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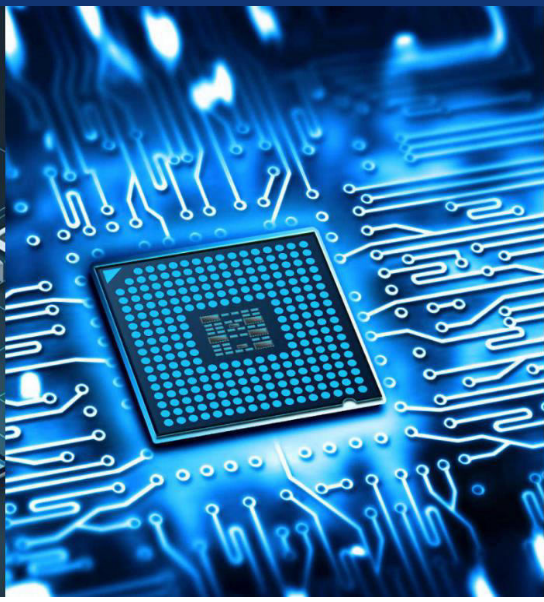

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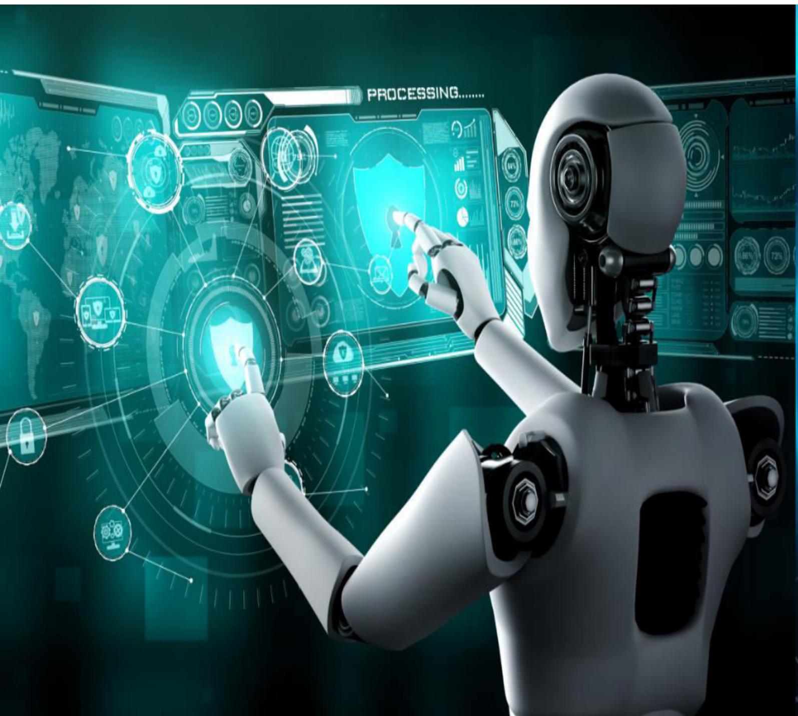

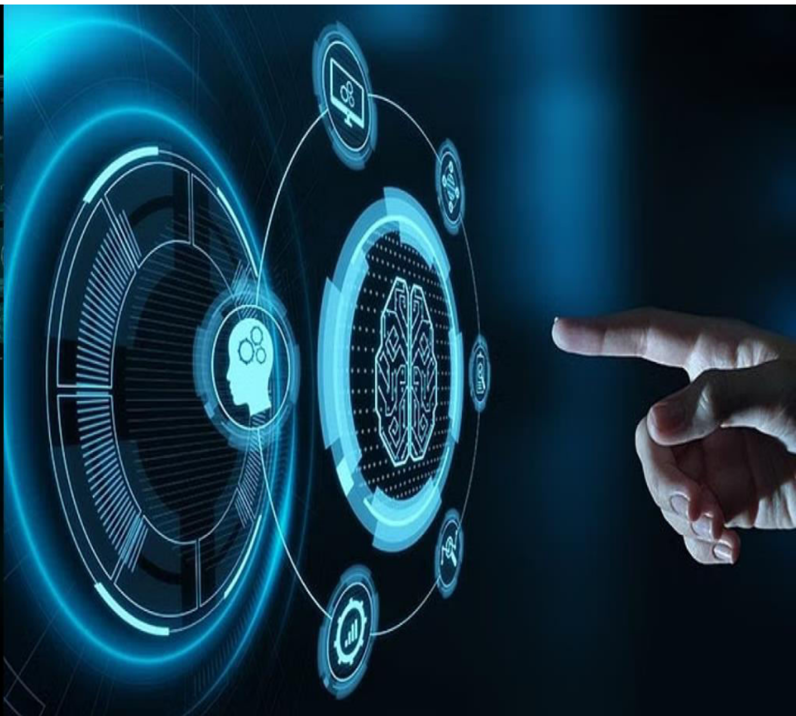

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Arduino-Based EMG Controlled Robotic Car

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ABSTRACT: This project aims to develop and design of a Brain-Controlled Robotic Car, integrate brain computer interface (BCI) technology with robotics to enable hands-free navigation. Utilizing electroencephalogram (EEG) signals acquired through a non-invasive headset the system interprets specific brainwave patterns corresponding to user intent. These signals are processed and translated into motion commands forward, backward, left, right, or stop. The processed data is wirelessly transmitted to a microcontroller , which controls the movement of the robotic car via motor drivers. This innovation offers significant potential for people with physical disabilities, enabling them to interact with and control assistive robotic systems using only their thoughts. The project demonstrates the feasibility of brain-controlled mobility, contributing to advancements in assistive technology and human machine interaction.

