



Telemonitoring System for Healthcare

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Abstract: This paper addresses about telemonitoring system. Recently, a lot of advancement has been carried out in the field medical engineering. Telemonitoring system achieved great popularity for patient healthcare. Telemonitoring system allows consultancy from physician at distance, monitoring of patient status information or suffering critical health problem, while patient reside at remote area or away from hospital. There are numerous kind of diseases which requires immediate action e.g. cardiac abnormalities, heart attack, epilepsy etc. This paper presents a comprehensive study about healthcare for outdoor patient. Furthermore, the parameters responsible for minimum time coverage and thereby carries less delay for action has also been discussed.

Keywords: Telemedicine, Telemonitoring, Telehealth, Information and Communication Technologies (ICT).

I. INTRODUCTION

Telemonitoring systems interact with acquisition, processing and secure transmission of patient to remote location, where medical expert provides counselling to patient in emergency condition or if the life of patient is in trouble (Chisanga, *et al.*, 2017) (Mateev, *et al.*, 2011). In fact transportation takes time for patient to reach at hospital. To solve outpatient's distance problem telemonitoring systems deployment becomes mandatory. As people living standard are getting improved day by day and people also have their strong concern about healthcare issues. By using this technology it may helpful to resolve healthcare relevant problem promptly for patient at distance. Therefore, telemonitoring systems plays an important role in resolving healthcare relevant issues and it is beneficial towards healthy life for patient belong to remote area.

Telemonitoring systems useful for remote patient to resolve healthcare issue and it is widely deployed in emerging hospital. Brief system architecture as shown in (Fig. 1). Telemedicine is the source of treatment for patient in chronic health situation. Where patient suffers various diseases such that epilepsy, cardiovascular diseases, obesity, diabetes and other chronic health condition. Telemedicine adopted for better management of patient healthcare. Prompt diagnosis of patient disease definitely help to patient for right treatment and patient may able to live healthy life and also it improve the healthcare standard of patient by using technology. Electronic communication offers exchange of medical information from one position of patient to

another position physician using telemedicine devices technology. It also provides an opportunity to improved health of patient recovery management record online (Maglogiannis, *et al.*, 2009) (Yun-Sheng *et al.*, 2011) (Panicker *et al.*, 2015).

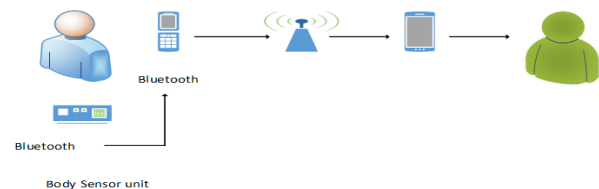


Fig. 1. System architecture

Telemedicine technology provides online transmission of patient health status where it gives consultancy to patient. It is also depends on reliable and timely information delivered from source to destination. Overview of telecare system as shown in (Fig. 2). Telemedicine technology used sensor devices to analyze chronic disease and to know updated status of patient and accordingly disease management strategy plan get prepared. Frequently on daily basis patient health status can be monitor regularly using telemonitoring systems even patient at home or reside at a distance from hospital. Also physician may collect medical information of patient about health stability or instability situation of patient (Wang, *et al.*, 2017).

Recently, Bio-medical engineering has developed a lot particularly towards non-invasive method of treatment by using telemonitoring system. There is plethora of scope for improvement is available for

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further research work to provide reliable medical information because it is very important for saving human life or otherwise it could be life threaten, if collected information mislead. Also there is transmission delay and data integrity factors are known as critical parameters that must be considered for reliable

transmission from distance, since sensitive medical information carried out by telemonitoring system. Development in telemonitoring system is the need of today time, it is important requirements and its offer several diagnostic benefits as well (Kocsis, *et al.*, 2015), (Xianhai and Cunxi, 2009) (Mantas, *et al.*, 2009).

