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Wireless Robot for Metal and Dust Collection

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Abstract*: This robot features a conveyor system that it may utilise to move the aforementioned materials as well as distinguish between metallic and non-metallic materials. Additionally, dust and metallic waste will be gathered utilising hoover systems and magnets, respectively. Research on commercially available devices for sorting metallic garbage, such as magnetic conveyor systems, should be conducted before the project is launched.An apparatus for mechanically manipulating things and moving them from one location to another is a conveyor system.. Metal and non-metal waste have been separated using magnetic pulleys. It is necessary to follow the standard design process flow, which calls for the production of conceptual and detailed designs before fabrication. Prior to manufacturing, analysis equipment was done by doing calculations, such as the computation of gear and motor torque. The battery powers the entire system, while the solar panel powers the battery's charging. In this work, a completely automated conveyor system that may be used to the management of metallic trash is detailed in detail along with the predicted results.*

Keywords: Ferrous, Non-ferrous, Bluetooth Module, Arduino, IOT

I. INTRODUCTION

One of the biggest problems facing today's and future industries is the management of metal waste. In order to maintain a safe environment, make place for future operations, and reuse this material, efficient metal waste management in industries is crucial. These metal scraps are still being gathered by hand in many companies, which is a laborious process.Since it must be mechanised, we have chosen a robotic system for the metal scrap collection in this work.In general, there are two primary categories for scrap metals.

1. FERROUS: Metals containing iron make up ferrous waste. In the processing and creation of new ferrous goods, iron and steel scrap is a crucial component. Recycling ferrous waste reduces the environmental impact of huge scrap accumulations in landfills and other disposal regions. Recycling minimises energy uses alongside.

2. NON-FERROUS: Metals devoid of iron are included in non-ferrous scrap. Because items are now constructed from thinner gauge metal and there is a greater usage of other materials, such as plastic for products like drink cans and pipes, the amount of non-ferrous scrap generated has been significantly reduced.

Using a magnetic roller mechanism, the robot will collect the ferrous particles from the shop floor as it moves about the factory floor. The roller will be propelled by the electric motor. The ferrous particle will be collected by the roller once it begins to rotate, and it will be transported to the collecting chamber. Vacuumnozzles are installed at the very end to collect the dust in a storage space. The entire arrangement is portable and requires no maintenance.

II. LITERATURE REVIEW

The major goal of this work is to remotely monitor and control the direction of a motor using mobile phone techniques and signalling in order to operate the robot for automatically collecting scrap from various places or surfaces. Moving robots can move in a variety of directions, including forward, backward, left, and right [1].

[2] discusses a trash collection and processing robot system. The autonomous robot is capable of carrying out tasks including recognising metals and escaping obstacles. To collect all the scraps, the robot follows a random path.

Manually gathering these scraps is one option. However, doing so is rather laborious and has a few drawbacks, such as requiring more labourers and taking more time. It also requires good training and organisation[3].

The smooth movement of scrap materials is made possible by a conveyor system coupled with a scrap handling robot, enabling automated sorting, processing, and disposal. The robot and conveyor system work together to optimise the

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overall productivity and efficiency of the scrap handling process. The conveyor system effectively moves the scrap, maintaining a constant flow of materials[4].

According to the authors of [5], an automated electromagnetic scrap collection AGV that avoids barriers operated blindly while only considering avoiding obstacles.

III. METHODOLOGY

3.1.Studying the conventional methods of Scrap Collection

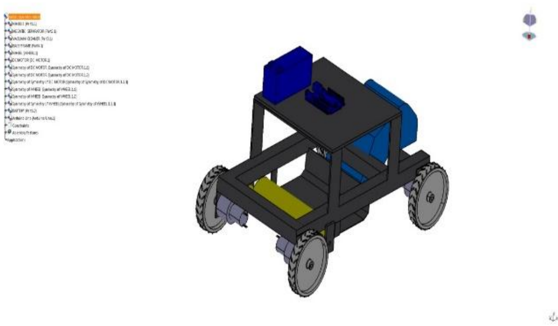
In workshops, human labour is frequently used as the main technique of collecting metallic scrap, which is generally not regarded as the best method. This strategy needs the training of scrap collection employees, which raises labour expenses. Manual collection can be laborious, ineffective, and perhaps dangerous, especially in workshops where there may be waste metal that is sharp or potentially harmful. Conveyor belts and other mechanical sorting equipment are examples of efficient and automated scrap collection systems that can be used to increase production, lower labour costs, and improve workplace safety. These cutting-edge techniques can speed up the collecting procedure, improve the classification of various kinds of metallic trash, and boost the overall effectiveness of workshop operations.

