Prediction and Detection of Stress using IoT and Supervised Learning Approach

Uma.S, Umamaheswari.R,.Parlapalli Prudhvi

Assistant Professor, Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai: 600062
Final Year,B.Tech,Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Avadi, Chennai: 600062

Abstract

Stress is the common reaction to many worse situations. High stress will leads to physiological and behavioral change. Continuous stress rate affects the human body in different aspects. This work aims to alert the individuals about their stress level through IoT and machine learning algorithms. This proposed work continuously monitors the heart rate of a person through the IoT devices since it is difficult for a cardiac surgeon to predict a person's age from pulse since both are nonlinear. The heartbeat of a person varies depending on various factors also the pulse rate of an over trained person, athlete, obese; less exercising person varies from person to person. This work monitors a person heartbeat and continuously stores the values in the cloud, the cloud in turn depends on the machine learning training algorithms predicts the stress rate of a person and alarms the individual about their unhealthy condition. The approved individual can sign in, see the report and take activities, for example, counseling a clinical individual, play out some reflection or yoga activities to adapt to the condition.
Keywords: Cloud, Machine Learning, Heartbeat, IoT, Pulse rate, physiological and behavioral change, Stress

1. Introduction

Abundance stress happens during a kind of enthusiastic, social, and even some physical manifestations and therefore the side effects of pressure shift hugely among various people. Aggregate physical markers frequently announced by those enduring overabundance stress remembers resting scatters or changes for dozing propensities (a sleeping disorder or dozing excessively), muscle pressure, muscle hurts, migraine, gastrointestinal issues, and weakness. Existing ailments of an individual can even get exacerbate because of the pressure. Enthusiastic and conduct side effects which will go with abundance stress incorporate anxiety, instability, changes in dietary patterns including gorging or undereating (prompting weight increase or misfortune), loss of excitement or vitality, and mentality changes, similar to fractiousness and sorrow.

A. Causes and Effects of Stress

On investigation it is anticipated that none of the signs or manifestations implies most likely that there is a raised feeling of anxiety since those indications are regularly brought about by other clinical and additionally mental conditions. It is additionally realized that people under pressure have a more prominent inclination to collaborate in unfortunate practices, as unreasonable use or maltreatment of liquor and drugs, cigarette smoking, and making diminished exercise and nourishing admission, than their less-focused on partners. These undesirable practices can additionally build the seriousness of indications related with pressure, regularly bringing about an "endless loop" of manifestations and unfortunate behaviors[7].

The experience of pressure is exceptionally individualized. What establishes overpowering worry for one individual probably won't be seen as worry by another. In like manner, the side effects and indications of ineffectively oversaw pressure will be diverse for each individual. Stress identifier is an IOT gadget which may distinguish the anxiety of an individual utilizing their pulse perusing.

Every single one of the machine focuses on a decent client base and includes noteworthy uses inside the clinical business. Besides, there are not really not many informational collections accessible which gives information a couple of client resting heartbeat and raised heartbeat and consequently the one's which are accessible contain information of negligible 200 people which isn't sufficient to actualize an AI calculation. Through in this paper, we will handily assemble dependable information of various people. Also, when we are preparing, our pulse rate ought to be raised, particularly if an individual is doing any cardio-practice and relies on an individual's age. Since practicing has become an area of a great many people's every day system, it's pivotal to spot whether he/she is practicing accurately or not6].

B. Data Collection and Analysis

At the point when individuals are pushed or apprehensive, there's an ascent in their pulse, somewhat like there's a spike inside the heartbeat when an individual has an assault, deductively alluded to as myocardial infarction[3][8]. This gadget locally gathers heart beat perusing from an individual and sends it to a server on Thing Speak. All the calculation is finished on the server, which at that point at long last predicts whether the individual is focused or not. It creates a graph of the data of individual in the server. Node MCU is utilized as itunderpins Wi-Fi availability and the improvement board utilizes C for programing language.

