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Stress Detection Using Machine Learning Algorithms

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***Abstract*: Stress is intuited as the most important element in the person life. The World Health Organization is defined as stress is a mental health problem that affects the citizens. In world so many people are suffering from stress. Stress is one of the main symptoms in all the human being for the mental health. Stress can affect all the aspects of our life including our emotions, thinking ability, our behaviour etc. So we have to control the stress. The proposed system we have taken the statistical dataset and also considered the six attributes are Electrocardiogram, Electromyogram, Galvanic Skin Response Hand and Foot, Heart Rate and Respiration. Based on these attributes values we have compared with the threshold values and using machine learning algorithms like decision tree, Naïve-Bayes and K-Nearest Neighbour. We have been used appropriate algorithms to get increased accuracy and predict the stress level.**

***Keywords*: Electrocardiogram (ECG), Electromyogram (EMG), Galvanic Skin Response (GSR), Heart Rate, Machine Learning, Respiration, Stress.**

1. Introduction

The stress is one of the main symptoms in our human life. Stress conducts a major role in life of people. Stress may lead many diseases like cardio-vascular disease, lungs problems, breathing problem, cancer and other diseases. Due to the population in the global the stress level among the people increased. Nowadays stress is a common symptom in all human being.

The stress conducts major life-or-death problems in a people around the world. When a people are suffering from stress their normal behaviour will be changed and which leads to some life routine problems. For this we have to continuous monitoring their behaviour through using machine learning algorithms which are implemented in the system from that we will get the real time data for analysing their behaviour accurately of the system. In India 85% of people are suffering from stress. Nowadays due to the stress the person will undergo depression.

The stress detector system will differentiate the difference between normal behaviour person and stressed person. The physiological devices have been used for the continuous monitoring of the stressed person and it will help the parametric values for the doctors to predict whether the person is normal or stressed. The parallel the physiological devices monitor the behaviour of the person and stores in a database and these data will be maintained in a database for the further analysis by the doctors. Based on those values the doctors easily predict the stress level in the person. So these analysis get whether the person in stress or not stress. The proposed algorithm and devices are used for predict depression level in India. When we use physiological devices it will monitor daily the values of the person and it stores in a database, so we can get the weekly or monthly values and with respective doctors based on that values doctors can predict which type of diseases are suffering from person and we can easily treat the person based on that values. Because when the people above 60 years there suffering from many diseases and these proposed systems know which type of disease they are suffering from based on these devices we can predict stress or any other disease. We are proposing a project based on the machine learning classification algorithms which will predict the normal behaviour of the person and stressed person.

Stress is defined as when the person is suffering from stress the person gets over strain and not comfortable with any work, sitting silently, thinking something, he is not mind is not with him. The relationship with the people is also differing. The stress the person will not be happy. The person is in stress or depressed we have to consult the doctor to get the suggestion the doctor will predict the level of stress and proposing neurologist and psychiatrist for the further analysis and diagnostic.

The person is in stress the person will get scare because due to the stress he will cure or not. When the person having stress initial stage the doctors will easily cure, but the person is in suffering from chronic disease he will get other disease. Due to the stress the person may get diseases like heart related disease, cancer, asthma etc. When the person is in stress the person will sit alone he always thinking something.

Remaining part of the proposed system is classified as: related work information such as various schemes proposed for the stress is discussed in Section II. Section III explores the experimental approach to perform the stress detection in machine learning is discussed. In the following section IV,

provides details about the result of the experiment and also the comparison with various models of stress, and followed by Section V the paper is concluded.

2. Related Work

The idea of stress detection system will help the doctors to predict the stress level using machine learning algorithms. The researchers are proposing their work related to person stress detection.

