Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Integrating IoT and Machine Learning for Real-Time Monitoring of Health and Managing

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One of the most potential industries to benefit from the Internet of Things, or IoT, phenomenon is healthcare. This study examines the creation and application of an Internet of Things (IoT)-based health monitoring system intended to continually monitor and assess essential health indicators like blood pressure, heart rate, blood sugar, and physical activity. The system facilitates preventative and personalized healthcare by offering real-time data to patients and healthcare professionals through a linked network of sensors and devices. Through the use of remote monitoring, early detection of possible health problems, and prompt medical action, this innovative solution seeks to improve patient outcomes, lower healthcare costs, and increase overall efficiency.

Keywords: Embedded system, IoT, Patient monitoring system, Microcontroller, Cloud.

1. Introduction

The technology has grown as the most important aspects of modern world. This is adjusted to methods of living, working, playing, and learning for each individual [1]. The internet is a useful instrument for a number of reasons, including business, finance, and education,Businesses, leisure, social media, shopping, and so forth. IoT is going to be the next big internet trend. Imagining A world in which several things are able to communicate, and share data over public networks or personal net protocols be carried out via IoT. The linked items gather the data on a regular basis, analyze it, and take the necessary action, offering complementary intelligent networks for analysis, making decisions and designing [2]. This is the realm in which the World Wide Web. Most people think about IoT as connecting reject

the victimization that occurs on the internet and its affiliates control over these items or distant observation. However, IoT is defined as building an intelligent invisible network that is able to be recognized, managed, and programmed [3]. Due to a variety of distinct risk factors, such as dietary imbalance and physical inactivity, the number of people with chronic diseases is rising in low- and middle-income nations[3]. A WHO research states that smoking causes 4.9 million deaths from cancer, obesity causes 2.6 million deaths, elevated cholesterol causes 4.4 million deaths, and high blood pressure causes more than 7 million deaths [1]. Treatment for chronic diseases varies greatly, as do their symptoms. Some will take the patient's life if they are not watched over and treated promptly. For a number of years, specialized health centers determined the standard measurements of heart rate, blood pressure, and glucose levels. The advancement of technology has led to a wide range of functional sensors providing essential indicators, including glucose meters and blood pressure cuffs [4].

A state-of-the-art method that uses the Internet of Things (IoT) to transform healthcare is an IoT-based health monitoring system[5]. In order to continuously gather and communicate critical health data from patients to healthcare providers in real-time, this system seamlessly integrates a variety of smart devices and sensors. It improves medical outcomes, lowers healthcare expenditures, and facilitates remote monitoring and prompt intervention[6]. IoT-based health monitoring systems have the potential to significantly improve healthcare delivery efficiency and safeguard people's wellbeing in this age of digital revolution.

An Internet of Things-based health monitoring system's main goals are to:

Enable Remote Monitoring: Give medical professionals the ability to monitor patients' health metrics and vital signs from a distance in real time[7]. Early Identification and Action: Recognize health problems and abnormalities as soon as possible to enable early medical action and avoid complications. Improve Medical Care: By offering individualized, data-driven insights for better managing chronic illnesses and treatment, you can raise the standard of healthcare. Lower Healthcare Costs: By avoiding health problems and deterioration, you can cut down on emergency room visits, hospital admissions, and overall healthcare costs. Encourage Patients: Give people simple access to their own health data and insights to empower them to take a more active role in their own health. Scalability and Accessibility: Provide a healthcare system that is both accessible and scalable so that it can handle a wide spectrum of patients, including those who live in underserved or distant locations.

2. Literature Review

The system that was previously used for health observance was the fixed surveillance system, which could only be observed when the patient was within the medical facility or in hospital. Both patients and doctors require a great deal of time [8]. The patient must be hospitalized under the current system in order to receive regular medical care or observe regular holidays. The patient's health parameters are measured by the systems and sent over completely distinct platforms, such as Bluetooth protocol, among others. These are employed in information transfer for short-range communication. The physician is unable to obtain every detail in the smallest amount of time [9]. The monitoring system, which is only detectable when the patient is in bed in a hospital, is the system utilized for health monitoring. Large, recently accessible

systems are exclusively found in hospital intensive care units [10]. These days, patients can use Zig Bee to send information about them to concerned physicians or their loved ones.

