Smart Hospital Management System using Hybrid Cloud and AI

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***Abstract*— The swift advancement of IoT technology enables the seamless interconnection of numerous smart devicesthrough the internet, thereby improving data interoperability across diverse applications. However, this rapid progress has resulted in a significant increase in the availability of real-time data, posing challenges in data storage and accessibility. Instances of unnoticed irregularities potentially impacting patient health may arise for example, due to staff supervision, or distracted caregivers, this research proposes a system that combines sensor technology with the Internet of Things to address these challenges. This approach enables remote monitoring of patient health parameters, saline levels, heartbeat, blood pressure, temperature, and power consumption. The overarching objective of a smart hospital management system, employing hybrid cloud, IoT, and AI technologies, is to furnish a comprehensive and efficient solution for hospital operations management, thereby enhancing healthcare quality and patient satisfaction. The system harnesses hybrid cloud technology for robust data storage and management, IoT technology for connecting diverse medical tools and detectors to the cloud for real-time data analysis and decision-making.**

Keywords — Internet of Things, Non-intrusive Monitoring, Intelligent Healthcare Facility, Embedded Systems, Sensor Technologies, ESP8266 Node MCU

I. INTRODUCTION

Smart hospital management systems are increasingly adopted by hospitals worldwide to monitor patient care and treatment progress, thereby enhancing patient outcomes. These systems also enable hospitals to optimize resource utilization, giving them a competitive advantage. They employ advanced administrative software systems, addressing the complex management challenges posed by the growing patient population. To improve patient care and reduce costs, hospitals need to streamline their operations, and SMART hospital management system software, utilizing software programs, offers a novel solution to these challenges. The (IoT) is defined as the interconnection of smart tool to perform everyday tasks, aiming improve the standard of living for people. The implementation of modern hospital management systems, intended to track pertinent data and the patients' vital signs, represents one such approach. [1]

The proposed framework integrates both software and hardware elements, combining IoT and WSN technologies with the concept of reconfigurability to continuously monitor responses throughout the sensing period. Even countries with higher doctor-to-patient ratios, such as the US, China, Spain, Italy, The UK and France, along with other nations, are encountering difficulties in containing the COVID-19 outbreak among their healthcare professionals. To effectively manage COVID patients in Indian hospitals, there is an urgent need for medical staff and high-quality PPE kits. Utilizing tools that let physicians keep an eye on different facets of their work, a smart healthcare administration system will guarantee that patients receive the best care possible.

II. LITERATURE SURVEY

Wang emphasize the considerable clinical challenge presented by non-healing infections such as venous leg ulcers and diabetic foot ulcers, impacting millions of patients worldwide. Managing chronic wound care poses ongoing complexities, including challenges in accurately measuring wound size, conducting comprehensive wound assessments, monitoring wound healing progress in a timely manner, and effectively managing cases. Despite significant advancements in digital health technology, the creation of smart wound care management systems remains imperative. One major hurdle is the requirement for extensive collaboration and interaction among nurses and doctors throughout the intricate wound care process.

Abdeen introduces a smart ambulance system that integrates modern technology to improve emergency response times. The system aims to minimize the duration from the ambulance's arrival to the patient's hospital admission and subsequently reduce waiting times at the hospital. Leveraging real-time data on hospital capacities and road traffic conditions, the system makes informed decisions regarding which hospital responds to the patient's request, which ambulance to dispatch, the optimal route to reach the

patient, the preferred hospital for the patient's condition, and the most efficient route to the chosen hospital. These decisions collectively contribute to reducing both response time and the time from the patient's doorstep to medical intervention. The efficacy of the proposed approach is validated through analytical and simulation studies. [2]

Albahri. introduce a smart health observing system tailored for hospital provider in their study, utilizing wearable health data sensors. The system collects health information from 500 patients displaying various symptoms, utilizing a diverse array of wearable detectors including electrocardiogram, oxygen saturation sensor, blood pressure monitor.
The system discerns priority levels and determines the necessary healthcare services, along with the quantities of healthcare interventions required.

Services indicative of hospital status were gathered from some hospitals located in Baghdad. A decision matrix was formulated at Tier 4 by intersecting multi-healthcare services, utilizing multicriteria decision-making (MCDM) methodologies, notably the combined analytic hierarchy process (AHP). Subsequently, the hospitals underwent ranking based on this comprehensive analysis.

