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ARDUINO BASED ROBOTIC ARM

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ABSTRACT: This research paper presents an in-depth exploration of the design and implementation of an Arduino-based robotics arm. The study focuses on the technical aspects of the arm, including its mechanical structure, electrical components, and programming, with a special emphasis on the Arduino microcontroller. The paper also delves into the potential applications of the robotics arm in various sectors, highlighting its potential to revolutionize automation and efficiency. The research is divided into several sections, each discussing a different aspect of the robotics arm. The first section provides an overview of the fundamental principles of robotics and the crucial role of Arduino in this field. The second section delves into the mechanical structure of the robotics arm, discussing the design and functionality of its various components. The third section focuses on the electrical components of the arm, detailing the role of each component in the overall functioning of the arm. The fourth section discusses the programming involved in the operation of the robotics arm, highlighting the role of the Arduino microcontroller in controlling the arm's movements. The final section explores the potential applications of the robotics arm in various sectors, including manufacturing, healthcare, and agriculture. The paper concludes with a discussion on the potential impact of the robotics arm on the future of automation and efficiency in various sectors. The research underscores the potential of Arduino-based robotics arms to revolutionize various sectors through automation, enhancing productivity and efficiency. Keywords: Arduino based robotic arm, Arduino microcontroller, principles of robotics and the crucial role of Arduino, applications of the robotics

I.INTRODUCTION

The field of robotics has witnessed significant advancements over the years, with the development of an Arduino-based robotics arm representing a notable stride. Arduino, an open-source microcontroller, has been instrumental in the creation of cost-effective and efficient robotic systems. This paper aims to delve into the intricate details of designing and implementing an Arduino-based robotics arm, exploring its potential in revolutionizing various sectors through automation The paper begins by discussing the fundamental principles of robotics and the crucial role of Arduino in this field. It then transitions into a detailed examination of the technical aspects of the robotics arm, including its mechanical structure, electrical components, and the programming involved. The subsequent sections delve into the potential applications of the robotics arm in various sectors, highlighting how it can enhance efficiency and productivity by automating task. The objective of this research is to provide a comprehensive understanding of the technical aspects of developing an Arduino-based robotics arm and to underscore its potential in revolutionizing various sectors. Through this research, we aim to contribute to the ongoing advancement of robotics technology. The paper will provide valuable insights into the design, implementation, and potential applications of an Arduino-based robotics arm, thereby contributing to the broader understanding of robotics technology The research paper will also discuss the potential impact of the robotics arm on the future of automation and efficiency in various sectors. It will highlight how the Arduino-based robotics arm can revolutionize various sectors through automation, enhancing productivity and efficiency. This paper will provide a comprehensive overview of the Arduino-based robotics arm, its design, implementation, and potential applications. Through this research, we aim to contribute to the ongoing advancement of robotics technology and to underscore the potential of Arduino-based robotics arms in revolutionizing various sectors.

II. PROBLEM STATEMENT

The field of robotics has made significant in recent years, with the development of advanced robotic systems capable of performing complex tasks. However, these advancements have often come at a high cost, making them inaccessible to many individuals and organizations, particularly in developing countries. The high cost of robotic technology often limits its accessibility and utilization, thereby hindering the potential benefits that these systems could offer Moreover,

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the design and implementation of robotic systems require specialized knowledge and resources. This complexity often acts as a barrier, preventing many potential users from taking advantage of the benefits that robotic technology can provide. The lack of user-friendly and cost-effective robotic systems has led to a gap in the market, with many sectors not fully utilizing the potential of robotics technology. Furthermore, while there are several existing models of robotic arms in the market, most of them are expensive and require specialized knowledge to operate.

This has made it difficult for many individuals and organizations to adopt these systems, thereby limiting their potential benefits. The high cost and complexity of robotic systems also pose a challenge in terms of scalability. As the demand for automation increases, the need for cost-effective and scalable robotic systems becomes even more pressing. The lack of such systems can limit the potential for growth and development in various sectors, including manufacturing, healthcare, and agriculture.

In addition to the cost and complexity, there are also limitations in terms of the functionality and adaptability of existing robotic systems. Many robotic arms are designed for specific tasks and are not easily adaptable to perform other tasks. This lack of flexibility can limit their potential applications and utility.

