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A Study into the Potential of IOT for Smart Healthcare

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Abstract

This study reflects the importance of IoT connected devices in the healthcare industry. Currently, with the development of certain technologies; this particular sector concentrates on improving the entire treatment procedure provided to patients. In this case, IoT devices have a vast importance in the field of aiding doctors and patients to keep daily track of health conditions. Medical tools that are used to cure serious diseases work quite faster in case IoT is connected. IoT devices help both doctors and patients in the entire treatment process. Not only patients or doctors, these devices help health care workers in many factors such as tracking wheelchairs, nebulizers, pacemakers and many more. Most importantly, no one needs to remember the records of every patient as it saves each and every single data of every patient. Doctors can check the past history of patients while checking the patient. It is obvious that these devices work faster than human hands. The IoT system has done a great job on saving time for both patients and doctors. More or less every healthcare unit is connecting the tools with the IoT system.

Keywords

Doctor, Healthcare, IoT, Patients, System.

INTRODUCTION

In recent era, like several sectors, the healthcare sector has concentrated on ameliorating overall treatment procedures to bring betterment in patients' lifestyles and in this field, the importance and contribution of IoT in several healthcare institutions cannot be denied. Internet of things (IoT) devices can automatically gather health grades such as blood pressure, heart rate, body temperature, and many more things that are important for a proper treatment of every patient who are not actually available in the health centres. Healthcare that have IoT devices or sensors provide steady and constant health related data and important and essential signs such as blood pressure, glucose monitoring, heart rate, body temperature and this process does not require the presence of the patients [1]. Not only this data, the IoT system can be used for track pacemakers, nebulizers, oxygen equipment, and many other monitoring tools. The IoT system includes many monitoring devices such as heart rate monitoring, glucose monitoring, hand hygiene monitoring, mood and depression monitoring, inhaler devices monitoring and many more. IoT devices can automate the speed of work and make the process of patient care smooth by utilizing the healthcare flexibility solutions.

Communication between each and every machine, movement of every data and interactivity has made healthcare organizations more fruitful. The IoT system can save a lot of time for both healthcare workers and patients. Three most important elements of an IoT system are "internet", "connectivity", and "things". IoT elements are bonded together by several wired and wireless technologies, networks, protocols and standards to give prevalent connectivity. This mind blowing technology has authorized doctors and nurses or any kind of healthcare employee to monitor the actual conditions of every patient and this can stop any extreme emergency situations such as diabetes, cardiac attacks, heart blocks or failure, asthma attacks and many more.

MATERIALS AND METHODS

Research methodology is the particular techniques or procedures utilized for recognize, choose, process and examine data of a topic. In this research, research methodology allows every reader to severely estimate overall reliability and validity of this study. In this study, secondary research is followed as this research methodology is a type which is already assembled, collected, arranged and published by others. This process involves studies and reports by government agencies, commerce organizations or every other business. This method includes a researcher utilizing the data which some other person has already collected for their own purpose. Qualitative research is a method of realistic investigation that looks for a well understanding of social situations within the natural setting. This method is utilized to catch important and crucial data that is not explained in qualitative data of values, beliefs and motivations.

This study has followed an inductive research approach as it allows the researcher of the study to start with particular measures and observations, and progresses to finding patterns and themes in data. This approach permits the researcher to create a quick provisional hypothesis which can be surveyed. Secondary data collection method has also been followed in this research as this is the type of data that is

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gathered by someone apart from the real user. Peer review is an assessment process where editors of journals and other specialist scholars seriously evaluate the logical merit and quality of the study and its research [2]. Those articles which move this procedure are published in the peer-reviewed literature.

RESULTS

An idea about smart healthcare

Smart healthcare is a technology of health service which utilizes systems such as IoT, wired gadgets, and mobile internet to strongly use data, link each and every person, organizations that are related to healthcare and next manages and give answers to health ecosystem requirements in a good manner. Smart healthcare makes this happen to expand the care even after the patients get the discharge from the healthcare centres or nursing homes [3]. Smart healthcare elements can differ based on the monitoring technology. Electrocardiogram, blood glucose, blood pressure, electromyography, heart rate, body temperature sensors, oxygen saturation, motion sensors, gyroscope, motion sensors are the most commonly used sensors or systems that are being utilised in smart healthcare.

Smart healthcare can access some exhilarating facilities such as the location identification and tracking facilities, extremely high speed transmission network based facilities. Smart healthcare is not only helpful for the workers or doctors, it is also extremely helpful for the patients as it can have the facility of robot services [4]. And it is obvious that robot services can work faster than humans. In smart healthcare units, reality services are expanded that help each and every worker. These healthcare units can use AI-based methods. The arrival of IoT technologies eases the process of progress of every healthcare unit from one-on-one communication to telehealth or telecare. The three most important motto of every healthcare is developing the experience of each and every single patient of care involving satisfaction and quality, developing the health of every single person, and decreasing the cost of entire health care. These three things are easily possible in case healthcare is using smart technologies. Smart technologies can help in quicker and more correct access to patient records [5]. Electronic health records are one of the most useful technologies in smart health care units. Smart technologies can develop the process of care in health care units. In smart health care units, diagnostics can be better as the technology is faster.

