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AUTOMOBILE FUNCTIONALITIES CONTROLLED BY MYOGRAPHIC MOVEMENTS

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Abstract: The arm is frequently injured due to the variety of tasks and uses it is subjected to. Arm pain is something that everyone has encountered at some point in their lives. It could happen gradually or all of a sudden. It has an effect on our day, making it difficult for us to engage in activities like exercise, everyday tasks, and recreation. Every person has a different pain point, a different type of pain, and a different explanation for their suffering. Given the complexity of the causes of pain, everyday exercise is necessary. For older individuals in particular, an automobile is designed and tested to determine the highest threshold value and compare it to the threshold set before the onset of disease, discomfort, or injury. This aids in identifying the issue through the creation of a personalized physiotherapy strategy for arm pain and offers long-term relief that is effective for you.

Keywords: Sarcopenia, muscle movement, arm pain, microcontroller

I. INTRODUCTION

The progressive loss of muscular mass and strength with advancing age is known as sarcopenia. Muscle weakness is the predominant sign of the illness. Sarcopenia is a form of muscle atrophy primarily brought on by ageing naturally. Physical inactivity and a poor diet, according to scientists, may be causes of the illness.

How can I prevent sarcopenia? Since that sarcopenia is a normal component of ageing, you might not be able to totally prevent it. Yet, there are things you may do to stop the disease's spread. They comprise:

Make nutritious meal selections: Continually consume a nutritious diet that contains high-quality proteins. During each meal, aim for 20 to 35 grammes of protein.

Exercise: Continue to lead an active lifestyle that includes activities like resistance training. With our idea, we hope to effectively encourage regular fitness among the elderly while also providing them with amusement.

II. PROBLEM STATEMENT

Exercise is widely accepted as a helpful strategy to improve physical functioning in older persons, eventually enhancing overall health. According to certain research, older patients who exercise using VR show increases in their balance, response speed, executive function, and lower limb muscle strength. They also show improvements in their mobility and fall prevention. These research may be convincing, but there isn't enough proof to conclude that VR workouts will enhance physical functioning any more or any less than traditional exercise regimens.

As a result of age-related, illness-related, and disuse-related alterations in the central and peripheral neural systems, older persons exhibit decreased movement and balance control. Certain therapeutic activities, such as those demanding multi-segment coordination, anticipatory postural adjustments, and tasks requiring split attention, can be utilised to increase neuroplasticity in order to counteract these detrimental alterations. Exergaming, however, has the potential to improve motor learning by fusing physical and mental challenges in an engaging and dynamic fashion. This will encourage players to pay attention to the game's outcomes rather of the actual motions they make. The use of VR for therapeutic reasons is gaining more attention. Systematic evaluations of VR have been conducted in populations with particular medical disorders, such as post-stroke patients and those who have balance issues or falls, in various therapeutic contexts, and in samples from a variety of age ranges.

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The usage of VR has been shown to have only marginally or inconclusively improved outcomes in specific studies. Systematic reviews, however, highlight a major shortage of research with considerable methodological quality and confirm that there is not enough data to suggest VR-based fitness programmes. Yet, VR is the most costly item and not everyone can afford it. Thus, we provide a toy automobile that can be driven in real time using only on your muscles.

Stretching and balance exercises for older individuals should be a regular element of their weekly physical activity. Physical activity with multiple components can enhance physical function and assist lower the risk of damage from falls. The purpose of this study is to determine whether exercises involving interactive games (exergames) can enhance physical functionality in older persons.

III. COMPONENTS IMPLEMENTATION

Based on the ATmega328P, the Arduino Nano is a compact, comprehensive, and breadboard-friendly board that was introduced in 2008. With a more compact design, it provides the same connections and specifications as the Arduino Uno board. The Arduino Nano has 30 male I/O headers that are arranged in a DIP-30-like format and can be programmed using the Arduino Software integrated development environment (IDE), which is available both online and offline and is shared by all Arduino boards. The board can be powered by a 9 V battery or a type-B mini-USB connection.

