



# SMART DUSTBIN

## A PROJECT REPORT

*Submitted by*

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**COIMBATORE - 641 049**

**(An Autonomous Institution Affiliated to Anna University, Chennai)**

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# **KUMARAGURU COLLEGE OF TECHNOLOGY**

**COIMBATORE – 641 049**

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## **BONAFIDE CERTIFICATE**

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## **ABSTRACT:**

As people are getting smarter so are the things. While the thought comes up for Smart cities there is a requirement for Smart waste management. The idea of Smart Dustbin is for the Smart buildings, Colleges, Hospitals and Bus stands. The Smart Dustbin thus thought is an improvement of normal dustbin by elevating it to be smart using sensors and logics. Smart dustbins is a new idea of implementation which makes a normal dustbin smart using ultrasonic sensors for garbage level detection and sending message to the user updating the status of the bin using GSM modem and ESP 8266 module .The system consists of aurdino and various sensors to determine the level of garbage. This system is an improvement of the existing system with various improvements such as uploading the data to the cloud with the help of a wi-fi module.

## TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
1	ABSTRACT	4
	LIST OF FIGURES	
2	INTRODUCTION	8
3	EXISTING SYSTEM	9
4	PROPOSED SYSTEM	10
5	HARDWARE REQUIREMENTS	10
5.1	Ultrasonic sensors	10
5.2	GSM Modem(SM 900A)	13
5.2.1	Features	14
5.2.2	Indicator LED and Buttons	15
5.3.1	Aurdino Board	15
5.3.2	Why Arduino UNO is used?	20
5.4	Gas Sensors	21
5.4.1	Types	22
5.4.2	Catalytic Bead (Pellistor):	23
5.4.3	Photoionization	24
5.4.4	Infrared point	25
5.4.5	Infrared imaging	25
5.4.6	Semiconductor	26
5.4.7	Ultrasonic	26
5.4.8	Holographic	27
5.4.9	Calibration	27
5.5	PIR Sensor	28
5.5.1	Operating principles	29

5.5.2	Construction	29
5.5.3	Operation	31
5.5.5	Differential detection	31
5.5.6	Product design	32
5.5.7	PIR motion sensor design	32
5.5.8	Focusing	33
5.5.9	Placement	33
5.5.10	PIR remote-based thermometer	34
5.6	Wi-Fi Module	35
5.6.1	Features	37
5.7	Level converter	38
5.8	Buzzer	39
<b>6.</b>	<b>SOFTWARE DESCRIPTION</b>	<b>40</b>
6.1	Arduino IDE	40
6.1.1	Writing Sketches	42
6.2	IOT Platform(Ubidots)	44
<b>7</b>	<b>BLOCK DIAGRAM</b>	<b>45</b>
<b>8</b>	<b>WORKING</b>	<b>46</b>
<b>9</b>	<b>WORKING MODEL</b>	<b>47</b>
<b>10</b>	<b>CONCLUSION</b>	<b>48</b>
<b>11</b>	<b>REFERENCE</b>	<b>41</b>

## **LIST OF FIGURES**

<b>FIGURE NO</b>	<b>TITLE</b>	<b>PAGE</b>
5.1.1	Ultrasonic sensor	13
5.3.1	Arduino UNO	17
5.3.2	Arduino	18
5.4.1	Calibration	28
5.5.2	PIR sensor	30
5.5.3	PIR based occupancy sensor	30
5.5.6	PIR product design	32
5.5.10	PIR remote-based thermometer	35
5.7.1	Level converter	39
5.8.1	Buzzer	39
6.1.1	Writing sketches	43
9	Working model	47

## **2.Introduction:**

In this fast paced world it is difficult to monitor the level of garbage in the dustbins.For this we have proposed the smartdustbin system.This system consists of PIR sensor to sense garbage that has been dropped outside the dustbin.The system also consists of IOT capabilities

The Internet of Things, also called The Internet of Objects, refers to a wireless network between objects. Usually the network will be wireless and selfconfiguring, such as household appliances. Internet of Things refers to the concept that the Internet is no longer just a global network for people to communicate with one another using computers, but it is also a platform for devices to communicate electronically with the world around them.

The Internet of Things (IOT) is the network of physical objects— devices, vehicles, buildings and other items which are embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

### **3.Existing system:**

In 'smart garbage management system' system, the level of garbage in the dustbins is detected with the help of Sensor systems, and communicated to the authorized control room through GSM system. Microcontroller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently. Here in this system, Infrared (IR) sensor is used for garbage level detection. IR sensor radiates light which is invisible to the human eye because it is at infrared wavelengths, but it can be detected by electronic devices. GSM module is used for communication purpose, to send message to the control room when the container is full. Arduino board is used to interface the sensor and GSM module. The IR sensor arrangement is act as level detector .The output of level detector is given to the microcontroller. The AT commands are used to facilitate the messaging service through the GSM Module. This program is burned in the microcontroller with the help of Arduino software (IDE). These messages consist of information of garbage levels of respective dustbins. Depending on the information sent to control room, the authority informs the concern person of the respective area about garbage level. Then the concerned person makes sure that the garbage of that particular area is collected by sending the cleaning vehicles.

