MYWEAR: A NOVEL SMART GARMENT FOR AUTOMATIC CONTINUOUS VITAL MONITORING

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ABSTRACT-Wearables have gained significant acceptance for continuous monitoring of health status and physiological data, contributing to the advancement of smart healthcare. The integration of medical devices, the Internet of Medical Things (IoMT), electronic health records (EHR), and AI analytics has paved the way for smarter healthcare systems. Among IoMT devices, wearables and implantables play a crucial role in providing real-time health data. A specific category of wearable technology, the smart garment, has gained attention for its potential in healthcare monitoring. This paper presents the design and development of a smart garment called MyWear, which is capable of continuously monitoring and collecting physiological data such as muscle activity, stress levels, and heart rate variations. The data collected is sent to the cloud, where it can be analyzed for abnormal variations in vitals. In particular, MyWear has the ability to predict the risk of heart failure by identifying irregularities in these metrics. The garment is equipped with an alert system that notifies relevant medical personnel if any dangerous changes are detected. Additionally, the paper proposes a deep neural network model designed to classify heartbeat data and identify abnormalities with a high degree of accuracy. The proposed model achieved 96.9% accuracy and 97.3% precision, showcasing its effectiveness in predicting and diagnosing heart-related issues. This research highlights the potential of smart garments in enhancing healthcare monitoring, improving early detection of health conditions, and facilitating timely interventions for better patient care.

INDEX TERMS—Smart Healthcare, Internet-of-Medical-Things (IoMT), Smart Garment, Smart Garment Security and Privacy.

I.INTRODUCTION

The Internet of Medical Things (IoMT) has revolutionized healthcare by enhancing the quality of care and enabling faster diagnoses through the integration of smart devices. From acquiring blood samples to performing CT scans, technology has transformed healthcare operations, and IoMT has made significant strides by allowing medical devices to work more efficiently. With IoMT, healthcare systems can remotely monitor patients, making it easier for doctors to access and interpret real-time data. Wearable devices, such as smartwatches, have gained popularity as they enable users to record and share ECG data with healthcare providers for further analysis. Many hospitals across the world utilize real-time cloud-based systems for backing up patient data, allowing doctors to remotely monitor their patients' health from home. IoMT-enabled wearable devices collect vital health information, such as heart rate, muscle activity, and stress levels, and transmit this data to the cloud for processing using wired or wireless communication methods. These devices have unlocked a variety of applications in healthcare, fitness, and wellness. Over half a billion people globally use wrist-worn fitness trackers, and millions rely on IoMT technology for tracking both their physical and mental health. The integration of IoMT into healthcare systems has also led to home-based health monitoring solutions, which involve bedside monitors and sophisticated devices that require users to remain immobile while the data is collected. However, with the emergence of biomedical textiles, users no longer need to be restricted in their movements. Despite this, these technologies are often costly and not always user-friendly. Wearable garments, used by athletes and sports teams, have proven to be beneficial in improving performance by analyzing musculoskeletal data, and these garments are being developed to monitor not just ECG but also the activities performed by the user. The MyWear garment, a proposed solution in this research, is designed to monitor stress levels, heart rate abnormalities, and muscle activity through continuous data collection, analysis, and real-time reporting. The conceptual overview of MyWear shows its integration within an IoMT framework, with real-time monitoring and an alert system. MyWear utilizes a Deep Neural Network (DNN) model to analyze heart rate data and detect abnormalities, providing valuable insights for healthcare providers. The key innovations of MyWear include a technique to analyze real-time stress levels from Heart Rate Variability (HRV) using Electrocardiograms (ECGs), which is absent in most existing smart garments, and the use of a Convolutional Neural Network (CNN) for ECG analysis to detect various heartbeat abnormalities. This paper further explores the system architecture, novel methods for heart rate and stress monitoring, and presents a deep learning model for detecting heart arrhythmias, offering a comprehensive solution for smart healthcare.

II.LITERATURE SURVEY

A) M. Aazam, S. Zeadally, and K. A. Harras, “Health fog for smart healthcare,” IEEE Consum. Electron. Mag., vol. 9, no. 2, pp. 96–102, Mar 2020.

