Life Guardian: Enhancing Health Awareness through Sensor Fusion

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Abstract: This ground-breaking technology provides a health monitoring system that smoothly incorporates temperature, infrared (IR), heart rate, and SpO2 sensors. By combining these sensors, the initiative offers real-time, non-invasive tracking of critical physiological indicators, enabling proactive health management and early detection of possible concerns. With data representing body temperature, blood pressure, cardiovascular activity, and oxygen saturation levels, sensor fusion technology users can comprehensively understand their health. This user-friendly technology gives people the power to decide for themselves what is best for their health. It has the potential to revolutionize telemedicine, remote patient monitoring, and early warning systems in the healthcare industry. This study not only demonstrates the potential of sensor fusion for health monitoring, but it also can revolutionize personal healthcare and promote a society that is more concerned with its overall health. Our application is being developed to be operated by an authority that will have access to all of the data about every individual user's reading. In case of an abnormality, the application will offer an indication in addition to an image of the affected person. To capture visuals of the user in unusual circumstances, we are deploying a pie camera.

1 Introduction

Health covering systems give precious sapience into the condition of a structure, enabling itineraries to form better opinions regarding conservation and help to ensure the safety of a structure's occupants. Unfortunately, two factors have led to the lack of wide relinquishment of health monitoring systems.[1] First, systems are precious to install with costs adding faster than a direct rate as systems grow in size. Second, the benefits presently deduced from a permanently installed structural monitoring system are delicate to quantify in terms of costs saved to structural possessors. easily, if the installation cost of covering systems can be reduced, while system capabilities are expanded to include robust identification of structural damage, perpetration of health covering systems would come wide [2]. Wireless seeing bumps, with their on-board data processing capacities, are also ideal for monitoring operations where data interrogation is performed automatically, therefore barring the demand for a mastermind to examine a prohibitively enormous aggregation of data collected by the seeing network (Strasser and Kiremidjian, 1998). also, wireless seeing networks can be installed fleetly making temporary, exigency deployments of health monitoring systems possible at fairly short notice With these provocations in mind, we explore in this chapter the unique challenges encountered in the practical perpetration of wireless structural health monitoring systems, strategies for prostrating those challenges including tackling considerations and bedded data recycling infrastructures, integration of wireless detectors into larger cyber-environments, and the extension of wireless detectors into operations taking actuation similar as active seeing and feedback structural control. To deal with the abnormalities without obligating physical intervention, we are developing an application that will assist in making it easier to access the dispensary head. Also, the application keeps track of how many individuals are using it, generates think-speak data, and stores user data with each user's picture of the problem [3]. Individuals are using it, generates think-to-speak data, and stores user data with each user's picture of the problem.

2 Block Diagram

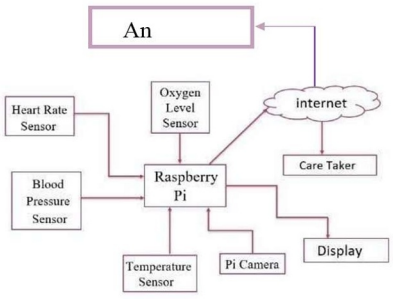

Fig 2.1. A block diagram illustrating the working of Life Guardian: enhancing health awareness through sensor fusion

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The most important part of this project is the monitoring of health conditions with five different parameters at the same time. It also provides safety precautions as well as an indication The block diagram that follows shows the structure or workflow of the application. First to show are the menu and a welcoming note. Secondly, the flow displays the parameters, which include temperature, blood pressure, oxygen saturation, and heart rate. Upon completion of the session and log, the user's readings are shown. The device continues to operate normally and the loop stays continuous as long as the readings are below the threshold level; this operation is known as normal functioning. When the user's health values exceed the preset thresholds, the pie camera will turn on, snapping a picture of the user and sharing the set of data from the cloud to the app with the relevant authorities, which is known as the unexpected state. The sets of overall readings appear in the data history, wherein the app's authority allows for tracking the user from anywhere and also contributes to the avoidance of data loss, thus preserving the users' health condition monitoring

