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Development of Explainable AI Models for Healthcare Applications

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Abstract

IoT networks are used in SHM systems, and they generate enormous amounts of data every second that must be handled. Exercise and room temperature are examples of wearable, wireless, and ambient IoT sensors. Therefore, the massive volume of data needs significant processing skills. To collect, handle, and evaluate the intricate big data produced by these devices, a business intelligence and analytics platform has been required. Unconventional deep learning techniques have gained popularity for assessing and diagnosing the massive amounts of medical data we deal with. To facilitate patient monitoring, a Smart Health Management (SHM) system often incorporates Wireless Sensor Networks (WSN), Wireless Body Area Networks (WBAN), and the Internet of Things (IoT). It also introduces additional technologies like artificial intelligence (AI) and machine learning (ML) to help with the diagnosis, identification, and prediction of medical diseases. Additionally, as data volume, speed, and variety continue to rise, technologies like cloud computing and edge/fog computing become essential. The literature contains a number of surveys that examine SHM. These review and survey studies' main goal is to analyse the systems in certain situations, examining elements such as architecture, applications, diseases, issues, difficulties, and new trends.

Keywords: Deep Learning, Underwater Fish Species, Aquatic Animals.

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Introduction

Because of contemporary medical services, life expectancy has considerably grown during the past few decades. However, support and ongoing monitoring are frequently required for the healthcare domain's stakeholders, including patients, physicians, clinicians, caregivers, and equipment. In these circumstances, an autonomous supporting system might be helpful. Every industry, including healthcare, might undergo a change thanks to computing and machine learning (ML). Exciting developments in cloud computing, analytics, ubiquitous computing, and the Internet of Things could make the deployment of Smart-Health Knowledge Systems a reality (Wani et al., 2024). Through the creation of new connections between an individual's body, their natural environment, and the internet, these cutting-edge technologies aim to generate and oversee "participatory" medical information. Smart Healthcare Monitoring (SHM) systems specifically aim to support various groups, including individuals with disabilities, those dealing with chronic illnesses, elderly patients, newborns, and those recovering from surgery. All of these individuals have illnesses that require real-time, remote monitoring using SHM equipment. The SHM has been made possible by a number of instruments that allow for continuous monitoring of health indicators and values, automatic therapy management, real-time information tracking, and patient self-management. The integration of computer networks, medical devices, and healthcare applications is now known as the Internet of Medical Things (IoMT). Despite this, the SHM systems utilize state-of-the-art medical software and equipment, networking, and technology. SHM systems provide a promising solution to many of the issues by utilizing a range of technologies to connect patients and their care delivery environment. (Sindiramutty et al., 2024). Use our AI material Detector to find AI-generated material and turn it into something more relatable. Simply paste your words, and you'll quickly get precise, lifelike results. The text we are examining is as follows: We are discussing technologies such as wireless body area networks (WBAN), edge computing, mobile communication, ubiquitous computing, and the Internet of Things. Furthermore, other fields—like Big Data, cloud computing, ubiquitous computing, and M-Health—are also very significant to this topic in the modern world. In addition, we cannot ignore the fascinating opportunities that AI and machine learning present for the medical field. In many cases, artificial intelligence (AI) can carry out healthcare activities as well as or even better than humans.

