Smart Dustbin using Arduino, Ultrasonic Sensor & Servo Motor

Introduction:

Dustbins (or Garbage bins, Trash Cans, whatever you call them) are small plastic (or metal) containers that are used to store trash (or waste) on a temporary basis. In some places, littering is a serious offence and hence Public Waste Containers are the only way to dispose small waste. In this project, I have designed a simple system called Smart Dustbin using Arduino, Ultrasonic Sensor and Servo Motor, where the lid of the dustbin will automatically open itself upon detection of human hand.

Concept behind Smart Dustbin using Arduino

I have already used Ultrasonic Sensor in Object Avoiding Robot, where upon detecting an object, the Robot will change its course of direction.

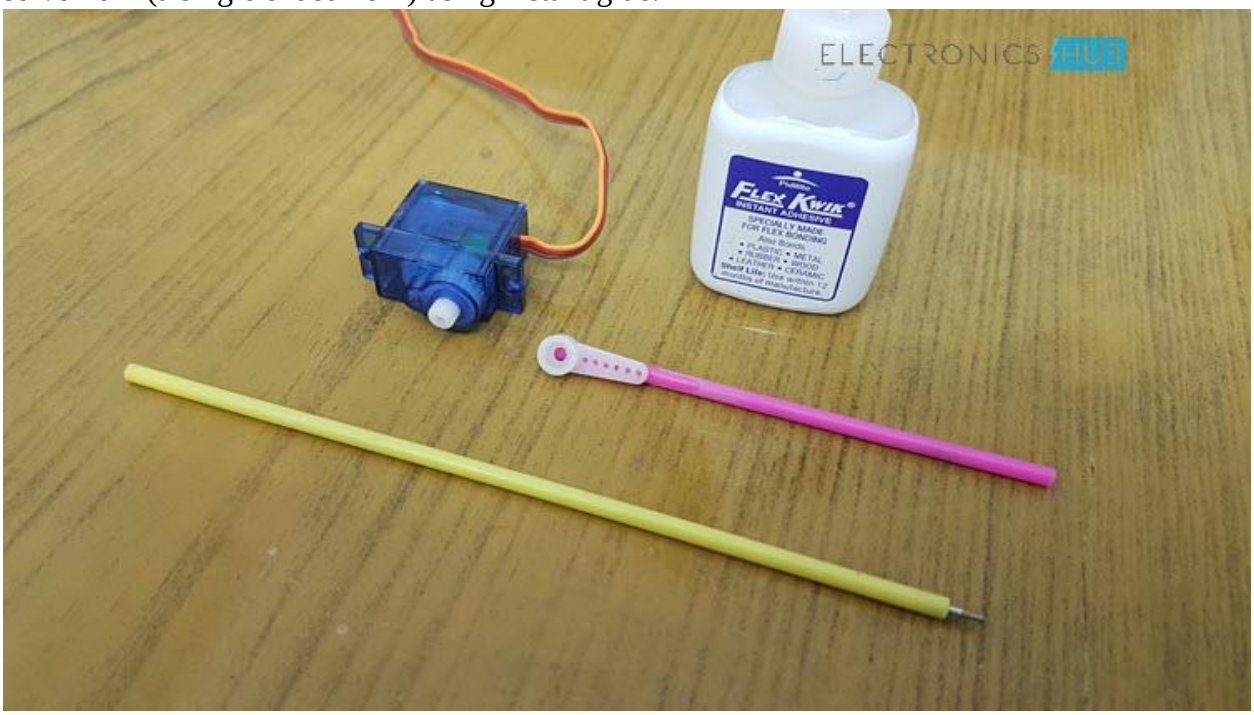
A similar methodology is implemented here, where the Ultrasonic Sensor is placed on top of the dustbin's lid and when the sensor detects any object like a human hand, it will trigger Arduino to open the lid.

How to Build a Smart Dustbin using Arduino?

Connecting the Servo

Now, let me take you through the actual setup and build process of the Smart Dustbin using Arduino.

To open the lid, I have fixed a small plastic tube (like an empty refill of a ball-point pen) to the servo horn (a single ended horn) using instant glue.



For this mechanism to be able to open the lid of the dustbin, it must be placed near the hinge where the lid is connected to the main can.

Also, make sure that the lifting arm is parallel to ground under closed lid condition.

NOTE: According to the Laws of Physics, you will require more energy to push the lid from the hinge than at the extreme end.

