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Smart Refrigerator Using Load Cell and IOT Protocols

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Abstract: *With the improvement of advancements in different fields our lives are coordinated to the smart and more intelligent routine. We are following new advancements as opposed to old methodologies. The devices should be intelligent enough to provide our necessities. The kitchen is the most conspicuous zones of intelligent application, one of these devices is the fridge/refrigerator. Since the current way of life is driving individuals investing less energy on healthy food preparation at home, pleasurable and fit lifestyle can be supported with smart kitchenware such as a smart refrigerator. This paper manages the planning of an intelligent fridge which can detect the amount just as nature of the nourishment things kept inside it. With smart detecting innovation, this fridge will keep beware of the expiry of nourishment items and the waste of edible things. It will be sharp enough to tell the present status of sustenance things through an android application on our mobile phone, and will similarly remind us about the things that are going to rot before they truly get ruined. In this manner, it will save money and wastage of food. And, help us to carry on more advantageous way of life.*

Keywords: *Smart Device, Smart Refrigerator, MQTT, COAP, Load Cell, Gas Sensor, Camera, Android Application, Cloud/IOT HUB, Internet of Things (IoT).*

I. INTRODUCTION

Automation is the most essential piece of our life in the present time. Automation accommodated home enables us to control IoT devices such as Light, entryway, fan, AC, fridge, and so on. A refrigerator is the most frequently used electrical appliance in the kitchen all over the world for food storage and keeping it fresh. A simple refrigerator can be upgraded into a smart cost-effective machine using a smart refrigerator module which consist of sensors like load cell, gas sensor, camera module, etc. Smart refrigerator looks at the status of the nourishment of food for e.g. weight, quantity, quality, and freshness, etc. The significance of this work will be, to remove rot sustenance, lessen sickness and make a more beneficial way of life for current age individuals. In this present era, a human being is used to deal with technology that we can say it as the internet of things (IoT). Smart applications with hypermedia capability are being used in today's life. As we look around ourselves, we see upgradation with superior technology, for example, mobile phones, kitchen appliances and many more. Smart appliances include washing machine, television, refrigerator etc. Here we discuss the smart refrigerator system because people are very stuck in the present lifestyle. They do not really have time to look after their basic healthy habits and diet; the man leaves home at early morning and returns back around evening there is no time for a person to take care about ourselves. In this work, we are using a raspberry pi as the main processor in our system which will be interacting with the internet as well as with user and sensors present in the smart refrigerator. There are other processor boards available in the market like **Node MCU**, **Arduino Duo**, **Arduino Mega**, etc. but we are using **Raspberry Pi** as a processor of our work. Because it has Broadcom BCM2835 SoC full high definition multimedia processors with 512mbSDRAM memory and it works on the Linux operating system. In this work, we are using various sensors like gas sensors, load sensors, and cameras as it is a vision sensor. A similar class of food items is placed at different-different blocks. So, to differentiate it we are using a camera module which will give a real-time image. Load cell to get the proper weight of the food item. And gas sensors to detect the freshness of food items. The quickly paced advancement and the present current living has brought depressive change on individuals' way of life towards less physical exercises and endeavors and an uneven terrible eating routine. Careless dietary patterns can cause disease issues in late life on the off chance that we don't begin eating nourishing sustenance genuinely. For example, issues coming about because of unfortunate dietary patterns and ways of life are turning into a major wellbeing danger in a large portion of the developed countries. In this paper, we trust that applications that focus on better wellbeing are vital. Our work will be to display an application advancement that will predominantly center towards the intelligent refrigerator with better wellbeing liability.

II. LITERATURE SURVEY

Aurel-Dorian Floarea et.al proposed a next-generation refrigerator connected to the IoT, a fridge that is revealed as an IoT object and connects with the things kept inside gathers data about the process this data into significant information that is later gone on through an IoT stage to its users[1]. Shouming Qiao et.al proposed a refrigerator based on the technology of RFID. A refrigerator will gather information about food items in a refrigerator and according to the food inside the refrigerator, it can

provide recipes[2].Suhuai Luo et.al proposed a system used for better nourishment and health of human life. It is planned for managing things kept in the refrigerator and inciting its users with cooking techniques depending upon what kind of item is available [3].Kebande et.al proposed a refrigerator system that indicates how vulnerabilities can be abused and recognized possible countermeasures as a course that can secure touchy and basic data in an IoT-based condition[4]. Deepti Singh et.al proposed work on refrigerator system with intelligence, which can sense the weight of the food items placed in the refrigerator and sends a notification to the user’s mobile through amobile app when the weight goes below the threshold value [5]. Emily Moin proposeda system that uses the barcode scanning method of getting information about the packing of the food item and communicates with the system through RFID [6]. Folasade Osisanwo et.al gives a brief idea about asystem uses RFID tagging. The refrigerator is provided with a Wi-Fi system to transmit datato the user [7].