2.1 Components

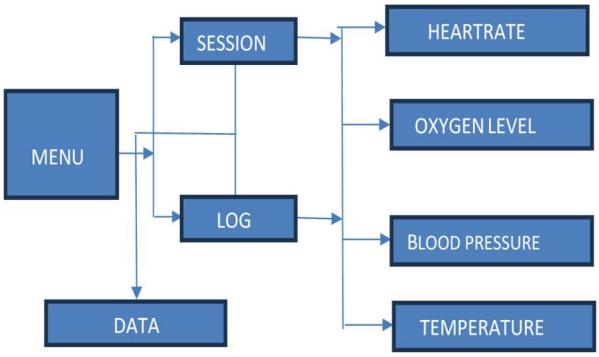

Fig 2.2 Block Diagram for App Development

The components used in this paper are as follows:

2.1.1 Raspberry pi

The Raspberry Pi's hardware has undergone numerous modifications, each with a different type of CPU, memory capacity, networking support, and peripheral device compatibility. This feature made it ideal for the project's execution. Additionally, it accepts a wide range of programming languages, which makes project analysis extremely simple. Furthermore, it has storage facilities where all of the data that the system provides is recorded. The dimensions of a Raspberry Pi 4 are reduced, along with its general-purpose input/output capability and input/output potential. USB storage can also be utilized with it. The Raspberry Pi is also compatible with a wide range of other operating systems. A microcontroller is precisely what it is

2.1.2 MLX90614 SENSOR

Temperature values are detected by the MLX90614 sensor. The MLX90614 is user-friendly and has excellent accuracy. This temperature sensor is contactless. We are using this sensor to take advantage of its value-added features. Its advantages include low cost, high accuracy, and effortless adaptation mechanisms. Blending it is easy [4]. Furthermore, it structures a temperature-sensing element for air conditioning in residences, companies, and enterprises. It gives accurate body temperature estimations.

2.1.3 MAX30100 SENSOR

The MAX30100 sensor integrates blood pressure, heart rate, and pulse oximetry in a single gadget. Internal LEDs, photodetectors, low-noise electronics, and ambient light rejection are all incorporated. With its rapid information outputs, the MAX30100 presents an extensive solution that simplifies the design process for mobile and variable gadgets. With its rapid information outputs, the MAX30100 presents an extensive solution that simplifies the design process for mobile and variable gadgets. We can only measure three parameters simultaneously through the MAX30100, which makes it more efficient with space and less affordable. It is a connected gadget. The way it functions is that the infrared LED light can be used to obtain the heart rate's analog to digital converter value, and an algorithm can then be used to process the corresponding digital and analog values.

2.1.4 PI CAMERA

The Raspberry Pi camera board is a designed add-on module for Raspberry Pi hardware. We are using this to capture the image of the person who gets abnormalities in their parameter and the captured image of the person and the data of the person will be sent to the telegram bot application.

2.1.5 LCD DISPLAY

The abbreviation for liquid crystal display is LCD. This display serves as our means of presenting the user with our work. The display range measures 16 by 4, and it shows the values of all four parameters along with clear information. For example, it displays the temperature, heart rate, blood pressure, and oxygen levels. Because it precisely fits our project, LCDs are far more effective and produce superior output. The key benefits of using this module are its low cost, ease of programming, animations, and unrestricted display of special characters, animation, and custom characters. The LCD and sensor can be interfaced quite simply.

2.1.6 SD CARD

The Raspberry Pi requires an SD card that is preinstalled with a version of the Linux operating system because it has less internal mass storage or an operating system built in. SD cards are necessary for the user's data to be stored, and they also offer photo storage. We are utilizing a 32GB RAM SD card. It stipulates large data storage.

2.1.7 THING SPEAK

Thing Speak, an IoT analytics platform service, enables users to aggregate, analyze, and visualize real-time data streams in the cloud. It offers instantaneous conceptualizations of the data uploaded by devices to Thing Speak, which can be processed and analyzed online using MATLAB or another online form. Things Speak offers real-time analysis of all the parameters, including blood pressure, oxygen saturation, temperature, and heartbeat. Configuring a channel is the initial step of employing Thing Speak; under each channel exist fields that enable you to log multiple kinds of statistics. After that, using the Thing Speak API or HTTP requests, you can send data to your Thing Speak channel in an abundance of ways.

