Design & Implementation of Environment Dust and Wastebasket Monitoring System

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Declaration

It is declared hereby that this project paper or any part of it has not been submitted to anywhere else for the award of any degree.

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Abstract

Waste and environment management is one of the primary problem that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. It in turn leads to various hazards such as bad odor & ugliness to that place which may be the root cause for spread of various diseases. To avoid all such hazardous scenario and maintain public cleanliness and health this work is mounted on a smart garbage system. The main theme of the work is to develop a smart intelligent garbage alert system for a proper garbage management .This paper proposes a smart alert system for garbage clearance by giving an alert signal to the municipal web server for instant cleaning of dustbin with proper verification based on level of garbage filling. This process is aided by the IR sensor which is interfaced with Atmega-328 (Arduino) microcontroller to check the level of garbage filled in the dustbin and sends the alert to the municipal authority once if garbage is filled. The whole process is upheld by an embedded module integrated with GSM module

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CHAPTER I

INTRODUCTION

1.1 Introduction

Proper management of waste should be a priority to reduce environmental pollution and to ensure the safety of public health. In developing countries, waste management and awareness is an emerging concept. To ensure the sound environment and sustainable development, appropriate management of waste is a must. Nevertheless, in developing countries, due to lack of infrastructure and unsustainable practices have made waste management worst, which leads to environmental contamination. The open dumping and picking of waste within open dumpsites lead to serious health risks like skin infections and chronic diseases. In slum areas, the situation gets worst because of the high density of the population. It is a clear indication that environmental / health issues and poor waste management are interrelated. The increase in population, urbanization, and industrialization increases the waste generation level throughout the world. More than 64% of the population in the developing countries and more than 84% in the developed ones will be in urban areas by 2050 [1]. Hence waste management is a global issue in terms of various environmental and social impacts. The world generates 2.01 billion tons of municipal solid waste annually, with at least 33% that - extremely conservatively - not managed in an environmentally safe manner. Global waste is expected to grow to 3.40 billion tons by 2050. Worldwide, waste generated per person per day averages 0.74 kg but ranges widely, from 0.11 to 4.54 kg. The total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050 [2]. Now, like other low-income countries, Bangladesh is one of the developing countries in the world, with a huge population within a small area. Dhaka is the capital city of Bangladesh, having an area of 306.8 km2 [3]. Dhaka's 2020 population is estimated at 21,005,860, while 2030 may see as many as 27.3 million residents [4]. That indicates that Dhaka city is overpopulated. However, the waste management of Dhaka city is somehow overlooked by the local government. Around 234,000 deaths, including 80,000 in urban areas, due to environmental contamination and related health risks in 2015, making it one of the worst affected countries in the world [5]. A place like Dhaka city, where the density of people is high, just needs to provide an effective waste management system. A suitable approach that can manage waste in such a way so that it does not pollute the environment and ensure the safety of public

health. Fig. 1 (a) shows a garbage bin in the Laksmibazar area of old Dhaka. It is a regular picture of urban areas of Bangladesh. The waste management of urban areas of Bangladesh is not environment friendly. The dustbins have no lid over them, and most of them are placed on busy roads of urban areas. The dustbins are cleaned every day at the pick hour of the day when everyone goes to their workplace, and students go to their schools, colleges, or universities. Overflow of waste is seen frequently in almost all of the dustbins. Because of that, various kinds of infectious diseases are spread, and many people, especially children, losses their lives every year.

(a) (b)

Fig. 1. (a) An open dustbin (b) Waste in Chittagong

The situation gets worst on Eid-Ul-Azha, which is the secondlargest festival of Muslims. It is also known as 'Feast of Sacrifice'. Most of the people in Bangladesh are Muslims. On this day, Muslims sacrifice cow, camel, or ram. These animals are slaughtered in open space that badly affects the environment. A picture is shown in Fig. 1 (b), where the wastes are kept on busy roads of Chittagong generated because of Eid-Ul-Azha. The slaughtering of animals in open space and mismanagement of waste makes urban life miserable and causes the spread of different kinds of diseases. The waste generated from urban life can be different types, as a paradigm, plastic, leather products, and rubber, textile and wood, glass, metal, paper, organic matters, and others. Fig. 2 shows the different kinds of waste generated per day (in kg) in different cities of Bangladesh. It is seen that Dhaka and Chittaging city generates more waste than the other cities. Among the different types of wastes, the most generated wastes are paper and organic matter, and the other types of wastes have an insignificant amount. Based on the above issues, this paper proposed an effective and efficient garbage management system. The proposed system uses sensors for identification of personnel and measuring

garbage level. Continuous data regarding garbage levels are available for personnel through the display of the garbage bin. This smart garbage bin provides an automated lid to personnel. When there are personnel detected within a 30 cm range of the garbage bin, the lid opens if the garbage bin is not filled up and the rest of the time, it remains closed. The garbage bin also sends a message to the corresponding authority to collect waste when the bin is 100% filled up. Arduino Uno synchronizes the whole automated system. A real prototype of the proposed smart waste management system in a small-scale bin is designed and found satisfactory results. Therefore, in brief, the contributions of the paper are,

1.2 Motivation

Bangladesh is known as a land of natural beauty. Its scenic beauty, beauties of rivers, seasonal cycle and sea shore is famous all over the world. Besides that according to recent studies, Dhaka is the world's second most polluted city. There are many causes behind pollution and our existing garbage management system is one of them. As our Nation is growing up, we should deploy latest technologies to make our lifestyle better. In our project, we are using microcontroller and GSM concept to make our existing waste collection system more convenient. It will result less pollution and energy efficient.

1.3 Problem Statement

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high housing demands which have been drastically risen as a result of migration from villages to cities to find work. In order to accommodate the growing population in the urban area, the government has also constructed more apartment complexes. There are several issues faced by the residents of the flats. One of them is disposal of solid waste. Unlike private houses, the residents of all the apartments use a common dustbin, which tends to fill up very quickly. This overflowing of garbage is a sanitary issue which might cause diseases like cholera and dengue. Moreover it is a waste of fuel to travel around a complex or an area to find that some of the garbage are filled and some are not. Also, on rare days, problems might arise that there is so much garbage that the truck doesn't have enough capacity. The idea struck us when we observed that the garbage truck use to go around the town to collect solid waste twice a day. Although this system was thorough it was very inefficient. For example let's say street A is a busy street and we see that the garbage fills up really fast whereas maybe street B even after two days the bin isn't even half full. This

example is something that actually happens thus it lead us to the "Eureka" moment! What our system does is it gives a real time indicator of the garbage level in a trashcan at any given time. Using that data we can then optimize waste collection routes and ultimately reduce fuel consumption. It allows trash collectors to plan their daily/weekly pick up schedule.

An IR obstacle Sensor is used for detecting whether the trash can is filled with garbage or not. Here IR obstacle Sensor is installed at the side of Trash Can and will measure the level of garbage from the top of Trash can and we can set a threshold value according to the size of trash can. If the level will be higher than this threshold value, means that the Trash can is full of garbage and we will print the message “Basket is Full” on the message and if the distance will be less than this threshold value, then we will print “Basket Empty”.

1.4 Methodology

An integrated Arduino program is developed to synchronize the identification system, automated lid system, micro-controller, display system, and communication system. IR sensor is attached to the front side of the garbage bin. The transmitter of the IR sensor emits an infrared sound that is beyond the human eye listening range, and the receiver receives the reflected infrared by the solid objects. A + 5 V power supply is used to power the system. The electrical connection between all the components used to develop the proposed system. A closed bin is presented here to avoid interference with the external factors like animals and unusual weather conditions that can cause littering of waste. The garbage level inside the garbage bin is continuously monitored by an IR sensor set up inside the garbage bin. After the garbage bin is filled up, the display will show Bin Full.

1.5 Rationale of the Study

Bangladesh has crossed over from Least Developing Countries (LDCs) by achieving all the three conditions and going to be recognized as developing countries economically and socially. The country is thriving through Information and Communication Technology (ICT). Government and private organizations are gradually developing with modern technology such as automation. Besides commercial and technological development, our lifestyle is also developing. We are engaging modern technologies in every aspects of our life for a smart and convenient life. By using smart city concept in our city, we can contribute to the ongoing development of our country. Besides that, it will mitigate some bothersome problems our

city. This study is intended to make garbage collection system of our city smarter to escape from coarse situation.

1.6 Objective

Current waste collection system of Dhaka city provides periodic waste collection following a fixed schedule. Dustbins are usually placed beside road and there is no emergency collection option as the responsible persons are unable to see the real-time status of dustbins. As a result, sometimes we have to experience awkward situation. However, this system will provide real-time dustbin status to the responsible employees along with other facilities.

Most important stakeholder of this system is the driver who drives waste collection truck. He needs to know current status of all dustbins. Using a Smartphone is more convenient for driving direction before the driver than any other device.

1.7 Expected Output

Our primary goal is to develop a real-time waste collection system and environment monitor that will help to avoid unwanted air pollution in public places as the dustbins are usually situated in public places and beside busy road. We also tend to make this system more efficient requiring less fuel consumption and less working hour by providing shortest direction to the bin. Beside these, there will be authentication to permit only authorized person, profile management and collection history for statistics.

CHAPTER II

THEORY OF THE PROJECT

2.1 Introduction

This chapter includes the total over view of the device. In this chapter we have followed-up the theory of Arduino UNO, IR obstacle sensor and other components. Here we can know that the total system overview of the projects. And we will also know that how the equipment are working with each other.

