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Smart Garbage Bin

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ABSTRACT

Garbage management is real trouble in society. The population and the garbage also are increasing proportionally. Many times, we see that the garbage bins are placed in public places are overflowing. The negligence of authorities and carelessness of the public create an unhygienic condition for the people, lead to health problems (some deadly diseases & human illness) and also create bad smell which causes damage to local ecosystems. Here we propose a smart garbage bin that can detect the level of garbage at various parts of the dustbin, level of garbage can be monitored via an app and sends message alert to respective authorities to collect that trash when it crosses a threshold level.

Keywords: Waste management system, Arduino IDE, Ultrasonic sensor, Bluetooth, Kodular

1. INTRODUCTION

Solid waste management has become one of the main concerns nowadays. In the present circumstance the amount of solid waste in the city is growing exceptionally with the economical and industrial up-gradation, change in utilization, increase in population, and way of life of the urban population. The traditional way of monitoring the wastes in waste bins is a hectic process and utilizes more human effort, time, and allowed budget gets depleted on waste gathering and transportation that can avoid with our present technologies. In this project, we have proposed a model that can store and detect the level of waste also. An app has been developed to monitor level of waste in the waste bin. If bin is filled up to a certain level, then it will send a message to the responsible authority to clean it up. This bin will be useful for college, school campuses as well as office cubicles also. Anyone can use it for domestic purposes also.

2. ARCHITECTURE OF PROPOSED SYSTEM

In general, we use the pedal waste bins for storing wastes in college, school campuses as well as office cubicles, hospitals, etc. This pedal mechanism is very simple as a foot is pressed on the pedal (A) linkage B moves downwards linkage C moves upwards. Linkage C is connected to moving pivot D on the lid. Pivot E is fixed and allows rotation of the lid.

Our proposed model has an ultrasonic sensor on the front side of the pedal waste bin. This sensor is mounted on the bin and attached by m-seal. If anyone comes closer to the bin up to 15cm range then the bin will open, it will remain open for 6 sec then the lid will be closed again. Here we have used a rack and pinion along with a servo meter. Ultrasonic sensor senses object within range of 15 cm then servo motor rotates pinion. Rotating pinion helps rack to slide through a casing in a downwards direction. The sliding rack creates pressure on the pedal which helps to open the lid of the bin.

If this bin becomes 99.99% then the lid will not open still anyone comes closer to a range of 15 cm of the bin.

3. HARDWARE DESCRIPTION

3.1 Pedal Bin

This pedal mechanism is very simple as a foot is pressed on the pedal (A) linkage B moves downwards linkage C moves upwards. Linkage C is connected to moving pivot D on the lid. Pivot E is fixed and allows rotation of the lid.



Figure 1: Pedal bin

3.2 Ultrasonic Sensor

An ultrasonic sensor can convert electrical energy into acoustic waves and vice versa. The famous HC SR04 ultrasonic sensor generates ultrasonic waves at 40kHz frequency. Typically, a microcontroller is used for communication with an ultrasonic sensor. To begin measuring the distance, the microcontroller sends a trigger signal to the ultrasonic sensor. The duty cycle of this trigger signal is 10µs for the HC-SR04 ultrasonic sensor. When triggered, the ultrasonic sensor generates eight acoustic (ultrasonic) wave bursts and initiates a time counter. As soon as the reflected (echo) signal is received, the timer stops. The output of the ultrasonic sensor is a high pulse with the same duration as the time difference between transmitted ultrasonic bursts and the received echo signal. Theoretically, the distance can be calculated using the TRD (time/rate/distance) measurement formula. Since the calculated distance is the distance traveled from the ultrasonic transducer to the object—and back to the transducer—it is a two-way trip. By dividing this distance by 2, you can determine the actual distance from the transducer to the object. Ultrasonic waves travel at the speed of sound (343 m/s at 20°C). The distance between the object and the sensor is half of the distance traveled by the sound wave. The following equation calculates the distance to an object placed in front of an ultrasonic sensor:

Equation

$$distance = \frac{time\ taken \times speed\ of\ sound}{2}$$



Figure 2: Ultrasonic Sensor

3.3 Rack and Pinion

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. A rack and pinion drive can use both straight and helical gears. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railroad car engages a rack placed between the rails and helps to move the train up a steep gradient.



