Khulna University of Engineering & Technology, Khulna

Department of

Electronics & Communication Engineering

Project Proposal Report on:

Circuit for Extracting (γ)-band EEG Signal

Course No: ECE-3200

Course Title: Electronics Project Design & Development

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Supervised By

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Related Course studied:

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Title: Basic Electrical Engineering	Code: EEE-1109	Obtained Grade…….
Title: Analog Electronics II	Code: ECE 2101	Obtained Grade ……..
Title: Signals & Systems	Code: ECE 2107	Obtained Grade ……..

For Md Sajib Rahman (1909028)

Title: Basic Electrical Engineering	Code: EEE-1109	Obtained Grade……
Title: Analog Electronics II	Code: ECE 2101	Obtained Grade ……..
Title: Signals & Systems	Code: ECE 2107	Obtained Grade ……..

Motivation:

A study of Archives of Public Health states that, people with motor disabilities constitute about 10% of the total population of Bangladesh. These people are more likely to undergo poor health and associate facilities than those without disabilities. According to the World Health Organization (WHO), about 15% of the world's population lives with some form of disability, of whom 2-4% experience significant difficulties in functioning. The global disability prevalence is around 10%. An estimated 1.3 billion people, or 1 in 6 people worldwide, experience significant disability. Thinking about providing a better life for this huge amount of population, hopefully this project will help to contribute in designing cost-effective EEG signal (Gamma Band) extraction model that will pave the way of creating suitable solutions like brain-computer interface for solving and timely detection of certain motor disabilities which will decrease the difficulties faced by motor disabled people. The successful achievement of this project goal will bring me profound satisfaction and a sense of inner fulfillment. The project will also provide a certain pathway in medical sectors for implementing necessary tools and technologies which can ease the sufferings of such a large number of people.

Objectives:

The main objective regarding this project is to develop a gamma (γ)-band EEG signal extraction circuit and analyze particular circuit blocks based on the model to obtain certain comparative results. The specific objectives can be summarized as follows:

- To ensure proper detection EEG signal
- To implement individual circuit blocks in NI Multisim
- To analyze voltage gain referred to the source voltage
- To calculate compatible resistance and capacitance values
- To implement the circuit in the beadboard
- To visualize the ultimate EEG signal in the oscilloscope

Research Methodology & Implementation:

The initial data extraction of EEG signal can be executed by following two of the below-mentioned proposed processes.

i. **Accessing reference data being oriented with power source:** The reference brain signal data will be collected for both the normal person and motor disabled person. We would like to simulate the probable circuit by providing a power source that matches with the collected signal data characteristics. After passing through several circuit blocks, the extracted signal will be compared to characteristics of the reference signal.

ii. **Accessing reference data being oriented with direct human body interaction:** Direct biological artifacts related to different motor disabilities will be used as a signal source for the extraction circuit. The probable circuit will use that direct interaction as its power source of the signal. After passing through several circuit blocks, the extracted signal will be compared to characteristics of the reference signal.

Between the two possible or proposed methodologies, we will be focusing on the first one which is **Accessing reference data being oriented with power source.**

We can design a modified block diagram that will be the sequential implementation of our implemented methodology for the circuit