3.2.Framing the Robot Setup

- Base: The robot is stable and mobile because to its solid base. It has wheels or tracks so it may move about the shop floor.
- Motors: For movement of robot vehicle the motion is required which will be provided by motors. This motors will be directly connected to the wheels of robot.
- Conveyer: The robot may have an integrated conveyor belt or a dedicated storage space where it can place the scrap it has gathered. This makes it possible to collect data continuously without having to stop it frequently.
- Control system: A central control system that coordinates the robot's motions and processes data from the sensors controls the robot. It can be set to work in a more flexible way or to follow predetermined patterns.
- Power Source: For the robot to operate autonomously inside the workshop, it needs a power source, often in the form of batteries or a linked power supply.

3.3.Design of CAD Model

This stage entails recognising the special goals and requirements of the scrap collection robot. Think of things like the kind of scrap to be collected, the setting it will operate in, size and weight restrictions, and any required special features or functionality. Create the first designs and design thoughts for the robot. Take into account the components' integration, size, mobility, and overall structure. To explore several options, sketch rough concepts.Using CAD software, construct a thorough 3D model of the scrap gathering robot. Begin by building the model with simple geometric shapes, then gradually add more complex details and elements. Verify the pieces' fit and precise dimensions.



3.4 Selection of Components for Robot

One of the most important steps in the development process is choosing the right components for the robot. The performance, durability, and cost of the robot are significantly impacted by the choice of components. By comparing various motors we decided to use two motor with 30 rpm speed, two solar plate of one Watt each. 12 V, 8 amp battery

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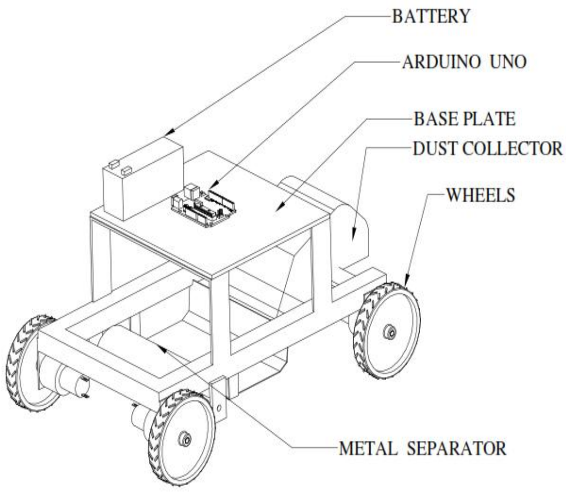
which provides battery backup for 2hrs. we also have used 2 Solar Plate of 1 Watt each, roller motor with 10 rpm and Vacuum cleaner of 12 Watt.

3.5.Simulation Using Ansys

Engineers may assess robot performance, identify collisions, conduct stress analysis, optimise motion, and mimic the robot's operation in a realistic environment by simulating scrap collection robots using ANSYS. It makes it possible to evaluate reach, range of motion, and the capacity to handle various types of scrap. ANSYS aids in the detection of design faults, trajectory optimisation, reduction of energy usage, and cycle time reduction. Engineers can reduce the cost of physical prototypes and the likelihood of design errors by simulating the robot's behaviour before making design decisions. Overall, ANSYS simulation helps to ensure the effectiveness, security, and dependability of scrap collection robots while saving time and money throughout the design phase.

IV. WORKING OF THE SYSTEM

To increase its effectiveness and automation, the wireless scrap collection robot has a number of cutting-edge characteristics. The hoover mechanism is made specifically to collect dust and debris in an efficient manner, ensuring comprehensive cleaning of the workstation. The magnetic conveyor system also facilitates the attraction and movement of metallic waste, expediting the collection procedure. The robot's functionality depends heavily on wireless communication because it enables remote control and monitoring. Operators may direct the robot's motions, keep an eye on its performance, and make any necessary adjustments in real time. This wireless link also enables simple integration with other networks or systems for data analysis and sharing. A rechargeable battery pack on the robot ensures continuous operation without the need for regular battery replacements. Additionally, to encourage sustainability, the robot can be equipped with solar panels to use clean energy, increasing its working period and lowering its environmental effect. The robot's sturdy chassis facilitates mobility, allowing it to move around the workspace's different surfaces with ease. In order to enable continuous operation without the need for periodic emptying, the collected junk can be momentarily kept in a storage chamber. An effective and automated system for the collection and management of waste materials is produced by the wireless scrap collecting robot's integration of these cutting-edge features.



