TMR Magnetic Field Mapper

Team Flatirons

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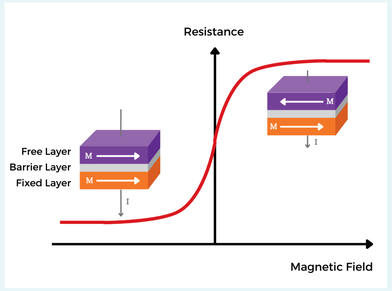
OVERVIEW

Tunnel magnetoresistance (TMR) sensors have higher sensitivity, lower power consumption, and smaller size compared to other types of magnetic sensors. Our initial goal was to use these sensors to create a highly sensitive metal detector that could detect small surgical tools, such as needles or tweezers, that may be left in a body during a procedure. The TMR sensors presented a learning curve and uncertainty about if they could work for this application. The project was rescoped to research the operation and capabilities of the sensors to better understand it and determine the feasibility for a retained item detector.

KEY FEATURES

The TMR Magnetic Field Mapper uses TMR sensors oriented along the x, y, and z axes to generate a heatmap of the magnetic field over a region. The gantry moves the sensor PCB in a grid pattern and allows us to perform controlled tests with the TMR. The heatmap algorithm provides a visual indication of the magnetic field magnitude.

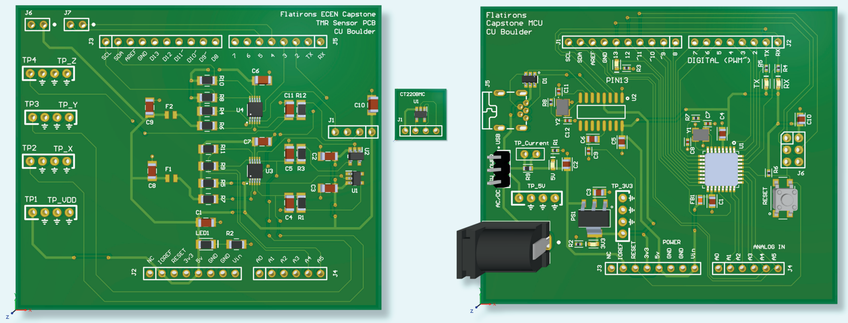
TMR SENSOR



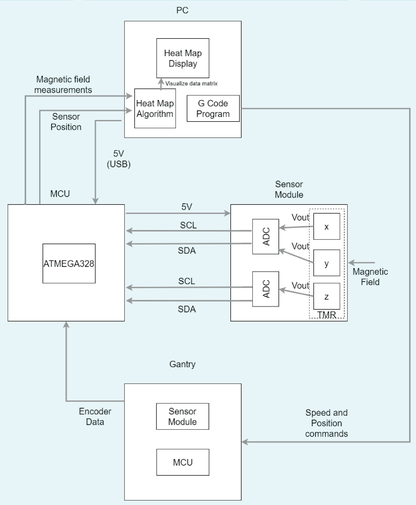
- Very thin (1-3nm) insulating layer between two ferromagnetic electrodes
- Resistance changes based on the magnetization direction in the electrodes relative to each other
- Electrons tunnel through insulator layer to generate current

SYSTEM DESIGN

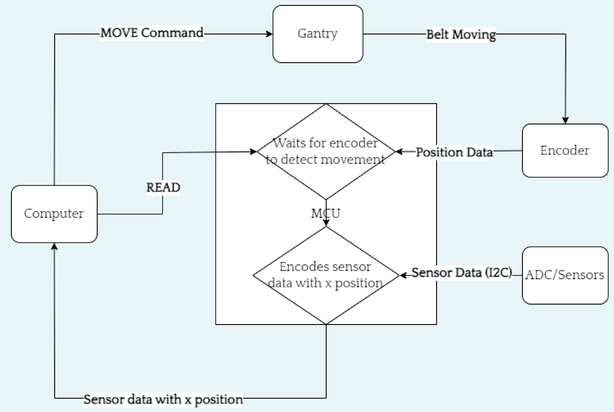
A gantry based TMR sensor tester that maps the magnetic field of magnetized objects.



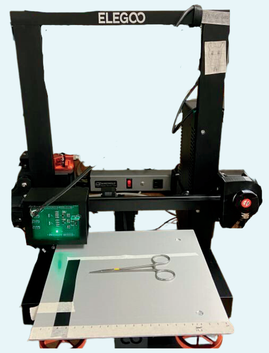
TMR Sensors	Analog to Digital Converter	Microcontroller
The Crocus CT220 TMR sensor measures the magnetic field and outputs an analog voltage linearly proportional to the field strength.	The ADS1115 is a low noise ADC that reads the sensor output voltage and converts it to a digital signal that is sent to the microcontroller.	The ATMEGA328 collects the TMR sensor measurements from the ADC and gantry position from an encoder and sends the data to the heatmap algorithm.

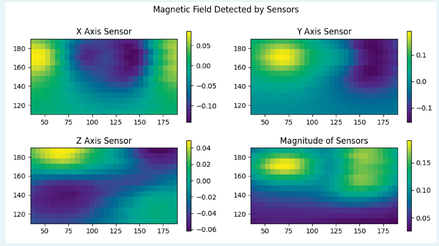


SOFTWARE



HEATMAP





ACKNOWLEDGEMENTS

We would like to thank our sponsor Aaron Mattmiller at Medtronic, our faculty advisor Gabriel Altman, and Professor Eric Bogatin.