2.1.8 AN APPLICATION

The dispensary head will hold the authority to keep track of this app, and this exposes all user readings. The app evaluates and displays health parameters including blood pressure, heart rate, saturation level of oxygen, and temperature to offer a proactive indication of the user's health. If users are notified of abnormalities, an alert message with an image and readings is forwarded to the authorized authority. We are using the MIT app inventor cloud platform for developing the application. Block-based visual programming languages can be applied to develop Android apps via the assistance of MIT App Inventor, an efficient platform. It empowers beginner and seasoned programmers to create applications for the Android and iOS operating systems, a system that was initially created by Google and is currently operated by the Massachusetts Institute of Technology (MIT). Blocks can be inserted within an app to create the logic behind it with no need for you to compose a single line of code. For those who aren't comfortable with programming, this makes it understandable. These are the fundamental block diagram and app-related images that were created with the help of the MIT-led initiative, as was previously indicated. The app starts with a welcome message that appears for five to eight seconds. Subsequently, the screen will present a four- parameter interface before transitioning to an internal second interface that functions as a log and session. The Log displays the user's past data, while Sessions deals with the user's data as it is currently displayed. The data history will look like the next user interface. This interface will deliver all the information that the user needs. The eventual aim of the project is to use the Pie camera to take a user image and send it to the cloud together with the full set of four readings [5]. The functionality of the pie camera is revealed when the user's readings exceed the threshold values, then the pie camera will switch on and start capturing images of the operator. Readings are then moved to the APP from the cloud. These enable the authorities to become aware of the user's medical condition and make an effort to offer the user medication or counselling. As previously said, this image is delivered to the Telegram bot and the app. The Check Abnormal Condition interface will display the entire workings of the anomaly. We also include the reset option here, which will be used in certain authority viewpoint scenarios. Therefore, the MIT open- source software is used to develop the front end, and JavaScript and the principles of Python are used to build the back end.

2.1.9 TELEGRAM BOT

The device is interfaced with both the application and the Telegram bot, sharing the data regarding abnormal conditions with both. A Telegram bot is also developed in addition to the application. To guarantee the best possible service, a backup plan is provided even though the task is comparable. The authorities will be notified about the user in one of two ways, regardless of the Circumstances.

3 Hardware Implementation

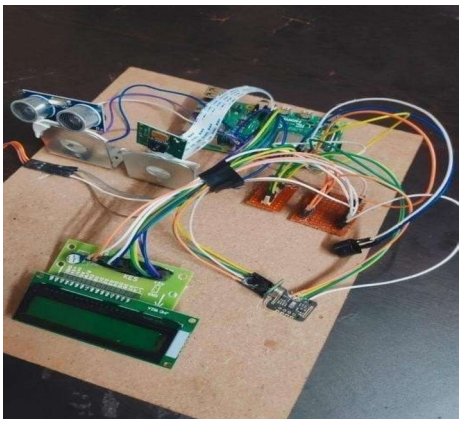

Fig.3.1. Hardware Assemble

The hardware implementation of Life Guardian—improving health awareness through sensor fusion—is addressed in this section. In this case, the Raspberry Pi 4 module, LCD screen, IR sensor, pie camera, MAX30100, and MLX90614 had been employed. A Life Guardian's whole circuit is represented in Figure 2: Improving health awareness via sensor fusion. All of the sensor interfaces are provided by the Raspberry Pi, which also stores the output data. The temperature value is provided by the MAX30100. The oxygen level, blood pressure, and heart rate are all presented by the MLX90614 device. Further, the LCD will display the output values. The system educates the user of a suspicious condition with a buzzer and sends values along with a user photo to the application. Modern

technology is used to protect patient data. Added to that, only a small number of authority members have access to the user's data. A connection is made between the Raspberry Pi's GPIO pins and the internal pins of Vin, SDL, SCM, and GND on the mlx90614 and max30102. Similarly, the Raspberry Pi's terminals on the max30102, which contain pins for Vin, SCL, SDA, and GND, work. By using the formula "(round (objecttemperature,1)) * (9/5)) +32)", the monitoring system's temperature can be expressed in Fahrenheit. The Thing Speak IOT platform also uses these parameters as representations [6]. All of the user's parameters, as well as the duration of their interaction with the device, are recorded and displayed in a numerical and graphical model on the Think Chat platform.

