IOT BASED PATIENT HEALTH MONITORING

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A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled **"HEALTHLINK"** is the bonafide work of **Ashish Barpete (21BAC10037)** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported here does not form part of any other project / research work on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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LIST OF FIGURES

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ABSTRACT

The rapid advancement of Internet of Things (IoT) technology has revolutionized various sectors,

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including healthcare. This abstract presents a detailed overview of an IoT-based health monitoring system focusing on pulse and temperature measurement.

The project aims to enhance healthcare services by providing real-time monitoring of vital signs, thereby facilitating timely intervention and improving patient outcomes. The proposed system consists of wearable sensors capable of measuring pulse rate and body temperature. These sensors are seamlessly integrated into the IoT ecosystem, enabling continuous data collection. The collected data is transmitted wirelessly to a central hub, typically a smartphone or a dedicated gateway device, via Bluetooth or Wi-Fi connectivity.

Upon receiving the data, the central hub processes and analyses it using advanced algorithms. Machine learning techniques may be employed to identify patterns, trends, and anomalies in the vital signs data. Additionally, the system utilizes cloud-based storage for secure long-term data storage and accessibility.

Healthcare providers, caregivers, and patients themselves can access the monitored data through a user-friendly interface, such as a mobile application or a web portal. Real-time alerts and notifications are generated for abnormal readings, enabling immediate medical attention if necessary.

Furthermore, the system supports remote monitoring, allowing healthcare professionals to track patients' health status from any location. This feature is particularly beneficial for elderly patients, individuals with chronic illnesses, or those requiring post-operative care.

In conclusion, the IOT-based health monitoring system presented in these abstract holds great potential to revolutionize healthcare delivery by enabling continuous, real-time monitoring of pulse rate and temperature. By leveraging IoT technology, this project aims to improve patient outcomes, enhance healthcare efficiency, and promote proactive healthcare management.

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1. INTRODUCTION

1.1 Introduction

In the era of digital transformation, the fusion of healthcare and technology has paved the way for revolutionary advancements, reshaping traditional paradigms of patient care and management. One such groundbreaking innovation is the Internet of Things (IoT)-based health monitoring systems, which leverage interconnected devices to gather real-time health data, enabling proactive and personalized healthcare interventions. Among these devices, the Pulse Temperature Meter stands out as a quintessential tool, offering comprehensive insights into vital physiological parameters crucial for assessing an individual's health status.

Nowadays Internet of Things (IOT) is widely adopted in many applications that its importance is extending in our daily life. The IOT technology is also developing in the healthcare monitoring system for providing effective emergency services to patients. It is also being used as E-health application on different aspects such as early detection of medical issues, emergency notification and computer-assisted rehabilitation. The Smartphones has become the indispensable part of the people's daily life and these are connected with the sensor to monitor the health of the subject. This sensing based surveillance system acquires various data from the wards and diagnostic equipment, and mines these data for efficient and automatically control of healthcare. The IOT healthcare system provides an efficient monitoring and tracking that helps to improve the resource management of people [4]. Cloud computing is used to handle the healthcare data and provides resource sharing facilities like, flexibility, data service integration with scalable data storage, parallel processing and security problems earlywe delve into the intricacies of an IoT-based health monitoring project centred around the Pulse Temperature Meter, elucidating its significance, functionality, and potential impact on healthcare delivery.

The integration of IoT in healthcare heralds a new era of patient-centric care, characterized by continuous monitoring, data-driven insights, and remote interventions. Unlike conventional healthcare approaches reliant on sporadic clinic visits or hospital admissions, IoT-enabled health monitoring transcends temporal and spatial constraints, providing a holistic view of an individual's health in real-time. This paradigm shift not only empowers patients to actively engage in their well-being but also equips healthcare providers with actionable information to deliver timely interventions and preventive measures.

The wearable or sensor implanted in the patients in the IOT based healthcare system has very limited battery supply. The frequent charging of these devices and mobile devices may fatigue the patients and require engagement of the nurse, which affects the user experience. The energy consumption of the cloud data center is also very large and thus increases the cost of cloud computing. But actually, a health monitoring system requires cloud services with low latency and energy consumption [7]. Another issue in healthcare monitoring is the security that the data can be easily corrupted by the attacker or hackers. Hence, it is necessary to develop a privacy-preserving IOT based healthcare system and has to be integrated with patients for efficient data transfer. Few pieces of research were involved in improving the security of data transmission in the IOT system. In this context, studies related to the IOT based healthcare systems are investigated in terms of accuracy, computational time and current difficulties in the development. One of the considerable and important research is to monitor the heart patients, which is achieved by using the sensor devices. ECG data are used to monitor the patients and the data has been directed to the professionals for analysing the signal.

At the heart of this IoT-driven healthcare ecosystem lies the Pulse Temperature Meter, a versatile device designed to measure and analyse two vital physiological parameters: pulse rate and body temperature. Compact, portable, and user-friendly, the Pulse Temperature Meter seamlessly integrates into everyday life, enabling individuals to monitor their health proactively without disrupting their routine activities.

The Pulse Temperature Meter operates on a sophisticated blend of sensors, wireless connectivity, and data analytics algorithms, enabling seamless data acquisition, transmission, and interpretation. Equipped with high-precision sensors, the device accurately measures the pulse rate by detecting arterial pulsations and monitors body temperature through non-invasive techniques such as infrared thermometry. Leveraging wireless communication protocols such as Bluetooth or Wi-Fi, the device transmits the acquired data to a centralized platform, where it undergoes comprehensive analysis and visualization.

The adoption of IOT-based health monitoring systems, spearheaded by devices like the Pulse Temperature Meter, holds immense potential to revolutionize healthcare delivery across diverse domains. By enabling early detection of anomalies, facilitating remote patient monitoring, and fostering proactive interventions, these systems enhance the efficiency, accessibility, and affordability of healthcare services. Moreover, by promoting preventive care and patient

empowerment, they contribute to improved health outcomes, reduced healthcare costs, and enhanced quality of life for individuals worldwide.

1.2 Motivation for the work

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The motivation behind embarking on an IoT project centered around health monitoring, particularly a pulse temperature meter, is multifaceted and compelling. Primarily, such a venture stems from a growing recognition of the invaluable role that technology can play in advancing healthcare accessibility, efficiency, and accuracy. By integrating IoT devices into health monitoring, individuals can proactively manage their well-being in real-time, enabling early detection of potential health issues and facilitating timely interventions. Specifically, a pulse temperature meter offers a non-invasive means of monitoring vital signs, providing continuous and precise measurements without the inconvenience or discomfort associated with traditional methods. This device holds promise not only for personal health management but also for remote patient monitoring, enabling healthcare professionals to remotely assess patients' conditions and adjust treatment plans accordingly. Furthermore, the data collected by these devices can be aggregated and analyzed to identify patterns, trends, and potential health risks at both individual and population levels, thereby informing public health initiatives and contributing to the advancement of medical research. In essence, the motivation behind developing an IoT-based health monitoring system, particularly one incorporating a pulse temperature meter, lies in its potential to revolutionize healthcare delivery, empower individuals to take charge of their health, and ultimately improve health outcomes on a global scale.

The pulse temperature meter, specifically, provides a non-invasive and continuous means of monitoring vital signs, empowering individuals to take proactive measures towards their well-being. Its ability to facilitate early detection and intervention further underscores its importance, potentially mitigating health risks and complications. Additionally, in an increasingly interconnected world, remote patient monitoring becomes paramount, with IoT devices enabling healthcare providers to remotely assess patients' conditions and adjust treatment plans as needed. Moreover, the aggregated data from these devices not only informs individual health management but also contributes to broader public health initiatives and medical research, driving improvements in healthcare delivery and outcomes on a global scale. Thus, the motivation lies in the promise of revolutionizing

healthcare, empowering individuals, and advancing medical knowledge through innovative IoT solutions.

Early detection of health issues is crucial for successful treatment and management. Continuous monitoring allows for the prompt identification of deviations from baseline readings, indicating potential health issues such as infections or fluctuations in health conditions. Timely intervention, whether through self-management techniques or medical consultations, can prevent the progression of illnesses and reduce the risk of complications.

Furthermore, the advent of IoT facilitates remote patient monitoring, enabling healthcare providers to track changes in health status in real-time without the need for frequent in-person visits. This personalized approach to healthcare optimization leads to improved patient outcomes while reducing healthcare costs associated with hospital admissions and readmissions. Moreover, the aggregated data from IoT devices holds immense potential for informing public health initiatives and advancing medical research. By analyzing large datasets, researchers can identify epidemiological trends, risk factors, and population health patterns. This information informs the development of targeted interventions, policies, and medical treatments, driving innovation in healthcare delivery and medical advancements.

In essence, the motivation behind developing an IoT-based health monitoring system with a pulse temperature meter lies in its potential to transform healthcare delivery, empower individuals in managing their health, and contribute to broader public health efforts and medical advancements.

