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# ADVANCED AMBULANCE MANAGEMENT WITH IOT INTEGRATION

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## ABSTRACT:

This paper is present an The Advanced Ambulance Management with IoT Integration system leverages Internet of Things (IoT) technology to optimize emergency medical services and streamline ambulance operations. This system integrates GPS modules for real-time vehicle tracking, RFID sensors for automated patient data identification, and IoT-enabled health monitoring devices to provide continuous updates on a patient's vital signs during transit. IoT gateways and cloud servers facilitate data transmission and storage, ensuring seamless communication between ambulances, hospitals, and emergency control centers. Traffic signal control units integrated with IoT sensors prioritize ambulance routes, reducing delays caused by traffic congestion. Mobile applications and dashboards provide real-time updates to healthcare professionals, enabling proactive preparedness at the receiving hospitals. The system also utilizes environmental sensors to monitor conditions such as temperature and humidity inside the ambulance, ensuring optimal conditions for patient safety. IoT-enabled predictive maintenance components monitor ambulance performance to minimize downtime due to technical issues. This integrated approach improves response times, enhances patient care, and ensures efficient resource utilization, revolutionizing traditional ambulance management with real-time, data-driven decision-making powered by IoT technology.

Index terms: Ambulance, Healthcare, IoT, Real time monitoring, sensors, remote, patient monitoring, wearable device.

# INTRODUCTION

The demand for effective healthcare systems has significantly increased, particularly in urban areas where rapid population growth and traffic congestion pose substantial challenges to emergency medical services (EMS). Among these services, ambulance systems are critical in ensuring timely medical assistance and saving lives during emergencies. However, traditional ambulance management often faces various inefficiencies, including delayed response times due to traffic, miscommunication between hospitals and ambulance staff, inadequate patient monitoring during transit, and inefficient allocation of resources. These limitations can lead to significant delays in care delivery, which could mean the difference between life and death in critical situations. To address these challenges, the integration of the Internet of Things (IoT) into ambulance management offers a transformative solution, enabling smarter, more efficient, and responsive emergency services.

The Internet of Things (IoT) is a network of interconnected devices capable of collecting, transmitting, and analyzing data in real time. This technology has already revolutionized various industries, and its integration into healthcare, particularly ambulance management, presents an opportunity to overcome existing challenges. By connecting ambulances, hospitals, and emergency control centers through IoT devices, a seamless flow of information can be achieved, ensuring faster response times, improved coordination, and better patient care. IoT-enabled systems empower ambulances to function as mobile healthcare units equipped with smart devices for real-time tracking, communication, health monitoring, and environmental control, ensuring the delivery of efficient and effective emergency services.

One of the core components of an IoT-integrated ambulance system is real-time location tracking through GPS technology. This feature enables emergency control centers to identify the exact location of ambulances and assign the nearest available vehicle to an emergency site, drastically reducing response times. Additionally, route optimization algorithms, powered by IoT and integrated with traffic management systems, allow ambulances to navigate through congested areas efficiently by prioritizing their movement through smart traffic signal control. This reduces delays caused by heavy traffic, ensuring patients reach healthcare facilities as quickly as possible.

Another critical aspect of IoT integration in ambulance management is the use of advanced health monitoring devices. These devices continuously track and transmit patients' vital signs, such as heart rate, blood pressure, oxygen saturation, and body temperature, to the receiving hospital in real time. This live data transmission allows hospital staff to prepare for the patient's arrival and initiate necessary treatment without delay. Moreover, IoT-powered wearable devices enable paramedics to monitor patients' conditions throughout transit, ensuring timely interventions when required. This enhances patient outcomes by bridging the gap between pre-hospital care and in-hospital treatment.

In addition to patient health monitoring, IoT integration enhances operational efficiency through automated resource management. For instance, RFID sensors can be used to track medical equipment and supplies in ambulances, ensuring that they are adequately stocked for emergencies. Predictive maintenance systems, another IoT innovation, monitor the condition of ambulance components in real time, identifying potential issues before they lead to breakdowns. This minimizes downtime and ensures that ambulances are always in optimal condition to respond to emergencies.

Environmental sensors within ambulances are another vital component of the system, ensuring that the internal environment remains conducive to patient care. These sensors monitor parameters such as temperature, humidity, and air quality, alerting staff to make adjustments if needed. This ensures patient comfort and safety, particularly for critical cases that require specific environmental conditions.

The integration of IoT in ambulance management also fosters seamless communication between emergency stakeholders. IoT-enabled platforms provide a unified interface where ambulance staff, hospital teams, and control centers can exchange real-time information. Mobile applications and dashboards display live updates on ambulance location, estimated arrival times, and patient status, enabling better coordination and preparedness at all levels. This enhanced communication not only improves response times but also ensures that hospitals are ready to provide immediate care upon the patient's arrival.

