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IOT HealthNet Monitoring System (Enhancing Healthcare Through IoT Sensors)

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***Abstract*— Healthcare is given the extreme importance now a- days by each country with the advent of the novel corona virus. So in this aspect, an IoT based health monitoring system is the best solution for such an epidemic. Internet of Things (IoT) is the new revolution of internet which is the growing research area especially in the health care. With the increase in use of wearable sensors and the smart phones, these remote health care monitoring has evolved in such a pace. IoT monitoring of health helps in preventing the spread of disease as well as to get a proper diagnosis of the state of health, even if the doctor is at far distance. In this paper, a portable physiological checking framework is displayed, which can constantly screen the patient's heartbeat, temperature and other basic parameters of the room. We proposed a nonstop checking and control instrument to screen the patient condition and store the patient information's in server utilizing Wi-Fi Module based remote correspondence. A remote health monitoring system using IoT is proposed where the authorized personal can access these data stored using any IoT platform and based on these values received, the diseases are diagnosed by the doctors from a distance.**

Keywords*— Internet of things, Health sensors

INTRODUCTION

Nowadays, wireless technology has increased in various sectors such as control, automation, etc. To provide better healthcare service, the biomedical field uses the Internet of Things. The Internet of Things is used in hospitals as well as personal health care systems. To ensure innovative work this kind of technology is used by doctors. IoT is treated as smart technology, various parameters are present in this technology to measure consumer power, enhance efficiency, and evaluate cost-related issues. Doctors can detect various chronic diseases by using this technology. Various factors are maintained by this technology in healthcare such as heart rate, body temperature, respiration rate, blood pressure, and this technology is involved in the diagnosis of disease. This paper has been described about the system of Internet of Things and its use in the health care department.

IOT IN HEALTHCARE SYSTEM

Modern healthcare systems are conducted with the help of various technical aspects such as wearable devices, a cloud of things, and IoT. According to Krishnan et al. (2018), the health care department can monitor all activities of patients, record patient's data, and send these data remotely with the presence of the Internet of Things. Secure data transmission is important to maintain this connection. To implement IoT in the healthcare department, this technology is designed properly with high-performing and multiple communication standard. To maintain information-intensive health applications a resource-based data retrieving method is introduced. To control the activities of patients this technology is combined with a smart box, which is treated as a medical system. To increase security in data transmission, Web Real-Time Communication process is implemented properly. An electronic sphygmomanometer is enabled to maintain communication via Bluetooth and other android applications. This technology is involved in the recording of any transmitted data by using mobile devices and other electrical devices. Distributed flow environment for Internet of Things healthcare is involved in real-time application. To maintain patient's information local server and communication process is implemented when a patient is under the observation of any healthcare department. To analyse electrocardiogram signals an IoT based system with embedded medical platforms is used, this system is conducted by maintaining various heart functions. In a few cases, to increase mobility of patient IoT Portable Medical devices are implemented in the healthcare system. However, use of IoT Portable Medical Devices can increase security threats and negative drawbacks. To predict various kinds of disease, light-weight IoT devices are used with existing databases. Therefore, IoT can implement a cloud-based high-performing fine-grained health information access control framework to collect information about security related issues and cloud reciprocity issues. To challenge real-world application a proxy-based approach is implemented for IoT devices. For blind people, the Internet of Things can introduce a portable electrical device with mounted ultrasonic range finders. These devices help blind people to detect any obstacle near then, by using Bluetooth headphones. To alert blind people by vibrio tactile feedback, IoT can introduce depth sensor-based den navigation systems, however, this system is consists of a limitation of database connectivity. Akhila et al. (2017) stated that, implementation of IoT is conducted by maintaining four-protocol layers. Sensors and transmitters are linked with systems in the physical layer. Signal transmission from sensors to the cloudlets is conducted through a network layer. The Middleware layer can store data in the cloud and incense availability of data.

