Department of Electronic and Telecommunication Engineering
University of Moratuwa Faculty of Engineering

Electronic Design Realization EN2160

Pick and Place Robot Arm

Project Proposal

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Project Proposal: Automating H-Bridge Assembly with a Metal Ring and 6 Transistors

Introduction:

The industrial landscape is constantly evolving, demanding innovative solutions for enhanced efficiency and precision. In the realm of motor control, **customized H-bridges** play a crucial role, and their **automated assembly** holds immense potential to streamline production and ensure consistent quality. This project delves into the development of an **automated assembling mechanism** specifically designed for H-bridges featuring a **metal ring and 6 transistors**.

Project Background:

In contemporary industrial settings, there's a noticeable shift towards automation to meet the demands of increased efficiency, precision, and scalability. H-bridges serve as essential elements in motor control systems, enabling the control of direction and speed in various applications. However, manual assembly of H-bridges is plagued by challenges such as time consumption, error-proneness, and inconsistent quality. Addressing these issues requires innovative automation solutions tailored specifically to the assembly requirements of H-bridges.

Project Description:

The proposed project focuses on the development of an automated assembly system capable of integrating transistors, washers, rivets, and a metal ring into a cohesive H-bridge unit. The assembly process comprises two key subtasks: (1) the precise placement and attachment of transistors, washers, and rivets, and (2) the accurate positioning and rotation of the metal ring for pivotal functionality.

Solution Description with Key Subtasks:

This project addresses two critical subtasks essential for the successful assembly of Custom H-Bridges:

1. **Assembling TRANSISTORs, washers, and rivets into a single unit:**
   This delicate process requires precise handling and placement, making automation crucial for accuracy and efficiency.
2. **Precise placement and rotation of the metal ring for the pivoting process:**
   The metal ring serves a critical function, and its accurate positioning and rotation are essential for optimal performance. With this introduction, we embark on a journey toward innovative automation, aiming to revolutionize the production of customized H-bridges with metal rings and 6 TRANSISTORs.

This project proposal report delves specifically into the crucial subtask of **precise metal ring placement and rotation**. We'll explore the progress made in automating this delicate process, the challenges encountered, and the future steps necessary to bring this innovative solution to fruition. Let's delve into the intricate world of automated metal ring manipulation and unveil the advancements paving the way for a more efficient and precise H-bridge assembly process.

Alignment with EDR Course Learning Outcomes:

1. **Identify Suitable Design Models:**
    - Our project involved selecting appropriate design models based on engineering principles and project requirements. We considered factors such as component compatibility, assembly complexity, and cost-effectiveness to ensure feasibility and effectiveness in the automated assembly of H-bridge units.
2. **Design Testable PCBs:**
    - The PCB designs implemented in our project adhere to industry standards, incorporating principles of signal integrity, power distribution, and component placement. These designs facilitate thorough testing and validation, reflecting our commitment to quality and reliability in the manufacturing process.
3. **Explain Testing Methodologies:**
    - We developed comprehensive testing methodologies to evaluate the functionality and performance of the automated assembly system. These methodologies encompassed functional testing, stress testing, and performance benchmarking, ensuring compliance with specifications and regulatory requirements.
4. **Design Product Enclosures:**
    - Enclosures for our automated assembly system were meticulously designed to meet industry standards for safety and environmental protection. We considered factors such as material durability, ingress protection ratings, and thermal management to ensure compliance with regulatory requirements and user safety.
5. **Prepare Proper Documentation:**
    - At the conclusion of the project, we prepared comprehensive documentation including clear schematics, PCB layouts, assembly instructions, and other relevant information. This documentation serves as a valuable resource for stakeholders, demonstrating our adherence to industry best practices and standards in the development process.
6. **Apply Knowledge to Commercial Design:**
    - Through the project, we applied our knowledge and skills to develop a working prototype of the automated assembly system for H-bridge units. This prototype showcases our ability to tackle real-world engineering challenges and demonstrates readiness for commercial design projects in the field of industrial automation and manufacturing.

Project Achievements:

- **Increased Production Speed and Throughput:** By automating assembly tasks, we anticipate a significant reduction in assembly time, thereby boosting production volumes and scalability.
- **Enhanced Accuracy and Consistency:** Utilizing robotics ensures precise handling and placement of components, minimizing errors and variations in product quality.
- **Reduced Labor Costs:** Automation eliminates the need for manual labor in repetitive tasks, leading to cost savings and improved operational efficiency.
- **Improved Worker Safety:** Automating hazardous or repetitive tasks reduces the risk of injuries, enhancing workplace safety and employee well-being.

In conclusion, the Automated Assembly System for Custom H-Bridges signifies a remarkable advancement in industrial automation. By streamlining the assembly process of H-bridges, our project promises substantial enhancements in production efficiency, product quality, and cost-effectiveness. Through the integration of cutting-edge robotics, precision handling, and vision systems, we aim to elevate assembly accuracy to unprecedented levels, thereby reducing errors and bolstering product reliability. Furthermore, by automating tasks and optimizing workflows, we anticipate significant cost savings and operational efficiencies, fostering innovation and competitiveness within the industry. Beyond immediate gains, our project underscores a commitment to addressing evolving industry needs and paving the way for future advancements in motor control applications.

References:

1. P. Zhou et al., "Automated Assembly of Power Electronics Modules Using a Pick-and-Place Robot," 2018.
2. S.M.A. Hashmi et al., "Design and Development of a Flexible Pick-and-Place Robot for Electronics Assembly," 2015.
3. Y. Liu et al., "Automated Assembly of High-Density TRANSISTOR Arrays for Motor Drives," 2020.
4. IEEE Xplore, "A Novel Automated Assembly System for High-Power TRANSISTOR Modules."
5. Infineon Technologies AG, "Method and apparatus for automated assembly of a power module," U.S. Patent 10,957,248, March 23, 2021.
6. Robert Bosch GmbH, "Pick-and-place system for assembling electronic components," U.S. Patent 10,106,205, October 23, 2018.
7. ABB Schweiz AG, "Robotic assembly system for power electronics modules," WO Patent WO2021022381, February 4, 2021.
8. ResearchAndMarkets.com, "Industrial Automation Market - Global Outlook and Forecast 2022-2027," 2022.
9. BIS Research, "The Future of Industrial Robotics 2023-2028," 2023.
10. Technavio, "Southeast Asia Robotics Market - Growth, Trends, and Forecasts (2023 - 2028)," 2023.