

A Survey on Transforming Healthcare with IoMT : The Power of Connected Medical Devices

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ABSTRACT

This thorough analysis examines current developments in medical technology, with an emphasis on the Internet of Medical Things (IoMT) and its uses. It covers IoMT's contribution in creating wearable internet monitors for dispersed monitoring systems, addressing pregnancy-related issues, and is divided into four subject groups. Along with blockchain adaption, it also highlights privacy and dependability in IoMT-based health monitoring systems. The paper also emphasizes the contributions of IoMT to healthcare diagnosis and monitoring, including machine learning and edge-AI-based cardiovascular health monitoring and fall prediction. It also covers data science and healthcare informatics techniques, such as using lightweight cryptography to ensure real-time security in remote patient monitoring and identifying unusual user behavior. IoMT has the potential to transform patient care, diagnostics, and data-driven decision-making across a range of healthcare areas, as the paper highlights overall.

Keywords : Medical Technology, Internet of Medical Things (IoMT), Wearable Devices, Remote Monitoring, Healthcare Diagnosis, Data Science, Distributed Monitoring, Pregnancy, Reliability, Privacy, Blockchain, Healthcare Monitoring, Fall Prediction, Cardiovascular Health, Machine Learning, Edge-AI, Healthcare Informatics, Anomaly Detection, Security, Cryptography, Patient Care.

I. INTRODUCTION

Motivation:

A new era of innovation in healthcare has been brought about by the convergence of technology and the Internet of Medical Things (IoMT). This compilation of fifteen papers offers a thorough examination of IoMT technology and its wide range of

applications in healthcare. These articles highlight the transformational potential of IoMT, from wearable biomedical equipment designed specifically for expectant mothers to remote monitoring systems guaranteeing dependability and security. Furthermore, the significant influence that IoMT is having on patient care and results is highlighted by insights into healthcare monitoring, diagnosis, data science, and

informatics. When taken as a whole, these pieces provide an engaging look at how IoMT is changing the face of healthcare today, including enhanced delivery, tailored interventions, and data-driven insights for better patient outcomes.

Problem Statement:

Making the most of the Internet of Medical Things (IoMT) is essential in the ever-changing field of medical technology, especially in the areas of wearables, data science, remote monitoring systems, and healthcare diagnostics. Wearables and IoMT integration have the potential to revolutionize healthcare, especially space-distributed monitoring for expectant mothers. Optimizing data science for healthcare informatics continues to present problems, including security, privacy, and dependability issues. This paper suggests generative design approach for Internet of Medical Things wearables, blockchain-based secure remote monitoring, cloud-based IoMT diagnostic systems, and anomaly detection in remote patient monitoring. By addressing these issues, medical technology can advance and improve patient care and outcomes in a variety of healthcare settings.

Objectives:

The goals of the paragraph with 15 citations in the article are to summarize the contributions, methods, and results from different articles. These include examining the use of wearables based on the Internet of Medical Things, researching the dependability of remote monitoring systems, evaluating notification management in medical monitoring, and investigating the potential applications of blockchain technology in patient care. They also intend to look at blood pressure therapies through mHealth, fall detection devices, and healthcare monitoring for the diagnosis of heart disease. The goals also include comparisons between theme groups, security in IoT systems, and anomaly detection in patient monitoring. In the end, they aim to talk about the consequences for upcoming studies and real-world healthcare technology applications.

II. BACKGROUND AND CONTEXT

All together, these publications provide a thorough examination of state-of-the-art developments in data science, medical technology, and healthcare monitoring. They address a wide range of subjects, such as the use of blockchain technology to remote patient monitoring systems and the use of Internet of Medical Things (IoMT) technology for wearable monitors for expectant mothers in space. The articles explore important topics such wearable biomedical device design processes, how IoT technology is integrated into medical devices within the IoMT framework, and how reliable remote online monitoring systems are. Furthermore, they cover particular applications including automated fall detection in smart homes, remote patient monitoring for pandemic control, and lifestyle modifications for blood pressure control utilizing machine learning and IoMT devices. The significance of data security and privacy in these systems is further highlighted by the investigation of anomaly detection in remote patient monitoring and the application of lightweight cryptography for safe healthcare monitoring. All things considered, these publications work together to advance healthcare technology that might have a big influence on patient care and healthcare delivery globally.

control, and lifestyle modifications for blood pressure control utilizing machine learning and IoMT devices. The significance of data security and privacy in these systems is further highlighted by the investigation of anomaly detection in remote patient monitoring and the application of lightweight cryptography for safe healthcare monitoring. All things considered, these publications work together to advance healthcare technology that might have a big influence on patient care and healthcare delivery globally.

