Smart Logistics for Quality Food during Pandemic Crisis

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Abstract. The conventional method of checking the safety and freshness of goods (fruits and vegetables) is done manually by a person during the loading and unloading process. In this real-time monitoring system, the goods are monitored using sensors. Temperature, photoresistor and ultrasonic sensors are used to gather information about the freshness of the product. The ESP8266 module in the model sends data given by the sensors to the Arduino board and then sends that to a phone/computer for remote monitoring in transit. This system can keep check the goods from being damaged or rotten during transportation. There were several instances in which, stale food was delivered to the restaurants and several people got infected. This system could be monitored by the health department to avoid decayed food consumption by the consumers.

Keywords: Smart Logistics, IoT ,Node MCU.

I. INTRODUCTION

Our country's diverse climatic conditions have ensured the availability of all kinds of fresh fruits and vegetables. While China stands first, India stands second in the world in the production of fruits and vegetables. It has been estimated that around ninety million metric tonnes and One seventy million metric tonnes of fruits and vegetables had been produced by India respectively in the year 2015. In India, around six million hectares of land area is used for the cultivation fruits and Ten million hectares of land area is used for the cultivation of vegetables [1].

India ranks first in the production of okra and ginger and it is the second largest producer of brinjal, cabbage, cauliflower, and onion amongst vegetables. Amongst fruits, India stands second in the world in terms of producing papayas, mangoes and bananas.

Smart Logistics System has been designed in such a way that the sensing of the goods' condition is done continuously, and the data is simultaneously sent to the cloud server from where the owner will be able to access the data anytime.

We have made use of different sensors like dHT11 sensor to measure the temperature, LDR sensor to measure the intensity of light, and Ultrasonic sensor to measure the distance in our proposed system. We have discussed about the system's architecture in section 2, its implementation in section 3, section 4 covers the obtained results and the paper is concluded in section 5.

II. ARCHITECTURE

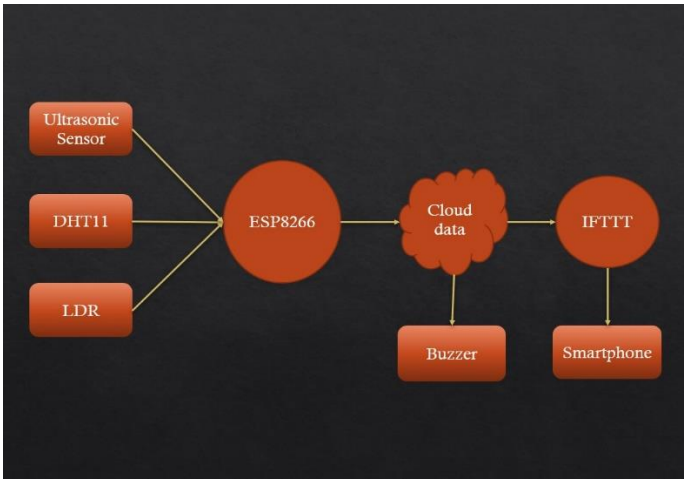

Figure 1: Architecture of the system

Figure 1 depicts the inputs from three sensors comprising of Ultrasonic, DHT11, and LDR sensors. The gathered entities are sent to the cloud through ESP8266 (NodeMCU) and then if the values exceed the given threshold limit then it activates the buzzer to alert the driver. This is simultaneously sent through an IFTTT protocol to send an alert message/mail to smartphone/computer.

III. IMPLEMENTATION

The model takes input from three sensors, temperature sensor to measure the surrounding temperature, ultrasonic sensor to measure the distance and LDR to measure the intensity of light.

All the three sensors take input in analog format first and then analog to digital converter formats it into digital signal and this is used to transmit to cloud through NodeMCU. This project was tested using TinkerCad and Thingspeak. The same project will be tested using hardware equipments too.

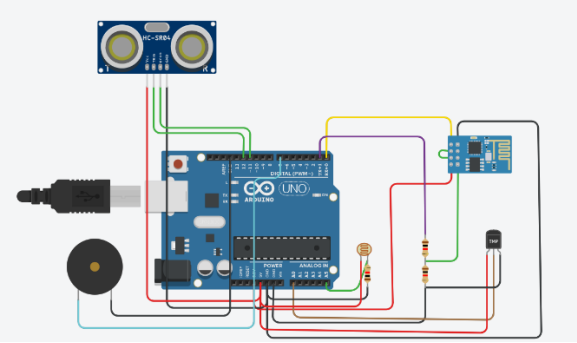

Figure 2: Software Implementation using TinkerCad and ThingSpeak

As shown in Figure 2, the Arduino board gets the input from the sensors and analyses the data and sends it to ESP8266 which will send it to cloud. The board receives the data and it is sent to cloud, which is possible through coding which is done with Arduino IDE in C language.

