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RC Scrap Collection Bot

Samimohammad J. Pathan, Malhar P. Dhavale, Sahil R. Maru, Sayyed Shahzad A. Mohd. T. Ahmed.

Abstract: ***Any industrialist is trying to have automation on his shop floor to increase the production and to reduce the investment on manpower [2]. Taking this fact in consideration we made a visit to a small study and found that we can make a working model which can reduce the idling time of worker very effectively up to the mark. We studied that the scrap collecting one of the universal jobs for any industry and especially in Indian industries which are using the traditional techniques. These traditional techniques for scrap collecting take the physical involvement of a worker and this involvement increases the idling time and by involving concept of this bot we can reduce money too. We are having a concept to use the modern circuits in the market in the traditional scrap collecting systems and manufacture a fully modern and automated scrap collecting system which do not require any physical contact of the worker. We are introducing automation in the traditional scrap collecting systems. The automation in this system can tolerate the negligence of worker during the system is in operation as this system have a full proof system on its own.***

Keywords: ***Traditional Scrap Collection Technique, Automated Scrap Collection Technique.***

I. INTRODUCTION

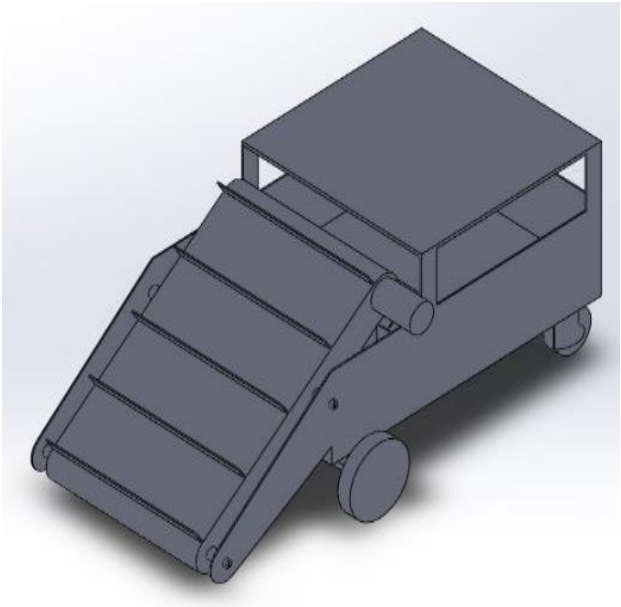
Through this Mini-project we are introducing the new concept of scrap collection from small workshops and floors of industries where manufacturing and automation happens. In industries where automation and manufacturing happen their different kind of products like Solid, Semisolid, Liquid, etc. are used there this bot can easily do its job of cleaning as compared to traditional cleaning operations which takes a lot of time. This is a futuristic working model which will be accepted by every industry as we are providing a flexible set up for their industry.

This scrap collecting Robot can be operated with the help of remote control. So, it will be a wire-free as well as worker free system. By considering the floral area of industry initially we will try to cover the 8000 m2 area under the remote-controlled area. This range is flexible and can be changed according to the floral area of industry.

This system works on wireless circuits. A remote-controlled circuit that can operate two motors which are installed at the rear wheels of the scrap collecting system. These circuits have a range of 100 meters to 500 meters. We have a large variety of circuits so we can choose one of them according to the floral area of particular industry.

So, this is a brief introduction about Mini-Project. In next chapter we are continuing with Literature Survey of the Mini-Project.

Solidworks Model of Proposed Bot



II. REVIEW OF LITERATURE

A. Survey Existing System

Workshop waste management is one of the major issues in todays and future industries [1]. Efficient metal waste management in industries is very important in order to ensure, a safe environment, make room for future operations and reuse of this material. At present, in many industries, these scraps are still being collected by manpower, which is a cumbersome task [5]. Therefore, it needs to be automated, so in this work we have opted a robotic solution for the scrap collection.

