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Soldier Health Monitoring System - A Robust System that helps in monitoring various Health Parameters

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Abstract: ***Security is of prime importance to every nation. Soldiers are the backbone of security systems and therefore, their physical fitness is extremely important. In view of this it is essential to have a real-life system wherein body parameters' of Soldiers are being continuously monitored and subsequently analyzed for understanding their health status. In this paper, an attempt has been made for developing body parameters monitoring system through which soldiers' physical fitness is monitored. This system facilitates to ensures that the physical fitness of the soldiers in the field is in the acceptable range.***
Index Terms: Android studio, Firebase, Weather API, Python

I. INTRODUCTION

In today's world, every nation is more concerned about the safety and security of the nation. However, as soldiers play a critical and vital role in protecting our nation from enemies, their physical fitness is of utmost importance. Therefore, Health Monitoring Systems are developed for viewing the health status of the soldiers. These systems also facilitate monitoring real-time locations of the soldiers. It is important to communicate soldiers' health status data to the control unit for further actions like allowing/disallowing the soldier to remain in the field. Given above, in this paper, we have proposed Soldier Health Monitoring System wherein body parameters such as heart rate, body temperature, and blood pressure are continuously monitored along with atmospheric external parameters such as pressure, temperature, wind speed, and elevation of the geographical area in which the soldier is posted.

II. LITERATURE SURVERY

The authors [1] have proposed the use of a keypad for con- necting with the main headquarters and also have implemented the Bomb Detector using IED (Improvised explosive device). They have also proposed the use of GPS which will solve the problem of communication between the soldiers, Keypad with SOS facility, and Bomb Detector using paper sensors. In [2] paper, authors have proposed a methodology to develop a system for real-time health monitoring of soldiers, consisting of interconnected Body Sensor Network and has also intro- duced the concept of vibration sensor. In [3] Joint Advanced Technology Centre (JATC) at IIT Delhi has a research vertical Smart and Intelligent Textile (SITEX). Under this vertical, faculties and researchers have been working on the development of smart soldier jackets for the Indian Army. The objective of the project is to develop technology prototypes of soldier jackets embedded with sen- sors for physiological monitoring, chemical and gas sensors, integrated interconnects and antennas to ease the mobility of the soldier with the capability of detecting various threats and in-built communication electronics.

III. PROBLEM STATEMENT

In the proposed work, body parameters such as heart rate, body temperature, and blood pressure of soldiers' are contin- uously monitored along with atmospheric external parameters such as pressure, temperature, wind speed, and elevation of the geographical area in which the solder is posted. Acquired soldiers' body parameter data is analyzed for identifying deviations from the expected range of parameter values. Ac- cordingly, alert notifications are issued to the control unit for further necessary action.

IV. BODY PARAMETERS

A. Heart Rate

Heart rate is the speed of the heartbeat measured by the number of contractions (beats) of the heart per minute (bpm). Heart rate depends on the body's need for oxygen-rich blood. During physical activity, the body needs more oxygen-rich blood; the heart rate rises to well over 100 beats per minute. When your heart rate is too fast, it's called tachycardia. In general, a fast heart rate is defined as a heart rate of over 100 beats per minute. When your heart rate is too slow, it's referred to as bradycardia. Bradycardia is typically defined as a heart rate that's less than 60 beats per minute.

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As mentioned earlier, both tachycardia and bradycardia can be indicators of an underlying health condition. A heart rate that's too low or high for an extended period, can lead to a variety of potentially serious health complications, including blood clots, heart failure, recurring fainting spells, and sudden cardiac arrest. (refer [10])

Age (years)	Target heart rate zone at 50 to 85 percent exertion (bpm)	Average maximum heart rate at 100 percent exertion (bpm)
20	100 to 170	200
30	95 to 162	190
35	93 to 157	185
40	90 to 153	180
45	88 to 149	175

