IMAGE PROCESSING AND MACHINE LEARNING FOR HUMAN STRESS DETECTION

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Abstract—
The major goal of this study is to use vivid Machine Learning and Image Processing methods to identi-fy stress in the human body. Our system is an upgraded version of previous stress detection systems that did not include live detection or personal counselling, but this system includes live detection and periodic analysis of employees, as well as detecting physical and mental stress levels in them and providing proper stress management remedies via a survey form. Our method is primarily focused on stress management and cre-ating a healthy and spontaneous work environment for workers in order to get the most out of them during working Hours.
Keywords— Facial Expressions, K-Nearest Neighbor Classifier, Stress, Stress prediction

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1. INTRODUCTION

Stress management systems are necessary for detecting stress levels that affect our socio-economic situation. According to the World Health Organization, stress is a mental health disorder that affects one out of every four people (WHO). Mental and financial troubles, as well as a lack of clarity at work, bad working relationships, despair, and, in extreme situations, death, are all symptoms of human stress. This necessitates the provision of therapy to help stressed people manage their stress. While it is impossible to totally eliminate stress, taking preventative measures may help you cope. Only medical and physiological peoples can now determine whether or not someone is depressor (stressed). A questionnaire is one of the most used methods for detect-ing stress. This technique relies primari-ly on individual responses; people will be hesitant to communicate whether or not they are worried. Automatically de-tecting stress lowers the likelihood of health problems and improves society's well-being. This involves the creation of a scientific approach for assessing stress levels in people using physiological markers. Since stress is such a signifi-cant societal contribution, a variety of approaches for detecting it have been investigated. It enhances people's quality of life, according to Ghaderi Tal. Stress was assessed using data from respira-tion, heart rate (HR), face electromyog-raphy (EMG), Galvanic skin response (GSR) foot, and GSR hand, with the finding that parameters related to the respiratory process are critical in stress detection. Maria Viqueira et al. present a method for anticipating mental stress that relies only on GSR as a physiologi-cal sensor and uses a standalone stress detecting device. Electrocardiograms alone were utilized by David Liu and colleagues to predict stress levels (ECG). The effectiveness of multimodal sensors in detecting stress in working individuals is investigated experimental-ly. Sensor data from pressure distribu-tion, heart rate, blood volume pulse (BVP), and electro dermal activity is used in this investigation (EDA). In ad-dition, an eye tracker sensor is used, which analyses eye movements in con-nection with stressors such as the Stroop word test and information regarding pick-up tasks.

Nowadays, the IT industry is creating a new standard in the market by introducing new technology and goods. Employee stress levels were also found to set the bar high in this research. De-spite the fact that many companies pro-vide mental health benefits to their workers, the problem remains out of control. In this study, we attempt to go further into the topic by attempting to identify stress patterns in working em-ployees in businesses. We plan to use image processing and machine learning methods to analyse stress patterns and narrow down the elements that greatly influence stress levels. Machine learning approaches such as KNN classifiers are used to categorise stress. The employee's picture is snapped by the camera, which acts as input, and image processing is employed at the first step for detection. Picture processing is used to improve an image or extract relevant information from it by converting the image to digi-tal form and executing operations on it. By taking a picture from video frames as input and producing an image or attrib-utes related with that image as output.

Image processing consists of three phas-es:

- Importing the image using photo capture software
- Analysing and altering the pic-ture
- As a result of the output, a pic-ture that has been modified or a report based on image analysis.

