Applying Machine Learning Techniques to Categorize and Reduce Stress in Human Beings

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Abstract:- The number of individuals in the modernworld experience elevated stress level, which is non-specific response on the body and plays a significant toll on health, productivity at work, relationships and also effect overall well-being. Many individuals are not aware of the stress triggers and potential health problems caused by prolonged stress. In order to effectively combat stress and its ill effects on health, stress triggers and responses to stress must be recognized and managed in real time. In this paper, applications of machine learning techniques are suggested to categorize and reduce stress is explored. The idea of monitoring stress and reducingstress usesmethods like personalized music, wallpaper themes, favorite games or favorite food ordering and so on. Activities which reduce stress and their degree of reduction are monitored in real time and based on customized stress reduction portfolio is designed using machine learning algorithms.

Keyword: *Chronic stress, Categories of Stress, Wearable sensors, Machine learning techniques.*

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I. INTRODUCTION

The chronic stress (non-specific behavior of person) cause elevated change in the overall well-being namely cause irritability, anxiety, depression, headaches and insomnia [1]. Stress can be short term and long term, short term stress are normal namely due to test, interview and so on, Long term stress are termed as chronic, Chronic stress is also a factor in behavior such as overeating, not eating enough, alcohol or drug abuse and social withdrawal. Increase in chronic stress lead to prone of mental disorders, anxiety and mood swings in early life. Illness of stress related namely post-traumatic stress disorder (PSTD) which occurs after extreme stress and changes the volume of the gray and white matter in the brain.

Numerous consumer wearable's today include sensors and other features for monitoring heart rate (HR), heart rate variability (HRV), physical activity level, and galvanic skin response (GSR). Consumer wearables capable of monitoring all four of these physiological signals can provide an accurate stress status profile in real time. With the help of machine learning, wearable applications not only make it possible for individuals to monitor and manage stress themselves, but also provide analyses far beyond the reach of traditional medical devices.

As the population increases in the world, the ratio of health careers is rapidly decreasing. Actually, the Organization for Economic Co-operation and Development (OECD) warns about future shortages of available health workers and doctors [3]. Therefore, there is an urgent need to create new technologies to monitor the health of people, both physical and mental, during their daily life with the aim of supporting health workers, caregivers, and doctors in their tasks. These technologies, also known as Quality of Life Technologies (QoLTs), have emerged as the concept of applying findings from different technological areas to assist people and improve their quality of life.

An emerging research topic inside QoLTs is their application to psychology and self-therapy to improve the mood of people and thus, their quality of life. Although there exist several technologies to support the health of people at the physiological level, the technologies that are able to provide similar support at the mental level are almost inexistent.

Treating negative mental states in people is becoming a priority in our new societies. In particular, stress is a big problem in modern populations due to the increment of stressful situations during everyday activities including work. Stress is a natural reaction of the human body to an outside perturbing factor. The physiological responses to stress are correlated with variations in heart rate, blood volume pulse, skin temperature, pupil dilation, electro-dermal activity. Stress may have beneficial effects on fighting the stress factor, like increasing reflexes, but it was determined that long term stress is correlated with various health problems like depression and premature ageing

Stress is creating new problems that have a great impact in our societies and economies. For example, according to the Mental Health Foundation in UK [3], around 12 million adults in the UK visit their general practitioner doctor (GP) each year with mental health problems, most of which are

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related to stress. As a consequence, 13.3 million working days are lost per year due to stress problems. Moreover, according to the World Health Organization stress has a cost of around 8.4 million to UK enterprises. Finally, current appointments for national health mental services in UK, such as Cognitive Behavioral Therapy (CBT) are taking 3-6 months to be processed, with the subsequent danger for the patient because cumulative stress may have broad negative consequences on societal well-being and costs In this research we aim to detect stress and reduce stress in people using wearable sensors that measure physiological responses.

II. LITERATURE SUVERY

In [1] author explored the mechanism to monitor stress using wearable sensors and mobile phones. They find out the overall performance of 15 sets of related features: sleep survey; Big Five ; post survey ;phone survey (morning) ;phone survey (evening) ;CALL ;SMS ; MOB ; SC ;ACC ; COMM ; SCREEN etc. Reorganization take place using six kinds of classifier: 1) Support vector machine (SVM) with linear kernel 2) SVM with Radial basis function (RBF) kernel 3) k-nearest neighbors (k=1-4) 4) Principal component analysis (PCA) and SVM with linear kernel 5) PCA and SVM with RBF kernel 6) PCA and knearest neighbors (k=1-4).

In [2], Intelligent Mobile Health Monitoring System collects human's physiological data with the help of bio-sensors. The data is accumulated in the sensor network and a concise of the collected data is send to a patient's personal computer. These devices transmit data to the medical server for determination. After the data is analyzed, the medical server sends response to the patient's personal computer. The patients can take necessary actions depending on the response. The IMHMS contains following three components. They are Wearable Body Sensor Network; Patients Personal Home Server and Intelligent Medical Server.

