

**B.E. Project Report On**

# **IoT Based Smart Jar**

*Submitted in partial fulfilment for the award of degree of*

**BACHELOR OF ENGINEERING**

*in*

**ELECTRONICS ENGINEERING**

*Under the Guidance*

*of*

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# CERTIFICATE

This is to certify that the project entitled 'IoT Based Smart Jar' is a bonafide work of 'TANMAY KULKARNI (28)', 'DHEERAJ MORE (32)', 'AKSHAY PHONDKE (45)', 'TARANG KHANDARE (25)' submitted to the University Of Mumbai in partial fulfilment of the requirement for the award of the degree of "Undergraduate" in "Electronics Engineering".



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# Project Report Approval for B. E.

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We declare that this written submission represents our ideas in our own words and where other's 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 with honesty and integrity and have not misrepresented or fabricated or falsified 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 strict penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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## **ABSTRACT**

This project is about building a smart jar using NodeMCU and ultrasonic sensor to track the contents in the jar dynamically from anywhere in the world with the help of internet. .This smart Jar allows us to keep track of the stocks, and it is easily accessible from using the internet. The Jar includes an ultrasonic sensor at the top of it and uses the ultra-sonic reflected waves to figure out at what extent the Jar is filled and how much space is left inside the jar. Whenever the amount of content changes in the jar, it is sensed by the NodeMCU, and the same is updated on the webserver. This can be helpful to track supplies and plan for restocking from anywhere in the world. The jar is smart enough to send the level of jar filled through email and warns when the jar is empty or less than the threshold value set as per the requirement. It would be helpful for the user to track the details of contents in the jar without their actual presence

# 1. INTRODUCTION

## 1.1 Need

Nowadays, In our day to day life , people became more busy such that they are much more immersed in their work schedule and are unable to concentrate or take care of their household things. Most of the time people find it difficult to track their kitchen items, because nowadays it has become a room of least visit.

In a scenario, where people find hard time to prepare their own food, it is even more difficult for them to track their grocery items in their room. They even waste most of their time in ordering and tracking the remaining items in kitchen room.

In this project, I made an IoT Based Smart jar using NodeMCU ESP8266 Module and ultrasonic sensor that tracks the exact percentage of the contents in the jar. This helps the user to know the quantity of content in the jar and can access the information through the Internet from anywhere in the world. It takes the speed of the emitted waves and time taken to travel as the parameters and gives the actual content of the jar.

## 1.2 Role of IoT

IoT when compared to other technologies, is one of its kind, which has the maximum capability. Other advantages include less human effort in the work field, reduction of cost, enhancement in data collection and analysis. IoT is also capable in using the resources effectively. The embedded system can be of type microcontroller or type microprocessor. Both of these types contain an integrated circuit (IC).

The essential component of the embedded system is a RISC family microcontroller like Motorola 68HC11, PIC 16F84, Atmel 8051 and many more. The most important factor that differentiates these microcontrollers with the microprocessor like 8085 is their internal read and writable memory. The essential embedded device components and system architecture are specified below.

The IoT ecosystem is not easy to define. It is also difficult to capture its proper image due to the vastness and emerging possibility and the rapidity with which it is expanding in the entire sector. However, the IoT ecosystem is a connection of various kind of devices that sense and analyse the data and communicates with each other over the networks. In the IoT

ecosystem, the user uses smart devices such as smartphones, tablet, sensors, etc. to send the command or request to devices for information over the networks. The device response and performs the command to send information back to the user through networks after analysed. The typical IoT ecosystem is shown in below image, where the smarter devices send and receive data from the devices themselves in the environment that are integrate over network and Cloud Computing.

## **Objectives**

- To have easy management of Inventory
- To handle details of sales, purchase, balance stock
- Making Stock Manageable
- Dealing with Day-to-Day requirement of supplies

## 2.

## Literature Review

Richard M. Voyles and Joewood Bae [1] presented ‘Smart Tupperware: An Example of Bluetooth Wireless Sensor Networks for Human Assistive Mechatronic Systems’. Using personal digital assistant, the status of the foodstuff in the kitchen is determined automatically by reforming the shopping list of the user. Sensors and Processors are used to calculate the parameters like the characteristics of the contents, weight and the quantity kept in the Jar. The containers used to recondition the status of the content and informs the base station, a personal system without wired medium. The properties and characteristics are maintained as a database and the base station has a web page to update the details of each container. This automated method is used to avoid the human errors created during the process not to get interrupted. By using Wi-Fi, the container status having the content synchronizing with the database will be updated in the user’s personal digital assistant. For measurement a bar code scan can be used for further ease of use.

Pal Amutha, Chidambaram Sethukkarasi, Raja Pitchiah [2] described about the ‘Smart Kitchen Cabinet for Aware Home’. This paper presents the design and development of a “Smart Kitchen Cabinet” which identifies the grocery items in the kitchen store. The weight of an item is measured in the Kitchen Cabinet is augmented with sensors which is refreshed in the database whenever ingredients are kept or removed out for cooking. Radiofrequency identification (RFID) tag is used for locating and tracking the particular place with the Jar for the kitchen. The analysis and optimization for the Jars with RFID tags and antennas are made for comparing the performance and the outputs are discussed. The system also generates automated shopping list when an item reaches the defined threshold level, which is based on requirement and consumption pattern of family members.

Manali Chaudhari, Prof. Srinu Dharavath presented ‘Study of Smart Sensors and their Applications’. This paper gives the brief idea about the basic structure, standards, applications and some recent developments in smart sensor technology in different fields. Smart sensors as compared to the sensors can sense along with special purpose computing devices which are connected in sensor networks. Critical devices can be monitored as well as managed remotely by using wireless sensor networks which yields better performance of system with better decision-making abilities and better control. The new advances in wireless technologies are emerging in varies fields like supply chain logistics, monitoring of systems, data collection and application controls. The main purpose of smart sensor networks is to reduce human

intervention and management control in different systems. Wireless devices including actuators, sensors and gauges can now be monitored wirelessly.

Widodo Budiharto [4] presented ‘The Framework of Home Remote Automation System Based on Smartphone’. The purpose of this paper is to make a mobile application on a Smartphone device so that the user can control electronic devices and to see the amount of flow that has been used in the amount of dollars, so the problem is the difficulty in saving electricity can be resolved. Lot of questionnaires are used to analyze the feedback from the people and design updates are done accordingly. Literature survey, various observations and questionnaires with various ideas from the customers are used to design the hardware in united modelling language (UML) and to apply in the testing and designing of the codes for the communication between the operating systems and android. Thus, the Consumption of electricity is reduced with various optimization methodology to control the home appliances using mobile phones, which takes the technology to the higher level for the next generation.

