GSM Based Garbage Monitoring System

Surbhure Swapnil[1], Nazirkar Nagesh[1], Khartude Akash[1], Sangle Nilesh[1]
Dr. Avchat H. S (Asst. Professor)[2]
Department of Electrical Engineering, HSBPVT's Group of Institutions, Kashti, Maharashtra, India

A R T I C L E I N F O

A B S T R A C T

In the recent times, Urbanization has increased tremendously. At the same phase there is an increase in waste production. Waste management has been a crucial issue to be considered and efforts using traditional bins as currently used in City has remained inefficient in managing garbage even though helps in garbage collection. This project is a way to achieve this good cause. In this project, a smart bin built and installed in a housing uses a microcontroller-based platform Arduino Uno board which is interfaced with GSM, a pair of level sensor (laser with a photocell) and a stepper motor modelled compressor. The housing is to isolate the garbage from the environment. The laser with a photocell is placed at the top of the bin which will measure the stature of the bin, the compressor connected to the circuit is positioned just at the top level of the bin for compression. The Arduino is programmed in such a way that as the dustbin is being filled, the sensor is activated to monitor the fill level. Once the garbage reaches the positioned level of the sensor, a message will be sent to the circuit which will trigger the compressor to compress and finally an alert through the GSM will be sent to the waste management authority for bin emptying when the bin gets filled up again after the compression. Once the bin is emptied, people can reuse the dustbin. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it will reduce the interaction of waste with the environment, increases the volume of bins for garbage collection through the compression feature, avoids unnecessary lumping of wastes on roadside. Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems. Breeding of insects and mosquitoes can create nuisance around promoting unclean environment, which is a great blow City is facing today.

Keywords :- Photocell, GSM, Garbage, Foul Smell

I. INTRODUCTION

Environmental problems are raised by modern cities for waste collection and disposal. Therefore, smart waste management systems became essential for cities that aim to reduce cost and manage resources and time. Currently, the trend is shifting towards smart devices to overcome common problems such as waste management issues. Optimizing the process of trash collection is the main purpose of the smart solutions provided by industry. However, the cost of applying such solutions is still relatively high.

GSM based Arduino waste management system is an innovative community waste bin designed for efficient and reliable waste management for a greener City. City faces the issue of disposal of Total amount of 12,710 tons of waste it produces daily from industries, work places and houses to dispose off. The common collection methods for waste disposal in City are;

1) Door to door collection
2) Curb side collection
3) Block collection
4) Community bins

The GSM based Arduino waste management system targets a crucial aspect of its solution (the compacting and collection of waste). The GSM based Arduino waste management system bears following features;

1)Innovative design to decrease chances of interaction of waste with atmospheric agents.

2)Solar powering with a DC battery to reduce additional pressure on the national grid, and for the system to operate even when there is no sunlight.

3)Compaction of waste to increase capacity of trash bin.

4)Fill level monitoring using an IR

5)SMS alerts using GSM model coupled with and Arduino Uno board to the waste management authority.

6)Easier provision for removal of bin.

This project GSM based Garbage Monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a SMS. For this the system uses IRs placed over the bins to detect the garbage level and compare it with the garbage bins depth.

The system makes use of Arduino uno board, LCD screen, GSM modem for sending data. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level of garbage collected in the bins. Whereas GSM is built to show the status to the user, monitoring it with SMS. The SMS consists of text related to all garbage bins. The LCD screen shows the status of the garbage level. The system puts on LCD screen continuously monitoring of garbage with Arduino board. Thus this system helps to keep the city clean by informing about the garbage levels of the bins by providing SMS to the respective person.

II. LITERATURE SURVEY

The major incapability of present waste bin collection systems in City are:

1)Lack of information about the full level of the bin

2)No compression system to increase volume of bin

3)There is no estimation to the amount of solid waste present inside the bin and the surrounding area due to the scattering of waste.