In [4], they presented an approach to detect mentally stressful events using only a heart rate monitor (HRM). The method is related with the principal dynamics modes of Marmarelis, After Heart rate variability analysis done.

In [5], The Galvanic Skin Response (GSR) or galvanic skin level (SCL) is a measure of skin conductivity which is substantial related with human emotional condition during stress and activation level.

Skin conductance level or response (SCL and SCR), is an approach of measuring the electrical conductance of the human skin which varies with human mental and emotional conditions.

For the analysis of galvanic skin response, two electrodes are placed such that the conductive path between them crosses the palm of the hand. Skin resistance or it's reciprocal; skin conductance this variable is used for measurement

Ohm's Law states that skin resistance equals the voltage applied between two electrodes on the skin divided by the current passed through the skin. Hence measuring the potential difference of skin and acquired by data acquisition system.

In [6],They find out a new spectral feature that approximate calculate the balance of the autonomic nervous system by mixing information from the power spectral density of respiration activity i.e. breathe and heart rate variability. They also calculate features like mean, median and standard deviation from skin conductivity level and response. From this they calculate ambulatory stress with the help of logistic regression model.

Figure: Wearable Sensors Devices

As shown in above figure, with the help of wearable sensors signals like ECG information, skin conductance response and breathe rate is measured. After decomposition of EDA take place in to skin conductance level and skin conductance response

In [7], authors stated principled machine learning approaches to classifying large data of continuously acquired, multivariate physiological data, with the help of wearable patient monitors, Also gives early warning of serious physiological problem , such that a degree of valuation care may be provided.

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In [9], authors have analyzed the reported literature on wearable sensors and devices for monitoring different

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human activities. It is revels that many more light-weight, high-performance wearable devices will be available for monitoring a wide range of activities.

III. PROPOSED METHODS

As we explore the current work, we find following important open issues to be solved

1. Measurement of stress with great accuracy
2. Classification of stress into various levels
3. Reduction of stress using mechanisms like Jokes, Music or recommendation for breathing exercise.
4. Continuous stress measurement and improvising the stress reduction with consideration for personalization.

The main focus are: 1.Measurement of stress using wearable sensors 2.Classification of stress using machine learning approach 3.Using Fuzzy logic to decide the suitable stress reduction approach and fine tuning.

The effectiveness of approach metric are Accuracy measures if the stress is detected accurately at all times. This will be measured by the number of times stress detected accurately divided by the number of time stress happened

Classification accuracy measures if the stress is classified accurately.

Stress reduction % measures the amount of stress reduced due to the stress reduction approach followed.

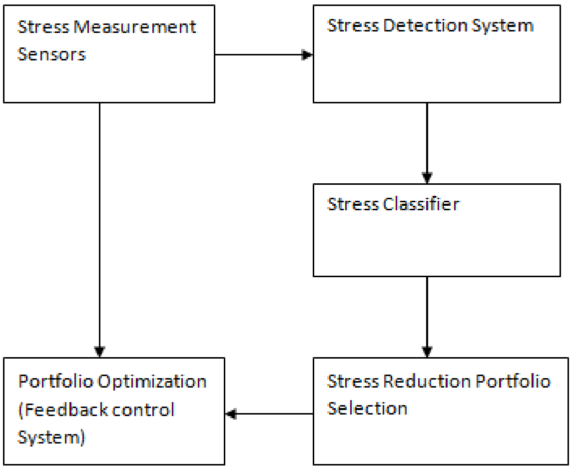

Figure: Proposed Method

Stress Measurement Sensors: Sensors measure the parameters like heart beat rate, pressure, EMG, ECG signals.

Challenge in this component is selection of suitable parameters for monitoring stress.

Stress Detection System: This system extracts features from the measured signals and then uses the features to detect the presence of stress.

Challenge in this component is selection of features for detection of stress accurately

Stress Classifier: The stress classifier measures the level of stress and classifies to various stress levels. The levels are personalized according to the subject and different for each person.

Challenge in this component is selection of suitable parameters to classify the stress. Classification accuracy must be improved.

Stress Reduction Portfolio selection: The portfolio selection module interacts with the mobile phone and extracts the favorite music, jokes, videos etc. and based on it builds a portfolio. Based on the stress level, stress reduction method is designed and proposed to subject. This is learning based system and its fine tunes based on the control from the Portfolio optimization component.

Challenge in this component is application of machine learning methods to select the best stress reduction method.

Portfolio Optimization: This component uses methods like Fuzzy logic to continuously optimize the Portfolio selection component.

Challenge in this component is optimization of methods for the portfolio selection.

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