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Design and Development of Cartesian Coordinate Robot

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Abstract: ***For precise motion control in Cartesian coordinates, essential for assembly tasks requiring both force and position control to ensure part integrity and smooth operation. Previous methods lacked the ability to maintain fast and accurate motion control in the presence of modeling errors and external disturbances. Our proposed scheme comprises both nonlinear and linear components in the control input. The nonlinear part stabilizes and decouples robot dynamics in Cartesian coordinates, while the linear part, drawing from servomechanism theory, mitigates modeling errors and disturbances.***
Keywords: Servo Motor, Cartesian coordinates, Robot dynamics

I. INTRODUCTION

A Cartesian coordinate robot is an industrial robot whose three principal axes of control are linear. The Cartesian Coordinate robot is also known as the linear robot. This mechanical arrangement simplifies the robot control arm solution. Cartesian coordinate robots, also known as rectilinear or gantry robots, represent a fundamental archetype of robotic systems. Characterized by their linear motion along three orthogonal axes (X, Y, and Z), Cartesian robots are widely utilized in various industries for tasks requiring precise positioning, high repeatability, and efficient automation. Cartesian robots operate within this spatial framework, moving in straight lines along predefined paths to execute tasks with accuracy and reliability. The design of a Cartesian coordinate robot typically consists of a rigid frame constructed from aluminum, steel, or other materials, forming a rectangular or cubic structure. Linear actuators, such as ball screws or linear motors, are employed to drive motion along each axis, controlled by sophisticated feedback systems to ensure precise movement. In recent years, the rise of collaborative robotics has expanded the role of Cartesian robots beyond traditional industrial settings, with these machines increasingly employed in environments where human-robot interaction is essential, such as healthcare, logistics, and service industries. As automation continues to revolutionize various sectors of the economy, Cartesian coordinate robots remain at the forefront, driving productivity, improving quality, and unlocking new possibilities for innovation and efficiency.

II. OBJECTIVES

1) Seamless Integration with Existing Systems
2) Improved Task Flexibility
3) Increased Workspace Coverage
4) Improved Efficiency and Productivity

III. METHODOLOGY

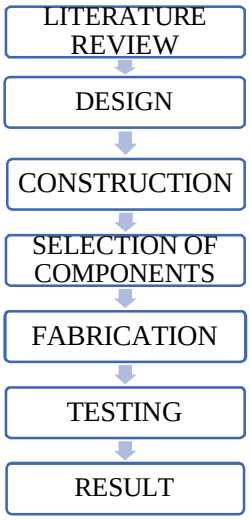

Fig 1**:** Flowchart of Cartesian Coordinate Robot

Cartesian co-ordinate robot is very essential and more versatile in the present industrial field. Further implementing the rotational axis in order to obtain additional degree of freedom. The cartesian coordinate robot with gripper acts as the pick and placer which uses the DC motors for performing the task powered by 12 V power supply. The aluminium gripper functions with the help of SG-90 Servo Motor aided by ESP32 board powered by 6 V power supply.

1) The ESP32 board is used as control unit for an operation of servo motor which controls gripper.
2) Aluminium Gripper is used to perform pick and placing task.
3) Rack and Pinion is used to carry out the X-axis function.
4) We have used DC motor to access the freedom of rotational axis.
5) The X - axis and Y - axis is functioning with the help of motors which rotate the screw rod.

IV. IMPLEMENTATION

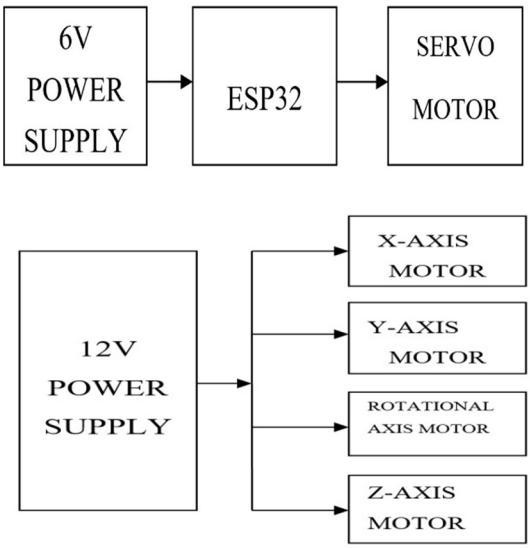

Fig 3: Prototype of the Model

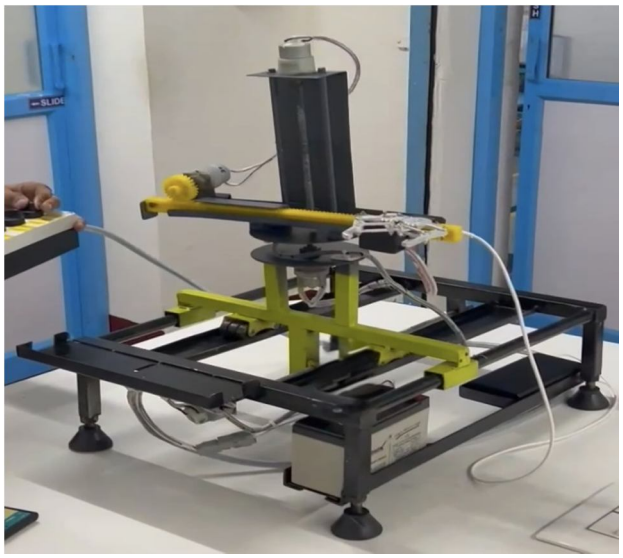

Fig 2: Block Diagram of Cartesian Coordinate Robot

V. RESULT

The prototype model was made according to the block diagram and the results were as expected. The functioning rotational axis was obtained satisfactorily using different type of transmissions. The X, Y and Z axis are functionable along with rotational axis. The X-axis is operated by Rack and pinion, Y and Z-axis are functionable by the help of screw rod.
The exact figure of resulted Cartesian Coordinate Robot is shown,

