International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

A Smart Kitchen Automation and Grocery Management System using IoT

K. Sakthisudhan, S. Mohanraj, T.V.P. Sundararajan

Abstract*: Goal of any innovation and development is to provide comfort and ease to human life. The rise of the term Smart Homes in recent years is due to the possibility of applying Internet of Things (IoT) for the home automation. Our system provides Smart grocery level management using Internet of Things (IoT). The smart containers which are incorporated with sensors are used to collect the data about grocery level in it. This data is stored in the cloud platform accordingly with the help of Wireless protocol. This process takes place daily. The information includes the stock level of all items, items which need to buy and the quantity need to buy and items which we use often etc. This information can be viewed through the Mobile application based on which the user can be provided with inputs based on which the order for a particular item can be placed. All homes can also be connected with the cloud. If we connect the system to the cloud of shop owner, we don't even need to go to the shop we can make delivery to our doorstep.

Index Terms*: Internet of Things (IoT), Ultrasonic Sensor, Microcontroller, Wi-Fi Module, Cloud Storage, Data Analysis, User Interface.

I. INTRODUCTION

Implanted frameworks are an integral part of each cutting edge electronic segment. These are low power utilization units that are utilized to run explicit errands for instance remote controls, clothes washers, microwaves, RFID labels, sensors, actuators and indoor regulators utilized in different applications, organizing equipment, for example, switches, switches, modems, cell phones, PDAs, and so forth. Typically, inserted gadgets are a piece of a bigger gadget where they perform explicit undertaking of the gadget. For instance installed frameworks are utilized as arranged indoor regulators in Heating, Ventilation and Air Conditioning (HVAC) frameworks, in Home Automation implanted frameworks are utilized as wired or remote systems administration to computerize and control lights, security, sound/visual frameworks, sense environmental change, observing, and so forth. Inserted frameworks will likewise be at the foundation for the organization of numerous Internet of Things (IoT) arrangements, particularly inside certain industry verticals and Industrial Internet of Things (IoT) applications. Significant players in implanted framework equipment and programming advancements are expecting to convey these changes into their items to exploit developing IoT Market. The zones that will change are Real Time Operating Systems (RTOS) and chip and microcontrollers, trailed by memory impressions and systems administration, open source networks and engineers.

A key component in effective kitchen management is inventory control. Grocery management is managing the grocery items which we have in our kitchen. This is done by keep tracking of the grocery items in each container. In our kitchen we are having many grocery items in many forms. Like solids or liquids or in powder forms. Each item is stored in its each respective container. These grocery levels may fall depending upon our usage in daily days. This usage may vary for every day. If their level goes down we have buy and again have to store. Grocery Management includes keep tracking their levels every day irrespective of the container and forms and indicating us that this particular grocery level is low which you have to buy if their level goes down. In this hectic world people may don't have the time to check into the grocery levels. If they continue using the grocery items without checking into it, one day they will gets emptied without their knowledge. At that time, it will affect the cooking process. If they are on the process of cooking, some dishes cannot be done without some grocery items. In that situation they won't have the time to go to the grocery store to buy that one particular item in order to complete cooking. It leaves only anger and frustration if they are in a hurry to complete it. Finally the entire cooking will become mess. This is why we have keep track of the grocery items in order to manage it.

This grocery management can also be done manually without any systems. For manual management, either we have to keep in memory or we have to write it down. It may be better for home makers but for carrier people it will be hard to notice and remember little things. Especially in metro cities mostly all houses contain working husband and wife. For those families it is really hard. If they went out for shopping there may be chances for them to forget to shop some groceries. At that time they have to remember which item is needed and how much it is needed.

Revised Manuscript Received on 30 May 2019.

***** Correspondence Author

K. SakthiSudhan*, Associate Professor, Department of Electronics & Communication Engg., Dr.N.G.P. Institute of Technology, Coimbatore, Tamil Nadu, India-641 048

S. Mohanraj, Assistant Professor, Department of Electronics & Communication Engg., M.Kumarasamy College of Engineering, Karur, Tamil Nadu, India-639 113

T.V.P. Sundararajan, Professor, Department of Electronics & Communication Engg., Sri Shakthi Institute of Engineering & Technology, Coimbatore, Tamilnadu, India-641 062.