The C can run in ESP 12E Module. It's an elevated level language shell that takes one contribution from the client, executes it and returns the outcomes back to the client. Additionally, this work utilizes a heartbeat sensor to identify the beats from which we determined the heartbeat rate. The clinical world has seen solid relationships among's pressure and heart condition, malignant growth and such terminal diseases. Further pressure has been appeared to debilitate resistant frameworks, additionally as drop execution out and out measurements of accomplishment [1][5]. Stress can't be measured and is very hard to recognize. Through mapping of pressure and heartbeat, we will recognize huge amounts of things, for example whether the individual is anxious or not, regardless of whether the individual is in worry or dread, whether the individual is working out, whether the individual is over prepared, remote observing of a patient with heart condition and so on [4][9].

2. RELATED WORK

Pulse fluctuation alludes to the beat to pulsate modifications inside the pulse. Reliable with National Institute of Health, newborn children for the most part have a heartbeat of very 100 thumps for every moment which settles down between 60 to 100 pulsates every moment (resting pulse) for adolescents 10 years and more seasoned, and grown-ups. Pulse is straightforwardly corresponding to an individual's wellness [10]. An individual who is in fine condition will have a resting beat in the scope of 50-60 bpm contrasted with a mean person whose heartbeat may vacillate between 60 - 80 bpm, though a very much prepared competitor can have a heartbeat as low as 40 bpm [11].

The diagnosticity of heartbeat is confined by a few variables like ecological stressors and mental and physical outstanding burden. The interest control model of occupation strain tells that employments during which individuals have low social help and no power over their activity are progressively upsetting for example when there's a lopsidedness between the work request and along these lines the individual's capacity to meet those demands[2].

On the off chance that the condition is durable, it might cause cardiovascular ailments. There's a straightforward increment in an individual's heartbeat when he's pressure or apprehensive, yet the balance contrasts from individual to individual, According to a cardiovascular specialist, it's hard to foresee age from beat since it is nonlinear. In any case, we will utilize an individual's heart beat to anticipate whether that individual is fit, unfit and clear came down or not, gave we've that individual's age. Studies have

indicated that if competitors have a superior resting pulse at 7:00 am inside the morning for at least 3 continuous days then he/she is over prepared. Overtraining can cause decline in wellness and quality of a competitor an individual can have a greatest beat of (220 - (his/her age)). Utilizing this as a proposal, specialists shake the defibrillator during heart failure. At the point when an individual is working out or inside the rec center then his heartbeat ought to be inside the scope of fifty - 70% of (220 - (his/her age)). On the off chance that his heartbeat is a littler sum than this, at that point he needs to practice more earnestly [3][4].

3. DESIGN & IMPLEMENTATION

The created model recognizes whether an individual is in pressure utilizing changeability in his/her heartbeat. It additionally can help in distinguishing example of changes during an individual's heartbeat when he/she is working out at the exercise center. Every gadget is singular explicit and wishes to be aligned for it to work appropriately.

