Location- Aware Real Time Health Monitoring Using Haversine Distance Approach

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Abstract: This research proposes a Real-Time Health Care Monitoring System that integrates wearable physiological sensors with a Global Positioning System (GPS) to continuously monitor patient health and location. The system collects vital signs including heart rate, body temperature, and blood oxygen levels, transmitting them to a cloud-based server through wireless communication. To assess spatial relationships, the Haversine distance formula is employed to compute the shortest geographical distance between the patient's current location and designated medical facilities or caregivers. This enables rapid identification of proximity to care centers, improving emergency response coordination. A centralized dashboard allows clinicians to observe real-time health metrics and location data, triggering alerts when predefined health thresholds are crossed or when patients are far from necessary medical support. The integrated approach enhances traditional health monitoring by adding geospatial awareness, supporting timely interventions, and offering a scalable solution for remote and mobile healthcare services.

Keywords: Real-time health monitoring, wearable sensors, global positioning system (GPS), Haversine distance calculation, remote patient monitoring

Introduction

Modern medical and healthcare procedures are being transformed by new, highly sophisticated technology. Advanced data connectivity, deep learning, artificial intelligence, cloud computing, big data, and other machine-learning approaches are at the heart of new mobile health systems, or "M-Health." Using modern technologies that enable cellular networks and cloud storage, data is gathered from sensor nodes and transmitted to local databases. The data is gathered through cloud computing services or medical facilities for further processing. Machine learning techniques are also being utilised for accurate illness analysis and categorization. Using a machine learning methodology, this section provides a comprehensive look at the architecture of M-Health systems. For a few crucial minutes of

tracking the location of the ambulance using GPS, this is employed to save human lives. The heart rate, temperature, and other vital signs are also sent to the hospital or doctor through SMS. Doctors can take required action on behalf of patients after an SMS has been received.

An acronym for mobile health, m Health describes the practice of medicine and public health that is aided by mobile technology. This word is often used when referring to mobile communication devices like smart phones, tablets, and personal digital assistants (PDAs) for health services, information, and data gathering. M Health is a sub segment of eHealth, which uses information and communication technology (ICT), such as computers, mobile phones, communications satellite, patient monitors and other devices to provide health services and information to patients and their caregivers. An m Health application may involve the use of mobile devices to gather community and clinical data, to deliver/share healthcare information for practitioners/researchers/patients, to track a person's vital signs in real-time, and to provide direct treatment via mobile telemedicine.

Proposed Monitoring System for Real Time Health Monitoring

The sensors being fixed in the patient's body determines a few significant signs like temperature, blood pressure, and heartbeat rate. Sensors and Bluetooth chip are fixed to the E-health shield linked with Arduino. This chip transmits the information to the patient’s mobile device in which the application exists. This application in the device analyses the information sent by the sensors and identifies the abnormality if any. If abnormality is found, alert message is sent to the patient. In addition, the information related to the nearer healthcare service provider (HSP) is also provided to the patient. Moreover, the application has the ability to track the location of the patient which is informed to the HSP. The message sent to the service provider contains the patient's abnormal information so that the patient's status can be tracked for sending the emergency team to provide treatment for the patient as indicated in figure 1.

The system begins to work and receives the information sent by the sensors. GPS provides the longitude and latitude information about the location of the patient. These information are helpful for the nearest service provider to know the patient’s location so that an ambulance and be sent immediately to help them. This information are displayed and even stored by the application for future use for the patient and physicians at any time from anyplace. When the patient moves, the distance between the patient and every HSP near to the patient is calculated. During emergency, the device delivers the following messages. If

any abnormal conditions exist, alert message along with the location of the nearest service provider is sent to the patient to indicate the situation. This message helps the patient to visit the physician for diagnosis is required. The next message is for the nearest service provider to inform the patient's location and condition. If normal, the device keeps on monitoring and sends no alert message. With the help of the data received from various sensors, when emergency, for various events or actions such as sitting, walking, and running; every cluster possibly predicts these based on the information gathered.

