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Measuring Magnetic Field Values in a Solenoid Valve using Arduino Microcontroller

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***Abstract*—This work plans to present a minimal-expense exploratory setup utilizing an Arduino-based microcontroller to concentrate on the attractive enlistment idea. A Corridor Impact sensor or hall effect sensor to identify the attractive fields inside a long solenoid applied the DC current. The outcomes uncovered that for the DC changed up to 160 mA, the Arduino microcontroller sensor handled the attractive fields in a scope of up to 5.30 mT. The gathered information between the flows and the attractive fields was straight plotted with 0.99. Ampere's regulation was applied to appraise how much loop turn was utilized with around 1.8% blunder and around 1,020 rounds. This device is cheap, simple to assemble, and exhibits Material science factors on the Arduino board. The examination, alongside the conversation of magnetism and electricity, will be helpful for understudies in physical science class.**

***Index Terms*— Microcontroller, Arduino, Hall effect, Electric field and Magnetic field.**

I. INTRODUCTION

Educating and learning materials coordinated with a legitimate informative methodology can uphold understudy learning and increment understudy achievement. Such materials are essentially significant in the two Physical science address classes and research facilities for elevating understudies to appreciate properties of issues and regular peculiarities. Notwithstanding, a gear expected for constant information is much of the time costly and its support should be finished by particular professionals [1] [2].

A review to create informative instruments in light of minimal expense materials exists and become more well known. These days, there is a fast development of electronic innovations and microcontroller-based named Arduino, in which an enormous number of sensors can be connected to quantify a few actual boundaries such as distance, time, force, voltage, current, opposition, attractive fields, etc [3] [4].

An Arduino is an open-source gadget stage that permits to screening and control of different simple advanced signals. Arduino microcontroller can be joined with sensors and other all the more remarkable information handling gear to get the ideal arrangement [5].

Arduino board and its use in Physical science training research have been accounted for as modest gadgets and precision information handling in many works, for instance, fostering an Arduino-based undertaking to research the straightforward symphonious movement of a mass on a spring [6], utilizing the Arduino and its PC connection point to inspect the trait of photovoltaic cells [7], applying to an estimation of attractive motion densities [8].

In this paper, the uses of the Arduino board and its solenoid sensor in an electromagnetic exploration by utilizing Ampere's Regulation to research the attractive fields inside a solenoid were presented. The attractive fields can

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be recognized by the Corridor Impact sensor when the DC flows are applied to the solenoid by a variable DC power supply. Its information is handled by an Arduino board and displayed on the LCD shows. The connection between the attractive fields and the DC flows applied to a solenoid can be observed. Furthermore, various turns in the loop utilized can likewise be explored.

II. METHODOLOGY

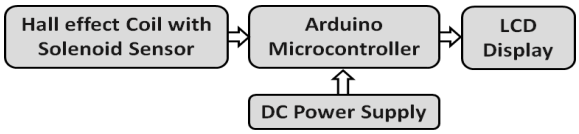

Figure 1. Proposed flow of Magnetic Measurement in a solenoid valve using Arduino Microcontroller

The Proposed flow of Magnetic Measurement in a solenoid valve using Arduino Microcontroller and here various components were utilized such that,

A. Hall Effect sensor

It is worked by the attractive fields from an extremely durable magnet or an electromagnet. A direct Corridor Impact sensor is a little flexible semiconductor gadget, which its aspect is around 3.00×4.00 mm^2. The direct source yield voltage is set up by the stockpile voltage and shifted in proportion to the strength of the attractive fields. The direct Corridor Impact sensor works voltage 3 to 6 DCV, and partners with the strength of the attractive fields around from 150 to 150 mT with responsiveness is around 18 mV/mT.

B. Solenoid coil and experimental setup

1,000 turns of a solenoid copper curl in the air center are utilized in this trial, the length of the solenoid is 3.840 ± 0.005 cm, and its width is around the range of 5.910 ± 0.005 cm. Within width of the solenoid (air center) is around the range of 2.120 ± 0.005 cm. The attractive fields inside the solenoid are assessed by Ampere's regulation as displayed in beneath conditions. so the attractive fields inside the solenoid are as:

$$\oint B \cdot dl = \mu_0 \cdot I \text{ enclosed} \quad (1)$$

where I is the DC current inside the solenoid, N is some of the curl turns, L is the length of the solenoid and μ_0 is an attractive porousness, individually.

$$B = \mu_0 \cdot N \cdot I / L \quad (2)$$

where I is the DC current inside the solenoid, N is the number of coil turns, L is the length of the solenoid and μ_0 is the magnetic permeability, respectively.

C. Arduino Microcontroller

Arduino (UNO) is a microcontroller board given the ATMEGA 328P. It comprises 14 computerized input/yield pins (6 of them can be utilized as PWM yields), 6 simple data sources, a 16 MHz quartz gem, a USB association, a power jack, an ICSP header, and a reset button. It contains important parts to help the microcontroller and is not difficult to interface with a PC through a USB link or power it with an air conditioner to DC connector (or battery) to begin. The Arduino UNO can be modified with Arduino Programming (IDE).

