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INTERNET OF THINGS APPLICATIONS IN HEALTHCARE SYSTEM

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Abstract

The Internet of Things (IoT) is a system of wireless, interrelated, and connected digital devices that can collect, send, and store data over a network without requiring human-to-human or human-to-computer interaction. The IoT promises many benefits to streamlining and enhancing health care delivery to proactively predict health issues and diagnose, treat, and monitor patients both in and out of the hospital. The aim of this viewpoint paper is to provide an overview of the current IoT technology in health care, outline how IoT devices are improving health service delivery, and outline how IoT technology can affect and disrupt global health care. As the IOT solutions are increasing day by day, healthcare is also improving a lot.

1. Introduction

IoT stands for Internet of things, which refers to the interconnection of physical devices such as appliances and vehicles, that are encapsulated with software, sensors, and connectivity which enables these objects to connect and exchange data.
This technology allows for the collection and sharing of data from a vast network of devices, creating opportunities for more efficient and automated systems.

The Internet of Things (IoT) is a concept that reflects "a collection of everything, anywhere, anytime connected, anywhere, on any service and on any network".

One of the most attractive application areas of IoT is healthcare us the opportunity for many medical applications such as remote health monitoring, exercise programs, chronic illness and elderly care.

A few years ago, the diagnosis of diseases and abnormalities of the human body was possible only after a physical analysis in a hospital. Most patients had to stay in the hospital for the entire treatment period. This led to an increase in healthcare costs and also burdened healthcare facilities in rural and remote areas. Technological advances over the years have now made it possible to diagnose various diseases and monitor health using miniature devices such as smart watches. In addition, technology has transformed a hospital-centric healthcare system into a patient-centric system. For example, many clinical tests (like measuring blood pressure, blood sugar levels, pO2, levels, etc) can be done at home without the help of a doctor. In addition, clinical data can be transmitted from remote areas to health centres using advanced telecommunications services. The use of such communication services has improved the availability of health services. IoT has not only increased independence, but also diversified a person's ability to interact with the external environment. With futuristic protocols and algorithms, the Internet of Things became an important factor in global communication. It can connect a large number of devices, home appliances, wireless sensors and electronic devices to the Internet. IoT applications can be found in agriculture, automotive, home and healthcare. The growing popularity of IoT is due to its better accuracy, lower costs and ability to better predict future events. In addition, the IoT revolution has been fuelled by increased knowledge of software and applications, innovations in mobile and computer technology, the easy availability of wireless technology and the growth of the digital economy. IoT devices (sensors, actuators, etc) are integrated with other physical devices to monitor and exchange data.

2. IoT and Healthcare

Healthcare is one of the noblest areas of IoT application. Through IoT, doctors can help people through the Internet. Portable IoT-based health monitoring devices can significantly reduce the distance between the patient and the doctor. IoT allows you to approach each patient individually, analyze their health status, and calculate their individual treatment method. With portable sensors, doctors can remotely monitor patients' health and respond in real time. However, real-time metrics require an uninterrupted Internet connection. Although IoT in healthcare is developing quickly, still not in full use in some medical industries. The development of adequate Internet applications for traditional medicine still has some difficulties. With a significant increase in the number of medical research, the IoT will probably lead to attracting more of them in the coming years. Modern medical professionals are faced with the need for collecting a large amount of big data and their analysis and interpretation to make informed and personalized decisions. All that takes considerable effort and time. New technologies of the IoT can speed up and facilitate this process. In connection with the mass introduction of electronic registration of health, a growing amount of digitized medical data is seen. Fully viewing and assessment of all this information takes a lot of time.

