WASTE MONITORING SYSTEM USING INTERNET OF THINGS

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Abstract

Nowadays, there a number of techniques, which are used for collection and management of wastes. Wi-Fi technology is one of the best networks used to send data in high speed and mostly used in many projects. The sensor is chosen to monitor the status of garbage. The garbage bin contains Ultrasonic sensor which is used to detect the garbage level. The Ultrasonic sensor is placed inside the garbage bin at lead position. When it reaches the limit then that indication is sent to Node MCU micro-controller. The micro-controller sends an indication to Municipal Corporation through Wi-Fi technology. Then the all collected organic wastes need to be monitored to check whether the organic wastes are completely decomposed or not. To monitor the organic wastes three sensors are used. The Ultrasonic sensor is placed inside the bin containing organic waste at the lead position is used to detect the bin level, the MQ-4 sensor will sense the methane gas level, the DHT11 sensor will sense the temperature and humidity level of organic wastes. The indication is sent to the Node MCU micro-controller. Micro-controller sends the indication to the Cloud using Wi-Fi technology. The updated data in the cloud is handled by Ubidots which is a restful API. The updated data to the cloud is visited by Agriculture Research Center to make further actions to dispose of the organic waste for the recycling process.

Keyword: Ultrasonic sensor, MQ-4 sensor, DHT11 sensor, Node MCU micro-controller, Cloud, Ubidots, LED, Bread Board, Jumper wires, Servo motor.

I. INTRODUCTION

In the present day, Internet of things (IOT) plays an important part in society. Internet of Things (IOT) is a network of physical devices, vehicles, home appliances and other devices embedded with Electronics, software, sensors and connectivity which enables the object to connect and exchange data. As per the above process, this project is also an IOT project which is embedded with electronics, sensors and connectivity to collect and send data.

Sensors and software embedded in physical devices are linked through wired or wireless networks are defined as Internet of Things (IOT).

Internet of Things (IOT) domain is the domain of this project where sensors, microcontroller and connectivity are used to monitor the wastes level, gas level, temperature humidity level using sensors and then the indication is send to microcontroller. The microcontroller sends the indication to the agriculture research centre for reuse purpose when the wastes are completely decomposed.

This paper is to monitor, dispose and reuse of wastes using some chosen sensors which are given below. Given sensors are used to monitor the wastes whether it is decomposed or not. Wastes are needed to be completely decomposed because after decomposed wastes only can be used to further reuse process. So this paper is used to monitor the wastes and the sensors used here are shown below.

To monitor waste level ultrasonic sensor is used. Ultrasonic sensor is a popular as well as low cost module. This sensor emits signal as trigger at particular time intervals when the signal strike an object then it is reflected back as echo to the sensor. Based on the time interval

between trigger and echo the distance is calculated.

To monitor the methane gas level of wastes MQ-6 sensor is used. This sensor is simply used to detect the methane gas which is present in air. If the methane gas is high, the output of the module is high level or else the output is low level.

To monitor the temperature and humidity level of wastes DHT11 sensor is used. This sensor can be used to test the temperature and humidity content in air. If the temperature is high, the output of module is high level else the output is at low level. This sensor consists of resistive-type humidity measurement component and an NTC temperature measurement component where resistive-type humidity measurement used for Humidity measurement and NTC temperature measurement used to measure Temperature.

Then the data of this sensor is send to the microcontroller. The micro-controller used in this project is Node MCU micro-controller. Node MCU micro-controller reads the data from sensor and then proceeds to the next stage by uploading it to the cloud by using wireless networks.

The device in the container uses Wi-Fi for sending the sensed parameters of fill level, gas level, temperature, and humidity level of wastes and also waste level of the garbage to the web page by using Ubidots.

The Ubidots platform is used to send message to the respective person mobile number based on the given condition.

