**Automated Pulse Sensing Tool**



**國立東華大學資訊工程系**

**National Dong Hwa University**

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110 CSIE Undergraduate Project Report

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**3rd year Project Final Report**

**~ Automated Pulse Sensing Tool ~**

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**Project Name:** Automated Pulse Sensing Tool

**Project Client:**          Medical Professionals

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**專題報告原創性聲明**

**National Dong Hwa University**

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**Statement of Originality**

I hereby affirm that the submitted project report is the result of research under the supervision of my advisor. Except where due references are made, the report contains no material previously published or written by another person or group. All significant facilitators to the project have been mentioned explicitly. Should any part of the statement be breached, I am subject to the punishment enforced by the University and any legal responsibility incurred.



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In the process of conducting this project, I have received an abundance of support.

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**ABSTRACT:**

Due to the rise in popularity of technology, especially of the internet, people have sought to use creative and functional methods of implementing it in their daily life. Automation, for instance, can have a huge impact in the amount of time saved doing remedial tasks. As seen in the manufacturing sector, both throughput and speed are pushed to the limit with industrial robots in the place of working human beings. This exponential improvement that automation brings should be applied to something more important such as the medical field.

Combining automation with medical tools creates a crossroad for the tool proposed in this project. With an automated pulse sensor that can remotely record a person’s pulse faster, medical checkups for the elderly living in remote areas becomes easier and more efficient. By using a cloud-based platform, this tool can also give doctors the ability to remotely observe multiple people’s pulse recordings at any given time. Limitations on location and time would be eradicated as a result of the implementation of this tool.

**Keywords:** automation, medical, pulse, cloud-based

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**INTRODUCTION**

In this evolving technological era, it is common to find ourselves dependent on automation technology whether it may be for a simple smart home device or something more complex such as a self-driving car (autonomous vehicle). Regardless, it is important to note that this fundamental use of automation can have a drastic impact on our seemingly difficult life. As popularity and demand grow, I believe that the next logical step is to implement automation in more important roles such as for medical purposes. By doing this, more time will be saved which potentially may save more lives.

Due to its popularity here in Eastern Taiwan, the specific medical procedure that I want to automate is pulse diagnosis in Traditional Chinese Medicine (TCM). As opposed to pulse diagnosis in western medicine that retrieves little information from a single point, TCM pulse diagnosis focuses on three locations, cun, guan and chi, on a person’s wrist to get the condition of the heart, liver, and kidney respectively. Although it is argued that TCM pulse diagnosis results are biased and only dependent on the practitioner’s experience and intuition, there have been many studies that aim to quantify the methods and assessments that can be drawn from the diagnosis. Moreover, most of the Taiwanese population, especially the elderly, rely on TCM assessments and consultations when they’re sick.

Therefore, with the advantages that automation brings and the popularity of Traditional Chinese Medicine in Taiwan, I propose a fully automated pulse sensing tool that will allow for users to measure their pulse with ease.

With the simple push of a button, this tool will detect the pulse location on a person’s wrist, move the pulse sensor to that location, and then finally make a digital recording of the pulse reading that will automatically be uploaded to the cloud.

As a result, the pulse reading can be analyzed by a doctor anywhere in the world making it more convenient for patients to see the doctors and for doctors to analyze and assess pulse diagnosis.

**MOTIVATION AND RESARCH PROBLEM**

Technology has solved many of our proximity problems whether it may be remote schooling due to COVID-19 or online conferences for company chains in different locations. The value of being able to connect with each other regardless of our location is quite essential in this modern age. Although we take it for granted, this idea of connection must be pushed to its limit. Therefore, the motivation of this project is to extend this connection to people who are physically unable to go for frequent doctor visits as a result of living in remote areas.

Small villages, especially in the east of Taiwan, lack the efficient number of doctors and special experts that are needed due to high numbers of elderly population living in those areas. Because of this, a lot of people need to travel far distances just to get a routine check-up. This poses a problem when they are physically unable to go due to health conditions, lack of transport, or the dynamic COVID-19 restrictions. The proposed tool allows for convenience as the goal is to make it accessible for people to send their information remotely to the doctor for examination.

**RESEARCH METHOD**

The project’s goal was to make an automated system that remotely transmits data. It needed both the necessary hardware to move motors and measure the pulse and the necessary software for detection of the wrist location, GUI for users, and the transmission of data. Therefore, I have split the project into two main parts as shown below: hardware and software

1. **Hardware**

The three main hardware components necessary to complete the project were the step motors to move the sensor, the camera as digital input for detection, and the pulse sensor to measure the pulse. Fortunately, I was provided with a Creality CR10s 3D printer that had all the necessary motors with its stop switches connected in an X,Y,Z plane shown below in Figure 1.

A picture containing text, indoor, desk, cluttered

Description automatically generated

**Figure 1: 3D printer with dimensions**

The repurposing of this 3D printer required reprogramming the stepper motors that were connected to the motherboard. The motherboard, which is housed separately with the battery, is an Arduino2560 microcontroller and can therefore be controlled using the Arduino IDE. After the reprogramming was done, the motors could move in accordance with the X, Y, and Z Cartesian plane based on coordinates that was supplied to it through the serial.

The pulse sensor and camera were both provided by the lab as well. The pulse sensor is a special sensor as shown in Figure 2 (left). The camera is a StereoLabs ZED dual camera as shown in Figure 2 (right). Because the website specifically advertises it for autonomous robotics due to its high frame rate and long-range 3D sensing, it was selected for the project.

**Figure 2: Pulse Sensor and ZED Dual Camera**

Lastly, to mount both the camera and the sensor together for the motors to move, I had to learn how to design a 3D model and how to print using a 3D printer. Fortunately, the lab had a functioning 3D printer to my disposal, so I designed a 3D-printed part shown below in Figure 3. (On the left shows the design of the part in the software and the right shows the printed piece).

**Figure 3: 3D-printed part**

After all the necessary hardware configurations were done, the right USB drivers were installed, and USB extensions were added to each hardware component, the final hardware product is shown below in Figure 4.

**Figure 4: Completed Hardware**

1. **Software**