REAL - TIME STRESS MONITORING SYSTEM USING IOT TECHNOLOGY

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

Stress is a prevalent health concern in today's society, and timely detection and management are crucial for overall well-being. The proposed system utilizes a network of IoT-enabled sensors to continuously measure physiological parameters indicative of stress levels, including heart rate, galvanic skin response, and temperature. These sensors transmit data to a centralized IoT platform for real-time processing and analysis. Advanced algorithms are employed to interpret the sensor data, detect patterns, and assess the user's stress levels. The system incorporates various techniques for personalized stress assessment, adapting to individual differences and environmental factors. Users are provided with LCD, to visualize their stress levels, receive feedback, and access resources for stress management. Additionally, the system includes provisions for timely alerts and notifications to users and healthcare professionals in case of elevated stress levels or potential health risks. The purpose of the study is to examine how IoT technologies are applied in the medical industry and how they help to raise the bar of healthcare delivered by healthcare institutions. The study will also include the uses of IoT in the medical area, the degree to which it is used to enhance conventional practices in various health fields, and the degree to which IoT may raise the standard of healthcare services

The main contributions in this paper are as follows: (1) importing signals from wearable devices, extracting signals from non-signals, performing peak enhancement; (2) processing and analyzing the incoming signals; (3) proposing a new stress monitoring algorithm (SMA) using wearable sensors; (4) the proposed stress monitoring algorithm (SMA) is composed of four main phases: (a) data acquisition phase, (b) data and signal processing phase, (c) prediction phase, and (d) model performance evaluation phase

The proposed real-time stress monitoring system offers a scalable, efficient, and personalized approach to stress management, empowering individuals to proactively monitor and address their stress levels for improved health and well-being.

LIST OF ABBREVIATIONS

IOT	-	INTERNET OF THINGS
GSR	-	GALVANIC SKIN RESPONSE
BP	-	BLOOD PRESSURE
ADC	-	ANALOG TO DIGITAL CONVERTOR

LIST OF SYMBOLS

$SPO2$	-	SATURATION OF PERIPHERAL OXYGEN
C	-	CENTIGRADE
BPM	-	BEATS PER MINUTE

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The Internet of things (IoT) has transformed the healthcare industry by enabling remote monitoring of patients' health status [1]. The integration of wearable sensors with IoT technologies has enabled continuous monitoring of physiological signals, leading to early detection of health problems and the ability to intervene before the condition worsens. Stress is a common health problem that can lead to various physical and mental disorders. IoT has the potential to be utilized in numerous industries, including efficient energy, transportation, agriculture, university campus connectivity, healthcare, logistics, and others,allowing physical objects to communicate and share information with one another through the internet [1].

IoT technology have sinificantly impacted healthcare by shifting routine medical tests and healthcare services from hospitals to homes, making it easier for patients and healthcare professionals to utilize medical equipment [2]. With IoT integration, portable sensors can provide more precise data, and medical devices' usability can be enhanced by implementing an android program in conjunction with IoT. The implementation of various technologies, particularly IoT, is likely to have a significant impact on all sectors, particularly in the medical field, as it can improve people's quality of life[2]. Stress is a condition caused by transactions between individuals and the environment that creates a perception of distance between the demands of the situation and the resources in a person's biological, psychological, and social systems.

Stress is a major concern in the modern society now a day. All are engaged in their works and almost all people including students, employees all are working restlessly to meet their deadlines, targets etc. Quite often, people are aware of being under heavy work pressure and mental stress levels, but neglect their state of health[3][4] . They also forget to have medicine at the right time and it may lead to fatal effects sometimes death also. Certain levels of sensors like heart beat level, blood pressure etc. can be alarming if left uncontrolled. When the right medicine is given at right time, it can help prevent heart attacks and reduce the probability of deaths. So design of stress detection and health monitoring technology that could help people to understand their state of mind and body is very essential . In the recent years, wireless technology is playing a crucial role in various sectors as well as biomedical to provide better health care.[5][6] Many devices are being developed for continuous monitoring. In many of the existing systems, the data is recorded and stored in general storage server that is generally accessible to the staff and doctors only . In the proposed system, a model is designed to monitor the heartbeat rate, blood pressure, temperature and humidity and respiration using various sensors which will be will be uploaded to the server through WIFI module. A message could be sent to concerned person or doctor through GSM module. The model consumes less power and is designed to detect the level of stress with good efficiency .[7-9]

Stress is the natural factor that causes unstable homeostasis . Stress will cause an increase in blood pressure (BP) by a mechanism that triggers an increase in adrenaline levels . Stress will stimulate the sympathetic nerves, causing an increase in BP and heart rate (HR).[10][11] Stress will increase if peripheral vascular resistance and HR increase, thereby stimulating the sympathetic nerves . The occurrence of stress will react to the body, including increased muscle tension, HR, and BP . Stress that has a positive impact is called eustress. The type of stress is characterized by an increased pulse but without a feeling of threat. Stress that has a negative effect is called distress, characterized by anxiety or concern. This kind of stress can be a short-term or long-term occurrence .[12] Currently, medical experts use psychophysiological questionnaires to evaluate human stress levels during counseling or interviews. However, this is highly dependent on the ability and sensitivity of experts in extracting information on patients.