It is not only buying the item but also concerns the quantity of buying each item. That is why manual management of grocery is very hard and we need some system to manage it. The following are the things which we have to do for better grocery management. Keep track the levels of grocery items in each containers daily, Indicate us that the particular grocery level is low when its level falls below its threshold and Have to buy the needed item and store it again in the containers. Our undertaking proposes a brilliant framework for doing the previously mentioned things. Presently multi day's life for everybody has turned out to be so riotous and tedious, at such time we require a brilliant framework at our kitchen too. To put on records and watching all the basic need at home is troublesome. More often than not we stay in wrong conviction that we have enough basic supply in our kitchen yet we need to confront void containers at the season of crisis when the prerequisite is must that gives us bother. Furthermore, to stay away from this, some time we purchase all that could possibly be needed basic need and store it at our home for a long time, which is likewise a burden can make harm basic need. Both this circumstances are issues. Framework that can give ceaseless dimension estimation and can tell us about low dimension of substance is required to keep away from these issues. This unit keeps the client advised about the amount changes in the unit utilizing the Internet of Things innovation. The number of organizations outfitting IoT abilities in the field of shrewd home frameworks will keep on quickly increasing. Mechanical progressions that keep on including new abilities and highlights have been improved with and all the more dominant sensors, and information gathering. With the coming of AI combined with ML and IoT, the whole worldview of shrewd kitchen gadgets has been consistently rising and the creators and technologists have been continually endeavouring to make the correct parity. Ever thought about how plan for tech can enable you to change your common kitchen into a keen kitchen? A standout amongst the most able use cases in a kitchen is the steady stockpiling and renewal of basic needs. So consider the possibility that the most widely recognized extra or item in your kitchen is the one that keeps a track on your stock and makes a shopping list on your advanced cell, and gets it conveyed specifically to your doorstep. To change our ordinary shopping into the above situation our kitchen holders likewise need to change. So we concocted the brilliant compartments for keen basic supply the board.

Our system provides Smart Shopping using Internet of Things (IoT). The above mentioned smart containers are used to collect the data about grocery level. The sensors are connected to each container to track its grocery level. These sensors sense their levels and the information in stored in the cloud platform accordingly with the help of Wi-Fi. This process takes place daily. The information includes the stock level of all items, items which need to buy and the amount need to buy, the item which we use frequently and items used often etc. This information can be viewed through our Mobile application, this is the so called Internet of Things (IoT). If we just carry our mobile phone during shopping, it will clearly shows the shopping details. We don't have to note it down or we don't have to remember things, the only thing to do is to see the mobile and start shopping.

In this smart grocery level management system there is no chance for missing any item or chances for buying extra quantities. In this way the entire kitchen lies in our hands. This information not only comes to our mobile application but also comes to the accounts which we want. We also connect the contacts of our family members also. So anyone we wish can shop. If we connect the contact of the shop owner, we don't even need to go to the shop to buy all items. If we place the order all the items which we need to buy will be delivered from the shop to our door step. Through this we can save time for shopping which will be more effective for working people and makes them to concentrate in other works.

II. RELATED WORKS

Chetal.S.Patil et al., represented that Brilliant basic need framework is a savvy and better approach for shopping for food that goes about as our aide and re-characterizes the methodology towards shopping for food. This framework causes us to keep up the shrewd basic need the board which is essential prerequisite for each family unit individual. Here we are going to think about the dimension estimation detecting utilizing ultrasonic sensor of strong or fluid substances just as temperature estimation utilizing temperature sensor, and as per that the request will be put for shopping of that specific basic supply. This framework acquaints us with the straightforward usage and usable application with the ease answer for the basic man [5].