V. CIRCUIT DIAGRAM

The project's circuit diagram, which illustrates how the robot's parts are connected, is shown below. HC 05 When a specific button is touched, this tool's serial connections send data through Bluetooth. Data is transmitted to the ARDUINO through TX, the ARDUINO transmits a signal, and the ARDUINO's signal is received by the RX. If the information obtained is 1, the data is confirmed. When the acquired information is 0, the Driven turns on and then shuts off.

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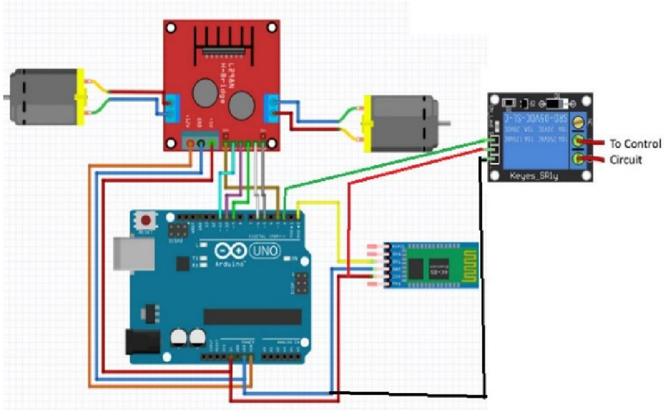
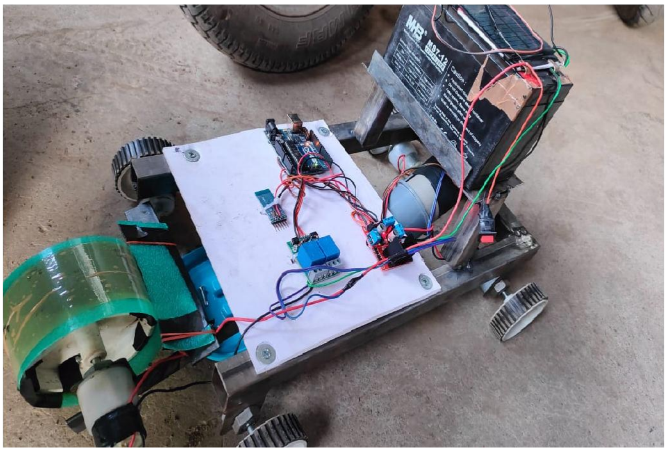


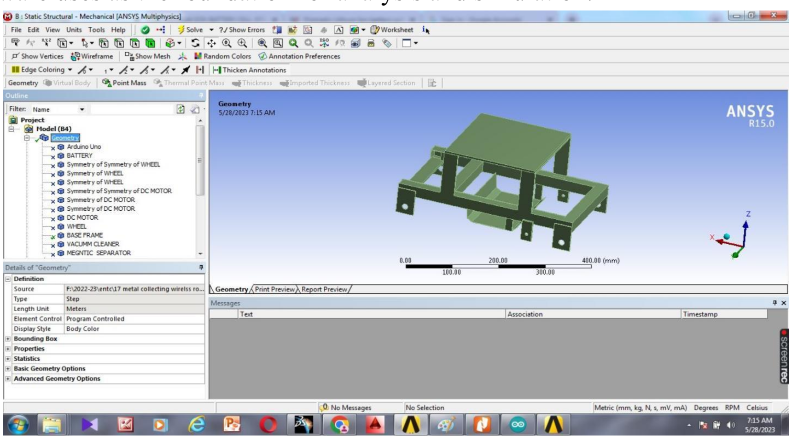
ACTUAL MODEL:



VI. SIMULATION

6.1 Geometry

A geometry diagram in ANSYS is a visual representation of a structure or component's geometric model or CAD (Computer-Aided Design) model. It provides a graphical representation of the model's shape, dimensions, and features, which the ANSYS software uses as the foundation for analysis and simulation.