1.3 Problem statement

Design a system that continuously monitors a patient's heart rate and sends an alert to healthcare providers if it exceeds a predetermined threshold, ensuring timely intervention in case of cardiac abnormalities.

Develop an IoT-based solution that tracks a patient's body temperature in real-time and notifies caregivers if it deviates from the normal range, enabling prompt treatment for fever or hypothermia.

Create a wearable device that monitors a patient's activity levels and sends automated reminders for medication intake or physical therapy exercises, promoting adherence to treatment plans and improving overall health outcomes.

Implement a remote monitoring system that measures a patient's blood pressure at regular intervals and generates personalized health reports, facilitating remote consultations with healthcare professionals and empowering patients to take proactive measures for managing hypertension.

Build a home-based monitoring solution that tracks a patient's oxygen saturation levels and provides visual feedback through a user-friendly interface, enabling individuals with respiratory conditions to monitor their lung function and adjust treatment accordingly

- Continuous Heart Rate Monitoring and Alert System:

The challenge lies in designing a system that can accurately and continuously monitor a patient's heart rate in real-time. An essential component is setting up a mechanism to determine a predetermined threshold beyond which an alert is triggered to healthcare providers. Ensuring the reliability and timeliness of alerts is crucial for enabling prompt intervention in case of cardiac abnormalities**.**

- Real-time Body Temperature Tracking and Notification System:

Designing an IoT-based solution for real-time body temperature monitoring requires accurate temperature sensors and a robust communication infrastructure. Deviation detection algorithms must be developed to identify when the patient's body temperature falls outside the normal range. Notifications to caregivers need to be timely and actionable, facilitating prompt treatment for conditions such as fever or hypothermia.

- Wearable Device for Activity Monitoring and Treatment Reminders:

Developing a wearable device involves integrating sensors to accurately track the patient's activity levels. Automated reminders for medication intake or physical therapy

exercises need to be personalized and tailored to the patient's specific treatment plan. The challenge lies in ensuring seamless integration with the patient's daily routine and user-friendly interaction to promote adherence to treatment plans.

- Remote Blood Pressure Monitoring and Health Reporting System:

Implementing a remote monitoring system for blood pressure measurement requires reliable and accurate blood pressure monitoring devices. Personalized health reports need to be generated based on the collected data, providing actionable insights for both patients and healthcare professionals. Facilitating remote consultations requires secure communication channels and user-friendly interfaces to empower patients to take proactive measures for managing hypertension.

- Home-based Oxygen Saturation Monitoring and Feedback System:

Building a home-based monitoring solution for oxygen saturation levels involves selecting appropriate sensors and designing a user-friendly interface for visual feedback. The challenge lies in ensuring the accuracy and reliability of oxygen saturation measurements, particularly in diverse environmental conditions.

Empowering individuals with respiratory conditions requires providing actionable insights and guidance for adjusting treatment based on the monitored data.

1.4 Objective of the work

The objective of the IoT project centered around health monitoring with a pulse and temperature meter is to provide real-time, accurate, and convenient health data monitoring for individuals. By leveraging Internet of Things (IoT) technology, this project aims to create a seamless and non-intrusive method for users to monitor their vital signs, particularly pulse rate and body temperature, from the comfort of their own homes or on the go. The primary goal is to enhance healthcare accessibility and empower users to take proactive measures towards maintaining their well-being. Through the integration of sensors, wireless connectivity, and data processing algorithms, the system will continuously gather vital sign data and transmit it to a centralized platform, such as a smartphone application or web interface. This platform will offer users comprehensive insights into their health status, including trends over time and potential anomalies, enabling early detection of

health issues and facilitating timely intervention when necessary. Furthermore, the project aims to ensure user privacy and data security by implementing robust encryption protocols and adhering to stringent privacy regulations. Ultimately, the objective is to develop a user-friendly, reliable, and cost-effective solution that promotes proactive healthcare management and improves overall quality of life.

The IoT health monitoring project sets out with a multifaceted mission aimed at revolutionizing healthcare accessibility and user engagement. At its core, the project endeavors to seamlessly integrate cutting-edge IoT technology into the realm of healthcare, offering individuals a novel approach to monitoring their well-being. One of its primary objectives is to foster a user-centric approach, ensuring that the needs and preferences of users are at the forefront of its design and implementation. By adopting this user-centric perspective, the project seeks to address the inherent challenges individuals face in managing their health effectively. Through extensive user research and feedback mechanisms, it aims to gain profound insights into the daily struggles, motivations, and aspirations of its target audience. Armed with this understanding, the project endeavors to craft a solution that not only meets the functional requirements of health monitoring but also resonates with users on a personal level.

Central to the project's objectives is the concept of continuous monitoring and feedback. Rather than offering sporadic snapshots of health data, the project aims to provide users with real-time insights into their vital signs. This continuous feedback loop empowers individuals to stay informed about their health status at all times, enabling them to proactively manage their well-being and take timely action when necessary. Moreover, the project aspires to go beyond the mere presentation of raw data. It seeks to provide users with actionable information and personalized recommendations tailored to their unique health profiles. By contextualizing health data and translating it into meaningful insights, the project aims to empower individuals to make informed decisions about their lifestyle, diet, and healthcare interventions.

In line with its commitment to user privacy and data security, the project sets stringent standards for the protection of sensitive health information. Robust encryption protocols and adherence to privacy regulations are integral components of its design, ensuring that user data remains confidential and secure at all times. Ultimately, the overarching objective of the IoT health monitoring project is to democratize healthcare, making it more accessible, intuitive, and empowering for individuals worldwide. By leveraging the transformative potential of IoT technology, the project seeks to usher

in a new era of proactive health management, where individuals are empowered to take charge of their well-being and lead healthier, more fulfilling lives.

1.4 Literature review

Extensive research has been dedicated to the exploration of various technologies such as information technologies (IT) in complementing and strengthening existing healthcare services. In particular, the Internet of Things (IoT) has been widely applied to interconnect available medical resources and provide reliable, effective and smart healthcare service to the elderly and patients with a chronic illness. The aim of this project is to summarize the applications of IoT in the healthcare industry and identify the intelligentization trend and directions of future research in this field.

Based on a comprehensive literature review and the discussion of the achievements of the researchers, the advancement of IoT in healthcare systems have been examined from the perspectives of enabling technologies and methodologies, IoT-based smart devices and systems, and diverse applications of IoT in the healthcare industries. Finally, the challenges and prospects of the development of IoT based healthcare systems are discussed in detail.

Extensive research efforts have been devoted to exploring the potential of various technologies, notably information technologies (IT), to enhance and complement existing healthcare services. Among these technologies, the Internet of Things (IoT) has emerged as a key player, offering the promise of interconnecting available medical resources and delivering reliable, effective, and intelligent healthcare services, especially tailored for the elderly and patients with chronic illnesses. The overarching goal of this project is to provide a comprehensive overview of the myriad applications of IoT in the healthcare industry while also identifying the trends of intelligentization and mapping out future research directions in this rapidly evolving field.

To achieve this objective, the project embarks on a thorough literature review encompassing a wide range of studies and scholarly discussions. By synthesizing insights from existing research, the project aims to elucidate the multifaceted roles played by IoT in reshaping healthcare delivery models. Through this comprehensive review, the project seeks to shed light on the transformative potential of IoT in addressing the complex needs of diverse patient populations. The examination of IoT's advancement in healthcare systems is approached from several key perspectives. Firstly, the project delves into the enabling technologies and methodologies that form the foundation of IoT-

driven healthcare innovation. This includes exploring IoT architecture, communication protocols, data analytics frameworks, and security measures, among other crucial components. By dissecting these enabling factors, the project aims to provide a deeper understanding of the technical underpinnings driving IoT's integration into healthcare ecosystems.

Furthermore, the project scrutinizes the proliferation of IoT-based smart devices and systems tailored for healthcare applications. These devices range from wearable sensors and remote monitoring platforms to interconnected medical equipment and smart home healthcare solutions. By examining the functionalities and capabilities of these IoT-enabled solutions, the project seeks to highlight their role in facilitating personalized and proactive healthcare interventions. Moreover, the project investigates the diverse applications of IoT in the healthcare industry, spanning remote patient monitoring, chronic disease management, telemedicine, preventive care, and healthcare infrastructure optimization. Through in-depth case studies and empirical evidence, the project aims to showcase the real-world impact of IoT-driven healthcare innovations across various domains. Finally, the project addresses the challenges and prospects associated with the development of IoT-based healthcare systems. This includes discussing issues related to data privacy, security, interoperability, regulatory compliance, and scalability. By identifying these challenges and proposing potential solutions, the project aims to inform strategic decision-making and inspire future research endeavors aimed at harnessing the full potential of IoT to improve healthcare access, quality, and affordability.