III.FOCUS AND SCOPE

The healthcare industry has been profoundly impacted by the spread of Internet of Medical Things (IoMT) technology, especially in the area of wearable biomedical equipment. Articles like "A Wearable System Implementation for the Internet of Medical Things (IoMT)" and "Generative Design Methodology for Internet of Medical Things (IoMT)-based Wearable Biomedical Devices" highlight the creative advancements in this field. Furthermore, as mentioned in "Ensuring the reliability of remote online monitoring systems," the convergence of IoMT and remote monitoring systems has resulted in breakthroughs in reliability assurance." This integration is further emphasized in papers like "Managing Notifications and Alerts Generated by an IoMT-based Health Monitoring System for Older People" and "Heart Lung Health Monitor: Remote At-Home Patient Surveillance for Pandemic Management," which elucidate the critical role of IoMT in enhancing healthcare accessibility and management, especially during crises." Papers like "Managing Notifications and Alerts Generated by an IoMT-based Health Monitoring System for Older People" and "Heart Lung Health Monitor: Remote At-Home Patient Surveillance for Pandemic Management," which clarify the crucial role of IoMT in improving healthcare accessibility and management, particularly during crises, further emphasize this integration. Titles such as "A Healthcare Monitoring System for the Diagnosis of Heart Disease in the IoMT Cloud Environment Using MSSO-ANFIS" and "Good-Eye: A Device for Automatic Prediction and Detection of Elderly Falls in Smart Homes" further demonstrate the convergence of IoMT with healthcare monitoring and diagnosis. These publications highlight how IoMT can support individualized diagnosis and proactive healthcare measures. Furthermore, papers like "Detecting Anomalous User Behavior in Remote

Patient Monitoring" and "Real-Time Distant Healthcare Monitoring IoT System Secured by Lightweight Cryptography," which clarify the critical role of data analytics and cybersecurity in IoMT-driven healthcare systems, demonstrate the synergy between IoMT and data science. All things considered, these articles demonstrate how IoMT is revolutionizing several healthcare fields and ushering in a new era of patient-centered, data-driven healthcare.

IV.METHODOLOGY

This article's methodology synthesizes information from a wide range of sources, including wearable technology, remote monitoring systems, data science, healthcare diagnostics, and the Internet of Medical Things (IoMT). The study integrates insights from papers investigating the role of IoMT technology in wearable online monitors for space distributed monitoring systems for pregnant women, generative design methodologies for IoMT-based wearable biomedical devices, and the implementation of wearable systems within IoMT frameworks through a systematic review and analysis of pertinent literature. It also draws from studies on the dependability of remote monitoring systems, how to handle notifications and alarms in IoMT-based health monitoring for the elderly, and how to use blockchain to provide safe remote patient monitoring. The study also includes research on healthcare monitoring and diagnosis, such as IoMT cloud-based healthcare monitoring systems for diagnosing heart disease, mHealth interventions for improving blood pressure, and devices for automatically predicting and detecting senior fall incidents. In conclusion, it includes data science and healthcare informatics research, including real-time remote healthcare monitoring IoT systems protected by lightweight encryption and the identification of unusual user behavior in remote patient monitoring. The article offers a comprehensive knowledge of the changing medical technology landscape by emphasizing significant accomplishments

and difficulties in a variety of disciplines through the use of this thorough methodology.

V. LITERATURE REVIEW

1) Internet of Medical Things (IoMT) and Wearable Biomedical Devices:

“IoMT Technology as the Basis of Wearable Online Monitors for Space Distributed Monitoring Systems for Pregnant Women”

Z. Yuldashev, A. Sergeev, and N. Nastueva's paper, "Space Distributed Monitoring Systems for Pregnant Women," was given at the 2021 Wave Electronics and its Application in Information and Telecommunication Systems (WECONF) conference in St. Petersburg, Russia. This research explores how Internet of Medical Things (IoMT) technology may be used to create wearable internet monitors specifically designed to track pregnant women in space. It highlights the convergence of medical technology, space science, and maternal healthcare as it talks about integrating IoMT into space dispersed monitoring systems. Its contents will probably cover topics including sensor technology, data transmission, space environment-specific difficulties, and pregnant women's healthcare concerns. [1].

