SYNOPSIS PROFORMA

Submitted By:

Areej 2021-SE-13

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KING EDWARD MEDICAL UNIVERSITY, LAHORE
SYNOPSIS PROFORMA

Title of Research Project: NEURO INSIGHT	
Synopsis Submitted For: ☐ **MD / MS / MDS** ☐ **Ph. D** ☐ **M. Phil** ☐ **Research Grant**	**Discipline:** **Software Engineering**
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Qualification	Year	Institution
BS SE(BS Software Engineering)	**2025**	**UET Lahore New Campus**

Practical Experience (list all; with dates of employment):

Name of Parent Institution (if on Deputation):		
Name of Academic Supervisor / Principal Investigator: Dr.Irfan Yousaf	**Signature:**	**Date:**
Name of Co Supervisor / Co-Principal Investigator: Mr.Waqas Ali Zafar	**Signature:**	**Date:**
Name of Chairman/ Head of Department	**Signature:**	**Date:**
Name of Principal/ Dean	**Signature:**	**Date:**
Convener, Institutional Review Board **PROF. DR. SAQIB SAEED**	**Signature:**	**Date:**
Chairman (Advanced Studies & Research Board) ☐ **Approved** ☐ **Not Approved** **Vice Chancellor, KEMU**	**Signature:**	**Date:**

TITLE:

Epilepsy is a common neurological condition that requires an accurate diagnosis and timely medical assistance for effective treatment. This project aims to develop an application or system using advanced deep-learning techniques to diagnose epilepsy and categorize its types based on electroencephalogram (EEG) signals. The application will utilize Convolutional Neural Networks (CNN) or Recurrent Neural Networks (RNN) or Long Short-Term Memory (LSTM) networks to analyse EEG data. Data will be gathered from two to three hospitals in Lahore and annotated by specialist doctors to ensure accuracy. This approach fills a significant gap, as many current solutions rely on online benchmark data that may not accurately reflect the characteristics of our target demographic. Using locally specific data, our system intends to provide more precise diagnostic outcomes. In addition to diagnosis, the application or system will feature an early forecasting capability to predict potential epileptic episodes. This functionality aims to alert users about upcoming seizures, facilitating timely interventions and improved management of the condition. A key objective of this project is to aid young doctors in learning to diagnose epilepsy. The system will allow them to compare their analyses with the system's findings, thereby enhancing their diagnostic skills through practical experience. This educational tool bridges the gap between theoretical knowledge and practical application, ultimately aiming for better patient outcomes.

INTRODUCTION:

Epilepsy is a prevalent neurological disorder, affecting over 50 million people worldwide, with 80% of cases in low- and middle-income countries. Characterized by sudden seizures, epilepsy disrupts brain activity, impacting part or all of the body. With appropriate diagnosis and treatment, an estimated 70% of individuals with epilepsy could be seizure-free.

Electroencephalography (EEG) plays a crucial role in analyzing epileptic seizures. This non-invasive technique involves placing electrodes on the scalp to record the brain's electrical activity. During a seizure, EEG patterns deviate from normal signals. Epileptic events consist of four primary phases: preictal, ictal, postictal, and interictal, with patients mainly in the interictal state. Identifying the preictal phase is vital as it allows for timely medical intervention to prevent seizures and related accidents.

Traditionally, seizure detection from EEG signals relied on manual expert inspection, a time-consuming and error-prone process. To improve efficiency, machine learning techniques have been applied, primarily focusing on hand-crafted features in time and frequency domains. However, these methods often lack consistency in feature selection and may vary in classification accuracy.

Our project utilizes advanced deep learning techniques—Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Long Short-Term Memory Networks (LSTMs)—to automate feature extraction and enhance seizure detection and prediction accuracy. This approach offers reliable and efficient analysis by eliminating the need for manual feature selection.

We are developing a desktop application specifically for healthcare professionals in Lahore, using locally sourced EEG data. This tool allows doctors to input EEG signals and promptly receive automated diagnostic results. Data annotation is conducted with input from specialist doctors to ensure accuracy.

This deep learning-based system provides real-time analysis of EEG signals, aiding in epilepsy diagnosis and early seizure prediction. Designed as both a diagnostic aid and educational resource, the application empowers healthcare providers with faster, more accurate insights into epilepsy, ultimately improving patient outcomes and enhancing clinical expertise.

