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# Cogent System for Detection of Stress Using IOT and Machine Learning Algorithms

**Mr. P. Bujjibabu,**
Associate Professor, Department of Electronics and Communication Engineering
Aditya Engineering College, Surampalem, A.P, India.
bujjibabu82foru@gmail.com

**Vasanthi Gopisetti**
Department of Electronics and Communication Engineering
Aditya Engineering College, Surampalem, A.P, India.
19a91a04k5@aec.edu.in

**Tarun Sai Kiran Medisetti**
Department of Electronics and Communication Engineering
Aditya Engineering College, Surampalem, A.P, India.
19a91a04m6@aec.edu.in

**Sandeep Surisetti**
Department of Electronics and Communication Engineering
Aditya Engineering College, Surampalem, A.P, India
19a91a04o6@aec.edu.in

**Abstract**
Now- a- days, Stress is becoming a crucial factor in a persons with robotic lifestyles. According to the World Health Organization, stress is a type of mental illness that affects the health of citizens. There is no one in the world who does not suffer from stress or depression. Stress is a part of our daily life, but having stress for a long time can leads to many problems like depression, suicidal thoughts and heart attack. This project aims to develop an application for detection of stress using IoT and machine learning (ML) techniques, with the help of Arduino, Node MCU, LM35 temperature sensor, and Pulse sensor. The system uses the pulse sensor to measure the user's heart rate, which is an indicator of stress, and the LM35 sensor to measure body temperature, which can also indicate stress. The data is then transmitted wirelessly to a Node MCU, which processes the data and sends it to the cloud for analysis.

The cloud-based ML model analyzes the data and generates a stress score based on the heart rate and body temperature readings. The score is then sent back to the Node MCU, which can provide real-time feedback to the user. The system is designed to help individuals manage stress by providing an objective measure of stress levels, personalized feedback, and recommendations for stress management activities. By using IoT and ML techniques, the system can continuously learn and improve its accuracy in detecting and managing stress levels.

So that a person can know his stress level and can decide whether to concern a doctor or not, thus this application can help a person to avoid a doctor unnecessarily on the basis of his/her stress level. In this project, we can use two different machine learning models on our dataset built using the

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suggestion of doctors and reference papers on this dataset and model. Both models are giving an accuracy of 100% on both training and test data so that the models are exactly fitting by the training data. It uses real time Firebase which provides a platform to connect, manage and store data from IoT devices of our application, manipulating data (reading data from user) and to show the result of the output (Prediction).

Finally, this project can be a great way to learn about IoT, ML, and sensor interfacing while also providing a valuable tool for improving personal health and well-being.

**Keywords:** Stress Prediction, IoT, Machine Learning, Real-time data, Heartbeat rate, Temperature, Servers, Decision Tree Algorithm, Random Forest Algorithm.

## Introduction

I. INTRODUCTION

Stress is a common problem that affects many people around the world. Excessive or prolonged stress can lead to various health problems, both physical and mental. Therefore, it is important to monitor and manage stress levels in order to maintain good health and well-being. Certain amount of stress is necessary for our lives, but too much stress brings negative consequences such as decrease in level of concentration, mental health issues such as anxiety and depression. Sometimes, it 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.

Remote Stress detector is an IOT device which can detect the stress level of a person using his/her heartbeat reading. When people are stressed or nervous, there is an increase in their heartbeat just like there's a spike in the heartbeat when a person is having a heart attack. This device locally collects heart beat reading from a person and sends it to a server. All the computation is done on the server, which then finally predicts whether the person is stressed or not. Node MCU is used as the development board and Google Collab for programming language.

This project involves the development of a stress prediction and monitoring system using IoT and machine learning. The system uses temperature and heart rate sensors to collect data on stress levels, which is transmitted to a Firebase Realtime database using Node MCU. The collected data is then used to train a decision tree classifier that can predict stress levels as "No Stress", "Moderate Stress", or "High Stress". The predicted values are sent back to Firebase and displayed on a 16x2 display using Node MCU.