II. RESULT AND DISCUSSION

The experimental arrangement contains the DC current, fluctuating from up to 160 mA, which is produced by the DC power supply through a specific 100Ω resistor and applied into a solenoid loop, to change the attractive fields inside the solenoid. The attractive fields were recognized from the straight Corridor sensor by finding the sensor at the middle edge of the solenoid loop measurement or inside the solenoid. Likewise, the Lobby sensor can be applied to estimate the periphery field of the solenoid. For Vcc (Supply voltage), GND (Ground), and Information (Signs) of the Corridor sensor, which were associated with 5V, GND, and A3 (Simple info channel 3) of Arduino board, separately. The Arduino board peruses the crude voltage of simple info channel 3 from the straight Lobby Impact sensor. The voltage information was determined and changed over completely to the attractive field values. The control succession was customized with Arduino Programming (IDE) and showed the outcomes utilizing the LCD screen.

The DC flows were applied in a scope of up to 160 mA from 20 mA and got the size of attractive fields in a scope of up to 5.30 mT. The hypothetical attractive fields inside the pre-owned solenoid, which get from condition (2) while considering DC flows at 160 mA, was around 5.30 mT. It shows around 0.6% distinction between the exploratory and hypothetical extents of the attractive fields. It is an inexact 1.6% mistake of the information computation since there are 1,000 real turns of the curl utilized. This may be impacted by the self-enlistment of the sensor, and the clamor in estimating the attractive fields at various locales. This shows a high precision for estimating the attractive fields inside a solenoid of this minimal expense exploratory setup utilizing an Arduino board. Besides, the expansion of attractive field values when the applied current increments were straightly plotted and made sense of by condition (2). In this trial, we just got a straight relationship between the attractive field (B) and the applied current (I) as B = 33.24I mT with R2 = 0.99. The number of the curl divert was determined from the slant of the B-I chart and found as around 1,016 turns.

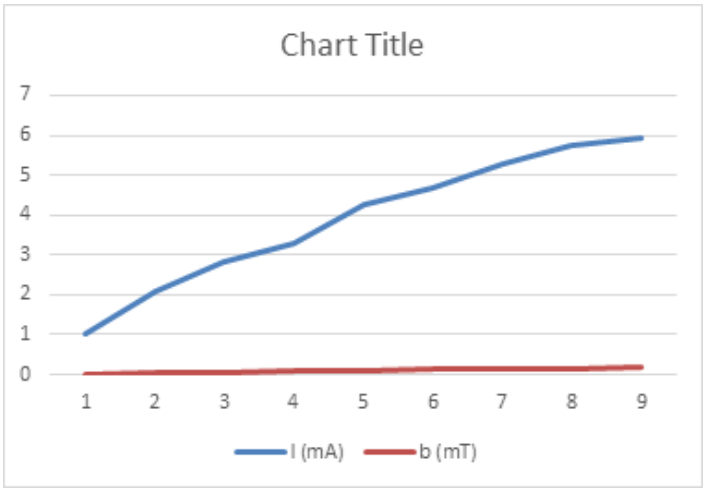

Figure 2. Magnetic Measurement in a solenoid valve coil

III. Conclusions and Future Work

This paper proposed the use of the Arduino board and its hall effect sensor to research the attractive fields inside a solenoid. It constantly shows the information through the LCD screen with a couple of percent mistakes. Besides, it is minimal expense parts and simple to plan. Material science instructors can create educational and learning materials to help understudies find out about the power and attraction, specifically, Ampere's regulation. It tends to be a useful discretionary device for Physical science address classes and research facilities in both secondary schools and college levels

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References

[1] Llorens J L S, Merino J J G, Caturla J G, Eslava P J, Cintas S R and Herranz J R 2016, Comput. Geosci. 94, pp 1–10.
[2] Wishkerman A and Wishkerman E, “Application note: A novel low-cost open-source LED system for microalgae cultivation”, Computers and electronics in agriculture, pp, 56-62, 2017.
[3] Koenkaa I J, Sáiz J and Hauser P C 2014 *Comput. Phys. Commun.* **185** 2724–9.
[4] Lahfaoui B, Zouggar S, Mohammed B, and Elhafyani M L 2017 *Energy Procedia* **111** 1000–9
[5] Dhankani K C and Pearce J M 2017 *HardwareX* **1** 1–12
[6] Galeriu C, Edwards S and Esper G 2014 *Phys. Teach.* **52** 157–9
[7] Zachariadou K, Yiasemides K and Trougkakos N 2012 *Eur. J. Phys.* **33** 1599–610
[8] Atkin K 2016 *Phys. Educ.* **51** 024001.