Faculty of Electronics & Computer Technology and Engineering

DEVELOPMENT OF HAND TESTER MONITORING SYSTEM FOR REHABILITATION PATIENT BY USING ARDUINO

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Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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A project report submitted
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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours)

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DEDICATION

I sincerely dedicate myself to my parents and express my gratitude for their love, support, encouragement, and sacrifices throughout my entire life. I could never have made it to this point without their support and efforts. A special thanks is also extended to all my siblings, who have never stopped encouraging and counselling me in all I do. I would especially like to thank all of the lecturers who have helped and advised me during my studies. All my friends who have supported me during this happy journey will never be forgotten. I cannot put into words how much I appreciate each one of you.

ABSTRACT

The main purpose of the development of Hand Tester Monitoring System for rehabilitation patient by using Arduino is to monitor the patient's hand strength after the therapy process. Additionally, the Hand Tester Strength Exercise was changed to obtain accurate readings so that each patient's improvement in hand grip strength could be determined. Through aid, users can engage in perceptual motor training. Users usually are unaware of their progress after each exercise. The data presentation technique will assist the doctor or physiotherapist in planning the patient's future workout routine. When a tool can provide a measurement, it is possible to predict hand strength by using a pressure sensor (LM280 with an Arduino controller) to detect the hand pressure. Therefore, this project's implementation can improve hand strength performance. The forearm, wrist, or hand musculoskeletal disorders (MSDs) are the focus of this project's research on rehabilitation health care providers for patients with distal upper extremity musculoskeletal diseases. measurements of bodily elements like pain, grip, pinching, and motion that affect function. It follows that it is obvious that putting this idea into practise can enhance hand strength performance.

ABSTRAK

Tujuan utama pembangunan Sistem Pemantauan Penguji Tangan untuk pesakit pemulihan dengan menggunakan Arduino adalah untuk memantau kekuatan tangan pesakit selepas proses terapi. Selain itu, Latihan Kekuatan Penguji Tangan telah ditukar untuk mendapatkan bacaan yang tepat supaya setiap peningkatan kekuatan genggaman tangan pesakit dapat ditentukan. Melalui bantuan, pengguna boleh melibatkan diri dalam latihan motor persepsi. Pengguna biasanya tidak mengetahui kemajuan mereka selepas setiap latihan. Teknik persembahan data akan membantu doktor atau ahli fisioterapi dalam merancang rutin senaman masa depan pesakit. Apabila alat boleh memberikan ukuran, adalah mungkin untuk meramal kekuatan tangan dengan menggunakan sensor tekanan (LM280 dengan pengawal Arduino) untuk mengesan tekanan tangan. Oleh itu, pelaksanaan projek ini dapat meningkatkan prestasi kekuatan tangan. Gangguan muskuloskeletal lengan bawah, pergelangan tangan atau tangan (MSD) adalah fokus penyelidikan projek ini mengenai penyedia penjagaan kesihatan pemulihan untuk pesakit dengan penyakit muskuloskeletal bahagian atas distal. pengukuran elemen badan seperti sakit, cengkaman, cubitan, dan gerakan yang menjejaskan fungsi. Ia berikutan bahawa ia adalah jelas bahawa meletakkan idea ini dalam amalan boleh meningkatkan prestasi kekuatan tangan.

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LIST OF ABBREVIATIONS

v	-	Voltage
Vdd	-	Positive Supply Voltage
Vss	-	Negative Supply Voltage
Vo	-	Output Voltage
Rs	-	Register Select Signal
R/W	-	Read/Write select Signal
E	-	Enable signal
OLED	-	Organic Light -Emitting Diodes
PMOLED	-	Passive- Matrix Light -Emitting Diodes
AMOLED	-	Active- Matrix Light -Emitting Diodes
LCD	-	Liquid Crystal Display
CTS	-	Carpal Tunnel Syndrome
HAVS	-	Hand-Arm Vibration Syndrome
Pa	-	Pascal
FSR	-	Force Sensing Resistor

CHAPTER 1

INTRODUCTION

1.1 Background

A series of diseases or injuries, especially muscles and tendons can cause a decrease in the functions carried out by the hand. These complications can be caused by congenital conditions, excessive injuries caused by certain movements or trauma. Consequently, this project is a tool that can measure the strength of a hand patient by looking at the process of their hand strength after experiencing various hand rehabilitation therapies.

1.2 Background study

Damaged, irritated, or compressed nerves result in numbness. As in the case of a slipped disc in the back or carpal tunnel syndrome in the wrist, one nerve branch or a number of nerves may be impacted. The longer, more sensitive nerve fibres (such those leading to the feet) can become damaged by certain disorders like diabetes or poisons like alcohol or chemotherapy medications, which results in numbness. Nerves outside the brain and spinal cord are frequently affected by numbness, which typically results in a lack of sensation in the arms, legs, hands, and feet. Life-threatening conditions like strokes or tumours are rarely the cause of numbness on its own or numbness together with pain or other unpleasant sensations[1].

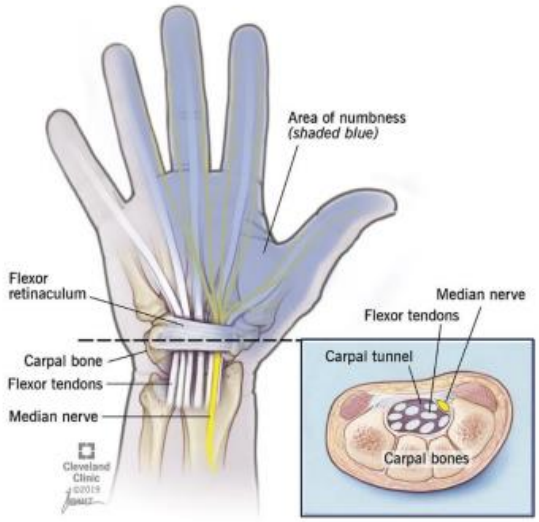


Figure 1-1: Area of sensation of numbness in the hands

A median nerve damage at the wrist leads to carpal tunnel syndrome, a common and occasionally fatal mononeuropathy. Carpal Tunnel Syndrome is generally more common in women and persons over 45. Inheritance, repeated hand use, frequent wrist flexion (such as while chatting on the phone), frequent wrist flexion (such as when driving), pregnancy, diabetes, rheumatoid arthritis, wrist fractures, and thyroid issues are additional risk factors for Carpal Tunnel Syndrome[2].

To assess how well the human median nerve is functioning and to identify whether there is too much strain on the nerve, electrophysiological tests are required. The examination will also assist the doctor in assessing the patient's carpal tunnel syndrome's severity. Secondly, consider whether the nerve is squeezed elsewhere. Third, find out if any other nerves are impacted. In addition, whether the patient has a medical ailment that affects their nerves, like neuropathy. Nerve conduction studies (NCS) are one type of electrophysiological examination that is possible[3]. These tests monitor the signals moving through the patient's hand and arm's nerves, which can identify when a nerve is not successfully transmitting its signal. The severity of the patient's condition can be assessed by the doctor using nerve conduction investigations, which can also aid direct treatment.The electrical activity of muscles is then measured using an electromyogram (EMG). If the patient has any nerve or muscle injury, the EMG readings can demonstrate this[4].

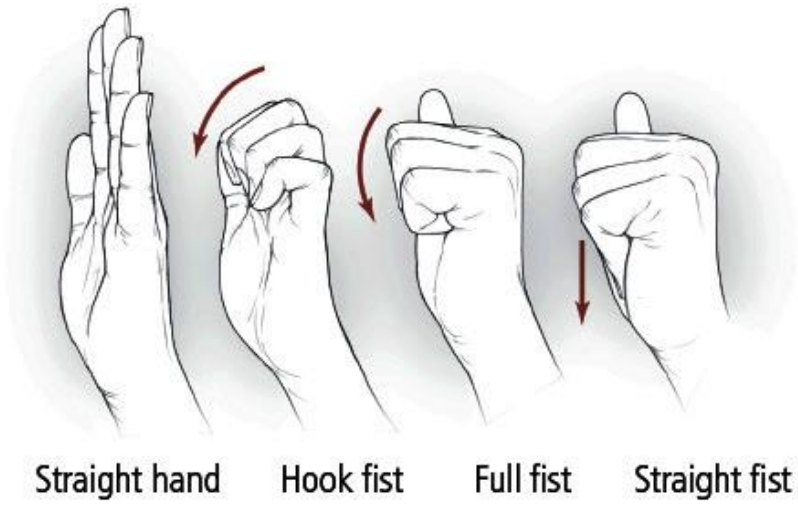


Figure 1-2: Exercise to improve hand mobility

Therapists usually recommend special exercises depending on their condition. In specific, it helps to increase joint movement or to extend muscles and tendons by stretching. These exercises are useful for osteoarthritis as well as for lateral humeral epicondylitis and golfer's elbow but are not unnamed or painful for joints. Other movements reinforce the muscles around the joint to create more force or improve stamina. This is useful for tendon inflammation (tendinitis) and non-painful arthritis symptoms.

Figure 1-3: Hand ball

Patients may participate in a home workout programme for this hand and finger treatment during which they are told to do a ball. The nine muscles which close the hand as well as the nine muscles that open and spread the hand may both be strengthened by using this ball as a hand exercise therapy tool. The hand, wrist, and elbow receive more strength, balance, and blood flow as a result of this therapy.

Figure 1-4: Hand gripper

Hand grip offers the tension needed to exercise strength training. But any exercise doesn't record the pressure as it shuts and releases the hold. Proper form and hence an acceptable number of repetitions are necessary for successful strength training. The gradual, gentle range of closeness and release of the cycle will improve the numbness of the patient[1].

1.3 Problem Statement

To encourage accurate reading and capture the progress hand grip strength for each patient, the hand tester strength exercise was modified. This ideal aid tool provides excellent therapy for perceptual motor training activity. Users sometimes do not know their improvement every exercise they are doing. The data presentation technique will help the doctor or physiotherapy to try and do the following exercise routine for their patient.

1.4 Project Objective

In this study, there are a few objectives that will be achieved:

I. To design a Low-Cost hand tester monitoring system for rehabilitation patients.
II. To observe and analyse the performance of the system efficiency.
III. To develop an automatic hand grip strength reading with database system.

1.5 Scope of Project

Designing a prototype of the hand tester monitoring system is the goal of this project. Only numbness patients are the focus of this experiment, who will have their hand pressure exercises monitored for strength. This project makes use of an Arduino-Uno microcontroller board connected to an LCD display, and FSR force sensor. The project's disadvantage is that it mainly focuses on the numb hand because this is frequently a critical moment for numbness patients who need more care. Next, this project only focuses on force reading, which will be shown on an LCD display to determine how much hand grip strength has improved[2].

1.6 Thesis statement and outline

This thesis's outline provides a comprehensive overview of the Hand Tester Strength Monitoring System for Rehabilitation Patients by using Arduino project. The first project report is divided into two chapters. The introduction of the project, which includes its scope, issue description, objectives, and project briefing, is made clear in Chapter 1.

The theoretical research and literature review linked to the project are described in the following chapter, chapter 2. The main background study/theory for this project is based on patient studies and projects in the numbness patient circle.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

As was previously said, measuring hand grip strength can help predict outcomes and enhance the quality of life for elderly. There are several ways to assess grip strength. This chapter is frequently important for identifying the gap in the literature that the research can address. This chapter was written using the preceding study, article, thesis, journal, or other type of published information that falls under the project's scope and title[3].

As a result, the researcher will benefit from this chapter in that they will learn more, have more ideas, and be able to start with the intended project outcome.