Figure 3: Rack & Pinion

3.4 Bluetooth Module

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth. It has 6 pins, Key/EN, VCC, GND, TXD, RXD, State. E.g., Send data from Smartphone terminal to HC-05 Bluetooth module and see this data on PC serial terminal and vice versa. To communicate smartphone with HC-05 Bluetooth module, smartphone requires Bluetooth terminal application for transmitting and receiving data. You can find Bluetooth terminal applications for android and windows in respective app. store. o, when we want to communicate through smartphone with HC-05 Bluetooth module, connect this HC-05 module to the PC via serial to USB converter.

Before establishing communication between two Bluetooth devices, 1st we need to pair HC-05 module to smartphone for communication.

Pair HC-05 and smartphone:

Search for new Bluetooth device from your phone. You will find Bluetooth device with “HC-05” name. Click on connect/pair device option; default pin for HC-05 is 1234 or 0000.

After pairing two Bluetooth devices, open terminal software (e.g., Teraterm, Realterm etc.) in PC, and select the port where we have connected USB to serial module. Also select default baud rate of 9600 bps.

In smart phone, open Bluetooth terminal application and connect to paired device HC-05.

It is simple to communicate, we just have to type in the Bluetooth terminal application of smartphone. Characters will get sent wirelessly to Bluetooth module HC-05. HC-05 will automatically transmit it serially to the PC, which will appear on terminal. Same way we can send data from PC to smartphone.



Figure 4: Bluetooth Module

3.5 Arduino Uno

The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family. Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. The ATmega328P can easily be replaced, as it is not soldered to the board. The ATmega328P also features 1kb of EEPROM, a memory which is not erased when powered off. The Arduino UNO features a barrel plug connector, that works great with a standard 9V battery.

Table 1: Arduino Uno Specification

Board	Name	Arduino UNO R3
	SKU	A000066
Microcontroller	ATmega328P	
USB connector	USB-B	
Pins	Built-in LED Pin	13
	Digital I/O Pins	14
	Analog input pins	6
	PWM pins	6
Communication	UART	Yes
	I2C	Yes
	SPI	Yes

Power	Circuit operating voltage	5V
	Input voltage (recommended)	7-12V
	Input voltage (limit)	6-20V
	Supported battery	9V battery
	Battery connector	Power jack
	DC Current per I/O Pin	20 mA
	DC Current for 3.3V Pin	50 mA
Clock speed	Main Processor	ATmega328P 16 MHz
	USB-Serial Processor	ATmega16U2 16 MHz
Memory	ATmega328P	2KB SRAM, 32KB FLASH, 1KB EEPROM
Dimensions	Weight	25 g
	Width	53.4 mm
	Length	68.6 mm



