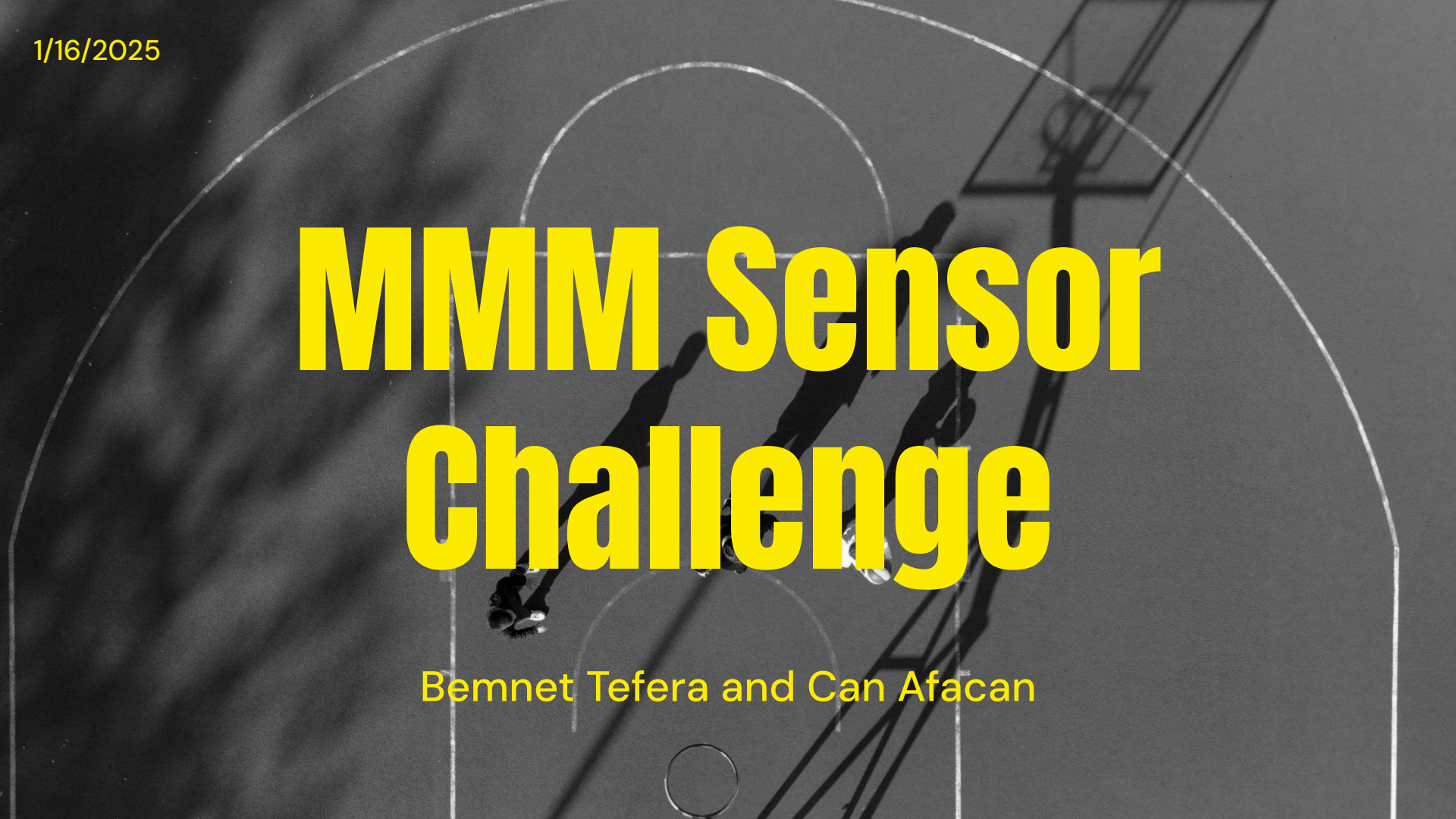
1/16/2025



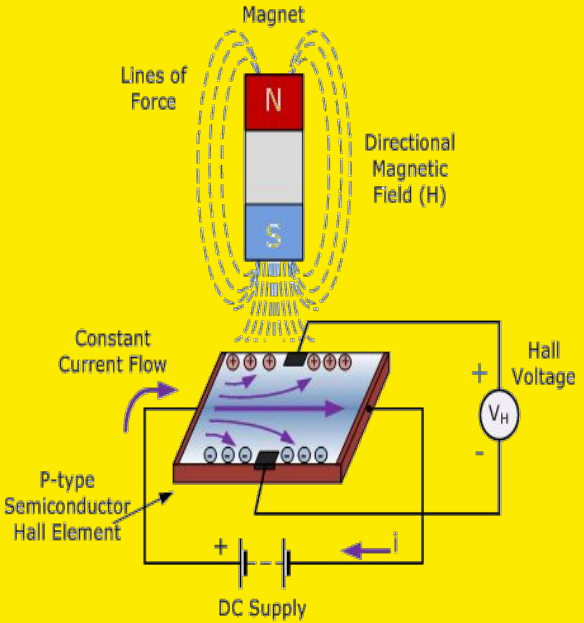
MMM Sensor Challenge

Bemnet Tefera and Can Afacan

Magnetic Motion Tracker

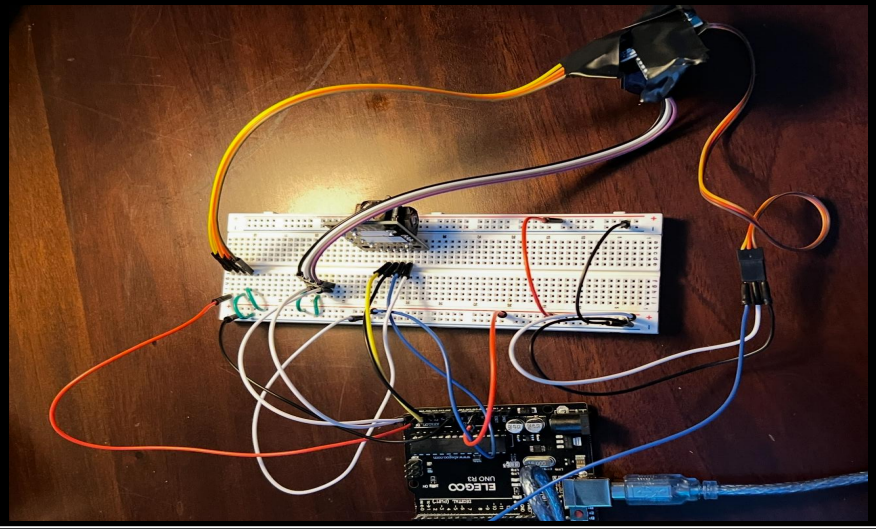
Objective

- Explore the behavior of magnetic sensors (both Hall effect and AMR digital compass)
- Measure and interpret magnetic field strength and direction
- Give the user the ability to position sensors as they see fit