2.2 Theory

The system architecture of the automatic output appliance can be divided into 3 main Modules. They are:

1. CPU
2. Communication system
3. Control system

We've developed the system that can monitor waste bin and environment. Our system has several IR obstacle sensor to detect the level. Based on the input signal microcontroller operate light and sent sms. For example when bin is empty then microcontroller detect it by IR sensor and display Bin Empty. Beside this, there are also smoke and dust sensor which detect smoke from surrounding area and sent sms to authority if there are any air pollution.

2.3 Microcontroller

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. Sometimes referred to as an embedded controller or microcontroller unit (MCU), microcontrollers are found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances among other devices. Microcontroller is a single chip microcomputer made through VLSI fabrication.

2.3.1 Arduino UNO

Arduino Uno is one of the microcontroller boards manufactured by the Arduino and it is a microcontroller board based on Atmel's ATmega328P microcontroller. "Uno" means one in Italian and the Uno board is the latest in a series of USB (Universal Serial Bus) Arduino boards which is the reference model for the Arduino platform. The Arduino Uno board has a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button, 6 analog inputs and 14 digital input/output pins (of which 6 can be used as PWM outputs). It uses the Atmega16U2 programmed as a USB – to - serial converter instead of FTDI USB – to – serial driver chip which was used in all the pre-ceding boards. The board has 32 KB flash memory of which 0.5 KB is used by boot-loader, 2 KB of SRAM, 1 KB of EEPROM and 16 MHz clock speed.

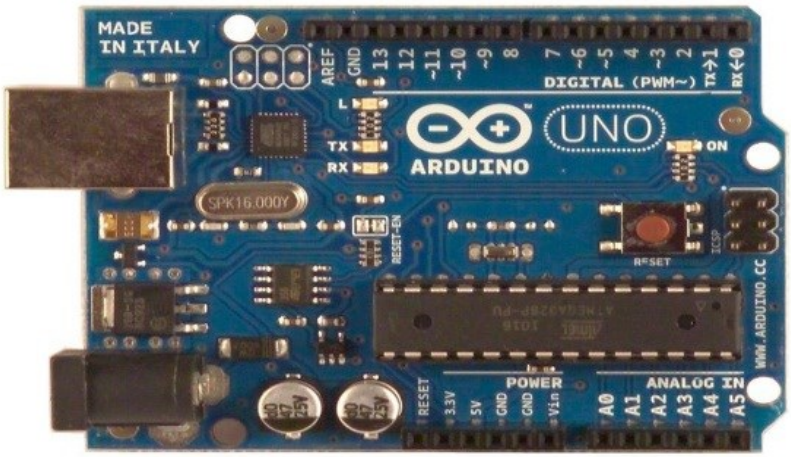

Fig 2.1: Arduino UNO

Reprinted from the Arduino Board Uno Figure 1 shows the Arduino Uno Board manufactured by the Arduino in Italy. It can be powered via a USB connection or with an external power supply. As can be seen in figure 1, pins A0 to A5 are the analog input pins, pins 0 to 13 are 14 digital input/output pins and the pins with a "~" sign can be used as digital pins PWM o can be used as input or output pins by selecting the mode by using the function Pin-Mode() and then using the function digital Read() or digital Write() according to the ne-cessity. Pins 0(RX) and 1(TX) are

used for serial communication while pins 10(SS), 11(MOSI), 12(MISO) and 13(SCK) are used for SPI (Serial Peripheral Interface) communication. In addition to pin 0 and 1, a Software Serial library allows serial communication on any of the Uno's digital pin.

The microcontroller is a low-power CMOS (Complementary Metal Oxide Semiconductor) 8-bit microcontroller based on the AVR enhanced RISC (Reduced Instruction Set Computer) architecture. The powerful execution of instructions in a single clock cycle leads to the achievement of 1 MIPS per MHz throughputs allowing the designer to optimize power consumption versus processing speed.

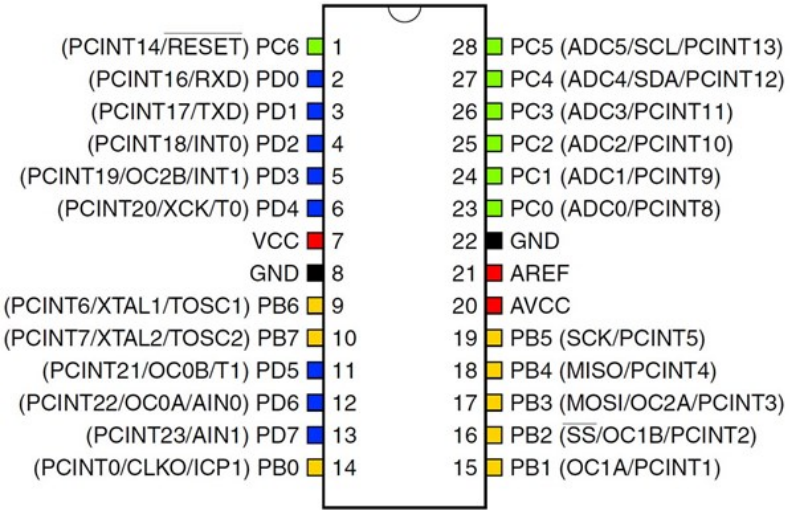

Fig 2.2: ATmega328P Microcontroller

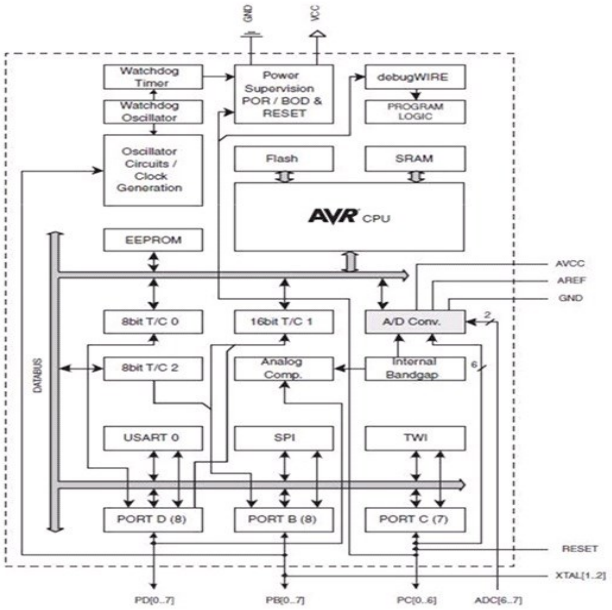

Fig 2.3: ATmega328 Microcontroller Architecture

Reprinted from Datasheet of ATMega328 the internal architecture of the microcontroller is shown in Fig 2.3.3 (02). The central processing unit (CPU) is the brain of the microcontroller which controls the execution of the program. The MCU (Microcontroller unit) consists of

4K/8K bytes of in-system programmable flash with read-while-write capabilities, 256/412/1K bytes EEPROM along with the 512/1K/2K bytes of SRAM. Along with this, the MCU consists of many other features

- 23 general purpose I/O lines and 32general purpose working registers
- flexible timer/counters with compare modes, internal and external interrupts and a serial programmable USART
- A byte-oriented 2-wire serial interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable watch-dog timer with an internal oscillator and 5 software -selectable power saving modes.

The five, software selectable, power saving modes are idle mode, Power-down mode, Power-save mode, ADC Noise Reduction mode and the Standby mode. As mentioned in section 2.1.2, the CPU is the brain of the microcontroller which controls the execution of the program. Therefore the CPU is able to access the memories, perform calculations, control peripherals and handle interrupts. The AVR uses the Harvard architecture with separate memories and buses for program and data to maximize the performance as well as the parallelism. The principle of execution of instructions in the program memory is the single-level pipelining. The concept of pre-fetching the next instruction while executing one instruction enables the instructions to be executed in every clock cycle and the program memory is in the System Reprogrammable Flash memory.

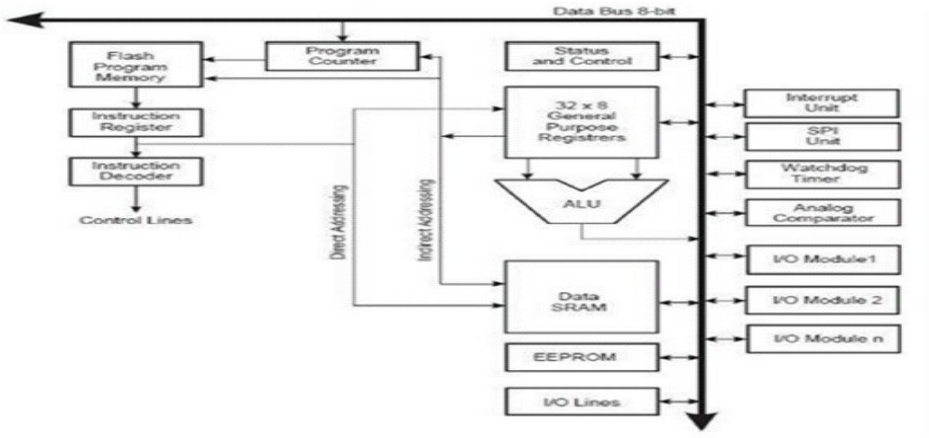

Fig 2.4: Block diagram of the AVR CPU Core architecture

Reprinted from Datasheet of ATMega328, The block diagram of AVR CPU Core architecture is shown in figure 3. The fast-access Register File contains 32 x 8 bit general-

purpose working registers with a single cycle access time which results in a single -cycle ALU operation. The arithmetic and logical operations between the registers or between the constant and a register are supported by the ALU. The status register is updated to reflect information about the result of the operation after an arithmetic operation. The boot program section and the application program section are the two main sections of the program flash memory. Stack stores the return address of the program counter during the interrupts and subroutine calls which is allocated in the general data SRAM. The size of the stack is limited by the total size and usage of the SRAM. The data SRAM is accessible through five different addressing modes supported in the AVR architecture while the stack pointer is read/write accessible in the I/O space. The memory spaces in the AVR architecture are all linear and regular memory maps.