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*Correspondence Author(s)
Samimohammad J. Pathan*, Department of Mechanical Engineering, Rizvi College of Engineering, Mumbai University, Bandra, Mumbai (Maharashtra), India. E-mail: samipathan405@gmail.com, ORCID ID: https://orcid.org/0009-0005-0951-538X
Malhar P. Dhavale, Department of Mechanical Engineering, Rizvi College of Engineering, Mumbai University, Bandra, Mumbai (Maharashtra), India. E-mail: malhar19112002@gmail.com, ORCID ID: https://orcid.org/0009-0006-7267-3986
Sahil R. Maru, Department of Mechanical Engineering, Rizvi College of Engineering, Mumbai University, Bandra, Mumbai (Maharashtra), India. Email: sahilmaru1112@eng.rizvi.edu.in, ORCID ID: https://orcid.org/0009-0008-2764-0063
Sayyed Shahazad T. A. Mohd. Ahamed, Department of Mechanical Engineering, Rizvi College of Engineering, Mumbai University, Bandra, Mumbai (Maharashtra), India. Email: shahzad@eng.rizvi.edu.in, ORCID ID: https://orcid.org/0009-0002-9780-3346

B. Limitations Existing System or Research Gap

As increase of population leads to increase in production & manufacturing. As more products are manufactured the amount of waste is also increased in workshops.
In past the collection of scrap was done by manpower only. Now some of electromagnetic robots [3] are present which are used by big industries as they are very costly and therefore it can't be used in small industries. In such case, most of the companies hire an employee for the collection of workshop scraps on fixed salary in which the companies are paying a minimum amount of 120000 per annum to the employee. There are many risks that are to be faced by employee while collecting scraps as there are many minor metal scraps which can damage eyes while cleaning it can get stuck in hands and many more.

C. Problem Statement and Objective

Sometimes while working 8 to 14 hours a day employees get tired also and as a result the work done is not perfect. Sometimes industry also faces problem and is unable to pay salary on time so to overcome all these problems we have designed a RC Controlled Scrap Collecting Robot.

Let us see the advantages of this Robot over manpower: [1]

SR. No.	Manpower	Robot
1	Employee can't work continuously at a time	Robot can work continuously at a time without getting tired
2	Employee can get injured while collecting scraps	Robot cannot get injured while collecting scraps
3	Company has to give salary to the employee monthly	Robot don't need any monthly salary only the manufacturing price has to be pay.
4	Company has to pay more than 120000 per annum per employee	Company has to pay only the manufacturing price once

The main objective of our robot is to overcome all the problem that have been face by manpower. Our robot has been designed in such a way that it can be used by many small industries also as it is of less cost. It does not need any human energy we just have to operate it by using RC Controller.

D. Cost Spent Report

Components	Per Component Price	No. of Components	Total
DC DC Buck converter	220	1	220
DC DC step doun	120	1	120
L clamps (Motor mount)	20	2	40
DPDT Relay	35	4	140
DPDT switch	15	1	15
Belt (2 feet)	100	2	200
Castor wheels	50	2	100
Pulley	40	4	160
Cells	60	6	360
BMS	100	2	200
Cell holder	40	2	80
Casing capping (2m))	60	2	120
nut, bolt, washer	20	3	60
L brackets	8	10	80
rubber glue	25	1	25
nuts		15	20
bolts	3	15	45
Fevikwik	75	1	75
Nut and bolt		20	25
tyre tube	10	2	20
DC jack	20	2	40
glue stick	15	4	60
TOTAL			**2205**

E. Scope of Proposed bot

Our robot can be used in future workshops. Some modification can also be done like we can expand the capacity of storing scraps. We can also mount a camera on robot by which we operate it by using our mobile in some specific range without entering in the workshops also.