In conclusion, the field of robotics faces significant challenges in terms of cost, complexity, scalability, and adaptability. These challenges have hindered the widespread adoption and utilization of robotic technology, particularly in developing countries and sectors that require cost-effective and adaptable solutions. The development of a cost-effective, user-friendly, and adaptable robotic arm can help address these challenges and unlock the full potential of robotics technology.

III. OBJECTIVES OF PROJECT

1. **Design and Construct a Robotic Arm:** Develop a mechanical structure for a robotic arm that is capable of performing a wide range of tasks, including pick-and-place, object manipulation, and precise positioning.

2. **Arduino-Based Control System:** Implement a control system based on Arduino microcontrollers to drive and control the robotic arm's movements and functions.

3. **User-Friendly Interface:** Create a user-friendly interface that allows users to interact with and control the robotic arm easily, potentially using a graphical user interface (GUI) or a smartphone app.

4. **End-Effector Attachment: Design** and implement different end-effector attachments (e.g., grippers, suction cups) that can be easily swapped for various applications.

5. **Precise Positioning and Accuracy:** Ensure that the robotic arm can achieve precise positioning and accuracy to meet the demands of its intended tasks.

6. **Safety Measures:** Incorporate safety features, such as emergency stop buttons and obstacle detection, to ensure safe operation in various environments.

7. **Programming Flexibility:** Enable users to program the robotic arm for specific tasks or integrate it with external sensors and systems for more advanced functionalities.

8. **Documentation and Tutorials:** Create comprehensive documentation, tutorials, and guides to assist users in assembling, configuring, and programming the robotic arm.

9. **Cost-Effectiveness:** Strive to keep the project cost-effective by using readily available components and materials, making it accessible to a wide audience.

10. **Expandability and Customization:** Design the robotic arm with expandability in mind, allowing users to add additional degrees of freedom or customize it for specific applications.

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11. **Educational Use:** Promote the use of the robotic arm as an educational tool, providing resources for students, educators, and hobbyists to learn about robotics, programming, and automation.

12. **Open-Source Contribution:** Share the project as open-source, encouraging collaboration and contributions from the maker and robotics communities to enhance its functionality and features.

IV. SCOPE OF PROJECT

1. Design and Prototyping:

- Develop a detailed design specification for an Arduino-based robotic arm, outlining the mechanical structure, electronics, and overall system architecture.
- Create a functional prototype of the robotic arm to validate the design concept and identify potential improvements.

2. Hardware Integration:

- Select and integrate suitable actuators, sensors, and end-effectors, ensuring compatibility with the Arduino microcontroller platform.
- Implement robust connections and interfaces for seamless communication between hardware components.

3. Software Development:

- Program the Arduino microcontroller to control the robotic arm's motors and actuators, implementing precise and efficient movement algorithms.
- Develop a user-friendly interface, enabling convenient control and monitoring of the robotic arm's functions.

4. Applications and Use Cases:

- Explore and evaluate potential applications of the Arduino-based robotic arm in industrial automation, research, and educational settings.
- Identify specific use cases where the robotic arm can demonstrate its versatility and practical utility.
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- Produce a detailed research paper outlining the project's methodology, findings, and contributions to the field of Arduino-based robotics.

5. Knowledge Dissemination:

- Present the project findings through demonstrations, presentations, and documentation to share knowledge with the academic and robotics communities.
- Encourage collaboration and feedback to contribute to the collective understanding of Arduino-based robotic arm technologies.

V. EXISTING SYSTEM

Existing system:

The robot has been design to mimic the movement of a human arm. This section will present a full description of the hardware of the robot design and it is divided into two main sections: mechanical and electrical design.

Mechanical Design: The robot had a round base with a diameter of 22cm and the height of 15cm. the robot degree of-freedom mechanism is directly powered by servo motors. Acrylic is used as the robot base because it is easy to be formed, cheap, strong and can bear the motor weight and movement. The robotic arm is constructed using servo brackets that are made of aluminums because it is light weight but stiff to mimic the bone structure of a human arm. The robot gripper is also made of aluminum because of the same reason as the main robot arm structure.

Electrical Design: The block diagram is as shown above. Basically, this robot has 5 outputs which consist of the robot base, the robot shoulder, the robot elbow, the robot wrist, and the robot gripper

Power Supply: It is basically consist of transformer, rectifier filter and regulator circuits. Power supply units (PSU) are used in computers. Amateur radio transmitters and receivers and all other electronic equipments that used dc voltage as an input. A power supply takes the ac from the ac source and the stepdown transformer which is connected to AC

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source decrease the voltage from 230v to 12v ac, and then it is converted to unregulated dc by rectifier unit. This rectified unregulated dc voltage is filtered by filter capacitor and regulated by electronic regulated i.e., ic7812, ic7809, ic7805.

