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Garbage Monitoring System using Internet of Things (IoT)

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Abstract: ***There has been a sharp increase in urban development plans during the past few years .Solid waste management, which affects health problems and pollutes the environment of our civilization, has been one of the key environmental concerns. One of the main issues in the modern era is the identification, monitoring, and control of wastes. The old method of manually checking the waste in trash cans requires more human labor, time, and expense, all of which can be easily avoided with the use of current technologies. The Smart Buildings, Colleges, Hospitals and Bus Stands are the intended recipients of the Garbage Monitoring System concept. The garbage monitoring system is a technique that keeps cities hygienic and tidy.A novel concept called the garbage monitoring system turns a standard trash can into a smart one by employing ultrasonic sensors to detect the level of rubbish and DC motors to close the garbage bags.***

Keywords: ***Arduino; Sensors; Garbage; IOT;***

I. INTRODUCTION

The environment should be clean and hygienic for better life leads in India. In the present scenario, many times it is seen that the garbage bins or dust bin are placed at public places in the cities are overflowing due to increase in the waste every day. These overflowed garbage bins can create an obnoxious smell and make an unhygienic environment. This leads to the rapid growth of bacteria and viruses which can cause different types of diseases. The proposed system shall overcome such problems by alerting the status of garbage bins as well as helps to keep dry and wet garbage separately so that different processes- composting, recycling, incineration shall be applied to different kinds of garbage. By intimating the notification of garbage filled, the number of trips of the garbage collecting vehicle shall be also reduced. Shyam et al have researched waste collection management.

It can read, collect, and transmit huge volume of data over the Internet. Such data, when put into a spatiotemporal context and processed by intelligent and optimized algorithms, can be used to dynamically manage waste collection mechanism . S. Kanta et al. worked on efficient garbage collection systems with wireless sensor network and mores focus on IoT [2]. S. Kumar et al. worked on the system which checks the waste level over the dustbins by using Sensor systems.

Once it detected immediately this system alerts to concern authorized through GSM/GPRS. A. Arber et al. have analysed a distributed cross-layer commit protocol (CLCP) for data aggregations and its support for query based search for IoT application. J. Joshi et al. have proposed a solution about the Smart Bin is a network of dustbins which integrates the idea of IoT with Stack Based Front End approach of integrating Wireless Sensor Network with focus on software . N. Kumar et al. have proposed 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 [6].

II. LITERATURE REVIEW

[1], In order to learn more about the recently completed task, many articles were read before writing. A weight sensor is sometimes used in artwork to detect rubbish. The magnitude of the loss in the trash can is stated. In any event, the amount of trash in the trash can doesn't provide any information. So the infrared sensor (IR) was used for waste discovery. Since the IR sensor emits light at infrared frequencies, it is invisible to the human eye, but electronic sensors can detect it. An IR transmitter is part of the LED that emits the IR bar. graphical user interface, IR sensor, microcontroller, and innovation (GUI).

[2], The waste management framework is divided into two parts: programming and unique flagging tools. The device is attached as an afterthought to the receptacle's dividers. The receptacle has two parts: the transmitter and the sensor recipient. The sensor is used to display the level of the canister connected to the transmitter, which informs the recipient and the worker when the canister is full. A supervisor is a worker side arrangement whose job it is to locate the shortest route and motivate the driver to collect it as quickly as possible

[3], The planning for waste management centres on different waste item components, homegrown storage, trash bins, and vehicle selection. The waste stream keeps stopping in the gathering trucks between the waste object and the homegrown container. Based on RFID developments, new trash cans are introduced to an aggregate canister. The technology makes use of intelligent vehicles and trash cans with radio frequency identification. (RFID). It still has a worldview based on bad luck. The Arduino with IoT approach outweighs all the drawbacks, including the usage of little street, low effort, fuel use, and safe environment.

[4], Ultrasonic sensor tracks and tests the amount of garbage in the bins, and if a person wants to throw the garbage, an android app is programmed to direct the user to the bin and by using GPS sends a warning message to the municipal department about bin status using cloud, NodeMCU.

[5], When someone wants to throw away rubbish, an android app

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is designed to point them in the direction of the nearest trash can while also utilising GPS to send a warning message to the municipal department about the status of the bins using the cloud and NodeMCU. rubbish in the bins is monitored and tested by an ultrasonic sensor.

