

Chapter 22

A Cloud-Based Smartphone Solution for Transmitting Bio-Signals From an Emergency Response Vehicle

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ABSTRACT

Most developing countries are currently unable to provide adequate, let alone advanced healthcare support to rural areas. Telemedicine combines the capability of information technology and dedicated people working towards the common goal of providing good quality healthcare in remote areas. In this article, the authors propose a system that can be used to transmit patient vitals like pulse rate, oxygen saturation, and perfusion index readings to a doctor in a remote area, while a patient is in transit. This system uses a smartphone application, a pulse oximeter, and the real-time data transferring capabilities of Firebase (a cloud database). The application has been tested under various network conditions which includes connection types such as 2G (2nd Generation), 3G (3rd Generation), 4G (4th Generation), and Fiber To The Home (FTTH). The work also discusses the possible reasons for the higher performance found in 4G networks over 3G and 2G cellular connections.

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1. INTRODUCTION

Information technology and computer systems have come a long way over the time in providing assistance in the medical field. This has resulted in the creation of telemedicine, breaking the distance barrier by providing health assistance. It has helped in establishing remote communication between a patient and a doctor and enabled them to transmit auditory and visual information. Telemedicine plays a major role in providing health assistance to remote areas where proper hospitals or healthcare centers are unavailable or scarce. Doctors and healthcare experts all around the world are able to discuss and come up with optimal solutions to difficult problems. Another area in which telemedicine provides assistance is in transmitting bio-signals like ECG, Pulse Rate, SpO₂, etc. This helps a doctor in diagnosing patients even before they get to the hospital, which in certain cases could help in saving lives.

Villages rarely have advanced healthcare facilities, so when a patient is in need of better medical expertise and facilities, they are forced to seek out hospitals in major towns and cities. It is important to quickly decide which hospital has all the required facilities. This can be done with the help of a smartphone application that makes use of a database with relevant data. The software can also be equipped with the features for gathering patient vitals and transmitting them over to the doctor after the hospital has been decided.

The proposed system models a smartphone application that targets the Android platform. The novelty of the proposed system lies in the system's capability to transmit biosignals of a patient captured with the help of a pulse oximeter device during the patient transfer phase from an Android smartphone. The android application can change the content shown within the application based on the user's designation and can gather bio-signals from a patient and deliver it to the doctor. This means that when a doctor logs in to the application, he/she will be shown the activities (user interface of an android application) appropriate for a doctor like the list of patients. When a paramedic logs in to the application, he/she will be shown activities with options to create new patient data and upload patient biosignals. For communication purposes, the application uses LTE connectivity. The proposed system will help a doctor in acquiring the biosignals of a patient and provide instructions to the paramedic if necessary based on the acquired information. For implementation, experimentation and testing purposes, an Android platform is being used. Pulse oximetry is one of the common measurements widely used in a clinical setting. A human eye can only recognize hypoxemia when the oxygen (O₂) saturation is below 80%. But according to research done by Boston et al. (Bohnhorst, Peter, & Poets, 2000), O₂ saturation < 90% were observed for at least 5 min duration in 26% of the patients. So, it is vital to detect acute hypoxemia which is hard to detect with human eyes. In this system, we are using a pulse oximeter device for getting the bio-signals (SpO₂) from a person. The research is done to understand the reliability of the proposed system in different types of cellular connection.

2. RELATED WORKS

In 2003, Roberto J Rodrigues and Ahmad Risk (Rodrigues & Risk, 2003) presented a review of health trends and issues in the ICT (Information and Communication Technologies) in introducing eHealth technologies in Latin America and the Caribbean. They have proposed actions that can be followed for the faster development of eHealth technologies in the region. The authors conclude that the region is currently not prepared for adopting the ICT. Another research by Ricardo Cardoso et al. (Cardoso et al.,

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