In summary, this project endeavors to provide a holistic understanding of IoT's role in revolutionizing healthcare delivery, from its enabling technologies to its diverse applications and associated challenges and prospects. Through a rigorous examination of existing literature and empirical evidence, the project aims to contribute to the ongoing discourse on IoT-driven healthcare innovation and inspire future research efforts aimed at realizing the full promise of IoT in transforming the healthcare landscape.

1.8 Overview of the Project:

The IoT project for patient health monitoring revolves around the integration of pulse and temperature sensors into a comprehensive monitoring system. The system is designed to continuously measure and transmit pulse rate and body temperature data to a centralized platform for analysis. By leveraging wireless connectivity and cloud-based infrastructure, healthcare

professionals can remotely monitor patients' vital signs in real-time, enabling proactive healthcare management and personalized interventions.

Pulse Sensor:

Central to the project is the pulse sensor, which is responsible for measuring the heart rate of the patient. The pulse sensor utilizes optical sensing technology to detect changes in blood volume as pulses pass through blood vessels. By emitting infrared light and measuring the reflected light intensity, the sensor can accurately capture the pulsatile nature of blood flow. This information is then processed to calculate the heart rate, providing valuable insights into the patient's cardiovascular health. The pulse sensor is non-invasive and can be easily integrated into wearable devices or medical equipment for continuous monitoring.

Temperature Sensor:

In addition to the pulse sensor, the project incorporates a temperature sensor to monitor the patient's body temperature. The temperature sensor, typically based on semiconductor technology such as the LM35 sensor, provides accurate and reliable temperature measurements. By placing the sensor in contact with the patient's skin or integrating it into wearable devices, continuous monitoring of body temperature can be achieved. Changes in body temperature can indicate various health conditions, including fever, infections, or inflammatory responses, making temperature monitoring a crucial aspect of patient health assessment.

Integration with IoT:

The integration of pulse and temperature sensors with IoT technology enables real-time monitoring and remote access to patient data. The sensors are connected to IoT-enabled devices, such as microcontrollers or development boards like Arduino or Raspberry Pi, which collect and process sensor data. Wireless communication modules, such as Wi-Fi or Bluetooth, facilitate the transmission of data to cloud-based platforms or mobile applications. This seamless connectivity enables healthcare providers to access patient data from anywhere, at any time, facilitating timely interventions and personalized healthcare management.

Data Transmission and Analysis:

Once the sensor data is collected and transmitted to the cloud, it undergoes further processing and analysis. Machine learning algorithms may be employed to analyze the data, identify patterns, and detect anomalies indicative of health issues. By leveraging historical patient data and predictive analytics, healthcare providers can anticipate potential health risks and tailor treatment plans accordingly. Real-time alerts can be generated for critical events, prompting immediate intervention when necessary. Additionally, the data collected from multiple patients can be aggregated and anonymized for population-level health analysis and research purposes.

User Interface and Visualization:

The project incorporates a user-friendly interface for visualizing patient data and facilitating interaction with healthcare professionals. Graphical displays, such as dashboards or mobile applications, present real-time updates of pulse rate and temperature readings in an intuitive manner. Trends and historical data can be visualized through interactive charts and graphs, enabling healthcare providers to track changes in vital signs over time. Customizable alerts and notifications can be configured to notify healthcare professionals of abnormal readings or critical events, ensuring timely intervention and patient care.

Benefits and Applications:

The IoT project for patient health monitoring offers numerous benefits and applications across various healthcare settings. In hospital environments, the continuous monitoring of vital signs can enhance patient safety and reduce the risk of adverse events. Remote patient monitoring enables patients to receive care in the comfort of their homes while maintaining connectivity with healthcare providers. For elderly or chronically ill patients, IoT-enabled health monitoring systems can provide peace of mind to caregivers and family members, knowing that their loved ones' health is being monitored closely. Furthermore, the wealth of data collected from IoT devices can drive advancements in personalized medicine, population health management, and medical research.

Challenges and Considerations:

Despite the promising potential of IoT-enabled patient health monitoring, several challenges and considerations must be addressed. Data privacy and security are paramount, given the sensitive nature of patient health information. Robust encryption protocols and access control mechanisms are essential to safeguard patient data from unauthorized access or breaches. Additionally, interoperability standards must be established to ensure seamless integration and compatibility between different IoT devices and platforms. Regulatory compliance with healthcare standards and guidelines, such as HIPAA in the United States or GDPR in Europe, must also be adhered to ensure ethical and legal use of patient data.

1.9 Summary

The advent of the Internet of Things (IoT) has paved the way for innovative solutions in healthcare, particularly in the realm of patient health monitoring. This detailed summary delves into an IoT project centered around patient health monitoring, with a specific focus on pulse and temperature sensors. By combining advanced sensor technology with IoT connectivity, this project aims to provide real-time monitoring of vital signs, enabling early detection of health issues and timely intervention to improve patient outcomes.

In conclusion, the IoT project for patient health monitoring represents a significant advancement in healthcare technology, leveraging pulse and temperature sensors to enable real-time monitoring of vital signs. By integrating IoT connectivity, cloud-based infrastructure, and data analytics, healthcare providers can remotely monitor patients' health status, facilitate timely interventions, and improve patient outcomes. While challenges such as data privacy and interoperability remain, the potential benefits of IoT-enabled patient health monitoring are vast, offering personalized healthcare solutions and driving innovation in the field of medicine.

2. LITERATURE SURVEY

2.1 Introduction

The study of “IoT” was comprehensive and montages relations and constraints. The main goal of “IoT” is to ensure that, in conjunction with “electronic sensor” devices, Internet-based communications and the sending and reception of information are conventionally accessible. In a report “28.4 billion IoT users in 2017 and by 2020 they are going up to 50.1 billion” remained the result of one report. “IoT”, according to scientific charity, provides a range of services. “Wi-Fi, mobile phone, NFC, GPS etc.” is continuity of contact. The IoT main aim, though, is to incorporate organizations, mechanization so that messages can be transmitted without interruptions, compared to software creation; the start of the programmed is the most frequently recycled sensors with accelerometers, compression-embedding camps such as the “MCUS, MPUs”. The services have improved “intelligent fitness, transportation, grids, parking and intelligent homes.” Therefore, the core goal of IoT is to combine organizations and mechanization in order to provide messages continuously.

The initial opinion for the “IoT phase is divided into criteria, specifications and implementation” is comparable to software development overall. An essential method is the final section containing the company process. “H.” In order to understand the specifications of any IoT project Eskelinen submitted two questions and included them in the design phase. These moments of designbased science lead to adequate exploration of the following concepts, before the construction is funded, a strategy needs to be created that blends realistic goals with theory, and one has to bear in mind at the same time that real life is a research centre. Systematic and professional testing methods should be carried out. The designs should always be taken into account for any failure, and the designs chosen should be demonstrated to be durable over time. While Saini et.al developed its healthcare system, the consumer was the subject of the study: the programmed specifications used a basic design methodology similar to typical software development courses.

The WSN is a significant part of IoT, and it also plays an important role in its healthcare applications. They are known for their high-end and miscellany wireless control systems over other regular devices. Working on the WSN for pulse rates and oxygen saturation was emphasized by Rotariu and Manta in 2012. Yuehong etc., on the other hand, and ECG and blood pressure sensors mounted on the mobile telephone in 2016. With the IoT approach in the health analogy, the wireless network improves, he said. Tan et.al used Wi-Fi technology for its 2012 work in the control area to

relay messages on different body functionality, such as blood pressure, pulse rate, body temperature and oxygen saturation. J.J.R. and Wannenburg. Bluetooth was introduced into the smart phone by Malekianc to track patients further

2.2 Algorithm

This algorithm outlines the flow of operations in the Arduino code for health monitoring, including temperature sensing and heartbeat monitoring functionalities.

Algorithm: Health Monitoring System with Arduino

1. Initialization:
   1.1 Include necessary libraries for I2C communication and LCD display.
   1.2 Initialize the LiquidCrystal_I2C library with the specified I2C address, columns, and rows.
   1.3 Define variables and pins for temperature sensor, heartbeat sensor, and LCD display.

