

Detection of Stress using Wearable Biosensor

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Abstract: As the population increases in the world, the ratio of health care takers is rapidly decreasing. Therefore, there is an urgent need to create new technologies to monitor the physical and mental health of people during their daily life. In particular, negative mental states like depression and anxiety are big problems in modern societies, usually due to stressful situations during every day activities including work. This paper presents a machine learning approach for stress detection on people using wearable physiological sensors with the final aim of improving their quality of life. The presented technique can monitor the state of the subject continuously and classify it into "stressful" or "non stressful" situations. Our classification results show that this method is a good starting point towards real-time stress detection. Stress is a natural reaction to various stress-inducing factors which can lead to physiological and behavioural changes. If persists for a longer period, stress can cause harmful effects on our body. Stress is a major concern in our day-to-day life. The human environments including worksite, home or society can induce stress on an individual to some extent. There are many ways that our body can react to stress, these reactions are mainly classified to either physiological reactions which includes the 'fight or flight' response by the Autonomous nervous system (ANS) of our body or behavioural reactions which includes defensive behaviour, days functional and expressive behaviour, the body sensors along with the concept of the Internet of Things can provide rich information about one's mental and physical health.

Index Terms: Stress, heart rate, temperature, sweat, facial expression, arduino, IoT.

I. INTRODUCTION

In this research we are trying to analyze the stress level of human being by Facial Landmarks and also with biosensors, which is a bio potential signal generated by the heart. In this project for good result, we have made combination of medical science with technology as biomedical engineering. First of all, we have tried to acquire signal from the heart in order to detect the stress of a particular body. The system classifies facial expression of the same person into the basic emotions namely anger, disgust, fear, happiness, sadness and surprise. The main purpose of this system is efficient interaction between human beings and machines using eye gaze, facial expressions, cognitive modeling etc. Here, detection and classification of facial expression scan function as a natural way for the interaction between man and machine. And the system intensity varies from person to person and also varies along with age, gender, size and shape of face, and further, even the expressions of the same person do not remain constant with time.

II. PROPOSED SYSTEM

LM35 Temperature Sensor: This sensor measures the ambient temperature and outputs a voltage proportional to the temperature. It is connected to the analog input pin A3 of the Arduino Uno.

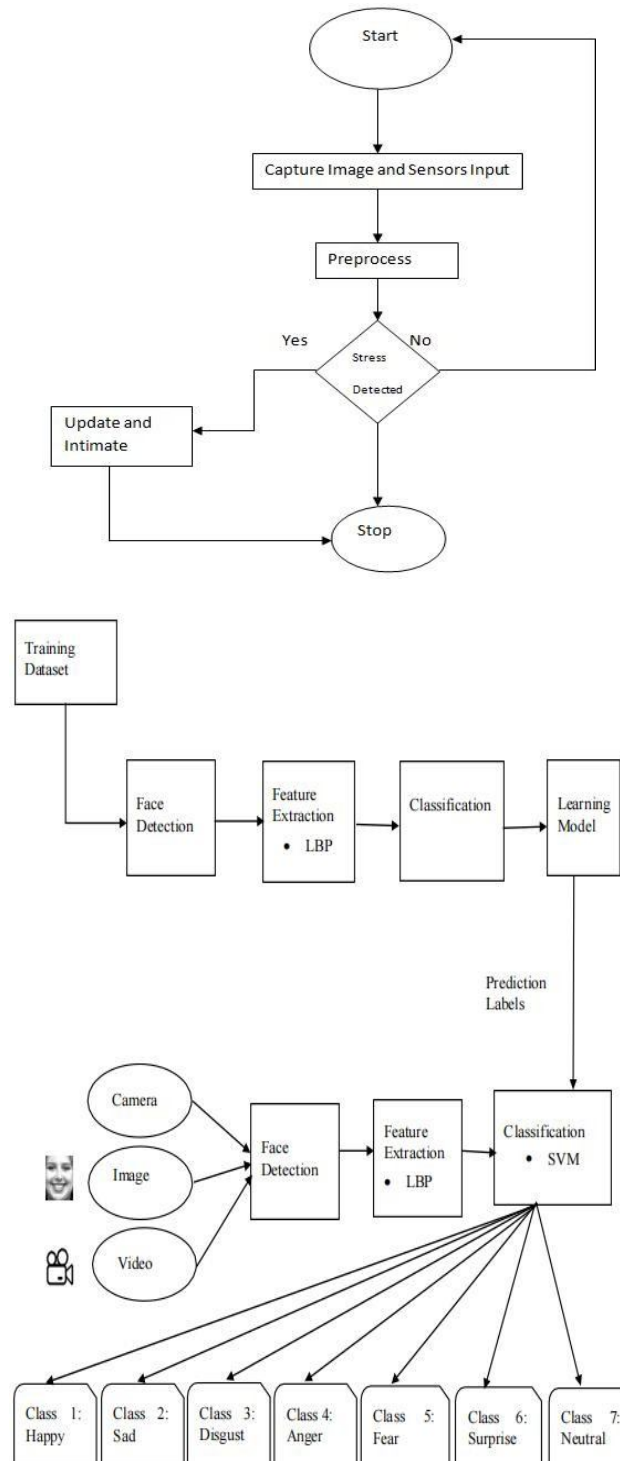
Heart beat Sensor: This sensor is used to measure the heart rate of a person. It works by detecting the changes in blood volume as the heart beats. The output of the sensor is connected to the digital input pin A0 of the Arduino Uno.