As healthcare systems continue to evolve, IoT-enabled ambulance management stands as a testament to the transformative potential of technology in saving lives and improving the quality of care.

# LITERATURE SURVEY

In the last few years, several studies have used wearable technology to monitor health. A number of the contemporary evaluation techniques are discussed in the part that follows, along with some of their drawbacks:

In 2021, Mohd. Hamim, Sumit Paul suggested a IOT based remote health monitoring system for patients and elderly people[1]. In this prototype they used sensors like heart pulse, body temperature, galvanic skin response sensors for collecting data of patient. The collected data are sent to cloud storage and can be accessed by android app. In our system use different sensors including oximeter sensor for better accuracy of patient health care which can be delivered the data by real time notification.

In 2020, Carmela comito, Deborah falcone proposes a paper about integrating IOT and social media for smart health monitoring[2]. They expressed the method of tracking patient health by using various sensor and which processed by microcontroller. Then the data sent to cloud-based storage. Mainly they focus on social media users health conditions for being over face screening. In our system which take care of all people including elderly people.

In 2022, Punit Gupta, Deepika Agrawal have developed a IOT based smart healthcare kit[3]. This kit has used the IOT technology for better efficiency of transmitting data of patient health conditions. They use temperature, blood pressure, heart rate sensors for analyzing the health conditions of patients. The collected data are sent web application. In our system, we use real time notification via SMS.

In 2021, Salma sultana, Sadia Rahman suggested an IOT based integrated health monitoring system[4]. This paper proposes a smart healthcare monitoring system based on IoT, enabling 24/7 patient monitoring by doctors. Health data is collected via sensors and stored in the cloud, accessible through a mobile app.

In 2020, bong jia. Radzi Ambar presented a elderly care monitoring system with IOT application[5]. This paper aims to develop an IoT-based wearable device for elderly fall detection using an accelerometer. The system connects to the Thing Speak IoT platform, allowing remote monitoring by care providers. They use accelerometer sensor and used the Wi-Fi module for data transmission. In our system, we use GPS module for live location tracking of patient.

In 2020, Dev Gupta, Swarnaltha has proposed a paper on basis of integrated healthcare monitoring devices for obese adults using internet of things[6]. This paper aims to implement IoT technology for continuous real-time monitoring and evaluation of health conditions in obese adults. The device developed measures key physiological parameters such as SpO2, blood pressure, body temperature, and pulse rate, transmitting the data to an IoT dashboard for remote monitoring by healthcare professionals.

In 2021, E.N. Ganesh has developed a health monitoring system using raspberry pi and Iot[7]. This proposed idea will help doctors to know about the state of patient health and monitor anywhere in the world. In this proposed idea the sensors gather the medical information of the patient that include patient's heart rate, blood pressure, and pulse rate then using camera the patient is lively monitored through the raspberry kit and this information is sent to the internet and stored in a medical server.

In 2022, G. Karthick, P. Pankajavalli has proposed a paper about A Review on Human Healthcare Internet of Things: A Technical Perspective[8]. This survey paper explores the advances in Human Healthcare Internet of Things (H2 IoT) and analyses the present-day networks, architectures, topologies, platforms, services and applications in healthcare. This paper also surveys the challenges in H2 IoT design, privacy, security, threats and attack classification. In our system, we resolve all the problem faced by this paper.

In 2021, Mohd Javid has present paper on basis of Internet of Things (IoT) enabled healthcare helps to take the challenges of COVID-19 Pandemic[9]. The application of IoT helps for the better care of the patient during COVID-19 Pandemic. Real-time monitoring is successfully done with IoT and saves lives from different problems like diabetes, heart failure, asthma attack, blood pressure, etc. Smart medical devices are connected via a smartphone to transfer the required health data to the physician smoothly. These devices also collect data on oxygen, blood pressure, weight, sugar level etc.

In 2021, Ali I. Siam, Mohd. Almaiah developed a Secure Health Monitoring Communication Systems Based on IoT and Cloud Computing for Medical Emergency Applications[10]. This paper presents a secure smart monitoring portable system based on Internet-of-things (IoT) technology. The implemented system is designed to measure the health parameters: heart rate (HR), blood oxygen saturation (SpO2), and body temperature, simultaneously. An ESP8266 integrated unit is used for processing, encryption, and providing connectivity to the cloud over Wi-Fi.