Nowadays, researchers developed scientific tools that are more effective in detecting stress. The methods designed to detect stress include physiological signals and biochemical samples . Typically, biochemical samples use urine, saliva, and blood samples to identify the effects of stress on the human body . Many physiological signals have attracted researchers to develop a stress detection system . Stress can be triggered by physiological responses, physical activity such as running, and lack of sleep. It causes health problems, namely the effects of chronic stress, such as hypertension, cardiovascular disease, and memory problems . Symptoms of stress must be detected and monitored earlier to avoid dangerous conditions.[13-15]

1.1.1 IOT(INTERNET OF TECHNOLOGY)

The Internet of Things (IoT) stands at the forefront of a transformative technological revolution, redefining the way we interact with the world around us. In essence, IoT represents a vast network of interconnected devices and systems, seamlessly communicating and exchanging data through the internet. This interconnectivity extends beyond traditional computing devices, encompassing everyday objects, appliances, vehicles, and even industrial machinery. At its core, IoT empowers these objects with the ability to gather, share, and act upon information in real-time, fostering a level of intelligence

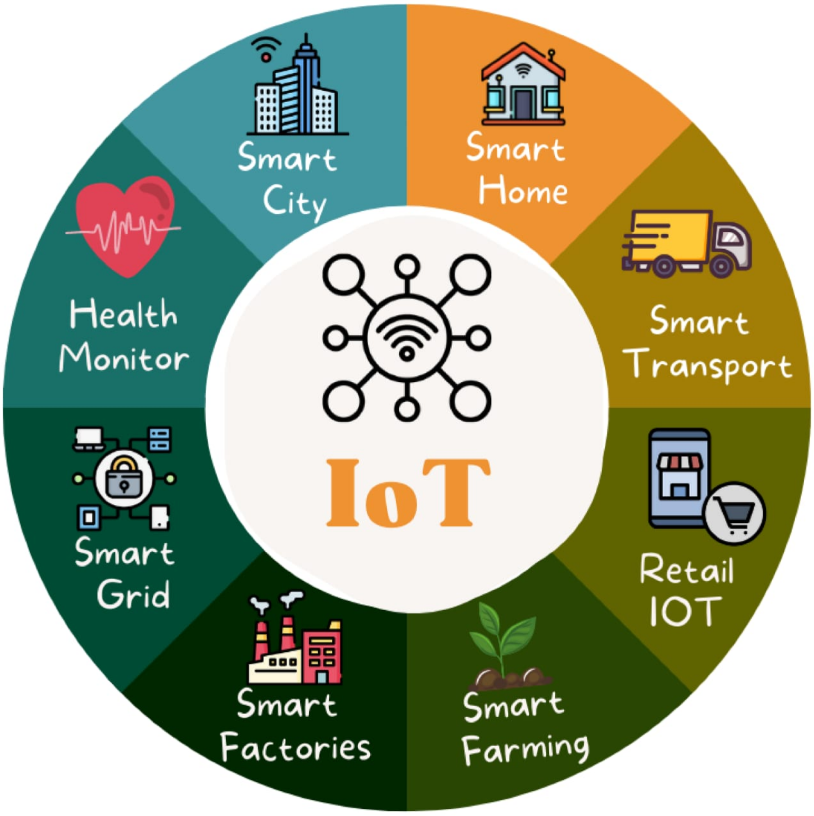

Figure 1.1: IOT

and responsiveness that was once confined to the realm of science fiction. This paradigm shift has far-reaching implications across various sectors, from smart homes and cities to industrial automation, healthcare, and agriculture.The foundation of IoT lies in the integration of sensors, actuators, and communication technologies into the fabric of our physical surroundings. These sensors capture data from the environment, while actuators enable devices to respond to the information received. The collected data is then transmitted through networks, often leveraging the power of the internet, to centralized platforms where it can be analyzed and acted upon.

The potential of IoT is vast and multifaceted. In smart homes, IoT enables the creation of intelligent ecosystems where devices collaborate to enhance convenience, security, and energy efficiency. In healthcare, it facilitates remote patient monitoring, personalized treatment plans, and the efficient management of medical resources. In agriculture, IoT offers precision farming solutions, optimizing crop yields and resource utilization.As the IoT ecosystem continues to expand, questions surrounding data privacy, security, and interoperability have come to the forefront. Striking a balance between innovation and safeguarding user information becomes crucial to the sustainable growth of IoT.

In this era of connectivity, the Internet of Things heralds a new era of efficiency, convenience, and intelligence. As the network of interconnected devices continues to evolve, so too does the potential for innovation and the positive impact on our daily lives. The journey into the age of IoT promises to revolutionize the way we perceive, interact with, and derive value from the world around us.

