IOT BASED SMART REFRIGERAT SYSTEM

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***Abstract*—In the era of the 21st century, we see a rapid improvement of technology in various fields. it tends us to use a Smarter device in our day-to-day Lifestyle. we all admire following new technology instead of perspective. So for this purpose, we all want some smarter devices that will fulfill our requirements. As we see the kitchen is one of the most prominent Zones of intelligent devices as well as daily needs. So one of those devices in the kitchen is a smart refrigerator. So manually monitoring all items inside the refrigerator daily it's not practically possible. So for that purpose, we have to convert our regular refrigerator into a "Smart refrigerator". People spending less time on their healthy food preparation at home and it may harmful to us. Smarter refrigerator module is designed to transfigure any existing refrigerator into a Smart cost-effective one, It will compare the quantity as well the quality of the food, status of food, etc., and told us regarding this via Android application. It will notify us about spoilage of Food, it will reduce illness & make healthier Lifestyle. By the sensing technology, this device told us or notify us about the expiration dates of our food. So we can use it before it gets spoiled. It can remotely notify the users and control items inside the refrigerator.**

Keywords—IoT, Android app, Smart Refrigerator, Load cell, MQ4, Ultrasonic sensor, Cloud, NodeMCU, HX711(Load Cell Amplifier) sensor.

I. INTRODUCTION

Being in 21st-century human being wants to deal with smarter technology or we can also say internet of things. The lot requires Pervasive connectivity to billions of heterogeneous devices, In rapid growth for devices in a smart home, the environment envisioned a wide range of Novel service applications. know smart kitchen 1st comes to our mind when we think about IoT. The reason behind this is we all know that kitchen is the and Largest user of energy at home. If we look around us technology like mobile phones, kitchen appliances & many more. Here we develop a system smart refrigerator because the people are very busy in their day-to-day lifestyle usually no one has time to look after their healthy habits and diets. So to solve this problem we are going to deal with a technology called a smart refrigerator that helps us to maintain a healthier lifestyle without any extra efforts.

Nikhil Kakade, Prof. (Dr.) S. D. Lokhande has proposed a system "IOT based intelligent home using Smart devices" it will sense the daily needs of particular items we required in our fridge &automatically. Placed order to the grocery shop[1]. Deepti Singh, Preet Jain, developed a system it can sense the weight of the food items placed in the Refrigerator & send a notification to the owner. through the mobile app when the weight falls below the threshold level[2].

The main objective of doing this smart refrigerator is to save our Life which means we don't give enough time for Preparing our healthy diet. so it will automatically monitor all things in the refrigerator and notify us regarding this. It will tell us the quality & quantity of food, expiration of food, etc. by using cost-effective Sensors!!

II. EASE OF USE

Our system will automatically monitor all the things inside the refrigerator and notify the user regarding this. It allows us to see what we have left in our Refrigerator from anywhere through the android application. Also, it will tell us about the food expiration. As it will check & notify about quantity as well as the quality of Food so you remember to eat them before they get bad and saving you to an added cost of buying it again. Use of this device is as simple as you use your Android device.

III. PROPOSED WORK

A. Methodology:

The system we are proposing is dependent upon IOT so to interact with our system we should need a proper internet connection facility and some electronic module that can be connected to the internet and also can be programmed as per the requirement of the user the NodeMCU [ESP8266 based development board] it can full-fill all those requirements and

also it comes with blynk application and cloud support so we can choose NodeMCU as a brain of our smart refrigerator.

B. Block Diagram:

The below figure shows the block diagram of our proposed smart refrigerator system. Based on this block diagram we can broadly classify our system into three sections such as Input section, Control section, and Output section.

