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Review Article

Medicine Reminder and Monitoring System for Secure Health Using Internet of Things

Fadanvis Prafulla[1*], Dehankar Manisha[2], Guru Shubhada[3], Sachin Patil[4], Nandkishor Bankar[5]

[1]Department of Shalya Tantra, Datta Meghe Ayurvedic Medical College Hospital and Research Centre, Nagpur, India; [2]Department of Shalakya Tantra, Datta Meghe Ayurvedic Medical College Hospital and Research Centre, Nagpur, India; [3]Department of Sharir Kriya, Datta Meghe Ayurvedic Medical College Hospital and Research Centre, Nagpur, India; [4]Department of Community Medicine, Datta Meghe Ayurvedic Medical College Hospital and Research Centre, Nagpur, India; [5]Department of Microbiology, Jawaharlal Nehru Medical College, Nagpur, India

ABSTRACT

Internet of Things (IoT) is a system of internet-connected devices which collect and transfer data over a wireless network without human intervention. Smartphones, wearable devices like health band or smart watch are examples of IoT. IoT works on four components are sensors, network communication, analytics (cloud) and application. Non adherence to treatment is a major reason for poor control of diseases like hypertension, diabetes which ultimately leads to complications. Medicine reminder apps and smart devices can be very helpful to overcome this problem. Smart watches and devices have applications which can monitor persons heart rate, blood oxygen, body temperature, blood pressure, ECG etc. Readings of these parameters can be shared with a doctor who is connected through internet. In critical situation immediate intervention can be done by the physician by advising appropriate medicine. Thus use of IoT is crucial in monitoring of health of the individual. COVID-19 pandemic patients are being monitored and treated from a distance with the help of internet-connected smart devices. Shortage of skilled human resources in health care sector can be addressed by using this technology. It will be a boon for health services in public sector. Considering the economical turnover of IoT in health care sector globally, adopting this technology in India is need of hour.

Keywords: Internet of things; Smart phone; Smart watch; Monitoring of health; Blood oxygen; Treatment adherence

INTRODUCTION

Indian health care system has always been under pressure because of limited resources of all kind. Shortage of doctors, nursing staff, other health care providers, drugs, instruments and machineries have affected health services for large number of population. Both communicable and non-communicable types of diseases are challenging our public and private health sectors. Technological advances have helped medical field a lot. Treatment guidelines available for various diseases are there but their execution has been poor because of many reasons.

One of the important reasons for poor control of diseases has been non adherence to medication. Forgetfulness of patients to take medicines as per dose leads to disease progression and its complications. For example, many hypertensive patients lead to hypertension and cerebral dysfunction. They are a major risk factor for heart failure, but adherence to antihypertensive treatment is poor. About 41% of heart attack patients don't take their antihypertensive pills [1]. Similar observations are there for other diseases like diabetes. According to a study in North-East India, about 33% of patients of diabetes forget to take their regular oral hypoglycemic agents. Non adherence to medication is a well-documented problem especially for patients with chronic conditions [2]. A survey study on epilepsy patients stated that at least 50% of patients forget to take medicine at least once a month. Various methods and ideas have been tried to overcome this issue. But results are not satisfactory [3].

Correspondence to: Fadanvis Prafulla, Department of Shalya Tantra, Datta Meghe Ayurvedic Medical College Hospital and Research Centre, Nagpur, India, Tel: 9860460984; E-mail: prafullas26@gmail.com

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Reminder pill packaging or containers that organize drugs by single dose or day of the week is a relatively simple idea intended to help people remember to take their prescribed dose. Reminder packaging increased the number of pills taken by patients by 11% points. But perhaps it is too passive, and patients need something like an alarm to alert them when they've missed a dose. Electronic pill monitors can do that. Some just remind patients to take their medication [4].

The Internet of Things (IoT) refers to a system of interrelated, internet-connected devices that are able to collect and transfer data over a wireless network without human intervention. Inter-connected devices are smart enough to share information with us, to cloud based applications and to each other (device to device). Thus IoT works on four component sensors, network communication, analytics (cloud) and application. Electronic devices, smartphones and gadgets are ruling the world now. Availability of internet at minimal cost encourages use of these smart devices for various purposes. Shopping, Booking tickets, Bank transactions are few examples (Figure 1).