2. Setup:
   2.1 Initialize the LCD display with appropriate settings (16 columns and 2 rows).
   2.2 Set pin modes for the heartbeat sensor and start button.
   2.3 Clear the LCD display and print initial messages for health monitoring.~~In recent years, the integration of Internet of Things (IoT) technology with healthcare systems has revolutionized the way patient health is monitored and managed. One significant area of focus within IoT healthcare applications is the monitoring of vital signs such as pulse rate and temperature. These two parameters are crucial indicators of an individual's health status, providing valuable insights into their cardiovascular function and overall well-being.~~

~~The utilization of IoT in pulse rate and temperature monitoring systems offers several advantages over traditional monitoring methods. IoT devices, such as those based on ESP8266 & Arduino platforms, enable continuous and remote monitoring of these vital signs, allowing healthcare providers to access real-time data from anywhere. This remote accessibility not only improves the quality of patient care but also enhances the efficiency of healthcare delivery, particularly in remote or underserved areas.~~

~~This literature survey aims to explore the advancements, challenges, and emerging trends in IoT-based health monitoring systems focused on pulse rate and temperature. It will delve into the various~~

~~methodologies, sensor technologies, data transmission protocols, and data analysis techniques employed in these systems. Understanding the current landscape of IoT health monitoring systems will provide valuable insights into the potential for further innovation, improved patient outcomes, and enhanced healthcare services.~~

~~The survey will also examine the role of IoT platforms such as ThingSpeak, which facilitate data collection, storage, analysis, and visualization. These platforms offer valuable tools for healthcare professionals to interpret and act upon the data generated by IoT devices, leading to more informed decision-making and personalized patient care.~~

~~Through this literature survey, we aim to gain a comprehensive understanding of the current state-of-the-art in IoT-based pulse rate and temperature monitoring systems. By identifying key challenges and opportunities, we can pave the way for the development of more effective, scalable, and accessible IoT solutions for healthcare monitoring, ultimately improving the quality of life for patients and enhancing the efficiency of healthcare services.~~

~~2.2~~

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~~3.~~ Main Loop:

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3.1 Read temperature sensor value and convert it too Celsius.
3.2 Display temperature on the LCD display.
3.3 Check if the start button is pressed to initiate heartbeat monitoring.
3.4 If heartbeat monitoring is started:
3.4.1 Increment heartbeat count when the sensor detects a heartbeat.
3.4.2 Calculate heartbeats per minute (HB per min) every 10 seconds.
3.4.3 Reset heartbeat count and timer after each calculation.
3.5 Continue looping and updating the LCD display.

4. Timer Interrupt:
4.1 Implement a timer interrupt function to increment the timer every second and update the LCD display with elapsed time.

2.3 Objective

The objective of this literature survey is to:

1. Review and analyze existing research studies and publications on IoT-based health monitoring systems focusing on pulse rate and temperature.
2. Identify the current state-of-the-art technologies, methodologies, and advancements in sensor technologies, microcontrollers, communication protocols, and data processing algorithms used in these systems.
3. Explore the challenges and limitations faced in implementing IoT-based health monitoring systems for pulse rate and temperature.
4. Understand the applications, benefits, and potential impact of these systems in healthcare, including remote patient monitoring, early detection of health issues, and personalized healthcare delivery.
5. Provide a comprehensive overview of the literature to inform researchers, developers, and healthcare professionals about the trends, opportunities, and future directions in IoT-based health monitoring systems for pulse rate and temperature.
6. Synthesize the findings from the literature to identify gaps and areas for further research and development in this field.

2.4 Core area

The core area of this project revolves around developing an IoT-based patient health monitoring system

~~This survey is organized into several sections, each~~ focusing on pulse rate~~different aspects of IoT health monitoring systems. The following sections will provide an overview of existing literature, including research studies, technical papers,~~ and temperature. This system combines hardware components such as Arduino microcontrollers, sensors for ~~commercial products related to~~ pulse rate and temperature measurement, and communication modules like ESP8266 for data transmission. The project aims to leverage~~monitoring using~~ IoT technology to enable real-time monitoring of vital signs remotely, facilitating timely interventions and personalized patient care.

At the heart of the system lies the Arduino microcontroller, which serves as the central processing unit for data acquisition, processing, and control. Connected sensors, including pulse rate and

temperature sensors, gather physiological data from the patient. These sensors interface with the Arduino board, which processes the raw sensor data to derive meaningful health metrics such as pulse rate and body temperature. The Arduino code implements algorithms for sensor data interpretation and communicates with other components of the system.

The integration of communication modules, such as the ESP8266 Wi-Fi module, enables seamless connectivity to the internet and facilitates data transmission to remote servers or cloud platforms. This connectivity allows healthcare providers or caregivers to access real-time patient data from anywhere, enhancing the efficiency of patient monitoring and healthcare delivery. Additionally, it opens up possibilities for data analytics, trend ~~. The survey will also discuss the methodologies, data~~ analysis, and predictive modeling to identify patterns and anomalies in patient health metrics.

A crucial aspect of the project is the development of a user-friendly interface for data visualization and interaction. Display devices such as LCD screens or graphical user interfaces (GUIs) provide visual feedback of vital signs, allowing both healthcare professionals and patients to monitor health parameters in real-time. Alerts and notifications can be implemented to notify users of abnormal readings or critical events, ensuring timely intervention and patient safety.

The scalability and expandability of the system are essential considerations, allowing for future enhancements and integration with additional sensors or functionalities. By designing a modular and flexible architecture, the project aims to accommodate evolving healthcare needs and technological advancements. Moreover, adherence to regulatory standards and best practices in data security and privacy is paramount to ensure the confidentiality and integrity of patient data.

In summary, the core area of this project involves the development of an IoT-based patient health monitoring system that integrates hardware components, communication modules, and software algorithms to enable real-time monitoring of vital signs. By leveraging IoT technology, the system offers remote accessibility, data analytics capabilities, and user-friendly interfaces, contributing to improved patient ~~ techniques, and~~ outcomes and healthcare delivery. With a focus on scalability, flexibility, and compliance, the project aims to address the evolving needs of healthcare and empower both patients and healthcare providers with valuable insights into patient health metrics.

2.5 Research issues/observations

2.5.1 Research Issues:

The literature survey uncovered several key research issues that are prevalent in the field of IoT-based patient health monitoring systems. One prominent issue is the lack of standardization and interoperability among different IoT devices and platforms. The heterogeneous nature of ~~reported in~~ these systems often leads to compatibility issues, making it challenging to integrate diverse sensors, communication protocols, and data formats seamlessly. This fragmentation hinders the scalability and interoperability of IoT health monitoring solutions, limiting their effectiveness and widespread adoption. Addressing this issue requires collaborative efforts from stakeholders to develop standardized protocols, data formats, and interfaces that promote interoperability and compatibility across various IoT devices and platforms~~studies~~.

Another critical research issue identified in the literature is the need for enhanced data security and privacy measures in IoT health monitoring systems. The transmission and storage of sensitive patient health data over networked environments raise significant concerns about data breaches, unauthorized access, and privacy violations. Vulnerabilities in IoT devices, communication channels, and cloud platforms pose risks to the confidentiality and integrity of patient information. Mitigating these security risks requires the implementation of robust encryption mechanisms, access control policies, authentication protocols, and secure communication channels to safeguard patient data throughout its lifecycle. Additionally, compliance with regulatory standards such as the Health Insurance Portability and Accountability Act (HIPAA) and the General Data Protection Regulation (GDPR) is essential to ensure legal and ethical handling of patient health information.

2.5.2 Observations:

In addition to research issues, the literature survey yielded several noteworthy observations regarding the current state of IoT-based patient health monitoring systems. One observation is the growing trend towards the integration of advanced technologies such as artificial intelligence (AI) and machine learning (ML) in these systems. AI and ML algorithms offer capabilities for predictive analytics, anomaly detection, and personalized healthcare interventions based on patient data patterns. These technologies have the potential to enhance the diagnostic accuracy, prognostic capabilities, and treatment outcomes of IoT health monitoring systems, ushering in a new era of data-driven and personalized healthcare delivery.

Another observation is the increasing emphasis on user-centric design principles and human-computer interaction (HCI) methodologies in the development of IoT health monitoring interfaces. Recognizing the diverse needs, preferences, and abilities of end-users, designers are striving to create intuitive, accessible, and engaging interfaces that empower patients and healthcare providers to interact with health data effectively. User-friendly interfaces, coupled with features such as customizable dashboards, real-time alerts, and interactive visualizations, enhance user engagement, adherence to treatment plans, and overall satisfaction with IoT health monitoring systems. Furthermore, incorporating feedback from end-users through iterative design processes fosters continuous improvement and optimization of user interfaces for better usability and user experience.

Overall, the literature survey highlights the importance of addressing research issues such as standardization, interoperability, data security, and privacy in IoT-based patient health monitoring systems. Furthermore, observations regarding the integration of AI/ML technologies and user-centric design principles underscore the evolving landscape of IoT health monitoring and the potential for innovation in improving patient care and healthcare delivery. Addressing these research issues and leveraging emerging technologies and design methodologies will be crucial for advancing the field of IoT-based patient health monitoring and realizing its full potential in improving patient outcomes and quality of care.

2.62.4 Summary

This literature survey explores the advancements and challenges in IoT-based health monitoring systems focused on pulse rate and temperature. The integration of Internet of Things (IoT) technology has revolutionized patient care by enabling continuous and remote monitoring of vital signs. Pulse rate and temperature are critical indicators of cardiovascular function and overall health, making them essential parameters to monitor in healthcare settings.

