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A machine learning based 'wearable depression, anxiety and somatisation monitoring IOT system (WDASMS)' for the prevention of suicides

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Abstract. Tamil Nadu reportedly is the alternate loftiest rates of pupil self-murder in India. According to report from the National Crime Records Bureau (NCRB) for 2020, about 46 people failed each day by self-murder in the state; further than two of these victims each day were scholars. The government of India's domestic seminaries for meritorious pastoral children have reportedly witnessed 49 self-murders in just five times and half of the children who killed themselves on the premises were Dalits and Adivasis, Educationalists point at the pressure mounted on scholars for marks and competitive examinations as one of the main reasons. Utmost seminaries have councillors but going to the council has a smirch about it still. Domestic seminaries where these cases are passing more need to be covered more. Children dying by self-murder due to academic pressure are unheard of in other countries. Utmost of the A huge number of enquiries revealed depression and anxiety to be implicit risk factors for self-murder. Heart health is good among students between the ages of 15 and 25. A few physiological parameters are altered by anxiety and depression. Hence, current pulsation is the symptom for psychiatric diseases. Clinical trials have demonstrated that mental reasons, most frequently anxiety, depression, and somatoform illnesses, are present in cases with pulsation. Psychiatric problems like anxiety and somatization are linked to palpitation. A study found that individuals with high levels of both depression and anxiety are 54.77 times more likely to commit suicide, which is a significant increase above individuals with either high levels of anxiety or depression (2.46). (26.32).. Naturally students studying +2 and preparing for high marks are in under depression and it's dragged for two times. When the examinations are nearing and the results are nearing, the combined depression and anxiety factor increases the threat for committing self-murders for84.5. Hence, a system with literacy and decision making medium is needed to constantly monitor the students to take prompt conduct. A wearable IoT device transmits with scholars Id, the pulsation position constantly to the fellow knot. Logistic Retrogression machine literacy algorithm is used for decision making grounded on the probability of circumstance. The authorities are informed in their widgets and prompt conduct can be taken. This system will be more applicable to the boarding seminaries, where the children are far down from their parents and the number of self-murders are high particularly among +2 grade. This system can be used for colourful communities, where the working culture gives depression and anxiety.

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1. Introduction

As According to the National Crime Record Bureau's (NCRB) Accidental Deaths and Self-Murders in India (ADSI) report from 2020, 8.2% of students in the nation committed suicide before graduating. Tamil Nadu had the fourth-highest percentage of academics who committed self-murder, at 7.4%. (930 self-murders).Every time numerous children with high aspiration and good eventuality are committing self-murder, due to the academic depression and high anxiety. Hence, a support system is the need of the hour to cover these kiddies during the ineluctable period, through which the society can cover the unborn leaders.

Inquiries say that there are relationship between pulsation and internal health. The consummations revealed that 85.4 of the pulsation cases were psychiatric diseases, and that internal problems were more common in these patients than in a group of healthy individuals. One can look at where the pulse is and how it varies by using a machine learning technique. Algorithm equipped IOT system can take opinions and make the authorities to take prompt conduct.

2. Literature survey

Mullick et al. [1] carried out a research in June 2022 to predict teenage depression using mobile and wearable sensors. In order to effectively predict depression scores and changes in depression inflexibility in teenage individuals, the researchers employed multimodal machine learning approaches. The study emphasises how wearable and portable sensors may improve the early detection and monitoring of adolescent depression. A work on feature extraction for EEG-based depression and anxiety detection was finished by Minkowski et al. [2] in November 2021. The Trait Anxiety Inventory (TAI) questionnaire was used by the researchers to gauge the individuals' degrees of anxiety, and they found that the traits they extracted could reliably differentiate between melancholy and anxiety. The work highlights the potential of EEG-based feature extraction to enhance the diagnosis and treatment of depression and anxiety disorders. In December 2020, Ahmed et al. [3] did research on a machine learning method to recognise sadness and anxiety using supervised learning. The study determined that the machine learning approach could precisely identify melancholy and anxiety using questionnaires to assess the intensity of depression and anxiety. The study emphasises the potential of machine learning to enhance the diagnosis and treatment of depression and anxiety disorders. Fukuda et alstudy .'s [4] on employing a wrist-worn sleep sensor to forecast melancholy and anxiety was completed in March 2020. The temporal ratio of REM sleep to light sleep was a helpful feature for assessing sorrow, optimism, and anxiety, the study revealed. It also showed that the sensor's capacity to anticipate degrees of sadness and anxiety was typically correct. The study highlights the opportunity for wrist-worn sleep sensors to support early detection and monitoring of anxiety and depression. A good screening method for identifying people who could benefit from further assessment and therapy is the use of sleep data as a biomarker for mood disorders.

