



## Role of IoT and Data Analysis in Determining Mental Well-Being

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# Role of IoT and Data Analysis in Determining Mental Well-Being

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## Abstract

IoT devices like Fitness bands and smartwatches can play a key role in determining the mental health of people. We have seen the rising trend in people integrating them in their lifestyle and smartphone applications being developed to detect step count and sleep monitoring through their sensory perceptions and GPS functions. Analysing the data generated by them we can get clear insights into the factors to detect declining mental health.

We analysed, data from The DISCover project to build a classification model in Logistic Regression to find if the patients mental health is declining, using the physical symptoms monitored in the commercially available wearable bands.

Previous researches show a negative correlation between physical activities and phq9 scores of patients. We found that IoT devices can play a major role in researching mental health as done in the research Digital Signals in Chronic Pain done in Evidation Health, along with step count and activity tracking have a higher rate in predicting mental health compared to sleep data generated in fitness bands even without taking the emotional attributes.

Keywords— Fitbit, DISCover, phq9, Python, Evidation Health.

## 1 Introduction

The Internet of Things (IoT) is a network of physical devices and other elements that have been connected with electronic components, software, sensors, and network connectivity, allowing these items to gather and share data.[1]

It's a network of networks made up of millions of private, public, academic, corporate, and government networks, ranging in size from local to worldwide, and connected via a variety of electrical, wireless, and communication networks.[2]

The Internet of Things (IoT) technologies and infrastructure have the potential to transform the delivery of health care. Corporal detection devices on the network, in conjunction with sensors in our daily lives, enable the continuous and real-time gathering of information about an individual's physical and psychological health, as well as their associated behaviours.[3]

Medical informatics, which combines medicine and information technology, will alter healthcare as we know it, lowering costs, decreasing inefficiencies, and saving lives.[4]

In this paper, we show that how the basic IoT devices like Fitness bands, smart watches and health monitors with sensory functionalities are used to detect the mental health of the individuals and machine learning algorithms to predict whether the personnel is on the verge of developing psychological issues.

## 2 Impact of COVID-19 in Declining Mental Health

Neuropsychiatric diseases account for around 14% of the worldwide illness burden, owing mostly to the chronically burdensome character of depression and other prevalent mental disorders, alcohol and drug use disorders, and psychoses. Such estimations have heightened awareness of the significance of mental diseases in public health.[5]

Young adulthood has been identified as a transformational era in which people make significant progress in their identity development while dealing with insecurity and feeling stuck between youth and adulthood. The COVID-19 pandemic added to the already stressful characteristics of this developmental stage, interfering with significant events, opportunities, and social relationships. As the epidemic worsens, college students are expected to face more challenges, which might have a severe influence on their mental health.[6]

Interpersonal challenges, financial hardship, matching their own or others' expectations, and academic worries are all significant sources of stress among college-bound developing adults.[7] During the pandemic, students' troubles show a higher level of struggle coping with and addressing the challenges of developing adulthood. Due to constant changes in class format, work status, and housing, they felt a great deal of insecurity.[8].

## 3 Monitoring Mental Health Through IOT

A fitness band is a wearable gadget that records and monitors fitness-related activities such steps taken, distance travelled, total sleep time, and heart rate.

These devices are being used by millions of people worldwide, they connect to other devices like smartphones and monitor various health parameters to provide a brief overview of our body.[9]

People suffering from anxiety have elevated levels of heart beat and blood pressure.[10]

Anxiety has been linked to nightly and early morning hypertension among hypertensive patients, according to a new blood pressure monitoring research.[11]

These attributes can be easily monitored through these trackers and the data generated from them are pre-processed and analysed by the applications in our smartphones & tablets and can be shared with a medical professional.

## 4 Methodology

### 4.1 Dataset Used

For each month of information gathering from participants, the dataset consists of 35,694. Between January 2018 and January 2020, 10,036 people in the United States participated in the DiSCover Project, a one-year longitudinal research in which they wore consumer-grade wearable devices during the study and answered monthly questionnaires regarding their mental health and/or lifestyle changes. The data subsets utilised in this study were data from participants' consumer-grade wearable devices (Fitbit) worn during the trial on step and sleep. Participants were asked to fill out a brief survey every month

describing changes in their lifestyle and medication during the previous month. They were then asked to complete the Patient Health Questionnaire (PHQ-9) every three months.[12]

## 4.2 Feature Selection & Analysis

We went for the data, captured by the Fitness band i.e average of steps, sleep on weekday, and sleep on weekdays and weekends along with the phq9 score and category of the participants, the final phq9 score they belong, at the end of the trails. The features we integrate our initial model were the physical characteristics of the participants monitored by the fitness band over the two years of the experiment.

## 4.3 Missing Data

The dataset used in its raw form is missing several value, so before building any models around it we used an analysis of missing attributes and build a heat-map and dendrogram to showcase it. We chose Python's Pandas library to read the parquet file in fastparquet engine and dtale to perform Missing Analysis on the selected features.

## 4.4 Model

Regression methods have become an essential part of any data analysis that seeks to describe the connection between a response variable and one or more explanatory factors. The result variable is frequently discrete, with two or more potential values. For the study of this data, the logistic regression model is the most commonly employed regression model.[13]

$$y = e^{(b_0 + b_1 * x)} / (1 + e^{(b_0 + b_1 * x)})$$

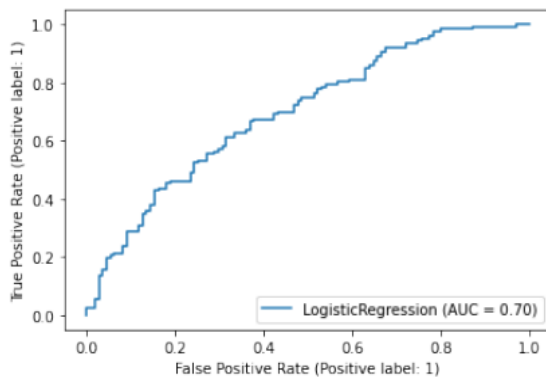
## 4.5 Results

We used the sklearn library in Python to build a classification model in Logistic Regression, since outcome we want is dichotomous.

The data is split between training set and test set before preprocessing it using standard scaler.

We found that the number of days with less than 5 thousand steps in the last days of the experiment correlates positively with the declining mental health and the total step count of people along with the light activity and 6 minute rolling routine, from the analysis.

The model we trained using the features outputs the Confusion Matrix :  $\begin{bmatrix} 68 & 43 \\ 41 & 85 \end{bmatrix}$  and results in a 0.66 f1 score with 0.66 precision without taking emotional parameters or the initial phq9 score into the consideration.



**Figure 1:** ROC Curve

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