III. ANALYSIS

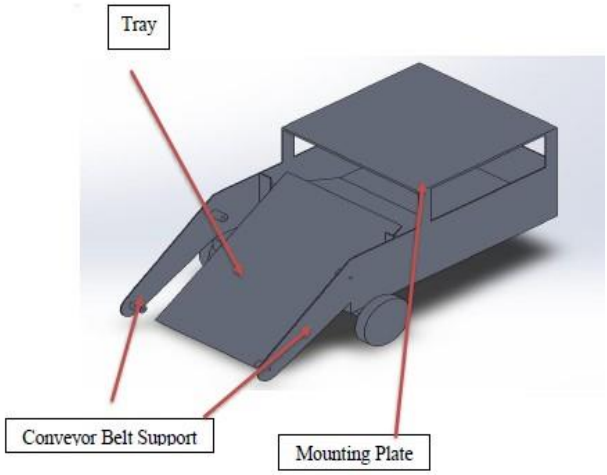
Based on the objective stated in previous chapter, a design of a Remote-controlled scrap collection bot is prepared. Upon understanding the layout of the workshop, it is been determined that the overall dimensions of the bot should not exceed more than 750mm x 750mm x 750mm. also, a clearance of 1mm is kept between the floor and the tray. The weight of the bot is roughly estimated to be around 5 to 6 kg. The range of the transmitter and receiver of the bot is taken up to 100m. the Receiver will give an output of 6v which cannot run the motors, so a circuit is designed that will take this 6v as input signal and give a 12-v output. Based on these factors certain hardware components are selected which are listed and explained under the "Details of Hardware and Software" section of the chapter.

A. Details of Hardware and Software

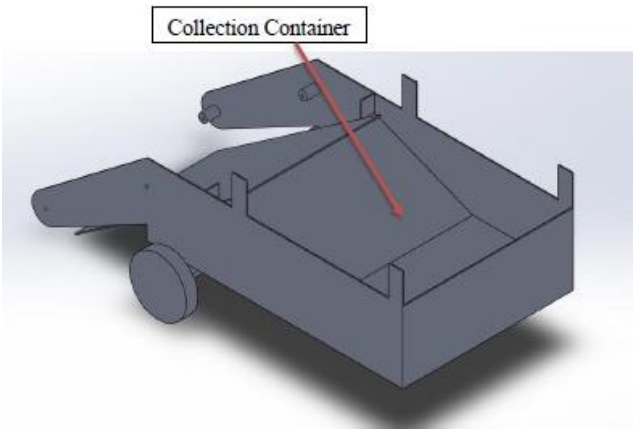
Sr. No.	Hardware Required	Details/ Specifications
1.	Casing capping	Casing capping of approximately 12 to 15 feet in length. (To build the frame of the bot).
2.	MDF board/ PVC sheet	MDF board and PVC sheet of thickness 2 millimetres to 15 millimetres is used as panels for the bot (for example base plate, mounting plate for batteries and other circuits, etc.)
3.	Screws	Used to assemble the frame.
4.	Motors	Three 12-volt motors (speed in the range of 100 RPM to 300 RPM) is used to drive the bot and the conveyor belt.
5.	RC transmitter and receiver	Used to control the bot remotely (estimated range of 100 meters). the output signal of the receiver is 6 volts.
6.	Relay	Used to make a motor control circuit. It takes input of 6 volts from receiver and provide a 12 volts output for the motor.
7.	Cells	For the power source, 3.7 volts Lithium-Ion cells are used to create a battery of 11.7 volts to 12.6 volts.
8.	Battery Management System (BMS)	BMS is used to safely charge and discharge the battery pack. The BMS is of 3S type (used for 3 cells connected in Series).
9.	Battery holder	Three cell battery holders are used to hold the cells and to have ease in making the battery pack.
10.	Charger	A 12 volts charger is used to charge the battery pack. The output current will be 3 amperes to 5 amperes.
11.	Connecting Wires	Used to make the various electrical connections of the bot.
12.	Conveyor belt	Used to lift the scrap onto the tray.
13.	Rubber strips	It is the main component which pushes the scrap onto the tray.
14.	Wheels	Two types of wheels are used for the bot. two normal wheels which are the driving wheels and two caster wheels for turning. Driving wheels are on the front of the bot and the caster wheels at the rear.

