

Design and Making of Pick and Place Robotic Arm Manipulator

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ABSTRACT: This project explores the entire journey of building a robotic arm that mimics the movements of a human arm to perform tasks like picking up, placing, and manipulating objects. To achieve precise and flexible motion, the arm is constructed with multiple degrees of freedom. The design combines essential disciplines, e.g. mechanical structure, electronics, and programming to create a synchronized system where actuators and microcontrollers, Arduino Nano and ATmega328P, control the joint movements. Sensors are integrated to provide feedback and enable a higher level of automation. The manipulator is built using affordable components, making it both functional and accessible. The project aims to showcase how robotic arms can be effectively used in areas like industrial automation, education, and research. Throughout the process, students engage with core engineering principles including kinematics, dynamics, control systems, and mechatronics, reflecting the deeply interdisciplinary nature of robotics development.

KEYWORDS: Robotic Arm, Arduino Nano, Hardware-Software-Mechanical Design, Automation.

I. INTRODUCTION

Robotics technology has rapidly advanced in recent years, with its primary goal being to support humans in performing specific tasks more efficiently. Among the various types of robots, robotic arms are also known as manipulators and stand out for their ability to lift, hold, and move objects with high precision and accuracy. This capability makes them especially valuable in improving production quality and reducing operational time in industrial settings. In this project, a robotic arm is controlled wirelessly through Bluetooth technology. The system utilizes an HC-05 Bluetooth module interfaced with a microcontroller. A custom Android application is developed to send serial commands from a smartphone to the Bluetooth module, which are then processed by the microcontroller to control the servo motors accordingly. This setup enables intuitive, real-time control of the robotic arm, making it functional and user-friendly.

II. LITERATURE SURVEY

Robotic arms are playing an increasingly vital role in automating repetitive and precise tasks across various industries, helping improve not just productivity; but also safety and accuracy. The availability of microcontrollers like Arduino and wireless modules such as the HC-05 Bluetooth unit, building these robotic systems more accessible, particularly for educational and low-cost industrial applications.

For instance, Choudhari et al. [1] developed a robotic arm powered by Arduino Uno and servo motors, which could be wirelessly controlled via Bluetooth. Their design proved especially useful for tasks in hazardous environments and could be easily reprogrammed for different operations. In a similar effort, Bhujbal et al. [2] created a four degree of freedom robotic arm managed through an Android app, demonstrating its efficiency in pick and place functions.

Recent advancements in robotic arm control systems have increasingly leveraged smartphone-based interfaces for intuitive user interaction. Heamawatanachai and Mayang [3] demonstrated a six-axis robotic arm controlled via Bluetooth and Wi-Fi, applying forward and inverse kinematics to improve movement precision and efficiency over traditional methods.