3. Methodology

The ideal system that we aim to construct would help monitor the patient's condition when they're getting in and out of bed [11]. The system's main objective is to transmit data via a webpage for continuous online patient monitoring. This kind of equipment would take vital signs all the time, such as temperature and heart rate, compare them to a certain range, and immediately alert the doctor if any of the readings went above a predetermined threshold. This system uses a microcontroller to transmit data [12]. Because of its connection to the Internet of Things, doctors and caregivers may access data. The patient's medical information is stored in the cloud. the techniques employed in this suggested system [13].

METHODS

Data Acquisition: The Pulse and SpO2 Meter MAX30100 continuously captures pulse rate and SpO2 levels through the PPG technique. The Thermal Sensor LM35 monitors the user's body temperature.

Data Processing: The Arduino processes the real time data from the sensors, performing necessary calculations and formatting. This collected data is converted into a suitable format for transmission.

Wireless Transmission: The Wi-Fi module establishes a connection to the Thing Speak cloud platform. - Processed data is wirelessly transmitted to Thing Speak for real-time storage and analysis [14].

Cloud Storage and Analysis: Thing Speak receives and stores the transmitted data in channels specific to each sensor. The cloud platform enables users, caregivers, and medical professionals to remotely access and monitor the collected health data[15].

Alerts and Notifications: Thing Spear’s built-in analytic tools allow for the creation of custom alerts, if vital signs deviate from the predefined range, the system triggers alerts via SMS, email, or other notifications .

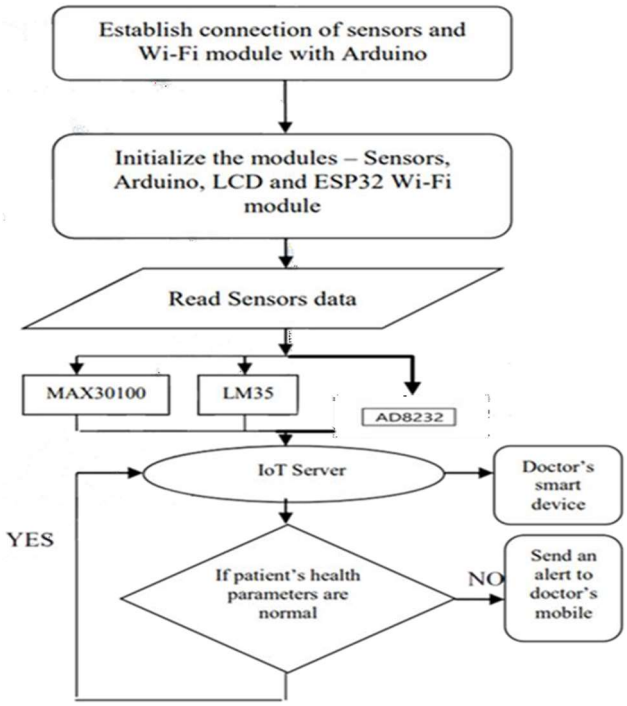

Figure 1 Flow Chart of the proposed system

Major Differences Between product available in Market versus the Developed Prototype:

This IoT-based Health Monitoring System with IoT ECG differentiates itself through continuous real-time monitoring, immediate alerts for abnormalities, and advanced predictive analytics. Unlike competitors, it offers seamless integration with mobile apps and cloud platforms, ensuring user-friendly, secure, and personalized healthcare management.

