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IIoT Based Health Monitoring System

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Abstract: In the field of interconnected medical devices & sensors, Internet of Things (IOT) has played a vital role in the healthcare industry for the next generation patient care. Moreover, there is an increase in the number of elderly & disabled people each day and there is a need for an immediate healthcare infrastructure in treatment of such people to avoid unnecessary & preventable deaths.In this paper we are presenting a Health IIoT enabled monitoring framework, where ECG and other healthcare data are collected by mobile devices and sensors and securely sent to the server for seamless access by healthcare professionals Signal enhancement, watermarking, and other related analytics will be used to avoid identity theft or clinical error by healthcare professionals. The suitability of this approach has been verified through both experimental evaluation, and simulation by using an IoT- driven ECG - based health monitoring service in the server.

Keywords: Signal enhancement; watermarking

I. INTRODUCTION

Today, the use of the Healthcare monitoring system is rapidly increasing .According to Gartner and Forbes, it is estimated that by 2020, the Internet of Things (IoT) will contribute $1.9 trillion to the global economy and $117 billion to the IoT-based healthcare industry [1]. In reference to this, it is estimated and expected that the Healthcare Industrial IoT (HealthIIoT) will be one of the vital players in the Industrial Internet of Things (IIoT) - driven healthcare industry. IIoT, also remarkably has an influence across many large and small health care corporates and industries.

As a result, an increasing number of wearable IoT devices, tools, and apps are being used for different monitoring applications e.g., glucose Monitors , ECG monitors, and blood pressure monitors to avoid unnecessary and preventable death due to hospital or other related errors. At times, errors may occur before, during, or after hospitalization. Currently, Health IIoT is still in its preliminary stages with regards to design, development, and deployment; however, IoT-based solutions are currently displaying a remarkable impact, and shaping out a growing market in today's healthcare industry and tomorrow's emerging IIoT - based healthcare monitoring solutions. It can also be predicted, IIoT has the potential to save 50,000 people and more each year in the USA by avoiding preventable deaths due to unavoidable hospital error [2]. Researches reveals, in the healthcare Industry IoT can provide better care with reduced costing, minimize the direct patient0healthcare staff interaction, and ubiquitous access to quality care [3].Mohammed Et Al, has developed a remote patient monitoring system using web services and cloud computing [4]. Hassanalieragh Et Al, has discussed the challenges and opportunities of health monitoring and management using IoT [5]. To date, however, no comprehensive study has been published about server-assisted IIoT-driven health monitoring. High-quality and Safe healthcare service is of Supreme importance to patients. Accordingly, health care data security and patients' privacy are some of the important issues that will have a great impact on the future success of Health IIoT. One of the major issues in the IIoT-based health care system is the confidentiality & protection of privacy. In general, a healthcare service provider receives data from its users (such as patients) and shares them with registered clinics or healthcare professionals. The provider may also distribute the data to health insurance companies and pharmaceutical companies. Moreover, patient data can be vulnerable to hackers during cloud transfer or synchronization with interconnected devices. To this end, this paper describes an IIoT based health monitoring framework, where health monitoring signals are authenticated. At the receiver side, the smartphone software or desktop application removes noise from the signal, insert a watermark for security purposes, heartbeat is monitored via an algorithm. The watermarked signal is then transmitted to server; the features are taken out and divided via one class machine classifier. The classification with watermarked signal is passed to the Doctor for analysis. The doctor then sends back the server. The server then intimate to the patient.

II. PROPOSED HEALTH IIOT ENABLED MONITORING FRAMEWORK

Health IIoT has ability to boost today's healthcare industry with cheap and good care by a large number of interconnected machines, devices and sensors, and collect patient data. This HealthIIoT technology will play an important role in a number of health monitoring applications, to form a Healthcare Industrial IoT ecosystem. Fig. 1 describes a IIoTdriven healthcare system. As shown in Fig. 1, one stakeholder is connected to another type of s shown in Fig. 1, one type of stack holder is connected to other stakeholder to form a difficult HealthIIoT ecosystem. It also release emergency services to the patient when required, and orders pharmacy. In the system, interconnected 'Things' are coordinated. It gives fast transfer of patient information with the stakeholders, so that patient data are