Ruinian et al., [17] proposed an IoT framework, in which a modest radio recurrence recognizable proof (RFID) tag can be connected to every item which, when put into a brilliant shopping basket, can be consequently perused by a truck outfitted with a RFID per user. Therefore, charging can be led from the shopping basket itself, keeping clients from holding up in a long line at registration approve the plausibility of such a framework we assemble a model framework to test usefulness, and plan a safe correspondence convention to make the framework viable. Punam Khobragadee et al., proposed an Inventory Management System programming which is useful for the organizations work tool shops, where storekeeper keeps the records of offers and buy. Fumbled stock methods disillusioned clients, an excessive amount of money tied up in distribution centers and slower deals. This venture dispenses with the administrative work, human issues, manual postponement and accelerate process. Stock Management System will be able to follow deals and accessible stock, advises a storekeeper when it's an ideal opportunity to reorder and the amount to buy [14]. Mansi Mhaske et al., [10] utilized a framework containing the things connected with NFC tag, android telephone having NFC peruser which peruses the label data when put into the trolley. At that point this data is send to primary charging server which computes the all out number of acquired things and sends the determined bill to the gadget joined to trolley for showing it in plain view of advanced mobile phone. Alongside this framework we are executing an Android application for compensating office. The application depends on the trolley number and all out number of bought things.

Ankush Yewatkara et al., [2] represented that a super market is where clients come to buy their everyday utilizing items and pay for that. So there is a need to figure what number of items sold and create the bill for the client. When we go to shopping bazaar for shopping, we need to work for choosing the correct item. Subsequently, we are proposing to build up a savvy shopping basket framework that will monitor bought items and furthermore online exchange for charging utilizing RFID and ZigBee. There will be an incorporated framework for the proposal and online exchange. In addition, likewise there will be RFID peruser at the leave entryway for against robbery.

Nerella Ome et al., [12] proposed an IoT based sensors to cloud system using ESP8266 and Arduino Due. In this system sensors like temperature sensor and humidity sensor are used to sense information the device and converts it to digital using arduino due board. This board supports ESP8266 Wi-Fi module which transfers and stores information to the Things Speak cloud platform. This information can be viewed in the web pages or in the mobile applications. Arjoo Pathan et al., [3] proposed a system Smart Super market framework for Shopping Mall. This uses RFID readers and IoT. This creates smart baskets in which the RFID readers are incorporated. This will indicate the total Bill amount of the goods which is in the basket by reading all the RFID Tags attached to every goods. These RFID readers are attached to the top edges of the basket or the trolley. Also it will show the weight of the basket and the number of items dropped into it along with total cost.

Santosh H.Kalange et al., [18] proposed Smart Retailing utilizing IoT. This framework utilizes RFID peruser, RFID Tags, Lad cell, HX711 weight sensor, Wi-Fi module, Arduino Uno board. The fundamental pointed of undertaking is utilizing IoT innovation tackle the genuine issue face by retailer and client utilizing the android App. In proposed framework retailers realizes that amount of items stays in market. Basis of that If item are less in amount we send cautioning Message to retailers work area for refill the items or request the enhanced one from merchant. By clients side there is application which will recognize the item is accessible or not and in the event that accessible, at that point it demonstrate the genuine value, sustenance, expiry date and so forth identified with that item which spare the season of client. Akshay Pendbhaje et al., [1] proposed the IoT in Home Grocery Management System. They used the load cell to measure the grocery weight, Raspberry Pi microcontroller board which uses MQTT protocol. The objective of this paper is to propose a system which will track the availability of groceries in the kitchen. It also searches for better options of e-commerce sites with lower prices to order the product and displays the list on the user's Smartphone from where the user can order and procure those items. The test data is considered according to the daily usage of a grain in the kitchen. Hardi Desai et al., [6] proposed IOT based basic need observing framework to screen the staple dimensions at homes and market. Here burden sensors and remote transmission module associated with a focal hub. The focal hub is in charge of handling the information got from the heap sensors. By transferring this information into online information stream it tends to be utilized for further examination. In view of the got information, basic supply level in each house is estimated. Here thing talk stage is utilized for plotting of charts, histograms and so on.