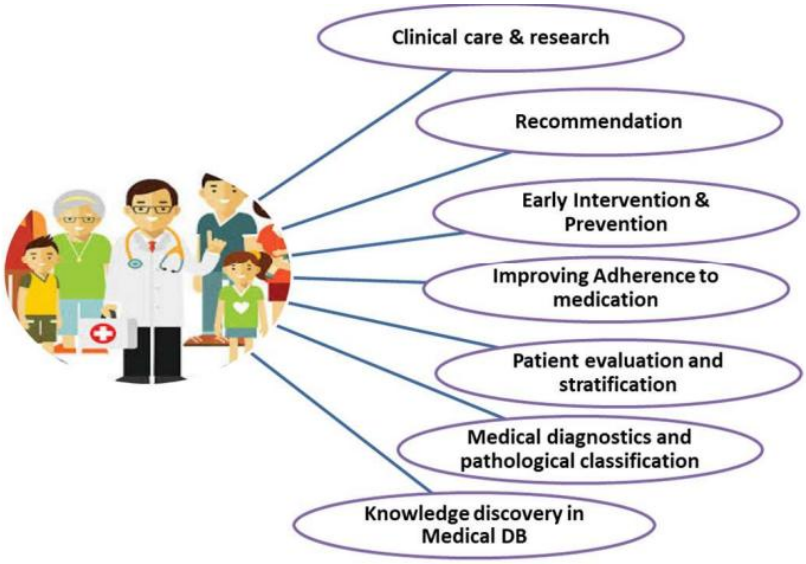


Fig. 1: Healthcare Informatics Use-Cases

Problem Statement

The SHM has significantly changed the way that healthcare is envisioned. Real-time data collection is possible via the wearable, embedded, and pervasive IoT sensors, including patient situations like mobility. A subfield of artificial intelligence called machine learning (ML) uses scientific and mathematical methods to learn from data and extract new insights, which increases the intelligence of healthcare applications (Yang, 2022). Cognitive science brings together various scientific fields, leveraging AI, machine learning, and a range of mathematical techniques to deepen our understanding and uncover fresh insights. It's playing a crucial role in enhancing the intelligence of applications. Cognitive technologies are essentially computer advancements that mimic certain elements of human

decision-making on a larger scale. These days, cloud computing is necessary to handle the enormous volumes of data involved and to enable the widely used Internet of Things (IoT) in healthcare. But more reliable designs are needed for vital healthcare systems that demand greater precision, accessibility, and real-time responses. Fog computing (FC) and edge intelligence are two examples of advanced cloud concepts that have lately gained popularity.

WSN, WBAN, and IoT technologies often come together in a Smart Health Monitoring (SHM) system to facilitate patient monitoring. It also incorporates other cutting-edge technologies like artificial intelligence (AI) and machine learning to aid in the diagnosis, identification, and prediction of medical disorders. As the pace, variety, and volume of data continue to rise, tools like cloud computing and edge/fog computing are becoming more and more crucial (Sadeghi et al., 2024). The literature contains a large number of surveys on SHM. These review and survey studies' primary goal is to investigate the systems in a particular setting, encompassing topics such as architecture, applications, illnesses, difficulties, and new trends.

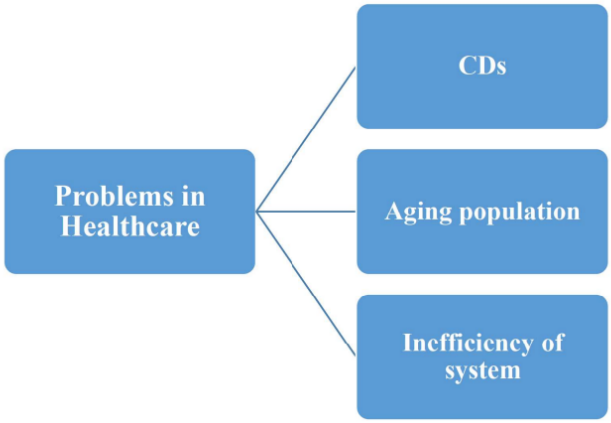


Fig. 2: Problems in Health Care

Materials and Methods

Use our AI material Detector to find AI-generated material and turn it into something more relatable. Simply paste your text, and you'll quickly get relatable, accurate results. The text we are examining is as follows: The Internet of Things (IoT), cloud computing, fog computing, and telehealth technologies are all essential components of what is known as healthcare 4.0. Recently, several innovative healthcare architectures have emerged, designed for precise screening of symptoms like fever, cough, body aches, and even monitoring social distancing (Srinivasu et al., 2022). We can now do contemporary statistical analyses, monitor patient health in real-time, and provide efficient diagnoses and treatments because of developments in machine learning, deep learning, and big data analytics. This study aims to identify the challenges within the Healthcare 4.0 landscape and explore the real-time Smart Healthcare Monitoring (SHM) framework. The ultimate goal is to offer patients timely diagnostic support, treatment options, and strategies for disease detection and prevention. Accurately predicting a patient's health status has always been a complex task, and diagnosing diseases or assessing their severity often requires a series of intricate tests. In the SHM framework for Remote Patient Monitoring (RPM), the study has first examined advancements in AI and ubiquitous computing. IoT, mobile technologies, cloud computing, analytics, machine learning, and cognitive computing power these frameworks. Then, a clever framework for the efficient and automated prediction of renal illness was put out. Additionally, the architecture makes use of innovative and effective feature selection (Loh et al., 2022). Subsequently, an Edge Based Framework (SEHM) was developed to use medical and AAL tools to monitor patients with chronic diseases like diabetes and blood pressure disorders in real time. The architecture that loads the cloud-based learner on the local system has been improved with the deployment of Deep-Chaotic Whale O (CWO) on Local System. Additionally, a thorough SPMR framework has been put forth to remotely monitor BP problem patients. Here, the innovative Categorical Cross E optimization is applied in conjunction with deep learning technology to effectively predict disease in SPMR. Findings: Research on different cognitive strategies for sophisticated health care frameworks has resulted from this study. The DL method converges efficiently using both CCE and CWO. We have shown that, with the help of DL libraries like scikit-learn, Tensorflow, and Keras, cognitive approaches like Deep Neural Networks can be quickly and easily implemented on local systems to