Furthermore, training the medical staff of the technology based on AI, that is very associated with the IoT, is needed as well. Through coordinated actions of such digital technologies as the IoT and AI, doctors can better tailor treatment to patients' needs. With these technologies, it is possible to handle a much greater volume of information to store and analyze it in order to closely follow the progress of a particular disease or process. Skilfully combining practical personal experience with the possibilities of new methods of diagnosis, collection, and analysis will lead to positive changes in healthcare management. Eventually, the IoT introduces network-enabled technologies, involving wearable and portable devices that can trigger, detect, synergize, and connect with other comparable media across the Internet. The IoT is deeply reshaping data production, use, and distribution. Average subjects frequently use these systems to follow their diet consumption, sleep, vital signs, exercise, and other physical states, whereas IoT technologies periodically gather and work on ecological data, which affects an individual's health. Eventually, this interoperability has introduced a start for novel production of medical alternatives.

3. Applications of IoT in Healthcare

IoT in healthcare can make important contributions to research, clinical practice and patient care. On a wider scale, it also has various applications related to the insurance and industrial sectors. In all the mentioned contexts, the contribution of the Internet of Things is based on four principles. The first principle is data collection supported by interconnected devices such as sensors, displays, detectors, ecliptics and cameras. Another principle is transformation of data. Having said that, it should be mentioned that the input from sensors and other related devices is in analog form and needs to be converted to digital for further processing. The third principle involves data storage, which is mostly achieved through a cloud-based system. The fourth principle is data processing using advanced analytical methods, which ultimately provides users with the information they need to make decisions.

The above principles already exist in most areas of healthcare, from handwritten patient reports to linked laboratory databases. What makes them unique in the IoT context is that the flow of data is continuous and the impact of IoT-based decisions can be immediate. For patients, IoT infrastructure mainly consists of mobile devices. Wearables may include oxygen saturation, blood pressure, pulse/heart rate, glucose monitoring depending on patient history and parameters being monitored. These devices can provide personal attention in case of an acute condition or gradual deterioration. They can also be used as reminders when connected to exercise and calorie counting software or to an appointment and recommendation system. As for doctors, IoT provides real-time connection to their patients, colleagues, clinic or laboratory. A cardiologist can be notified of a patient's arrhythmia and a diabetologist can be notified of a patient's hypoglycaemia emergency. In both cases, patients receive immediate medical guidance and support.

Doctors can assess patients' adherence to treatment. It is not just about an outcome (e.g. blood pressure) increasing when patients neglect treatment, but it can also be about device monitoring. It claimed that pillboxes could be tracked by counting how many times they were opened each day. Evidence shows that datasets from IoT devices can help doctors determine the best treatment process and management strategy for their patients. This is an important contribution to personal health care. This large-scale big data can inform future treatment outcomes.

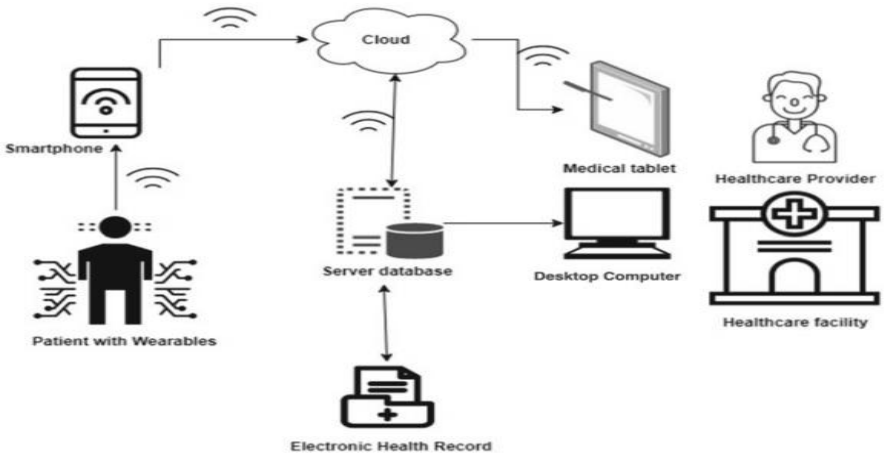
Major hospitals and research centres act as incubators for IoT applications. The reason for this is the high load and variability of the information processed there, the responsibility of these institutions and the available funding. In addition, hospitals and laboratories can use IoT to monitor the health status of inpatients and outpatients that were previously overlooked. In addition, research institutions can continuously and time-consumingly monitor the progress of experimental work, the deployment of equipment and the availability of resources. Communication and sensing devices, in many cases, later grow into multidimensional IT solutions. Growing IoT technologies have helped scientists and doctors create new healthcare solutions. IoT-related health research is very important because it is crucial to provide effective preventive care and better quality and cost-effective services.