[6], IoT garbage control is proposed through a site page. To show the measure of trash assembled and cause bearings for vehicles in the reusing focus, the page offers a schematic perspective on the canisters and shows the waste gathered in shading.

[7] Once the trash is filled, alarm rings. The RFID placed inside the trash will intimate about the overflowing of trash to the corporation office. The RFID placed at the corporation office is serial interfaced with PC.

[8] Alarm sounds when garbage is full. The corporate office will be informed by the RFID implanted inside the trash about the trash overflow. The PC and the RFID are serially interfaced at the corporate headquarters.

[9], Smart Garbage Monitoring System using Internet of Things(IoT).By using the IOT,Arduino microcontroller, ultrasonic sensor, Wi-Fi module and a heap battery.

III. METHODOLOGY

The smart garbage bins have Ultrasonic Sensors placed on the lid which detects the garbage level in the bins. By this, the garbage bins can be monitored and the monitoring information can be obtained through the webpage. The level of the garbage is compared with the depth of the bins.The system contains Arduino family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer. The web page gives a graphical view of the garbage bins and highlights the garbage collected in colour in order to show the level of garbage collected. The LCD screen shows the status of the garbage level. The systemputs on the buzzer when the level of garbage collected crosses the set limit.

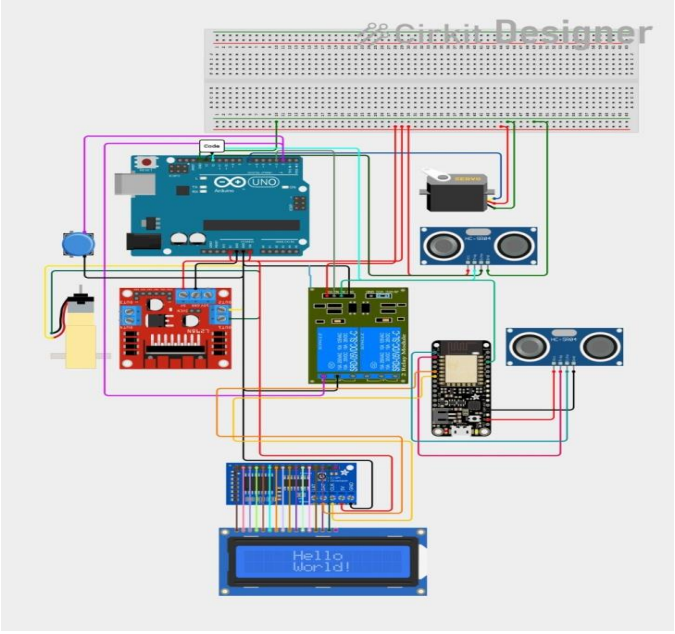

Figure 1: Circuit Diagram

IV. COMPONENETS

Hardware Requirements

- Arduino UNO
- HC-SR04 ultrasonic sensor
- Motor Driver
- NodeMCU
- Servo Motor
- Force Sensor
- Relay
- DC Motor
- Connecting Wires
- Dustbin

Software Requirements

- Arduino IDE

Ultrasonic Module:The ultrasonic sensor is a device that determines one object's separation from another by using ultrasonic sound waves. An ultrasonic sensor uses a transducer to communicate and obtain ultrasonic heartbeats, which are then used to transmit information about the location of an object. It is used to track the amount of garbage. It is made out of Trigger pulse (Input), Echo pulse(output), 5V supply, 0V Ground.

The ultrasonic sensor vibrates when an event occurs that is outside the range of human hearing. This sensor calculates the distance to a goal by measuring the time lags between the transmission and receiving of an ultrasonic.

DC Motor: Mechanical energy is converted into electrical energy by it. It often dumps waste. The engine will rotate towards the clock as a result of a positive and negative extrememity in the engine terminals. Additionally, if possible, the generator opens and closes the trash lid.

NodeMCU: The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint – an important consideration to be aware of.

The most common models of the NodeMCU are the Amica

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(based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board. The open-source design of the base ESP8266 enables the market to design new variants of the NodeMCU continually.

Motor Driver: A motor driver is an electronic device or circuit that controls the speed, direction, and torque of an electric motor. Motor drivers are used in a wide range of applications. Motor drivers can be implemented using discrete components or as integrated circuits (ICs).Motor driver ICs typically integrate multiple functions, such as PWM control, current sensing, and protection features, into a single package, making them easier to use and reducing the amount of external components required.