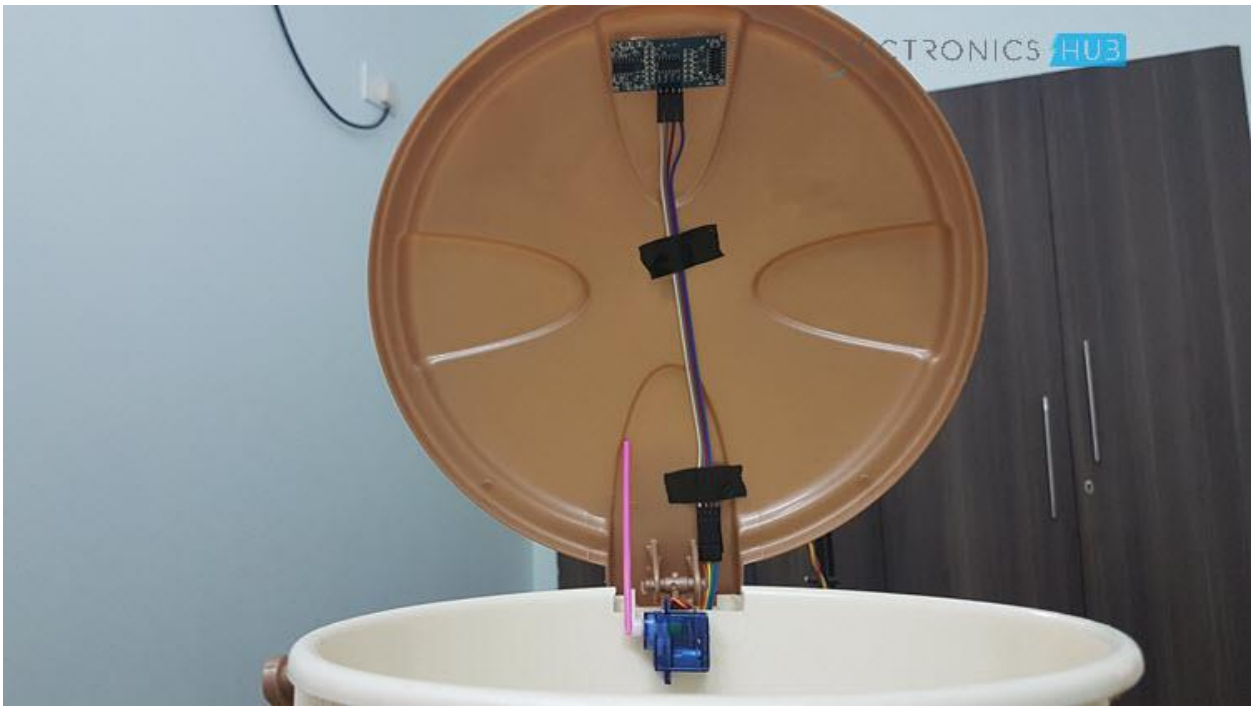
Connecting the Ultrasonic Sensor

Make two holes corresponding to the Ultrasonic Sensor on the lid of the dustbin, as shown in the following image.

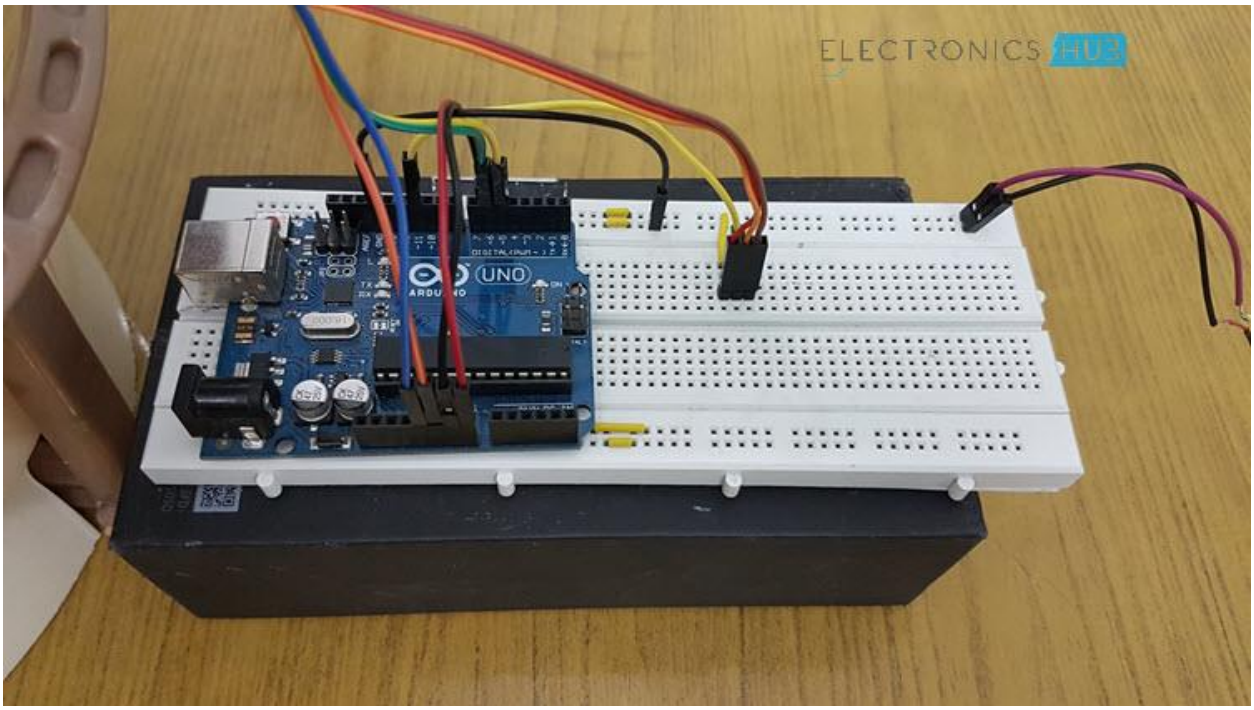
WARNING: You must use a sharp object with a lot of force to make these holes.
Now, from the inside, place the Ultrasonic Sensor through the holes and fix its position with the help of glue.

Wiring up the Components

The final step in the build process is to make the necessary connections using long connecting wires as per the circuit diagram and securing these wires so that they don't hang around.