## 3. Components Specifications

### 3.1 Hardware Environment

- NODE MCU ESP8266 (WIFI MODULE)
- ULTRASONIC SENSOR (HC- SR 04)
- BREAD BOARD
- JUMPER WIRES
- JAR

### 3.2 Software Environment

- ARDUINO IDE
- SUBLIME TEXT OR NOTEPAD
- IFTTT (IF This then that )

#### 3.1.1 ESP8266 (WIFI Module)

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for the development of IoT (Internet of Things) embedded applications.



Fig 3.1.1 ESP8266 WiFi Module

The **ESP8266** is a very user friendly and low-cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible.

It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly. However this version of the module has only 2 GPIO pins (you can hack it to use up to 4) so you have to use it along with another microcontroller like Arduino , else you can look onto the more standalone ESP-12 or ESP-32 versions. So, if you are looking for a module to get started with IOT or to provide internet connectivity to your project then this module is the right choice for you.

<b>Pin Number</b>	<b>Pin Name</b>	<b>Alternate Name</b>	<b>Normally used for</b>	<b>Alternate purpose</b>
1	<b>Ground</b>	-	Connected to the ground of the circuit	-
2	<b>TX</b>	GPIO – 1	Connected to Rx pin of programmer/cut to upload program	Can act as a general purpose Input/output pin when not used as TX
3	<b>GPIO-2</b>	-	General purpose Input/output pin	-
4	<b>CH_EN</b>	-	Chip Enable – Active high	-

5	<b>GPIO - 0</b>	Flash	General purpose Input/output pin	Takes module into serial programming when held low during start up
6	<b>Reset</b>	-	Resets the module	-
7	<b>RX</b>	GPIO – 3	General purpose Input/output pin	Can act as a General purpose Input/output pin when not used as RX
8	<b>Vcc</b>	-	Connect to +3.3V only	

**Table 3.1.3 ESP8266 Pin Configuration ESP8266-01 Features**

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined
- Supports Deep sleep (<10uA)

- Supports serial communication hence compatible with many developments' platform like Arduino
- Can be programmed using Arduino IDE or AT-commands or Lua Script

### 3.1.2 ULTRASONIC SENSOR HC SR 04

**Description:** The HC-SR04 is a type of ultrasonic sensor which uses sonar to find out the distance of the object from the sensor. It provides an outstanding range of noncontact detection with high accuracy & stable readings.

**Pinout:**

- Vcc: This pin provides a +5V power supply to the sensor.
- Trigger: This is an input pin, used to initialize measurement by transmitting ultrasonic waves by keeping this pin high for 10us.
- Echo: It is an output pin, which goes high for a specific time period and it will be equivalent to the duration of the time for the wave to return back to the sensor.
- Ground: This is a GND pin used to connect to the GND of the system.



**Figure 3.1.2 Ultrasonic sensor HC SR-04**

**Features:**

- The power supply used for this sensor is +5V DC
- Dimension is 45mm x 20mm x 15mm

- Quiescent current used for this sensor is <2mA
- The input pulse width of trigger is 10µs
- Operating current is 15mA
- Measuring angle is 30 degrees
- The distance range is 2cm to 800 cm
- Resolution is 0.3 cm
- Effectual Angle is <15°
- Operating frequency range is 40Hz
- Accuracy is 3mm

**Brief:**

**HC-SR04 Ultrasonic (US)** sensor is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications, where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

*Formula: Distance = Speed of sound × Time*



**Figure 3.1.3 Transmission Reception**

### 3.1.3 ARDIUNO UNO

Arduino uno is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

Arduino UNO features AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output.



**Figure 3.1.4 Arduino UNO**

This board contains a USB interface i.e., USB cable is used to connect the board with the computer and Arduino IDE (Integrated Development Environment) software is used to program the board.

The unit comes with 32KB flash memory that is used to store the number of instructions while the SRAM is 2KB and EEPROM is 1KB.

The operating voltage of the unit is 5V which projects the microcontroller on the board and its associated circuitry operates at 5V while the input voltage ranges between 6V to 20V and the recommended input voltage ranges from 7V to 12V.

## Arduino UNO Components

The Arduino UNO board contains the following components and specifications:

**ATmega328:** This is the brain of the board in which the program is stored.

**Ground Pin:** there are several ground pins incorporated on the board.

**PWM:** the board contains 6 PWM pins. PWM stands for Pulse Width Modulation, using this process we can control the speed of the servo motor, DC motor, and brightness of the LED.

**Digital I/O Pins:** there are 14 digital (0-13) I/O pins available on the board that can be connected with external electronic components.

**Analogue Pins:** there are 6 analogue pins integrated on the board. These pins can read the analogue sensor and can convert it into a digital signal.

**AREF:** It is an Analog Reference Pin used to set an external reference voltage.

**Reset Button:** This button will reset the code loaded into the board. This button is useful when the board hangs up, pressing this button will take the entire board into an initial state.

**USB Interface:** This interface is used to connect the board with the computer and to upload the Arduino sketches (Arduino Program is called a Sketch)

**DC Power Jack:** This is used to power up the board with a power supply.

**Power LED:** This is a power LED that lights up when the board is connected with the power source.

**Micro SD Card:** The UNO board supports a micro-SD card that allows the board to store more information.

**3.3 V:** This pin is used to supply 3.3V power to your projects.

**5V:** This pin is used to supply 5V power to your projects.

**VIN:** It is the input voltage applied to the UNO board.

**Voltage Regulator:** The voltage regulator controls the voltage that goes into the board.

**SPI:** The SPI stands for Serial Peripheral Interface. Four Pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) are used for this communication.

**TX/RX:** Pins TX and RX are used for serial communication. The TX is a transmit pin used to transmit the serial data while RX is a receive pin used to receive serial data.