improve the performance of infrastructure connected to health. The models have been evaluated using a variety of performance metrics in order to best validate them.

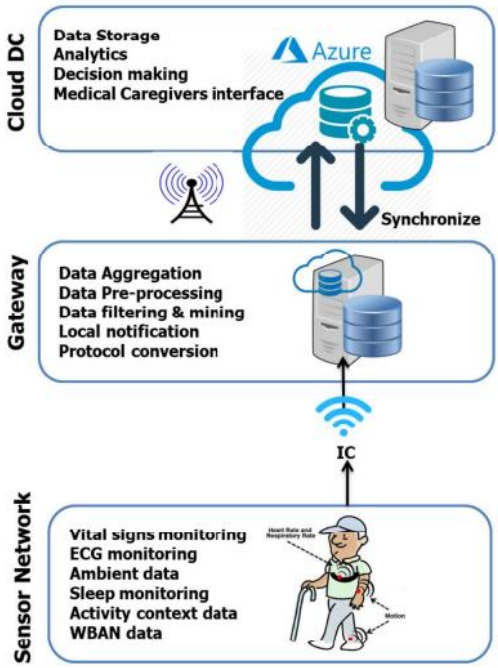


Fig. 3: Illustration of Smart Healthcare Monitoring Framework

Experimental Result

We believe that effectively and thoughtfully using machine learning in structural health monitoring will lay the groundwork for advancements in remote patient monitoring and healthcare. Advanced algorithms for data analysis in structural health monitoring are completely feasible and can enhance recommendations that help avoid or lower the risk of complications and allow for the early detection of major problems associated with chronic and other diseases (Chaddad et al., 2023). Through analytics, knowledge-driven learning, and logical analysis, this research seeks to design and create machine learning and deep learning-based healthcare systems that bridge the gap between data and knowledge.

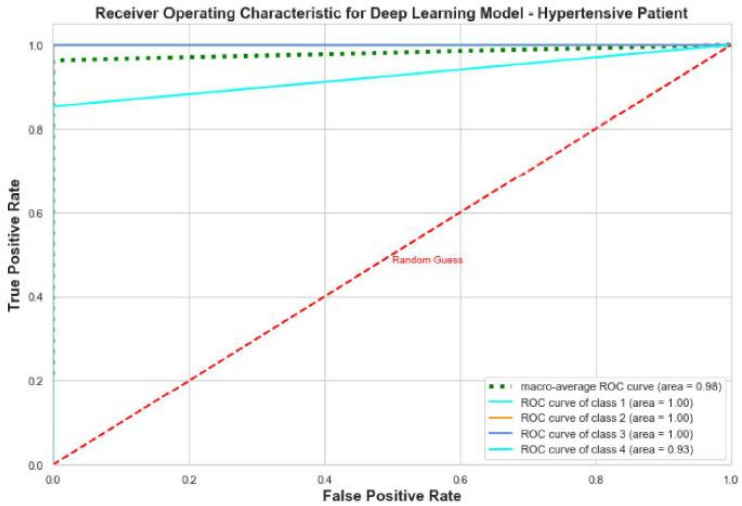


Fig. 4: ROC Curve

We believe that effectively and thoughtfully using machine learning in structural health monitoring will lay the groundwork for advancements in remote patient monitoring and healthcare. Using sophisticated algorithms for data analysis in structural health monitoring is completely feasible. This can enhance recommendations that help prevent or lower the risk of complications and allow for the early detection of major problems associated with chronic and other diseases. Through analytics, knowledge-driven learning, and logical analysis, this research seeks to design and create machine learning and deep learning-based healthcare systems that bridge the gap between data and knowledge (Saraswat et al., 2022).