2.2 Numbness Hand

Diseases that affect the nerves in the blood vessels that go to the hand might cause numbness in the hand. Tingling is the same as having numb fingers or hands. Paresthesia of the wrist is the name for these symptoms. Nerve damage known as peripheral neuropathy frequently causes numbness or tingling. Peripheral neuropathy has many causes, but one of the main ones is chronic or uncontrolled diabetes. Another explanation for peripheral neuropathy is alcoholism. The symptoms of a number of disorders, such as vascular disease, Raynaud's disease, multiple sclerosis, stroke, and multiple sclerosis, can manifest as numbness, burning, pain, or tingling in the fingers and hands.

Carpal tunnel syndrome is brought on by the compression of the median nerve during passage through the carpal tunnel. The carpal tunnel is made up of the ligament that crosses the top of the wrist and the carpal bones that are located at the base of the wrist. The median nerve sends sensory and motor information to the thumb and three middle fingers. Inflammation or compression could cause symptoms to appear. Although the cause of carpal tunnel syndrome is unknown in the majority of instances, any or all of

the following factors may contribute, including repetitive, small, and regular hand movements (such those produced when typing or using a keyboard). Secondly, hormonal or metabolic changes (such menopause, pregnancy, or a thyroid disorder). Thirdly, type 2 diabetes can cause changes in blood sugar levels. Last but not least, additional wrist illnesses or injuries such as a family history of carpal tunnel syndrome, dislocation, break, strain, or sprain.

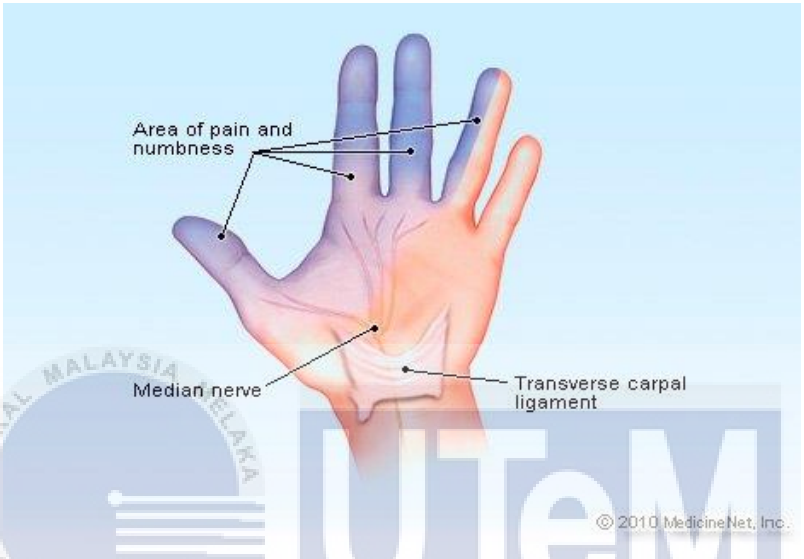


Figure 2-1: Carpal Tunnel Syndrome

2.3 Causes Numbness of Hand

One or more of the nerves in your arm or wrist may be damaged, irritated, or compressed, resulting in hand numbness. Numbness can also be an indicator of peripheral nerve diseases like diabetes, though with this condition, comparable symptoms typically start in the feet first. Rarely, issues with your brain or spinal cord can produce numbness, albeit in these circumstances arm or hand weakness or loss of function also happens. It is uncommon for numbness to be the only symptom of potentially fatal conditions like tumors or strokes[4].

Numbness in the hands can result from a variety of factors. Among these, several sleeping positions may impose stress on the nerves in the hands and arms. If the hands are tucked beneath the head while sleeping on one's stomach, hand numbness may result. People who sleep on their sides may bend their arms or wrists, which reduces the amount

of blood that gets to their hands. Those who sleep on their backs risk having numb hands when they wake up if they put their head on their arm[5].

Figure 2-2 : The wrong sleep postures

Inflammation of the median nerve results in carpal tunnel syndrome. The carpal tunnel is a tiny aperture on the palm side of the hand that is ringed by bones and ligaments. A compressed median nerve causes weakness, numbness, and tingling in the hand and arm. Repetitive hand movements, medical conditions, and the shape of the wrist can all contribute to carpal tunnel syndrome. The tingling and numbness are often gone with the proper care, and wrist and hand function are restored.

The conditions that comprise diabetes mellitus affect how the body utilises glucose or blood sugar. Glucose is a major energy source for the cells that make up the muscles and tissues. The brain uses it as its main source of energy. Primary symptoms of various forms of diabetes vary. Diabetes, irrespective of form, can lead to excessive blood sugar levels. A high blood sugar level may cause serious health problems. Diabetes type 1 and type 2 are both chronic conditions. Prediabetes and gestational diabetes are among the diabetes issues that may be resolved. Prediabetes develops when blood sugar levels are greater than normal. However, the blood sugar levels are not elevated enough to be classified as diabetes.

2.3.1 Testing and Treatment For Carpal Tunnel Syndrome(CTS)

Self-testing, however, is not a foolproof method. Your next step should be to follow up with a doctor for more conclusive tests, like below[6]:

i. **History of symptoms.** Your healthcare provider will look at the symptom pattern. For instance, issues with the little finger may indicate something different than carpal tunnel syndrome as the median nerve does not supply sensation to that digit. Carpal tunnel syndrome symptoms typically arise when using a phone, holding a newspaper, or tightly gripping the steering wheel. Additionally, they frequently occur at night, and you might wake up groggy from them.

ii. **Physical examination.** A physical examination will be performed by your doctor. They will bend the wrist to assess the strength of the muscles. They may also tap on the nerve or simply press on it to cause symptoms in many people.

iii. **Ultrasound.** Ultrasound. Your doctor might suggest an ultrasound to get a clear picture of the bones and nerves in your wrist. You can determine if the nerve is being compressed by doing this.

iv. **Electromyography.** The little electrical discharges that muscles produce is measured by this test. During this test, your doctor will implant a thin-needle electrode into a few chosen muscles to monitor the electrical activity that happens when muscles contract and relax. This examination may rule out other conditions while detecting damage to the muscles controlled by the median nerve.

v. **Nerve conduction study.** In an electromyography variant, two electrodes are attached to the skin. A short shock is given to the median nerve to test whether electrical impulses in the carpal tunnel are delayed. This test may be performed to pinpoint the condition and rule out any others.

2.3.2 Carpal Tunnel Syndrome treated under a doctor ‘s (National Institute of Neurological Disorders and Stroke)

Under a doctor's guidance, carpal tunnel syndrome treatments should start as soon as possible. The treatment of underlying conditions like diabetes or arthritis should come first[7].

a) Non- Surgical procedures

I. *Splinting*. Initial treatment usually involves using a fragment at night.

II. *Avoiding activities during the day which will cause symptoms*. Many breaks from work may be used by some people who experience some discomfort so they can rest their hands. The application of cold packs can be beneficial if the wrist is red, heated, and swollen.

III. *Over-the-counter drugs*. Various drugs have the potential to lessen carpal tunnel syndrome-related discomfort and swelling in specific situations. Aspirin, ibuprofen, and other non-prescription medicines are examples of anti-inflammatory drugs (NSAIDs), but they haven't been demonstrated to be effective in treating CTS.

b) Surgery

I. *Open surgery*, the carpal ligament is cut after a wrist incision of up to 2 inches to enlarge the carpal tunnel, according to a classic method of treating carpal tunnel syndrome. Except in the case of unique medical problems, this treatment is often carried out as an outpatient procedure while being under local anesthesia.

II. *Endoscopic surgery* can minimize postoperative pain and allow for a quicker functional recovery than open surgery, but it may also carry a higher risk of complications and call for additional surgery. The surgeon makes one or two small cuts (about a half-inch each) on the wrist and forearm, inserts a camera on a tube, views the nerves, ligaments, and tendons on a monitor, and then uses a small knife inserted through the tube to cut the carpal ligament, the tissue holding the joint together. Following surgery, the ligaments typically heal and create greater room than previously. Even while some symptoms may go away right away following surgery, complete healing from carpal tunnel surgery can take

months. Infections, nerve damage, stiffness, and scar pain can all occur in some people. Grip strength usually decreases but eventually gets better. After surgery, most people will need to adjust their work routines for a few weeks, and other people may need to arrange work or even change careers.

2.4 Risks of Carpal Tunnel Syndrome

Carpal tunnel syndrome is three times more common in women compared to men. Among those at high risk are people with diabetes and other metabolic conditions that directly affect the body's nerves and lower their resilience to pressure. Adults are the only ones that commonly receive CTS. Anxiety or damage to the median nerve might result from work-related concerns. While CTS is a danger for persons in all industries and occupations, those who engage in repetitive finger-using activities or employment are more likely to develop the condition. High force (hammering), prolonged use, severe wrist motions, and vibration can put persons at risk of developing carpal tunnel syndrome.Apart from that, there are many factors that can also contribute to the development of carpal tunnel syndrome such as pregnancy, alcoholism, older age, diabetes etc[8].

2.5 Analysis of previous research

In research or invention by Dr. Jerome Grossman[9], they design 'Six Week Therapy Pac' which will help reduce the symptoms of carpal tunnels. Apart from that, Maria Cole's exercise in improving mobility technique such as picking, gripping, spinning, and pressing is a basic precision that can diagnose patient responsiveness. In addition, the semi-vertical mouse innovation designed by Gold touch demonstrates all the advantages of an ergonomic device[10]. The ergonomic nature decreases chance arm syndrome, avoids carpal tunnels, is more relaxed for arthritis sufferers and eliminates exhaustion when operating pain-free.Finally, data transfer requires an interface. Thus, one method of transmitting device data to another is described in Tony Siciliani's Bluetooth Data Transfer for Android.

2.6 Comparing previous research

In table 2-1 shows the comparison of previous research on numbness treatment for physiotherapy by using gripping method. The comparison includes the advantages, disadvantages, and methods.

Table 2-1: Comparing previous research

AUTHOR/ INVENTOR [REFERENCE NO.]	TITLE/ APPROACH	METHODS	ADVANTAGES	DISADVANTAGES
Dr. Jerome Grossman[9]	Six Week Therapy Pac	Carpal Solution Nighttime Stretching Treatment 	1. Reliable products that work at home. 2. No need for surgery. 3. Reduction in symptoms happens more quickly.	1. Cannot display result. 2. Not suitable for kids.
Maria Cole[11]	Give grip strength a hand.	Grip mobility Technique	1. Simple technique exercise. 2. Can detect mobility of hand 3. Suitable for all ages.	1. Cannot display result.

Gold touch[12]	7 Benefits of an ergonomic mouse	Designed semi-Vertical mouse	1. Reduces risk of mouse arm syndrome. 2. Prevent Carpal Tunnel. More comfortable for arthritis sufferers.	1. Costly.
Tony Siciliani[10]	Bluetooth Data Transfer with Android	Android Developer's Bluetooth	1. The user's ability to move from one application to another. 2. Quickly provided data. 3. Internet connection not necessary.	1. Limit distance

CHAPTER 3

METHODOLOGY

3.1 Introduction

The implementation of procedures and methods in this project will be covered in this chapter. The project must be finished according to the methodology, which serves as a guideline. This chapter will serve as the basis for an explanation of every step of the project's duration. This chapter will provide a thorough explanation of each procedure step to help people in understanding. To guarantee the project is completed properly, methodology should be strictly adhered to. Additionally, the project timetable and routine would be covered in this chapter. The actions that need to be completed along with the times allocated for each activity are listed in the project schedule and routine. This is necessary to guarantee that the project can be completed on time.

3.2 Project Methodology

This chapter's chapter will go into more detail regarding the methodology used to develop a Development Hand Tester Monitoring System for Rehabilitation by using Arduino[13]. The project methodology's purpose is to give the developer a practical approach and step-by-step procedure to ensure that the project can be completed quickly and reliably. The full project phase technique is presented using a flowchart format. The project's framework is thought to be a suitable medium for producing project plans because it is easy for developers to understand. To show how well-organized this project is, the procedure has been split into several many steps. The development of the hand tester monitoring system using Arduino is shown in Figure 3-1.