Specifications

Microcontroller: Atmel ATmega328
Operating Voltage (logic level):5 V
Input Voltage (recommended):7-12 V
Input Voltage (limits):6-20 V
Digital I/O Pins: 14 (of which 6 provide PWM output)
Analog Input Pins: 8
DC Current per I/O Pin: 40 mA
Flash Memory: 32 KB (of which 2KB used by boot loader)
SRAM : 2 KB
EEPROM: 1 KB
Clock Speed: 16 MHz
Dimensions: 0.70” x 1.70”

Features

• Automatic reset during program download
• Power OK blue LED
• Green (TX), red (RX) and orange (L) LED
• Auto sensing/switching power input
• Small mini-B USB for programming and serial monitor
• ICSP header for direct program download

• Standard 0.1 spacing DIP (breadboard friendly)

• Manual reset switch

Microcontroller IC ATmega328p

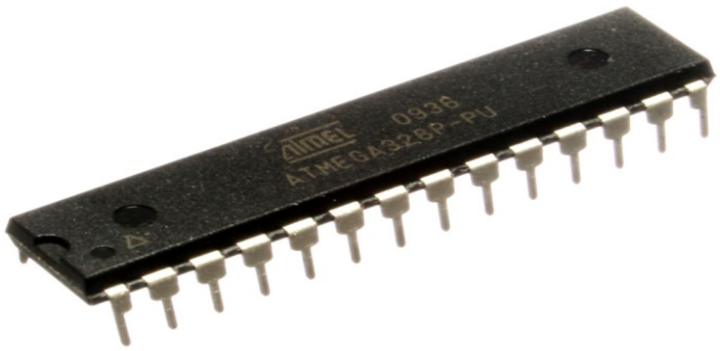

Fig 2.5: Microcontroller IC ATmega 328p.

The high-performance Microchip picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

3.4.1 Power supply, inputs and outputs

Either Arduino is supplied with USB connection or with an external power supply (recommended with 7-12V), outputs are going to have a continuous voltage due to voltage regulators and stabilization capacitors present on the board. These power supply pins are:

- **VIN:** it is the input power supply that will have the same voltage that we are supplying the Arduino with the external power supply
- **5V:** power supply of 5V, this voltage may come from VIN pin anda voltage regulator or from the USB connection.

- **3.3V:** power supply that will provide 3.3V generated by an internal regulator, with a maximum current of 50 mA.
- **GND:** grounding pins

3.4.2 Digital inputs and outputs

Each of the 14 digital pins can be used as an input or output. Besides, each pincan supply or receive a maximum of 40 mA and has a pull-p resistance from 20 to50 kOhm. In addition, some pins have specialized functions such as:

- Pin 0 (RX) and 1 (TX). They are used to receive (RX) and transmit (TX)in TTL serial communication.
- Pin 2 and 3. External interruptions. Pins in charge of interrupting the sequential program established by the user.
- Pin 3, 5, 6, 9, 10 and 11. PWM (pulse width modulation). They form 8output bits with PWM with the function analog Write ().
- Pin 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI(Serial peripheral interface) communication.
- Pin 13. LED. There is a LED connected to the digital pin 13. When thepin value is HIGH, the LED is on, and when the value is LOW, the LED is off.

3.4.3 Analog inputs

Arduino UNO has 6 analogical inputs, from A0 to A5, and each one offers abresolution of 10 bits (1024 states). By default, there is a voltage of 5V, but that rangecan be modified using the pin AREF and using the function analogReference(), where the user introduces the DC external signal he wants to use as reference.

2.4 IR Obstacle Sensor

Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region, mid infrared region and far infrared region.

Fig 2.6: Optical Sensor

The wavelengths of these regions and their applications are shown below.

- Near infrared region — 700 nm to 1400 nm — IR sensors, fiber optic
- Mid infrared region — 1400 nm to 3000 nm — Heat sensing
- Far infrared region — 3000 nm to 1 mm — Thermal imaging

The frequency range of infrared is higher than microwave and lesser than visible light.

For optical sensing and optical communication, photo optics technologies are used in the near infrared region as the light is less complex than RF when implemented as a source of signal. Optical wireless communication is done with IR data transmission for short range applications.

An infrared sensor emits and/or detects infrared radiation to sense its surroundings. The working of any Infrared sensor is governed by three laws: Planck's Radiation law, Stephen – Boltzmann law and Wien's Displacement law.

Planck's law states that "every object emits radiation at a temperature not equal to 0^0K". Stephen – Boltzmann law states that "at all wavelengths, the total energy emitted by a black body is proportional to the fourth power of the absolute temperature". According to Wien's Displacement law, "the radiation curve of a black body for different temperatures will reach its peak at a wavelength inversely proportional to the temperature".

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength can be used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

Optical lenses made of Quartz, Germanium and Silicon are used to focus the infrared radiation. Infrared receivers can be photodiodes, phototransistors etc. some important specifications of infrared receivers are photosensitivity, detectivity and noise equivalent power. Signal processing is done by amplifiers as the output of infrared detector is very small.

3.5 Smoke Sensor

Sensitive material of MQ-5 Smoke sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, convert change of conductivity to correspond output signal of gas concentration.

MQ-5 Smoke sensor has high sensitivity to Methane, Propane and Butane, and could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application.

Fig 2.7: Smoke Sensor Module

Features:

- Indication of the signal output.
- Dual signal output (analog output, and TTL level output)
- TTL output signal is low. (When low output signal light, and can be connected directly to the microcontroller)
- 0 ~ 5V analog output voltage, the higher the concentration, the higher the voltage.
- Smoke , Liquefied petroleum gas, natural gas, city gas, better sensitivity.
- Has a long life and reliable stability

- Fast response and recovery characteristics
- Operating voltage: DC 5 V

Application :

- Domestic Smoke detector
- Industrial Smoke detector
- Portable Smoke detector

3.6 GSM Module

A number of signal detecting devices are available in the market. These devices include:

- Ethernet Module
- WIFI Module
- Bluetooth Module
- SIM / GSM Module

All of the devices have their own advantages and disadvantages but we will be targeting that particular device which best suits our requirement. There are certain features that should be considered when choosing the GSM module for use. The features are

- Long Distance Coverage
- Function description
  - Supply voltage: 3.5V - 4.2V
  - Power consumption: sleep mode < 2.0mA, idle mode < 7.0mA
  - GSM transmission (avg): 350 mA
  - GSM transmission (peek): 2000mA
  - Module size: 25 x 23cm
  - SIM card socket: microSIM
  - Antenna connector: IPX
  - Status signaling: LED
  - Working temperature range: -40 do + 85 ° C
- Has high-performance
- Low Cost

This GSM module can easily achieve data. Its operating frequency is among the 900/1800/1900 MHz frequency band. In SIM800L signal transmit time of different devices stands at a 0.5 seconds interval so that the work load of SIM chip can be reduced substantially and more sleeping time can be saved for GSM module. This module is set with serial interface, which is easy to use and simplifies the overall design.