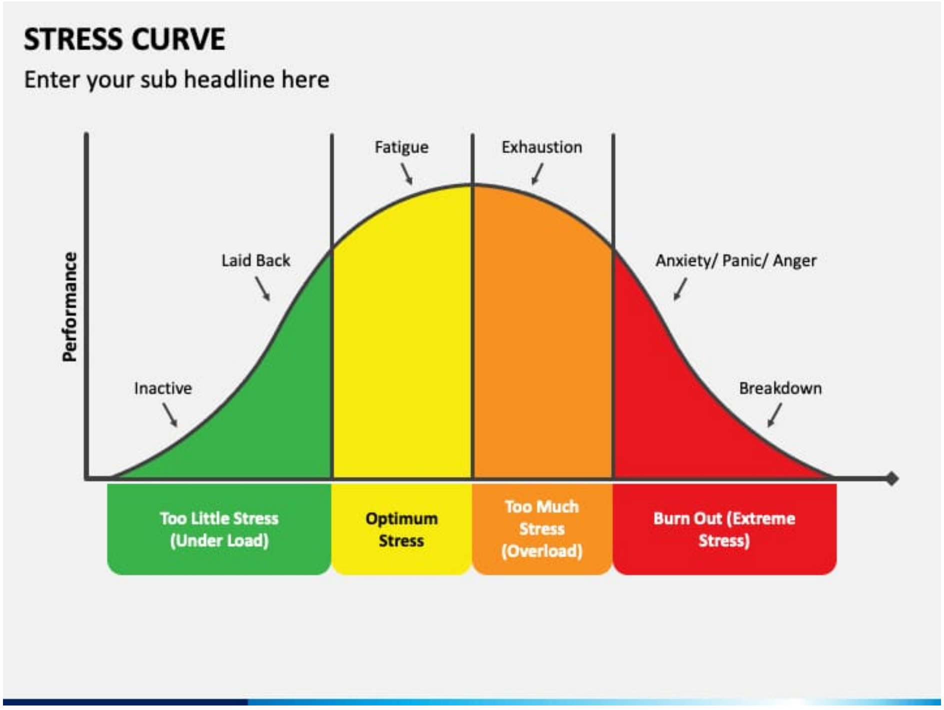

Figure 1.2: STRESS LEVELS

1.1.2 STRESS

Stress is a natural and adaptive response that the body experiences when faced with challenges, changes, or threats. It is a physiological and psychological reaction that prepares an individual to cope with a perceived danger or demand. While stress is a normal part of life and can sometimes be beneficial, helping individuals stay focused and alert, chronic or excessive stress can have detrimental effects on physical and mental well-being.Common sources of stress include work pressures, relationship issues, financial concerns, major life changes, and environmental factors. Individual responses to stress can vary, and what may be stressful for one person might not be for another.

Symptoms of stress can manifest physically, emotionally, or behaviorally. Physical symptoms may include headaches, muscle tension, fatigue, and sleep disturbances. Emotional symptoms may involve irritability, anxiety, or feelings of overwhelm. Behavioral changes can include changes in appetite, social withdrawal, or difficulty concentrating.Effective stress management involves recognizing the sources of stress, developing coping mechanisms, and adopting a healthy lifestyle. Techniques such as mindfulness, exercise, adequate sleep, and seeking social support can contribute to a more balanced and resilient response to stress. If stress becomes chronic or overwhelming, seeking professional help from healthcare providers or mental health professionals may be beneficial.

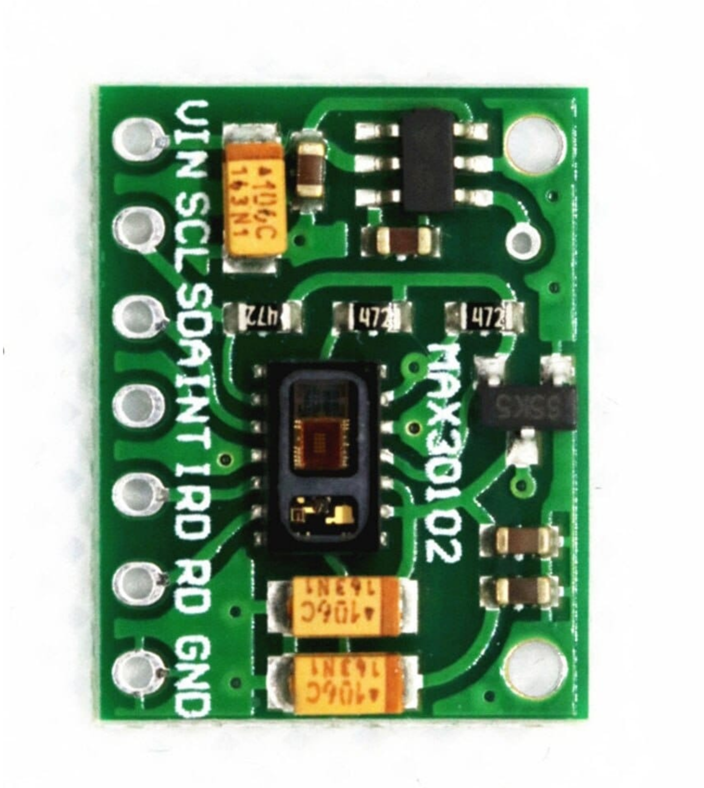

Figure 1.3: MAX 30102

1.1.3 STRESS DETECTION USING VARIOUS SENSORS

Stress detection using various sensors involves monitoring physiological and behavioral indicators associated with stress. Different types of sensors can capture different aspects of the body's response to stress. Here are several types of sensors commonly used for stress detection:

Heart Rate Sensors: Photoplethysmography (PPG) sensors or electrocardiogram (ECG) sensors can measure the heart rate and heart rate variability (HRV). Elevated heart rate and altered HRV are often associated with stress, and continuous monitoring provides insights into the autonomic nervous system's activity.