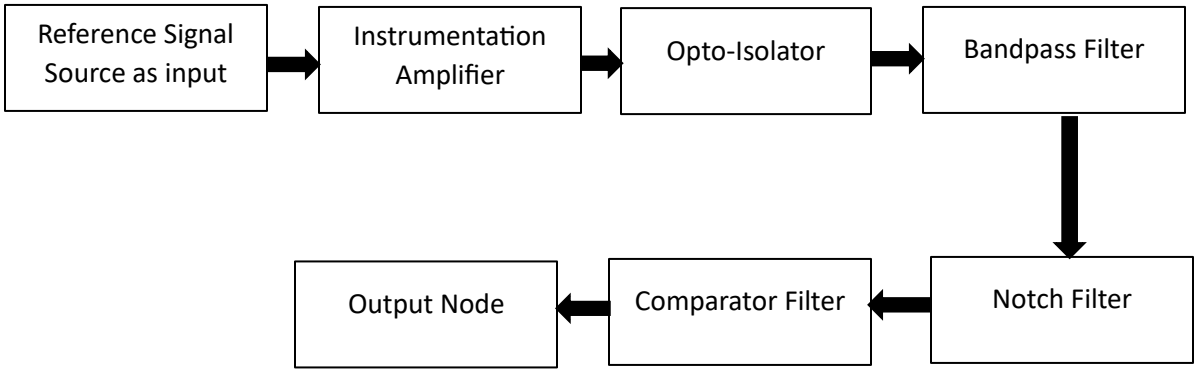

Figure 1: Block diagram for gamma (γ)-band EEG signal extraction

The connection between the preferred methodology and the above-mentioned block diagram is that the 'Reference signal source or input node' is referring to the access of reference data along with power source (function generator) without being exposed to direct human body interaction. In the methodology, human body interaction is indicated to the human brain scalp, from where the source signal is likely to be extracted using the 10-20 electrode placement method. Later on, the signal is needed to be pre-processed before applying to the input node of the circuit model. To avoid these complications and due to limitations regarding hardware access, the reference source

signal is selected as the primary voltage source of brain signal which will provide almost similar amplitude and frequency of a brain signal.

To complete the circuit the below blocks are needed to design.

1.Instrumentation Amplifier Block Design

2.Opto-isolator Block Design

3.Band-pass Filter Block Design

4.Notch Filter Block Design

5.Comparator Block Design

Work Plan:

Cycle Count	Works & Progress
4^{th} & 5^{th} cycle	To study for the project
6th cycle	To consult with supervisor
7^{th} cycle	To start simulation
8^{th} & 9^{th} cycle	To collect component
10^{th} cycle	To implement in breadboard
11^{th} cycle	To check further
12^{th} cycle	Discussion with supervisor
13^{th} cycle	To Finalize the project
14^{th} cycle	To submit the project

Expected Outcome:

1. **Successful Development of the Gamma-Band EEG Signal Extraction Circuit:**
    - The primary expected outcome is the successful design and implementation of the circuit for extracting gamma-band EEG signals.
2. **Accurate Detection of EEG Signals:**
    - The circuit should demonstrate its capability to accurately detect and process gamma-band EEG signals, contributing to reliable signal extraction.
3. **Validation of Simulation Results in Practical Implementation:**
    - Verify the alignment of simulation results with practical implementation, ensuring that the circuit functions as intended under real-world conditions.

4. **Optimized Voltage Gain and Circuit Performance:**
    - Achieve an optimized voltage gain and overall circuit performance, enhancing the amplification capabilities crucial for EEG signal analysis.
5. **Identification of Compatible Resistance and Capacitance Values:**
    - Determine and validate resistance and capacitance values that are compatible with practical implementation, ensuring the circuit's stability and functionality.
6. **Successful Implementation on the Breadboard:**
    - Demonstrate the successful transition from simulation to practical implementation by effectively configuring the circuit on a breadboard.
7. **Visualization of EEG Signals on an Oscilloscope:**
    - Showcase the visualization of the ultimate EEG signals on an oscilloscope, providing a tangible representation of the circuit's effectiveness in processing gamma-band signals.
8. **Documentation of Challenges and Solutions:**
    - Document any challenges encountered during the project and outline the corresponding solutions, contributing to a comprehensive understanding of the circuit's performance.
9. **Identification of Market-Available Components:**
    - Provide information on alternative components available in the market, addressing the challenge of non-availability of specific components identified during simulation.
10. **Contribution to Future Research and Applications:**
    - Lay the groundwork for future research and applications by contributing valuable insights into the development of circuits for gamma-band EEG signal extraction, potentially paving the way for advancements in healthcare technologies.
11. **Enhanced Understanding of Practical Circuit Implementation:**
    - Foster an enhanced understanding of the complexities associated with translating theoretical circuit designs into practical, functional implementations.

Signature of Student 1: …… Date: …….

Signature of Student 2: …… Date: …….

Signature of Supervisor: …….. Date: …….