Machine learning, which is an ap-plication of artificial intelligence, gives the system the capacity to autonomously learn and develop from self-experiences without being explicitly designed (Arti-ficial Intelligence). Machine Learning creates computer programs that can ac-cess data and utilize it to learn for them-selves. Explicit programming produces a mathematical model based on "training data" to accomplish the work based on predictions or judgments using Machine Learning. Image mining is a technique for extracting hidden data, associating picture data, and discovering new patterns not visible in the image. This cate-gory includes image processing, data mining, machine learning, and datasets. According to conservative estimates in medical literature, stress is the cause of 50-80 percent of all physical diseases. Stress is regarded to be the major cause of cardiovascular disease. Stress is asso-ciated to diabetes, ulcers, asthma, mi-graine headaches, skin issues, epilepsy, and sexual dysfunction. Each of these conditions, as well as a slew of others, has a psychosomatic basis (i.e., induced or exacerbated by mental factors like stress). There are three impacts of stress:

- Guilt, humiliation, anxiety, an-ger, and frustration are some of the subjective symptoms of stress. Individuals may also ex-perience fatigue, tenseness, nervousness, irritability, moodi-ness, or loneliness.
- Behavioural impacts of stress indicate visible changes in a person's behaviour. Increased accidents, drug or alcohol usage, out-of-context laughing, outra-geous or argumentative behaviour, extremely excitable moods, and/or excessive eating or drinking are all signs of be-havioural stress.
- Cognitive stress may cause a decline in mental capacity, poor judgment, impulsive choices, forgetfulness, and/or hypersen-sitivity to criticism.

1.1 LITERATURE SURVEY

1. Detecting stress and anxiety in films using facial clues
AUTHORS: G. Giannakakis, D. Manousos, F. Chiarugi

Through video-recorded face clues, this research creates a framework for detecting and analyzing stress/anxiety emotional states. Through a range of external and internal stresses, a complete experimental methodology was designed to produce systematic di-versity in emotional states (neutral, calm, and stressed/anxious). In order to measure emotion expression more ob-jectively, the study focused mostly on non-voluntary and semi-voluntary facial signals. Eye-related events, mouth activ-ity, head motion characteristics, and heart rate assessed via camera-based photo-plethysmography were also inves-tigated. In each experimental phase, a feature selection technique was used to pick the most robust characteristics, fol-lowed by classification algorithms that discriminated between stress/anxiety and neutral states with reference to a relaxed condition.

In addition, a ranking transformation based on self-reports was presented to study the relationship be-tween face attributes and a participant's reported stress/anxiety level. Specific facial signals generated from eye, mouth, head, and camera-based cardiac activity acquire excellent accuracy and are acceptable as discriminative markers of stress and anxiety, according to the findings.

2. Detection of Stress Using Image Pro-cessing and Machine Learning Tech-niques

AUTHORS: Nisha Raichur, Nidhi Lonakadi, Priyanka Mural

Stress is an uncomfortable state of emotional arousal that individuals feel in settings such as sitting in front of a computer for lengthy periods of time. Computers have become a way of life; we spend so much of our time on them that we are more impacted by the ups and downs they create. One cannot total-ly avoid using computers for work, but one should at least limit his or her use if he or she is concerned about being stressed at a certain moment. Monitor-ing a person's mental state while work-ing in front of a computer for an extend-ed period of time is critical for their safety. This research uses real-time non-intrusive movies to assess a person's emotional state by analyzing their facial expression. Each video frame contains a distinct feeling, and the stress level is determined in the hours after the video recording. We use a method that enables us to train a model and compare differ-ences in feature prediction. Theano is a Python framework aimed at speeding up the execution and development of the linear regression model, which is em-ployed as a deep learning technique in this case. The results of the experiments reveal that the devised method works effectively with a generic model of all ages.

3. Techniques for Predicting Stress in Working Employees Using Machine Learning

AUTHORS: U. S. Reddy, A. V. Thota and A. Dharun

Stress problems are a wide-spread problem among today's working IT professionals. Employees are more likely to experience stress when their lifestyles and work environments change. Despite the fact that many sec-tors and corporations provide mental health-related programs and attempt to improve the office environment, the problem remains out of Control. In this research, we will use machine learning approaches to examine stress patterns in working people and to identify the ele-ments that have a significant impact on stress levels. Data from the OSMI men-tal health survey 2017 answers of work-ing professionals in the IT sector were used to help with this. After proper data cleaning and pre-processing, we used a variety of Machine Learning approaches to train our model. The accuracy of the models mentioned above was deter-mined and compared. Among the mod-els used, boosting had the best accuracy. Gender, family history, and the availa-bility of health benefits in the job were found as key characteristics that impact stress using Decision Trees. With these findings, businesses may focus their ef-forts on reducing stress and providing a more pleasant working environment for their workers.