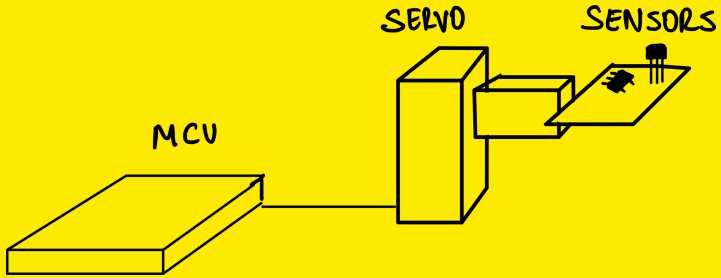


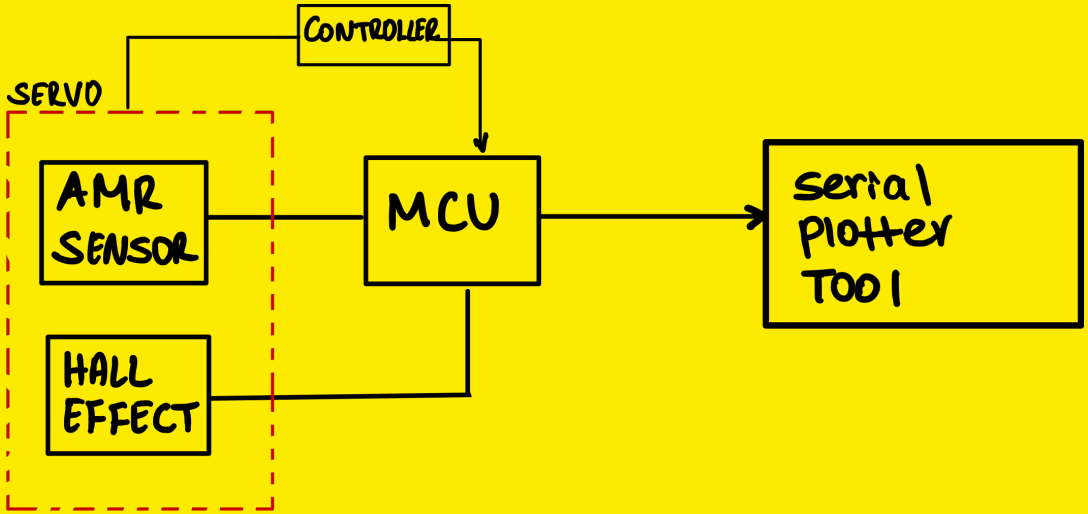
Design Components & Purpose

Arduino Uno: Sensor Communication and Programming
Hall Effect Sensor: Check for the presence of a magnetic material using the Hall Voltage
AMR Sensor: Track real time magnet position and field magnitude
Controller and Servo: Position adjustment of the magnets



