POSITION SENSORS

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***Abstract*—In this laboratory, two types of position sensors were explored: the magnetic sensor and the Hall type sensor. The operation of each sensor was analyzed and its response to different conditions was observed. Using an oscilloscope, the signals generated by each sensor when detecting the presence of nearby objects were recorded. These experiments provided a deeper understanding of how these sensors work and their potential applications in control and monitoring systems.**

I. Introduction

Position sensors play a key role in numerous applications, from motor control systems to motion detection devices. In this lab, two types of position sensors were explored: the magnetic sensor and the Hall-type sensor. These sensors are widely used in the automotive, electronics and robotics industries due to their ability to detect the position of objects and components accurately and reliably. Detailed study of these sensors provides a deeper understanding of their operation and their application in a variety of systems and devices.

II. General Objective

The main objective of this lab is to analyze the operation and characteristics of magnetic and Hall-type position sensors. It seeks to understand how these sensors detect the position of objects and how they can be used in different applications for system control and monitoring.

III. Specific Objectives

- To explore the operation of the magnetic position sensor and to understand its response to the presence of a magnetic field.
- To analyze the behavior of the Hall type sensor and its ability to detect movements and changes in the position of objects.
- Compare the characteristics and applications of both types of position sensors.
- Evaluate the accuracy and reliability of the sensors under different operating conditions.

IV. Materials

- Magnetic position sensor.
- Hall type sensor.
- Oscilloscope.
- Power supply.
- Metal objects (for the magnetic sensor).
- Connection cables.

V. Theoretical Basis

Magnetic position sensors are based on the detection of magnetic fields to determine the relative position of metallic objects. These sensors typically employ a permanent magnet and a Hall effect sensor to measure changes in the magnetic field generated by the moving object. When a metallic object approaches the magnetic sensor, it alters the surrounding magnetic field, which causes a variation in the output voltage of the Hall-effect sensor. This variation is proportional to the position of the object relative to the sensor. Magnetic position sensors are widely used in automotive, industrial and automation applications due to their ability to detect position with high accuracy and reliability. On the other hand, Hall-type sensors are based on the Hall effect, a physical phenomenon that occurs when an electric current flows through a conductor placed in a magnetic field perpendicular to the direction of the current. The Hall effect generates a potential difference in the conductor, known as Hall voltage, which is proportional to the strength of the applied magnetic field. Hall-type sensors use this principle to detect changes in the magnetic field and convert them into electrical signals. These sensors are commonly used in applications that require the detection of proximity, velocity, current and position, among others.

VI. Experimentation

In the laboratory, experimentation was carried out with the magnetic position sensor and the Hall type sensor. First, the necessary electrical connections were made to feed and read the output signals of each sensor using an oscilloscope. For the magnetic position sensor (it can be powered with a voltage between 5-12V, 12V was used for this lab), its response to the presence of a metallic object, such as a magnet or a piece of metal, was observed. The output signals of the sensor were recorded in the form of peaks using the oscilloscope and analyzed how they varied as a function of the position and distance of the object with respect to the sensor. Subsequently, the Hall type sensor was examined. The same electrical connections were made, with the exception that this sensor works only at 5V and its operation was observed on the oscilloscope, where it was shown that the more movement the lower part of the sensor received, the more it emitted a series of square-shaped pulses visualized by the oscilloscope. These experiments provided a practical understanding of the operation of magnetic and Hall-type position sensors, as well as their ability to detect changes in the magnetic environment and convert them into electrical signals. The results obtained made it possible to evaluate the accuracy, sensitivity and reliability of each sensor under different operating conditions.

Fig. 1. Hall effect position sensor

Fig. 2. Magnetic position sensor

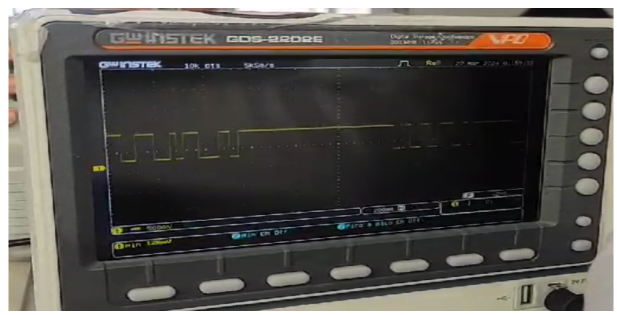

Fig. 3. Oscilloscope graph of the Hall effect sensor

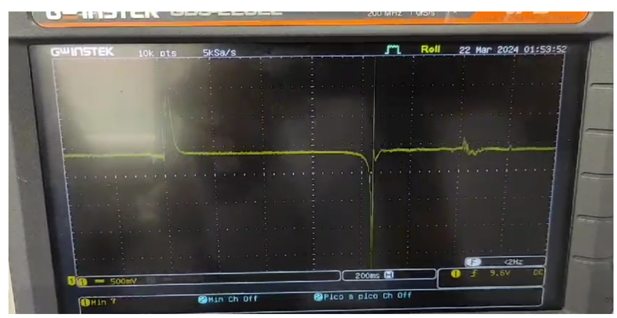

Fig. 4. Oscilloscope graph of the magnetic sensor

VII. Conclusions

The study of magnetic and Hall-type position sensors revealed their ability to detect the position of objects and generate electrical signals in response to changes in their environment. It was observed that the magnetic sensor responded to the presence of magnetic fields emitted by metallic objects, while the Hall-type sensor converted changes in magnetic fields into detectable electrical signals. These findings highlight the importance of these sensors in a variety of applications, from automotive safety systems to position control devices in robotics. Understanding their operation and characteristics is critical to their effective use in electronic systems and devices.