4)No alert systems for emptying of bins

To remove these problems many systems have been developed in City as well as other countries. Some of such researches are summarised below:

Electronic Waste Collection Systems Using Internet of Things (IoT): Household Electronic Waste Management in Malaysia; This work discusses the application of smart collection systems pertaining to the Malaysian e-waste management and recycling sector. A smart household e-waste collection box was designed, fitted with e-waste level measurement sensors to record the disposal data. A backend server was developed which automatically notifies and schedules e-waste collectors to dispatch and collect the e-waste when the volume of the collection box reaches a certain threshold (e.g. box is 80% filled). A mobile application was developed in this work and public end

user are intended to use it to dispose their household e-waste. The smart system was successfully developed as a proof-of-concept in this work and it could be beneficial to improve the household waste consumer electronics collection in Malaysia.[1]

Smart Waste-Bin with Real-Time Monitoring System; This paper presents IoT innovation project of a smart waste bin with real time monitoring system which integrates multiple technologies such as solar system, sensors and wireless communication technologies. The aim of the project was to provide an efficient and cost-effective waste collection management system hence providing clean, healthy and green environment. The study proposed a new framework that enables remote monitoring of solid waste bin in real-time via Wi-Fi connection, to assist the waste management activity.[2]

IoT-Based Intelligent Waste Bin; The amount of the waste humans' discards is rapidly increasing and will not be controlled without transformational changes. Waste management companies will be hugely impacted with such increments as they should provide resources for the collection of such waste with minimum or even zero income. This project aims to develop smart real-time waste management and monitoring system that optimized the resources and maximized the efficiency. The system is designed based on three main elements; Master station, Slave station, and Internet of things (IoT) platform. The master pin station gathers the data from the slave stations and transmits it to the IoT application for remote management and monitoring purposes. The system is powered up by using solar panels. Four parameters are used for monitoring and managing the waste: temperature value, level in percentage reading, smoke detection, and the global positioning system (GPS) location. The development phase of the system is designed into two phases; system modelling and hardware implementation.[3]

A Waste Collection Mechanism Based on IoT; This proposes a smart waste collection system with the help of IoT. Information will be sent to municipality centre using GSM which the waste can be collected in time.

This method is supported by IR, a weight sensor and MQ gas sensor which are attached to an Arduino Uno microcontroller. When the values read by the sensors reach a threshold, an alert is sent to the Municipality server. The real-time progress of the waste collection can be examined with the help of this system. This method will enable waste collection on time and thereby ensure a safer environment.[4]

Smart Dustbin for Economic Growth; In the recent decades, Urbanization has increased tremendously. At the same phase there is an increase in waste production. Waste management has been a crucial issue to be considered. This paper is a way to achieve this good cause. In this paper, smart bin is built on a microcontroller-based platform Arduino Uno board which is interfaced with GSM modem and IR. IR is placed at the top of the dustbin which will measure the stature of the dustbin. The threshold stature is set as 10cm. Arduino will be programmed in such a way that when the dustbin is being filled, the remaining height from the threshold height will be displayed. Once the waste reaches the threshold level IR will trigger the GSM modem which will continuously alert the required authority until the waste in the dustbin is squashed. Once the dustbin is squashed, people can reuse the dustbin. At regular intervals dustbin will be squashed. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary dumping of wastes on roadside. Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems. Breeding of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases.[5]

City Waste Management System Using GSM; The aim is to accommodate more and get the dustbin cleaned timely using alert services. In many places, the Municipal waste bins are overflowing and they are not cleaned at proper time. As a result of which the consequences are severe. It includes overflow of waste

International Journal of Scientific Research in Science, Engineering and Technology | www.ijsrset.com | Vol 11 | Issue 3