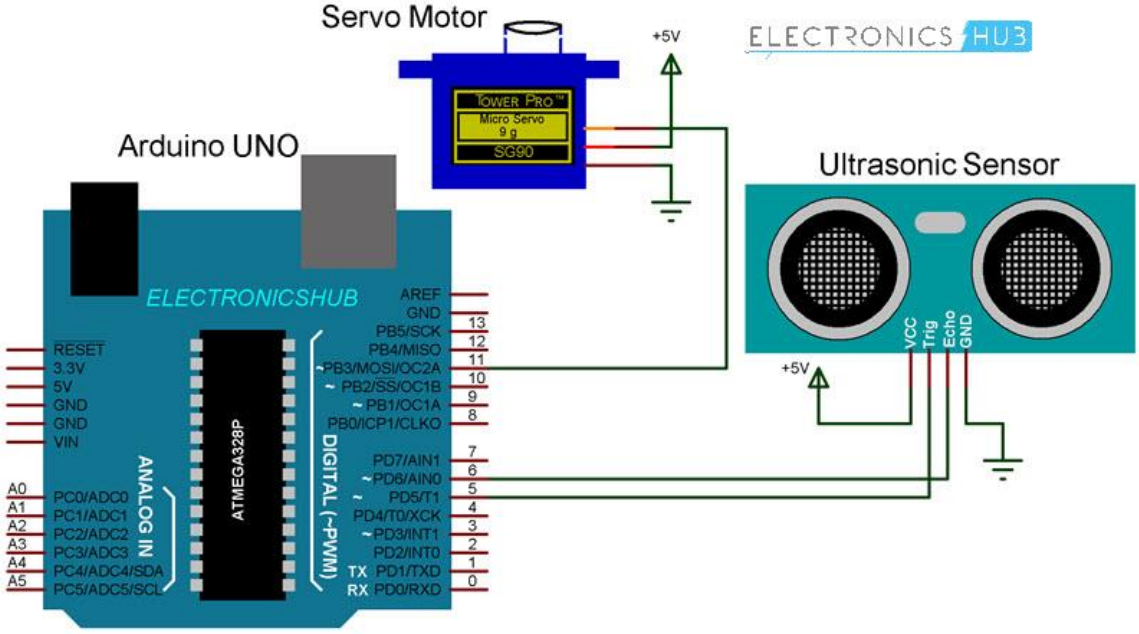


Ultrasonic Sensor and Servo Motor are connected to respective pins of Arduino. This finishes up the build process of the Smart Dustbin.



Circuit Diagram

The following image shows the circuit diagram of the Smart Dustbin using Arduino.



Components Required

- Arduino UNO
- HC-SR04 Ultrasonic Sensor Module
- TowerPro SG90 Servo Motor
- Connecting Wires
- 5V Power Supply
- A small dustbin with hinged lid
- Miscellaneous (glue, plastic tube, etc.)

Garbage monitoring system using IoT

INTRODUCTION

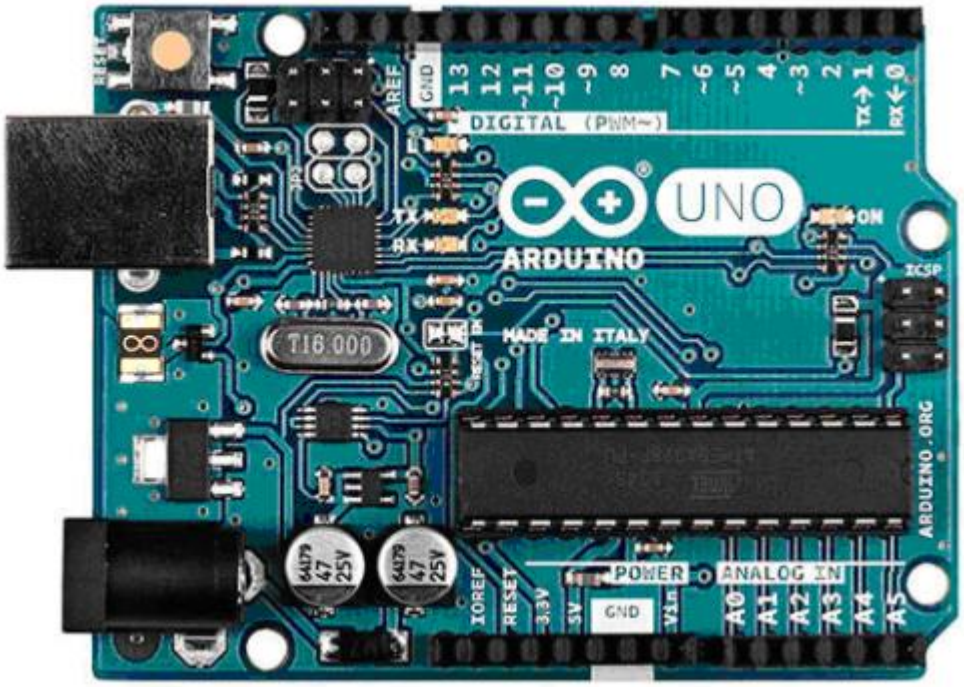
IoT or Internet Things refers to the network of connected physical objects that can communicate and exchange data among themselves without the desideratum of any human intervention. It has been formally defined as an “Infrastructure of Information Society” because IoT sanctions us to amass information from all kinds of mediums such as humans, animals, conveyances, kitchen appliances. Thus, any object in the physical world which can be provided with an IP address to enable data transmission over a network can be made part of an IoT system by embedding them with electronic hardware such as sensors, software, and networking gear. IoT is different from the Internet as in a way it transcends Internet connectivity by enabling everyday objects that utilize embedded circuits to interact and communicate with each other utilizing the current Internet infrastructure Since then the scope of IoT has grown tremendously as currently it consists of more than 12 billion connected devices and according to the experts it will increase to 50 billion by the end of 2020. Manufacturers have gained insight into how their products are used and how they perform out in the real world and increase their revenues by providing value-added services that enhance and elongate the lifecycle of their products or services. With the help of this system, the minimal number of smart bins can be used around the whole city and the city will still be much cleaner. Therefore, it is beneficial to use such an existing infrastructure for designing the proposed security system. The disadvantages of the existing system are that the employees must go and check the bins daily whether they are filled or not, which results in high cost. If the bin doesn’t get emptied on time, then the environment becomes unhygienic, and illness could be spread. The proposed system will help in removing all these disadvantages. It will also help in reducing the cost as the employees will have to go only at that time when the bin is full. This will also help in resource optimization and if the bins will be emptied at a time, then the environment will remain safe and free from all kinds of diseases. The paper is organized as follows:

Literature review

A Smart Dustbin proposed by, based on IoT in which the smart bin was built on a platform which was based on Arduino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. The bin was interfaced with a system based on microcontroller which had IR wireless systems with a central system that showed the status of the garbage in the bin. In the end the sensor could only detect the weight of waste present in the bin but not the level of waste. In this system, the level of garbage in the bin was detected by the ultrasonic sensor which will send the data to the control room using the GSM module. A GUI was also developed to check the information that was related to the garbage for different locations, GUI was based on MATLAB, so it was different. Two units were present in the system, slave unit was in the bin whereas the master unit was there in the control room. The sensor will check the level of garbage and send it to the slave unit which will further send the data to master unit which at last will inform the authorities to clean the bin. The system worked in two parts, the first part was to find the companies that were involved in collecting the waste and owned trucks and who could also organize some drivers for collecting the garbage from various parts of the city in the truck and pass on the city dumps or the recycling organizations. The second part was to make a system that could handle all the communications of all the people involved and could also maintain the data which will be collected while working around in the city. Various bins were placed around the city which was provided with an embedded device that was low in price and helped in tracking the garbage level in the bins. The

transmitter section consists of a microcontroller and sensors which check the level of the garbage, and the data is passed onto the system with the help of the RF Transmitter, then RF Receiver receives the data and sends it to the client associated so that the bin can be emptied quickly.

Materials and Methodology



Arduino is an open source, PC paraphernalia and programming organization, endeavor, and client group that plans and produce microcontroller packs for constructing programmed devices and intelligent object that can detect and control questions in the real world. The inception of the Arduino extend began at the Interaction Design Institute in Ivrea, Italy.

3.2. ESP8266 (Wi-Fi Module)

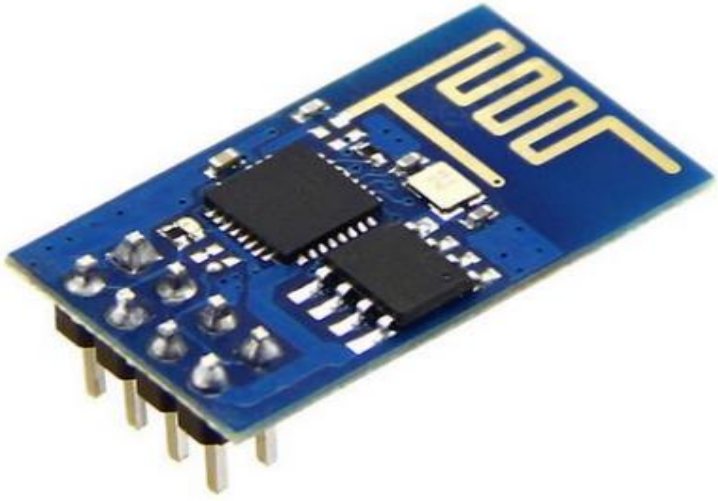


Figure 2. ESP8266.

ESP8266 is a Wi-Fi module that will give your project access to Wi-Fi or the internet. It is a very cheap device, but it will make your projects very powerful. It can communicate with any

microcontroller and make the project wireless. The TX and RX pins will be responsible for the communication of ESP8266 with the Arduino.

3.3. Ultrasonic Sensor

The Ultrasonic Sensor is used to measure the distance with high accuracy and stable readings. By using the time that it takes to strike the object and come back, you can calculate the distance. Two are VCC and GND which will be connected to the 5V and the GND of the Arduino while the other two pins are Trig and Echo pins which will be connected to any digital pins of the Arduino. The trig pin will send the signal and the Echo pin will be used to receive the signal. To generate an ultrasound signal, you will have to make the Trig pin high for about 10us which will send an 8-cycle sonic burst at the speed of sound, and after striking the object, it will be received by the Echo pin.

Figure 3. Ultrasonic Sensor.

A modern solderless breadboard consists of a perforated block of plastic with numerous tin-plated phosphor bronze or nickel silver alloy spring clips under the perforations. Interconnecting wires and the leads of discrete components (such as capacitors, resistors, and inductors) can be inserted into the remaining free holes to complete the circuit. Where ICs are not used, discrete components and connecting wires may use any of the holes. A breadboard is utilized to build and test circuits expeditiously afore finalizing any circuit design. The breadboard has many apertures into which route components like ICs and resistors can be connected. A typical breadboard that includes top and bottom power distribution rails is shown below figure 4.