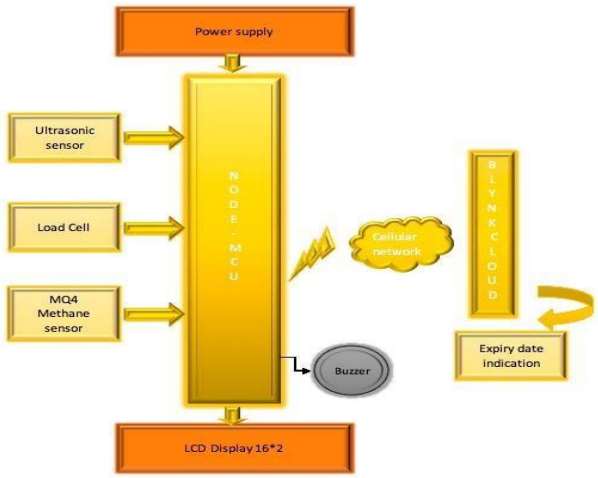

Fig. 1. Block Diagram of Proposed System

1) Input section

This section includes all the sensors used in the smart refrigerator model which are load sensor, ultrasonic sensor, mq2 gas sensor, etc.

The components of sensors in the input section will monitor the inside environment of the refrigerator and constantly forward the information to the control section the sensors used in this section is,

a) Load cell sensor:

In the smart refrigerator module, we are using a 6kg load sensor. the day-to-day experience we can say that a common human will not store expensive amounts i.e. more than 5-6kg of one type of vegetable at a time in the refrigerator that's why here we use a 6kg load cell [3] sensor will be sufficient. It is a force sensing module made up of a strain gauge. The sensor should calibrate first before using.

b) HX711:

The electrical signal output by the load cell is analog and is very small and requires specialized applications to overcome to the remind HX711 is used HX711 is a precise 24-bit analog-to-digital converter specially designed for convert weight scales. It converts analog input from load cell into a digital signal for a NodeMCU, HX711 also has an inbuilt low-noise programmable gain amplifier(PGA). with selectable gain of 32,64 & 128 also provides an on-chip regulated power supply for load cell [4].

c) Ultrasonic Sensor:

Ultrasonic ranging module HC-SR04 is used in the smart refrigerator it offers a 2cm to 400cm non-contact measurement function this is a very effective and cost-efficient sensor that provides accuracy up to 3mm. The module includes an ultrasonic wave transmitter-receiver and control circuit[5].

d) Gas sensor:

The mq4 gas sensor has a high sensitivity to Ch4 (methane)it also detects other gases such as alcohol smoke, which mostly is used for leakage detecting, and in the smart refrigerator model, it will detect any gas leakage and freshness of the vegetable-based on their outdoor[6].

2) Control section

This section gets input information from various sensors from the input a section processes it and according to the condition and process, flow gives a specific output signal to the output signal.

In the smart refrigerator system, we are using the NodeMCU ESP8266 i2e receiver module as a controller to input to get input signal processing it, and sends an output signal to the respective output device. NodeMCU consists of an onboard microcontroller as well as a Wi-Fi module. This makes the board useful and to make system design compact mode NodeMCU has 11 general purpose input-output pins (GPIO's) for interfacing peripherals to the NodeMCU. In this project, NodeMCU play a significant role it has 16 MB Max flash memory to stored program and can be program using Arduino IDE will keep our smart refrigerator system to work in the real-time interactive session with internet and user.

3) Output section

The output section can be also divided into two parts as a physical device used to give output or software application which are cloud best is used for real-time monitoring via smartphone or any other device. For physical output indication, we use a buzzer, 16*2 alphanumeric LCD with i2c LCD interfacing and a red LED and in the software section, we have two applications first one is the blynk app which will give us real-time monitoring and grocery management app.

a) Buzzer:

Is a device that will warn the user by making a sound loud to indicate any malfunctioning or whenever there is gas leakage.

b) LCD Display:

Is the 16*2 alphanumeric LCD is used to give a status of the inside environment of the fridge which will display the already perform character for the specific situation?

c) I2C LCD Interface:

The NodeMCU is preferred also it is cheap but can't provide more no of GPIO pins to connect more peripherals as LCD requires 8-10 consecutive pins to be interfaced for proper working it will be not possible therefore we have used an i2c LCD interface it will take signals from NodeMCU serial and provide a parallel interface to the LCD.

d) Red LED:

We have also interface a red LED indication indicator to indicate danger or in simple words, it will indicate the malfunctioning.

e) Blynk App:

A blynk is a special approved by esp8266 community and building community for the cloud interface for the NodeMCU all data of esp8266 NodeMCU will be stored on the cloud Blynk by the linked server was design for IoT it can control hardware remotely also can display sensor data stored data visualization it and do many other cool things this app allows you to create an amazing interface for your project using various of widgets and provide it is an open-source for all easy handler thousands of devices can with the help of bling cloud.