“Generative Design Methodology for Internet of Medical Things (IoMT)-based Wearable Biomedical Devices”

Presenting at the 2021 3rd International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA) in Ankara, Turkey, the paper "Generative Design Methodology for Internet of Medical Things (IoMT)-based Wearable Biomedical Devices" by C. Dilibal, B. L. Davis, and C. Chakraborty examines the use of generative design principles in the creation of wearable biomedical devices within the IoMT framework. It outlines methodological techniques for creating wearable healthcare devices and explains how IoMT technology may be integrated

into them for monitoring and management. It is probable that the article contains case examples that illustrate how well the suggested technique works. This effort uses wearable technology to leverage generative design methodologies to promote breakthrough healthcare solutions.[2].

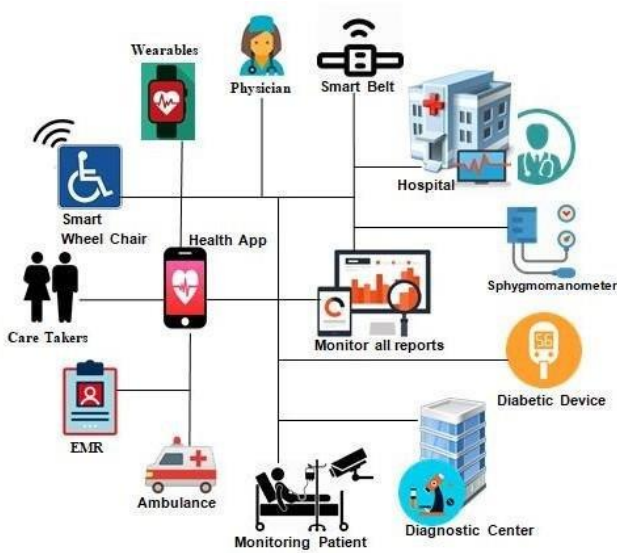
"A Wearable System Implementation for the Internet of Medical Things (IoMT)"

The use of wearable technology in the context of the Internet of Medical Things (IoMT) is examined in the paper "A Wearable System Implementation for the Internet of Medical Things (IoMT)" by R. B. Arslan and Ç. Candan, which was presented at the 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) in Glasgow, Scotland in 2022. It probably covers a wide range of topics, including wearable device design and development, IoMT architecture, system implementation approaches, biomedical signal processing methods, healthcare applications made possible by wearable systems, and deployment issues. Through its discussion of these subjects, the study advances wearable technology in healthcare and enhances patient care.[3].

"Contemplate on Internet of Things Transforming as Medical Devices - The Internet of Medical Things (IOMT)"

The evolution of Internet of Things (IoT) technology into medical devices within the framework of the Internet of Medical Things (IoMT) is examined in the paper "Contemplate on Internet of Things Transforming as Medical Devices - The Internet of Medical Things (IOMT)" written by V. PremaLatha, E. Sreedevi, and S. Sivakumar. It was presented at the 2019 International Conference on Intelligent Sustainable Systems (ICISS) in Palladam, India. It probably covers the IoMT's architecture, uses, advantages, and difficulties in the healthcare industry.

The article provides information on how IoMT is transforming healthcare delivery through novel applications including tailored medication and remote patient monitoring. The research advances our knowledge of IoMT's potential to revolutionize healthcare and enhance patient outcomes by tackling these subjects. [4].



