# Automated Pulse Sensing Tool

NDHU Undergraduate Project
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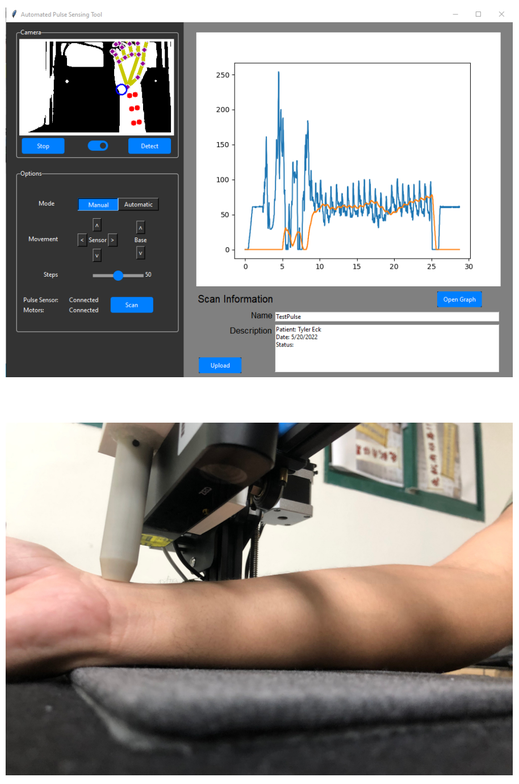
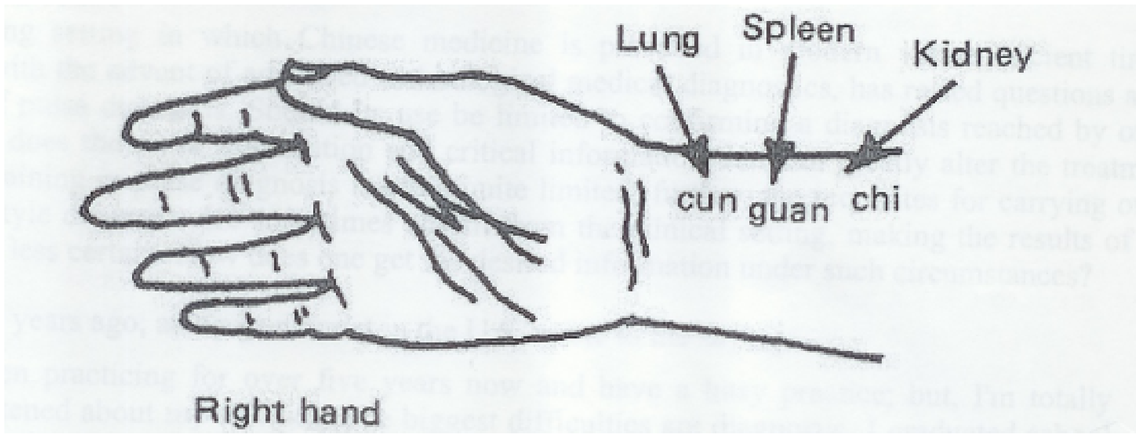





## INTRODUCTION

Automation technology is slowly progressing into our daily lives whether it may be for a simple smart home device or for a complex fully autonomous vehicle. With its rise in popularity, the next logical step of progression should be used for medical tools as its implementation could potentially save lives.

Traditional Chinese Medicine (TCM) pulse diagnosis is the specific procedure that will be automated in this project. TCM pulse diagnosis focuses on three location: cun, guan, and chi, on a person's wrist. With the pulse readings of these three points, each with different levels of pressure, a TCM doctor can make assessments of the body parts and diagnosis the patient if needed.




## OBJECTIVE

**The main objective is to design and implement a fully automated pulse sensing tool that will allow for users to measure their pulse with ease.**

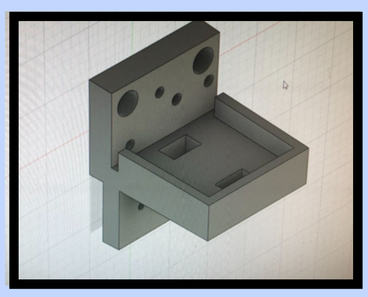
**With the push of a button, the tool will detect the pulse location, move the sensor to that location, digitally record the pulse reading and upload it to the cloud for the doctor's observation.**

