

Design Details Document Robotics Club NIT Patna

I. Design of Robot-1 (R-1):

A. Overall Dimensions and Estimated Weight:

The robot R-1 is crafted with dimensions measuring 700mm x 700mm x 500mm, weighing a total of 12kg. This design prioritizes optimal manoeuvrability in confined spaces. Breaking down the weight distribution, the microcontrollers, actuators, wheels, motor drivers, receivers, and batteries collectively contribute to approximately 3kg, while the CAD model accounts for an estimated 9kg.

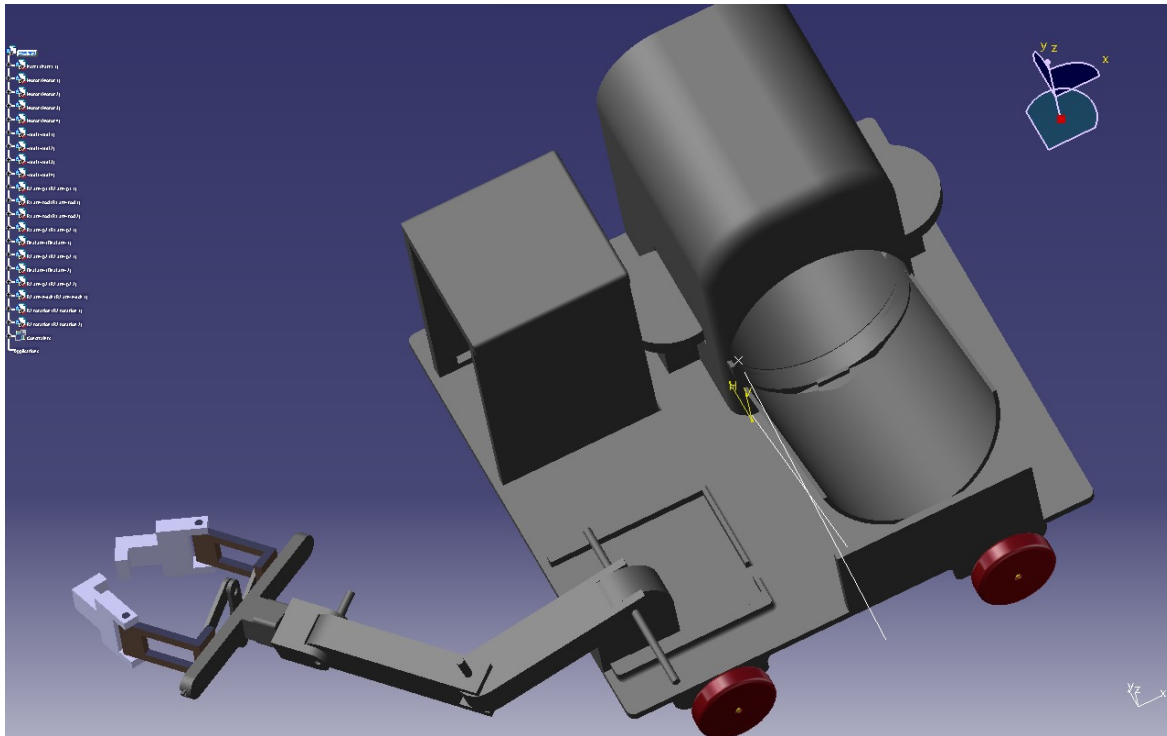


Fig.: R-1 Design and Roboarm.

B. Type of Drive:

The robot R-1 features a four-wheel drive system with Mecanum wheels, driven by high-performance DC gear motors equipped with precise encoders. These motors are seamlessly controlled by advanced motor drivers, ensuring not only omnidirectional movement for enhanced manoeuvrability but also allowing for fine-tuned and responsive control. The choice of Mecanum wheels, carefully selected to handle the weight of the robot R-1, further contributes to its overall

agility and adaptability in diverse environments.

C. Type of Actuators:

The propulsion system integrates four DC gear motors with encoders and four motor drivers, enabling precise control and navigation. The robotic arm with a customized gripper for pick-and-place tasks, incorporates five servo motors and one DC gear motor. This arm efficiently handles the manipulation of seedlings, paddy rice, and empty grain. For the specific task of launching paddy rice and empty grain, a dedicated mechanism powered by two DC gear motors ensures effective and accurate throwing capabilities. The overall actuator system is designed for comprehensive and efficient operation.

D. Type of Sensors:

Our strategy involves employing robot R-1 in Areas 1 and 2, where it operates without sensors, relying on manual control through a radio transmitter and receiver. This deliberate design choice emphasizes simplicity and cost-effectiveness, aligning with the nature of the tasks in these areas. Meanwhile, in Area 3, we deploy robot R-2, adhering to a differentiated approach based on task requirements and operational efficiency.

E. Seedling, Paddy Rice, and Empty Grain Picking Mechanism:

The robotic arm, featuring three degrees of freedom powered by three servo motors, incorporates a customized gripper. This specialized gripper, comprising two servo motors and one DC gear motor, is designed for the gentle picking of seedlings, paddy rice, and empty grains. The intricate mechanism not only minimizes potential damage but also significantly enhances precision in handling these tasks.