Sweat Sensor: This sensor is used to detect the level of sweat on the skin. It works by measuring the skin's electrical conductivity, which increases as the skin becomes sweatier. The Arduino Uno's analogue input pin A4 is connected to the sensor's output.

Arduino Uno: The Arduino Uno is the microcontroller board that controls the overall operation of the system. It is connected to the LM35 temperature sensor, heart beat sensor, and sweat sensor, and processes the sensor readings to determine the stress level of the person. Connect the LM35 temperature sensor, heart beat sensor, and sweat sensor to the Arduino Uno board Upload the program in the Arduino Integrated Development Environment (IDE) to read the sensor data. The program should include the following steps:

1. Read the LM35 temperature sensor's voltage output using the analog Read() function.
2. Convert the voltage reading to temperature using the formula: $\text{temperature} = (\text{analog Read (A0)} * 5.0) / 1024.0 * 100.0$.
3. Read the digital heart beat sensor's output using the digital Read() function. Read the voltages we at sensor's output using the analog Read()function.
4. Convert the voltage reading to sweat level using appropriate calibration values.
5. Process the sensor data to determine the stress level of the person using a suitable algorithm. For example, a simple algorithm could be used to calculate the weighted average of the sensor readings, with higher weights assigned to the heart beat and sweat sensor readings.
6. Output the stress level to the display module.
7. Upload the program to the Arduino Uno board using the Arduino IDE.

Place the temperature sensor, heartbeat sensor, and sweat sensor on the person's body in suitable locations.

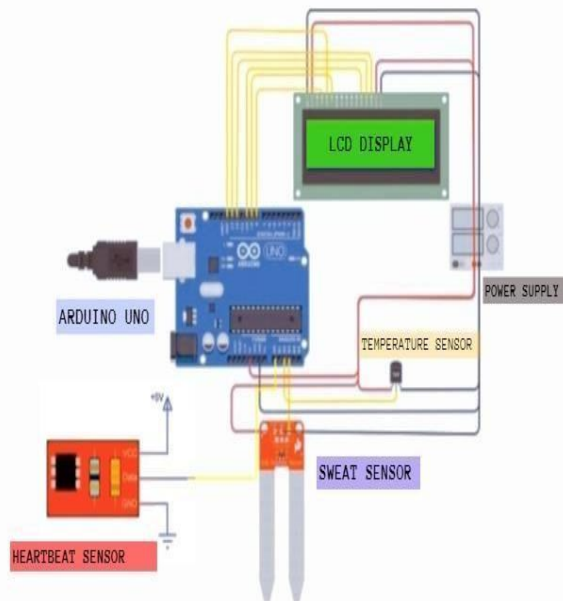


PROPOSED MODEL

Our proposed system has the ability to detect stress level of a person by sensing heartbeat, temperature and sweat using appropriate sensors and to analyse the facial expression of a person using open cv platform. Firstly, the system will read facial emotions using facial land mark techniques. Then read the temperature using the temperature sensor, sweat using the sweat Sensor and finally read the heart rate of a person using the heart beat Sensor. In the proposed algorithm, face image and facial land mark detection is performed first for stress recognition. We used a Convolution Neural Network (CNN) algorithm. In the proposed network, the face images and expression detected earlier are inputted to output stress recognition results. The results of face recognition are composed of students present in the class.