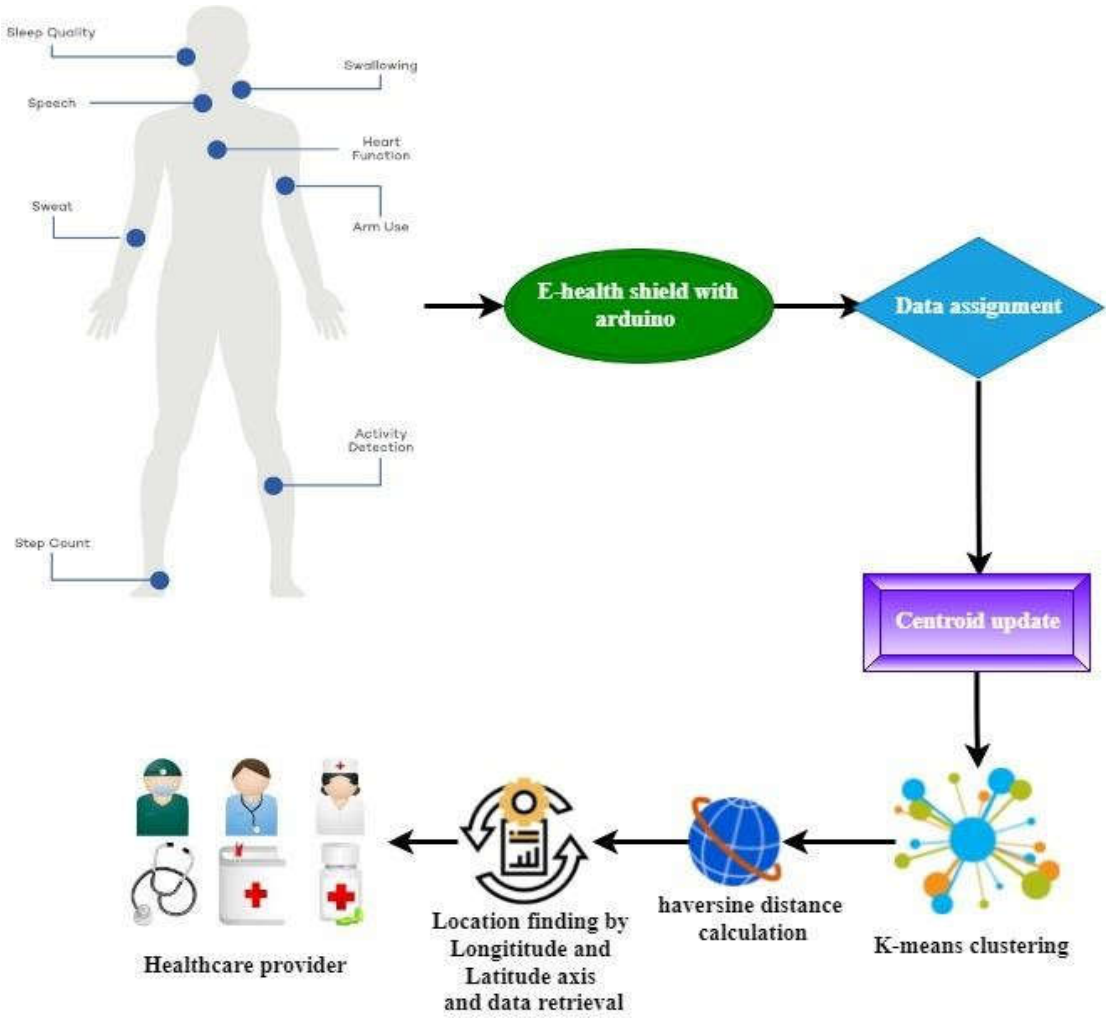

Figure 1: Architecture of Proposed Healthcare Monitoring System

Health Issues Detection System

It is vital to monitor someone with a known medical problem to see if their medicine is working or if it needs to be increased, lessened, or altered. Health status measurements include pathological and clinical measures, which are often observed or assessed by doctors or devices. Blood pressure, temperature, X-rays, and tumors growth are all signs of illness.