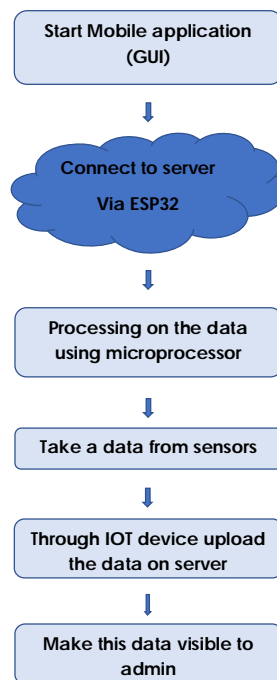


Fig.1. Process Flow

III. METHODOLOGY

A. Network Protocol

1) *MQTT*: We are using the MQTT network protocol for communication between Raspberry Pi and the user. In this work, Raspberry Pi is our broker which manages user and sensor connected to it.

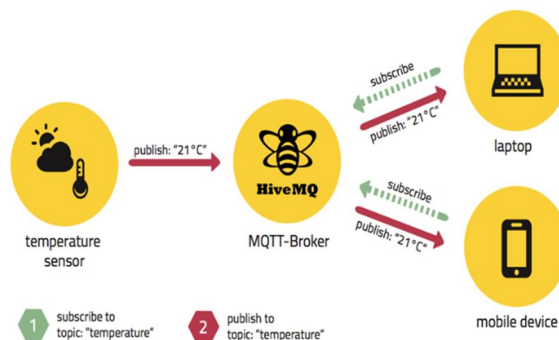


Fig.2. MQTT Network Protocol

2) *COAP*: We are using a COAP network protocol for connecting camera to cloud data. We are using here a Wi-Fi-based camera, in which we are using its Wi-Fi as IOT gateway andfor image transmission.

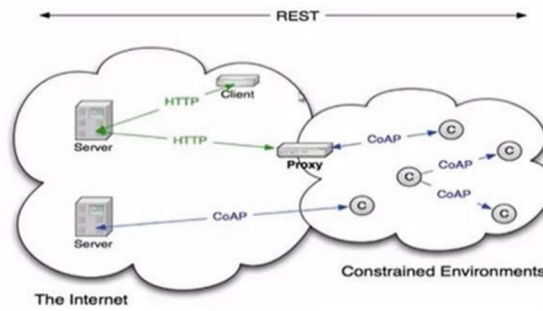


Fig.3. COAP Network Protocol

IV. PROPOSED SYSTEM

The proposed work is to introduce an intelligent refrigerator system, which is definitely not hard to use and preservationist for the customer. It is prepared for illuminating its owner about the activities going on inside it by the INTERNET on the phone. The android application made here is used as a GUI (Graphical User Interface) for the customer where they will be able to watch the condition of the food item kept inside the refrigerator. The whole system is managed by **Raspberry Pi** having Broadcom BCM2835 SoC full high definition multimedia processors with 512mb SDRAM memory and it works on the Linux operating system. It also has a built-in Wi-Fi which we will use as a communication gateway for the android application. As the weight of the food item goes below a threshold value which will be given by the user, the system gives a notification and ask for a refill. Similarly, if the food item starts to decay it will ask the user to remove it from the refrigerator.

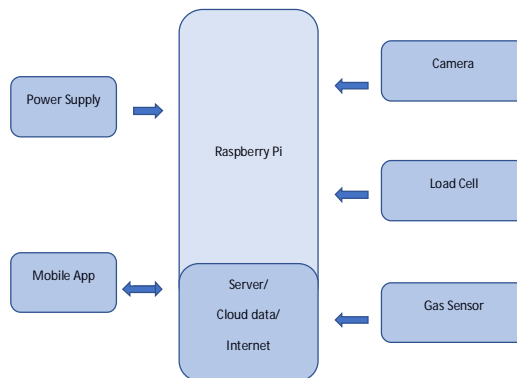


Fig.4. Block diagram

V. PROCESS FLOW

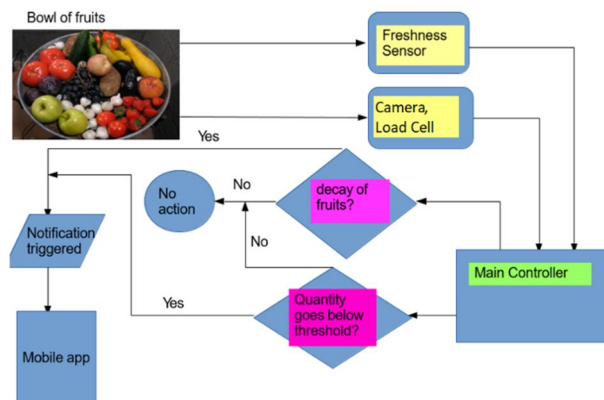


Fig.5. The process flow of the Smart Refrigerator

The means pursued structuring the framework are:

- A. Check the initial weight of the food item.
- B. Check freshness of the food item.
- C. Take the picture of the food item for the records.

- D. Record all the data in the database.
- E. If the food is below threshold weight, notify the user.
- F. If the food is decaying, notify the user.
- G. Send all this data to the cloud and the user will access it on mobile through the web application.