In addition to the display, a separate web page is developed that displays the real-time values of heart rate, temperature, and prediction, providing users with a comprehensive view of their stress levels. The web page is built using a web framework and libraries such as Django, HTML, CSS, and JavaScript. The system provides users with an easy-to-use tool for monitoring and managing their stress levels, promoting better health and well-being. By providing real-time data and predictions, users can take action to reduce stress levels when necessary and maintain a healthy lifestyle.

### ML – Machine Learning

Machine Learning (Shortly "M.L.") is a subset of man-made brainpower that shows a machine how to gain from information and experience without being customized. As such, it perceives examples and investigations past information to arrive at better resolutions without including human experience. This robotization will save human time in business and helps them in going with better choices. Lately, ML helps in tackling complex issues in regions like money, medical services, assembling, and strategies. In the future additionally, because of the headway of

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innovation and existing techniques, it will additionally create and assist with accomplishing numerous new things.

**IoT – Internet of Things**

The Internet of Things (IoT) is a sought-after innovation that permits the client to interface mixed sensors and devices to the Web. The expression "Internet of Things" alludes to networks that connect devices to the Internet and offer information to the client. These sensors are continually delivering information that shows how successfully the gadgets are performing. The IoT stage gathers information from different sources, examinations it, and concentrates significant data in view of the requirements.

## II. LITERATURE REVIEW

[4] Reshma Radheshamjee et. al., 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 this proposed system due to the twitter dataset, they will not get accurate accuracy.

[14] Mr. Purnendu Shekhar Pandey proposed a system as Heart rate variability refers to the beat-to-beat alterations in the heart rate and it is directly proportional to a person's fitness. A person who is in good shape will have a resting heart rate in the range of 50-60 bpm compared to an average individual whose heart rate might fluctuate between 60 -80 bpm, whereas a well-trained athlete can have a heart rate as low as 40 bpm. The diagnosticity of heart rate is restricted by several factors like environmental stressors and mental and physical workload. If the condition is long lasting, it may lead to cardiovascular diseases. There is a clear increase in a person's heart rate when he is stress or nervous. When a person is working out or in the gym then his heart rate should be in the range of 50% - 70% of (220 - (his/her age)). If his heart rate is less than this then he needs to exercise harder.

[5] Wan-young Chung et. al., 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 this proposed system they have used the physiological devices where they get some problem in calculating the values.

[6] Madhavi Ganapathiraju et. al., 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 these 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 these values when the values will change, we easily get the person is having some problem. Limitations:

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In this proposed system the data are collected from the physiological devices and calculate the values.

[24] M. A. Rosales et al. investigated student stress during an oral exam by using ECG. The difference from other HRV using articles is that they detected stress using ultra short-term HRV (3 min). They recorded controlled resting base condition from the same student after a vacation. 18 features were extracted from the time and frequency domains. Non-linear features were also used. 12 out of 18 features correlate with stress. Naive Bayes, Decision Tree, SVM and Multilayer Perceptron classifiers were applied to the data. They achieved the best accuracy with the C4.5 tree classifier which is approximately 80%. The strong sides can be listed as the measurement of daily life stress of students during an oral exam and ultra short-term HRV usage.

**III. Methodology**

Working Principle: This system includes two sensors to detect the stress and based on the readings from these sensors, a person can decide whether to concern a doctor or not and it can help a person to avoid a doctor unnecessarily based on his stress level.