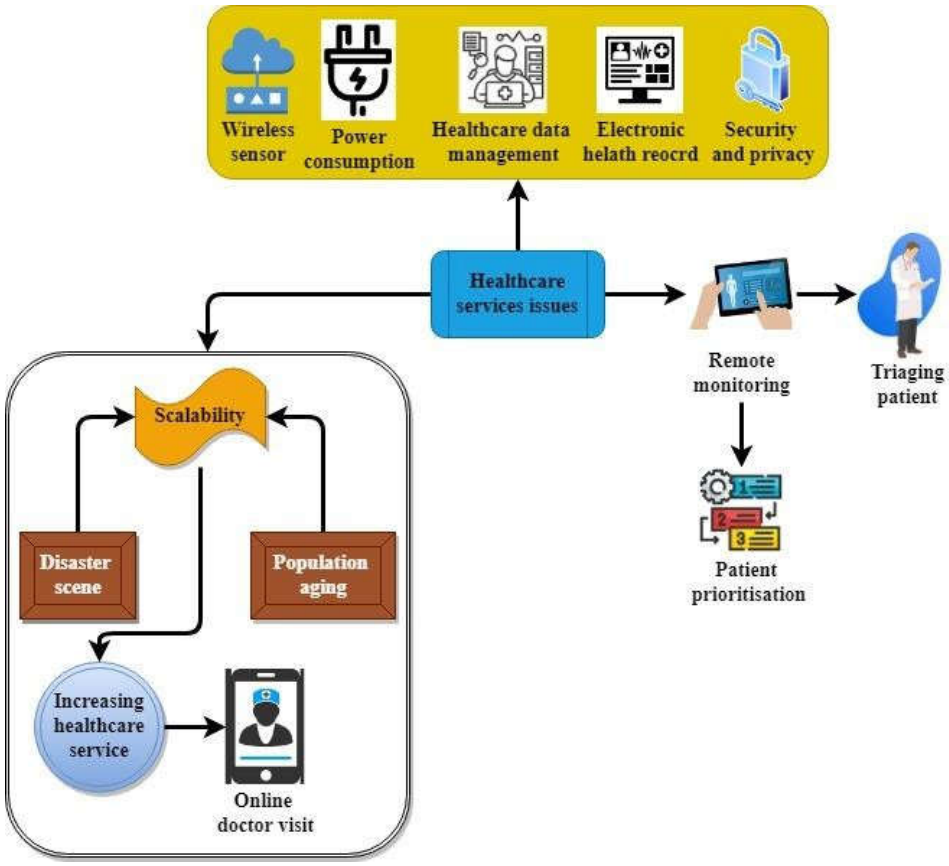

Figure2 Detection of Human Health Issues

Figure 2 denotes to monitor and control a specific occurrence or phenomenon remotely is the fundamental goal of a wireless sensor network (WSN). The most common applications of wireless sensor networks are environmental monitoring and irrigation control. In electrical engineering, power consumption refers to the quantity of electricity needed to run an equipment, such as a refrigerator. There are two popular ways to measure the amount of electricity consumed: watts and kilowatts. Healthcare data management is the practise of storing, protecting, and analysing data obtained from various sources. Managing the massive amount of healthcare data now accessible allows us to gain a more complete picture of our patients, customize treatments, improve communication, and ultimately improve health outcomes. E- health records track a patient's medical information, including all of the demographics, progress notes, concerns, and drugs they've taken under the care of a certain physician.

Results and Discussion

A well-functioning suitable prototype was created using the hardware components like GPS / GPRS / GSM MODULE V3.0, Lily Pad Temperature Sensor, Pulse Sensor and Arduino linked with each other to provide a healthier system. The key component of this model is the data mining module used for diagnosing the disease. After valuable features are extracted from heartbeat and body temperature, approaches based on machine learning like SVM and neural network are used to implement these decision models