A pin-equivalent evolution of the Nano was launched by Arduino in 2019 under the name Arduino Nano Every. It has twice as much RAM and an ATmega4809 processor that is more powerful. The automobile project requires the dependencies.

- Arduino Nano
- Nrf24lo1 Radio Module
- Flex Sensor
- Eye Blink Sensor
- L298n Motor Driver
- Power Supply
- Ultrasonic Sensor
- I2C with LCD Display

IV. WORKING

The Flex Sensor is positioned directly over the nearby muscle group. The divider circuit receives the signal that was read from the sensor.

The threshold voltage is essentially the analogue voltage that the voltage divider circuit produces. When a predetermined threshold is achieved, the microcontroller analyses the input and sends the radio command to move the car forward. The automobile won't receive a command if the threshold is not met, which will put an end to its ability to move. Fig. 1 shows the hardware prototype of the proposed method. The requirements for the automobile project are as follows.

- A bend sensor that is put on specific muscle groups will be used to read the signal from the user.
- The flex sensor must be used to read, amplify, and rectify the user's signal.
- The Arduino Nano microcontroller must translate the signal.
- The signal must be sampled by the microcontroller at a rate of 500 Hz (every 2ms).
- The microcontroller will be in charge of driving the vehicle, which will move ahead when specific muscle areas are flexed.
- The vehicle must come to a complete stop within one second of the driver relaxing the muscle beneath the threshold.
- The control device's noise must be reasonably managed in order to prevent interference with the signal received by the muscle sensor board.
- The C programming language must be used to create the code that controls the microcontroller.

Two switch modules on the breadboard provide the user with the choice to select between forward, backward, and left or right directions.

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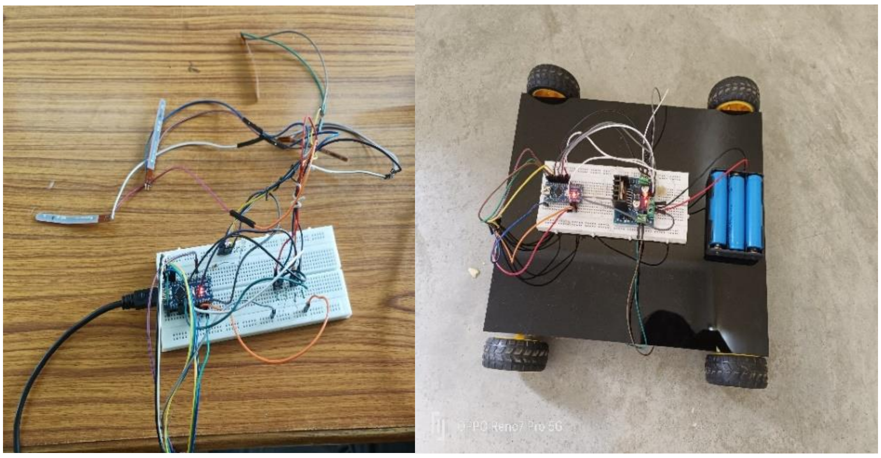