178

which results in land pollution, spread of diseases, also it creates unhygienic conditions for people, and ugliness to that place. The term waste management usually relates to all kinds of waste, whether generated during the extraction of raw materials, the processing of raw materials into final products, the consumption of final products, or other human activities, including municipal, agricultural, and social like health care etc. There needs to be system that gives prior information of the filling of the bin that alerts the municipality so that they can clean the bin on time and safeguard the environment. To avoid all such situations, we intend to propose a solution for this problem Smart Waste Bin, which will inform the authorized person when the waste bin is about to fill and will send the location of bin by using GSM.[6]

Dust Mobin-A New Bin for Smart Indoor Wastage Management System; On the concerns of the territory domestic refuse regulation which influences the health and surroundings of a locality. In the fresh decennium, urbanization has expanded tremendously. At the same instant an increment in refuse production. Managing waste has been a pivotal concept to be pondered. As the citizenry is enlarging day by day, the habitat should be clean and hygienic. Priory we have to fix this issue so that our interior environment should stay neat and clean, a dustbin was developed which is fully automatic and consists a many features like controlling via mobile phone, auto detection and display of space over the dustbin, auto open lid to throw waste after detecting it, self-visiting to cabins, giving notifications via SMS and alerting nearby people after getting filled fully which will help the interior environment to remain hygiene. They also used IoT and machine learning to make the bin more autonomous in terms of technology. It is controlled via mobile means such that people can call it near to themselves by their mobile phones, which will be easy for people to throw waste into it.[7]

Design of a Smart Bin Innovated for Smart Cities; This work was based on designing a machine that can compress waste. The machine could be used in hospitals, hotels, and stores to decrease the volume of waste produced which will decrease their costs. This machine will be user friendly for anyone using it
The machine is designed and fitted with a dumping lid through which waste is dumped it also protects the waste from coming directly in contact with the environment and thus reducing the problem of spreading diseases and animal wandering around. The machine is integrated with a pair of IR sensors that monitors the status of the bin and once the bin is full, the central control unit which is the ATMEGA8A controller triggers the motor. This rotary motion is converted to linear one using gear assembly and compactor plate comes down compacting the waste. It is also designed with a controller that monitors and triggers on the GPS/GPRS module to send a signal wirelessly to the central server requesting a clean off.[8]
There are also several foreign companies who offer smart trash bins managed by a web-based application. ECUBE labs and Bigbelly offer smart trash compactor bins, which powered by solar cell panel and battery. Clean CUBE bin uses IR and Bigbelly smart trash bin uses laser sensor to measure fullness status. Moreover, most companies offer IoT sensors, which can be easily installed on available trash bins. ECUBE labs, ENEVO and SMARTBIN offer battery powered versions of these ultrasonic IoT sensors. Moreover, CUBE labs offer solar powered one. However, COMPOLOGY offers IoT sensor that uses a camera to detect the fullness status of large industrial trash containers. Most of these IoT sensors and smart bins integrate temperature, tilt and acceleration sensors to detect vandalism, fire, trash collecting and usage events. All these solutions make use of cellular networks to send data from the IoT sensors and bins to their cloud hosted web-application portal over the internet. These web applications monitor fullness level, energy usage, fire alerts, and give real-time readings and historical reports in addition to schedules and routes for

International Journal of Scientific Research in Science, Engineering and Technology | www.ijsrset.com | Vol 11 | Issue 3

179

optimized trash collection. Finally, contrary to the mentioned solutions, this paper aims at developing a similar modelled system in City that features a solar-battery powering, fill level monitoring, waste chamber with a locker, waste compression system and GSM alerts, to efficiently and significantly reduce the canker of waste in City.

The Garbage monitoring has to be effectively and efficiently implemented the variety of proposal we put and some of them already implemented, But it cannot be effect on the system performance so we done a project among this problem in a different method in low cost using embedded module GSM. The smart garbage monitoring system in cities using GSM proposed a method. which monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page, in which system uses IRs placed over the bins to detect the garbage level and compare it with the garbage bins depth. The proposed system uses Arduino family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer, GSM, IR.