As a new research object, IoT is spreading more and more in several commercial and scientific fields, especially in medicine. Impressively, with the dramatic proliferation of Smartphone's and wearables, IoT-based technologies are changing health from a traditional centralized system to more personalized health systems.

Recently, e-health has started to be used to provide personalized medical services to meet people's health needs. IoT is an important advancement in the era of big data, supporting multiple timely technical programs to optimize services. Today, the medical system uses IoT data analysis as a source of consumer information to discover more information, diagnose diseases at an early stage and decide on important assumptions to improve the quality of life.

Finally, the rapidly increasing demand for an improved healthcare system over time. IoT devices can collect and share data instantly to other cloud platforms, making it easy to collect, store and explore large amounts of data. IoT devices would be suitable for company computerization or remote monitoring of the local environment. IoT applications in healthcare are promising because they can improve access to care, reduce costs and significantly improve patients' quality of life. The healthcare industry and insurance systems can also make their work

more efficient with the help of IoT applications. Data storage, product evaluation, patient evaluation and faster reimbursement services could all be based on the Internet of Things. However, such applications may be subject to serious legal obstacles due to the lack of privacy policies and also economic interests in the processing of such data.



Overview of IoT in Healthcare

4. Healthcare System Architecture

Application the Internet of Things (IoT) to healthcare makes it smarter, faster and more accurate. Healthcare has a different IoT architecture that drives the healthcare system.

IoT Healthcare System Architecture

5. Product Infrastructure

The infrastructure of an IoT product, such as hardware/software, reads signals from sensors and displays them on a separate device. Sensors: Healthcare IoT has various sensor devices such as pulse oximeter, EKG, thermometer, fluid level sensor, sphygmomanometer (blood pressure) that read the patient's condition (data). Connectivity: The IoT system provides better connectivity (Bluetooth, WiFi, etc.) for devices or sensors to read data from the microcontroller to the server and vice versa. Analysis: The health system analyzes the sensor data and correlates to obtain the health parameters of the patient and improve the health of the patient based on this analysis data. Application platform: IoT system access to information about healthcare workers with a monitoring device for all patients and all information.

6. IoT Healthcare Services and Applications

According to Market Research reports that the Internet of Things (IoT) healthcare industry will grow by 37.6 percent. If one thing is certain, IoT has changed healthcare in many ways in recent years and will continue to do so in the years to come. . Here are IoT applications in healthcare that everyone needs to know about.

I. Implantable glucose monitoring systems

Devices with sensors can be implanted under the skin for patients with diabetes. The devices' sensors send information to the patient's mobile phone when their glucose level drops too low, and also store historical data. It also allows patients to tell when they are most likely to be at risk of low glucose in the future and now.

II. Activity trackers during cancer treatment

In general, the right treatment for a cancer patient depends on more than just their weight and age. Their lifestyle and fitness level also play a big role in what the right treatment plan means for them. Active trackers monitor the patient's movements, fatigue, appetite, etc. In addition, data collected by the monitoring device before and after treatment informs healthcare professionals what changes need to be made to the recommended treatment plan.

III. Heart monitors with reporting

Patients can wear devices that monitor their heart rate and can determine if they have high blood pressure. Healthcare providers can transfer patients' heart rate monitor data when they need it during checkups and exams. Wearable devices can even alert healthcare professionals if a patient is having an arrhythmia, palpitations, a stroke or a full-blown heart attack. An ambulance can then be dispatched in time, which can be the difference between life and death.

IV. Medical alarm systems

Individuals may wear something that looks like jewellery, but is intended to alert family members or friends in an emergency. For example, if a person is wearing a medical alert bracelet and falls out of bed in the middle of the night, emergency responders are immediately notified on their smart phones that their help is needed.

