GROUP – 05

ROBOLUTION INTERN PROJECT

DESIGN A TRI-OPERATIONAL ROBOTIC ARM CONTROLLED USING ECG SIGNALS, ENABLING HANDS-FREE COMMAND OVER GRASPING, ROTATING, AND LIFTING ACTIONS THROUGH REAL-TIME ANALYSIS OF CARDIAC PATTERNS FOR ASSISTIVE AND BIOMEDICAL APPLICATIONS.

Mentor & Members:

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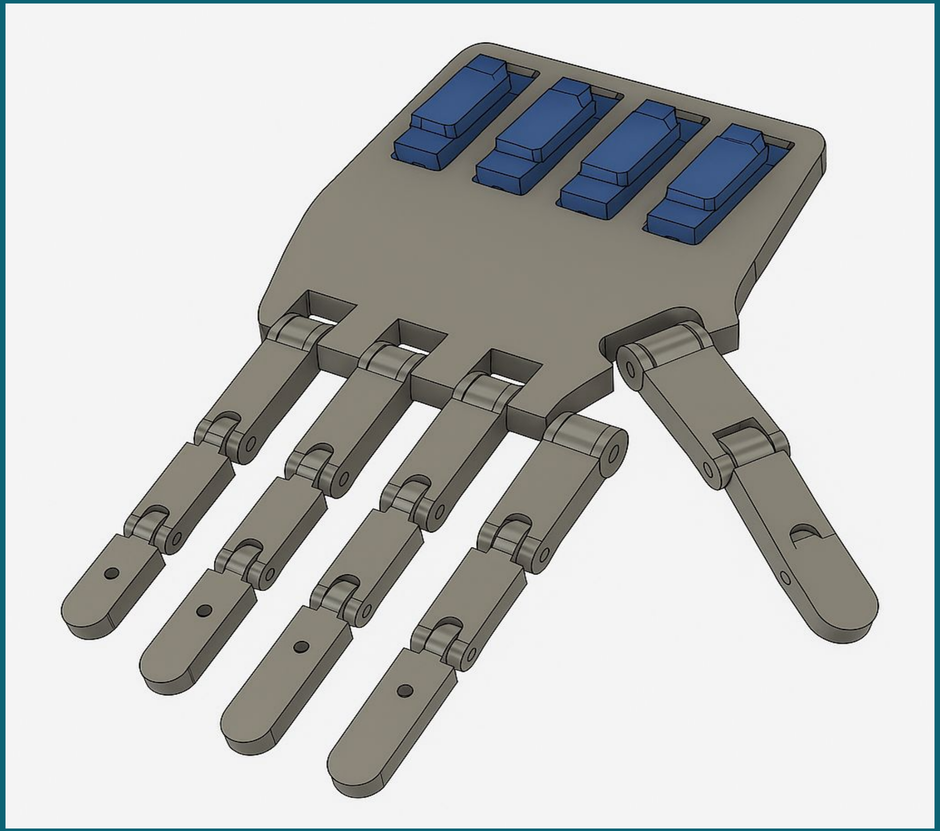
Problem Statement

- Design a tri-operational robotic arm controlled using ECG signals, enabling hands-free command over grasping, rotating, and lifting actions through real-time analysis of cardiac patterns for assistive and biomedical applications.

