SMART GARBAGE COLLECTOR AND DISPOSER

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ABSTRACT

With the advent of technologies, all the things around us are getting smarter. Since with the motive of a smart city, there is a need for smart waste management. This project depicts the model of a smart trash can for malls, airports, hospitals, schools and colleges. The Smart garbage collector and disposer is nothing but a normal dustbin modified with the help of embedded system enhancing it to be intelligent. Smart garbage collector and disposer is the new motive which uses sensors for trash level detection and automatic routing. It also uses DC motors and servo systems for movement and disposal of wastes to reduce human intervention in the domestic waste disposal. This can be used in real time to reduce human intervention in waste disposal.

KEYWORDS: Ultrasonic sensor, Waste Disposal, Servo motors, Atmega controller, Smart bin, Waste management.

I. INTRODUCTION:

In this modern era, it is frequent to see the dustbin gets overflowed due to improper disposal schedules and laziness. It creates unhygienic conditions with bad odour and is the root cause of many diseases [1]. Due to our busy lives, it is impossible to spend time for waste disposal or to monitor the dustbins. So, we have developed a model of Smart garbage collector and disposer which takes care of the disposal of wastes when it is full leaving no traces of residual wastes in the dustbin and maintains the healthy environment. The proposed model uses sensors to gather the data and monitor the number of wastes and motors to efficiently dispose of them. The proposed system provides solution for waste management problems by providing
1.Continuous monitoring of wastes.
2.Complete disposal without human efforts.

II. EXISTING WORK AND PROPOSED SYSTEM:

In existing system of the smart dustbin, the level of garbage in dustbins are detected using sensors and they are communicated to the user with GSM modules which requires the people to dispose of the trash in the bin [2][3]. Some of the systems use line following approach to translocate the bin from one place to the another and they also require people to dispose of the waste.

But in our system, it uses Ultrasonic sensors for sensing amount of trash in the bin and RF transmitter and receiver at the place to dump the waste. Automatic routing is done by using guided tape method.

Once when the appropriate amount of trash is reached the interrupt is sent to moving section and the motor is ON. Once when it is ON it moves following the line and once when the RF signal is received at the place where the wastes are to be dumped, the servo motors present in the system throws the trash into the main bin or dump yard. And once disposal is done the moving system along with the Bin reverts back following the same path and comes to its original place. All user wants to do is charge the battery.

III. METHODOLOGY:

The block diagram shows the components used in this Smart garbage collector and disposer.

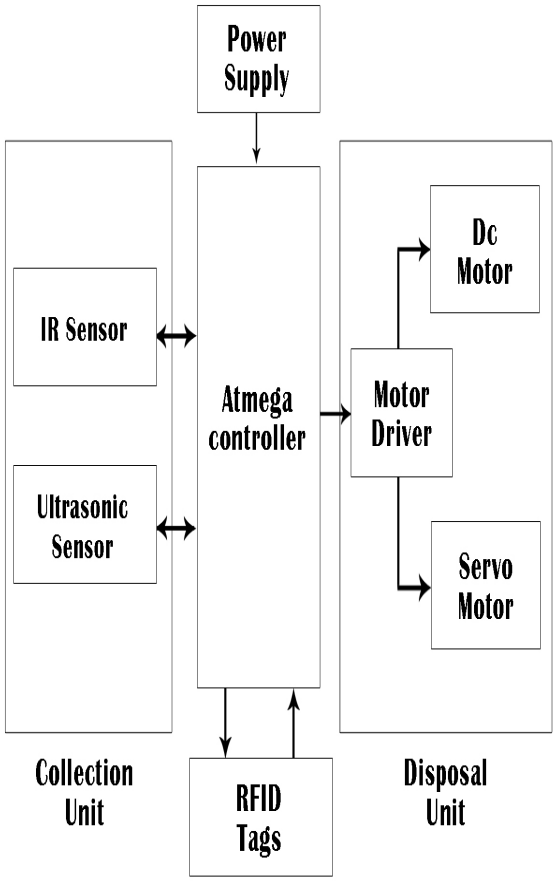

Fig.1. Block Diagram of Smart garbage collector and disposer

The IR sensors are used to detect the path for the guided motion of the moving system. The IR transmitters emit the infrared rays which are detected by the IR detector and appropriate signal is generated. The Ultrasonic sensors are used to check the trash level within the threshold and once the threshold is reached it sends an interrupt to the moving system for further actions. The RFID Tags are employed for the location of the place where the wastes are to be disposed. DC motor is used for movement based on the algorithm and the servo motor is used for disposal of wastes appropriately. The dustbin is used to collect the trash thrown by the people normally and once the amount of trash contained is more than the particular level above which the trash spills out the interrupt is sent to the microcontroller from Ultrasonic sensor. Once the microcontroller gets the interrupt signal it switches on the moving system and the whole system moves through the guided tape continuously till the near-field communication is established by RFID tags. And once it is established the system stops and the servo systems starts its operation to dispose the trash at that particular place. Once proper disposal is completed the moving system reverts back its operation follows the guided tape and then comes back to its original position and stops. This process continuous again and again when the trash level increases above the threshold level inside the bin.

