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Design of Remote Patient Monitoring System for Chronic Diseases

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Abstract: Nowadays, Chronic diseases are turning out to be widespread. Treatment and observing of these diseases require going to hospitals regularly, which adds to the burdens of hospitals and patients. Present day's advancements in smart sensors and communication devices add to improving the medical care system such that will reshape medical services such as Remote Patient Monitoring (RPM) methods based on the collection of patient's body vital signs extricated using intrusive and non-invasive techniques, then sending them continuously to caretakers and doctors. This information might help doctors in taking the perfect decision at the right time. The objective of this paper is to design research headings on Remote Patient Monitoring (RPM), proposing a design of AI-based RPM, its benefits, its challenges, and its possible future bearings.

Keywords: Remote Patient Monitoring (RPM), Electronic Health Record (EHR), and Internet of Things (IoT)

I. INTRODUCTION

Remote Patient Monitoring Systems (RPMS) considering Nurse Navigators (NNs), E-Health, and patient engagement can help patient treatment and positively affect the nature of care (by reducing emergency situations) and treatment cost (by limiting readmissions). However, the degree of this impact relies upon effective implementation which is often limited. This is somewhat due to the lack of interest paid to the RPMS setup stage preceding implementation. The model of the RPMS can be planned at this stage and different obstacles are expected. Our point was to cover an RPMS design case to give insight into the technology needed to deal at the design level. Then again, Patient Monitoring systems are significant in emergency clinics; for instance, they can be used to rank patients in view of their health conditions, permitting clinics to focus on critical patient care.

The widespread utilization of smartphones has essentially impacted the number of patients using healthcare services. The number of patients utilizing smart devices has increased from 35,000 in 2013 to 7 million out of 2018. In this way, RPMs altogether impact patients with different supporting technologies.

Remote Patient Monitoring Systems (RPMS) play a significant part in both doctor and patient. They help doctors in diagnosis and treatment as well as further improve medical services remotely, which influences the patients' quality of life.

II. DESIGN AND DIFFERENT COMPONENTS OF THE RPM SYSTEM

Standard RPMs are planned to persistently capture a variety of health information from patients and permit doctors to be consistently observed using different inward and outer smart sensors.

The principal steps of building RPMs can be summed up as follows,

1. **Data acquisition:** The patient's vital signs are continuously checked using invasive methods. This progression is used to extricate essential signs, for example, (ECG, EEG, pulse, blood pressure, and so on). In addition to these health vital signs, smart wearables are used to get other context factors, for example, (room temperature, humidity, and so on)

2. **Data Transmission and Storing:** All the health data is aggregated and transmitted to the cloud side for analysis, processing, and decision making. Cloud information could be gotten to from various sources incorporate (research center, rescue vehicle, facilities, drug store, and so forth)

3. **Backend systems:** All information is analysed, then used to assist doctors in decision-making about patient condition.

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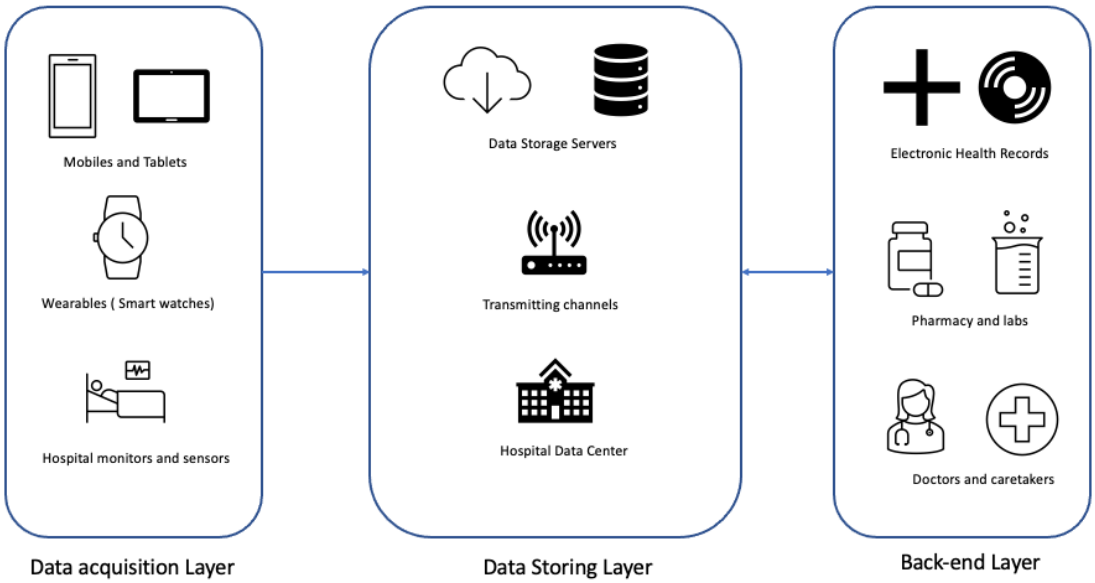

Fig. 1 General architecture of Remote Monitoring system patients

The following points detail the advantages of RPMS in the medical domain.

- Provides patient assurance: RPMs could give (24x7) care at home through wearable sensors, which are utilized to much of the time measure patient vital signs, give a continuous proposal in view of the patient's health condition.

- Increase patient mindfulness and responsibility: the continuous gathering of patient information increase patient mindfulness about his/her health status.

- Provision of minimal expense solutions: Based on the RPMs diminishes the expense of hospitalization and admissions, consequently, saving money on the absolute expense of healthcare services.

