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Kitchen Grocery Items Monitoring System Based on Internet of Things

[1]Mohammad Salah Uddin, [2]Md. Daud Ali Khan and [3]Md. Naim Khan

[1,2,3]Department of Computer Science and Engineering, East West University, Aftabnagar, Dhaka-1212, Bangladesh

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Abstract: An automation system for monitoring the kitchen grocery items/cooking ingredients is presented in this paper. We are busy with our job/education/business, due to them sometimes we are not aware about the cooking ingredients (rice, eggs, oil, salt etc.) which are mandatory for making our breakfast, lunch or dinner. This situation happens frequently on people who live alone (bachelor person) or people who have not any servant even the busy home engineers (house wife) are also sufferer of this situation. We relied on street food or junk food due to this phenomenon. During the holiday or weird weather this situation is more painful; most of the grocery shops are closed during those time. As a result, we fight with our hungriness which may lead some critical diseases. People living in remote area suffer more with this situation. With this respect, an automated cooking ingredients/kitchen groceries monitoring system is presented in the paper. The conceptual design and prototype implementation are elaborated throughout this paper. This system is helpful for avoiding some odd situation described beyond.

Keywords: Smart Kitchen/Home, Automation, Embedded system, groceries monitoring, Internet of Things.

1. INTRODUCTION

Mr. Michele is a 28 years old works as a security petrol officer. As a security personal he has a very tight working schedule. He is very concern about his health. Michele always performs the calories measurement during his meal and never take any kinds of junk food. He relies on self cooking beyond those reason. Michele lives in down-town for reducing the life expenditure and does not have any home servant. He performs the cooking regularly. One day, he saw some grocery items for cooking is not available/empty as a result, he is unable to makes his meal. If he able to check the status (amount) of grocery items before go for cooking, he will avoid the unwanted situation. People with dementia and elderly person also suffering the above situation. We are presenting a system for helping Michele by providing a remote solution for monitoring the grocery items.

The rest of the paper is organized as bellow: The related works is presented in Section 2. Section 3 deals with all the hardware components. The proposed system is described in Section 4. Cost analysis and testing are presented in Section 5 and Section 6 respectively. Finally, conclusion is given in Section 7.

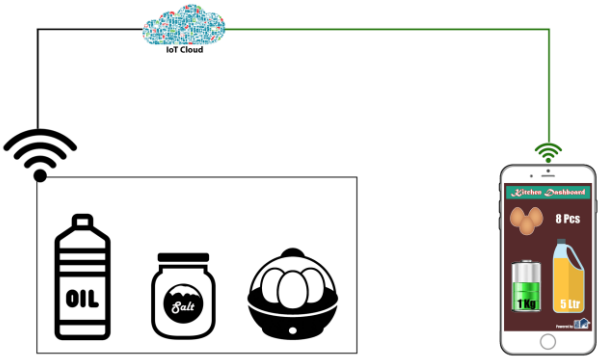


Figure 1: Architectural view of our system.

2. RELATED WORKS AND GADGETS

Some academic research work in the field of smart kitchen environment are briefly presented throughout this section. Additionally, some existing smart gadgets closely related to kitchen domain are also elaborated.

A. EGG MINDER-The smart egg tray

Quicker and GE jointly introduced smart eggs container namely EGG MINDER [1] presented in Fig. 2. It's a smart device which help users by proving the information about the eggs. Its provide indication about

E-mail: uddin@ewubd.edu, akash.bangla@gmail.com

the oldest eggs and remaining eggs on the container. A wireless connected mobile apps is used for sending push notification when the amount of eggs running low. A built-in led indication is available for marking the oldest eggs. User can easily identify the oldest eggs by using this device as well as amount of eggs remain on the device.

