

# A Computerized Goniometer for Magnetic Field Optimization of Spin Resonance of Nitrogen Vacancies in Diamond

Marshal Dong

May 3, 2023

## Abstract

This project uses a stepper motor, an accelerometer, an Arduino chip, and a computer interface to form an automatic system to rotate a goniometer. The stepper motor clamps onto a goniometer knob to turn it based on a string command from the user. A user clicks different buttons on the GUI to send different string commands to the Arduino. The accelerometer triggers when a stepper motor rotates the knob to a side such that it stops moving, and shuts down the system to prevent goniometer damage.

## 1 Introduction

My research project involves a magnet attached to two goniometers, and the two goniometers control the two angles of a spherical coordinate system, through which we model a magnetic field. Two long-standing issues are the inconvenient hand-tuning of the goniometer knobs and the inaccurate read-out-by-eye. The experiment is situated inside a light-blocking box and both tuning and reading the goniometers require opening the box. The experiment is sensitive to vibration, and opening and closing the box vibrates the experiment. In addition, one of the goniometers is difficult to read due to its orientation. A computerized system can help us to mitigate both of these issues. We avoid the vibration from opening and closing the box and can conveniently read the goniometer readings on the computer screen.

## 2 Materials

- Two Arduino Uno
- 17HS4401S 1.7A Torque:43N.cm Stepper Motor
- HR4988 DMOS Microstepping Driver
- MMA8452Q, 3-axis, 12-bit/8-bit digital accelerometer
- 12V DC Power Supply
- Wires, resistors, capacitors, and breadboard