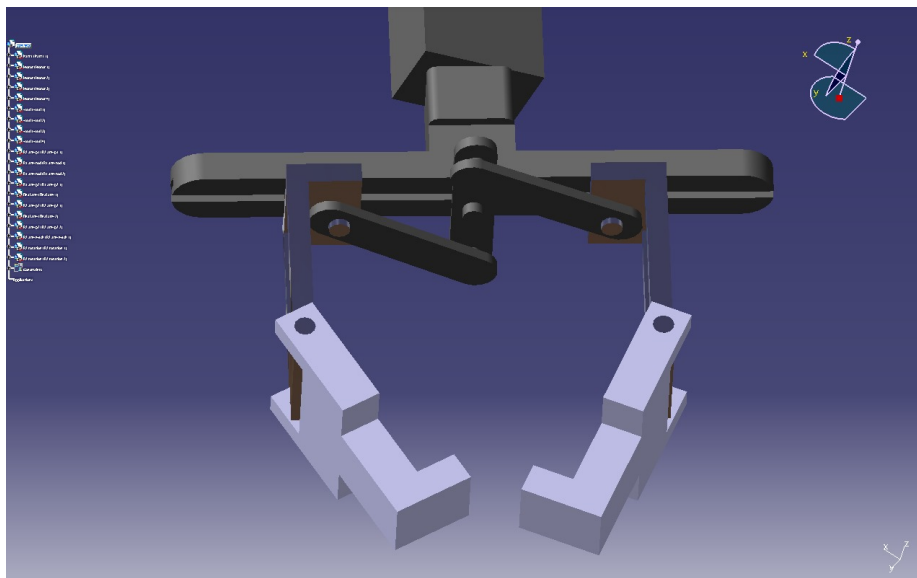


Fig:- Custom Gripper

F. Brief Description of Seedling Planting, Transferring Paddy Rice, and Empty Grain Mechanism (R-1):

The robotic arm of R-1 is versatile, carrying out three vital tasks seamlessly. Firstly, it excels in planting seedlings with a precision and adjustable gripper, ensuring its optimal placement. Additionally, the same robotic arm showcases its capability by efficiently collecting paddy rice from the field. Moreover, it is equipped to transport both paddy rice and empty grains from one location to another.

G. Paddy Rice and Empty Grain Launcher Mechanism:

The robotic arm of R-1 demonstrates remarkable versatility through its seamless execution of multiple tasks. Primarily, it excels in precisely planting seedlings using an adjustable gripper, ensuring optimal placement in prepared holes. Additionally, this same robotic arm proves its efficiency by adeptly picking paddy rice from the field. Notably, it is also equipped with the ability to transport both paddy rice and empty grains from one location to another. Furthermore, the DC motor-powered launcher mechanism adds another dimension to its capabilities. This mechanism employs a system wherein placing paddy rice or empty grain at the launcher's designated spot initiates a gravity-induced rolling motion. Subsequently, the two DC motors, rotating at high speed, facilitate the throwing of the paddy rice or empty grain to Area 3.

II. Design of Robot-2 (R-2):

A. Overall Dimensions and Estimated Weight:

The robot R-2 has overall dimensions of 500mm x 600mm x 450mm, weighing 11kg. Notably, the microcontroller, wheels, actuators, sensors, motor drivers, and batteries collectively account for approximately 2.5kg, while the CAD model contributes to the remaining 8.5kg.

B. Type of Drive:

The robot R-2 is equipped with a Mecanum drive system, featuring four-wheel drive powered by high-performance DC gear motors with precise encoders. These motors are skillfully managed by advanced motor drivers, providing seamless control for omnidirectional movement. The Mecanum wheels selected for the robot R-2 not only support its weight effectively but also enhance its agility and adaptability in various environments. This design ensures that R-2

achieves automated functionality with precision and responsiveness similar to the manually controlled R-1.

C. Type of Actuators:

The propulsion system of robot R-2 comprises four DC gear motors with encoders and four motor drivers, ensuring precise control and navigation. Additionally, the robotic arm on R-2, equipped with three servo motors for three degrees of freedom and a linear gripper driven by one servo motor, employs a total of four servo motors. This robotic arm is adept at efficiently executing pick-and-place tasks, particularly excelling in the manipulation of paddy rice.