Fig. 1 Hardware prototype of the proposed system

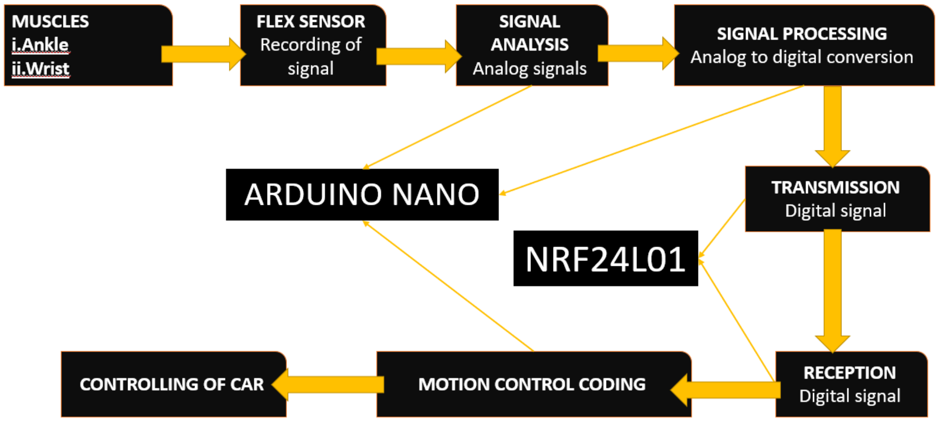

Fig. 2 Flow diagram of the proposed system

The flow diagram of the proposed system is shown in fig.2. The signal from the flex sensor is analyzed and the controlling is performed according to the motion control code in Arduino controller.

A.Microcontroller input and outputs

The system's different inputs and outputs are described in this section as shown in Table I, II, III and IV.

Table I Transmitter inputs

COMPONENT	I/P PINS
Flex Sensor	A1, A2, A3, A4
Eye Blink Sensor	A5

Table II Receiver inputs

COMPONENT	I/P PINS
NRF24LO1 Radio Module	D12, D11, D13

Table III Transmitter outputs

COMPONENT	O/P PINS
NRF24LO1 Radio Module	D10, D9

Table IV Receiver outputs

COMPONENT	O/P PINS
NRF24LO1 Radio Module	D10, D9
Motor Driver	D5, D6, D7, D8

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B.Flex sensor input and outputs

The analogue input of the microcontroller receives the output of the flex sensor. To obtain the threshold voltage, a voltage divider is constructed and the input from the flex sensor is routed via the circuit. To perform some exercises, the flex sensor is placed over the muscles. For this project, the four regions (two ankle joints and two elbow joints) were selected.

C.Controls

The automobile controls are explained in the section that follows using the flex sensor. Several EMG inputs are replaced by the flex sensor. Flex sensors are utilised in place of EMG inputs, which are used to illustrate the capability of many EMG inputs at a lower cost as an EMG input for this system costs roughly $60. We can control the direction of the automobile by folding our elbows and ankles in specific ways to move it forward, backward, left, right, and in combinations along each axis. Table V and Vi shows the flex sensor output in degree and milli voltage, respectively.

Table V Control flow of the car with flex sensor output in degree

DIRECTIONS	FLEX SENSORS OUTPUTS (in degrees)			
	FLEX 1 R-ANKLE	FLEX 2 L-ANKLE	FLEX 3 R-ELBOW	FLEX 4 L-ELBOW
FRONT	180	<100	180	180
BACK	<100	180	180	180
LEFT	<100	<100	<100	180
RIGHT	<100	<100	180	<100

Table VI Control flow of the car with flex sensor output in milli-voltage

DIRECTIONS	FLEX SENSORS OUTPUTS (in analog milli-voltage)			
	FLEX 1 R-ANKLE	FLEX 2 L-ANKLE	FLEX 3 R-ELBOW	FLEX 4 L-ELBOW
FRONT	<793	>850	180	180
BACK	>850	<793	<793	<793
LEFT	>850	>850	>850	<793
RIGHT	>850	>850	<793	>850

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V. SIMULATION AND RESULTS

A.Hardware test

This test confirmed that the automobile was in proper starting and stopping order and that all of the hardware was communicating. By enabling the user to add left- or right-handed directions as well as switch between forward and backward directions, this test also confirmed that the four flex sensors worked as planned.