The survey delves into methodologies, sensor technologies, data transmission protocols, and data analysis techniques used in IoT health monitoring systems. It also examines the role of IoT platforms such as Thing Speak, which facilitate data collection, storage, and visualization for healthcare professionals. Understanding the current landscape of IoT-based health monitoring systems provides

insights into opportunities for innovation and improvement in patient outcomes and healthcare services.

Through this survey, we aim to gain a comprehensive understanding of the state-of-the-art in IoT-based pulse rate and temperature monitoring. By identifying challenges and opportunities, we can pave the way for the development of more effective and accessible IoT solutions, ultimately enhancing patient care and the efficiency of healthcare delivery.

3. SYSTEM ANALYSIS

3.1 Introduction

The integration of Internet of Things (IoT) technology in healthcare has transformed the way patient health is monitored and managed, particularly in the context of vital signs such as pulse rate and temperature. IoT-based health monitoring systems offer numerous advantages, including real-time monitoring, remote accessibility, and data-driven insights, making them invaluable tools for healthcare professionals.

This system analysis aims to delve deeper into the architecture, functionality, and performance of IoT health monitoring systems focused on pulse rate and temperature. The analysis will examine the various components, including sensors, microcontrollers, communication modules, and data processing algorithms, that constitute these systems. Understanding the interactions and dependencies among these components is essential for assessing the system's reliability, scalability, and effectiveness in real-world healthcare scenarios.

IOT is the growing technology in the internet environment in conjunction with real time connected objects. It is popular in many different industries because of convergence from the simple object into a smart object. This has a long term impact on the health monitoring, administration and clinical service to patient's physiological information. Patients are connected with sensors and the data has been associated with control devices, then it forwards to the health-monitoring unit. Sometimes data are stored in the cloud, which helps to manage the number of data with security.

An important area in the IOT is security because when dealing with data transmission from the sensor to cloud centre it is a possible loss of integrity and confidentiality and also it is complex to encrypt the data received from low resource devices. Cloud is a distributed environment so that it is the best option to store the medical data which more flexible for remotely caring patients accessed by doctors and Vice Versa. The IOT and cloud start handshake for real time processing which turns to give complexity in architecture to sending and receiving data. To reduces the complexity in IOT and cloud a novel framework is proposed to manage the IOT real time data and scientific-based unrelated IOT data then tested the cloud environment provides Software as a Service (SaaS) in the hybrid cloud environment. This research proposed a Service Management Framework for IOT devices in Cloud (SMFIC) that contains three types of layers and five important components such as consumer layer which is used to collect data from smart home, patient, social network and smart healthcare service, next type is service provider layer which provides the sharing of physical

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resources, service management, virtualization and security and privacy, the final layer is middle layer it is managing the services between provider and consumer based on available resources. Kumar and Gandhi proposed an IOT architecture with a machine learning algorithm for early detection of heart diseases. It involves three-tier architecture for collecting sensor data from wearable devices, storing the data into the cloud and regression-based prediction model for heart diseases. This proposed framework is implemented by using Apache HBase and Apache Mahout for cloud storage and data prediction analytics. The outcome of this research completely a patient can find early detection of heart diseases.

Furthermore, the analysis will explore the data transmission protocols, data storage mechanisms, and data visualization techniques employed in IoT health monitoring systems. These aspects play a crucial role in ensuring the seamless collection, storage, and interpretation of patient health data, ultimately facilitating informed decision-making and personalized patient care.Through this system analysis, we aim to identify strengths, weaknesses, opportunities, and threats associated with IoT health monitoring systems focused on pulse rate and temperature. By critically evaluating the system's architecture and functionality, we can uncover areas for improvement and innovation, leading to enhanced patient outcomes and more efficient healthcare services.

