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# Design and Manufacturing of Automised Waste Management Bin

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**ABSTRACT:** Waste management has been a crucial issue to be considered. This project is a way to achieve this good cause. In this project, smart bin is built on a microcontroller-based platform Arduino UNO board which is interfaced with servomotors and Ultrasonic sensors. Ultrasonic sensor is placed at top of the dustbin which will measure the stature of the dustbin. The threshold stature is set at certain limit. When garbage reaches that threshold limit, ultrasonic sensor will trigger rack and pinion mechanism to compress the garbage. This process will be repeated 3 times after that the lid of the dustbin will be locked until, the dustbin is squashed. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on roadside, foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems.

**KEYWORDS:** Smart Bin, Arduino, Servo Motor, Ultrasonic Sensor, Compactor, Waste management.

## I. INTRODUCTION

As we are progressing from a developing country to a developed country, everything is getting smart and modernized, so why not dustbins. We all might have once experienced or have seen even though there is the provision of dustbin in different areas but they are either broken or completely filled due to which people throw garbage besides the dustbin instead of inside the dustbin. So, providing dustbins isn't really the only thing that should be done to reduce or to control the waste but proper management of garbage in the dustbin and their disposal is required. Also, our government has recently started a cleanliness drive called 'SWACHH BHARAT ABHIYAN' for a good cause and being a citizen of this country, we should be the one taking care of our country's hygiene starting from our native places.

The waste management has been crucial issue to be considered. With garbage comes pollution; from the burning of garbage, we are destroying the atmosphere just as fast as we are just leaving the garbage on the ground. When you burn garbage, it gives off extremely poisonous gases into the atmosphere. If a person breathes this air, it can hurt their lungs and if untreated can result in cancers or even death. Even if we bury our garbage not all of it will decompose, as there are some materials that needs centuries to decompose. By polluting the ground, it can seep into our farming soil and even into our ground water, which can cause dramatic consequences.

We cannot overlook a thing which makes a country or say world a better place to live. Here before, everyone might have once thought to make our native places clean but haven't worked towards it sufficiently. As a modernized generation student, we have come up with slightly different idea of disposing bins. Using coding and different mechanisms we have tried to make such a modernized dustbin. Also, we have taken the current situation of COVID-19 under consideration and hence we thought to make a automatized dustbin which will allow people to throw garbage inside the dustbins without actually touching the dustbin lids. Also, the garbage collector does not need to touch the garbage directly during the disposal and could empty the bin with a great feasibility. Probably, there are hundreds of automatic dustbins out there but this dustbin will not only have automatic opening and closing but it will also consist of a compactor which will compact the garbage and remove the void spaces in-between and will allow more garbage to settle in. It also has electronic sensors, sensing the level of the garbage in the bin to avoid the overflowing of garbage.

## II. PROBLEM STATEMENT

- To implement a smart bin built on a microcontroller-based platform Arduino UNO board which is interfaced with AC Motor and Ultrasonic sensors which can sense the level of waste in the dustbin and compress it using a compactor mechanism also, it will alert the user when it is completely filled.

## III. METHODOLOGY

First of all, a single-phase motor of specification 1500 rpm, 50Hz, 230V and 0.12KW is selected according to the calculation. This motor is coupled to a gear box of gear ratio 30:1 for reduction of the speed as it is the requirement of the project. Now, this assembly is supported by a plate attached to the enclosure made up of mild steel. To reduce the vibrations caused by the motor the assembly is welded to the plate instead of bolting it down to the plate. This assembly is kept perpendicular to the dustbin and at 150mm distance from the top of the bin. The assembly of motor and gear is further connected to a pinion of 18 teeth, 4mm module, PCD 72mm, which further acts as a driver to the rack of the system which has a length of 464.95 mm, 37 number of teeth and travel of 400 mm. For the action of compression, a compacting plate is attached at the end of the rack which is having dimensions slightly less than the opening of the bin so that the certain clearance is maintained between the plate and the bin, while compactor will compress the garbage. So, the dustbin is 40cm x 40cm and the compacting plate is of 30cm x 30cm. An electronic circuit is built using Arduino, optocoupler, diode and resistor and a code to rotate the motor clockwise and anticlockwise for the rack to move up and down performing the action of compression. An ultrasonic sensor is used to detect the level of the garbage and activate the circuit of compactor. This ultrasonic sensor is placed on the enclosure at a certain height from the base of the bin. The enclosure has an opening to allow people to put the garbage in the bin. Also, a door is given for removing of the bin from the enclosure when the bin is full.

