

Logistic Regression on Data Generated by Wearable IoT for Predicting Changes in Mental Health Scores

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Abstract— Smartwatches and fitness bands are two examples of IoT devices that may be quite helpful in determining a person's mental health. People are progressively adopting them into their daily life, and smartphone apps that measure step count and sleep utilising sensory perceptions and GPS capabilities are being developed. We can gain a full grasp of the indications of poor mental health by analysing the data they generated.

We used physical symptoms recorded by commercially available wearable bands to develop a classification model in Logistic Regression to predict whether the patient's mental health is deteriorating.

Previous research has discovered a relationship between phq9 levels in patients and physical activity. We observed that IoT devices may play an important role in mental health research, as demonstrated by the paper Digital Signals in Chronic Pain published in Evidation Health. Even without considering emotional factors, step count and activity monitoring had a greater likelihood of predicting mental health than sleep data obtained by fitness bands.

Index Terms— Digital Signals, Logistic Regression, GPS, Fitness Bands, DISCover, Evidation Health.

I. INTRODUCTION

The Internet of Things (IoT) is an interconnected system of physical objects and other elements that can collect and exchange data thanks to electronic parts, software, sensors, and network connectivity. [1]

It is a network of networks composed of millions of private, public, academic, corporate, and government networks linked by various electrical, wireless, and communication networks. The scale of these networks varies from local to global. [2]

The Internet of Things (IoT) technologies and infrastructure may alter health-care delivery. The physical and psychological health of a person, as well as their connected behaviours, may be continually and in real-time acquired by bodily detecting devices on the network and sensors in our daily lives. [3]

Healthcare as we currently know it will change as a result of medical informatics, a field that integrates medicine and information technology, which will save costs, eliminate waste, and save lives. [4]

In this work, we show how typical IoT devices with sensory capabilities, such as fitness bands, smart watches, and health monitors, may be used to detect people's mental health, and how machine learning algorithms can be used to predict whether a person is likely to develop psychological disorders.

II. COVID-19'S IMPACT ON DETERIORATING MENTAL HEALTH

The continuously onerous nature of depression and other common mental illnesses, alcohol and drug use

disorders, and psychoses account for around 14% of the global disease burden. These projections have increased understanding of the importance of mental illnesses to public health. [5]

It has been determined that young adulthood is a transformative stage during which people make important strides in the development of their identities while coping with uneasiness and a sense of being caught between youth and maturity. The COVID-19 pandemic interfered with important occasions, chances, and social connections, adding to the already stressful qualities of this developmental stage. College students are projected to experience greater difficulties as the pandemic progresses, which might have a serious impact on their mental health.[6]

College-bound young people experience tremendous stress due to a variety of factors, including interpersonal difficulties, financial difficulties, the need to meet expectations of others and themselves, and scholastic concerns.[7]

Students' problems during the pandemic demonstrate a greater degree of difficulty adjusting to and managing the demands of maturing maturity. They experienced a significant lot of instability as a result of the frequent changes in their housing, employment situation, and class structure. [8]

III. IOT-BASED MENTAL HEALTH MONITORING

A fitness band is a portable device that keeps track of fitness-related activities including heart rate, steps walked, distance travelled, and total amount of sleep.

Millions of people use these gadgets throughout the world; they link to other gadgets like smartphones and track numerous health indicators to provide us a quick picture of our bodies. [9]

Blood pressure and pulse rate are increased in those who are anxious. [10]

According to a recent study using blood pressure monitoring, anxiety has been connected to the nocturnal and early morning hypertension experienced by hypertensive individuals. [11]

These characteristics are readily tracked by these trackers, and the data they create is pre-processed and analysed by the apps on our smartphones and tablets before being shared with a medical practitioner.

IV. METHODOLOGY

A. Dataset Used

The dataset contains 35,694 rows for each month of information gathered from participants.

Between January 2018 and January 2020, 10,036 Americans participated in the DiSCover Project, a one-year longitudinal research in which participants wore consumer-grade wearable devices and replied to monthly questionnaires on their mental health and/or lifestyle changes. Data from consumer-grade wearable devices (Fitbit) worn by experiment participants were utilised as step and sleep data subsets in this investigation. Participants were requested to answer a brief survey each month explaining any changes to their daily routines or medication use over the prior month.

