Hand Gesture Controlled Movable Pick and Place Robot

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ABSTRACT:

In today's environment, robotic automation is progressively being drawn to and utilised in industry and daily regular jobs. This study, on the other hand, presents a strategy for replacing buttons and joysticks with a newer technology, namely, directing the complete Robotic Arm with a user's hand movement, motion, or gesture. The purpose is to change people's perceptions about remote controls for manually operated robotic arms. Pick and place robots are a sort of technology that is utilised in the industrial sector to do pick and place activities. The method is designed to eliminate human mistake and interference, resulting in more precise work.The system is intended to use a basic, flexible, and minimal control method. There are various fields where human interaction is troublesome, yet the process must be run and regulated, which necessitates the use of robots. Pick and place robots, according to the literature, are created and deployed in a number of industries, including the bottle filling business, surveillance to identify and destroy explosives, and so on. The project's purpose is to build a gesture-controlled robot with a robotic arm capable of performing any pick-and-place job. The pick and place robot are controlled using radio frequency communication.The Robotic Hand features independent controls for opening and closing the gripper, moving it up and down, forward, and backward, and rotating the base clockwise and counterclockwise. The displacement of the robotic arm on the chassis is supported by four Omni wheels. The robotic arm in use has four degrees of freedom. This robot's adaptability may be increased by adding line follower, wall hugger, obstacle avoidance, metal detector, and other capabilities.

INTRODUCTION:

The purpose of this project is to design and build a "Movable Gesture Controlled Robotic Arm," which consists of three components: an accelerometer, a robotic hand, and a platform. It is essentially an Accelerometer-based Robotic Hand

system that use RF signals to control a Robotic Hand equipped with a small and low-cost 3-axis (DOF) accelerometer. The Robotic Hand is connected to a mobile platform that is wirelessly controlled by an accelerometer.To capture a human hand's gesture, an accelerometer is inserted or attached to it. When the switch is turned on, the robotic arm moves accordingly, and when it is turned off, the platform moves correspondingly. The user's and operator's hand gestures and postures are synchronised with the robotic arm and platform. Some of the activities performed by Robotic Hand are PICK and PLACE / DROP, RAISING and LOWERING, and ROTATING CLOCKWISE/ COUNTERCLOCKWISE the goods.

The platform also performs the following motions: FORWARD, BACKWARD, RIGHT, and LEFT.The major purpose of this project is to design and construct a volatile robotic arm with four degrees of freedom (DOF) capable of performing a basic reflexive grasp on a variety of goods. The system is built on a servo, point-to-point, cylindrical robot with four degrees of freedom (DOF). Rather than manipulating or manufacturing items, this strategy focuses on the challenge of holding things of varied shapes. This type of grasping device may be used for a variety of applications, including defective item retrieval systems, planetary and oceanic exploration, and robotic surgery. This research is largely focused with item selection and removal. It works with glove-based technology and is based on hand motions.

RELATED WORK*:*

In robotics research today, many robotic hands are used, each with its unique set of capabilities and design needs. This section includes an overview of various recent widely used and/or important robotic arms. Several robotics research programmes have been launched with the goal of recognising human gestures. The following are some of the most frequent systems:

Vision-Based Gesture Recognition

It primarily functioned in the field of Service Robotics, and the researchers finally developed a cleaning robot. They developed a hand gesture-based interface for manipulating a mobile robot. A camera will be used to track a person's movements and recognise arm motions. A rapid, adaptable tracking algorithm enables the robot to quickly track and follow a human under changing lighting conditions in the office environment. It will clean and use a camera to monitor its progress.

Motion Capture Using Sensor Recognition

This method of identification allowed the creation of an accelerometer-based system for wireless communication with an industrial robotic arm. This project's robotic arm is powered by an ARM7-based LPC1768 core. MEMS is a three-dimensional accelerometer sensor that records human-arm motion and creates three distinct analogue output voltages in three spatial axes. To detect gripper movement, two flex sensors are used.

Finger Gesture Recognition System Using Active Tracking Mechanisms

The fundamental purpose of the author's system (based on the recognition technique) is to enable it to connect with a portable device or a computer via finger motion recognition. Apart from motions, speech may also be utilised to interact, hence this technology can be used as part of a Perceptual User Interface (PUI). The technique might be used for Virtual Reality or Augmented Reality systems.