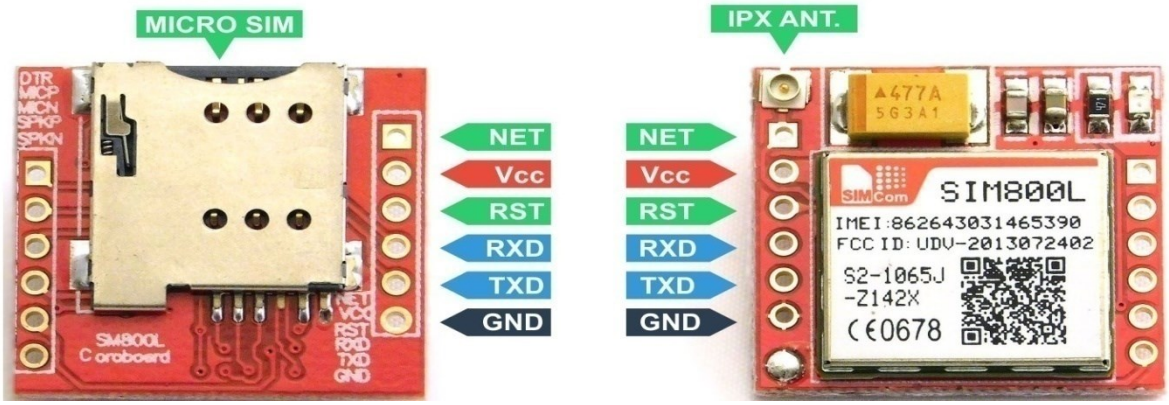

Fig 2.8: SIM800L GSM Module

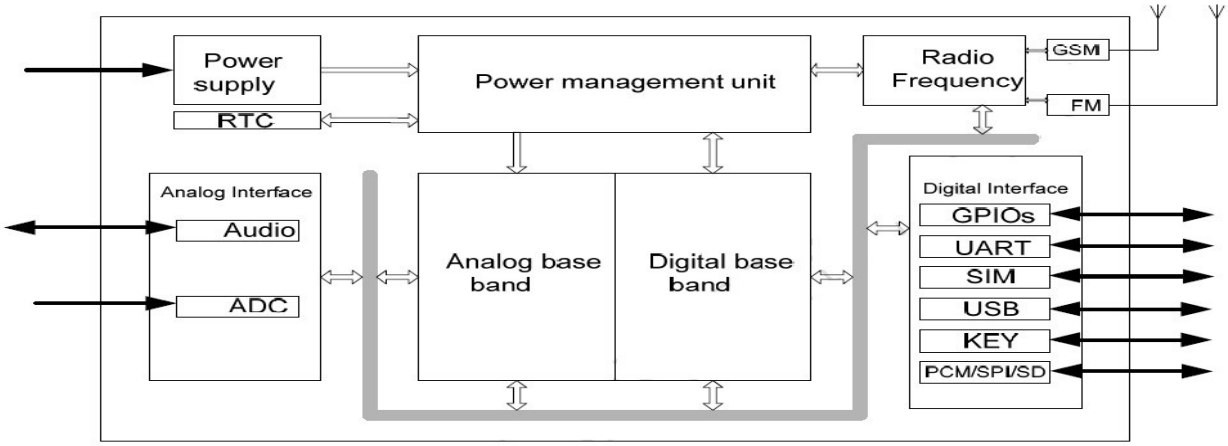

Fig 2.9**:** Schematic Diagram of SIM800L GSM Module

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

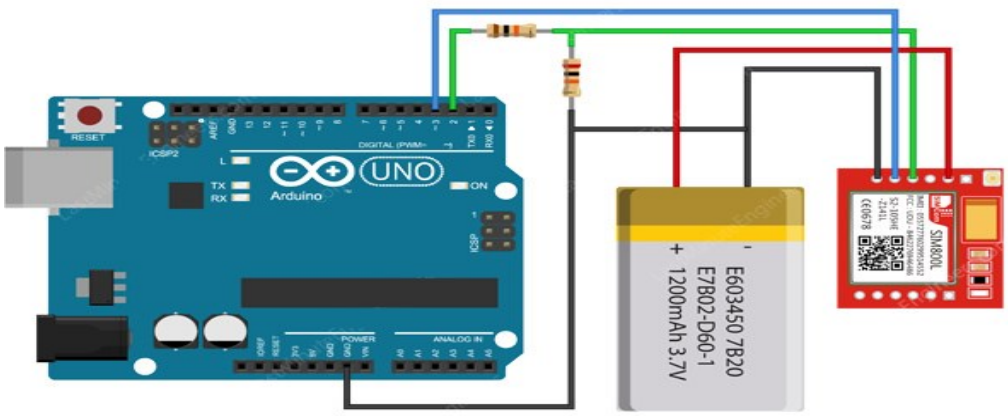

Fig 2.10: Circuit Diagram for Arduino and GSM module Connection.

2.5 Optical Dust Sensor

Sharp's GP2Y1010AU0F is an optical air quality sensor, designed to sense dust particles. An infrared emitting diode and a phototransistor are diagonally arranged into this device, to

allow it to detect the reflected light of dust in air. It is especially effective in detecting very fine particles like cigarette smoke, and is commonly used in air purifier systems.

Specifications:

- Low Current Consumption (MAX: 20mA)
- Typical Operating Voltage: 4.5V to 5.5V (MAX: 7V)
- The presence of dust can be detected by the photometry of only one pulse
- Enable to distinguish smoke from house dust
- Dimensions: 1.81 x 1.18 x 0.69" (46.0 x 30.0 x 17.6mm)

Fig 2.11: Optical Dust Sensor

Table 2.5: Connection of Dust Sensor

Pin	**Function**
V-LED	Connect to 5.0V with resistor of 150Ω in between.
LED-GND	Connect to GND.
LED	Connect to any digital pin of Arduino Board.
S-GND	Connect to GND.
Vo	Connect to any analog pin of Arduino Board.
Vcc	Connect to 5.0V.

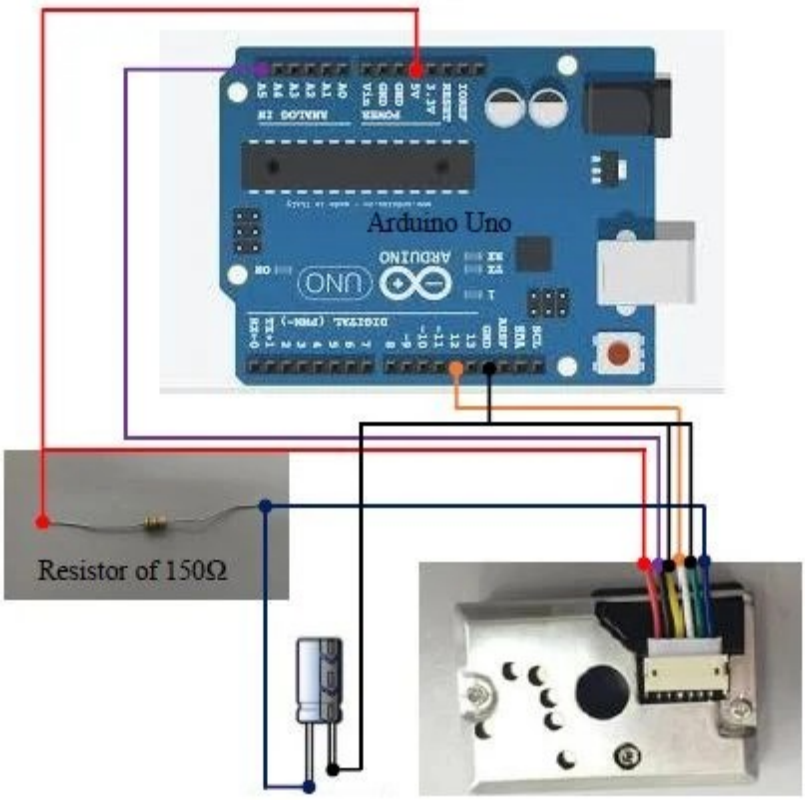

Fig 2.12: Arduino and Dust sensor connection

2.4 Communication system

A number of signal detecting devices are available in the market. These devices include:

- Ethernet Module
- Wi-Fi Module
- Bluetooth Module

All of the devices have their own advantages and disadvantages but we will be targeting that particular device which best suits our requirement. There are certain features that should be considered when choosing the Bluetooth module for use. The features are

- Wireless transceiver
- Function description
    - Can work at the low voltage (3.1V~4.2V).
    - The current in communication is 8mA.
    - This module can be used in the SMD.
    - It's made through RoHS process.
    - The board PIN is half hole size.

- Has a 2.4GHz digital wireless transceiver.
- Small (27mm×13mm×2mm)
- Peripherals circuit is simple.
- It's at the Bluetooth class 2 power level.

➢ Low power consumption

➢ Has high-performance wireless transceiver system

➢ Low Cost

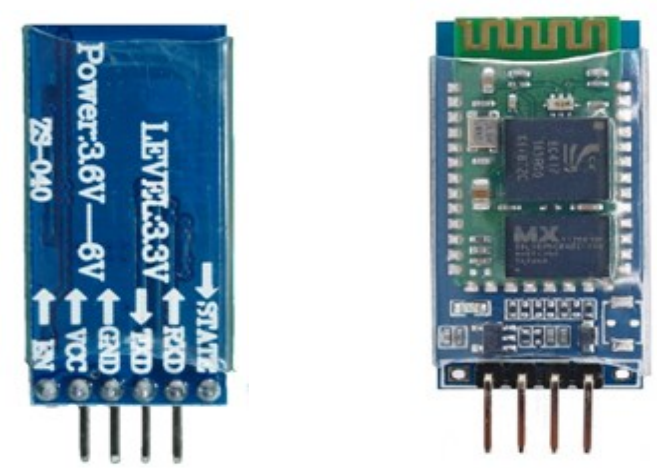

Fig 2.13: HC-06 Bluetooth Module

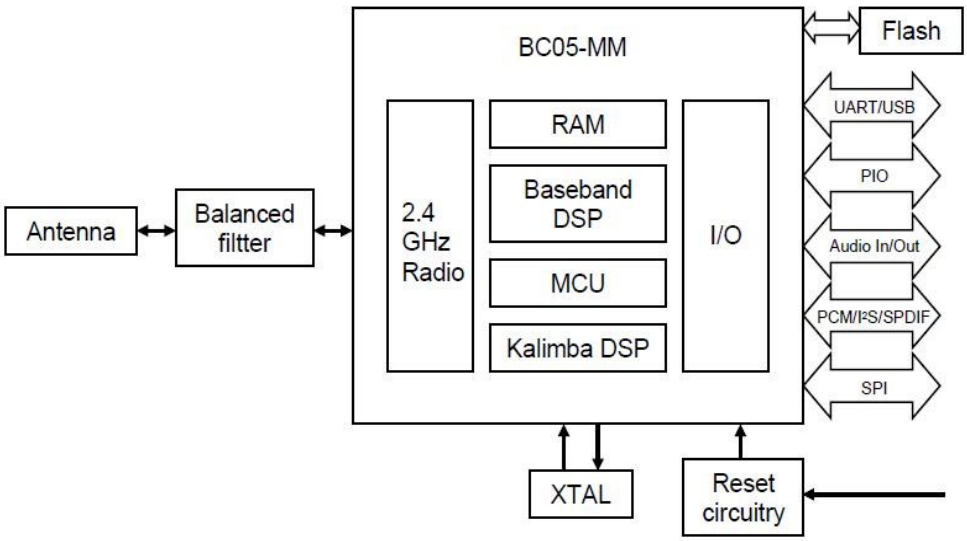

Fig: 2.14: Schematic Diagram of Bluetooth Module

This Bluetooth module can easily achieve serial wireless data transmission. Its operating frequency is among the 2.4GHz frequency band. In Bluetooth 2.0, signal transmit time of different devices stands at a 0.5 seconds interval so that the workload of bluetooth chip can be reduced substantially and more sleeping time can be saved for bluetooth. This module is set with serial interface, which is easy to use and simplifies the overall design.