Participants were instructed to complete the PHQ-9 Patient Health Questionnaire every three months. [12]

B. Data Analysis & Feature Selection

We chose the information provided by the fitness band, such as the average number of steps taken each day, the amount of sleep each night and on weekends, as well as the individuals' final phq9 scores and the categories to which they belong. The physical characteristics of the subjects tracked by the fitness band during the course of the experiment's two years served as the basis for our initial model's features.

C. Missing Values

The dataset used in this research lacks a number of values in its raw form, therefore before creating any models based on it, we performed an analysis of its missing characteristics and created a heat map and dendrogram to illustrate it. To read the parquet file in the fastparquet engine, we picked the Python Pandas library, and dtale was used to conduct Missing Analysis on the chosen features.

D. Statistical Model

Any data study that aims to characterise the relationship between a response variable and one or more explanatory factors must now include regression methods. Usually discrete, the outcome variable has two or more possible values. The logistic model is a statistical model that represents the likelihood of an event occurring by making the event's log-odds a linear combination of one or more independent variables. Logistic regression is used in regression analysis to estimate the parameters of a logistic model.

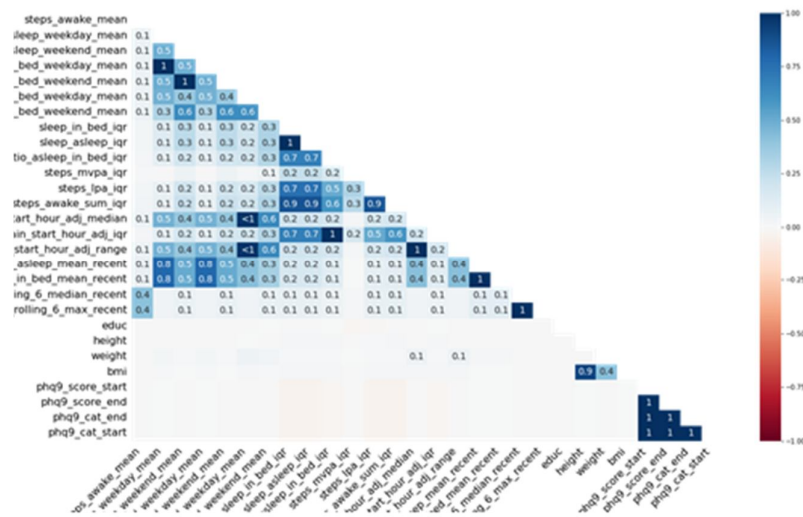


Figure 1. Heat map (Correlation of features)

The logistic regression model is widely used regression model for the purpose of analysis of this type of data. [13] After selecting the features we put them in an array and made train and test by splitting the data into them which is twenty five percent of the whole data. We then pre-processed that by using standard scaler before fitting them into the model. We initialised the random state to 0 and ran the classifier. We then implement various metrics to calculate the precision and accuracy.

V. FINDINGS AND RESULTS

We discovered that the number of days with fewer than 5,000 steps positively correlated with subjects' overall step counts, their level of light exercise, and their 6-minute rolling routine.

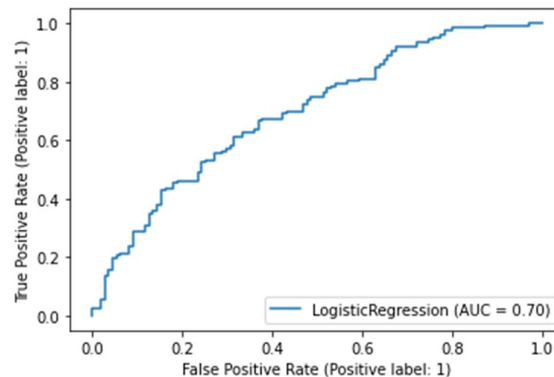


Figure 2. ROC Curve

The Confusion Matrix is produced by the model we trained using the features: [[68 43][41 85]] without taking emotional characteristics or the baseline phq9 score into account, and yields a 0.66 f1 score with 0.66 accuracy with the ROC curve drawn to a 0.70 AUC.

VI. CONCLUSION

Our findings show a positive relationship between the number of days with less than 5,000 steps in the trial's final days and participants' total step counts, as well as light activity and a 6-minute rolling programme. Our findings show that IoT devices and wearable trackers, which are commercially available to the general population, can play a key role in assessing mental health owing to 24 hour monitoring and the collection of precious data, which can open new doors in mental health research and analysis.

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