Following are the details of the parts –

### Electric Motor and Enclosure

We used electric motor to power our proposed system. We have selected electric motor which operates at 1500 rpm and 230 V, 50 Hz single phase supply. It will provide 0.12KW power output at 50rpm. This output power of electric motor is connected to rack and pinion gear box for compression purpose. Also, we have provided Enclosure around the dustbin. So that, the components of our proposed system remain unaffected from rain and other atmospheric conditions. This increases safety, reliability and durability of components.

### Ultrasonic Sensors

As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target i.e., Garbage level. An optical sensor has a transmitter and receiver, whereas ultrasonic sensor uses single ultrasonic element for both emission and reception. We have used ultrasonic sensor for garbage level detection. As soon as garbage reaches the predetermined limit of ultrasonic sensor it will operate compactor through Arduino.

### Arduino UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs—light on a sensor, a finger on a button, or a Twitter message—and turn it into an output—activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

### Rack And Pinion Gear Box

We have selected Rack and Pinion mechanism to compress garbage present in waste bin. Rack and pinion gear box will perform function of compactor in proposed system. By compressing the garbage, we can increase the storage capacity of traditional waste Bin. We designed the gear box according to gear design procedure and found out dimensions of rack and pinion.

#### Dimensions of Pinion:

No. of Teeth = 18

Module = 4mm

PCD = 72mm

Face width = 40mm

Pitch = 12.566 mm

#### Dimensions of Rack:

No. of Teeth = 37

Module = 4 mm

Rack Length = 464.95 mm

Face width = 40 mm

#### Servomotor

Servo implies an error sensing feedback control which is utilized to correct the performance of a system. It also requires a generally sophisticated controller, often a dedicated module designed particularly for use with servomotors. Servo motors are DC motors that allows for precise control of angular position. They are actually DC motors whose speed is slowly lowered by the gears. The servo motors usually have a revolution cut-off from 90° to 180°. A few servo motors also have revolution cut-off of 360° or more. But servo motors do not rotate constantly. Their rotation is limited in between the fixed angles. So, we have used Servomotor for opening and closing of lid.

### IV. ANALYTICAL RESULTS

Fig 1 shows the CAD Model

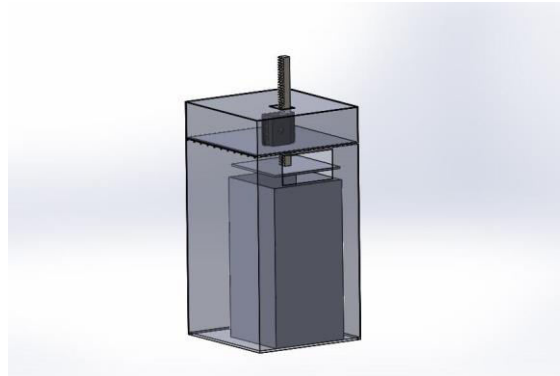
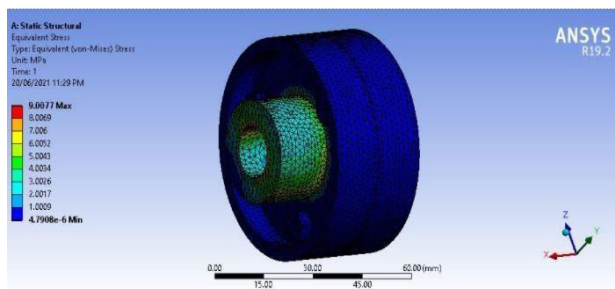


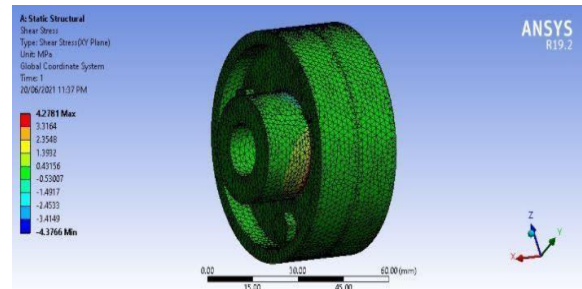
Fig. 1

Analysis of Various Parts –

Coupling of motor and Shaft –

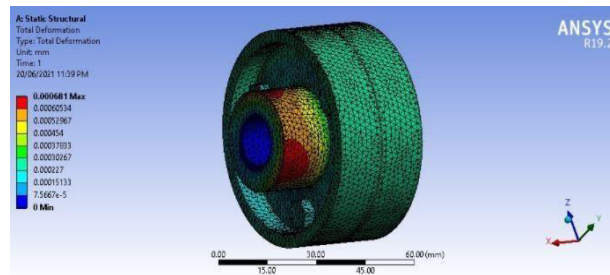


(1)