Skin Conductance Sensors: Galvanic skin response (GSR) or electrodermal activity (EDA) sensors measure the skin's electrical conductance, which changes with sweat gland activity. Increased skin conductance is linked to sympathetic nervous system activation, indicating arousal and stress.

Temperature Sensors:Skin temperature sensors can detect changes in skin temperature, which can be influenced by stress-induced vasoconstriction or vasodilation. An increase or decrease in skin temperature may be indicative of stress, depending on the individual's physiological response.

Figure 1.4: GSR SENSOR

Figure 1.5: DS18B20

CHAPTER 2

LITERTAURE SURVEY

As we have researched through so many research articles and different proposed methods.

2.1 REFERENCE 1

Currently, medical experts use psychophysiological questionnaires to evaluate human stress levels during counseling or interviews. Typically, biochemical samples use urine, saliva, and blood samples to identify the effects of stress on the human body. This research explains that stress detection can be done by analyzing psychological signals and the importance of monitoring stress levels. The authors develop research on stress detection based on psychological signals. The system then processes the recorded data; the android application displays the calculation results. The database can also be accessed as a spreadsheet via a web application. The design of real-time stress detection and monitoring using internet of things (IoT) can work well.

2.2 REFERENCE 2

The effects of stress are causing rigorous damage to the mental as well as physical state of humans. It is very difficult to identify whether a person is in stress. The person may look healthier physically but may not be in a state of good health due to the stress within the body. Their mental stability also gets affected and may further lead to chronic ailments due to persistent stress. However, it is very essential to monitor stress levels regularly which help in diagnosis of any abnormalities in the body that may lead to chronic illness in future. The Wireless networks based on IOT (Internet of Things) provides wide range of opportunities to monitor stress levels regularly and transmit the information to the concerned for immediate action. A model is designed and developed to detect the stress levels using various sensors such as heartbeat rate, blood pressure (BP), body temperature and concentration of CO_2 gas. Further based on the values of these sensors, the levels of stress is calculated and the information is transmitted using IOT.

2.3 REFERENCE 3

The concept "Internet of Things" (IoT), which facilitates communication between linked devices, is relatively new. It refers to the next generation of the Internet. IoT supports healthcare and is essential to numerous applications for tracking medical services. By examining the pattern of observed parameters, the type of the disease can be anticipated. For people with a range of diseases, health professionals and technicians have developed an excellent system that employs commonly utilized techniques like wearable technology, wireless channels, and other remote equipment to give low-cost healthcare monitoring. Whether put in living areas or worn on the body, network-related sensors gather detailed data to evaluate the patient's physical and mental health. The main objective of this study is to examine the current e-health monitoring system using integrated systems. Automatically providing patients with a prescription based on their status is the main goal of the e-health monitoring system. The doctor can keep an eye on the patient's health without having to communicate with them. The purpose of the study is to examine how IoT technologies are applied in the medical industry and how they help to raise the bar of healthcare delivered by healthcare institutions. The study will also include the uses of IoT in the medical area, the degree to which it is used to enhance conventional practices in various health fields, and the degree to which IoT may raise the standard of healthcare services. The main contributions in this paper are as follows: (1) importing signals from wearable devices, extracting signals from non-signals, performing peak enhancement; (2) processing and analyzing the incoming signals; (3) proposing a new stress monitoring algorithm (SMA) using wearable sensors; (4) comparing between various ML algorithms; (5) the proposed stress monitoring algorithm (SMA) is composed of four main phases: (a) data acquisition phase, (b) data and signal processing phase, (c) prediction phase, and (d) model performance evaluation phase; and (6) grid search is used to find the optimal values for hyperparameters of SVM (C and gamma). From the findings, it is shown that random forest is best suited for this classification, with decision tree and XGBoost following closely behind.

2.4 REFERENCE 4

Farming herdsmen, sheep dealers, and veterinarians are increasingly interested in continuously monitoring sheep basic physiological characteristics (such as the heart rate and skin temperature) outside the laboratory environment, with the aim of identifying the physiological links between stress, uncomfortable, excitement, and other pathological states. This paper proposes a non-invasive Wearable Stress Monitoring System (WSMS) with PhotoPlethysmoGram (PPG), Infrared Temperature Measurement (ITM), and Inertial Measurement Units (IMU) that aimed to remotely and continuously monitor the stress signs of sheep during transportation. The purpose of this study was implemented by following the multi-dimensional sensing platform to identify more pressure information. The designed WSMS showed sufficient robustness in recording and transmitting sensing data of physiology and environment during transport.