## **4.Proposed system:**

Smart dustbins is a new idea of implementation which makes a normal dustbin smart using sensors for garbage level detection and sending message to the user updating the status of the bin. As soon as the dustbin is full it moves in the predefined path to reach the larger container with the help of motors and wheels. The system design and implementation are explained in detail in further in the paper.

## **5.Hardware Requirements:**

The hardware requirements for the system are as follows.

### **5.1Ultrasonic Sensors:**

Knowing the distance you are away from an object is very important in robotics or even for tasks just as simple as driving. Ultrasonic sensor As shown in the Fig 1. Ultrasonic distance sensors use a sound transmitter and a receiver. An ultrasonic distance sensor creates an ultrasonic pulse, often called a "ping", and then listens for reflections (echo) of the pulse. This pulse of sound is generally created electronically using a sonar projector consisting of a signal generator, power amplifier and electro-acoustic transducer/array. A beam former is usually employed to concentrate the acoustic power into a beam, which may be swept to cover the required search angles To measure the distance to an object, the time from transmission of a pulse to reception is measured and converted into a range by knowing the speed of

sound. This signal together with noise is then passed through various forms of signal processing, which for simple sensors may be just energy measurement. It is then presented to some form of decision device that calls the output either the required signal or noise. This decision device may be an operator with headphones or a display, or in some systems this function may be carried out by software. Further processes may be carried out to classify the target and localize it, as well as measuring its velocity. Some ultrasonic sensors have multiple beams to provide all round cover while others only cover a narrow arc, although the beam may be rotated, relatively slowly, by mechanical scanning.

Ultrasonic sensors are divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound.

In a similar way to radar and sonar, ultrasonic transducers are used in systems which evaluate targets by interpreting the reflected signals. For example, by measuring the time between sending a signal and receiving an echo the distance of an object can be calculated. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions.

Ultrasonic probes and ultrasonic baths apply ultrasonic energy to agitate particles in a wide range of materials

Ultrasonic transducers convert AC into ultrasound, as well as the reverse. Ultrasonics, typically refers to piezoelectric transducers or capacitive transducers. Piezoelectric crystals change size and shape when a voltage is applied; AC voltage makes them oscillate at the same frequency and produce ultrasonic sound. Capacitive transducers use electrostatic fields between a conductive diaphragm and a backing plate.

The beam pattern of a transducer can be determined by the active transducer area and shape, the ultrasound wavelength, and the sound velocity of the

propagation medium. The diagrams show the sound fields of an unfocused and a focusing ultrasonic transducer in water, plainly at differing energy levels.

Since piezoelectric materials generate a voltage when force is applied to them, they can also work as ultrasonic detectors. Some systems use separate transmitters and receivers, while others combine both functions into a single piezoelectric transceiver.

Ultrasound transmitters can also use non-piezoelectric principles, such as magnetostriction. Materials with this property change size slightly when exposed to a magnetic field, and make practical transducers.

A capacitor ("condenser") microphone has a thin diaphragm that responds to ultrasound waves. Changes in the electric field between the diaphragm and a closely spaced backing plate convert sound signals to electric currents, which can be amplified.

The diaphragm (or membrane) principle is also used in the relatively new micro-machined ultrasonic transducers (MUTs). These devices are fabricated using silicon micro-machining technology (MEMS technology), which is particularly useful for the fabrication of transducer arrays. The vibration of the diaphragm may be measured or induced electronically using the capacitance between the diaphragm and a closely spaced backing plate (CMUT), or by adding a thin layer of piezo-electric material on diaphragm (PMUT). Alternatively, recent research showed that the vibration of the diaphragm may be measured by a tiny optical ring resonator integrated inside the diaphragm (OMUS)



**Fig 5.1.1**

## **5.2 GSM Modem(SM 900A):**

GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily using gsm. The modem can either be connected to PC serial port directly or to any microcontroller through MAX232. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging. This GSM modem is a highly flexible plug and play quad band SIM900A GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

This is an ultra compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mmx24mmx3mm, SIM900A can fit in almost all the space requirements in user applications, especially for slim and compact demand of design.

### **5.2.1 Features:**

- Dual-Band 900/ 1800 MHz
- GPRS multi-slot class 10/8GPRS mobile station class B
- Compliant to GSM phase 2/2+Class 4 (2 W @850/ 900 MHz)
- Class 1 (1 W @ 1800/1900MHz)
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- Low power consumption: 1.5mA(sleep mode)'
- Operation temperature: -40°C to +85 °C
- Status indicator(D5):It will flashes continuously whenever the call arrives otherwise it is left ON.
- Network LED(D6):This led will blink every second which indicates that the GSM module is not connected to the mobile network. Once the connection is established successfully, the LED will blink continuously every 3 second

### 5.2.2 Indicator LED and Buttons:

**STATUS:** Power status of SIM900.

**PWR:** Power status of GPRS module.

**PWR:** After the GPRS module power on, you need to press the POWER button for a moment to power on the SIM900 module.

**RESET:** Reset the SIM900 module.

### 5.3 Arduino Board:

**Arduino** is an open source, 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),<sup>[1]</sup> 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

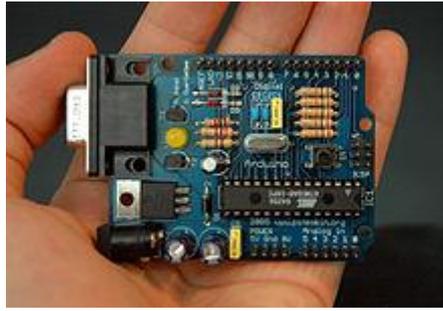
boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy,<sup>[2]</sup> 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. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The source code for the IDE is released under the GNU General Public License, version 2.<sup>[8]</sup> Nevertheless, an official Bill of Materials of Arduino boards has never been released by Arduino staff.