DATA COLLECTION AND TRANSMISSION

Important wearable sensors are provided towards patients to maintain Electromyography (EMG) muscle activity, respiratory rate, and Temperature. These devices are implemented in the healthcare system to detect and analyse various diseases such as fever, arrhythmia, and blood pressure. IoT can introduce high-performing technologies that are able to be connected with skin and multiple body parts to detect and measure diseases. Various physiological parameters are involved in the measurement of physiological data. Therefore, to transmit acquired data, a small hardware system is capable of creating communication software and involved in the preprocessing of collected data. Small sensors are conducted with effective batteries, without charging and replacement these batteries are able to work continuously. Data transmission is conducted with the presence of system components, recorded data of patients is transferred one location to the healthcare department with the presence of these system components. Collected data is relayed towards healthcare through the internet for storage. Sensors of Internet of Things can work via concentration such as smartphones with the presence of the internet. To remodify all sensing nodes in the health monitoring system, IoT tries to customize existing Wireless Sensor Network. This customization process depends on distance between sensors and health care, this factory helps the health monitoring system to collect more physical Information by avoiding redundant tasks. To handle emergencies, IoT can maintain a low energy consumption process and set accurate threshold levels. The low power protocol for communication is increased by IoT to maintain the limit of energy consumption.

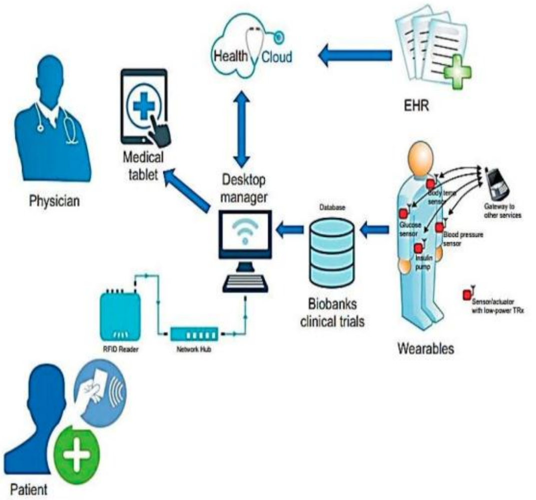

Fig1 Data collection and n transcription of IoT in healthcare

SYSTEM OF IOT

Figure 2 depicts that the proposed system of the Internet of Things. To collect health-related data various health monitoring sensors are used, such as, communication and data acquisition are conducted by controllers, who are involved in data transmission via the internet. Server is able to maintain data processing, where data is collected and aggregated properly. This entire process is shown in the web page to provide an understandable format of Health- related information such as data management.

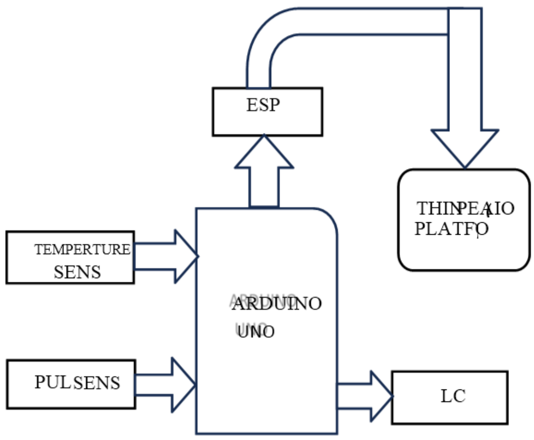

Fig 2 SYSTEM OF IOT

Figure 3 can provide information about workflow of the system. Firstly all, sensors can provide results towards the analysis phase via processing units and cloud servers. In the analysis phase, results are analysed, if any abnormal activity is found, then this system can enable emergency activity and provide information towards doctors about patient health. Subasi et al. (2018) stated that, critical condition hospitals are maintained by this process.

