

SMART GROCERY MANAGEMENT SYSTEM USING INTERNET OF THINGS

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Abstract

Developing smart phones and smart systems can provide a different dimension to the method of our shopping, banking, and several activities that we carry out in our day to day life. Smart grocery system is a smart and new way of grocery shopping that acts as our helper and re-defines the approach towards grocery shopping. For an oversized range of various heterogeneous end systems, the internet of Things (IOT) could be ready to incorporate seamlessly and transparently. Whereas it also provides open access to choose subsets of information for an event of digital services. Therefore building a general design for the IoT is really a advanced task, in the main attributable to the extraordinarily massive kind of services, devices and link layer technologies, which will be concerned in such a system. For the smart city application we specifically focus on IOT, in this system. This system helps us to maintain the smart grocery management which is basic requirement for every household person. Here we are going to study the level measurement sensing using ultrasonic sensor of solid or liquid substances as well as temperature measurement using temperature sensor, and according to that the order will be placed for shopping of that particular grocery. This system introduces us to the simple implementation and usable application with the low cost solution to the common man.

Keywords- open access, link layer technologies, heterogeneous end system.

1. INTRODUCTION

Internet of Everything or Network of Everything is additionally known as Internet of Things (IoT). When physical objects or things are embedded with physics, sensors and software then the network called IOT is formed. This network has property to change objects to exchange knowledge with the assembly, operator and/or different connected devices supported the infrastructure of International Telecommunication Union's international Standards Initiative. IOT permits the detection of objects and controlling them remotely across existing network infrastructure. Thus a network makes a scope for a lot of direct integration between the physical world and computer-based systems. This leads to improved accuracy, potency and economic profit. Every factor is unambiguously acknowledgeable through its embedded system however is in a position to interoperate among the present internet infrastructure.

Now it is possible to visualizes a near future with the recent communication paradigm that is Internet of Things (IoT), where the thing of daily life are going to be equipped with transceivers, microcontrollers, for electronic communication between the things and create them ready to communicate with each other and with the users [1]. Thus the IoT is a thought of creating the network which sanctions quick access and interaction with a large form of devices like, home appliances, police investigation cameras, observation sensors, displays, actuators, vehicles, and so on. The variety of applications of IOT can create use of the possibly huge

quantity and kind of information generated by such objects for supplying new services to companies, public administrations and citizens. IOT has applications in various domains, such as industrial automation, home automation, mobile care, medical aids intelligent energy management and traffic management, smart grid and plenty of others. [2].

An application that has been designed for future generation smart shopping system is called Smart Grocery System. The name itself suggests the smartness of the system. This system will help the user to get proper management of grocery in our kitchen. The user no longer has to worry about continuously monitoring groceries at our homes. Here we get notification when the level of content in the storage bottles will be low, then immediately we can place order for that particular content. Level measurement is the continuous task going on here by level measurement sensor. As well as simultaneously this system will give us idea about the temperature inside the bottle so that protecting the content according to the weather conditions, and suitable temperature can be maintain for different content as per its requirement. Temperature is measured using temperature sensor.

Section 2 provides an outline of the problems we face. Section 3 describes the proposed solution to the problem and section 4. Gives measuring principle and operation mode of smart grocery system. The paper is concluded with a brief discussion of the benefits of system to society for creating our city smart.

2. PROBLEM STATEMENT

Grocery shopping these days has become a job. The client needs to continuously monitor groceries at home and also has the work of managing coupons, maintaining shopping lists, standing in restraint out queues, reading the fine print on food cans, and even needs to find out within which rack and row he or she may notice that item. A big proportion of the grocery shoppers would thus have an interest in an additional convenient, quicker grocery shopping option. Now a day's life for everyone has become so hectic and time consuming, at such time we require a smart system at our kitchen also. To put on records and observing all the grocery at home is difficult. Most of the time we remain in wrong belief that we have enough grocery in our kitchen but we have to face empty bottles at the time of emergency when the requirement is must that gives us inconvenience. And to avoid this, some time we buy more than enough grocery & store it at our home for many days, which is also an inconvenience can cause damage to grocery. Both this situations are problems. System that can give continuous level measurement and can notify us about low level of content is required to avoid these problems. Further in section 3 we will describe details of this solution