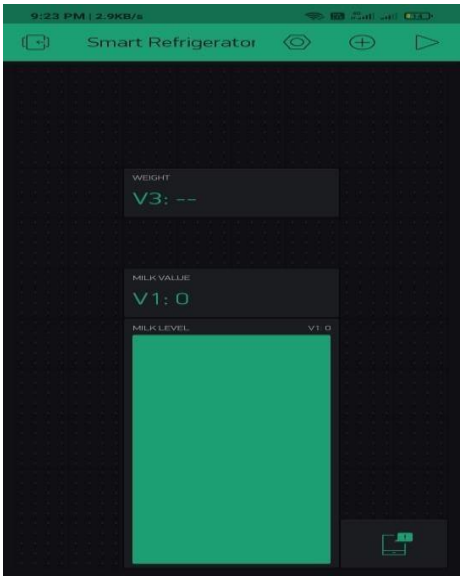

Fig. 2. Blynk App

f) My Smart Refrigerator App:

We have created this App. In that, we can do grocery management. 1st we will create a list of items inside the refrigerator. then we have to insert all the information regarding that item next time we just have to modify our information.

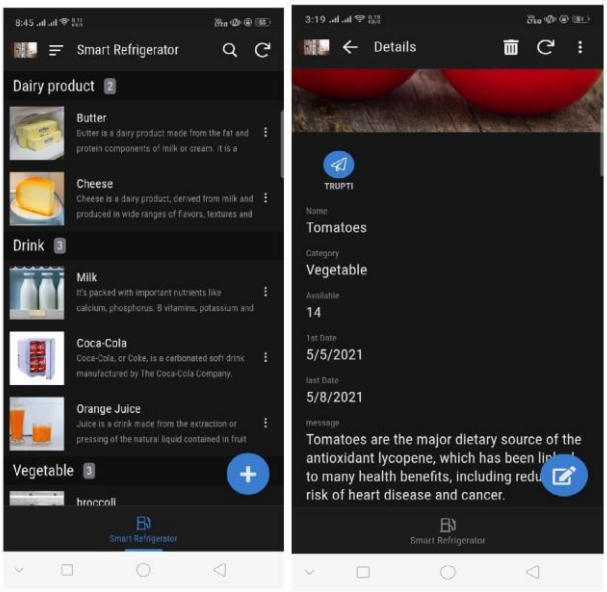

Fig. 3. My Smart Refrigerator App

Here we can display 1st and Last data of items i.e. expiration data and we also see the total available items and we have a facility to send a manual message via. Feature available there.

If we edit any information like if an item expired we have to remove it from App as well fridge so we can't use it. then it will send a Pop-Up message that the items list get is modify & regarding remove items. Likewise, we can monitor the grocery of the refrigerator through this amazing App.

