BIOMEDICAL AND LIFE SUPPORT SYSTEM FOR DEFENCE

AFREEN KHANAM A
School of Information Science and Engineering
Presidency University
Bangalore,Karnataka India
afkhanam0005@gmail.com

DEVI.S
Asst.Professor Computer Science and Engineering ,Guide
Presidency University
Bengaluru ,Karnataka,India
devi.s@presidencyuniversity.in

***Abstract*— Networking, public and private companies, and international governmental organizations have all undergone radical change as a result of the Internet and the development of smart sensing gadgets. The goal of this study is to examine wearable health monitoring devices that people can use to track physiological data such as body temperature, heart rate, blood pressure, pulse, and other vital signs. The system described in this study uses smart biosensors to wirelessly interface human physiological characteristics with a computer system. It is a graphical user interface (GUI)-based system. By boosting efficiency, lowering costs, and preventing medical errors, the integration of these technologies has the potential to significantly improve healthcare quality. Smart biosensors built into wearable health monitoring devices provide a handy and unobtrusive way to continuously check vital indicators. This makes it possible for people to take charge of their health, identify early warning signs, and respond appropriately to any healthproblems.**

Individuals may see and understand their physiological data using the GUI-based system's user-friendly interface. It enables real-time vital sign monitoring, recording, and analysis, allowing users to follow their health improvement and remotely share this information with medical providers. The system's wireless protocols enable seamless connection between wearable technology and the computer system, By boosting efficiency, lowering costs, and preventing medical errors, the integration of these technologies has the potential to significantly improve healthcare quality. Smart biosensors built into wearable health monitoring devices provide a handy and unobtrusive way to continuously check vital indicators. This makes it possible for people to take charge of their health, identify early warning signs, and respond appropriately to any health problems, eliminating the need for cumbersome wired connections.

Keywords*— *Bio-sensors, Physiological parameters, Wireless protocols, GUI

*Introduction (***Heading 1***)*

The Defence Research and Development Organization's (DRDO) Defence Bioengineering and Electromedical Laboratory (DEBEL) is devoted to carrying out research and development in the domains of bioengineering and electromedical technology with an emphasis on defence applications. Aeromedical engineering, life support systems, and nuclear, biological, and chemical (NBC) protection are among DEBEL's speciality areas. We seek to counter military threats and gain an advantage over prospective adversaries by making investments in defence research and technology. Technological developments have increased military options, allowing us to support stability and minimise casualties both in combat and outside of it.

The use of health monitoring systems, which enables the quantitative evaluation of physiological characteristics in patients, is an important component of defence research. The Graphical User Interface (GUI) system used to measure numerous physiological data, such as heart rate, blood pressure, pulse, body temperature, and ECG, is the subject of this study. This system uses bio-sensors to find and keep track of the pertinent patient parameters. These wearable sensors make direct physical touch with the human body and provide ongoing physiological monitoring.

Serial connection protocols including UART, RS-485, and UPorts are used to facilitate seamless communication between the bio-sensors and the GUI system. The main goal of this project is to create a graphical user interface (GUI) that can accurately identify and record several physiological characteristics of patients in space. Through the accurate and real-time monitoring of patients' vital signs, this research intends to improve the standard of healthcare.

It is crucial to keep track of physiological variables when in orbit. Long stretches of seclusion, exposure to microgravity, and potentially dangerous circumstances are all part of space missions. It is essential for astronauts' health and the success of the mission that any physiological abnormalities in astronauts are promptly and accurately detected. The GUI system created for this project makes it possible for astronauts and medical staff to efficiently monitor vital signs, assisting in the early identification of health conditions and the application of suitable therapies.

The GUI system also affects healthcare in ways that go beyond the realm of space. It provides an intuitive interface that may be used in a variety of healthcare facilities, including clinics, hospitals, and even home monitoring systems. Remotely tracking physiological data in real time has the potential to improve the efficiency and patient-centeredness of healthcare delivery. By utilising wireless protocols, medical staff may remotely check on patients' vital signs, cutting down on the number of times they have to visit the hospital and optimising resource use.

The adoption of cutting-edge technologies, such the GUI-based system for physiological parameter monitoring, shows DEBEL and the DRDO's dedication to transforming healthcare in both the defence and civilian sectors. This research enhances healthcare efficiency, lowers medical errors, and improves patient outcomes by incorporating bio-sensors, serial communication protocols, and user-friendly interfaces. The use of this technology in space missions also emphasizes its value in harsh situations where quick identification and reaction to physiological changes are essential for astronaut safety and mission accomplishment.

I. EXISTING WORK

The creation of a graphical user interface (GUI) system for health monitoring is one of DEBEL's primary research focuses. Heart rate, blood pressure, pulse, body temperature, and ECG are among the physiological data that can be measured by this GUI system. By making direct physical touch with the human body, wearable bio-sensors are utilized to continuously and instantly monitor key data.