3. PROPOSED SOLUTION – SMART GROCERY SYSTEM

This plugin uses sensing and inbuilt Wi-Fi capabilities of the Edison board to connect to cloud. Smart City plugin is cloud enabled solution which helps in remote monitoring, alerting and decision making. Smart City Plugin android app helps in mobile monitoring and alerting on-the-go. This facilitates us with smart system of shopping the grocery. This system intimate user when the levels of groceries are low. It gives the live details of the levels of grocery in the container also it intimates the temperature and humidity of the content so we can also determine if it is in good condition or not.

The SMART Grocery management can provide benefits as follows:

- Automated ordering to grocery stores – on daily/ weekly/ monthly basis.
- The consumption pattern_of the different foods – based on which the user can be provided inputs on how much more / less he can place order for a particular item.

4. SYSTEM DEVELOPMENT AND REQUIREMENTS

Smart grocery system was developed using Intel Edison Arduino board. Here HC-SR04 Ultrasonic sensor is used for level measurement which gives the signal of low level to the board. Temperature sensor is used to measure the humidity in the container. And messages are sending by MQTT protocol for communication to the cloud connectivity.

4.1 System Requirements

Below hardware and software requirements are in detail.

Hardware Requirement

- 1 Intel Edison board/Arduino uno board (5V, 8-bit, 16MHz AVR)
- 2 Ultrasonic sensor (HC-SR04)
- 3 Temperature sensor

Software Requirement

1. Node.js (Intel XDK IDE) for Cloud connectivity
2. Arduino IDE for sensor detection
3. Eclipse IDE for Android application development
4. IBM Bluemix PaaS cloud
5. MQTT protocol for communication

