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Smart trash bin for waste management using odor sensor based on IoT technology

Steffy Thankam Wilson

steffythankamwilson7@gmail.com

Amal Jyothi College of Engineering,
Kanjirappally, Kottayam, Kerala

Tophia K. Sebastine

tophiasebastine@gmail.com

Amal Jyothi College of Engineering,
Kanjirappally, Kottayam, Kerala

Merin Daniel

merindaniel@cs.ajce.in

Amal Jyothi College of Engineering,
Kanjirappally, Kottayam, Kerala

Vineeth Martin

vineethmartin@cs.ajce.in

Amal Jyothi College of Engineering,
Kanjirappally, Kottayam, Kerala

Neenu R.

rneenu@amaljyothi.ac.in

Amal Jyothi College of Engineering,
Kanjirappally, Kottayam, Kerala

ABSTRACT

IoT is transforming cities in a tremendous way. Efforts are made for having smarter ways of city waste management. Waste management always finds difficulty in knowing when to collect waste. If the vehicle comes to collect too early it would lead to unnecessary trips. And when comes to collect too late will result in an overflow of waste. Even though the level is moderate the odor produced by the waste can cause air pollution. These problems stated can be resolved using IoT technology used by this project. An app is designed to monitor the levels which the user can view. The workers need not want to approach the bin to know whether a waste is ready to be removed. Also, it is used to monitor whether the bin is not full and if not checks the smell of waste and then the bin can be removed.

Keywords— Smart bin, Internet of Things (IoT), Ultrasonic sensor, MQ136 Gas sensor, NodeMCU

1. INTRODUCTION

IoT is the ever growing technology. It can be scaled with sensors as we require. IoT allows devices to generate and exchange data. IOT aims at facilitating human by reducing their efforts. IOT helps in automation of equipment to an extent. The connected devices in the network will have a Unique Identifier (UID). Urban areas are always developing at a good pace. There are many projects deployed for the realization of smart cities. The smart city has a good economy, smart mobility, good governance and smart people who have good health, job etc. In fact, the smart city provides Quality of living. Waste management is a major concern in a local and global level. The waste workers have to inquire about each bin on several spots at different cities. Trips cannot be planned in accordance with the need. This is a time consuming and wastage of fuel in the garbage can. There are systems which take data from bins

regarding garbage level, but the smell remains a problem. If the level is not filled it will not bother about the smell. Smell raised from waste bin can cause pollution as well as spread diseases. In the present scenario with the development of advanced technologies waste management ought to have improvements. To tackle this problem an effective solution, the proposed IoT based waste management system is being introduced.

2. LITERATURE SURVEY

IoT Based Waste Management for Smart City by Parkash, Prabu V. Level of the dustbin is displayed when garbage is full. [3] Smart Wi-Fi Dustbin System by Akshay Bandal, Pranay Nate, Rohan Manakar, Rahul Powar. In this paper, when somebody dumps trash into a dustbin the bin ashes a unique code, which can be used to gain access to free Wi-Fi. Sensor check garbage fills in the dustbin or not and Router provides Wi-Fi to the user. [4]

Arduino is best described as a single-board computer that has deliberately been designed to be used by people who are not experts in electronics, en-Gingering, or programming. It is inexpensive, cross-platform (the Arduino software runs on Windows, Mac OS X, and Linux), and easy to program. Both Arduino hardware and software are open sources and extensible. Arduino is also powerful: despite its compact size, it has about as much computing muscle as one of the original navigation computers from the Apollo Programmers, designers, do-it-yourselfers, and artists around the world take advantage of Arduino's power and simplicity to create all sorts of innovative devices, including interactive sensors, artwork, and toys. [5]

“Waste Bin Monitoring System Using Integrated Technologies”, Publish by Kanchan Mahajan, Prof. J. S. Chitode. In International Journal of Innovative Research in Science, Engineering and Technology. In this paper Zig bee and

Global Mobile Communication System (GSM) used. The sensors are placed in the garbage bins placed at the public place when the garbage reaches the level of the sensors. When garbage at threshold level gives sms through GSM. The technology used by Zig bee, Global Mobile System (GSM), ARM 7 Controller. The range of communication of the zig bee is almost 50 meter. [2].