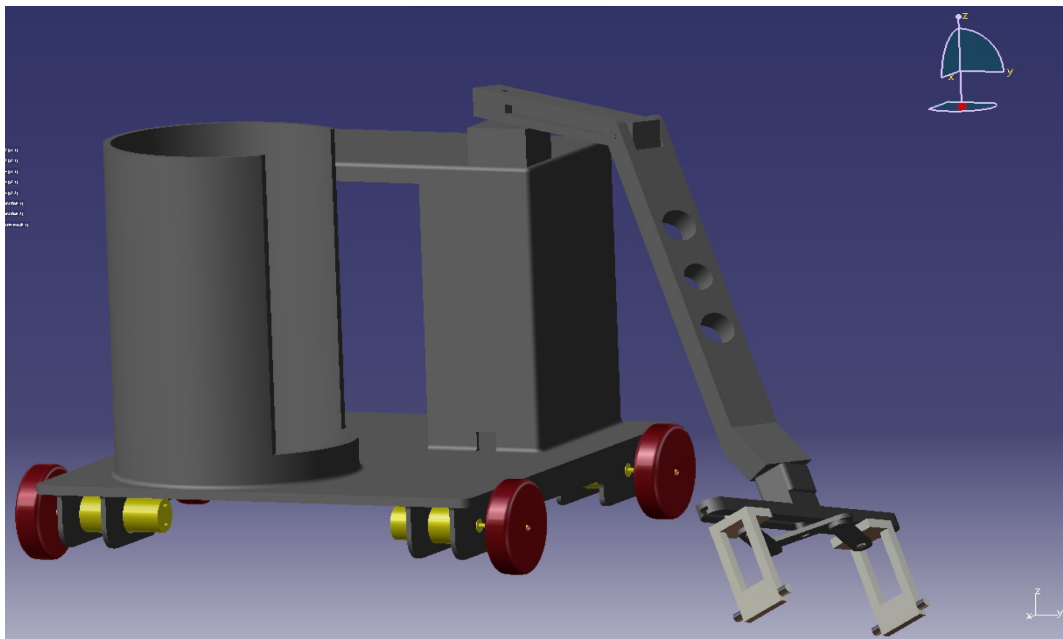


Fig.:- R-2 Robot design and arm design.

D. Type of Sensors:

R-2 is outfitted with a Pixy2 camera featuring a pan and tilt mechanism specifically designed for automated object recognition and precise positioning within a mixture of paddy rice and empty grains. This advanced camera system enhances R-2's capability to autonomously identify and distinguish paddy rice from the mix, enabling efficient automated operations in agricultural settings. The pan and tilt mechanism further ensures accurate positioning for optimal identification and handling of the targeted grains.

E. Seedling, Paddy Rice, and Empty Grain Picking Mechanism (R-2):

The operational scope of robot R-2 excludes areas 1 and 2, specifically avoiding the picking and placing of seedlings in those regions. This strategic decision is grounded in achieving optimal

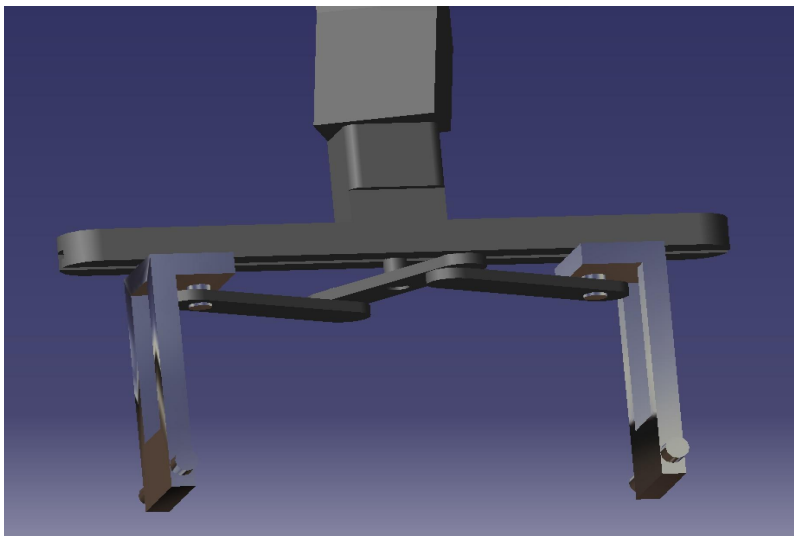
task completion through a well-distributed workload between the two robots. By assigning distinct responsibilities, a simplified and efficient design for each robot is achieved.

F. Brief Description of Seedling Planting, Transferring Paddy Rice, and Empty Grain Mechanism (R-2):

Robot R-2 is not involved in seedling planting or the transfer of paddy rice and empty grain to maintain a straightforward and efficient design. This decision ensures optimal task distribution between robots, enhancing overall operational effectiveness. Instead, R-2 focuses on its strengths, particularly in area 3, where it excels in manipulating paddy rice with its specialized 3-degree-of-freedom robotic arm and linear gripper.

G. Collecting Paddy Rice and Storing in Silos Mechanism (R-2):

Robot R-2 excels in the specialized task of manipulating paddy rice within the designated area 3. This capability is driven by its advanced features, including a 3-degree-of-freedom (3DoF) robotic arm and a precision linear gripper. In area 3, R-2 plays a crucial role in collecting paddy rice from a mixture of paddy rice and empty grain.



The design of the storage space in R-2 is specifically tailored for efficient rice handling. This storage space is engineered to accommodate two paddy rice units simultaneously. Moreover, the robotic arm is configured to carry one additional paddy rice while in motion. This ingenious design allows R-2 to collect three rice units in a single

operational cycle. The collected paddy rice is then efficiently deposited into the silo located in Area 3. The silo, designed with a capacity of three units, ensures that R-2 maximizes its efficiency in paddy rice collection and storage operations within the designated area.