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THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

EXTENDED ABSTRACTS

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Cover Design: Dr. Mohd Khairulnizam Ramlie
Typesetting : Zarinatun Ilyani Abdul Rahman

PSYCHESYNC: SMARTWATCH TRACKING AND CLASSIFYING MENTAL HEALTH FOR PERSONALIZED WELLBEING

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ABSTRACT

Long-term and persistent mental health problems can lead to severe mental disorders and even death in individuals. The real-time and accurate classification of individual mental health has become an effective method to prevent the occurrence of mental health disorders. In recent years, intelligent wearable devices have been widely used for monitoring mental health and have played a significant role. This study aims to devise an innovative design approach for smartwatch prototypes that can accurately classify individual mental health conditions. The aspiration is for this smartwatch to facilitate early detection, prevention, and intervention, thereby serving as a blueprint for enhancing individual mental well-being.

Keyword: classify, mental health, prototype, smartwatch, tracking

1.   INTRODUCTION

In recent years, there has been a significant surge in the prevalence of mental health disorders such as anxiety, depression, and stress, leading to a corresponding increase in suicide rates and a decrease in human productivity (Abu Hasan, 2023). Classifying whether an individual is experiencing a mental illness poses a big challenge. In this regard, traditional methods of diagnosing mental health conditions have typically relied on subjective and time-consuming approaches, which can be susceptible to inaccuracies (Cooper, 2018). In addition, long-term treatment management and assessment are essential for reducing patient symptoms and recovery but are challenging to achieve with traditional methods. Therefore, it is imperative to detect the mental health condition of individuals at an early stage and prevent the occurrence of mental health problems. The aforementioned problems have triggered a notable surge in demand for mental health care technology, resulting in the development of new devices featuring remote, wearable, and portable functionalities capable of early detection or symptom management.

Introducing wearable healthcare systems, such as smartwatches, has demonstrated their effectiveness in providing non-intrusive continuous monitoring solutions that capture real-time data (Masoumian et al., 2023). Special sensors are installed in these devices that continuously monitor the user's mental health condition and keep records of the data. Despite the several advantages of

utilizing this smartwatch for early disease detection, it also presents various challenges. These challenges encompass concerns regarding the accuracy and reliability of the algorithms, as well as high precision in detecting changes in health status over time. Addressing this research gap, this study introduces a novel design methodology for smartwatch prototypes with enhanced accuracy, explicitly targeting the precise and reliable detection of mental health status, particularly depression, anxiety, and stress. Consequently, these devices have the potential to mitigate morbidity and alleviate the economic strain on the healthcare system, empowering patients to seek assistance promptly or take proactive measures to mitigate symptoms or triggers.

2. METHODOLOGY

The PSYCHESYNC Smartwatch Tracking system is a smartwatch-based mental health detection system. The smartwatch developmental prototype encompasses three phases: data collection, data pre-processing, model training, and evaluation and deployment. The PSYCHESYNC smartwatch Tracking Prototype is illustrated in Figure 1.
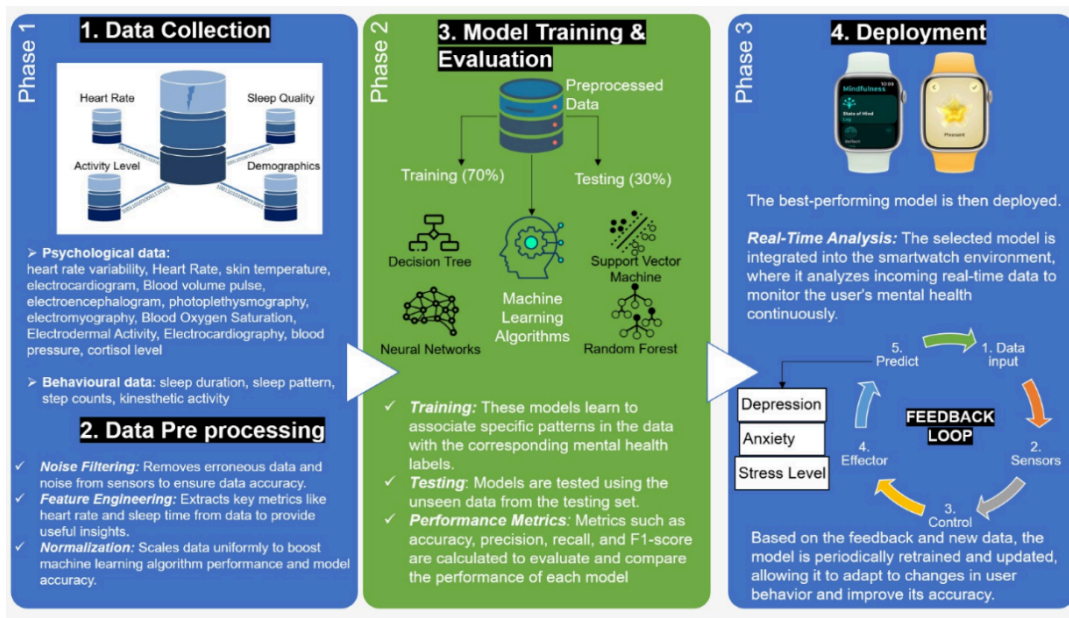