## Arduino UNO Pinout

There is a range of Arduino boards available in the market but the Arduino UNO is the most common board used in the electronic industry. The following figure shows the Arduino UNO Pinout for better understanding:



Figure 3.1.5 Arduino UNO Pinout

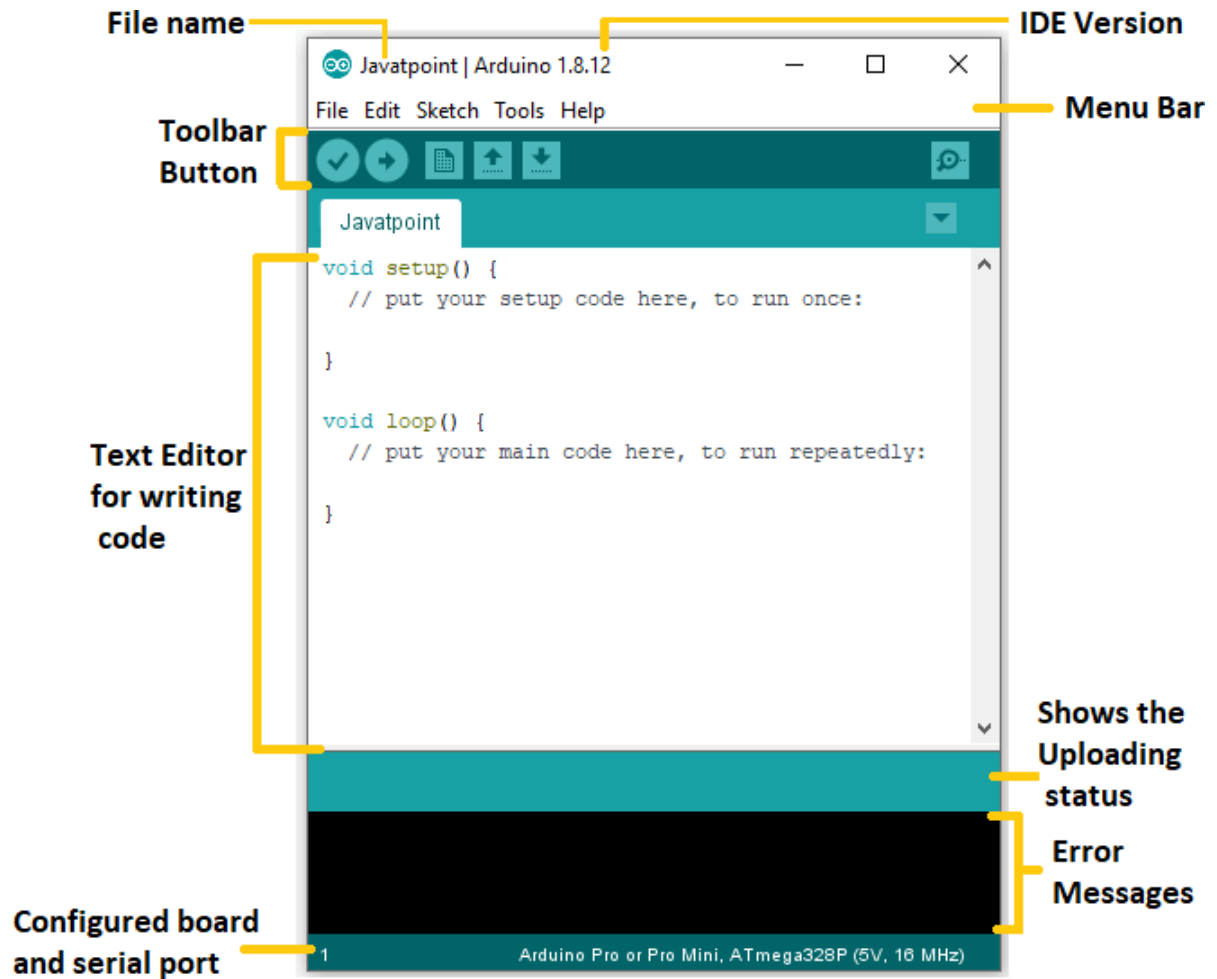
## 3.2. Software Description

### 3.2.1 Arduino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as **Windows, Mac OS X, and Linux**. It supports the programming languages C and C++. Here, IDE stands for **Integrated Development Environment**.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuine and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ion.'

The Arduino IDE will appear as:

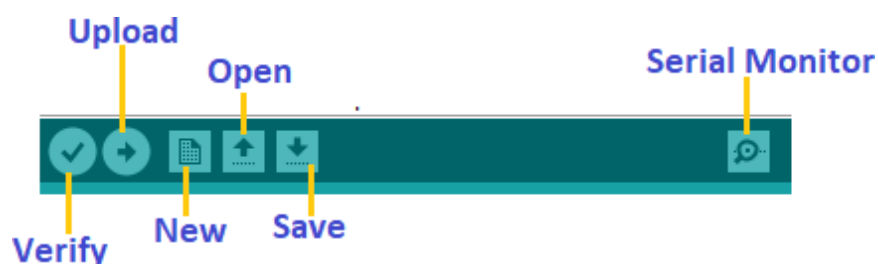


Let's discuss each section of the Arduino IDE display in detail.

## Toolbar Button

The icons displayed on the toolbar are **New**, **Open**, **Save**, **Upload**, and **Verify**.

It is shown below:



This is a Wi-Fi module which is used to communicate with the robot over the Wi-Fi IEEE 802.11 standard. The module consists of flash memory on which the code is to be uploaded.

### Protocol Used:

For transmission of the data packets UDP (User Datagram protocol) is used due to high bandwidth requirements.

IDE Used: Arduino IDE is used for programming ESP8266 by installing specific drivers and libraries for communicating with the module.

### Working Algorithm of ESP 8266 Wi-Fi

According to the figure, a topology is implemented in which two devices are connected to the same Wi-Fi network. The two devices are:

- the Wi-Fi module which is in the robot and the Laptop/Smartphone
- in which the JAVA based app is installed.

The ESP8266 connects to Wi-Fi in the following manner:

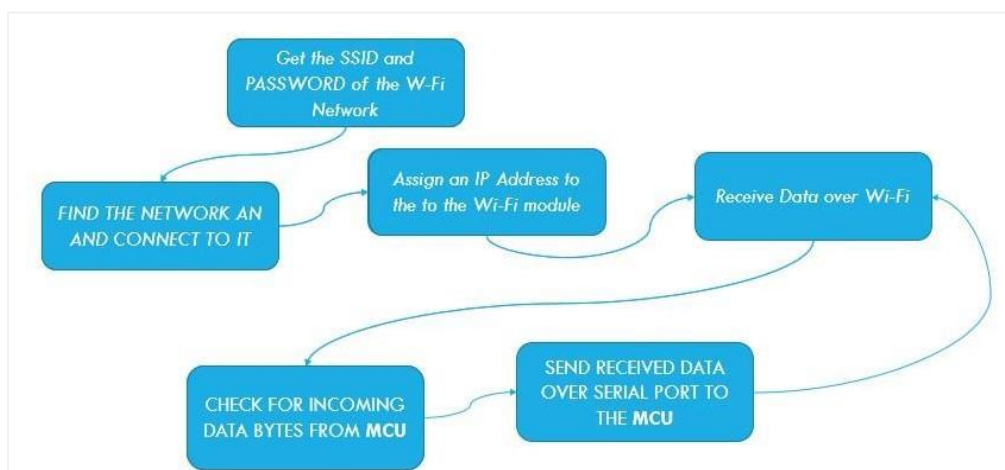
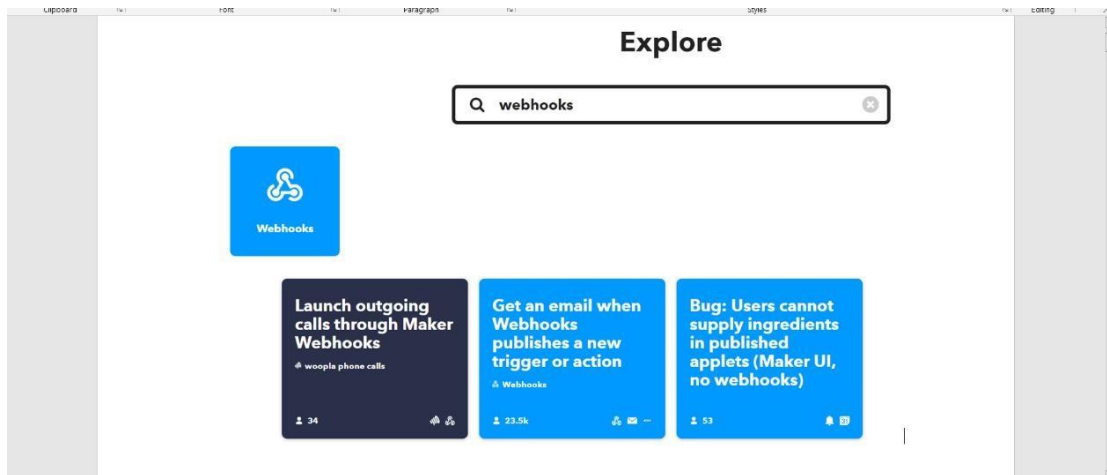


Figure 3.2.1 Wi-Fi Connection Algorithm

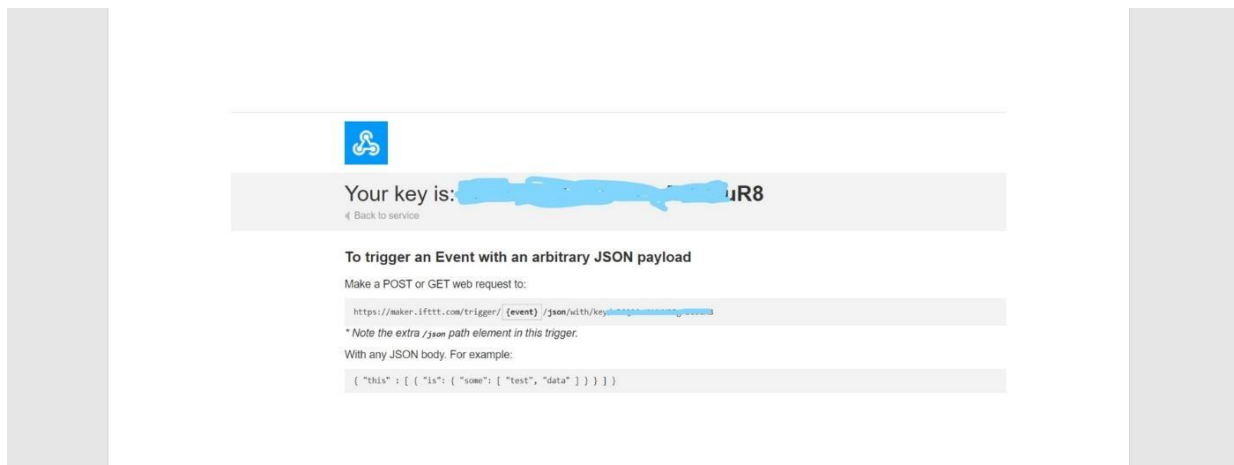
## 3.2.2 IFTTT

IFTTT (If This Then That) is a web-based service using which we can create chains of conditional statements, called applets. Using these applets, we can send Emails, Twitter, Facebook notifications. Here we are using IFTTT to send Email notifications when the Jar is almost empty.

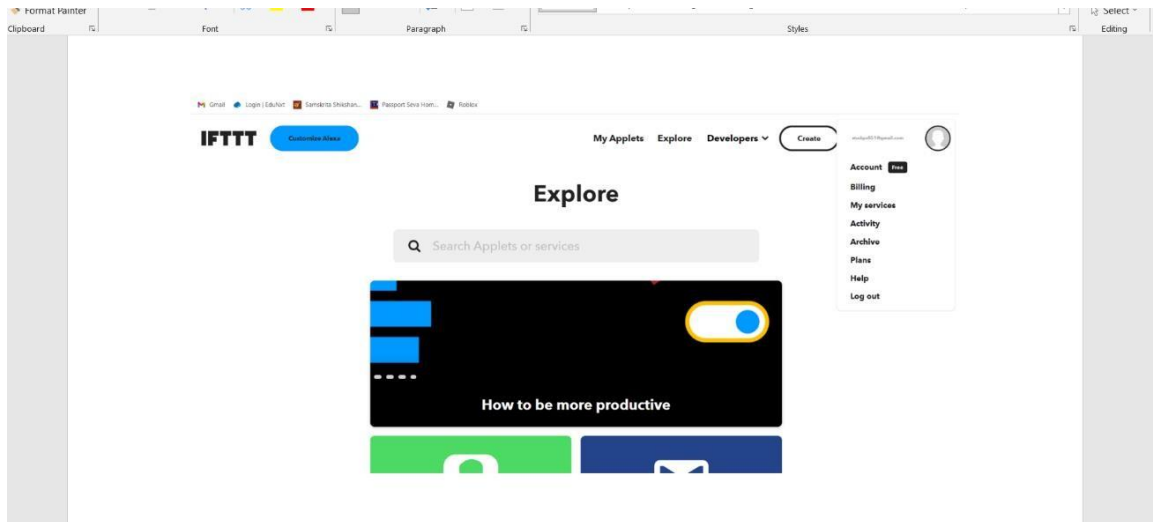
First login to IFTTT and search for **‘Webhooks’**.



Now to get the Private key, click on **‘Documentation’**. Copy this key somewhere, it will be used in the code.