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3.2 Proposed System

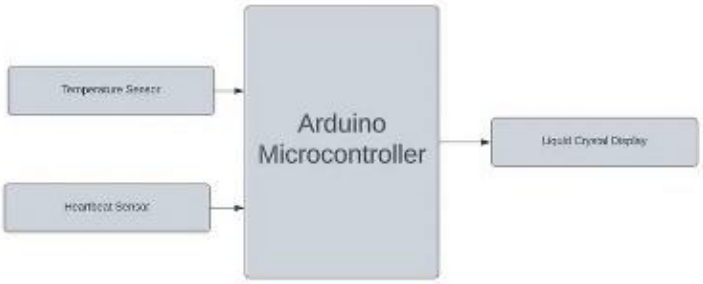

Figure1: Block Diagram

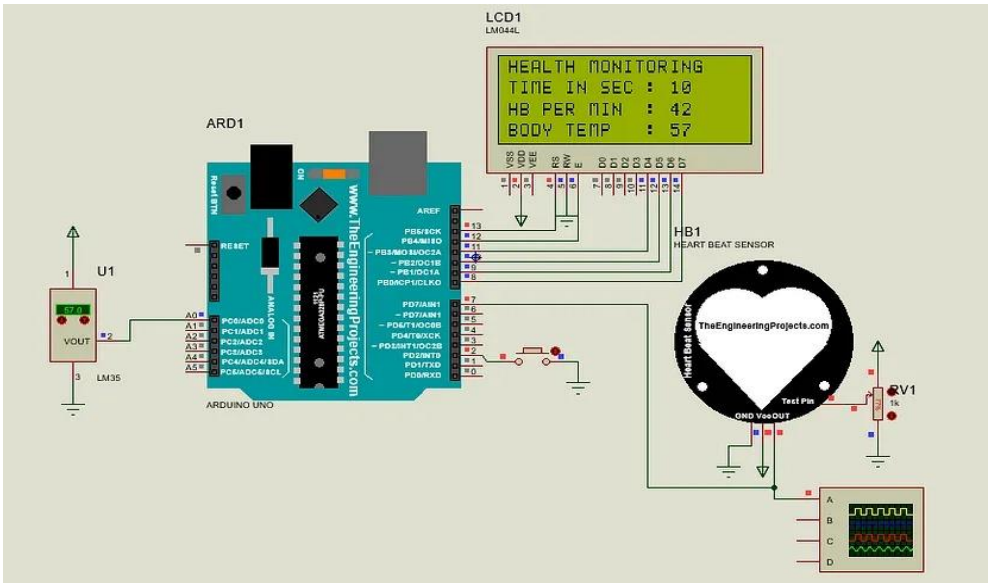

Figure 2: Simulation

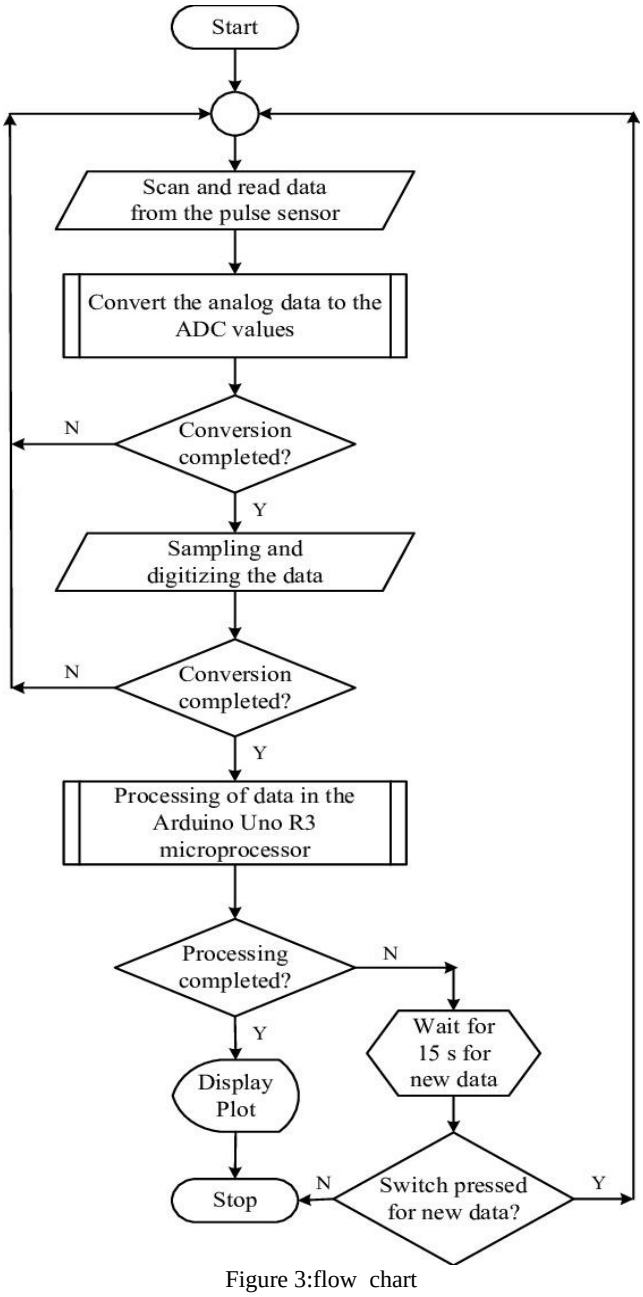

Figure 3:flow chart

Figure 4: Pulse Rate Sensor

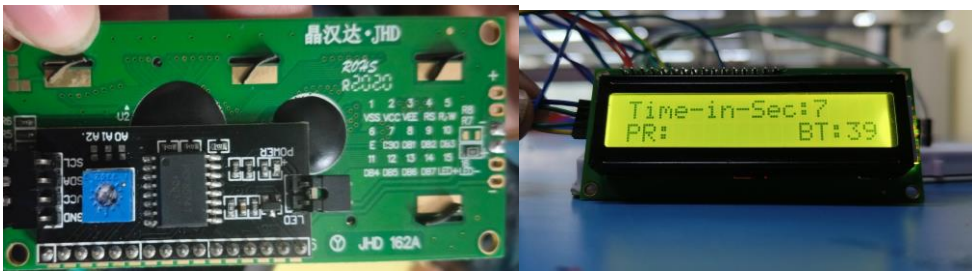

Figure 4: LCD 16x2

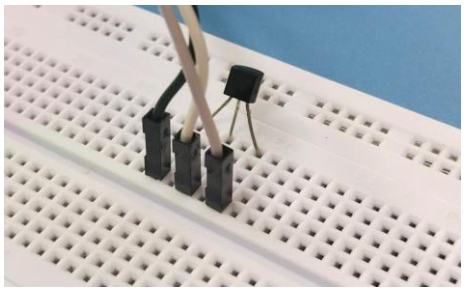

Figure 5: Temperature Sensor

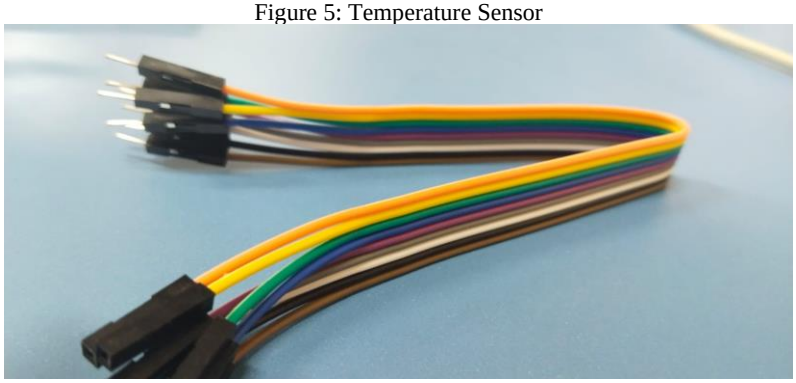

Figure 6: Jumper Wires

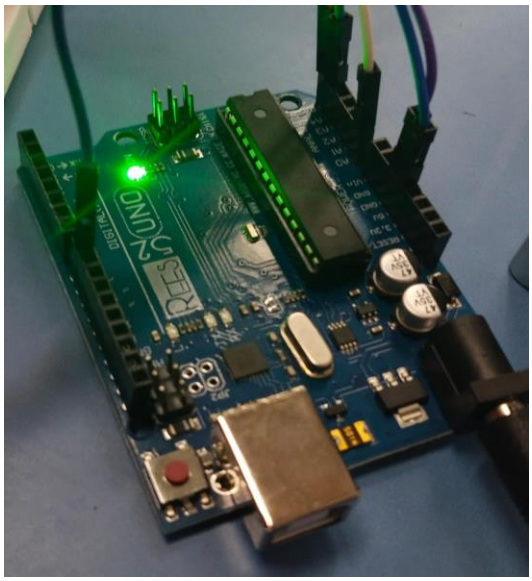

Figure 7: Arduino Uno

In this detailed exploration, we delve into the hardware requirements of an IoT-based health monitoring system focused on pulse and temperature measurement. The system integrates various components, including sensors, microcontrollers, displays, and communication modules, to enable real-time monitoring of vital signs and data transmission for analysis. This project delves into the exciting realm of Internet of Things (IoT) for healthcare applications. We'll build a system using Arduino, a microcontroller board, to monitor your vital signs in real-time.

Hardware Requirements:

Arduino Uno (or compatible): This is the brain of the system, responsible for processing sensor data and controlling the LCD display. Arduino serves as the foundational platform for the IOT Patient Health Monitoring project by providing a versatile microcontroller board capable of interfacing with a wide range of sensors. Through Arduino's programming environment, we will process sensor data, perform calculations, and control external devices. This enables the collection of vital health metrics such as heart rate, temperature, and movement data. Arduino's flexibility also allows for seamless integration with communication modules, enabling real-time transmission of health data to healthcare providers or monitoring systems. Overall, Arduino's accessibility and adaptability make it

an indispensable tool in creating cost-effective and scalable IoT solutions for patient health monitoring.

- LCD Display (16x2 or similar): This acts as the output interface, displaying your body temperature and heart rate readings. The LM35 temperature sensor operates on the principle of linear temperature-to-voltage conversion. It consists of a temperature-sensitive integrated circuit that produces an output voltage linearly proportional to the Celsius temperature. The LM35 sensor is interfaced with the Arduino Uno board through analog input pins. The output voltage from the LM35 sensor is converted into temperature readings using the Arduino's analog-to-digital converter (ADC). The temperature readings are then processed and displayed on the LCD display in degrees Celsius or Fahrenheit, providing real-time monitoring of the individual's body temperature.

- LM35 Temperature Sensor: This tiny marvel converts temperature variations into electrical signals the Arduino can understand. In addition to the pulse sensor, the project incorporates a temperature sensor to monitor the patient's body temperature. The temperature sensor, typically based on semiconductor technology such as the LM35 sensor, provides accurate and reliable temperature measurements. By placing the sensor in contact with the patient's skin or integrating it into wearable devices, continuous monitoring of body temperature can be achieved. Changes in body temperature can indicate various health conditions, including fever, infections, or inflammatory responses, making temperature monitoring a crucial aspect of patient health assessment

- Pulse Sensor: This sensor, often worn on your fingertip, detects blood flow fluctuations and translates them into digital pulses for the Arduino to interpret and calculate your heart rate. The pulse sensor is a critical component of the health monitoring system, responsible for measuring the heart rate of the individual. It

typically consists of an optical sensor that detects changes in blood volume as pulses pass through blood vessels. The sensor includes an infrared LED and a photodetector placed on opposite sides of the fingertip or earlobe. When the heart beats, blood flow increases, causing more light absorption and a decrease in the photodetector's output voltage. This change is then amplified and filtered to extract the pulse signal, which provides information about the heart rate. The pulse sensor is interfaced with the Arduino Uno board for signal processing and data analysis.

- Jumper Wires: These colorful connectors establish electrical pathways between all the components.

- .Power Supply :The power supply module delivers the required electrical power to operate the components of the health monitoring system. It ensures stable voltage and current levels to prevent malfunctions or damage to sensitive electronic components. The power supply may incorporate voltage regulators, battery management circuits, and power conditioning components to meet the system's power requirements. Depending on the application scenario, the power supply can be powered by batteries for portable or mobile use, or by mains electricity with appropriate adapters for stationary installations.

- Breadboard (optional): This prototyping platform provides a convenient workspace to assemble your circuit without soldering. The breadboard serves as a prototyping platform for assembling and connecting the various electronic components of the health monitoring system. It consists of a grid of interconnected metal clips or sockets embedded in a plastic base. The breadboard allows for easy insertion and connection of wires, sensors, and other electronic components without the need for soldering. It provides a convenient and flexible means of testing and iterating the hardware design before final implementation. The

breadboard facilitates rapid prototyping and development of the health monitoring system, enabling experimentation with different sensor configurations, wiring layouts, and component placements.

In conclusion, the hardware requirements for an IoT-based health monitoring system centre around pulse and temperature measurement include essential components such as the pulse sensor, Arduino Uno board, 16x2 LCD display, LM35 temperature sensor, breadboard, and ESP8266 module. These components work synergistically to enable real-time monitoring of vital signs and wireless data transmission for remote analysis. By leveraging the capabilities of these hardware components, healthcare professionals can monitor patients' health status more effectively and intervene promptly in case of abnormalities. Further advancements in sensor technology, wireless communication protocols, and IoT integration are expected to enhance the functionality, reliability, and accessibility of health monitoring systems, thereby improving healthcare outcomes and patient care.

Sensor Interfacing:

It will establish communication lines with the LM35 sensor connected to an analog pin. The code reads the analog voltage and converts it to a meaningful temperature value in degrees Celsius.It will configure a digital pin for the pulse sensor's output. The code reads the digital signal fluctuations and calculates the number of pulses per minute, translating it to your heart rate.

Data Processing and Display:

The code takes the raw sensor data, performs any necessary calculations (e.g., temperature conversion), and formats it for display on the LCD .It controls the LCD to display clear and concise information, typically showing your current body temperature and heart rate.

