Grocery Management using IoT

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Abstract

Today, automation using IoT is growing rapidly and is making everybody's work easier. This paper is an attempt to address the challenges faced in automating the kitchen with focus on 'Grocery Management Using IoT'. Every month, the user has to manually check a large set of grocery items, decide what has to be procured and how much. Instead, this entire process of checking, listing, procuring and storing can be automated using an IoT based Android. Ultrasonic-Sensors are used to read the data. An Arduino board sends data to the central receiver, which in turn sends the data to the server through a local Wi-Fi. When the level of any item reduces or reaches a certain level, a notification is sent to the users' smart phone and the user is presented with a few options to proceed further with. In this approach, the user gets to choose from the heterogeneous variety of grocery items, based on the requirement and frequency of use of a particular ingredient. For every product in the shopping list, the app shows a wide range of subset for the user to choose from, giving more transparency on the product, seller, price, etc. User decides whether to place an order that instant or delay it by a few days or add it to the monthly grocery list. This automation gives budgeting for the present month and also an estimate for the following month as well.

Keywords: *Arduino, Ultrasonic sensor, Central Receiver, Iot, Android Application.*

1.   Introduction

This work is to automate a particular process in the kitchen. Sensor technology and Internet of Things are the two basic concepts behind our work. Nowadays, everybody look for a change in the way things are done in our day to day lives. As we speak, most of our daily chores are being automated and things are being made easier and easier. So also, the mechanization of the kitchen is basic and would make work and cost planning simpler and effective.

The automation of the kitchen consists of lights, exhaust fan etc. [1], but our paper addresses the issues of automating only the grocery management in the kitchen. The first task is to measure the quantity of the grocery item in the respective container. The current systems use Infra-red (IR) sensors [1][3] and Ultrasonic sensors [2][4], our system will be utilizing the Ultrasonic sensor because, unlike the IR sensor, the light will not interfere with the measurement of the grocery item in the container. Systems also have a humidity sensor and a temperature integrated in the hardware attached to the container [2] to check the quality of the current grocery item, this will only increase wiring, make the hardware bulkier and collects extra data which may or may not be used by all the user. Our proposed system focuses more on the grocery level of the container, thus narrowing down the area of focus.

Prevailing system proposals have the entire system connected and communicating through wires, where two Ultrasonic sensors are mounted on a single Arduino board along with a temperature and a humidity sensor [2], or hardware units of all the nodes connect as a single system using wires [1][3][4], thus making the basic installation of the system in the kitchen a complicating and a grueling task.

On checking the level of the grocery item in the container, an appropriate action is supposed to be carried

out following the retrieval of this data. Most of the current systems send a notification to the user by sending an SMS [3], presenting the data in a web application [1] or an Android app [1][2][4]. In order to send the notification to the user, the data has to be uploaded to the server. In the pre-existing systems, the data is directly uploaded to the server or SMS is sent as the system is either using a Raspberry Pi [1][3][4] or a GSM module [3], which will affect the unit cost of the hardware required for a single container.

Most systems stop at the point of presenting the data to the user [1-3], but it does not guide the user with the required steps to proceed further with (unlike [4]). These systems provide the current level of the grocery item and/or when the threshold level has been reached and the grocery item is on the verge of getting over.

In order to overcome the current setbacks, we hereby propose a system which, the programming of the Arduino is used by the team to sense the items' level in the container using an Ultrasonic sensor and if the level of the item is below the threshold level then, it sends the data to the central receiver using a Radio Frequency module. This in-turn sends it to the database and it will be presented to the user through an android application. The android application is the user end of the application and will display the data in a creative and appealing fashion where the user can perform the further action based on their needs for that particular month or the following month. The user will have an account of the number of products and also the quantity of the products in the kitchen even if the user is outside the house, they will know what is needed to be bought for the kitchen as the data is available for the user in an android application format so they can order the item immediately or can add to the monthly list, as per their needs for that month

The main aim of this project is:
1. To develop an application to detect the level of items in each container using ultrasonic sensors and notify the user.
2. To connect the data from the kitchen and present it through an android application to the user.
3. To know the amount of each item in the kitchen, to know what has to be bought and what not to, and get an approximate idea of the following month's budget.
4. To order the grocery item as soon as notification is received or anytime later depending on their convenience.