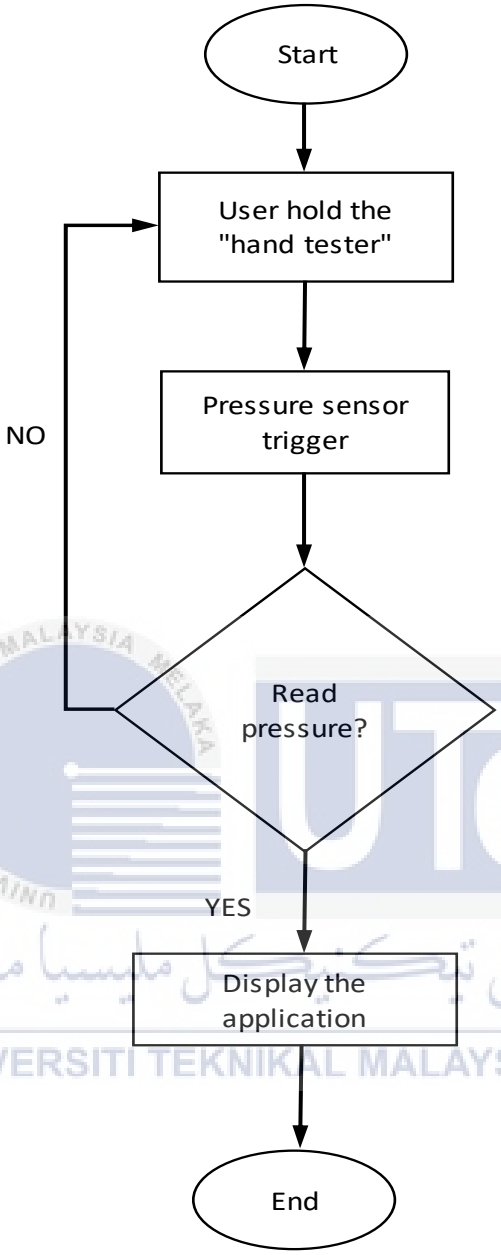


Figure 3-1: Flowchart project

I. Electronic Design.

Electronic design illustrates how the project simulation circuit was put into practice as well as the component types that were chosen and used in the project[14]. Tinker Cad software is used to build and simulate the project circuit for simulation circuit design. The FSR force sensor is the element that functions as an input sensing element in this project. for the temperature system.

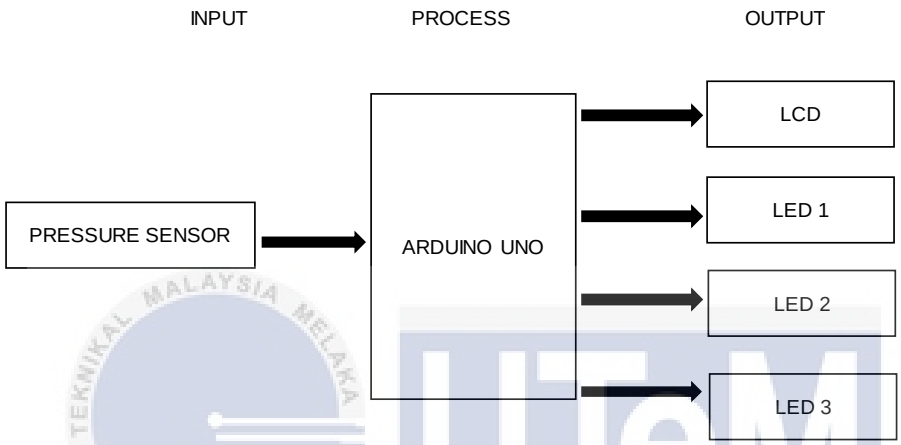


Figure 3-2:Block diagram for the system

One of the microcontrollers with a higher rate of popularity among programmers is Arduino UNO. It includes simple features for program creation and is an open-source processing platform. Simple computer interfaces are also available for the Arduino UNO.

The Arduino UNO is a better choice for this project than other microcontroller units like the Raspberry PI and Cytron SK40C microcontroller module because it is more affordable and has enough input/output (I/O) pins to meet the project's system requirements. Other than that, Arduino uses the C programming language and appears to be simpler to use than Raspberry PI modules, which use Python.

II. Software Design

Software design is the process of using software to simulate and implement a project's design, which includes the circuit and system code. This phase is important and should be treated seriously since it will be the criteria for connecting the system code with the simulation circuit and will be used to gate the simulation results of numerous project components. The project system's program code is written and built using the Arduino IDE software. The IDE software provides a built-in component library that may be simply added to, removed from, or reprogrammed by the programmer to achieve the desired output state. When the program code has an error, debugging or program code troubleshooting is required. The IDE software can also be used to implant the program code onto the microcontroller unit operation.

3.3 Component List

3.3.1 Arduino UNO R3 Microcontroller

One of the durable microcontroller boards that is frequently used for robotics and other electronic applications is the Arduino board. Since there is a sizable community of programmers who have shared their best work through internet forums, it is an open-source platform for creating new electronic works of art. This is actually very beneficial for a new developer who is just getting started in the electronics field. The board itself is easily able to communicate with a wide range of electronic equipment, including sensors, GPS units, Bluetooth modules, motors, cameras, and even smart phones. The Arduino UNO microcontroller used in this project is depicted in Figure 3-3[15].

Figure 3-3: Arduino UNO R3 Microcontroller unit

The In-Circuit Serial Programming (ICSP) header, power jack, Universal Serial Bus (USB) connector, 14 digital Input/Output (IO) pins, and 6 analogue IO pins are all included in the Arduino UNO R3 microcontroller board. Everything needed to support the microcontroller's operation is on the board itself. The Atmega8U2 on the Arduino UNO board, in contrast to earlier boards, uses a USB-to-serial driver chip from Future Technology Device International (FTDI). In comparison to other microcontrollers, this causes the board to get smaller. The features of the Arduino UNO R3 are displayed in Table 3-1.

Table 3-1: Features of Arduino UNO R3 microcontroller board

No.	Features	Description
1	Microcontroller	ATmega328
2	Operating Voltage	5v
3	Input Voltage(recommended)	7-12v
4	Digital IO pins	14 (6pins provided with PWM)
5	Analog IO pins	6 pins
6	DC current per IO pins	40mA
7	Flash Memory	32kB
8	clock	16MHz
9	EEPROM	1kB(ATmega328)

3.3.2 Potentionmeter

The rotary type potentiometers are used mainly for obtaining adjustable supply voltage to a part of electronic circuits and electrical circuits. The volume controller of a radio transistor is a popular example of a rotary potentiometer where the rotary knob of the potentiometer controls the supply to the amplifier. This type of potentiometer has two terminal contacts between which a uniform resistance is placed in a semi-circular pattern. The device also has a middle terminal which is connected to the resistance through a sliding contact attached with a rotary knob. By rotating the knob one can move the sliding contact on the semi-circular resistance. The voltage is taken between a resistance end contact and the sliding contact. The potentiometer is also named as the POT in short. POT is also used in substation battery chargers to adjust the charging voltage of a battery. There are many more uses of rotary type potentiometer where smooth voltage control is required.

Figure 3-4: Potentionmeter

3.3.3 Liquid Crystal Display (LCD)

The LCD is one of the display devices that is usually utilized with the microcontroller. A wide range of messages, including alphabets, punctuation, geek letters, and user-generated symbols, are displayed using it. In comparison to other display technologies like Organic Light-Emitting Diodes (OLED), Passive-Matrix Organic Light-Emitting Diodes (PMOLED), and Active-Matrix Organic Light-Emitting Diodes (AMOLED), LCD lags behind AMOLED and PMOLED in terms of technological development, but it is still appropriate for use because of its low cost and energy-efficient features. Figure 3-6 displays a 16x2 LCD display module.

Figure 3-5: 16x2 LCD Display

The LCD interface can be used in three different ways, including the I2C transfer protocol, an 8-bit data transfer mode, and a 4-bit data transfer mode. It only needs 4 data lines to send 4-bit data, which reduces the number of Arduino IO pins required. Figure 3.20 below illustrates the 4-bit data transfer connection between the Arduino and LCD, and Table 3.5 details the transmission requirements for 4-bit LCD data transfer.

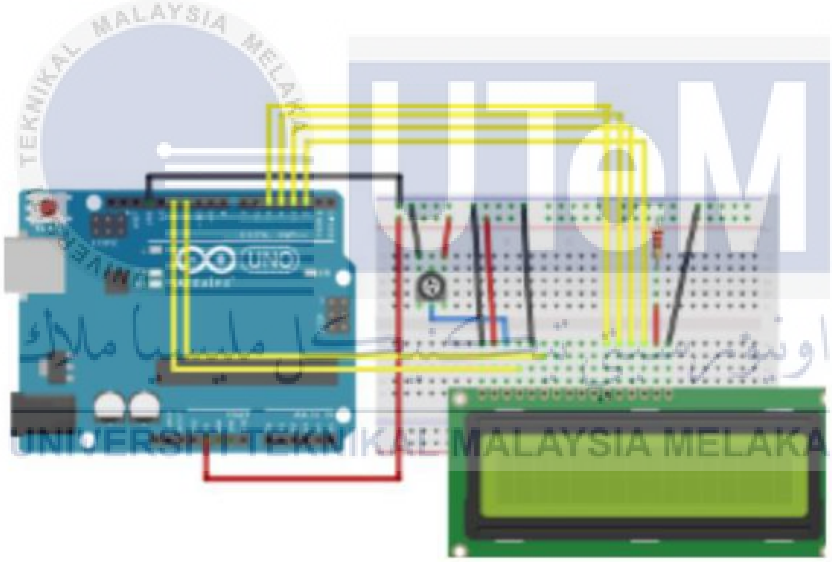


Figure 3-6: 4-Bits LCD data Transfer Wiring Connection.

Table 3-2: 4-Bits LCD Data Transmission Specification.

Pin no.	Symbol	External connection	Function
1	Vss	Power Supply	Signal Ground
2	Vdd		Power supply
3	Vo		Contrast control
4	Rs	MPU	Register select signal
5	R/W		Read/Write select signal
6	E		Enable signal
7-14	DB0-DB7		4-bits/8-bits bidirectional data line
15	LED+	LED backlight power supply	Vcc(5Vdc)
16	LED-		GND(0V)

3.3.4 FSR force sensor

Fundamentally, FSRs are resistors that, in response to applied pressure, alter their resistive value (measured in ohms Ω). Although these sensors are inexpensive and simple to use, accuracy is not always guaranteed. They also differ slightly, maybe by 10%, amongst sensors. In other words, users should only anticipate receiving ranges of responses while using FSRs. FSRs are not a good option for precisely determining how many pounds are on them, even if they are capable of detecting weight [17].

Figure 3-7: FSR force sensor

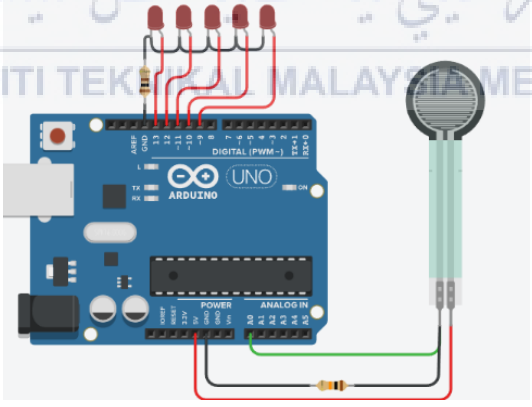


Figure 3-8: The basic connecting FSR Sensor with Arduino

A basic connection between an Arduino Uno and an FSR sensor is shown in Figure 3-8. An open-source electronics platform is called Arduino. An Arduino Uno Microcontroller is what it is made of. It can receive inputs from several sensors and allows the user to

communicate commands to the Arduino microcontroller. It offers the Arduino IDE for writing code and connecting hardware, such as sensors and Arduino boards.