Although the hardware and software designs are freely available under copy left licenses, the developers have requested that the name *Arduino* be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product.<sup>[9]</sup> Several Arduino-compatible products commercially released have avoided the project name by using various names ending in *-duino*.<sup>[10]</sup>



**Fig 5.3.1**

An early Arduino board with an RS-232 serial interface (upper left) and an Atmel ATmega8 microcontroller chip (black, lower right); the 14 digital I/O pins are at the top, the 6 analog input pins at the lower right, and the power connector at the lower left.

Most Arduino boards consist of an Atmel 8-bit AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features.<sup>[12]</sup> The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012.<sup>[13]</sup> The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed *shields*. Multiple, and possibly stacked shields may be individually addressable via an I<sup>2</sup>C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial

adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.



Fig 5.3.2

An official Arduino Uno R2 with descriptions of the I/O locations

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The *Diecimila*,<sup>[a]</sup> *Duemilanove*,<sup>[b]</sup> and current *Uno* provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board<sup>[15]</sup> and Boarduino<sup>[16]</sup> boards may provide male header pins on the underside of the board that can plug into solderless breadboards.

Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining

compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility.

The Arduino Uno is a microcontroller board based on the ATmega328 . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

### 5.3.2 Why Arduino UNO is used?

Arduino UNO is mainly used in our smartdustbin system mainly because it satisfies all our requirements

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labelled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

## **5.4 Gas Sensors:**

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in fire fighting.

Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Exposure to toxic gases can also occur in operations such as painting, fumigation, fuel filling, construction, excavation of contaminated soils, landfill operations, entering confined spaces, etc. Common sensors include combustible gas sensors, photo ionization detectors, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors. More recently, infrared imaging sensors have come into use. All of these sensors are used for a wide range of applications and can be found in industrial plants, refineries, pharmaceutical manufacturing, fumigation facilities, paper pulp mills, aircraft and ship-building

facilities, hazmat operations, waste-water treatment facilities, vehicles, indoor air quality testing and homes.

### **5.4.1 Types**

Gas detectors can be classified according to the operation mechanism (semiconductors, oxidation, catalytic, photoionization, infrared, etc.). Gas detectors come packaged into two main form factors: portable devices and fixed gas detectors.

Portable detectors are used to monitor the atmosphere around personnel and are either hand-held or worn on clothing or on a belt/harness. These gas detectors are usually battery operated. They transmit warnings via audible and visible signals, such as alarms and flashing lights, when dangerous levels of gas vapors are detected.

Fixed type gas detectors may be used for detection of one or more gas types. Fixed type detectors are generally mounted near the process area of a plant or control room, or an area to be protected, such as a residential bedroom. Generally, industrial sensors are installed on fixed type mild steel structures and a cable connects the detectors to a SCADA system for continuous monitoring. A tripping interlock can be activated for an emergency situation.

#### **Electrochemical gas detectors:**

Electrochemical gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized or reduced. The amount of current produced is determined by how much of the gas is oxidized at the electrode,<sup>[3]</sup> indicating the concentration of the gas. Manufactures can customize electrochemical gas detectors by changing

the porous barrier to allow for the detection of a certain gas concentration range. Also, since the diffusion barrier is a physical/mechanical barrier, the detector tended to be more stable and reliable over the sensor's duration and thus required less maintenance than other early detector technologies.

However, the sensors are subject to corrosive elements or chemical contamination and may last only 1–2 years before a replacement is required.<sup>[4]</sup> Electrochemical gas detectors are used in a wide variety of environments such as refineries, gas turbines, chemical plants, underground gas storage facilities, and more.

#### **5.4.2. Catalytic Bead (Pellistor):**

Catalytic bead sensors are commonly used to measure combustible gases that present an explosion hazard when concentrations are between the lower explosion limit (LEL) and upper explosion limit (UEL). Active and reference beads containing platinum wire coils are situated on opposite arms of a Wheatstone bridge circuit and electrically heated, up to a few hundred degrees C. The active bead contains a catalyst that allows combustible compounds to oxidize, thereby heating the bead even further and changing its electrical resistance. The resulting voltage difference between the active and passive beads is proportional to the concentration of all combustible gases and vapors present. The sampled gas enters the sensor through a sintered metal frit, which provides a barrier to prevent an explosion when the instrument is carried into an atmosphere containing combustible gases. Pellistors measure essentially all combustible gases, but they are more sensitive to smaller molecules that diffuse through the sinter more quickly. The measureable concentration ranges are typically from a few hundred ppm to a few volume percent. Such sensors are

inexpensive and robust, but require a minimum of a few percent oxygen in the atmosphere to be tested and they can be poisoned or inhibited by compounds such as silicones, mineral acids, chlorinated organic compounds, and sulfur compounds.

