PROSTHETIC ARM

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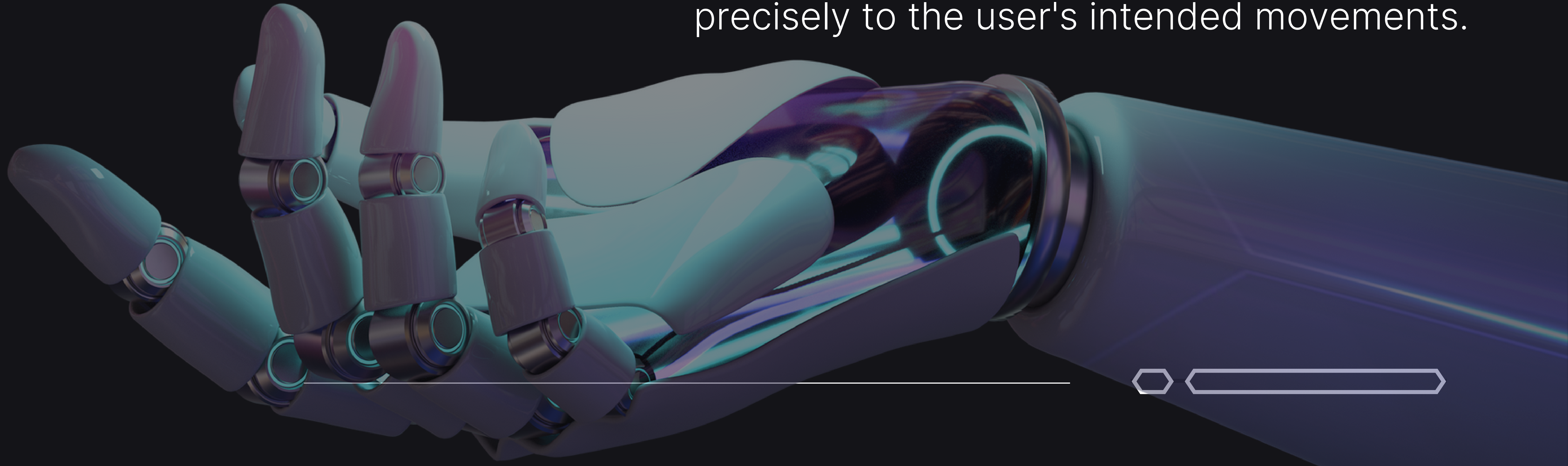
OBJECTIVE

Our project objective is to develop an innovative prosthetic device that surpasses existing alternatives in both cost and functionality. Our goal is to replicate the human arm's capabilities to the greatest extent possible, prioritizing durability, speed, and efficiency. To achieve this, we plan to utilize EMG signals from nerve endings, which will allow the prosthetic arm to respond precisely to the user's intended movements.



PHASE I

Learned about components and functions: Arduino Uno,Servo motors,Potentiometers Other motors Conducted research in:
Human Wrist Biomechanics
History and development of Prosthetic arms
Took measurements of joint angles for each finger
Developed a DIY model of Body-Powered Prosthetic Wrist
Recent developments:
Fingers can fold and unfold
Controlled by Arduino-programmed Servo Motor

JOINTS	INDEX FINGER	MIDDLE FINGER	RINGFI FINGER	LITTLE FINGER
MCP	85	84.8	86.5	89
PIP	98.83	102.3	97.91	86.5
DIP	79	78.33	76.8	83.73

The angles of the PIP, DIP, and MCP joints of all fingers of the right hand (excluding the thumb) were measured and averaged for both male and female individuals, as shown in the table.

PHASE II

Gained insights from biomechanics research and DIY model observations
Performed 3D printing of prototype model designed in Fusion 360
Assembled printed parts using super glue to form a human arm shape
Implemented fishing lines as ligaments and bolts for joints
Integrated Flex Sensors on the prototype
Flex Sensors measure bending/deflection by changing resistance
Mimics human finger movement
Placed Flex Sensors on a hand glove worn by a team member
Finger movements captured and replicated on prototype fingers
Flex Sensors connected to Arduino microcontroller and servo motors
Calibrated Flex Sensors for accurate finger movement replication
Focused on mimicking joint movements precisely
Phase II ongoing, with a clear plan for Phase III

PHASE III

In this phase, EMG Sensors are implemented which detect electrical nerve signals from muscles and send them to the Arduino Microcontroller which in turn is responsible for the movement of Servo Motors connected to the fingers of our prototype on placing the conductive pads are placed on certain positions of volunteer's forearm and accordingly it reads the nerve signal and works. Calibration of the sensor has been done on proper understanding of the working and mechanism of the EMG Sensor leading to precise and controlled movement of the prototype.

