INDUSTRIAL ROBOT IN PICK & PLACE

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ABSTRACT

The pick and place robot stands as a cornerstone technology within the manufacturing industry, engineered with the precise task of executing pick and place functions autonomously. This system represents a pivotal advancement aimed at eradicating human errors while delivering heightened precision in its operations. By harnessing this technology, manufacturing processes can achieve enhanced efficiency, thereby streamlining operations and optimizing output.At its core, the pick and place robot serves as a vital asset in driving productivity gains while simultaneously mitigating operational costs over the long term. Moreover, its deployment addresses a myriad of challenges that are otherwise insurmountable for human operators, particularly in environments characterized by high temperatures, confined spaces, or heavy load requirements. By assuming these tasks, the robot not only ensures consistency but also enhances workplace safety by reducing human exposure to hazardous conditions.This project represents a fundamental leap forward in the development and customization of pick and place robotics, leveraging the peripheral interface Programmable Logic Control (PLC) as the central nervous system to orchestrate the robot's movements seamlessly. With its ability to rotate a full 360 degrees in both clockwise and counterclockwise directions, coupled with horizontal arm movements for efficient object manipulation, the robot emerges as a versatile solution capable of adapting to diverse manufacturing environments.Furthermore, the inherent advantage of this robotic system lies in its cost-effectiveness, as it offers a construction solution that is notably economical without compromising on performance or reliability. Through this innovative approach, manufacturers can unlock new opportunities for process optimization while fostering a more sustainable and competitive operational model.In conclusion, the integration of pick-and-place robotics driven by PLC technology marks a paradigm shift in manufacturing automation, heralding a future defined by precision, efficiency, and cost-effectiveness.

Keyword: Pick and Place Robotic Arm., servo motors, gripper joint, aluminum frames.

1. INTRODUCTION

In this highly developing society time and manpower are critical constrains for completion of task in large scales. The automation is playing important role to save human efforts in most of the regular and frequently carried works. One of the major and most commonly performed works is picking and placing of jobs from source to destination.The pick and place robot is a microcontroller based mechatronic system that detects the object, picks that object from source location and places at desired location. The main exploration in this project 1s about robotics project including a description of the recently programmed behaviours.

The reports begin with an overview of the robot integrated system. It then continues with a description of the aspects of the robot, including robotic arm mechanisms their motor and servo actuators. This complete system allows the robot wander about its environment and to interact with certain objects that it encounters.

The sensors provide the robot with its only information about the environment that it inhabits. These sensors include IR sensors on the robot platform which collects data while the programmed behaviours translate the information into commands to its actuators. The robot’s behaviours include line following, pick the object up, and deliver them to specific areas in its environment.

At its core, pick and place robotics embodies the marriage of precision engineering and intelligent automation. The concept is elegantly simple yet profoundly impactful: automate the repetitive task of picking up objects from one location and accurately placing them in another. While this task might seem trivial to human operators, it presents significant challenges in the realm of automation, requiring advanced robotics, computer vision, and machine learning algorithms to execute flawlessly.

The genesis of pick and place robotics can be traced back to the early experiments in industrial automation during the mid-20th century. However, it wasn't until recent decades, with the advent of more sophisticated sensors, actuators, and computing technologies, that pick and place robots truly came into their own. Today, they are ubiquitous across a wide range of industries, from automotive and electronics to food and pharmaceuticals.

Moreover, pick and place robots are inherently versatile, capable of adapting to a multitude of tasks and configurations with minimal reprogramming. Whether it's handling different sizes and shapes of objects, operating in confined spaces, or integrating with other machinery seamlessly, these robots excel in diverse manufacturing environments. This flexibility not only enhances operational efficiency but also future-proofs production lines against evolving demands and product variations.

1.1 Background

Pick & Place robots are used in a wide variety of material transfer applications. Basically, the machine takes a product from one spot in the manufacturing process and places it into another location. A good example is a robot picking items off a conveyor belt and placing them into packaging boxes.

The typical pick and place application requires high amounts of repetitive motion. Robots can eliminate human operation of haz.ardous tasks such as chemical spraying or heavy lifting. . Pick and place robots have high return on investment when consistent shaped parts or containers are handled. Unlike human operators, robots also have the ability to work for an extended time.