It need to download a bluetooth debugging assistant from play store for mobile phone to connect phone with the Bluetooth HC-06 module, after download and install the package on mobile it needs to enable Bluetooth and open app bye click connect it appear hc-06 and click. A window will pop up asking for a PIN, the password is: 1234, click ok to connect by thus the mobile is able to send data to controller.

2.5 Transformer

A transformer is a passive electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described the induced voltage effect in any coil due to changing magnetic flux encircled by the coil.

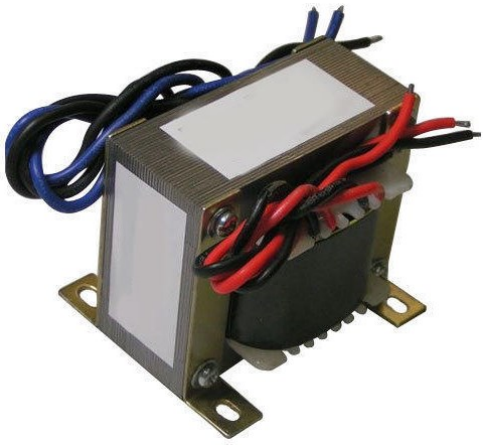

Fig 2.15: step down transformer.

Transformers are used for increasing or decreasing the alternating voltages in electric power applications, and for coupling the stages of signal processing circuits.

Basically, transformer are two types.

1. Step up transformer

2. Step down transformer

We have used step down transformer as required for our project. Which is 220v to 12v 3000mA step down transformer.

2.6 Diode

A diode is a specialized electronic component with two electrodes called the anode and the cathode. Most diodes are made with semiconductor materials such as silicon, germanium, or selenium. Some diodes are comprised of metal electrodes in a chamber evacuated or filled with a pure elemental gas at low pressure. Here we used converted AC into DC using a bridge-wave rectifier that consists of four diodes

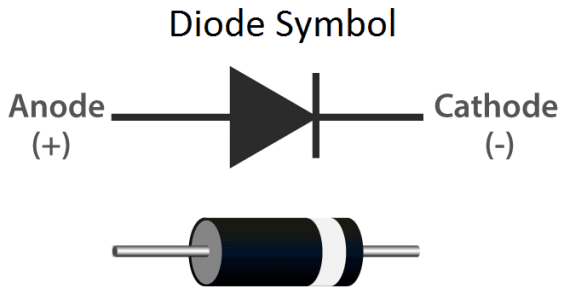

Fig 2.16: Diode.

2.7 Full wave rectifier

A Full wave rectifier is a circuit arrangement which makes use of both half cycles of input alternating current (AC) and converts them to direct current (DC). This arrangement is known as a Bridge Rectifier. It uses the entire AC wave (Both positive and negative sections). Each diode uses 0.7v when conducting and there are always two diodes conducting.

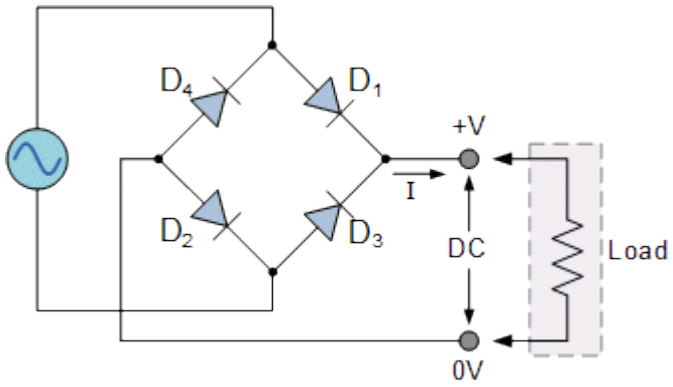

Fig 2.17: Full wave rectifier is a circuit diagram

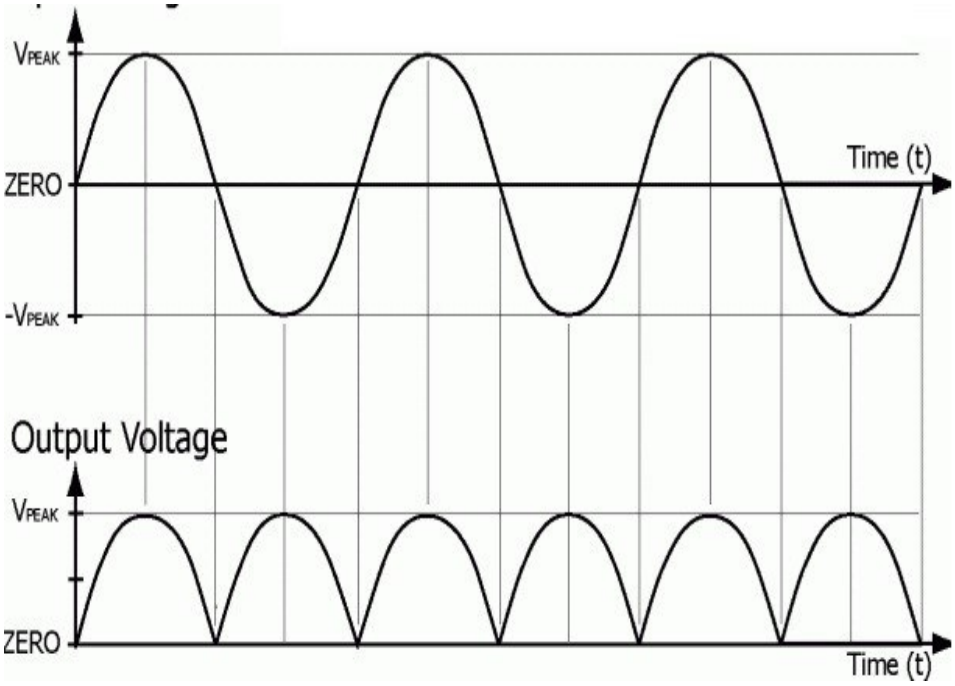

Fig 2.18: Full wave rectifier wave from

2.8 Buck Converter Module

A buck converter (step-down converter) is a DC-to-DC power converter, which steps down voltage from its input to its output. The basic operation of the buck converter has the current in an inductor controlled by two switches. In the idealised converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off, and the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle

Fig 2.19: DC-DC Buck Converter

CHAPTER III

DESIGN & FABRICATION

3.1 Introduction

The implementation of the project is done after simulating the schematic circuit properly. In this chapter, the function of every section in the circuit is investigated with coding and also with physical outlook. To give a proper and clear concept about the operation the entire system is separated into different parts. In this chapter also discusses the working process of the circuits used in various parts with following chart, block diagram and corresponding designed diagram.

3.2 Idea and Methodology

SMART DUSTBIN USING ARDUINO is an gsm based project. Here we are using arduino for code execution, for sensing we used IR sensor. It will bring drastic changes in tern of cleanliness with the help of technology. Everything is getting with smart technology for the betterment of human being. So this help in maintaining the environment clean with the help of technology. It is a sensor based dustbin so it would be easy to access/use for any age group. Our aim is also to make it cost effective so that many numbers of people can get the benefit from this. And it should be usable to anyone and helpful for them.

Methodology:

In this work, we have used GSM Module, IR sensors, Arduino microcontroller and Gas sensor. When the dustbin is 100 percent filled, the warning message is sent to authorized person with the help GSM Module. It not only sense the extent to which the dustbin is filled but also senses the environment.

3.3 Block and Circuit Diagram

This project is basically based on both the arduino nano and IR obstacle sensor. In this project we control our microcontroller by input of sensor. Bin contains three sensors to detect waste. In our project the IR sensors are the input of microcontroller and GSM and Indicator are the output of the microcontroller.

