ARDUINO BASED SMART GARBAGE MONITORING SYSTEM USING PIC MICROCONTOLLER

[1]Priyanka Goli

[1] Assistant Professor,
[1] Computer Science Engineering,
[1]Global Academy of Technology, Bangalore, India.

Abstract: **The Internet of Things is a network of physical devices embedded with electronics, software, sensors. With the growth of cities, the waste produced also increases. Many of the world's developing cities are still lacking in the area of waste management, in particular, the collection of garbage within the cities. Because of this, garbage tends to pile up in certain areas. This not only poses a health risk to the surrounding communities, but also creates unpleasant environments for the residents. To provide a solution to this problem, a smart garbage monitoring system is therefore proposed to tackle the issues faced. This system will allow the city authorities to better manage their resources in the collection of garbage and provide a platform that will allow for an efficient garbage collection system. This paper proposes a smart alert system for garbage clearance by giving an alert signal to the municipal authorized personnel for instant cleaning of dustbin with proper verification based on level of garbage filling. This process is aided by the ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the dustbin and sends the alert to the municipal web server once if garbage is filled.**

IndexTerms – **Internet of Things, Arduino UNO, Waste management, Sensors.**

I. INTRODUCTION

The Internet of Things is the name given to the computerization of everything in the lives of people. Already Internet-enabled thermostats, light bulbs, refrigerators, and cars can be bought. Soon everything will be on the Internet: the things owned by people, the things people interact with in public, autonomous things that interact with each other. The Internet of Things (IoT) is the inter-networking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. A **humidity sensor** senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. If you are sourcing a ultrasonic ranging module, the HC-SR04 is good choose . Its stable performance and high ranging accuracy make it a popular module in electronic market. A **passive infrared sensor** (**PIR sensor**) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. GSM-GPS shield is a SIM808 GPRS/GSM/GPS Shield, which is use the newest A7 GSM/GPRS/GPS module, A7 module is a GSM/GPRS/GPS function module. It supports GSM/GPRS Quad-Band（850/900/1800/1900） network. Also, it supports voice calls, SMS messages, GPRS data service and GPS function. We can use it make a simple phone. The module is controlled by AT command via UART and supports 3.3V and 4.2V logical level.

Features:

- Operating temperature -30 °C to + 80 °C.

- 1KG peak suction.

- Low standby current.

- Operating Voltage 3.3V-4.2V.

- Power voltage> 3.4V.

- Standby average current 3ma less.

- Support the GSM / GPRS four bands, including 850,900,1800,1900MHZ

- GPRS Class 10

II. LITERATURE REVIEW

2.1 System analysis of municipal solid waste management in Chandigarh and minimization practices for cleaner emissions.
Year: 2014
Author : Khaiwal Ravindra, Kamalpreet Kaur, Suman Mor
Rapid urbanization and population growth makes efficient management of municipal solid waste (MSW) a challenge to municipal authorities. Considering this, the current study appraised the MSW practices including waste generation, collection, transportation, disposal and treatment in Chandigarh. The strength of MSW management includes the involvement of various public-private stakeholders including the Municipal Corporation of Chandigarh (MCC). The city has door to door waste collection system for its transportation at collection-cum-transfer station (Sehaj Safai Kendra, SSK). Chandigarh one of the union territory of India is located in northern part of the country. The city is among the highest per capita income city and therefore one of the richest cities in the country. Chandigarh has witnessed population of 1.05 million (2011, Census). Relevant literature and information on the waste management practices in Chandigarh was reviewed for conducting the present study. Key information was collected from the stake- holders through interviews and recorded office data for waste generation, transport and disposal. To validate or cross check the gathered information extensive field visits were made from the waste collection to the final disposal/processing sites to know the role of each element in waste management. Representative waste samples were also collected from different locations to get infor- mation about the physical composition of the waste.

2.2 Garbage Collection Management System
Year: 2016
Author: Pranjal Lokhande, M.D.Pawar.
Introduction of adamantine problem for environment is pollution that causes fickleness, instability, hard or disquiet to ecosystem. Now days, there are a number of techniques, which are used for the collection and management of the garbage. Zigbee and GSM technologies are not only latest trends but also one of the best combinations to use in the project. Set of carefully chosen sensors to monitor the status of garbage bin. The smart garbage bin consist sensors namely ultrasonic sensor, gas sensor and moisture sensor. Ultrasonic Sensor is used for detect the garbage level. The ultrasonic sensor is placed inside the garbage bin at lead position, gas sensor will sense the toxic gases and moisture sensor will sense moist in bin then that indication will give to PIC micro-controller. The controller will give indication to the cleaning authority and needs urgent attention. The Pic-micro-controller will indication by sending SMS using GSM technology. These Dustbins are interfaced with the central system showing status of garbage in Dustbin on GUI.