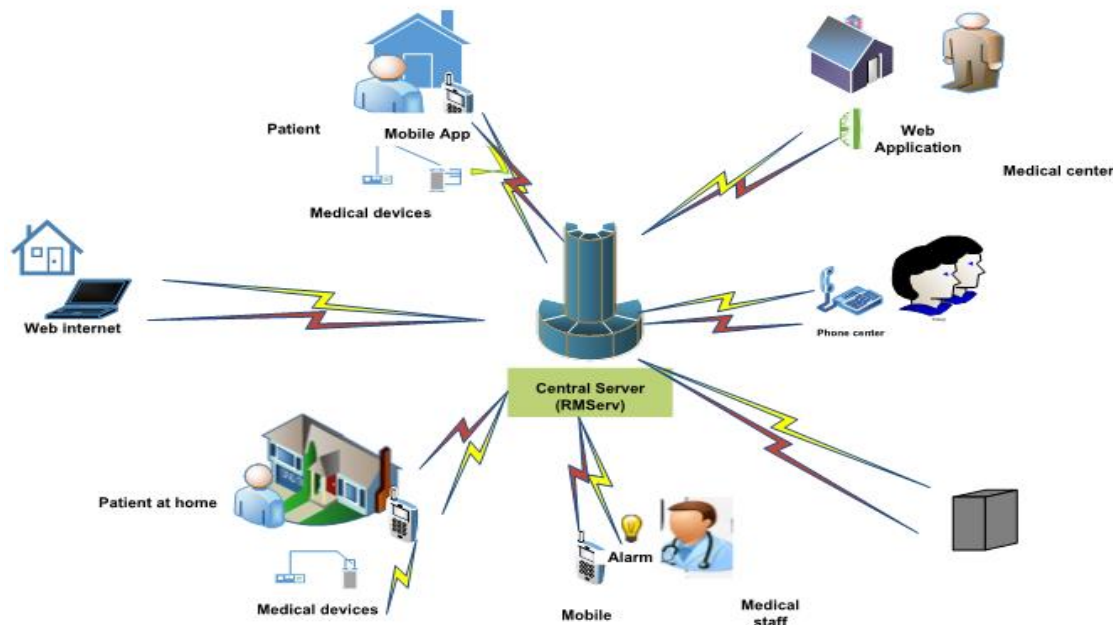


Fig. 2. Overview of telecare system

Rapid growth of modern wireless communication and electronic engineering offers new method of patient treatment such as telemonitoring system. Efficient and accurate transmission of data or medical information required continuous monitoring or real time data of patient is also become possible in today time. Accurate patient location can be observed by using GPS technology for multiple patients at different locations. GPRS provides broad network coverage or wider coverage, high speed processing of data and it would be better to avoid WiFi signal. Therefore, wireless mobile communication using GPRS technology is used for remote monitoring. However, it consumes high power energy but it provides high reliability (Xu 2008).

As population ratio is going to increase day by day and to provide adequate and effective health care facilities to the public of rural area is challenging task, where patient resides at remote or a distance from hospital. This gap can be overcome by using wireless communication technology by implementation of telemonitoring systems. It is also a challenge in today time to make this technology user friendly and it should not be cost effective. Patient data can be collected by

using telemonitoring systems where it generates an alarm, if it exceeds preset assigned limits values of received data. Some standard limits or ranges values is given in below (**Table 1**). Telemonitoring systems is also very useful for people carries disabilities and also beneficial for old aged people (Isais, *et al.*, 2003).

Healthcare services to remote distance called telehealth achieved tremendous growth in recent years for patient at home. Several chronic patient diseases can be monitor from home to hospital such that chronic obstructive pulmonary disease, hypertensive disease, asthma or diabetes, congestive heart failure, blood pressure, temperature, ECG, Cerebral palsy, etc. Telehealth care known to be as effective and beneficial for patient reside at rural areas (Argha and Celler, 2017).

The rest of paper is organized as follows in section II, presents the evaluation of research work and background information about telemonitoring system. Section III, discusses about telemonitoring systems. While in section IV, concludes the paper with its future work.