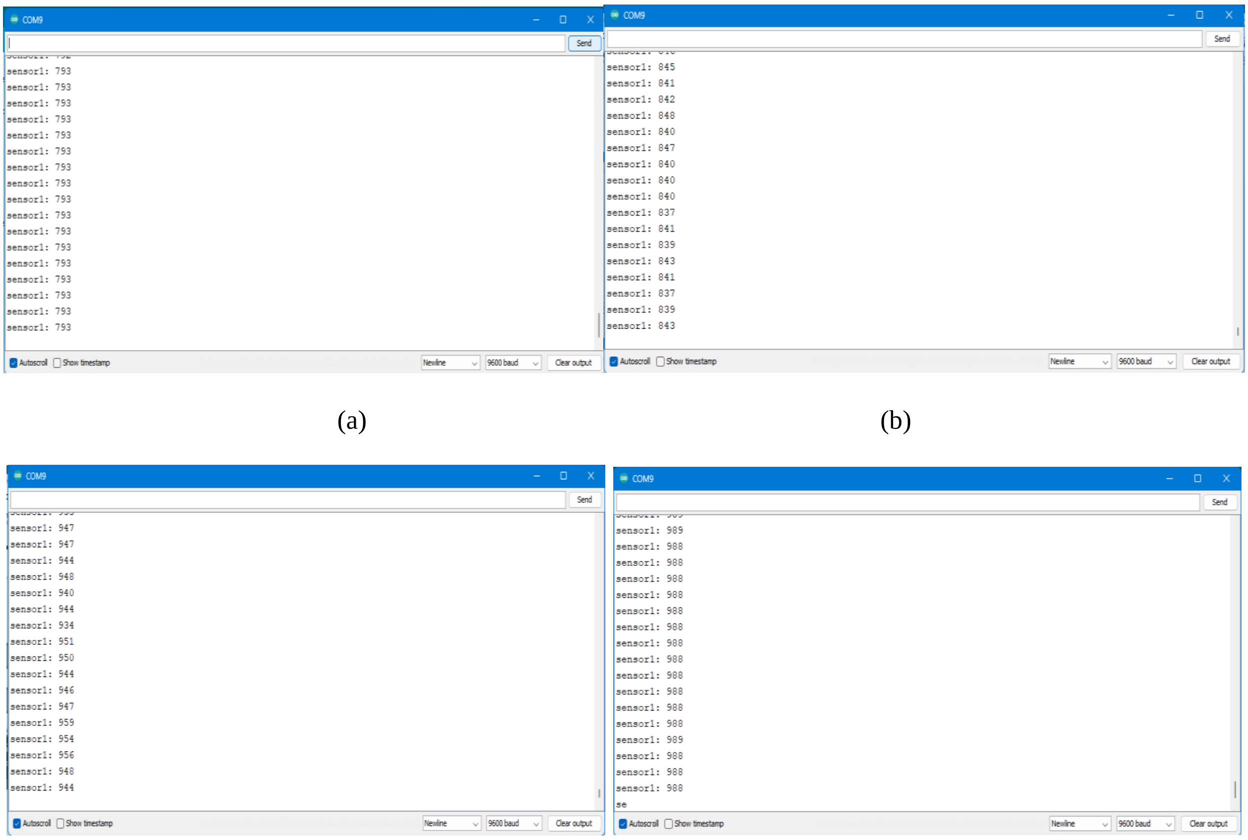
B.Voltage divider signal test

By attaching the flex pins to the oscilloscope and ensuring that a signal is visible that corresponds to the outputted muscle movements, this test is confirmed. The voltage divider circuit board is then attached to the flex pins, and we check to see if the signal is still present and noise-free. Images captured while the flex pins were attached to the logic analyzer.

C.Functional and noise test

Powering the system and enabling a user to operate the vehicle by flexing the muscle group to which the diodes are linked verifies the results of this test. The system is acting as planned and responding to the muscle movements, as shown by observation of the car's motion.

By measuring the flex signal for noise with a logic analyzer and oscilloscope, this test is confirmed. In order to produce a legible signal, the amplitude of the flex signal must be much greater than that of the noise. In order to source the flex signal for this test, diodes might be linked to a user.