Dar highlight the critical need for swift and efficient response to emergencies to prevent loss of life, as prolonged rescue efforts often result in fatalities. They suggest that sophisticated technology-equipped vehicles and Roadside incidents can be promptly identified and reported with the help of advanced road infrastructure. Unfortunately, poorer nations frequently lack this kind of infrastructure and automobiles, so inexpensive fixes are required.to address this issue, IoT-based systems have been increasingly deployed for the detection and reporting of roadside incidents. [3]

Kajornkasirat aim to developed IoT-based Smart HMS capable of gathering health data from wearable devices through API technology. The collected data encompass energy metabolism, heart rate, and sleep patterns. The system comprises both web and mobile applications, leveraging MySQL software for its database system and programmed with PHP-script, JavaScript, Java, and HTML5. The mobile applications were crafted using Android Studio. Additionally, a recommendation system was devised utilizing data mining techniques and a Rule Induction algorithm to discover association rules. [4]

Park address the demanding and stressful environment faced by paramedics in emergency medical services (EMS), where they must make rapid decisions with limited data and contend with constrained resources and competing priorities. Efficient care necessitates coordinated workflows among patients, caregivers, paramedics, and medical centres. However, in conventional EMS setups, acquiring precise information regarding the emergency cause and the patient's medical background can be problematic, potentially leading to delays or inappropriate treatment.

III. Project Description

A. *Existing System*

Hospital administration systems currently rely on manual operations and traditional IT systems for tasks like maintaining patient data, appointment scheduling, and inventory management. However, these systems often encounter problems such as ineffective processes, data silos, and inadequate data analytics capabilities.

As a result, hospital staff may experience delays, errors, and an increased administrative workload, leading to suboptimal patient care and higher expenses. In countries like India with limited resources, kidney disease is a significant concern, causing 65% of deaths worldwide. Additionally, kidney disease can lead to other chronic conditions, including high blood pressure, diabetes, anemia, brittle bones, and nerve damage.

B. *Proposed System*

Use In response to the challenges faced by paramedics in emergency medical services (EMS), we propose a comprehensive strategy that integrates sensor technology with IoT to enhance patient care and streamline hospital management processes. This innovative approach enables remote monitoring of crucial parameters such as electricity control, saline bottle levels, and patient health status. By leveraging IoT connectivity, the system can promptly detect any deterioration in a patient's condition and send out alerts, ensuring timely intervention by medical staff to prevent any instances of improper treatment. Within the context of hospital management, tools that enable doctors to monitor diverse aspects of their responsibilities in the delivery of optimal treatment. However, the integration of IoT technologies also presents challenges, particularly in managing the increased volume of real-time data. Mishandling of saline bottles, often attributable to staff errors or high patient loads, can lead to severe complications such as "AIR EMBOLISM," underscoring the importance of effective monitoring systems. To address these challenges and improve hospital processes, IoT healthcare management systems can incorporate automation and decision support features, thereby reducing manual errors and enhancing overall operational efficiency. This holistic approach promises to revolutionize emergency medical services, ultimately leading to improved patient outcomes and better healthcare delivery.

IV. Design Methodology

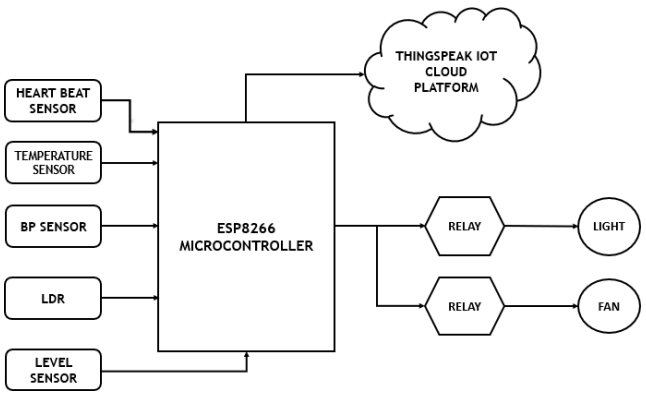


Fig..4.1.System Architecture

A. Block Diagram Explanation

A diverse array of devices, including wearable technology, smart beds, asset-tracking systems, and environmental sensors, play pivotal roles in patient monitoring and facility management within healthcare settings. These IoT devices are instrumental in collecting a wide range of patient data, encompassing vital signs, movement patterns, asset locations, and environmental parameters. This data is then transmitted to cloud-based platforms for further analysis and processing. Specific sensors, such as heartbeat and blood pressure sensors, focus on gathering information Regarding the victim's pulse rate and bp levels, the integration of IoT devices in healthcare enables continuous monitoring and real-time tracking of these vital signs, ensuring timely detection of any abnormalities or deviations from baseline values.