Figure 5: Arduino Uno

3.6 Jumping Wire

A jump wire (also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

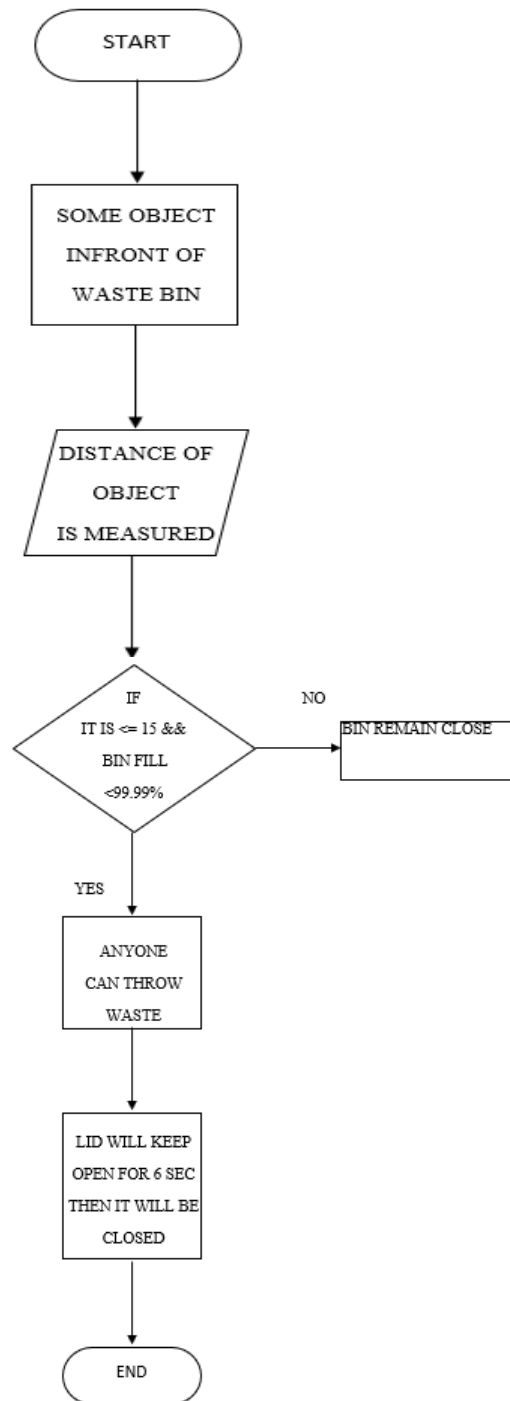


Figure 6: Jumping Wire

4. App for Monitoring Purpose

We have used Kodular to develop this application named as “DUSTBIN MONITOR”. Kodular is a free online suite for mobile apps development. It mainly provides an online drag-and-drop Android app creator, on which everyone can create any kind of app without programming a single line of code. When anyone enters into app, he/she has to give a mobile number and then press that “SAVE NUMBER” button. This will save the number with in tiny database set. This number may belong to respective authority who will clean up the bin. Then we have to press connect button and before that we have to open bluetooth of our mobile phone. It will drive to a page where we have to pair the bluetooth module of waste bin. After that press the “FETCH STATUS” button to see the level of waste in bin. If level shows 99.99% then message will be sent to that earlier number and it will be “SMART DUSTBIN FULL PLEASE CLEAN IT UP”.

