Early Responsive Continuous Monitoring System to Protect the Patient Health Using Wireless Body Sensor Networks

Shaik Yakhoob[1], D. Murali[2]
[1]*PG Student, QUBA College of engineering and technology*
[2]*Associate Professor, QUBA College of engineering and technology*

***Abstract*—The COVID-19 pandemic has wreaked havoc globally and still persists even after a year of its initial outbreak. Several reasons can be considered: people are in close contact with each other, i.e., at a short range (1 m), and the healthcare system is not sufficiently developed. Wireless body sensor networks (WBANs) are a new advance utilized in recent years to increase the quality of human life by monitoring the conditions of patients inside and outside hospitals, the activities of athletes, military applications, and multimedia. Bans consist of intelligent micro or nano - sensors capable of processing and sending information to the base station (BS). Sensors will be embedded in the body. Network forming of these sensors envisages long-term medical care without restricting patients normal daily activities as part of diagnosing or caring for a patient with a chronic illness or monitoring the patient after surgery to manage emergencies. So, the main theme of this project is that, using WBAN sensor's we need to find the COVID-19 impacted patient's health condition and give them the treatment by taking their symptoms into account or by telling them about the COVID-19 precautions. By using this sensor, we can know the patients' health condition and we can send them the instructions which was needed by them.**

***Index Terms*— COVID-19, SARS-CoV-2, respiratory illness, droplets, aerosols, fomites, symptoms, fever, cough, loss of taste, asymptomatic transmission, high-risk groups, pneumonia, organ failure, immune system, prevention, treatment**

I. INTRODUCTION

1.1 Introduction

COVID-19 is a contagious respiratory illness caused by SARS-CoV-2. SARS-CoV-2 spreads from one individual to another through droplets emitted when an infected person coughs, sneezes, or talks or the individual inhales infectious aerosols. It might likewise be spread by indirect transmission via fomites (contaminated surfaces) to the hand upon contact and from hands to the mucous membranes on the face, as people touch their faces frequently. The most common signs and symptoms of COVID-19 are fever, cough, and trouble breathing. Fatigue, muscle pain, chills, headache, sore throat, runny nose, nausea or vomiting, diarrhea, and a loss of taste or smell may also occur. The signs and symptoms may be mild or extreme and usually appear 2–14 d after exposure to SARS-CoV2. Some people may not have any symptoms, but are still able to spread the virus. Most people with COVID-19 recuperate without needing special treatment. However, other people are at higher risk of serious illness. Those at higher risk include older adults and people with serious clinical issues, such as heart, lung, or kidney disease, diabetes, cancer, or a weak immune system. Serious illness may include life-threatening pneumonia or organ failure. Research is being performed to treat COVID-19 and to prevent infection with SARS-CoV-2.

Wireless Sensor Networks (WSNs) have become an important research issue and will become an integral part of human life in the near future. WSNs are a network of sensor nodes spatially distributed throughout the environment, each of which has a particular purpose independently and in cooperation with other nodes. The main goal of these networks is to collect data on the environment and transfer it to the base station (BS) or remote server. The information is then analyzed in detail. A wireless sensor is the smallest unit within a network, with unique characteristics such as support for wide dispersion, mobility, and reliability.

1.2. Motivation:

The project is, using WSN sensor's we need to find the impacted patient's health condition and give them the treatment by taking their symptoms into account or by telling them about the precautions. By using this sensor, we can know the patients' health condition and we can send them the instructions which was needed by them. That are able to monitor the early symptoms and common health conditions and the telehealth framework for the remote screening and diagnosis of disease. This application includes wearable sensors connected to the human body to monitor and track body movements and measure physiological parameters such as body temperature and heart rate. These sensors gather information and send it to the BS for analysis, storage, and processing. Then, the data are safely sent to remote medical servers via the Internet or other media.

The primary objective of this project is to develop an explainable data-driven digital twin model that accurately predicts key battery states, specifically state of charge (SOC) and state of health (SOH), in electric vehicles (EVs). The project aims to integrate a variety of advanced machine learning algorithms, including Deep Neural Networks (DNN), Long Short-Term Memory (LSTM) networks, Convolutional Neural Networks (CNN), Support Vector Regression (SVR), and others, to build a robust and reliable prediction model. In addition to achieving high prediction accuracy, the project also seeks to incorporate explainable AI techniques to provide transparency and understanding of the model's predictions. By achieving these objectives, the project aims to enhance battery management systems, ultimately contributing to the improved performance, safety, and longevity of batteries in EVs.

II LITERATURE SURVEY

2.1 Summary: In this paper, authors did several experiments to get the best services to the customers based on analyzing the feedback given by the customers.