For cloud data, we are using Thingspeak, which is an open source platform where data can be viewed by authenticated users only in various kind of methods like graphs and chart.

The Data which is received, is processed, transmitted and shown in real time as a graphics tool .Arduino Uno board is based on real time emulation and also supports embedded fast memory. It is easy to use in places where size matters for access control because of its low power consumption and small size. It is best used for protocol convertors and gateways in communication and hence gives large processing power and high buffer size.

ESP 8266 is an economical Wi-Fi module that has a Wi-Fi chip which includes TCP/IP protocols. It starts directly from external flash when it hosts the applications. Due to its integrated cache, the system performance increases, and the memory requirement decreases. When the Wi-Fi module acts as a Wi-Fi adaptor, wireless Internet access can be achieved for any microcontroller-based design using the UART interface.

The Wi-Fi module makes use of the serial pins for communication of data. For establishing communication between a Wi-Fi module and a microcontroller, it needs two wires. It sends Wi-Fi tasks to the board therefore allowing Arduino board code to be quite simple. ESP8266 is called through SPI and UART protocols and hence makes it effortless to build an IoT application. We do not need to have TCP/IP running in our own board because we can use AT commands to connect to networks. We can send data to the internet, i.e. to the central server by simply connecting the board to ESP8266 directly.

III. A Sensors

A sensor is a semiconductor device that performs the sensing of changes in its surroundings continuously and the data is simultaneously sent to the computer in the form of electrical signals. This decreases the error in reading data, minimizes the workload and reduces the time taken to read the data. Depending on its functions, it is used in various embedded system devices. In fact, IoT would not have been possible if not for sensors.

1) Temperature sensor

A temperature sensor performs the function of continuously sensing the surrounding for temperature readings and this data is sent to the computer in the form of electrical signal. We have different temperature sensors like Thermocouples, Resistance Temperature Detector (RTD), dHT11, etc. Temperature sensors are used in various embedded systems for various purposes. Some key areas where temperature sensors are being used are in air conditioners to maintain the temperature of the room, in the transportation of fish to maintain the appropriate temperature. In our system we are making use of DHT11 sensor to monitor the surrounding temperature of fruits and vegetables. Since it ranges from (0 – 50) °C, this can be used to monitor the temperature for all varieties of fruits and vegetables.

2) Ultrasonic Sensor

An ultrasonic sensor is used to measure the distance. It works on principle of transmitting and receiving sound waves. First, sound waves are transmitted from the sensor. Once the waves hit on any object it is reflected back to the sensor. Depending on the total time taken by the sensor to transmit and receive the sound waves the distance is calculated using the distance formula. It also comes with few drawbacks. If there is no object in the direction of wave emission then there will be any reflected wave which results in infinite distance. Also, if the object doesn't have an even surface then the emitted waves will be reflected in a different direction, which again results in loss of reflected wave and infinite distance. In our proposed system, ultrasonic sensor is used to keep a check on the fruits and vegetables from being displaced. In case, while being transported in an uneven road there's a possibility of the goods to fall down and if left like that it'll be damaged. Also, if there's any theft it won't come to our notice immediately. So, to make sure nothing happens to the goods, ultrasonic sensor is used to keep a check on it.

3) LDR Sensor

An LDR is a photoresistor that is used in an embedded system devices to measure the intensity of light. Photoconductivity is the principle that is followed by LDR. Smart streetlight is a device that works using an LDR. Each variety of fruits and vege-

tables requires a particular lighting condition to keep it fresh, if exposed to excessive light it may get spoiled in shorter span of time. In our proposed system we have made use of LDR sensor to ensure sufficient lighting conditions for respective fruits and vegetables. This ensures fresh transportation of fruits and vegetables.

III.B. Working on Thingspeak

- Sign in to your account on thingspeak.
- Create a new channel with required parameters.
- Give the field names: Temp, Light intensity, Distance changed.
- Click on the Save Channel option and the API key will be generated.
- Copy the read and write API keys in the body of the program.
- Modify the program so that it writes to separate fields.
- Select charts to create multiple charts with the received data.
- Data which is sent and received both happens in real-time.

III.C. Working with IFTTT

- Login to the IFTTT account using google/mail.
- Create a wen hooks Applet which will be available in applet window.
- Give an input option.
- Select webhooks services to get Http Request.
- Select to send notification and then create the action.

IV. Security of the system

The first way of enhancing security of data is by providing an authentication to it no matter even if a user wants to update a little information.

The next step will be encrypting the data which is being sent or received as it must be protected as it transitions from the device across the cloud. It is best to use industry-standard, peer-reviewed cryptographic functions for encrypting the data.