III. MATERIALS AND METHODS

A. Methodology

The system is having the architecture as below, which consists of ultrasonic sensor, Arduino microcontroller, Wi-Fi module, Cloud, Mobile Application. The Fig. 1 shows the architecture of overall system. The ultrasonic sensor is attached to each kitchen container containing grocery items in different forms. This forms the sensor node. Then the sensor nodes are connected to the Arduino microcontroller. The Wi-Fi module ESP8266 is connected to the microcontroller. The grocery level information from the sensors are pushed into the cloud using the Wi-Fi module. In the cloud, the data is stored and analysed. This analysed result can be visualized using the mobile application.

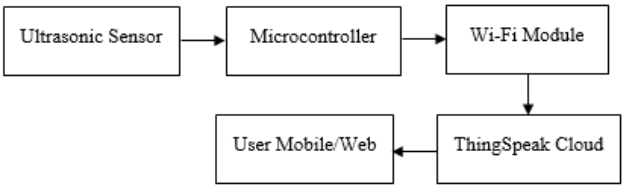

Fig. 1 Smart Grocery Level Management

B. Internet of Things

Internet of Things (IoT) is the concept of machine-to-machine communication without any human intervention. This communication will take place through the internet. It is one of the fastest growing platforms used to connect wide embedded applications. The embedded models together with internet and cloud form the Internet of Things. In our Smart Grocery Management System the data from the ultrasonic sensor will reach the cloud platform through the internet. Then this data can be retrieved from the cloud and visualized. This setup is the so called Internet of Things.

C. Ultrasonic Sensor

The system uses the Ultrasonic sensor. The ultrasonic sensor is used to measure the distance using the ultrasonic waves at the frequency of 40 Hz. It can measure distance up to 400cm. Each kitchen container contains an ultrasonic sensor attached to it.

This sensor will measure the level or depth of the grocery material in the container by calculating the time difference between the transmitted waves and the received waves. Here the distance is referred to as level or depth of the grocery. This sensor will give the analog voltage as the output of the sensor. The microcontroller will changes over this simple voltage into computerized information. The Wi-Fi module sends these sensor esteems to the cloud.

D. Microcontroller

The microcontroller is a compact integrated circuit or a small computer that contains a processor, memory and peripherals. These microcontrollers can be used as an embedded system. The majority of microcontrollers in use today are embedded in automobiles, telephones, appliances, and peripherals for computer systems etc. In our project the Arduino Uno microcontroller is used. It is used to get the useful data from sensor. So that we can identify the level of goods present in the container. The microcontroller is also connected with the Wi-Fi module. Through the microcontroller and the Wi-Fi module the collected data will reach the cloud.

E. Wi-Fi Module

The ESP8266 Wi-Fi module is used here. It is having TCP/IP protocol stack integrated on chip. The Wi-Fi module is used to make the microcontroller get connected to the Wi-Fi network. This module is customized to send the AT directions to make the module work in customer mode. The module can be utilized in both customer and server modes. The ultrasonic sensor with the microcontroller and Wi-Fi module fills in as the customer hub which is fixed on the highest point of the compartment in this framework. The client nodes send the data to the server node through Wi-Fi module and the server node here is the remote servers or the cloud.

F. Cloud Storage

Cloud storage is like the data storage part of the computer where data is stored in multiple remote servers. This stored data can be accessed through the internet. In this system the Thing Speak cloud platform is used. Thing Speak is one of the open source cloud used for many Internet of Things applications. The data regarding the grocery level is stored in the cloud using Wi-Fi module. Then the stored sensor data can be analyzed and can be retrieved using HTTP protocol.

G. Data Analysis

The sensors that are deployed in the kitchen containers are referred to as the things or connected devices. The data about the grocery collected from the sensors are pushed into the IoT Cloud Platform through the local area network. The cloud initially performs data collection and management. Therefore the incoming data are stored which then followed by Predictive Analysis. Predictive Analysis helps in obtaining the results that can be expected in the future. The algorithm for the Predictive Analysis is developed from analysing the current incoming results and the past historical results. Then the analysed data from the cloud platform can be visualized in the embedded models like apps or websites.