B. Blood Pressure

Blood pressure (BP) is the pressure of circulating blood against the walls of blood vessels. Most of this pressure results from the heart pumping blood through the circulatory system. Following are the limits for different degrees of blood pressure. During this cycle, the period of relaxation is called diastole and the period of contraction is called systole. (refer [9])

Category	Systolic BP, mmHg	Diastolic BP, mmHg
Optimal	< 120	< 80
Normal	120–129	80–84
High normal	130–139	85–89
Grade 1 hypertension	140–159	90–99
Grade 2 hypertension	160–179	100–109
Grade 3 hypertension	≥ 180	≥ 110
Isolated systolic hypertension[b]	≥ 140	< 90
The same classification is used for all ages from 16 years.		

C. Body Temperature

The normal human body temperature range is typically stated as 36.5–37.5 °C (97.7–99.5 °F).
Hyperthermia occurs when the body produces or absorbs more heat than it can dissipate. It is usually caused by prolonged exposure to high temperatures. Hyperthermia at or above about 40 °C (104 °F) is a life-threatening medical emergency that requires immediate treatment. In hypothermia, body temperature drops below that required for normal metabolism and bodily functions. In humans, this is usually due to excessive exposure to cold air or water, but it can be deliberately induced as a medical treatment. Symptoms usually appear when the body's core temperature drops by 1–2°C (1.8–3.6 °F) below normal temperature.

V. WORKING

In a real-life application, the soldiers' body parameter data will be acquired by the hardware system built on the soldiers' strap, and the same is tied to the torso area on the body.
However, in this proposed work, we have emulated the body parameter data through a python code and this data is concur- rently made available as a realtime database. Firebase, the real- time database which is used to sync up the application data in the cloud is used for this purpose. An android application, GUI, is also designed and developed for visualizing this data. Analysis of body parameters of multiple soldiers can be done simultaneously.

A. Methodology For Data Generation

Python code is developed to randomly generate body param- eters data within the normal limits of the human body as mentioned in section IV above. This data is generated for each soldier. Three parameters namely Blood pressure, temperature, and heart rate are chosen. For each parameter, a specific range is set to generate the first data point. The range for body temperature is set for 36-37°C; the range for blood pressure is set for 80-90 mmHg for Diastolic BP and 120-140 mmHg for Systolic BP; the range for heart rate is set between 30-50 percent of the maximum heart rate. The formula for heart rate is 208 -(0.7*age).