4.2 System Architecture

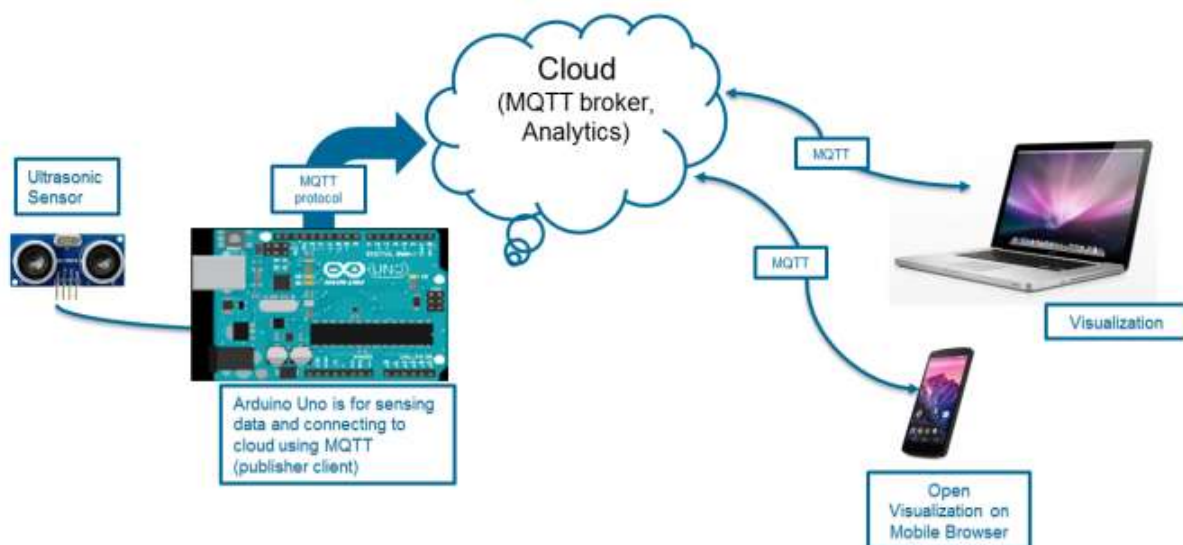


Fig 1. Block diagram of smart grocery system

Diagram Description

Ultrasonic sensor: Ultrasonic sensors can both sense and transmit hence they are also called as transceivers. Ultrasonic sensors work on a principle as same as that of transducers, transducers convert ultrasound waves to electrical signals or contrariwise. They can solve even the most advanced tasks involving object detection or level measurement. When ultrasonic sensing elements generate high-frequency sound waves then an echo is generated that is received back by the sensor. The distance to an object is measured by measuring the time interval between sending the signal and receiving the echo. Once the ultrasonic wave is launched, the timing is begun and ultrasonic transmitter emits an ultrasonic wave in one direction. As soon as this wave which is spreaded in air will encounter an obstacle on the way would come back instantly. Once the ultrasonic receiver would receive the reflected wave it will stop timing.

Operation Mode

The period of time taken by ultrasonic pulses to reach to the surface of the medium and back is used to determine continuous level measurement. The modified angle during filling and emptying granulated solids and also the rough liquid surfaces influence the reflection of the ultrasonic pulse. This will also impact the measurement of Chemical and physical properties of the medium don't influence the measurement result. Hence the abrasive and aggressive, viscous and adhesive media will be easily measured.

Measuring Principle

The principle of measuring ultrasonic distance is used here for measuring the time from launch to reflection. Once the obstacle is encountered, and then the distance between the transmitter and obstacle is calculated. The calculation done according to the time and also the speed, and also according to time difference distance measurement principle. This measured distance output is sent to Arduino uno board

Arduino Uno: Arduino is an open-source platform. That is incredibly easy-to-use for hardware and software. Arduino boards can read inputs like light on a sensor, a finger on a button, and switch it into an output - activating a motor, turning on an LED. All this can be defined by a group of instructions programmed through the Arduino software (IDE). Arduino was born at the Ivrea Interaction design Institute as a simple tool for quick prototyping. This board differs from simple 8-bit boards as they are used for IoT applications and embedded environments. Arduino Uno is a microcontroller board based on the ATmega328P. The output from ultrasonic sensor is connected to the board, and the board is connected to a computer with a USB cable this board is used for sensing data and connecting it to cloud using MQTT protocol (publisher client).

MQTT Protocol: Need to manage the communication between these connected devices is a focus of the Internet of

Things. Most web traffic is carried using a protocol called Hypertext Transfer Protocol (HTTP). But HTTP has a number of limitations that make it a poor choice as an Internet of Things protocol. As MQTT offers a number of significant advantages over HTTP such as improved user experience, more flexibility and scalability, lower running costs, lower development costs and insanely efficient, hence MQTT protocol is used for internet of things.