Recent research has looked at the possibilities of technologically based treatments for mental health problems such depression, anxiety, and suicidal ideation. Due to biases and other distractions, Shukla et [5] alresearch .'s from 2020 showed the limitations of utilising the Patient Health Questionnaire as a diagnosis tool for depression. They suggested a method that could provide a more objective and trustworthy method of diagnosis, using statistical and energy aspects of voice data, to identify depression. In a research published in September 2019, Jaiswal et al. [6] used machine learning algorithms to examine facial films captured during interviews with individuals who were filling out questionnaires on sadness and anxiety. The study illustrated the promise for technology-based solutions in the early diagnosis and monitoring of these diseases by showing how behavioural and psychological features gathered in the films might predict sadness and anxiety. In June 2019, Aledavood et al. [7] presented research on the use of smartphone-based sleep monitoring to track sleep in individuals with mental illness. According to the study, smartphone sensors can provide informative information on the sleeping

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patterns of people who have mental diseases, which might be useful for diagnosing and treating conditions including depression, anxiety, and psychosis. The M-SID architecture, an IoT-based edge-intelligent framework for detecting suicidal ideation, was created by Prabha Sundaravadivel et al. [8] The study showed how machine learning algorithms and wearable sensors may be used to monitor patients continuously and identify those who are at risk for suicidal ideation. These studies demonstrate the potential for technologically supported ways to provide more objective, trustworthy, and non-intrusive methods for the identification and treatment of mental health problems. These remedies may eventually result in earlier detection and intervention, which would enhance patient outcomes and quality of life.

3. Physiological changes due to depression and anxiety

3.1. Cortisol

Although cortisol is frequently referred to as the stress hormone, it is also vital for many important physiological functions. The current cortisol testing procedures require a person to wait several days for lab findings, which can have altered by the time they are heard. For academics and medical professionals, wearable sensors that track cortisol levels in real-time would be a game-changer.The amount of cortisol in sweat may now be measured instantly, precisely, and continuously thanks to a new gadget. The apparatus employs a stretchy patch with holes to capture perspiration. Cortisol blocks the charged ions from passing across a membrane like sodium and potassium ions do. A patch's electrical sensor locates the obstructions and sends signals to a linked device for examination. The gadget is a potential tool for identifying normal and abnormal cortisol levels in biofluids including perspiration, saliva, and serum since it can produce results in only a few short seconds.

A non-invasive, accurate, and quick method of measuring cortisol levels in response to certain stress-related circumstances is made available by this novel instrument. The capacity to measure cortisol levels quantitatively and objectively can aid in the diagnosis of medical conditions and shed light on the effects of stress on memory, metabolism, the immune system, and blood pressure.In conclusion, wearable sensors that can track cortisol levels in real-time have the power to completely change the way that science and medicine are conducted. A potential new invention that provides a non-invasive, accurate, and quick technique for gathering objective data on cortisol levels is the new instrument that monitors cortisol levels in sweat. Tools for controlling stress-related diseases may become more precise and available as a result of more research and development in this area.

3.2. Cortisol

Because skin temperature is regulated by sympathetic nerve activity, which represents the progression of information processing in the brain, skin temperature is a useful indication for objectively assessing human sensations. As a result of factors like blood vessel constriction, the amount of heat given to the skin reduces and skin temperature rises when stress, tension, or other symptoms occur. The body might undergo changes as a result of anxiety, including a drop in skin temperature. The body's "fight or flight" reactionThis might happen as a result of, which is brought on by the release of adrenaline and other stress hormones. This reaction may lower skin temperature by causing blood vessels to constrict due to a reduction in blood supply to the skin. The temperature of the skin can also drop as a result of sweating, another anxiety symptom.