Figure 2: Smart EGG MINDER

B. Hydration Reminder

A smart water bottle developed and marketed by Hidrate Inc. [2]. The system easily calculates the amount of water needs by a user in the companion apps based on their height and physiology. A Bluetooth enabled micro-controller with sensors and the companion mobile apps, tracks the amount of water consumed by a user throughout the day. Drinking reminder notification has been performed by a flashing led. Similar types of smart bottles are presented in [3].

Figure 3: Different type of Amazon dash button for different products. Dash service is already discontinued.

C. Amazon Dash Button

Amazon introduce a button based cloud connected device for ordering specific products from amazon. The user of amazon dash button (in Fig. 3) needs to register their dash button with his/her amazon account. While any items such as, coffee, tea, shaving cream, washing powder etc. are running low user can easily order them from amazon by clicking this dash button rather than going to the shopping site. The main disadvantage of dash button is that, several dash button is needed for several items and the dash button only works with amazon. The details dash button category and other terms and condition for using amazon dash button are described in their website [4]. The Amazon discontinued their dash service from March 01, 2019.

D. Smart Kitchen Cabinet

A RFID (Radio Frequency Identification) based smart kitchen cabinet is presented in [5]. The system measures the load information/weight of any type of kitchen ingredients such as spices, sugar, salt, flower, rice etc. using load/weight sensor. The identification of different ingredients has been performed by active RFID tags. A back-end database is used for storing the weight information of any specific items. A GUI (Graphical User Interface) based application is developed for user interaction. The limitation of this system are, users need to load/unload one item at a time. The power consumption of system is very high, due to the nature of sensors and actuators. The system may expect radio frequency inference due to several RFID tags.

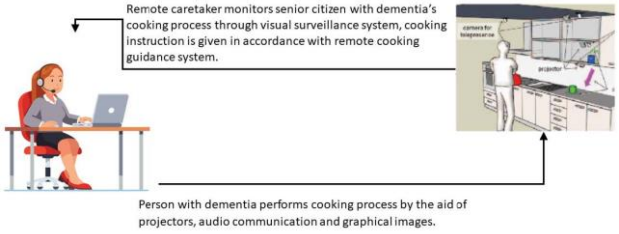


Figure 4: Smart kitchen environment setup [6].

E. Visually-aided Smart Kitchen Environment

A smart kitchen atmosphere for senior citizens suffering from dementia has proposed in Fig. 4. Its a video surveillance based virtual cooking assistant system for older people with dementia. The system uses multiple video cameras for observing the cooking process whether projection based graphical images and audio messages are used for proving the instructions. This virtual cooking assistant system requires a remote caretaker for monitoring the cooking process visually as well as proving the instructions.

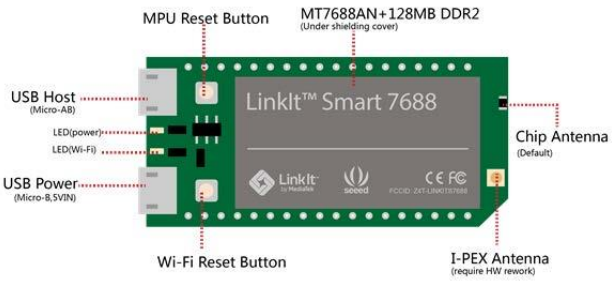


Figure 5: The Linkit smart 7688 Dou compact development board.

3. Description of Hardware Components

The hardware components such as sensors, controlling board and others electronics elements are briefly listed in this section.

A. *Linkit Smart 7688 Dou*

Linkit Smart 7688 Dou (Fig. 5) is an open source compact controller board based on MT7688[7] SOC and ATmega32u4[8] microcontroller. The board was developed by MediaTek Labs Inc. [7], a Chinese open source hardware manufacturing company. They have launched the Linkit smart dou in December 2015.The board consists an 802.11n Wi-Fi radio module, a 580 MHz MIPS (million instructions per second) CPU, one-port fast Ethernet PHY, USB2.0 host, PCIe, SD-XC, I2S/PCM and multiple low-speed I/O's in a single SoC.The board provides an all-in-one solution for rich IoT based project development in home and office automation.