Reshma Radheshamjee et. al., [1] proposed a system as in this project the datasets are collected from social-media. Nowadays when person is in stress or depression they will post the quotes or any other images to face book, twitter or any other social media. In twitter so many post the quotes or any other wordings in discussion form or as a post. Based on the twitter dataset they will collect the data, they have proposed the system used the support vector machine and Naïve Bayes algorithms. Based on the algorithm that predict the detection the person is in stress or depression. In twitter dataset they have consider stress, depression etc. They have used the sentimental analysis to classify the depression and stress. When they use more techniques or algorithms we can get the best results and also it shows the precision and recall values. They have used the confusion matrix to predict the stress and depression.

Limitations: In these proposed system due to the twitter dataset they will not get accurate accuracy.

Alisha RM et. al., [2] proposed a system as safety measures have taken to the girls. Nowadays the women and girls not having safety. In a world nowadays we are seeing the girl or women get raped in some of the places. Based on these problems so many girls are suffering. Based on this proposed system we are use the devices based on this values we can get the real time values. They have used accelerometer, body temperature and Galvanic skin response. This is a wearable device the girl should wear this device whenever the girl goes outside. The device will store all the data in database. Based on these values we have some idea about the values when girl is in risk, when she will run her body temperature and she will sweat more. Based on these values we can predict the girl is in danger when the values above threshold value or less it will give alert message with respective person. Based on this message the police or other person can save her life.

Limitations: In these proposed system they have used the some of the devices to get appropriate values. Due to the devices they will not get the accurate values.

Wan-young Chung et. al., [3] proposed a system as stress detection by drivers. Nowadays we hear so many news as the road accidents. The driver will die due to the accidents. The driver will die in accidents we don't know what is the problem in that. When the driver will sleep or he is having some problem due to that he will get accident. The proposed system as he has used the physiological devices where motion sensor, Galvanic skin response and body temperature based on these devices it will collect the data and that data should be stored in database. When the driver will get the sleeping or he is not well based on these values we can predict the driver is having some problem we can alert the driver. Based on the data we can alert the driver as ringing the sound.

Limitations: In these proposed system they have used the physiological devices where they get some problem in calculating the values.

Purnendu Shekar Pandey et. al., [4] proposed a system as stress detection is based on the machine learning. When we predict the stress based on the heart rate and electrocardiogram values. When the person is in stress based on the person age will also differ. Based on the person values we can detect the stress.

Limitations: In these proposed system they will predict the stress based on the heart rate and ECG.

Madhavi Ganapathiraju et. al., [5] proposed a system in which monitoring of the stress by physiological devices. When we use physiological devices we can get the accurate values. When we see any person from the outside we don't know the person is in healthy or not. Due to this problem we can easily predict the person is having any disease or stress. In this physiological devices are Galvanic skin response, body temperature, pulse rate and their motion sensor are used. When we use the physiological device it will store the values based on this values when the values will change we easily get the person is having some problem.

Limitations: In these proposed system the data are collected from the physiological devices and calculate the values.

Saraju P Mohanty et. al., [6] proposed a system as when the person is in stress the person will eat more or some people will eat less, based on this values we can detect stress. In this system we have use the camera where camera will capture the images based on the images we can easily predict the person is in stress or not stress from the eating this images are stored in cloud.

Limitations: In these proposed system when the person is in stress. The person will eat the food more or less.

Vasa cursin et. al., [7] proposed a system in which the data is collected from socio-network in which we will get the dataset based on the data we will train the data into training data and testing data based on the training data we will predict and detect the person is in depression or not. We are using statically data where we are having existing data based on the data we will store that values. Based on the algorithms the data is collected from face book. Detection of stress is a major problem in a world.

Limitations: The proposed system in which prediction of the stress is based on the Facebook.

Istavan Kosa et. al., [8] proposed a system as stress detection with a low cost device. When we use low cost devices the values will not be accurate. They have used the heart rate and chest belt. In a chest belt some of the devices are inserted are pulse sensor to detect the pulse of the human being. Based on the devices we can also predict the stress.

Limitations: The proposed system is having chest belt and

heart rate from these two devices they will predict the stress.

3. Architecture Design

Stress detection is one of the important topics in machine learning. Due to the stress the people will not happy and there will not doing their work correctly. Based the values we can easily predict the values.