The body's temperature can be used to gauge a person's level of stress. An individual's body temperature ranges between 36 and 37 degrees Celsius. The temperature ranges that indicate a person's health are as follows:

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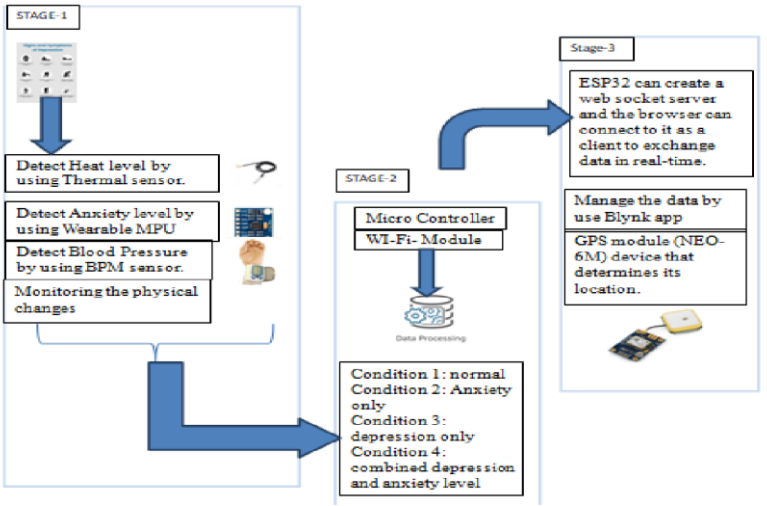
Temperature	Condition
Below 26°C	Highly Tensed
26 - 29°C	Slightly Tensed
29 - 32°C	Mildly Calm
32 - 35°C	Quietly Relaxed
Above 35°C	Deeply Relaxed

3.3. Palpitation

Palpitations, which are the feeling that one's own heart is beating, can be brought on by a number of medical disorders or external factors. Additionally, depression can alter how the body processes emotions and increase sensitivity to physical sensations like pulsations. The interpretation of symptoms like pulsations as indications of a serious illness may also be more common in those with depression, which can exacerbate anxiety and depressive symptoms. Anxiety-related heartbeats can feel like they are competing, fluttering, beating, or skipping a beat. An increase in palpitation may occur in reaction to particular stressful circumstances. You could also have pulsations as a result of an anxiety issue (inordinate or patient solicitude). Fluttering some individuals detect a flopping or uneasy feeling in the coffin. Your heart can seem to be flipping. An irregular heartbeat might make you feel as though your heart is beating too quickly or too slowly. You can start to feel concerned about your heart rate fluctuating. You can also experience a brief stop in your heartbeat. Your heart may be pounding loudly or even explosively. Some claim that they can mentally feel their heart beating. Heart rate variability can be used to correlate the stress (HRV). A person is deemed fit and healthy when their HRV rating is above 50. However, the individual is also tense and hyperactive. If the HRV value is between 2 and 15 and between 14 and 25, the person is also tense and hyperactive.

4. Methodology

4.1. Architecture diagram



A wrist-worn device that gathers data from pulse oximeters, oscillometric sensors, thermistors, and 3-axis accelerometers was created using the ESP32 microcontroller, which has a built-in Bluetooth module and a high-performance processor. To guarantee reliable data gathering, the device's sensors were positioned near to the skin. The ESP32 microcontroller examined the physiological data obtained and used an Apriori method to calculate the stress index score. The gadget can recognise the user's position,

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behaviours, and state every second and is intended for those who are facing high stress and suicide thoughts.

4.2. Temperature sensor

A B350 NTC thermistor is a type type temperature sensor that gauges temperature utilising a particular material's negative temperature coefficient (NTC) properties. In the designation, the "B350" stands for to the thermistor's nominal resistance, which is normally around 3500 ohms at 25 degrees Celsius (77 degrees Fahrenheit). The resistance of an NTC thermistor varies with temperature, often decreasing as the temperature rises. The temperature of the thermistor can be determined using this change in resistance. A circuit that monitors resistance and interprets it as a temperature value can be used with the B350 thermistor. Our project is being used to gauge whether a person is under stress based on their body temperature.