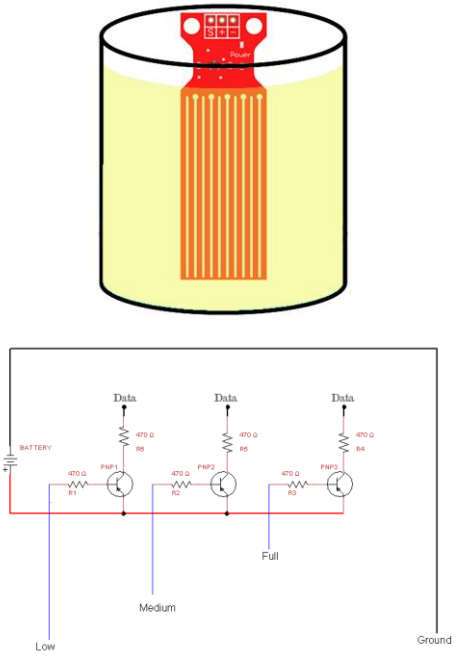


Figure 6: Design view of oil bottle.

B. *Description of Oill Bottle*

We have developed a sensor connected oil bottle by analyzing the conductivity properties of liquid substance. we placed three electrodes inside the bottle. The liquid level is estimated by the output points of the electrodes edge. Fig.6 shows the bottle design in details.

C. *Egg Tray Description*

The presence of eggs is determining by using the Ir(infra-red) transmitter and receiver. We have placed some Ir distance transducer on the button of the egg tray. The sensing of eggs is done by taking the measurement of Ir sensors. The Egg tray is illustrated in Fig.7.

D. *Building Salt Jar*

The distance measurement method of sound wave has used for determining the salt amount. we placed ultrasonic sensor on the cap of the salt jar 8. We took two reference distance such as empty jar and jar with full of salt from ultrasonic sensor. The approximation of the salt amount has done by using those reference distance along with sensor's data.

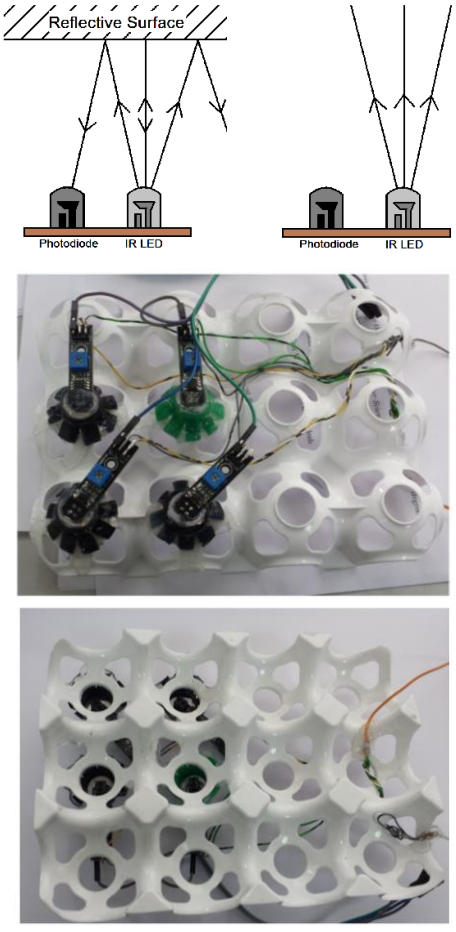


Figure 7: Prototype design of Egg tray.