4 Software Implementation

The software solution includes an interface named Show Data History. You can tap or click on the interface to get the total readings of all users who have used the device thus far. The authority can validate the readings of a user in the history

Fig 4.1 App Display with First Interface

The LCD screens and the 19th data readout enable us to observe the images that were previously mentioned.

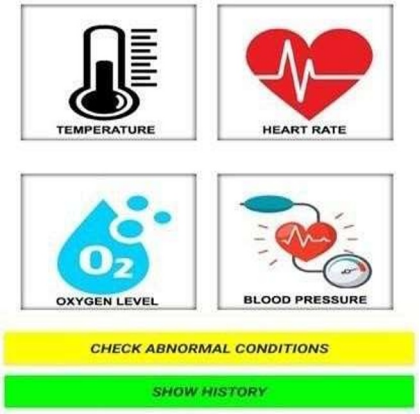

Fig 4.2 Parameter Display on App

5 Output

User ID	Date time	Temp	Pulse	Spo2	Bp
1	1/5/2024, 5:37:03 PM	98	89	98	100/74
2	1/5/2024, 5:38:30 PM	97	75	99	110/73
3	1/5/2024, 5:40:18 PM	97	69	98	113/68
4	1/5/2024, 5:40:50 PM	98	87	98	100/65
5	1/5/2024, 5:41:23 PM	97	69	97	107/69
6	1/5/2024, 6:05:41 PM	97	77	96	117/74
7	1/5/2024, 6:06:18 PM	97	89	96	98/74
8	1/5/2024, 6:07:13 PM	97	71	99	99/72
9	1/5/2024, 6:08:08 PM	97	89	98	120/80

Refresh

Fig 5.1 Initial Activation of Display

Fig 5.2 Parameters Displayed on Screen

Fig 5.3 Output on display

Two forms of the output are provided: one is displayed, and the other is available within the application. Any output that appears on the LCD will additionally show up in the application. However, any abnormalities in the user's conditions will be identified and warned by a buzzer. A picture of the user will also be taken and sent, along with its values, to a nearby caretaker via a telegram bot application. The results of the testing can be viewed remotely by a physician or other medical professional. The data security of the database system is safeguarded by the advanced Encryption Standard (AES). The information is only accessible to those who are authorized to credit to the a secret key generated by this process, which can be used to decrypt patient records the status is shown on the LCD.

6 Results

We can implement an app application and forward the data by using the monitor readings. The device's design enables it to send the usage value to the app application, where the status is shown on the LCD for the following three seconds. The displayed parameter readings are sent to the caregiver's mobile device to generate future health guidance and awareness.

91	3/5/2024, 12:22:53 PM	97	83	97	97/73
92	3/5/2024, 12:24:37 PM	97	69	99	111/65
93	3/5/2024, 1:16:09 PM	97	69	99	102/75
94	3/5/2024, 1:17:11 PM	97	82	99	100/80
95	3/5/2024, 1:18:05 PM	98	83	96	101/83
96	3/5/2024, 1:21:32 PM	97	83	98	102/69
97	3/5/2024, 1:22:56 PM	102	89	96	119/83
98	3/5/2024, 1:25:30 PM	97	84	97	103/81
99	3/5/2024, 2:08:21 PM	97	81	98	116/82
100	3/5/2024, 2:22:12 PM	97	79	96	118/82

Refresh

Fig 6.1 Real-Time Data History

Details on : 03-05-2024 13:23:49 Temp:102 Pulse:89 SPO2:96 BP:119/83

Fig 6.3 Visual data for abnormal condition

The application has been developed to safeguard against privacy issues by limiting access to the app to the caretaker, who is the only individual with authority over it. These enable the data to be encrypted and come with pre-designed pass keys throughout the app. Fig 6.3 and 6.4 show clear visual data for the abnormal condition with readings and pictures captured by the Pi camera.