RELATED WORK

Pranjal Lokhande [3] proposed consists of two parts which is transmitter and receiver section. In transmitter section, an ultrasonic sensor detects the level of garbage in the dustbin, and moisture sensor detects the wet garbage in dustbin or water level in dustbin and gas sensor is used here to detect the toxic, unhygienic gases generated in dustbin due to the garbage or waste part which has thrown into the dustbin. These sensors are sensed the content related to the dustbin and send the information to the PIC micro-controller and transmit the information to the receiver. Then GSM Modem sends the information about the garbage level to the workers of the municipality. Next receiver section consists of Zigbee receiver which transmits the information about garbage to the government. Prasad Kulkarni [4] proposed system consist of the ultrasonic sensor is connected to the dustbin for the sense the level of the dustbins. The ultrasonic sensor is worked on the property of sound and frequency there are two terminals of a sensor which is Echo and trigger. Echo which transmits the waves and these reflected waves are captured by the trigger. This sensor gives the captured signal to the microcontroller then the micro-controller sense the signal and immediately takes action. The 16MHz crystal oscillator is provided to the microcontroller for the internal operation Sim 900 GSM modules are used for the communication purposes. Which works on a frequency of 850/900/1800/1900 MHz and also has the high frequency as compared to the other GSM module. The implementation of the waste management system is done using ultrasonic sensors, microcontroller, and GSM module. When the garbage level reaches its maximum, this system provides the cleaning of dustbins. Saurabh Dugdhe [5] proposed system consists of scheduling trucks by finding the shortest path between the almost filled waste bins and bins which have produced harmful gases and gives a route for collection. The system will consist of setting up smart waste bins/ trash cans per society, which will be IoT enabled. These smart bins will transmit information about its fill status and harmful gas levels. The proposed system provides efficient and optimized routes to collect maximum waste with less cost and fuel. The system provides estimated dates for collection of waste, real-time bin status, expected to fill updates for the bins, and optimized the shortest path for waste collection. The system will summarize the collected information and generate reports.

II. SOFTWARE AND HARDWARE COMPONENTS

A. Ultrasonic sensor

Ultrasonic sensor is a device used to calculate the distance using sound waves. Ultrasonic sensor emits signal as trigger at a particular time intervals when the signal strike an object then it is reflected back as echo to the sensor. Based on the time interval between trigger and echo the distance is calculated by using the given below formula.

Fig 1.1Ultrasonic Sensor

Equation: $d = v \times t$
Where,
d- Distance Measurement.
v- Ultrasonic spreading velocity in Air.
t- The time value from transmitting to receiving.

B. MQ-6 sensor

The MQ-6 gas sensor is used to detect the concentration of methane gas in the environmental air. This is suitable for detecting methane gas level of the wastes in the container. This Sensor is suitable for sensing the gas level content like propane, butane and especially for methane

Fig 1.2 MQ-6 Sensors

If the methane gas is high, the output of the module is high level or else the output is low level. The sensor output values can show by means of both analog and digital.

C. DHT11 sensor

The DHT11 sensor used to sense the Temperature and Humidity where output is in the form digital signal output.

Fig 1.3 DHT11 Sensors

As shown in Fig 1.3, this sensor consists of resistive-type humidity measurement component and an NTC temperature measurement component where resistive-type humidity measurement used for Humidity measurement and NTC temperature measurement used to measure Temperature.

D. Node MCU Micro-controller

A micro-controller is an integrated circuit that is capable of running programs. There are many instances of those on the market today from a variety of manufacturers.

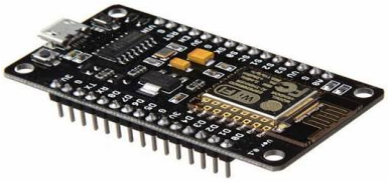

Fig 1.4 Node MCU

Node MCU micro-controller is an alternative microprocessor to the ones already mentioned but also has Wi-Fi and TCP/IP (Transmission Control Protocol/Internet Protocol) support already built in. What is more, it is also not much more expensive than an arduino.

E. Bread Board

A breadboard is used for the concept of prototyping of electronics. Breadboard is also a synonym for prototype. It is reusable, because this type of breadboards does not require soldering. So, it is easy to use for creating temporary prototypes and experimenting with circuit design.

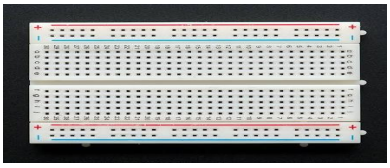

Fig 1.5 Bread Board

For this reason, breadboards are popular with students and in technological education.

F. Ubidots

Ubidots are used to display the garbage level, gas level, temperature and humidity level of wastes in structure form. To, display the uploaded data in a web page Ubidots API is used.

Ubidots offers a platform for the user that enables them to easily capture sensor data and turn it into useful information. The Ubidots platform can send data to the mobile according to the given condition

G. Cloud

Via the network, the signals are sent to a web based software application from the Node MCU board. For that purpose cloud is used. Data sends to the cloud is performed by creating a new web page using HTML. When a web page is created, then a working program is fed to

Node MCU to upload the sensed data send by the sensors to the created web page.

When the data are uploaded once then the next updated data which is send to the web page needs to be overwriting the existing one which is not possible. To overcome the above one a restful API called UBIDOTS is used.

H. Jumper wires

Jumper wires are used for connecting sensors with Micro-controller. Jumper Wire is an electrical wire with a connector or pin at each end, which is normally used to interconnection between sensors and Micro-controller.