OBJECTIVES:

- To gather real-time EEG data from epilepsy patients in collaboration with local hospitals, ensuring it represents the local demographic.
- To employ deep learning techniques, such as CNN and LSTM, to automate the analysis and classification of EEG signals.
- To develop a user-friendly application providing real-time seizure prediction and detection for healthcare professionals.

OPERATIONAL DEFINITION:

- **Operational Definition:**

Since the model for detecting epilepsy from EEG data is still under development, this study outlines preliminary definitions and planned methods for measuring key outcomes. Once the model is developed, these definitions will be finalized based on the chosen model's functionality and performance.

1. **Epileptic Seizure:**
    - **Definition:** An event characterized by abnormal electrical activity in the brain.
    - **Planned Measurement**: Seizures will be identified as specific EEG patterns labeled by neurologists, with the model trained to recognize these patterns.

2. **Detection Accuracy:**
    - **Definition:** The model's ability to correctly identify epileptic seizures.
    - **Planned Measurement:** Accuracy will be assessed by comparing the model's predictions with expert-labeled data, measured as the percentage of correct diagnoses among total cases tested.
3. **False Positive Rate:**
    - **Definition:** The occurrence of non-seizure events incorrectly classified as seizures.
    - **Planned Measurement:** Once the model is operational, false positives will be recorded as a percentage of non-seizure events mislabeled by the system out of all non-seizure cases.
4. **Seizure Duration:**
    - **Definition:** The length of time each seizure event lasts.
    - **Planned Measurement:** Seizure duration will be measured from the start of seizure activity to the return of normal brain patterns in EEG data, as identified by the neurologist.
5. **Model Efficacy:**
    - **Definition:** The model's effectiveness in correctly detecting and classifying seizures.
    - **Planned Measurement:** Efficacy will be evaluated based on both detection accuracy and the speed of identifying seizure events.
6. **Sensitivity and Specificity:**
    - **Sensitivity:** The model's capacity to detect true seizure events.
        - **Planned Measurement:** Sensitivity will be calculated as the proportion of true seizures identified by the model out of all actual seizures.
    - **Specificity:** The model's capacity to avoid false detections.
        - **Planned Measurement:** Specificity will be calculated as the proportion of non-seizure events correctly identified as non-seizures.

HYPOTHESIS:

1. **Primary Hypothesis**: EEG data contains distinct patterns that can reliably indicate the presence of epilepsy. A deep learning model trained on EEG signals will accurately detect and classify epileptic seizures in patients.

2. **Secondary Hypothesis**: The model will differentiate between various types of epilepsy by identifying unique EEG signatures associated with each type.

MATERIAL AND METHODS:

- **Study Design**: Observational study using retrospective and prospective data collection.
- **Setting**: Neurology departments at King Edward Medical University, Lahore.
- **Duration of Study**: [Start and end dates for the study,]
- **Sample Size**: EEG data from 500+ patients diagnosed with epilepsy.
- **Sampling Technique**: Non-probability, convenience sampling.
- **Sample Selection**:

    - **Inclusion Criteria**: Patients diagnosed with epilepsy who consent to participate.
    - **Exclusion Criteria**: Patients with incomplete EEG records or other unrelated neurological disorders.

DATA COLLECTION PROCEDURE:

EEG data will be collected from the neurology departments of Shalamar Hospital and King Edward Medical University in Lahore. This process will involve:

1. **Patient Recruitment**: Neurologists will recruit patients diagnosed with epilepsy.
2. **EEG Data Recording**: EEG signals will be recorded and monitored in clinical settings.
3. **Data Annotation**: Neurologists will annotate seizure phases (preictal, ictal, interictal, postictal) to ensure model accuracy.
4. **Data Security**: All data will be stored securely with encryption, and patient confidentiality will be maintained.