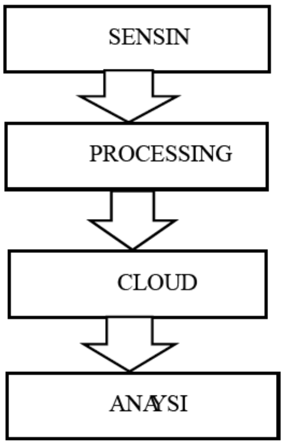

Fig 3 WORKFLOW

LIST OF COMPONENTS

Node MCU ESP8266
Infrared Sensor (IR Sensor) Module
LCD Display
Digital DH11 Temp Humidity Sensor
MAX30100/30102 Oximeter
Heart pulse sensor
Buzzer
Software Used - Arduino IDE
Language Used- C++

Node MCU ESP8266-
Node MCU ESP8266 is a low-cost, Wi-Fi-enabled microcontroller used for IoT applications. It is based on the ESP8266 Wi-Fi module and allows easy integration of sensors and devices for real-time monitoring and automation.

Key Working Functions:
Microcontroller & Wi-Fi Module: The ESP8266 chip acts as both a microcontroller unit (MCU) and Wi-Fi module, enabling wireless communication It can connect to the internet via Wi-Fi and send or receive data from cloud servers or other devices.

GPIO Control: It has General Purpose Input/Output (GPIO) pins for interfacing with sensors, relays, LEDs, motors, and other peripherals devices. It can read digital and Analog signal and control external hardware.

Programming & Development: It supports Lua scripting and is commonly programmed using Arduino IDE, Micro Python, or Node MCU firmware Code is uploaded via a USB-to-serial interface (built-in CP2102/CH340G chip).
Communication Protocols: Supports I2C, SPI, UART, and PWM for data exchange with sensors and devices Can act as a Wi-Fi client or access point (AP).
Cloud & IoT Integration: Can send sensor data to cloud platforms (e.g., Firebase, MQTT, Blynk, Thing Speak) Ideal for applications like remote health monitoring, home automation, and smart agriculture.

An Infrared (IR) sensor in IoT-based health monitoring systems is used for non-contact measurement of vital signs like heart rate, body temperature, and blood oxygen levels. It works by detecting infrared radiation emitted from the human body and analysing variations to measure physiological parameters.
Working Principle:

Infrared Transmission & Detection:
The sensor emits infrared light and detects the amount reflected or absorbed by the body. Changes in IR absorption patterns help measure body parameters.

Applications in Health Monitoring: Heart Rate Monitoring: Uses Photoplethysmography (PPG) to detect blood volume changes. Body Temperature Measurement: Infrared thermometers measure temperature based on emitted radiation.
Oxygen Saturation (SpO2) Measurement: Works with pulse oximeters to analyse light absorption in blood.

IoT Integration: The sensor data is processed by microcontrollers (like Node MCU ESP8266) and sent to cloud platforms for real-time monitoring alert can be generated if abnormal values are detected.

The DHT11 sensor is widely used in IoT-based health monitoring systems to measure temperature and humidity, crucial for patient comfort and health tracking.

Working Principle:
Sensing Elements: Uses a thermistor to measure temperature. Uses a capacitive humidity sensor to measure moisture in the air.
Data Processing & Transmission: The sensor convert Analog readings into digital signals Uses a single-wire communication protocol to send data to a microcontroller (e.g., Node MCU ESP8266)
IoT Integration: The collected data is processed and sent to cloud platforms
(like Blynk, Firebase, or Things peak) for real-time monitoring Alerts can be set if temperature/humidity crosses safe limits, useful for patient monitoring in hospitals or at home.
Key Features:
Temperature Range: 0–50°C (±2°C accuracy)
Humidity Range: 20%–90% RH (±5% accuracy)
Low Power Consumption & Easy to Interface

The MAX30100 and MAX30102 are pulse oximeter and heart rate sensors used in IoT-based health monitoring systems. They measure oxygen saturation (SpO_2) and heart rate (BPM) using infrared (IR) and red LEDs.
Working Principle:
Light Absorption Method (Photoplethysmography - PPG)
The sensor emits red and IR light into the skin. Oxygen-rich blood absorbs more IR light, while oxygen-deficient blood absorbs more red light. The difference in light absorption helps calculate SpO_2 levels and heart rate.
Data Processing & IoT Integration: The sensor sends raw data to a microcontroller (e.g., Node MCU ESP8266 or Arduino) via I2C communication. The processed data is uploaded to cloud platforms (Blynk, Firebase, or Thing Speak) for real-time health monitoring. Alerts can be triggered if values are abnormal.
Key Features:
Measures SpO_2 (Blood Oxygen Level) & Heart Rate
Low Power Consumption (3.3V/5V)
I2C Interface for Easy Integration
Suitable for Wearable Health Monitoring Devices