A secure update mechanism is provided as updating the system is crucial and it gives new firmware to the system as most of the times data attacks happen to system while updating as it becomes vulnerable, secure mechanism is provided.

As open source software's are used, chance of vulnerability attacks are more compared to licensed software. So, an open-source update plan is generated, and an individual is assigned to watch for published vulnerabilities and when it arises, update the software, test the integrity of the information and deploy an update to reduce the user's risk.

V. RESULTS

Approved users can log in to thingspeak to see the results by entering the username and password the results are displayed are calculated real time and when using IFTTT we can see the received notification through the smartphone as shown in Figure 3.

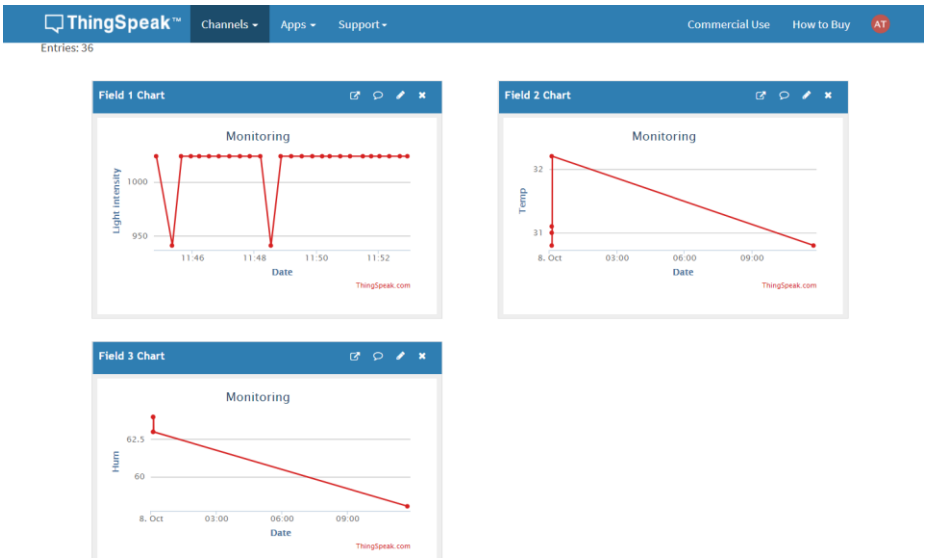

Figure 3: Data logged in Thingspeak

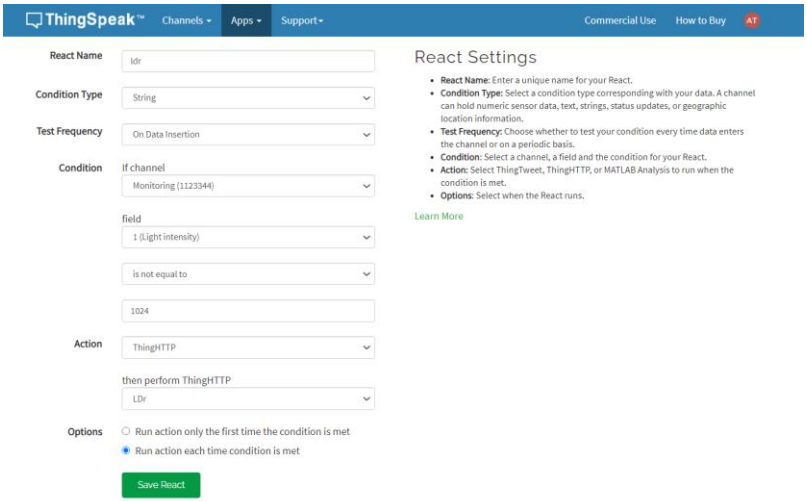

Figure 4: Creating react for IFTTT in Thingspeak

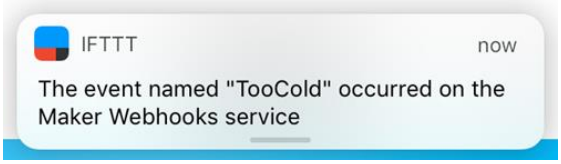

Figure 5: Notification on Phone

From Figure 3,4&5 we can see that whenever there is temperature drop or change to the given maximum temperature which was set, a notification/Alert message is sent to the desired user which will help the user to find the error in real-time and fix it at that moment.

VI. CONCLUSIONS

The proposed Smart and Secured Logistics system has been implemented and checked. This sends warning messages and alerts to the transporter. The transporter can implement this system and take care of the goods without any human interference to check the condition of the goods. This system is user-friendly and can be easily installed and monitored by less-skilled individuals.

As many IOT devices have security issues we have implemented key security measures to overcome those issues as the data will be safe and private to the users. IoT is becoming a part of our day to day life and it is important to implement in various fields to create the best ecosystem.

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