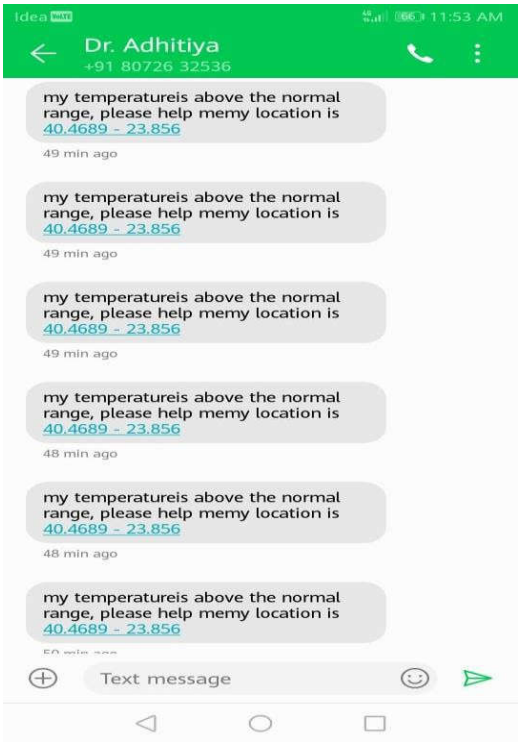

Figure 3 :Message to Nearest Hospital

Table 1 shows the classification accuracy with variable data length when applying machine learning technique.

Table 1Analysis of Classified Accuracy

Transmitted Data Length(B)	Classified Accuracy(%)
0	80
500	93
1000	91
1500	96
2000	98

2500	93
3000	86

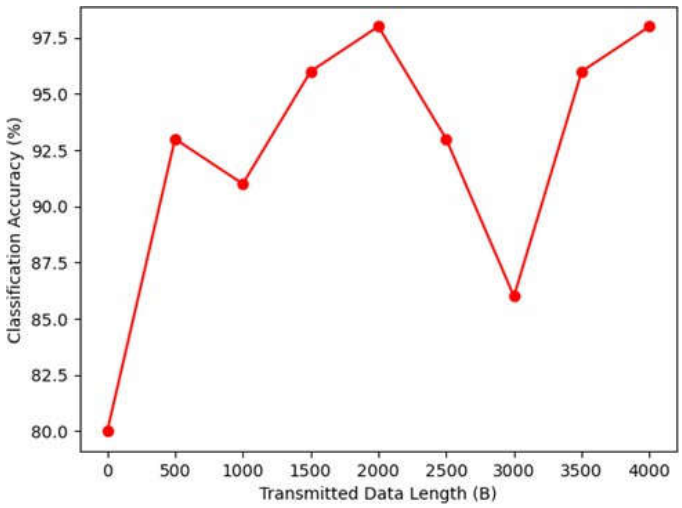

Figure 4 Comparison of Classification Accuracy

Figure 4 shows the classification accuracy when applying machine learning technique, whereas the increased data length does not affect the accuracy. With the range of 4000 bytes, the classification accuracy is 98%. Table 2 Indicate the analysis of time for both mobile health and smart health

Table 2Analysis of Time for M-Health and S-Health

Time (hrs)	m-health	s-health
0	100	100
10	90	90
20	70	69
30	60	55
40	50	48
50	30	28
60	5	3

Figure 5 shows the comparison of time and battery life for both m-health and s- health when applying machine learning technique, whereas the result shows, the battery life is extended for more time.