This proposed system assures the cleaning of dust bin soon when the garbage level reaches its maximum threshold. The embedded C technique is enhancing the system to achieve the desired result. Thus this system helps to keep the city clean by informing about the garbage levels of the bins by providing SMS to the respective person.

DISADVANTAGES OF EXISTING SYSTEM

1. Time consuming and less effective.
2. High costs.
3. Unhygienic environment and look of the city.
4. Bad smell spreads and may cause illness to human beings.
5. More traffic and noise.

III. METHODOLOGY

The proposed system is divided into two sections: an administration section which has two sub sections (Control Room and Collecting sections) and a service section. In the service section, residents throw away the waste in the bin and that information with the sensors is collected and transferred to the administration section's control room (indicated below in fig 2.1 as a mobile phone) when the bin is full after three successive compressions and the waste collector (indicated below in fig 2.1 as a truck) comes to collect the waste.
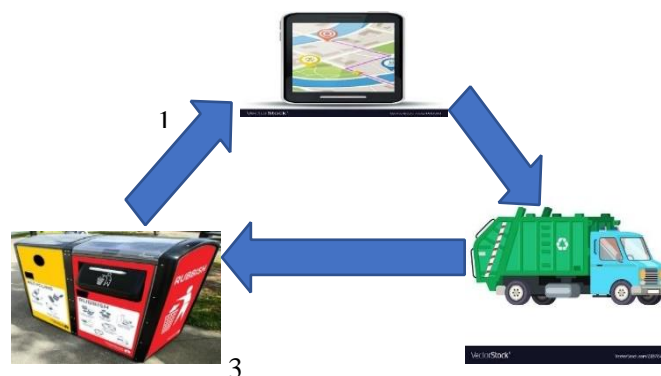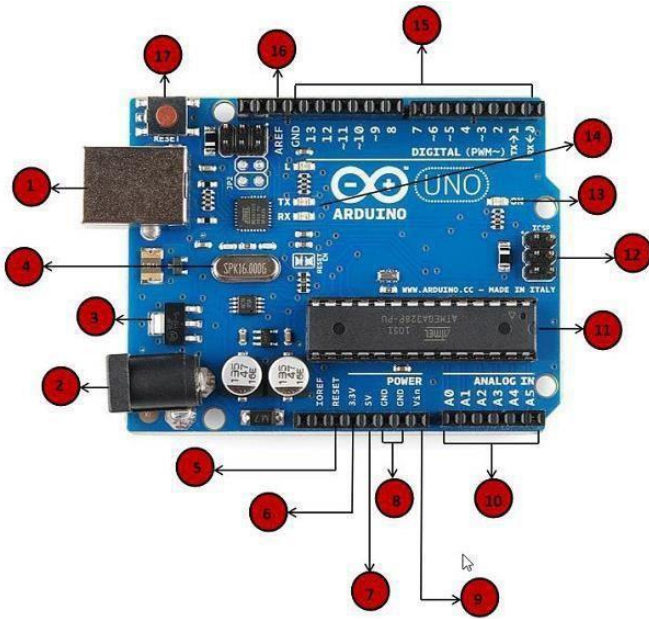

FIG. Block diagram of the basic operation of the system

The solar cells of the solar panel absorb energy from the sun in the form of sunlight then electrons within the cells becomes excited and begin to flow generating an electrical current which is captured by the solar panel's wiring system and channelled to charge the battery.

The battery supplies DC voltage to a 12V DC voltage regulator which regulates the voltage and gives an output of 9V to the Arduino Uno and GSM Boards.

The Arduino Uno Board according to the program code uploaded to it takes the fill level information from the fill level sensors connected to the bin with a compressor to issue a compressing command to the compressing system then sends an SMS to the waste authority after two (2) successful compressions through the GSM.