Figure 1: Typical Pick & Place Robot

pick and place robotics have become indispensable assets in modern manufacturing, deployed across a diverse array of industries and applications. From high-speed assembly lines to precision machining operations, these robots play a pivotal role in driving efficiency, quality, and competitiveness. Their ability to automate repetitive tasks with unparalleled precision and reliability has transformed the way products are made, ushering in an era of smart factories and Industry 4.0.The applications of pick and place robots are diverse and can be found in industries such as automotive manufacturing, electronics assembly, food and beverage packaging, and e-commerce fulfilment centres. These robots are particularly well-suited for tasks that involve repetitive and precise movements, as they can work continuously without fatigue and with consistent accuracy.

In recent years, advancements in robotics technology, such as the development of collaborative robots (cobots) and the integration of artificial intelligence and machine learning algorithms, have further enhanced the capabilities of pick and place robots, making them more flexible, intelligent, and easy to deploy in various manufacturing environments.

1.2 Project Objectives

In a project context, the objectives related to pick and place robots could vary depending on the specific application and industry. However, here are some common project objectives that might involve pick and place robots:

- Automation:

Implementing pick and place robots to automate repetitive and manual handling tasks, thereby improving efficiency, reducing labor costs, and minimizing errors in the production process.

- Increased throughput:

Utilizing pick and place robots to enhance production throughput by accelerating the transfer of items between different stages of manufacturing or assembly lines.

- Precision and accuracy:

Ensuring that pick and place robots can consistently handle objects with high precision and accuracy, minimizing the risk of damage or defects during the handling process.

- Flexibility:

Designing pick and place robot systems that are flexible and adaptable to handle a variety of different products or components, allowing for easy reconfiguration and scalability as production needs change.

- Integration:

Integrating pick and place robots seamlessly with other equipment, machinery, and control systems within the manufacturing environment to create a fully synchronized and efficient production line.

- Safety:

Implementing safety measures and features to ensure the safe operation of pick and place robots, especially in collaborative environments where humans and robots work together.

- Optimization:

Employing advanced algorithms and optimization techniques to optimize the performance of pick and place robots, such as path planning algorithms to minimize cycle times and energy consumption.

- Cost-effectiveness:

Maximizing the cost-effectiveness of pick and place robot solutions by considering factors such as initial investment, maintenance requirements, and return on investment (ROI) over the lifespan of the system.

By defining clear objectives related to pick and place robots in a project, stakeholders can effectively plan, execute, and evaluate the success of the implementation while ensuring alignment with overall business goals and manufacturing objectives.

1.3 Project Scope

To implement an autonomous mobile robot which drive a vehicle without any human interface. It builds by micro-controller (Basic Stamp), servo motors and infrared sensor and all the program is uploaded into the controller to makes its own decision and determine the position.

In order to design successful pick and places robot, scopes are required to assist and guide the development of the project. The scope should be identified and planned to achieve the objective of the project successfully on the time. The scopes for this project are:

- To design a program that controls the robot movement.
- To design mechanical structure for the robot.
- To fabricate Circuit Board for the controller.

1.4 Benefit of Project

The benefits of a project involving pick and place robots can be substantial and wide-ranging, impacting various aspects of manufacturing operations. Here are some key benefits:

- Increased Efficiency:

Pick and place robots can significantly enhance production efficiency by automating repetitive tasks that would otherwise require manual labor. Robots can work continuously without breaks, leading to higher throughput and reduced cycle times.

- Improved Accuracy and Consistency:

Robots are capable of performing tasks with high precision and consistency, minimizing errors and variability in production. This results in improved product quality and reduced rework or scrap rates.

- Labor Cost Reduction:

Automating pick and place tasks reduces the reliance on manual labor, leading to potential cost savings associated with wages, benefits, and training expenses. This allows businesses to allocate human resources to more value-added tasks.

- Enhanced Safety:

By offloading repetitive and potentially hazardous tasks to robots, the risk of workplace accidents and injuries can be significantly reduced. Safety features such as sensors and protective barriers further ensure the safe operation of pick and place robots, especially in collaborative settings.

- Flexibility and Scalability:

Pick and place robots can be programmed and reconfigured to handle various products, sizes, and production requirements. This flexibility allows manufacturers to adapt quickly to changing market demands and scale their operations accordingly.