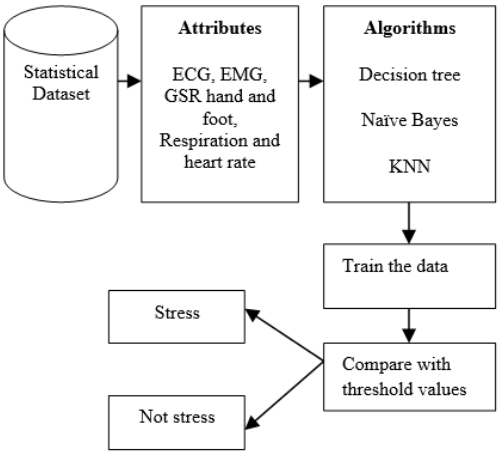


Fig. 1. System Overview

In a proposed system figure 1 shows that we have used the statistical dataset where we have used the six attributes are Electrocardiogram, Electromyogram, Galvanic Skin Response Hand and Foot, Respiration and Heart Rate. Based on these algorithms we will pre-process the data and that data is divided into training dataset and testing dataset. The dataset is compare with the threshold values and that value will compare and predict the person is in stress or not stress.

We have to collect the data from datasets and that data should be pre-processed. Some of the pre-processed steps are we have to import the dataset, import the libraries, we have to clean. Based on that data we have encode the data and that data is dividing into training data should be 80% and testing data should be 20%.

A. Electrocardiogram

Electrocardiogram measures the electrical activity of the heart rate and the rhythm. Electrocardiogram measures the normal resting rhythm and stressed rhythm.

B. Electromyogram

Electromyogram measures the electrical activity of the muscle. When the person is in stress the muscle tension will also be increased.

C. GSR Hand and Foot

Galvanic Skin Response measures the electrical activity of the sweat secretion. When the person is in suffering from stress the sweat glands will also be increased. The sweat glands are highest in hand and foot region of the human being.

D. Respiration

When the stress is increase on that time the respiration is also varies. Respiration is measured by breaths per minute.

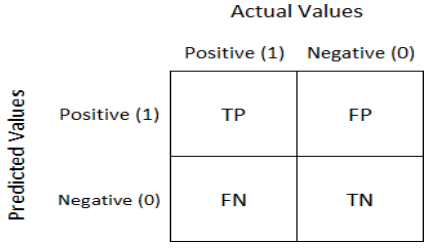
E. Heart Rate

Heart Rate is measure as beats per minute. The normal heart rate is 60-100 beats per minute.

As showed in a figure 2 to prevent the stress detection using machine learning approach.

- Step 1: Data collection means collecting the data in my project I have use the statistical datasets where I have considered the six attribute based on these attributes we will collect the data.
- Step 2: Data pre-processing where we will be cleaning the data and also see the any missing data is available in the values are to be checked.
- Step 3: Feature extraction is done by the values where in the values we have encoded the values means the original data is encoded into unreadable format. Because so many people are hacking the information due to the hacking will lost all the information.
- Step 4: We have extract the features by some of the algorithms are decision tree having root nodes and sub node, when we consider in my project the root node is the dataset further it is divided into sub-nodes as attributes, further the attributes divided into trained data and compare with threshold value that value predicts the person is in stress or not stress , Naïve Bayes is used for probability classification we calculating the problems based on assumptions and probability and K-Nearest Neighbour is used for classification technique and predicts the nearest neighbour in the data.
- Step 5: The dataset is divided into training dataset and testing dataset, always the training dataset is more than the testing datasets.
- Step 6: Based on the trained value we will test the result as 0 as not stressed and 1 is stressed. When we consider the trained value we have to compare with the threshold value based on these values we can predict and detect the person is in stress or not stress.

F. Confusion Matrix



In a confusion matrix the predicted values are measured by Precision and accuracy.