Smart health care units are part of the e-health occurrence. A smart healthcare unit develops the process of patient care by utilising automated or robotic and optimised processes, specifically the Internet of Things, to link medical devices to Artificial intelligence and data analysis. Smart healthcare units mainly use “remote monitoring” and “automated healthcare systems”. One of the most useful smart technologies is connected inhalers. This mind blowing technology saves lives in nursing homes by helping people to remember when to take the inhalers to continue a schedule that is healthy. The most important conceptions of smart healthcare units are mHealth and eHealth services. Smart healthcare means the smart care that is provided to the patients. The process of information of patients moved immediately from one sector to another sector or from one worker to another worker depending on the place the patient is scheduled to go further is called smart care. This means information is straight away accessible at the correct place in an appropriate format, without making any delay in recognising every patient’s records.

Figure 1: Internet of things in smart healthcare

An understanding of the role of IoT in healthcare industry

The most important work of the Internet of Things (IoT) is monitoring the health condition of every patient. Apart from that, there are several places where Internet of Things (IoT) can be used and extremely useful in healthcare centres. IoT gadgets are connected to the sensors that are utilised for tracing the actual location of medical tools such as pacemakers, nebulisers, wheelchairs, oxygen equipment, and many other monitoring tools. IoT develops effectiveness in the workspace. The largest advantage of Internet of Things (IoT) is, this method provides the maker the authority to automate and optimise the operating effectiveness. IoT increases the safety of both the workplace and workers. This system makes the maintenance process more predictive. IoT authorised hygiene monitoring gadgets help in stopping every person from getting infected [6]. Internet of Things (IoT) devices also guide in asset management such as pharmacy catalogue control, environmental monitoring, illustration, checking the temperature of refrigerator and temperature and humidity control. Every single person often faces several problems in healthcare centres and these problems should be stopped. IoT systems are hoped to play an extremely important role in solving these major problems. Some of the major problems have been depicted below:

Slow treatment procedure and hold up in hospital discharge

Patients or the companion of patients often face an excessive delay in discharge due to insufficient workforce and capacity. Insufficient workforce capacity causes lack of care of the patients. Hospitals or nursing homes faced this problem extremely in the pandemic. Also, because of insufficient equipment and specialists, the procedure of

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treatment becomes excessively slow. With the implementation of the internet of things or popularly known as IoT, the process of treatment can be faster and more fruitful and every disease can be easily curable.

Small number of patient engagement and medication attachment

Every person does not frequently have the drugs that are prescribed by the doctors or would rather have the medicines recommended by friends. IoT healthcare solutions provide medication that can be tracked by remote [7]. And also helps in patient engagement which can help doctors to control the treatment procedure in a better way.

Lower cost

Remote Internet of Things (IoT) monitoring reduces the visiting costs of doctor's offices and hospitals. Healthcare information that is managed electronically is also less costly to analyse and access than the records that are kept in copies or any kind of papers.

Faster diagnosis or treatment

Personal data or reports of patients such as blood pressure and glucose checking assist doctors to make more effective and fruitful decisions. These systems give information to inspect past treatments, decrease errors, check symptoms, and develop the current treatment process.

The role of IoT in healthcare units

The everyday challenges that both workers and patients have to face quite frequently in healthcare units have to be stopped. These challenges have created a new and extremely fruitful system known as IoT. "Internet of Things" (IoT) has a lot of benefits such as; it gives authority to enable actual-time monitoring, gives a better and efficient solution to gather information about the patient, tracing the patient's activity [8]. With this technology doctors can focus on the advanced treatment and deliver an excessive good treatment. Doctors and nurses get a good understanding of the actual condition of every patient.

Figure 2: Major issues resolved by IoT

Focusing on most important internet of things in healthcare institutions

Escalation rate of chronic sickness and ageing population have caused shear on recent healthcare systems. In healthcare institutions, pressure of providing high-quality treatment to patient segments is accelerating everyday with the increasing demand of resources like nurses, doctors, and beds [9]. However, the internet of things plays an indispensable role in reducing these pressures in the healthcare sector and usage of IoT has been capable of ensuring a better quality treatment to all patients. A few days ago doctors were unable to observe the betterment or deterioration of patients' health on a daily basis. IoT has brought a significant change in this case as doctors are aided by "internet of things" in the field of monitoring health conditions of individuals. Recently, aged people are able to keep track of their health situations with the help of IoT devices.