V. Absorption sensors

Patients can now swallow devices with sensors that look like tablets. Once the sensors are swallowed, they transmit information to the patient's mobile app, which helps monitor the correct dose of medication. Most medications are not taken as directed due to forgetfulness or other human error. This consumable sensor ensures that patients take the right medication at the right dose at the right time. Some swallow able tubes are also used to more accurately diagnose patients with conditions such as irritable bowel syndrome and colon cancer.

VI. Medicine dispensers

Devices can now be implanted in the patient to deliver medication in constant doses throughout the day. Patients will be notified when they need a refill. Doctors can also be notified of missed doses during routine visits.

VII. Wireless sensors

Wireless sensors are used in laboratory and hospital refrigerators to ensure that blood samples, chilled drugs and other biomedical materials are always at the correct temperature.

VIII. Traceable inhalers

IoT inhalers tell patients what they are doing or experiencing to trigger asthma attacks by sending the information to their Smartphone or tablet. This information may also be shared with their doctors. Connected inhalers also remind patients to take their medication. Wearable's to fight depression

Apple has created an app for its Apple Watch to help bipolar patients cope with depression. The app tracks the patient's periods outside of scheduled appointments and helps track cognitive and mood functions.

IX. Combined contact lenses

Currently, connected contact lenses measure glucose levels in diabetic patients. But in the short term they can help restore eye focus and improve vision.

X. Local service

Items such as wheelchairs, scales, defibrillators, nebulizers, pumps or monitoring devices can be tagged with IoT sensors and easily located by healthcare professionals. Physical devices can often be lost or difficult to track, but with IoT, employees know where everything is.

XI. Remote monitoring

With IoT devices, healthcare professionals can monitor their patients who have just undergone surgery or are going home for outpatient treatment. They are alerted when a patient reaches a critical condition or needs immediate help.

IoT innovations in healthcare are expected to grow in 2018 and beyond. The IoT applications in healthcare listed above are just the beginning.

XII. Asthma Monitoring

Asthma is a chronic disease that can affect the airways and cause breathing difficulties. In asthma, the airways become constricted due to swelling of the airways. Many health problems such as wheezing, cough, chest pain and shortness of breath follow. There is no right time for an asthma attack, and an inhaler or nebulizer is the only lifesaver at that moment. Therefore, it is possible to check its status in real time. Several IoT-based asthma monitoring systems have been proposed in recent years. In 2015, a smart HIoT solution was proposed for

asthma patients, with the help of which the breathing rate was recorded by a smart sensor. Health data was stored in a cloud server that provides access to caregivers for diagnostic and monitoring purposes. Raji proposed a respiratory monitoring and alarm system where the LM35 temperature sensor was used to measure the respiratory rate. This was achieved by monitoring the temperature of inhaled and exhaled air. Respiratory data were sent to the health center and displayed on a web server. The proposed system also triggered an alarm and automatically sent a notification to the patient when a threshold value was reached. In another study, the proposed system not only monitored and informed patients about their asthma status, but also suggested the right amount of medicine to administer to patients. In addition, the system could analyze environmental conditions and direct the patient to move from a place unsuitable for his health. A list of features that can be included when considering further development of an IoT-based asthma monitoring system is proposed.

XIII. Other Notable Applications

The application of HIoT is different and not limited to the functions mentioned above. With the rapid growth of technology, the number of HIoT applications is increasing significantly. Some research areas where the integration of IoT devices was not clearly demonstrated in the past are now using this technology effectively. This may include cancer treatment, distant surgery, abnormal cell growth, hemoglobin detection, etc. A new IoT-based framework has been proposed for cancer treatment that integrates the different stages of cancer treatment, including chemotherapy and radiotherapy. A mobile application was used for online consultation of doctors. The results of the patients' laboratory tests were stored on a cloud server and could be accessed by the healthcare provider to decide on the timing and dosage of the medications.