available only to authorized healthcare. Finally, server based analytic enables analyzing, storing, closely monitoring, and securely sharing the data further review and advice, aimed towards fulfilling services of Industrial IoT in regard to patient care, real time patient monitoring, and avoiding hospital error. It creates a platform for interconnected devices to work with large data from anywhere. The data are actually generated by interconnected smart devices, communication software, and their usage in healthcare monitoring. Data are collected and analyzed from health records, sensors, devices, and smartphones. This analysis attach the decision making power of Doctors, and enables patients have a role in managing their health. Outlines how the flow of a patient's healthcare data is captured .how it is transferred through a connection to the server data for further analysis such as feature extraction, classification, verification, workload measurement. After being processed and securely stored in the server, the data is either used by Doctor, or given to external systems for further industry specific healthcare IoT solutions. The major components of the framework are given below. Healthcare staff and other related user: Patients will upload their ECG reading with the help of ECG reading device, the device is connected with the internet and the reading will be stored in server, and from the server the health care professional will fetch the data and advice the patient according to the reading.

Fig 1. Conceptual illustration and scenario for HealthIoT ecosystem

ECG signal capturing and recording service: this service is used for reading the records and storing the records from different devices and Smartphone.

Secure transmission service: allows secure and protective transmission of ECG signals through the internet. We use watermarking for encryption and later it is extracted to verify the authenticity. Resource allocation manager: it will manage the resources and web services. Server system manager: it manages all machines and allocates resources through resource allocation manager, for example ECG monitoring manager, and watermarking manager.

1) *ECG signals and record serving management:* This is used for user management and user health report record and store on the server database.
2) *ECG monitoring session management:* used for controlling and managing the session, and also used for locating and tracking activities.
3) *Feature extraction and classification management:* before sending the data to the server it fetches the data from the Smartphone.
4) *Signal reconstruction enhance and watermarking:* for the propose of tracking the performance of the function the web service generates the records.

III. PROPOSED HEALTH MONITORING APPROACH

An ECG monitoring system base was proposed by Pandeyaetal. In their system, ECG data were collected by mobile devices and were sent to the server for analysis. The system was just a, and therefore, problems remained in its fully practical usage in term of data collection and transmission. The first issue is to ensure the effectiveness of ECG data collection through mobile devices. Physiological artifacts can be caused by muscular activities that result in small spikes, and by human motion that results in large swings in the recorded data. Non-physiological artifacts can be produced by electrical interference and electrode malfunction.

Electrode malfunction is initiated by loose connections, electrode misplacement, low amount of electrode gel, etc. Of them, electrode misplacement is a major source of malfunction of ECG data. Cable misplacement can even result in ECG that resembles cardiac abnormalities like ectopic rhythm. Therefore, in the proposed framework, the recorded ECG signals are enhanced before processing .In the enhancement stage; the recorded ECG signal is passed through a low pass filter to suppress the high frequency components that are referred to noise. A 25 point moving average filter is then applied to the output of the low pass filter to smooth the signal.

IV. RESULT

We have now calculated the BPM of the patients and sent the recorded values to the Hospital server.

Fig 2. BPM Calculation

V. CONCLUSION

IIoT-driven healthcare monitoring is an emerging healthcare service that may potentially revolutionize the healthcare industry in terms of improving access to patient information, and offer quality patient care through continuous monitoring from anywhere at any time, through a multitude of devices. With HealthIIoT, healthcare professionals may be able to access patient information, store it, and analyze it in a real-time manner to monitor and track the patient. However, interconnected wearable patient devices and healthcare data (such as ECG signals) are subject to security breaches. To this end, this paper describes a cloud-integrated HealthIIoT monitoring framework, where healthcare data are watermarked before being sent to the cloud for secure, safe, and high-quality health monitoring. Future work will involve testing the proposed HealthIIoT monitoring framework for data security and notification functions, as well as implementing a test trial with real world patients and health professionals.

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