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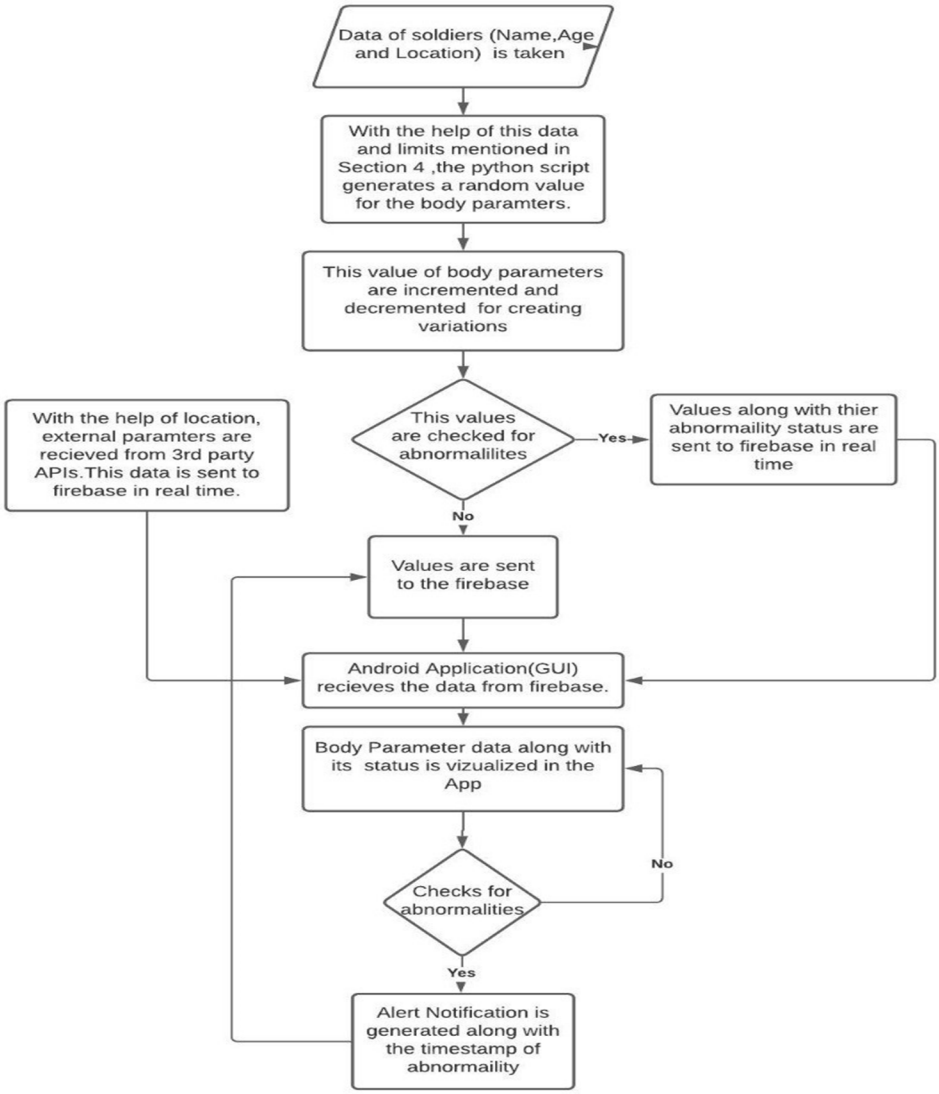
Thereafter, a number is generated randomly within +0.5 to - 0.5 for body temperature, and -5 to +5 for blood pressure and heart rate. This randomly generated number from the above limits is added to the number from the first set of randomly generated data for creating consecutive variations in the data. This process is done continuously for every parameter. A special function is written in the python script which verifies the data points (temp, bp, and heart rate) added to the database against the normal limits of the human body. If the updated data points of the database are against these limits, then this data status will be sent to the real-time database(firebase) and an alert notification will be issued. (refer[8]).

As the firebase library is imported in the python script, once the python code data is updated, the real-time database (Firebase) is also updated accordingly.

The external parameters such as external temperature, atmo- spheric pressure, wind speed, and elevation of the particular location will be fetched from a third-party weather API. As normal limits of the human body may change with respect to external parameters. It is necessary to acquire external parameters' database.

To visualize the soldiers' database, an android application with reliable and user-friendly GUI is developed in android studio using JAVA 8. This App fetches the data from the database (Firebase). The profile of every soldier is displayed in the Android application. On selecting an individual profile, a dash- board showing a realtime reading of body parameters along with their status with respect to normal/abnormal condition of the soldier is displayed. If any abnormality is observed, an alert will be generated along with the respective recorded time.

