SMART DUSTBIN USING ARDUINO

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Abstract— An exponential increase in Human population possess a huge challenge to garbage management system and hence in sustaining a clean Environment. Numerous Cities all over the world are endangered because of poor garbage management. This paper investigates the region of the arrangement of waste disposal and waste management with the help of technology. It gives a detailed explanation of how we can accomplish the objective of 'Clean India' along with the utilization of Arduino, sensors, servers, and, and even human psychology. In the COVID-19 pandemic, we observed the risk of contamination is high in the case of the cleaning staff of Hospitals. So, to limit the risk somewhat we can execute an automated dustbin. Considering this fact, the project escalated with amendment's overtime. Working throughout the course, the project is now completed. The project's outcome is a working remote-operated robotic dustbin named 'Smart Dustbin' with a range ranging from a minimum of 3 meters, which can be extended up to 100 meters. This dustbin can be worked by the cleaning staff from a safe operation chamber and collect waste from confirmed contaminated persons reducing the risk of contamination for the workers of the Hospital.

Introduction :-

The rate increasing population in our country has increased rapidly and also we have an increase in garbage which have increased environmental issue. A dustbin is a container that collects garbage or stores items which recyclable or non-recyclable, decompose, and non-decompose. They are usually used in homes, office, etc, but in case they are full no one is there to clean them and the garbage are spilled out. The surrounding of a dustbin is also conducive to increasing the pollution level. In this manner, we have designed a smart dustbin using ARDUINO UNO, an ultrasonic sensor that will detect the thing to be thrown in the dustbin and open the top with the help of the motor. It is a decent gadget to make your home clean, practically all offspring of home consistently make it grimy and spread litter to a great extent by electronics, rappers, and various other things.

This paper presents a cost-effective and efficient design of an intelligent waste collector which aims to reduce the risk of contamination for the Hospital workers. This framework depends on two significant tasks. The first is the mobility of the bot to its destination. For that, we have an operator equipped with the remote far off which controls the bot carrying the waste container. And second is that it opens and closes its lid sensing the presence or absence of the user respectively. The working prototype is a powered 5 V DC power supply. The input provided by the operator is a parallel input that is converted to series data with the help of an encoder which is transmitted wirelessly through the Bluetooth module of a range of 3 meters which can be an extender up to 100 meters. Thus received data is decoded by a decoder which is needed for the motor driver module which runs the BO motor. This way our bot can arrive at its destination based on the data given to it from a distant operator. For opening and closing, we are using a Servo motor equipped with the limiting switch. The proximity sensor has 2 infrared LEDs which emit and receive infrared light respectively. They sense the presence of the user through the process of reflection of infrared radiation and show a change in electrical parameter which is then compared with the known value with the help of the operational amplifier. If there is a user, the motor operates causing the lid to open, and if the user leaves the dustbin, the lid closes itself.

LITERATURE REVIEW

Notable research work is already done in this field and one of the recent related work is done by S. Zavare and her colleagues [1] on sensor nodes connected to an Arduino board-based control system that uses a GSM module to send prior alert messages to the municipality by a server hosting web application. The whole system including a GPS module for tracking the bin and ultrasonic sensor was interfaced with Node MCU whose built-in Wi-Fi module was used to connect the control system. Apart from all these works, a smart solid waste management system is designed by Trushali S. Valade and her group [2], which will check the status and give an alert of dustbin fullness all the more altogether framework has a component to proficient individuals to utilize dustbin appropriately and to consequently detect and encourage to clean garbage present outside the dustbin. However, one more work done by Rishabh Kumar Singhvi and his group [3] in implementing a system based on the Internet of Things (IoT) that cannot only send a message to the enterprise about the overflow and toxicity level of the dustbins but additionally a site is likewise developed to supervise the data related to the dustbins. The message is sent utilizing the GSM module to