3. PROPOSED SYSTEM

Increase in waste leads to many health problems and also the gases produced from wastes leads to air pollution and spreads diseases. The existing system mainly focuses on to monitor the level of the waste using the ultrasonic sensor, it monitors the level of the waste and the notifications are sent to the workers through an android app when the bin is full. When organic waste decay H₂S gas is produced, this is hazardous. In this proposed system along with the ultrasonic sensor an odor sensor, MQ136 is used to detect the H₂S gas of the waste and the bin can be removed whenever there is a foul smell, even though the bin is not full. This is the main advantage of the proposed system when compared to the existing system. In this system, also there is an android app to get the notifications regarding the bin. The workers can be login to the app using Gmail. And the workers get a notification through this app if either of these conditions is true and the workers can remove the waste.

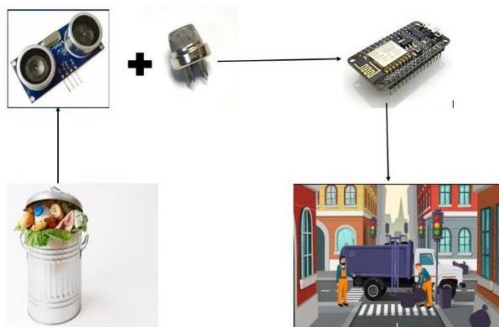


Fig. 1: System architecture

4. HARDWARE RESOURCES AND FEATURES

4.1 Ultrasonic Sensor

Ultrasonic Sensors which is shown in Fig 1 are used to measure the distance. It is basically a 4 pin module, namely VCC, Trigger, Echo, and Ground. It includes an ultrasonic transmitter, receiver, and control unit. The ultrasonic sensors commonly used with Arduino ARM, Raspberry Pie etc. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. The distance can be calculated by measuring the time between the emission and reception. That is, $L = \frac{1}{2} * t * c$, where L is the distance, t is the time between the emission and the reception and c is the sonic speed.



Fig. 2: Ultrasonic Sensor

4.2 MQ136 H₂S gas sensor

MQ-136 is a gas sensor used to detect the H₂S. The sensitive material of MQ-136 is SnO₂. It has 6 pins namely H pin, A

pins and B pins. The enveloped MQ-136 which is shown in figure 2 have 6 pins, 4 of them are used to fetch signals and other 2 are used for providing heating current. They are most commonly used as air quality control equipment for buildings. The resistance value of MQ-136 is different from various kind and concentration gases so when using these components sensitivity adjustment is very necessary. It has a long lifespan and fast response. It possess to a simple drive circuit with low cost.



Fig. 3: MQ136

4.3 ESP 8266 – 01

It is a low powered microcontroller developed by Espressif System, which specializes in building low power communication devices such as the Bluetooth and Wi-Fi chipsets. It requires a 3.3 v input and draws low current which can work for a long time at a stretch. It contains 2 usable GPIO pins which are used to create standalone sensor– transmitter pairs. The inbuilt Wi-Fi chip in ESP 8266 helps to get connected with the LAN.

4.4 Node MCU

NodeMCU is an open source IoT platform. NodeMCU, as shown in figure 3 means a firmware rather than a development platform. NodeMCU controls the data traffic between the sensors and the firebase. It consists of analogue and digital I/O pins that communicate with the HCSR04 and MQ136. It is a microcontroller Unit based on the 12E version of the Esp-8266. It has an extended number of GPIO pins and features an onboard Digital-Analogue Converter (DAC) so that it can read analogue sensor values. Unlike the 01 version of the ESP board, the NodeMCU can run at a higher processing frequency and support multiple sensor and integration.