Accelerometer-Based Gesture Recognition

This Gesture Recognition technology has gained in prominence in a noticeably brief period of time. The accelerometer is a valuable tool for detecting and identifying human body movements due to its low moderate cost and comparatively small size. Several studies on the recognition of gestures using acceleration data and Artificial Neural Networks have been conducted (ANNs).

OVERALL DESIGN OF THE SYSTEM

A. Block Diagram Proposal

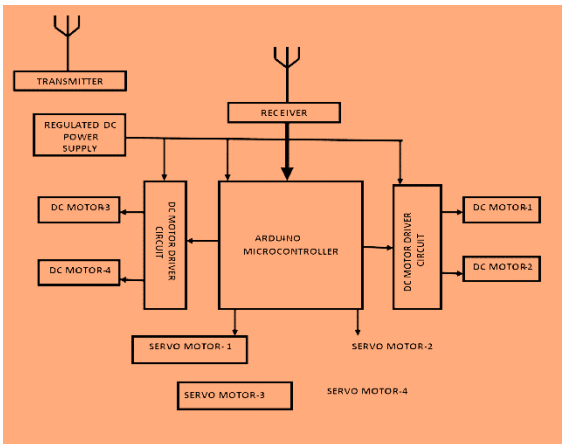
Figure depicts the overall system design. There are Flex Sensors, Servo Motors, an Arduino UNO, an Arduino Nano, an RF transmitter, an RF receiver, a Motor Driver L293D, an accelerometer, and a power supply included.

The pick and place robotic arm consist of a robotic arm attached to a moving vehicle (chassis). The car may go on any type of surface, smooth or rough. The pick and place robot contains four chassis motors and four servo motors for the pick and place operation. The pick and place arm are composed of an arm assembly with a jaw that can move up and down, forward, and backward, as well as rotate clockwise and counterclockwise.

The arm assembly is powered by four motors:

- Rotation in both clockwise and anticlockwise directions
- For both upward and downward movement
- For forward and reverse motion
- To open and close the gripper

The motor is controlled by a motor driver IC and an Atmega328 microprocessor. The input or controlling signal is provided by a wireless play station and is interfaced with the microcontroller through an RF receiver module. When a signal from the play station is received, it is decoded in the controller, and the required controlling signal is sent to the system's actuators (dc motors or servo motors).



B. Major Robotic Hand Components

In this study, we construct a robotic arm with four degrees of freedom that can pick up various objects and position them in various locations. The system has been separated into the following sections based on functionality: -

- Arm robot
- Platform
- System of communication

All of these components are addressed more below:

a. **Robotic Arm:**The most significant part of the system is the robotic arm, which picking up and dropping project tasks. The robotic arm is equipped with a Gripper (for picking and placing items) and an Arm (for raising and lowering objects and rotating). Servo Motors are used to regulate movement in both the Arm and the Gripper. When commanding the Robotic Arm, these motions are

synchronised with the user's hand gestures. Based on the RF module settings, the lowest point servo is installed in such a way that it moves the top base horizontally from 0 to 180 degrees.

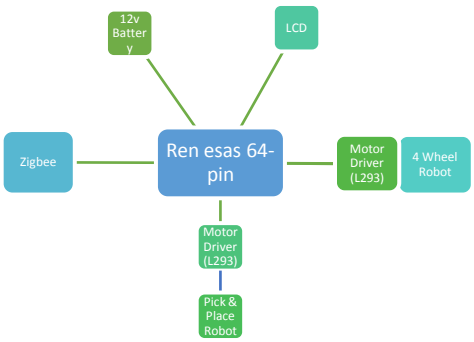


Fig 1: Receiver block diagram.

b. Platform: The Platform is just the project component on which the Robotic Arm is placed. The platform is propelled by DC motors and moves in rhythm with the user's other hand movements in order to control the Robotic Arm. The accelerometer is attached to the user's one hand and records hand motions. In addition, various hand movements cause the platform to move. This element of the project is in charge of transporting the entire project from one area to another.