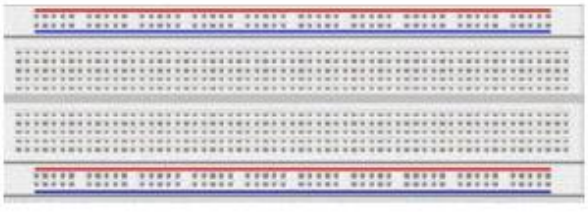


Figure 4. Bread board.

Figure 5. Jump Wires.

4. Proposed System

Proposed System The existing system has the limitations as time consuming, trucks go and empty the containers, even they are empty. So, proposed model talks about how to make use of the recent advancements in technology to make our place clean and tidy. The implementation starts by setup ESP8266 by flashing the latest version of the firmware. This enables s the Blynk libraries efficiently communicate and avoid producing error. To flash the latest firmware, download the ESP8266 flasher tool and the latest firmware from the internet which would be in the bin format and flash the ESP8266 with it. connect the microcontroller, ultra-sonic sensor, buzzer and the ESP8266 using the jumper wires. It also makes it easy to connect multiple inputs to a single pin on the Arduino board.

Figure 6. Hardware components connection.

Following sketch diagram as shown in Figure 7, shows how the components are supposed to be connected using the breadboard and the jumper wires.

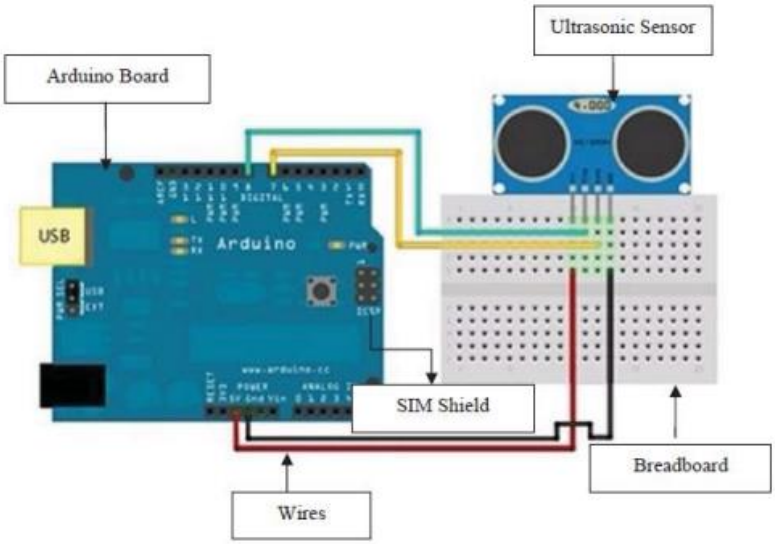


Figure 7. Sketch Diagram.

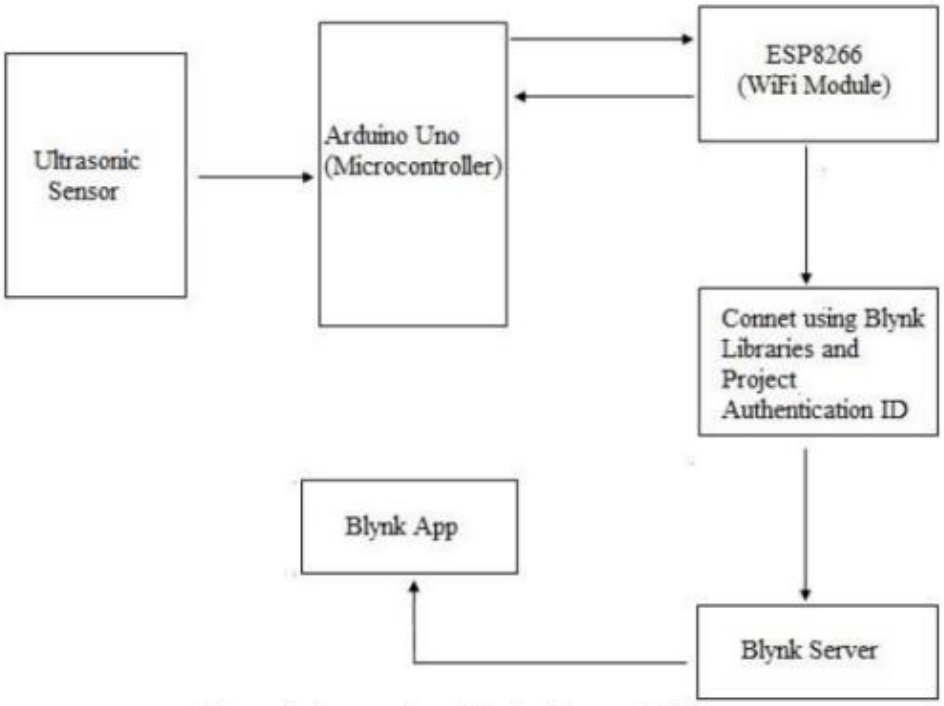
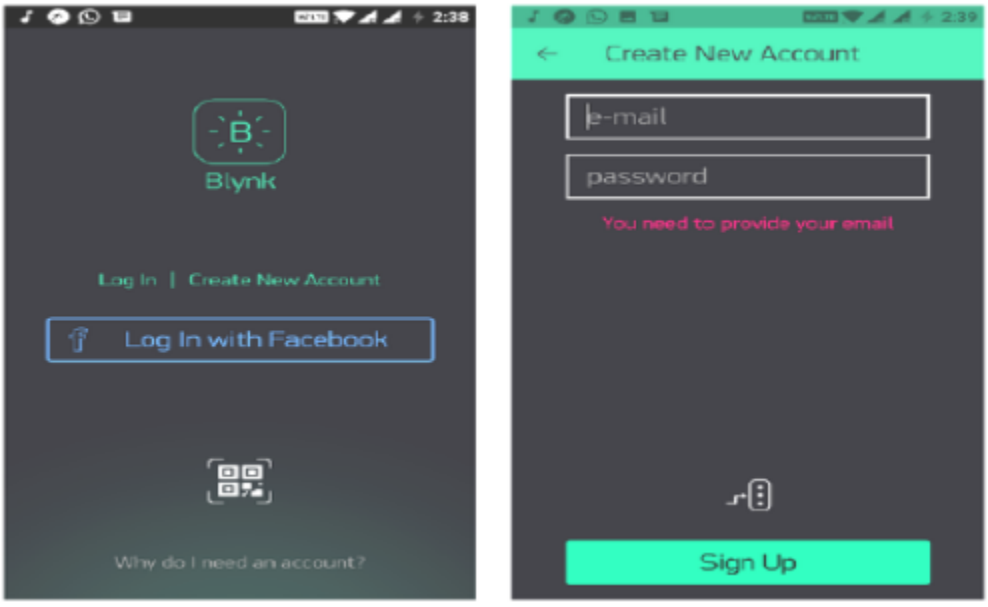
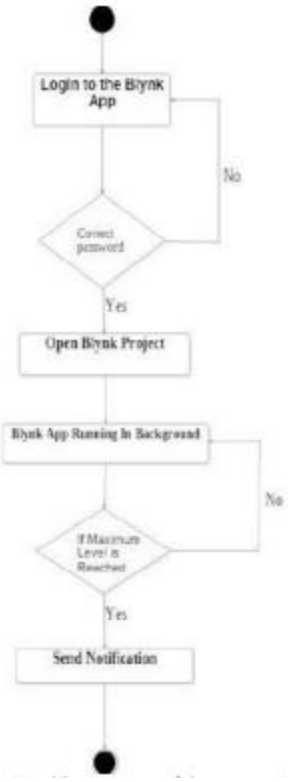