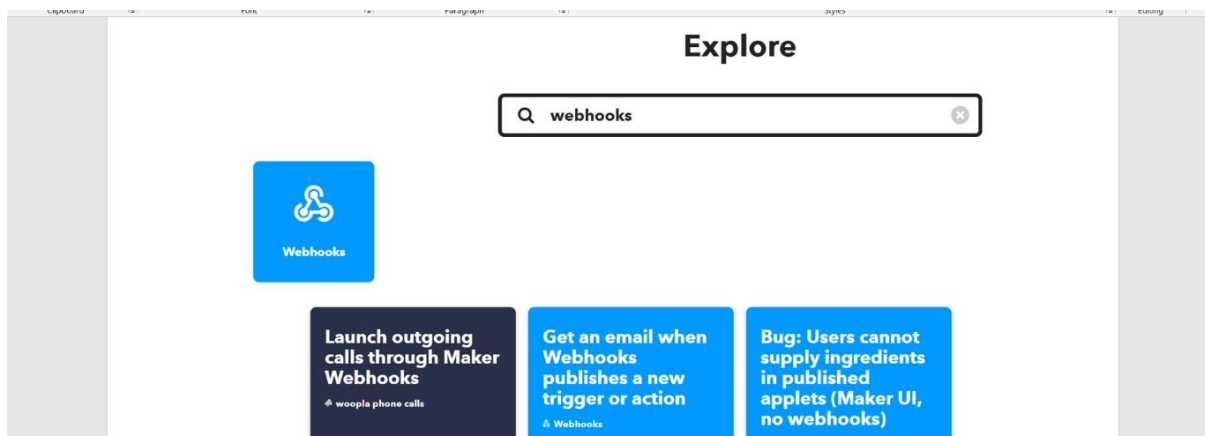
As we have the private key, we will create an applet using Webhooks and Email services. To create an applet, click on your profile and then click on **‘Create’** from available options.



Now in the next window, select *If This Then That*.



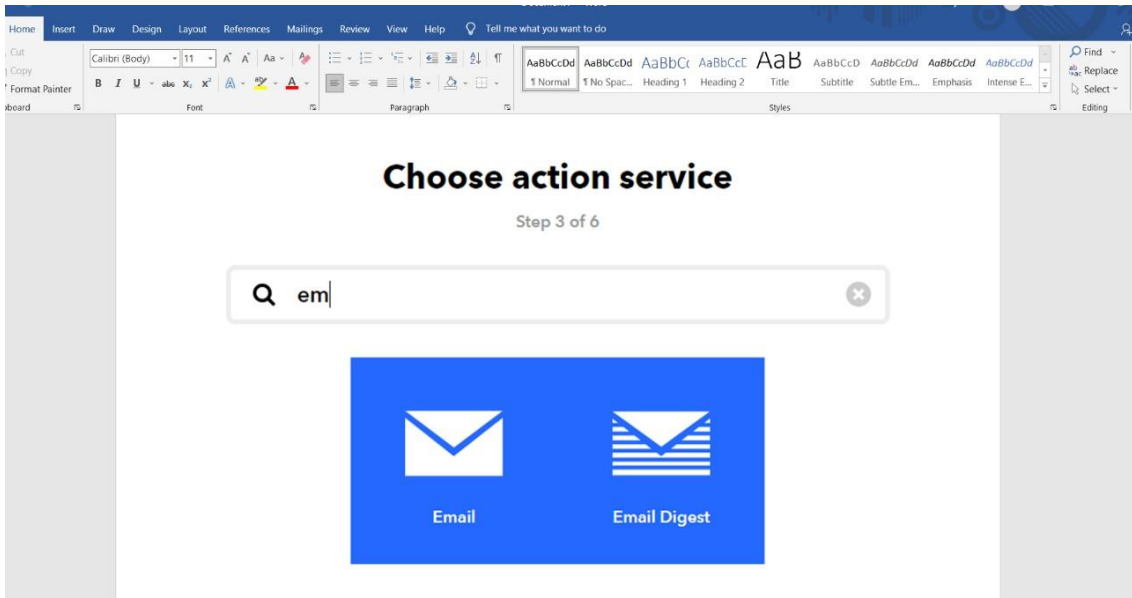
In 'This' field we will use webhooks to get the web requests from the NodeMCU.



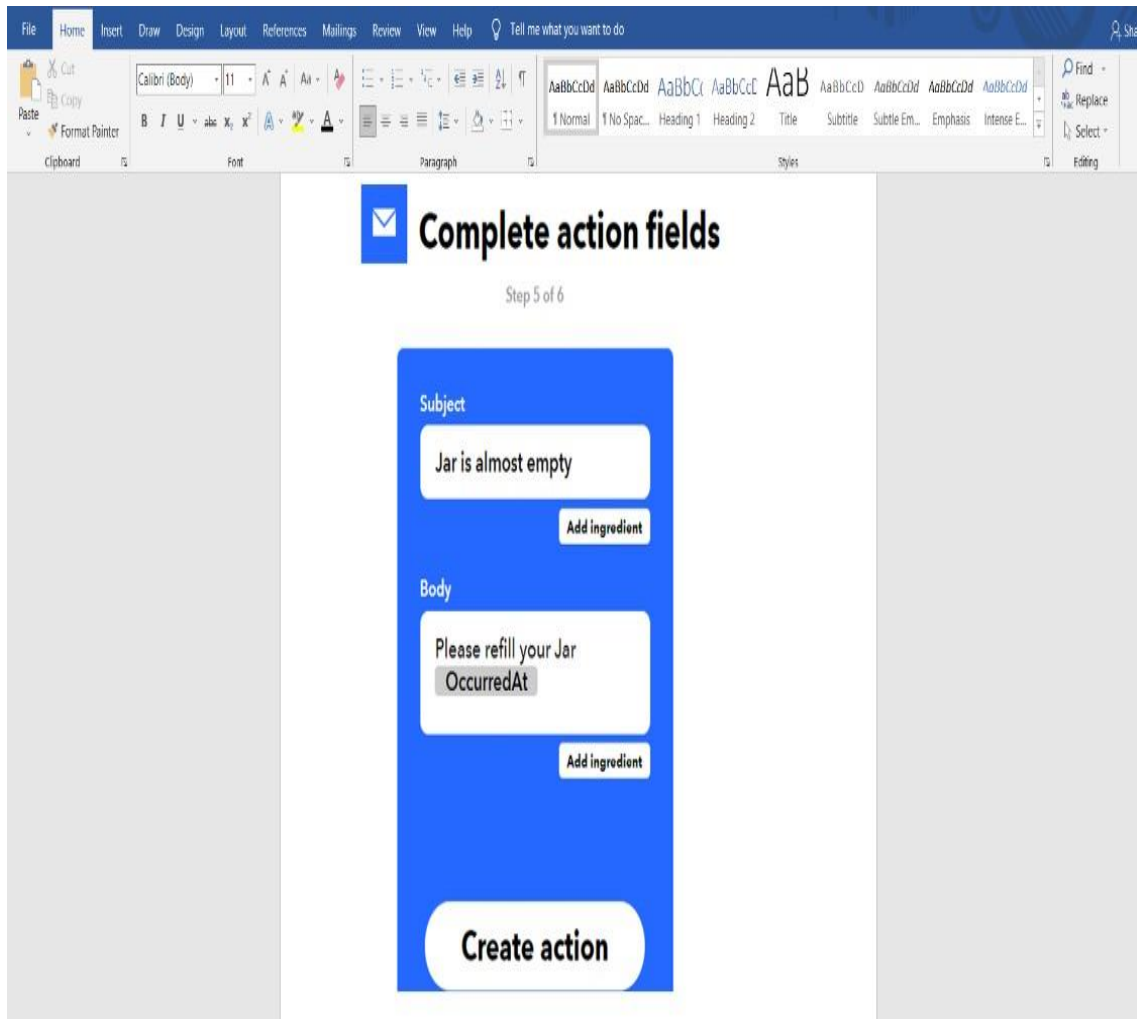
Now select *'Receive a Web Request'* trigger and then enter the event name as *jar event* and then click on *'Create Trigger.'*



After this, click on **'When I'** and then click on email.