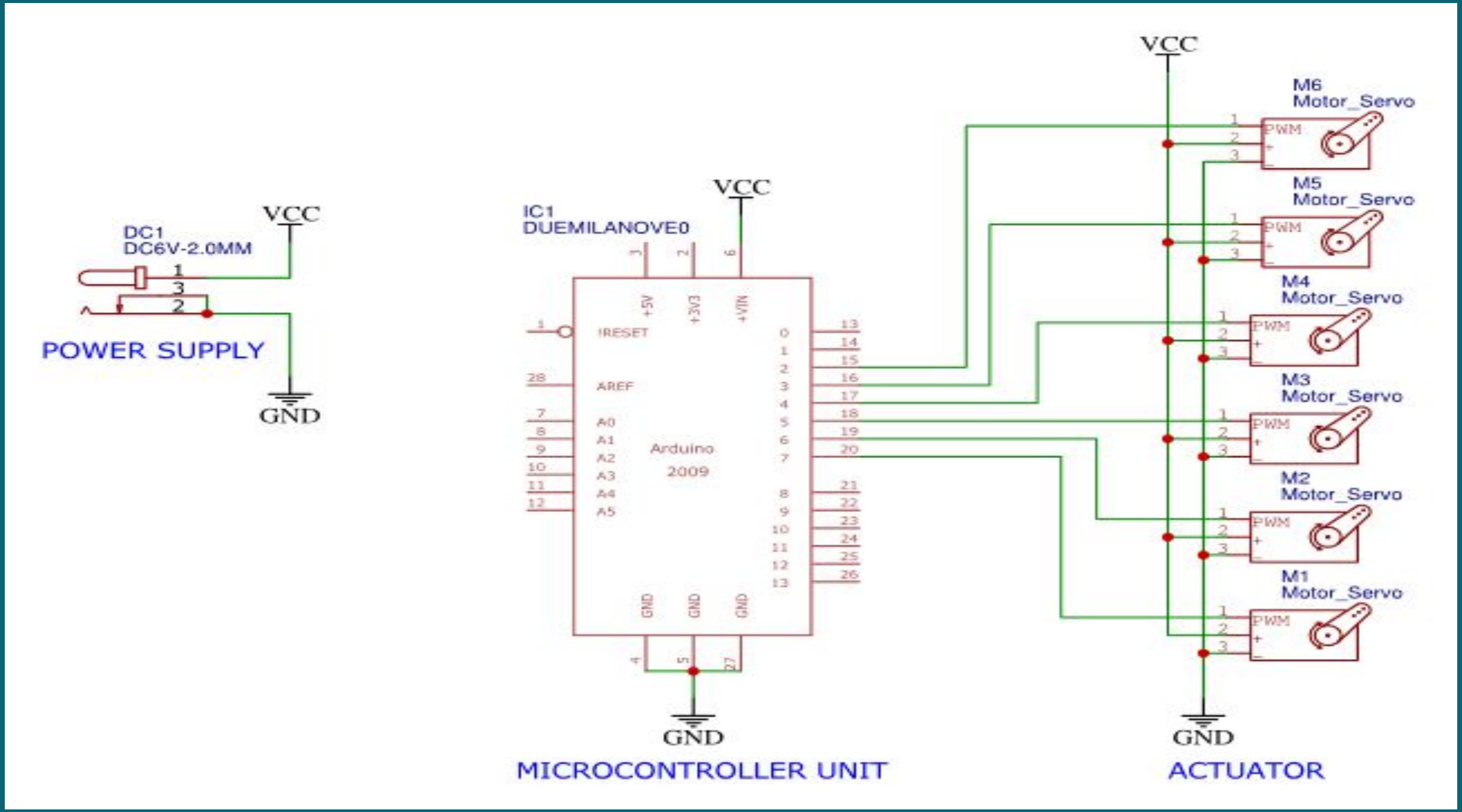
Components:

1. NodeMCU ESP8266 AMICA CP2102 Wi-Fi Development Board
2. MG90S Mini Servo Motor(180 Degree) (6x)
3. XL4015 5A Constant Current/Voltage LED Drives Lithium Battery Charging Module
4. Muscle Sensor kit (EMG Signal)
5. NMC 18650 7.4V 2500mAh 3C 2S1P Li-Ion Battery Pack
6. Robotic arm kit / Fusion 360 + 3D Printing
7. Nylon Fishing Line
8. stepper motor
9. Jumper Wires
10. Breadboard

Basic Prototype:



Circuit Diagram:



Project Concept:

The core idea of this project is to develop a tri-operational robotic arm that can mimic human hand movements through muscle signal control. The robotic arm is designed to perform essential actions like grasping, rotating, and lifting using EMG (Electromyography) signals collected from the user's muscles.

- This innovation lies at the intersection of biomedical engineering and robotics, aiming to create an assistive device that responds to natural body signals, enabling hands-free control for individuals with limited mobility or in environments where manual control is impractical.