A comparison of this project, this consider key metrics that differentiate your new prototype from existing products. We can compare metrics such as:

- Real-time Monitoring
- User-friendliness
- Predictive Analytics
- Integration with Mobile Apps
- Data Security
- Healthcare Cost Reduction

The body temperature, pulse rate, room temperature, and humidity sensors' readings are calibrated by the microprocessor. These sensor values are then sent to the database server. The cloud-based data can be accessed by authorized users through the IoT application platform. These sensor values are then sent to the database server.The cloud-based data can be accessed by authorized users through the IoT application platform. Even if they are far away, the doctor

can still prescribe the medications and suggest the best course of action.

4. Results and Discussion

Figure 2 (Old versus New):

Old Interface:

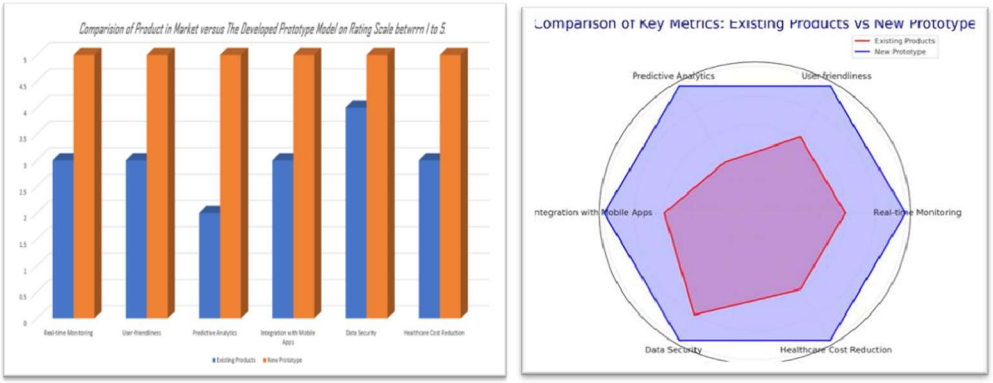

Figure 3:New Interface with App Monitoring (Android and iOS):

Figure 4: Graphical Representation

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5. Future Work

AI and Machine Learning: Enhanced use of AI and ML algorithms for data analysis, predictive analytics, and early disease detection, improving personalized healthcare recommendations.

Edge Computing: Using edge computing to process data locally, lower latency, improve real-time monitoring, and protect privacy of data.

Wearable Technology: Continued innovation in wearable devices, including smart clothing and accessories, to provide continuous and unobtrusive health monitoring.

Interoperability: Standardization initiatives to guarantee smooth data flow and integration between various IoT devices and health systems.

Chronic Disease Management: The development of Internet of Things (IoT)-based solutions that provide patients with improved health tracking and management capabilities.

The use of surveillance of patients remotely has grown in assisted living and home healthcare environments in an effort to lower readmission rates to hospitals by keeping an eye on patients' vital signs and general health.

Data Monetization: The ethical monetization of health data is being investigated with the goal of helping both individuals and healthcare institutions.

6. Conclusion

These days, the Internet of Things is thought to be one of the feasible solutions for any remote valuable tracking, particularly in the area of health management. It makes it easier for each person to achieve their goals. Parameter data remains at the hospital and is safely stored in the cloud are decreased for standard, regular exams, and the majority of It's critical that disease can be tracked and health diagnosed remotely by any physician. This paper presents an IoT

based health surveillance system was created. The framework observed the room relative humidity, heart rate, and body temperature and temperature with the help of sensors that are likewise shown on an LCD.Then, a medical server receives these sensor values via wireless exchange of information. After that, these data are obtained in a personal smartphone with IoT platform authorization.