(2)



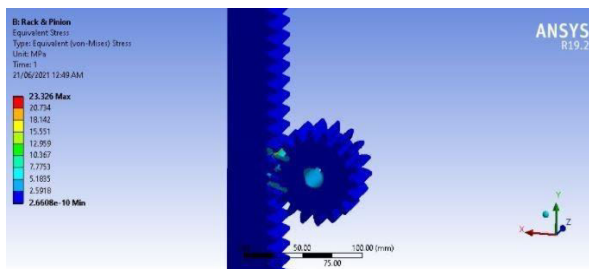


(3)

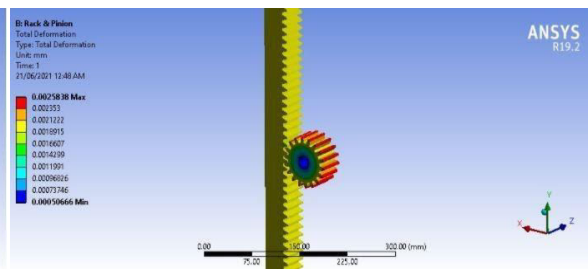
Table-1

Sr. No.	Parameter	Maximum	Minimum
1	Equivalent Stress	9.0077 N/mm	4.7908 e <sup>-6</sup>
2	Shear Stress	4.2781 N/mm	-4.3766 N/mm
3	Deformation	0.000681 mm	7.5667 e <sup>-5</sup> mm

### Rack and Pinion –



(1)

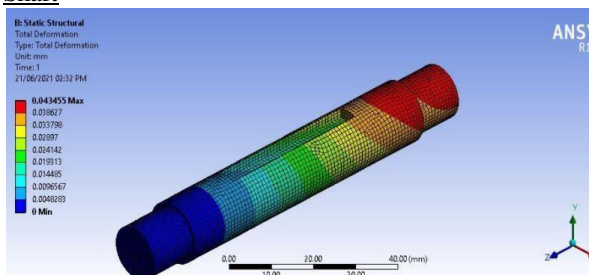


(2)

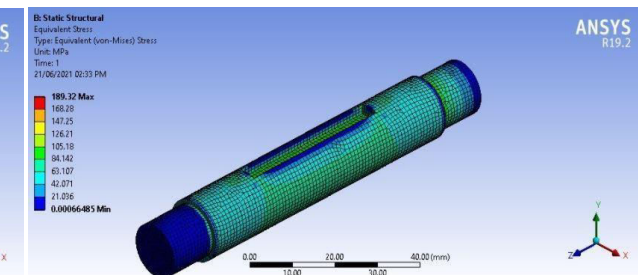
Table-2

Sr. No.	Parameter	Maximum	Minimum
1	Equivalent Stress	23.326 N/mm	2.6608e <sup>-10</sup> N/mm
2	Deformation	0.00258 mm	0.000506 mm

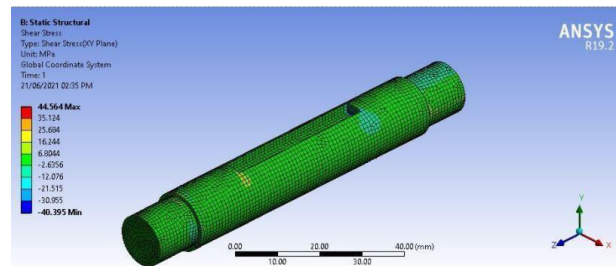
### Shaft –



(1)



(2)



(3)

Table-3

Sr. No.	Parameter	Maximum	Minimum
1	Deformation	0.043455 mm	0 mm
2	Equivalent Stress	189.32 N/mm	0.00066485 N/mm
3	Shear Stress	44.564 N/mm	-40.395 N/mm

## V. CONCLUSION

Various features such as durability, affordability, prevention against damage and maintenance issues are addressed when these smart dustbins are designed. This Smart Dustbin can contribute a lot towards clean and hygienic environment in building a smart city. The waste compactor was designed and used to reduce the volumes of waste generated from the households ending up at the collection or disposal sites and simultaneously act as a storage facility. As a result, there are going to be a lot of benefits as it will increase savings in transportation costs branches of fuel cost, labour cost, cost of whole trucks, and the cost of maintenance. All these savings give an indication that the trash compactor baler has reached its goals. Not only does the trash compactor baler achieve savings in transportation costs but also it helps in keeping the streets clean as it prevents overfilling of garbage bins, which will hopefully make the country look much more attractive and help improve the overall image of the nation.

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