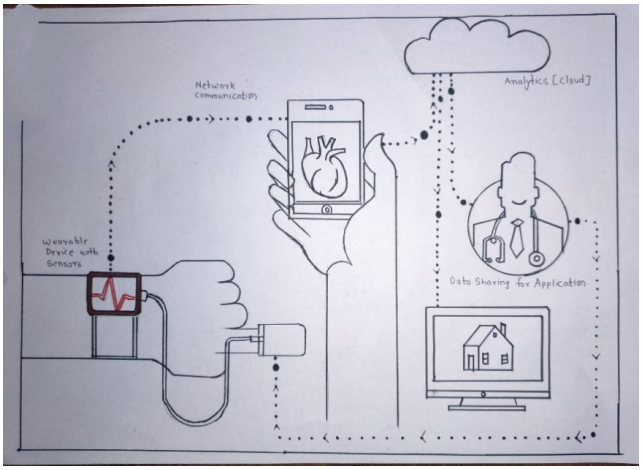

Figure 1: Components of IoT.

Wearable is a type of electronic device that is worn as accessories (smart watch, health band), which can also be embedded in clothing, implanted in user's body and sometimes even tattooed on the skin. Wearable technology is at the forefront of Internet of Things (IoT), as it has been quickly adopted in smart devices and computers. Smart devices are designed in such a way they capture and utilize every bit of data which you share or use in everyday life. And these devices will use this data to interact with you on daily basis and complete tasks. Wearable technology has greater advantages and implementations in healthcare.

LITERATURE REVIEW

IoT for medicine reminder

Patients with chronic health problems like hypertension, diabetes need to take medicines regularly at fixed times. More over patients with multiple disease condition like Coronary artery disease, High blood pressure, diabetes have to take more number of pills for longer durations. It is troublesome for patients and ultimately leads to non-adherence to treatment. In patients with depression and other psychological ailments, the chances of irregular medicine consumption are higher. In India approximately 52% of non-pregnant women's are suffering from anemia. Hypothyroidism is also a common problem in Indian women [5]. Typical Indian women are mostly family duty bound.

They are so preoccupied with caring for their family that they forget or refuse to take medication for their health problems. This compromises the health of themselves and future generations also.

Regular consumption of medicine will help to avoid consequences of these diseases. Smart phones, wearable electronic devices like smart watch which have various applications are useful to solve this problem. Setting of a simple alarm in mobile or wearable device can give daily reminder at fixed time for a particular medicine. For a single medicine, once in a day, it will be helpful.

But for multiple medications throughout the day it may not. There are various apps for medicine reminder which are inbuilt in wearable devices or can be downloaded from play store.

These apps are designed in such a way that once we enter brief medicine history and ongoing treatment of patient, it gives reminder message for every tablet as per its timing. Data entered in device is analyzed and customized suggestions are prompted.

As these devices are connected to the internet, they also automatically provide dietary instructions for that particular patient. Tracker in these wearable devices calculates your daily walk in kilometers. So in a patient of diabetes where mostly daily walking is advised, less than minimal required walking distance will be notified to patient. Number of calories burned during exercise is also displayed in these devices which help in management of obesity.

Technology of internet of things has been proved to be one of the best innovations for health care system. Medicine reminder apps and devices has improved treatment adherence of patients. Through these apps, information about medicines advised to a patient by his doctor is linked with that available on the internet.

Thus other information like adverse effects of medicine, probable drug interactions is shared with patient. Patient himself can learn about medicines which he should not take together. It makes patient more oriented towards his treatment and unnecessary panic is avoided.

Monitoring of health

These wearable devices or apps are also helpful to monitor vital parameters of healthy individual. These devices can capture data like pulse rate, blood oxygen level (SpO_2) etc. Vital parameters within normal range indicate health of the person while deviation from normal range alerts him to consult a physician. Few smart devices also monitor sleep quality, stress level and breathing pattern. Such information and appropriate advices are prompted to the person intermittently. So these IoT is useful to secure health (Figure 2).