IoT devices can be seen in both forms like wireless and wearable. There are many "wirelessly connected devices" such as glucometer, "heart rate monitoring cuffs", and blood pressure which have changed the everyday life of many patients [10]. Elderly individuals can take personal care through the regular usage of IoT devices. In recent days, doctors have been able to gather more information related to patients' health just because of the internet of things, as these devices help doctors to be aware of the requirements of patients. In many cases, instant medical attention is needed by patients; doctors have been capable of managing these factors in an efficacious way with the aid of IoT devices. Some patients suffer from long day sickness due to the lack of best treatment procedures [11]. However, doctors can ensure the high-quality treatment process by prioritising the usage of IoT devices in several healthcare institutions. IoT gadgets provide a huge number of latest chances or opportunities for the employees of healthcare units or medical professionals, and also for patients to check themselves. In addition, the diversity of wearable IoT gadgets provides an arrangement of challenges and benefits, for both patients and healthcare workers.

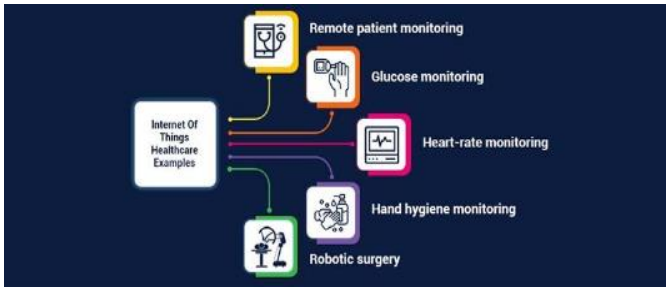

Figure 3: Instances of IoT healthcare

"Glucose monitoring"

More or less every person with diabetes has a problem with glucose. Monitoring glucose has been tough for collectors. Not only is it difficult to check glucose levels and keep the records manually, but also checking so many reports of several patients' glucose levels at the definite time the test has been done [12]. In case the glucose level changes or fluctuates extremely, a regular glucose test may not be enough to find the problem. Glucose monitoring gadgets reduce the requirement to keep data or records manually, and professionals can alert patients when glucose level is not normal. The IoT system eliminates the need of remembering or keeping a test report manually as it can save it on the system.

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Heart rate checking by IoT device

IoT technology can be used in many areas in the health sector and one of them is the measuring of the heart rate using the IoT technology devices. Devices which are used exclusively are Ardiano and Thingspeak along with this the other things which are required for its successful operation are pulse sensor, 10k potentiometer, 1k resistor, an LCD screen, high speed internet and connecting wires. Using all this equipment at first the heart beat will be detected using a pulse sensor and it will draw readings on the LCD screen in beats per minute [13]. It will further send the signals to the Thingspeak server with the help of high speed internet connectivity and finally the heat rate is monitored using the IoT device.

"Remote patient monitoring"

This monitoring system is the most common and used process of IoT gadgets in healthcare units such as hospitals or nursing homes, clinics, diagnostic centres and many more. These devices can spontaneously gather health standards such as blood pressure, heart rate, body temperature. This is more beneficial to the patients who are not actually present in the healthcare unit. This system reduces the requirement for patients to travel to the healthcare units or for patients to gather it by themselves [14]. An IoT device gathers data of every patient in a healthcare centre, and forwards the information to a software application in which the healthcare workers can check it. Algorithms might be utilised to examine the information in order to endorse treatments or give rise to alerts [15]. In case, an IoT gadget finds an uncommon or unexpected low heart rate will automatically give rise to an alert so that professionals of healthcare units can step in.

"Hand hygiene monitoring"

In every hospital, it is extremely necessary for doctors, nurses, and patients to maintain the hygiene of their hands to prevent the spread of contagious diseases. Doctors and nurses have to touch some equipment or other things that have already been used by patients. Sometimes, healthcare providers are affected by infectious diseases just because of the deficiency of the maintenance of hand hygiene [16]. Recently, accelerated application of IoT devices has helped both healthcare providers and patients to keep hygienic condition of hands. These devices are used by many healthcare operations to provide people with reminders about the sanitization process of their hands. Hence, in the field of maintaining a healthy environment in hospitals, the importance of this IoT device is huge.

"Parkinson's disease monitoring"

Health Care unit workers should be able to evaluate the fluctuation of a patient's symptoms in an entire day. IoT devices give guarantees to make this work easier by frequently gathering information about symptoms of Parkinson [17]. Also, this system makes sure that one patient can go home quickly rather than staying in a hospital or nursing home for a long period of time.