The use of serial connection protocols like UART, RS-485, and UPorts enables seamless communication between the bio-sensors and the GUI system. The major goal of this project is to develop a graphical user interface (GUI) system that can precisely recognize and record various physiological features of patients in space.

The goal of real-time and accurate vital sign monitoring is to raise the standard of healthcare during space missions, where astronauts' health is particularly challenged by prolonged isolation, exposure to microgravity, and potentially dangerous situations.

The GUI system created by DEBEL has wider uses in healthcare in addition to helping space missions. It offers a user-friendly interface that may be used in a variety of healthcare facilities, such as clinics, hospitals, and home monitoring systems. Medical staff can remotely check on patients' vital signs by using wireless protocols, which minimizes the need for frequent hospital visits and makes the most use of available resources. By increasing productivity, lowering mistakes, and improving patient outcomes, this technology has the potential to enhance healthcare delivery.

Adopting innovative technology, such the GUI-based system for physiological parameter monitoring, demonstrates DEBEL and DRDO's dedication to revolutionizing healthcare in the defence and non-defense sectors. This research aims to improve healthcare efficiency, enhance patient outcomes, and contribute to the safety and success of space missions by enabling quick identification and response to physiological changes in astronauts. It does this by integrating bio-sensors, serial communication protocols, and user-friendly interfaces.

II. PROPOSED WORK

This research focuses on analyzing various wearable health monitoring devices that people use to track physiological data like heart rate, blood pressure, pulse, and body temperature. The goal of this project is to develop a GUI that can locate patients in space and identify numerous pshycological factors.

a)Labels and Entry Fields: Create labels and entry fields to display and input information such as device number, packet number, date, time, packet length, checksum, and ECG samples. You can use the Label and Entry widgets from Tkinter to create these components.

b)File Selection: Add a "Select File" button that allows the user to choose the file containing the health monitoring data. You can use the filedialog.askopenfilename() function to open a file dialog box for file selection.

c)Data Processing: After the user selects a file, you need to process the data from the file. This may involve reading the file, extracting the required information, and storing it in variables or data structures for further use.

d)Graph Plotting: Use a graph plotting library like Matplotlib to plot the ECG samples on a graph. You can create a canvas widget using FigureCanvasTkAgg from Matplotlib and display the graph within the GUI.

e)Displaying Information: Create labels or text fields to display the processed information such as device number, packet number, date, time, packet length, checksum, etc. Update these labels with the corresponding values after processing the data. Organize Components: Use layout managers like pack() or grid() to organize and position the GUI components within the main window. Place the labels, entry fields, buttons, and other elements in a visually appealing and intuitive layout. Error Handling: Implement error handling mechanisms to handle cases such as invalid file formats, missing data, or any other potential errors that may occur during data processing or file selection. User-Friendly Features: Consider adding features such as clear/reset buttons to clear the displayed information, tooltips to provide additional information, or progress indicators to show the progress of file processing or graph plotting.

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 07 ISSUE: 05 | MAY - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

III. ARCHITECTURE

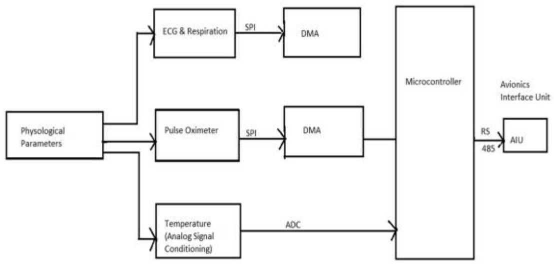

FIG 3.1 ARCHITECTURE

1. Wearable Sensors: The system starts with wearable sensors that capture physiological data. These sensors include ECG sensors to measure heart activity, respiration sensors to monitor breathing patterns, pulse oximeters to measure blood oxygen levels, and temperature sensors to monitor body temperature. The sensors interface with a microcontroller avionics unit.

2. Microcontroller Avionics Interface Unit: The microcontroller avionics interface unit acts as the central hub for data acquisition and processing. It communicates with the wearable sensors and receives the analog signals from each sensor. The unit includes analog signal conditioning circuits to process and amplify the weak analog signals received from the sensors.

3. Analog-to-Digital Conversion: The conditioned analog signals from the sensors are converted into digital signals using analog-to-digital converters (ADCs). The ADCs sample the analog signals at a high frequency to capture accurate data. The digital signals are then passed to the microcontroller avionics unit for further processing.

4. Data Processing and Fusion: The microcontroller avionics unit processes the digital signals to extract relevant physiological parameters. It applies algorithms and signal processing techniques to detect ECG patterns, analyze respiration rates, calculate blood oxygen saturation levels, and measure body temperature. The unit may use pre-trained machine learning models or signal processing algorithms to enhance accuracy.