References

1. S. Sasi, S. B V and A. R. Aswatha, “Assistive Device Based on Machine Learning Approach for Communication of Visually Challenged and Muted Community” 2023 4th International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, 2023, pp. 1048-1054, doi: 10.1109/ICOSEC58147.2023.10275924. . (Journal Article)
2. Pawan Kumar, V., Aswatha, A.R., Sasi, S. (2018). Grayscale Image Encryption Based on Symmetric-Key Latin Square Image Cipher (LSIC). In: Hemanth, D., Smys, (eds) Computational Vision and Bio Inspired Computing . Lecture Notes in Computational Vision and Biomechanics, vol 28. Springer, Cham. https://doi.org/10.1007/978-3-319-71767-8_40 (Chapter in an edited book)

3. M. D. Roopa, S. Sasi, S. Babu, A. Agrawal, K. P. Vinaik and S. C. Patil, "The IoT & MIMO Communication Technology: A New Computer Communication Approach," 2023 International Conference on Communication, Security and Artificial Intelligence (ICCSAI), Greater Noida, India, 2023, pp. 785-791, doi: 10.1109/ICCSAI59793.2023.10420973. (Journal Article)
4. S. J. Jung and W. Y. Chung, "Flexible and scalable patient's health monitoring system in 6LoWPAN," SensorLett., vol. 9,no. 2, pp. 778–785, Apr. 2011. (Journal Article)
5. W. Y. Chung, C. Yau, K. S. Shin, and R. Myllylä, "A cell phone based health monitoring system with self-analysis processor using wireless sensor network technology," in Proc. 29th Annu. Int. Conf. Eng. Med. Biol. Soc.,Lyon, France, 2007, pp. (Journal Article)
6. G. Lawton, "Machine-to-machine technology gears up for growth," Computer, vol. 37, no. 9, pp. 12–15, Sep.2004. (Journal Article)
7. C. Kim, A. Soong, M. Tseng, and X. Zhixian, "Global wireless machineto- machine standardization," IEEE Internet Comput., vol. 15, no. 2, pp. 64–69, Mar.–Apr. 2011.
8. Real time wireless health monitoring application using mobile devices, International Journal of Computer Networks & Communications (IJCNC) Vol.7, No.3, May 2015, Amna Abdullah, Asma Ismael, Aisha Rashid, Ali Abou-ElNour, and Mohammed Tarique. (Journal Article)
9. Secured Smart Healthcare Monitoring System Based on Iot, International Journal on Recent and Innovation Trends in Computing and Communication Volume: 3 Issue: 7 Bhoomika.B.K, Dr. K N Muralidhara. (Journal Article)
10. Goutam Motika, Abinash Prusty," Wireless FetalHeartbeat Monitoring System Using ZigBee & IEEE 802.15.4 Standard", 2011 Second International Conference on Emerging Applications of Information Technology, 978-0-7695-4329-1/11, 2011 IEEE DOI 10.1109/EAIT.2011.89 . (Journal Article)
11. S. M. Mahalle, P. V. Ingole, "Design and Implementation of Wireless Body Area Sensor Network Based Health Monitoring System", International Journal of Engineering Research & Technology, Vol. 2 Issue 6, pp. 105-113, June 2013. (Journal Article)
12. M.Prakash, CJ Kavitha Priya, "An Analysis of Types of Protocol Implemented in Internet of Things Based on Packet Loss Ratio", Proceedings of International Journal of Information and Communication Technology for Competitive Strategies, ISBN: 978-1-4503-3962-9, DOI: https://doi.org/10.1145/2905055.2905085, 4th – 5th Mar 2016 (Journal Article)
13. M. Prakash, U. Gowshika, T. Ravichandran, "A Smart Device Integrated with an Android for Alerting a Person's Health Condition: Internet of Things" Indian Journal of Science and Technology, Vol 9 (6), February 2016.DOI: https://doi.org/10.17485/ijst/2016/v9i6/69545 (Journal Article)
14. S. Biradar and S. Sasi, "Design and Implementation of Secure and Encoded Data Transmission Using Turbo Codes," 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Bengaluru, India, 2018, pp. 1-7, doi: 10.1109/ICCCNT.2018.8493760. (Journal Article)
15. S. Sasi and L. S. Jyothi, "A heuristic approach for secured transmission of image based on Bernstein polynomial," International Conference on Circuits, Communication, Control and Computing, Bangalore, India, 2014, pp. 312-315, doi: 10.1109/CIMCA.2014.7057813. (Journal Article)