"Mood and depression monitoring"

Details about depression indications and common mood of a patient are a different type of data which is quite tough to collect frequently. Even a few years ago, doctors and nurses or the healthcare employees were unable to know the current mood of a patient. Workers had to ask patients about their feelings quite frequently but were not able to predict unforeseen mood changes [18]. And it was obvious that patients did not get accurate reports of depression. However, nowadays with the help of faster technology, healthcare employees are able to provide an accurate and genuine report of depression to a patient. IoT gadgets such as "mood-aware" can solve these issues like a dream [19]. This device gathers and examines information such as blood pressure and heart rate and gives an accurate and proper report of mental health of a patient. Advanced and developed IoT gadgets can even track the movement of eyeballs of patients.

"Connected inhalers"

Situations such as Chronic Obstructive Pulmonary Disease or popularly known as COPD or asthma often come all of a sudden without any warning. Inhalers that are connected with IoT can assist patients by monitoring the frequentness of asthma attacks [20]. Also, IoT connected inhalers can warn patients in case one forgets the inhaler at home. In addition, these IoT connected inhalers give an alert notification when the patient is not using it properly.

"Connected contact lenses"

Nowadays, people can even use contact lenses that are connected with IoT. These IoT connected contact lenses collect healthcare information in a submissive and non-trespassing way. And most importantly, these contact lenses can take pictures as there are micro cameras installed in these contact lenses [21]. Even if these IoT connected contact lenses that have micro cameras installed in them are used to solve healthcare problems, this is also an extremely useful device for digital communication or interaction.

"Ingestible sensors"

Gathering information from inside of a human body is really a messy and extremely troublesome process. No one wants to have a camera installed inside of their own body to track the problems. With the help and guidance of ingestible sensors, it is possible to gather the data from digestive and many other problems in a less interfering way [22]. This device helps to collect the accurate report of the PH levels of one's body and the source of internal bleeding. Ingestible sensors are extremely small to be swamped or swallowed quite easily.

"Robotic surgery"

By implementing tiny 'internet connected robots' inside an individual's body, doctors can execute the surgeries that are quite tough to process with human hands with less disturbance. In addition, these robotic surgeries functioned

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by tiny IoT gadgets can decrease the size of slits needed to process the operation, guiding the process to a less interfering process and quicker healing for every patient [23]. These robotic devices are immensely reliable to process an operation with extremely less disturbance. These small robotic devices can clarify difficult conditions inside human bodies while a surgery is happening.

DISCUSSION

The result of this study reflects the usage of IoT devices in the healthcare industry. A few years ago, IoT devices were not there to help healthcare employees. Reports of diseases were not used to be accurate. However, currently, more or less each and every healthcare unit is using IoT devices and these devices are doing a mind blowing job. This system has decreased the patient hold up problem and did a great job on the slow treatment process. Also this technology has worked great on hold up in patients' discharge process. IoT devices are helping patients to remember about the medicines on time. One of the major works that this system has done is, it has decreased the visiting cost of the doctor checkup. And also the IoT process helps to do the treatment process faster and a better diagnosis. These devices reduce errors, improve the treatment process and inspect the past treatments.

IoT devices do several jobs such as heart rate checking, blood pressure checking, glucose monitoring, hand hygiene monitoring, remote patient monitoring and many more. Also this system can be connected with the inhalers and contact lenses and these contact lenses have a micro camera installed inside. One of the most revolutionary work that IoT has done is, it can track one person's mood swings and work on depression. By checking heart rate and blood pressure this device can provide an accurate and genuine report of depression or mental health. In recent days, no one has to ask a patient frequently about their feelings or mood as this system can easily track that.

CONCLUSION

This entire study is based on how the IoT devices are doing great on healthcare units. Medical equipments that are connected with IoT systems are doing their job faster and more effectively. Devices are being more reliable and accurate with this system. Both doctors and patients are having a more hassle free treatment process. Not only doctors or patients, healthcare workers are also having a huge help from these systems as this system helps in finding pacemakers, wheelchairs, oxygen pumps and nebulizers and many more things. One of the most important things is this system does not require healthcare employees to remember all the data in mind as this system can save data of every patient. Also medical tools that are connected with IoT systems provide the most accurate and genuine reports.

The healthcare industry is going to be more accurate, cheaper and effective in future with the help of IoT. It will help in making more customized and problem oriented tools based on the requirements. IoT will also assist sufferers or patients to have more trouble free visits in healthcare units and will provide easier treatment and more data about patients' health in an extremely short period of time. Doctors will be able to trace the health problems more effectively of a patient with the help of medical IoT wearable's. The information collected from the IoT healthcare gadgets might assist doctors perform the best monitoring and treatment process for sufferers or patients. IoT is doing a great job on continuing to modify the health care world as more medical professionals and patients. IoT keeps up with transforming the healthcare industry from data collection and patient monitoring with remote to ingestible and wearable sensors.

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