5. Communication and Display: The processed physiological parameters are sent to a graphical user interface (GUI) for visualization and analysis. The GUI displays real-time data, including ECG waveforms, respiration patterns, blood oxygen levels, and bodytemperature. It provides interactive graphs, charts, and numeric displays for easy interpretation of the data.

6. Data Storage and Logging: The system may include a data storage component to store the collected physiological data for further analysis and reference. This can involve local storage within the microcontroller unit or external storage options such as an SD card or a cloud-based database. The stored data can be used for historical analysis, generating reports, or sharing with healthcare professionals.

7. Alerting and Notifications: The system can be equipped with an alerting mechanism to notify users about critical health conditions. It monitors the physiological parameters in real-time and triggers alerts if any values exceed or fall below predefined thresholds. Alerts can be displayed on the GUI, sent as notifications to mobile devices, or communicated through other means.

8. Power Management: Efficient power management is crucial for wearable health monitoring systems. The architecture should include power management mechanisms such as power-saving modes, battery monitoring, and intelligent power allocation to ensure optimal battery life and uninterrupted operation.

9. Security and Privacy: To protect the sensitive health data, the system should incorporate security measures such as data encryption, user authentication, and secure communication protocols. It should comply with privacy regulations and guidelines to ensure the confidentiality and integrity of the collected data.

It's important to note that the above architecture provides a high-level overview and can be customized based on specific requirements and constraints. The selection of microcontrollers, sensors, communication protocols, and software frameworks will depend on factors such as cost, power consumption, processing capabilities, and the intended application environment

IV. RESULTS

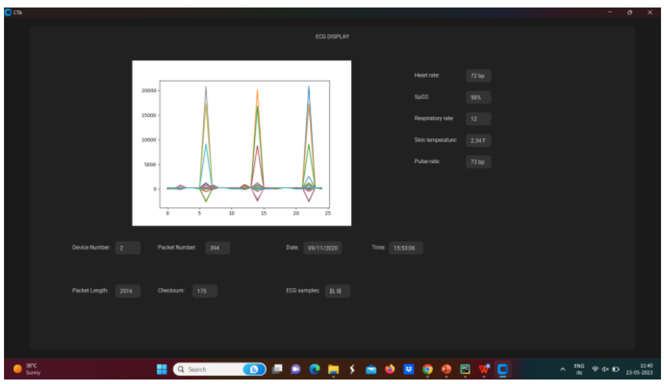

FIG 4.1 RESULT

The above picture represents the Graphical User Interface(GUI) of the Health Monitoring System.The effectiveness of the proposed health management system in streamlining the physological parameters of patients such as skin temperature,SpO2,Respiratory rate and pulse rate.
The graph is plotted with time(sec) on X-axis and Amplitude(mV) on Y-axis. The obtained GUI also consists of the time, date, device number ,packet length nad packet number.
a)Overview of Data Collection:
Description of the data collection process in the space environment. Explanation of the physiological parameters monitored (e.g., heart rate, blood pressure, oxygen saturation).Details of the sensors used and their placement on patients.
b) Real-time Graphical Display:
Demonstration of the graphical user interface developed using Tkinter..Description of the features and functionalities of the interface. Examples of the real-time graphical representation of physiological parameters.
c)Data Analysis:
Statistical analysis of the collected data. Presentation of trends and patterns observed in the physiological parameters. Comparison of the monitored parameters under different conditions (e.g., during exercise, rest, or emergencies).
d)System Performance Evaluation:
Evaluation of the system's accuracy in monitoring physiological parameters. Comparison of the monitored values with established medical standards. Discussion of any limitations or challenges encountered during data collection.
e)Reliability and Usability: Discussion of the system's reliability in capturing and displaying real-time data.
Evaluation of the usability of the Tkinter-based graphical interface in the space environment.

V. CONCLUSION

In summary, the goal of this project is to create a graphical user interface (GUI) for analysing data from wearable health monitoring systems, with a focus on physiological variables like heart rate, blood pressure, pulse, and body temperature. Additionally, the GUI will be able to locate patients in space and recognise different psychological aspects.

Several important components are included in the GUI's suggested architecture. Information such as device number, packet number, date, time, packet length, checksum, and ECG samples will be shown and entered using labels and entry fields. A "Select File" button will allow users to choose the file holding the health monitoring data. Reading the file, extracting the necessary data, and storing it for later use are all parts of data processing.

A graph plotting library like Matplotlib will be used to visualise the ECG samples. Using FigureCanvasTkAgg, the GUI will use a canvas widget to display the graph. To show processed data such device and packet numbers, times, dates, packet lengths, checksums, etc., labels or text fields will also be developed. After the data has been processed, these labels will be updated with the correct values.