3.4 Estimation Reading If the Hand Tester is in 2 Kg

The table below shows a general indication voltage if the user can get from an FSR at different levels of applied force [16].

Force (lb)	Force (N)	FSR Resistance	Voltage across R
None	None	Infinite	0V
0.04lb	0.2N	30KΩ	1.3V
0.22lb	1N	6KΩ	3.1V
2.2lb	10N	1KΩ	4.5V
22lb	100N	250Ω	4.9V

Figure 3-9: The table 3-9 provides a general indication of the analog voltage

3.5 Project Estimation Cost

The planning for the Hand tester Monitoring System for Rehabilitation Patient by using Arduino project will be covered in this chapter's subsection. It is essential to make sure that the task can be finished in the allotted time. In addition, project planning offers the approaches and processes needed to finish the project. The Gantt chart approach is used in this project to plan out the task and estimate time to ensure that it can be finished on schedule and properly. For this Hand Grip Strength Monitoring System for Physiotherapy Application Via Arduino project, the estimated cost is shown in Table 3-3

Table 3-3: Project Estimation Cost

No.	Materials or component	Price (RM)
1	Arduino UNO R3	32.00
2	Potentionmeter	1.00
3	FSR sensor	8.00
4	Proskit solder ZD-723N	35.00
5	LCD 16X2	20.00
6	Soldering lead	3.00
7	Female jumper	6.00
GRAND TOTAL (RM)		**105.00**

3.6 Summary

This chapter focuses on project methodology and goes into great detail about it. The most crucial part of handling a project is the chapter on project methodology, which makes sure that the task can be carried out methodically while being directed by the appropriate project methodologies. The project structure plan, project system operation, project determination, and full project integration are the four stages of the technique that serve as a roadmap for the developer.

Based on previous research and a literature review, the appropriate criteria that need to be controlled are decided while creating the project structure plan. Later, the system

development project was established. Researching and identifying every component and controlled aspect relevant to the project is essential at this point. The stage of project determination occurs when the mechanical, electronic, and software designs have been created. To achieve the project's goals, the entire integration of the project will then be tested and troubleshot regularly.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter, the project's conclusion and further discussion will be covered. It includes all project research that was produced through simulation for the prior project. The criterion for determining whether the project aims are achieved will be the final outcomes of these evaluations and reviews.

4.2 Analysis of project functionality

By specifying the task or section to be completed, function analysis aids in precisely describing and identifying the properties of the technique. It will outline the project's features and results analysis.

4.2.1 LED light and LCD display Functionality

The three LED lights as the indicator to show the level of the strength hand pressure. Apart from that, the LCD is used to show the reading of the user's hand strength while the The pc is used by the patient to monitor the exercises and see the progress of their hands. The triple-colored LED light at the top of the control box serves as a navigation system for the patient to see their progress with each workout. The LCD display, and the arrangement of the LED lights (green, yellow, and red). is shown in Table 4.1 respectively.

Table 4-1: LED light Functionality Description.

No.	LED Light	Function description
1	YELLOW	High achievement
2	YELLOW	Medium achievement
3	YELLOW	Lower achievement

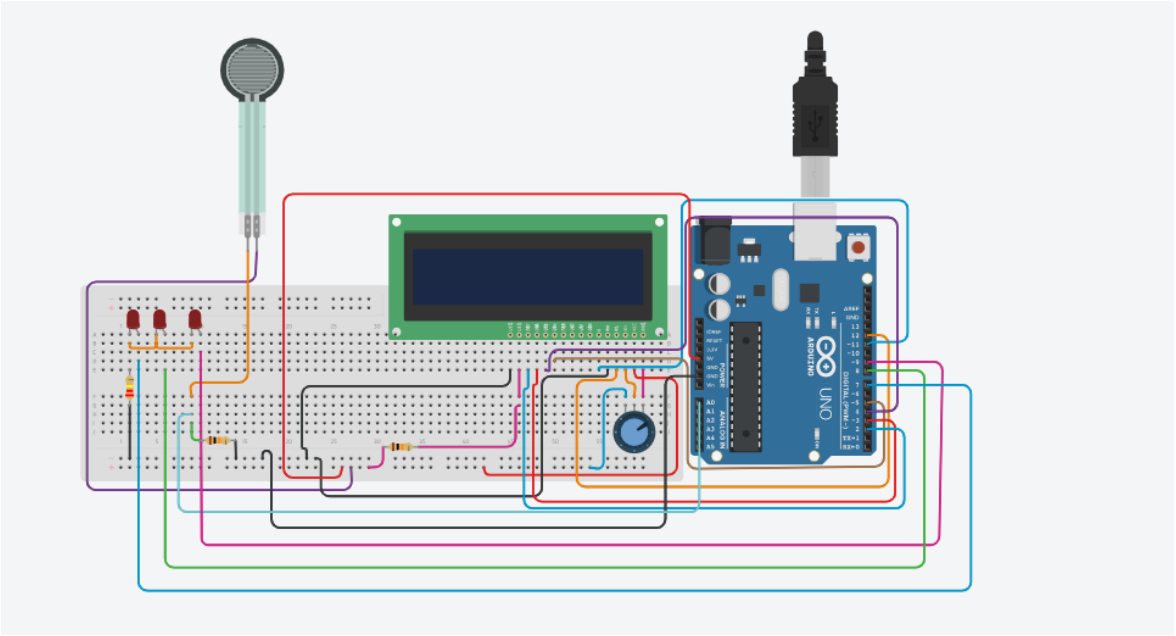


Figure 4-1 : Schematic of project

The only input device for the circuit at first is a hand ball. The main circuit board (Arduino Uno) processes the measurement data, converting the detected input values into force values in kilogrammes. The output screen and the patient's outside indication both show these force values in real-time. Despite the fact that these output devices are quite common, the force indicator of the LED sequence serves a specific purpose. In addition to demonstrating the force used, it also makes an effort to elicit a neurological response from the patient as a result of their active involvement in the healing process. The database where the force values are stored receives the force values at the same moment.

4.2.2 Analysis of Pressure for Hand Numbness Functionality

To monitor the measurement of the pressure value at a certain range based on the strength of the hand grip in the previous chapter, the device was built up using an Arduino spreadsheet and Microsoft Excel. To make sure the system works properly, the functioning of the gadget has been examined before the project prototype goes through the real experiment. Figure 4-2 displays the value of pressure.

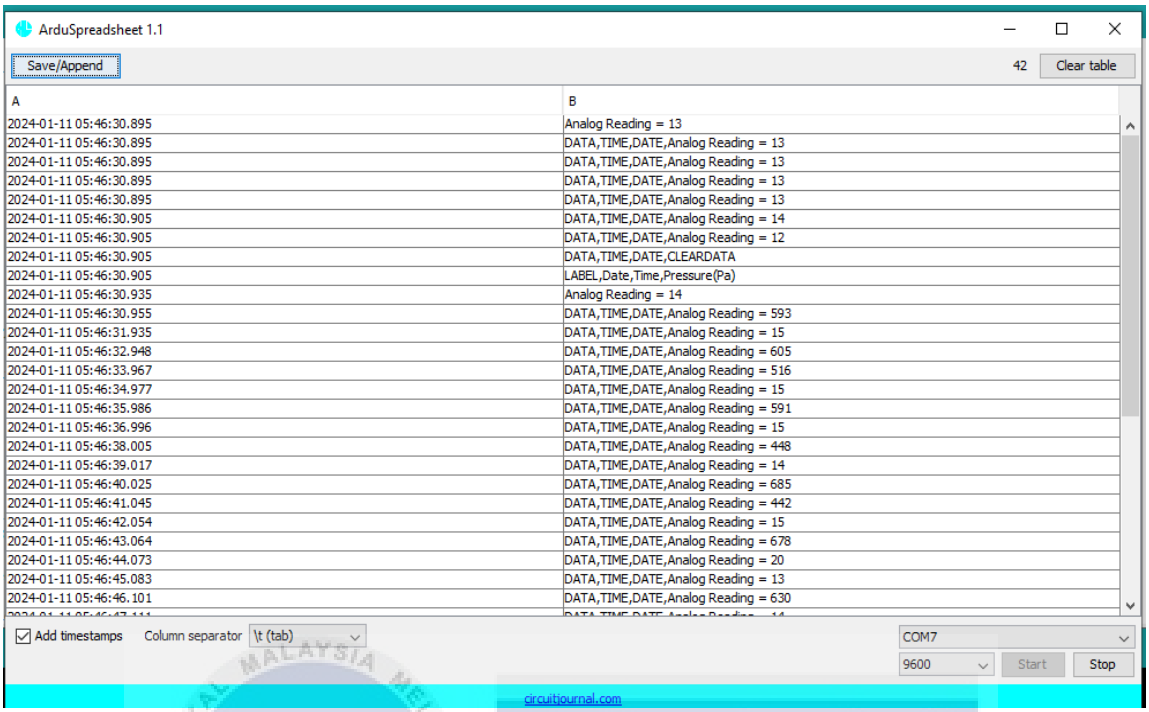
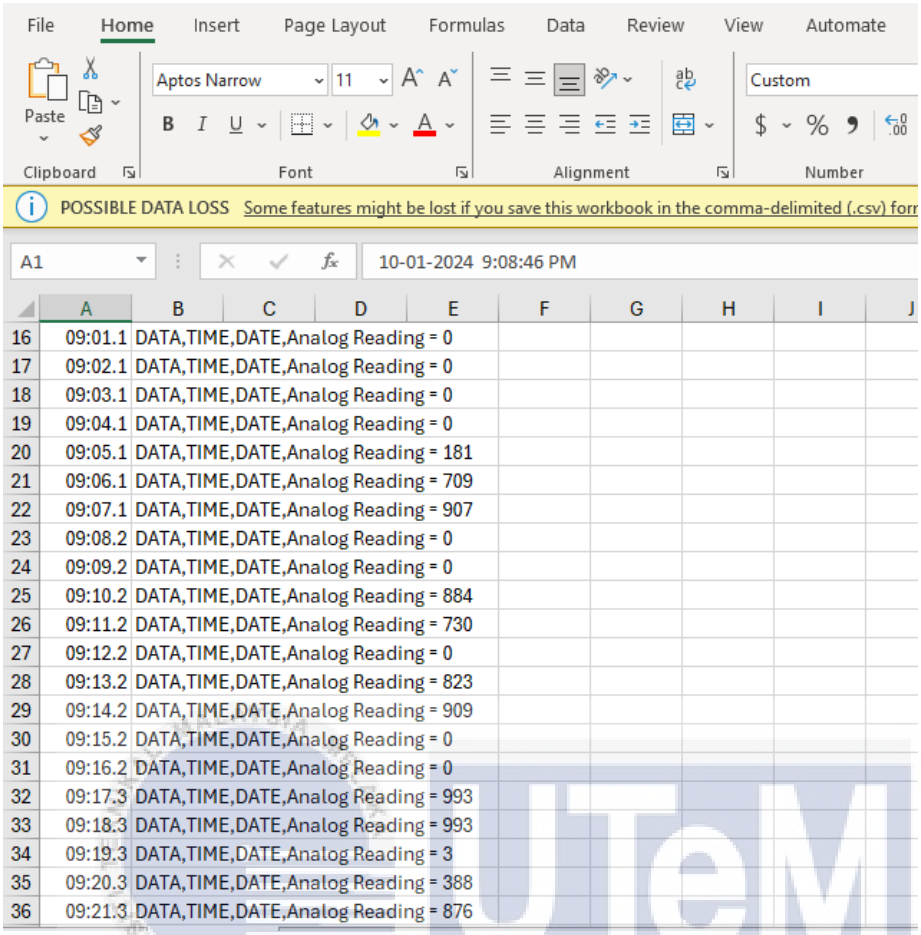


Figure 4-2: The Example of force value in Arduino Spreadsheet

The Arduino spreadsheet is used as output display to display the data. Then, the data will automatically linked into Microsoft Excel. This tool is easier way to save the data without use any data or wifi connection.