III. PROBLEM DEFINITION

We see many times the dustbins which are in bad conditions. Garbage in dustbin all overflowed as well as spelled out the garbage from dustbin. People thrown garbage on that dustbin which already overflowed. Sometimes due to this garbage bad smell created, toxic, unhygienic gases are produces due to unclean garbage bins. It is very bad look of the city which is way to support to the air pollution and to some harmful diseases which are easily spreadable.
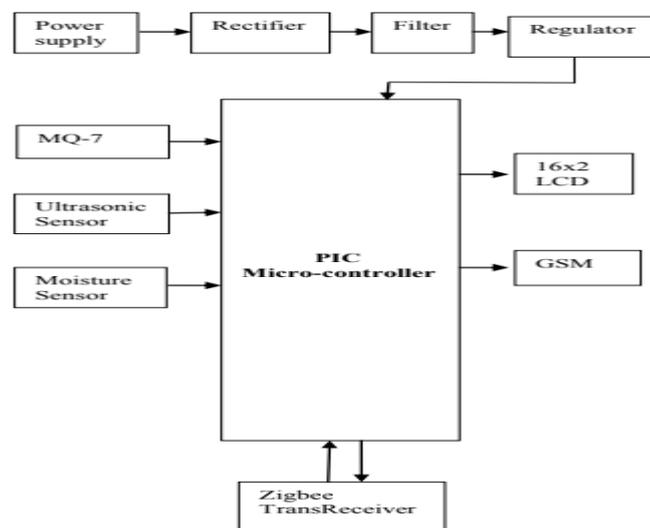

Figure 1: Block Diagram of Proposed System

The Figure 1 represents the components which are used in system. The block diagram shows different components are used in our system. Ultrasonic sensor, Gas sensor, Moisture sensor, PIC micro-controller, GSM Modem, Zigbee CC2500, Power supply. This proposed system is divided into two parts like transmitter section and receiver section. In transmitter section consist of sensors,PIC micro-controller, Zigbee transmitter is connected to the dustbin. Where ultrasonic sensor is used to detect the level of garbage in dustbin, moisture sensor is used to detect 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 thrown into dustbin. These sensors are sensed the content related to the dustbin and send the information to the PIC micro-controller.
There is power supply is given to the PIC micro-controller for drive the system. PIC micro-controller is read the data from sensor and then proceed to the next stage by using zigbee transmitter. This information is wirelessly transmitted. There is GSM Modem is used here for sending the information related to the garbage in dustbin to the authority who take appropriate action. There is receiver section consist zigbee receiver which is used to display all information related to garbage in bin on PC screen in the form of graphical user interface (GUI). Following are result which can be obtained from this proposed system:
- Garbage level, moisture level and toxic gases detection inside the dustbin.

- Transmit the information wirelessly.

- Data can be collected anytime and from anywhere.

- The real-time transmission of information carried out.

- Avoid the situation of overflowed dustbin.

IV. PROPOSED WORK

4.1 Problem Statement
In India, a garbage crisis is propagating, which is the cause of a number of environmental problems and public health issues. India's rapid economic growth has resulted in a substantial increase in solid waste generation in urban centers. Urban areas in India alone generate wastes which is higher than many countries' total daily waste generation.

4.2 Existing Work
In **New York**, Each container is equipped with a chip that detects when the bin is full or too smelly, allowing trash collectors to make a pickup where they're needed most. Bigbelly, a Massachusetts-based waste management company, is hoping to turn its trash and recycling bins into wireless hotspots throughout New York City. The project began in downtown Manhattan, where more than 170 of Bigbelly's solar powered "smart" bins have already been installed. Each container is equipped with a chip that detects when the bin is full or too smelly, allowing trash collectors to make a pick-up where they're needed most. But the city thought the already-high-tech bin could still use an upgrade.

Pune Municipal Corporation is administrating the city and serving the citizens by using new technologies. PMC has taken an initiative by implementing the new idea of automation and monitoring of waste management operations. As waste management operations all over the world attempt to become cleaner and greener. PMC is using the new technologies like GPS Tracking System, Ultra High Frequency Radio Frequency Identification, IOT Sensors along with mobile and web application to improve and smoothen ground level mechanisms for waste collection and efficient processing and re-cycling of waste.