4. A sternal ECG is used to classify acute stress using linear and non-linear heart rate variability analyses.
AUTHORS: Tanev, G., Saadi, D.B., Hoppe, K., Sorensen, H.B

The diagnosis of chronic stress is crucial in predicting and lowering the risk of cardiovascular disease. This pro-ject is pilot research with the goal of establishing a technique for identifying short-term psychophysiological altera-tions using HRV properties. The goal of this pilot project is to identify and ac-quire insight into a collection of charac-teristics that might be utilized to detect psychophysiological alterations associ-ated with chronic stress. Images, noises, mental activities, and rest were used to evoke four distinct forms of arousal, which were then identified using linear and non-linear HRV characteristics from electrocardiograms (ECG) obtained by the wireless wearable ePatch® recorder. Sample entropy, detrended fluctuation analysis, and normalized high frequency features were used to get the greatest identification rates for the neutral stage (90 percent), acute stress stage (80 per-cent), and baseline stage (80 percent). It was discovered that standardizing non-linear HRV variables for each partici-pant was a crucial component in improv-ing classification outcomes.

5. Healthy Office: Using smartphones and wearable sensors, employees may recognize their moods at work.

AUTHORS: Zenonos, A., Khan, A., Kalogridis, G., Vatsikas, S., Lewis, T., Sooriyabandara

Workplace stress, anxiety, and depression are detrimental to employees' health and productivity, and they are costly. Sensor technologies, such as smartphones and wearables with physio-logical and movement sensors, have been the focus of recent research in this field. In this paper, we look at the feasi-bility of deploying such gadgets for mood detection in the workplace. Every two hours, we propose a new mood de-tection framework that can recognize five intensity levels for eight distinct kinds of emotions. We also propose a smartphone app ('Healthy Office') that is meant to promote formal self-reporting and give data for our model. In a small-scale user research, we gather wearable sensing data in an office setting to assess our technology. Our trials have shown encouraging results, enabling us to accurately distinguish different types of emotions.

2. Project Description

2.1 Problem Statement

Image capturing is automated, so it collects photographs whenever a typical behavior occurs. The detecting of sys-tem will be fooled. If the picture is dis-torted while being captured, the system will provide incorrect findings. Continued picture capture results in massive, useless datasets. Detection will become more time demanding or incorrect as a result of the auto collected picture da-tasets.

2.2 Existing System

Work on stress detection in the present system is based on digital signal pro-cessing, which takes into account of galvanic skin reaction, blood volume, pupil dilation, and skin temperature. Other research on this topic relies on a variety of physiological signals and vis-ual aspects (eye closure, head move-ment) to assess a person's stress levels while they are at work. These measures, on the other hand, are obtrusive and un-comfortable in practice. Every sensor reading is compared to a stress index, which is a number that is used to deter-mine the amount of stress.

Disadvantages of Existing System

- Non-stationary temporal per-formance commonly pigeon-holes physiological signals for analysis, and the extracted char-acteristics explicitly reveal the physiological signals' stress in-dex
- Different individuals may react or express differently under stress, therefore it is difficult to discover uniform pattern to characterize the stress emotion.
- The ECG signal is immediately analysed using the frequently used peak j48 technique.

2.3 Proposed system

To categorize stress, the suggested Sys-tem Machine Learning techniques, such as KNN classifiers, are used. The em-ployee's picture is provided by the browser, which acts as input, and Image Processing is employed at the first step for detection. Picture processing is used to improve an image or extract relevant information from it by converting the image to digital form and executing op-erations on it. By taking an image as input and producing an image or image-related qualities as output. On the rounder box, the emotions are represent-ed. Angry, Disgusted, Fearful, and Sad are all stress indicators.