2.   Related Work

[1]This paper manages the estimation of ingredients in the kitchen, in this project Raspberry pi is used to control the functionality of the system and the data will be presented in the android application as well as website, through which the user can place orders of the ingredients from the nearby store This application additionally monitors the temperature of the kitchen and sets it to a particular degree. This project has also made use of light sensors, the lights in the kitchen glows only if the user is in the kitchen.

In this project, the user does not receive a notification automatically about the low level of grocery in the container, he can get to know about the low level only when he manually checks the app, and this is time consuming. Our project makes the users work easy in monitoring the grocery levels by sending a notification automatically when the item is in the verge of getting over.

[2] This paper tells us about the smart shopping system called smart grocery system. This system uses a HC-SR04 Ultrasonic sensor to measure the low level of the grocery in the container, the user can also keep a track of the groceries in the kitchen. The user will be notified when the item is over and can place an order immediately. Temperature sensor is used to measure the humidity in the container.

This project gives the user live details of the ingredient level in the container and we see that in this implementation they have connected two ultrasonic sensors to one Arduino board which includes a lot of wiring. Practically if this is implemented for many containers, the complexity increases by decreasing the ease of use. Our project overcomes this problem as it is a wireless implementation. The Arduino will detect the level of the grocery item in the container using ultrasonic sensor as soon as the level of the item goes below the threshold and the data is sent to the central node using radio frequency module.

[3]This project talks about an IoT based system which uses an IR sensor along with Arduino and GSM modem. In this project, IR sensor is used to measure the level of an item in the container, and if it is below the minimum quantity, the data is sent to Arduino and with the help of GSM modem the user receives an SMS.

One of the main drawbacks of this system is that the user only receives a notification about the low level of items in the container and cannot place orders. This project has made use of Infrared sensor which in turn uses light waves to read data. This sensor fluctuates in certain wavelength of light due to which there are high chances of obtaining the incorrect values. The functionality of IR sensors will be affected in low light, as a result the sensor will not read the exact values if the container is placed in a low light area but ultrasonicsensors will overcome this drawback as it uses sound waves to detect objects which gives us the exact values.

3.   Proposed System

Grocery management has become quite a bit of a task. The one who purchases needs to continuously keep a track of groceries in the container at their houses, maintain the shopping list, standing in queues, reading the print on the food cans, so on. A huge number of grocery shoppers would require some convenient and a faster shopping option. To keep a track of day to day grocery in the form of a record is difficult. A research was held in order to get an idea of the problems faced by the people in terms of managing the grocery; the information received was used

to handle the problem more efficiently. An Android Application is designed that automates this process of checking the groceries in kitchen containers which will notify the user when the particular grocery item goes below the threshold level.
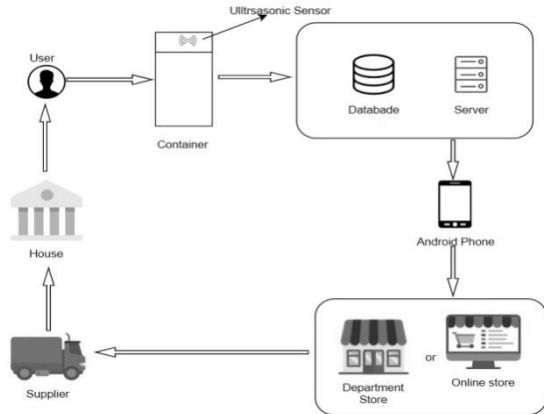

Figure 1:Implementation of Grocery Management

4. Implementation

The ultrasonic sensor that is mounted on the lid of the container will measure the level of the item in the container at regular intervals. Once the level of the grocery in the container falls below the threshold level, the sensor reads the data and sends it to central node using RF module. The system connects to the local Wi-Fi with the help of NodeMCU and uploads the data received from the ultrasonic sensor to the local server XAMPP, which in turn notifies the user about the grocery level through an android app named "Gromiot" indicating the particular item is in the verge of getting over. Through this android application the user can order the grocery item either on Gromiot or can order the item on Amazon which is an added functionality of the app or can also add the item to the cart depending upon their requirements.