The below functional flow diagram 1 shows(Fig. 3) how the indication is created if the grocery level in the container is reached to the certain level. The variable 'x' indicates the current level of the grocery in the container. The values L1, L2, L3 indicate the grocery level in the container as full, half filled and low respectively. Initially the ultrasonic sensor senses the levels of grocery items in the container. Then the controller checks for the first condition that if the container is full or not. If true, it will give "The container is full" indication. If false it goes on to check the next condition. The second condition checks that if the container is half filled or not. If true "The container is half filled" indication. If not it checks the last condition that whether the container level is low or not. If low, it shows "The container level is low" indication. Otherwise, it shows the indication that "The container is empty.

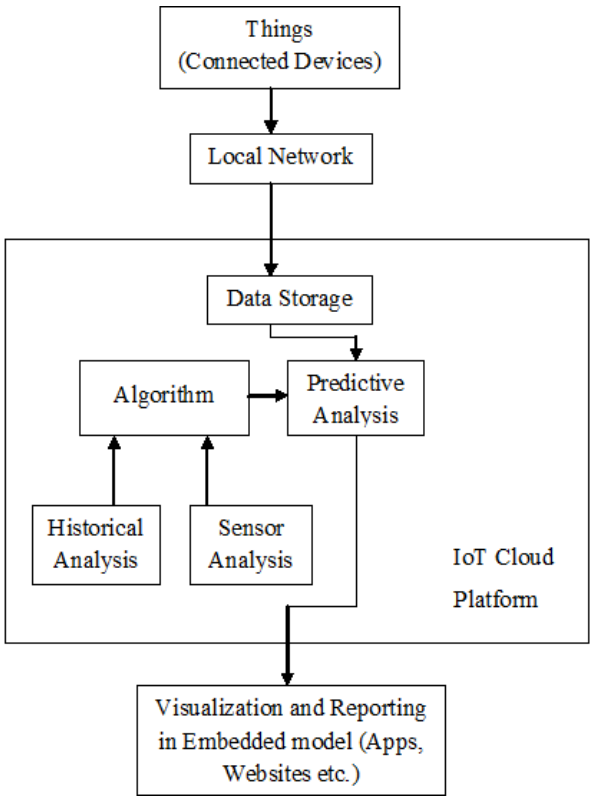

Fig. 2 Data Analysis

The above functional flow diagram 2 shows how the indication is generated if the consumed calorie level of the particular gram reaches its threshold. Let us take three different varieties of grams which contain different calorie levels. The variables c1, c2, c3 represents the calorie level have to be consumed per week of three grams respectively. The values x, y, z represents the current calorie levels consumed so far of three grams respectively. Initially the ultrasonic sensor starts sensing the grams levels in the container, once the containers are refilled at the starting of the week.

The controller then checks for the condition that whether the current consumed calorie levels x, y, z reaches the threshold values c1, c2, c3. If true it gives indication that enough calories of this particular gram are consumed. If not, the above process repeats. In this way the system checks the calories levels continuously which will help us to aware of the amount of calories consumed by us and helps to improve our health.

H. User Interface

After analysed at the back end, the results can be viewed with the help of user interfaces like Android Applications in Mobile Phones, Web pages in Computers, Laptops, and Tablets etc.