Fig. 4: Node MCU

5. RELATED WORKS

In solid waste bin monitoring system garbage bin set the public place then Camera set for garbage bin location. The camera captured the image for the garbage bin. Radio Frequency Identification (RFID), GPS and GIS send an image for a work station. The RFID reader and camera are mounted in the truck when the truck comes closer to the bin RFID reader communicated RFID tag. & send all the information. The System is use controlling Hut. This Controlling Hut is SMS Technology. The GPS and GPRS mapping server to analysing data of various location. The control station compiled all the information and stored in the system database. The bin status and waste truck were monitored. [1]

In waste bin monitoring system using zig bee and Global Mobile Communication System (GSM). The sensors are placed

in the common garbage bins placed at the public place when the garbage reaches the level of the sensors. Then that indicated will give in indication to the driver by ARM7 they sending SMS using GSM technology. The technology used by Zig bee, Global mobile system (GSM), ARM 7 Controller. The range of communication of the zig bee is almost 50 meter. They use for range GSM Module, analysing the image we get an idea about the level of garbage. The zig bee and GSM system would be able to monitor the solid waste collection process. This technique overcomes some disadvantages which are the use of the minimum route, low cost, fuel use, clean environment. [2]

6. EXPERIMENTS AND RESULTS

Figure 7 shows a complete circuit of IoT based Smart Trashbin. The MQ-136, ultrasonic sensor and NodeMCU microcontroller are the different hardware components used in this circuit. The ultrasonic sensor is used to calculate the amount of waste by calculating the distance level and the MQ-136 is used to detect the foul smell. Figure 8 shows the real-time data of smart trash bin in firebase console. In real time data, the distance and odor can be monitored using real-time database. The distance is measured in cm (centimeter) whereas the odor is measured in ppm (Parts Per Million).

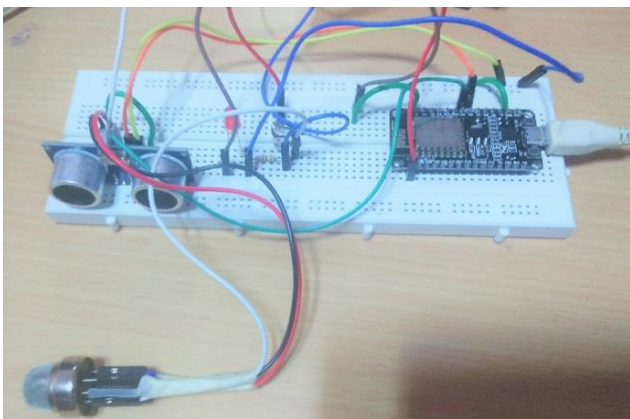


Fig. 5: NodeMCU with the ultrasonic sensor and MQ-136

7. CONCLUSION

In this paper, we introduce an IoT based smart bin for level detection and odor detection. This proposed system involves technologies like Ultrasonic sensor, MQ136, and NodeMCU. Ultrasonic sensor for level detection and MQ136 for odor detection. NodeMCU is a microcontroller used as a development platform. The data from the Node MCU is stored in the firebase. The workers can be log on to the app using their Gmail. The data are fetched from the firebase to the app and the workers get the notification if the bin became fill or there is high emission of foul smell. By this proposed system we can reduce pollution, spreading of toxic gases etc.

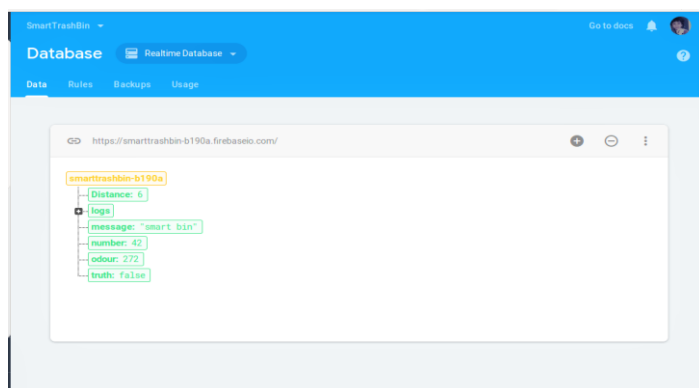


Fig. 6: The real-time data is shown in Firebase

8. FUTURE WORK

In this proposed system the odor as well as the distance can be detected to reduce the amount of emission of toxic gases and overflow of waste. In the future, it can be implemented with a solar cell for effective power supply for more efficiency. Also can be implemented with more than one bin using RFID. And the location of the bin can be tracked using a GPS module. The waste can be compressed to 25 per cent using a compressor module, thereby the waste can be added thrice which can be up to 75 per cent which helps to reduce the regular waste collection.

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