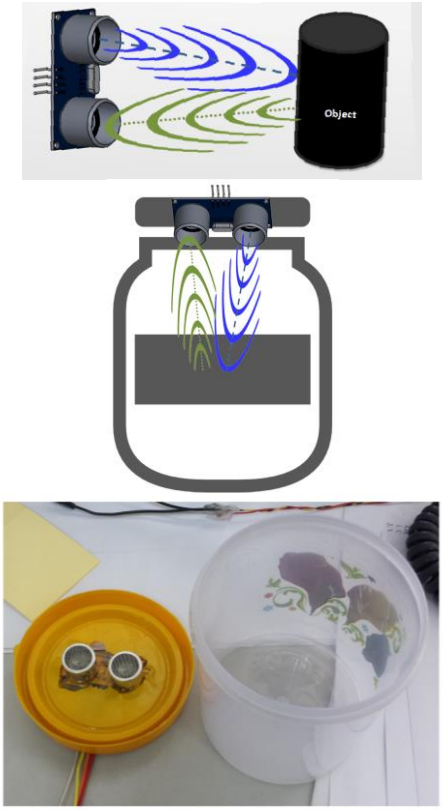


Figure 8: The sensor connected salt jar design.

4. SYSTEM ARCHITECTURE

A conceptual view of our system is elaborated in Fig. 1 and the prototype system along with schematic/circuit diagram is presented in Fig. 9. We choose Mediatek microcontroller based open source development board namely Linkit Smart Dou as a main controller module for this system. All the hardware/sensors for developing this system is discussed in section-3. A source program for controlling data flow and managing the sensors data written in C compiled and flashed on microcontoller's (Linkit Smart Dou) memory. Data transmission between cloud and physical device is manipulated by WiFi networks. An open source IoT-cloud platform [9] is used here for prototype implementation. The open source IoT-cloud platform provides data encryption and access method regulation.

We have developed an android based mobile application for monitoring/visualizing the status of the grocery/cooking items in the kitchen. The developed mobile application shows the remaining amount of groceries items. The mobile application collects data from IoT-cloud and visualize them. The screen-shot of the mobile application is available in Fig. 10 The application also provides push message based alert notification if any items are going low. A user/admin account Id and credential is mandatory for establishing the communication between physical device with the mobile apps.

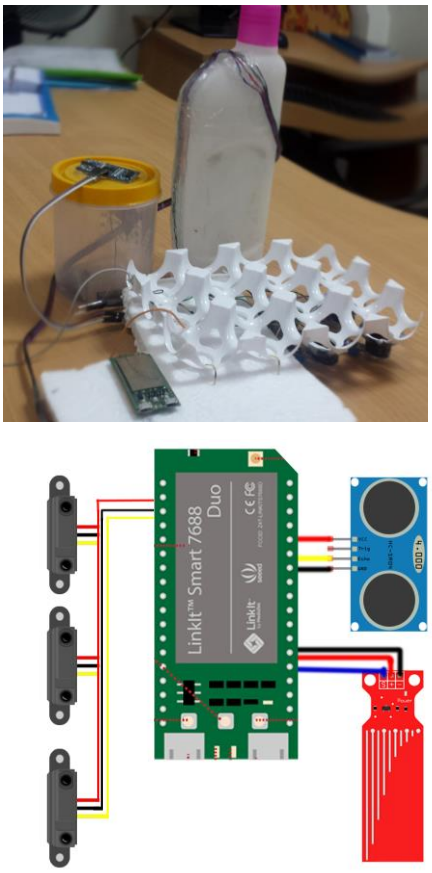


Figure 9: The prototype implementation(up) and the schematic diagram(down) of the proposed system.

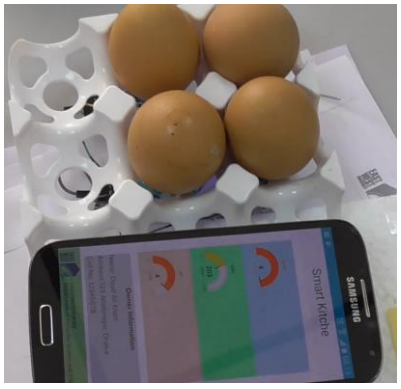
Figure 10: The Mobile application for monitoring the grocery items of kitchen; version two(left) and version one(right).

