

BUILDING AN ARDUINO BASED SMART DUSTBIN

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COMPUTER SCIENCE 207

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INTRODUCTION

The project I have decided to do is an Arduino Based Simple Dustbin. I have undertaken this project with a view to making the dustbin smarter. These days everything we use is becoming smart. Like the smartphone, smart tv, smart car, smart electronics, etc. In this era of smartness should not the dustbin be smart too?

Making a dustbin smarter may look like something silly but we can actually find a home where they don't use dustbin? The dustbin is a part of daily life. All the junks and disposable things of the house are stored before throwing them away.

The main idea of the Arduino based smart dustbin is that there will be an ultrasonic sensor attached with the body of the dustbin. When it will sense someone's presence within a certain radius the lid of the dustbin will open automatically with the help of the motor. Another ultrasonic sensor connected with a piezo buzzer will give out sound when the garbage reaches a certain level.

There are many makers who made smart dustbin. They tried to add more features to the smart dustbin making it more accessible to people. Like someone who is paralyzed up to a certain extent may find it hard to open a bin, but if it opens and closes on its own, less energy is needed by an individual. Details will be further discussed in the paper.

INSPIRATIONS

I am not the first person to come up with this idea of “Smart Dustbin”. There are many people out there who have made this project and took it to newer levels of advancement. There are dustbins that have the ability only not to open and close on its own but one can also control the movements of it with the phone. It can also detect the garbage level inside it and send notifications to then mobile.

I have browsed through different types of smart dustbin. The one I will be remaking is from the website bestelectronicsproject.com.^[1] This site helped me to identify clearly the materials that will be needed for the project including the type of motor and sensor I will need. In fact, a part of my code has been taken from this site to control the servo motor.^[1]

The site bestelectronicsproject.com made the smart dustbin by using a plastic bucket. For me, it is not possible to make the necessary holes to fit the ultrasonic sensor in it with home tools. So I will be using construction paper to make the structure of a dustbin.

DESIGNING PROCESS

The design of the Smart Dustbin is very easy and it takes a few hours to make it stand up. The smart dustbin is made of two ultrasonic sensors, one servo motor, a breadboard, the Arduino UNO, one piezo buzzer. The dustbin is made of construction paper.

The dustbin is made first. One can also buy any regular dustbin and then attach the microcontroller on it. Then holes are made in front of the dustbin to fit one ultrasonic sensor in the front. It is used to sense the presence of anything approaching the bin so that the lid opens with the help of a servo motor.

The reason I didn't buy any dustbin and turned it to a smart dustbin because it wasn't possible for me to make holes on plastic or tin using homemade tools. Also, I thought it would be fun to make the whole thing on my own. But one can buy a readymade dustbin and follow my code and building process to turn it to a smart one.

Initially, the plan was to make the frame of the dustbin using cardboard. But as it does not bend and cannot be given any shape easily so I used construction paper. A board paper was used to make the base. The picture of the building process is given in [APPENDIX C \(a\)](#).

The original plan with the cardboard was to set the microcontroller outside of the dustbin by sticking it with glue with the outer body but later as construction paper was used it could not take the weight of the Arduino. A stand was made inside the

dustbin with board paper to set up the Arduino and breadboard. The picture of the setup is given in [Appendix B](#).

BUILDING PROCESS

The materials required for the project-

- Arduino UNO
- Breadboard
- Ultrasonic sensor HC-SR04 (2)
- Servo motor
- Trashbin
- Piezo buzzer
- Jumper wires

Arduino UNO

“The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced with various expansion boards and other circuits” (Wikipedia). The Arduino board is connected with the servo motor, buzzer, and ultrasonic sensors and through this board, the materials get electric power to function. The pins of the Arduino board, 5V, GND the and digital pins are connected to the other materials through the breadboard.

Ultrasonic sensor

An ultrasonic sensor can detect the person in front of the dustbin. The ultrasonic sensor works on the ultrasonic sound frequency. It has two pins TRIG and ECHO. trig pin transmits the ultrasound wave and ECHO pin receive the sound wave and the duration of the sound travel. So the ultrasonic sensors are used for the purpose of distance sensing.

For the smart dustbin, one ultrasonic sensor is attached in the front and the other one inside the dustbin. The front one senses motion within a certain distance and makes the servo motor open the lid. [APPENDIX F](#) has a picture of the position.