1. INTRODUCTION

In recent years, the integration of brain-computer interface (BCI) technology with robotics has opened new frontiers in assistive technology, particularly for individuals with physical disabilities. A Brain Controlled Robotic Car represents a compelling application of this integration, allowing users to control a robotic vehicle using only their brain signals—without any physical movement. This system relies on the interpretation of electrical activity in the brain, typically captured using non-invasive electroencephalogram (EEG) sensors, to generate control commands for robotic motion .The motivation behind developing a brain-controlled robotic car stems from the growing need for accessible, hands-free control systems in assistive mobility and rehabilitation. For individuals suffering from conditions such as paralysis, muscular dystrophy, or spinal cord injuries, traditional input methods like joysticks or voice commands may not be viable. A brain- controlled system offers an alternative that leverages cognitive effort and neural signals as a direct communication channel with machines.

II. BLOCK DIAGRAM AND METHODOLOGY

2.1 BLOCK DIAGRAM

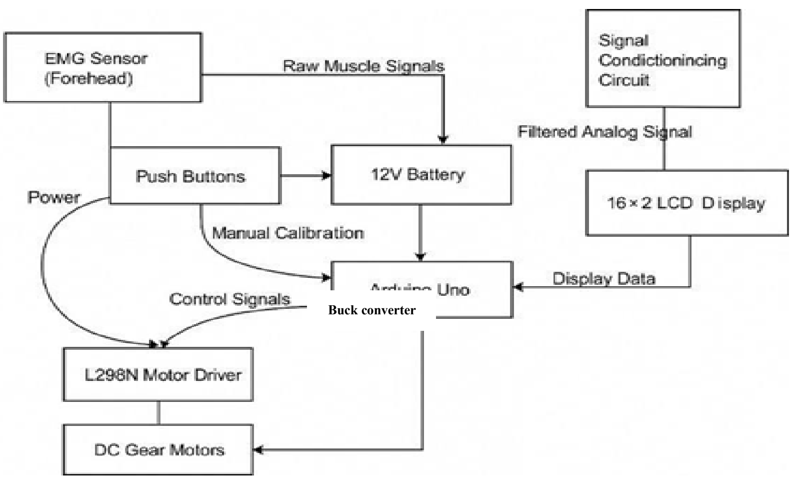

Fig 1. Block diagram of Arduino based EMG controlled Robotic car

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2.2 WORKING METHODOLOGY

The system operates by detecting and interpreting electrical signals from the user's forehead muscles using an EMG sensor. These signals are transmitted to the Arduino Uno microcontroller, which processes them to determine user intent. The signal acquisition begins with the EMG sensor detecting electrical activity when the user intentionally contracts their forehead muscles. The raw signals are first amplified and filtered to remove noise and artifacts. The Arduino then processes these signals using threshold detection algorithms to identify intentional muscle contractions. For direction selection, muscle contractions lasting 1- 2 seconds cycle through movement options (Forward, Backward, Left, Right), displayed on the LCD. Activation of the selected direction occurs when the user maintains contraction for more than 2 seconds, triggering the motor driver to engage the wheelchair's motors in the chosen direction. The system continuously monitors muscle activity and automatically stops the wheelchair when the signal falls below the activation threshold, ensuring safe operation.

The flow diagram of Brainwave Controlled Robot is shown in fig 2 . It shows all the step-by-step functions of robot, how it will be controlled by using brainwave signals. After Switching on the Brainwave headset and the Robot kit, the processor will initialize and the headset will starts sensing the signals and after sensing the signals it will transfer them to through the Bluetooth and the acquisition module will receive the signals in the processor and in the processor the EEG signals comparison will be done if it is yes then the robot will move according to the signals or else it will go to the relay circuit and robot movement will be there and the process will be stopped.