5. FLOW CHART



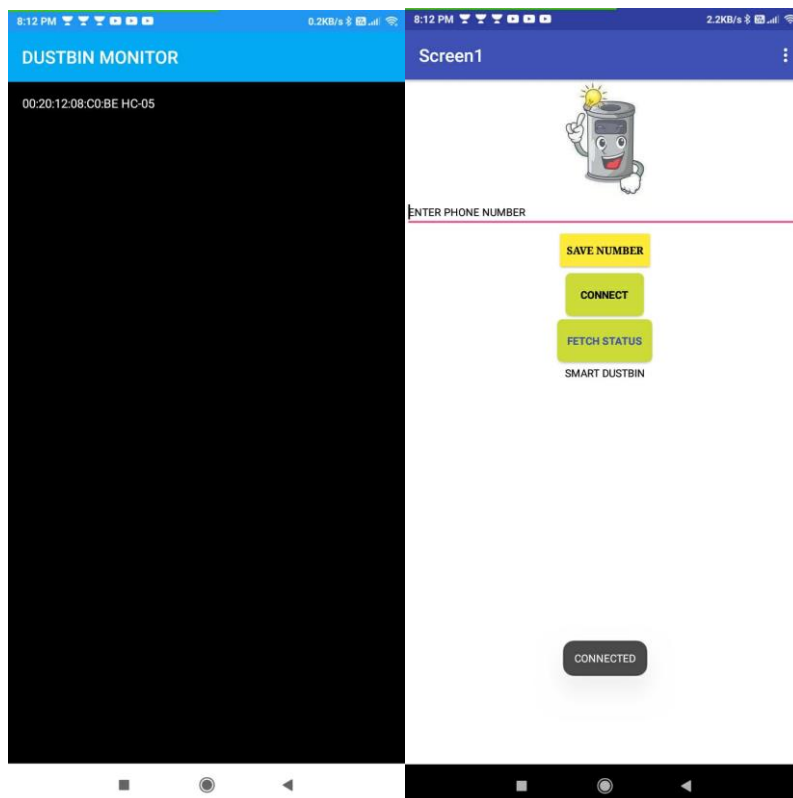
6. ADVANTAGE

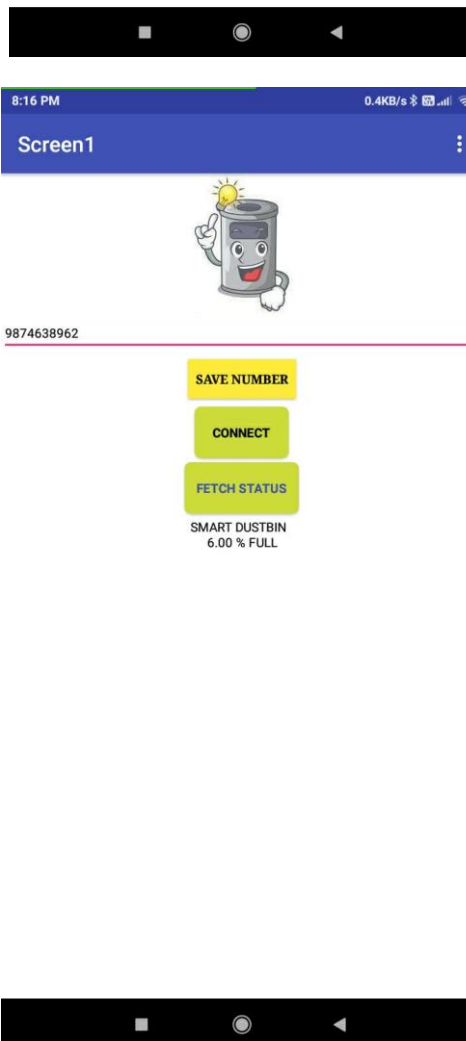
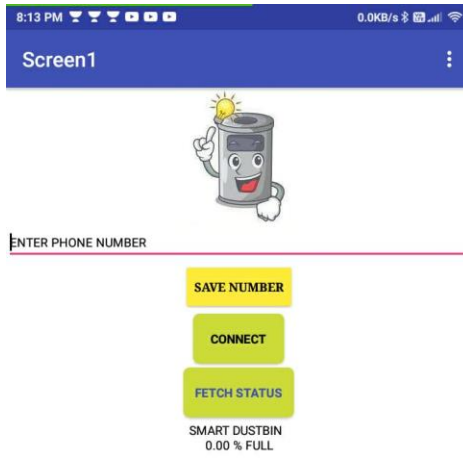
- Garbage level detection feature.
- Less manpower required for waste collection and transportation is reduced.
- Real-time and live data from the garbage bin can be obtained via app.
- Smart garbage bin makes any college and school campuses ‘SMART’ enough with efficient waste management.

7. APPLICATIONS

- School
- College
- Office cubicles
- Shops
- Shopping mall
- Hospital also

8. EXPERIMENTAL PROTOTYPE AND RESULTS





9. FUTURE WORK & CONCLUSION

We have presented a smart garbage monitoring system. The system is based on Bluetooth. It measures the waste level in the dustbins and sends this data to the database. The height of waste in the dustbin is calculated using the ultrasonic sensor. The threshold level may vary from the dustbin to dustbin as it depends on the dimension of dustbin and height at which the sensor is placed. After calculating the garbage level, if the detected value is above the threshold, then, the device will show it on app as well as sends message to particular mobile number provided earlier.

In the future, we can develop our application to show graph of waste levels according to time by time. From this data we can be able to predict at what time bins are used hugely. The processed data will be sent to the concerned authorities through email. The data can be viewed in the android app. We would like to enhance the system for different kind of wastes, namely solid and liquid wastes.

10. ACKNOWLEDGEMENT

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