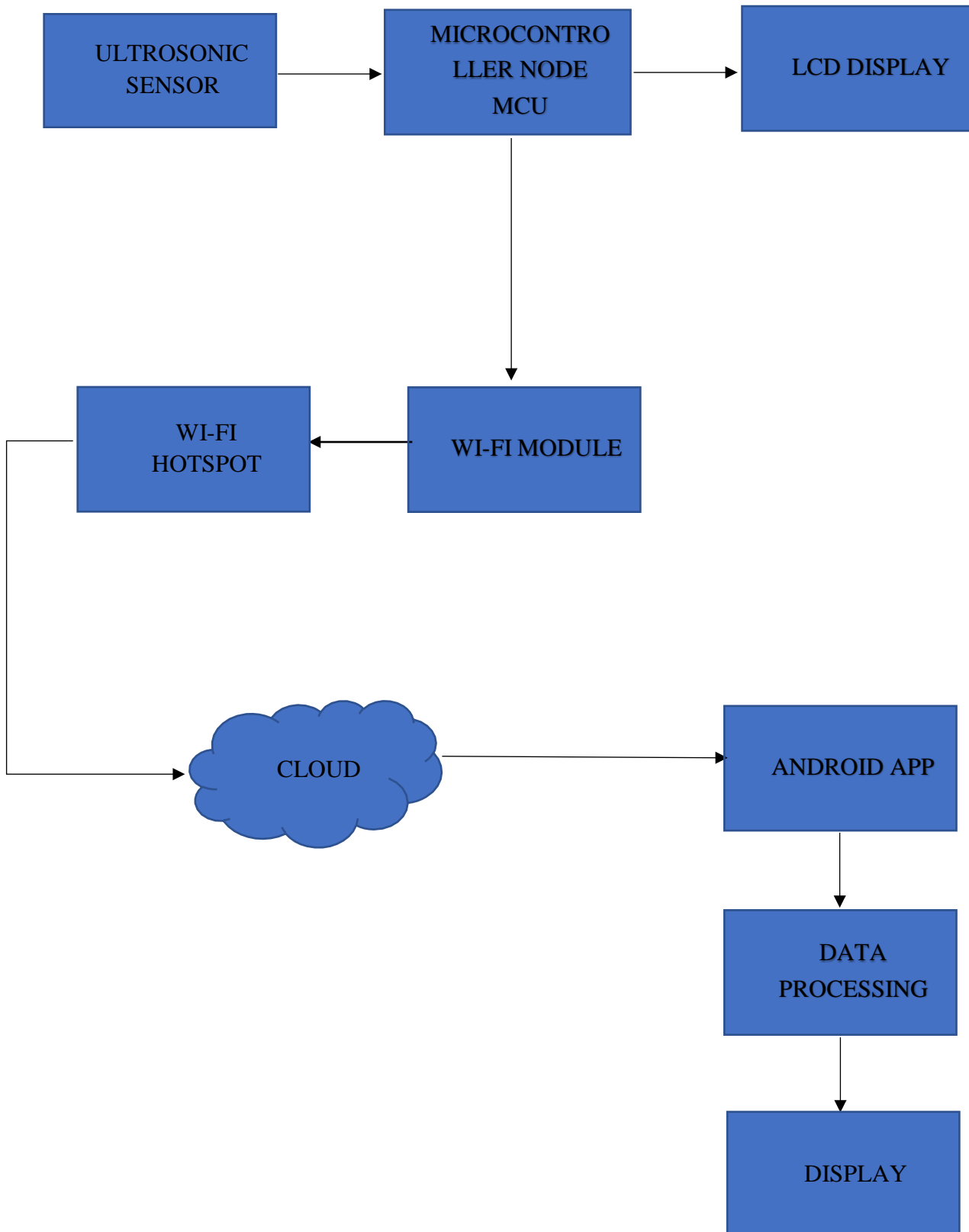
Now in Email, click on **'send me an email'** and enter the email subject and body and then click on create action.



In the last step, click on 'Finish' to complete the Applet setup.

## 4. Block Diagram And Explanation

### 4.1 Block Diagram



Ultrasonic module says the percentage content present inside the smart jar. The display shows the name of the tablet, expiry date and micro controller is used for the display purpose. The Microcontroller process the data and send to the cloud using ESP8266. The cloud contains some specialized program which prints our data in the form of pie chart (level). The display in the app is made using tabular column which mentions the name, the date of expiry and level of item present inside the jar. The android app is usually made using Arduino studio and we have used xml and java programming to design the board. The Arduino board is based on embedded c language and html coding to get the data using node Microcontroller unit. The ultrasonic sensor is used to transmit and receive the signal. The indication will be shown when the obstacle is not present, because the receiver will receive the sound waves within a short duration of time. If an obstacle is present, the signal will be received with a delay of time and it is applicable to a shorter distance.

