Department of Computer Science and Engineering
Bangladesh University of Business and Technology (BUBT)

CSE 478: Literature Review Records

Student's Id and Name	**Name:** Abu Yusuf Sarker and **ID:** 19202103417
Project Title	Depression Detection using Machine Learning
Supervisor Name & Designation	**Name:** Khan Md. Hasib & **Designation:** Assistant Professor, Department of CSE, BUBT
Course Teacher's Name & Designation	**Name:** Khan Md. Hasib & **Designation:** Assistant Professor, Department of CSE, BUBT

Aspects	Paper # 1 (Title)
Title / Question (What is problem statement?)	Machine Learning-based Approach for Depression Detection in Twitter Using Content and Activity Features
Objectives / Goal (What is looking for?)	The main aim of the work was to propose a Machine learning-based approach for Depression Detection in Twitter Using Content and Activity Features
Methodology / Theory (How to find the solution?)	A quantitative study is conducted to train and test various machine learning classifiers to determine whether a twitter account user is depressed, from tweets initiated by the user or his/her activities on Twitter. The work was divided into three phases, • The first phase was the collection of data, • The second phase was pre-processing and computation of data, and • Third phase was the visibility of results.
Software Tools (What program/software is used for design, coding and simulation?)	Document Viewer, Machine Learning Frameworks, NLTK, Database Management, Version Control, spaCy, Gensim, VADER Sentiment Analysis.
Test / Experiment How to test and characterize the design/prototype?	We use a dataset for Twitter users who suffer from depression. The self-reports are collected by searching Twitter using a regular expression. Candidate users are filtered manually, and then, all their recent tweets are continuously crawled using the Twitter Search API. To ensure that users are disclosing their own depression and not talking about a friend or a family member, a human annotator reviews these tweets. For each user, up to 3000 of their most recent public tweets are included in the dataset, and each user is isolated from the others. Note that this 3000-tweet limit is derived from Twitter's archival polices [40]. Non-depressed users are collected randomly and checked manually to ensure they never post any tweet containing the character string "depress." In an effort to minimize noisy and unreliable data, users with fewer than five Twitter posts are excluded.
Simulation/Test Data (What parameters are determined?)	1. Initial Paper Evaluation 2. Checklist Development 3. Data Inspection 4. Ethical Considerations 5. Synthesize Findings
Result / Conclusion (What was the final result?)	The results support the same conclusion: although the dataset becomes richer, the detection algorithm becomes more stable and the trade-off between precision and recall becomes narrower. Moreover, SVM outperforms other detection algorithms with better accuracy. • SVM-L and NB show an increase that reaches 82 • SVM-L and 80 • The F measure is also increased, reaching 0.79 in SVM-L.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	In the future, the work could be extended for different applications like weather forecasting, military applications, food predictions, etc.
Terminology (List the common basic words frequently used in this research field)	Social Media Analytics, Depression Detection, Machine Learning (ML), Support Vector Machine (SVM), Naive Bayes, Decision Tree, Feature Selection

Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	

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Aspects	Paper # 2 (Title)
Title / Question (What is problem statement?)	Detection of Child Depression using Machine Learning Methods
Objectives / Goal (What is looking for?)	The main aim of the work was to propose an approach for Detection of Child Depression using Machine Learning Methods
Methodology / Theory (How to find the solution?)	Unhappy, nothing fun, irritable mood, diminished interest, weight loss/gain, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue, thinking or concentration prob- lems or indecisiveness, suicide attempt or plan, presence of any of these five symptoms have been identified as 11 important features to detect depression among children and ado- lescents.
Software Tools (What program/software is used for design, coding and simulation?)	RF, Boruta, TPOTclassifier, XGB, DT, GaussianNB.
Test / Experiment How to test and characterize the design/prototype?	Our dataset containing 5839 nondepressed class and 471 depressed class, is completely imbal- anced [39]. By separating the entire dataset into training (70 observations) datasets, the random forest classifier has been employed with the Boruta method yielding the 11 input features. In this paper, the random forest classifier has been used with Boruta algorithm for its unbiased and stable selection by splitting the entire dataset into training and test datasets accompanied by 63 top ranked features. Using the sci-kit-learn module, the TPOT classifier has been applied to the training set.
Simulation/Test Data (What parameters are determined?)	Target variable: The variables informing the status of depression confirming by doctor or mental health professional, continuing diagnosis of depression have been selected for measuring the target variable. If any of these variable's value is true, target variable is confirmed as depressed = 1, otherwise nondepressed = 0. Feature selection: In our dataset, a minority class is observed to have a 'Depressed' class, whereas a majority class is considered to become a 'Nondepressed' and thus the data set is imbalanced. All variables that inform the depression confirmed by a doctor or professional mental health care professional, other than the target variable, have been removed from the training set as they were considered in the target variable.
Result / Conclusion (What was the final result?)	Depression detection in child and adolescent is very important for the early diagnosis for their learning as well social and academic development. In this study, Random Forest (RF) has proved to be an efficient and accurate classifier to detect depression using YMM, a large dimensional dataset of mental health of children and adolescents in Australia. Moreover, the performances of all four algorithms (XGB, RF, DT, and GaussianNB) in terms of confusion matrix parameters.

Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article) In the future, the work could be extended for different applications like weather forecasting, military applications, food predictions, etc.

Terminology (List the common basic words frequently used in this research field) Children Analytics, Depression Detection, Machine Learning (ML), Support Vector Machine (SVM), Naive Bayes, Decision Tree, Feature Selection

Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
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Aspects	Paper # 3(Title)
Title / Question (What is problem statement?)	Detecting Student Depression Using Smartphone Data
Objectives / Goal (What is looking for?)	The main aim of the work was to propose an approach for Detecting Student Depression Using Smartphone Data
Methodology / Theory (How to find the solution?)	A neural network has multiple hidden layers between input and output layers. The computation of a high number of parameters is necessary for training a neural network with several layers, which raises computational expense and energy use. The application was built using Android Studio version 2021.2.1. To develop this app, we considered some frameworks such as TensorFlow Federated, PySyft and Deep Learning for Java.
Software Tools (What program/software is used for design, coding and simulation?)	Python, Android/IOS development tools, Pandas, NumPy, XGBoost, Zoom, Slack
Test / Experiment How to test and characterize the design/prototype?	We employed an android application developed by the authors at [41] to collect da-ta. A group of students from the Computer Science and Engineering department at Ahsanullah University of Science and Technology was recruited for data collection. The interested volunteers were provided with a Google Form link that contained the Paper—Depression Detection Through Smartphone Sensing: A Federated Learning ApproachPHQ-9 questionnaire and a Google Drive link to download the app. Sensor data was collected from their smartphones for two weeks. The app was running in the device's background, and readings from the accelerometer, gyroscope, gravity, and magnetometer sensors were taken once every five minutes. Then the data was uploaded and stored in a real-time database called Firebase.
Simulation/Test Data (What parameters are determined?)	A total of 205 participants filled in the PHQ-9 questionnaire, of which only 145 downloaded the app. However, we accumu-lated sufficient data from only 80 volunteers. Around 90% of them were aged be-tween 21-25. Amongst them, 66.25% of the participants were male, and the remaining 33.75% were female. So, the collected data was not from a diverse group. As shown in Figure 2, the dataset was also heavily imbalanced.
Result / Conclusion (What was the final result?)	The findings of our experiment are described in this section. Before federated training, a centralized neural network was trained based on smartphone sensor data, and then prediction was performed on the test set. 20% of the data was utilized for testing, while 80% was used for training. To evaluate the model, we used accuracy, precision, recall, and F1-score as the performance metrics. Accuracy can be defined as how frequently the classifier makes the correct prediction. The ratio of samples that are accurately classified as positive to all the samples that are classified or misclassi-fied as positive is known as precision.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	In the future, the work could be extended for different applications like weather forecasting, military applications, food predictions, etc.