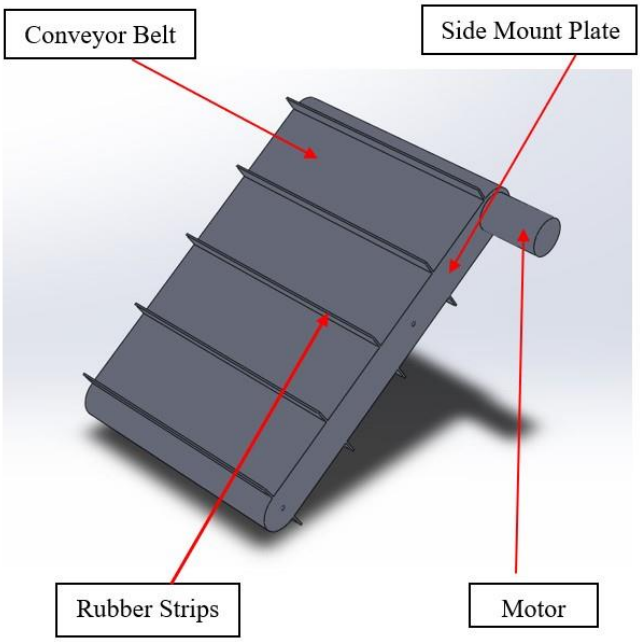
B. Design Details

Based on the concept of the bot and its working, a model is prepared in SolidWorks [8] to explain the design and functionality of the bot. below are some images and explanation of the parts and functions of those parts.

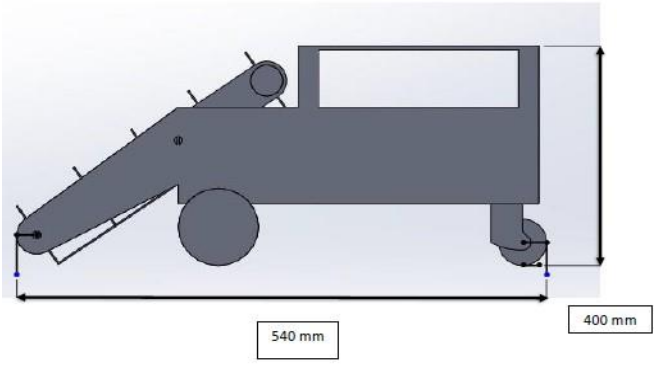


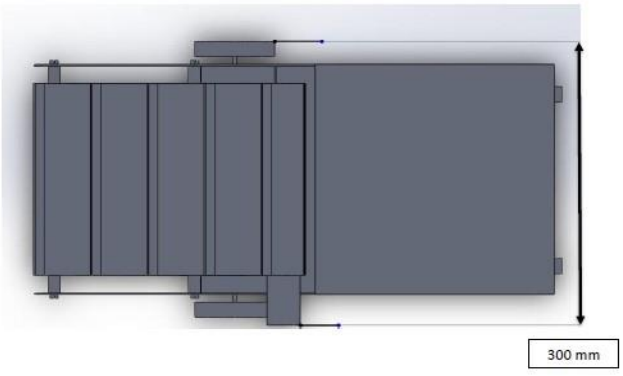
The above figure shows the body of the RC Scrap collection bot. the parts and their function are as follows.
Tray: - Used to deliver the Scrap into the Collection Container
Conveyor Belt Support: - To support the Conveyor Belt and keep it in place.
Mounting plate: - To mount the electronic components.
The figure on R.H.S. shows the collection container of the bot in which the scrap is collected and stored.





The above figure shows the conveyor belt assembly for collecting the scrap. As the conveyor belt rotates in anti-clock wise direction, the rubber strips fixed to the conveyor belt pulls the scrap onto the tray and into the collection container.





The above figure shows the overall dimensions of the RC scrap collection bot. The dimensions are in Millimeters.