### 3 Diagrams and Photos

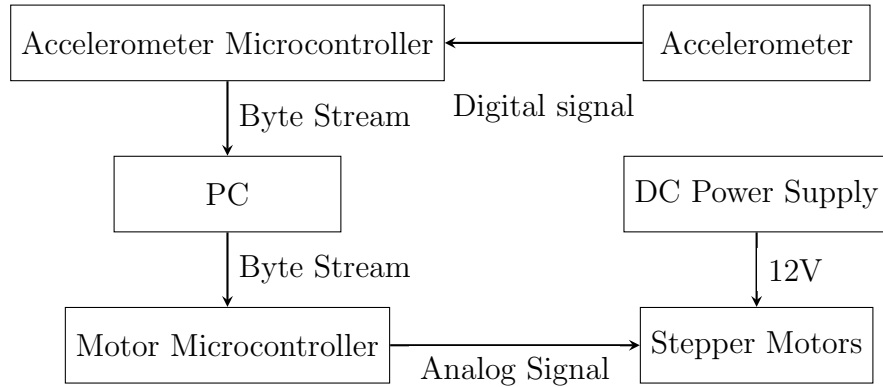


Figure 1: System block diagram

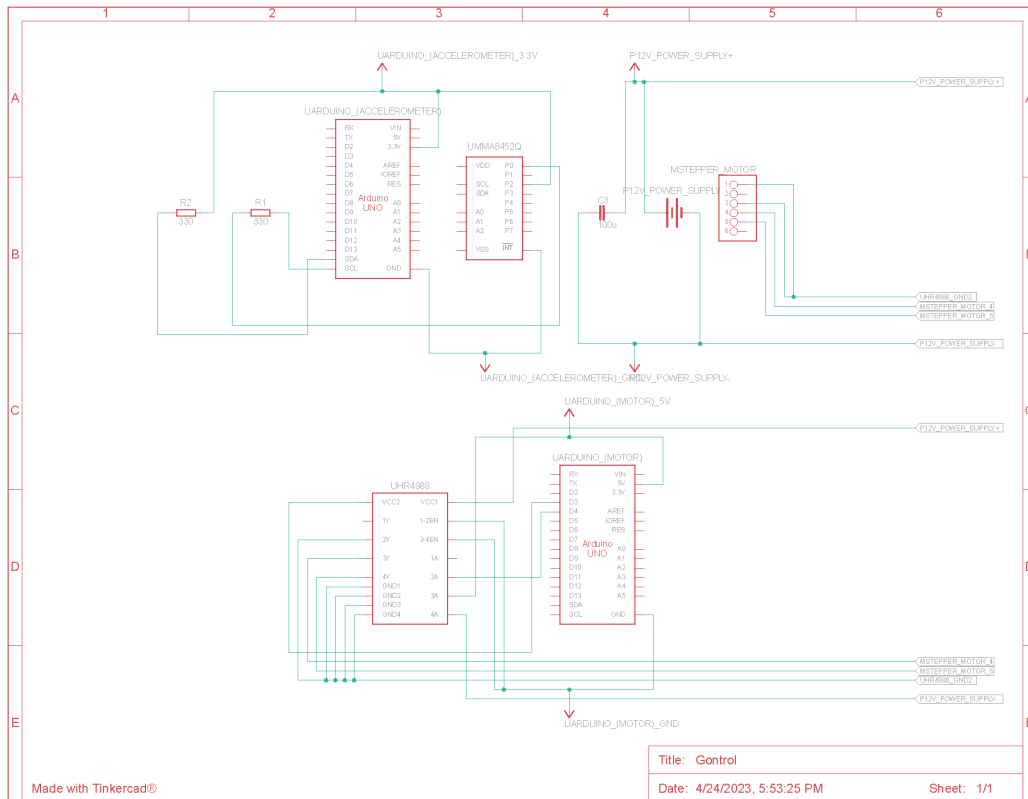


Figure 2: Electronics schematic



Figure 3: Python Tkinter GUI

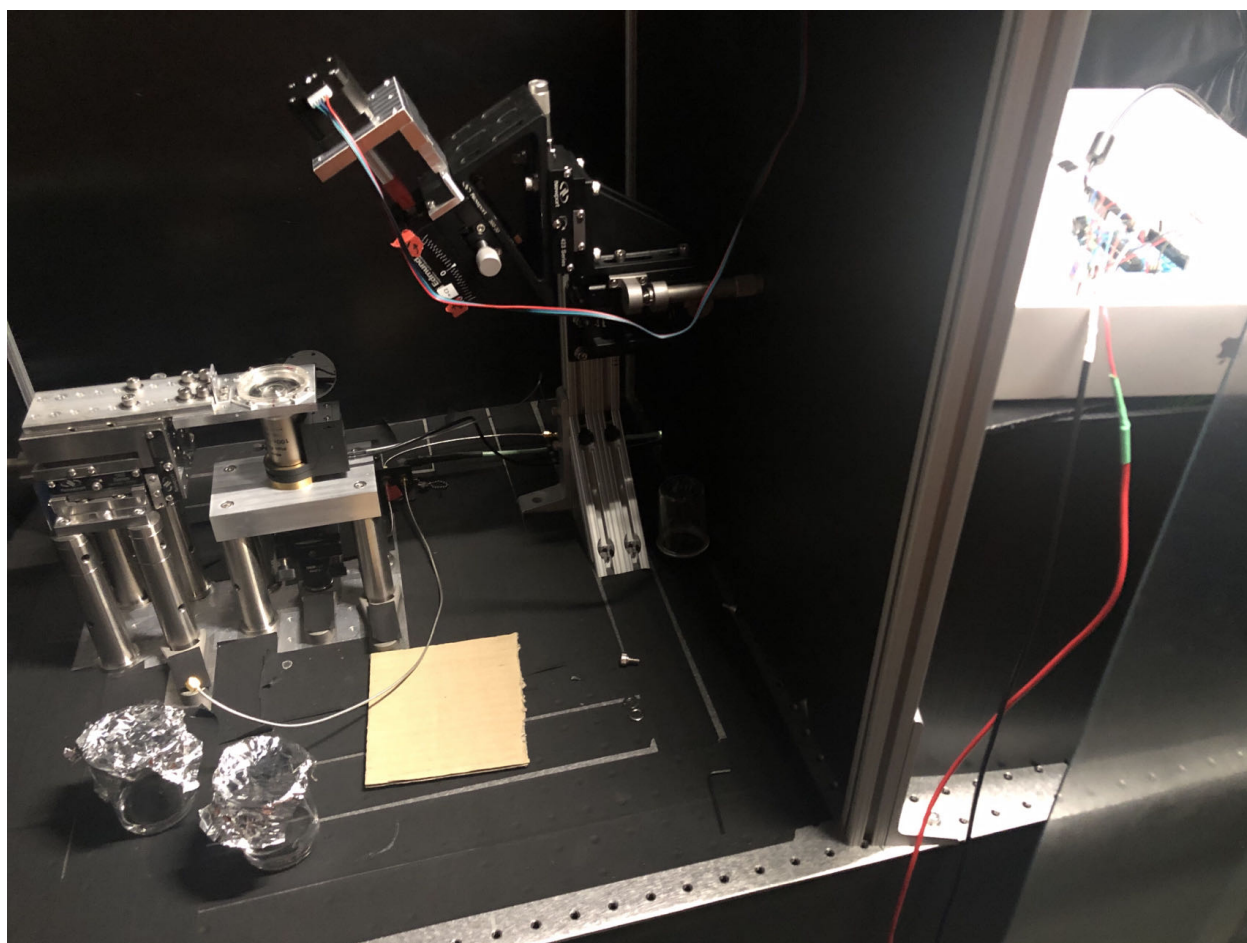


Figure 4: Testing the system on an experiment