(a) (b)

(c) (d)

Fig. 3 Logic analyzer images. (a) Analog voltage in 180 degrees, (b) Analog voltage in <100 degrees, (c) Analog voltage in <60 degrees and (d) Analog voltage when not connected

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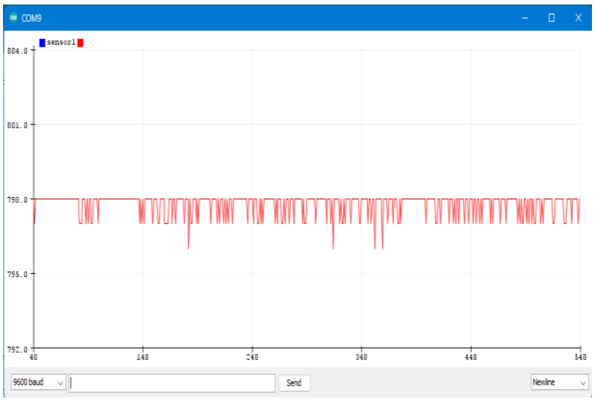

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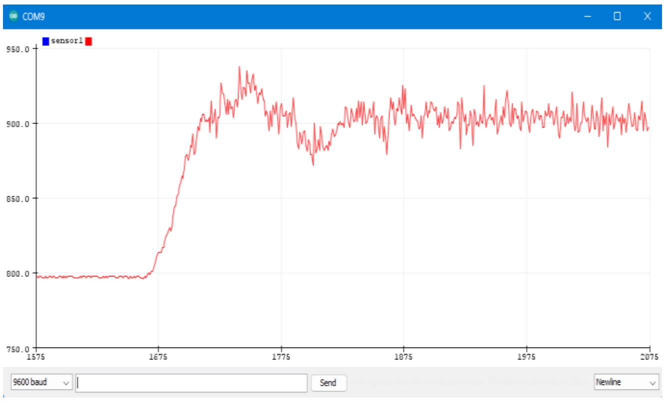

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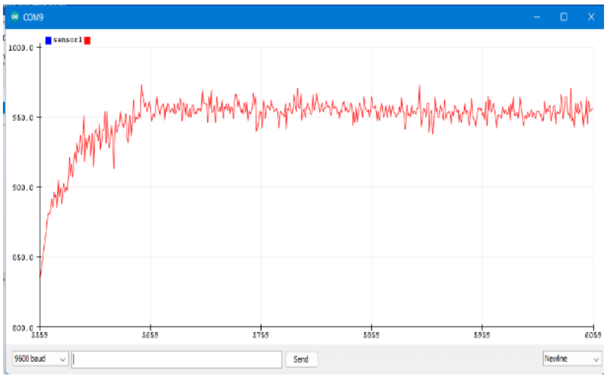

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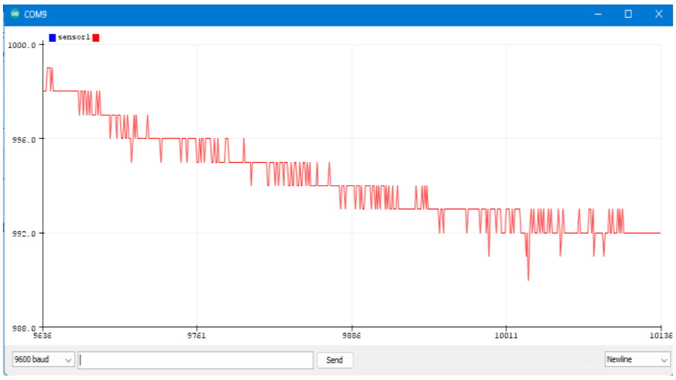

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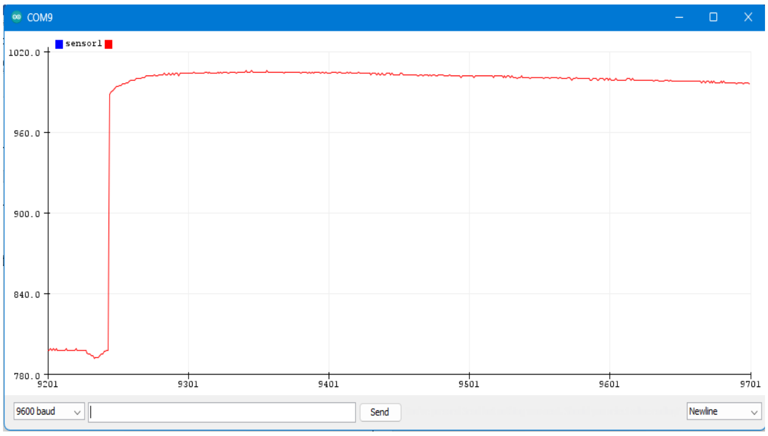