C. Methodology

The making of the bot is as follows: -

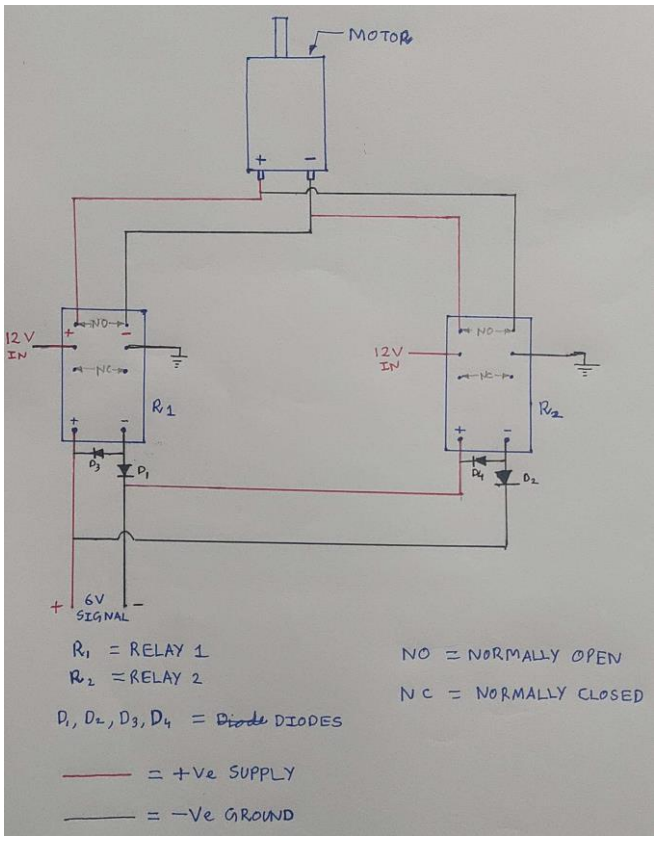
1. First the frame is made using the Casing capping strips and MDF board/ PVC sheet.
2. Then the electronic circuits are made which include Motor Control Circuit, Battery pack.
3. Next, the electronic components and circuit are attached to the frame along with the motors and wheels.

The electronic circuits for the Motor control and the Battery pack [4] [6] [7] are to be made to get the desired functionality like controlling the motor (Forward and Reverse) and to charge the battery in safe manner (Prevent over charge and discharge, balance charging etc.)

The Motor control circuit is designed by the team members from scratch using standard component available in market i.e., the Relay.

The Electric Circuits are shown in the images below: -

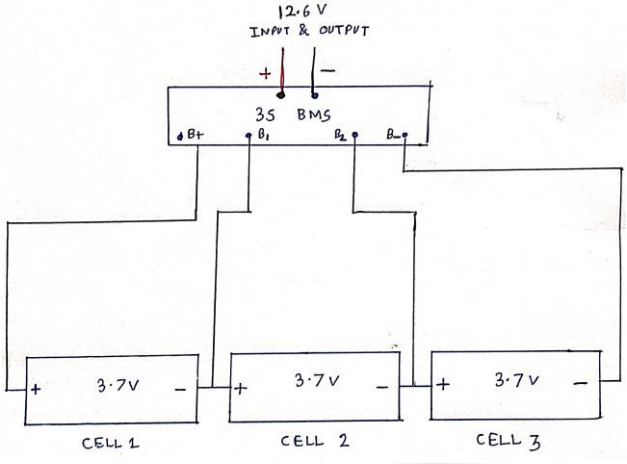
- Motor control circuit: -



The above circuit is a Motor control Circuit. Here we give a 6 volts DC input signal and depending on the polarity of the signal, the motor at the output changes direction.

In the above diagram the relay (R1) is turned on and the motor rotates in one direction. When we reverse the signal polarity, relay (R2) will turn on and motor will rotate in other direction.

- Battery pack circuit: [4] [5]



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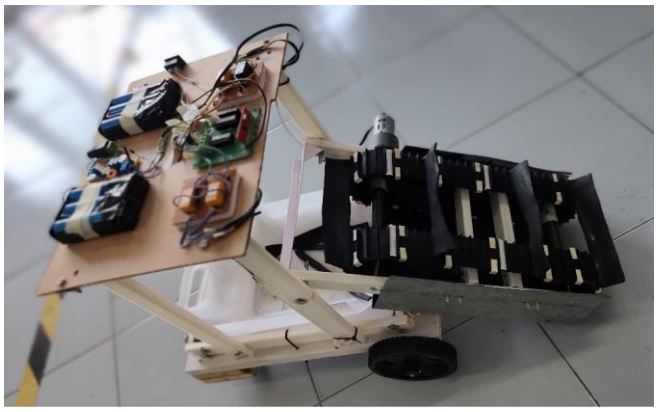
The above circuit shows a battery management system connected to a three-cell battery pack (cells connected in series to give 11.1 volts to 12.6 volts).
In the BMS board, the 12.6 volts terminal serves as the output to the bot as well as the input to the battery pack for charging (shown by 12.6v input and output). This BMS helps the battery to maintain a proper voltage level i.e., between 11.1 volts and 12.6 volts.

