology is environmentally beneficial because it uses reused, rechargeable batteries and relatively little power. So, the impact on the electricity cost won't be significant. The system also plays the role of a maid by reminding the user when their groceries are low so that they can get more before they run out.

This project presents the concept and implementation of an IoT-based collaborative kitchen surveillance system. The disadvantages of recording and capturing the real-time live levels of the receptacles in the cupboard are overcome here. This gives the exact product amount in each receptacle within the wardrobe. Because it is a continuous tracking, the data in the database contains up-to-date information about the quantities of products in the wardrobe. The suggested work can be extended further by instantly transmitting the grocery store's purchase along with the shopping list.

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Appendix III: Plagiarism report of paper

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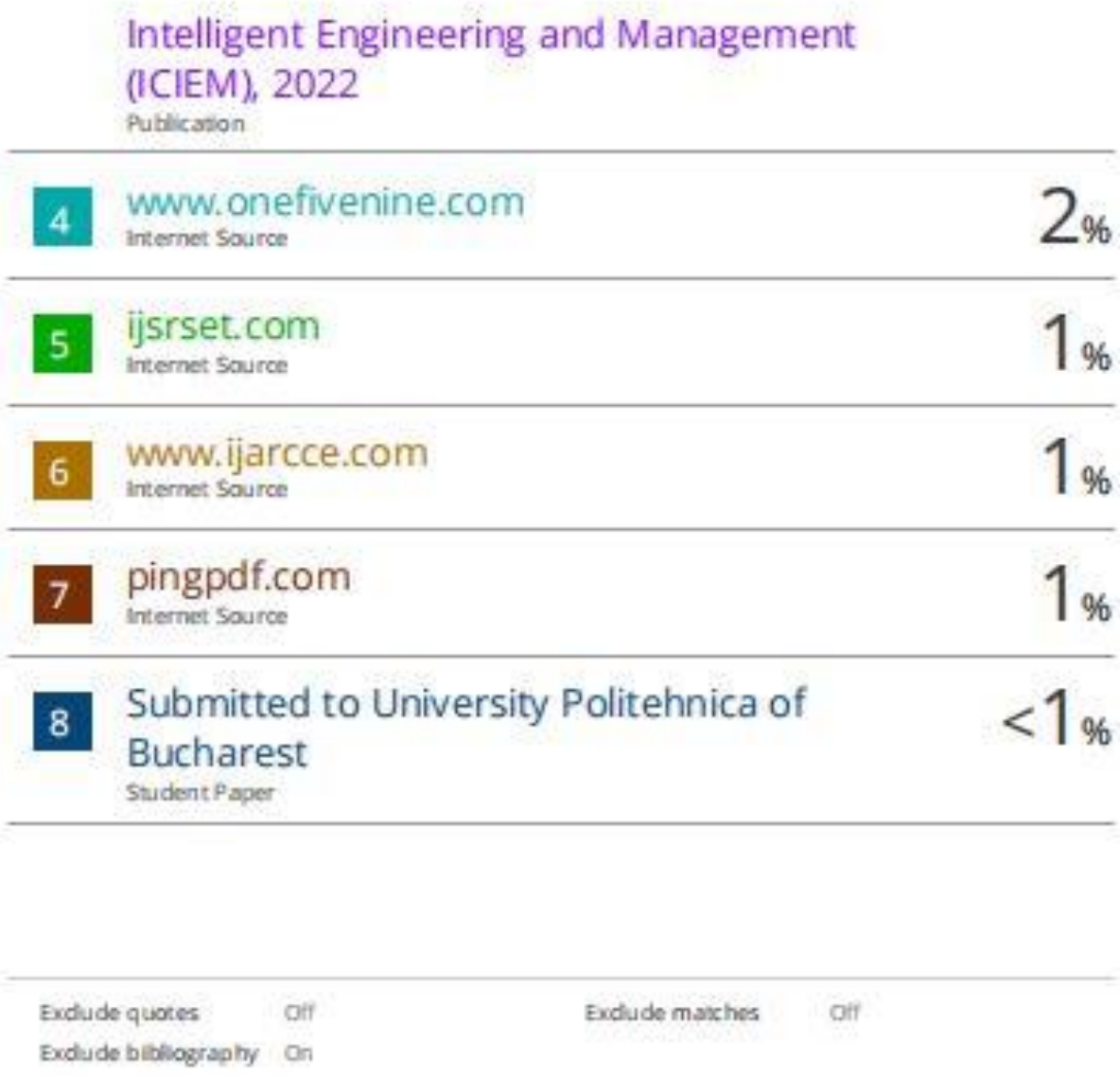

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