VI. SYSTEM DESIGN

- A. The very first component of our system is the main processor Raspberry Pi. It has BCM2835 SoC full high definition multimedia processors with 512mb SDRAM memory and it works on the Linux operating system.

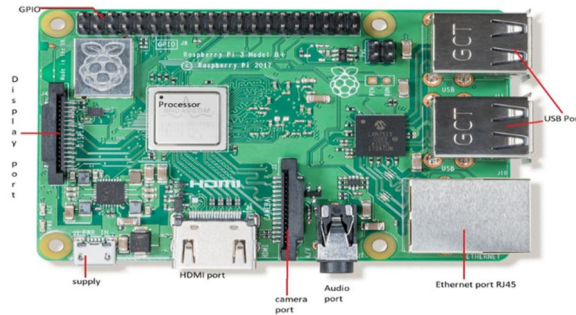


Fig.6. Raspberry Pi

- B. Here we are using the ESP32-cam module which is a Wi-Fi-based camera, we get images directly on the server and also it can be used as an IoT gateway.



Fig.7. Wi-Fi Camera Module

C. Wi-Fi Modem

There are other Wi-Fi innovations, for example,

- 1) WiMAX (IEEE Standard 802.16)
- 2) Bluetooth (IEEE Standard 802.15.1)
- 3) ZigBee (IEEE Standard 802.15.4)

We selected ESP32 because of following reasons

- 1) Development is easy
- 2) The higher version of ESP8266
- 3) Low cost
- 4) Small size
- 5) Wide range
- 6) UART interface with the microprocessor

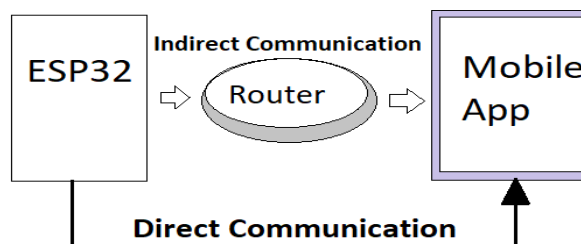


Fig.8. At Home Application

VII. RESULT

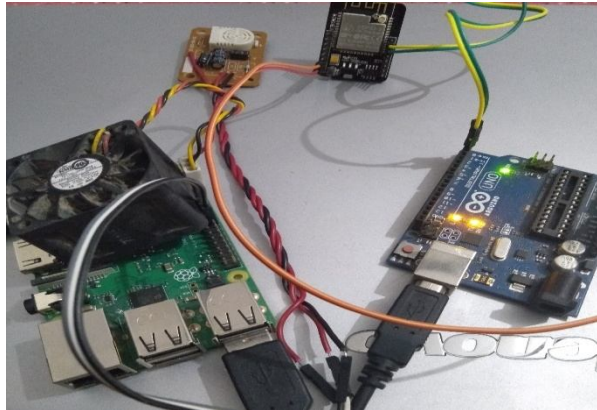


Fig.9. Hardware of Refrigerator

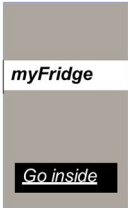
	Control temperature	Place a new item
	Set purchase rules	Set meal timings
	Freshness of items	Quantity of items
	Wiki of items	Get recipe suggestions
	My diet details Check for notifications Peek inside my Fridge Disable some features	

Fig.10. Front Screen of app

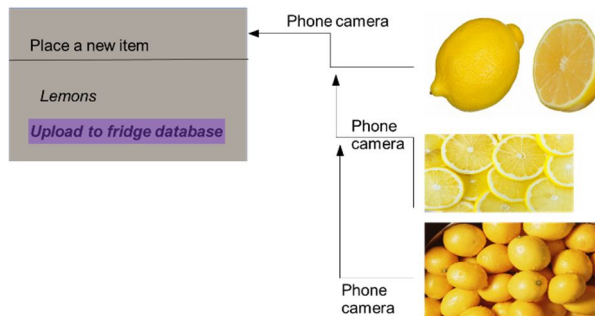


Fig.11. Placing New Item

VIII. CONCLUSION

We have given a smart refrigerator application. The proposed smart refrigerator can enable prosperity. It is planned for regulating things set away in it. What's more, besides, through the intelligent refrigerator people can save some money with less effort. We are certain that such kind of smart refrigerator will be a basic part in future smart homes. The possibility of the insightful fridge is obviously more coming to than educating the customer about the substance of the fridge. The smart refrigerator is conservative and easy to use.

IX. FUTURE WORK

The smart refrigerator is more coming than educating the customer concerning the substance of the refrigerator. The refrigerator would then have the ability to cross reference and follow up on decreasing the fixings used in future dinner suggestions and constraining sustenance misuse. In the era of the Internet of Things, it's hard to imagine that one thing can't talk to the other thing. In the case of the fridge, it might converse with a water purifier to advise it that the quantity of water bottles has gone underneath limit, and presumably some water is required in the refrigerator to be cooled. It can similarly speak with a microwave in the middle of supper timings. With such use cases, many applications can be developed.



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