Advantages of Proposed System

- The output of image analysis is a transformed image or a report.
- By providing proactive stress management solutions, the Stress Detection System assists workers in dealing with chal-lenges that cause stress.
- We'll take pictures of staff at regular intervals, and then give them the traditional survey forms.

2.4 Module Description

The following modules are used in this project:

- User
- Admin
- Data Pre-process
- Machine Learning (K-Nearest Neighbour Classification)
- Here, we will use haarcas-cade_frontalface_default.xml (classifier)
- User:

The first may be registered by the user. For future contact, he needed a valid user email and cell phone number while regis-tration. After the user has regis-tered, the customer may be acti-vated by the administrator. After the customer has been activated by the admin, the user may log into our system. The user must first provide the system with an image as input. The image's attributes and relevant emotion will be extracted using the Py-thon package. It is also feasible to recognize many faces in a same picture. The stress level will be shown by facial expres-sions such as sadness, anger, and so on. After the picture pro-cessing is complete, we will begin the live feed. We can also see the face expressions of many people on the live broad-cast. TensorFlow live stream is more accurate and faster than tensor flow live stream. After that, we'll import the dataset in order to calculate the KNN clas-sification accuracy precession scores.

 Admin: With his credentials, the administrator can log in. He may activate the users after log-ging in. Only the activated user may access our apps. The admin may dynamically set the pro-ject's training and testing data in the code. In a hidden frame, the admin may see all of the users' identified results. He can dis-cern the emotions of the photos by clicking a hyperlink on the screen. The results of the K-nearest neighbor classification discovered may also be seen by the admin. The spreadsheet with the data. We may extend the da-taset size based on fictitious values by allowing authorized people to do so.

 Data Pre-process: Dataset con-tains a grid view of an existing dataset with numerous proper-ties; however, Property Extrac-tion produces a newly designed dataset with only numerical in-put variables as a result of Prin-cipal Component Analysis fea-ture selection, which transforms to six principal components: Condition (No stress, Time pressure, Interruption), Stress, Physical Demand, Performance, and Frustration.

 Machine Learning: K-Nearest Neighbour (KNN) is a classifi-cation and regression analysis algorithm. It's a supervised learning system for determining whether or not a person need therapy. The dependent variable is classified by KNN based on how similar it is to a comparable instance from previously col-lected data. KNN A statistical model with a binary dependent variable is known as classifica-tion. KNN is used to estimate the parameters of a KNN model in classification analysis. A bi-nary KNN model, mathemati-cally, contains a dependent vari-able with two potential values, which is represented by an indi-cator variable, with the two val-ues labelled "0" and "1".

3. Project Design and Analysis

3.1 Architecture

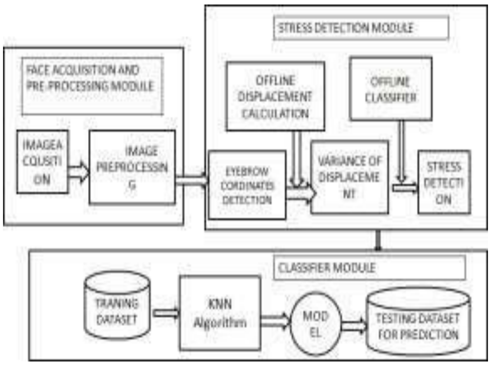

Fig.1 Architecture

Fig. 2 Data Flow Diagram (DFD)

- A bubble chart is another name for a DFD. It is a basic graphical for-malism that may be used to depict a system in terms of the data it re-ceives, the processing it does on that data, and the data it generates as output.
- The data flow diagram is one of the most important modelling tools (DFD). It's used to symbolize the numerous parts of the system. These components include the sys-tem process, the data used by the process, an external entity that in-teracts with the system, and the in-formation flows in the system.