IV. RESULT AND DISCUSSION

The changes in Type of Battery used, Material for making Frame and scrap collecting container resulted in change of the cost for making the project. Initially the battery was lead acid battery which was heavier, costly and occupying more space than the current lion battery. The frame material was chosen to be aluminum but it was heavy and difficult to fabricate as cost of fabrication was high. Later PVC pipe was selected for making the frame but due to round shape and weight it was eliminated and was replaced with PVC Casing Strips (casing caps). The Scrap collecting container was going to be made through metal sheets but later changed to a Plastic container as it resulted in loss of weight and les time for its fabrication. The Efficiency of driving motor increased as the weight was reduced after making the changes also overall cost got reduced after making the changes in the material used. As the PVC frames were hollow so it got difficult to mount them together with screws because after tightening the screws the frame was getting squeezed; so, to overcome this problem wooden pieces were inserted where the screws were inserted so the frame retains its shape properly.

To turn the bot and providing required direction a steering system was required so instead of installing external motors and mechanism we used castor wheels in front so it can turn when motion is given to a single rear wheel respect to its direction. To control the motors simultaneously when needed relay switch (relay circuit) were used. Diodes were used to control the direction of current flow while the setup is being charged by the charging adaptor, so the current should not backflow in opposite direction in charge time.



DISCUSSION

The bot being used as a product in future can be helpful to the user as it can reduce the manpower by being a semi-automated machine. By making certain modifications in the electric circuits and programming it; it can be turned into a fully automated machine.

By making it fully automatic it can be used on spots which can be unsafe for humans to visit like places which are under radiation or places which are exposed to flammable chemicals or boiler plants. Since the weight has been reduced as mentioned above it reduces cost of production.
Due to its flexible and independent design it can be either used on large scale and small scale just by making it into different size according to the amount of land being swept.
The idea of making the model (Project) decided was not easily available on the Internet, though similar topics were available out of which modifications were done then the project was described.

Thought on adding a mop on the other end of the machine was decided but due to weight of the mop after getting wet could lead to power loss and also the mop cloth has to get change and sent for wash after time-to-time operations.

V. CONCLUSION

Automation is very important in today's life. We can do most of the things without wasting our much energy by the help of technology and gadgets. It becomes very easy to do multiple things by the use of technology. Expenses can be saved most of the human injuries & accidents can be avoided by using gadgets & bots. In industry & workshops manufacturing process produces lots of waste like chips and minor particles which can get into nails while collecting this waste and this can damage an employer this can be prevent by using our RC scrap collection bot. Industry can save daily or monthly wages of employers too. By making our RC Bot Scrap Collection Bot we've developed a fabrication skill. We get to know about BMS & Battery connections & working of transmitter & receiver. It has made us to belief that automated systems can also provide better reliability & performance and reduced costs for the performance of many functions. Automation is advanced in many ways like physical, perceptual tasks in all kind of systems. All the electronics parts are mounted on it cautiously in the manner adding to the best working of unit. All the equipment's are created and utilized on the frame.

APPENDIX

Appendix I: -

Robot run time calculations:

Power consumption of one motor = 12w

Therefore, Power consumption of three motors = 36w

Considering other peripherals like RC receiver, final consumption = 45w

Now,

Considering the batteries are fully charged i.e., 12.6v, and each battery having capacity of 2000mAh.