Enhancements for the Future:

Integrate code to trigger visual or audio alerts on the LCD or a buzzer if your temperature or heart rate falls outside a predefined healthy range. Data Logging: Incorporate an SD card module with the Arduino. This allows you to store your readings over time on the SD card for later analysis on a This project provides a solid foundation. You can push the boundaries further by: Alerts: computer. This can be helpful for tracking trends and identifying potential health concerns.

Wireless Communication: Add a Wi-Fi or Bluetooth module to your system. With this addition, you can transmit your health data to a smartphone app or a cloud platform for remote monitoring. This allows you or a healthcare professional to access your vitals from anywhere with an internet connection.

3.4 Observation

S.no	Temperature(degree Celsius)	BPM
1.	37	78
2.	36	65
3.	37	90
4.	30	78

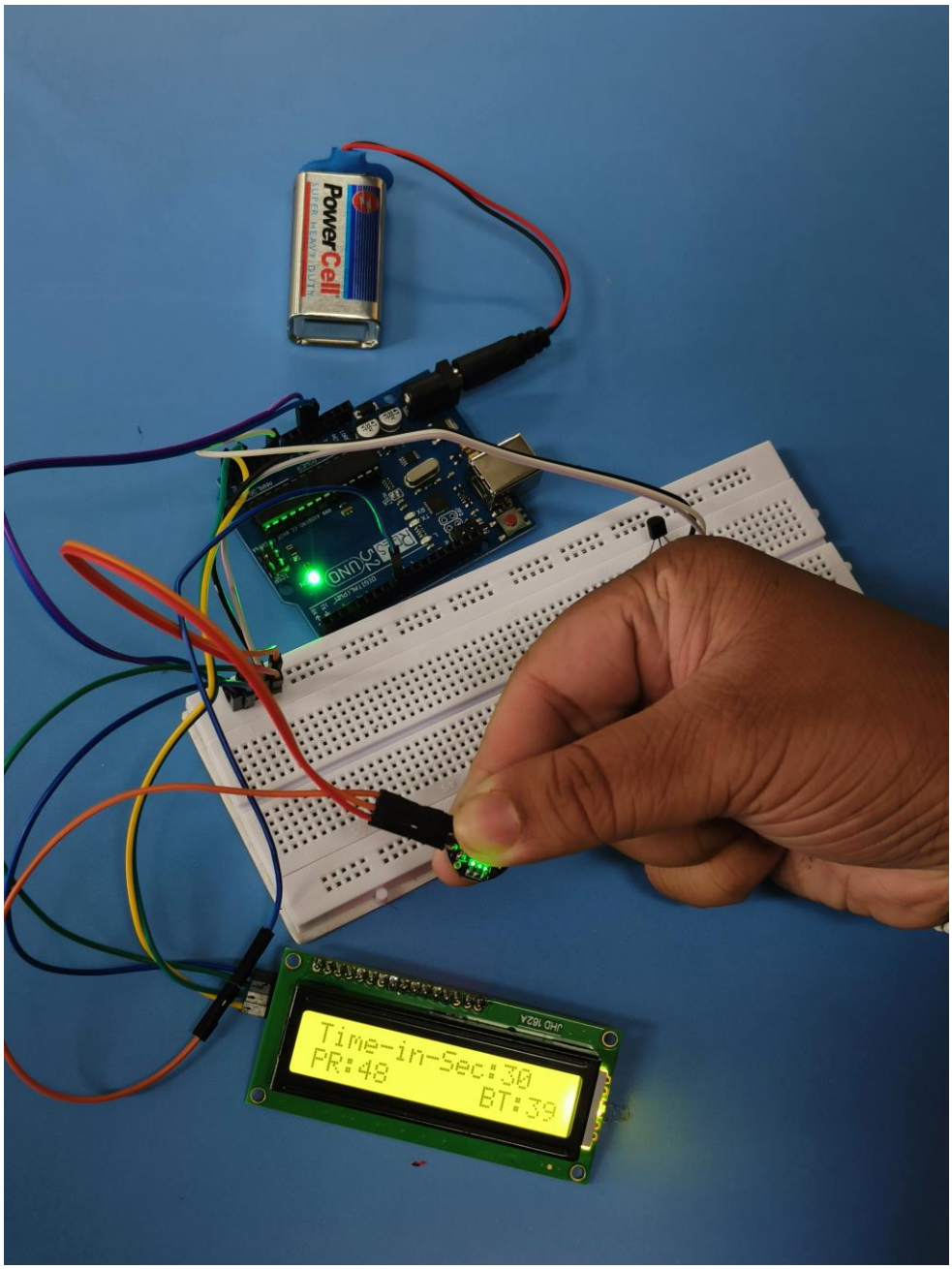

Figure 8: Main Project Circuit (1)

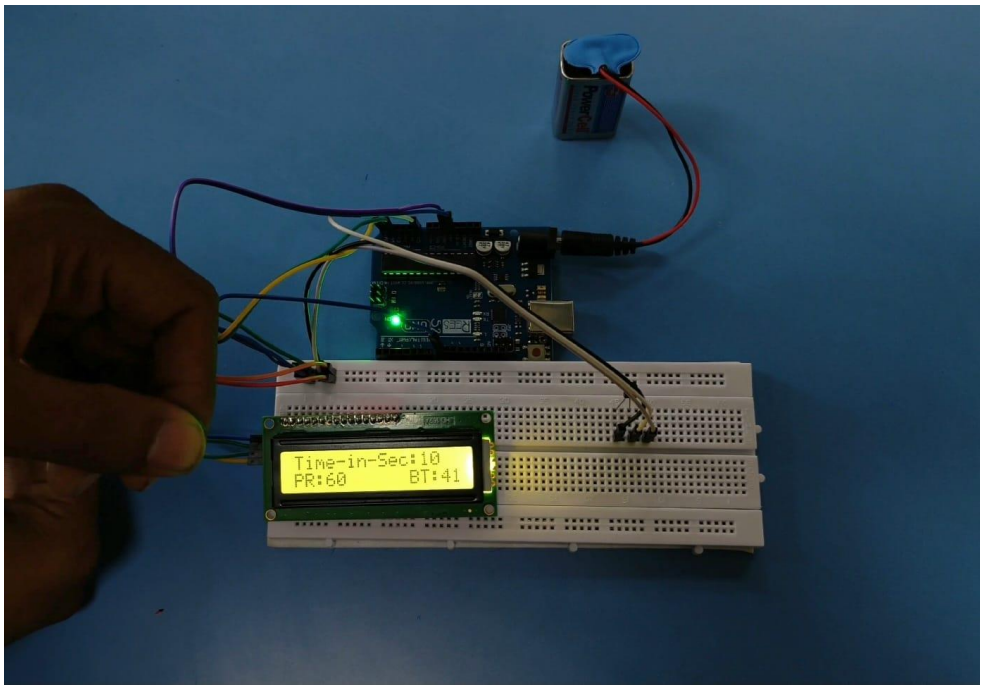

Figure 9: Main Project Circuit (2)

Figure 10: LCD with readings

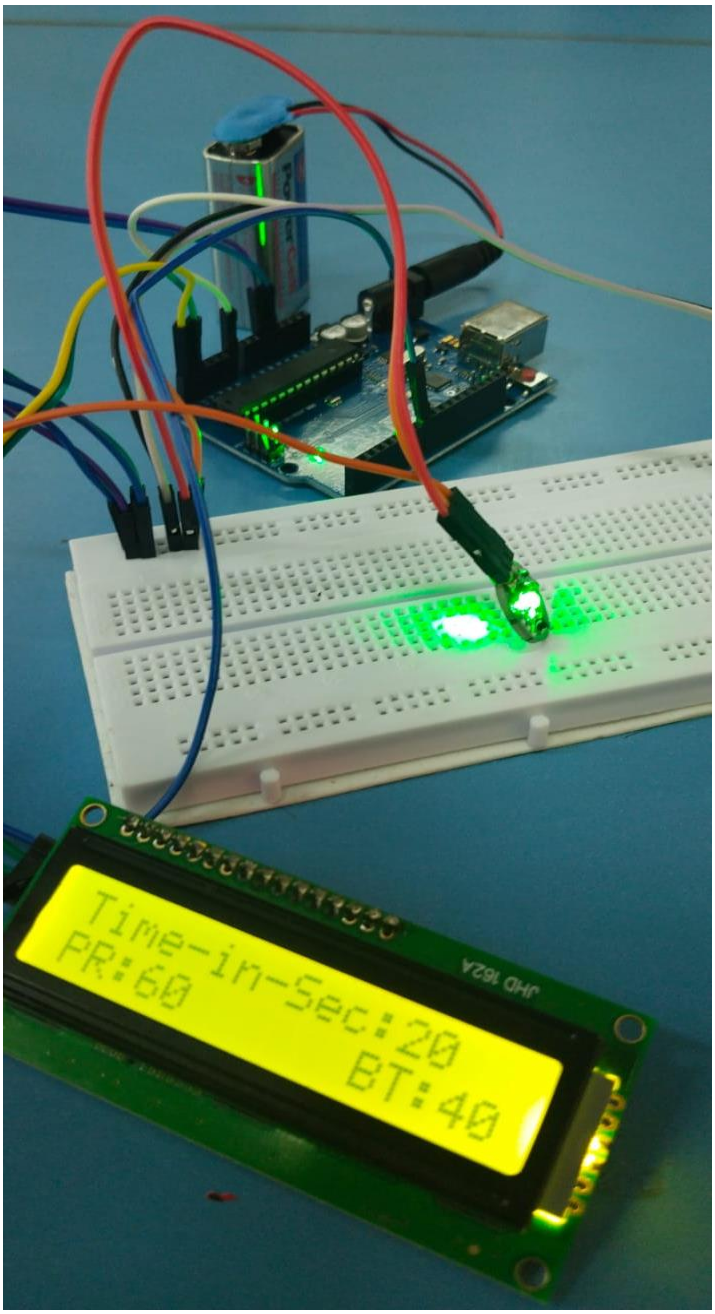

Figure 11: Main Project Circuit (3)