Figure 8. Proposed model - Architecture Diagram.

5. Configuring Blynk App

To connect to the internet, we make use of a prebuilt platform called the Blynk app. After the user installs the Blynk app on the smartphone, an account is to be created in the app to access its services. Let us create an account and add a new project to get started. The configuration of the Blynk app and account creation is shown in figure 10.





6. Experimental results

The user checked the notification was checked by the user on the blink app, so it can be said that the system has worked in the way we planned. Proper security was also given to the hardware components so that the output which comes is accurate because further actions must be taken based on the output.

Smart Bin: Internet-of-Things Garbage Monitoring System

Abstract

This work introduces the design and development of a smart green environment of the garbage monitoring system by measuring the garbage level in real-time and to alert the municipality where never the bin is full based on the types of garbage.

The system shows the status of different four types of garbage; domestic waste, paper, glass, and plastic through LCD and Thing Speak in real-time to store the data for future use and analysis, such as prediction of the peak level of garbage bin fullness.

Introduction

According to United Nations Population Fund (see www.unfpa.org), by 2030 five billion people will be living in urban areas, therefore, there is no surprise where Malaysian produce an average of 30,000 tons of waste every day, and only 5% percent of it is recycled. According to the Ministry of Urban Wellbeing, Housing and Local Government shows that this waste is resulting in tremendous land and air pollution for the environment, health problems for communities, and bottlenecks to economic growth. Waste can be divided into two categories, liquid, or solid waste, both can be hazardous. Mainly, liquid waste came from a point source or non-point source discharges such as wash water from homes, liquids used from cleaning in industries, and waste detergents. Locally, in Perlis, the waste management is managed by the Daman company which

was given the responsibility by the state council to collect the waste. Though, the waste collection is consistent however the current collection does not allow the local municipal to know the status of the garbage bin either full or empty. Current garbage collection is inefficiencies, time waste, and required a huge amount of human energy. The objectives of the project are to design a prototype of an Internet-of-Thing (IoT) garbage monitoring system and alert the garbage collectors of the fullness of the bin by identifying the level of garbage based on the depth of the bin.