the cell phone and information connected with the dustbin status is refreshed on the website. On this site, People can likewise submit grumblings connected with dustbin or waste administration. In the suggested framework, Arduino is utilized as a microcontroller to interact between GSM/GPRS module with Ultrasonic and gas sensors that are utilized for estimation of level and poisonousness separately. Moving further, research on Smart Bin Implementation for Smart Cities done by Narayan Sharma, Nirman Singha, and Tanmoy Dutta is a work of consideration. They didn't create a smart bin, but by enabling sensors on them, they connected many smart bins throughout the area with the help of the cellular network, which helped in analyzing a large amount of data about waste management around the city [4]. Whenever we are talking about user-friendly improvements, significant work is done in this by Ahmed Imteaj and his group [5]. This system being an android based application where the user himself can contribute to cleaning his city, it notifies volunteers to come forward so that they can inform the city corporation. The amenities of this application are - it enables the user to detect a nearby dustbin's location with path, helps to see an available volunteer on the map, notifies them using google push service notification, and guides them on how to submit a report to authorities if a problem arises. All this work has been done on notifying the municipality and volunteering and maintaining hygiene problems, but the main psychological area was left untouched. It has always been a human tendency to ignore things that won't satisfy their greed in any way, and so in this research paper, we have developed a system that can not only notify the municipality when it is full but also attracts the users by giving them some credits per usage. This framework is a sensor connected and deals with QR code checking which opens the lid of the dustbin automatically when a user approaches as well as instructs the user how to utilize the dustbin through an LCD display.

PROBLEM DEFINITION

Hospital staffs are among the frontline workers who fight against contagious diseases. They are constantly in contact with an infected person in the hospital and also with healthy people during their off-hours. So, they can serve as a disease carriers. This was among the major problem which made COVID-19 difficult to control. In this era, we must be prepared for more dangerous outbreaks than COVID-19. The exponential growth of population and increase in population density of the world possesses difficulty in controlling the contageeneous diseases. So, to minimize this problem to some extent our smart dustbin, which is a remote-operated waste bin can be some help.

Motivation

This project is designed to help overall human beings by reducing the risk of contamination of the hospital cleanliness staff by a contactless collection of the waste. We

observed that during the COVID-19 pandemic the risk factor for the cleaning staff of the hospital was high as they had to be in contact with the confirmed contaminated patients for cleanliness and also they get in touch with other non-contaminated people. So, we can use robots instead of humans for such works.

Objectives

- To move the dustbin to the desired position through wireless.
- To open and close the lid of the dustbin detecting the presence or absence of its user respectively.

Materials and METHODOLOGY

Smart dustbin using Arduino and sensors is an IOT-based project. Here we are using Arduino for code execution, for sensing we used an ultrasonic sensor that will open the lid and wait for a few moments. It will bring drastic changes intern of cleanliness with the help of technology. Everything is getting with smart technology for the betterment of human beings. So this helps in maintaining the environment clean with the help of technology. It is an IOT-based dustbin so it can be easy to use for any age group. Our aim is also to make it cost-effective so that many numbers of people can get the benefit from this. Furthermore, it should be useful to anybody and accommodating for them. To finish our project, we require some software as well as some Hardware.

Software Requirement :

Arduino IDE
Hardware Requirements :

Arduino UNO
Arduino Mega
Dustbin
Servo motor
IR Sensor
LED's
Jumper wires
Wooden Board
Motor Driver
Motors
Bluetooth Module
Breadboard
Rechargeable Batteries
Switch

PROCEDURE :

Now, let's come to the actual setup and build process of the Smart Dustbin using Arduino. First, start with the mechanism to open the lid. We have used Arduino Mega, Servo Motor, and IR sensors for this purpose. In order to

open the lid, we have used LEDs, Buzzer, and a GSM module that monitors the level of dust in the dustbin, that shows the level with LEDs and when the dustbin gets filled Buzzer makes a sound and Send SMS alert to the person. Second, comes the mechanism for the make Movement to the dustbin. We have used a Motors and Motor driver, IR Array, and Bluetooth module. So it can be controlled Manually by the person or Automatically (Line Follower).