	A	B	C	D	E	F	G	H	I	J
16	09:01.1	DATA,TIME,DATE,Analog Reading = 0								
17	09:02.1	DATA,TIME,DATE,Analog Reading = 0								
18	09:03.1	DATA,TIME,DATE,Analog Reading = 0								
19	09:04.1	DATA,TIME,DATE,Analog Reading = 0								
20	09:05.1	DATA,TIME,DATE,Analog Reading = 181								
21	09:06.1	DATA,TIME,DATE,Analog Reading = 709								
22	09:07.1	DATA,TIME,DATE,Analog Reading = 907								
23	09:08.2	DATA,TIME,DATE,Analog Reading = 0								
24	09:09.2	DATA,TIME,DATE,Analog Reading = 0								
25	09:10.2	DATA,TIME,DATE,Analog Reading = 884								
26	09:11.2	DATA,TIME,DATE,Analog Reading = 730								
27	09:12.2	DATA,TIME,DATE,Analog Reading = 0								
28	09:13.2	DATA,TIME,DATE,Analog Reading = 823								
29	09:14.2	DATA,TIME,DATE,Analog Reading = 909								
30	09:15.2	DATA,TIME,DATE,Analog Reading = 0								
31	09:16.2	DATA,TIME,DATE,Analog Reading = 0								
32	09:17.3	DATA,TIME,DATE,Analog Reading = 993								
33	09:18.3	DATA,TIME,DATE,Analog Reading = 993								
34	09:19.3	DATA,TIME,DATE,Analog Reading = 3								
35	09:20.3	DATA,TIME,DATE,Analog Reading = 388								
36	09:21.3	DATA,TIME,DATE,Analog Reading = 876								

Figure 4-3 : Example of force value in Microsoft Excel

Arduino Spreadsheet is a add - on tools in Arduino IDE to send data automatically to Microsoft Excel. It can now send data directly to Excel from any of microcontrollers connected to any sensor and serial port of a PC.

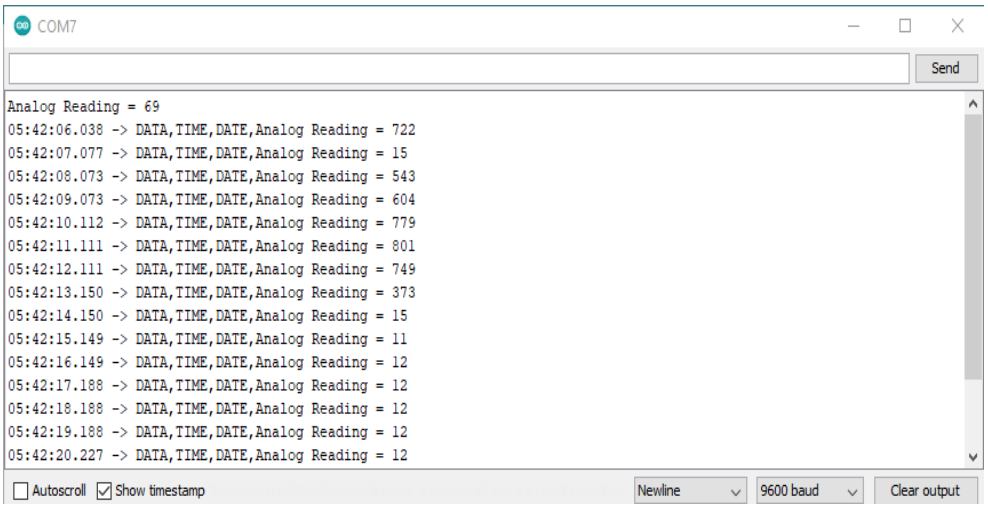


Figure 4-4 : Example of force value in Serial Monitor

Figure 4-5: Example of force value in Serial Plotter

From the Arduino Software, pressure reading can be capture from serial monitor (value reading) and serial plotter (for graph). The figure above shows an example reading from the pressure sensor. However, the Arduino Spreadsheet cannot capture the any value in serial monitor and graph by serial plotter.

4.2.3 Analysis of Numbness Hand Grip Performance under Project Implemation

By putting the project design actual action, variables including time, force value, and generation were measured and recorded, as mentioned in the previous chapter. Throughout the experiment, all pertinent data, including pressure, time required, average squeezing ball, and performance, was collected. Table 4-2 displays the data that was recorded during the experiment.

Table 4-2 : The experiments data for numbness hand grip implementation in 1 minutes.

I. Age	24 years old
II. Criteria	This patient is a young girl who is active in sport.

Table 4-3 : High ability patient doing exercise

Time Taken (60 seconds)	Force (g)	Force (g)	Force (g)
1	0	557	967
2	975	706	0
3	0	787	0
4	0	800	0
5	0	775	0
6	0	757	967
7	0	802	0
8	0	758	643
9	0	0	438
10	0	0	289
11	119	0	570
12	0	468	967
13	572	747	0
14	868	477	0
15	808	0	968

16	100	671	520
17	0	0	969
18	0	781	968
19	0	391	969
20	280	533	969
21	692	739	0
22	739	0	537
23	640	521	0
24	305	756	0
25	378	357	0
26	584	795	327
27	683	573	496
28	734	0	455
29	664	780	0
30	500	722	0
31	123	359	651
32	120	0	0
33	0	0	533
34	0	528	0
35	32	597	0
36	212	0	0
37	291	0	394
38	0	562	0
39	0	585	0
40	0	261	562
41	0	368	0
42	975	0	968
43	977	0	346
44	0	0	968
45	975	0	968
46	0	478	967
47	0	969	0

48	0	323	0
49	0	969	967
50	0	0	0
51	0	0	205
52	0	0	0
53	0	0	223
54	119	0	771
55	0	0	572
56	572	0	309
57	868	0	223
58	808	0	771
59	977	0	0
60	976	0	309
Average	294	354	379

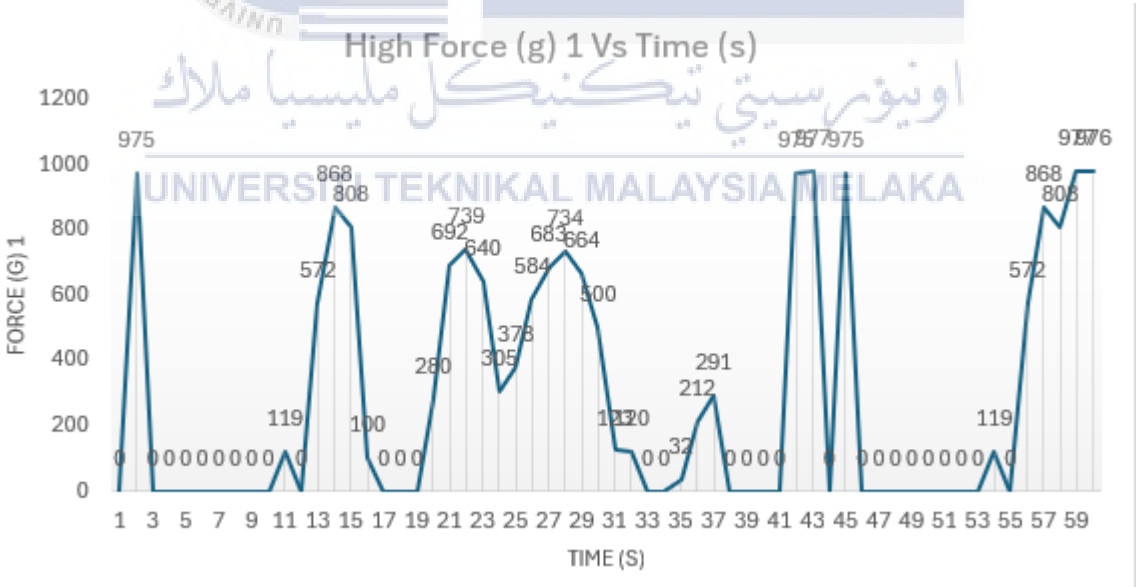


Figure 4-6 : High Force (g) 1 Vs Time (s)

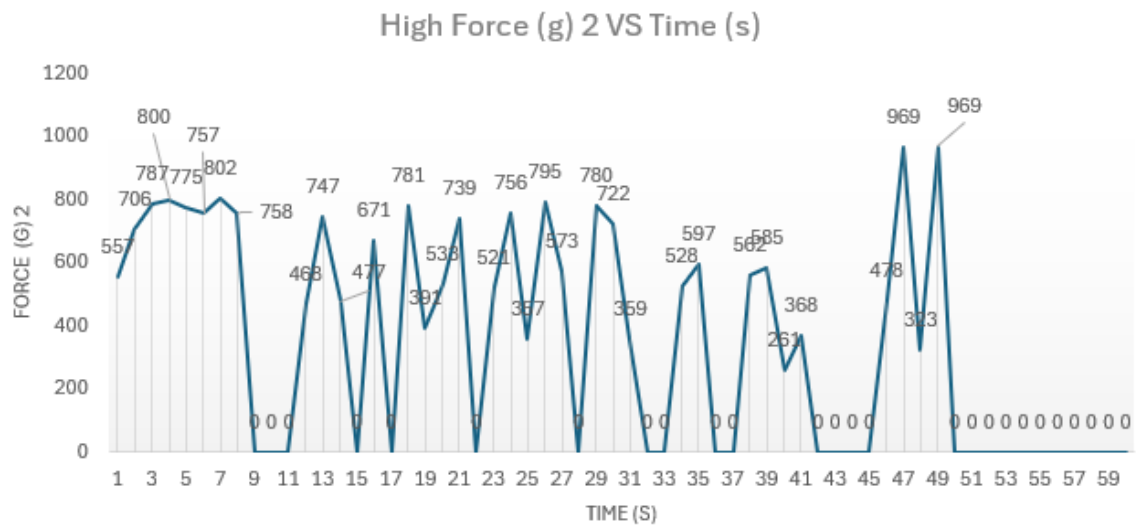


Figure 4-7: High Force (g) 2 Vs Time (s)

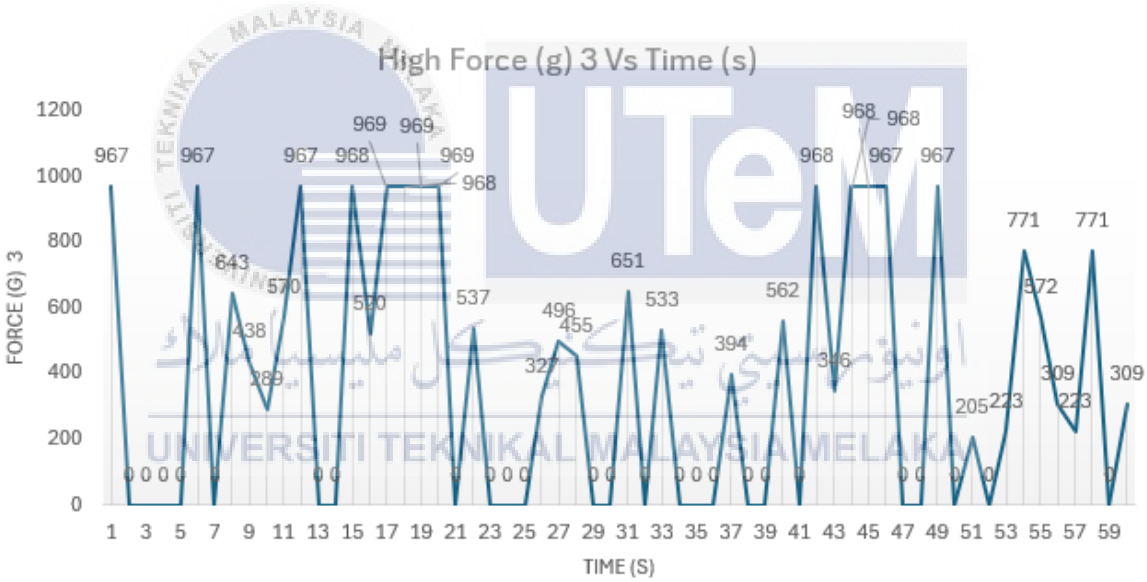


Figure 4-8 : High Force (g) 3 vs Time (s)