Arduino IDE
Arduino IDE is an open-source platform used to program microcontrollers like Node MCU ESP8266, ESP32, and Arduino boards in IoT-based health monitoring systems. It allows developers to write, compile, and upload code for sensor integration, data processing, and cloud communication.
Key Functions of Arduino IDE in Health Monitoring Systems:
Sensor Integration: Interfaces with sensors like MAX30100 (pulse oximeter), DHT11 (temperature/humidity), and IR sensors.
Reads patient data like heart rate, oxygen levels, and body temperature.

Data Processing & Control: Uses C++-based programming to process sensor values. Applies algorithms for filtering and analysing health data.

Wireless Communication & IoT Integration: Sends health data to cloud platforms (Thing Speak, Firebase, Blynk, MQTT, or Google Sheets) using Wi-Fi (ESP8266/ESP32). Enables real-time remote monitoring via mobile apps or web dashboards.
Alerts & Notifications: Triggers alerts via LEDs, buzzers, or mobile notifications if health parameters go beyond normal levels.

LCD DISPLAY
LCD (Liquid Crystal Display) screens are widely used in IoT-based health monitoring systems to display real-time patient data, such as heart rate, oxygen levels (SpO_2), body temperature, and humidity. They provide an easy way to visualize health parameters without requiring an internet connection.

OVERALL IMPACT OF IOT IN PATIENT MONITORING SYSTEM

The integration of Internet of Things (IoT) in healthcare has revolutionized patient monitoring, enhancing efficiency, accessibility, and accuracy in medical care. Below are the key impacts of IoT-based patient monitoring systems:

Real-Time Health Monitoring & Early Detection

Impact:
IoT devices continuously track vital signs like heart rate, SpO_2, blood pressure, glucose levels, and temperature. Immediate alerts help in early detection of critical conditions (e.g., heart attacks, low oxygen levels in COVID-19 patients).
Example: Wearable smartwatches detect abnormal heart rhythms and notify users/doctors. IoT ECG monitors detect irregular heartbeat patterns and send alerts.

Improved Patient Care & Remote Monitoring

Impact: IoT- based monitoring reduces hospital visits by
Allowing patients to be monitored from home. Doctors
Can access real time patient data remotely enabling quick - decision making.

Example-elderly patient with chronic diseases (diabetes, hypertension) can be monitored remotely COVID-19 patients can be tracked for oxygen levels And temperature at home.

Enhanced Efficiency & Reduced Hospital Workload
Impact: Automated patient monitoring reduces the burden on doctors and nurses. IoT devices replace manual checks with real-time alerts and reports.
Example: In ICUs, smart sensors monitor patient vitals 24/7 and notify doctors of emergencies.AI-driven predictive analytics suggest treatment plans based on historical data.
cost reduction in Healthcare Services
Impact: Remote monitoring reduces hospital admissions and in-person consultations. Preventative care through early diagnosis lowers treatment cost. Example: IoT-based glucose monitors help diabetics adjust insulin levels at home, avoiding hospital visits. Smart inhalers for asthma patients track symptoms and medication usage.

Data-Driven Decision Making & AI Integration
Impact:
IoT generates large volumes of patient data that can be analysed using AI & Big Data analytics. Predictive analytics help doctors in early disease detection & personalized treatment.
Example: AI-powered IoT platforms predict heart disease risks based on ECG data. Machine learning algorithms analyse patient history to detect early symptoms of chronic diseases.

Improved Patient Safety & Emergency Alerts
Impact:
IoT provides instant alerts for abnormal vitals, preventing medical emergencies. Patients with conditions like epilepsy, heart disease, and respiratory disorders receive timely medical attention.
Example: Fall detection sensors alert caregivers if an elderly patient fall IoT pacemakers send alerts if a patient's heart rate becomes abnormal.