C. Flowchart:

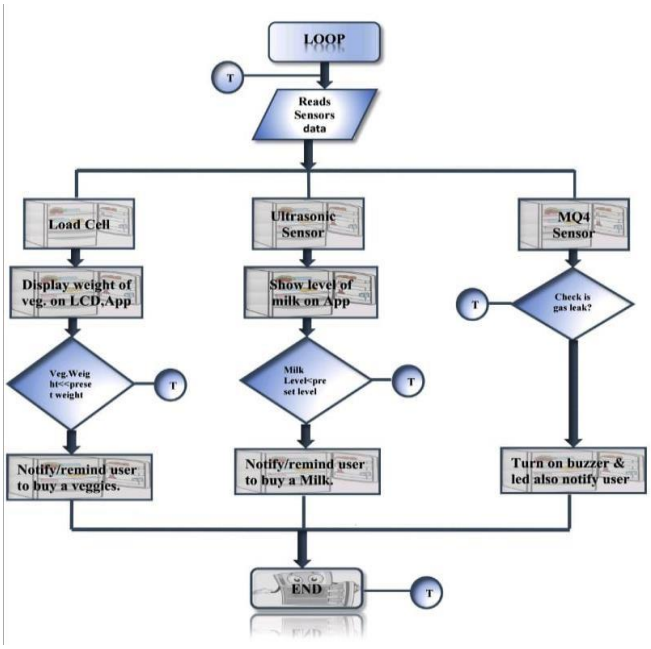

Fig. 4. Flowchart

The above flow chart illustrates the entire flow of the proposed Smart Refrigerator module. The entire system works on the +5v supply including all sensors Vcc component NodeMCU requires +3.3v & all other required 5v as supply input.

When the module is turned on NodeMCU Resets and start executing the program for starting first.it will connect to the hotspot having SSID & password entered in the program. Then NodeMCU will get online through the internet using Wi-Fi & After that, it will connect to the blynk cloud &from that Blynk app. When all initialization & setup is done program flow enters in an infinite loop where NodeMCU does the operation of taking input and reading data from various sensors according to that takes decisions & sends a control signal to output devices.

NodeMCU read the input data from the load cell, ultrasonic sensor & MQ4 gas sensor which indicate inside environments.

Load cell gives the weight of the vegetable placed in the section of the refrigerator continuously with some specific time delay and NodeMCU displays that weight on the LCD connected to it & also sends that weight to the application through the internet. NodeMCU also keeps eye on the weight measured, If the measured weight is below some predefined value forex 500 0.5kg then the interrupt will be generated and NodeMCU send data to the app which will remind the user or

give notification to the user that the vegetable section is lack of vegetable please get some as soon as possible After this it will again! Starts from starting loop.

- Load cell calculation:

$$Measured\ Force = \frac{A * measured\ mv}{v} + B(offset)$$

Unit of your measurement Force is grams, kg, pounds, etc.

the capacity of this cell is 1.0-0.15 mv/v which corresponds to a sensor capacity of 5kg.

$$Capacity = A * Rated\ output$$

$$A = \frac{Capacity}{Rated\ output} = \frac{5}{1.0}$$

$$A = 5$$

Offset is quite varying between the individual load cell

$$Offset = 0.5 * measured\ output$$

The ultrasonic sensor is used in this system to detect the level of milk in the milk jar. This sensor is attached to the lid of the milk jar which will continuously send & receives Ultrasonic pulses towards the bottom of the jar & gives the accurate level of milk to the NodeMCU. NodeMCU forwards this data to the app which will show the milk level on the app. It will also compare the present milk level with a threshold level if it is less then it will remind the user to buy some milk & store it in the fridge for future use.

- Ultrasonic Sensor calculation:

$$speed = 340m/s = 0.034cm/us$$

$$time = \frac{distance}{speed} = \frac{10}{0.34us} = 294us$$

$$distance = \frac{speed * time}{2} = \frac{0.034 * 294}{2} = 4.99$$

Suppose 10cm is the distance of the Object.

A gas sensor is used to detect any, gas leakage or any spoilage of food items which spreads bad smells & also can contaminate other food items. if any a rare case any gas leakage or spoilage occurs the MQ4 gas sensor will immediately detect it & sends a high priority interrupt to NodeMCU. NodeMCU will immediately turn on the Buzzer & the and red light inside the refrigerator and also gives a reminder to the user from the app.

In the program flow, the above loop will be continuously run for an infinite time NodeMCU receives data from the sensor & do according to the program flow after that it will again start from the first.

