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Vibro Machine for Part Sequencing

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Abstract: ***This project presents the development of a vibro machine designed for controlled vibration applications, such as material handling, sorting, and compacting. The system utilizes a 12V coil electromagnet with a 15kg pulling capacity to generate vibrations, which are transmitted through a bowl. To facilitate efficient oscillations, an FR4 sheet acts as a spring mechanism, providing the necessary restoring force.***
The Arduino Nano serves as the main control unit, generating adjustable pulse signals to regulate the electromagnet's activation. A MOSFET IRFZ44 is used as a switching device between the microcontroller and the electromagnet, ensuring efficient power delivery and control. By adjusting the pulse width and frequency, the vibration intensity can be finetuned based on application requirements.

I. INTRODUCTION

The system is designed to be cost-effective, energy-efficient, and adaptable for various industrial and automation applications. Its modular nature allows for easy modifications, making it suitable for tasks such as automated part feeding, material separation, and compaction processes. This project demonstrates a simple yet effective approach to implementing a vibrationbased automation system usingmicrocontrollerbased control This project presents the development of a vibro machine designed for controlled vibration applications, such as material handling, sorting, and compacting. The system utilizes a 12V coil electromagnet with a 15kg pulling capacity.

The core of the machine consists of a 12V coil electromagnet with a 15kg pulling capacity, which generates vibrations to agitate a bowl. To achieve controlled oscillations, an FR4 sheet is used as a spring mechanism, providing flexibility and stability. The Arduino Nano is programmed to deliver adjustable pulse signals to the electromagnet, allowing precise control over the vibration intensity and frequency.

A MOSFET IRFZ44 is implemented between the Arduino and the electromagnet to handle power switching efficiently. This setup ensures optimal power utilization while maintaining reliable and consistent vibrations. The system's modularity and adjustability make it suitable for various industrial applications, including automated material handling and part feeding systems.

This project aims to provide a cost-effective and efficient solution for vibration-based automation, leveraging microcontroller-based control for enhanced precision and flexibility.

A vibro machine is a mechanical system designed to generate controlled vibrations for various industrial and automation applications, such as material sorting, feeding, and compacting. This project focuses on developing a compact and efficient vibro machine using an Arduino Nanobased control system.

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II. LITERATURE REVIEW

1) Antoni, RB Randall Mechanical systems and signal processing 18 (1), 103-117, 2004 Vibration analysis of machines gains greatly in efficiency if periodic vibrations can be separated out from non-deterministic ones.

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2) Ildar Badretdinov, Salavat Mudarisov, Eduard Khasanov, Salavat Akchurin Mathematical Modelling of Engineering Problems 9 (1), 2022 This article presents the results of a study of the vibrations of the deck of a pneumatic sorting machine.
3) A Fedotov, G Denisov EMC'91: Non-Ferrous Metallurgy—Present and Future, 257, 2012 The most efficient and ecologically safe method of recovering metals from recycled materials is the vibratory method.
4) Cristea Aurora Felicia, Bălcău (CSCC), 1-6, 2023 The paper starts from a practical, real study, in which the presence of vibrations and their transmission to other components of the equipment damages its structure.
5) CA Gulo, M Rahayu, S Martini, MI Kurniawan Science and Engineering 528 (1), 012009, 2019 PT. Perkebunan Nusantara VIII is a company that produce orthodox black tea in Indonesia with a land area of less than 400 hectares.

III. PROBLEM STATEMENT

In industrial automation, material handling, and manufacturing processes, precise and controlled vibrations are essential for tasks such as feeding, sorting, screening, and compacting materials. Traditional vibratory machines often rely on complex mechanical setups or expensive industrial controllers, making them costly, less flexible, and inefficient in power consumption.

A. *Working Principle*

1) Signal Generation: The Arduino Nano generates PWM pulses, controlling the activation and deactivation of the electromagnet.
2) Electromagnetic Actuation: The MOSFET switches the electromagnet on and off, creating a rapid attraction and release cycle.
3) Vibration Control: The FR4 sheet acts as a spring mechanism, maintaining oscillatory motion with minimal energy loss.
4) Adjustability: The vibration intensity and frequency can be modified via software, making the system adaptable for various applications.



B. *Advantages of the Proposed System*

1) Cost-Effective: Uses low-cost components while providing high performance.
2) Energy-Efficient: MOSFET switching and PWM-based control reduce power consumption.
3) Customizable & Scalable: Adjustable vibration intensity for different applications.
4) Low Maintenance: Fewer moving parts compared to traditional mechanical vibratory systems.

C. *Expected Outcomes*

1) A fully functional vibro machine with adjustable vibration control.
2) Improved efficiency and power management using PWM and MOSFET switching.
3) Reduced operational costs compared to traditional vibratory machines.
4) Adaptability for various applications, including material handling, sorting, and industrial automation.

D. *Key Features of the Working Mechanism*

1) Precise Vibration Control: PWM-based control allows fine-tuned vibration intensity.
2) Energy Efficiency: The MOSFET switching mechanism ensures minimal power loss.
3) Customizable Operation: Adjustable frequency and intensity for different applications.
4) Low Maintenance: No mechanical motors or gears, reducing wear and tear.

