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Self-Adjusting Solar Panels for Optimal Sunlight Absorption

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ABSTRACT :-

Stair-climbing robots have generated great interest in the field of robotics as their potential applications in many sectors—including search and rescue, delivery services, and maintenance operations—have drawn attention. This paper presents the design and implementation of a stair-climbing robot with a gripper mechanism capable of traversing complex terrain including staircases while performing tasks requiring object manipulation.

Built on a robust mechanical framework, the robot moves steadily across several types of stairs. Its mobility is provided by a combination of specialized wheel designs and articulated legs fitting the height and depth of every step. Made to grasp, lift, and transport objects of various sizes and weights, the integrated gripper makes the robot appropriate for tasks requiring both mobility and agility.

The control system of the robot is driven by a microcontroller processing sensor data, dynamically changing its movement and gripper actions. Even in unpredictable environments, this ensures efficient and smooth operation. The robot is a great tool for uses in environments where human intervention might be difficult or dangerous since it can climb stairs and control items independently.

This paper covers the design process, mechanical and electronic components, and the algorithms controlling the stair-climbing robot with a gripper. Results of experiments reveal the robot's capacity to complete its intended tasks, therefore underlining its potential application in the actual world.

1 INTRODUCTION :-

Often, robots have been employed for a great variety of tasks. One field where robotics has considerable promise is goods transportation. Transporting using robots raises difficulties as they cannot climb stairs or cross uneven ground. A robot could do that, therefore using robotics is beyond our wildest dreams.

Most robots run on either a wheeled or a tracked system. Though wheeled systems offer great speed and a significant steering advantage, this can be difficult to use in off-road conditions and for climbing over obstacles.

Though tracked robots are far better in uneven terrain, they still have trouble climbing stairs.

Apart from the two tracks it uses for horizontal movement, this Stair Climber Robot has dual tracked, retractable arms especially meant to help it climb stairs and large obstacles with case.

These retractable arms can also be pulled back when not in use. This allows the robot to make better use of energy.

Moreover, this robot sports a set of four gripper arms allowing it to hold and carry items.

These onboard gripping arms, which automatically clamp down when an object is between them, are driven by an onboard pressure sensor.

Made for soft object gripping, the gripper arms ensure no damage to the item.

2 LITERATURE REVIEW :-

The possible applications of stair climber robots with grippers in many industries including search and rescue, logistics, and healthcare have drawn growing interest in recent years. The outstanding study by A. Gupta et al. (2019) underlines the design and implementation of a stair-climbing robot including adaptive gripper. Using both passive and active wheels, the robot can efficiently cross uneven terrain. The adaptive gripper increases its ability to grasp and handle objects, therefore qualifying it for environments such disaster sites.

M. Zhang et al. (2020) also significantly contributed by developing a stair-climbing robot using a novel mechanical design including a climbing mechanism. and a gripping robotic arm. Their work emphasizes the importance of stability and mobility during stair climbing and demonstrates the robot's ability to transport goods on building sites.

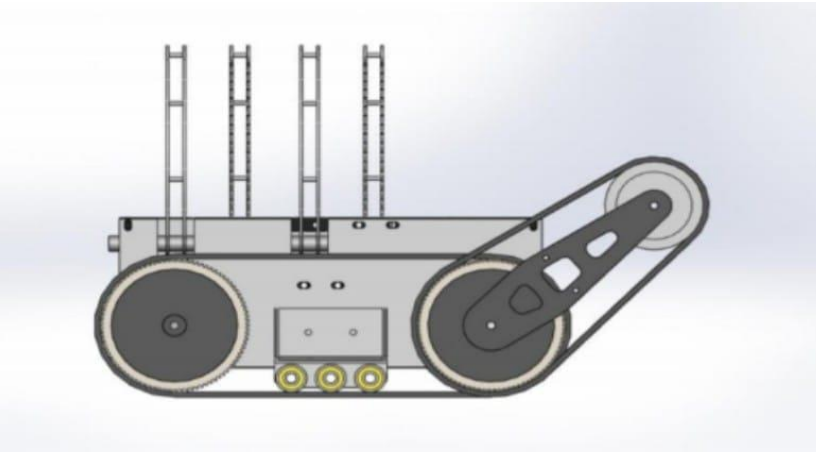
The study by R. Kumar et al. (2021) also investigates how computer vision interacts with a stair climber robot equipped with a flexible gripper. This robot negotiates complex staircases and locates obstacles using image processing methods. The design of the gripper is maximized for various gripping

requirements, therefore enhancing the use of the robot in dynamic environments.
At last, S. Lee et al. (2022) propose a multi-functional gripper modular stair-climbing robot intended for use in medical settings. By shifting items up and down stairs, their research demonstrates how the robot may assist those with mobility constraints. By way of straightforward user need-based modification, the modular design emphasizes the flexibility of stair climber robots in practical application.
When considered together, these studies reveal the advances in stair-climbing robots with grippers, emphasizing their mechanical design, stability, adaptability, and technological integration to enhance performance in different environments.

3 ACTUAL METHODOLOGY FOLLOWED :-

The Stair Climber Robot with Gripper is built using a methodical approach to address the challenges of climbing stairs and traversing uneven terrain, so allowing the robot to carry items safely.

The Stair Climber Robot with Gripper is designed using a methodical approach to address the challenges of climbing stairs and traversing uneven terrain, therefore enabling the robot to transport objects safely as well. The method is made up of the following phases:



1. Structure and Design:
Built on a dual-tracked system, the robot provides stability and mobility on many surfaces including rough terrains. The robot can easily cross several environments by horizontal movement on the main tracks.
Its stair-climbing capability is aided by two retractable tracked arms. When the robot encounters stairs or large obstacles, these arms provide more support and traction. When not in use, the arms fold to conserve energy and maintain efficiency during normal movement.

2. Mobility Mechanism:
Four high-torque DC motors drive the robot's tracked system, therefore ensuring its efficient movement over uneven terrain. Motor drivers connecting these motors to the tracks are controlled by an Atmega328 microcontroller. An RF receiver forwards movement commands from a wireless remote control to the microcontroller.

Although the tracked design enables the robot handle even the roughest terrains, the retractable arms provide it the ability to ascend stairs.

2. Mobility Mechanism:
Designed for soft item handling, the robot has four arms. Driven by two DC motors, the gripper lets it alter its hold depending on the size and shape of the object. Aboard pressure sensor changes the grip automatically to avoid damage to delicate items.
Appropriate for transferring various items, the pressure sensor ensures that the robot applies just enough force to securely hold items.

4. Control and Communication:
Commands from this controller reach the RF receiver on the robot; the Atmega328 microprocessor processes them to run the motors for forward, backward, turning, or stair-climbing motions.
Using pressure sensor signals, the microcontroller also controls the gripper mechanism, determining the appropriate force to apply when gripping objects.

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