The second ultrasonic sensor is with the piezo buzzer. The work of this sensor is to make the buzzer emit a sound when the garbage in the bin reaches a certain limit.

Servo motor

Servo motor uses here to make the movement in the dustbin cap. when someone detects in front of the sensor it will send the information to the Arduino microcontroller and Arduino gives the signal to the servo motor to rotate some degree which we have to calibrate duration of assembly. We have to measure the distance cover by the cap and calibrate this distance with the motor rotation. for example, if the cap takes 2 cm movement then how much degree rotation will we need by a servo.

The servo is placed on the lid. The wire of the servo goes inside the bin from a hole made beside it. The lid is divided into two halves which allows one side of the lid

open when one ultrasonic sensor senses motion. The servo is attached with a string that opens the lid when the servo moves in a 180-degree angle. My servo is capable of carrying very lightweight. That is another reason for using construction paper for the lid. To see the servo fixture go to [APPENDIX C](#) (b).

Piezo Buzzer

A piezo buzzer is a type of electronic device that's used to produce a tone, alarm or sound. It's lightweight with a simple construction. The main work for the piezo buzzer in this project is after a certain amount of waste gets deposited in a dustbin then it will start to make a sound.

USER MANUAL FOR SMART DUSTBIN

The set up of a smart dustbin is very easy. The first and foremost work is to download the code into an Arduino UNO. [Appendix E](#) contains information to find the code. After uploading the code the rest of the materials are needed to set up. The picture in [APPENDIX A](#) shows the connections.

- 1) First, two pins from the Arduino, GND(ground) and, 5V are to be connected with the breadboard's GND (-) and 5V (+). Breadboard view is available on [APPENDIX D](#)
- 2) For the first ultrasonic sensor connect -
VCC on the ultrasonic sensor to the 5V pin on the Arduino.
Connect the Trig pin on the ultrasonic sensor to pin 2 on the Arduino.

Connect the Echo pin on the ultrasonic sensor to pin 3 on the Arduino.
Connect the GND on the ultrasonic sensor to GND on the Arduino.

For the second ultrasonic sensor ...connect -
VCC on the ultrasonic sensor to the 5V pin on the Arduino.
Connect the Trig pin on the ultrasonic sensor to pin 4 on the Arduino.
Connect the Echo pin on the ultrasonic sensor to pin 5 on the Arduino.
Connect the GND on the ultrasonic sensor to GND on the Arduino.

3)The buzzer has two pins. The positive pin has to be connected with Pin 10 and the negative side with the GND.

4) The servo motor has three wires. The brown one goes to the GND, the red one goes to 5V and the yellow one goes to pin 9 of Arduino.

The ultrasonic sensor connected with the servo motor should be faced outside of the dustbin so it will be able to detect the motion of someone approaching. The second ultrasonic sensor should be connected with the buzzer should be inside so that it can give out sound when garbage reaches its limit. The servo motor is connected with a string from the inside in such a way that the motor can open a lid. See [Appendix C](#) (b) how the servo motor is attached.

SETBACKS AND FAILURES

In the project, one of the first difficulties I faced is to make the structure of the dustbin. Though I was sure I would be using cardboard to make the dustbin instead of buying a regular dustbin instantly while trying to make it I understood that it was not possible to twist and bend cardboard on my wish. I did not have much time left and was adamant to make the dustbin on my own. So I used construction paper.

As a part of my project is inspired by the Best Electronics Project.com and followed their materials requirement but they had a problem with the codes for which it was hard for me to start the writing of the code initially. But later with the help of Arduino

Project Hub [3], necessary changes were made to measure the distance of the ultrasonic sensor from which it will trigger the motor servo to open up.

Another project that helped me to understand the method on how to make the buzzer work is from the project “How to use a Magnetic Door Switch” on Instructibles.com.[2] This project was used for information gathering purposes only. No code or hardware was used from this site.

Though the piezo buzzer and servo motor worked great individually with the ultrasonic sensors but after combining the two codes both of the material stopped working. I had a hard time finding out the possible collisions and errors inside the code.

Changing the delays and adding new functions in the code made the servo motor and buzzer working without any pause. This happened possibly because The connection with the ultrasonic sensors was cut off. The servo motor was making a 180-degree movement continuously and the buzzer was making sound. Again changes were made and measurements were changes in the code and loops were added. Some high and low also had to be changed. Finally, after crossing so many hurdles the code started to work as expected.