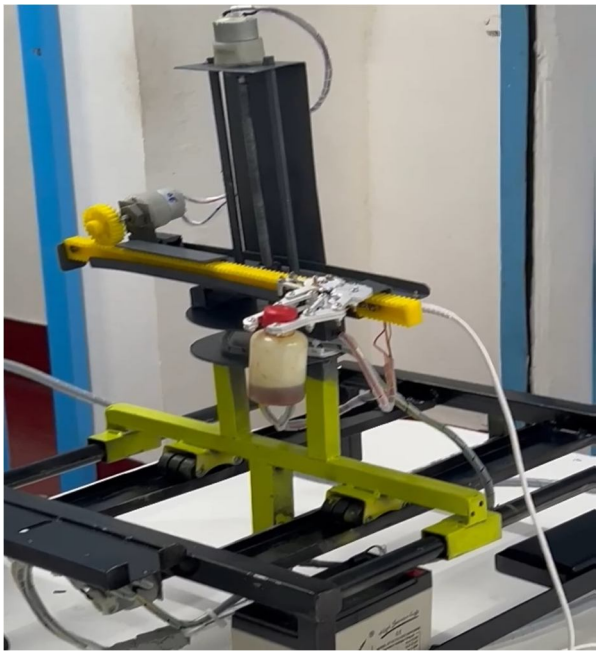

Fig 4: Gripper as Pick and Placer

VI. CONCLUSION

The proposed system basically serves in 4 axes. X, Y, Z and Rotational Axis. This is a
cost efficient solution for Industrial automation, Agricultural Industry, Food industry etc. This system is more efficient than the other cartesian coordinate robots available in the market. The information can also be used by the Government authorities for the construction purpose of buildings by 3D printing method.

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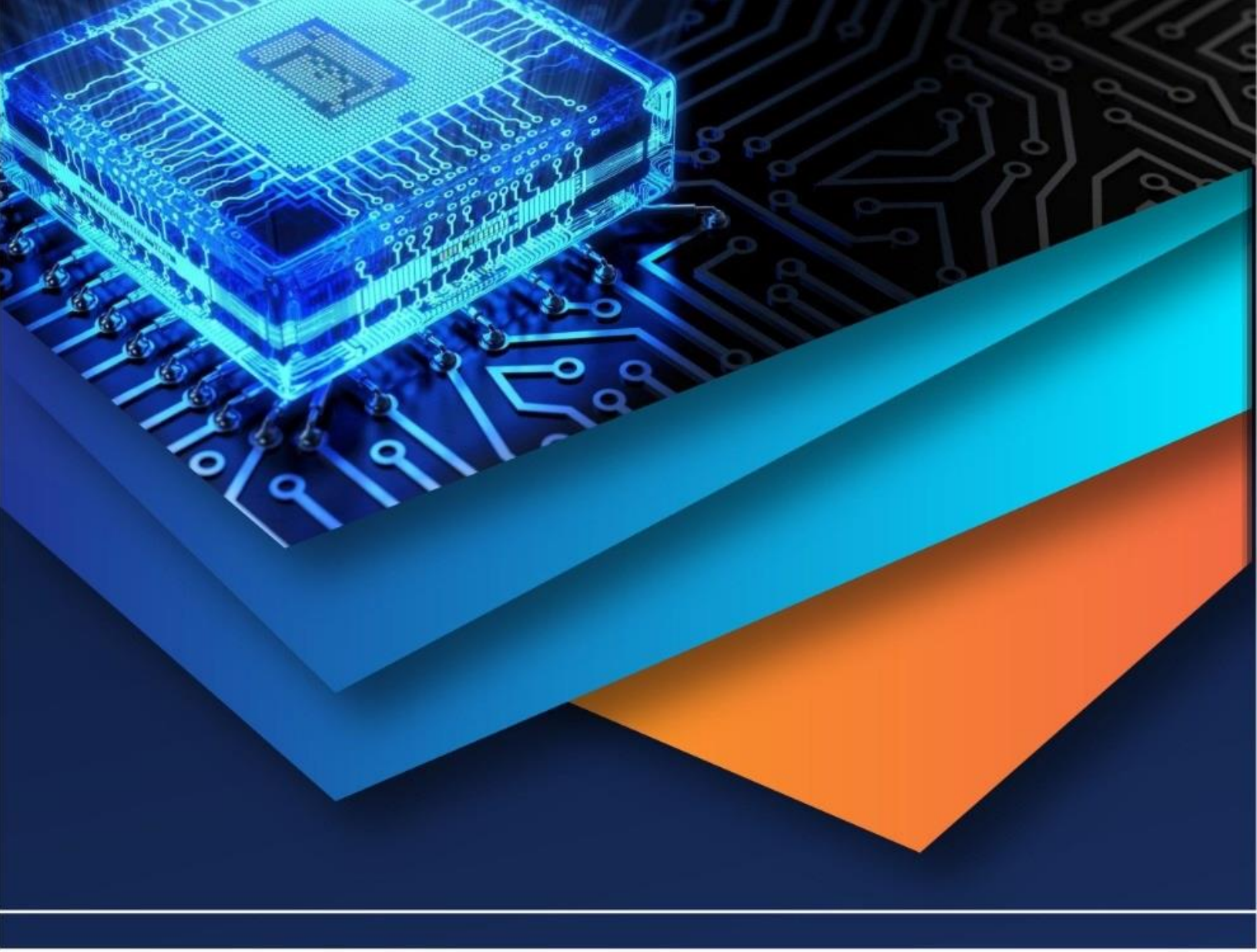

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