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IOT Based Robotic Arm Using NodeMCU

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ABSTRACT

In recent years, the integration of robotic arms into various industries has the landscape of automation. These programmable mechanical devices, designed to perform revolutionized tasks that replicate human movements, have become essential tools in manufacturing, logistics, healthcare, and more. With their ability to enhance efficiency, ensure precision, and improve workplace safety, robotic arms are transforming traditional workflows and driving innovation.

As industries face increasing demands for productivity and flexibility, the significance of robotic arms continues to grow, making them a cornerstone of modern automation technologies. This project explores the functionality, applications, and impact of robotic arms in automation, highlighting their critical role in shaping the future of various sectors.

***Keyword: -** Robotic arm, Automation, Innovation, Flexibility, Productivity, Applications*

INTRODUCTION

In recent years, the field of robotics has experienced rapid advancements, making it more accessible to enthusiasts, hobbyists, and researchers. One particularly intriguing project within this realm is the development of a robotic arm, which serves as a fundamental building block for understanding automation and control systems. The robotic arm not only demonstrates the principles of mechanical design and electronics but also integrates software programming, enabling users to explore the fascinating intersection of hardware and software. This project focuses on creating a robotic arm powered by the NodeMCU ESP8266, a versatile microcontroller that combines the capabilities of traditional microcontrollers with Wi-Fi connectivity. The ESP8266 allows for remote control and monitoring, offering a unique opportunity to interface the robotic arm with smartphones or computers. This connectivity opens new avenues for innovation, such as implementing control via a web interface, voice commands, or even integrating with IoT platforms.

The design and construction of the robotic arm involve several key components, including servo motors, which provide precise control over movement, and a sturdy frame, which supports the arm's structure. The selection of materials for the arm’s frame can vary from lightweight plastic to more durable metals, depending on the desired strength and functionality. Each joint of the arm is typically powered by a servo motor, allowing for a wide range of motion and enabling the arm to perform tasks such as grasping, lifting, or manipulating objects. As we embark on this project, we will explore the various stages of development, from the initial design and selection of components to the programming and integration of control systems. The project will also highlight the importance of kinematics, which is the study of motion without considering the forces that cause it.

Understanding both forward and inverse kinematics will be crucial in programming the robotic arm to execute precise movements and tasks.

REVIEW OF LITERATURE

A robotic arm is a mechanical arm that can be programmed to perform tasks similar to those performed by humans. The robotic arm's primary function is to move an end effector between locations, such as to pick up and transfer various objects [1].

Because of the current IoT revolution and the increasing use of robots in daily operations, Internet of Robotics Things (IoRT) applications are rapidly becoming a reality. IoRT benefits robotic systems by connecting, exchanging, and transmitting distributed computation resources, business activities, context information, and environmental data [2].

If the robot is connected to the internet, users can delegate jobs to it remotely via networks; this eliminates the need for the user to be physically present on-site because the job can be completed entirely by the robot. The capabilities of the robotic system are enhanced by IoT technology, which is illustrated with an HMI interface implemented in a smartphone via wireless Wi-Fi connectivity using an microcontroller. The arm's objective is to create a low-cost and reproducible robot that assists comprehension of robotics design through project-based learning, from theoretical elements through practical coding and prototype fabrication. [3].

These difficulties of near real-time data transfer and multi-platform implementation at the control end can be solved using the Internet of Things (IoT) and web apps. This article details the design and implementation of a web-based robotic arm control system using the MQTT (Message Queuing Telemetry Transport) protocol and an ESP8266 microcontroller (a network data transmission module)[4].