To achieve an aesthetically pleasing and understandable layout, the GUI components will be arranged and placed using layout managers such as pack() or grid(). In order to address any problems during data processing or file selection, error handling mechanisms will be put in place. To improve usability, user-friendly elements like clear/reset buttons, tooltips, and progress indicators will be taken into account.

Overall, this GUI will offer a user-friendly interface for processing data from wearable health monitoring systems and locating psychological aspects. Users will be able to learn important new things about their physiological parameters, which will help with patient monitoring and care in space.

VI. FUTURE SCOPE

In the proposed work of creating a GUI for a health monitoring system, there are several additional aspects to consider:

a) Real-Time Data Display: Design the GUI to display the physiological parameters in real-time as they are being monitored. This can involve updating the values on the GUI interface continuously as new data is received from the wearable health monitoring modules.

b) Alarm and Alert Mechanisms: Implement an alarm system that can detect abnormal values or patterns in the physiological parameters and generate alerts or notifications. This can help in promptly identifying any potential health issues or emergencies. The GUI should provide visual or auditory cues to draw attention to critical situations.

c) Logging and Storage: Include functionality to log and store the monitored physiological data for future reference and analysis. This can involve saving the data to a file or a database. Additionally, provide options to export the data in different formats for further processing or sharing.

d) Data Analysis and Visualization: Incorporate tools for analyzing and visualizing the monitored data. This can include generating statistical summaries, trends, and graphs to provide insights into the patient's health status over time. Utilize libraries like NumPy, Pandas, and Seaborn to facilitate data analysis and visualization tasks.

e) User Profiles and Data Management: Develop a system that allows for the management of multiple user profiles, especially in scenarios where the health monitoring system is used by different individuals. Provide options for users to create and edit their profiles, which can include personal information, health history, and settings specific to their needs.

f) Integration with External Devices or Systems: Consider the possibility of integrating the GUI with external devices or systems, such as electronic medical records (EMR) systems or other healthcare infrastructure. This integration can enable seamless data exchange, facilitate comprehensive patient monitoring, and enhance the overall efficiency of healthcare processes.

g) User Authentication and Access Control: Implement appropriate security measures to ensure that only authorized personnel can access the GUI and the monitored data. This can involve incorporating user authentication mechanisms, role-based access control, and encryption of sensitive data.

h) Usability Testing and User Feedback: Conduct usability testing sessions with potential users to gather feedback on the GUI's design, functionality, and user experience. Incorporate user feedback to make iterative improvements and enhance the overall usability and effectiveness of the health monitoring system.

i) Documentation and User Support: Provide comprehensive documentation and user support resources to assist users in understanding and utilizing the GUI effectively. This can include user manuals, FAQs, video tutorials, and online forums or help desks for addressing user queries or issues.

It is important to note that the implementation details and specific features of the GUI will depend on the targeted user group, the intended environment of use (e.g., space missions), and any specific requirements or constraints provided by the project stakeholders.

REFERENCES

[1] Nguyen, Tuan D., et al. "Advancements in military and civilian field medical technology: current challenges and future trends." The Journal of Trauma and Acute Care Surgery 83.4 (2017): S48-S57.

[2] Holmes, Charles F., et al. "US Army Medical Research and Development Command Combat Casualty Care Research Program: 50 years of research and development." Journal of Trauma and Acute Care Surgery 73.6 (2012): S491-S497.

[3] Langan-Evans, Carl, et al. "Physiological demands of Load Carriage During Extreme Heat: A systematic review." Journal of Strength and Conditioning Research 34.12 (2020): 3657-3671.

[4] Deuster, Patricia A., Daniel G. O'Connor, and Harris R. Lieberman. "Nutritional considerations in special operational and U.S. military populations: a conference report." Military Medicine 181.Supplement_1 (2016): 3-114.

[5] Scott, Jonathan M., et al. "Injury prevention and control in tactical military units: current practices and future directions." Sports Medicine 45.6 (2015): 763-780.

[6] Irwin, Christopher, et al. "Environmental medicine and military operational readiness: casualties, risk factors, and mitigation strategies." American Journal of Preventive Medicine 44.3 (2013): 253-261.

[7] Li, Xin, et al. "Biomechanical and physiological responses to military load carriage: a review." Ergonomics 60.7 (2017): 912-927.

[8] Andreoni, Giuseppe, et al. "A perspective on the deployment of biomedical nanotechnology in military medicine." Frontiers in Bioscience 22.5 (2017): 925-944.

[9] Haque, Amranul, et al. "Life-support systems for extreme environments: A review." Life Sciences in Space Research 20 (2019): 67-80.

[10] Donner, Maria, et al. "Life support in space habitats: a comprehensive approach." IEEE Aerospace and Electronic Systems Magazine 34.12 (2019): 38-48.