2.5 REFERENCE 5

Excessive stress during pregnancy could cause adverse effects for the mother and her unborn baby, disrupting the normal maternal adaptation throughout pregnancy. Such conditions could be tackled to some degree via traditional clinical techniques, although an automated healthcare system is required for providing a continuous stress management system. Internet of Things (IoT) systems are promising alternatives for such real-time stress monitoring. In conventional IoT-based stress monitoring, stress-related data is collected, and the stress level is determined using a pre-defined model. However, these systems are insufficient for pregnant women whose physiological data are changing over the course of their pregnancy. Therefore, an adaptive monitoring system is needed to estimate stress levels, considering the maternal adaptation such as heart rate elevation in pregnancy. In this paper, we propose a stress-level estimation algorithm based on heart rate and heart rate variations during pregnancy. The algorithm is distributed in an edge-enabled IoT system. We test the performance of our algorithm using supervised and unsupervised learning via an unlabelled set of data from a 7-month monitoring. The monitoring was fulfilled for 20 pregnant women using wearable smart wristbands. Our results show a 97.9Random Forest.

2.6 REFERENCE 6

Reactive oxygen species (ROS) are oxygen derivates and play an active role in vascular biology. These compounds are generated within the vascular wall, at the level of endothelial and vascular smooth muscle cells, as well as by adventitial fibroblasts. Physiologically, ROS generation is counteracted effectively by the rate of elimination. In hypertension, a ROS excess occurs, which is not counterbalanced by the endogenous antioxidant mechanisms, leading to a state of oxidative stress. Angiotensin II, the active peptide of the renin-angiotensin-system (RAS), is a significant stimulus for ROS generation within the vasculature. It was also documented that at the level of subfornical cerebral regions an inappropriate RAS stimulation may lead to an increased vascular sympathetic activity. More recently, in conditions of fetal undernutrition, it was also proposed an increased vascular sympathetic activity secondary to inappropriate RAS activation, leading to the development of hypertension in adult life. The present review will discuss the complex interaction between RAS activation, vascular ROS generation and increased sympathetic outflow in hypertension.

2.7 REFERENCE 7

Stress is an escalated psycho-physiological state of the human body emerging in response to a challenging event or a demanding condition. Environmental factors that trigger stress are called stressors. In case of prolonged exposure to multiple stressors impacting simultaneously, a person's mental and physical health can be adversely affected which can further lead to chronic health issues. To prevent stress-related issues, it is necessary to detect them in the nascent stages which are possible only by continuous monitoring of stress. Wearable devices promise real-time and continuous data collection, which helps in personal stress monitoring. In this paper, a comprehensive review has been presented, which focuses on stress detection using wearable sensors and applied machine learning techniques. This paper investigates the stress detection approaches adopted in accordance with the sensory devices such as wearable sensors, Electrocardiogram (ECG), Electroencephalography (EEG), and Photoplethysmography (PPG), and also depending on various environments like during driving, studying, and working. The stressors, techniques, results, advantages, limitations, and issues for each study are highlighted and expected to provide a path for future research studies. Also, a multimodal stress detection system using a wearable sensor-based deep learning technique has been proposed at the end.

2.8 REFERENCE 8

In recent years, stress and mental health have been considered as important worldwide concerns. Stress detection using physiological signals such as electrocardiogram (ECG), skin conductance (SC), electromyogram (EMG) and electroencephalogram (EEG) is a traditional approach. However, the effect of stress on the EMG signal of different muscles and the efficacy of combination of the EMG and other biological signals for stress detection have not been taken into account yet. This paper presents a comprehensive review of the EMG signal of the right and left trapezius and right and left erector spinae muscles for multi-level stress recognition. Also, the ECG signal was employed to evaluate the efficacy of EMG signals for stress detection.

2.9 REFERENCE 9

Stress is a common response by human body when facing with certain conditions such as depression. Stress can occur in all range of ages but in general stress is mostly experienced in adulthood. If a person experiences stress, then the body will react to respond to the cause of stress. One of the body responses is an increased of heart rate, and the palm will release a cold sweat. In this paper, a system to diagnose the degree of saturation and strain in humans using fuzzy logic method is designed and studied by employing several sensors such as temperature sensors to measure body temperature, Galvanic Skin Response (GSR) used to detect the conductivity of the skin of two fingers and heartbeat sensors to find out how many heartbeats occur in a minute or Beat Per Minute (BPM). The sensed values of three sensors will be sent over a wireless network to the database, and the data processing with the fuzzy method is performed on the webserver. Testing on 15 subjects taken 5 times for each subject, the system sensor data retrieval successfully sends and stores data in database. On the 15 subjects, there were 12 subjects with the diagnosis of stress level in stable condition so that it can be concluded the system can work with percentage $(12/15) \times 100 = 80$. Then the results of processing the three sensors displayed on the website and the patient can also see the results through android application.

2.10 REFERENCE 10

In general, medical equipment at the Hospital to monitor body temperature such as a thermometer is less effective for nurses and doctors because it takes time to come to the patient's room to retrieve body temperature data. Then, when the patient's condition suddenly worsens, it still takes time for the treatment process. Therefore, the authors intend to make a tool that can help nurses monitor the patient's body temperature through an Android smartphone in real time and equipped with telemedicine that can send notifications in the form of SMS when the patient's body temperature is outside the normal limit. The working principle of this tool is that the body temperature data received by the DS18B20 sensor that will be processed by the Atmega328 microcontroller, then displayed on the OLED LCD and sent to an Android smartphone via Bluetooth HC-05. If body temperature data is outside the normal range, the Android application will send an SMS to another recipient's smartphone. Based on the results of the tool testing, the highest data error results is 0.829and the lowest is 0. For the process of sending data using Bluetooth HC-05 by taking measurements every 1 meter, the maximum distance obtained is 13 meters with a hitch. In the application of telemedicine in the form of automatic SMS sending successfully sends body temperature to other recipient's cellphone.