- DFD depicts how data flows through the system and is trans-formed by a sequence of transfor-mations. It's a graphical representa-tion of data flow and the changes that occur when data goes from in-put to output.
- DFD is sometimes referred to as a bubble chart. At any level of ab-straction, a DFD may be used to depict a system. DFD may be di-vided into levels, each representing a different degree of information flow and functional detail.

Algorithm:

1) Start
2) Using a camera, capture the input image/object.
3) If the image/object is clear, it may be used as input, or it can be told to be rechecked.
4) After the input picture has been recognized, it displays the ob-ject/stress images in the form of emotions such as joyful, sad, furi-ous, and so on.
5) Stop

3.2 Input Design

The information system and the users are linked via the input design. It entails defining data preparation criteria and procedures for turning transaction data into a format that may be used. Pro-cessing may be done in one of two ways: by scanning a computer for data from a written or printed document, or by having individuals manually enter the data into the system. The goals of input design are to decrease the quantity of data needed, control mistakes, reduce delays, remove superfluous steps, and simplify the process. The input is meant to give security and convenience while maintaining confidentiality. The follow-ing aspects were considered by Input Design:

- What data should be given as input?
- How should the data be orga-nized or coded?
- A conversation to assist opera-tional people in offering feed-back.
- How to prepare input valida-tions and what to do if a mistake occurs.

Objectives of input Design

- The process of translating a us-er-oriented description of an in-put into a computer-based sys-tem is known as input design. This design is critical for avoid-ing data entry mistakes and di-recting management in the right way for collecting accurate in-formation from the computer-ized system.

- It is accomplished by designing user-friendly data input panels that can manage enormous amounts of data. The purpose of input design is to make data en-tering simpler and error-free. The data entering panel is set up in such a manner that you may execute all of the data manipula-tions. It also allows you to see your records.
- It will validate the data after it has been input. Screens may be used as v input information. Appropriate messages are sent when required, ensuring that the user is never caught off guard. As a result, the goal of input de-sign is to produce an easy-to-follow input layout.

3.3 Output Design

A quality output is one that satisfies the end user's needs and shows information clearly. Any system's processing results are conveyed to users and other systems through outputs. In output design, it's decided how information will be dis-placed for immediate use, as well as the format. hard copy output. It is the most important and direct source information to a user. The system's relationship with the user is improved via efficient and intelligent output design.

- Computer output should be built in an orderly, well-thought-out manner; the proper output must be generated while ensuring that each output part is designed in such a way that users will find the system easy to use. They should identify the exact output that is required to satisfy the cri-teria while analysing and de-signing computer output.
- Decide on how you'll deliver the data.
- Create a paper, report or other document that includes the in-formation from the system.

An information system's output form should achieve one or more of the fol-lowing goals.

- Disseminate information regard-ing previous actions, present status, or future estimates.
- Alert people to significant events, opportunities, challeng-es, or warnings.
- Initiate a reaction.
- Verify a decision.

3. CONCLUSION

The Tension Detection System monitors collected photographs of authorized us-ers to forecast stress in workers, making the system safe. When the authenticated user logs in, the picture capture is done automatically depending on a time peri-od. Based on certain common conver-sion and image processing processes, the acquired pictures are utilized to deter-mine the user's stress. The system will then use Machine Learning algorithms to analyze the stress levels, resulting in more efficient outcomes.

5. Future Enhancement

In the health-care industry, biomedical wearable sensors combined with Internet of Things technologies have shown to be a winning combo. The advantages of employing such gadgets have had a fa-vorable influence on both patients and clinicians. Early detection of medical issues, quicker medical aid through Re-mote Monitoring and Telecommunica-tion, an emergency alarm system to in-form the caregiver and personal physi-cian, and so on are only a few of its ben-efits. By continuously monitoring and delivering frequent feedback on stress levels, the suggested work on constructing a multimodal IoT system ensures to be a better health aid for a person. In the future, it would be interesting to expand on this work by integrating additional physiological char-acteristics, such as an activity identification system, and using machine learning ap-proaches to the construction of a stress de-tection model.

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