In the advanced form, makers have used wheels to control the movement of the dustbin, some have connected it with the mobile using wifi or Bluetooth. Though I

thought I would be able to make the advancements, in the end, I did not have the time or energy to make further progress with the project.

A major setback I thought would be in the project was working alone as I do not have much coding experience. I thought it will be not possible for me to complete the project. But with time I realized I can and the most advantageous thing for me was I was able to work with my own time and space. I did not have to work according to others' wishes and I am content with the project.

MILESTONES

Overall the project can be considered as a successful one because the main idea was to turn a basic dustbin into a smart dustbin. If I had just bought a regular dustbin and add materials in it then the result would be more standard. Having long wires to make the connections is very necessary for this project, I did not have long wires for which I faced problem to set the materials in the dustbin. As a result, the project ended up looking not well organized.

If I had enough time I would have used wood or cardboard to make the outer frame of the dustbin. This would make my project long-lasting and dependable. I have used construction paper for which the dustbin is very lightweight and it is difficult to attach microcontrollers in it.

The hardest part for me in the project was to make the code on my mind work in reality. First I sketched two individual codes. The first one is to make the ultrasonic sensor work with the buzzer and the second one was to make the ultrasonic sensor work with the servo motor. Measuring the distance on the code with the serial monitor so that the buzzer and ultrasonic sensor works at the right time was worth working for and I enjoyed it. Combining the two codes proved very difficult for me. Though I thought merging to complete codes would be easy but after merging it the code was not working as I imagined and significant changes have to be made.

CONCLUSIONS

CS 207 is a class that focuses on developing students' interest in building and controlling multimedia arts and DIY projects. Though for the lab Arduino UNO was compulsory, we were allowed to use any type of microcontroller for the project we want to. As I am a new programmer I used an Arduino UNO as now I have a few months experience on this microcontroller.

Making the smart dustbin was indeed fun. Though eventually, I wanted the smart dustbin to be more modified by adding it with Bluetooth but due to lack of time and my experience I wasn't able to do it. Just working on the lid part to open on its own by using the ultrasonic sensor and servo motor proved difficult. I had to try again and again to make the code work successfully.

Honestly, it was hard for me to come up with a project. For a certain amount of time, I was very worried about what project to choose and how to complete it on time, etc. As I am not experienced and I wasn't working on any group I thought maybe I will not be able to pull up the project. But in the end, I worked hard and was able to come up with something that makes my effort and this course successful.

REFERENCES

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<https://www.instructables.com/id/How-to-Use-a-Magnetic-Door-Switch-Sensor-With-Ardu/>

[3] Nussbaumer. Jake. "How to use an ultrasonic sensor with Arduino". December 16, 2017

<https://create.arduino.cc/projecthub/jake/how-to-use-an-ultrasonic-sensor-with-an-arduino-63527b>

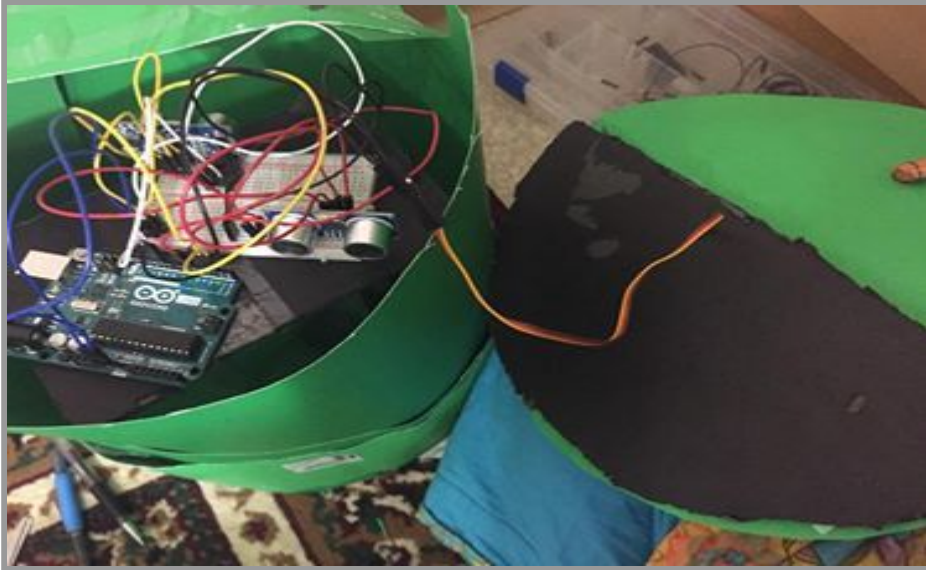
APPENDIX

Appendix A: Hardware Design



This is the final hardware design before putting the microcontroller and the other materials in the frame of the dustbin.

