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A Review on Real Time Processing and Transferring ECG Signal by a Mobile Phone for Multiple Patients

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***Abstract* - The real-time processing and transfer of ECG (Electrocardiogram) signals using mobile phones have become increasingly important in modern healthcare systems. This paper presents a system that captures ECG signals from a patient via a portable ECG sensor, processes the data in real time on a mobile device, and transfers it to healthcare professionals or remote monitoring systems through wireless networks. The proposed system leverages the processing power of modern smartphones to filter, analyze, and extract significant features from the ECG signals, such as heart rate and arrhythmia detection, using signal processing algorithms. By using mobile communication technologies (e.g., 4G/5G), the processed data is then transmitted to cloud servers or medical centers, enabling continuous monitoring and timely diagnosis. This approach enhances patient mobility, reduces the need for bulky medical equipment, and supports real-time decision-making for critical heart conditions. The system also integrates user-friendly interfaces, ensuring accessibility for both patients and clinicians. Initial results demonstrate the system's efficiency in providing accurate ECG analysis with low latency, showing potential for widespread use in telemedicine and remote healthcare monitoring applications.**

Keywords: ECG Signal, mHealth, Real time processing, Electrocardiogram, ECG sensor.

I. INTRODUCTION

In recent years, advancements in mobile health technologies have transformed the way healthcare services are delivered. One of the most significant developments is the real-time processing and transferring of Electrocardiogram (ECG) signals using mobile phones. This technology allows healthcare providers to monitor multiple patients heart conditions simultaneously, ensuring timely diagnosis and intervention in critical situation. ECG signals are essential for assessing the electrical activity of the heart and detecting abnormalities such as arrhythmias, myocardial infarctions, and other cardiovascular diseases. The system works by acquiring ECG signals from patients through wearable sensors or portable ECG devices. These signals are then processed in real-time on a mobile phone, where algorithms analyze the data for potential abnormalities. The processed ECG data can be transmitted wirelessly to healthcare professionals through secure communication channels, enabling them to monitor multiple patients simultaneously, regardless of their location. This approach enhances the efficiency of healthcare delivery by reducing the need for constant in-person monitoring, allowing timely interventions, and improving patient outcomes. Additionally, it is particularly beneficial in emergency situations, rural areas, or during large-scale medical events where multiple patients need to be monitored in real-time. The use of mobile phones for ECG signal processing and transfer can significantly reduce healthcare costs and improve access to medical services globally.

II. RELEVANCE

Real-time processing and transferring ECG signals via mobile phones revolutionizes cardiovascular healthcare by enabling remote monitoring, timely diagnosis, and emergency response. This technology integrates seamlessly with wearable devices and IoT applications, increasing accessibility and convenience. Healthcare costs decrease as hospital visits minimize, and research benefits from large-scale data collection. Despite challenges like signal quality and power consumption, the benefits are profound:

- Remote monitoring for timely interventions
- Enhanced patient engagement and self-management
- Improved diagnosis accuracy
- Streamlined clinical workflows
- Advanced medical research and algorithm development

III. LITERATURE REVIEW

Mahsa Raeiati: In mobile health care monitoring, compression is an essential tool for solving storage and transmission problems. The important issue is able to recover the original signal from the compressed signal. The main purpose of this paper is compressing the ECG signal with no

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loss of essential data and also encrypting the signal to keep it confidential from everyone, except for physicians. In this paper, mobile processors are used and there is no need for any computers to serve this purpose. After initial preprocessing such as removal of the baseline noise, Gaussian noise, peak detection and determination of heart rate, the ECG signal is compressed. In compression stage, after 3 steps of wavelet transform (db04), thresholding techniques are used. Then, Huffman coding with chaos for compression and encryption of the ECG signal are used. The compression rates of proposed algorithm are 97.72 %. Then, the ECG signals are sent to a telemedicine center to acquire specialist diagnosis by TCP/IP protocol.

Kambiz Bahaadinbeigy: The real-time ECG signal processing system based on mobile phones is very effective in identifying continuous ambulatory patients. It could monitor cardiovascular patients in their daily life and warns them in case of cardiac arrhythmia. An ECG signal of a patient is processed by a mobile phone with this proposed algorithm. An IIR low-pass filter is used to remove the noise and it has the 55 Hz cutoff frequency and order 3. The obtained SNR showed a desirable noise removal and it helps physicians in their diagnosis. In this paper, Hilbert transform was used and the R peaks are important component to differ normal beats from abnormal ones. The results of sensitivity and positive predictivity of algorithm are 96.97% and 95.63% respectively. If an arrhythmia occurred, 4 seconds of this signal is displayed on the mobile phone then it will be sent to a remote medical center by TCP/IP protocol.

IV. OBJECTIVES

1. The main objective of this project is to develop a system that can capture, process, and transmit ECG signals in real time using a mobile phone.
2. The system aims to allow for continuous patient monitoring, early detection of heart abnormalities, and efficient communication with healthcare professionals.

V. ANALYTICAL TREATMENT

Here's an analytical treatment for real-time processing and transferring ECG signals by a mobile phone for multiple patients:

The system utilizes a mobile phone's processing unit to acquire, process, and transmit ECG signals from multiple patients in real-time. The ECG signal is first filtered to remove noise, baseline wander, and powerline interference, followed by amplification to increase signal strength. Feature extraction techniques detect R-peaks, QRS complexes, and other relevant features, enabling arrhythmia detection. Fast Fourier Transform (FFT), Wavelet Transform, and Machine Learning algorithms facilitate real-time processing. The mobile phone's communication modules securely transmit the processed ECG data to a remote server or cloud for storage and analysis. Data encryption ensures confidentiality, and cloud storage solutions (AWS, Google Cloud, Microsoft Azure) enable scalable storage. A database management system (MySQL, MongoDB) efficiently manages multiple patient profiles, real-time ECG signal streaming, and alert systems for abnormal heart rhythm detection.

VI. METHODOLOGY

1. Signal acquisition.
2. Signal processing.
3. Feature extraction.
4. Real time processing and analysis.
5. Secure data transmission.
6. Monitoring and alerting.

VII. CONCLUSION

Recent technological advances, especially that of the mobile phone have had the possibility of developing health care systems with the aim of monitoring the health status of patients. A software program is designed to receive the ECG signal, real-time process it in the mobile phone and then transfer to a remote medical center. A diagnostic software program is designed to help physicians and medical assistants who have problems in distinguishing ECG and work in deprived regions. The main objective is to access optimized method to eliminate noise of the signal and maintain important property of ECG signal and monitor the patient round the clock. Heart rate is a vital signal to determine a patient's health status. With continuous measurement, we can be successful in early and rapid diagnosis of two major adverse cardiac disorder such as bradycardia (decreases in heart rate) and tachycardia (increase in heart rate). Primary experiments had successful results for our health care system.

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