During alignment the individual ought to be during a casual state of mind and ought to rest. This is regularly done to arrange a benchmark, after adjustment, the gadget utilizes this gauge (which is distinctive for every person) to work out whether that individual is in pressure/anxious, over prepared or as of now preparing. The heartbeat readings are pushed to the server where they are sifted utilizing a client's system id to remain track of readings for a specific individual as appeared in (Fig.5). They're outwardly indicated utilizing an associated disperse plot as appeared in (Fig.6).
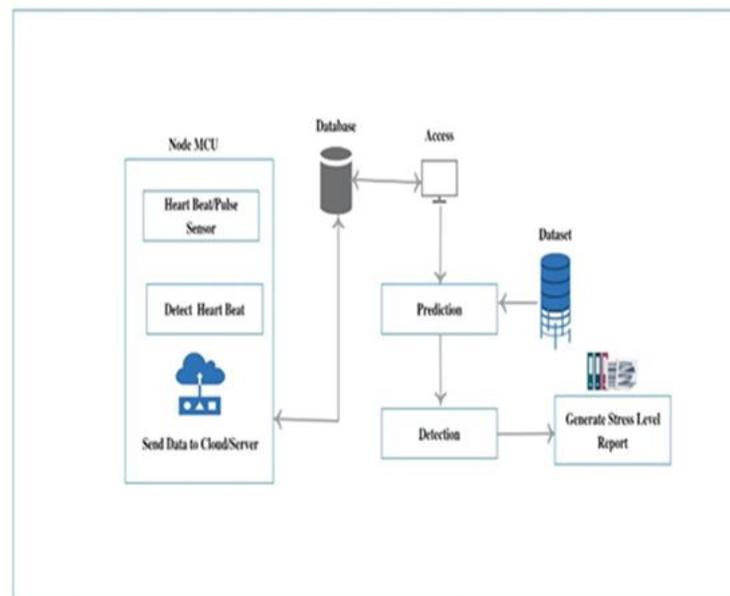
Fig 1 Proposed System

A. NodeMCU

NodeMCU is a low-cost WiFi open source IoT platform. It is a firmware which runs on ESP8266 WiFi and the hardware is supported by ESP-12 module. It is open source environment where coding can be done in Arduino. NodeMCU combines node and MCU which is a micro-controller unit. The firmware uses the Lua scripting language. Arduino environment supports C and C++ languages. The proposed work uses C language for implementation [3].

B. Heartbeat Sensor / Pulse Rate Sensor

Heartbeat Sensor is an electronic device which is used to measure the heartbeat or pulse rate of an

individual. Heart beat can be measured and monitored in two ways either by placing the sensor in the wrist or neck or by manually placing the hands in neck or wrist and measuring it for 60 Seconds. The sensor is connected to the NodeMCU and the readings are recorded in the serial monitor and in the cloud storage.
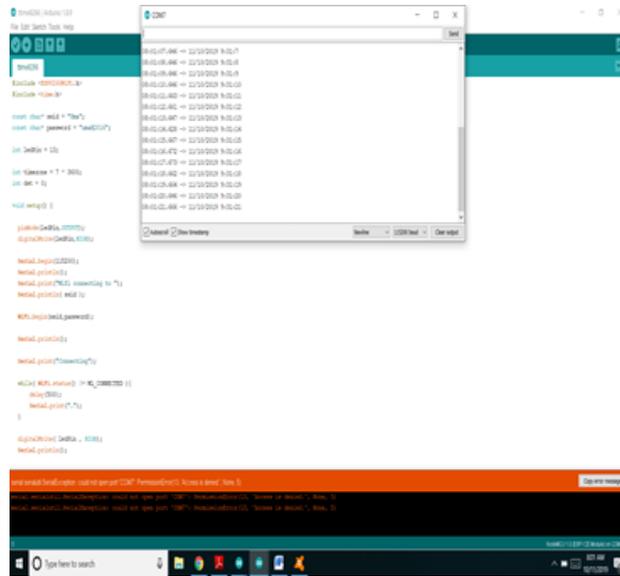
C. Serial Monitor