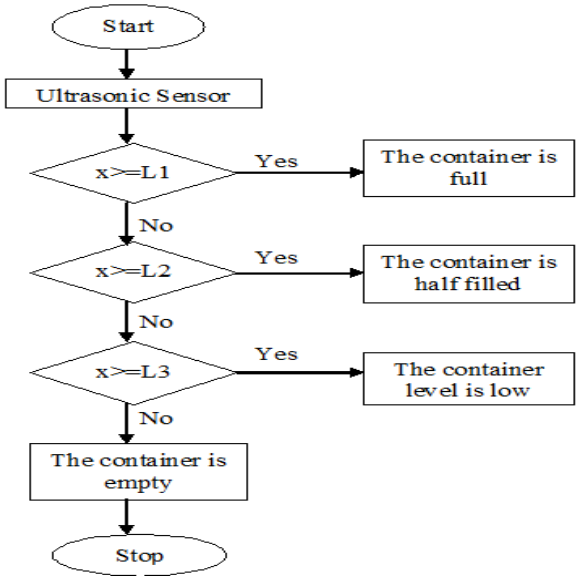

Fig. 3 Functional flow diagram 1

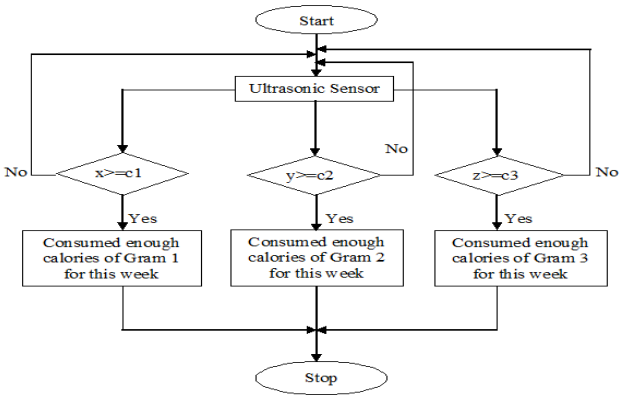

Fig. 4 Functional flow diagram 2

IV. RESULTS AND DISCUSSION

In Smart Grocery Level Management System for Kitchen Automation we have used Ultrasonic Sensors in the lid of each container to find out the grocery level in it. These sensors are connected to the NodeMCU Board. By calculating the time difference between the transmitted signal and the received signal from the Ultrasonic Sensor, the grocery level from the top of the container is measured. In that way we can find out the grocery level. The collected grocery information is stored in the cloud platform where analysis takes place and finally viewed by Android Application. The screenshots of various level measurements are given below. In grocery level management system two ultrasonic sensor are used. This measures the grocery levels of two separate containers. For that, two separate fields are created in ThingSpeak. These fields give the graphical visualization of the transferred sensors data separately.