Garbage Monitoring System

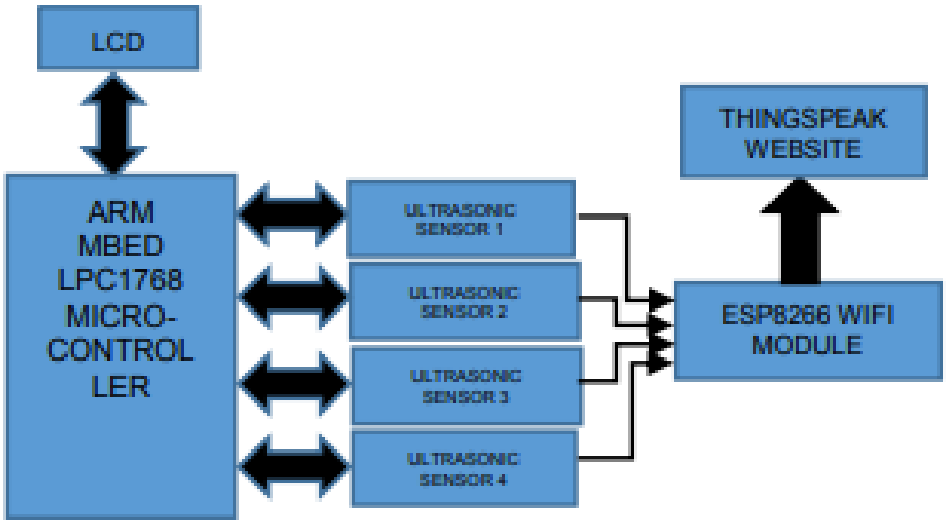
Waste management is the activities and actions required to manage waste from its origin to its final disposal. The term normally relates to all kinds of waste, whether generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, or other human activities, including municipal, agricultural, and social. Waste management is intended to reduce the unfriendly effects of waste on health, the environment, or aesthetics. Waste management practices are not uniform among countries developed and developing nations, regions urban, rural areas, sectors residential and industrial. Prakash and Prabu must design IoT Based Waste Management for Smart City for solving the trash overflow which create unhygienic condition and bad smell around the surrounding. S.S.Navghane et al., use the dustbin that interfaced with microcontroller based system having IR wireless systems along with a central system showing the current status of garbage, on mobile web browser with HTML page by Wi-Fi. Smart Garbage System (SGS) is proposed to reduce the amount of food waste. “Smart Bin’ by was designed to manage the waste collection system based on smart city. The network of sensors-enabled smart bins connected through the cellular network generates a large amount of data, which is further analyzed and visualized in real-time to gain insights into the status of waste around the city. Meanwhile, Catania and Ventura proposed smart waste collection by using the smart-M3 platform to improve and optimize the handling of solid urban waste by introducing ‘green points’ for encouraging citizens to recycle. On the other hand, Medvedev et., al IoT components such as RFIDs, sensors, cameras, and actuators for efficient waste collection by proposed Decision Support System (DSS) for efficient waste collection in Smart Cities.

Methodology

demonstrates a system based on Internet-of-Thing (IoT) that allows waste management to monitor based on the level of the garbage depth inside the dustbin. The system lets users be alert to the level of garbage on four types of garbage: domestic waste, paper, glass, and plastic. Implementation of proposed waste management system

Meanwhile, Fig 2 shows the proposed system through a block diagram.

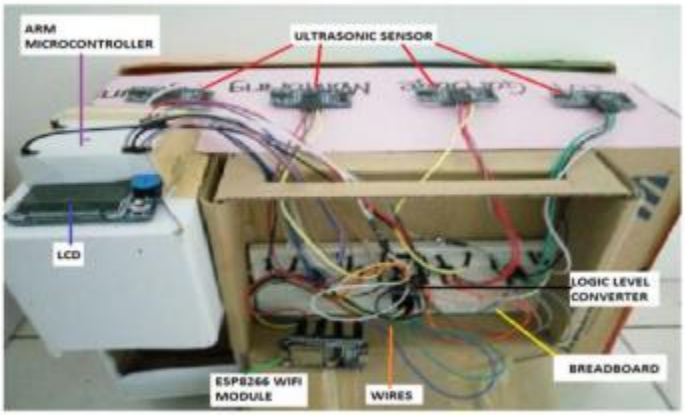
The proposed system is using an ultrasonic sensor as input and is placed at the maximum level of the garbage bin. The system consists of the ultrasonic sensor which measures the garbage level and an ARM microcontroller that controls system operation whereas everything will be connected to Thing Speak. At the same time, the level of garbage also will display on LCD to allow users to know the level of garbage in the dustbin without opening it. The four ultrasonic sensors connect to the ARM microcontroller to detect the level of garbage of each bin based on the depth of the bin. In this work, the system will try to monitor the depth of the garbage based on garbage type. Here, four ultrasonic sensors are connected to the ARM microcontroller and ESP8266 Wi-Fi module using a logic level converter.



need at least 5V to generate the data and display the data on LCD. To make connect the ultrasonic sensor to the Wi-Fi module, need logic level converter to reduce the voltage. Circuit Diagram These four sensors are then connected to ESP8266, a low-cost Wi-Fi chip with a full TCP/IP stack that gives any microcontroller access own network Wi-Fi. It requires minimal external circuitry and integrates a 32-bit Ten silica MCU, standard digital peripheral interfaces, antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, and power management modules all in one small package. The data then been collected then send to Think Speak to analyze and visualize uploaded data.

Result and Discussion

Fig 4 shows a complete circuit of the IoT garbage monitoring system.



A complete circuit of IoT garbage monitoring system the system is evaluated by testing the emptiness and fullness of the garbage bin. Fig 5 (a) shows that the garbage bin is empty thus level of garbage is empty. Data will then display the percentage of the fullness of the bin on LCD that attaches to the bin to alert the user's percentage of the fullness of the bin.

