

Survey on Stress Detection Using Multiple Sensors through Wearable Devices



KAUSHAL PATEL¹, PROF. ASHISHKUMAR PATEL²

Researcher, LDRP Institute of Technology and Research¹, India, kaushalpatel1512@gmail.com

Asst. Prof, LDRP Institute of Technology and Research², India, ashish_ce@ldrp.ac.in

ABSTRACT

An Individual method of living on with a daily existence it directly influences on your overall health. Since stress is the significant infection of our human body. Like depression, heart attack and mental illness. WHO says “Globally, more than 264 million people of all ages suffer from depression.”[8]. Also the report says that most of the time people are stressed because of their work. 10.7% of People disorder with stress, anxiety and depression [8]. There are different method to discovering stress ex. Smart watches, chest belt, and extraordinary machine. Our principle objective is to figure out pressure progressively utilizing smart watches through their Sensor. There are different kinds of sensor available to find stress such as PPG, GSR, HRV, ECG and temperature. Smart watches contain a wide range of data through various sensor. This kind of gathered information are applied on various machine learning method. Like linear regression, SVM, KNN, decision tree. Technique have distinct, comparing accuracy and chooses best Machine learning model. This paper investigation have different analysis to find and compare accuracy by various sensors data. It is also check whether using one sensor or multiple sensors such as HRV, ECG or GSR and PPG to predict the better accuracy score for stress detection.

Key words: stress, multiple sensors, smart watches, machine learning, PPG, ECG, real time.

1. INTRODUCTION

Stress is one of the most serious health issues, these days. Stress causes heart disease, high blood pressure, diabetes and also serious mental disorders such as depression or anxiety [6]. For Example some individuals feel more pressure when something comes up in their life which isn't normal. Stress can be survived however it relies upon how to deal with it. A couple of individuals put aside some push to manage it and some viably handle it. Researchers say that females are more stressed as compared to men. These strategies are contrasted

to find out which technique gives the highest accuracy when ordered utilizing different machine learning algorithms.

2. RESEARCH QUESTIONS

RQ1: What are the strategies/methods that can be utilized to recognize Stress using a smart watch?

RQ2: What are the different Machine learning algorithms available that can be applied to detect stress?

RQ3: to discover whether the accuracy of stress detection relies upon the ML algorithm applied.

RQ4: Which sensors and ML algorithm combination gives the highest accuracy score, when detecting stress?

RQ5: are there any limitation of using different methods to predict stress?

RQ6: What is the future scope of the study?

3. STRESS DETECTION METHOD

RQ1: What are the strategies/methods that can be utilized to recognize Stress using a smart watch? [1]

A. PPG(photoplethysmogram)

PPG is monitoring devices which contain a light source and a photo detector. PPG is a non-invasive technology that uses a light source and a photo detector at the surface of skin to measure the volumetric variations of blood circulation [2]. The light source produces light to a tissue and the photo detector measures the mirrored light from the tissue. Light reflects on proportional to blood volume variation. Sensor works on infrared LED which penetrates the skin and blood vessels. PPG is less expensive. It is measure by heart rate. If in human body, heart bit accidentally changes and also changes in skin tone then there is possibility of human is in stress.

B. GSR(Galvanic Skin Response)

GSR is also called as EDA (Electro dermal activity). A GSR sensor allows us to measure sweat gland activity, which is related to emotional arousal [3]. Sweat glands are tied to our nervous system and body processes like our immune system, so GSR can help tap into information about our current physiological and psychological state [4]. The reason behind to choose GSR method for stress as well as

fitness trackers. GSR plays big roll to finding stress because it have ability to reliably monitor emotions. It will very useful method to find stress and fit into the machine learning model for better accuracy.

C. ECG (Electrocardiography)

Electrocardiography is the process of producing an electrocardiogram [5]. ECG also called as EKG. It is a graph of voltage versus time of the electrical activity of the heart [5] using electrodes placed on the skin [4]. This electrodes detected any small changes then it will cause in cardiac muscles and It will causing stress, high BP. late stet innovation pattern shrewd, ECG sensor are found a way into almost wearable gadget.

D. Temperature

Temperature is one of the important factor to find stress. It will unappropriated behavior because it will change due to some factors. Increase skin temperature when blood flow rate is also increasing. Nervous system also increase the skin temperature in stress that is why increasing blood flow.

RQ2: What are the different Machine learning algorithms available that can be applied to detect stress?

There are two types of machine learning algorithms? [1].

1. Supervised learning
2. Unsupervised learning

A. Supervised learning:

Supervised technique labelled data can be used to train the algorithm, where labelled data means depended y and in depended x variable both are given to train the model.

$$y=f(x);$$

Here x is an input variable and y is an output variable. As input data is fed into the model, it adjusts its weights through a reinforcement learning process, which ensures that the model has been fitted appropriately [6]. Supervised learning have two types 1. Classification 2. Regression. Technique can choose based on which type of data and in datasets which variable is depended and in depended variable that what matter.in Supervised learning, output data already given to machine, machine have to predict the how accurately performed model.

1. SVM

SVM stands for support vector machine. In machine learning SVM can be used for classification and regression. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane [15]. SVM picks the extraordinary vectors that

help in making the hyperplane. These extreme cases are called as support vectors, and consequently calculation is named as Support Vector Machine.