VI. FLOWCHART

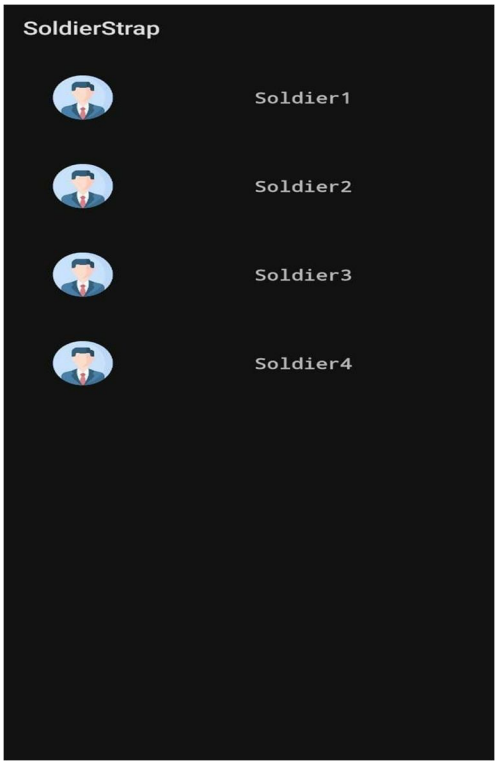


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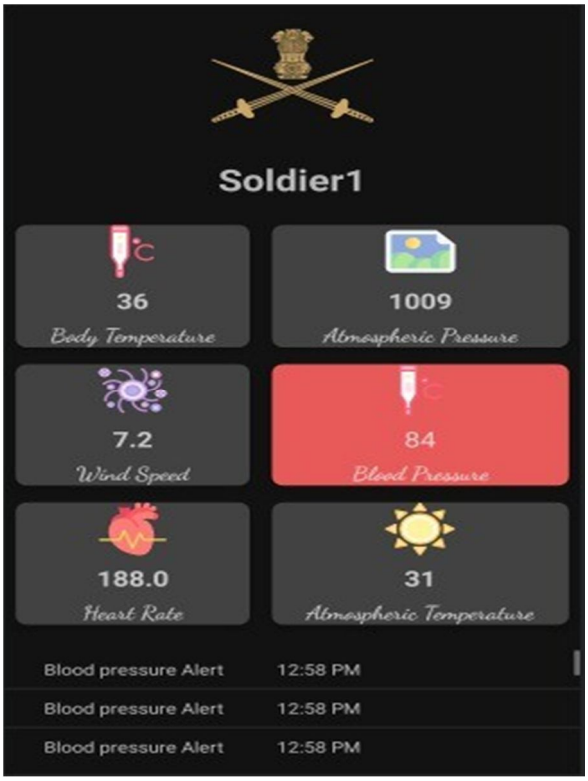
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VII. RESULT

