AI-Driven Early Detection of Mental Health Disorders Using Speech and Behavioral Patterns

Kehinde Iyioluwa Adeyinka
http://orcid.org/0009-0009-7685-6693
University of Science and Technology, Beijing, China

Taye Iyinoluwa Adeyinka
http://orcid.org/0009-0006-4357-6319
University of Science and Technology, Beijing, China

ABSTRACT

Early detection of mental health illnesses is vital to beat the disease and prevent deterioration; therefore, it is considered essential to the improvement of treatment outcomes. Over recent years, artificial intelligence has evolved into a powerful tool for early detection of mental health issues, often before any clinical diagnosis. This article looks at some AI-powered methods that analyze patients' speech and behavioral patterns with a view toward early diagnosis of mental health. These systems can pick up on very subtle cues that might signal the presence of disorders such as depression, anxiety, and PTSD, using machine learning models, NLP, and computer vision to analyze speech patterns, facial expressions, vocal tones, and even digital behaviour. There will be a discussion on how these AI technologies enable ongoing monitoring and early intervention in real-world contexts such as wearable technology, telemedicine, and mobile applications.

1. INTRODUCTION

Mental health diseases are some of the leading causes of morbidity worldwide and affect quite a significant portion of the population. According to statistics by the WHO (World Health Organization, 2022), approximately one in four is likely to suffer from mental illness sometime in their lives. The most common diagnoses include bipolar disorder, schizophrenia, anxiety, and depression. The real implications of these conditions are far more impacting people's psychosocial performance. However, they also include economic costs related to lost productivity, the strain on health systems, and employee absences. In light of this, it is impossible to overestimate the urgent need for more active means of identifying and treating problems. However, mental disorders keep popping up, and time-honored methods of diagnosing

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and treating arrive virtually at (Gnaulati, 2018), or after, the moment of impact. Subjective self-reported symptoms, a primary component of current procedures to diagnose, for example, anxiety or depression, also consist of clinician assessments; again, it is open to errors of judgment. Due to personal stigma or a lack of understanding of their disease, people may not completely recognize or articulate the start of symptoms, which makes self-reporting particularly limited (Sandhya, 2024). Furthermore, especially in their early stages, mental health issues may manifest in ways that are challenging to measure (Clark et al., 2017). This emphasizes the necessity of early detection methods beyond evaluations based on symptoms.

It is impossible to overstate the importance of early diagnosis in mental health. Better treatment outcomes, such as less severe symptoms, improved quality of life, and even reduced total strain on healthcare systems (Ball et al., 2015), result from early detection (Zangani et al., 2022). Early intervention in mental health disorders has shown not only a more effective reduction of symptoms but also a reduced long-term risk related to chronic conditions such as hospitalization and suicide. Artificial intelligence (AI) now has a decisive role in the early diagnosis of these mental disorders (Graham et al., 2019). AI has immense potential for changing healthcare by providing innovative solutions to various problems that conventional approaches cannot tackle. The ability of AI to process and assess big, complicated data sets allows early detection of mental health illnesses (Su et al., 2020). In particular, AI combined with speech and behavioral pattern analysis has shown great promise in the early detection of mental health disorders in a scalable, effective, and objective manner (Olawade et al., 2024).

Traditional diagnoses of mental health disorders, though in wide usage, suffer from some very significant setbacks that diminish their effectiveness. One such major setback is dependence on subjective considerations (Harvey et al., 2004). Practitioners of mental health quite often make use of questionnaires or structured interviews, which are dependent upon self-reporting by patients (Heinrich et al., 2011), which could be fallacious or biased. Sometimes, because of a lack of insight or the fear of stigmatization, patients may overstate symptoms or underreport them; this adds so much subjectivity and makes the job of recognizing the problem in its early stages very difficult. Moreover, the frequently ambiguous symptomatology and the overlapping among many mental health illnesses add to the challenge of a diagnosis. For example, clinicians may find it hard to differentiate between anxiety and depression without prolonged observation or clinical intervention since the two conditions share many symptoms, such as fatigue, irritability, and concentration problems. In addition, stigma or belief that mental health disorders will disappear can prevent the affected individuals from seeking care immediately. A significant factor contributing to the lack of early intervention that could have reduced the severity of the condition is the delay in seeking professional help. Traditional diagnostic methods are also time-consuming and not readily available, particularly in rural or resource-poor settings (Olatunji et al., 2024). Many individuals cannot access mental health services at all, or they may have to wait several months for an appointment with a specialist. Unless treated promptly, these situations run a greater risk of the mental health issue deteriorating further and developing into a chronic illness, which often requires more complex and expensive treatment.

The pitfalls of traditional diagnostic methods can create an urgent need for novel, effective, scalable, and unbiased solutions. AI-driven solutions have a high potential to solve these issues, especially those that investigate speech and behavioral patterns (Corti et al., 2023). Clinicians can thus diagnose their patients much faster and introduce more targeted interventions by using the real-time analysis provided by AI of complicated datasets for insight into their mental health. These AI-powered techniques can also closely monitor patients, observing behavioral, linguistic, and other changes that a human observer would have missed.