2.2 WORKING FLOWCHART

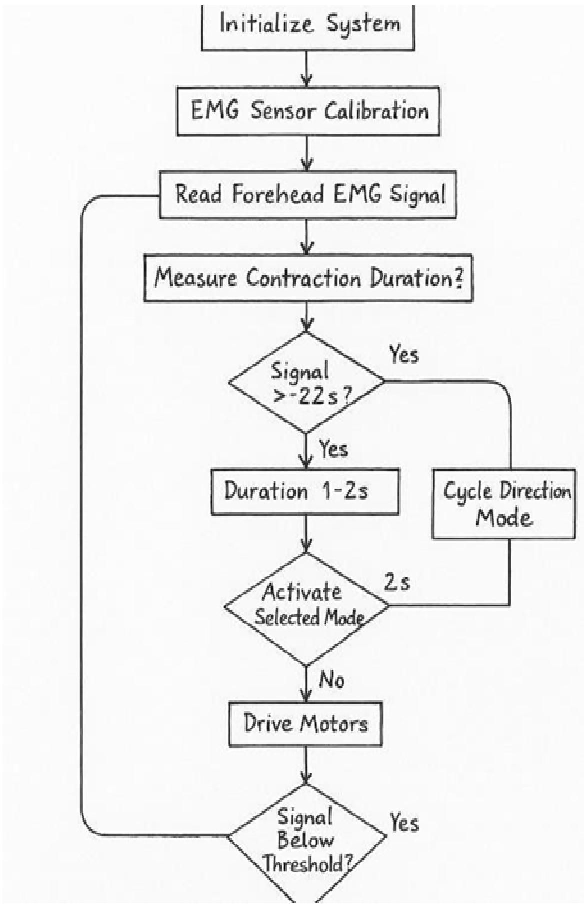

Fig 2. Flow Chart of Arduino based EMG controlled Robotic Car

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The above fig2 represent the flow chart of the proposed model i.e., Arduino based EMG controlled Robotic Car. It explains about the flow of working of the proposed model.

III. COMPONENTS REQUIRED

3.1HARDWARE REQUIREMENTS

3.1.1 ARDUINO UNO

Fig3. Arduino uno

The Arduino Uno is an open-source microcontroller board based on the Microchip
ATmega328P microcontroller and developed by Arduino The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo

Fig4. 100 RPM BO Motor

It is a BO Series 1 100RPM DC Motor Plastic Gear Motor. The BO series straight motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors. A small shaft with matching wheels gives an optimized design for your application or robot. Mounting holes on the body & lightweight makes it suitable for in-circuit placement. This motor can be used with 69mm Diameter Wheel for Plastic Gear Motors and 87mm Diameter Multipurpose Wheel for Plastic Gear Motors**.** Low-cost geared DC Motor. It is an alternative to our metal gear DC motors. It comes with an operating voltage of 3-12V and is perfect for building small and medium robots. Available with 60 and 150 RPM. The motor is ideal for DIY enthusiasts. This motor set is inexpensive, small, easy to install, and ideally suited for use in a mobile robot car. They are commonly used in our 2WD platforms.

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3.1.3 Battery

Fig5. Battery

This LG INR18650 M26 2600mAh Lithium-Ion Battery gives value for your money. It comes with a rated voltage of 3.7 volts and a capacity of 2600mAh. It is a single cell, compact, and powerful battery cell with 2600 mAh capacity. It is very convenient to install in your project to full fill the 3.7 Volt requirement with high capacity.

3.1.4 Lcd display

Fig6. Lcd display

This is a basic 16 character by 2-line Alphanumeric display. Black text on Green background. Utilizes the extremely common HD44780 parallel interface chipset. Interface code is freely available. You will need Minimum 6 general I/O pins to interface to this LCD screen. Includes LED backlight. Works in 4bit and 8 bit Mode.

3.2 SOFTWARE REQUIREMENTS

3.2.1 ARDUINO IDE

The Arduino IDE is essential for developing and uploading the control program to the Arduino Uno in an EMG-based robotic car project. It allows users to write code that reads muscle signals from the EMG sensor, processes them, and sends appropriate commands to motor drivers, enabling the car to move based on muscle activity

IV. RESULT AND CONCLUSION

4.1. Result

The EMG-Based Brain-Controlled Robotic Car was successfully designed and implemented using forehead muscle signals to control vehicle movement. By utilizing an EMG sensor placed on the forehead, the system accurately captured muscle activity from intentional facial expressions like eyebrow raises. These signals were processed by the Arduino Uno to identify specific patterns and translate them into directional commands such as Forward, Backward, Left, and Right. The two-stage control logic— direction selection followed by activation—ensured that the car responded only to deliberate muscle actions, reducing the chances of accidental movements. Real-time status updates were displayed on a 16x2 LCD, allowing the user to monitor system feedback effectively

Figure 5 Result of Arduino based EMG Controlled Robotic Car

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4.2. Conclusion

The Brain-Controlled Robotic Car project demonstrates the potential of brain-computer interfaces (BCIs) in developing assistive technologies that enhance mobility for individuals with physical impairments. By utilizing EMG sensors to detect muscle signals from the forehead, and integrating components such as the Arduino Uno, L298N motor driver, and DC motors, the system successfully translates neuromuscular signals into directional commands. The design emphasizes cost-effectiveness, ease of implementation, and real-time responsiveness, making it a practical solution for hands-free control of robotic movement.

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