Node MCU uses Arduino software for coding implementation; (Fig 2) shows the connection of heart rate sensor and NodeMCU. After necessary connection plug in the connector cable of NodeMCU to laptop/Desktop/Mobile. Open the installed Arduino software and choose Tools from the menu bar. Then select the type of Board required such as Arduino/NodeMCU/Lilypad etc. since we have used NodeMCU, ESP12E module is selected. Include the necessary libraries and type the code, upload and execute the code, check the port configured in the Arduino and open the serial monitor to observe the heart rate readings. In parallel send the readings to the cloud service registered. Fig 3 shows the Arduino environment and the coding part. This also shows how the heart beat readings are continuously displayed in the serial monitor. Likewise to employ machine learning algorithms many readings for several individuals should be taken in continuous days as shown in Fig 4, for proper analyzing and implementing machine learning algorithms.
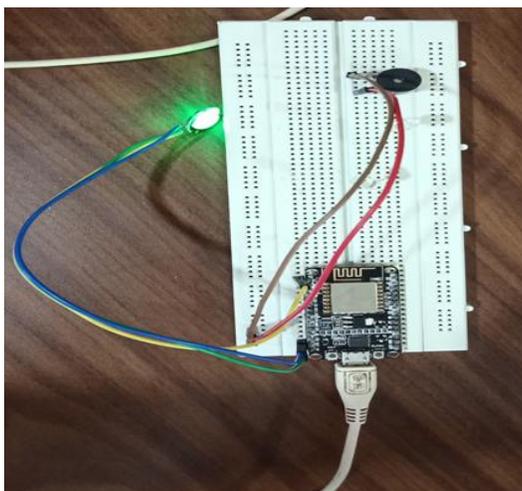

Fig 2 Connection NodeMCU with pulse sensor

D. Cloud Services

Cloud services are provided to customers for secure mass   storage. The stored data can be accessed by all authenticated users whenever required. They in turn can carry out their analyzing from the collected data. Cloud provides the users their information in various formats demanded by the customers such as csv files, excel files, json files etc.. for evaluating or investigating the collected data or to extract the meaningful information from the gathered data. There are various cloud service providers for the growing IoT devices such as Amazon, IBM Watson, Azure, DigitalOcean, Oracle, AskSensor, FireBase, Thingspeak etc

Fig 3 Serial Monitor with Heart Rate Monitor
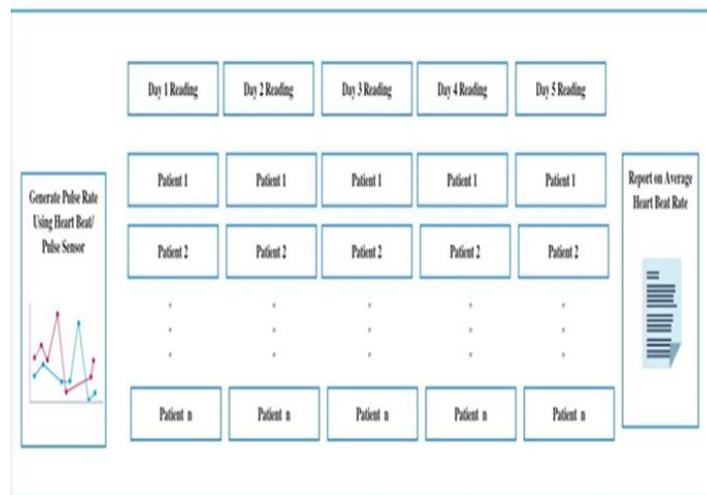