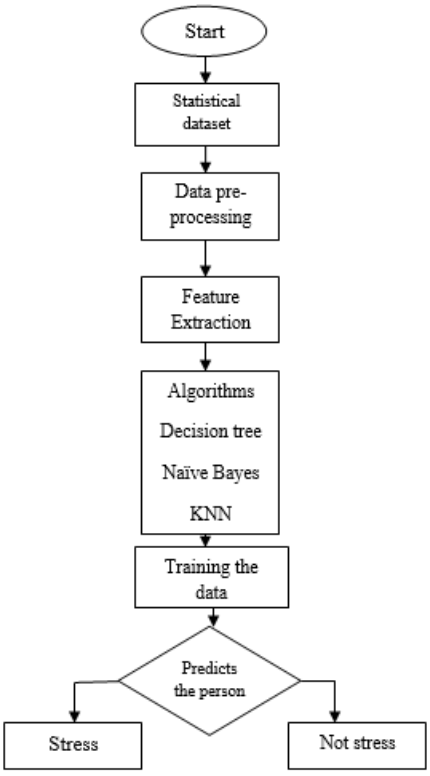


Fig. 2. The flowchart of the project

G. Algorithms

1) Decision Tree

Decision tree [Figure 3] is a representation of all the possible features to a tree. Decision tree is divided into root node, Sub node, Splitting node and the terminal node or child node. Decision tree is represented as tree like structure. Each of the nodes are further nodes are divided into additional nodes.

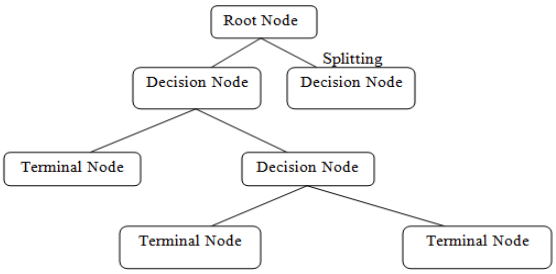


Fig. 3. Decision tree

A decision tree as further constituents is:

1. *Root node:* Root node represents the main node and it divides into so many sub nodes.
2. *Splitting:* The root node is split into one or more nodes.
3. *Decision node:* When sub node is further divided into sub node is called as decision Node.
4. *Leaf node or Terminal node:* Nodes do not split into terminal node.
5. *Branch node or sub node:* The sub node of a complete tree is called as sub node.
6. *Parent and Child Node:* Parent node is a root node, root node is further splits into sub node and that node is divided into sub node are called as leaf or child node.

2) Naïve Bayes Classifier

Naïve Bayes is one of the classification algorithms. Naïve-Bayes is one of the supervised learning techniques. Naïve Bayes is classified as a probability classifier and it is based on the bayes theorem. Naïve Bayes is the simplest algorithms for classification based on Bayes theorem.

Naïve Bayes are used for large sets of data. For example: When considered the apple as a fruit and also relate the entire feature because it apple is in red colour, it is round shape, and also defined its diameter. So assume based on the probability of getting the fruit is an apple or not apple.

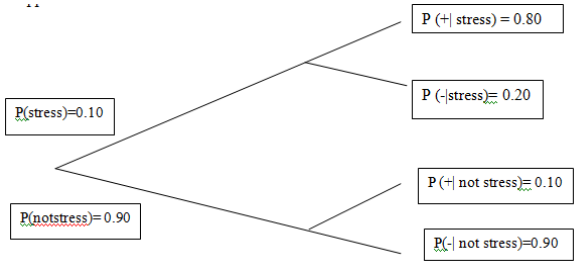


Fig. 4. Example of Naive Bayes

3) K-Nearest Neighbour

K-Nearest Neighbor is one of the important classification algorithms. K-Nearest Neighbor stores all the feasible cases and classifies new cases based on a similar measure of the data. K-Nearest Neighbor measures the nearest neighbour by the surrounding. K-Nearest Neighbour is divided into classification and regression. The neighbours are taken from a group of objects.

Working of K-Nearest Neighbour Algorithm:

K-Nearest Neighbours algorithm uses feature similarity to predict the values of new datasets which is having new data point will be assigned a value based on the points in the training set.