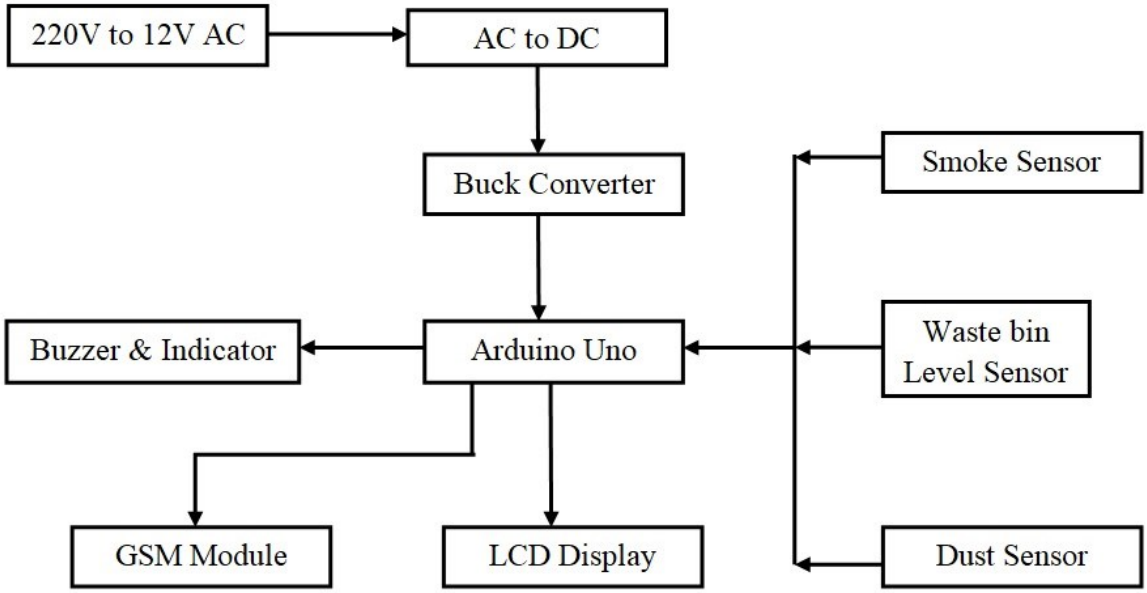

Fig 3.1: Block diagram of project

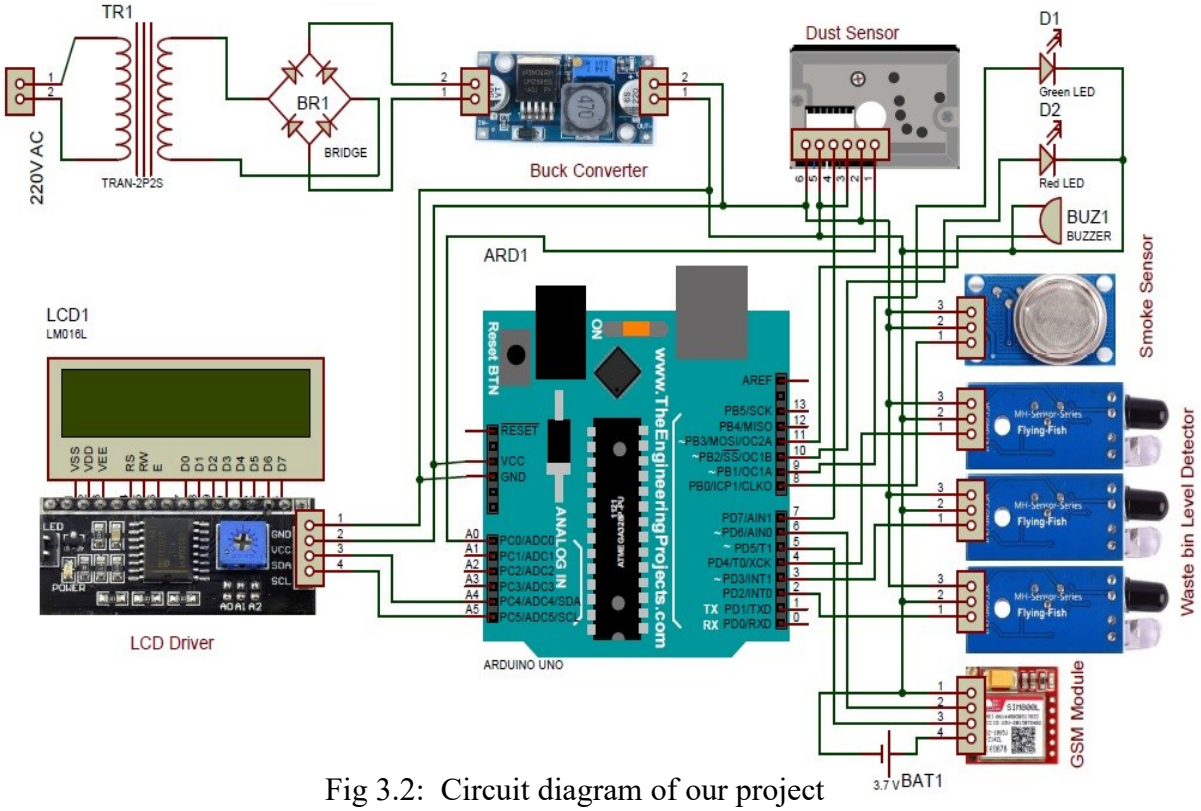

Fig 3.2: Circuit diagram of our project

Our project is basically microcontroller based. We can see how many sensor and indicator lights are connected to microcontroller. There was a transformer, bridge rectifier and buck converter to ensure power source of the project.

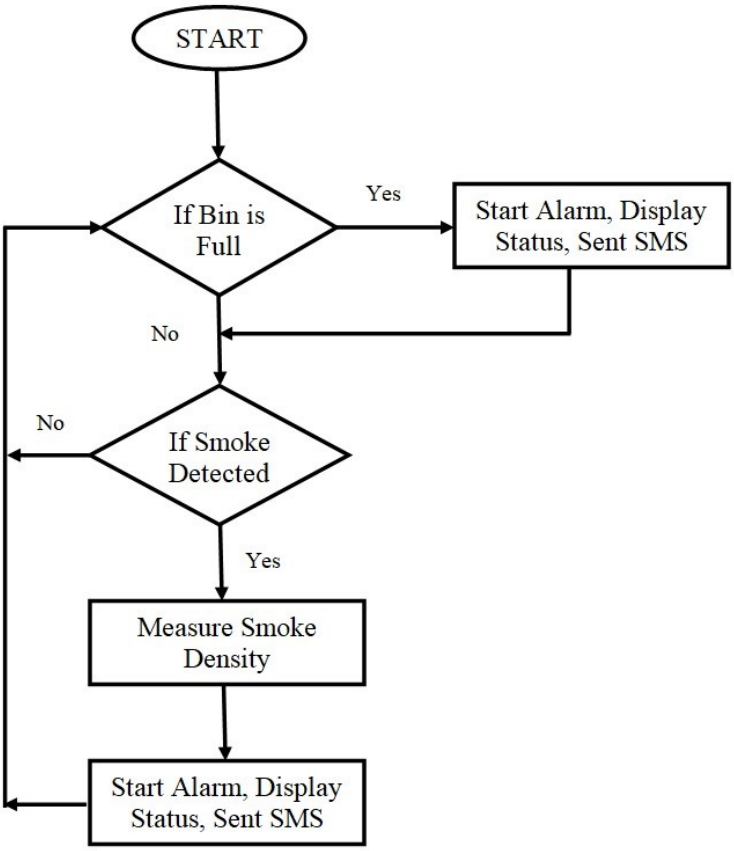

Fig 3.3: Flowchart of the project

3.4 Hardware Design

The project will help peoples who want to do something or make something with the help of Arduino. The project is designed in two parts, these are the software part and another one is the hardware designing. In this project we have used some basic components like IR (Inferred Ray) sensor as a density detector, LED and Microcontroller.

As a microcontroller we have used Arduino Nano Board here, which is perfect for building a new project or doing anything in the field of robotics or something that is smart to use. To use an Arduino we have to use the Arduino Software which free for all users and can be downloaded from http://www.arduino.cc. The Arduino program is based on C/C++ Programming language. And a huge collection of example is provided in their websites which are also free for all. And the software is one of the easiest software to use.

The hardware design of this project is very simple and efficient also. First of all we have designed the IR sensor. The IR sensor generally works as counter. And counter passes a signal after a significant number of gesture or movement is detected. Then we have designed

the whole circuit in the breadboard by the aid of microcontroller. Arduino Nano plank is the perfect choice to make the project more efficient and easy also.

In this control system we have used some basic components to design this circuit. These components are found easily at any electronics shops or markets. For counting we have made a light sensor with some basic components. The output of this circuit is connected to the Yellow, Green and Red lights of Traffic Signal.

The system was designed to be simple and the experimental setup included the prototype model of traffic lights showing lights from the four sides of a junction. The model included traffic lights each on the four sides; depicting red, yellow and green colors. These are designed using colored bulbs of red, yellow and green color. The input signal was given through four different switches to control the timings of four directions.

3.5 Working with Arduino Software

First download and install the Arduino IDE for Mac, Linux or Windows to arduino.cc. Windows users also necessity to install a driver. Gather your plank via USB, start the Arduino application and elect Arduino Uno to the tools to plank menu. Bare the design table. Bare Examples: 01. Basics: Blink. Click the toolbar button to upload it to your plank.

The Integrated Development Environment (IDE):

Microcontroller needs software for programming. The Arduino plank has its own integrated development environment (IDE). It is gratis and anybody can download it from its official. That gives Arduino Plank to reach much users and it also helps it to get.

IDE Parts:

a) Compile: Before program “code” can be sent to the board, it needs to be converted into instructions that the board understands. This process is called Compiling.

b) Stop: This stops the compilation process.

c) Create new Sketch: This opens a new window to create news ketch.

d) Open Existing Sketch: This loads a sketch from a file on our computer.

e) Save Sketch: This saves the changes to the sketch.

f) Upload to Board: This compiles and then transmits over the USB cable to our board.

g) Serial Monitor: Until this point when our programs (sketches) didn't work, we just pulled out our hair and tried harder.

h) Tab Button: This lets you create multiple files in your sketch. This is for more advanced programming than we will do in this class.

i) Sketch Editor: This is where write or edit sketches

j) Text Console: This shows you what the IDE is currently doing and is also where error messages display if make a mistake in typing program.

k) Line Number: This shows what line number your cursor is on.