Fig 4 Continuous Monitor of Heart rate Day wise

In the proposed system ThingSpeak is used as a cloud service. ThingSpeak is a cloud and IoTAnalysis and prediction service that permits to aggregate visualize and analyze the datasets or data streams stored in the cloud. All IoT devices can collect their data in the serial monitor and transfer the same to the cloud services where frequent monitoring and updating takes place. Analyzing and prediction parts can be carried in the cloud itself and outputs can be achieved in the form of the graph. Fig 5 shows how the serial monitor reading is displayed and stored in the cloud. To access the cloud service, proper sign up is needed for customers. There are two types of cloud service provided one is free service which is limited, for demonstration purpose free service can be used and the users can learn to use the platform, second type is paid and extended service. The charges are done on the basis of cloud storage or the range of storage the customers have bought. Since large dataset needs to be collected in our proposed work, we have used the paid version of the ThingSpeak cloud services.
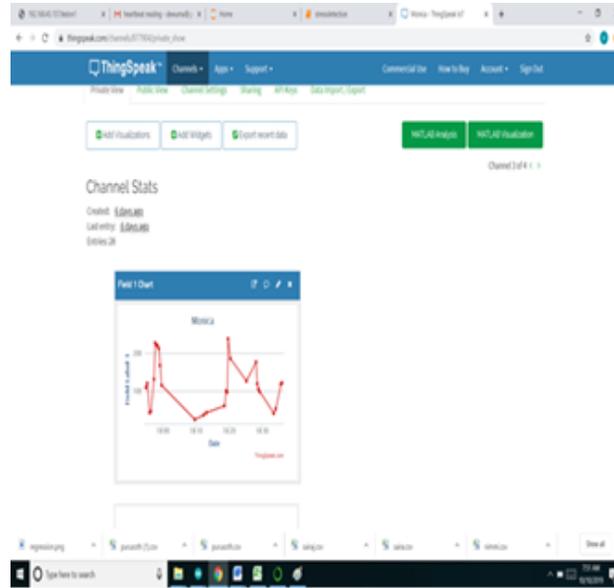
Fig 5 Cloud with Heart Rate Readings

E. Machine Learning Algorithms

From the collected data, machine learning algorithms can be used to predict the stress, a person's heart rate is measured continuously and recorded in the cloud, and the stored data can be retrieved from the cloud providers. For various persons the same thing is carried and the data is recorded. This work can be used by the doctor or the patient to know about their stress level, whenever the stress rate crosses the normal rate the doctor warns the patient, or when it reaches the dangerous level the doctor can start their immediate treatment to the patient. This implementation part can be done with the help of our coding. Another approach is using the supervised machine learning approach called Linear Regression. This approach predicts the stress rate of an individual from the collected csv files. Fig 6 shows the Linear Regression plot graph for the collected data where the x-axis denotes the age and y-axis denotes the heart beat rate. For very good accuracy large dataset is required.
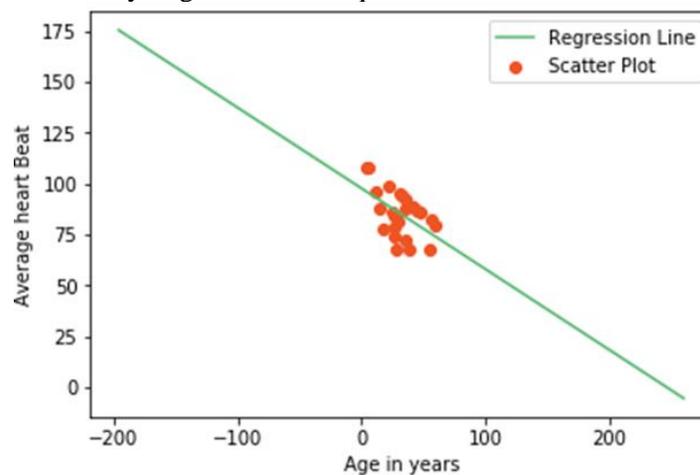
Fig 6 Linear Regression

Fig 7, shows the graph of the stress detection of various persons under various age group. The proposed work sticks to the medical standards for the normal and abnormal stress rate.
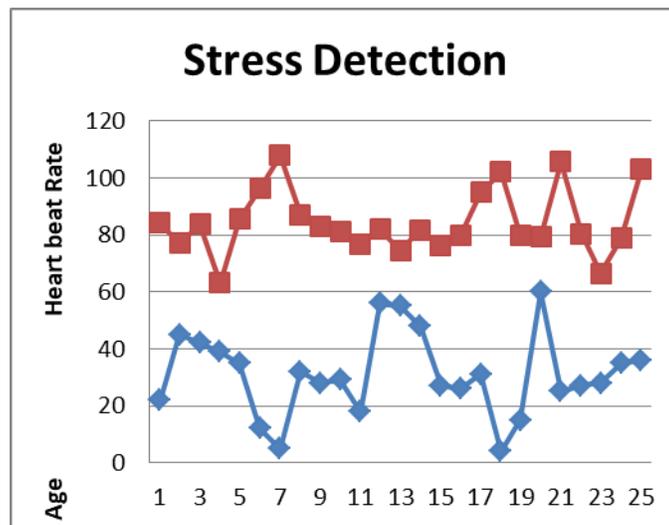
Fig 7 Stress Detection