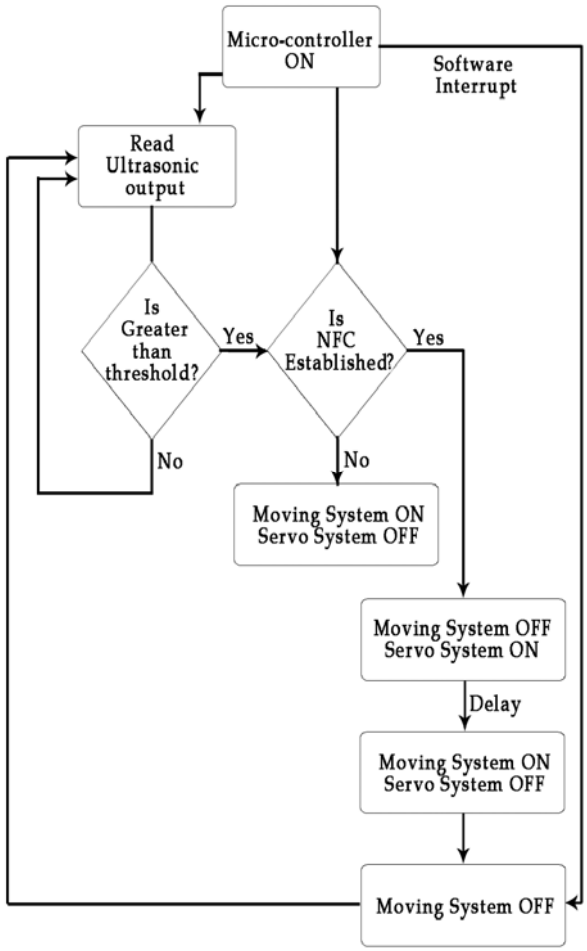

Fig.2. Software flow of Smart garbage collector and disposer

This way the Smart garbage collector and disposer maintains hygienic conditions of the place.

IV. DESIGN AND IMPLEMENTATION:

The Smart garbage collector and disposer can be divided into three modules one is the detection of trash, the second one is the movement of the dustbin to the predefined location and the third one is dumping of trash.

1.MODULE 1 - TRASH LEVEL MONITORING

Garbage level detection is done by using Ultrasonic sensors. The Bin is checked at regular intervals for the trash level and continuous monitoring is achieved by using ultrasonic sensor.

Once when the threshold is reached the flag is set for the motion of the bin [4].

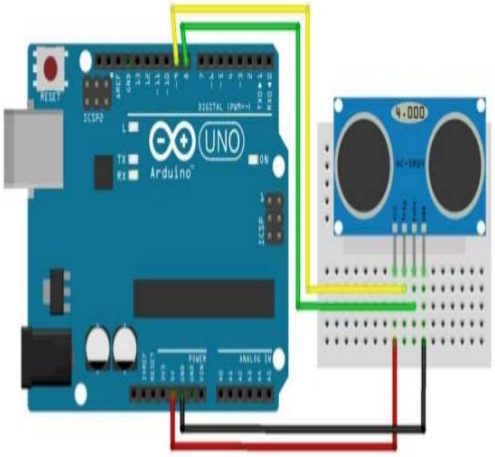

Fig.3. Interfacing Ultrasonic sensor in TinkerCad

2. MODULE 2 – MOTION OF TRASH CAN

The motion of the dustbin is based on the guided tape concepts which are related to light. An array of a sensor is used to detect the line. Based on the status of sensors, special circuit or controller decides the position of the line and also the required direction of motion required to follow the line [5]. The motor driver circuit is used to ON/OFF the LEFT/RIGHT motors of the robot to provide desired motion.

ALGORITHM FOR MOTION OF BIN:

STEP 1: Check the sensor output.
STEP 2: When both the left and the right sensor senses white then robot move forward.
STEP 3: If both sensors come on black line, the robot stops.
STEP 4: If left sensor comes on black line then robot turns left side.
STEP 5: If right sensor sense black line then robot turn right side until both sensors come at the white surface.
STEP 6: Goto Step 1.

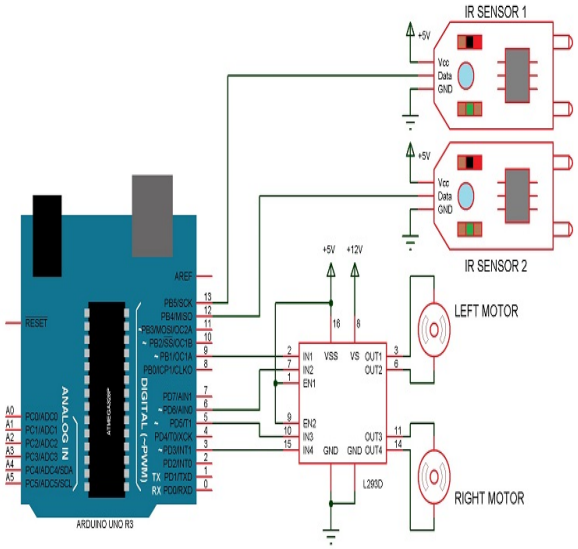

Fig.4. Interfacing IR sensor and motor using Proteus software

3.MODULE 3 – DISPOSAL OF TRASH

The trash disposal is done by the use of servo systems which are triggered once the Near field communication is established by RFID tags. Once NFC is established the servo motor moves forward and backwards at an appropriate angle to dispose the trash at a particular place [6][7].

