Detection of Depression on Social Media X with FastText Feature Expansion Using Hybrid Deep Learning CNN-GRU

1st Wahyu Nata Mahendra
School of Computing
Telkom University
Bandung, Indonesia
mahendranata@student.telkomuniversity.ac.id

2nd Erwin Budi Setiawan
School of Computing
Telkom University
Bandung, Indonesia
erwinbudisetiawan@telkomuniversity.ac.id

***Abstract*— Depression is a mental illness that is experienced by many people in the world. Depression can have serious repercussions such as suicide if not treated early. Therefore, it is important to conduct early detection to provide mental support and appropriate treatment. Detection can be done through one way, namely identifying posts on social media. Thus, this study aims to detect depression through Indonesian tweets on social media X using a hybrid deep learning approach, namely Convolutional Neural Network (CNN), Gated Recurrent Unit (GRU), CNN+GRU, and GRU+CNN, by utilizing FastText feature expansion and applying optimization. The dataset used consists of 50,523 data and corpus similarity with a total of 100,594 used in feature expansion. This research evaluates the model performance using five scenarios including Split Data, N-Gram, Max Features, Feature Expansion, and Optimization. The best results were obtained with Split Data 90:10, Unigram + Bigram + Trigram, max features 10,000 for CNN and GRU, and 5,000 for the hybrid model. Feature expansion using FastText Top 1 on the combination of Tweet + IndoNews dataset improves hybrid model performance. The Nadam optimizer provides optimal results for CNN+GRU, while Adam is optimal for GRU+CNN. The CNN+GRU and GRU+CNN hybrid models achieved the best accuracy of 83.19% with an improvement of 1.36% and 83.32% with an improvement of 1.44%, respectively, showing significant improvement over the baseline.**

Keywords—convolutional neural network, depression, fasttext, gated recurrent unit, hybrid deep learning, optimization.

I. INTRODUCTION

Depression is a serious mental disorder that affects behavior and daily life, impacting millions of people worldwide [1]. Feelings of hopelessness, lack of motivation and interest in activities such as physical, social activities, and unpleasant mood swings are signs of depression [2]. Mood changes that are often experienced are depressed feelings such as feelings of unhappiness, anxiety, loss of appetite, boredom, lack of concentration, and others [3]. Despite the availability of effective treatments for mental health illnesses, depression is still a major problem, with around 280 million people in the world having experienced it, as estimated by the World Health Organization (WHO) [4]. Depression is one of the main reasons for the approximately 800,000 deaths by suicide that occur every year worldwide [5]. Depression and suicide are two mental illnesses that can be prevented and treated [6]. The first step that needs to be done is to identify and detect people who are at risk of depression, one way that can be done is to analyze their posts on social media [7]. Social media is one of the means or places for people with depression to express their hearts, complaints, and depressed feelings [8].

Social media platforms have evolved rapidly. X, the new name for Twitter, X is a widely used platform in Indonesia and has the fourth highest number of users [9]. Platforms such as X have a significant appeal to individuals to share thoughts and emotions about a series of events that exist in everyday life [10]. Many individuals with depressive symptoms make posts or tweets with language that can express feelings of helplessness, guilt, worthlessness, and self-hatred [11]. Thus, the data on social media can be used as a basic capital to detect depression [12]. Depression detection can be done using machine learning algorithms with various features [13]. In addition, previous research on depression identification has used both hybrid and non-hybrid deep learning techniques.

In the study [10], a hybrid deep learning model CNN-LSTM with FastText is used to detect depression from text analysis on social media, there is semantic information used to consider out-of-vocabulary (OOV). In addition, to obtain a better representation of the text, the method chosen is FastText embedding. To extract global information and local features with dependency, CNN and LSTM are combined. From the research with the hybrid model and FastText, obtained f1-score with a value of 0.88 and an accuracy value of 87%. In another study [14], a new learning framework called DepressionNet Model was created to identify depression from tweets on Twitter. The DepressionNet model applies feature extraction using BERT, and the model used is CNN + GRU. The GRU and CNN models have better performance by learning more attributes from the data when compared to the existing base model. The DepressionNet model performed best with an f1-score of 0.912 and an accuracy of 0.901.

Many studies have been conducted on the case of depression detection, but as far as the author knows, there is no study that specifically uses Indonesian-language X data with a hybrid deep learning strategy CNN + GRU equipped with optimization and FastText as a feature expansion method. This research is specifically focused on social media X as the main platform, with a limitation on Indonesian data, without covering other platforms or other languages. Therefore, this research aims to improve the accuracy of depression detection through the application of feature expansion using FastText and a hybrid deep learning CNN + GRU approach in a predefined context. The results are expected to help detect individuals who experience symptoms of depression earlier to minimize risks such as suicide, improve individual quality of life, and become a consideration in decision making in the health sector, especially in Indonesia.