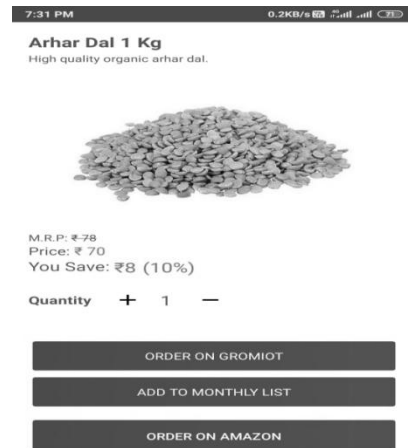Figure 2: Container with ultrasonic sensor
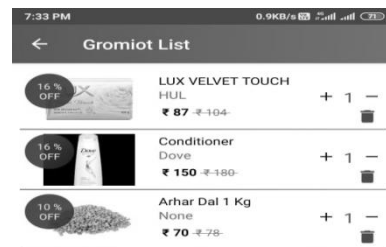

Figure 3: Each item page of Gromiot
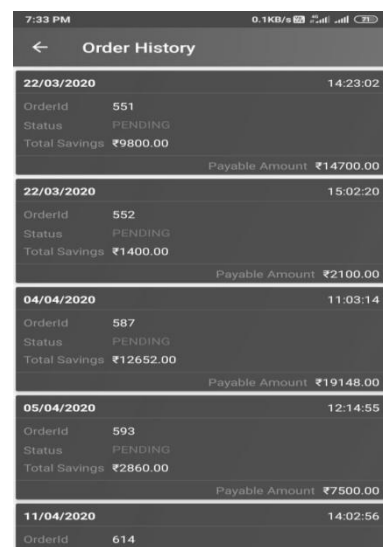

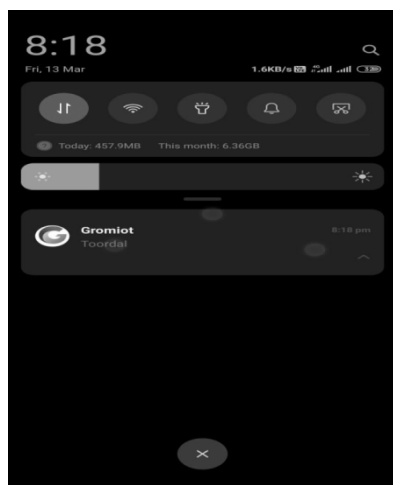Figure 4: Add to monthly list

Figure 5: Order history of Gromiot

Figure 6: Notification of Gromiot

5. System Design And Analysis

A. Sensors

The ultrasonic sensor is mounted on the container lid in order to measure the depth of the container. The ultrasonic sensor generates sound waves to measure the distance of the object. The ultrasonic sensor measures the level of item in the container at regular intervals and if the threshold level of the item has reached, the data is sent to NodeMCU.

B. Node MCU

NodeMCU controls the sensor and is the main control unit of the system. It connects to the local Wi-Fi and uploads the data received from the sensor to XAMPP.

C. RF Module

NRF24L01 is a radio transceiver. It consists of a single chip and functions are a band of 2.4 – 2.5 GHz ISM. This radio module consists of power amplifier, a frequency synthesizer, demodulator, enhanced ShockBurst, a modulator, crystal oscillator and a power engine. Using an SPI interface, programming the frequency channels, protocols and the output power is very convenient. The NRF24L01 consumes very less current, which is merely 9.0mA which in the RX mode gives a throughput power of -6dBm and 12.3mA. This chip is extremely power efficient as if has the Standby mode and also a power down mode, which are both built-in features in this radio chip.