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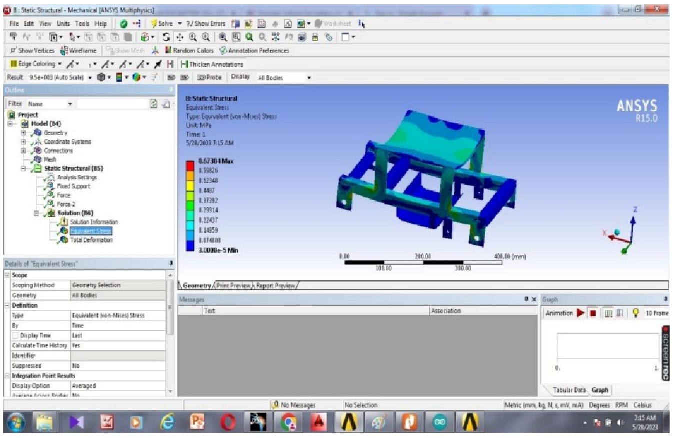
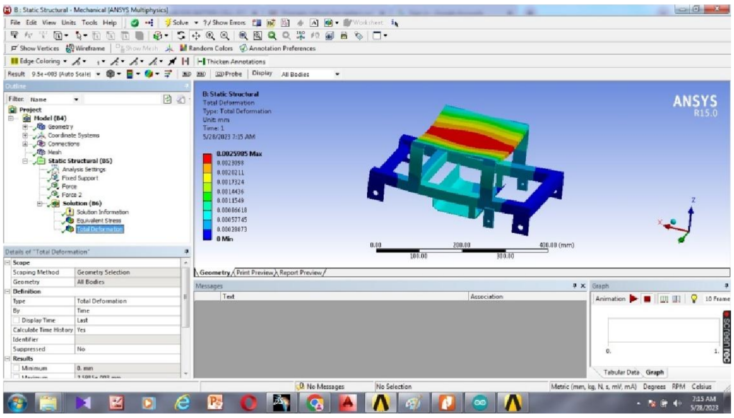
6.2 Stress Analysis Diagram

A stress analysis diagram in ANSYS is an illustration of how stresses are distributed within a component or structure. To represent stress levels, it uses colour contours or isolines. This graphic assists engineers in locating high stress locations, potential failure points, and making wise design choices to guarantee structural performance and integrity.



6.3 Total Deformation Analysis

In the terms of ANSYS, total deformation analysis is a simulation technique that determines and displays the total displacement and deformation of a structure or component under applied loads. It provides information on how the structure responds to loading circumstances by quantifying the size and direction of displacement at different sites in the model. Engineers may evaluate the integrity of the structure using this approach, spot places that have undergone significant deformation, and make well-informed design decisions that will increase performance and dependability.



VII. CONCLUSION

The wireless scrap collection robot, in summary, includes advanced features that improve its efficiency and automation in trash management. The hoover mechanism makes sure that dust and other debris are collected effectively, ensuring comprehensive cleanliness at the workstation. The magnetic conveyor system makes it easier to move metallic waste quickly and effectively. Remote management, ongoing monitoring, and seamless system integration are all made possible through wireless connectivity. Continuous operation and sustainable energy use are promoted by the availability of a rechargeable battery pack and the potential incorporation of solar panels. The robot's reliable chassis guarantees mobility across a variety of surfaces, and a storage chamber enables continuous collecting without requiring regular emptying. An effective and automated system for the collection and management of waste materials is produced by the integration of these cutting-edge characteristics.

VIII. FUTURE SCOPE

- Intelligent Navigation: The robot can navigate the workspace on its own by integrating cutting-edge sensors, machine learning, and computer vision algorithms.
- Intelligent Sorting: The robot may have mechanisms for intelligent sorting that automatically classify various waste products.
- Remote Monitoring and Analytics: The robot can be linked to a centralised control system, extending the range of wireless communication. This would enable proactive maintenance planning, data analysis for performanceevaluation, and remote monitoring of numerous robots.

Connecting the robot to Internet of Things (IoT) platforms and devices can provide real-time data monitoring, preventive maintenance, and integration with intelligent waste management systems.

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