BSCS 3-1 Thesis Writing 1 Research Proposal Template

| **Research Proposal** | |
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| **Proposed / Working Title** | Application of Sequence-to-Sequence (Seq2Seq) Models in the Detection of Artifacts in Electrodermal Activity Signals for Stress Detection |
| **Proponents** | Benolirao, Johana G.  Calubayan, Christaline B.  Cueva, Larry Miguel  Quiray, Deseree O. |
| **Rationale of the Research**   * *What global/national/local concern might be addressed by the proposed research?* * *Who will benefit from the research?* * *What gap in the existing literature/researches will the research study fill?* | **What global/national/local concern might be addressed by the proposed research?**   * Global Mental Health Crisis * Access to mental healthcare services with many regions facing shortages of Mental Health Professionals. * Public safety and security such as in identifying the effectiveness of stress detection for first responders and military personnel. * Impacts in learning and student academic performance.   **Who will benefit from the research?**   * The Future Researcher that can advance the understanding of EDA and its application in various fields, such as psychology, medicine, and human computer interaction. * Psychologists and Psychiatrists that could aid in diagnosing and monitoring mental health conditions like anxiety, depression, stress, and arousal levels. * Medical Professionals that could use the findings to develop new diagnostic tools for conditions related to autonomic nervous system function. * Also, Individuals that could benefit from improved mental health monitoring and interventions, leading to better stress management and overall health conditions.   **What gap in the existing literature/research will the research study fill?**   * Electrodermal Activity signals gathered from wearable sensors are considered as time series data and existing models that used traditional methods, particularly using SVM algorithm for the detection, are subject to some issues. The use of SVM may result in requiring tedious feature engineering, which is crucial to handle temporal dependencies. |
| **Research Objectives/Questions/Hypotheses**   * What specific objectives/ questions will your research study seek to attain/answer? * Are these questions specific, measurable, attainable, realistic, time-bounded, novel? | **What specific objectives/ questions will your research study seek to attain/answer?**  Research Objective/s:   * To create a hybridized model of LSTM and SVM to handle temporal dependencies * Compare the performance of the proposed model with the existing traditional models such as SVM, KNN, LogRes in detecting artifacts   Research Question/s:   * What is the performance of the hybridized LSTM-SVM in terms of:  1. Accuracy 2. Precision 3. Recall 4. F1 Score  * What is the optimal learning rate for the proposed model to achieve higher performance metrics than the other state of the art ML techniques such as SVM, KNN, Decision Tree? |
| **Knowing what happened in the past**  (Review of related study) | ***Theme 1: Detection of Artifacts in Ambulatory Electrodermal Activity Data***  Gashi et al. described artifacts as "changes in the recorded biosignal that do not stem from the signal source in question," which may be caused by the recording technology or recognized physiological reactions in the system that are not electrodermal signals.These may result in a waste of effort in acquiring electrodermal signals since they produce inaccurate information due to the low quality signals retrieved. This study employed strategies for an autonomous strategy to detect abnormalities in the structure of EDA signals and assessed signal quality in terms of thermoregulation responses. The model achieved a recall of 98%, a notable improvement of 42 percentage points over the baseline classifier. It is stated that the approach can replace or reduce the efforts of human experts to visually assess the received data, but further research into other aspects that may appear to be actual signals would make a significant contribution.  ***Theme 2: Automatic Artifact Recognition and Correction for Electrodermal Activity in Uncontrolled Environments***  Llanes-Jurado et al.(2021), investigated the impact of movement artifacts on recorded EDA signals under uncontrolled conditions, resulting in the obscurity of key patterns. This study looked into the use of a range of machine learning and deep learning technologies, such as support vector machines, recurrent neural networks (RNNs), and convolutional neural networks. In the experiment, the model that used an RNN fed with raw data identified 72% of the artifacts and obtained an 87% accuracy rate. The detected artifacts were automatically rectified with linear interpolation and a high degree polynomial. When evaluated, the automatically and manually corrected signals deviated from the raw signals. The study generated important results for future studies that might improve and develop artifact identification in EDA signals.  ***Theme 3: Automatic motion artifact detection in electrodermal activity data using machine learning***  Hossain et al. (2022) also investigated the use of machine learning for the automated identification of electrodermal activity data. For a more precise resolution, the researchers in this study used a reference signal free of motion artifact to identify data as clean or noisy using an annotated electrodermal database. A binary classification was created as part of the study's approach to identify the EDA segments that have motion artifacts. After that, features from the signals were taken out, categorized, hyperparameter tuned, and assessed. This experiment produced automatic motion artifact identification with 94.7% accuracy; the method's performance was compared to other well-established motion artifact detection techniques. However, given the limitations of this study and the need for more research, there is still a need for more investigation.  Research Gap :  Existing studies use SVM and other traditional models which offers exemplary performance when it comes to detection and removal of the artifacts but there is a limitation when it comes to treating the EDA signals acquired as temporal data which may be subject to temporal dependencies. |
| **Research Participants**  (Subjects for Experiment/Respondents for questionnaire)  *(Description and demographic profile of the participants)* | There will be no research participants for our study. It will only focus on developing a hybridized LSTM-SVM model for the detection of artifacts and testing it on an existing benchmark dataset for artifact detection and comparing its performance with the currently existing models. |
| **Ethical Considerations**  *(informed consent, disclosure of conflict of interest, anonymity)* | In conducting this research on developing a hybridized LSTM-SVM model for artifact detection, we will ensure data privacy by using anonymized, consented datasets and adhering to all licensing agreements for data usage. The model's accuracy and limitations will be transparently reported, with considerations for minimizing false positives and negatives to mitigate adverse impacts on downstream applications. We will acknowledge the dual-use nature of the technology and propose safeguards against misuse. Performance comparisons with existing models will be conducted under identical conditions using standardized metrics to ensure fairness. |
| **Data Collection**  *(Plan-Act-Observe-Discuss)*  Procedures, Tools, Methods, Techniques | Our study will be using a dataset by Llanes-Jurado et. al (2023) which is “Electrodermal Activity artifact correction BEnchmark (EDABE)” which is a dataset for training and testing artifact recognition and correction models to automatically remove major artifacts in EDA signals. |
| **Data Analysis**  Procedures, Tools, Methods, Techniques | In this study, the data collected from the EDABE dataset will be subjected to analysis using our proposed LSTM-SVM model. Data preprocessing such as filtering, artifact detection and correction, segmentation, normalization and standardization, and feature extraction preparation would be necessary. |
| **Gantt Chart (Attachment)** | See below |
| **References**  *(APA Format)* | Gashi, S., Di Lascio, E., Stancu, B., Swain, V. D., Mishra, V., Gjoreski, M., & Santini, S. (2020). *Detection of Artifacts in Ambulatory Electrodermal Activity Data. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 4(2), 1–31.* doi:10.1145/3397316  Hossain, M. B., Posada-Quintero, H. F., Kong, Y., McNaboe, R.,  & Chon, K. H. (2022, April 1). *Automatic motion artifact detection in*  *electrodermal activity data using machine learning*. Biomedical Signal  Processing and Control. https://doi.org/10.1016/j.bspc.2022.103483 |

|  | GANTT CHART | | | | | | | |  |  |  |  |  |  |
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|  | MONTH | | | | | | | |  |  |  |  |  |  |
| ACTIVITIES | | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | OCT | NOV | DEC |
| 1. Review of Related Works | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Keywords, Problem identification | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Instrument formulation (survey) and interview | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Identification of interventions | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Instrument Reliability and Validity Check | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Conduct initial survey | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Make adjustments to interventions based on survey results | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Implement the interventions based on survey | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Conduct after implementation survey | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Discussion of results | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Summary, conclusion and recommendation | |  |  |  |  |  |  |  |  |  |  |  |  |  |