Electromagnetic Accelerator

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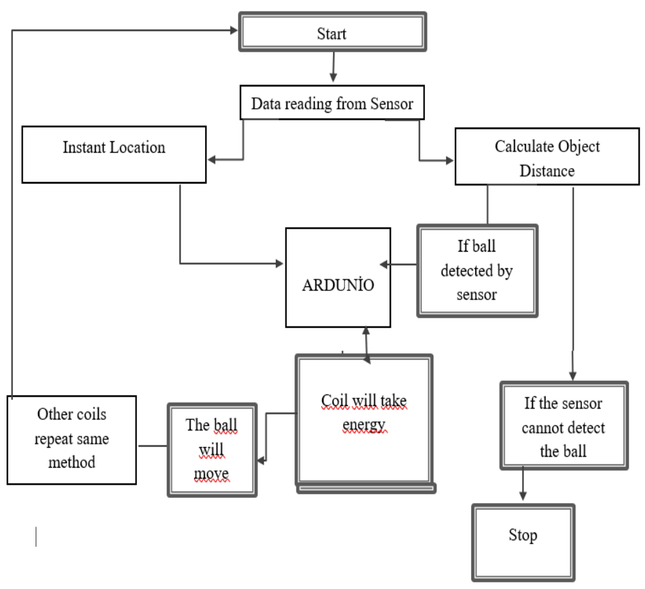
ABSTRACT

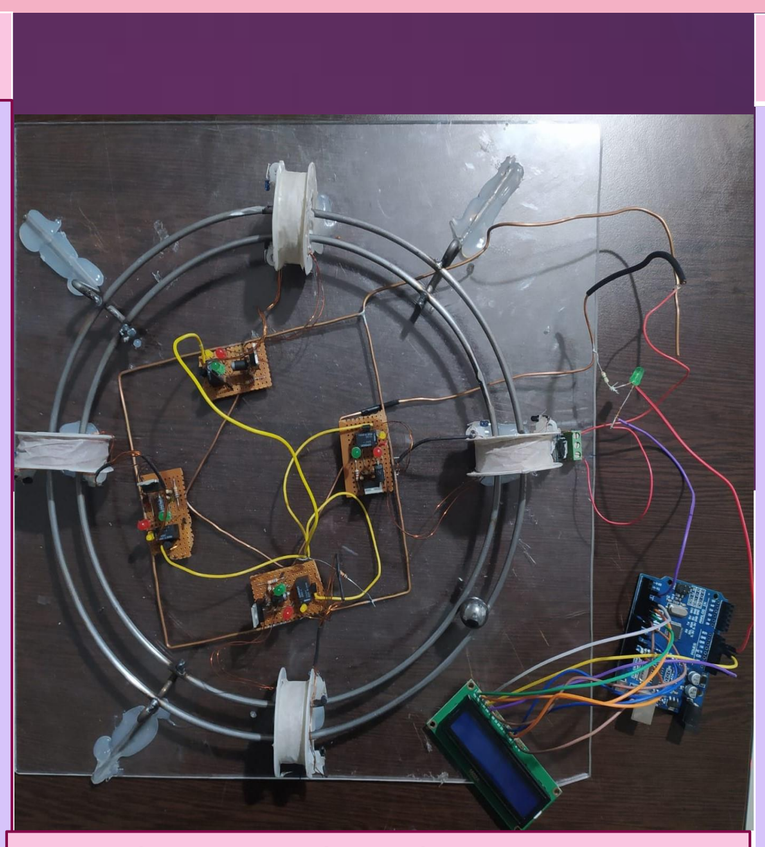
This project details the design and implementation of an electromagnetic accelerator using four controllable coils through an Arduino system. These coils induce circular motion in a metal ball along a circular path, maintaining a minimum speed of 50 cm per second. The system operates efficiently with a 12V, 16.5A power supply and a DC-DC converter designed in Proteus. Identified risks, such as overheating and software bugs, have been proactively addressed. Success criteria include sustaining the minimum ball speed and optimizing overall system performance, showcasing the integration of electromagnetic principles, advanced control systems, and efficient power regulation.

Introduction

Magnetic accelerator is the general name for devices that use electromagnetic fields to accelerate charged particles to high speeds and hold them together in bunches. Large accelerators are known as colliders in magnetic physics. In order to implement this system, very powerful electromagnets and very sensitive control systems are needed.

Flowchart of Project





Design Criteria

Objective Achievement
The project successfully moves a metal ball along a predetermined circular path, demonstrating the effective application of electromagnetic principles.

Path Dimensions
The circular path adheres to the minimum specified circumference of 50 cm, providing an optimal track for the ball's movement.

Speed Regulation
The system consistently propels the metal ball to a minimum speed of 50 cm per second, showcasing efficient speed control and momentum maintenance with dc-dc converter.

User Interface and Display
The Arduino Uno processes the sensor data and controls the system, with the ball's speed displayed on an LCD screen, offering a clear and user-friendly interface

Working Principle

This project demonstrates Lorentz force by using electromagnetic coils to propel a metal ball along a circular path. Controlled by proximity sensors and a DC-DC converter, each coil creates a magnetic field to move the ball, showcasing electromagnetic propulsion. An Arduino Uno microcontroller manages the system, displaying the ball's speed on an LCD screen. This compact setup provides a practical and engaging illustration of fundamental electromagnetic principles.

Main Components

Electromagnetic Accelerator, Arduino Control System, DC-DC Converter, Power Supply, Coil, LED, Sensors.

Conclusion

In conclusion, this project effectively demonstrates the application of Lorentz force through a hands-on model by placing electromagnetic coils around circular path to control the movement of a metal ball along a circular path, it visually and interactively explains key concepts of electromagnetic propulsion. The integration of proximity sensors, a DC-DC converter, and an Arduino Uno for real-time monitoring and control highlights the synergy between physics and modern electronics. This compact and educational setup not only enriches understanding of electromagnetic principles but also inspires innovative thinking in the fields of physics and engineering education
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References

[1] Sadiku, M. N. O. (2007). *Elements of Electromagnetics* (4th ed.). New York & Oxford: Oxford University Press. p. 386. ISBN 978-0-19-530048-2.

[2] *Cavicchi, Elizabeth. "Series and Parallel Experimenting with Electromagnets" (PDF). Pavia Project Physics, Univ. of Pavia, Italy. Archived (PDF) from the original on March 15, 2016. Retrieved August 22, 2015*

[3] Daniel W. Hart, "Introduction to Power Electronics", Prentice Hall, Upper Saddle River, New Jersey USA, 1997 ISBN 0-02-351182-6

[4] *"Arduino UNO for beginners - Projects, Programming and Parts". makerspaces.com. 7 February 2017. Retrieved 4 February 2018.*