- ❖ Gesture 1: To cause the platform to move forward.
- ❖ Gesture 2: To make the platform go backwards.
- ❖ Gesture 3: To make the platform turn to the right.
- ❖ Gesture 4: Make the platform turn to the left.

c. Communication System: This communication is important to the article's success. No system or project can work without a communication system. This holds true for this project as well. The only communication equipment required for this operation is the RF Module. This Module transmits the user's varied hand motions (encoded as 4-bit digital data) wirelessly to the receiver, which decodes the received 4-bit digital data and moves the arm, gripper, and platform correspondingly. Figures show block schematics of the whole project's communication system.

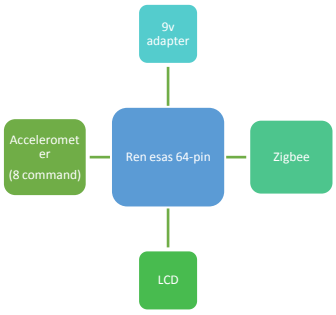
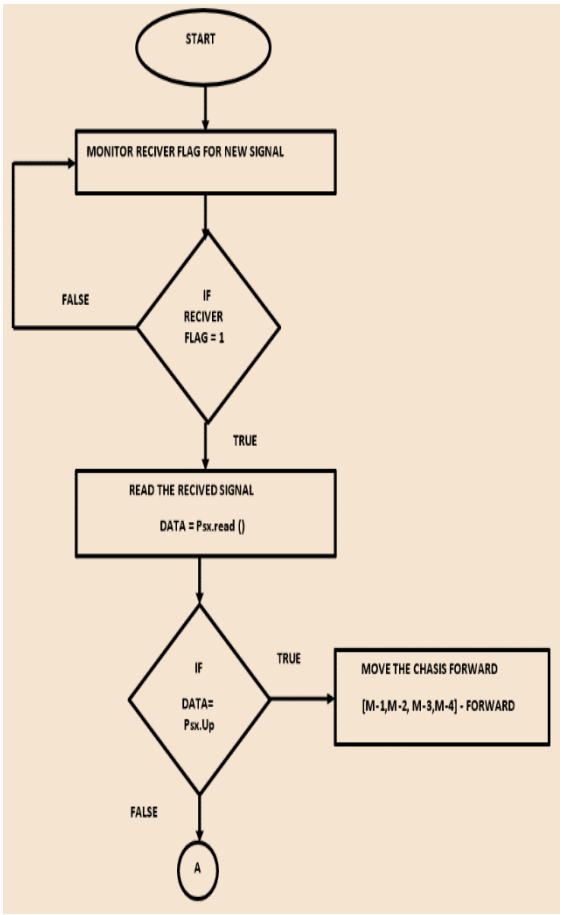
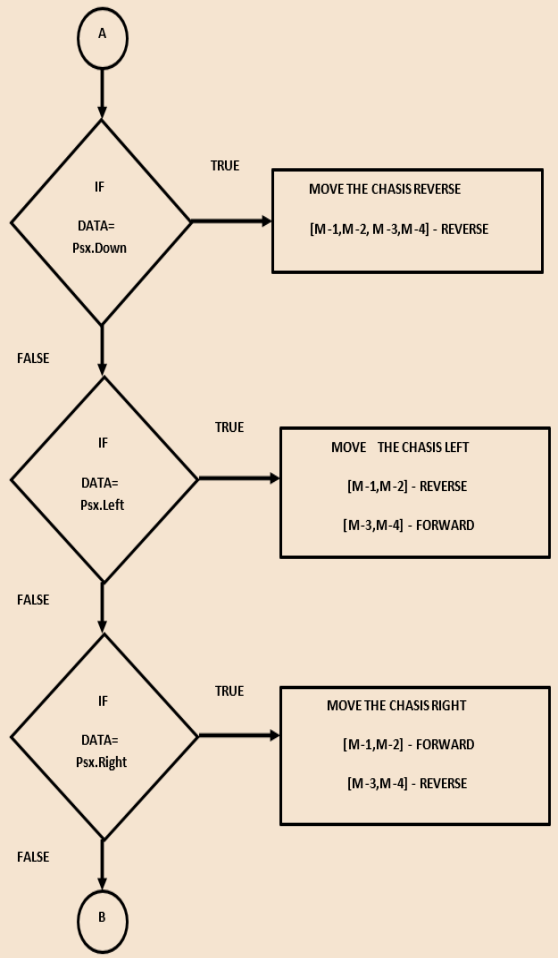


Fig 2: Transmitter block diagram.