HARDWARE

There are 6 hardware components, which is shown.



IV. SOFTWARE IMPLEMENTATION

Arduino IDE: The Arduino IDE (Integrated Development Environment) is a software program used for programming and developing applications for Arduino microcontroller boards. It is an open source platform that provides a simple and easy-to-use interface for writing, compiling, and uploading code to the Arduino board. Open CV- A library of programming functions called Open CV is primarily focused on real-time computer vision. Because of its modular design, the package contains a number of shared or static libraries. We are employing an image processing module with features like histograms, colour space conversion, affine and perspective warping, geometric picture transformations, linear and non-linear image filtering, and more. Libraries like the Viola Jones or Haar classifier, the LBPH (Lower Binary Pattern histogram) face recognizer, and the Histogram of Oriented Gradients (HOG) are all included in our project.

OPEN CV- PYTHON WORKING:

Open CV introduces a new set of tutorials which will guide you through various functions available in Open CV-Python. This guide is mainly focused on OpenCV 3.x version (although most of the tutorials will work with OpenCV2.x also). Prior understanding of Python and Numpy is necessary before beginning because this guide will not cover them. A solid understanding of Numpy is especially important for writing optimised Open CV-Python scripts.

V. RESULTS

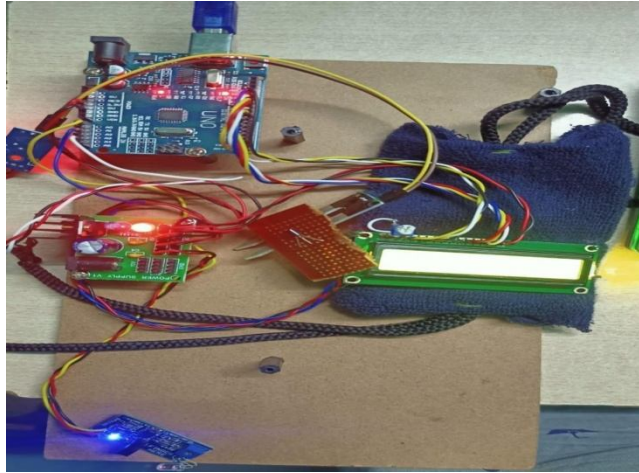
Wearable biosensors are devices that can measure physiological signals from the body, such as heart rate, skin conductance, body temperature, and movement patterns. These sensors can provide valuable information about an individual's stress levels, as stress often triggers specific physiological responses. The data collected from wearable biosensors can be analyzed using algorithm and machine learning techniques to identify patterns associated with stress. By monitoring changes in heart rate, skin conductance, or other relevant signals, these sensors can potentially detect when a person is experiencing stress or anxiety. Stress Level Assessment: Biosensors can provide a quantitative measure of an individual's stress level. This information can help individuals become more aware of their stress patterns and take steps to manage stress effectively.

Real-Time Feedback:

Wearable biosensors can provide real-time feedback to individuals, alerting them when their stress levels are elevated. This feedback can help individuals modify their behavior or engage in relaxation techniques to reduce stress.

Long-term Stress Monitoring: By continuously monitoring physiological signals, wearable bio sensors can provide long-term data on an individual's stress patterns. This information can be used to identify triggers or patterns that contribute to stress and develop personalized stress management strategies.

Research In sights: Aggregated data from wearable biosensors can contribute to stress research by providing Insights into population-level stress patterns, identifying stress-related trends, and evaluating the effectiveness of stress management interventions.



CONCLUSION

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