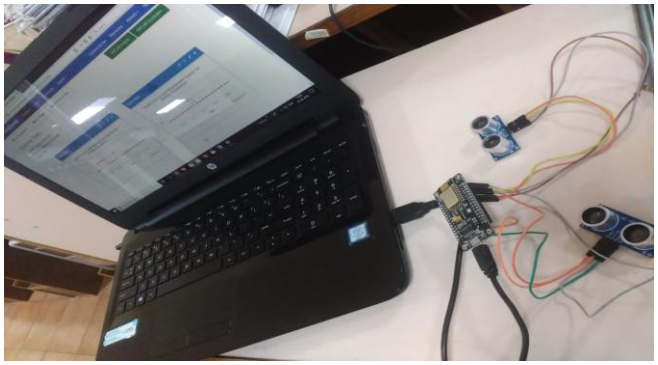

Fig. 5 Implemented Module

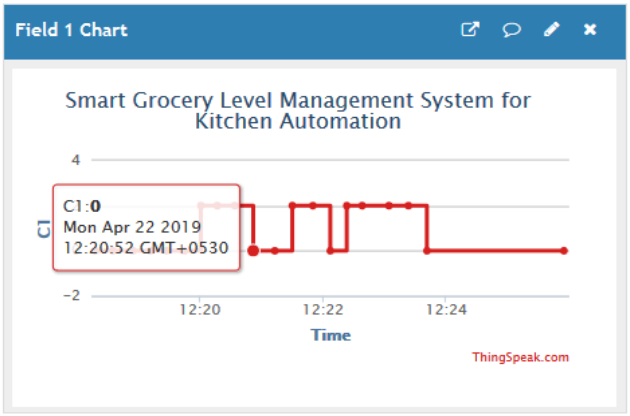

Fig. 6 Container 1 field chart

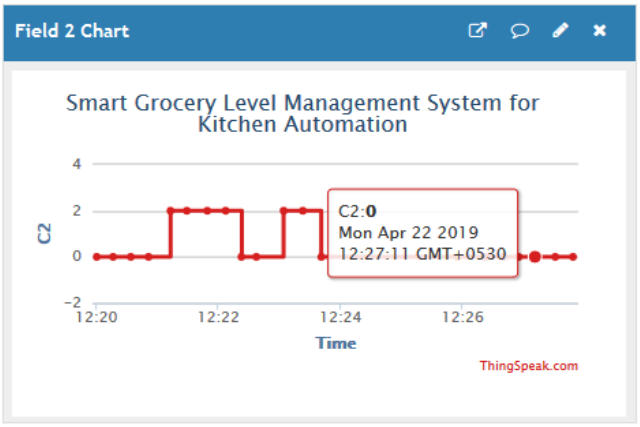

Fig. 7 Container 2 field chart

The Fig.6 shows the graphical representation of first ultrasonic sensor data. Here the x-axis is named as Time since the values vary with time and the y-axis is named as C1 which represents level of Container 1. The Fig.7 shows the graphical representation of second ultrasonic sensor data. Here the x-axis is named as Time since the values vary with time and the y-axis is named as C2 which represents level of Container 2. By placing the cursor on each value point in the field chart, we can view the exact level of the container along with date, day and time. Through MATLAB the analysis have been done. That will display the name of our project which we have given, space for typing our MATLAB code and the output console.

We have to type the code for our project and have to save and run the program. Then the output will be displayed in the output block. The Fig.8 is the screenshot for the result of MATLAB Analysis of Grocery level management. Here FieldId1 represents the level of container 1and FieldId2 represents the level of container 2. Since both the containers level falls below the threshold value, the results are showing the containers level as low.

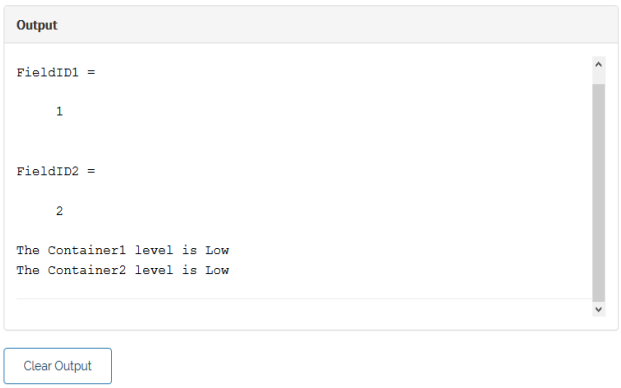

Fig. 8 MATLAB visualization

V. CONCLUSION

Embedded system together with IOT connects the people to the world. Sensors are deployed in the environment to collect the information and then the collected data and analysis results will be available to the end user through the Wi-Fi. This work done for smart shopping system that can be implemented in homes and grocery stores. With smart grocery system, one can be relax and stop worrying of continuously being in follow, and checking the grocery containers in our house. We will be notified about the low level of grocery and we can place order for particular item. This helps in ease of society and one-step forward of making our city smart. The collected grocery information is stored in the cloud platform where analysis takes place and finally viewed by Android Application. With the help of the results, we can efficiently serve the food grains.