2 LITERATURE REVIEW

Robotics has become the most common course in higher education or industries most of them are for industry purpose. In industries there are many robots are available but most of them are costly. There is need to develop a low-cost system for students or small-scale industries. For students it will be useful for learning the elements of robotics such as kinematics, dynamics, sensing, and control.

The aim of the project is to develop and design a mechanical structure of a robotic arm that can perform various operations like pick and place the object, material handling, welding, etc. the main objective is to control the robotic arm automatically and manually. This project focuses upon to create more useful, and build more compact, cheaper robotic arm to perform various dangerous tasks and to eliminate human error to get more precise result.

3 History

Conceived from a design for a mechanical arm patented in 1954(granted in 1961) by American inventor George Devol.Joseph Engel Berger – the Father of Robotics.

The history of pick and place robots is a testament to the evolution of industrial automation and robotics, reflecting decades of innovation, technological advancements, and industrial progress. Spanning from the mid-20th century to the present day, the journey of pick and place robots has been marked by key milestones and developments that have reshaped manufacturing processes across various industries.

In the 1950s and 1960s, the seeds of industrial robotics were sown as engineers and researchers began exploring ways to automate repetitive tasks in manufacturing. During this period, early iterations of pick and place operations were carried out using simple mechanical manipulators controlled by pneumatic or hydraulic systems. These rudimentary systems laid the foundation for more sophisticated robotic solutions in the years to come.

The 1970s witnessed a significant breakthrough with the introduction of programmable robotic arms capable of performing pick and place tasks with greater precision and flexibility. Companies like Unimation, founded by Joseph Engelberger and George Devol, pioneered the development and commercialization of industrial robots, with their Unimate robot becoming one of the first widely deployed robots in manufacturing facilities. Pick and place robots emerged as vital tools for handling materials and components in assembly lines, contributing to increased efficiency and productivity in factories around the world.

4 COMPONENT REQUIREMENTS

1.3 Controller (ESP32)

The ESP32 microcontroller is a versatile and powerful embedded system widely used in various IoT (Internet of Things) applications due to its low cost, low power consumption, and integrated Wi-Fi and Bluetooth connectivity.

With its dual-core processor architecture, rich set of peripherals, and ample memory resources, the ESP32 is capable of handling a wide range of tasks, including controlling pick and place robots.

As a controller for pick and place robots, the ESP32 provides the computational capabilities needed to execute control algorithms, interface with sensors and actuators, and communicate with other devices or systems. Its real-time processing capabilities make it suitable for tasks requiring precise timing and responsiveness.

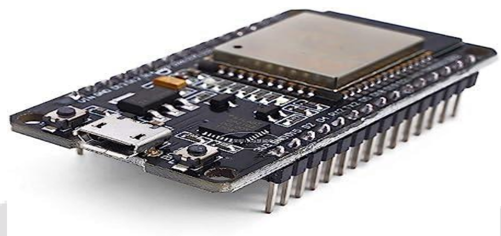

Figure 2: Controller (ESP32)

The integrated Wi-Fi and Bluetooth connectivity of the ESP32 enable seamless communication with external devices, such as smartphones, tablets, or cloud servers, allowing for remote monitoring, control, and data logging of the pick and place robot system. Additionally, the ESP32's support for various communication protocols, including MQTT, HTTP, and WebSocket, facilitates integration with existing network infrastructure and IoT platforms.

The ESP32's flexibility and programmability, coupled with its robust development ecosystem and extensive community support, make it an ideal choice for building cost-effective and scalable pick and place robot systems. Whether used as a standalone controller or as part of a larger networked system, the ESP32 offers the performance and connectivity required to meet the demands of modern manufacturing environments.

Moreover, the ESP32's low power consumption makes it well-suited for battery-powered applications, extending its use cases to wearable devices, environmental monitoring systems, and more.

1.4 Servo motor (5v)

A servo motor is a versatile electromechanical device commonly used in various applications across industries, from robotics to industrial automation. Operating on a simple principle, servo motors provide precise control over angular or linear position, velocity, and acceleration. This compact motor consists of a motor, feedback mechanism, and control circuitry, allowing it to maintain accurate position control.

The heart of a servo motor is its DC motor, which converts electrical energy into mechanical motion. Unlike regular DC motors, servo motors are designed for precise control, often featuring a gear train to increase torque and reduce speed. The motor's shaft is typically connected to an output mechanism, such as an arm or a wheel, enabling it to perform specific tasks.