Design Flow

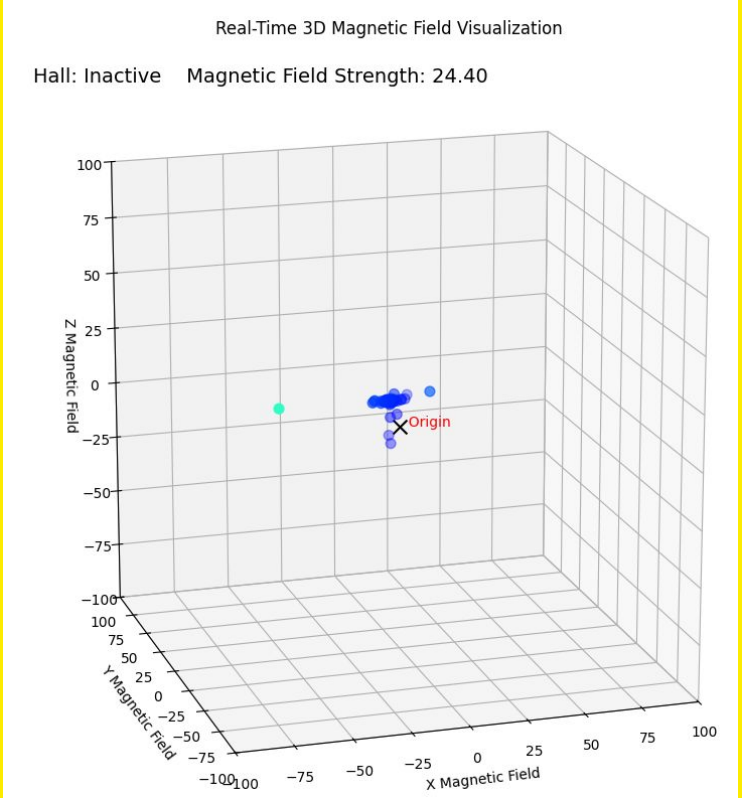

SERVO
SENSORS
MCU


CONTROLLER
SERVO
AMR SENSOR
HALL EFFECT
MCU
serial plotter TOOl

Testing and Output

```
Controller_X: 515, Controller_Y: 520, Voltage: 0.000, XMag: -18.04, YMag: 4.37, ZMag: 34.23
Controller_X: 515, Controller_Y: 520, Voltage: 0.034, XMag: -18.21, YMag: 4.37, ZMag: 34.27
Controller_X: 515, Controller_Y: 520, Voltage: 0.010, XMag: -18.21, YMag: 4.48, ZMag: 34.23
Controller_X: 515, Controller_Y: 520, Voltage: 0.015, XMag: -18.16, YMag: 4.43, ZMag: 34.32
Controller_X: 515, Controller_Y: 520, Voltage: 0.010, XMag: -18.11, YMag: 4.36, ZMag: 34.30
Controller_X: 515, Controller_Y: 520, Voltage: 0.000, XMag: -18.09, YMag: 4.34, ZMag: 34.23
Controller_X: 515, Controller_Y: 520, Voltage: 0.005, XMag: -18.11, YMag: 4.37, ZMag: 34.18
Controller_X: 511, Controller_Y: 516, Voltage: 0.000, XMag: -20.20, YMag: 3.79, ZMag: 30.10
Controller_X: 514, Controller_Y: 519, Voltage: 5.000, No magnetic field detected
Controller_X: 514, Controller_Y: 519, Voltage: 4.990, No magnetic field detected
Controller_X: 514, Controller_Y: 519, Voltage: 4.990, No magnetic field detected
Controller_X: 514, Controller_Y: 519, Voltage: 4.990, No magnetic field detected
Controller_X: 514, Controller_Y: 519, Voltage: 4.985, No magnetic field detected
Controller_X: 514, Controller_Y: 519, Voltage: 5.000, No magnetic field detected
```

Live sensor reading in the presence and absence of magnetic field.



Live recording of magent position.

Further Improvement

AMR Sensor

Problem: Currently has a hard time going back to initial value in the absence of magnetic field
Solution: Write a calibration algorithm that takes into account initial discrepancies

Hall Effect Sensor

Problem: Hall Effect Sensor jumps between two extreme voltage values (0.12V and 5v) in the presence of a relatively strong magnet.
Solution: Use two hall effect sensors positioned opposite from each other and add a differential amplifier to decrease sensitivity

Thank You