# III. REASON BEHIND USING IOT TO MAKE THE MEDICAL SYSTEM EASIER AND APPLICATION OF IOT IN HEALTHCARE

The medical system is gradually improving as a result of the use of IoT devices. IoT is currently influencing the medical research sector in a big way, making it possible to start a better medical system. IoT not only saves time but also money that may be put into research. Real-time monitoring is simple with IoT devices. The importance of real-time, on-time alerts in crucial situations cannot be overstated. For example, if a patient's heart rate, blood pressure, pulse, blood sugar, or other vital signs indicate that they are in a severe situation, automatic alerts will be sent to doctors or hospitals. One of

the main reasons for incorporating IoT devices into the medical system is to make it more efficient. IoT can help with the development of healthcare components such as medical equipment and facilities. It's used in healthcare applications like telemedicine, drug management, patient tracking, imaging, and overall hospital workflow. It has the potential to lead to the creation of novel medicines to treat a wide range of illnesses.

# IV. DISCUSSION ABOUT SENSOR WHICH WE USED IN OUR PROJECT



Figure 1: proposed block diagram

The sensors that were used in this experiment are detailed below.

#### A. Microcontroller

Choose a microcontroller that meets the system's requirements in terms of processing power, memory and input or output capabilities. Popular choices include Arduino, Raspberry Pi, or microcontrollers specifically designed for automotive applications.

#### **B.** Temperature sensor

The MLX90614 is an infrared thermometer for non-contact temperature measurements. Both the IR sensitive thermopile detector chip and the signal conditioning ASIC are integrated in the same TO-39 can.

#### C. Heart Rate Sensor

The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

#### **D. ECG Sensor**

The AD8232 ECG sensor is a commercial board used to calculate the electrical movement of the human heart.

#### E. GPS Module

It can track up to 22 satellites over 50 channels and achieve the industry's highest level of tracking sensitivity i.e. -161 dB, while consuming only 45 mA current.

#### G. GSM Module

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls.

#### F. Wi-Fi Module

The ESP8266WiFi Module is a self-contained SoC with integrated TCP/IP protocol stack that can give access to your Wi-Fi network (or the device can act as an access point).

## V. PROPOSED METHOD AND BLOCK DIAGRAM

An Arduino uno board was used in this system with a connection of Wi-Fi module to perform the IOT functions and android application based remote healthcare system. The sensor that used in this system to measure the parameters of body conditions like heart rate, oxygen saturation and body temperature from the following patient.

When the sensor measures the respective parameters will be calculated with the preset of dataset to monitor that the parameter reading is under the normal range. If it exceeds the limit range from any one of the parameters, it will send a SMS message via GSM module to the particular person who

monitor the patient along with the patient exact location. The respective data will be also store in cloud base storage. That data can be accessed by doctors through web applications from anywhere.

In this system, the power supply was applied to the Arduino board with the value of 3v - 5v to the Vcc pin. The sensors take the power supply from the microcontroller itself. Only the GSM module and GPS module uses relay to power up its activity. The sensors output data will be given to the analog pins in microcontroller board. The GPS is also sent the input data of location through the digital pin. After all process the output data was sent the GSM module via digital pin of microcontroller. With the help of wifi module the final output data are sent to cloud base storage. The AWS cloud storage is used for cloud storage of patient data and also with web application these data can be retrieved and view by the medical officials or doctors.

# VI. SIMULATIONS AND EXPERIMENTAL RESULTS

The proposed solutions have been designed using the software called proteus. This software is allowing users to simulate the behaviour of the designed circuits, providing a virtual testing ground before moving to the physical prototype stage.



Figure 2: Simulated circuit



#### Figure 3: Simulated result

The output of simulated was achieved by digital oscillator which is presented in the proteus software itself. The sharp rise and sharp fall ramp waveform denote that the heart rate of patients and below the waveform denotes that temperature rate in below it limits. If it exceeds the limit, the waveform will rise.

# VII. CONCLUSION

It has been proposed to implement a real time health care monitoring system to detect the abnormal conditions of a patient was described. Temperature and pulse parameters were acquired by the patient and processed with microcontroller to monitor the patient. Its purpose is to assist both the patient and the physician at any time and from any location. We can avoid a critical crisis by using this system. The number of patients is currently so large that doctors are having difficulty keeping track of them. Our system uses real-time data, so if an irregularity happens, a notification will be sent to the doctor right away, and the doctor will be able to take the appropriate steps personally or through the nurse.

#### **VIII. FUTURE WORK**

This project was developed with extra another sensor which is called oximetry sensors to monitor the oxygen level of patient. The features of obtaining the patients location with GPS module and transmitting the data over network using GSM module which has sim card within it. If any of one sensors parameter if beyond it limit, then it performs real time notification sender, all corresponding data will be stored in IOT platform for medical official's purpose.

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