FLOWCHART OF THE APPLIED CODE





The two figures above represent the approaches used to programme the system. By including the Psx.h header file when including the supporting files for execution, the signal received by the play station may be read on the Arduino platform using the built-in method Psx.read(). The receiver flag of the Arduino controller is monitored to detect any commands issued to the controller.

When the receiver flag rises high, it indicates that a control signal has been sent to the robot. The next stage is to comprehend the instructions you have been provided. The signal is read and recorded in the variable "DATA," and the algorithm then looks for the opcode that executes when it matches the code stored in "DATA."

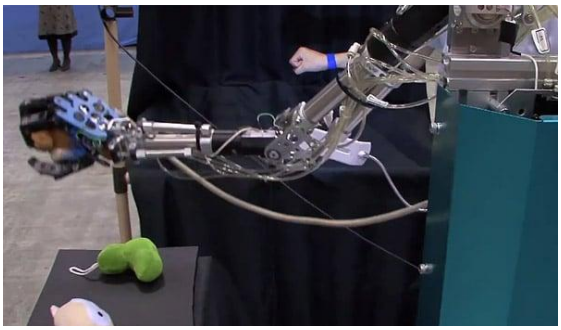
Example: As we know, when the UP button on the play station is pressed, the code read on Arduino by function is DATA = Psx.read(); which results in the value or data stored in variable DATA being Psx.Up. Now, the programme is constructed in such a way that what the controller should do when data is read as Psx.Up.

In this example, the controller instructs all four motors to drive forward. As a result, the chassis advances.

Similarly, if data is read and saved in the variable Psx.Down, all dc motors are told to travel in the opposite direction. As a result, the chassis slides backwards.

HARDWARE INSTALLATION

The pick and place robotic arm placed on the chassis is seen in Figure. The RF signal is used to operate the pick and place robot. Four Omni wheels support the robotic arm's displacement on the chassis. The implemented robotic arm has four degrees of freedom. The circuit is powered by a 12V 1A battery housed within the chassis' body.



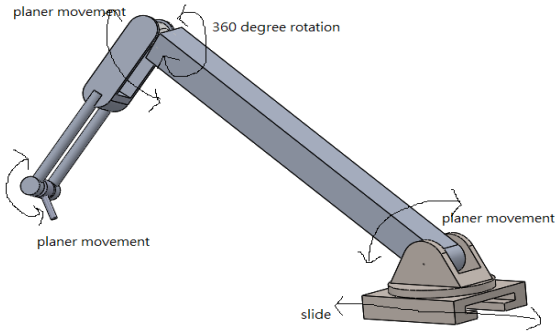


Figure depicts the transmitter, which uses an accelerometer to transmit the signal for the movement of the robot and the arm depending on the hand gesture. When the toggle button is turned on, the hand gesture controls the movement of the arm, and when it is turned off, the hand gesture controls the movement of the bot.

FUTURE SCOPE

The robot configured for pick and place operations may be made more adaptable and efficient by giving feedback and allowing it to perform without human involvement. It is made feasible by an image processing tool that is linked to this Arduino. Line follower, wall hugger, obstacle avoider, metal detector, bomb diffuser, and more characteristics can be added to increase its efficiency and allow it to run on its own without human interaction.

CONCLUSION:

Pick and place robots have a wide range of applications and may greatly minimise human labour with high speed and precision. When compared to human labour productivity, the robot's tenacity and quality of performance are unrivalled. The robot can be reprogrammed, and the tooling may be swapped out for different applications. Though certain pick and place robots have been designed to be controlled wirelessly and with various controllers, hand gesture-based robotics have shown to be superior to the previously mentioned robots. Overall, it is reasonable to infer that choosing and arranging things may be done effortlessly with the aid of these robots.

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