### **5.4.3 Photoionization**

Photoionization Detectors (PIDs) use a high-photon-energy UV lamp to ionize chemicals in the sampled gas. If the compound has an ionization energy below that of the lamp photons, an electron will be ejected, and the resulting current is proportional to the concentration of the compound. Common lamp photon energies include 10.0 eV, 10.6 eV and 11.7 eV; the standard 10.6 eV lamp lasts for years, while the 11.7 eV lamp typically last only a few months and is used only when no other option is available. A broad range of compounds can be detected at levels ranging from a few ppb to several thousand ppm. Detectable compound classes in order of decreasing sensitivity include: aromatics and alkyl iodides; olefins, sulfur compounds, amines, ketones, ethers, alkyl bromides and silicate esters; organic esters, alcohols, aldehydes and alkanes; H<sub>2</sub>S, NH<sub>3</sub>, PH<sub>3</sub> and organic acids. There is no response to standard components of air or to mineral acids. Major advantages of PIDs are their excellent sensitivity and simplicity of use; the main limitation is that measurements are not compound-specific. Recently PIDs with pre-filter tubes have been introduced that enhance the specificity for such compounds as benzene or butadiene. Fixed, hand-held and miniature clothing-clipped PIDs are widely used for industrial hygiene, hazmat, and environmental monitoring.

#### **5.4.4 Infrared point**

Infrared (IR) point sensors use radiation passing through a known volume of gas; energy from the sensor beam is absorbed at certain wavelengths, depending on the properties of the specific gas. For example, carbon monoxide absorbs wavelengths of about 4.2-4.5  $\mu\text{m}$ .<sup>[5]</sup> The energy in this wavelength is compared to a wavelength outside of the absorption range; the difference in energy between these two wavelengths is proportional to the concentration of gas present.<sup>[5]</sup>

This type of sensor is advantageous because it does not have to be placed into the gas to detect it and can be used for remote sensing. Infrared point sensors can be used to detect hydrocarbons and other infrared active gases such as water vapour and carbon dioxide. IR sensors are commonly found in waste-water treatment facilities, refineries, gas turbines, chemical plants, and other facilities where flammable gases are present and the possibility of an explosion exists. The remote sensing capability allows large volumes of space to be monitored. Engine emissions are another area where IR sensors are being researched. The sensor would detect high levels of carbon monoxide or other abnormal gases in vehicle exhaust and even be integrated with vehicle electronic systems to notify drivers.<sup>[5]</sup>

#### **5.4.5 Infrared imaging**

Infrared image sensors include active and passive systems. For active sensing, IR imaging sensors typically scan a laser across the field of view of a scene and look for backscattered light at the absorption line wavelength of a specific target gas. Passive IR imaging sensors measure spectral changes at each pixel in an image and look for specific spectral signatures that indicate the

presence of target gases.<sup>[7]</sup> The types of compounds that can be imaged are the same as those that can be detected with infrared point detectors, but the images may be helpful in identifying the source of a gas.

### **5.4.6 Semiconductor**

Semiconductor sensors detect gases by a chemical reaction that takes place when the gas comes in direct contact with the sensor. Tin dioxide is the most common material used in semiconductor sensors, and the electrical resistance in the sensor is decreased when it comes in contact with the monitored gas. The resistance of the tin dioxide is typically around 50 k $\Omega$  in air but can drop to around 3.5 k $\Omega$  in the presence of 1% methane. This change in resistance is used to calculate the gas concentration. Semiconductor sensors are commonly used to detect hydrogen, oxygen, alcohol vapor, and harmful gases such as carbon monoxide. One of the most common uses for semiconductor sensors is in carbon monoxide sensors. They are also used in breathalyzers. Because the sensor must come in contact with the gas to detect it, semiconductor sensors work over a smaller distance than infrared point or ultrasonic detectors.

### **5.4.7 Ultrasonic**

Ultrasonic gas detectors use acoustic sensors to detect changes in the background noise of its environment. Since most high-pressure gas leaks generate sound in the ultrasonic range of 25 kHz to 10 MHz, the sensors are

able to easily distinguish these frequencies from background acoustic noise which occurs in the audible range of 20 Hz to 20 kHz. The ultrasonic gas leak detector then produces an alarm when there is an ultrasonic deviation from the normal condition of background noise. Ultrasonic gas leak detectors cannot measure gas concentration, but the device is able to determine the leak rate of an escaping gas because the ultrasonic sound level depends on the gas pressure and size of the leak.

Ultrasonic gas detectors are mainly used for remote sensing in outdoor environments where weather conditions can easily dissipate escaping gas before allowing it to reach leak detectors that require contact with the gas to detect it and sound an alarm. These detectors are commonly found on offshore and onshore oil/gas platforms, gas compressor and metering stations, gas turbine power plants, and other facilities that house a lot of outdoor pipeline.

