NORTH SOUTH UNIVERSITY

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

FALL 2022

CSE499B/EEE499B/ETE499B

Senior Design Project II

Surface Electromyography (sEMG) Based Cost-Effective Prosthetic Arm

Faculty Advisor:

Md. Shahriar Hussain

Senior Lecturer

Department of Electrical & Computer Engineering

Names and IDs of the Team Members:

1. RIDHWAN HOSSAIN AFRIDI	***1822074043***
2. MD. ALIM ULLAH CHOWDHURY	***1811412043***
3. SABINA RAHMAN	***1822065043***

LETTER OF TRANSMITTAL

January 2023

To,

Dr. Rajesh Palit

Professor and Chairman,

Department of Electrical & Computer Engineering

North South University

Subject: **Submission of Capstone Project Report on** "**Surface Electromyography (sEMG) Based Cost-Effective Prosthetic Arm**"

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on "**Surface Electromyography (sEMG) Based Cost-Effective Prosthetic Arm**" as a part of our BSc program. The report deals with the design of a low-cost prosthetic arm for physically challenged people who do not have one or both arms. All our team members were very passionate about this project, and it helped us gain a lot of practical experience. We tried our best to meet all the dimensions required for the report.

We would be highly obliged if you kindly accepted this report and provided your valuable judgment. It would be our immense pleasure if you found this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

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Ridhwan Hossain Afridi

1822074043

Department of Electrical & Computer Engineering

North South University, Bangladesh

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Md. Alim Ullah Chowdhury

1811412043

Department of Electrical & Computer Engineering

North South University, Bangladesh

_____

Sabina Rahman

1822065043

Department of Electrical & Computer Engineering

North South University, Bangladesh

APPROVAL

Ridhwan Hossain Afridi (1822074043), Md. Alim Ullah Chowdhury (1811412043) and *Sabina Rahman (1822065043)* from the Department of Electrical and Computer Engineering of North South University, has worked on the Senior Design Project titled "**Surface Electromyography (sEMG) Based Cost-Effective Prosthetic Arm**" under the supervision of Md. Shahriar Hussain for the partial fulfilment of the requirement for the degree of Bachelor of Science in Engineering has been accepted as satisfactory.

Supervisor's Signature

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Md. Shahriar Hussain

Senior Lecturer

Department of Electrical & Computer Engineering

North South University

Dhaka, Bangladesh

Chairman's Signature

_____

Dr. Rajesh Palit

Professor and Chairman

Department of Electrical & Computer Engineering

North South University

Dhaka, Bangladesh

DECLARATION

This is to certify that this is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this property has been properly acknowledged.

Student's Names & Signature

1. Ridhwan Hossain Afridi

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2. Md. Alim Ullah Chowdhury

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3. Sabina Rahman

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ACKNOWLEDGEMENTS

We want to thank our faculty advisor, Md. Shahriar Hussain, Sir, for his constant support and motivation throughout this two-semester-long project. We would also like to thank our department, the Department of Electrical & Computer Engineering, for providing us with the necessary tools and equipment to complete the project.

ABSTRACT

Surface Electromyography (sEMG) Based Cost-Effective Prosthetic Arm

Surface Electromyography (sEMG) signals are biomedical signals that represent electrical currents generated during muscle activity, and our central nervous system controls these signals. As a result, we can develop a prosthetic arm using EMG technology. Currently, there are many myoelectric prosthetic arms available commercially. However, they are costly for developing countries like Bangladesh, India, and Pakistan. So we developed a cost-effective circuit to extract the electromyography signal from the skin. The signal from this detector circuit is imported in MATLAB using Arduino Uno R3 for signal analysis, such as Fast Fourier Transform (FFT) and Wavelet Transform (1-D), for the classification of features from the signal. We successfully detected two distinct features during the analysis: the Rest position and the Fist position of the hand. So we used the ESP32 microcontroller for the practical implementation of the system as it has better ADC (12-Bit), higher clock speed (80 MHz), better PWM, and lower power consumption. We used a threshold level to distinguish between the Fist and Rest positions. The threshold value was determined using the trial and error method, and this value may vary from person to person. Finally, the ESP32 drives five servo motors fitted inside the InMoov open-source 3D arm after determining the hand position.