2) Remote Monitoring Systems:

"Ensuring the reliability of remote online monitoring systems"

The design, implementation, and operation of remote online monitoring systems are examined in detail in the paper "Ensuring the reliability of remote online monitoring systems" by S. Alexandr and S. Mikhail, which was presented at the 2022 International Conference on Information Science and Communications Technologies (ICISCT) in Tashkent, Uzbekistan. With an emphasis on dependability, it emphasizes their significance across businesses, healthcare, and environmental monitoring. The study handles topics including network connection and cybersecurity risks while addressing aspects like system uptime, data accuracy, and resistance to failures and external disruptions. Real-time data analytics, fault-tolerant systems, and redundancy measures are among the techniques covered. By means of plausible case studies, it provides useful insights into dependability implementations that are effective,

leading to improvements and broad use of remote monitoring systems in many areas. [5].

"Managing Notifications and Alerts Generated by an IoMT-based Health Monitoring System for Older People"

Designed and run for the 2022 E-Health and Bioengineering Conference (EHB) in Iasi, Romania, the paper "Managing Notifications and Alerts Generated by an IoMT-based Health Monitoring System for Older People" by A. Alexandru, E. Tîrziu, E. Tudora, and D. Nicolau focuses on creating and managing an Internet of Medical Things (IoMT)-based health monitoring system specifically for older people. It covers methods for managing warnings and notifications, setting priorities according to seriousness, and making sure that health concerns are addressed promptly. The article discusses data privacy, security precautions, and interaction with current healthcare systems while placing a strong emphasis on user interface design and accessibility. Case studies might provide examples of real-world applications. In general, it offers guidance on how to efficiently manage alerts and messages in IoMT-based health monitoring systems for senior citizens, including usability, privacy, security, and integration with healthcare systems.[6].

"Heart Lung Health Monitor: Remote At-Home Patient Surveillance for Pandemic Management"

The creation and application of a remote at-home patient surveillance system specifically designed to monitor heart and lung health is covered in the paper "Heart Lung Health Monitor: Remote At-Home Patient Surveillance for Pandemic Management" by S. Shaji, R. K. Pathinarupothi, E. S. Rangan, K. A. U. Menon, and M. V. Ramesh. It was presented at the 2021 IEEE Global Humanitarian Technology Conference (GHTC) in Seattle, WA, USA. The study emphasizes how crucial a system like this is for managing pandemics, especially when it comes to respiratory ailments like COVID-19, as it allows for remote diagnosis, early identification, ongoing monitoring, and treatment of respiratory infections. It explores the technologies used in the Heart Lung Health Monitor, including wearable sensors, Internet of Things (IoT) devices, and communications technologies, to collect and send critical health

information from patients' homes to medical professionals. The study also emphasizes the need of protecting patient privacy and security while managing sensitive health data, as well as the need to take clinical validation and efficacy testing into account when evaluating the system's accuracy and dependability in practical settings. Overall, the study clarifies a complete approach to remote patient monitoring, highlighting its possible influence on pandemic control while prioritizing patient privacy and data security. [7].

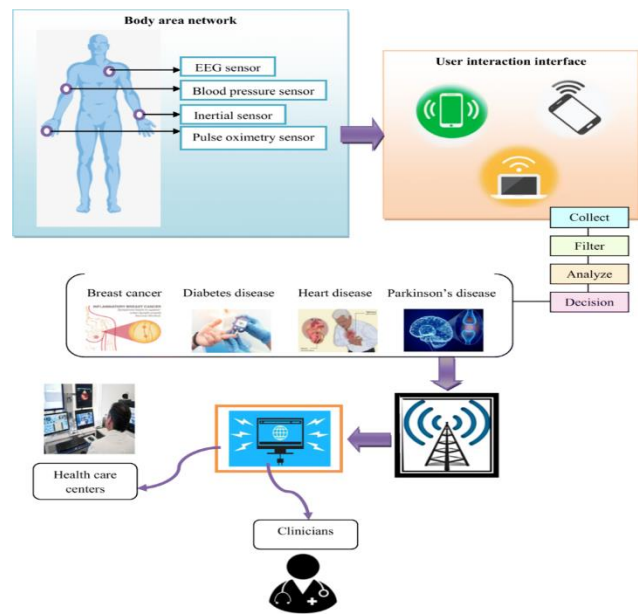
"Secure and Privacy-aware Blockchain-based Remote Patient Monitoring System for Internet of Healthcare Things"

