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# IOT In Home Grocery Management

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***Abstract:*** *Internet Of Things technology is changing our daily life by embedding sensors and actuators in all the appliances we use. The percepts from sensors are intelligently manipulated to make better decisions. Our system is introducing the use of Internet Of Things technology in the kitchen. In the current scenario, grocery shopping can be done online. But keeping track of the groceries is the main work of the person handling kitchen, failing which will result in insufficient items to cook. The system stated in this paper takes away this responsibility from the person handling kitchen. 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.*
***Keywords:*** *Internet Of Things, grocery management, smart home, MQTT, raspberry pi, loadcell.*

## I. Introduction

Internet Of Things is a technique which provides a better solution for human to machine and machine to machine interaction. It is a technology in which all the living and nonliving things are given a unique identifier. Without the need for human intervention or human interaction i.e. human to human or human to machine, multiple machines are communicating or transferring the data directly to other machines i.e. M2M a.k.a. machine to machine communication. The concept of smart devices started to emerge in 1982. All the things having electronics, sensors, software, actuator, networking connectivity which can communicate with each other, send message take decisions and actions accordingly. Nowadays women are working in different sectors of industry and they do lion's share in housework. Some unseen tasks they need to be pace with are keeping stock of grocery and other fast moving goods at home, without which it is not possible to do some major tasks like cooking, washing etc. In early days the household items purchase had to be done by going to shops or malls. This task is currently replaced by online shopping which reduced the time of traveling. But the need to keep track of grocery stock is still done manually. The purpose of the paper is the implementation of the Internet Of Things in household grocery management. This paper proposes a system which replaces the partial automation in purchasing these items by a fully automated system for placing the order.

The proposed system helps to smartly handle the grocery management at home so that to avoid situations like forgetting to buy grocery. It will be more helpful to the working woman to manage grocery backups. It is also useful for the seller and the manufacturer as the data accumulated from all the users can be used to understand the sales and the flow of the goods. The objective of the paper is to propose the grocery management system using of Internet Of Things technology. [1] [2] [3]

The entire paper is organized as follows: Section II describes the related work carried out. Section III contains the proposed architecture of grocery management system. Section IV using a test case complete working of the system is demonstrated. Section V concludes the paper by mentioning the future scope.

## II. Related Work

A systematic approach is used to attach sensors to all the appliances to make them communicate with the master computer. There is one master computer which accepts data from sensors and data is collected in every 0.5 seconds. The master computer will control the appliance based on the data collected from sensors. All devices use the message queue to communicate with each other. The data is sent using XML file to the main computer and the main computer controls all the computers [4]

A system is developed and implemented in metro subways of Japan city. A virtual supermarket is built in metro subways in Japan in a way that there are 2d codes of different products on metro station which can be seen from the window of the metro, so if a person wants to shop for that item he or she can use their Smartphone just to scan the barcode with preinstalled scanning software so the item will be recognized and payment can be made using the Smartphone and the product will be delivered to the home this system saves the access time of

the customers to buy the fast moving goods. Also, increase in sales was noticed by the supermarket after this experiment. [5]
A framework is proposed for implementation of IoT in sports. There are multiple gadgets available already on the market but they lack standard architecture. The process contains the following steps:

- Sensors are mounted on helmet and wristband etc.
- These sensors are connected to the Internet.
- Collect and work on real-time data by the sensor.

The first layer contains actual Sensors. The second layer uses communication protocols to send the data collected by the sensor to a higher level. This layer receives the data and processes it. This internet layer will send the data to the cloud and store the data or process the data in apps. [6] [7]

### 2.1. Raspberry Pi

The microcontroller is needed to manage the sensors and communicates with the Internet. Raspberry Pi is card sized computer board where an operating system can be installed. Programmers can install script and programs in the system. [8] [9]

### 2.2. MQTT protocol

The protocol is lightweight and achieves following goals:
1) It should offer a once-and-once-only assured delivery mode to enable a message to be reliably transferred from a remote sensor to a back-end application.
2) The protocol should be as lightweight as possible across the "wire" or other communication media. Most of the remote telemetry is done over low bandwidth, high-cost networks, and so minimizing the overhead of each message is highly desirable.
3) The protocol should be very easy to implement on embedded devices such as sensors and gateways.[10] [11] [12] [13]