CleanCUBE, A smart solar-powered waste compacting bin. Embedded sensors measure the bin fill-level in real-time and trigger automated compaction of waste, effectively increasing the bin capacity by 500% - 700%. Using either 2G or 3G wireless telecommunication technology, real-time data from CleanCUBEs is sent to Ecube Labs' online platform (CleanCityNetworks), allowing remote monitoring of bin status and fill-levels. The CleanCUBE boasts optional features such as Wi-Fi hotspot capability, LED back-lit advertisement panels, LCD screens, and motion-activated sound players.

4.3 Proposed System
This proposed system detects when the garbage bin is full and notifies the respected authority. The system sends a SMS to the respected authority when the bin is full. It also notifies if the bin contains a dry or a wet waste. The exact location of the bin is sent so that the authority can come and pick up the garbage. The doors are motorized so that only humans can access the bin.

4.4 Scope of the Work
The smart, sensor based dustbin will judge the level of waste in it and send the message directly to the municipal corporation. It can sense all the type of waste material either it is in the form of solid or liquid. According to the filled level of the dustbin, the vehicles from the municipal corporation will choose the shortest path with the help of the "TRANSPORTATION SOFTWARE", which will save their time. It emphasizes on "DIGITAL INDIA". The system is simple. If there is any problem with any equipment in the future, that part is easily replaceable with new one without any difficulty and delay.

V. SYSTEM DESIGN

5.1 Design Overview
Waste management is all the activities and actions required to manage waste from its inception to its final disposal [1]. This includes collection, transportation, treatment and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities. Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialized trucks. Waste collected is then transported to an appropriate disposal area. Nowadays, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening [2]. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization.

5.2 System Architecture
For the sensor network, a single hop network with a flat architecture was chosen. This was mainly to allow each sensor to communicate directly with the server and thus avoid the hassle that would be caused in two-way communication if a multi-hop network were to be used. Each of the sensor nodes therefore performs entry into the database and directly receives any data back from the server. The information stored on the server is then made accessible via a mobile phone application as well as a webpage as shown in fig.2. The independence of each of the nodes allows them to be placed without having to make any consideration on the other sensor nodes.
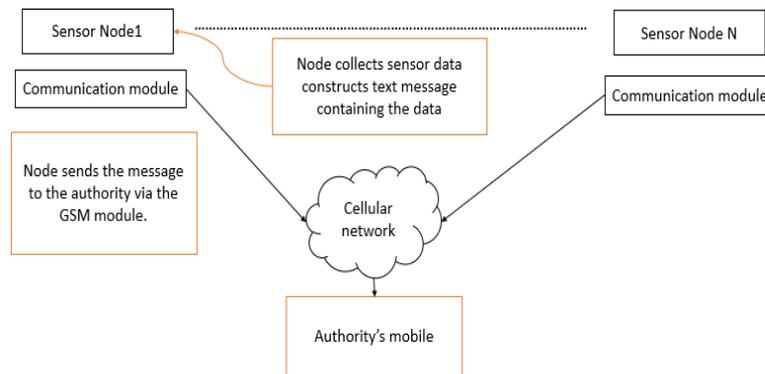
Figure 2: System Architecture

VI. SYSTEM MODULES

The system is categorized into 5 modules.

- Level Sensor
- Connection Module
- Microcontroller
- PIR Sensor
- Humidity Sensor

6.1 Level Sensor
Functionality: - The level to which the bin is filled is detected.
Input: - No input given
Output: - The level to which the bin is filled.
Working: - The Sensor is placed at the top of the bin. It measures the level to which the bin is filled. The data is sent to the microcontroller board

6.2 Connection Module
Functionality: - This module controls the sensors and processes the data.
Input: - The data from all the sensors.
Output: - Data to the communication module.
Working: - The data from the sensors are sent to the microcontroller. The microcontroller processes the data and sends the data to the communication module when needed.

6.3 Microcontroller
Functionality: - This module sends the text message to the Garbage clearing authority
Input: - The level to which the bin is filled and the location data.
Output: - A text message to the authority.
Working: - The microcontroller board forms the message that has to be shared with the authority. This message is shared to the authority using GSM via the communication module.

6.4 PIR Sensor
Functionality: - This sensor measures the humidity in the bin.
Input:- It absorbs the water vapor in the bin to measure the humidity.
Output: - The humidity level in the bin.
Working: - The sensor measures the humidity in the bin. According to the humidity level in the bin, the output voltage of the sensor is varied. This output level is measured by the microcontroller board and it is identified as dry or a wet waste bin.