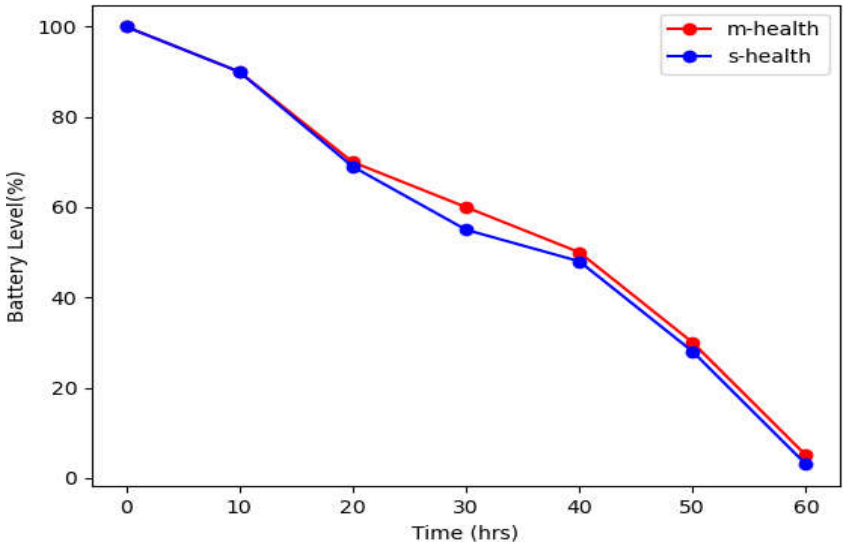

Figure 5 Comparison of Time for M-Health and S-Health

Figure 6 presents the comparison of delay for both m-health and s-health when applying machine learning technique, whereas the result shows, delay is minimized for smart health.

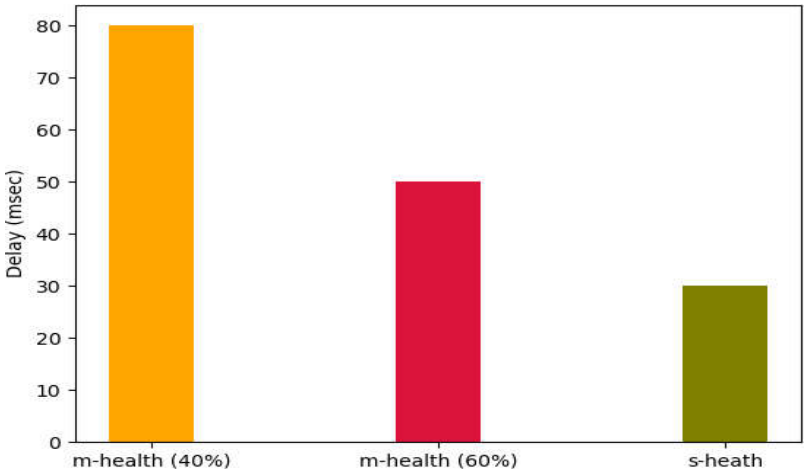

Figure 6 Comparison of Delay

Conclusion

The defined architecture comprises five components: web platform, web server, web service to send location, data base and mobile application. In future, a component can be added which allows healthcare centers to share their experiences so that others can be benefited. Semantic search components will be introduced into the site to allow users to refer to symptoms without understanding medical terminology.

References

[1] P. Verma and S. K. Sood, "Fog Assisted-IoT Enabled Patient Health Monitoring in Smart Homes," *IEEE Internet of Things Journal*, vol. 5, no. 3, pp. 1789–1796, Jun. 2018.

[2] R. K. Pathinarupothi, P. Durga, and E. S. Rangan, "IoT-Based Smart Edge for Global Health: Remote Monitoring with Severity Detection and Alerts Transmission," *IEEE Internet of Things Journal*, vol. 6, no. 2, pp. 2449–2462, Apr. 2019.

[3] "Remote Healthcare Monitoring using Wearable IoT Devices and Cloud Services," in *IEEE Conference Publication*, 2025.

[4] G. Saravanan, R. Punitha Gowri, A. S. V., D. R. S. Dheena, and K. K. M., "Survey on Remote Patient Monitoring System," in *Proc. 9th Int. Conf. Communication and Electronics Systems (ICCES)*, IEEE, 2024, pp. 1–5.

[5] S. Tiwari, N. Jain, N. Devi, and S. Ballari, "IoT Based Effective Wearable Healthcare Monitoring System For Remote Areas," *Proc. 2024 Int. Conf. Intelligent Systems and Advanced Applications (ICISAA)*, IEEE, 2024.

[6] O. O. Ogunduyile, K. Zuva, O. A. Randle, and T. Zuva, "Ubiquitous Healthcare Monitoring System Using Integrated Triaxial Accelerometer, SpO2 and Location Sensors," *arXiv preprint*, 2013.

[7] M. Nnamdi, P. Joboson, C. Bala, and C. D. Bala, "Monitoring Health Using IoT and ThingSpeak," *arXiv preprint*, Jul. 2024.

[8] "Wearable IoT Enabled Real-Time Health Monitoring System," *EURASIP Journal on Wireless Communications and Networking*, vol. 2018, Art. no. 298, Dec. 2018.