Presenting at the 17th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob) in Bologna, Italy in 2021, B. Zaabar, O. Cheikhrouhou, M. Ammi, A. I. Awad, and M. Abid's paper "Secure and Privacy-aware Blockchain-based Remote Patient Monitoring System for Internet of Healthcare Things" delves into the integration of blockchain technology with RPM systems within the Internet of Healthcare Things (IoHT). It highlights how blockchain technology might improve security, immutability, and transparency in the handling of medical data, particularly when it comes to RPM systems' privacy issues. The decentralized nature of blockchain technology and its advantages for patient confidentiality, fault tolerance, and data integrity are covered in the study. It also looks at implementation issues and provides answers, backed up with use examples that show off blockchain's usefulness in the healthcare industry. Overall, by addressing important issues including security, privacy, decentralization, and implementation obstacles, the study offers insightful information on the design, implementation, and possible effect of safe and privacy-aware blockchain-based RPM systems for IoHT.[8].

"Blockchain Adaptation of Remote Patient Monitoring with Internet of Medical Things"

The integration of blockchain technology with Internet of Medical Things (IoMT) devices for remote patient monitoring systems is the subject of the paper

"Blockchain Adaptation of Remote Patient Monitoring with Internet of Medical Things" by C. J. Godly, V. Balasubramanian, and B. Y. Jinila. It was presented at the 2022 International Conference on Computing, Communication, Security and Intelligent Systems (IC3SIS) in Kochi, India. With an emphasis on data integrity, patient privacy, and secure data transfer, it addresses how blockchain technology may improve security and privacy in the administration of healthcare data. The article discusses difficulties with data management, ownership, and patient consent, highlighting blockchain's contribution to solving these problems. It demonstrates the potential applications of blockchain-based remote patient monitoring systems to enhance patient care and healthcare data management. Overall, the paper contributes valuable insights into the adaptation of blockchain technology for enhancing the security, privacy, and efficiency of remote patient monitoring with IoMT devices.[9].



Healthcare Monitoring and Diagnosis:

"Good-Eye: A Device for Automatic Prediction and Detection of Elderly Falls in Smart Homes"

The "Good-Eye" device, which is intended for automatic prediction and detection of elderly falls in smart home environments, is introduced in the paper "Good-Eye: A Device for Automatic Prediction and Detection of Elderly Falls in Smart Homes" by L. Rachakonda, S. P. Mohanty, and E. Kougianos. The

paper was presented at the 2020 IEEE International Symposium on Smart Electronic Systems (iSES) in Chennai, India. In addition to discussing how IoT technology used in smart homes may be extremely helpful in preventing falls in the elderly, the research emphasizes the significance of early fall detection in this population. The Good-Eye gadget uses cameras and sensors to keep an eye on activities. It uses machine learning algorithms to anticipate and identify falls. In the event of a fall, it describes alert systems to notify emergency personnel or caretakers.

The study aims to improve the safety and well-being of older people living independently by evaluating and validating the device and assessing its accuracy and efficacy in real-world circumstances. [10].

"An mHealth Lifestyle Intervention Service for Improving Blood Pressure using Machine Learning and IoMTs"

A unique strategy to blood pressure management is described in the article "An mHealth Lifestyle Intervention Service for Improving Blood Pressure using Machine Learning and IoMTs" at the 2022 IEEE International Conference on Digital Health in Barcelona. The study suggests a holistic lifestyle intervention service that makes use of Internet of Medical Things (IoMT) devices, machine learning algorithms, and mobile health technology. The system seeks to improve blood pressure by personalizing therapies that target food, physical exercise, and other lifestyle variables through data analysis from wearable devices and other sources. Adaptive suggestions and real-time monitoring are made possible by the incorporation of machine learning.[11].

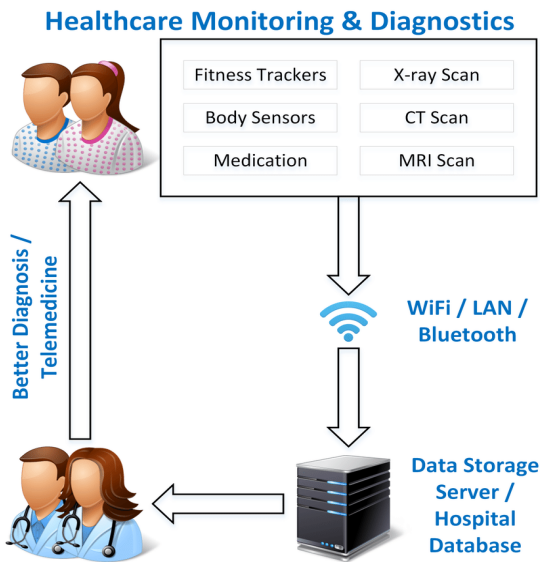
"Detecting Anomalous User Behavior in Remote Patient Monitoring"