2. RELATED WORK AND BACKGROUND INFORMATION

Technology development in the field of healthcare industry introduces a new scope in market for business perspectives as well. Home based e-health telemonitoring system brief view is shown in (Fig. 3). Where several patients based on mobile location and at different scenario has presented for getting the health care follow up recommended by medical physicians. Brief system architecture is shown in Fig. 1. It focus on different telemedicine applications. patient may able to take self-management for healthcare, thereby its adoptability is getting increased all over the world, it's also provide good impact on quality of life and reduces follow up visit of patient hospitalization and expensive transportation. Health care follow up is possible in today time even patient at home (Mantas, *et al.*, 2009)

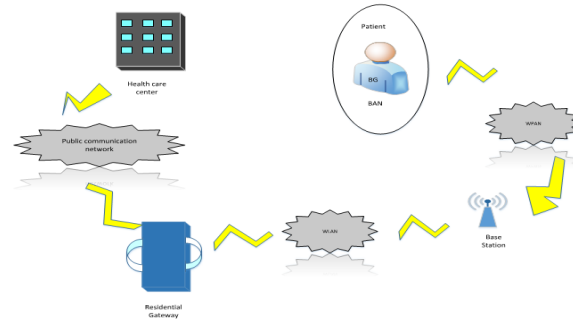


Fig.3. Home based e-health telemonitoring systems

Telemonitoring is known as sub branch of telemedicine. Telemonitoring system receive medical data via communication network and to secure privacy of individual data using security mechanism. Its plays an important role during transmission. This healthcare technology offers convenient usage, user friendly and comparatively low cost as compare to inside hospital care, (Panicker *et al.*, 2015) (Roudsari, *et al.*, 2000) Telemonitoring systems topology as shown in (Fig. 4).

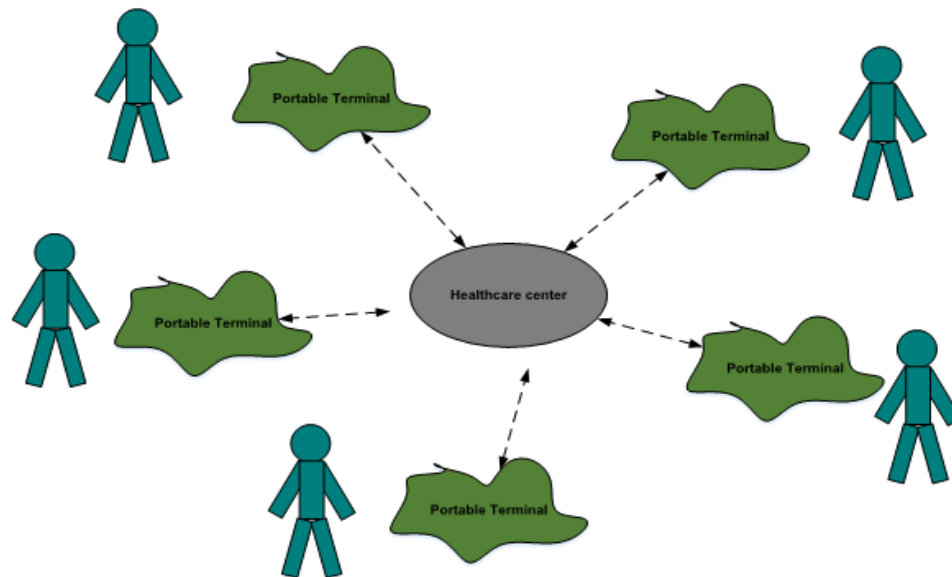


Fig. 4. Topology of telemonitoring systems

Telemonitoring systems require high speed data transfer rate for real time monitoring. It is very useful for chronic patient and for those patient got discharge from hospital and still require follow up therapy at home. Telemonitoring system help physicians to judge present health situation and to recommend therapy for patient, revise treatment and follow up progression overtime. Telemonitoring systems reduces the cost of patient healthcare services. Telemonitoring health care systems is accessible due to the development in Information and Communication Technology (ICT) by

the usage of wearable devices and wireless sensors (Li, *et al.*, 2007).

Telemonitoring systems utilizes advanced wireless communication sensors that associated with integrated circuits carries low power, lower in size, miniaturization and intelligent sensor greatly help to portable devices, which is made possible for early diagnosis and it helps to improve good health and quality of life. Remote monitoring of real time medical information or telemonitoring systems help patients to reduce hospital

physical visit, reduce transportation time and allow physicians to get insight patient health status known and then prescribe the level of care patient required.

