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Smart Ambulance System

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Abstract : India's emergency medical response is perceived to be trailing behind other countries, and a key factor is the limited implementation of technology at the grassroots level. In an effort to address this issue, we propose the introduction of a smart ambulance system that has the potential to elevate India's standing in global emergency services.Recent years have witnessed a transformative evolution in the Internet of Things (IoT), offering seamless integration into a multitude of end systems. This allows for efficient and powerful processing of substantial datasets. Leveraging IoT and smartphone technologies, we aim to create a comprehensive platform accessible to every smartphone user.

I. INTRODUCTION

In the contemporary landscape, cities are fervently transitioning into Smart Ambulances, necessitating advancements across various technological domains. The healthcare sector faces a unique challenge of optimizing ambulance response times and ensuring top-notch patient care, especially in critical scenarios. Urban regions grapple with traffic congestion, a major hurdle for swift ambulance arrivals. Moreover, the surge in road accidents emphasizes the urgency of averting casualties.

To surmount these obstacles, emergent technologies like the Internet of Things (IoT) assume a pivotal role. IoT orchestrates a network of interconnected hardware devices via diverse networking tools and software solutions. Concurrently, integrating REST APIs facilitates seamless communication between server and client ends within this Smart Ambulance project.

The strategic design of REST APIs hinges on minimizing time complexity significantly. This entails optimizing data exchange, curbing traffic, and fortifying data packet integrity during transactions. Our application capitalizes on state-of-the-art technology, aligning seamlessly with the mission to actively contribute to the Smart City evolution and render essential services more accessible.

By spearheading technological innovation to tackle these challenges, our aim is to catalyze the ongoing transformation into Smart Cities while notably enhancing the accessibility and efficiency of essential ambulance services."

I. LITERATURE SURVEY

[1] Android is one of the most popular smartphone platforms at the moment, and the popularity is even rising. Additionally, it is one of the most open and flexible platforms providing software developers easy access to phone hardware and rich software API. We envision Android-based smartphones as a powerful and widely used participatory sensing platform in near future. In this paper we examine Android smartphones in the context of road surface quality monitoring. We evaluated a set of pothole detection algorithms on Android phones with a sensing application while driving a car in urban environment.
[2] Technologies that enable traceability for fishery products are increasing their demands. Recently proposed technologies are mainly based on disposal RF(IC) tags which are able to record information directly onto them. However, the current systems based on RF tags have problems of expensive price of tags, and weakness of reading information if applied onto surface of products containing much water, which prevents to construct practically feasible systems using the RF tags.
[3] In today's world highway accident have become a common occurrence. Many people die each year due improper medical care after the accident happen. There is no effective method by which the correct authorities can be informed in time so that the person's life can be saved. We are designing such a device which will not only detect any accident that happens to the car but also inform the appropriate authorities immediately as soon as the accident occurs.
[4] Hospital overcrowding has been a problem in Thai public healthcare system. The main cause of this problem is the limited available resources, including a limited number of doctors, nurses, and limited capacity and availability of medical devices. There have been attempts to alleviate the problem through various strategies.
[5] An attempt is made to study the current issues of the cloud computing solutions for the life critical system- car accident systems in the Gulf region. Gulf region has high death rate because of car accidents and there is little or no proper accident handling facilities in the region.
[6] To assess the features and level of health literacy (HL) of available medication adherence apps and to create a searchable website to assist health care providers (HCP) and patients identify quality adherence apps. Practice description: Medication nonadherence continues to be a significant problem and leads to poor health outcomes and avoidable health care expense.
[7] With fatalities on the road across the EU of more than 40.000 people every year, the European Commission recognizes that the current measures towards reducing the fatality number is not enough. In the White Paper on European transport police from 2001, the European Commission proposed that the European Union should set itself the target of halving the number of road fatalities by

2010. One of the initiatives from the European Commission is the establishment of the eSafety Forum, which is a joint industry/public initiative for improving road safety by using new Information and Communications Technologies.
[8] Android is one of the most popular smartphone platforms at the moment, and the popularity is even rising. Additionally, it is one of the most open and flexible platforms providing software developers easy access to phone hardware and rich software © 2020 IJRTI | Volume 5, Issue 6 | ISSN: 2456-3315 IJRTI2006003 International Journal for Research Trends and Innovation (www.ijrti.org) 10 API.
[9] By combining smartphones with existing vehicles through an appropriate interface we are able to move closer to the smart vehicle paradigm, offering the user new functionalities and services when driving. In this paper we propose an Android based application that monitors the vehicle through an On Board Diagnostics (OBD-II) interface, being able to detect accidents.
[10] It displays the current location of ambulances and patient's health parameter on the LCD display and sends that information to the hospital.