#### **5.4.8 Holographic**

Holographic gas sensors use light reflection to detect changes in a polymer film matrix containing a hologram. Since holograms reflect light at certain wavelengths, a change in their composition can generate a colorful reflection indicating the presence of a gas molecule. However, holographic sensors require illumination sources such as white light or lasers, and an observer or CCD detector.

#### **5.4.9 Calibration:**

All gas detectors must be calibrated on a schedule. Of the two form factors of gas detectors, portables must be calibrated more frequently due to the regular changes in environment they experience. A typical calibration schedule for a fixed system may be quarterly, bi-annually or even annually with more

robust units. A typical calibration schedule for a portable gas detector is a daily "bump test" accompanied by a monthly calibration. Almost every portable gas detector requires a specific calibration gas which is available from the manufacturer. In the US, the Occupational Safety and Health Administration (OSHA) may set minimum standards for periodic recalibration



**Fig 5.4.1**

## **5.5 PIR Sensor**

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.

### **5.5.1 Operating principles**

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

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The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.

### **5.5.2 Construction**

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Infrared radiation enters through the front of the sensor, known as the 'sensor face'. At the core of a PIR sensor is a solid state sensor or set of sensors, made from piezoelectric materials—materials which generate energy when exposed to heat. Typically, the sensors are approximately 1/4 inch square (40 mm<sup>2</sup>), and take the form of a thin film. Materials commonly used in PIR sensors include gallium nitride (GaN), caesium nitrate (CsNO<sub>3</sub>), polyvinyl fluorides, derivatives of phenylpyridine, and cobalt phthalocyanine. The sensor is often manufactured as part of an integrated circuit.



Fig 5.5.2A PIR motion detector used to control an outdoor, automatic light.



Fig 5.5.3 An indoor light switch equipped with PIR-based occupancy sensor

A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".

### 5.5.3 Operation

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor.<sup>[2]</sup> When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.<sup>[4]</sup>

PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available—typically designed to mount on a ceiling. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over thirty meters (one hundred feet) away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage, or with individually selectable segments to "shape" the coverage.

### 5.5.5 Differential detection

Pairs of sensor elements may be wired as opposite inputs to a differential amplifier. In such a configuration, the PIR measurements cancel

each other so that the average temperature of the field of view is removed from the electrical signal; an increase of IR energy across the entire sensor is self-cancelling and will not trigger the device. This allows the device to resist false indications of change in the event of being exposed to brief flashes of light or field-wide illumination. (Continuous high energy exposure may still be able to saturate the sensor materials and render the sensor unable to register further information.) At the same time, this differential arrangement minimizes common-mode interference, allowing the device to resist triggering due to nearby electric fields. However, a differential pair of sensors cannot measure temperature in this configuration, and therefore is only useful for motion detection.

### **5.5.6 Product design**

The PIR sensor is typically mounted on a printed circuit board containing the necessary electronics required to interpret the signals from the sensor itself. The complete assembly is usually contained within a housing, mounted in a location where the sensor can cover area to be monitored.



### **5.5.7 PIR motion sensor design**

The housing will usually have a plastic "window" through which the infrared energy can enter. Despite often being only translucent to visible

light, infrared energy is able to reach the sensor through the window because the plastic used is transparent to infrared radiation. The plastic window reduces the chance of foreign objects (dust, insects, etc.) from obscuring the sensor's field of view, damaging the mechanism, and/or causing false alarms. The window may be used as a filter, to limit the wavelengths to 8-14 micrometres, which is closest to the infrared radiation emitted by humans. It may also serve as a focusing mechanism; see below.

### **5.5.8 Focusing**

Different mechanisms can be used to focus the distant infrared energy onto the sensor surface.

### **5.5.9 Placement**

Manufacturers recommend careful placement of their products to prevent false alarms (i.e., any detection not caused by an intruder).

They suggest mounting the PIRs in such a way that the PIR cannot "see" out of a window. Although the wavelength of infrared radiation to which the chips are sensitive does not penetrate glass very well, a strong infrared source (such as from a vehicle headlight or sunlight) can overload the sensor and cause a false alarm. A person moving on the other side of the glass would not be "seen" by the PID. That may be good for a window facing a public sidewalk, or bad for a window in an interior partition.

It is also recommended that the PIR not be placed in such a position that an HVAC vent would blow hot or cold air onto the surface of the plastic which

covers the housing's window. Although air has very low emissivity (emits very small amounts of infrared energy), the air blowing on the plastic window cover could change the plastic's temperature enough to trigger a false alarm.

Sensors are also often designed to "ignore" domestic pets, such as dogs or cats, by setting a higher sensitivity threshold, or by ensuring that the floor of the room remains out of focus.

Since PIR sensors have ranges of up to 10 meters (30 feet), a single detector placed near the entrance is typically all that is necessary for rooms with only a single entrance. PIR-based security systems are also viable in outdoor security and motion-sensitive lighting; one advantage is their low power draw, which allows them to be solar-powered.