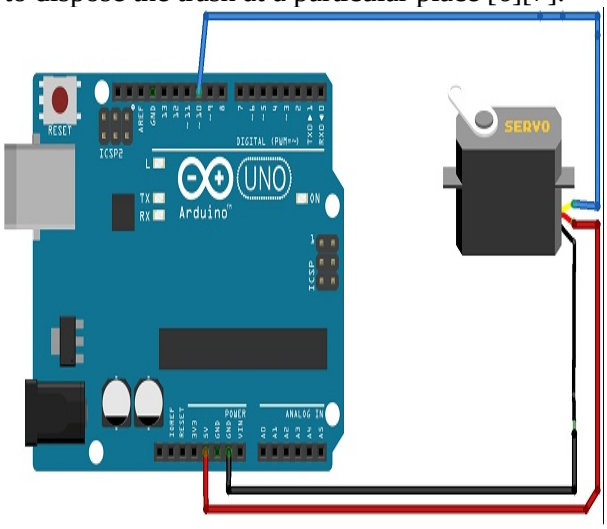

Fig.5. Interfacing servo motor using TinkerCad

4. CALCULATION OF TIME FOR THRESHOLD SETTING IN ULTRASONIC SENSOR:

The distance of the object by measurement of Ultrasonic sensor is given by
Distance= (travel time/2) * speed of sound.
Where the speed of sound is 340m/s. Time setting for the threshold is given by: Time

setting = 2 * Distance / Speed of sound. To set a threshold of 1m the time setting is given by:

Tu = 2 * 1 / 340 = 5882µs.

This time should be given as input to the microcontroller for detection of trash above 1m.

5 .POWER CONSUMPTION:

It is essential to calculate the power consumption for the system to design the battery ratings and the charging circuit.

The system consists of various components and devices has different power ratings and the total power dissipation of the system can be taken into account for designing battery ratings.

Here, V - Voltage, I – Current and P – Power dissipation.

The DC motor and servo motors are not used continuously. According to their usage power consumption is given and power consumptions of other components are calculated for one hour.

Table.1
Power Consumption table [8]

COMPONENTS	V(V)	I(A)	P(mWh)
Arduino	12	0.04	480
Motor driver	12	0.04	480
IR sensor	5	0.02	100
Ultrasonic sensor	5	0.05	250
DC Motor (5 mins)	12	0.3	300
Servo Motor (1 min)	12	0.3	60

The total power dissipation will be around 1.670Wh. So, the rating of the battery to be used is given by :-Battery rating = Power / Volts.

Battery rating = 1.670w * 24hrs / 12v = 3.34Ah So, the rating above this value would last for one full day and periodic charging should be done for continuity of service.

6 .RPM CALCULATION FOR SERVO MOTOR SELECTION:

Torque for the operation is given by Torque = Force * radius.

The force is given by the mass of the dustbin and radius is given by dimension of the motor. RPM is given by

RPM = (Power*60*Efficiency) / (Torque * 2)

. By using the datasheet and load requirements appropriate motor is used.

7 .OPERATING TIME CALCULATION FOR SPECIFIC ANGLE IN SERVO MOTORS:

The time setting for servo motor in microcontroller is given by the formula

Time for angle(µs) =

Req.Angle * UPD + Low Range.

UPD – Microseconds per degree (Generally 8). For 100-degree servo operation, the timing required will be:-

Tm = 100*8+450 = 1250µs.

This time should be given as input to the microcontroller for 100^{o} angle shift.

V. FEASIBILITY:

To take care of cost factor the side walls of the bin is laid with spaces for advertisements as it will be new tech and eye-catchy and also provides moving advertisements. The money from this advertisement will cover up the buying cost and maintenance cost of the Bin. This is a smart waste management technique as it involves less human intervention. This is effortless implementation and one-time investment and quicker cost recovery through advertisements. Presently, we have made it keeping in places like Airports, Malls, Business parks, Hospitals, Railway stations etc... and we will improve upon it to broaden the scope of places where it can be deployed. This innovation guarantees inculcation of healthy cleanliness habits being trendy in this context of time.

VI. CONCLUSION:

The complete design of the model is given and the circuit of Smart garbage collector and disposer is successfully implemented and the desired result is obtained. The path is laid and trial run is successfully completed. The complete disposal of trash at an appropriate time is done by this system which is the basic need in this context of time. The future prospectus may includewaste segregation techniques along with this bin.

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