Arduino Mega :

The microcontroller board like "Arduino Mega" depends on the ATmega2560 microcontroller. It includes digital input/output pins-54, where 16 pins are analog inputs, 14 are used like PWM outputs hardware serial ports (UARTs) – 4, a crystal oscillator-16 MHz, an ICSP header, a power jack, a USB connection, as well as an RST button. This board mainly includes everything which is essential for supporting the microcontroller. So, the power supply of this board can be done by connecting it to a PC using a USB cable, or battery or an AC-DC adapter. This board can be protected from the unexpected electrical discharge by placing a base plate.

Arduino is an open-source prototyping platform based on easy-to-u... ...ware. Arduino consists of both a ph... ...circuit board and a piece of software, ...Development Environment) that runs ... ...used to write and upload computer ... ...oard.
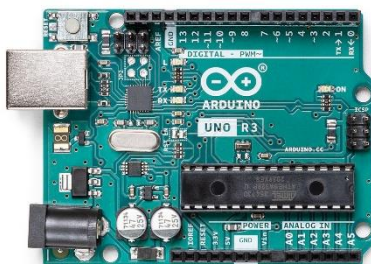
Servo Motor :

A **servo motor** is a type of motor fitted at the top of the dustbin to open the lid of the dustbin, 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.

IR sensor :

The IR sensor or infrared sensor is one kind of electronic component fitted in the front top of the dustbin, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion.

ULTRASONIC SENSOR :

After successfully servo motor and IR sensor are placed now it's time for the sensor, so the HC-SR04 Ultrasonic sensor is placed inside of the dustbin to monitor the Dust level inside the dustbin with the help of LEDs and a buzzer.

GSM Module :

SIM800L is a miniature cellular module that allows for GPRS transmission, sending and receiving SMS, and making and receiving voice calls. After connecting power module boots up, searches for the cellular network, and login automatically. It sends the alert message of the dustbin getting full to the person.

IR Array :

An IR sensor array consists of 5 TCRT 5000 sensors at the bottom, an IR sensor emitter and receiver arrangement at the front to detect obstacles or obstructions, and a bump switch (more commonly known as a limit switch). The array can be used effectively in robotic applications like a line follower robot.
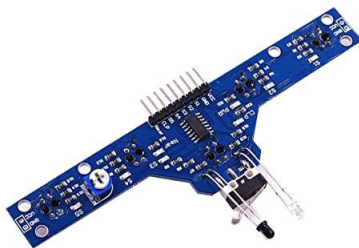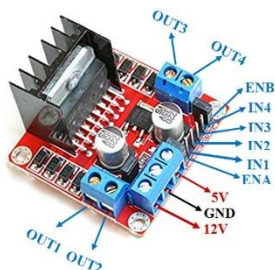

Bluetooth Module :

It is a small wireless serial communication module that can be connected with a Micro-Controller to receive and send data when connected with other Bluetooth devices.

Motor and Motor Diver :

It is a small circuit that hoists the motor driving IC and can control two motors at the same time. It controls the motor speed by pulse width modulation (PMW).

Li-ion Rechargeable Batteries :

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters.


Arduino IDE :

The Arduino integrated development environment (IDE) could be a cross-platform application written in Java, and derives from the IDE for the process programing language and also the Wiring projects. It's designed to introduce programming to artists and different newcomers unfamiliar with code development. It includes a code editor with options like syntax highlighting, brace matching, and automatic indentation, and is additionally capable of compilation and uploading programs to the board with one click. A program or code written for Arduino is named a "sketch". Arduino programs are written in C or C++.