4.3. Blood pressure monitor

A tool used to measure blood pressure is a blood pressure monitor. This is the pressure that blood places on the artery walls. Blood pressure monitors come in two varieties: manual and automatic. Typically, a manual blood pressure cuff, a pump, and a stethoscope make up a blood pressure cuff monitor. The cuff is inflated and wrapped around the upper arm. Using the pump the sound of the blood flowing is heard with a stethoscope. As the cuff is gradually deflated, through the artery. Systolic pressure is the point at which the sound of the blood moving through the artery first becomes audible, and diastolic pressure is the point at which the sound ceases to be audible.

4.4. GYRO sensor

A device that integrates many sensors to provide data on an object's motion and orientation is known as an MPU sensor, or motion processing unit sensor. Typically, MPU sensors consist of accelerometers, gyroscopes, and occasionally magnetometers. Accelerometers calculate the rate at which the velocity changes along one or more axes. They can be used to measure an object's acceleration or deceleration as well as its tilt or inclination. Gyroscopes track the rate of change of rotation in one or more axes, or angular velocity. They can be used to determine an object's angular velocity as well as its orientation or rotation. Locating the person's ankle and determining their status using this sensor.

4.5. Heart rate variability (HRV) analysis

The difference in time between succeeding heartbeats, or HRV, is quantified. HRV data analysis software may be trained to find patterns in the data that represent stress levels. For instance, stress is frequently linked to a decrease in HRV.

4.6. Speech analysis

Machine learning algorithms can be trained to analyse speech patterns and detect changes in tone, pitch, and other characteristics that indicate stress.

4.7. Activity tracking

Wearable technology can gather information on physical activity, sleep patterns, and other metrics that can be used to track stress levels, such as fitness trackers and smart watches. This data can be analysed using machine learning techniques to find patterns that signify stress.

4.8. Social media analysis

It is possible to train machine learning algorithms to analyse social media activity and spot trends that point to stress. An individual may be under stress if there is a rapid rise in negative posts or a drop in social participation, for instance. Machine learning algorithms can offer insights into a person's stress levels and assist them in better managing their stress by analysing these data points and trends. Also,

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based on a person's particular stress patterns and triggers, machine learning can be utilised to create individualised stress management regimens.

4.9. Collect data

First, need to collect data that will be used to train your machine learning model. This can include physiological data such as heart rate variability, skin conductance, and respiratory rate, as well as psychological data such as self-reported stress levels.

4.10. Pre-process data

Once collected the data, you will need to pre-process it to ensure that it is in a suitable format for machine learning algorithms. This may include steps such as data cleaning, normalization, and feature extraction.

4.11. Select machine learning algorithm

There are many machine learning algorithms that can be used for stress detection, including logistic regression, support vector machines (SVM), and neural networks. You will need to select an algorithm that is appropriate for your data and problem.

4.12. Train the model

After selecting an algorithm, you can train the model using your preprocessed data. This involves splitting your data into training and testing sets, fitting the model to the training data, and evaluating its performance on the testing data.

4.13. Test and refine the model

Once you have trained the model, you can test its performance on new data to see how well it can detect stress levels. You may need to refine the model by adjusting its parameters or trying different algorithms to improve its performance.

4.14. Deploy the model

Finally, deploy the model to make predictions on new data. This could involve integrating it into a mobile app or wearable device that collects physiological data in real-time and provides feedback on stress levels.There are several Python libraries that can be used for implementing machine learning models, including scikit-learn, TensorFlow, and PyTorch. These libraries provide a variety of tools for choosing algorithms, training models, and preparing data deployment.

5. Conclusion

Depression and anxiety have become more severe in recent years, which is continuing to harm the public's health. With the aid of academy counsellors, there is a proactive strategy to raise awareness of depression among domestic academy students so that they can recognise and assist depressed students. Aggressive, early intervention can prevent depression from getting worse and lessen its negative effects. To help the stressed-out domestic academy kids, establishing an accurate and efficient depression position monitoring system has become essential. This system is applicable to vibrant communities where the workplace culture gives depression and anxiety leads to committing self-murders.

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