The smart microcontroller unit named as Arduino nano can be programmed with the Arduino software. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino Uno from the Tools , Board menu (according to the microcontroller on your board).The IC used named as ATmega328 on the Arduino Uno comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer.

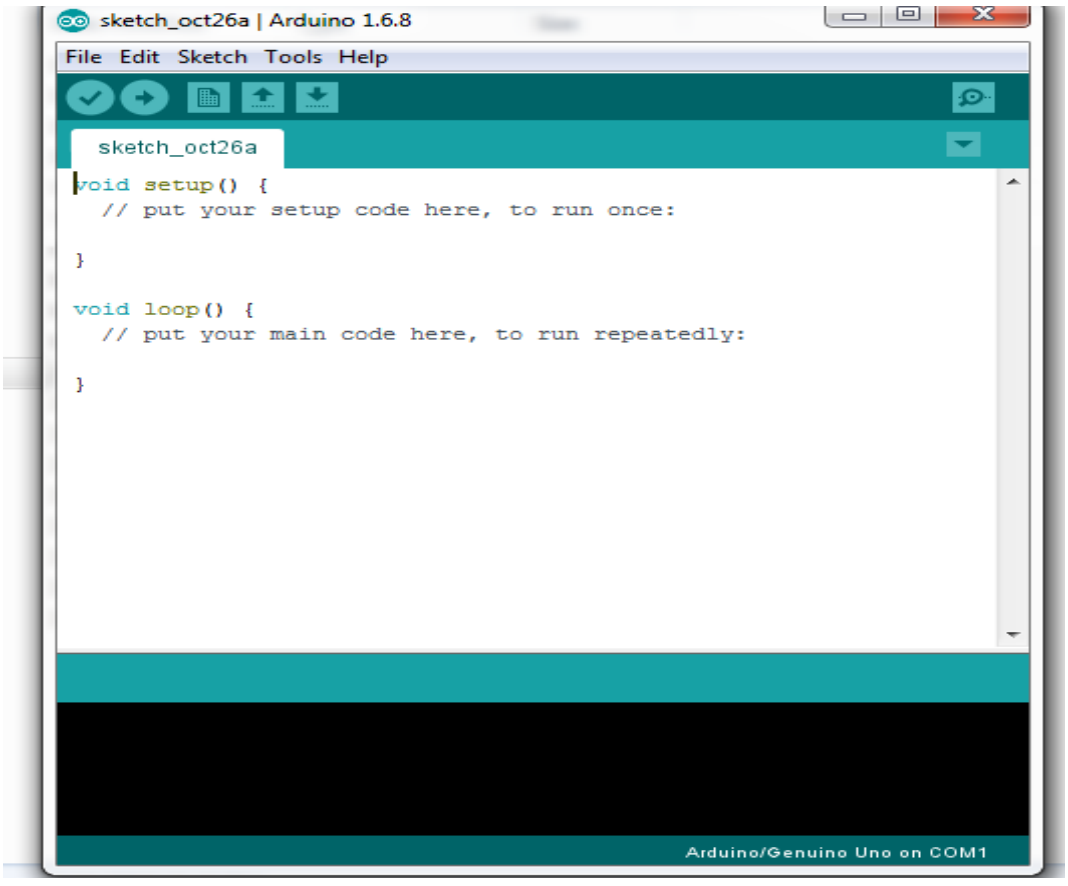

Fig 3.4: Programming platform for ARDUINO

Programming software of this line follower is known as ARDUINO-1.6.8. This is open source programming platform**.** The open-source ARDUINO environment makes it easy to write code and upload it to the input/output board. Here we use ARDUINO-1.6.8 platform.

To configure software, we have to use ARDUINO -1.6.8 named arduino.exe

To configure this programmer with computer we need a USB cable then check serial port and select the programmer from Aruino-1.6.8 platform such as,

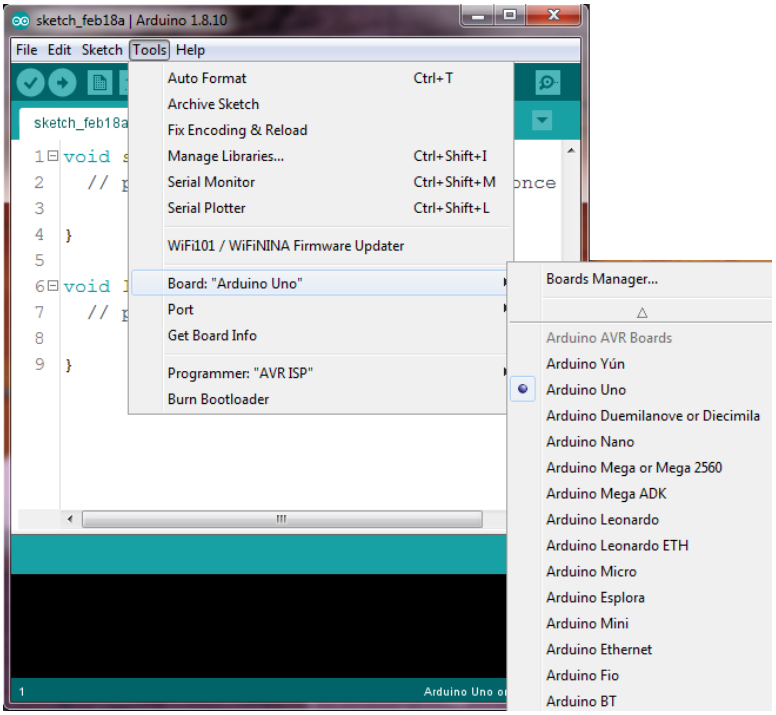

Figure 3.5: IDE configuration for ARDUINO UNO Programmer

Serial communication

It is used for the communication between Arduino and a computer or other devices. Every Arduino board has at least one serial port. This ports communicates thanks to the digital pins 0 (RX) and 1 (TX), and with the computer thanks to the USB connection.

Serial.begin(speed)

It establishes the speed of data in bits per second (bauds) for the transmission of data in serial communication.

Serial.read()

It reads the data from the serial port.

Serial.print(val,[format]) It prints the data to the serial port as ASCII text

Serial.println(val,[format])

It prints the data to the serial port as ASCII text but it jumps to a new line. *Serial.available()* It gives back the number of available bytes to be read by the serial port. It refers to data that has already been received and is available in the buffer of the port.

3.6 Project picture

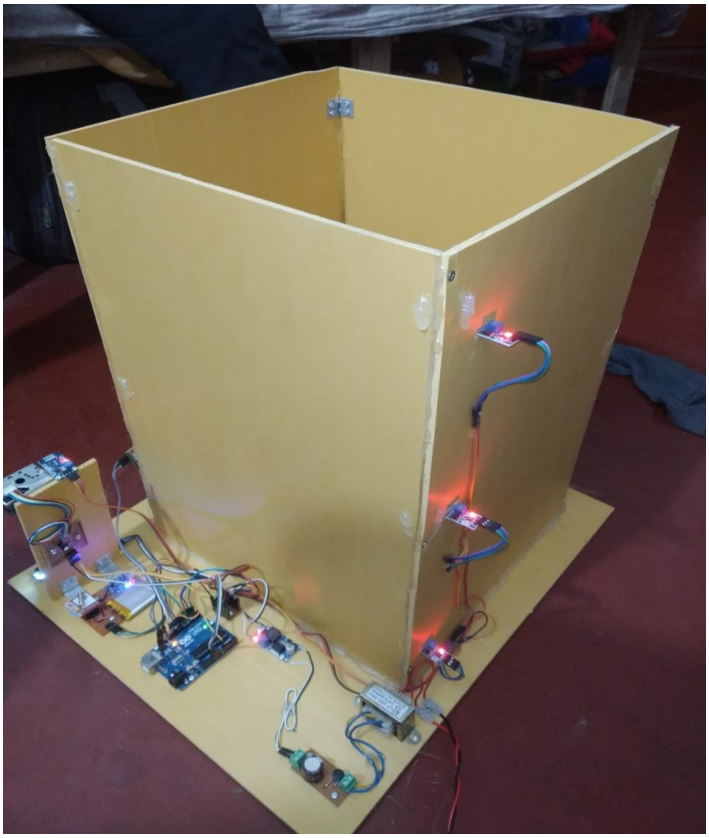

Fig 3.6: Project picture

3.7 Summary

This chapter mainly focused on implementation and the design of the system with a block diagram. In this chapter simulation is divided into some parts and operation of each part is discussed briefly. The output of our project shown in that chapter. We also discussed about the research and methodology of our whole project.

CHAPTER IV

RESULT & DISCUSSION

4.1 Introduction

In this chapter, we will discuss the outputs and the advantages of our project. There is a variation of coding and variation of using the software in this project. We will also discuss the time delay and efficiency and limitations of this project.

4.2 Results

In the count testing unit we have found that it works properly. Still the counter sometimes provides wrong results because of IR sensors sometimes may absorb normal light. Here first of all we tested the counter only with an LED, after finding that the counter works properly then we added that with the Arduino nano Board.

After testing all the components we have combined all the components together as like as the circuit design diagram and found that the application works correctly.