EMG Sensor

The EMG Sensor detects the electrical signals from the muscles on placing the conductive pads on certain positions of the volunteer's hand. The EMG Sensor consists of mainly three components: Surface Electrodes, Instruction Amplifiers, and Active Low pass filters. Surface Electrodes obtain the electric signals[5], the instrumentation filter removes the electromagnetic noises from the electric signals and the active low pass filter allows only the high-frequency signals to pass through[4] with a cutoff frequency of 482Hz,

ADVANTAGES

1) Strong built Quality
2) Portable and lightweight
3) Does not affect the human body
4) Easy to control

Applications

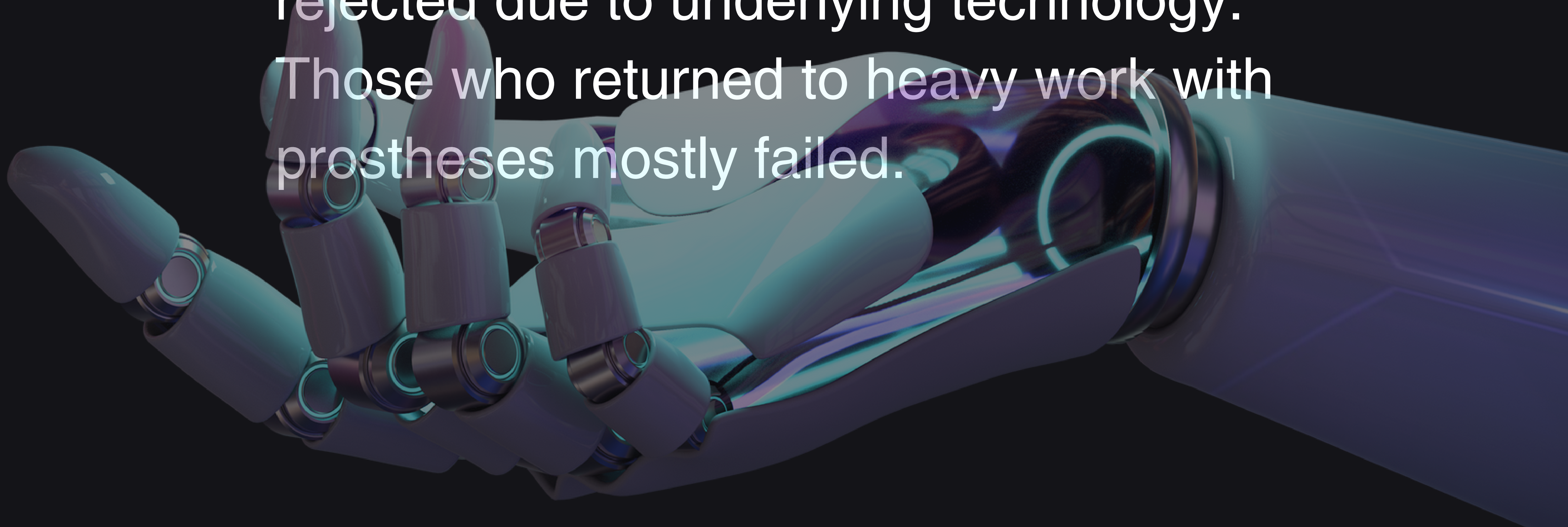
This prototype has multiple applications with its strong built quality and high efficiency with much lesser delay and latency as compared to other prostheses available in the market at the price point at which we have completed our project.

PROBLEMS

1) Lesser number of degree of freedoms than a human hand.
2) Not suitable for heavy weights. The weight bearing capacity needs to be studied in the future works. .
3) The material is not adjustable or easily modifiable to design changes