Servo motors are commonly classified based on their rotation range: continuous rotation and limited rotation. Continuous rotation servos can rotate continuously in either direction, making them suitable for applications requiring continuous motion, such as wheeled robots. Limited rotation servos, on the other hand, are designed to rotate within a specific angle range, typically between 0 and 180 degrees, making them ideal for precise positioning tasks.

1.5 Dc motor (12v)

12-volt DC motors are electromechanical devices that convert electrical energy into mechanical energy. They are widely used in various applications, ranging from automotive systems and industrial machinery to robotics and consumer electronics. The "12-volt" designation refers to the nominal voltage required to power these motors, making them compatible with standard 12-volt power sources such as batteries and power supplies.

The working principle of a 12-volt DC motor is based on the interaction between magnetic fields and electric currents, as described by Fleming's left-hand rule and the Lorentz force law. Here's a simplified explanation of how a DC motor operates.

When a voltage is applied across the motor's terminals, current flows through the armature windings, creating a magnetic field around the armature coil. This field interacts with the magnetic field produced by the stator, either permanent magnets or electromagnets, according to the Lorentz force law. This interaction generates a mechanical force, known as torque, causing the armature to rotate.

The commutator, a split-ring device attached to the armature shaft, ensures continuous rotation. As the armature turns, the commutator reverses the direction of current flow through the armature windings at specific points in the rotation cycle. This reversal maintains the alignment of the magnetic poles relative to the stator's magnetic field, sustaining the rotation.

12-volt DC motors find applications across numerous industries and sectors due to their versatility, reliability, and ease of control. They are used in automotive systems for powering components like windshield wipers and electric windows, in robotics for driving moving parts, in industrial machinery for controlling conveyor belts and pumps, in consumer electronics for operating fans and power tools, and in renewable energy systems for charging batteries in solar-powered devices and wind turbines.

The brushes, conductive contacts, maintain electrical contact with the commutator, allowing current to flow into the armature windings. This continuous flow of current ensures the sustained generation of the magnetic field necessary for rotation.

Figure 3: Dc motor (12volt)

1.6 Motor truer (L298)

The L298 motor driver is a popular integrated circuit (IC) designed to control the speed and direction of DC motors and stepper motors. It serves as a versatile and efficient solution for motor control applications in various fields, including robotics, automation, and hobbyist projects. The L298 is known for its robustness, ease of use, and ability to handle high currents, making it suitable for driving a wide range of motors.
The L298 motor driver IC integrates two H-bridge circuits, allowing it to control two motors independently or one stepper motor. Each H-bridge consists of four transistors configured in a bridge topology, enabling bidirectional control of motor speed and direction.

The L298 IC is connected to the DC motors or stepper motors through its output terminals. Each motor is connected to a pair of output terminals, with one terminal connected to the motor's positive terminal and the other to the negative terminal.

The speed and direction of the motors are controlled using logic-level input signals provided to the L298 IC. These signals determine the operation mode (forward, reverse, or braking) and the magnitude of the motor's speed.

The L298 IC includes built-in diodes for protection against back electromotive force (EMF) generated by the motors during deceleration. Additionally, it provides thermal protection and current sensing features to prevent damage to the IC and motors due to overcurrent or overheating conditions.

The L298 motor driver finds applications in various fields, including robotics, automation, RC vehicles, CNC machines, and 3D printers. It is commonly used for driving DC motors in wheeled robots, conveyor belts, and industrial automation systems, as well as stepper motors in precision positioning systems and motion control applications.

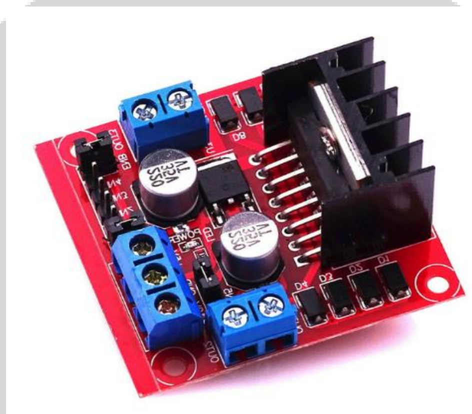

Figure 4: Motor truer (L298)

1.7 IR sensor

Infrared (IR) sensors are essential components in various electronic devices and systems, providing a means to detect and measure infrared radiation emitted or reflected by objects. They operate based on the principle of sensing changes in the intensity of infrared light, which is invisible to the human eye but can be detected and processed by specialized sensors.