Fig 1.6 Jumper wires

Jumper wires are used to connect the sensors and micro-controller. The sensor is fixed on to the bread board. The connection between the Node MCU board and sensor is made with the help of connecting wires.

I. Servo Motor

Servo motors are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. Servo motor contains minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually turn 90 degrees in either direction for a total of 180 degree movement.

Fig 1.7 Servo Motor

III. PROPOSED SYSTEM

Our waste monitoring system has IoT infrastructure integrated to it with Ultrasonic sensor and Node MCU as well as wireless networks like Wi-Fi to enable the use city administration. The city is divided into many sectors and each sector consists of many dustbins of same size, shape, build, and capacity which are located at regular intervals. A set of trucks will be used to collect the waste from the city. We call the bins smart because the bins will be “self-aware”. They will have a device which integrates sensors and communication technology. Each city has a workstation located at the municipal office, which gathers the information from the bins in that particular city. The device in the bin uses Wi-Fi for sending the sensed parameters of fill level to the workstations. The workstation maintains a web page that will hold real-time values acquired from the bins. The maintenance of the web page is done by using Ubidots. Ubidots offers a platform for the user that enables them to easily capture sensor data and turn it into useful information. The Ubidots platform can send data to the mobile according to the given condition. After receiving the message, the workstations calculate the shortest path in between almost filled bins and prepare a schedule for trucks for waste collection for the day. Hence the trucks have a schedule and route for waste collection for that particular day. All collected organic wastes needed to be monitored whether it is decomposed are not for further recycle process. For that, the organic wastes are sensed by the below three sensors. Ultrasonic sensor, MQ-4 sensor, DHT11 sensors are used to monitor the organic wastes. These sensors installed in the container and detect the fill level regardless of what has been deposited inside, Methane gas level of the wastes and temperature and humidity level of wastes. The device in the container uses Wi-Fi for sending the sensed parameters of fill level, gas level, temperature, and humidity level of wastes to the web page by using Ubidots. The user maintains a webpage that will hold real-time values acquired from the container. Ubidots offers a platform for the user that enables them to easily capture sensor data and turn it into useful information. The Ubidots platform sends message to the Agriculture Research centre according to the given condition.

Architecture Diagram

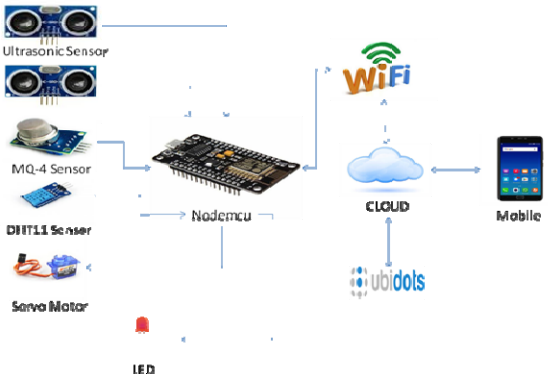

Fig 1.8 Architecture Diagram

IV. CONCLUSION

Currently in India waste collection has been treated in a static way. Using Internet of Things approach we proposed to tackle the problem of waste collection by the dynamic method. As waste directly affects public health, it has become an important issue. Domestic waste has been growing day by day and hence wastage management has very high priority. The generated waste needs to be collected and proper transportation should be made as well as proper waste treatment and disposal. Improper disposal & improper maintenance of the domestic waste creates issues in public health & environmental pollution. This paper attempts to provide practical solutions to help the local municipal administration in the waste management system. i.e., monitoring of domestic wastage clearance at the proper time to avoid damage to the public health. In this paper, Waste Collection System architecture using the Internet of Things has been proposed. The architecture consists of an embedded device with sensors and microcontroller for sensing information of Bins and sending to the workstation, which is situated at the municipal office. Then to dispose the all collected organic wastes into a container it needs to monitor whether it is decomposed or not. For that, this system is able to observe the organic wastes by using sensors. The data from the sensors is sent to the Node MCU microcontroller. Using Wi-Fi technology the Node MCU microcontroller will update to the cloud. The status of the wastes is shown on mobile or PC. This type of system is used to transfer data with less cost, low current consumption and used in every suitable way.

V. FUTURE SCOPE

1. In the future, this system need to overcome the problem of downtime and to upload the sense data from the sensor then send notification to the respective persons without fail.

2. In the context, have to provide attention in maintenance of hardware requirements inside the bins or container without any damage.

3. In future, the separated organic and inorganic wastes need to be monitored by giving alarm when the inorganic waste thrown into container containing organic wastes or vice versa using smart systems

VI. REFERENCE

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