2.2 Literature Survey

[1] Greenhalgh, T.; Jimenez, J.L.; Prather, K.A.; Tufekci, Z.; Fisman, D.; Schooley, R. Ten scientific reasons in support of airborne transmission of SARS-CoV-2. Lancet 2021, 397

First, superspreading events account for substantial SARS-CoV-2 transmission; indeed, such events may be the pandemic's primary drivers. Detailed analyses of human behaviours and interactions, room sizes, ventilation, and other variables in choir concerts, cruise ships, slaughterhouses, care homes, and correctional facilities, among other settings, have shown patterns. e.g., long-range transmission and overdispersion of the basic reproduction number (R0), discussed below. Consistent with airborne spread of SARS-CoV-2 that cannot be adequately explained by droplets or fomites. The high incidence of such events strongly suggests the dominance of aerosol transmission.

[2] Walsh, K.A.; Spillane, S.; Comber, L.; Cardwell, K.; Harrington, P.; Connell, J.; Teljeur, C.; Broderick, N.; de Gascun, C.F.; Smith, S.M. The duration of infectiousness of individuals infected with SARS-CoV-2. J. Infect. 2020, 81, 847–856.

Severe acute respiratory syndrome coronavirus, type 2 (SARS-CoV-2) is a highly infectious virus that is responsible for tens of millions of cases of coronavirus disease 2019 (COVID-19) worldwide.SARS-CoV-2 constitutes a significant public health concern due to its high basic reproduction rate (R0 of 4–5 in the unmitigated setting), the absence of immunity in the human population, the lack of effective treatment or vaccination approaches, the high SARS-CoV-2 viral loads detectable in respiratory samples, and the occurrence of transmission early in the disease course, often pre-symptomatically, or by those asymptomatic or pauci-symptomatic. Due to the lack of effective antiviral therapy or a vaccine, the rapid diagnosis, contact tracing, and isolation of suspected COVID-19 cases are of critical importance in the control of this pandemic Isolation is defined as separating those with symptoms of, or diagnosed with, COVID-19, from people who are not infected. This is distinct from quarantine, which is defined as separating and restricting the movements of people who were exposed or potentially exposed to COVID-19, as a precautionary

System Analysis & Feasibility Study

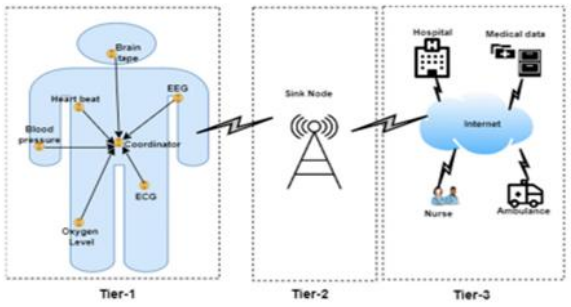
2.3 Existing Method

The Body Sensor Network for Elderly Health Monitoring (BSNEHM) is another existing model that uses wireless body sensor networks to monitor the

health of elderly patients. The BSNEHM consists of wearable sensors that collect data on physiological parameters such as heart rate, blood pressure, and body temperature, and a centralized system for processing and analyzing the data. The system can alert caregivers and healthcare providers in case of abnormal readings, allowing for early intervention

Disadvantages

1. Cost The cost of implementing these systems can be high, as it requires purchasing the sensors, communication devices, and software. This can make it difficult for healthcare providers in low-resource settings to adopt these technologies.
2. Complexity: The systems can be complex and require expertise in setting up, maintaining, and troubleshooting the devices. This can lead to a steep learning curve for healthcare providers, which may limit their adoption and use of the system.



III .DESIGN ISSUES

3.1 System Design

Input Design:

In an information system, input is the raw data that is processed to produce output. During the input design, the developers must consider the input devices such as PC, MICR, OMR, etc.

Therefore, the quality of system input determines the quality of system output. Well-designed input forms and screens have following properties

- It should serve specific purpose effectively such as storing, recording, and retrieving the information.
- It ensures proper completion with accuracy.
- It should be easy to fill and straightforward.
- It should focus on user's attention, consistency, and simplicity.
- All these objectives are obtained using the knowledge of basic design principles regarding