(e)

Fig. 4 Logic graphic images. (a) Serial plotter in 180 degrees, (b) Serial plotter in <100 degree, (c) Serial plotter in <60 degree, (d) Serial plotter when not connected and (e) Serial plotter when malfunctioned

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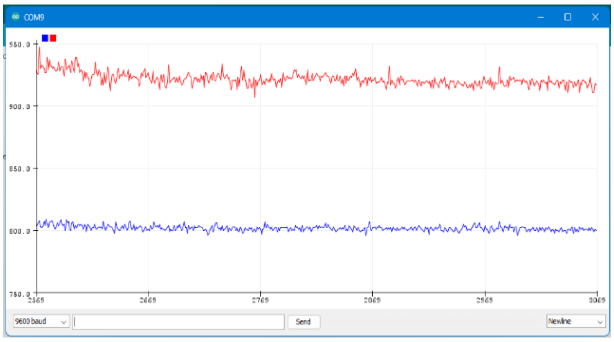

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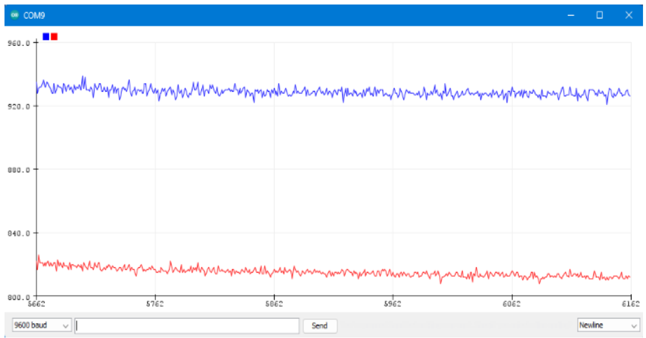

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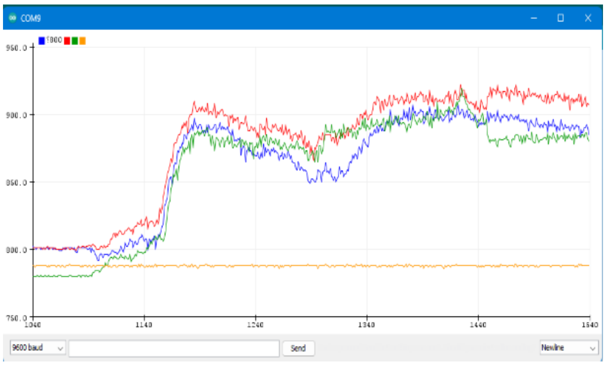

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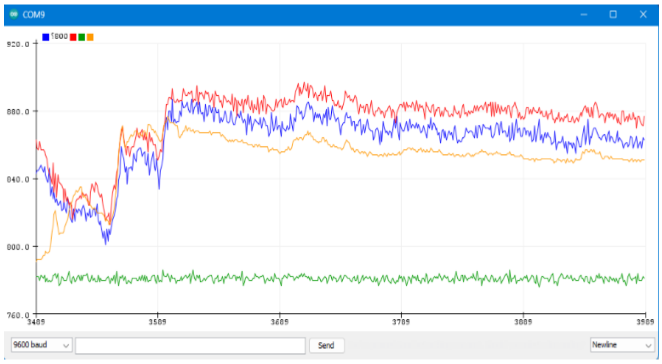