Therefore, capacity of battery = 12.6 * 2

= 25.2 Whr

Using two such batteries,

Total capacity = 25.2 * 2

= 50.4 Whr

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Run time of robot = total capacity of battery / power consumption of motors

= 50.4 / 45

= 1 hr 8 min (Approximate)

Considering losses, final run time is **45 min** (Approximate)

Appendix II: -

Robot speed

Speed of motor = 300 RPM

Diameter of wheel = 100mm = 0.1 m

Therefore, its circumference = pi*diameter = 0.31 m

Now,

Distance covered in 1 min = Speed of motor * Circumference

= 300 * 0.31 = 93 m/min

Finally,

Speed of bot in meter/sec = 93/ 60

= **1.55 m/s**

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DECLARATION

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Conflicts of Interest/ Competing Interests	No conflicts of interest to the best of our knowledge.
Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material/ Data Access Statement	Not relevant.
Authors Contributions	**Samimohammad Pathan** the one who came up with this idea of making RC scrap collection bot. I leaded the team from beginning of the project. I have contributed partly in the design of bot, soldering and helping in making connections of electrical circuits, did market survey with my fellow mates, after that bought components of the bot, managed budget of the fabrication and helped other authors in their respective works. **Malhar Pravin Dhavale,** Malhar Dhavale have contributed partly in the design of the scrap collection bot which included the design and fabrication of the conveyor belt. The model of the scrap collection bot was also made in solid works partly by me. I have also designed and partly fabricated the motor control circuit and then perfected it with the help of fellow authors. **Sahil Maru,** Deciding Material for model, making it cost effective and lighter in weight. Fabricating the model after the electric circuits were done. **Sayyed Shahzad Mohammad Tamsil Ahmed,** I have done literature survey on RC scrap collecting bot like how many types are available in the market how we can modify so it can be unique one. Other than that, I helped in fabrications of bot body and joining batteries in series, also in soldering work.

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AUTHORS PROFILE

Mr. Samimohammad Jalil Pathan completed my SSC from New English school, Vasai and Diploma from Veermata Jijabai Technological Institute, Matunga (VJTI). Currently I am pursing my B.E. from Rizvi college of engineering. Previously in diploma I worked on case studies of several companies who manufactures mechanical components and also I did research based study project on topic of oil seals. I also leaded as a team leader in diploma and on several occasions in degree and won several competitions too i.e., national level group discussion competition, Robo-soccer, team quiz competition. In addition to that I completed internships from reputed firms "Mazdock Ship builders ltd" and "Central Railway Loco Workshop, Parel". Currently I am working on the research based project under my college professor's guidance under the topic of "Peak-flowmeter"

Mr. Malhar Pravin Dhavale currently pursuing study in Mechanical Engineering field. I have completed my Diploma in Mechanical Engineering from "Veermata Jijabai Technological Institute" and currently pursuing B.E. Mechanical degree from "Rizvi College of Engineering". I have done Study projects on various topics related to core subjects and multidisciplinary subjects. Some of my works include "Study of Electric Vehicles" and "Study of Hydraulic Circuits". I am also working under my professor's guidance for designing an electronic peak flow meter. I have attended and successfully completed workshops like "Aero VJTI Aeromodelling Workshop" and "Robotics Workshop" held by VJTI. I have gained experience in the industry in the form of internships at "Mazdock Ship builders ltd." and "Central Railway Loco Workshop, Parel, Mumbai". I have also participated in Inter college technical paper presentation and technical Quiz contests. I have also participated as a team of 4 members in the "Pravin Gandhi Scrapyard Challenge" held by the American Society of Mechanical Engineers.

Mr. Sahil Maru Completed Diploma in Mechanical Engineering from Bhausaheb Vartak Polytechnic (Vasai) and Learnt Course of Auto Cad 2d and 3d which was offered by college. Pursuing B.E in Mechanical Engineering from Rizvi College of Engineering, Done Apprenticeship in Workshop of Western Railway

Mr. Sayyed Shahzad Mohammad Tamsil Ahmed student of Rizvi college of engineering from the branch of mechanical engineer. Fabrication is my favourite part in all kind of projects as i am more into designs and giving shapes. As I have a home business of electronic gadget repairing, I know about their electronics parts and can do soldering. Apart from these I know about HVACR and refrigeration's I like to developed more skills in me. As I am doing mechanical engineering i am more interested in automobile field. I am a kind of researchable person as I use to do something new, I do more research with the help of YouTube, google and nearby workshop areas.