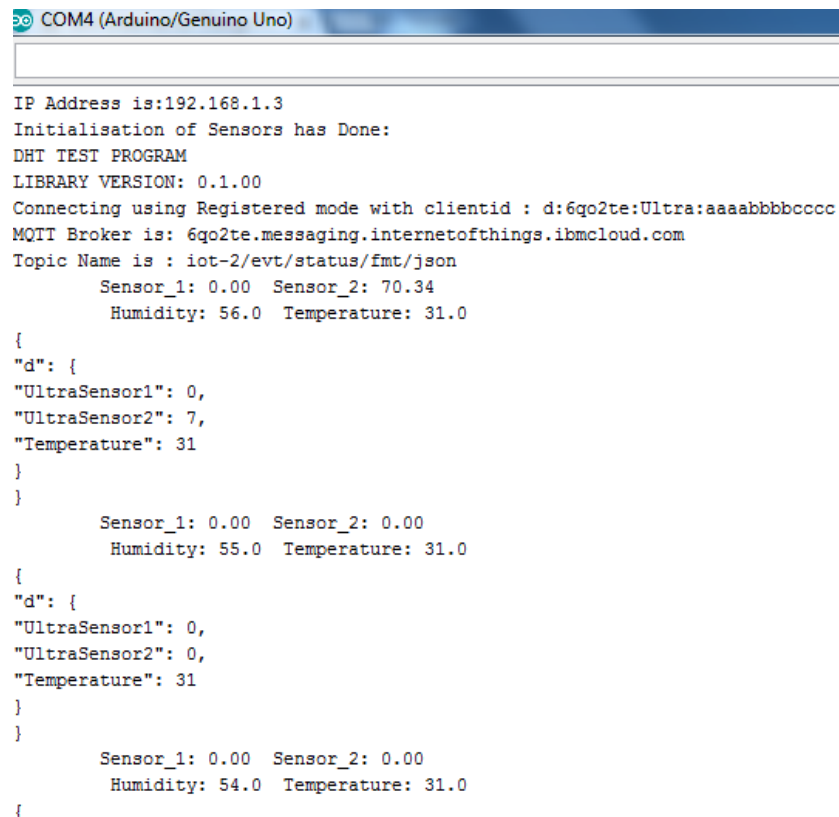
MQTT is Message Queue telemetry Transport it is a publish/subscribe protocol, which enables easy broadcasting of messages from one publisher to several subscribers. As shown in fig 1. By sending a message to the broker the connection is initiated through a publisher. Once the message is received the broker provides response to that with a status code. MQTT clients are behind routers. To translate from a private network address (like 192.168.x.x, 10.0.x.x) to a public they use network address translation (NAT). After establishing the connection the broker has to keep it open as long as the publisher doesn't send a disconnect command or it loses the connection. It is very simple and lightweight messaging protocol, with low-bandwidth, unreliable networks or high-latency. The principle of design aims to reduce network bandwidth and device resource needs. MQTT provides a scalable and cost effective way to connect your devices over the internet. MQTT additionally provides security by permitting to send a username and password for authenticating the client and also authorization. Then as shown in fig, we can get open visualization on our mobile or computer through the cloud.

5. ALGORITHM/STEPS

- Attaché the ultrasonic sensor to Arduino board. Here we are using four GPIO pins of Arduino uno – vcc, ground, trigger and echo.
- Calculate distance by using trigger and echo pin of ultrasonic sensor.
- Send/publish this distance data by using PubSubclient library by using Jason format and MQTT protocol to cloud server.
- Get the data at cloud server and visualize the data in the form of graph by using visualizer. As per the data make the decision whether we want to order the product or not.

6. RESULTS

The data sensed by the sensor is given to the board and the USB connection from the board is given to computer. As shown in fig 2. (a) And 2. (b) The output data is displayed on serial monitor, through the cloud using MQTT protocol. Fig 2.(a) shows the network connection by initially running DTPH test program and identifying IP address 192.168.1.3, it also shows initialization of sensor, client id, device name and MQTT broker name. All the initialization prints are displayed as soon as the connection has established.



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COM4 (Arduino/Genuino Uno)

IP Address is:192.168.1.3
Initialisation of Sensors has Done:
DHT TEST PROGRAM
LIBRARY VERSION: 0.1.00
Connecting using Registered mode with clientid : d:6qo2te:Ultra:aaaabbbbcccc
MQTT Broker is: 6qo2te.messaging.internetofthings.ibmcloud.com
Topic Name is : iot-2/evt/status/fmt/json
Sensor_1: 0.00 Sensor_2: 70.34
Humidity: 56.0 Temperature: 31.0

{
  "d": {
    "UltraSensor1": 0,
    "UltraSensor2": 7,
    "Temperature": 31
  }
}