The microcontroller segment of these systems receives inputs from various sensors and regulates devices such as lights and fans based on environmental conditions, as detected by sensors like the Light Dependent Resistor (LDR) and temperature sensors. For instance, the LDR sensor triggers the activation of lights in low-light environments, while the temperature sensor prompts the activation of fans when room temperatures exceed preset thresholds.

The data collected from these sensors, particularly temperature and LDR sensor readings, are crucial for automating the operation of lights and fans. Furthermore, advanced analytics and machine learning algorithms are employed within the cloud infrastructure to extract insights and generate predictions. Artificial intelligence algorithms analyze patient data to facilitate early detection of deteriorating health conditions, accurate diagnosis, and personalized treatment planning. Simultaneously, machine learning models scrutinize data to identify disease trends, optimize resource allocation, and automate administrative workflows. This comprehensive integration of IoT technology, sensor data, and advanced analytical techniques holds significant promise in enhancing patient care outcomes, streamlining healthcare operations, and driving efficiencies within healthcare facilities..

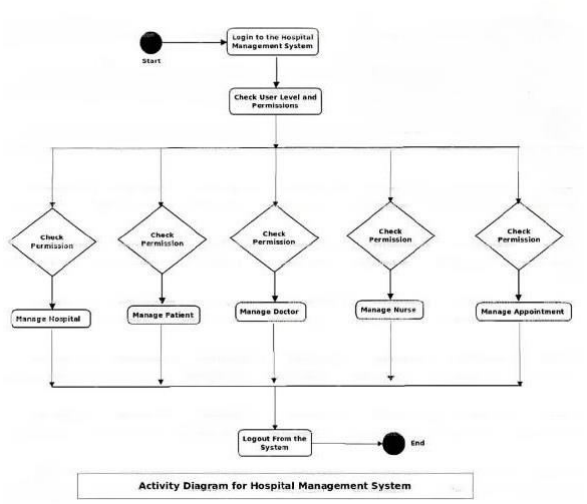
B. System Requirement

Hardware Requirement - Heartbeat Sensor, Level Sensor, Temperature Sensor, LDR, BP Sensor, Relay, Node MCU

Software Requirements - Arduino IDE, Embedded C, Thing Speak (IoT Cloud Platform)

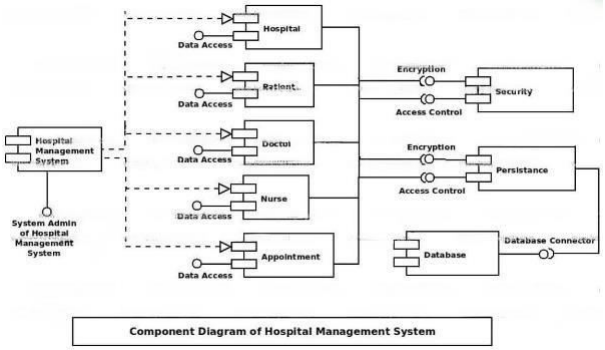
C. Activity Diagram

Activity diagram for hospital management system includes managing hospital, patient, doctor, nurse and appointments data to access all the information user need to login and need to check all the permissions and after completion user need to logout from the system



Activity Diagram for Hospital Management System

D. Component Diagram



Component Diagram of Hospital Management System

V. Results & Discussions

The Embedded C programming language serves as a fundamental tool for crafting software which are complex with specialized designs that are usually integrated into larger electronic devices and intended to perform tasks. These systems span diverse sectors, including automobile systems and medical equipment. Functioning at a low-level, Embedded C empowers developers to establish direct connections with hardware elements, enabling the development of code that seamlessly interacts with tangible components such as input/output (I/O) devices, memory modules, and microcontrollers. This direct interface with hardware facilitates the efficient execution of precise functions within embedded systems, ensuring their seamless integration and optimal performance within their respective environments.