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IV. FUTURE SCOPE OF THE VIBRO MACHINE

The vibro machine, as proposed, offers a solid foundation for further advancements and innovations in vibration control systems. With the continuous development of new technologies and materials, the following future directions and improvement can be considered for enhancing the capabilities and expanding the application of this vibro machine.

V. CONCLUSION

The proposed vibro machine system provides an efficient and cost-effective solution for generating vibrations using an electromagnetic mechanism, controlled through Arduino Nano and a MOSFET switching system. The adjustability of vibration frequency and intensity, along with energy-efficient design, makes the system highly adaptable for various industrial applications such as material handling, sorting, and automated processes.

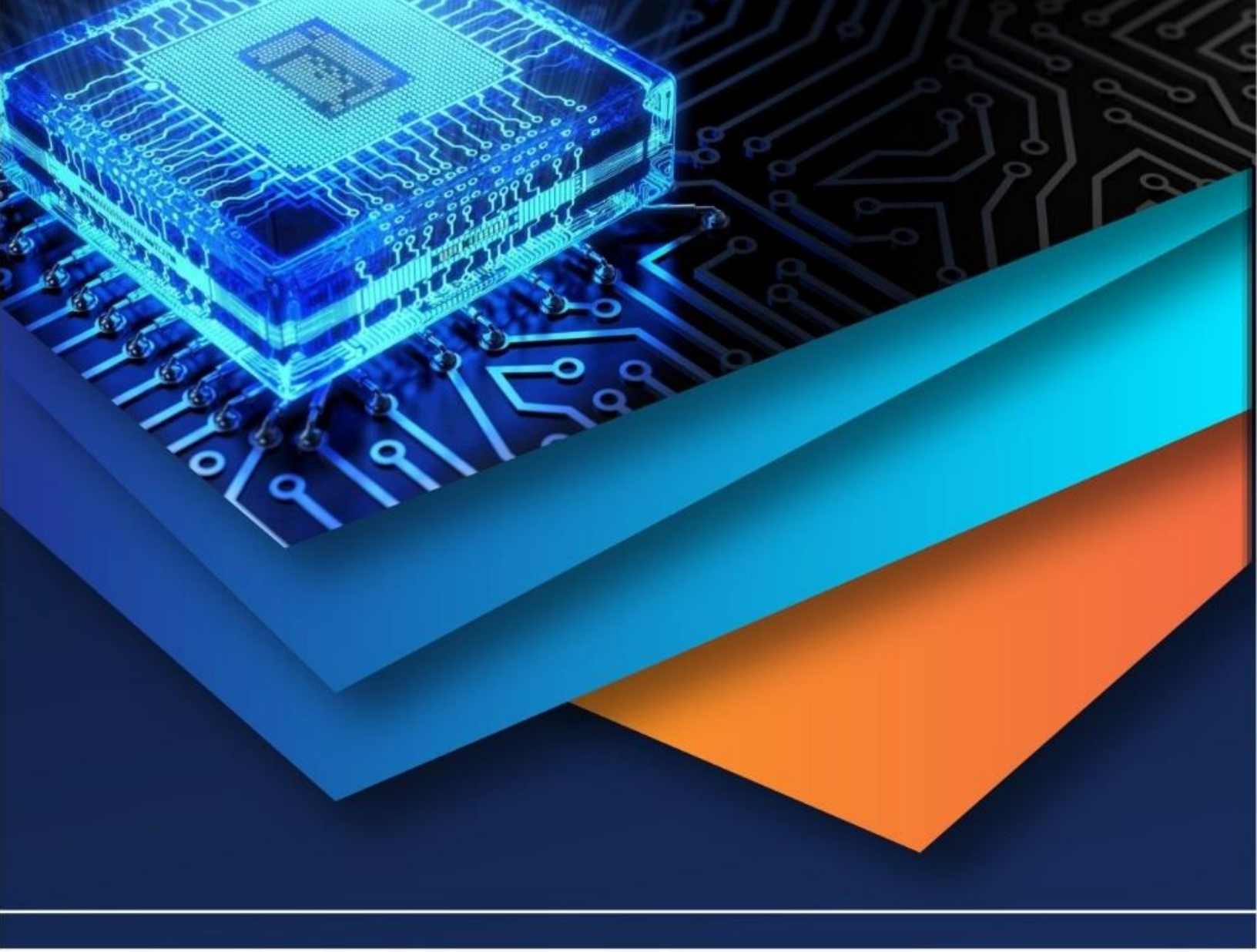
By leveraging PWM control, the system achieves precise vibration control, while the MOSFET IRFZ44 ensures reliable power switching, minimizing energy losses. The spring mechanism (FR4 sheet) optimizes vibration dynamics, ensuring smooth oscillations with minimal maintenance.

With a low-maintenance, compact, and reliable design, the vibro machine is well-suited for environments where cost, efficiency, and flexibility are essential. Additionally, its future potential to integrate with IoT, machine learning, and AI technologies opens up new opportunities for intelligent vibration control, predictive maintenance, and automation in industrial systems.

The development of this vibro machine marks a significant step towards creating smarter, energyefficient, and customizable vibration solutions for a variety of applications.

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