DATA ANALYSIS PRODECURE:

Data will be analyzed using deep learning techniques, employing frameworks like TensorFlow and Keras:

- **Descriptive Statistics**: Summary statistics for patient demographics and seizure details.
- **Deep Learning Analysis**: Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks for real-time seizure prediction and classification.
- **Software**: Python, TensorFlow, and Keras

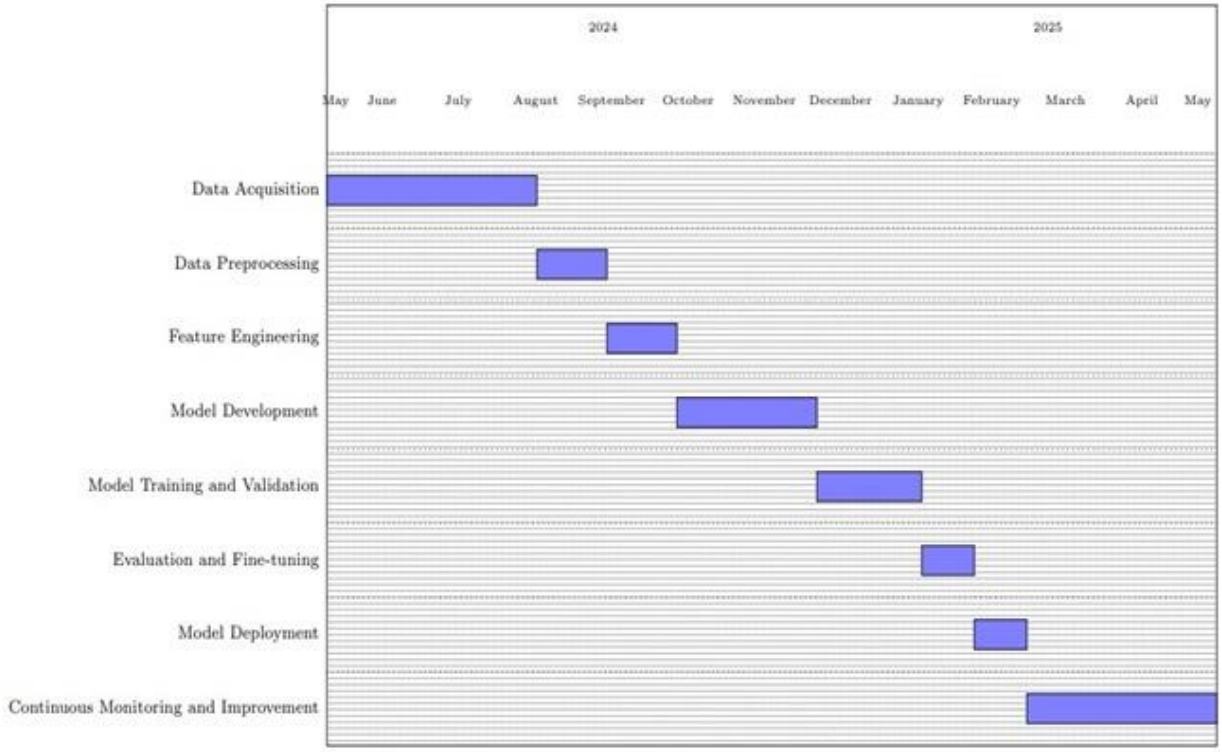
OUTCOME & UTILIZATION:

The anticipated outcome of this research is a robust diagnostic app for epilepsy that can be utilized by healthcare providers to deliver improved patient care. The tool will aid in early detection of seizure activity, potentially preventing injuries. Moreover, it will serve as an educational resource for trainee doctors.

SCHEDULE/PHASING:

Task	Duration (weeks)	Start Date	End Date
Data Acquisition	12	2024-05-25	2024-08-16
Data Preprocessing	4	2024-08-17	2024-09-13
Feature Engineering	4	2024-09-14	2024-10-11
Model Development	8	2024-10-12	2024-12-06
Model Training and Validation	6	2024-12-07	2025-01-17
Evaluation and Fine-tuning	3	2025-01-18	2025-02-07
Model Deployment	3	2025-02-08	2025-02-28
Continuous Monitoring and Improvement	11	2025-03-01	2025-05-15

Table 1: Project Schedule (Part 1)



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- Smith J, Doe A. Epileptic Seizure Detection Using CNN-LSTM Networks on EEG Data. *IEEE Trans Biomed Eng*. 2023;67(4):1234-1242.
- Kim Y, Park S. Epileptic Seizure Detection Using a Hybrid Deep Learning Model. *IEEE Access*. 2022;10:112233-112244.
- World Health Organization. Epilepsy: Health Topics According to WHO. *WHO Health Topics*. Available at: [URL].
- Maimaiti B, Meng H, Lv Y, et al. An Overview of EEG-Based Machine Learning Methods in Seizure Prediction and Opportunities for Neurologists. *Neuroscience*. 2022;481:197–218.