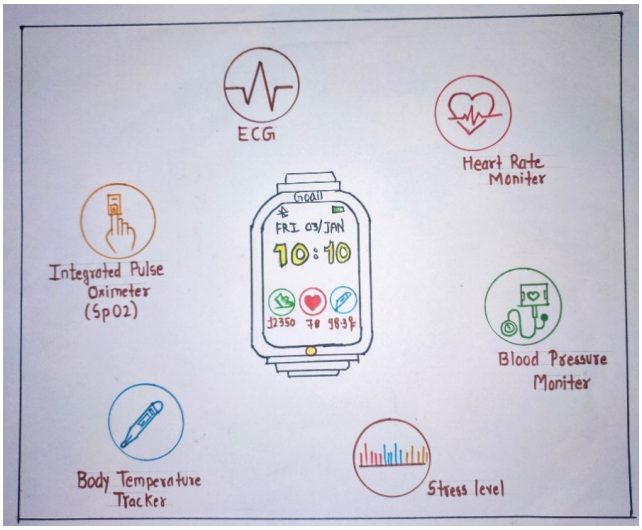

Figure 2: Applications of wearable devices.

According to a study in India, Coronary Heart Disease (CHD) which was the third-most common cause of premature death in 2005, has now shifted to the most common cause in 2016 [6].

Factors for prevention of CHD include physical activity, early detection of disease process and application of interventions to prevent the progression of the disease events. All this can be well monitored by wearable devices and IOTs. Newly launched apple watch is capable of generating ECG similar to a single lead electrocardiogram. It's a big achievement as it provides critical data to internet connected doctors. It may help in early intervention in acute cases of Myocardial infarction which can save life. Some of these smart devices also measure Blood pressure, which is again a boon to hypertensive patients. It can chart out readings of blood pressure which is then shared with doctor. It is beneficial if change in antihypertensive drugs and dosages are required.

DISCUSSION

In COVID-19 pandemic where we are facing shortage of health facilities and doctors, this Internet of Things can be really helpful. Patient tested positive for COVID-19 can be monitored for his oxygen level and body temperature through internet connected devices. So patient can stay home till his oxygen saturation, fever observed by doctor in hospital is normal. If significant drop in saturation level is observed, doctor can advise patient to get admitted in hospital. By this, crowding in health centers can be avoided, which will control the spread of disease. Patient can get timely treatment from best of the doctors. Unnecessary panic for getting bed in hospital will be avoided. IoT devices can track every individual. So it can alarm people to not go into COVID-contaminated areas. It can alert if person has been in contact with infected patient. It can guide to trace contacts as per travel history of a COVID infected patient.

Artificial intelligence is the future of all sectors which include Health care sectors too. In India where doctor patient ratio is 1:1456 against WHO recommendation of 1:1000, use of artificial intelligence like IoT can be a revolutionary [7]. In remote areas of the country where health infrastructure is poor, use of telemedicine at primary health centers or sub-centers has been effective, especially for sensitive population groups like mother and child health programs. Encouraging the use of IoTs in public health will result in more accurate patient diagnosis and treatment. It can lead to better implementation and assessment of health schemes.

According to a tech analyst company, IDC, there will be approximately 41.6 billion connected IoT devices or things by 2025. The automotive sector, security services, and building automation are the biggest users of IoT things and devices, followed by the health sector. According to reports, companies will be investing $15 trillion in IoT by 2025 [8]. Turnover of IoT in Health care market globally will reach up to $140 billion by 2024 [9]. Studies on related applications in healthcare were reported [10-13]. Few of the related studies were reviewed [14-17].

CONCLUSION

Medicine reminder apps and devices which are a part of IoT, increases adherence to treatment thus achieves better control of disease and reduces complications. Wearable devices can monitor parameters of a person like heart rate, blood oxygen, body temperature, blood pressure, ECG. These parameters are crucial for maintaining health of the individual. Shortage of skilled human resources in health sector can be addressed by this technology. Best of health services with more precision can be provided in remote areas of country. Hence use of IoT in medical field is a boon.

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