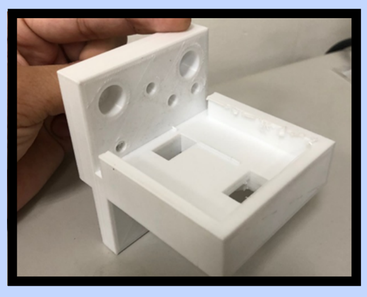
## IMPLEMENTATION

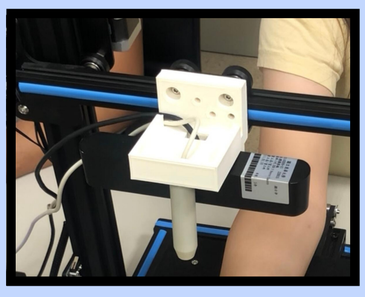
| Hardware | Software |
|---|---|
| Arduino Mega 2560 | Python Tkinter GUI |
| X,Y,Z Step Motors | Arduino Motor Control |
| Stereolabs Zed Camera | Pulse Detection |
| HK 2019 Pulse Sensor | Firebase Configuration |

## HARDWARE

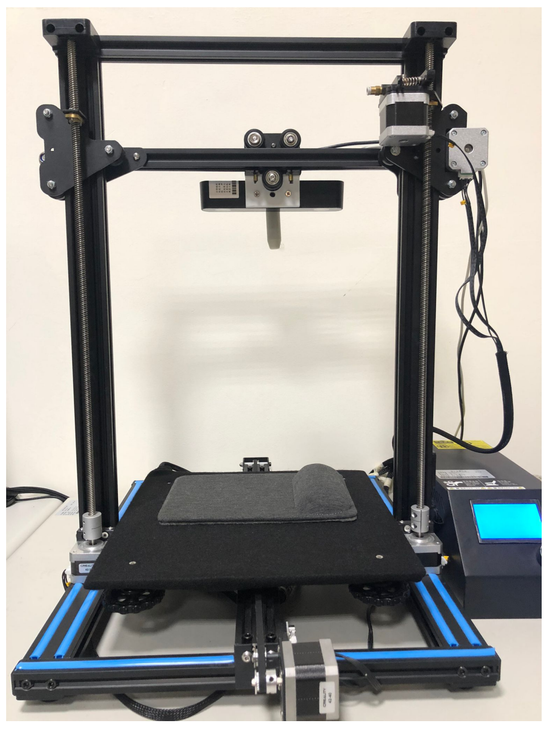
The main base was formed by repurposing a Creality 3D printer with the X,Y, and Z motors already incorporated. The motherboard is an **Arduino Mega 2560** and was reprogrammed to move motors freely. The Zed camera and the HK Pulse Sensor was mounted to the moving motors with a specially desgined 3D printed part shown below.