## III. Architecture

The architecture of the proposed system is shown in Figure 1. In the proposed system, grocery containers have load cell below it. The load cell is used to measure the weight of the content inside the container. These load cells are connected to the microcontroller with wires. Load cell sends the data to the microcontroller. The microcontroller used in this system is raspberry pi. It is connected to the Internet with the help of wifi. The microcontroller will read the data sent by the load cell and forward it to the application which resides on the Internet. The system will use the MQTT protocol for communication. The application will check the message sent by the microcontroller and identify quantity in each container. After the application receives the message it will calculate the daily use of the respective item. When the quantity is below the threshold, the system will notify the user about the user the information of current item in the container such as name, brand, quantity, the seller with top 5 sellers of the same product from the location of the user on their smartphone. Once the user places the order it will be sent to the web service which will make the entry of the order in the database and forward the order to the seller. The database of order is also helpful for sellers to identify which area is having demand for which brand and to analyze the market trend. The threshold is calculated based on the use of the thing inside the container. [14] The formula used to calculate the daily use and the threshold value is given below.

$$Dayuse = Nightweight - Morningweight \quad (1)$$

$$Averageuse_n = \frac{dayuse_1 + ... + dayuse_n}{n} \quad (2)$$

$$Threshold = 3 * Averageuse \quad (3)$$

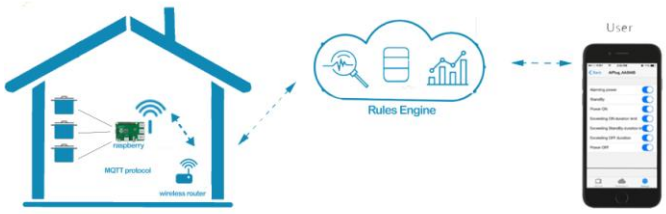


**Fig. 1.** Architecture of the system

The reason behind taking threshold = (3*average use) is the average use is the cumulative average of everyday use. The threshold will be reached approximately 3 days before the grocery getting over. Assuming that after placing the order the product will arrive in 2 days. The application will reorder the product once Nightweight < Threshold. The algorithm to calculate the weight is given below.

**Algorithm: Weightcalc()**

```
1.  threshold=0
2.  nightWeight=0
3.  morningWeight=0
4.  dailyUse=0
5.  totalCapacity=0
6.  Accept id
7.  Accept current weight
8.   if(time=8.00)
9.       Accept morningWeight
10. endif
11. if(time=23.00)
12.      Accept nightWeight
13. endif
14. dailyUse=(((morningWeight-nightWeight) / totalCapacity) + dailyUse) / NumberOfDays
15. threshold=dailyUse*3
16. if(currentWeight<=threshold)
17. reorder(id)
18. endi
```

## IV. Test Case

In this test case, a sample data of 28 days are taken wherein we have noted down the morning weight and night weight of one container. On day one, the container is filled with 10 kg of product. Application senses the morning weight at 8 am in the Morning and Night weight at 11 pm in the night, assuming that no usage is done in between this time period.

**Table 1.** Collected Sample Data

| Day | Morning weight | Night weight | Day use | Average use | Threshold |
|---|---|---|---|---|---|
| 1 | 10 | 9.9 | 0.1 | 0.10 | 0.30 |
| 2 | 9.9 | 9.8 | 0.1 | 0.10 | 0.30 |
| 3 | 9.8 | 9.3 | 0.5 | 0.23 | 0.70 |
| 4 | 9.3 | 8.8 | 0.5 | 0.30 | 0.90 |
| 5 | 8.8 | 8.5 | 0.3 | 0.30 | 0.90 |
| 6 | 8.5 | 8.3 | 0.2 | 0.28 | 0.85 |
| 7 | 8.3 | 8 | 0.3 | 0.29 | 0.86 |
| 8 | 8 | 7.8 | 0.2 | 0.28 | 0.83 |
| 9 | 7.8 | 7.5 | 0.3 | 0.28 | 0.83 |
| 10 | 7.5 | 7 | 0.5 | 0.30 | 0.90 |
| 11 | 7 | 6.8 | 0.2 | 0.29 | 0.87 |
| 12 | 6.8 | 6.6 | 0.2 | 0.28 | 0.85 |
| 13 | 6.6 | 6.2 | 0.4 | 0.29 | 0.88 |
| 14 | 6.2 | 6 | 0.2 | 0.29 | 0.86 |
| 15 | 6 | 5.9 | 0.1 | 0.27 | 0.82 |
| 16 | 5.9 | 5.5 | 0.4 | 0.28 | 0.84 |
| 17 | 5.5 | 5 | 0.5 | 0.29 | 0.88 |
| 18 | 5 | 4.9 | 0.1 | 0.28 | 0.85 |
| 19 | 4.9 | 4.3 | 0.6 | 0.30 | 0.90 |
| 20 | 4.3 | 3.8 | 0.5 | 0.31 | 0.93 |
| 21 | 3.8 | 3.5 | 0.3 | 0.31 | 0.93 |
| 22 | 3.5 | 2.6 | 0.9 | 0.34 | 1.01 |
| 23 | 2.6 | 2.1 | 0.5 | 0.34 | 1.03 |
| 24 | 2.1 | 1.8 | 0.3 | 0.34 | 1.03 |
| 25 | 1.8 | 1.2 | 0.6 | 0.35 | 1.06 |
| ***26*** | ***1.2*** | ***1*** | ***0.2*** | ***0.35*** | ***1.04*** |
| 27 | 1 | 0.5 | 0.5 | 0.35 | 1.06 |
| 28 | 0.5 | 0 | 0.5 | 0.36 | 1.07 |