**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. All the wires from all the components i.e. Ultrasonic Sensor, IR sensor, Servo Motor LEDs Buzzer, GSM module, Motor and Motor Driver, Bluetooth Module, IR Array are connected to respective pins of Arduino. This finishes up the build process of the Smart Dustbin. In Arduino code has been submitted, and with all hardware and software connections in Dustbin. We will run our dustbin, and wait if it's working or not.
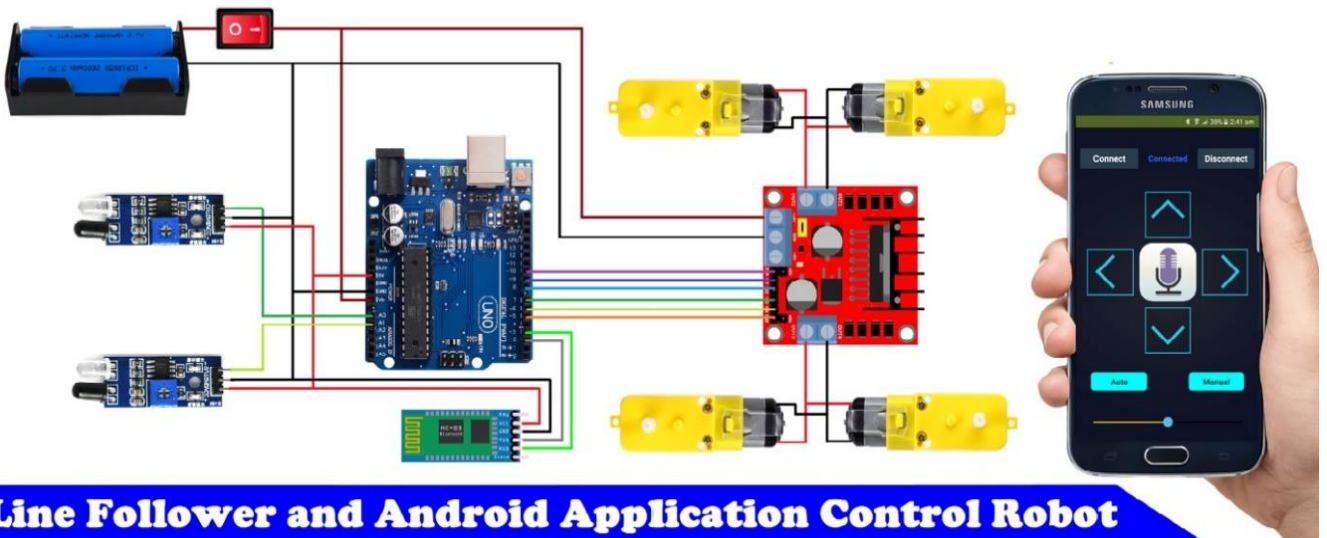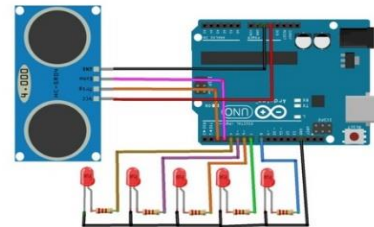
Circuit Diagram :-
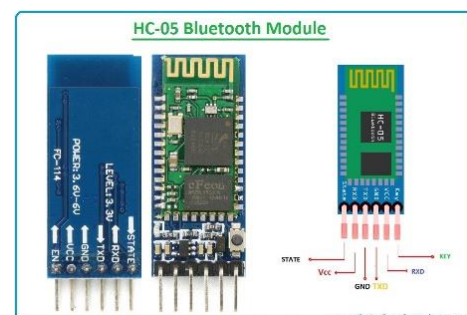
Dustbin using IR sensor and servo motor
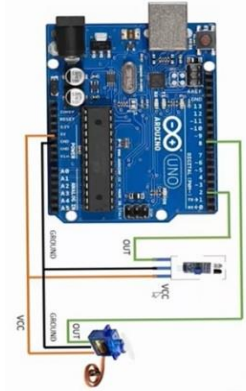
LED's distance Indicator

Line Follower and Android Application Control Robot

BLOCK DIAGRAM

USER INPUT

PHOTO EMITTER → PHOTO DETECTOR → SIGNAL PROCESSOR

IR TRANSMITTER   IR RECEIVER   VOLTAGE COMPARATOR

BLOCKING OBJECT

MOTOR 1 ← N/O ← RELAY ← DRIVER CIRCUIT ← (VOLTAGE COMPARATOR)