International Journal of Scientific Research in Science, Engineering and Technology | www.ijsrset.com | Vol 11 | Issue 3

180

IV. ARDUINO UNO

Arduino Uno is an open source, computer hardware microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs analog input/output (I/O) pins interfaced to the GSM module, the motor driver, the fill level sensors on the circuit board through soldering and gluing, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

It contains everything needed to support the microcontroller; this was connected to the computer through the Universal Serial Bus (USB) cable and a program code was upload through the Arduino Software Environment (IDE).

1) Power USB-
Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection.

2) Power (Barrel Jack)
Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack.

3) Voltage Regulator
The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.

4) Crystal Oscillator
The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz. 11

(5,17) Arduino Reset you can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET (5)

(6,7,8,9) Pins (3.3, 5, GND, Vin)
I. 3.3V (6) – Supply 3.3 output volt

II.5V (7) – Supply 5 output volt

III. Most of the components used with Arduino board works fine with 3.3v and 5v.

IV.GND (8) (Ground) – There are several GND pins on the Arduino, any of which can be used to ground your circuit.

V. Vin (9) – This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.

10)Analog pins- The Arduino UNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

11) Main microcontroller- Each Arduino board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

12) ICSP pin- Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often

referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output.

Actually, you are slaving the output device to the master of the SPI bus. 12

13) Power LED indicator- This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

14) TX and RX LEDs- On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.

15) Digital I/O- The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labelled can be used to generate PWM.

16) AREF- AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

Microcontroller- ATmega2560

Operating Voltage -5V

Input Voltage (recommended)- 7-12V

Input Voltage (limit)- 6-20V

Digital I/O Pins 54 (of which 15 provide PWM output)

Analog Input 16

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2005 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators.

V. CONCLUSION

This project work is the implementation of a GSM Based Arduino Waste Management System for a Green City using Fill level sensor (Laser + Photocell), Arduino Uno, GSM Module, Compressing System. This system focuses on paper and rubber waste, ensures that they are properly managed through compression in a controlled system as well as ensuring the cleaning of dustbins soon after the waste level reaches its set threshold after a set of compression instructions through SMSs. It takes power supply with the help of a solar panel and a backup battery. This system also helps to monitor and manage reports and hence can reduce the minimize inefficiencies in the overall management system. This reduces the total number of

International Journal of Scientific Research in Science, Engineering and Technology | www.ijsrset.com | Vol 11 | Issue 3

182

trips of waste collection vehicle and hence reduces the overall expenditure associated with the waste collection. It ultimately helps to keep cleanliness in the society. Therefore, the GSM Based Arduino Waste Management System for A Green City makes the Paper and Rubber waste management more efficient.

REFERENCES

1. Kai Dean Kang, Harnyi Kang, IMSK Ilankoon, "Electronic Waste Collection Systems Using Internet Of Things (IoT)" Chun Yong Chong Journal of Cleaner Production 252, 119801, 2020.

2. Norfadzlia Mohd Yusof, Mohd Faizal Zulkifli, Mohd Yusof, Nor Yusma Amira, Azziana Afififie Azman "Smart Waste-Bin W6ith Real-Time Monitoring System" International Journal of Engineering and Technology (UAE) 7, 725-729, 2018.

3. Moath Awawdeh, Anees Bashir, Tarig Faisal, Irfan Ahmad, Muhammad Khalil Shahid "IoT-Based Intelligent Waste Bin" 2019 Advances in Science and Engineering Technology International Conferences (ASET), 1-6, 2019.

4. Akshay Mohan, Shubham Johar, "A Waste Collection Mechanism Based On IoT" S Mini 2017 14th IEEE India Council International Conference (INDICON), 1-5, 2017.

5. U Nagaraju, R Mishra, Chaitanya Kumar Rajkumar Research Project "Smart Dustbin For Economic Growth". School of Information Technology and Engineering. VIT University, Vallore. India, 2017.

International Journal of Scientific Research in Science, Engineering and Technology | www.ijsrset.com | Vol 11 | Issue 3

183