PROPOSED SYSTEM

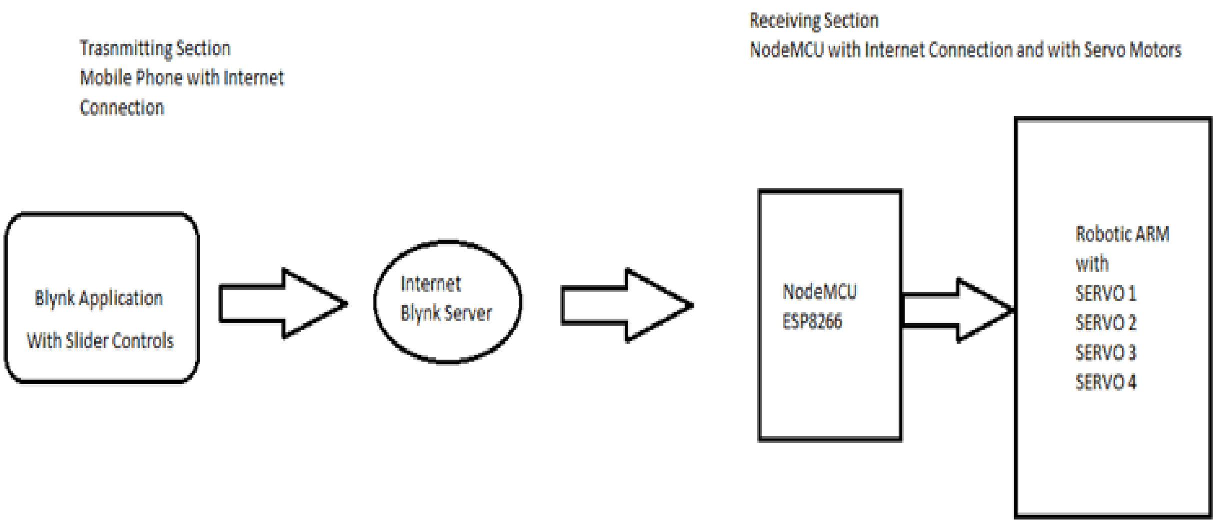

Fig.1.shows the block diagram of Operation.

- NodeMCU:
- This is the central controller that connects to the internet and controls the robotic arm. It processes

commands received from the web interface and sends control signals to the servo motors.

- Web Interface:
- This component allows users to interact with the robotic arm through a browser or a mobile app. It sends commands to the NodeMCU to move the arm or perform specific tasks.
- Wi-Fi Module:
- The NodeMCU includes a built-in Wi-Fi module (ESP8266) that enables it to connect to the internet and receive commands from the web interface.
- Power Supply:
- Provides the necessary power to the NodeMCU and the servo motors. This can be from a battery or an external power adapter.
- Servo Motors:
- These motors are responsible for moving the robotic arm's joints. Each joint is typically controlled by a separate servo motor, which receives signals from the NodeMCU.
- Microcontroller (NodeMCU):
- The microcontroller executes the program that interprets commands and controls the actuators (servo motors).

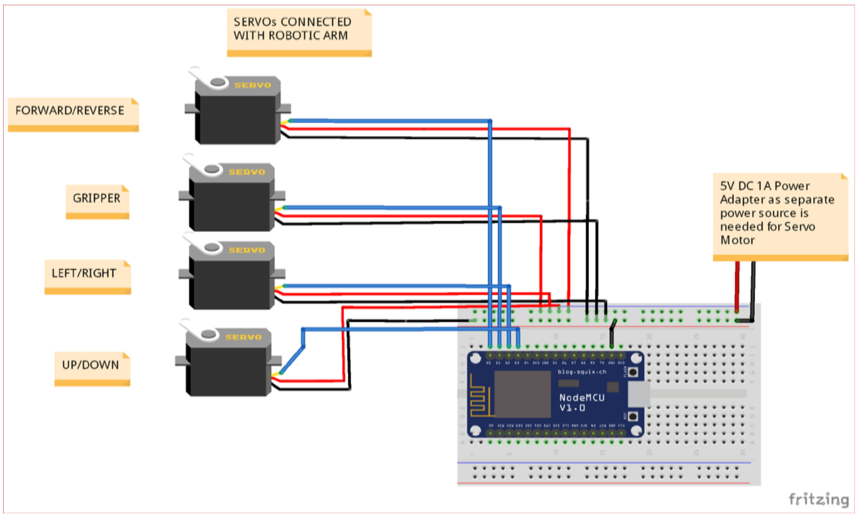

Fig.2. Shows Circuit diagram of Robotic Arm

Hardware Used

- NodeMCUESP8266
- Battery
- Servo Motors
- Robotic Arm Kit

SOFTWARE USED

- BLYNK-IOT FOR ESP8266
- C LANGUAGE

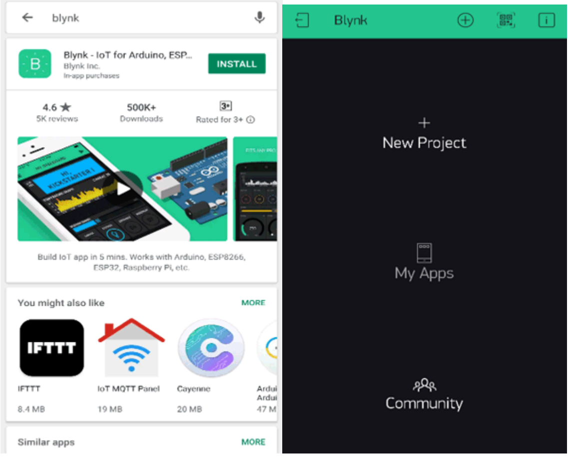

Fig.3. IDE softwer used for aperation

Working Principle

- Actuation: Servo motors or other actuators control the movement of joints.
- Control: Microcontrollers (like NodeMCU or Arduino) process input signals (from sensors or user commands) to control the arm's position and movement.
- Feedback: Some systems use sensors to provide data on the arm's position, ensuring accurate control.