VI. LIMITATIONS

1. **Limited Payload Capacity:**
   The robotic arm's payload capacity may be limited, making it unsuitable for heavy-duty industrial applications. It's essential to define and adhere to weight restrictions for safe operation.

2. **Restricted Reach:**
   The reach of the robotic arm may not extend as far as larger industrial counterparts, limiting its abilityto access objects or perform tasks in large workspaces.

3. **Relatively Slower Speed:**
   The robotic arm's speed may be slower compared to high-speed industrial robots, which could affect its efficiency in certain time-critical applications.

4. **Single-Arm Configuration:**
   Most DIY robotic arm projects focus on a single- arm configuration, which may not be suitable for applications requiring dual-arm manipulation or more complex interactions

VII. PROPOSED SYSTEM

The presented project outlines the design and implementation of a robotic arm controlled by an Arduino microcontroller through Bluetooth communication. The robotic arm, with six degrees of freedom (DOFs) driven by servo motors, is designed using SolidWorks 3D modelling software and manufactured with a 3D printer. The design includes three MG945 servo motors for the waist, shoulder, and elbow joints, and three smaller MG90S micro servo motors for the wrist roll, wrist pitch, and gripper. The Arduino Uno serves as the central controller, interfacing with an HC-05 Bluetooth module for wireless communication.

The project emphasizes the importance of understanding the geometric aspects of the robotic arm, involving calculations for angles, lengths of each link, and the positioning of the arm in three-dimensional space. The implementation involves precise control of joint movements, such
as waist rotation, shoulder motion, elbow gripper operations. The mobile application, created using MIT App Inventor, facilitates user interaction with the robotic arm through Bluetooth commands, enabling control over individual servo motors using sliders.

The flow graph illustrates the sequence of operations, with the robotic arm returning to its initial state after completing a command. The application allows users to manipulate the arm's orientation and extension for precise positioning and object manipulation. Overall, the project provides an integrated solution for mechanical design, electronic configuration, and mobile application development to control the Arduino-based robotic arm.

Figure1.Complete design of the robotic arm

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VIII. CONCLUSION

This research is intended to design a robotic arm fully controlled by Arduino platform over a safe distance through a mobile application. This robotic arm can be used in plenty of different industries or in areas which are unsafe for humans. The Arduino has been programmed to provide rotation to each servo motor corresponding to the sliders in the designed mobile application for usage from a distance. The final design hasbeen tested and the results show that this design completes its job accordingly.

REFERENCES

[1] C. S. Chen, S. K. Chen, C. C. Lai, and C. T. Lin, "Sequential motion primitives recognition of robotic arm task via human demonstration using hierarchical BiLSTM classifier," *IEEE Robotics and Automation Letters*, vol. 6, no. 2, pp. 502–509, Apr. 2021, doi: 10.1109/LRA.2020.3047772.

[2] X. Chen, X. Huang, Y. Wang, and X. Gao, "Combination of augmented reality based brain- computer interface and computer vision for high-level control of a robotic arm," *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 28, no. 12, pp. 3140–3147, Dec. 2020, doi: 10.1109/TNSRE.2020.3038209.

[3] P. Sutyasadi and M. B. Wicaksono, "Joint control of a robotic arm using particle swarm optimization based H2/H∞ robust control on arduino," *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, vol. 18, no. 2, Apr. 2020, Art. no. 1021, doi: 10.12928/telkomnika.v18i2.14749.

[4] A. H. Basori, "End-effector wheeled robotic arm gaming prototype for upper limb coordination control in home-based therapy," *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, vol. 18, no. 4, Aug. 2020, Art. no. 2080, doi: 10.12928/telkomnika.v18i4.3775.

[5] W. K. Saad, Y. Hashim, and W. A. Jabbar, "Design and implementation of portable smart wireless pedestrian crossing control system," IEEE Access, vol. 8, pp. 106109–106120, 2020, doi: 10.1109/ACCESS.2020.3000014.

[6] A. Cotta and N. T. Devidas, "Wireless communication using hc-05 bluetooth module interfaced with Arduino," International Journal of Science, Engineering and Technology Research (IJSETR), vol. 5, no. 4, 2016.

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