Morning time and night weight can vary based on users' usage. According to formulae day use, average use, the threshold is calculated. As we can see first two days the usage is constant that is 0.1 kilogram, so the threshold is low but as soon as there is some hike in the use in day three and four we can see the threshold value goes high. In the next few days as the usage is back to regular pace again the threshold is increasing slowly with the very small amount. On day 26, night weight is less than the threshold so we need to reorder the product on this day. And if we see in the next three days the content is getting over. Once the threshold is reached the microcontroller will send the data to the web application. After receiving information about container number, the web application will check the database which product was kept in the container.

After identifying the product, it will search the customer database to retrieve the area code of the customer. After getting area code, search the supplier table in the database, to retrieve the supplier details who supply product in the customer's area code. This the list ranked in ascending order based on the number of users of the same area of customer who recommends this supplier. Then send a link to purchase of the particular item to the customer on their mobile and the customer can choose which supplier to buy from. After the user places the order the transaction again will be saved on the database at a web application as this will be useful to keep track of the supplier the user has chosen and also this can be used to improve suggestions given to other customers. This information is also useful to track the trend in brand usage and the supplier popularity and service. As in the same area if many people are switching from one brand of product to another we can conclude that there is some reason that most of the customers are using this particular brand and they stopped using the previous brand. This data can be helpful to suppliers to maintain the stock of the items which are sold more and to discard the stock which is not bought by most of the people. Again same information can be useful for producers of the product as they can identify the product sale trend in different areas and which is their rival product/producer in a different area so they can make offers accordingly.

When a product is over, the user will get the option of different websites saying different suppliers in user's area, their rates, and how many users are using the particular supplier on mobile as shown in Figure 2.

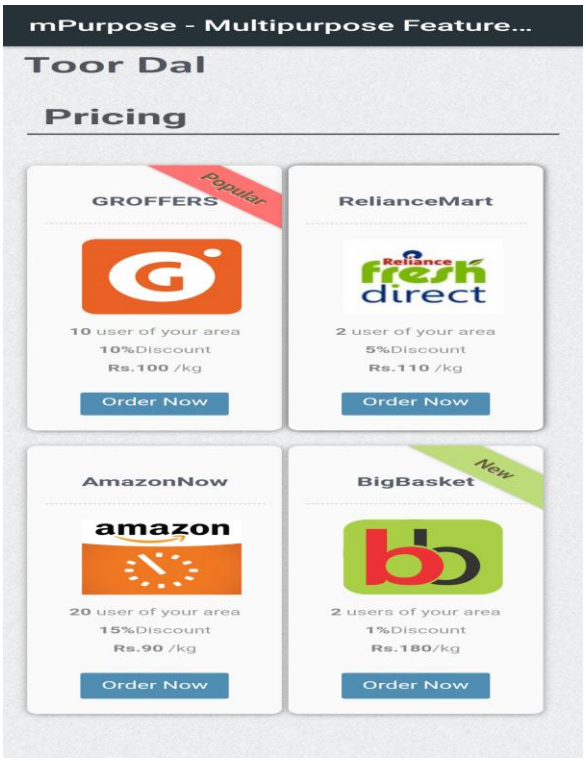


**Fig. 2.** Choice of Suppliers

After choosing a supplier the user can select the brand he wants the size he wants and quantity and order the product accordingly as shown in Figure 3.

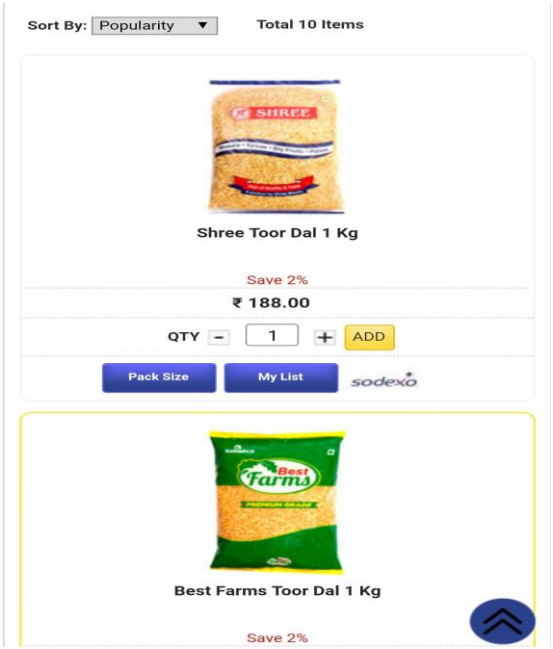


**Fig.3** Choice of brand for a supplier

## V. Conclusion

In this paper, a new grocery management system is being proposed to keep track of the availability of items in the kitchen. We use sensors to percept the daily usage of the groceries. If the precept goes below the set threshold value, a list of top 5 sellers will be sent to the user's smartphone from which he/she can do the online order and the item can be procured. MQTT protocol is used for data communication. From the seller perspective, he can analyze the data to identify the items in high demand and the area to be supplied to.