2.11 REFERENCE 11

Stress may be defined as the reaction of the body to regulate itself to changes within the environment through mental, physical, or emotional responses. Recurrent episodes of acute stress can disturb the physical and mental stability of a person. This subsequently can have a negative effect on work performance and in the long term can increase the risk of physiological disorders like hypertension and psychological illness such as anxiety disorder. Psychological stress is a growing concern for the worldwide population across all age groups. A reliable, costefficient, acute stress detection system could enable its users to better monitor and manage their stress to mitigate its long-term negative effects. In this article, we will review and discuss the literature that has used machine learning based approaches for stress detection. We will also review the existing solutions in the literature that have leveraged the concept of edge computing in providing a potential solution in real-time monitoring of stress.

2.12 REFERENCE 12

Imperceptible chronic recording of health status is vital to realize precision digital medicine to improve current diagnostic and treatment capabilities. Current sensing hardware is lacking such capabilities presenting a bottleneck for progress. In this chapter, we introduce wireless battery-free and highly miniaturized device platforms that enable chronic recording of vital signs, hemodynamics, and biomarkers that seamlessly integrate with current infrastructure such as smart phones. Operating principles, device technology, and sensing capabilities are examined with examples of commercialization demonstrating the impact of such devices.

2.13 REFERENCE 13

Among the panoply of applications enabled by the Internet of Things (IoT), smart and connected health care is a particularly important one. Networked sensors, either worn on the body or embedded in our living environments, make possible the gathering of rich information indicative of our physical and mental health. Captured on a continual basis, aggregated, and effectively mined, such information can bring about a positive transformative change in the health care landscape. In particular, the availability of data at hitherto unimagined scales and temporal longitudes coupled with a new generation of intelligent processing algorithms can: (a) facilitate an evolution in the practice of medicine, from the current post facto diagnose-and-treat reactive paradigm, to a proactive framework for prognosis of diseases at an incipient stage, coupled with prevention, cure, and overall management of health instead of disease, (b) enable personalization of treatment and management options targeted particularly to the specific circumstances and needs of the individual, and (c) help reduce the cost of health care while simultaneously improving outcomes. In this paper, we highlight the opportunities and challenges for IoT in realizing this vision of the future of health care.

2.14 REFERENCE 14

This is the era of modern life. The era of email, text messages, Facebook and Twitter, careers Crisis news coming from everywhere at any time. We (human) are assaulted with facts, pseudo facts, jibber-jabber, and rumour all posing as information. We text while we're walking across the street, catch up on email while standing in a queue. When people think they're multitasking, they're actually just switching from one task to another very rapidly. It has been found to increase the production of the stress that results overstimulate brains and cause mental fog or scrambled thinking. However, stress management should start far before the stress start causing illnesses. In this paper, a real-time personalized stress detection system from physiological signals is introduced. It is based on Pulse rate and temperature. That could record a person's stress levels.

2.15 REFERENCE 15

Due to the successful emergence of internet of things, sensor-based real-time health monitoring is getting popularized. A usable health-monitoring system is required for prolonged monitoring of the patient with reduced cost. This paper describes a working prototype system for real-time health-monitoring system using DS18B20 temperature sensor, Arduino Nano with micro-controller ATmega328 where Zigbee module is used for wireless communication. In this prototype sensor data gets acquired and analyzed to give proper feedback to the patient with or without mobility support at indoor. The sensor vitals are collected and sent to the computing device using shielded cable and ZigBee, i.e., through wired and wireless communication, respectively. Analysis of patient vitals based on medical definitions gives patient's real-time health condition so that if condition is not normal, then timely preventive measures can be taken to avoid further complication.

CHAPTER 3

PROPOSED METHODOLOGY

3.1 OVERVIEW

Creating a real-time stress monitoring system using IoT (Internet of Things) technology involves integrating various sensors, data processing units, and communication modules to collect and analyze stress-related data. Here's a general outline of how you could design such a system.

3.1.1 PULSE SENSOR

Pulse sensor works on the principle of plethysmography designed to detect cardiovascular signals from the skin surface based on signal fluctuations influenced by blood flow . Measuring and estimating HR from PPG signals during intense physical activity is challenging because it requires high accuracy. The PPG technique measured HR because it makes the device small and easy to use . The PPG principle is that the skin surface is illuminated by light from a light emitting diode (LED), infrared or red LED. The light that is transmitted or reflected by the skin's surface, collected through a photodiode, is then used to determine changes in blood volume. The photodiode is placed on the other side of the skin surface to detect the transmitted light . In this experiment, the pulse sensor used for HR detection is the MAX30102 sensor. The MAX30102 sensor is an integrated pulse oximetry sensor and HR monitor sensor. The output of the MAX30102 is HR and percentiles of oxygen saturations (SPO2). This sensor operates from 1.8 V and 3.3 V power . The MAX30102 can be configured via registers, and the digital output data is stored in the device first-in, first-out (FIFO).