Enhancing remote patient monitoring (RPM) systems is the topic of the article "Detecting Anomalous User Behavior in Remote Patient Monitoring," which was presented at the IEEE 22nd International Conference on Information Reuse and Integration for Data Science (IRI) in Las Vegas in 2021. It uses data science approaches to highlight anomaly identification in patient health data obtained through RPM. The study emphasizes how important it is to examine user

behavior in order to spot departures from the norm, which is essential for enhancing patient outcomes. The study suggests methods to improve RPM efficacy by combining many data sources and applying healthcare informatics concepts. [12].

"Paving the way to cardiovascular health monitoring using Internet of Medical Things and Edge-AI,"

The synergy between Internet of Medical Things (IoMT) and Edge-AI for cardiovascular health monitoring is explored in the paper "Paving the way to cardiovascular health monitoring using Internet of Medical Things and Edge-AI," which was presented at the 2022 2nd International Conference on Digital Futures and Transformative Technologies in Rawalpindi, Pakistan. Heart-related data is gathered by IoMT from medical devices, and Edge-AI analyzes it instantly on edge devices. Through the surveillance of variables such as heart rate, blood pressure, and ECG signals for early detection, this integration facilitates better monitoring of cardiac problems. Predictive analytics, feedback mechanisms, and anomaly detection algorithms are probably covered in the article in order to improve monitoring accuracy. It could also deal with issues like data security, the dependability of AI algorithms in edge settings, and chances to improve healthcare results. All things considered, it offers valuable insights into leveraging IoMT and Edge-AI for cardiovascular health monitoring. [13].



3) Data Science and Healthcare Informatics:

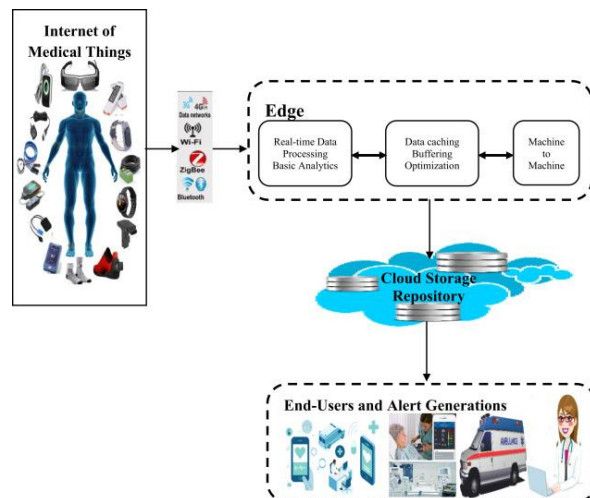
“Time Distant Healthcare Monitoring IoT System Secured by Lightweight Cryptography”

The 2023 Annual International Conference on Emerging Research Areas featured a paper titled "Real-Time Distant Healthcare Monitoring IoT System Secured by Lightweight Cryptography," which explores the combination of IoT technologies and lightweight cryptography in the context of real-time healthcare monitoring. It looks at how an Internet of Things system may be used for remote patient monitoring and stresses how crucial security is when working with private medical information. Through the use of lightweight cryptographic algorithms, the article guarantees effective security measures with minimal computing overhead. It probably talks about new developments and difficulties in this field, emphasizing how important it is to handle security issues with IoT devices in the healthcare industry. In order to improve the effectiveness and security of real-time healthcare, the study provides insights into the convergence of lightweight cryptography, IoT systems, and healthcare monitoring.[14].