6.5 Humidity Sensor
Functionality: - To detect the presence of a human hand.
Input: - Human Hand.
Output: - Voltage high if the presence of human is detected.
Working: - The sensor checks if there is anyone wanting to access the bin. When a human swings his hand over the sensor, the sensor sends a signal to the micro controller. Once the hand is taken away from the sensor, the signal is stopped.

VII. RESULTS AND DISCUSSION

This section describes the results of the "Arduino-based Smart Garbage Monitoring System using PIC Microcontroller". The snapshots are shown below for each module.

7.1 The garbage bin used for the implementation

Figure 3: Picture of the Bin.

7.2 Snapshot of the System

This picture shows the Arduino board and the GSM module.

Figure 4: The GSM module and the Arduino board.

7.3 Picture of Automated Door system
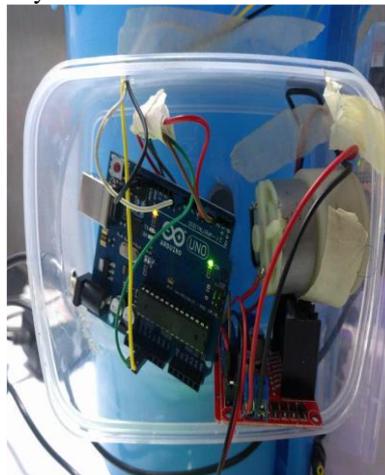
The figure 5 shows the automated door system.

Figure 5: The Arduino board, the motor driver and the motor.

7.4 Hand blocking the PIR sensor
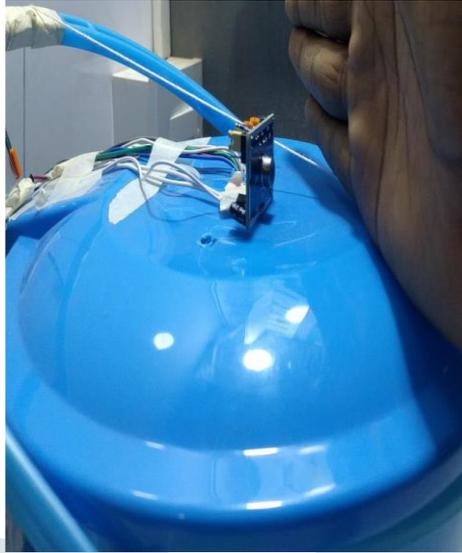
The PIR sensor is used to sense the object nearer to it.

Figure 6: A hand blocking the PIR sensor.

7.5 An open bin

Figure 7: Bin open with the ultrasonic sensor and the humidity sensor

VIII CONCLUSION

Garbage Management is a big issue for everyone to need action across it immediately. In this system is able to observe the different type garbage is thrown into dustbin by using sensors. When dustbin is full or overflowed then ultrasonic sensor is detected the level garbage in dustbin or some wet garbage is thrown into dustbin is detected by the Humidity sensor. This sensors output is given to the Micro-controller. In this system we use Global system for Mobile communication (GSM). These technologies are used for wirelessly data transmission over long distance. GSM module is used to send the Message to cleaning authority who clean the dustbin by using GSM. It is a real time system. This type of system is used in college campus, offices and many places where it is suitable. Further work would consider full development of the WSN for real time waste monitoring and collection.

REFERENCES

[1] V. N. Bhat, "A model for the optimal allocation of trucks for solid waste management," Waste Management & Research, vol. 14, (1), pp. 87-96, 1996.
[2] P. H. Brunner and J. Fellner, "Setting priorities for waste management strategies in developing countries," Waste Management & Research, vol. 25, (3), pp. 234-240, 2007.
[3] M. Sharholy et al, "Municipal solid waste management in Indian cities – A review," Waste Management, vol. 28, (2), pp. 459-467, 2008.
[4] L. L. Abarca-Guerrero et al, "Solid waste management challenges for cities in developing countries," Waste Management, vol. 33, (1), pp. 220-232, 2013.
[5] M. Angelidou, "Smart city policies: A spatial approach," Cities, vol. 41, pp. S3-S11, 2014.
[6] K. Ravindra, K. Kaur and S. Mor, "System analysis of municipal solid waste management in Chandigarh and minimization practices for cleaner emissions," Journal of Cleaner Production, vol. 89, pp. 251256, 2015.
[7] S. K. Amponsah and S. Salhi, "The investigation of a class of capacitated arc routing problems: the collection of garbage in developing countries," Waste Management, vol. 24, (7), pp. 711-721, 2004ss.