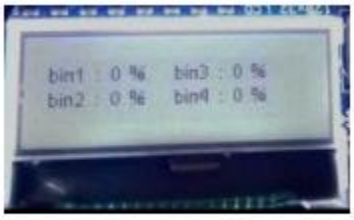
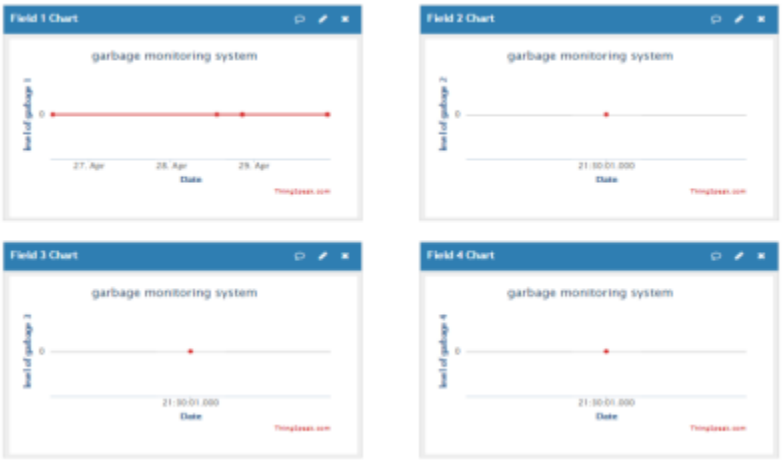


Fig 5(a) Fig 5(b)

Fig 5(a) Fig 5(b) Fig 5(a) shows the emptiness of the garbage bin and the level of garbage as shown on LCD in Fig 5(b).

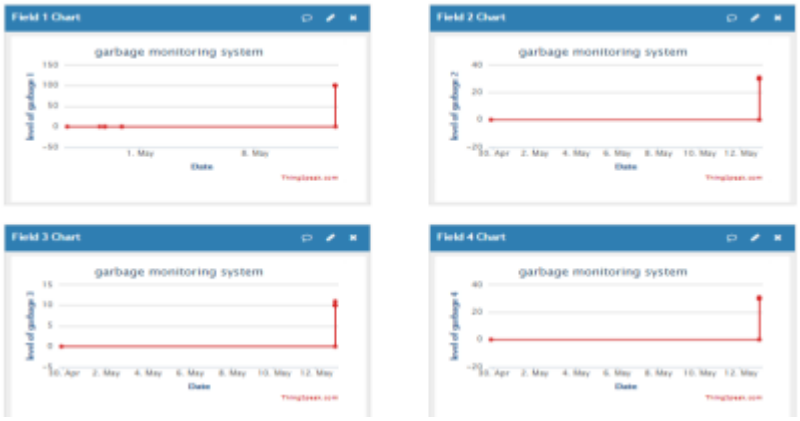


The data on the Thing Speak show the zero value because no garbage in the bin. The data on Thing Speak for each bin Fig 7(a) shows the dustbins are full of garbage. Moreover, data for each bin will display on LCD (Fig 7(b)) that attaches to the bin to alert the user how many percent of the garbage is in the bins.

Fig 7(a) Fig 7(b)

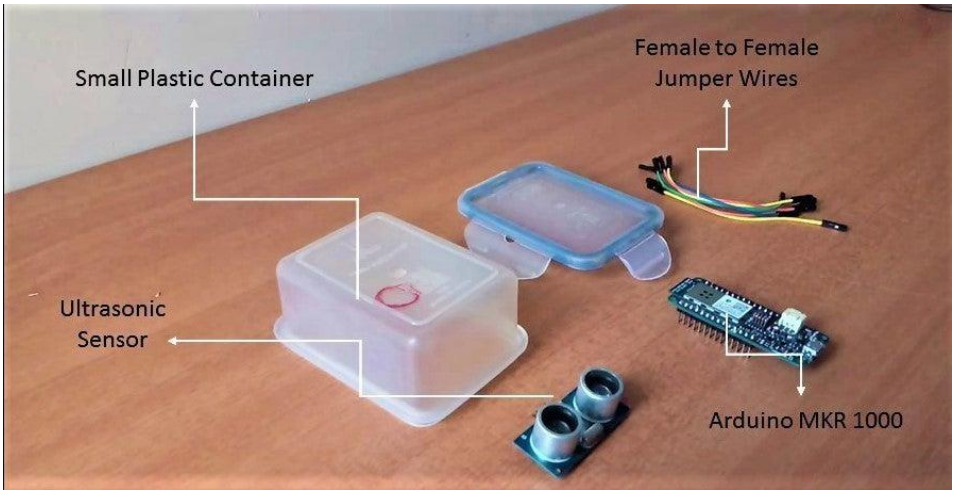
Fig 7(a) Fig 7(b) Fig 7(a) shows the garbage bin fill in with garbage and the level of garbage as shown on LCD in Fig 7(b).

The data on the Thing Speak will show the percentage for each bin to make sure the waste management can monitor it as shown in Fig 8.



My plan for the project

HARDWARE:



- **2 x AA Batteries** these batteries will power the Arduino board
- **Plastic Container** I found an old plastic container in which all the components could fit. The box is important as you can easily access the components and it's waterproof.
- **Battery Holder Case**
- **Ultrasonic Sensor** An ultrasonic sensor measures distance. It will be attached to the lid indicating the quantity of trash. Our system's key component.
- **Jumper Wires**
- **Arduino MKR1000** The center piece is one of Arduino's latest microcontrollers, which simplifies the task of connecting to the Internet using prebuilt libraries that can be downloaded.
- **White Spray Paint** Turn your regular box into a more professional product

TOOLS:

- **Electric Drill**
- **Hot Glue Gun**

SOFTWARE:

- **Arduino IDE**
- **Blynk** An android app that allows communication with WiFi compatible micro-controllers.