IV. SCHEMATICS

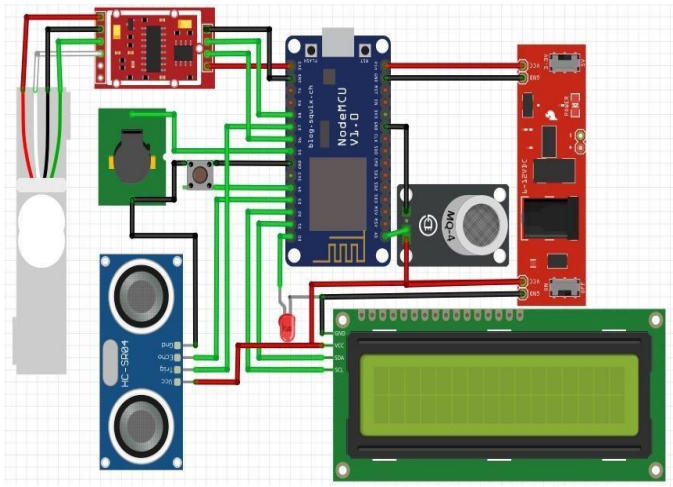

Fig. 5. Schematics Capture of The System

V. REAL-TIME IMPLEMENTATION

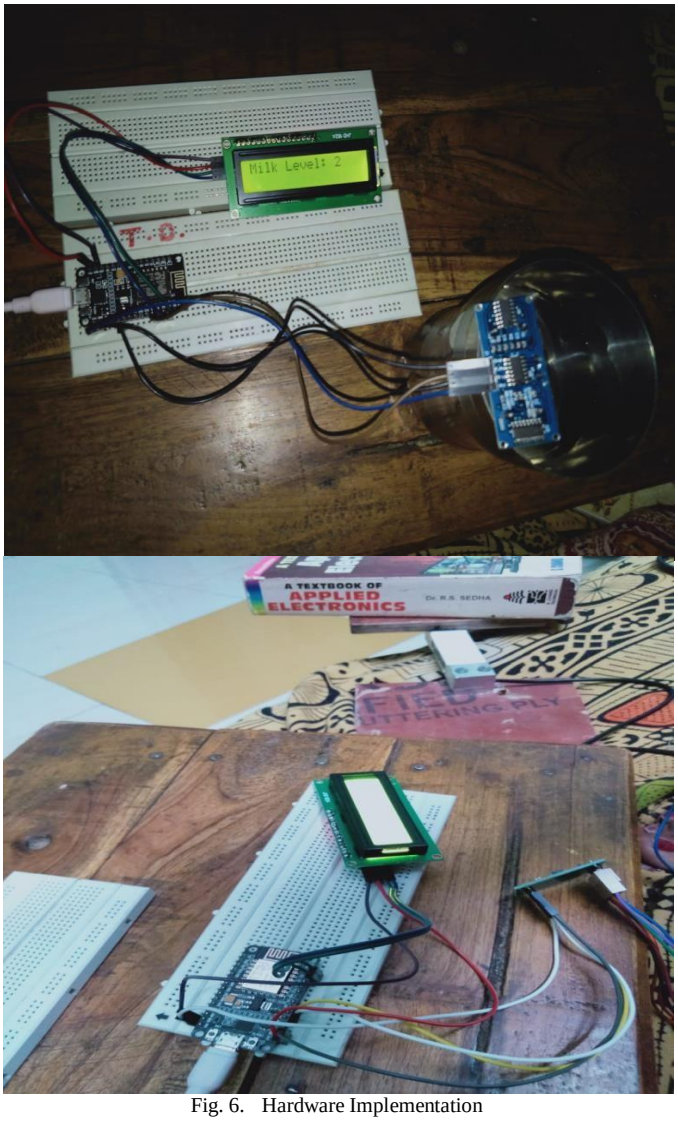

Fig. 6. Hardware Implementation

VI. EXPERIMENTAL RESULTS

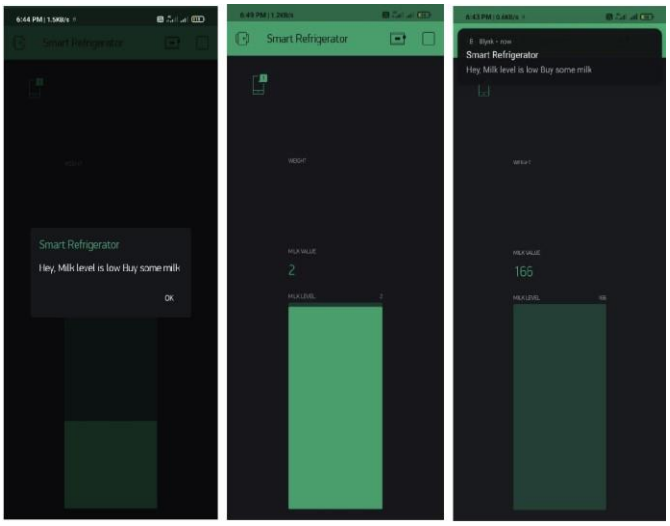

Fig. 7. Blynk App

VII. RESULT

Know a day's everyone is so much busy in their life. So by doing our work we forget to concentrate on our healthy diet. It will be harmful to us. so here we developed such a system named as "smart refrigerator" it will solve all these problems. As daily manually monitoring of our refrigerator is not practically possible. So our smart refrigerator automatically monitors all the things items in our Fridge. It will notify us regarding the weight of the refrigerator if the weight is below a threshold level

It will also monitor milk as milk is a daily need if milk goes low than the threshold it will notify us through a mobile app. then it will also display all those things on to LCD. It will notify us about the spoilage off food fold w regarding the expiration of the food items through the mobile app we can monitor all those things from anywhere with the android application.

VIII. CONCLUSION

The IoT-based smart refrigerator. can remotely notify the user & automatically control the Function inside the refrigerator. The proposed system can enable prosperity. Thus this smart refrigerator saves manual efforts & time in predicting future needs.

In the future, we can expand this system to defect the hotness of items we put inside the refrigerator.