A. *GUI - Android Application Interface*

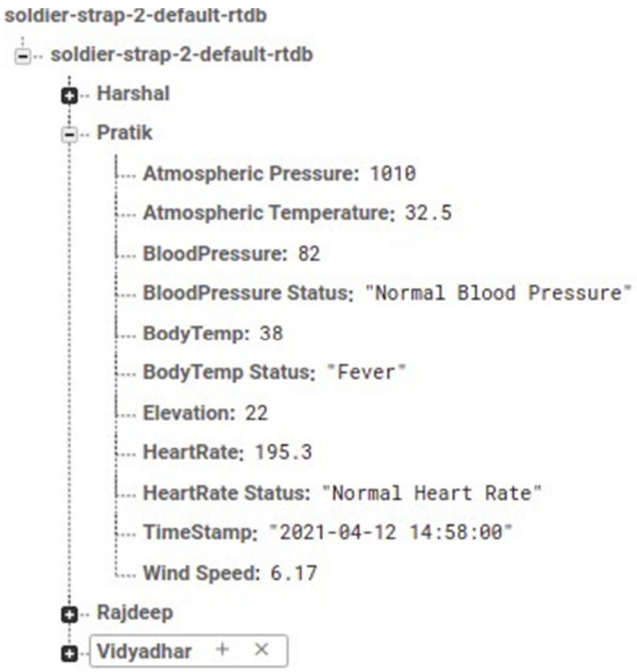


B. *Soldier's Parameters Inferface*



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C. Working of Firebase



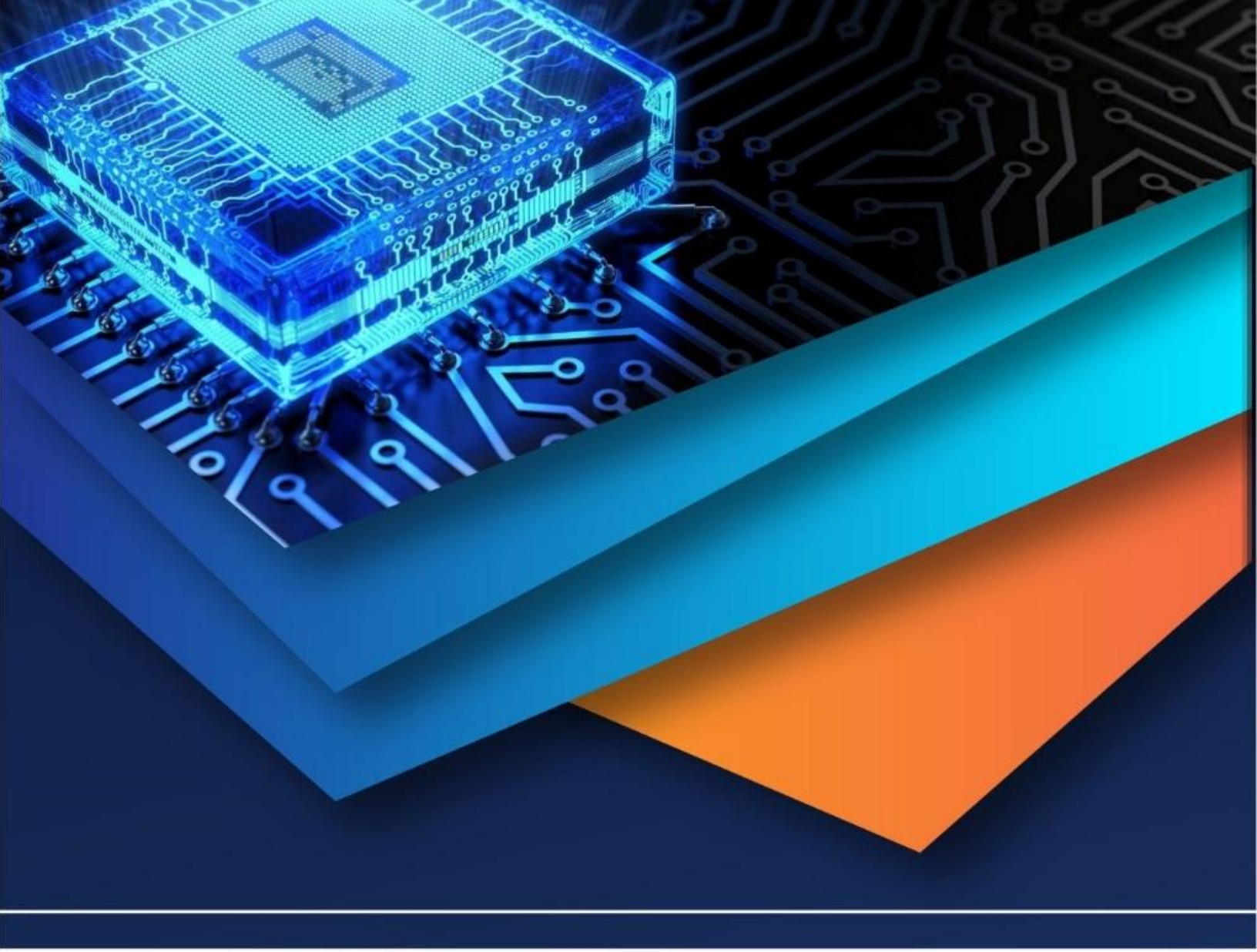
VIII. CONCLUSION

In this paper, an attempt has been made for developing body parameters monitoring system through which soldiers' physical fitness is monitored. Database of Soldiers' body parameters namely heart rate, body temperature, and blood pressure are satisfactorily generated and tested against normal limits of human body for deciding on soldiers' physical fitness. Accordingly, alert notifications are issued.This system facilitates to ensure that the physical fitness of the soldiers in the field is in the acceptable range. Python code is developed to generate the database and it is linked to the Firebase so as to update the database in real time. An android application is developed, which acts as a GUI for visualizing the data and creating alerts during abnormalities in the data.
This data can be used by the higher in command officer for advising medical help to the soldier, and also for general training and research purpose.

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