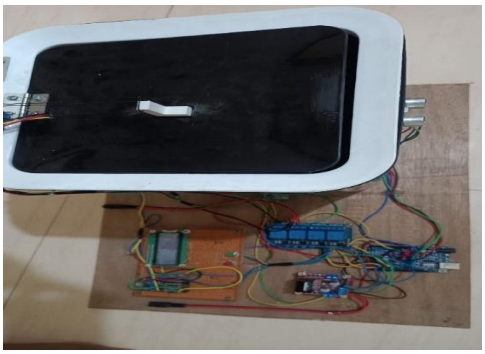
Servo Motor: A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision.

If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor.

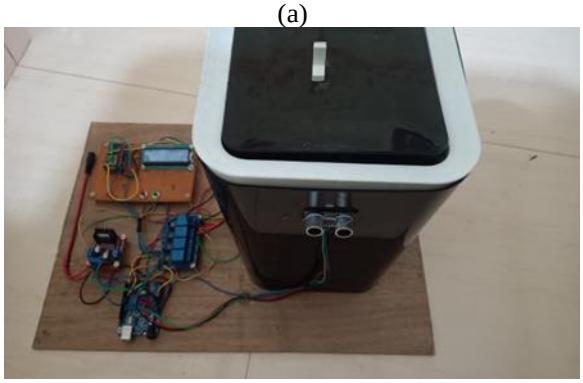
Relay: A relay is an electrically operated switch that is commonly used to control circuits with high voltages or currents using a low-power signal. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. It consists of an electromagnet that, when energized, pulls a set of contacts together or apart, allowing or blocking the flow of current through the circuit.

V. IMPLEMENTATION

The first component in this system is a adapter for the power supply, which is responsible for providing the electrical energy needed to power the other components .Ultrasonic sensor ranging module HC - SR04 is used to detect the level of garbage. The ultrasonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor. Ultrasonic sensors can detect movement of targets and measure the distance to them. Sensors can have an on or off digital output for detecting the movement of objects, or an analog output proportional to distance.



(a)



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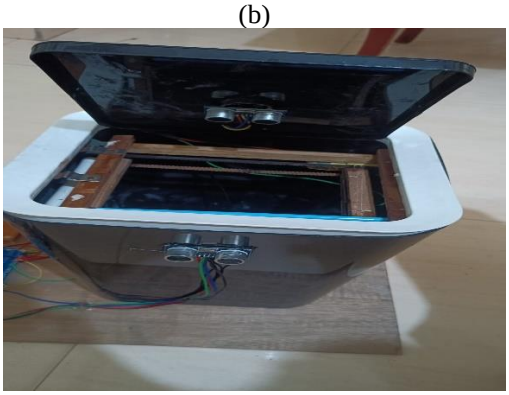

(c)

Figure 2: Working Model

ESP8266 is a wifi module for monitoring the garbage level in the dustbin bin using ultrasonic sensor.ESP8266 collects the data and the output sent to the relay.

Figure 3: Waste Dustbin at Choosen Location

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A relay used in this system is to control the power supply to the sensors or communication module based on certain conditions. The relay can be controlled by the microcontroller or microprocessor used in the garbage monitoring system. The microcontroller can read the sensor data and determine when to turn the relay on or off, based on predetermined parameters set by the user to access the Arduino that is connected to the motor driver . The use of a motor driver in a garbage monitoring system can improve its efficiency and reliability. It will rotate the motor as per the button state in the Arduino. It can also reduce the risk of littering and overflow of garbage bins or dumpsters.

A servomotor can be used in a garbage monitoring system to control the position of the lid of the garbage bin or dumpster. In this scenarios, S where the lid needs to be opened automatically to allow garbage to be deposited, and then closed to prevent animals or pests from accessing the garbage.

The use of a servomotor in a garbage monitoring system can improve its efficiency and reliability, by automating the process of opening and closing the lid of the garbage bin or dumpster. This can reduce the risk of littering, prevent animals or pests from accessing the garbage, and ensure that the garbage is disposed of properly. Additionally, it can reduce the need for manual intervention, which can save time and labor costs.

The DC motor is typically controlled by a motor driver, which receives input from the sensors or the microcontroller used in the garbage monitoring system. In this case, if the garbage bin or dumpster is getting full, the microcontroller can use the motor driver to activate the DC motor, which moves the garbage bin cover back and forth and the cover gets heated when the bin is overflowed.