"A Healthcare Monitoring System for the Diagnosis of Heart Disease in the IoMT Cloud Environment Using MSSO-ANFIS"

In 2020, M. A. Khan and F. Algarni published a paper titled "A Healthcare Monitoring System for the Diagnosis of Heart Disease in the IoMT Cloud Environment Using MSSO-ANFIS" in IEEE Access. The paper provides a thorough analysis of how to use cloud computing and the Internet of Medical Things (IoMT) to diagnose heart diseases. The goal of the project is to create a healthcare monitoring system that will track factors connected to the heart. It explores methods and tools for cardiac disease diagnosis, most likely using computational, machine learning, or data analytic approaches. The study highlights the integration of cloud-based resources and networked medical devices for healthcare applications by utilizing IoMT devices and cloud computing infrastructure.

It is possible that the study addresses the use of a certain approach known as MSSO-ANFIS, which may allude to an optimization method and an Adaptive Neuro-Fuzzy Inference System. Without access to the entire document, a thorough explanation is not possible, but it is likely that the study addresses the technical elements of system design, data analysis methods, and performance assessment of the suggested strategy.[15].



VI. SYNTHESIS AND DISCUSSION

Interdisciplinary Integration: Medical technology research draws from multiple disciplines, such as data analytics, wearable technology, and remote monitoring systems, to enhance healthcare services.

- **IoMT in Dispersed Monitoring Systems:** Articles like "IoMT Technology as the Basis of Wearable Online Monitors for Space Distributed Monitoring Systems for Pregnant Women" emphasize the role of IoMT in dispersed monitoring systems, especially for vulnerable populations like expectant mothers.
- **Design and Implementation of IoMT Devices:** "A Wearable System Implementation for the Internet of Medical Things (IoMT)" and "Generative Design Methodology for Internet of Medical Things (IoMT)-based Wearable Biomedical Devices" stress the importance of design and implementation in IoMT-based wearable devices for seamless integration into healthcare frameworks.
- **User Interface and Reliability in Remote Monitoring:** Papers like "Managing Notifications and Alerts Generated by an IoMT-based Health Monitoring System for Older People" underscore the significance of user interface and reliability in remote monitoring systems, particularly for elderly care.
- **Privacy, Security, and Pandemic Preparedness:** Publications such as "Heart Lung Health Monitor: Remote At-Home Patient Surveillance for Pandemic Management" and "Secure and Privacy-aware Blockchain-based Remote Patient Monitoring System for Internet of Healthcare Things" emphasize the importance of privacy, security, and pandemic preparedness in remote patient monitoring.
- **Preventive Healthcare Interventions:** Projects like "Good-Eye: A Device for Automatic Prediction

and Detection of Elderly Falls in Smart Homes" and "An mHealth Lifestyle Intervention Service for Improving Blood Pressure using Machine Learning and IoMTs" explore technology's role in preventive healthcare interventions, focusing on areas like blood pressure management and elderly care.

- **Diagnosis and Treatment of Cardiovascular Diseases:** Studies like "Paving the way to cardiovascular health monitoring using Internet of Medical Things and Edge-AI" and "A Healthcare Monitoring System for the Diagnosis of Heart Disease in the IoMT Cloud Environment Using MSSO-ANFIS" showcase the integration of IoMT, cloud computing, and AI in diagnosing and treating cardiovascular diseases.

VII. CONCLUSION

To sum up, the assortment of these varied papers highlights how Internet of Medical Things (IoMT) technology might revolutionize several aspects of healthcare. These papers collectively shed light on the wide range of possibilities in contemporary medical technology, from wearables that enable remote monitoring for expectant mothers to systems that guarantee the security and privacy of patient data in remote monitoring scenarios, and from creative fall detection tools for the elderly to real-time healthcare monitoring protected by cutting-edge cryptography. We are getting closer to a day when everyone will have access to individualized, effective, and cost-effective healthcare solutions as we investigate and utilize the potential of IoMT, data science, and healthcare informatics.

VIII. ACKNOWLEDGMENT

We are grateful to the writers and scholars whose works are cited in this synthesis for their important contributions. Our knowledge of smart city projects, urban mobility, and intelligent transportation systems

has been enhanced by their commitment to the advancement of artificial intelligence and traffic management. Additionally, thanks are due to the financial agencies and academic institutions who helped finance this research, as well as the planners and attendees of the publications and conferences where these ideas were discussed and spread. This synthesis has been greatly influenced by the discoveries and advancements made by scholars in this discipline.

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