Ideation:

1. **Muscle Movement Detection:** When the user moves or flexes their muscles, the EMG sensor detects the small electrical signals generated.
2. **Signal Sent to Microcontroller:** These signals are sent to a microcontroller (ESP8266) that understands them and decides what action to perform.
3. **Controlling the Robotic Arm:** Based on the signal, the controller sends commands to **servo and stepper motors** to move the fingers or arm.
4. For example:
    1. A small muscle flex could make the fingers close (grip).
    2. A stronger flex could rotate the wrist or lift the arm.
5. **Physical Movement:** The servo motors pull strings connected to the fingers, making them move like real human fingers.

Application :

1. **Assistive Device** — Helps disabled or paralyzed people control a robotic arm hands-free using heart signals.

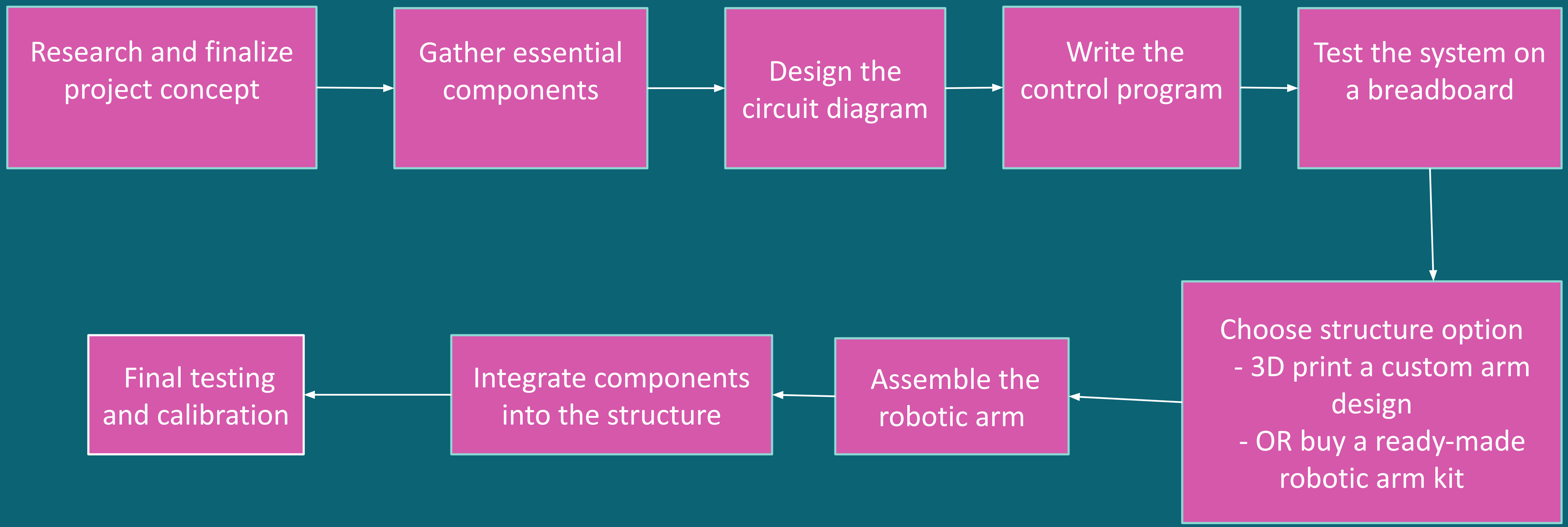
2. **Rehabilitation** — Assists in physical therapy by enabling simple movements through heart rate changes.

3. **Biomedical Research** — Studies how heart patterns can control machines and track emotional or stress states.

4. **Hands-Free Industrial Control** — Operates robotic arms in hazardous or sensitive environments without using hands.

5. **Gaming & VR** — Could be used in future bio-controlled games or virtual interfaces.

Flowchart:


Research and finalize project concept
Gather essential components
Design the circuit diagram
Write the control program
Test the system on a breadboard
Choose structure option
- 3D print a custom arm design
- OR buy a ready-made robotic arm kit
Assemble the robotic arm
Integrate components into the structure
Final testing and calibration

References:

1. ESP8266 Datasheet
2. MG90 Datasheet
3. Robu.in
4. Robocraze.com