A force sensor can be used in a garbage monitoring system to measure the weight of the garbage in the bin or dumpster. The force sensor is typically installed at the bottom of the garbage bin or dumpster and is connected to the microcontroller or microprocessor used in the garbage monitoring system. As garbage is added to the bin or dumpster, the weight of the garbage increases, causing a change in the force measured by the force sensor. The microcontroller or microprocessor can then use this information to determine when the garbage needs to be collected.

An LCD (Liquid Crystal Display) used in a garbage monitoring system to display important information about the status of the garbage bin or dumpster. The LCD can be used to display the current weight of the garbage, the status of the garbage level that is full or low. The LCD is typically connected to the microcontroller or microprocessor used in the garbage monitoring system, which receives input from the sensors and controls the display of information on the LCD. For example, if the weight of the garbage exceeds a certain threshold, the microcontroller can display a message on the LCD indicating that the garbage needs to be collected.

Blynk is an android application that allows the user to build user-friendly mobile output interface for operating, monitoring and controlling hardware projects. It can be operated on both android and iOS platforms. Blynk supports different types of microcontrollers such as Arduino boards, Raspberry Pi models and ESP8266. Here Blynk has been employed as a mobile interface to monitor sensor output data obtained from hardware module of smart garbage monitoring system.

Arduino IDE (Integrated Development Environment) is a software application used to write, compile, and upload code to Arduino microcontroller boards. It provides an easy-to-use interface for programming Arduino boards and allows users to write and upload code without needing to know the details of the underlying hardware. The Arduino IDE also includes a number of built-in libraries and functions that can be used to control the various components of an Arduino board, such as digital and analog pins, sensors, and actuators. These libraries and functions can be easily accessed and integrated into code using the IDE's graphical user interface.

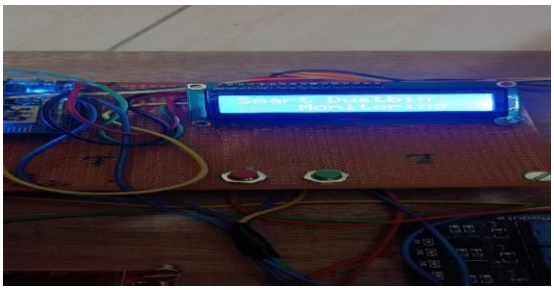

Figure 4: LCD Indication of Garbage Level

Figure 5: Garbage Level Using Blynk App

VI. WORKING

The working principle of this project works in two scenario. One of the scenario is mainly used component in this Internet of things project is ESP8266 which is a popular wifimodule for monitoring the garbage level of garbage bins using ultrasonic sensors. The working of Ultrasonic sensor transmits the ultrasonic waves, if the object is present in front of the sensor then the waves gets reflected back to the echo pin in the ultrasonic sensor and measures the distance between the sensor

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and the object.This ultrasonic sensors are mounted inside the bin to read the level of garbage fills and the output of the ESP8266 is sended to the relay. The relay acts as a switch mode, when the relay is high ,it will trigger the Button State in the Arduino. The motor will act according to the buttonstate by going front and backward. In second Scenario, Servo motor is used to control the opening and closing door of the garbage bin. It also includes a sensor to detect objects in front of the door. It does this by first moving the Servo motor to a specific angle to lift the door, then activating the door opener by setting the appropriate pins to HIGH and LOW, waiting for a while, and then closing the door by reversing the pins. After completing the process then the Servo motor moves back to its original position. And the garbage cover is sealed by using Dc motor with the help of motor drivers and the cover is sealed by heating the garbage cover and the caver can be taken by the user.

VII. CONCLUSION

The Implementation of Garbage Monitoring System can be a valuable tool for municipalities and waste management companies to optimize their waste collection processes and reduce costs. By using sensors, motors, communication devices, and the system can monitor the level of garbage in bins and automatically closes the garbage cover inside the dustbin and provide real-time data and analytics to optimize collection routes and schedules.

The system can also help to improve the overall cleanliness of the environment by ensuring that garbage bins are emptied regularly and efficiently. By automating the garbage collection process, the system can reduce the amount of time and resources needed for waste management, and minimize the impact of waste on the environment. Overall, Garbage Monitoring System can help to provide clean environment surroundings and reduces the cost for both consumers and companies.

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