IR sensors typically consist of an IR emitter and an IR receiver. The emitter emits infrared light, while the receiver detects the emitted or reflected light. The receiver then converts the detected infrared radiation into an electrical signal, which can be processed by electronic circuits.

When an object is present in the sensor's field of view, it absorbs or reflects some of the emitted infrared light. The amount of light detected by the receiver depends on factors such as the distance, surface characteristics, and material composition of the object.

The electrical signal generated by the IR receiver is processed by electronic circuits, which may include amplifiers, filters, and analogy-to-digital converters. These circuits analyse the signal and determine the presence or absence of objects based on predefined thresholds or criteria.

The IR emitter emits infrared light with a specific wavelength. This emitted light interacts with objects in its path, either being absorbed, transmitted, or reflected by them. The IR detector, positioned to receive the emitted or reflected light, detects changes in the intensity of the infrared radiation.

Depending on the application, the output of the IR sensor may be a digital signal (e.g., high or low) indicating the presence or absence of an object, or an analogy signal proportional to the intensity of the detected infrared radiation. This output can be further processed by microcontrollers, PLCs (Programmable Logic Controllers), or other control systems.

Figure 5: IR sensor

1.8 DHT11 Sensor

The DHT11 sensor is a popular and affordable digital temperature and humidity sensor used in various projects and applications. It provides a convenient way to measure both temperature and relative humidity in the surrounding environment. The DHT11 sensor operates based on a digital communication protocol and consists of a sensing element, signal processing circuitry, and a digital output interface.

The working principle of the DHT11 sensor involves sensing changes in temperature and humidity and converting these measurements into digital signals that can be read by a microcontroller or other digital device.

The DHT11 sensor includes signal processing circuitry that converts the analog signals from the sensing element into digital signals. This circuitry also compensates for temperature variations to ensure accurate humidity measurements.

Figure 7: DHT11 sensor

In summary, the DHT11 sensor provides a cost-effective solution for measuring temperature and humidity in various applications. Its digital output interface, compact size, and low power consumption make it well-suited for integration into a wide range of electronic devices and systems requiring environmental monitoring capabilities.

1.9 Adapter

An adapter is a device that facilitates compatibility between different electrical or electronic systems by converting one form of electrical power or signal into another. Adapters are commonly used in various settings to enable the connection and operation of devices that have different power requirements, plug types, or communication protocols.

Adapters come in various forms and serve different purposes. They may convert AC power to DC power, step up or step down voltage levels, or adapt plug configurations to fit different outlets or sockets. Additionally, adapters can convert signals between different communication standards, such as USB to Ethernet or HDMI to VGA, allowing devices with incompatible interfaces to communicate and interact seamlessly.

Adapters serve the purpose of bridging the gap between incompatible systems, facilitating communication, connectivity, or interaction between them. They allow devices or components from different manufacturers or with different specifications to work together without requiring extensive modifications or replacements.

1.10Convert belt

A conveyor belt, often referred to as a "convert belt," is a continuous loop of material that rotates around two or more pulleys to transport objects or materials from one location to another. These belts are widely used in various industries, including manufacturing, logistics, and transportation, for the efficient movement of goods and materials.

Converting a belt-driven pick and place robot into another form typically involves replacing or modifying the existing belt-driven mechanism with a different type of actuation or mechanism.

Figure 7: Convert belt

4.9 ***Bearing***

Bearings are crucial components in machinery and equipment, facilitating smooth and efficient motion by reducing friction between moving parts. They come in various types and designs to suit different applications, from simple household appliances to heavy industrial machinery.

Bearings work based on the principle of reducing friction between two surfaces in contact with each other. They achieve this by providing a rolling or sliding interface between the rotating or moving parts of a machine.

Figure 8: Bearing

4.10 Cloud (Blynk Iot)

When using Blynk IoT in a cloud working environment, you can achieve a seamless integration of IoT devices with cloud services to enable remote monitoring, control, and management.