Table 1: THE IMPLEMENTATION COST OF PROTOTYPE DEVICE.

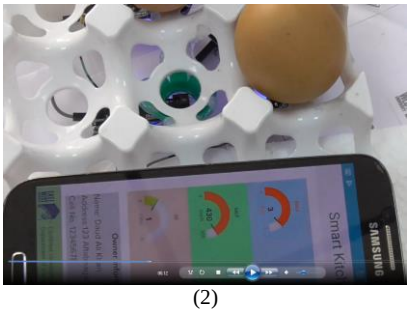
Components	*Cost in USD*
Development Board	*15.00*
Oil bottle	*5.00*
Salt Jar	*3.00*
Egg tray	*8.00*
Battery	*4.00*
Total	***35.00***

5. COST ANALYSIS

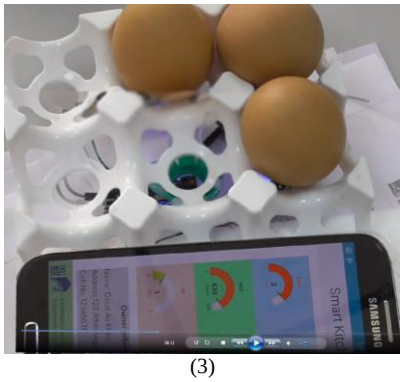
People all around the world welcoming the low cost system. The production cost of the prototype system is listed in Table.1. Manufacturing in industry level will reduced the cost by seventy percent.



(1)



(2)



(3)

Figure 11: The testing phase of the system.

6. SYSTEM TESTING

The test result of the system is presented in Fig.11 by using set of photos with proposed device and mobile application. The system works perfectly without any kind of malfunctioning during the testing phase.

7. CONCLUSIONS

In this paper, we developed a system for monitoring the grocery items or cooking ingredients like salt, egg and oil etc. remotely anywhere from the globe. The system consists of a physical device and a mobile application. The physical device uses some sort of sensors for sensing the remaining amount of grocery items. The system uses wireless network for transmitting data to the iot-cloud. The mobile application at the user end, collects data from the cloud and visualize them. The proposed system is helpful for students, person with dementia, person with no servant. The concept of this system is also useful for monitoring the super shop grocery items as well as restaurants inventory.

In future, we are planning to connect this device with online grocery shop as a result, users of this system/device will easily buy their goods before running low through their mobile device.

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APPENDIX

A. What is IoT (Internet of things)

Professor Ashton from MIT Auto-ID center, first proposed the IoT (internet of Things) as an emerging technology, during his (prof. Ashton) study in RFID (Radio Frequency Identification). Service composition with various applications are driven by internet of things (IoT). Objects/electronic components or appliances surrounding us, are able to interchange messages among them by using the power of IoT. The most popular architecture of internet of things is elaborated in Fig. 12; even through, it has several architectures. The perception/physical layer, network layer and application layer all together comprises the IoT. different type of smart terminals, actuators, sensors and various tags (RFID, NFC etc.) are connected to the IoT from physical/perception layer. The communication among "things" and human beings are performed by network layer. Abundant applications are provided by the application layer. More detail technical specifications of internet of things and its applications domain are nicely depicted on [10,11,12].