This system can further be improvised to make all the connections wireless; suggest recipes based on the contents available. Also if the user is consuming a healthy diet, it can be checked with the help of analysis of purchase frequency.

## References


[1]. C. Perera, A. Zaslavsky, P. Christen, and D. Georgakopoulos, "Context-aware computing for the Internet of things: A survey," IEEE Communications Surveys Tutorials, vol. 16, no. 1, pp. 414–454, First 2014.

[2]. D. Bandyopadhyay and J. Sen, "Internet of things: Applications and challenges in technology and standardization," Wireless Personal Communications, vol. 58, no. 1, pp. 49–69, 2011. [Online]. Available: http://dx.doi.org/10.1007/s11277-011-0288-5

[3]. M. Yun and B. Yuxin@articlevermesan2011Internet, title=Internet Of Thingsstrategic research roadmap, author=Vermesan, Ovidiu and Friess, Peter and Guillemin, Patrick and Gusmeroli, Sergio and Sundmaeker, Harald and Bassi, Alessandro and Jubert, Ignacio Soler and Mazura, Margaretha and Harrison, Mark and Eisenhauer, Markus and others, journal=Internet of Things-Global Technological and Societal Trends, volume=1, pages=9–52, year=2011, publisher=Rivers Publishers Aalborg , "Research on the architecture and key technology of Internet Of Things(iot) applied on smart grid," in 2010 International Conference on Advances in Energy Engineering, June 2010, pp. 69–72.

[4]. O. B. Sezer, S. Z. Can, and E. Dogdu, "Development of a smart home ontology and the implementation of a semantic sensor network simulator: An Internet Of Things approach," in Collaboration Technologies and Systems (CTS), 2015 International Conference on. IEEE, 2015, pp.12–18.

[5]. Z. Ju and Y. Li, "Analysis on Internet Of Things(iot) based on the "subway supermarket" e-commerce mode of Tesco," in 2011 International Conference on Information Management, Innovation Management and Industrial Engineering, vol. 2, Nov 2011, pp. 430–433.

[6]. P. P. Ray, "Internet Of Things for sports (IoT sport): An architectural framework for sports and recreational activity," in 2015 International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO), Jan 2015, pp. 1–4.

[7]. O. Vermesan, P. Friess, P. Guillemin, S. Gusmeroli, H. Sundmaeker, A. Bassi, I. S. Jubert, M. Mazura, M. Harrison, M. Eisenhauer, and others"Internet of things: A survey on enabling technologies, protocols, and applications",, IEEE Communications Surveys & Tutorials, volume=17, number=4, pages=2347–2376, year=2015

[8]. C. W. Zhao, J. Jegatheesan, and S. C. Loon, "Exploring IoT application using raspberry pi," International Journal of Computer Networks and Applications Volume 2, Issue 1, 2015.

[9]. M. Maksimovi´c, V. Vujovi´c, N. Davidovi´c, V. Milo˘sevi´c, and p. n. Peri˘si´c, Branko@miscbliss2003load, title=Load cell diagnostics and failure prediction weighing apparatus and process, author=Bliss, Doug and Stickel, Craig and Bentz, James W, year=2003, month=jun " 10".

[10]. B. Ullas, S. Anush, J. Roopa, and G. Rajum, "Machine to machine communication for smart systems using MQTT," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 3, no. 3, pp. 8242–8248, 2014.

[11]. HiveMQ, "MQTT Essentials," http://www.hivemq.com/blog/mqttessentials-part2-publish-subscribe/, 2015, [Online; accessed 20-February-2017].

[12]. J. M. Robinson, J. G. Frey, A. J. Stanford-Clark, A. D. Reynolds, and B. V. Bedi, "Chemistry by mobile phone (or how to justify more time at the bar)," September 2005. [Online]. Available: http://eprints.soton.ac.uk/28632/

[13]. A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of things: A survey on enabling technologies, protocols, and applications," IEEE Communications Surveys & Tutorials, vol. 17, no. 4, pp. 2347–2376, 2015.

[14]. D. Bliss, C. Stickel, and J. W. Bentz, "Load cell diagnostics and failure prediction weighing apparatus and process," Jun. " 10", publisher=Google Patents, note=US Patent 6,576,849 2003.