Fig 6.4. Temperature Sensor in Thing Speak

A Temperature sensor is connected to Thing Speak and can be used to detect and measure Temperature values. This is made feasible by the Stefan-Boltzmann Law, which states that all objects and living things emit infrared radiation (IR) and that the intensity of this radiation is directly correlated with the object's or living thing's temperature Thing Speak temperature monitoring is crucial to assessing environmental factors or body temperature in health-related contexts that might impact well-being [7].

Fig 6.5 Heart Beat value in Thing Speak

Beats per minute (BPM), also known as the standard unit of evaluation for heart rate, is represented by the

heart rate value in Thing Speak. The frequency with which the heart beats and circulates blood throughout the body is reflected in this crucial physiological parameter [8]. A person's heart rate can be tracked and recorded on Thing Speak to get a historical and real-time picture of their cardiovascular activity. Tracking fitness levels, analyzing general health, and spotting potential patterns all depend on this data. The heart rate information shown on Thing Speaks provides important information about a person's cardiac health, whether it is used for medical purposes or for tracking a person's health.

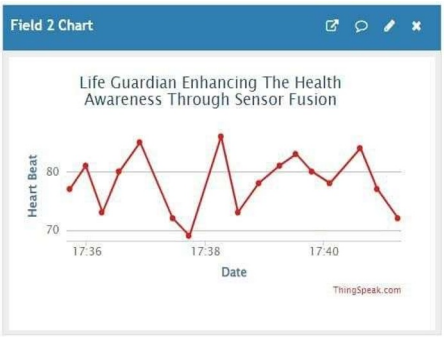

Fig 6.6 Oxygen Level value in Thing Speak

The oxygen saturation data offered by Thing Speak is particularly crucial in healthcare settings because it gives insight into a person's blood oxygen saturation. To spot respiratory problems, ensure an adequate supply of oxygen, and manage general health, it is crucial to monitor and analyze these values. Utilized for both scientific research and personal health monitoring, Thing Speak's oxygen level value is a useful tool for determining the amount of oxygen present in an area.

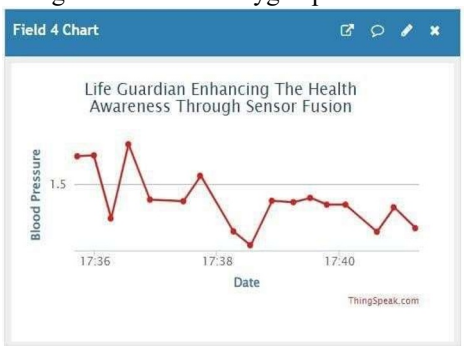

Fig 6.7 Blood Pressure Value in Thing Speak

The blood pressure reading that appears on Thing Speak is a measurement of the blood pressure of an individual, typically given in millimeters of mercury (mmHg). Systolic pressure, or the force the heart generates when pumping blood, and diastolic pressure, or the pressure at which the heart rests in between beats, form blood pressure. Thing Speak blood pressure monitoring offers historical and real- time data, providing insights into cardiovascular health. Assessing the risk of cardiovascular diseases, hypertension, or other related conditions requires the use of this information. The blood pressure reading on Thing Speak is a significant tool for tracking and managing cardiovascular health, whether it is used for medical purposes or personal health monitoring [9].

7 Conclusion

In conclusion, it has been shown that defining a person's health parameters is more efficient and reliable for poor and below-middle-class people in society. The successful implementation of these technologies in this project is not only a more effective way to operate a health device, but it also shows how modern control systems may be included in assistive equipment to improve user quality of life. Finally, the Life Guardian-Enhancing Health Awareness through Sensor Fusion is a remarkable technological application for improving the lifestyle of people with financial issues. Users can simply notify about their health condition through Life Guardian with more accuracy and availability. The application records user data with each user's photo in the problem, generates think-talk data, and maintains track of the number of people using it. In addition, this project has a scope to expand to include security features and meet user needs.

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