SOCIAL IMPACT AND ACCEPTANCE

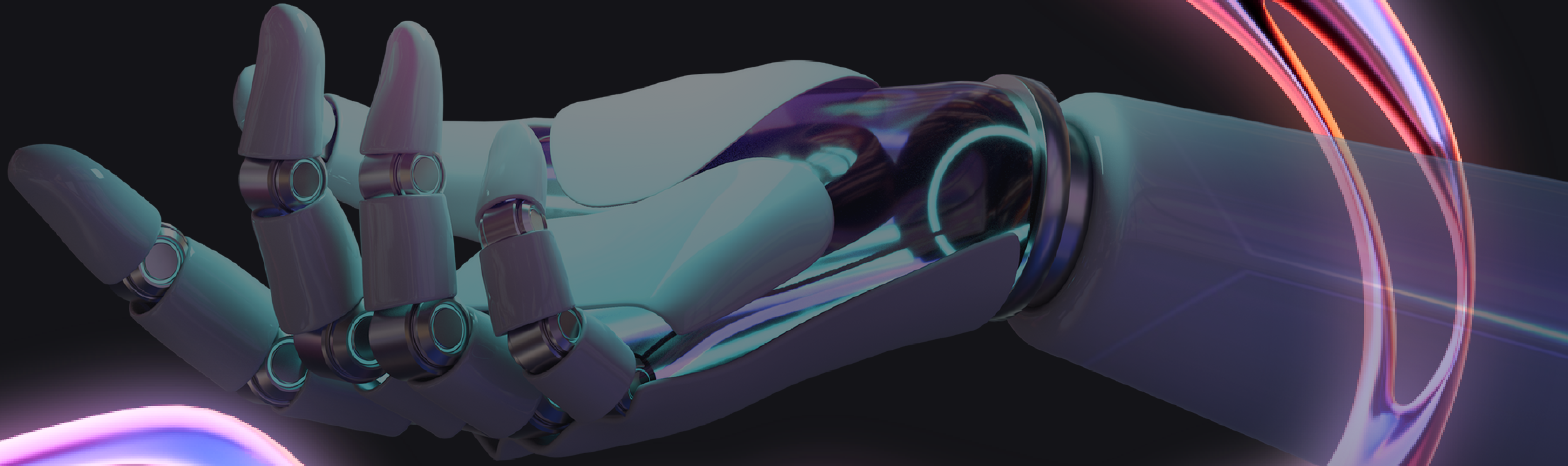
The acceptance rates for wrist and Myoelectric prostheses are 59% and 75%, respectively. Dissatisfaction rates are around 5%. Body-powered prosthetic arms are more popular for below elbow amputees as they can support heavy work for over 8 hours a day, while Myoelectric ones are rejected due to underlying technology. Those who returned to heavy work with prostheses mostly failed.



FUTURE PLANS

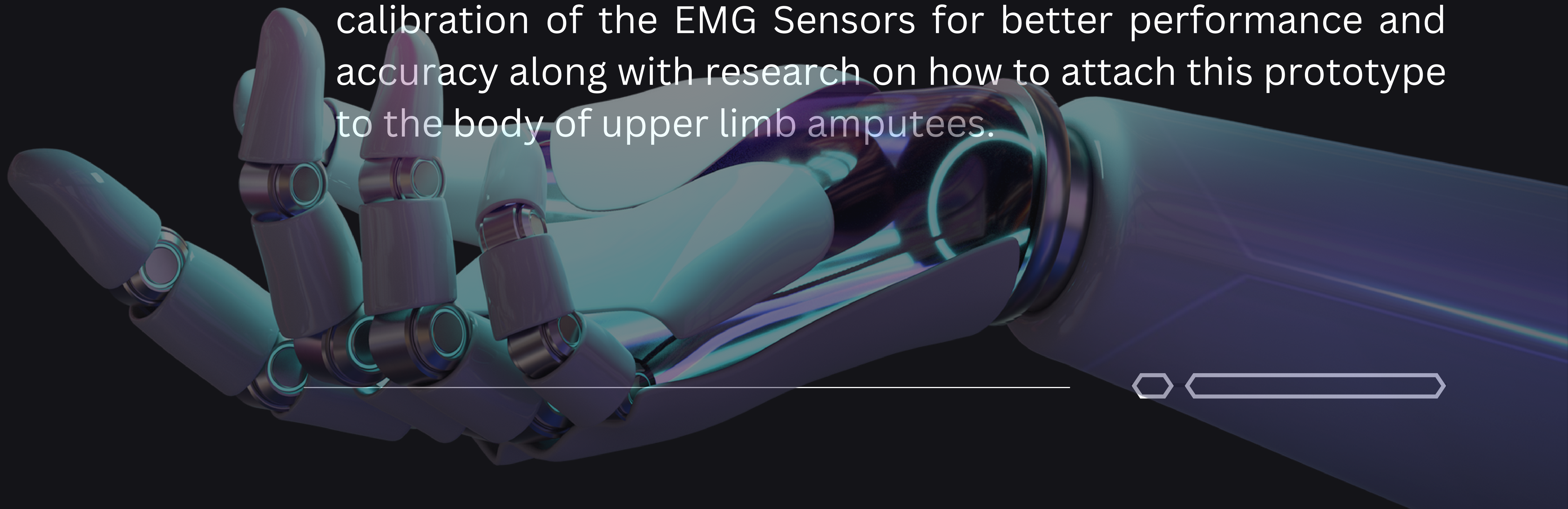
I/P → EMG SENSOR → MICRO CONTROLLER → SERVOS → O/P

SERVOS → ANGLE FEEDBACK → MICRO CONTROLLER



CONCLUSION

This work depicts the potential of EMG signals on how it can improve prosthesis technology. This work is completely done with the motivation of bringing a change in the lives of thousands of amputated people all over India and over the globe and also a small step in bringing a revolution in the prostheses industry. This paper provides a brief insight into the working and development of a Myoelectric Prosthetic Arm. Our future work would include further tuning and calibration of the EMG Sensors for better performance and accuracy along with research on how to attach this prototype to the body of upper limb amputees.



THANK YOU