3.3 Disadvantages/Limitations in the existing system

In the realm of IoT health monitoring systems, several limitations and challenges persist that impact their effectiveness and widespread adoption. One significant concern is the issue of data security and privacy. Transmitting sensitive health data over the internet raises the risk of breaches and unauthorized access. Additionally, the reliability of sensor readings poses another challenge, as factors like calibration, environmental conditions, and sensor placement can affect data quality. Inaccurate readings may lead to false alarms or erroneous analysis, reducing the system's reliability.

Battery life is a common constraint for battery-powered IoT devices used in health monitoring. Short battery life requires frequent recharging or replacements, particularly inconvenient for remote or resource-limited settings. Interoperability challenges also hinder seamless integration with existing healthcare infrastructure and electronic health record systems. Standardizing protocols and enhancing compatibility between systems are essential to improve interoperability.

Furthermore, the initial costs of setting up IoT health monitoring systems, including sensors and communication modules, can be prohibitive. This cost factor, along with limited accessibility to advanced technologies in underserved communities, affects equitable healthcare distribution. Regulatory compliance, such as adhering to HIPAA or GDPR standards, adds complexity to system development and deployment. These challenges collectively underscore the need for ongoing innovation and collaboration to overcome limitations and improve the efficiency, security, and accessibility of IOT health monitoring systems.

Detection & Treatment

Today, physicians can diagnose and treat much more diseases than in the past. However, even after years of practice, they can still struggle to make the correct diagnosis efficiently. This is where technologies such as IoT and AI can play a key role in providing reliable support for determining a diagnosis and the best course of treatment. AI technologies such as neural networks can quickly analyze the extensive amount of information available to physicians, streamline the diagnostic process, and help avoid mistakes by integrating both historical data and specific patient information. This is extremely important as huge amounts of healthcare data are starting to be available from a variety of sources – including IoT medical devices that can generate real-time data - making human pattern detection and interpretation increasingly difficult. We know, for example, that screening processes such as X-Rays and CT scans depend on the ability of the radiologist to correctly interpret

the results. However, on average, 10% of mammography screenings have inconclusive results for breast cancer, and require further biopsies which can often cause major mental and physical discomfort for patients. A similar issue is faced with screening of the thyroid, where 20% of biopsies result in further surgery in order to obtain a clearer diagnosis. Although not a replacement for trained physicians, AI systems can provide additional help to doctors by providing clearer images, highlighting suspicious regions, providing better analysis tools and individualized risk assessment for each patient, which in turn reduce the need for invasive procedures.

Overall, most articles in the Diagnosis & Treatment category indicate that technologies such as IOT and AI provide patients and doctors with clear benefits. However, the success of these technologies in healthcare will depend on doctors' and patients' willingness to accept the new technology. Thus, designers and implementers of these technologies should always keep usability and adoption in mind.

Sensor Network

Sensor networks provide the foundation for the design, development, and implementation of a variety of healthcare applications, many of which are discussed in other sections of this paper. Monares et al. propose a modelling approach that uses wireless sensor networks to evaluate IOT models during the design phase. The sensors enable better design and testing phases, which reduce the need to make major changes once the device is launched and results in significant cost savings. New designs for sensor networks also provide solutions to security and privacy issues. For example, Hou and Yeh introduce two secure communication protocols that facilitate single sign on for a variety of systems, servers, and devices. Sensor networks are also the foundation for operational excellence in hospitals, creating business value in addition to the value for patients, clinicians, and caregivers discuss previously. Perry (2016) discusses how IOT sensors can be used in healthcare business operations, in areas such as material management, pharmacy rentals, process management, expense management, and human resource management. Adding sensors to everything from patient beds to nurse badges and hand sanitizers can help a healthcare facility collect and analyze data to improve supply chains, change processes, and update procedures. For example, the use of such a sensor network allowed a hospital to identify issues in their daily processes and tackle them before they became a bigger problem (Perry, 2016). Sensor networks can promote automation and reduce human intervention in many processes, thus reducing costs and increasing efficiency (Rizwan, 2017). In addition, sensor networks can support the development of platforms for patients and caregivers. The Common Recognition Identification Platform (CRIP) is one such sensor-based

platform proposed by Miranda et al. CRIP allows for continuous health management and well-being through the integration and interaction of sensors and people. The system was tested in a nursing home environment and results showed increased patient adherence and awareness when undergoing treatment. Another such platform is the Aging in Place (AIP) system proposed in Fattah et al. (2017), which focuses on caregivers (rather than patients), who are suffering from more stress and depression due to their caregiver status. AIP tests showed it can help increase patient autonomy by providing medication reminders through lights and speakers at home and wrist bands and mobiles outside the home. This, in turn, reduced the pressure on people living with these patients.

Patient Care

Patient care is the most important aspect in any hospital, and the implementation of patient care technology in hospitals can be key in improving the quality of care. Future smart hospitals will rely on new integrated technology, an ecosystem of platforms, and staff that is able to use the new technology to re-invent the care process and better serve patient needs. After discharge, the smart hospital ecosystem can be extended through digital homes as well. This ecosystem will facilitate the constant monitoring, storing and analyzing of patient data. Robotics and AI are also emerging as key technologies in patient care and disease management, especially in the European Union, where new compliance and safety rules are in effect. While these patient care systems provide clear benefits for patients, doctors, and caregivers, there are potential ethical issue with continuous data monitoring and storage. Ludwin and Murry posit that the exponential growth of big data in healthcare raises such ethical issues. This is even more important, given the fact that patients are often monitored by numerous devices at the same time and they do not know what each device is monitoring and what data is being saved without their knowledge. The article finds that there is significant discussion in the literature to identify ways of going beyond current laws and allowing for certain exemptions with regards to consent as long as regular monitoring of data is implemented, but that other authors argue for more patient autonomy instead.

3.4 Conclusion and Future Work

The system analysis of IoT-based health monitoring systems focused on pulse rate and temperature revealed several key insights and considerations. The analysis delved into the architecture, functionality, and performance of these systems, highlighting both strengths and areas for improvement. A Smart Health care system is integration of hardware and software. Here hardware includes sensor & microcontroller and cloud system is software part. This is complete remote

monitoring system which includes task like data acquisition, data monitoring, data storing & managing. Using this system one can measure their own body parameters without help of health provider. After studying and understanding literature review and other existing work, I propose a technique which uses fewer amounts of hardware i.e. sensor & micro controller only and then data is store in the data base for future use. Also patient or his care taker or health care provider can be notify by email, if data is abnormal .In this system future work can be done by providing more sensors & providing more settings to android apps so that person can have more user friendly environment and will be able to do more task automatically rather than manually. This will enhance system performance.

One notable strength is the capability for real-time and remote monitoring offered by IoT technology. This allows healthcare professionals to access vital patient data from anywhere, improving the efficiency and timeliness of patient care. The analysis also emphasized the role of IoT platforms such as Thing Speak in facilitating data collection, storage, and visualization, enabling informed decision-making and personalized patient care.

However, the analysis identified several limitations and challenges in existing systems. Data security and privacy emerged as significant concerns, given the transmission of sensitive health data over the internet. Reliability of sensor readings, limited battery life, interoperability challenges, and the complexity of user interfaces were also highlighted as areas for improvement.

In conclusion, the system analysis underscores the potential of IoT-based health monitoring systems to revolutionize patient care. By addressing challenges such as data security, reliability, and interoperability, these systems can offer enhanced accessibility, efficiency, and personalized healthcare services. Ongoing innovation and collaboration will be crucial to overcoming these limitations and advancing the capabilities of IoT health monitoring systems.

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