Terminology (List the common basic words frequently used in this research field)	Depression prediction, Federated learning, mHealth, Smartphone sensors, Data security
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	

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Aspects	Paper # 4(Title)
Title / Question (What is problem statement?)	Depression Detection Through Smartphone Sensing: A Federated Learning Approach
Objectives / Goal (What is looking for?)	The main aim of the work was to propose an approach for Depression Detection Through Smartphone Sensing
Methodology / Theory (How to find the solution?)	The sensor data derived from smartphones correspond to the motion and position of a person. Previous studies have shown that smartphone sensor data has a high potential for correctly predicting depression severity [15], [20]. Another key factor in determining the degree of depression is demographic data, such as age and gender. We collected the participants' age and gender information during the data collection phase. However, only gender was used as the demographic factor in the current study. Most of the participants were between the ages of 21 and 25, indicating that the data was not truly representative of all age groups. So, we decided to exclude the age of the participants from this study.
Software Tools (What program/software is used for design, coding and simulation?)	Python, Android/IOS development tools, Pandas, NumPy, XGBoost, Zoom, Slack, TensorFlow, Jupyter.
Test / Experiment How to test and characterize the design/prototype?	The paper utilizes smartphone sensor data for predicting depression severity using a federated learning approach.
Simulation/Test Data (What parameters are determined?)	A total of 205 participants filled in the PHQ-9 questionnaire, of which only 145 downloaded the app. However, we accumu-lated sufficient data from only 80 volunteers. Around 90% of them were aged be-tween 21-25. Amongst them, 66.25% of the participants were male, and the remaining 33.75% were female. So, the collected data was not from a diverse group. As shown in Figure 2, the dataset was also heavily imbalanced.
Result / Conclusion (What was the final result?)	The study applies federated learning to predict depression severity using smartphone sensing capabilities and develops a deep neural network model for this purpose . The results of the study are quite promising, validating the potential of federated learning as an alternative to traditional machine learning for depression detection . The performance of the deep neural network model is measured in both centralized and federated learning settings, demonstrating the effectiveness of the federated learning approach
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	In the future, the work could be extended for different applications like weather forecasting, military applications, food predictions, etc.
Terminology (List the common basic words frequently used in this research field)	Smartphone features, Depression prediction, Federated learning, mHealth, Smartphone sensors, Data security

Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
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Aspects	Paper # 5(Title)
Title / Question (What is problem statement?)	A Deep Learning-based Model for Detecting Depression in Senior Population
Objectives / Goal (What is looking for?)	The main aim of the work was to propose an approach for A deep learning-based model for detecting depression in senior population
Methodology / Theory (How to find the solution?)	Demographic information and acoustic data of 56 Mandarin-speaking older adults with major depressive disorder (MDD), diagnosed with the Mini-International Neuropsychatric Interview (MINI) and the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5), and 47 controls was collected. Acoustic data were recorded using different smart phones and analyzed by deep learning model which is developed and tested on independent validation set. The accuracy of the model is shown by the ROC curve.
Software Tools (What program/software is used for design, coding and simulation?)	Python, NumPy, Google Cloud, Zoom, Slack, TensorFlow, Jupyter.
Test / Experiment How to test and characterize the design/prototype?	In order to test the performance of the depression classifier we collected a separate test set containing 109 participants in this trial who were depressed and non-depressed people aged between 50 and 65 collected online and outpatient of Peking University Sixth Hospital, The Fifth people's Hospital of Tangshan from November 2020 to September 2021, of which two were not enrolled because of ethnic minorities and four were excluded because of depression remission, which we'll mention in the following parts. Depressive episode was diagnosed in 56 individuals with 21 males (37.5%) and 35 females (62.5%), while the healthy control consisted of 17 males (36.2%) and 30 females (63.8%).
Simulation/Test Data (What parameters are determined?)	The mean age of disease group is 57.73 years (±4.69), and control group is 57.57 years (±4.96, p-value 0.869). There were no significant differences in age, gender and BMI between disease group and healthy control group (p ¿ 0.05; Table 1). Among 103 participants, there was a statistically significant difference in the HAMD score, HAMA score, SDS score between the disease group and the control group (p ¡ 0.05). The detail of demographic information of participants can be founded in Supplementary material.
Result / Conclusion (What was the final result?)	The quality of the collected speech affected the accuracy of the model. The initial sensitivity and specificity of the model were respectively 82.14% [95%CI, (70.16–90.00)] and 80.85% [95%CI, (67.64–89.58)].
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	Quality of collected speech affects the accuracy of the model. The model's initial sensitivity and specificity were 82.14% and 80.85% respectively.

Terminology (List the common basic words frequently used in this research field)	Deep Learning, Rapid Binary, MINI, DSM-5, Vocal Biomarkers
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	