- Display bin status on LCD
- Display Smoke Status
- Display Dust density
- Sent sms when bin is full
- Sent sms when smoke detected

4.3 Advantage

- Very simple circuit.
- Helps monitor garbage levels
- Uses very small amount of electricity.
- Ultimately helps in better planning of garbage pickups.
- Can help in reducing overflowing bins.
- Reduces trips to areas where the bins still have a lot of capacity.

4.4 Limitations of This Project

- Cannot detect liquid waste.
- Only detects the top of the garbage level. It wouldn't realize if there is space left.
- GSM module needs a 3.7V source.

4.5 Costing

Costing is always a vital issue to make any project. Price of electronics is not stable for a developing country like Bangladesh, because Bangladesh never produces electronics parts but import from other developed country and during import price depends upon the stock of foreign currency. Average price of parts used in this project is given bellow,

Table 4.1: Price list of hardware used at Automation System

Name	**Quantity**	**Unit Price**	**Total Price**
Arduinoo Uno	1	700	700
Buck converter	1	120	120
Transformer	1	300	300
IR Sensor	3	100	300
Smoke Sensor	1	90	90
Dust Sensor	1	800	800
GSM Module	1	450	450
Bridge Rectifier	1	20	20
3.7 V Battery	1	120	120
Battery Charger	1	50	50
LCD Display	1	320	320
Vero Board	2	25	50

Electric Cable	1	30	30
Plug	1	25	25
Jumper wire	1 set	250	250
Screw and Glue	1 set	150	150
PVC Board	1	800	800
		TOTAL COST	**4,575/- Taka**

4.5 Discussion

Here we are going to make an evolution changes toward cleanliness. The combination of intelligent waste monitoring and trash compaction technologies, smart dustbins are better and shoulders above traditional garbage dustbin. It is equipped with smart devices like sensor Arduinoetc. For social it will help toward health and hygiene, for business for we try to make it affordable to many as many possible. So that normal people to rich people can take benefit from it. Believe this will bring something changes in term of cleanliness as well technology.

The proposed smart waste management system is mainly developed to make the Dhaka city a better place to live in; however, it can be integrated with other cities' waste management plans. As the existing garbage management technique of Dhaka city is not automated or software-based, the government can apply the proposed garbage management system. Gradually and progressively, the government can take necessary steps to improve the system. By introducing the proposed garbage management system, the government can take the first step to make Dhaka a better place to live. South Korea has been using an organized garbage management system called Jongnyangie. It is an embodied waste management system for the effective collection of waste in South Korea. Wastes are collected differently as food waste, general waste, recyclable items, or bulky items. Different waste bins are used for different types of waste. The Shanghai MSW management regulation was published in 2019. They have found the MSW classification system is an effective way to solve the waste management system. MSW classification policy divides the wastes into four types. They are recyclable, hazardous, wet, and dry waste. All four types of wastes are collected separately in

different waste bins. With rapid urbanization, India is facing a massive waste management challenge. Over 377 million urban people live in 7935 towns and cities. They produce 62 million tons of municipal solid waste per annum. The government of India is working hard to solve their waste management problem. Ministry of Environment and Forests has introduced some waste management rules. Wastes are separated into domestic hazardous, wet, and dry type garbage. No person should throw, burn, or bury waste. The concept of partnership in Swachh Bharat has been introduced. Nowadays, everything is becoming technology-based. Therefore, by using GSM based waste bin and environment monitoring system the efficiency of the existing waste management can be increased many times.

CHAPTER V

CONCLUSION AND FUTURE WORKS

5.1 Conclusion

Population explosion, increasing industrialization, and rapid urbanization have to lead the world's environment into complete chaos. Due to the increased level of waste generation, gradually, it's getting difficult to survive in the densely populated urban area. Traditional waste management systems are a complete failure to handle such a large amount of garbage. The application of technology and its sophisticated service in every sector have made our life quite easy. It is high time to apply a technology-based approach to handle this increasing level of waste. A lot of research is going on regarding the proper waste management system. In this paper, we have proposed an IoT based integrated waste management system, which is a completely automated system capable of sharing information. The proposed system provides an identification system that helps to identify personnel in front of the bin. It also helps to control the automated lid for certain conditions. An ultrasonic sensor placed inside the bin helps in the continuous monitoring of the garbage level, and the value is shown on the LCD placed in front of the bin. When the garbage bin is filled up GSM module helps to inform the corresponding authority to collect the garbage. An Arduino board is used to control the whole automated system. That is how the proposed system provides efficient management of waste, eliminating spillover of waste, and avoiding the spread of diseases. The success of the proposed waste management system lies in the welfare of human beings as it helps to ensure a worthy urban life.

We built an efficient garbage monitoring system which can be used to monitor the level of garbage in the dump. This data can be further used to plan garbage collection trips more efficiently, ultimately reducing overflowing bins and helping have better public sanitation.

5.2 Future works

Automatic Garbage Fill Alerting system helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or cow enters inside or near the dustbin. Also some birds are also trying to take out garbage from dustbin. This project can avoid such situations. And the message can be sent directly to the cleaning vehicle instead of the

contractor’s office. Apart from this, differentiation can be made between dry trash bin and wet trash bin collecting plastic dry waste and biodegradable waste respectively. To implement this methane and smell sensors can be used. This helps in distinguishing the waste at the source and hence reducing the requirement of manpower. To enhance it further, an automated system can be developed which is able to pick up waste in and around the bin, segregate them and put them in respective bins.

In our present scope we are using manual decision making approach to select next dustbin to collect, like we are first checking on the dump levels at each dustbin and then proceeding to its location. So, the decision is made from the truck driver. But we will consider implementing a learning algorithm to automatically check the dump levels and make decisions for us like which way will be optimal for us. Furthermore, we will work for power supply solution using solar panel, developing waste amount sensing system for liquid waste.

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APPENDIX A

PROGRAM CODE

```
#include <Wire.h>
#include<SoftwareSerial.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x3F,16,2);
SoftwareSerial mySerial(5,6);
int measurePin = A0;
int ledPower = 7;
int Sensor1 = 4;//level sensor
int Sensor2 = 3;
int Sensor3 = 2;
int Sensor4=8;  //Smoke
int green=9;
int red=10;
int buzzer=11;

String number ="01789833616";


void setup(){
 Serial.begin(9600);
 mySerial.begin(9600);
 lcd.init();
 lcd.backlight();
  pinMode(ledPower,OUTPUT);
 pinMode(green,OUTPUT);
 pinMode(red,OUTPUT);
 pinMode(buzzer,OUTPUT);
 pinMode(Sensor1, INPUT_PULLUP);
 pinMode(Sensor2, INPUT_PULLUP);
 pinMode(Sensor3, INPUT_PULLUP);
 pinMode(Sensor4, INPUT_PULLUP);
analogWrite(green,10);
 digitalWrite(red,LOW);
 digitalWrite(buzzer,LOW) ;
 }

void loop(){




int lowlevel = digitalRead(Sensor1);
int midlevel = digitalRead(Sensor2);
```

```
int hihglevel = digitalRead(Sensor3);
int smokelevel = digitalRead(Sensor4);
digitalWrite(ledPower,LOW);


if (lowlevel==1 && midlevel==1 && hihglevel==1 )
{
 Serial.println(" Empty ");
 lcd.setCursor(0,0);
 lcd.print("Bin Status    ");
 lcd.setCursor(0,1);
 lcd.print(" Empty       ");
}


if (lowlevel==0)
{
 Serial.println(" Low Level ");
 lcd.setCursor(0,0);
 lcd.print("Bin Status    ");
 lcd.setCursor(0,1);
 lcd.print(" Low Level     ");

 }


if (lowlevel==0 && midlevel==0)
{
 Serial.println(" Mid Lavel ");

 lcd.setCursor(0,0);
 lcd.print("Bin Status    ");
 lcd.setCursor(0,1);
 lcd.print(" Mid Level       ");

 }


if (lowlevel==0 && midlevel==0 && hihglevel==0 )
{
 Serial.println(" Bin Full sms");
 lcd.setCursor(0,0);
 lcd.print("Bin Status   ");
 lcd.setCursor(0,1);
 lcd.print(" Full      ");
```

```
 mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number + "\"\r");
 delay(50);
 mySerial.print("Bin Full");
 delay(500);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);

 }


if (smokelevel==0  || hihglevel==0 )
{
 digitalWrite(green,LOW);
 analogWrite(red,30);
 digitalWrite(buzzer,HIGH);
}


if (smokelevel==1  &&  hihglevel==1)
{
analogWrite(green,10);
 digitalWrite(red,LOW);
 digitalWrite(buzzer,LOW);
}

if (smokelevel==1 )
{
 Serial.println(" Smoke Status ");
 lcd.setCursor(0,0);
 lcd.print(" Smoke Status ");
 lcd.setCursor(0,1);
 lcd.print(" Safe       ");
}




if (smokelevel==0  )
{
 Serial.println(" Smoke Status ");
 lcd.setCursor(0,0);
 lcd.print(" Smoke Status ");
 lcd.setCursor(0,1);
 lcd.print(" Detected      ");
```

```
 mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number + "\"\r"); //Mobile phone number to send
message
 delay(50);
 mySerial.println("Smoke Detected ");
 delay(50);
 mySerial.print("Smoke Density ");
 delay(50);
 mySerial.print(dustDensity);
  delay(50);
 mySerial.print(" mg/m3,");
  delay(50);
 mySerial.print("  Please take action ");
 delay(500);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);
}

}
```