REFERENCES

1. Akshay Pendbhajh, Prof.Sangeetha Rajesh, “IOT in Home Grocery Management”, 4th Somaiya International Conference on Technology and Information Management, 2017, pp 44-49.
2. Ankush Yewatkara, Faiz Inamdarb, Raj Singhc, Ayushyad, Amol Bandale, “Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft”, 7th International Conference on Communication, Computing and Virtualization, Volume:06, procs.2016.03.107, 2016, pp 793-800.
3. Arjoo Pathan, Rujuta Kokate, Abhijeet Mutha, Priyanka Pingale, Prashant Gadakh, “Digital India: IoT Based Intelligent Interactive Super Market Framework for Shopping Mall”, Volume: one, Issue: 1, 2016, pp 1-5.
4. Asle Fagerstrømab, Niklas Erikssonb, Valdimar Sigurossonc, “What’s the “Thing” in Internet of Things in Grocery Shopping? A Customer Approach”, International Conference on Enterprise Information System, 2017, pp 384-388.
5. Chetal.S.Patil, Kanaksing.N.Pawar, “SMART GROCERY MANAGEMENT SYSTEM USING INTERNET OF THINGS”, International Journal of Research in Engineering and Technology, Volume: 05, Issue: 07, 2016, pp 97-101.
6. Hardi Desai, Divya Smeet Somaiya, Hetal Mundra, “IoT based Grocery Monitoring System” in 14th International Conference on Wireless and Optical Communications Networks (WOCN), 2018.
7. Joo, Kwang Hyoun, Tetsuo Kinoshita and Norio Shiratori, "Agent based Grocery Shopping System Based on User’s Preference", In Parallel and Distributed Systems: Workshops, Seventh International Conference, IEEE, 2000, pp - 499-505.
8. Karuppiah Pal Amutha, Chidambaram Sethukkarasi, Raja Pitchiah, “Smart Kitchen Cabinet for Aware Home”, the First International Conference on Smart Systems, Devices and Technologies, 2012, pp 9-14.
9. M.Kranz, A.Schmidt, A.Maldonado, R.B.Rusu, M.Beetz, B.H¨ornler and G.Rigoll, “Context-aware kitchen utilities”, In Proceedings of the 1st international conference on Tangible and embedded interaction - TEI ’07, New York, New York, USA. ACM Press, 2007, pp - 213–214.
10. Mansi Mhaske, Mayuri Sawant, Ekta Bhattad, Amruta Gaikwad, Manoj Mulik, “Smart Shopping System Android Application”, International Journal of Advanced Research in Computer Science and Software Engineering, Volume:06, Issue:11, 2016, pp 124-127.
11. Marcus St¨ander, Aristotelis Hadjakos, Niklas Lochschmidt, Christian Klos, Bastian Renner, Max M¨uhlh¨auser, “A Smart Kitchen Infrastructure”, IEEE International Symposium on Multimedia, 2012, pp 96-99.
12. Mr.Nerella Ome, Mr.G.Someswara Rao , “Internet of Things (IoT) based Sensors to Cloud system using ESP8266 and Arduino Due”, International Journal of Advanced Research in Computer and Communication Engineering, Volume:05, Issue:10, 2016, pp 337-343.
13. Prof.R.V.Babar, Chaitanya Bapat, M.S.Gaikwad, “Grocery Inventry Automation Using Internet of Things and BLE Network”, International Journal of Innovative Research in Science Engineering and Technology, Volume: 05, Issue: 7, 2016, pp 13829-13834.
14. Punam Khobragade, Roshni Selokar, Rina Maraskolhe, Prof.Manjusha Talmale, “Research paper on Inventory management system”, International Research Journal of Engineering and Technology, Volume: 05, Issue: 4, 2018, pp 252-254.
15. Richard Voyles, Jaewook Bae, Bret Smith, David Kusuma and Ledu Nguyen, “Smart Tupperware: Active Containers for Kitchen Automation”, SICE Annual Conference, 2008, pp 3065-3069.
16. Rohan Wagle, Mayur Shah, Aditya Kadam, RamgopalSahu, “A Survey on Monitoring and Control system for Food Storage using IoT”, International Journal of Innovative Research in Computer and Communication Engineering, Volume:05,Issue:5, 2017, pp 9491-9495.
17. Ruinian Li, Tianyi Song, Nicholas Capurso, Jiguo Yu, Jason Couture and Xiuzhen Cheng, IEEE “IoT Applications on Secure Smart Shopping System”, IEEE Internet of Things Journal, Volume:04, Issue:6, 2017, pp 1945-1954.
18. Santosh H.Kalange, Dipti A.Kadam, Asmita B.Mokal, Avinash A.Patil, “Smart Retailing Using IOT”, In proceedings of International Research Journal of Engineering and Technology (IRJET) Nerul, Navi Mumbai, 2017, pp 263-268.