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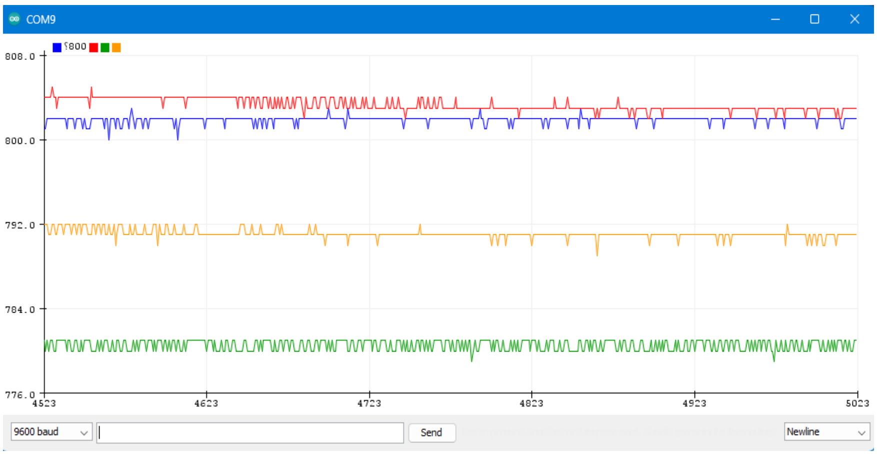

(e)

Fig. 5 Logic direction graph. (a) Forward direction, (b) Backward direction, (c) Left direction, (d) Right direction and (e) No motion

VI. CONCLUSION

This concept resulted in a functioning automobile that performed as needed. Each test in this part established that the project performed as needed. Although the DIP switch controls performed as needed, they did not offer the best amount of control. The car could respond to a user's intentions more intuitively by adopting more flexible input channels.

A smaller or less expensive microcontroller might have been utilized for this project because the circuitry employed to evaluate the signal was more than capable of fulfilling its straightforward purpose. If implemented, the various flex sensor inputs would have made better use of the microcontroller's capabilities.

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In addition to medical applications (motor rehabilitation, periprosthetic, assistive devices), human computer interfaces are other domains where neural interfaces are gaining popularity (gaming technology, remotely operated devices, human-machine interaction).

Yet ultimately, whether they are deployed in applications for daily life or not will depend on how effective this human-machine control interface is. A successful control interface requires advancements in both hardware and software, including smart electrodes, on-board computers, and auto-calibration and high-bandwidth information decoding.

REFERENCES

[1]. Woo-Keun Y, Goshozono T, Kawabe H, Kinami M, Tsumaki Y, etal.(2004) Model-based space robot teleoperation of ETS-VII manipulator. IEEE Trans on Robotics and Automation 20: 602-612.
[2]. Tayh-Jong T, Bejczy AK, Chuanfan G, Ning X (1994) Intelligent planning and control for telerobotic operations. Proc of IEEE/RSJ/GI Int Conf Intelligent Robots and Systems 1: 389-396.
[3]. Park J, Khatib O (2006) A haptic teleoperation approach based on contact force control. Int J Rob Res 25: 575-591.
[4]. Bitzer S, van der Smagt P (2006) Learning EMG control of a robotic hand: towards active prostheses. Proc of IEEE Int Conf on Robotics and Automation 2819-2823.
[5]. Farry KA, Walker ID, Baraniuk RG (1996) Myoelectric teleoperation of a complex robotic hand. IEEE Trans. On Robotics and Automation 12: 775-788.
[6]. Tenore F, Ramos A, Fahmy A, Acharya S, Etienne-Cummings R, et al. (2007) Towards the control of individual fingers of a prosthetic hand using surface EMG signals. Proc 29th Annual Int Conf of the IEEE EMBS 6145-6148.
[7]. Schulz S, Pylatiuk C, Reischl M, Martin J, Mikut R, et al. (2005) A hydraulically driven multifunctional prosthetic hand. Robotica 23: 293-299.
[8]. Zecca M, Micera S, Carrozza MC, Dario P (2002) Control of multifunctional prosthetic hands by processing the electromyographic signal. Crit Rev Biomed Eng 30: 459-485.
[9]. Pasarica, A.; Miron, C.; Arotaritei, D.; Andruseac, G.; Costin, H.; Rotariu, C. Remote control of a robotic platform based on hand gesture recognition. In Proceedings of the E-Health and Bioengineering Conference (EHB), Sinaia, Romania, 22–24 June 2017; pp. 643–646. [Google Scholar].