Figure 1 PSYCHESYNC: Smartwatch Tracking Prototype.

In phase 1, psychological and behavioral data are collected and stored in the database with multiple entities corresponding to different data structures. This smartwatch is equipped with a variety of sensors such as Heart Rate Variability (HRV), Heart Rate (HR), Skin Temperature (TMP), Electrocardiogram (ECG), Blood Volume Pulse (BVP), Electroencephalogram (EEG), Photoplethysmography (PPG), Electromyography (EMG), Blood Oxygen Saturation (SpO2), Electrodermal Activity (EDA), Blood Pressure (BP), and Cortisol Level. These have been selected based on prior research aimed at accurately classifying individual mental health conditions (Alhejaili, 2023; Cooper, 2018; Masoumian Hosseini et al., 2023; Rathbone, Clarry& Prescott, 2017; Zhang & Zhu, 2023). Noise filtering and normalization are performed automatically on the real-time

data before proceeding with model evaluation. **In phase 2**, pre-processed data is used for training and testing. The dataset is split into 70% training and 30% testing with 5-fold cross-validation. Four supervised machine learning algorithms (decision tree, random forest, neural networks, and support vector machine) are used to train the data. The best model will be selected based on accuracy measures. **In phase 3**, the best model with the highest accuracy is used for predictive analytics on mental health. There are three predictor variables (depression, anxiety, and stress). Finally, a feedback loop is implemented for real-time data capture for automated modeling and prediction.

3.   FINDINGS

The PSYCHESYNC Smartwatch Tracking system has a built-in multidimensional health management function that automatically monitors, detects, reminds, and generates diagnostic reports. The devices employ smartwatch technology to monitor mental health changes by utilizing various watch sensors (Figure 2). The system analyzes automatically generated psychological and behavioral data to monitor mood states in individuals with mental disorders. At the same time, the system analyses and classifies the trend of these mental health fluctuations and issues an early warning when the status is abnormal.
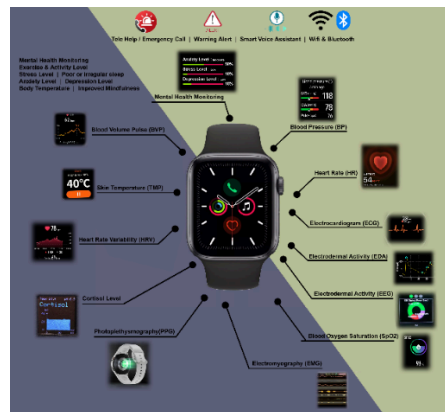

Figure 2 The PSYCHESYNC application user interface.

4.   CONCLUSION

The readily accessible physiological and behavioral sensing systems offer a promising avenue to improve the oversight and treatment of mental health conditions significantly. Utilizing such devices can bolster patients' self-awareness, thereby positively influencing their ability to manage their conditions. This heightened awareness regarding their mental well-being can serve as a preventive measure against the exacerbation and further complications associated with numerous mental disorders. Consequently, there is a pressing need for integrating technology within the realm of mental health, akin to its established presence in other medical disciplines, to furnish practical and readily deployable devices for affected individuals. The advancement of monitoring technologies stands to significantly assist patients in managing their conditions and substantially enhance their overall quality of life.

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