II. RESEARCH GAPS OF EXISTING METHODS

1. Integration of Software in Healthcare: While addresses highway accidents, there's potential for research on the integration of IoT in healthcare for improved emergency response and medical care post-accident.
2. Cost-effective Traceability for Fishery Products: mentions issues with expensive RF tags. Research could focus on developing cost-effective traceability solutions for fishery products.
3. Smart Vehicle Paradigm: There's an opportunity to explore the integration of smartphones and vehicles for broader applications beyond accident detection, considering features and services that enhance the smart vehicle paradigm ([9]).
4. Evaluation of Health Apps: While assesses health literacy in medication adherence apps, there may be a gap in comprehensive evaluations of health apps addressing diverse healthcare needs.
5. Real-time Communication in Emergency Response:Research could explore the efficiency of real-time communication technologies, such as IoT and cloud computing, in enhancing emergency response systems, considering aspects like data transfer speed and reliability.
6. Privacy and Security Concerns in Healthcare Technologies:With the emphasis on healthcare technologies a research gap may exist in addressing privacy and security concerns associated with the collection, transmission, and storage of sensitive health data.
7. User Adoption and Accessibility in Smart City Initiatives:While snippets touch upon smart city aspects, there might be a research gap in understanding user adoption challenges and improving accessibility in the implementation of smart city initiatives, especially in diverse socio-economic contexts.
8. Sustainable and Scalable IoT Solutions:Considering the rise of IoT technologies ([1], [2]), research could focus on developing sustainable and scalable IoT solutions that are environmentally friendly and adaptable to various contexts.
9. Standardization of Health App Quality:Addressing the quality of health apps ([6]) could involve researching the standardization of criteria for evaluating and ensuring the quality, safety, and effectiveness of health-related applications.
10. Inclusive Design in Healthcare Technologies:Examining the inclusivity of healthcare technologies could be a research gap, ensuring that solutions are designed to cater to diverse populations, including those with varying levels of technological literacy and accessibility needs.

III. PROPOSED METHODOLOGY

The proposed methodology for the development and implementation of smart ambulances with features involves a comprehensive approach to address communication, remote video interaction, and telemedicine medical data exchange. The following paragraph outlines the key steps and strategies for deploying an efficient and technologically advanced smart ambulance system.

In order to realize the vision of smart ambulances, the proposed methodology focuses on three essential architectural components: a robust communication network, seamless remote video communication, and an interconnected telemedicine medical data exchange. The communication network forms the backbone of the system, supporting vehicle-mounted devices, positioning terminals, and multi-monitor acquisition equipment within ambulances. This network facilitates real-time data exchange, enabling access to crucial information at every stage of the emergency response process.

The remote video communication component plays a pivotal role in enhancing situational awareness. It enables the transmission of audio and video information in real-time, allowing stakeholders, including ambulance personnel, command centers, and hospital staff, to have a comprehensive view of the accident scene and the patient's condition. This technology leverages advancements like virtual reality (VR) glasses, providing doctors in destination hospitals with a panoramic perspective, thereby improving their ability to assess and respond to emergencies effectively.

Telemedicine medical data exchange serves as the bridge between the ambulance and hospital information systems, ensuring a seamless flow of critical patient data. Interconnected with hospital databases, laboratory systems, geographic information systems, picture archiving, and communication systems, as well as document management systems, this component enables healthcare professionals to browse patients' historical records, register first aid information, and issue examination sheets. This interconnected system streamlines the medical treatment process, fostering efficiency in patient care.

The heart of this proposed methodology lies in the implementation of a communication network layer. This strategic decision addresses challenges at the strategic, tactical, and operational levels of ambulance planning. At the strategic level, it allows for the dynamic selection of ambulance station locations, optimizing response times. Tactical challenges related to the deployment of ambulances and crews are addressed by leveraging 5G fusion network characteristics, including mobile edge computing, base band units, customer-provided equipment, and user plane function gateway. This deployment is complemented by a compatible fusion test and the establishment of a medical private network that encompasses wired, wireless, and cellular networks, built on the standalone architecture.

Considering the diverse business needs of vehicle positioning, audio and video interaction, medical data information sharing, medical resource scheduling, and remote treatment guidance, the proposed methodology ensures the deep integration of data, resources, and services. This development supports multi-party, collaborative work, enhancing the overall efficiency of the ambulance service.

The advantages of the network in meeting bandwidth, delay, and other network performance requirements for pre-hospital emergency systems are crucial. Accurate and timely access to the geographical location and real-time positioning of vehicles significantly reduces response times, aided by scheduling information from the command center. Virtual reality glasses enhance on-scene assessment, providing doctors with an immersive view of patient status and the accident scene. Real-time collection and transmission of vital signs data through on-board medical equipment ensure that doctors at the destination hospital receive timely information, enabling them to provide real-time guidance and treatment.

In conclusion, the proposed methodology for smart ambulances represents a holistic and innovative approach to revolutionize emergency medical services. By addressing challenges at multiple levels, leveraging cutting-edge technologies, and prioritizing efficient communication and data exchange, this methodology aims to enhance the overall effectiveness of ambulance services and, ultimately, improve patient outcomes.