#### **5.5.10 PIR remote-based thermometer**

Designs have been implemented in which a PIR circuit measures the temperature of a remote object. In such a circuit, a non-differential PIR output is used. The output signal is evaluated according to a calibration for the IR spectrum of a specific type of matter to be observed. By this means, relatively accurate and precise temperature measurements may be obtained remotely. Without calibration to the type of material being observed, a PIR thermometer device is able to measure changes in IR emission which correspond directly to temperature changes, but the actual temperature values cannot be calculated



**Fig 5.5.3**

## **5.6 Wi-Fi Module:**

The **ESP8266** is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Expressive Systems.<sup>[1]</sup>

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, AI-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.<sup>[2]</sup> The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.

The **ESP8285** is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

The successor to these microcontroller chips is the ESP32.

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution.

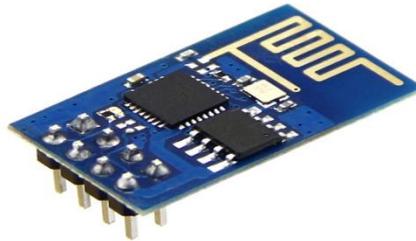
These are the first series of modules made with the ESP8266 by the third-party manufacturer *AI-Thinker* and remain the most widely available.<sup>[13]</sup> They are collectively referred to as "ESP-xx modules". To form a workable development system they require additional components, especially a serial TTL-to-USB adapter (sometimes called a USB-to-UART bridge) and an external 3.3 volt

power supply. Novice ESP-8266 developers are encouraged to consider larger ESP8266 Wi-Fi development boards like the NodeMCU which includes the USB-to-UART bridge and a Micro-USB connector coupled with a 3.3 volt power regulator already built into the board. When project development is complete, you may not need these components and can consider using these cheaper ESP-xx modules as a lower power, smaller footprint option for your production runs.

The ESP8266 Module is not capable of 5-3V logic shifting and will require an external Logic Level Converter. Please do not power it directly from your 5V dev board.

### **5.6.1 Features:**

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)

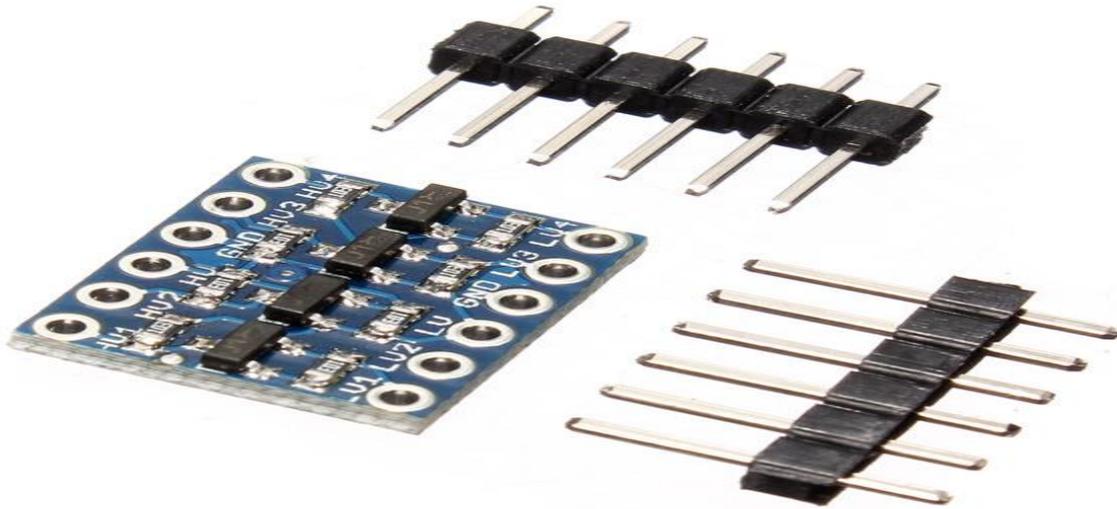


**Fig 5.6.1**

## **5.7 Level converter**

If you've ever tried to connect a 3.3V device to a 5V system, you know what a challenge it can be. The SparkFun bi-directional logic level converter is a small device that safely steps down 5V signals to 3.3V AND steps up 3.3V to 5V at the same time. This level converter also works with 2.8V and 1.8V devices. What really separates this Logic level converter from our previous versions is that you can successfully set your high and low voltages and step up and down between them safely on the same channel. Each level converter has the capability of converting 4 pins on the high side to 4 pins on the low side with two inputs and two outputs provided for each side.

The level converter is very easy to use. The board needs to be powered from the two voltages sources (high voltage and low voltage) that your system is using. High voltage (5V for example) to the 'HV' pin, low voltage (3.3V for example) to 'LV', and ground from the system to the 'GND' pin.



**Fig 5.7.1**

## **5.8 Buzzer**

A buzzer or beeper is an audio signaling device,<sup>[1]</sup> which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



**Fig 5.8.1**

## 6. Software Requirements:

The following are the software requirements of the smart dustbin system.