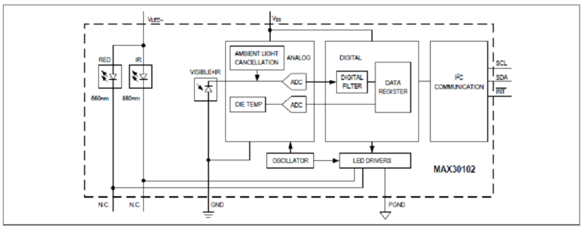

Figure 3.1: MAX30102

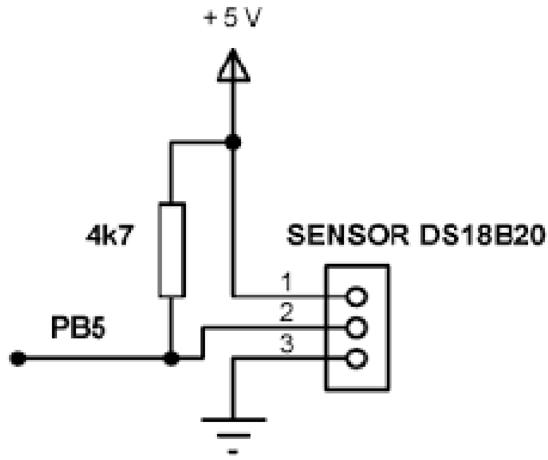

Figure 3.2: DS18B20

3.1.2 TEMPERATURE SENSOR

Normal body temperature changes depending on gender, continuous movement, food, fluid use, time of day, and for women during the menstrual cycle phase. The typical body temperature of a healthy adult can rise from 36.5 to 37.2 °C . In this experiment, the temperature detection using a DS18B20 sensor with three pins: the Vcc pin, ground, and data output. The voltage for this sensor to work is +5 V, and the output data from the sensor will go to the digital microcontroller PB5pin shown in Figure 3.2

3.1.3 GALVANIC SKIN RESPONSE(GSR)

The sensor which measures electrical conductance of our skin is known as GSR (Galvanic Skin Reaction) sensor. The electric conductance varies in proportion to moisture level of the skin. GSR value varies based on mental or physiological arousal as per sweating produced by our skin. EDA (Electro Dermal Activity) refers to electrical characteristics of pores and skin. It include pores and skin conductance, GSR (Galvanic Skin Reaction), EDR (Electro Dermal Response) , PGR (Psych Galvanic Reflex) , SCR (Skin Conductance Response), SSR (Sympathetic Skin Reaction) and SCL (Skin Conductance Level). The principle of EDA is that pores/skin resistance varies with respect to state of sweat glands. Operating voltage : 3.3V/5V

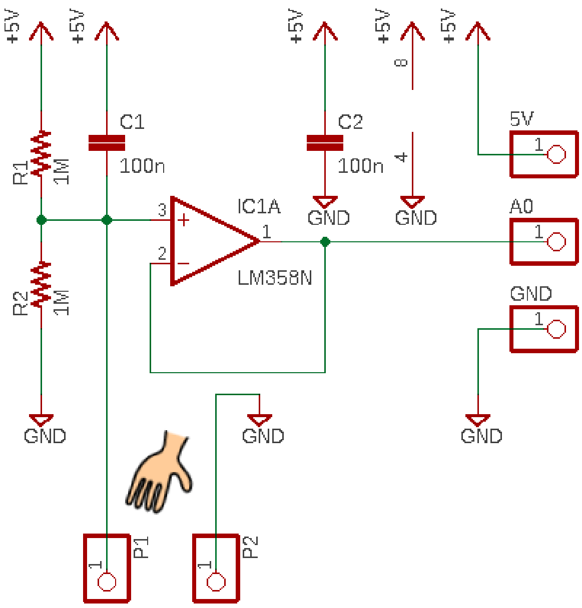

Figure 3.3: GSR SENSOR

3.1.4 SYSTEM DESGIN

Figure 3.4 explains the design of a real-time stress detection system, which consists of a microcontroller, temperature sensor, and HR sensor. The system as a whole gets power from the 5 V adapter. The DS18B20 read the temperature, and the MAX30102 read the HR and SPO2. The ESP reads the data and then processes it into stress information—the information displayed on the LCD and an android cellphone. We are monitoring via LCD for patients and through applications connected to IoT technology for other parties who need the data remotely.