Better Drug Management & Compliance
Impact: IoT tracks medication schedules and reminds patients to take medicines. Ensures patients follow prescribed treatments accurately.
Example: Smart pill dispensers notify patients when to take their medication. IoT insulin pens track glucose levels and suggest insulin doses.

Secure & Connected Healthcare Ecosystem
Impact: IoT healthcare integrates hospitals, doctors, pharmacies, and patients into a connected system. Data can be shared securely between healthcare providers.
Example: Cloud-based health records enable doctors to access patient history anytime, anywhere. Smart ambulances send real-time patient data to hospitals before arrival.

Challenges & Security Risks
While IoT improves healthcare, it also introduces challenges: Data privacy risks (cyberattacks on patient data). devices vulnerabilities (hacking of IoT devices). Connectivity issues (IoT devices require stable internet).
Solution: Encryption, strong authentication, and regular firmware updates ensure…

SECURITY ISSUES OF USING IOT IN PATIENT HEALTH MONITORING SYSTEM
IoT-based health monitoring systems collect, process, and transmit sensitive patient data, making them vulnerable to cyber threats and security risks. Below are some critical security challenges:

Data Privacy & Unauthorized Access
Issue: Patient health data (heart rate, SpO_2, temperature, etc.) is stored in cloud servers or transmitted over the internet, making it a target for hackers.
Risk: Unauthorized access to medical records can lead to privacy violations, identity theft, or insurance fraud.
Solution:
Use end-to-end encryption (SSL/TLS, AES) to protect data transmission.
Implement role-based access control (RBAC) to restrict data access.
Weak Authentication & Password Attacks
Issue: Many IoT health devices have default or weak passwords, making them vulnerable to brute-force attacks.
Risk: Hackers can take control of medical IoT devices, altering or stealing data.

Solution:
Implement multi-factor authentication (MFA) for healthcare providers.
Use strong, encrypted passwords that are periodically updated.
Data Tampering & Integrity Risk:
Incorrect health data can lead to wrong medical decisions, misdiagnosis, or even fatalities.
Solution:
Use hashing algorithms (SHA-256, HMAC) to verify data integrity.
Implement blockchain technology for secure and tamper-proof health records.
IoT Device Vulnerabilities & Malware Attacks
Issue: IoT medical devices (e.g., wearable sensors, pulse oximeters) have limited security features and can be infected by malware or ransomware.
Risk: Attackers can disable devices, demand ransom, or use them for botnet attacks.
Solution:
Keep IoT device firmware updated to patch security flaws.
Use firewalls & intrusion detection systems (IDS) to detect malware.
Unsecured Cloud & API Exploits
Issue: IoT healthcare systems often rely on cloud storage and APIs to transmit data, which can be exploited if not secured properly.
Risk: Attackers can intercept API requests, leading to data leaks or unauthorized access.
Solution:
Use OAuth 2.0 & API authentication tokens for secure API access.
Encrypt all cloud-stored health data using AES-256 encryption.
Network Attacks (Man-in-the-Middle & DDoS Attacks)
Issue: IoT devices communicate over Wi-Fi, MQTT, or Bluetooth, which can be intercepted by attackers.
Risk: Man-in-the-Middle (MITM) Attack: Hackers alter real-time health data.
DDoS (Distributed Denial of Service) Attack: IoT devices are flooded with fake requests, causing system failure.
Solution:
Secure Wi-Fi with WPA3 encryption and disable default SSID broadcasting Implement IoT intrusion detection systems (IDS) to detect unusual traffic.
Lack of Regulatory Compliance
Issue: IoT healthcare devices must comply with regulations like HIPAA (USA), GDPR (Europe), and ISO 27001. Many IoT health systems lack compliance.
Risk: Legal penalties, loss of trust, and service bans.
Solution:
Ensure data encryption, secure logging, and access control in IoT systems.
Conduct regular security audits to comply with healthcare standards.