Before Embedded C became prevalent, developers depended on assembly-level programming to code embedded systems. Although assembly languages provide direct control over machine instructions, they come with significant limitations. One notable drawback is their lack of software portability, making it challenging to transfer code between different platforms or systems. Additionally, programming in

assembly requires intricate knowledge of hardware architectures and results in lengthy development cycles for embedded applications. The complexity of writing and maintaining assembly code demands substantial resources, exacerbating the challenges associated with software development for embedded systems. These factors collectively contribute to the drawbacks of relying solely on assembly-level programming for embedded software development.

In healthcare, the integration of IoT devices represents a paradigm shift, enhancing patient care through real-time monitoring of vital signs such as BP, heart rate, and SPO2. This continuous monitoring enables healthcare professionals to promptly identify any deviations in patients' conditions and take immediate action. Moreover, IoT sensor's role to monitoring the performance of medical equipment to preemptively detect potential issues before they escalate. By reducing equipment failures, these sensors contribute to enhancing the overall quality of patient care. Additionally, the utilization of artificial intelligence (AI) enables the tracking of patient data and the development of personalized treatment plans, known as patient personalization. This personalized approach allows healthcare providers to mitigate risks and optimize treatment outcomes by tailoring interventions to meet the unique needs of each patient.

Fig 5.1 TEMPERATURE PLOT

Fig 5.2 HUMIDITY PLOT

Fig 5.3 LDR VALUE IN PLOT

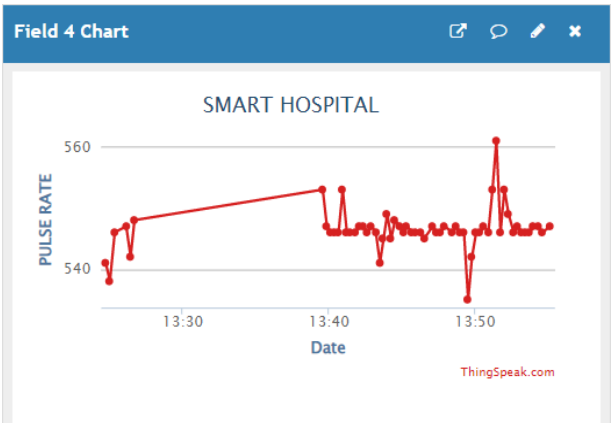


Fig 5.4 PULSE RATE

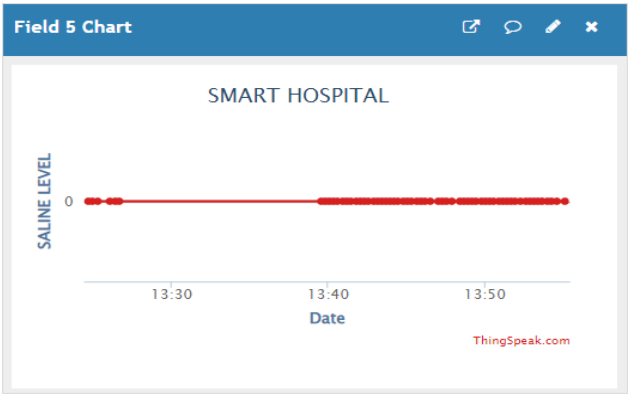


Fig 5.5 SALINE LEVEL PLOT

VI. Conclusion & Enhancement

This paper introduces a smart healthcare system powered by IoT technology, aimed at tracking daily health metrics and autonomously notifying users and healthcare providers of potential illness indicators. By leveraging IoT's capabilities, the system reduces stress on hospitals and medical professionals by proactively addressing health concerns before they escalate. With hospital management systems

becoming increasingly prevalent in healthcare organizations, there's a growing focus on optimizing workflows and enhancing patient care delivery. Smart hospitals, integrating IoT, hybrid cloud, and artificial intelligence, emerge as a solution to elevate patient care standards while reducing operational costs. Despite the considerable research demonstrating the potential benefits of these technologies in revolutionizing healthcare, their implementation also comes with challenges that need to be addressed.

These innovative systems facilitate real-time patient monitoring through IoT devices, enabling continuous assessment of vital signs and prompt detection of any deviations in health parameters. Predictive maintenance using IoT sensors helps preemptively identify equipment issues, minimizing failures and ensuring uninterrupted patient care. Furthermore, artificial intelligence aids in personalizing patient treatment plans, improving treatment outcomes, and reducing risks. By harnessing the capabilities of IoT, cloud computing, and AI, healthcare organizations can enhance patient care quality, streamline operations, and adapt to the evolving landscape of healthcare delivery.

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