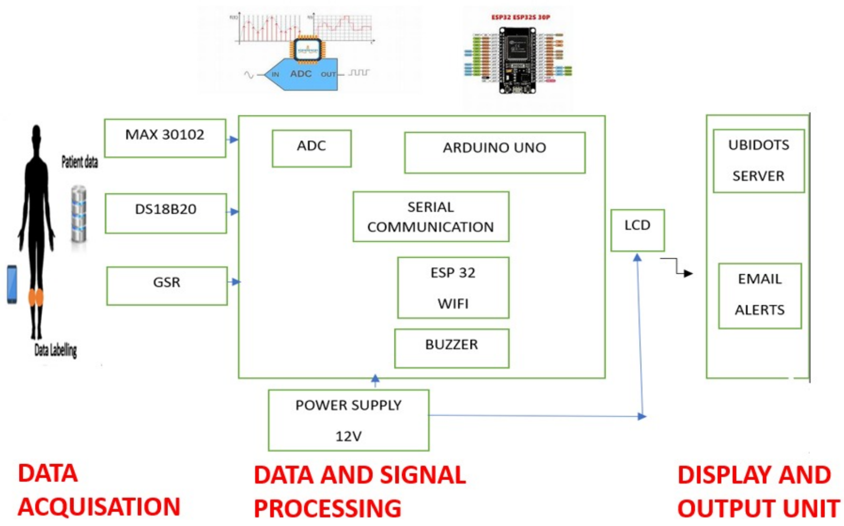

Figure 3.4: BLOCK DIAGRAM

3.1.5 FIRMWARE DESGIN

The firmware of a system is an essential component that determines its functionality. In the case of this system, the firmware is a program embedded in the Arduino Promini, created using the Arduino IDE. This firmware plays a crucial role in enabling the system to detect stress. To better understand the functioning of the stress detection system, Figure 3.5 provides a detailed flowchart that describes the various stages involved. By following this flowchart, the system can accurately identify stress levels and provide appropriate feedback to the user. Overall, the effective integration of the firmware and the flowchart makes the stress detection system a reliable and efficient tool for monitoring stress levels.

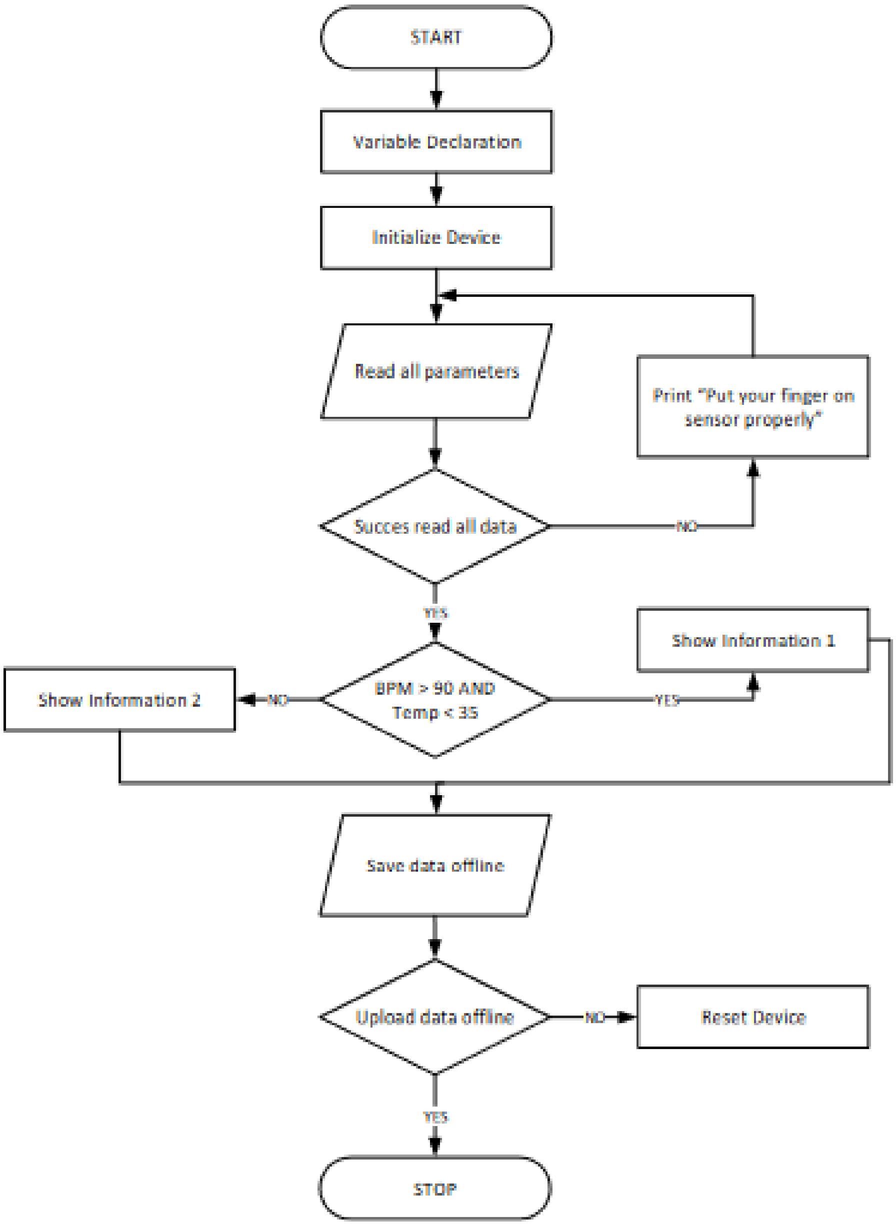

Figure 3.5: FLOW CHART

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