2. KNN

KNN is stands for K-Nearest Neighbors algorithm. It is one of the simplest algorithm in machine learning. K-NN is the compare the new data to available categories and put it into available category to new data. It classify on similarity on nearest available data point. K-NN algorithm use for regression but mostly used in classification. It does not learn from the training set because it store the data point at a classification time that why it is called as Lazy learner algorithm. In KNN, number of neighbors parameter are uses for finding better KNN value and it depends on value what you choose like knn=1, 3, 5 etc.

3. Logistic regression

Logistic regression use of binary type of classification. Stress prediction is binary type of classification stress/non stress. Logistic regression is used for statistical model. The logistic regression is a predictive analysis. Logistic regression is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variables [16]. Logistic Regression is part of a larger class of algorithms known as Generalized Linear Model (glm) [16]

B. Unsupervised Learning:

Unsupervised learning is a type of algorithm that learns pattern from unlabeled data.it is a machine learning technique in which the users do not need to supervise the model [14].unsupervised is less accurate and reliable method. Therefore unsupervised is unpredictable methods. It is also including clustering, neural networks etc. As the model has to predict its own dependent and independent variable that why Unsupervised is complex process as compared with supervised algorithm.

4.RELATED WORK

RQ3: To discover whether the accuracy of stress detection relies upon the ML algorithm applied? [1].

In this paper, Table-1 shows that different machine learning algorithm using different sensor/methods. Every algorithm have own identity of doing a classifying for stress prediction. It is relies upon different ML algorithm. Because first we have to know the behavior of wearable device data, to know how to correlate to each other attributes and do some feature engineering part after that we have to choose one of the closest behavior and fitted ML algorithm into the datasets. ML algorithm do matter for getting better accuracy score. As

we discuss above algorithm like Logistic regression, support vector machine, K-nearest neighbors and so on.

RQ5: Which sensors and ML algorithm combination gives the highest accuracy score, when detecting stress? [1].

As you can show below the table comparison between single and multiple sensor are available. Using random forest machine learning algorithm for ECG method for detecting stress accuracy score is 96% in wearable device. In multiple sensor highest accuracy gives PPG and PRV method using linear regression method, accuracy score is 86% for stress prediction.

use multiple sensor for predicting stress in real time using wearable device. The main advantages is using multiple sensor is getting better accurate prediction for stress detection

in real time. For now, technology tremendously increasing where you can easily predict your blood oxygen level, heartbeat, calories you burn in overall day, workout routine and so many things that might be easy for routine. Where Stress is the one of the most important topic for health. Researchers obviously thinking about how to overcome the stress in easy manner for that technology is one of the valuable part to overcome. Use of Multiple sensor from

Sr.No	Single Sensor			
	Methods	ML Algorithm	Author/Reference	Accuracy Rate
1	PPG	Linear Regression	Jongwoo Park[7]	86.35%
2	Temperature	Random forest	M.Gjoreski [11]	76%
3	HRV	SVM	K. Hovsepian [12]	72%
4	GSR	Logistic Regression	Ouwekerk et al[13]	91.66%
5	ECG	Random forest	S. Bhanushali[8]	96%
Multiple Sensor				
6	PPG+ PRV	Linear Regression	Fenghua L[10]	86 -91%
7	HRV+ Accelerometer	Random forest	Min Wu[9]	83.2%

Wearable device. With less expense accurate result.

Limitation

RQ6: are there any limitation of using different methods to predict stress? [1].

Using so many methods where number of limitation or problem are increasing. Every method have limitation. Like we are using wearable device, device have not enough battery life. As everyone face battery problem in their phone or smart watches. Also in some Smart watches have not enough sensor for detecting stress or some have multiple sensor to predict stress but not in accurate manner. IN PPG sensor during their daily activity PPG is not collect accurate data. The reason behind using multiple sensor therefore not depended into one method. PPG signal are more sensitive to motion artifacts and its generated by hand movement. Temperature method have one of the most inaccurate behavior. If user had normal body heat and sweat by exercising, aerobics then sensor detect into the stress. In summer temperature is not good method to stress in real time. Most of the smart watches have not GSR method. GSR is not responds to the smart watches to receive signal.

Future Scope

RQ7: What is the future scope of the study? [1].

In this paper, study show that finding stress prediction using wearable device but only one method/sensor. In future we will

Increasing Healthcare and Electronics gadgets. Improve health condition for getting better result for stress prediction.

REFERENCES

1. R. Katarya and S. Maan, "Stress Detection using Smartwatches with Machine Learning: A Survey," 2020 International Conference on Electronics and Sustainable Communication Systems (ICESC), Coimbatore, India, 2020, pp. 306-310, doi: 10.1109/ICESC48915.2020.9155568.
2. Castaneda D, Esparza A, Ghamari M, Soltanpur C, Nazeran H. A review on wearable photoplethysmography sensors and their potential future applications in health care. *Int J Biosens Bioelectron.* 2018;4(4):195-202. doi:10.15406/ijbsbe.2018.04.00125
3. How does a GSR sensor work? (n.d.). Retrieved from tobiipro: <https://www.tobiipro.com/learn-and-support/learn/GSR-essentials/how-does-a-gsr-sensor-work/>
4. Wareable. (2016, August 24). Retrieved from Sensors explored: Galvanic skin response: <https://www.wareable.com/wearable-tech/what-doe>