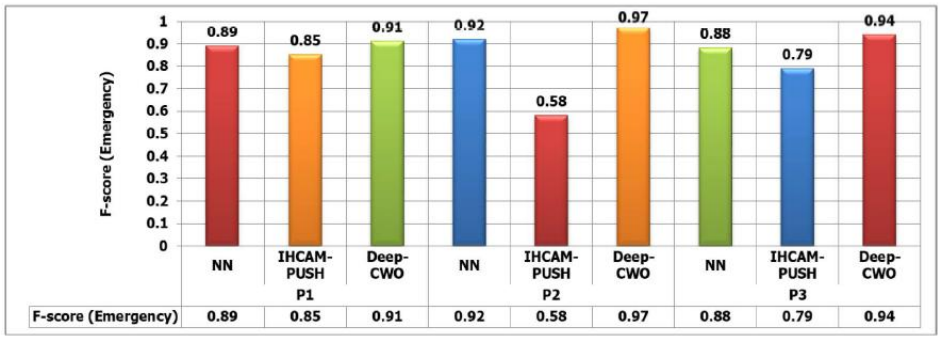


Fig. 5: F Score Measurement for Different Patient

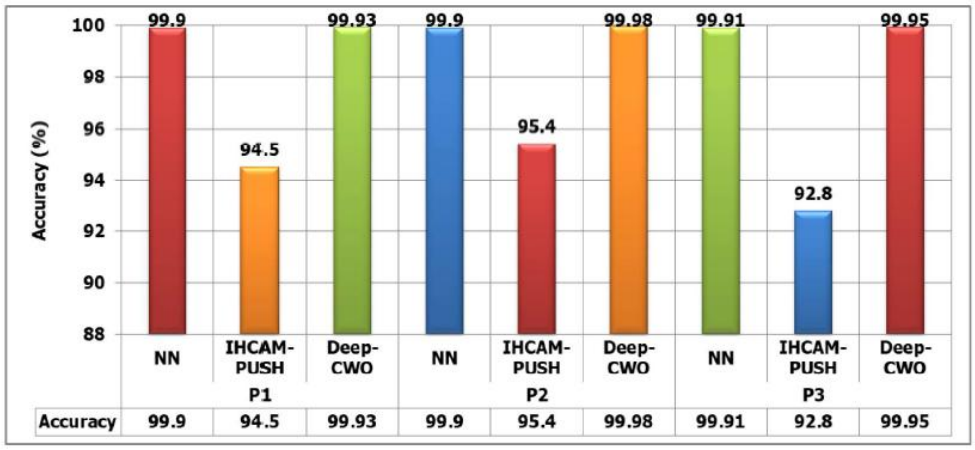


Fig. 6: Accuracy Monitoring for Different Patients

This work plays a key role in the exciting shift towards smarter, IoT-driven medical innovations that aim to prevent chronic diseases on a global scale. The goal here is to develop a cognitive science-based understanding of "Knowledge Systems for Healthcare Applications." This comprehensive review not only seeks to speed up innovation for doctors, patients, and hospitals eager to harness analytics within Smart Health Management frameworks, but it also aims to set a new standard for healthcare IoT. To make this evolution happen—especially in the realm of smart e-health—we need fresh technologies, innovative system architectures, and new computing paradigms.

Conclusion

AI systems can be implemented in SHM platforms to offer patients real-time clinical support, disease detection and prevention, and treatment. They can also be used with advantage in new platforms like healthcare 2.0 and Industry 4.0. The collaboration between the fog layer and clouds might be essential for these structures. To enhance remote communication, smart hospitals and homes can benefit from the installation of intelligent edge nodes. In the realm of healthcare 4.0, technologies like CC, FC, IoT, and telehealth care play a crucial role. These days, mobility is essential, and connectivity is pervasive as wearable and mobile devices grow in popularity, safety, and prevalence among employees and patients, creating new opportunities for user empowerment and engagement. Despite this, the publications examined focus on wellness, healthcare for the elderly, and patients with CDs.

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