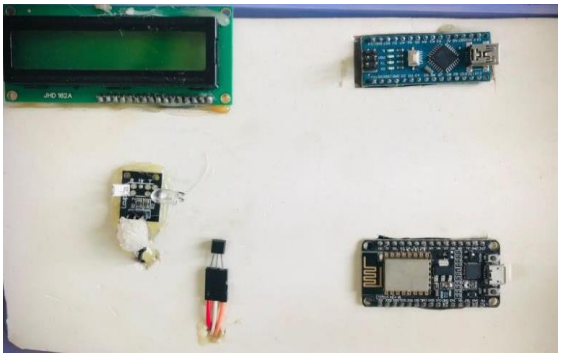
In this proposed system, we have predicted the stress level of every individual using Machine learning integration with IoT sensors. The system is used pulse sensor, temperature sensor, Arduino nano, I2C module, LCD display to detect the stress. User can monitor this sensor data using Fire base application, Node MCU ESP8266 as its central controller and wireless fidelity (Wi-Fi) as the communication technology. Arduino process this sensor data and display it on LCD module. As a result, a person can know his stress level, thus this application can help a person to avoid a doctor unnecessarily on the basis of his/her stress level.

Node MCU and Arduino based controller board is used to design this entire system.

Pulse sensor is connected to analog pin A0 of Arduino and LM35 is connected to out pin D13 of Arduino board. Then connect the Arduino board to the node MCU(Esp8266) through Tx and Rx pins. And also connect the Node MCU board and Arduino board through a USB cable. And LCD (16*2) display with I2C module to Node MCU. Embedded C program is used to write the logic of this system. Arduino IDE compiler is used to write the embedded c program.

In this project, we use two different machine learning (Decision tree and Random Forest) models on our data. Both models are giving an accuracy of 100% on both training and test data so that the models are exactly fitting by the training data.

**Equipment Image:**



**Hardware Requirements:**

- Node MCU
- Arduino Nano
- Pulse Sensor
- Temperature Sensor
- I2C Module
- LCD Module

**Software Requirements:**

- Arduino IDE Compiler
- Embedded C Programming
- Jupiter
- IoT
- Machine Learning
- Python

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**System Architecture:**

The sensors will interface with the microcontroller Node MCU ESP8266 that acts as an open-source IoT platform, it will send the data to the cloud storage which is the Firebase that has been developed to store the data information. Arduino IDE is a programming language that supports a library for Firebase that can connect any hardware over Wi-Fi. Firebase application is a platform with IOS and Android apps to control Node MCU ESP8266 through its inbuilt Wi-Fi shield. It can display the digitalized information data from the sensor and Realtime Firebase provides a platform to connect, manage and store data from IoT devices in real-time, as well as a platform for integrating and triggering machine learning models to make predictions based on that data.


Here are the steps to link IoT and ML using Realtime Firebase:

Set up IoT devices: First, we need to set up IoT devices that will collect and transmit data to Firebase. For example, we can use sensors to collect temperature, humidity, or light data from the environment.

Connect IoT devices to Firebase: Once the IoT devices are set up, we can use Firebase to connect to them. Firebase provides libraries and APIs that can be used to connect IoT devices to the Firebase database.

Collect data in Firebase: Once the IoT devices are connected to Firebase, data collected by the sensors can be stored in the Firebase database. Firebase provides real-time data synchronization, so the data is available in real-time.

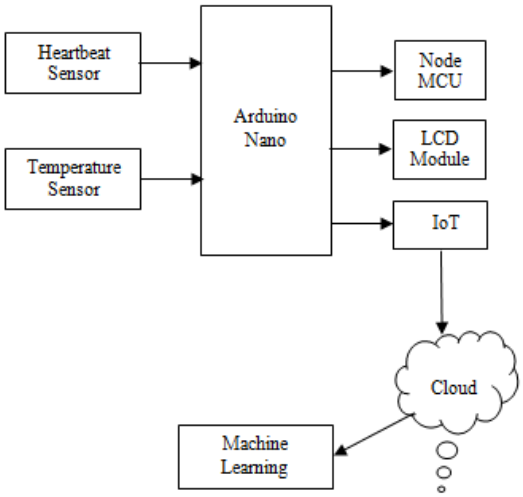
Train ML models: Once the data is collected in Firebase, you can use machine learning algorithms to train models based on the data. For example, you can use the collected data to train a model that predicts temperature changes.

Integrate ML models with Firebase: Once the ML models are trained, you can integrate them with Firebase. Firebase provides cloud functions that can be used to trigger ML models when new data is added to the database.