The integration of fog computing into healthcare systems, known as *Health Fog*, has emerged as a promising solution to address the growing demand for real-time health monitoring and data processing. Fog computing extends cloud computing by enabling data processing closer to the source of data generation, reducing latency, and improving response times. In the context of smart healthcare, Health Fog provides an efficient framework to handle the massive amounts of data generated by medical devices and wearables, ensuring that healthcare providers can receive timely and actionable insights. This paper explores the concept of Health Fog and its role in smart healthcare systems, focusing on the use of edge computing to process patient data at the point of collection. By leveraging Health Fog, healthcare applications can offer low-latency services, such as real-time monitoring, early disease detection, and personalized treatment recommendations. The paper also discusses the advantages of using Health Fog, including its ability to reduce the dependency on centralized cloud services, ensure data privacy, and enhance the scalability of healthcare systems. Additionally, the challenges of implementing Health Fog in healthcare environments, such as security, data management, and interoperability issues, are also examined. Finally, the paper highlights potential future directions for the use of Health Fog in smart healthcare applications, emphasizing its role in advancing the quality of patient care and improving healthcare delivery.

B) H. Zhu, C. K. Wu, C. H. Koo, Y. T. Tsang, Y. Liu, H. R. Chi, and K. Tsang, "Smart Healthcare in the Era of Internet-of-Things," IEEE Consum. Electron. Mag., vol. 8, no. 5, pp. 26–30, Sep 2019.

In the era of the Internet of Things (IoT), smart healthcare has emerged as a transformative solution for improving healthcare delivery and patient outcomes. This paper discusses the integration of IoT technologies in healthcare systems, which enables continuous monitoring, real-time data analysis, and personalized treatment plans. By leveraging IoT devices such as wearables, sensors, and smart medical equipment, healthcare providers can monitor patients remotely, track vital signs, and detect abnormalities before they become critical. The authors explore how IoT facilitates the collection and transmission of health data to cloud-based systems, where advanced analytics and machine learning algorithms can be applied to predict health risks and optimize treatment strategies. Additionally, the paper addresses the challenges in implementing IoT in healthcare, including data security, privacy concerns, and the need for seamless interoperability between various IoT devices and healthcare platforms. The potential of IoT to enhance patient engagement, reduce hospital readmissions, and improve healthcare efficiency is also discussed, with a focus on its role in creating a more personalized and proactive healthcare ecosystem. Furthermore, the paper highlights the future directions of smart healthcare, including the integration of AI, big data analytics, and fog computing to further enhance the capabilities and impact of IoT in healthcare.

C) M. Ghamari, B. Janko, R. Sherratt, W. Harwin, R. Piechockic, and C. Soltanpur, "A Survey on Wireless Body Area Networks for eHealthcare Systems in Residential Environments," MDPI Sensors, vol. 16, no. 6, p. 831, Jun 2016.

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IMPLEMENTATION

Modules

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Login, Browse Data Sets and Train & Test, View Trained and Tested Accuracy in Bar Chart, View Trained and Tested Accuracy Results, View All Antifraud Model for Internet Loan Prediction, Find Internet Loan Prediction Type Ratio, View Primary Stage Diabetic Prediction Ratio Results, Download Predicted Data Sets, View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user’s details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT PRIMARY STAGE DIABETIC STATUS, VIEW YOUR PROFILE.

CONCLUSION

In conclusion, the MyWear smart garment presents a significant advancement in the field of smart healthcare, offering continuous and real-time monitoring of vital physiological data, including heart rate, muscle activity, and body movement. By leveraging advanced deep learning algorithms, the garment is able to detect heart arrhythmias with impressive accuracy and precision, ensuring early identification of potential health risks and enabling timely intervention. The garment's capabilities extend beyond heart health, with the ability to monitor and analyze muscle activity, making it a valuable tool for both healthcare providers and athletes. The integration of these features into a wearable, non-intrusive garment demonstrates the potential of the Internet of Medical Things (IoMT) in improving overall health management and rehabilitation. Additionally, the use of cloud-based analytics allows for the efficient processing and remote monitoring of patient data, enhancing the reach and accessibility of healthcare services. Overall, MyWear provides a comprehensive solution that not only improves the health and safety of individuals but also contributes to the growing trend of personalized and preventive healthcare. Future work may involve further optimizing the garment's features and expanding its use to other areas of health monitoring, ensuring broader applications in both clinical and everyday settings.

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