- *Step 1:* For implementing the algorithm need to collect the dataset during the first step of K-Nearest Neighbour and load the training as well as test data.
- Step 2: Choose the value of K i.e. the nearest data points and k can be any integer.
- *Step 3:* Calculate the distance between test data and each row of training data with the help of method is to calculate the distance.
- *Step 4:* Based on the distance values, sort them in ascending order.
- *Step 5:* Choose the k rows for from the sorted array.
- *Step 6:* Assign a class to the test point is based on the class of each row.
- *Step 7:* End.

4. Result

The results of the stress detection where the data set is collected from the website where collect the statistical data and also consider the attributes for the dataset. Based on the statistical data train the dataset and compare with the threshold values and also use the classification algorithm from the machine learning techniques. Based on the threshold values the doctors will predict the person is in stress or not stress.

Accuracy measured from the datasets and accuracy measured for normalized dataset are 100% accuracy got in Decision tree, In Naïve- Bayes algorithm and K-Nearest Neighbor the results shows the classification accuracy, classification error, sensitivity, specificity, False positive rate and Precision of the dataset.

The predicted values for stress detection taken with the help of classification machine learning algorithms and get the values from the confusion matrix.

- Classification accuracy – 1.0
- Classification Error – 0.0
- Sensitivity – 1.0
- Specificity – 1.0
- Precision – 1.0
- False Positive Rate – 0.0
- True Target values – [0 1 0 0 0 1 0 0 1 0 0 0 1 1]
- Predicted Target value – [0 1 0 0 0 1 0 0 1 0 0 1 1]
- Accuracy measured for normalized dataset – 100%

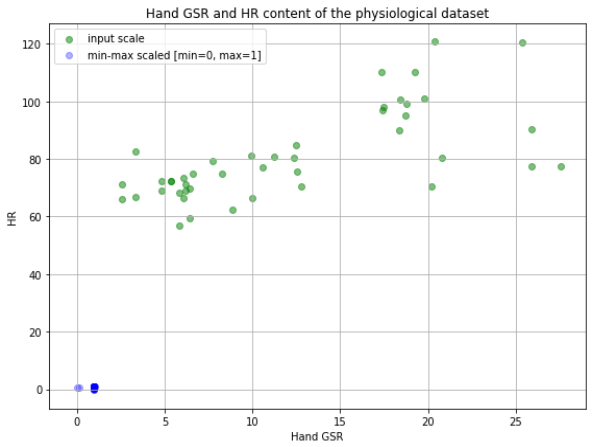


Fig. 5. Graph of predicted values for stress detection

The figure 5 shows the Graph of predicted values from Heart Rate and Hand GSR of the physiological dataset for detection of stress. The graph between Heart Rate and Hand Galvanic Skin Response predicted the values from the datasets.

The predicted values are showed in a graph where the values are represented in the form of dot. The values are predicted from the physiological dataset of Heart Rate and Hand Galvanic Skin Response and consider the values as minimum value is 0 and maximum value is 1.

The result analysis shows the detection of stress by the machine learning algorithms.

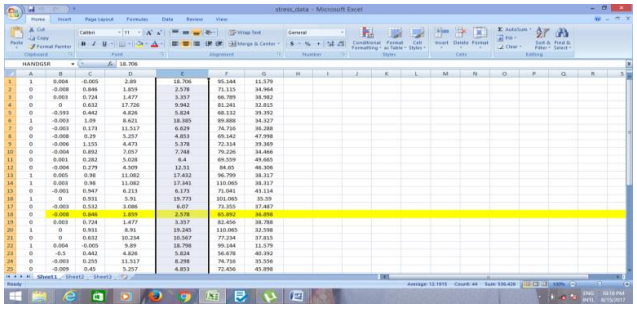


Fig. 6. Dataset list of the stress detection

In figure 6 shows that the dataset having the values where we have considered the six attributes based on this attributes we are consider the values and compare with the threshold values.