Sensor_1: 0.00 Sensor_2: 0.00
Humidity: 55.0 Temperature: 31.0

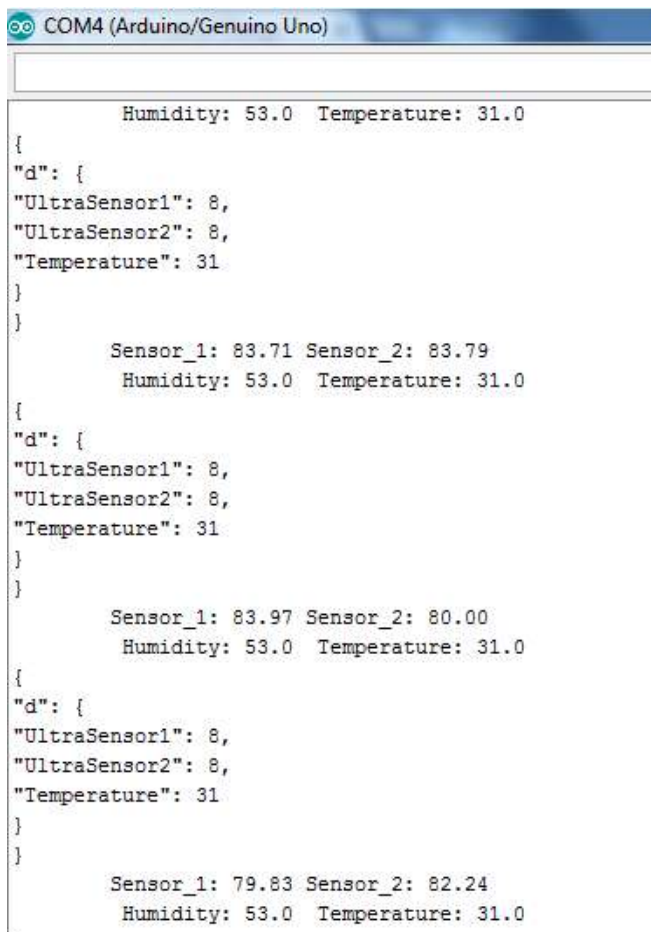
{
  "d": {
    "UltraSensor1": 0,
    "UltraSensor2": 0,
    "Temperature": 31
  }
}

Sensor_1: 0.00 Sensor_2: 0.00
Humidity: 54.0 Temperature: 31.0

{

```

Fig 2 (a) IP Address detection and initialization of sensors



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COM4 (Arduino/Genuino Uno)

Humidity: 53.0 Temperature: 31.0

{
  "d": {
    "UltraSensor1": 8,
    "UltraSensor2": 8,
    "Temperature": 31
  }
}

Sensor_1: 83.71 Sensor_2: 83.79
Humidity: 53.0 Temperature: 31.0

{
  "d": {
    "UltraSensor1": 8,
    "UltraSensor2": 8,
    "Temperature": 31
  }
}

Sensor_1: 83.97 Sensor_2: 80.00
Humidity: 53.0 Temperature: 31.0

{
  "d": {
    "UltraSensor1": 8,
    "UltraSensor2": 8,
    "Temperature": 31
  }
}

Sensor_1: 79.83 Sensor_2: 82.24
Humidity: 53.0 Temperature: 31.0

{

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Fig 2 (b) Changes in values of sensor1, sensor2, temperature, humidity

Fig 2. (b) Shows change in values of sensors as well as temperature and humidity. The live and instant changes in values of sensor 1 and sensor 2 are shown at output according to the change in distance measured by sensors. Both the sensors are attached to different container, they sense the level of the grocery in the container and gives the graphical output. According to that output we can decide whether we want to place the order for that item or not. In this way we can get the notification of our groceries and we can place the order for it according to our choice

7. CONCLUSION

In this paper, we have done the analysis of the solutions available for the implementation of smart grocery system using IoTs. Smart grocery system using IoT is cost effective and user friendly system for customers. It not only helps to induce organized for grocery shopping, it additionally saves our time and money. 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 get notification 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.

Future work or related work for smart grocery system is we can directly place order by android application in our smart phones, so developing an application to automatically placing order to grocery shops is further implementation in this system

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