D. XAMPP

For this project to work efficiently a server is required. XAMPP is a local server used here. Once the threshold level of the item is reached, NodeMCU uploads the data to the server which in turn helps us in notifying the user about the level of the grocery. A notification is sent to the user through an android app.

E. Firebase Cloud Messaging

This is a platform which provides the user the cloud service such as sending messages to android

F. Notification

The moment the level is reached, a notification pops up in the users' phone, intimating him/her about the containers current status. On receiving the notification, the user can choose any option such as Order Now, Add to cart or Delete based on his/her requirement.

G. Android Application

The android application helps the user in different manners. On receiving the notification the user is provided with a set of options, each with its own course of action for the user to follow. The options that are provided to the user are Order Now, Add to cart, Delete. The user can pick any of the options dependent on his/her prerequisite for the next month

If the user wishes to order the item immediately on receiving the notification, he can choose the option 'Order Now' and place the order on amazon. If the user wishes to maintain a monthly list of all the groceries and place the order for the following month at once, he can choose 'Add to cart 'option and add the item to the shopping list. If the user doesn't require the item he can choose the option 'Delete' and stop the process.

The user chooses any of the above choices dependent on his/her prerequisites for the next month, in light of the measure of thing staying in the store room and furthermore dependent on his financial limit for the month. This system not only helps us in maintaining a monthly list of items, it also helps the user in getting an approximate idea of the following month's budget and the user can order the grocery item through the application and procure the grocery item when notified.
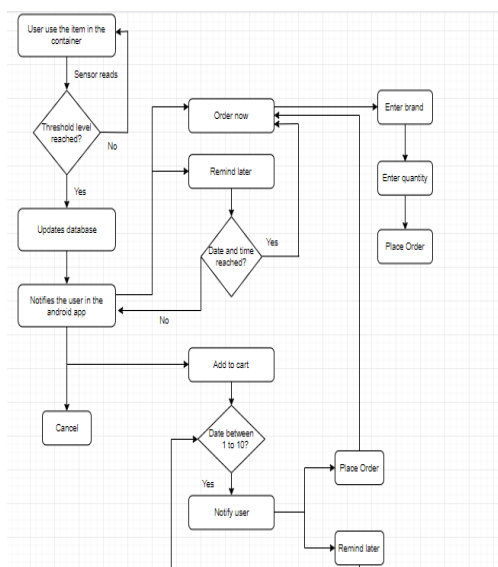

Figure 7: System Design

6.   Results

•   The user will be able to get notifications when the item in the container is in the verge of getting over.
•   The user will be able to add the item to the cart or delete from the same as per their requirements.
•   The user will be able to order groceries either through Amazon or Gromiot depending on their convenience.

7.   Conclusion and Future Scope

In this paper, we have done the analysis of the solutions available for the implementation of grocery management system using IoT. Grocery management using IoT is cost effective and user friendly system for customers. It not only focuses on easing the task of monitoring the groceries in the kitchen, it additionally saves our time and money. With this system, one can get rid of continuously monitoring the grocery containers in their houses. This reduces stress and saves time. This is an application which would be very useful for those who are in charge of the kitchen at houses, restaurants, industries etc. We will get notified about the low level of grocery and we can place order for the particular item. This application is just not for notifying which item is getting over, but it also helps in deciding what should or shouldn't be procured for the following month. It also gives the user a rough idea of the following months' budget. Since it is cheaper, making it easier for even small-scale users meet basic automation, hence, automating daily needs.

Future work of grocery management system is:

•   A plug and play system, where the user will be able to use the product from the moment it is bought and without worrying about the installation.

•   Distinctly identify the grocery item in the container with the help of RFID tag, which gives user the privilege to change the items in the container according to their will.

•   The final product is made easy for the user, the user will just have to mount the device under the lid of the container, turn it on, wait for 5 seconds for the device to read the container and then start using it to store the grocery item.

•   Remind me later feature, this feature will be useful if the user wants to be notified about the item anytime later.

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