Fig. 7. Accuracy showed by Decision Tree

In figure 7 shows that the accuracy measured by the decision tree algorithm. When we use more algorithms we can accuracy. Based on the accuracy we can easily detect the stress.

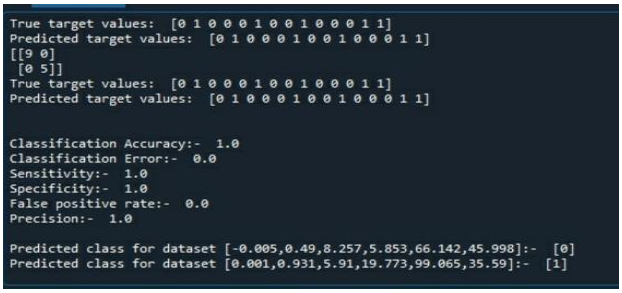


Fig. 8. Predicted values of Naïve Bayes and KNN

In figure 8 shows the predicted values are measured by Naïve Bayes and K-Nearest Neighbour. In predicted values it shows the target and predicted values, classification accuracy and error, sensitivity, specificity, false positive rate and precision.

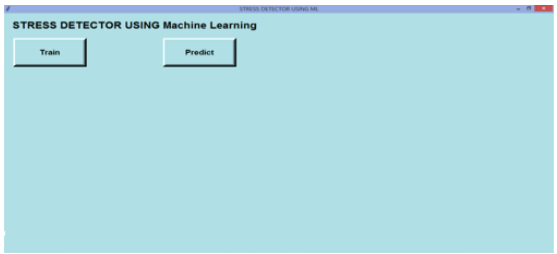


Fig. 9. GUI part of the stress detection

In figure 9 shows the graphical user interface part of the project where when we click on the train button it shows the username and password. It shows predicted value graph.

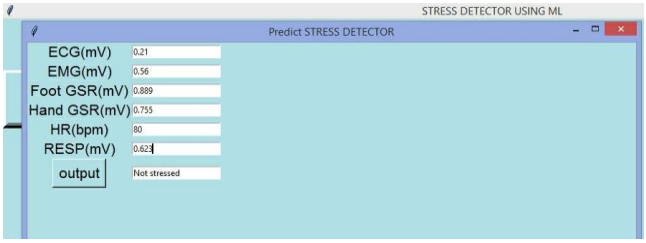


Fig. 10. Output of person shows not stressed

In figure 10 shows that output of person is not stressed where we have to enter the values based on that values and compare with threshold values we can predict the person is in stress or not stress.

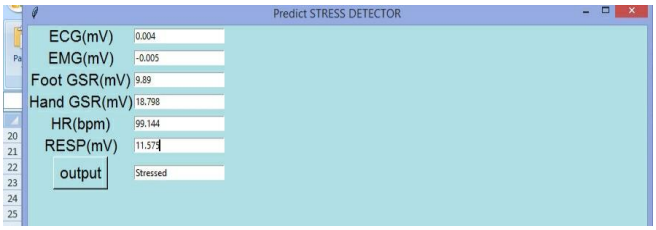


Fig. 11. Output of person shows stress

In figure 11 shows that output shows the person is suffering from stress based on the threshold values and dataset values.

5. Conclusion

The proposed system may help in predicting the stressed people, thereby helpful for the society in solving the serious existing problem of stress by knowing the rate of the stressed level and taking necessary steps and preventive measures to further decrease the stressed level. The proposed systems have taken statistical data and have taken some attributes are Electrocardiogram, Electromyography, Galvanic skin response hand and foot, Heart Rate, Respiration. Based on the values have used some of the algorithms are Decision Tree, K-Nearest Neighbor, Naïve Bayes to get accuracy because when use more algorithms can get best results will train that data and the data is also divided into training data and testing data and compare with the threshold values and that value declares whether the person is in stress or not stress.

6. Future Enhancement

The Future scope involves addition of the controller based hardware module to display the results of the real time values based on the heart rate, Galvanic Skin Response and respiratory sensors according to the state of the person.

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