OPENING OF LID   SWITCH   CURRENT AMPLIFER
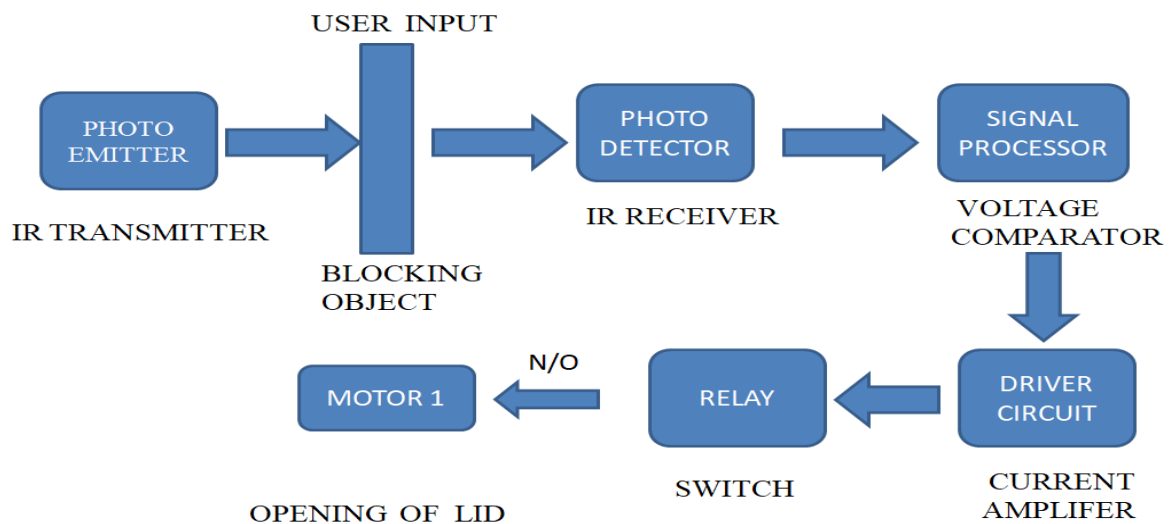
BLOCK DIAGRAM
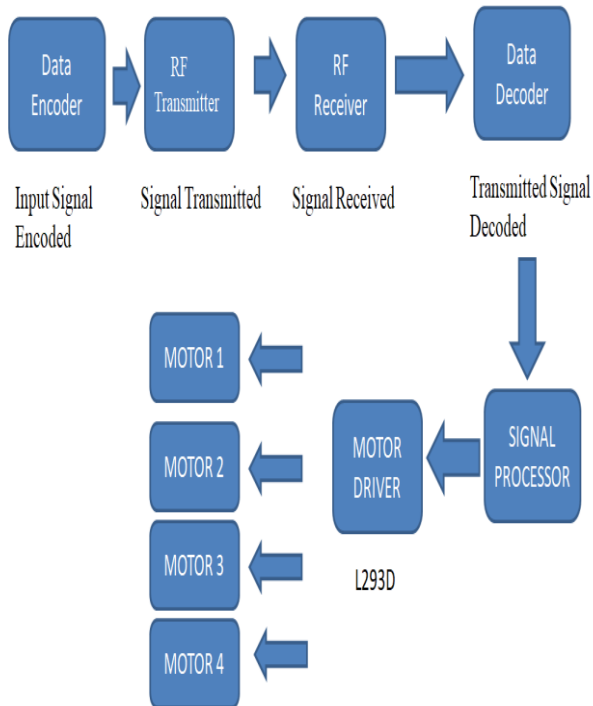
Working :-

After wiring and attaching all the devices and setting up to the Smart Dustbin, now observe all the important setups whether they are well connected or something missed. After the connection is set up now next step is to submit/upload code in Arduino and supply power to the circuit.