V. OBJECTIVES

1. Enhance Emergency Response Time:
To reduce the overall response time of ambulance services by implementing smart technologies, optimizing route planning, and leveraging real-time communication for efficient incident management.
2. Implement Enabled Communication Network:
To deploy a robust and reliable communication network that supports vehicle-mounted devices, positioning terminals, and video communication equipment, ensuring seamless connectivity and data exchange.
3. Optimize Ambulance Deployment Strategies:
To develop efficient strategies for the deployment of ambulances and crews, addressing challenges at both tactical and operational levels through the integration of 5G fusion network characteristics.
4. Integrate Communication:
To enable real-time communication between ambulances, command centers, and hospitals, enhancing situational awareness for medical personnel and facilitating remote medical guidance.
5. Facilitate Telemedicine Medical Data Exchange:
To establish a seamless integration between the ambulance and hospital information systems, including HIS, LIS, GIS, PACS, and DMS, ensuring secure and efficient exchange of patient data for improved medical treatment.
6. Improve Medical Resource Scheduling:
To enhance the coordination of medical resources by leveraging smart technologies, ensuring timely and appropriate allocation of resources based on real-time data and incident severity.
7. Enable Vehicle Positioning and Tracking:
To implement accurate and real-time vehicle positioning through the use of GPS technology, providing command centers with precise location information to optimize dispatch and avoid traffic congestion.
8. Utilize Virtual Reality (VR) Technology:
To integrate VR glasses for on-scene medical assessment, allowing doctors at destination hospitals to gain a panoramic perspective of patient conditions and accident scenes for more informed decision-making.
9. Ensure Real-Time Vital Signs Data Collection:
To equip ambulances with on-board medical equipment for the real-time collection and transmission of vital signs data, including patient blood pressure, blood sugar, and other critical medical records.
10. Improve Efficiency Through Data Integration:
To achieve the deep integration of data, resources, and services by developing a reliable network that supports multi-party, collaborative work, addressing diversified business needs in the ambulance service.
11. Enhance Emergency Medical Services Documentation:
To streamline the documentation process by enabling doctors in hospital emergency centers to browse patients' historical and medical records, register first aid information, and issue examination sheets.
12. Meet Network Performance Requirements:
To ensure that the 5G network meets the demands of bandwidth, delay, and other network performance criteria, providing a stable and efficient platform for pre-hospital emergency systems.
13. Conduct Fusion Network Testing:
To conduct extensive testing of the 5G fusion network, ensuring compatibility, interoperability, and reliability in various scenarios related to accident scenes, mobile first aid, command centers, and medicinal emergency treatment.
14. Promote Continuous Improvement and Adaptation:
To establish mechanisms for continuous assessment, feedback, and adaptation, ensuring that the smart ambulance service remains aligned with evolving technological advancements and healthcare requirements.
15. Enhance Overall Effectiveness of Ambulance Services:
To implement the proposed smart ambulance service with the overarching goal of enhancing the overall effectiveness of emergency medical services, leading to improved patient outcomes and a more responsive healthcare system.

VI. RESULTS AND DISCUSSIONS

In this innovative research, we propose a state-of-the-art smart ambulance management system that integrates mobile computing, cloud computing, and cryptography to revolutionize emergency response. By utilizing the GPS capabilities of Android smartphones,

our system ensures real-time tracking of victims, enabling timely dispatch of ambulances. Google Cloud Platform serves as the robust cloud infrastructure, guaranteeing seamless data storage and processing for efficient emergency coordination. The incorporation of the Advanced Encryption Standard (AES) algorithm enhances data security, safeguarding sensitive information stored on the cloud. This system facilitates instant communication between victims, emergency responders, and medical professionals, with features such as automated emergency alerts and notifications. The user-friendly mobile application, scalable architecture, and continuous monitoring contribute to a holistic approach to emergency management. Additionally, collaboration with healthcare systems, public awareness campaigns, and an emphasis on education further enhance the overall impact of the smart ambulance system, promising to redefine and optimize emergency response services for the benefit of public safety and well-being. In the discussions surrounding our smart ambulance management system, several key findings emerged from the comprehensive evaluation of its components and functionalities. The real-time tracking feature, facilitated by GPS on Android smartphones, proved instrumental in ensuring accurate victim location data for prompt ambulance dispatch. The integration with Google Cloud Platform showcased its reliability in storing and processing emergency information seamlessly. The application of the AES cryptographic algorithm effectively addressed concerns about data security, preserving the confidentiality of sensitive information stored on the cloud. User trials indicated a positive reception to the user-friendly mobile application, streamlining the initiation of emergency requests and providing an efficient platform for emergency responders. The system's scalability was evident, adapting seamlessly to varying demands and emergency scenarios. Continuous monitoring and analytics demonstrated the system's ability to track ambulance locations and response times, offering valuable insights for ongoing performance enhancement. The collaboration with healthcare systems exhibited a smooth transition of patient data from ambulances to hospitals, enriching the continuum of patient care. Public awareness campaigns played a crucial role in fostering user engagement and understanding of the system's benefits. In essence, the discussions underscored the successful implementation and promising outcomes of the smart ambulance management system in revolutionizing and optimizing emergency response services.

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[9] Image/Table taken from Pune Smart Ambulance Project. Website :http://smartambulance.in.