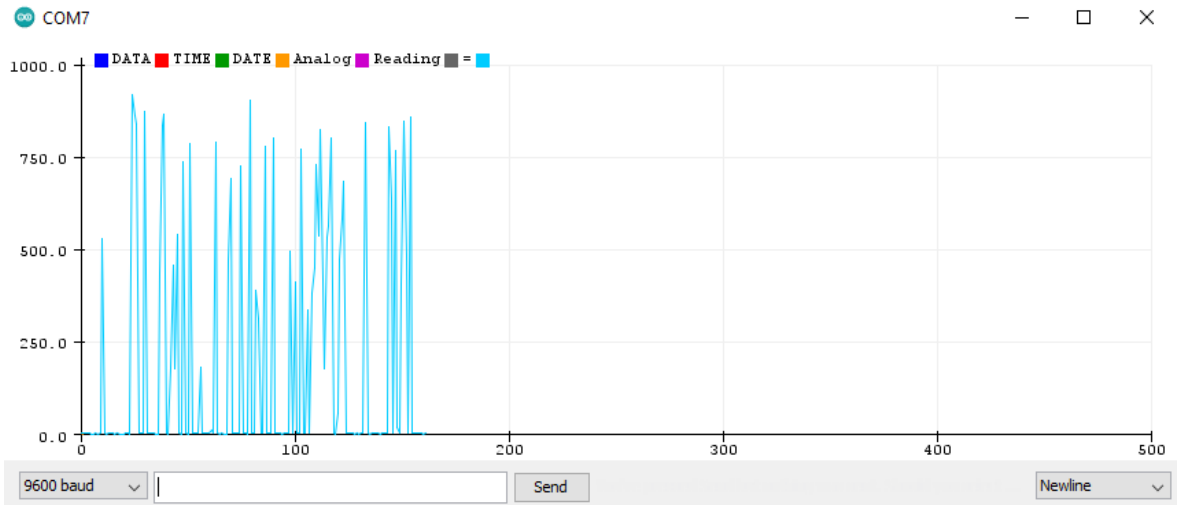


Figure 4-9: High Force (g) vs Time (ms) based on serial plotter

Table 4-4 :The experiments data for numbness hand grip implementation in 1 minutes.

I. Age	26 years old
II. Criteria	This patient is works in an office, doesn't move much and does work in front of a pc

Table 4-5 : Moderate ability patient doing exercise

Time Taken (60 second)	Force 1 (g)	Force 2 (g)	Force 3 (g)
1	0	0	0
2	0	0	0
3	0	563	0
4	0	0	0
5	0	0	0
6	0	622	1
7	0	0	0
8	0	539	0
9	0	0	400
10	0	233	355
11	0	625	437
12	0	0	576
13	0	672	302
14	0	2	510
15	0	1	360
16	0	669	574
17	0	1	1
18	0	1	832
19	0	0	536
20	181	522	487
21	709	256	782
22	907	1	79

23	0	0	814
24	0	436	130
25	884	294	849
26	730	0	119
27	0	577	413
28	823	117	710
29	909	1	136
30	0	0	829
31	0	482	74
32	993	184	211
33	993	0	817
34	3	4	490
35	388	647	635
36	876	2	725
37	165	0	241
38	0	438	841
39	715	265	555
40	621	2	200
41	1	5	0
42	0	613	172
43	894	2	167
44	116	0	781
45	885	507	192
46	879	653	205
47	744	0	790
48	145	3	231
49	60	289	662
50	0	635	792
51	0	0	192
52	130	0	764
53	0	0	156
54	92	0	198

55	0	0	792
56	0	0	324
57	0	0	364
58	0	0	0
59	0	0	128
60	0	0	0
Average	231	181	366

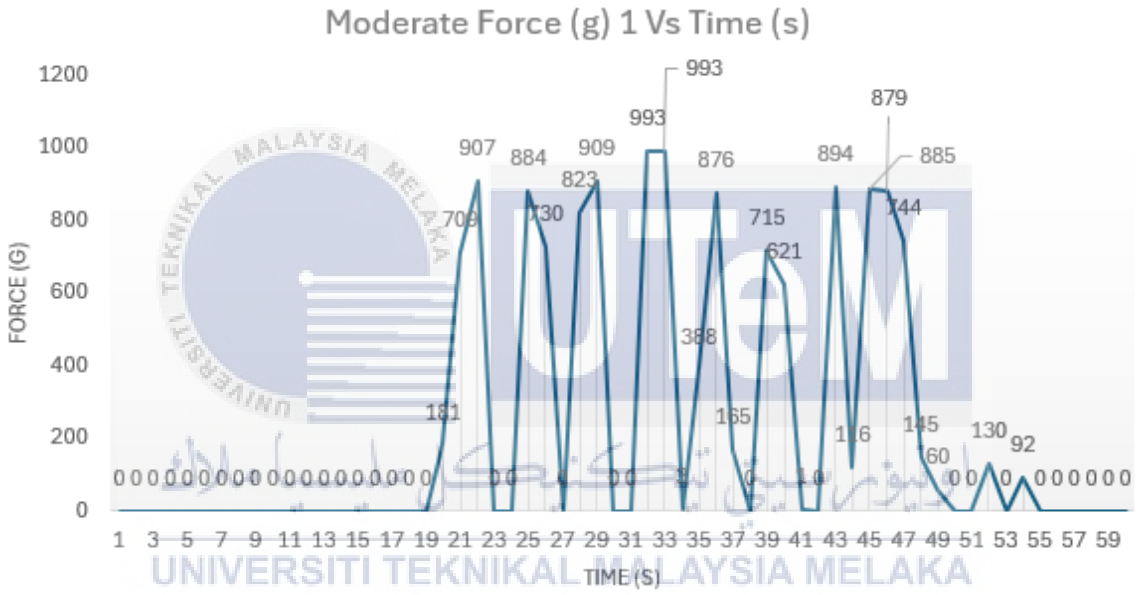


Figure 4-10 : Moderate Force (g) 1 Vs Time (s)

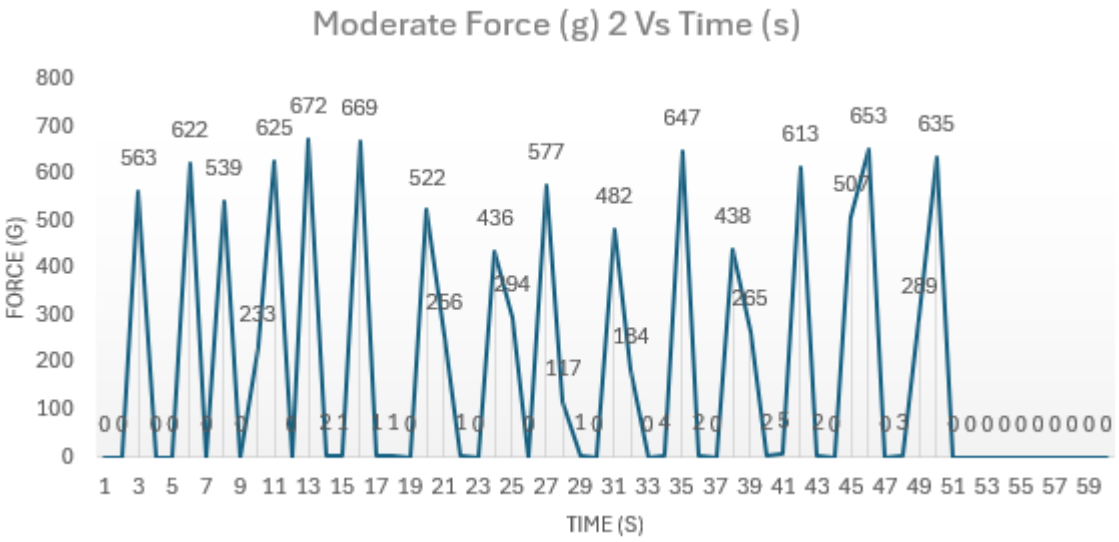


Figure 4-11 : Moderate Force (g) 2 Vs Time (s)

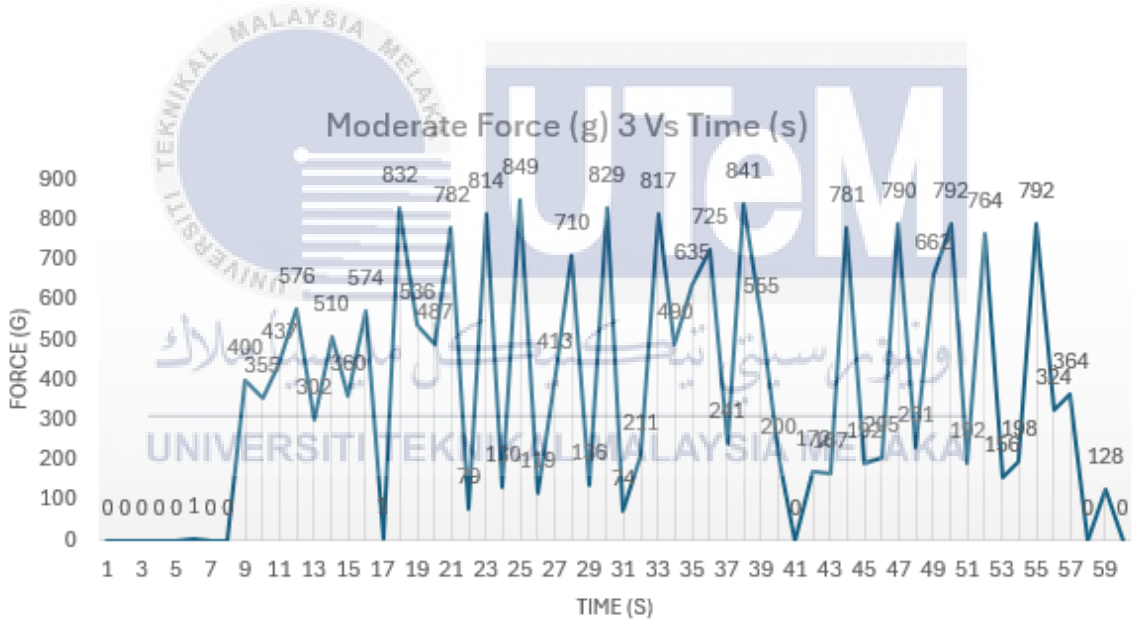


Figure 4-12 : Moderate Force (g) 3 Vs Time (s)

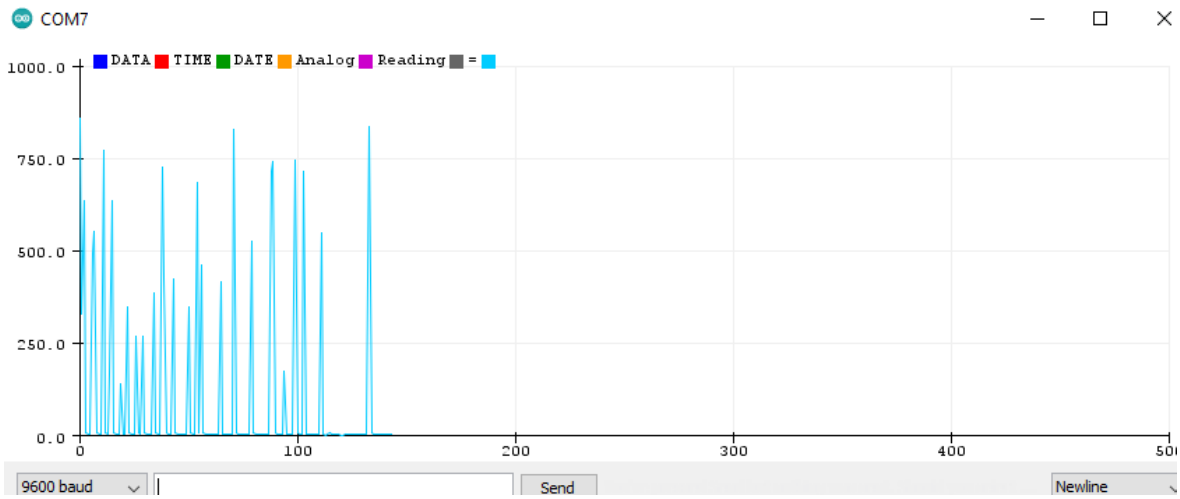


Figure 4-13: Moderate Force (g) Vs Time (ms) based on serial plotter

Table 4-6: The experiments data for numbness hand grip implementation in 1 minutes.