3. **TELEMONITORING SYSTEM**

Traditional telemonitoring system works for patient to resolve healthcare problem from home but due to inconvenient transportation, it produces delay in transmission, thereby to speed up transmission utilization of wireless broad band technologies such as

WiFi, Wimax, HSDPA etc., Telemonitoring system common parameters are telemonitoring client, telemonitoring server and telemonitoring workers. Telemetry is known as the branch of telemedicine, where this term is used for medicine. It provides an information about remote area patient follows diagnosis, patient health problem treatment and medical education. Using telemedicine patient, medical treatment is possible at any location around the world. Mobile telemonitoring systems as shown in (Fig. 5).

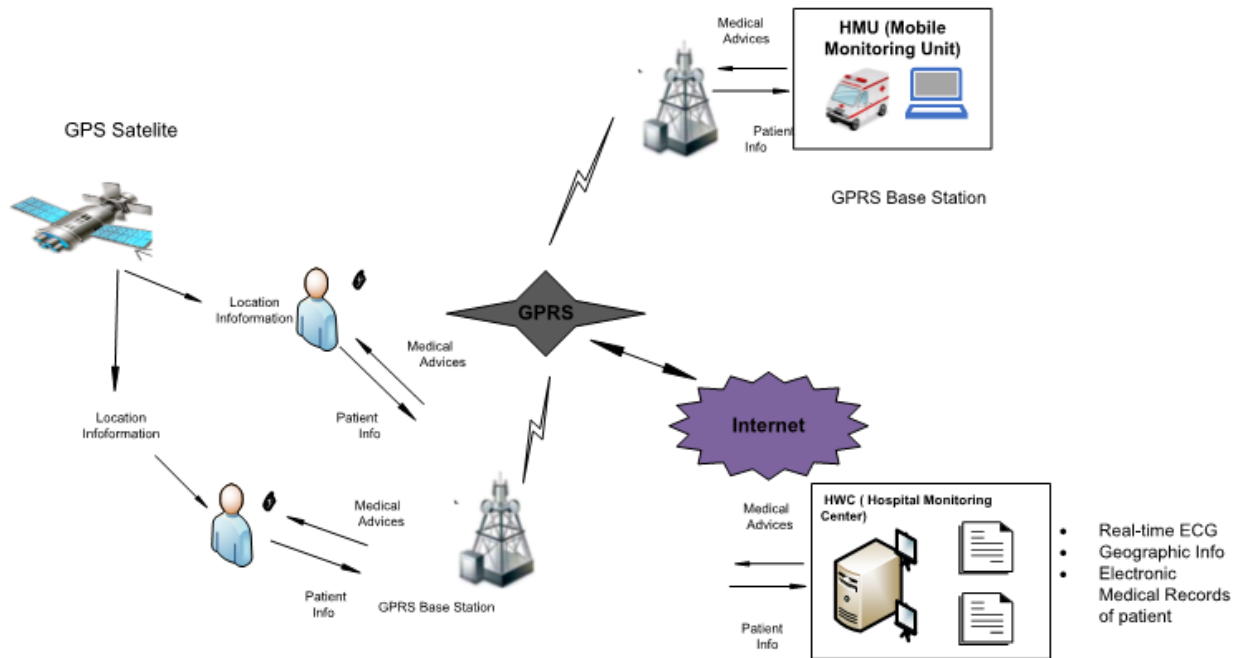


Fig. 5. Mobile Telemonitoring System

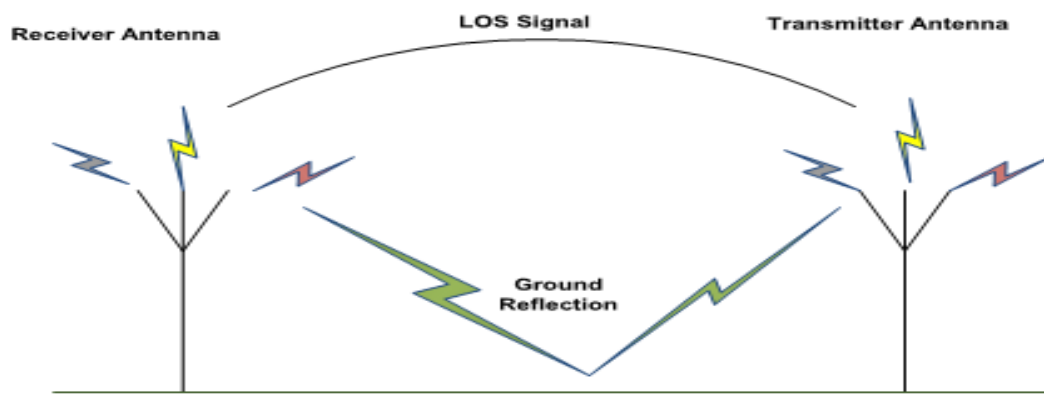


Fig 6. Fading effect in transceiver

Telemonitoring system consist of ICT and it follows several approaches likewise telehealth, e-health and telecare system. Delay in transmission produces loss of information and reliability. The factors involve

during radio waves transmission from transmitter to receiver end faced by various types of fading such as flat fading, frequency selective fading, slow fading and fast fading, Doppler spread, multipath delay spread,

path loss, shadowing effect etc., it plays an important role to degrade transmission which become cause of delay. Fading between transceiver is shown in below (Fig.6) (Ciobotariu *et al.*, 2011)

Telemonitoring system initially was limited to indoor patient, which was limited to wire based but as

development growth rate increases rapidly it got realize later on stagethat it carries importancefor outdoor patient in emergencies casesas well.Which is based on wireless instead of complex wire based system.By using mobile communication technology. This transition from wire to wireless healthcare monitoring system reduces dramatically for outdoor patient's to visit hospital for follow up treatment.

Table 1: Health care alarm limits

Signals Dependent Variable salarm Limits		
ECG	Heart Rate, Ventricular Beat, ST Segment, QT Time	ST Wave elevation & depression, T-wave inversion
Non-invasive blood pressure	Systolic, Diastolic, Mean, Pulse Rate	Systolic < 90mm Hg and systolic > 170mm Hg, HR < 50/min and
HR > 110/min		
Respiration	Breath Rate, Expired CO ₂	SpO ₂ (Haemoglobin oxygen saturation) < 90 (%)