IX. SCOPE FOR ADVANCEMENT

As we all know the future of IoT has the potential to be limitless. We can innovate any system using IoT.

→The future smart fridge will use a barcode scanner that will scan the expiry date products while keeping them in the fridge.

→In the future Cameras can be placed in the refrigerator that the user can able to see the contents available in the fridge on the user's mobile application from a remote area.

REFERENCES

[1] http://docplayer.net/38440061-Iot-based-intelligenthome-using-smart-devices.html

[2] http://ijarece.org/wpcontent/uploads/2016/08/IJARECE-VOL-5-ISSUE-72080-2084.pdf

[3] https://www.academia.edu/13146149/Datasheet_3133_Micro_Load_Cell_0_5kg_CZL635_What_do_you_have_to_know_How_does_it_work_For_curious_people

[4] https://www.alldatasheet.com/datasheetpdf/pdf/1132222/AVIA/HX711.html

[5] https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwiX85LL39DwAhVWJCsKHbbpBTYYABAAGgJzZg&ae=2&ohost=www.google.com&cid=CAESQeD2ybVYimKE_IsY2UCj2pw15PprAJTFYxCI6xSpjNsTmMoYAWWzNaePvZ9zYGEK7pOUSciN3nKfAFSADWNi9E&sig=AOD64_20INKMccyXIFRQcs_lRlB_vB05iw&q&adurl&ved=2ahUKEwjThYbL39Dw AhWylEsFHQ2XAP4Q0Qx6BAgDEAE

[6] https://components101.com/sensors/mq2-gas-sensor

[7] http://ijarece.org/wpcontent/uploads/2016/08/IJARECE-VOL-5-ISSUE-7-2080-2084.pdf

[8] http://www.ijrar.com/upload_issue/ijrar_issue_20543710.pdf

[9] https://www.engineersgarage.com/electronicprojects/arduino-based-smart-iot-food-qualitymonitoring-system/

[10] https://www.researchgate.net/publication/322653199_IoT_Based_Interactive_Smart_Refrigerator