I. Age	70 years old
II. Criteria	A patient who takes care of grandchildren, does farming activities and has high blood pressure.

Table 4-7: Poor ability patient doing exercise

Time Taken (60 seconds)	Force 1 (g)	Force 2 (g)	Force 3 (g)
1	0	602	832
2	0	0	1
3	0	328	0
4	0	1	0
5	0	0	0
6	0	691	830
7	0	0	1
8	0	0	0
9	0	0	822
10	0	0	591
11	0	0	0
12	0	0	0
13	0	0	803
14	0	0	1
15	774	0	0
16	773	0	748
17	740	0	1
18	714	0	728
19	1	0	0
20	0	0	779
21	698	765	1

22	634	694	0
23	0	1	627
24	0	0	763
25	661	0	0
26	638	0	0
27	1	0	0
28	0	765	0
29	653	694	0
30	0	1	0
31	0	0	0
32	0	723	0
33	0	0	0
34	0	0	0
35	0	170	0
36	0	763	0
37	0	1	1
38	0	0	0
39	0	0	0
40	0	0	0
41	0	0	809
42	0	0	1
43	0	691	0
44	774	0	0
45	773	685	105
46	434	1	802
47	645	0	1
48	1	649	0
49	717	1	0
50	1	0	0
51	672	0	1
52	1	1	0
53	588	0	0

54	0	0	0
55	617	0	0
56	1	0	0
57	608	0	0
58	1	0	0
59	616	779	0
60	1	0	0
Average	212	150	154

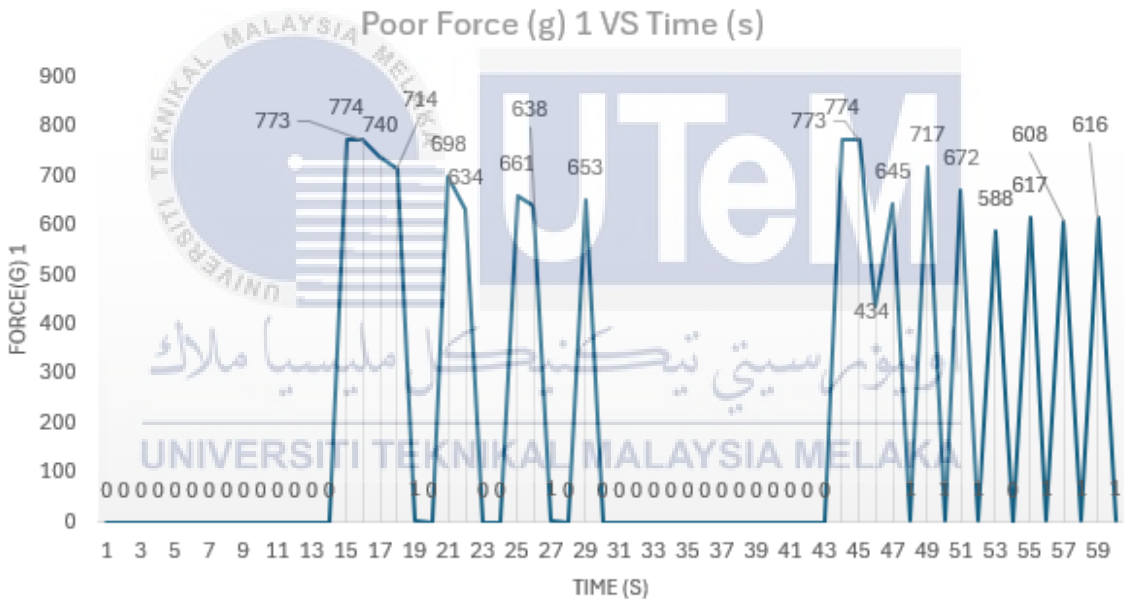


Figure 4-14 : Poor Force (g) 1 Vs Time (s)

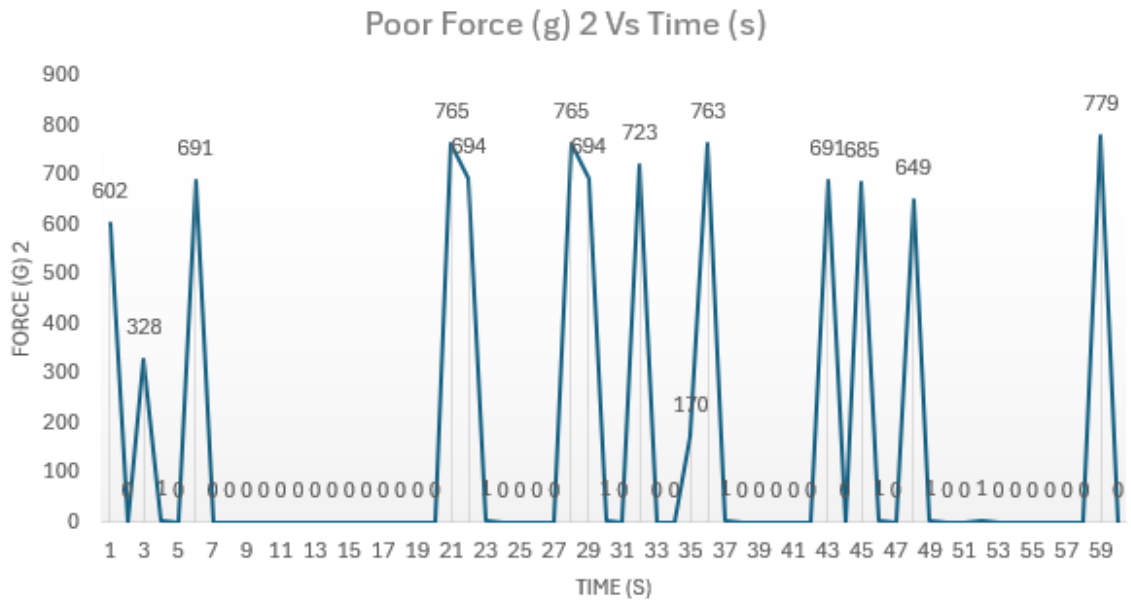


Figure 4-15 : Poor Force (g) 2 Vs Time (s)

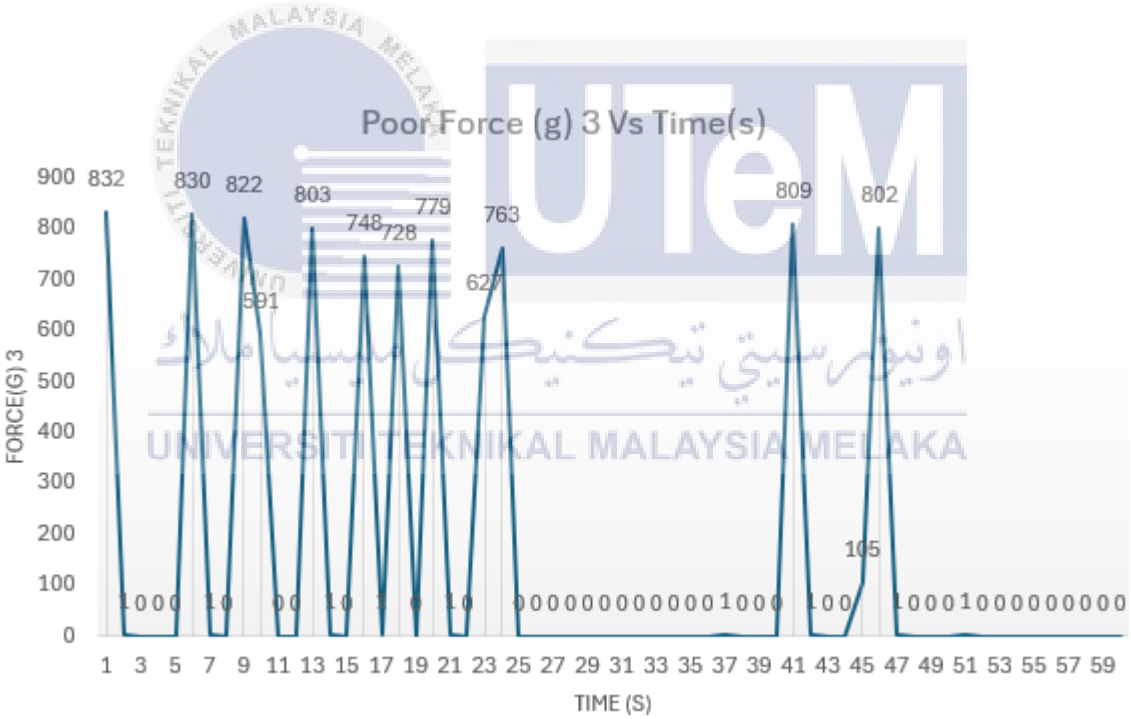


Figure 4-16 : Poor Force (g) 3 Vs Time (s)