CONCLUSION

The Internet of Things (IoT) in health monitoring systems has significantly enhanced patient care, real-time monitoring, and medical efficiency. By integrating IoT with wearable sensors, cloud computing, AI, and mobile applications, healthcare providers can remotely track vital signs such as heart rate, SpO_2 , temperature, and blood pressure, reducing hospital visits and enabling early disease detection

FUTURE SCOPE

The future of IoT in healthcare is highly promising, with advancements in AI, 5G, blockchain, and smart wearables enhancing patient care, predictive diagnosis, and hospital efficiency. As IoT technology evolves, its adoption in healthcare will redefine global medical practices, making healthcare smarter, accessible, and more efficient.

REFERENCES

[1] M. A. Khan, and M. A. Alghamdi. Mobile health (m- health) system in the context of IoT. In 2016 IEEE 4th International Conference on Future Internet of Things and Cloud Workshops (Fi Cloud W), pages 39–42, Aug 2016.
[2] Gulraiz J. Joyia, Rao M. Liaqat, Aftab Farooq, and Saad Rehman, Internet of Medical Things (IOMT): Applications, Benefits and Future Challenges in Healthcare Domain, Journal of Communications Vol. 12, No. 4, April 2017.
[3] Shubham Banka, Isha Madan and S.S. Saranya, Smart Healthcare Monitoring using IoT. International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 15, pp. 11984-11989, 2018.
[4] K. Perumal, M. Manohar, A Survey on Internet of Things: Case Studies, Applications,

and Future Directions, In Internet of Things: Novel Advances and Envisioned Applications, Springer International Publishing, (2017) 281-297.

[5] SM RIAZ, Dk, M.H.K.M.H., Kwak, K.S.: The Internet of Things for Health Care: A Comprehensive Survey. In: IEEE Access (2015).

[6] P. Rizwan, K. Suresh. Design and development of low investment smart hospital using Internet of things through innovative approaches, Biomedical Research. 28(11) (2017).

[7] K.R. Darshan and K.R. Anandakumar, “A comprehensive review on usage of internet of things (IoT) in healthcare system,” in Proc. International Conference on Emerging Research in Electronics, Computer Science and Technology, 2015.

[8] Internet of Things (IoT): Number of Connected Devices Worldwide From 2012 to 2020 (in billions). [Online]Available: https://www.statista.com/statistics/471264/iot-numberof-connected- devices world health state can be simulated and diagnosed using the MATLAB simulation.

[9] Valsala P, Surendran P, Implementation of an Emergency Indicating Line Follower and Obstacle Avoiding Robot, 16th International Multi-Conference on Systems, Signals and Devices, SSD 2019.

[10] VP, Shibi O, CMOS-DRPTL Adder Topologies, Proceedings of the 2018 International Conference on Current Trends towards Converging Technologies, ICCTCT 2018.

[11] VP, Manimegalai P, intend of power-delay optimized Kogge-Stone based Carry Select Adder, ARPN Journal of Engineering and Applied Sciences, 2018.

[12] VP, Surendran P, IoT based breath sensor for mycobacterium tuberculosis, Journal of Advanced Research in Dynamical and Control Systems, 2018.

[13] Firas Hasan Bazi Available Pharmacological Options and Symptomatic Treatments of Multiple Sclerosis." Systematic Reviews in Pharmacy 9.1 (2018),

[14] V P, Manimegalai P, Analysis of area delay optimization of improved sparse channel adder, Pakistan Journal of Biotechnology, 2017.

[15] V P, Sankaranarayanan K, Design of adder circuit with fault tolerant technique for power minimization, International Journal of Applied Engineering Research, 2014.

[16] Rajendran T et al. “Recent Innovations in Soft Computing Applications”, Current Signal Transduction Therapy. Vol. 14 No. 2, pp. 129 – 130, 2019.

[17] Emaya G et al. “User Suitability in s EMG based Hand Prosthesis for using Neural Networks”, Current Signal Transduction Therapy. Vol. 14, No. 2, pp. 158 – 164, 2019.