### 6.1 Arduino IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a *sketch*. Sketches are saved on the development computer as text files with the file extension *.ino*. Arduino Software (IDE) pre-1.0 saved sketches with the extension *.pde*.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consist of only two functions:

- *setup*: This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.
- *loop*: After *setup* has been called, function *loop* is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions. A typical program for a beginning Arduino programmer blinks an LED repeatedly

### **6.1.1 Writing Sketches:**

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension `.ino`. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

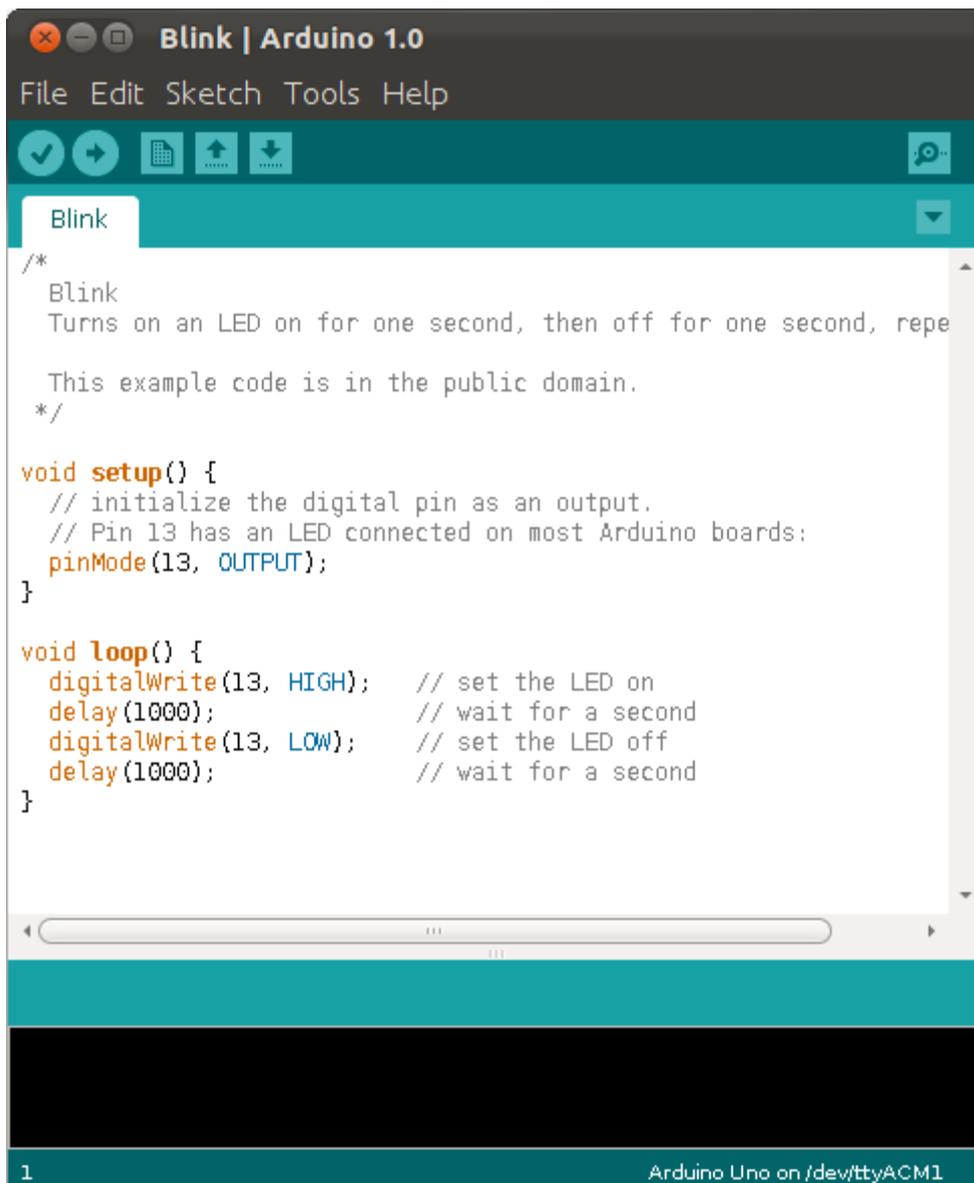


Fig6.1.1

## **6.2 IOT Platform(Ubidots):**

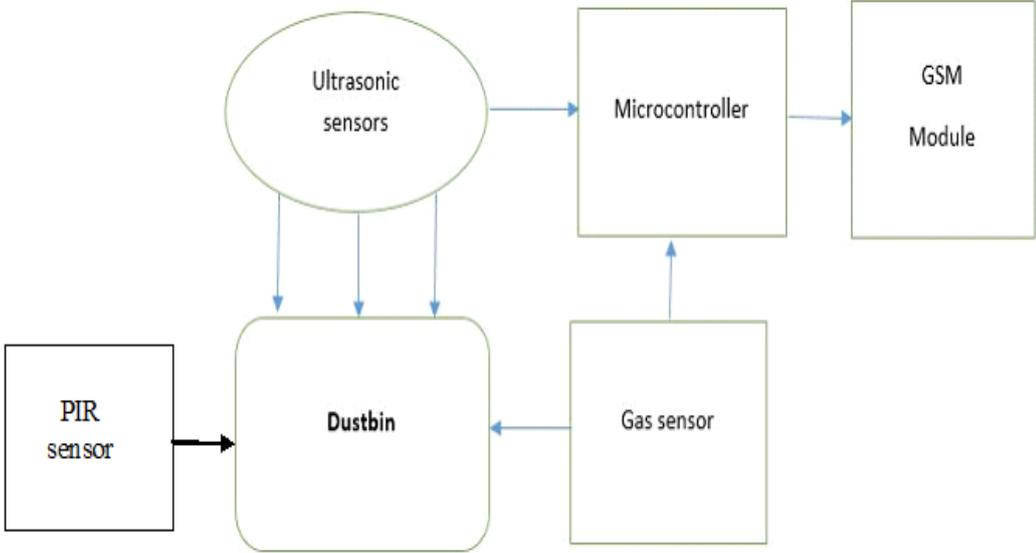
Ubidots is the IOT platform used here. It is used to upload the status in a webpage or a server. Ubidots is a open source free to use IOT platform.