The input signal that needs to be processed is obtained in the form of infrared light which is not visible from naked eyes. This signal is obtained from an IR transmitter. Then it reflects back after its incidents on a reflecting surface. The reflected light is then sensed by the IR receiver. Here the IR receiver is reverse biased as it working is in a reverse-biased region. Well, both the receiver and emitter and connected in parallel output and are taken from the receiver end connected in series with a resistor of 10k. The photo receiver receives the light which is observed by the change in potential difference. The voltage here varies from 0.3v to 0.6v approximately. But it may differ with the environment. The distance of reflection is inversely proportional to the voltage drop from the receiver. So when the object comes nearer to the sensor then it gives more voltage drop and so is true for the reverse case. When the system is powered ON, Arduino keeps monitoring for any things that come near the sensor at a given range. When an Ultrasonic sensor detects any object, for example, a hand or others, here Arduino calculates its distance and if it is less than a certain predefined value then the servo motor gets to activate first, and with the support of the extended arm of the lid. The lid will open for a given time then it will automatically close. Then the ultrasonic sensor which is fitted inside the dustbin measures and monitors the dust-filled inside the dustbin, when the dustbin is empty with the help of LEDs it indicates a green signal when the dustbin is half-filled it indicates a yellow signal, and when finally dustbin gets filled it indicates Red light and starts buzzer sound. It sends the SMS alert to the person's mobile that the dustbin gets full please Empty it.

Five rechargeable batteries as supply are used which are connected to the motor driver and Arduino respectively. When the circuit is energized, we will have to first pair the android phone with the Bluetooth module through the phone's Bluetooth setting the default password of the Bluetooth module will be ‗1234'. Once the phone gets paired open the application ‗CAR BLUETOOTH RC' which we can download from the ‗Google play store'. on opening the application there will be sets of control displayed on the screen. On the app screen you can there are two modes one is Manual and the second is Automatic. In the manual mode If the device has not been connected the control will be locked meaning the control buttons cannot be pressed. When the car is at its initial position the application automatically sends the command ‗S' meaning stop. The stop command is put in a loop that keeps on repeating throughout the execution of the program. As the user presses any control buttons the stop command will be interrupted by the move forward, backward, right, or left, depending on the user and the car moves likewise. The program is designed in such a manner that we can also give two commands at the same time i.e. move front and turn right or left and the same with the backward motion. Now second comes Automatic mode in automatic mode the dustbin with the help of IR Array follow the black line marked on the floor and reach to the person wait for some seconds, a person put the garbage in it after work done dustbin return to its initial position. The Arduino also stores the program in its memory so it does not require re-uploading of the Program. The IN1, IN2, IN3, and IN4 are the inputs for the motor driver that receives the command from the Arduino for the two motors respectively. The motor driver should be grounded with the Arduino ground pin (GND). The motor driver requires a minimum of 6v and above to run, any voltage below 6v the motor remains off. The RXD pin of the Bluetooth module is for receiving commands from the Android devices and sends to Arduino through this pin and the TXD is for transmitting or sending dates or information. It is supplied with a 5v dc source from the Arduino 5v pin. The main part of the above circuit diagram is Arduino UNO. The power supply section is very important. It should provide constant voltage to the devices for the successful working of the project.

Advantages :-

Following are the advantages of using Smart dustbin:

- A reduction in the number of waste collections needed by up to 80%, resulting in less manpower, emissions, fuel use and traffic congestion.
- System is used to indicate the level of wastages filled.
- A reduction in the number of waste bins needed.
- Maintain environment hygiene (i.e. no overflowing of waste and less unpleasant odor).
- It will help in bringing evolution by technology in term of cleanliness.

reducing the overall cost of solid waste management aided by solid waste segregation at the source itself and also by reducing the spread of pollution to a great extent. Moreover from a social point of view the persons involved in garbage collection, segregation, and disposal will be prevented from being infected and paving the way for their healthy well-being.

Result :-

The project 'Smart Dustbin' is completed with a fully functional prototype that meets all objectives of the project. The robotic dustbin receives the command from its operator and moves to different locations. It also does another task it is designed for, it opens its lid itself when the potential user of the dustbin approaches the dustbin and closes its lid when there is no user. It has been tested under different conditions and the different nature of the user, so far we have seen no big issues in our prototype.

Future Plans :-

The smart dustbin can be improvised to a large extent to include automatic segregation of different waste into biodegradable and non-biodegradable wastes so that a major issue hampering the solid waste management system can be resolved. With further improvement mechanisms to shoo away animals and birds from feeding and polluting the environment can be done. Thus these measures can reduce the Human cost involved and helps in

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