Pulse Oximetry	Pulse Rate, Pulse Volume, oxygen Saturation	PR <50/min and PR > 110/min
Other Data: Patient, Location, Movement, Voice and/or Sound Recognition		Stress in voice, Patient Fall Sounds, Patient Acceleration in z-axis

This was considered as great advantage of this technology especially for disabled people and for aged people. Development in mobile phone for healthcare perspective provides advantages of low power usage, lightweight, wearable user friendly telemonitoring devices also carries the property of high sensitive and flexible which is known as the advantage of this system. To transmit patient status or emergency situation where predefined fix threshold value has beenmaintained or fix range as shown in table 1. Sensor uses for medical data are known as bio sensor (Crombie, *et al.*, 1993).If it increases the threshold value of predefined ranges then it generates an alarm or alert signal to telemonitoring system to physician.

4. CONCLUSION

This paper discussed about the evaluation of telemonitoring systems for healthcare of outdoor patient. Proposed model observed medical data or information of patient and monitor it after sensing and connectivity. Furthermore system works after getting information from sensor. If exceeds the predefined threshold level then it triggers or switch to turn on alert that mean some abnormalities detected from the patient, after then system automatically send an alarm to the monitoring center placed at hospital for rescue patient health in emergency and therefore, necessary response of healthcare mechanism will be acknowledged for action after provided medical information at monitor center by network usingShort Service Message (SMS)

or email etc., for immediate response. It's conclude that telemonitoring systems provides higher degree of flexibility for patient healthcare analytics. Therefore, maximum outpatient may able to get benefits of healthcare by consultancy from physician reside at remote area. However, a lot of future scope is available to promote latest wireless technology toward its development. This research work on telemonitoring systems would be helpful to improve healthcare system andrequire discoursed more in the coming eras. Although this work does not entirely resolute the complete topic but it provides very useful information that will be useful for researchers.

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