## 5. Circuit Diagram & Implementation

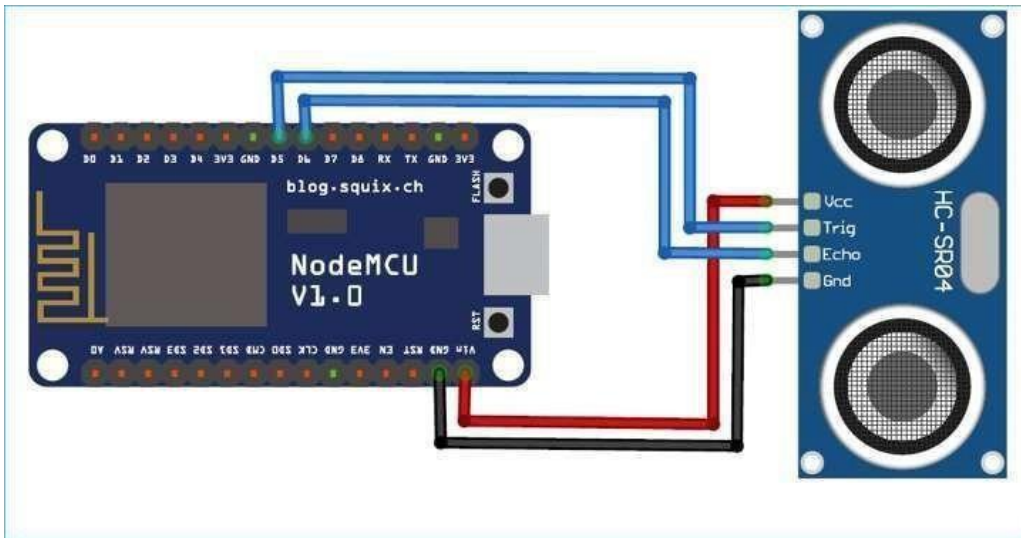


Figure 5.1 Circuit Diagram

The circuit connections are shown in the above circuit diagram, The D5 pin of the NodeMCU is connected to the Trigger pin of the ultrasonic sensor and the D6 pin is connected to the Echo pin of the sensor. The Vin pin of the NodeMCU is connected to the Vcc pin of the ultrasonic sensor whereas the ground pin of the sensor is connected to the ground pin of the NodeMCU. The NodeMCU is powered by the 5V power supply.

When the jar is set up and the setup is connected to a power supply, the ultrasonic sensor emits the waves and hits the level up to which the jar is filled. After that, it reflects back and travels in opposite direction towards the sensors and the sensor receives these waves through the receiver.

This is considered as the input to the system and this input is sent to the NodeMcu through the echo pin.

A pre-programmed code is already installed in the NodeMCU and as soon as it receives input from the echo pin it calculates the distance travelled with speed and time formula and simultaneously compares this with the total length of the jar and gives the percentage of jar is empty. This in turn conveys how much percent the jar is filled and this output is displayed in the system.

## 6. Advantages

- The smart jar can be used to track the exact contents of the jar from anywhere. It is mostly useful for those people who find it difficult to know the amount of content.
- This **smart Jar** allows us to keep track of the stocks, and it is easily accessible from using the internet. The Jar includes an ultrasonic sensor at the top of it and uses the ultra-sonic reflected waves to figure out at what extent the Jar is filled and how much space is left inside the jar. Whenever the amount of content changes in the jar, it is sensed by the NodeMCU, and the same is updated on the webserver. This can be helpful to track supplies and plan for restocking from anywhere in the world
- To manage grocery stockings these days is very hard especially with a busy schedule. The traditional system involves manual tracking of grocery items which results in visiting departmental stores several times a month for buying grocery items. For the whole family to manage grocery stocks manually is even more tedious. In this system weight of grocery container will be displayed on the user's smartphone and if the weight goes below threshold value it will send notification of stock replenishment.

7.

## **Application**

- The technology can also be used to track the quantity of medicine for patients who suffer from diseases like diabetes and who need to have regular medicine update. This jar saves them falling short of medicine and helps them keep their medicines in the jar updated.
- For merchants who own general store and who are away from their shop, this technology helps them to instantly order the amount of stock required for them to order by modifying the jar formula for bigger containers. The percentage of container filled would make their work easier.

## **8. FUTURE SCOPE**

In this proposed system we had created only one load cell prototype. Multiple load cell prototype can also be created in a similar way to identify differently grocery items in the kitchen. Also, a database using SQL can be created to have a past record of grocery items. Furthermore, an application platform can also be created to integrate all the things which include live tracking of multiple grocery items, database to see a past record of grocery items and if the grocery items are running out of stock, one-touch button is provided in the application to contact nearer grocery vendor by sending SMS of scarce grocery items.

## **CONCLUSION**

It is evident that this system is super cost effective to identify and track usage of the grocery items. Using ultrasonic sensors to measure the stocks, we have simplified the system which can be used for both solid and liquid stocks. As the user can clearly see the real-time value of the grocery container, it is easy to track our grocery items. The threshold value is chosen so that grocery stocks are sufficient for use until the new stocks arrive. Because of the low cost, effective design and easy implementation, it can be implemented to support the smart home initiative and become an essential prototype