- Begin by setting up your Blynk IoT project using the Blynk mobile app or web dashboard. Create a new project and configure the widgets to control and monitor your IoT devices. You can add buttons, sliders, gauges, graphs, and other widgets to interact with your devices.
- Connect your IoT hardware devices (such as Arduino, ESP8266, or Raspberry Pi) to the Blynk platform using the appropriate Blynk libraries and code. This code establishes a connection between your devices and the Blynk cloud server, allowing them to communicate.
- Choose a cloud service provider (such as AWS, Google Cloud Platform, or Microsoft Azure) to host your Blynk IoT project data and handle additional functionalities like data storage, analytics, and notifications.
- Configure your IoT devices to send data to the cloud service provider in addition to communicating with the Blynk server. This allows you to store sensor data and other device information in the cloud for further analysis and processing.
- Implement cloud functions or scripts to handle data processing, analytics, and automation tasks based on the data received from the IoT devices. For example, you can set up rules to trigger notifications or actions based on specific sensor readings or events.
- By integrating Blynk IoT with cloud services, you can harness the power of the cloud to enhance the functionality, scalability, and reliability of your IoT projects, enabling efficient cloud working and remote management of your devices.

5 METHODOLOGY

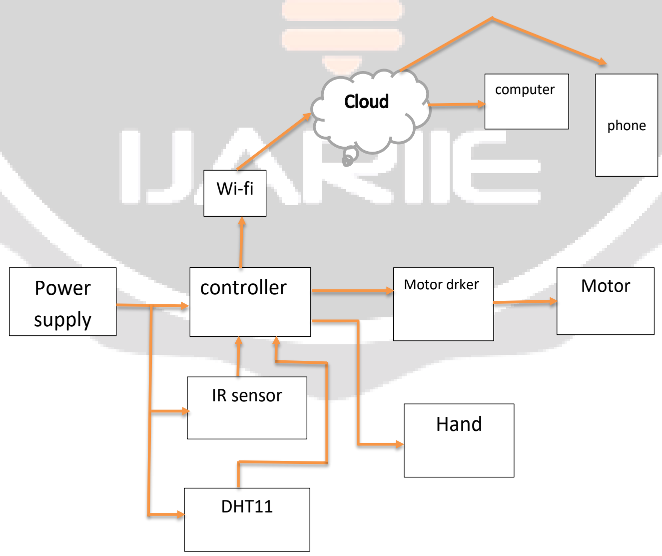

Figure 10: Block Diagram

Designing and implementing a pick and place robot requires a comprehensive methodology to ensure efficiency, accuracy, and safety in its operation. This methodology encompasses various stages, from conceptualization to deployment and maintenance.

Begin by identifying the specific requirements of the pick and place application, including payload capacity, cycle time, reach, accuracy, and environmental conditions.

Brainstorm and conceptualize the overall design and functionality of the pick and place robot, considering factors such as the type of end effector, motion control system, and communication interfaces.Develop detailed mechanical, electrical, and software designs based on the conceptual framework. This includes selecting appropriate components such as motors, sensors, actuators, and controllers. Pay special attention to safety features and ergonomic considerations.

Build a prototype of the pick and place robot to validate the design and functionality. This involves integrating the selected components, programming the control algorithms, and conducting initial tests to assess performance and identify areas for improvement.

Conduct rigorous testing of the prototype in simulated and real-world environments to evaluate its performance under different operating conditions. Use feedback from testing to refine the design, optimize algorithms, and enhance overall efficiency and reliability.

Integrate the pick and place robot into the target application environment, including any required conveyor systems, workstations, or production lines. Ensure seamless communication and coordination with other equipment and systems.

Provide comprehensive training to operators and maintenance personnel on the safe and effective use of the pick and place robot. Develop detailed documentation, including user manuals, maintenance procedures, and troubleshooting guides.

6 APPLICATION

Industrial robots are versatile machines used in various applications across industries. They can perform tasks like welding, painting, assembly, packaging, and more with precision and efficiency. When considering an application for an industrial robot, it's essential to define the specific task requirements, such as payload capacity, reach, speed, and accuracy. Additionally, factors like workspace layout, safety considerations, and integration with other systems should be taken into account.