III. PROPOSED MODEL: CHRONIC DISEASES MONITORING SYSTEM

In this research paper, I propose a design that could be helped to monitor chronic diseases called Clinical Decision Support System (CDSS). Patients with chronic diseases need constant checking for all vital signs to limit patient deterioration. The core part of the monitoring framework center around monitoring patients' vital signs. For instance, diabetes monitoring centers around blood glucose as it is the most proper way while diagnose diabetes. Notwithstanding the significance of blood tests in diabetes analysis, the other vital signs should be considered in monitoring diabetics, as when glucose level varies, blood vessels adversely influence the kidney, heart, vision, and so on. In this manner, it is critical to quantify different factors other than the glucose level, for example, body temperature, blood pressure, respiratory rate, conscious level, and so forth to keep away from diabetes complications.

The proposed monitoring system can be summarized in the following steps,

1. Smart biosensors are attached to a patient body. They constantly screen patient vital signs like glucose level, fatigue level (EEG), vision level, pulse, activity level, body temperature level, and so on Then all these vital signs are accumulated and transmitted to the Central Control Unit(CCU).
2. Our proposed design gives two monitoring stages, the offline and online monitoring frameworks. The offline mode runs by means of the principal layer Clinical Decision Support System (CDSS) that is added on a personal server and online through a cloud server, and the second layer CDSS. In the personal server, every patient sends his/her body vital signs, then, all patient information will be sent to the clinic's cloud server.
3. In the event that the internet connection is turned off or interrupted, the framework won't work as expected, and the patient cannot communicate with the servers. To overcome this limitation, a lightweight CDSS will be added to the patient side to screen the patient until the internet connection issue was fixed. The CDSS's first layer assists patients with recommendations and advice in view of the patient profile (i.e., EHR). This data will constantly refresh by finding and

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extracting information from the EHR. CDSS in the main layer resolves the patient-computer interaction issues and gives a straightforward and easy-to-use smart application.

4. Periodically, patient information is sent to a smart device (Phone with an internet connection) where a wireless area network is established between sensors and server components (Caregiver, provider, or family), which allows them to access and actually look at the patient condition and access patient vital information using this monitoring system. In the event that the framework recognizes abnormal signs, it will fire the alert and send a caution message to the emergency contacts.

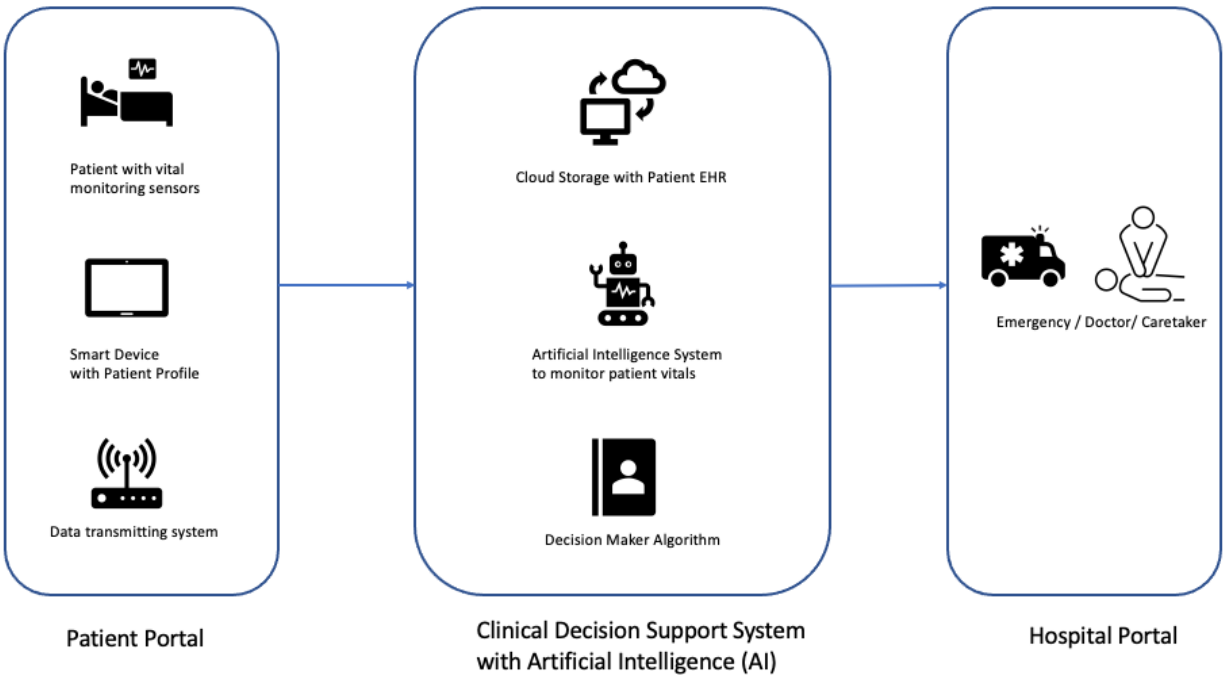

Fig. 2 Proposed Design of Remote Monitoring system for chronical disease patients

IV. CONCLUSION

In this paper, I attempted to give a comprehensive design of Remote Patient Monitoring (RPM) for chronic deceases. As with most studies, the proposed design is subject to a few limitations. This design focuses on RPMs for chronic disease, I attempted to address it from different perspectives. In any case, a few limitations ought to be noted. To begin with, I mostly focused on RPMs from the design side, while hardware (i.e., kind of sensors and types of servers etc) is not discussed. Even though limitations are recognized from an overall perspective, my contributions in this paper will motivate others to determine the current issues in this field.

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