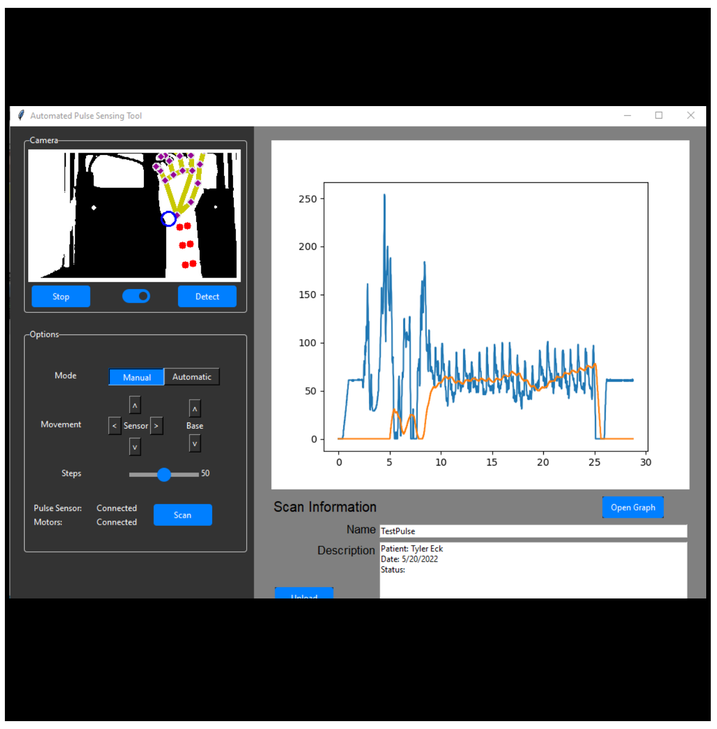




## RESULTS



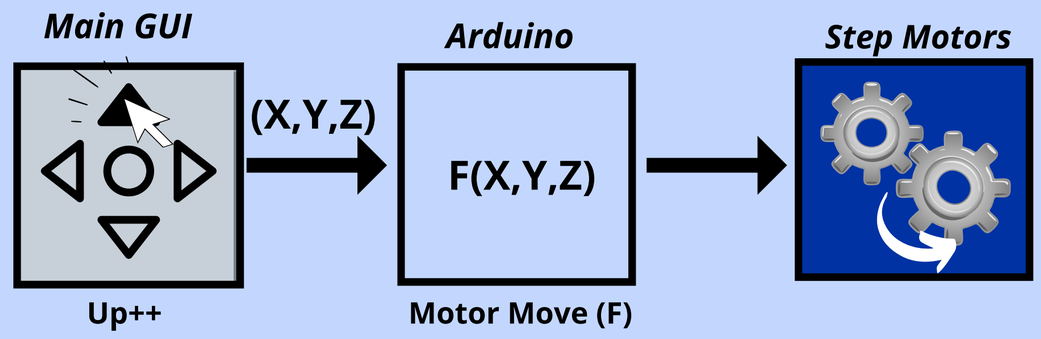
**Automated Pulse Sensing Tool**



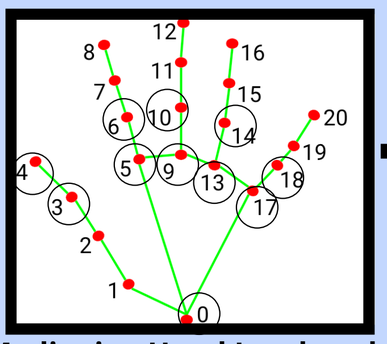

**Automated Pulse Sensing Tool GUI**

## SOFTWARE

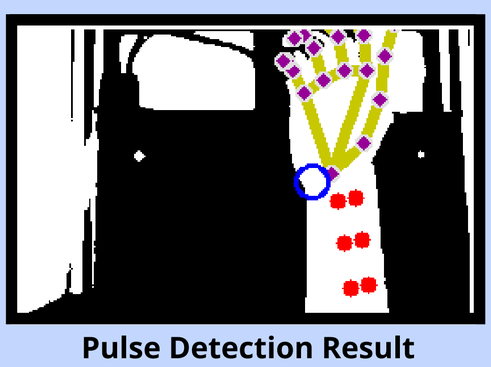
The main GUI program was written in **Python** using the popular GUI package **Tkinter.** In order to communicate with the Arduino, a Motor Movement function was written and uploaded to the Arduino in order to always listen for commands given by the main program. If any movement is required, coordinates (X,Y,Z) will be sent to the Arduino through serial.




The pulse detection point was calculated and identified by using a Python package called **Mediapipe.** As shown below, implementing Mediapipe can allow for hand detection with 21 marked points known as hand landmarks. With 11 of these landmarks, the pulse point was calculated using an algorithm developed by the 寸關尺辨識 team who are also members of the AI Lab.

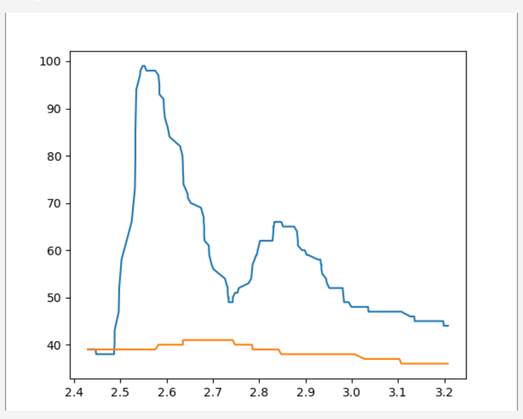


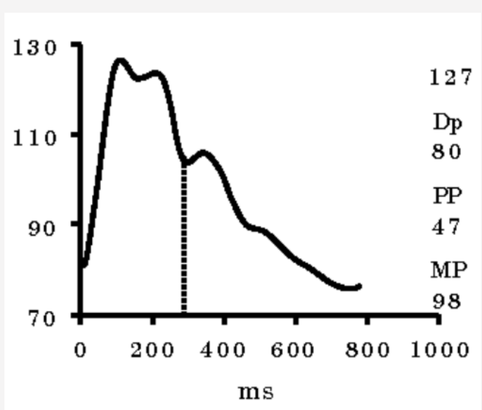

**Mediapipe Hand Landmarks**



**Pulse Detection Result**

On the left shows the hardware implementation of the Automated Pulse Sensing Tool with the connected camera, motors and sensor to the main base. On the right shows the GUI implementation of the Automated Pulse Sensing Tool with the live camera feed, configuration menu, and graph display.




Due to the similarities of shape to an official arterial pressure pulse form shown on the right, the automated tool proved to be effective in both finding and moving to the correct pulse point and recording and graphing the pulse reading properly

## CONCLUSION

The implementation and testing of this tool proved to successful. However, in order to get proper data to improve the detection algorithm and motor movement translation, this tool will need to be implemented in a hospital and tested by a TCM doctor.