- In a pick and place application, industrial robots are used to pick up objects from one location and place them in another with accuracy and speed. Here are some key considerations for implementing a pick and place industrial robot application:
- Object Recognition: The robot needs to identify and locate objects accurately to pick them up. This can be achieved using vision systems, sensors, or pre-defined coordinates.
- Gripping Mechanism: Choosing the right end-effector or gripper is crucial based on the shape, size, and weight of the objects being handled. There are various gripper types like vacuum, mechanical, and magnetic grippers suitable for different objects.
- Path Planning: The robot needs to plan an optimal path to pick up and place objects efficiently, minimizing cycle time and avoiding collisions.
- Programming: Robots are programmed to execute the desired pick and place sequences. This can be done using programming languages specific to the robot's controller or through intuitive programming interfaces.
- Safety: Implement safety measures like barriers, emergency stop buttons, and safety sensors to protect human operators and prevent accidents.
- Integration: Ensure seamless integration of the robot with other equipment, such as conveyor belts, sensors, and control systems, for a fully automated workflow.
- By carefully considering these factors, you can design an effective and efficient pick and place robot application tailored to your specific requirements.

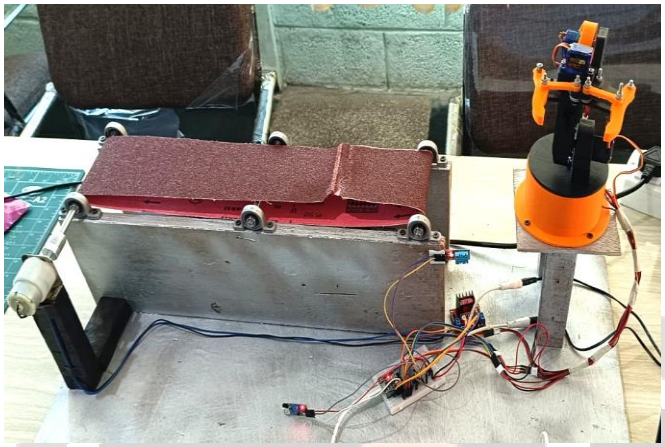

Figure 9: Working Model

7 FUTURE WORK

The future of industrial robots is promising, with ongoing advancements in technology paving the way for more capable, flexible, and intelligent robotic systems. Here are some areas of future work and trends shaping the evolution of industrial robots:

- Collaborative Robots (Cobots): The development of collaborative robots designed to work alongside humans safely is a growing trend. These robots can assist human workers in tasks like assembly, inspection, and packaging, enhancing productivity and efficiency.
- Artificial Intelligence and Machine Learning: Integration of AI and machine learning algorithms enables robots to learn from data, adapt to changing environments, and make intelligent decisions autonomously. This enables predictive maintenance, optimized task planning, and improved performance.
- Sensing and Perception: Advanced sensors, vision systems, and perception technologies are being integrated into robots, enhancing their ability to perceive and interact with the environment. This enables more complex tasks and greater flexibility in handling diverse objects.
- Mobility and Navigation: Mobile robots and autonomous guided vehicles (AGVs) are becoming more prevalent, allowing robots to navigate dynamic environments and transport materials within factories or warehouses autonomously.
- Modular and Scalable Systems: Modular robot designs that allow for easy customization and scalability are gaining popularity. This enables businesses to adapt robots to different tasks and easily expand their robotic workforce as needed.
- Energy Efficiency and Sustainability: Focus on developing energy-efficient and eco-friendly robotic systems to reduce energy consumption, carbon footprint, and operating costs.

8 CONCLUSION

Robots are examples of programmable automation, however they are also used in flexible or even fixed automation systems. The two reasons for selecting a robot to operate in a production line are first to reduce labor costs and second to perform work that is boring, unpleasant or hazardous for human beings. Robot can perform repetitive tasks at a steady place, be programmed to achieve and perform different unpleasant tasks, operation for long period without rest or break period, and response in automation manufacturing operation on a continuous basis.

Robot technology is an applied science that is referred to as a combination of machine tool fundamentals and computer application, the variety of technical features about the way a robot is construction and works and the factors that influence its selection robot system are usually classified as low technology and high technology groups. The capacity of a robot to position and oriented the end of its arm with accuracy and repeatability is an important control attribute.

Programming is the process of preparing a detailed sequence of operating instruction to solve a particular problem, testing it to ensure its accuracy, and preparing documentation to be run on a digital computer. Robot programming.

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