DATA COLLECTION INSTRUMENT:

The data collection proforma will capture patient demographics, EEG details, and seizure annotations as per the study's objectives.

Sanctity of data - Affidavit

I, Mr/Ms_____S/o_____
Student of_____
working in _____
Under Supervisorship of _____

Hereby undertake to abide by the following rules

1. **That the data collected during my attachment at King Edward Medical University (to be call KEMU here after) for which authorization is being granted by the Institutional Review Board (to be called IRB here after) of KEMU for which I have submitted my synopsis titled_____ _____ shall be used exclusively for the purpose of "not for profit" research and will not use for any other purpose what so ever. Any financial gain or patent originating from this research shall be equally shared with KEMU.**
2. **The data collected shall be strictly limited to the parameters defined in my synopsis titled _____ _____**
3. **That the identity of patients (cases) shall not be revealed.**
4. **That prior approval for research project (synopsis) has been obtained from the Institutional Review Board/ Ethical Committee of my parent institution.**
5. **That appropriate recognition and acknowledgement shall be given to KEMU in the publication of the paper/papers or any other medium of communication what so ever, if it utilizes the data/ graphs/tables/pictures collected from the aforementioned research, furthermore, in any subsequent publication or any other medium of communication what so ever, if it utilizes the above mentioned data/graphs/tables/pictures with proper acknowledgement (as mentioned below) and with prior intimation and authorization of IRB of KEMU.**
6. **The aforementioned acknowledgement/recognition shall be mutually decided between the principal investigator (myself) and the in charge of the unit concerned at KEMU, under intimation to the IRB of KEMU.**

I have read all the clauses of the above written agreement and hereby agree to be legally bound to this agreement in letter and spirit. I also understand that if I am in breach of this contract; I shall lose the right to the data/publication/graphs/tables collected/published (stored in any form physical/electronic) thereof. In addition, KEMU will reserve the right to initiate proceedings against me at any/all for a deemed appropriate. Research Supervisor (as shown below) shall stand witness and guarantor of this agreement and would be equally liable in case of breech of agreement.

Signature (Principal Investigator)
NIC No._____

Signature of Supervisor
NIC No._____

Proforma for Evaluation of Research Synopsis

Board of Studies

NOTE: (It should be filled in by All Members of BOS individually)

Title:_____

_____

_____

A. Must fulfill all of the following.

Sr.No.	Essential Criterion	No	Yes
1.	According to prescribed format		✓
2.	Principal Investigator and Co investigator mentioned		✓
3.	Consent form given		✓
4.	Proforma for data collection given		✓
5.	Follow up proforma given		✓
6.	Non-compliance with previous research protocol	✓	
7.	Repitition of Study	✓	

B. Kindly evaluate this research proposal and grade the research proposal against each item. Must get at least 1 in all sections to qualify. Please check the appropriate box.

Sr. No.	Criterion	Grading					
1.	Novelty of research idea	0	1	2	3	4	5
2.	Potential for capacity building (Skills)	0	1	2	3	4	5
3.	Multidisciplinary	0	1	2	3	4	5
4.	Contribution of research topic towards public benefit	0	1	2	3	4	5
5.	Contribution of research topic towards medical knowledge	0	1	2	3	4	5

Total Score	**25**	**Score Obtain**	

Name:_____ Signature: _____

List of Required Documents for Approval of Institutional Review Board

- **Informed Consent Form in English and Urdu**
- **Subject Recruitment Procedure**
  (e.g OPD, Indoor, Advertisement)
- **Investigator's Brochure and Available Safety Information for Patient**
  (Please devise patient information in Urdu detailing the complications, if any, and benefits of the device/ devices and comparison with conventional technique)
- **Investigator's Curriculum Vitae detailing qualification**
- **Sanctity of Data form - Affidavit duly filled in and signed**
- **Detailed Visit Forms**
  (Please make Separate Proformas for every visit. Keeping in Mind Inclusion and Exclusion Criteria)
- **Minutes of Board Of Studies / Approval of BOS**
- **Proforma for Evaluation of Research Synopsis filled in individually by members of the Board of Study**
- **Soft Copy of Synopsis along with soft copy of articles of all references submit in Research Center on CD.**