APPLICATION

- Welding :
- Setup: Robotic arms are equipped with specialized welding tools, such as MIG (Metal Inert Gas), TIG (Tungsten Inert Gas), or laser welding heads.
- Assembly:
- Component Handling: Robotic arms are equipped with specialized end effectors (grippers, suction cups, or magnetic tools) that allow them to handle a wide range of components, from small parts to large assemblies.
- Assembly Actions: The robots are programmed to perform a variety of tasks such as inserting parts, screwing, gluing, riveting, and placing components into positions.
- Precision and Flexibility: Robots can be pre-programmed for repetitive tasks or adapt to variations in the components using advanced vision systems, sensors, and AI-based algorithms.
- Coordination: In complex assembly lines, multiple robotic arms can be synchronized to work together on different parts of an assembly, ensuring efficiency and reducing the need for human intervention.
- Material handling:
- Picking and Placing: Robotic arms equipped with grippers, suction cups, or magnetic tools are used to pick materials from one location and place them in another. This can involve picking parts from a bin, placing them onto a conveyor belt, or organizing them in storage locations.
- Sorting and Organizing: Robots are capable of sorting parts based on size, shape, color, or weight. They can direct materials to different areas of a warehouse or production line based on predefined rules.
- Packaging: Robotic arms are used to pick products and place them into boxes or pallets, ensuring that the packaging process is efficient and consistent. This is especially useful in industries like food, consumer

goods, and electronics.

- Stacking and Palletizing: Robotic systems can arrange products or parts into specific patterns for easy storage or shipping. Palletizing involves stacking items in a way that maximizes space and ensures the safety of goods during transit.
- Pick-and-place operations:
- Picking: The robot identifies and picks an item from a designated location (such as a bin, conveyor belt, or pallet).
- Placing: After picking up the object, the robot then moves it to another location or performs further operations like sorting, stacking, or placing it on a production line.
- Precision: These operations require high precision, as the robot must handle various shapes, sizes, and weights of objects, ensuring that they are picked and placed correctly without damage.

RESULTS

Fig4. Robotic Arm Functioning Properly.

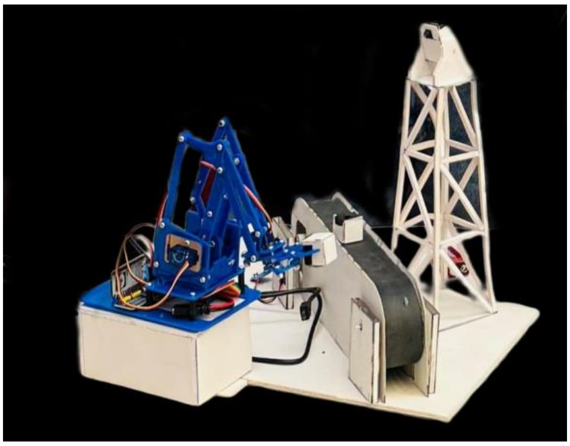

Fig.5.Whole Setup of Robotic Arm wirh Survillance Cam.

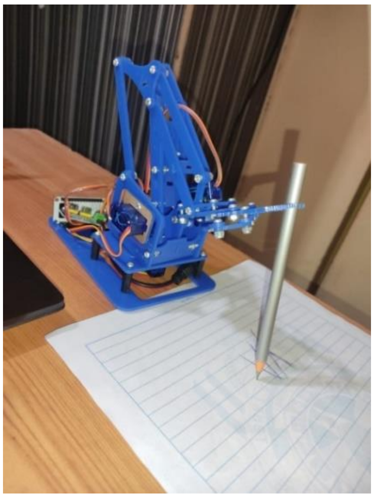

Fig.6.Robotic Arm Grabs the Box (Pick And Drop Operation).

CONCLUSION

The IoT-based robotic arm project using NodeMCU represents a significant intersection of robotics, automation, and internet connectivity. By integrating standard servo motors, the project allows for precise control and movement, making it suitable for various applications such as remote handling, object manipulation, and automated tasks.

Through this project, you'll gain hands-on experience in several key areas:

1. **IoT Integration**: Understanding how to connect and control devices over Wi-Fi, enabling remote operation and monitoring.
2. **Robotic Control**: Learning how to program and manage the movement of a robotic arm, which involves both hardware and software components.
3. **Prototyping Skills**: Developing skills in circuit design, assembly, and coding, which are crucial in many engineering fields.
4. **Problem-Solving**: Overcoming challenges related to design, control algorithms, and interfacing various components.

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