Predict in real-time: Finally, once the ML models are integrated with Firebase, you can use them to make real-time predictions. For example, you can use the ML models to predict the temperature changes in real-time.

In summary, Realtime Firebase provides a platform to connect, manage and store data from IoT devices in real-time, as well as a platform for integrating and triggering machine learning models to make predictions based on that data.

## IV Block Diagram




**RESULTS AND DISCUSSION**

The detection of stress is an important area of research and development, with many potential applications in public health and organizations. The IoT and ML are useful assets around here, allowing for the assortment, analysis, and interpretation of a lot of information in real-time. ML algorithms can be used to analyze data collected by IoT gadgets like sensors and cameras that monitor stress, for example, Heartrate and temperature. On completion the concept of Stress Detection using machine learning and IOT technology. The system uses temperature and heart rate sensors to collect data on stress levels, which is transmitted to a Firebase Realtime database

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using Node MCU. The collected data is then used to train a decision tree classifier that can predict stress levels as "No Stress", "Moderate Stress", or "High Stress". The predicted values are sent back to Firebase and displayed on a 16x2 display using Node MCU.

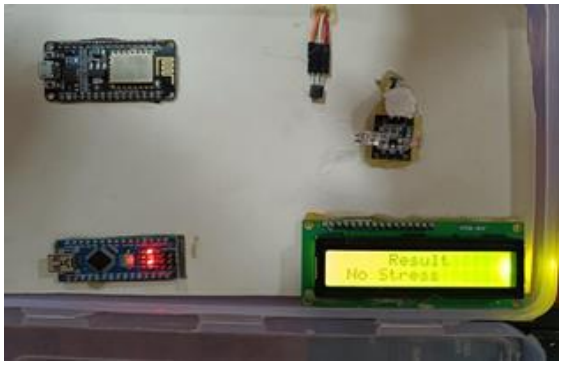


**Fig: Output of the final result**

In addition to the display, a separate web page is developed that displays the real-time values of heart rate, temperature, and prediction, providing users with a comprehensive view of their stress levels. The web page is built using a web framework and libraries such as Django, HTML, CSS, and JavaScript. The system provides users with an easy-to-use tool for monitoring and managing their stress levels, promoting better health and well-being. By providing real-time data and predictions, users can take action to reduce stress levels when necessary and maintain a healthy lifestyle.

This project mainly can be used in organizations where there is so much workload or pressure and the organization can provide yoga or mediation centers for the wellbeing of their employee. Overall, the combination of ML and IoT has great potential in stress monitoring and management, allowing for real-time data collection, analysis, and interpretation to support decision-making and improve outcomes. However, it is important to ensure that data privacy and security are maintained and that the technology is used responsibly and ethically.

## VI. Conclusion

Stress management is a crucial aspect of maintaining good mental and physical health. By combining IoT sensors, machine learning, and web technologies, the system offers a comprehensive solution for promoting better health and well-being. A possible application of this technology involves the development of a wearable device that tracks stress indicators such as heart rate, blood pressure, and skin temperature. The device could then use machine learning algorithms to analyze this data and provide personalized recommendations for stress management.

For instance, if the device detects high levels of stress, it could recommend relaxation exercises, deep breathing techniques, or meditation to alleviate the symptoms. Alternatively, if the device detects low levels of activity, it could suggest activities like exercise or a change in lifestyle habits.

Using IoT and ML in stress management can provide valuable insights and tools for people to improve their overall well-being. By incorporating the expertise of IoT and ML, these solutions can be further optimized to provide tailored and effective stress management strategies. Overall, the use of technology in stress management has the potential to revolutionize the way we approach stress management and improve people's lives.

Future aspects of this work can be to use a person's profile and his daily heart rate measurements along with his galvanic skin response to determine the mood of a person.

VII. Acknowledgement
We would also like to acknowledge the contribution of our colleagues and fellow researchers who have provided us with valuable feedback and insights throughout the project.

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