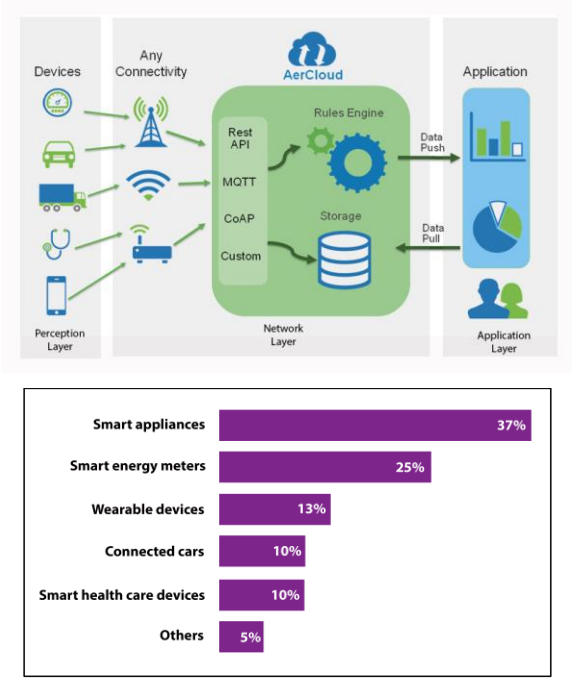

Figure 12: Three-layer architecture of IoT and its application domain source: GSMA report[12]).

REFERENCES

[1] Quirky and GE, "Egg minder -the smart egg tray". [Online]. Availlabe: https://goo.gl/qEHiXd, 2019

[2] Ulla Labs, "Hydration reminder-smart water bottle". [Online]. Available: https://www.ulla.io, 2018

[3] MBReviews. The best smart water bottles of 2019. [Online]. Available: https://goo.gl/EqHD1g

[4] Amazon Group, "Amazon dash". [Online]. Available: https://goo.gl/EqHD1g, 2017

[5] Amutha, K.P., Sethukkarasi, C., Pitchiah, R, "Smart kitchen cabinet for aware home," in *Proc.SMART'12*, 2012, The First International Conference on Smart Systems, Devices and Technologies, pp. 9–14, 2012

[6] Ikeda, S., Asghar, Z., Hyry, J., Pulli, P., Pitkanen, A., Kato, "Remote assistance using visual prompts for demented elderly in cooking," in *Proc. ISABEL'11*, 2011 4th International Symposium on Applied Sciences in Biomedical and Communication Technologies, pp. 46, 2011.

[7] MediaTek, "Linkit Smart 7688 Dou". [Online]. Available: https://labs.mediatek.com/en/platform/linkit-smart-7688, 2013.

[8] The Microchip Website. [Online]. Available: www.microchip.com/wwwproducts/en/atmega328, 2018

[9] The H2S Website. [Online]. Available: www.how2shout.com, 2018

[10] Whitmore, Andrew, Anurag Agarwal, and Li Da Xu, "The Internet of Things—A survey of topics and trends," *Information Systems Frontiers.* Vol-17(2), pp.261-274, Apr. 2015

[11] Li, Shancang, Li Da Xu, and Shanshan Zhao, "The internet of things: a survey," *Information Systems Frontiers.* Vol-17(2), pp.243-259, 2015

[12] GSMA: Gsma: The impact of the internet of things - the connected home. Tech. rep., KRC RESEARCH, 2012.

Mohammad Salah Uddin is an assistant professor of Computer Science and Engineering Department at East West University, Bangladesh, where he has been working since 2018. Prior this position he works as a researcher at Sapienza University of Rome, Italy. He completed his PhD degree in Robotics from Sapienza University of Rome in 2017. His research interest mainly focused on Robotics, Sensory systems, Machine Vision, Internet of things etc. He is a professional member of IEEE and hold a membership with IEEE Robotics and Automation society. He has some other national and international membership.

Md. Daud Ali Kahn completed B.Sc. degree in Computer Science & Engineering from East West University, Bangladesh in 2019. He is currently working as a software engineer in a repeated software farm in Bangladesh. His research work mainly focused on internet of things (IoT) and embedded system. He is a member of East West University Robotics Club.

Md. Naim Khan completed B.Sc. degree in Computer Science & Engineering from East West University, Bangladesh in 2019. He is currently working as a software engineer in a repeated software farm Bangladesh. His research work mainly focused on internet of things (IoT) and embedded system. He is a member of East West University Robotics Club.