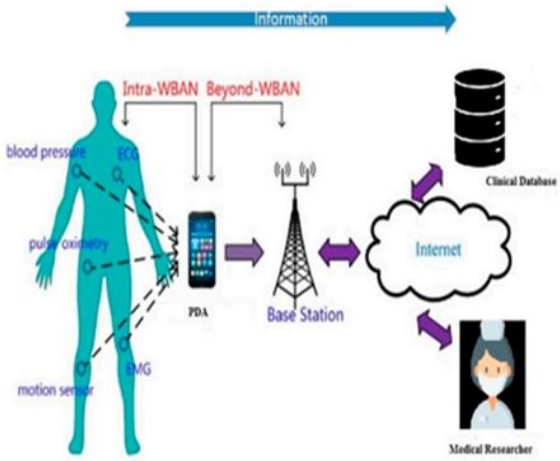
Objectives for Input Design

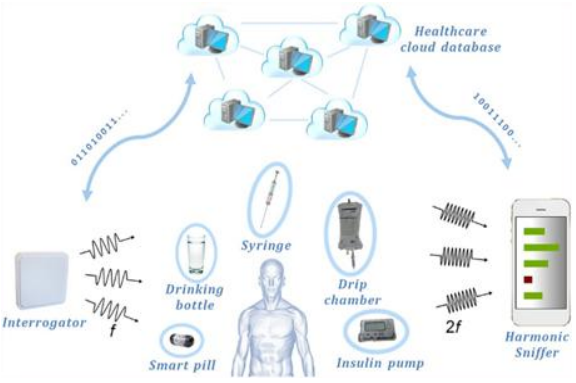
The objectives of input design are

- To design data entry and input procedures
- To reduce input volume
- To design source documents for data capture or devise other data capture methods
- To design input data records, data entry screens, user interface screens, etc.

3.2 Detailed Design of the project

Architecture





3.2.1 Workflow

1. First the sensor sends data to the Raspberry Pi.
2. Raspberry Pi processes the input data and gives a value.
3. The value is displayed on the LCD.
4. If the pressure value is less than the precise then it sends a signal to the buzzer.

5. The processed data is transferred to the cloud using Raspberry Pi because, it is inbuilt with Wi-Fi.
6. The cloud updates the value within no time, so we can monitor it using a web application as well as saline monitoring through the same web application.

IV. IMPLEMENTATION ISSUES

4.1 Introduction

Functional and non-functional requirements:

Requirement's analysis is very critical process that enables the success of a system or software project to be assessed. Requirements are generally split into two types: Functional and non- functional requirements.

Functional Requirements: These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected.

They are basically the requirements stated by the user which one can see directly in the final product, unlike the non-functional requirements.

Examples of functional requirements

1) Authentication of user whenever he/she logs into the system
2) System shutdown in case of a cyber-attack
3) A verification email is sent to user whenever he/she registers for the first time on some software system.

Non-functional requirements: These are basically the quality constraints that the system must satisfy according to the project contract. The priority or extent to which these factors are implemented varies from one project to other. They are also called non-behavioral requirements.

System Specifications

4.2 Requirements

4.2.1 H/W Requirements:

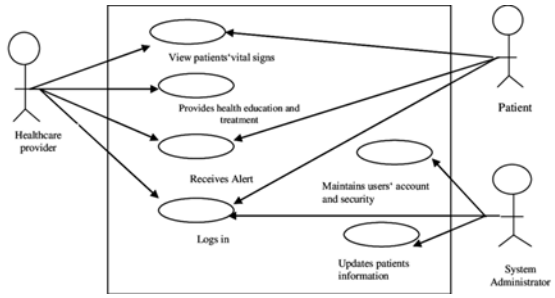
- Processor - I5/Intel Processor
- RAM - 8GB (min)
- Hard Disk - 256 SSD

4.2.2 S/W Requirements:

- Operating System Windows 10
- Server-side Script: Python 3.6
- IDE : PyCharm
- Libraries Used Pandas, NumPy, Scikit-Learn, Seaborn, Matplotlib.

Use Case Diagram

- A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis.
- Its purpose is to present a graphical overview of the functionality provided by a system in
- terms of actors, their goals (represented as use cases), and any dependencies between those use cases.
- The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.



V. CONCLUSION AND FUTURE ENHANCEMENTS

5.1 Conclusion

It. can provide valuable benefits to patients by continuously monitoring their vital signs and alerting healthcare providers if any abnormalities are detected. Such a system can improve patient outcomes by allowing for early intervention and timely treatment. However, it is crucial to ensure that the system is reliable, accurate, and secure. Developing a comprehensive test plan that covers functional testing, performance testing, security testing, and usability testing can help ensure that the system meets the necessary requirements and provides the intended benefits to patients. Overall, an early responsive continuous monitoring system using wireless body

sensor networks has the potential to be a valuable tool in protecting and improving patients' health.

5.2. Future Enhancements

1) Advanced sensor technology:

The continuous advancement in sensor technology can lead to the development of more accurate and reliable sensors.

These sensors can monitor a wider range of vital signs and provide more detailed information about the patient's health.

2) Personalized medicine:

Personalized medicine is an emerging field that aims to tailor medical treatments to an individual's unique genetic, environmental, and lifestyle factors.

3) Big data analytics

The large amounts of data collected by an early responsive continuous monitoring system can be analyzed using big data analytics tools.

These tools can provide insights into population health trends and help identify areas for improvement in healthcare delivery.

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