Ubidots was first born as an engineering services firm, specializing in hardware and software development for IoT projects in Latin America. Between 2012 and 2014, we accomplished hundreds of Internet of Things projects across industries like Healthcare, Oil & Gas, Energy, Manufacturing, Transportation and Retail, learning the nuts and bolts of IoT.

After going through the Boston MassChallenge Accelerator -with a purpose of turning ourselves into a global product-based startup- the idea of an IoT cloud was born; specially one that understood the real needs of hardware engineers.

Since its launch in 2014, the Ubidots Cloud has grown into one of the top IoT Platforms in the market, supporting thousands of IoT initiatives in more than 40 countries.

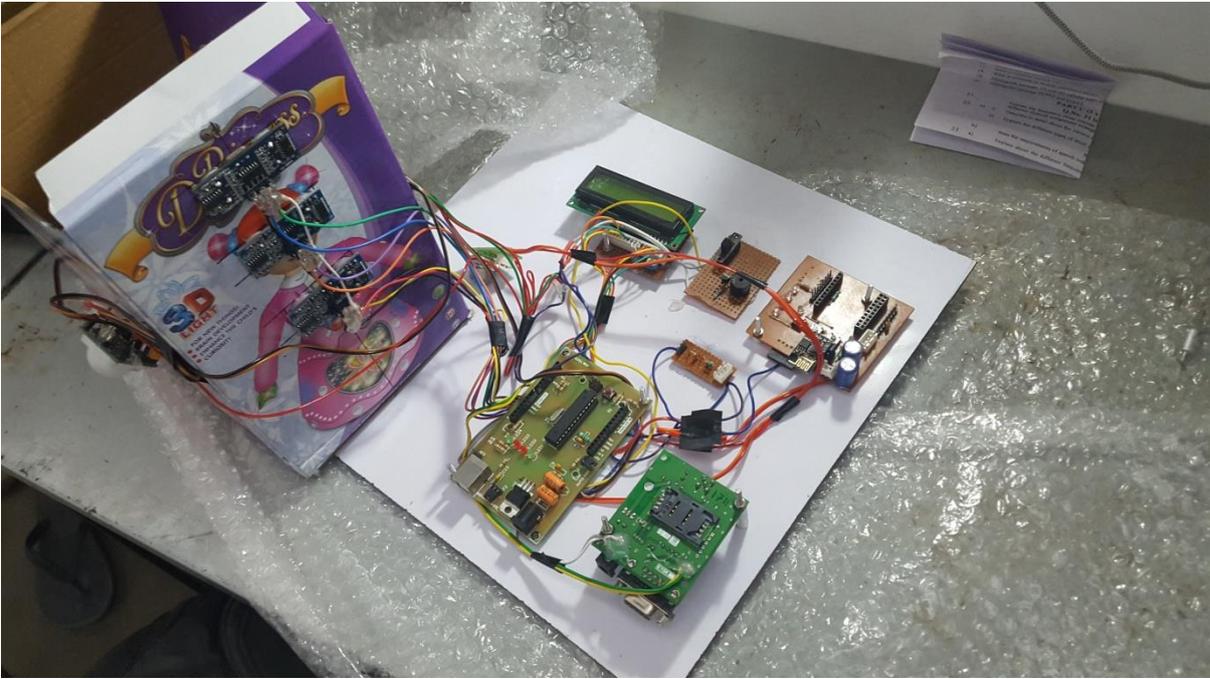
**7. Block Diagram:**



## **8.Working**

The working of the smart dustbin system consists of various sensors interfaced to the microcontroller. Three ultrasonic sensors are present inside the dustbin these sensors are used to indicate the level of garbage in the dustbin .Three PIR sensors are present in the corners of the dustbin to find out any garbage has been dropped outside. This is indicated by a alarm. An GSM module is used to send notification if the dustbin is full to corporation and also if an gas is detected by the gas sensor.The wifi module is used to upload the level of garbage in the cloud(Ubidots).

**9.Working Model:**



## **10.Conclusion:**

The smart dustbin system has been constructed to be time saving and more efficient to our daily life style. This system can be integrated with solar panels in future for power saving purposes and to prevent the use of batteries. This smart dustbin would be a major development in our day to day and our fast paced life style