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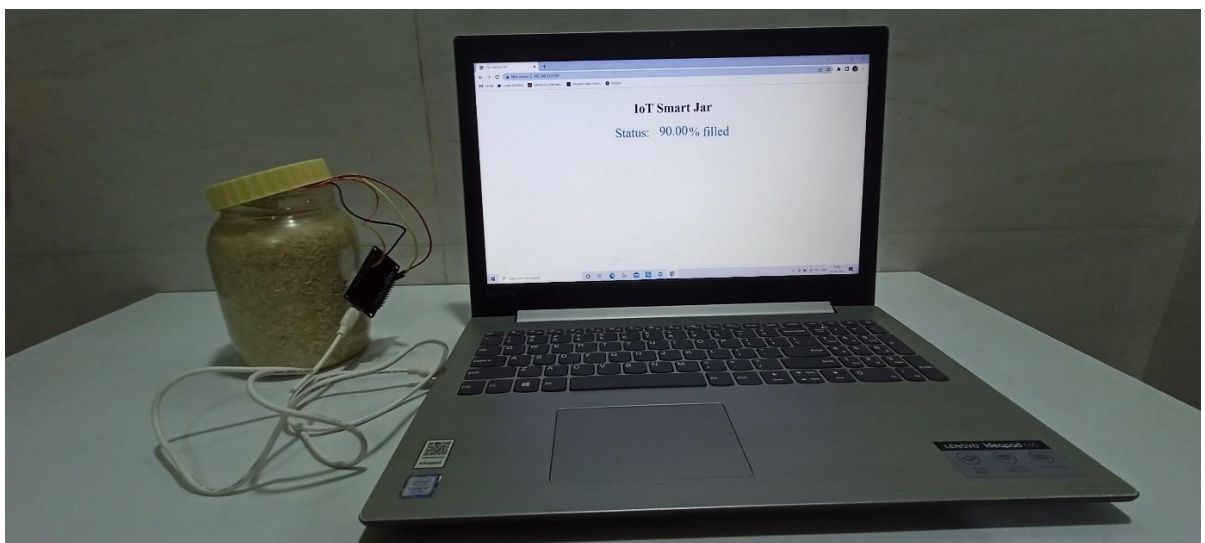
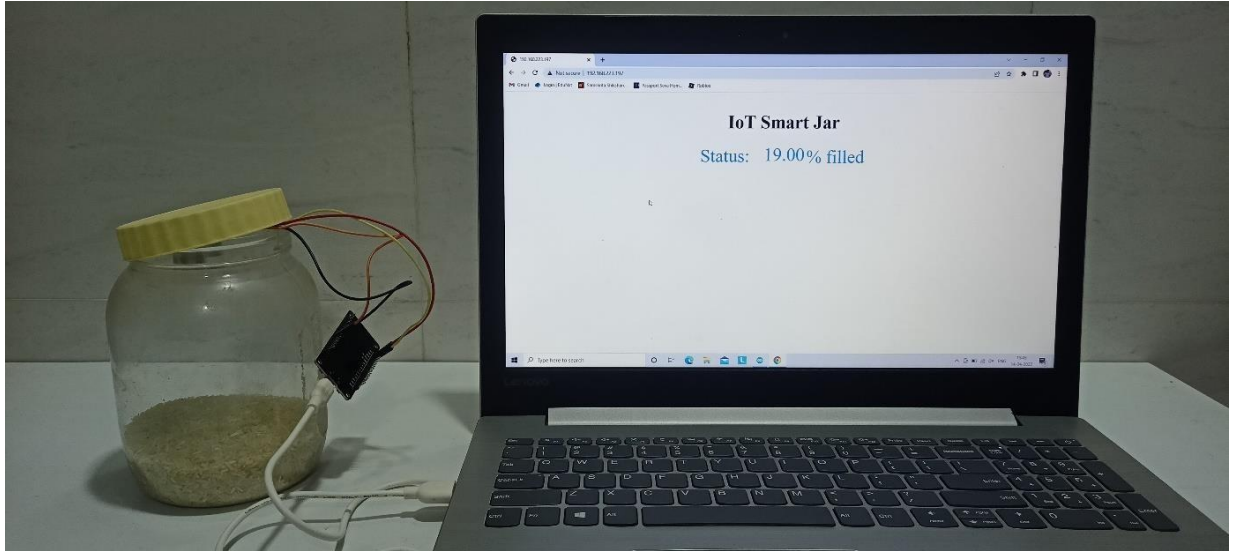
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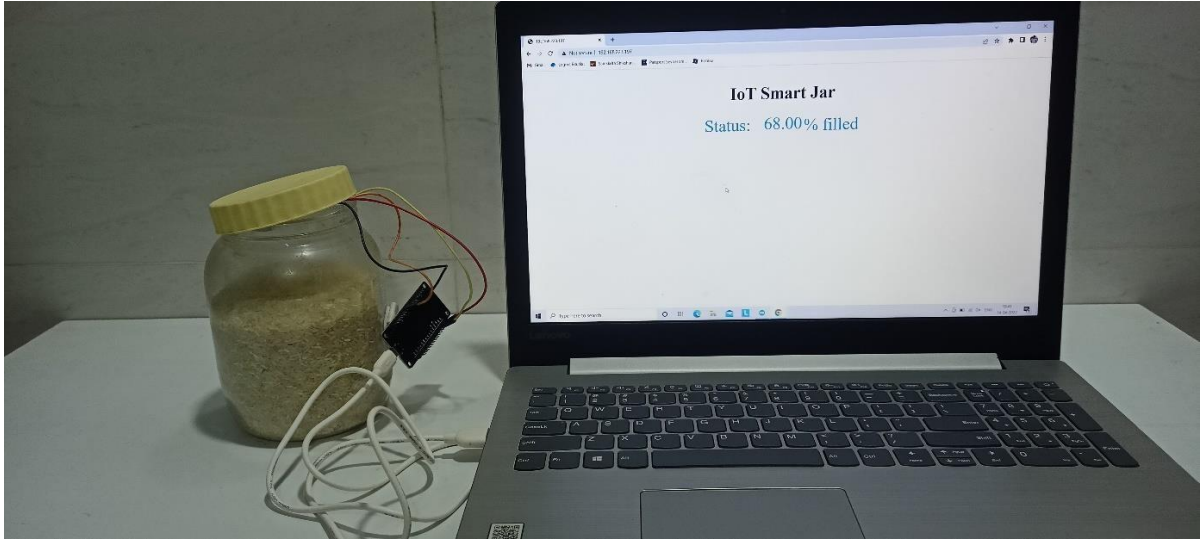
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# Results





## WEEKLY PROJECT REPORT

<b>Date</b>	<b>Activity</b>	<b>Outcome</b>	<b>Comment on Outcome</b>	<b>Resources Utilized</b>	<b>Next Meeting Date</b>	<b>Target</b>	<b>Guide Remark</b>
24/01/2022	Discussed about the best components to be used.	Came up with various alternative components	Chose best suitable components	Google Meet	31/01/2022	Target Achieved	
31/01/2022	Made a proper plan to assemble the project	The approach towards the project had to be efficient and less time consuming.	The plan was properly executable.	Google meet, MSword	07/02/2022	Target Achieved	
07/02/2022	Assembling Project	Project Testing	Found error	Google Meet	14/02/2022	Target Partially Achieved	
14/02/2022	Project Testing	Removing Errors	Error was solved	Google meet	21/02/2022	Target Achieved	
21/02/2022	Research on future scope	Attachment of an Breadboard	Unsatisfactory results obtained.	Google meet	28/02/2022	Target Partially Achieved	
28/02/2022	Pilot Testing	Readings taken with dynamic conditions	Results obtained with minimum errors.	Google meet	07/03/2022	Target Achieved	

07/03/2022	Presentation And discussion on future scope ideas.	Project snapshots and readings were taken	PowerPoint Presentation was prepared.	Google meet , MS PowerPoint	21/03/2022	Target Achieved	
21/03/2022	Discussion about how to get data on dedicated app.	Found relatable ideas and information to get started app development	Picked up suitable ideas and modifications for the project.	Google meet	04/04/2022	Target Achieved	
04/04/2022	Written down algorithm and drawn flowchart for the application	Flowchart completed	The flowchart will help to start actual coding process.	Google meet	11/04/2022	Target Achieved	
11/04/2022	To write pseudo code for the application	Got some related code and wrote down code	Did suitable changes in code.	Google meet	18/04/2022	Target Partially Achieved	
18/04/2022	Working on IoT	IoT ideas were discussed to get optimize experience	Design was approved.	Google meet	25/04/2022	Target Achieved	

<b>25/04/2022</b>	<b>Inspection of Application developed</b>	<b>The results were satisfactory</b>	<b>Results obtained with minimum errors.</b>	<b>Google meet</b>	<b>02/05/2022</b>	<b>Target Partially Achieved</b>	
<b>02/05/2022</b>	<b>Overall Project Assessment</b>	<b>The hardware part was working fine. The app was able to display desired output.</b>	<b>More enhancement to be done in software part</b>	<b>Google meet</b>	<b>09/05/2022</b>	<b>Target Partially Achieved</b>	