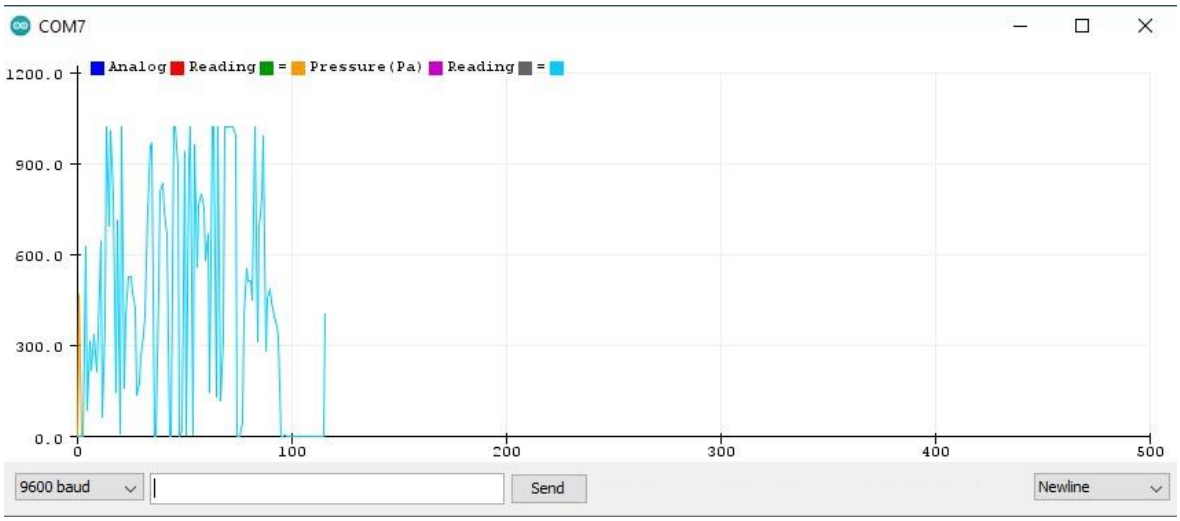


Figure 4-17 : Poor Force (g) Vs Time (ms) by using serial plotter

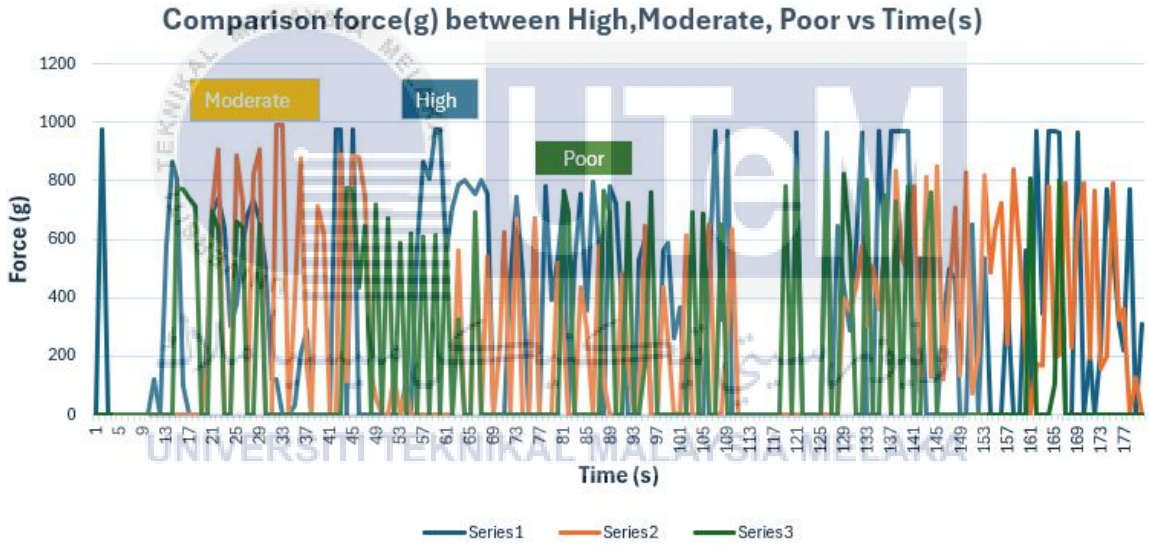


Figure 4-18 : The comparison force (g) between High,Moderate and Poor Vs Time (s)

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter will address the project's end in terms of the goal and development view that were mentioned in the early introductory chapter. This chapter includes an overview of the project as well as the results that were achieved in meeting the aims.

5.2 Conclusion

In conclusion, it is believed that this device is mostly used to treat disorders that affect grip strength, including CTS, HAVS, lack of muscle tone, and movement loss.Furthermore, the "Hand Tester Monitoring System for Rehabiliton Patient by Using Arduino" is a device for hand motor rehabilitation works to track progress in the recovery of prehensile movements (grip strength) caused by disease or accident. Additionally, it encourages the patient to become more active in their own healing. The physiotherapist can use it as a tool to keep track of the patient's progress and to help with therapeutic decision-making. Although the prototype has not yet been tested on real patients, it functions properly and has huge potential.

5.3 Recommendation For Future Improvement Project

The Hand Tester Monitoring System accomplishes the project's goals and is functional even if it simply makes use of the Arduino Spreadsheet. Furthermore, users can easily save data into Microsoft Excel without requiring an internet connection or Wi-Fi by using the Arduino Spreadsheet. The Arduino IDE software's Serial plotter feature allows users to automatically monitor handgrip reading trends. To make this project more robust

and dependable to carry out, though, a few adjustments must also be made. The user can only open one display (serial plotter) alone at a time, which is the first disadvantage of using one. Not only can the reading of such data not be watched in real time, but users are unable to use Arduino Spreadsheet or serial plotters during specific times. As a result, one of the potential enhancements that can be made to the project is the ability to monitor reading data between doctors and patients in real time. Lastly, sharing the data via a mobile application will make it much more fascinating. development of a Google Play Store architecture that can accurately track further training using therapeutic data.

REFERENCES

[1] O. F. P. Arboleda, B. B. C. Andrade, and E. C. P. Figueroa, "Device for Hand Motor Rehabilitation, Using Grip Force Sensing," *South Florida J. Dev.*, vol. 2, no. 2, pp. 3126–3134, 2021, doi: 10.46932/sfjdv2n2-151.

[2] "How to Export Data from Arduino to Excel - NerdyTechy." [Online]. Available: https://nerdytechy.com/how-to-export-data-from-arduino-to-excel/

[3] R. Ramadhani, E. D. Setioningsih, and T. Hamzah, "Hand Grip Measure Tool Post-Stroke Patients," *Indones. J. Electron. Electromed. Eng. Med. informatics*, vol. 1, no. 2, pp. 60–63, 2020, doi: 10.35882/ijeeemi.v1i2.3.

[4] "Carpal tunnel syndrome Information | Mount Sinai - New York." [Online]. Available: https://www.mountsinai.org/health-library/diseases-conditions/carpal-tunnel-syndrome

[5] "Hand and Finger Numbness_ Symptoms, Signs, Causes & Treatment."

[6] O. Polat, "Carpal Tunnel Syndrome," *Musculoskeletal Pain (Common Clinical Presentations)*, vol. 12, no. 4. pp. 209–215, 2022. doi: 10.3171/jns.1983.59.6.1031.

[7] "Carpal Tunnel Syndrome| National Institute of Neurological Disorders and Stroke." 2018. [Online]. Available: https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Carpal-Tunnel-Syndrome-Fact-Sheet

[8] CCOHS, "Diseases , Disorders and Injuries Carpal Tunnel Syndrome Fact Sheet," *Ccohs.Ca*, 2019, [Online]. Available: https://www.ccohs.ca/oshanswers/diseases/carpal.html#section-3-hdr

[9] "Why a Six Week Carpal Tunnel Treatment Protocol_."

[10] "Bluetooth Data Transfer with Android | Java Code Geeks." [Online]. Available: http://www.javacodegeeks.com/2013/09/bluetooth-data-transfer-with-android.html

[11] H. M. School, "Give grip strength a hand.," *Harvard Men's Health Watch*, vol. 21, no. 5. p. 4, 2016. [Online]. Available: https://www.health.harvard.edu/healthy-aging/give-grip-strength-a-hand%0Ahttp://uml.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=c8h&AN=119486676&site=ehost-live

[12] "7 Benefits of an Ergonomic Mouse | Goldtouch." [Online]. Available: https://www.goldtouch.com/7-ergonomic-mouse-benefits/

[13] K. Dimuatkan, D. I. Dalam, S. Cd, and R. O. M. Cd, "Projek Elektronik." pp. 1–19.

[14] “Send a message from Arduino to smartphone.”

[15] P. R. Manual, “Arduino UNO R3 Features,” pp. 1–13, 2022.

[16] W. Servers, “Step-by-Step Guide : Interfacing Force Sensing Resistor (FSR) with Arduino,” pp. 1–22, 2023.

[17] I. Electronics, “FSR ® 400 Series Data Sheet Human - Machine Interface Solutions for a Connected World FSR ® 400 Series Data Sheet,” 2015.

APPENDICES

Gantt Chart PSM 1

UNIVERISITI TEKNIKAL MALAYSIA MELAKA		DOC	PREPARED BY							CHECK BY							
DEVELOPMENT OF THE HAND TESTER MONITORING SYSTEM FOR REHABILITION PATIENT BY USING ARDUINO		PSM I	NOOR ASMIRA BINTI ZAKARIAA							ENCIK TS.TG MOHD FAISAL BIN TENGKU WOOK							
			B082010244							DATE				JUN, 2023			
			WEEK														
NO	**DESCRIPTION OF TASK**		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Briefing about PSM 1 and title selection	PLAN															
		ACTUAL															
2	Deciding title, objective, and scope	PLAN															
		ACTUAL															
3	Introduction (Chapter 1)	PLAN															
		ACTUAL															
4	Literature review (Chapter 2) and supervisor meeting	PLAN															
		ACTUAL															
5	Chapter 3 (Methodology)	PLAN															
		ACTUAL															
6	Supervisors review the Research Report and do correction	PLAN															
		ACTUAL															
7	Prepare slide and video presentation	PLAN															
		ACTUAL															
8	Presentation of PSM 1	PLAN															
		ACTUAL															
9	PSM 1 complete with Q&A	PLAN															
		ACTUAL															

Gantt Chart PSM 2

UNIVERISITI TEKNIKAL MALAYSIA MELAKA		DOC	PREPARED BY							CHECK BY						
DEVELOPMENT OF THE HAND TESTER MONITORING SYSTEM FOR REHABILITION PATIENT BY USING ARDUINO		PSM 2	NOOR ASMIRA BINTI ZAKARIAA							ENCIK TS.TG MOHD FAISAL BIN TENGKU WOOK						
			B082010244							DATE			JAN, 2024			
			WEEK													
NO	**DESCRIPTION OF TASK**		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Briefing about PSM 2 and title selection	PLAN														
		ACTUAL														
2	Meeting with supervisor, correcting report	PLAN														
		ACTUAL														
3	Continue chapter 4, buy component	PLAN														
		ACTUAL														
4	Troubleshoot hardware and coding	PLAN														
		ACTUAL														
5	Continue chapter 4	PLAN														
		ACTUAL														
6	Reconstruct circuit, error when simulating	PLAN														
		ACTUAL														
7	Discuss the report outcomes	PLAN														
		ACTUAL														
8	Final correction and submission to panel	PLAN														
		ACTUAL														
9	Presentation PSM 2	PLAN														
		ACTUAL														

Prototype Project

Figure 5-1: Top view project

Coding

```
#include <Wire.h>
#include <LiquidCrystal.h>
#define fsrpin A0
#define led1 9
#define led2 8
#define led3 7
int fsrreading;
int LEDbrightness;
void setup()
{
  //lcd.init();
  //lcd.backlight();
  Serial.begin(9600);
  Serial.println("CLEARDATA");

  Serial.println("LABEL,Date,Time,Pressure(Pa)");
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
}
void loop()
{
  lcd.setCursor(1,0); //First line
  lcd.print("NUMBNESS_PHYSIO");
  fsrreading = analogRead(fsrpin);
  lcd.setCursor(1,1); //Second line
  lcd.print("PRESSURE=" + (String)fsrreading + "  ");
  //fsrreading = analogRead(fsrpin);
  Serial.print("Analog Reading = ");
  Serial.println(fsrreading);
  Serial.print("DATA,TIME,DATE,");
  LEDbrightness = map(fsrreading, 0, 1023, 0, 255);
  delay(1000);

  if (fsrreading > 250)
  {
    digitalWrite(led1, HIGH);
  }
  else digitalWrite(led1, LOW);
  if (fsrreading > 500)
  {
    digitalWrite(led2, HIGH);
  }
  else digitalWrite(led2, LOW);
  if (fsrreading > 800)
  {
    digitalWrite(led3, HIGH);
  }
```

```
  else digitalWrite(led3, LOW);
}
```