Appendix B: Fixing the Arduino inside the dustbin

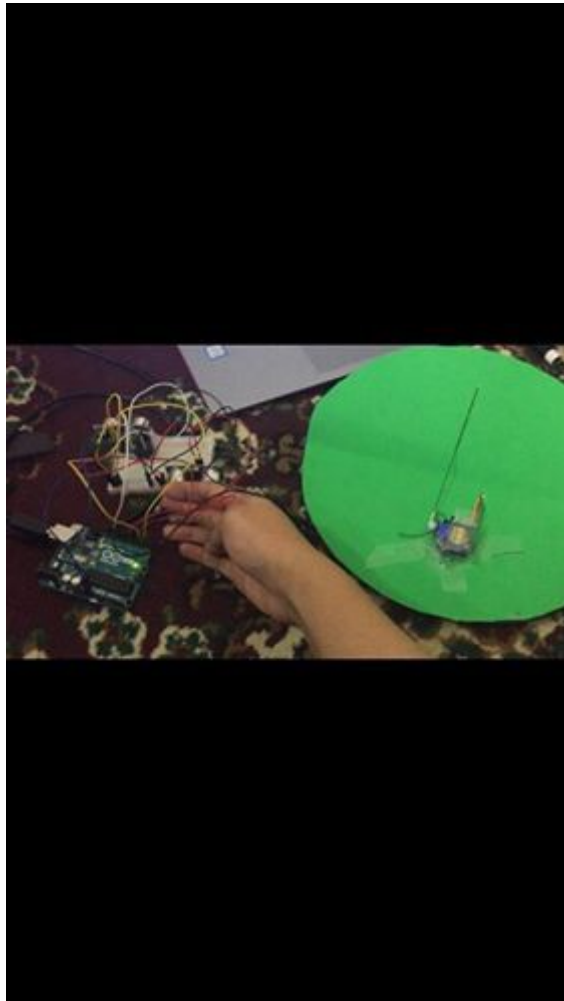


The construction paper could not carry the weight of the microcontroller and the breadboard so I had to make a stand inside the dustbin to keep the Arduino. This is the final fixture of the Arduino in the frame of the dustbin.

Appendix C: The body and lid of the dustbin made with construction paper.



(a) body

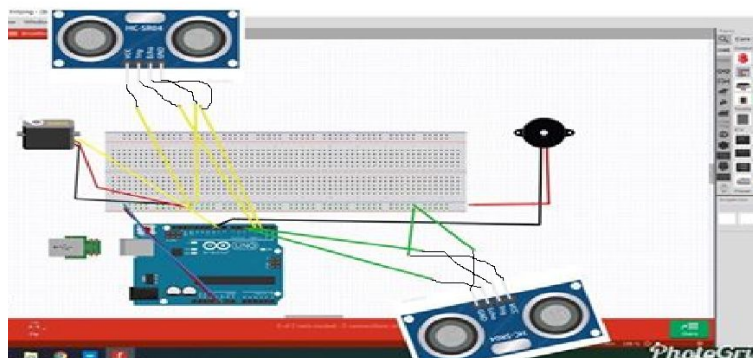


(b) lid

The body of the dustbin was made tight by covering it with paper.

The servo motor is attached to the lid and tied with a string.

Appendix D: breadboard view of the connections of the dustbin



Appendix E: The code

The codes required for this project are given in the GitHub link below-

<https://github.com/RupkathaManzur/CS-207>

The QR code given below will also take you to the GitHub repository for the Smart Dustbin-



As mentioned earlier the main code to control the servo motor is taken from the site bestelectronicprojects.com. [1]

Appendix F: Arduino based Smart Dustbin



This is the final result. As can be seen from the picture it has one ultrasonic sensor in the front and the servo motor is attached with a string to pull open the lid.