The doctors can maintain the record of their patient collected from this to diagnose their patient stress level, also to identify if the patient suffers from any other disease. Is the stress the root cause for the newly affected disease? Thus the stress rate analyzing and maintenance is very significant for the doctors to treat their patient, also the patient should be aware of their stress rate to avoid the dependent health issues.

4. CONCLUSION

Stress can hurt human wellbeing. Heart Beat Sensors peruses just the pulse. Be that as it may, this work plans to anticipate identify and foresee pressure. Web of Things (IoT) alongside Machine Learning (ML) is utilized to caution the circumstance when the individual is in genuine hazard. ML is utilized to anticipate the state of the patient and IoT is utilized to convey the tolerance about his/her intense pressure condition. Utilizing this as a rule, specialists can treat the patients.

References

1. Cornelia Setz, Bert Arnrich, Johannes Schumm, Roberto La Marca, andGerhard Troster, Member, IEEE, and Ulrike Ehlert, "Discriminating Stress From Cognitive Load Using a Wearable EDA Device", IEEE transactions on Information Technology in Biomedicine, Vol. 14, No. 2, March 2010
2. C. Doukas and I. Maglogiannis, ``Bringing IoT and cloud computing towards pervasive healthcare," in *Proc. Int. Conf. Innov. Mobile Internet Services Ubiquitous Comput. (IMIS)*, Jul. 2012, pp. 922_926.
3. P. Gope and T. Hwang, ``BSN-care: A secure IoT-based modern healthcare system using body sensor network," *IEEE Sensors J.*, vol. 16, no. 5,pp. 1368_1376, Mar. 2016.
4. Hock Beng Lim, "A Soldier Health Monitoring System for Military Applications," *International Conference on Body Sensor Networks*.
5. Y. Kawamoto, H. Nishiyama, N. Kato, Y. Shimizu, A. Takahara, and T. Jiang, ``Effectively collecting data for the location-based authentication in Internet of Things," *IEEE Syst. J.*, vol. PP, no. 99, pp. 1_9, Sep. 2015, doi: 10.1109/JSYST.2015.2456878.
6. Purnendu Shekhar Pandey, "Machine Learning and IoT for Prediction and Detection of Stress

""978-1-5386-3893-4/17/$31.00 ©2017 IEEEConference: 2017 17th International Conference on Computational Science and Its Applications (ICCSA)

7. Reshma Radheshamjee Baheti, Supriya Kinariwala," Detection and Analysis of Stress using Machine Learning Techniques", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-9 Issue-1, October 2019

8. Satya A. Paritala , Effects of physical and mental tasks on heart rate variability. http://etd.lsu.edu/docs/available/etd-08222009-204359/unrestricted/thesis.pdf

9. H. Viswanathan, E. K. Lee, and D. Pompili, ``Mobile grid computing for data- and patient-centricubiquitous healthcare,'' in *Proc. 1st IEEE Workshop Enabling Technol. Smartphone Internet Things (ETSIoT)*,Jun. 2012, pp. 36_41

10. N. Yang, X. Zhao, and H. Zhang, ``A non-contact health monitoringmodel based on the Internet ofThings,'' in *Proc. 8th Int. Conf. Natural Comput. (ICNC)*, May 2012, pp. 506_510.

11. G. Yang *et al.*, ``A health-IoT platform based on the integration of intelligent packaging, unobtrusive bio-sensor, and intelligent medicine box,'' *IEEE Trans. Ind. Informat.*, vol. 10, no. 4, pp. 2180_2191, Nov. 2014