7. Conclusion

The Internet of Things has transformed the healthcare industry and increased efficiency, reduce costs and focus on better patient care. Meanwhile IoT is growing from automation building blocks and machines to machines data transmission to the smallest sensors. We are also thinking about how to use the Internet of Things improving healthcare and how the Internet of Things is helping people and governments get better every day activities on a personal and public level. Although there are security issues with donation location data, we can give people permission to allow mechanisms to prevent the exploitation of people. However, there is still a lot to do to make the best use of this IoT technology. We need grow these applications in the future until the desired level of health is achieved to society.

8. References

1. A. Burgun, G. Botti, M.F., Beux, P.L.: Sharing knowledge in medicine: Semantic and ontologic facets of medical concepts. In: Proc. IEEE Int. Conf. Syst., Man, Cybern. (SMC). pp. 300–305 (1999)
2. A. J. Jara, F. J. Belchi, A.F.A.J.S.M.A.Z.I., Gomez-Skarmeta, A.F.: A pharmaceutical intelligent information system to detect allergies and adverse drugs reactions based on Internet of Things. In: Proc. IEEE Int. Conf. Pervasive Comput. Commun. Workshops (PERCOM Workshops). pp. 809–812 (2010)
3.Commission,E.:Internet of things strategic research roadmap. http://www.internet-of-thingsresearch.eu/pdf/IoT_Cluster_Strategic_Research_Agenda_2009.pdf (2009), [Online; accessed 18-Jan-2016]
4. Council, C.S.C.: Impact of Cloud Computing on Healthcare (2012)
5. Dash, P.K.: Electrocardiogram monitoring. In: Indian J. Anaesthesia,vol. 46). pp. 251–260 (2002)
6. of the European communities, C.: Internet of things in 2020. http://www.umic.pt/images/stories/publicacoes2/Internet-of-Things_in_2020_EC-EPoSS_Workshop_Report_2008_v3.pdf (2010), [Online; accessed 18-Jan2016]
7. G. Mantas, D.L., Komninos, N.: new framework for ubiquitous context-aware healthcare applications. In: Proc. 10th IEEE Int. Conf. Inf. Technol. Appl. Biomed. (ITAB). pp. 1–4 (2010)
8. GEORGE, F.: Causas de Morte em Portugal e Desafios na Prevenção. DGS (2012)
9. Group, I.E.W.: Guidance for industry-E6 good clinical practice: Consolidated guidance. In: U.S. Dept. Health Human Services, Food Drug Admin (1996)
10. H. A. Khattak, M.R., Sciascio, E.D.: CoAP-based healthcare sensor networks: A survey. In: Proc. 11th Int. Bhurban Conf. Appl. Sci. Technol. (IBCAST). pp. 499–503 (2014)
11. Hariharasudhan Viswanathan, E.K.L., Pompili, D.: Mobile Grid Computing for Data and Patient-centric Ubiquitous Healthcare. In: The First IEEE Workshop on Enabling Technologies for Smartphone and Internet of Things (ETSIoT) (2012)
12. Istepanian RS, Hu S, P.N.S.A.: The potential of Internet of m-health Things "m-IoT" for non-invasive glucose level sensing. In: Conf Proc IEEE Eng Med Biol Soc. (2011)
13. L. Atzori, A. Iera, G.M.: The Internet of Things: a survey," Computer Networks. vol. 54, pp. 2787–280 (2010)
14. medicalaugmentedreality.com, I.S. How augmented reality can bridge the gap in healthcare? http://www.augmentedrealitytrends.com/augmented-reality/healthcare-industry.html (2014), [Online; accessed 18-Jan-2016]
15. R. S. H. Istepanian, E.J., Zhang, Y.T.: Guest editorial introduction to the special section on m-health: Beyond seamless mobility and global wireless health-care connectivity. In: IEEE Trans. Inf. Technol. Biomed.,. pp. 405–414 (2004)
16. S. M. RIAZUL ISLAM, DAEHAN KWAK, M.H.K.M.H., KWAK, K.S.: The Internet of Things for Health Care:A Comprehensive Survey. In: IEEE Access (2015)
17. S. Sarma, D.L. Brock, K.A.: The networked physical world (2000)
18. da Saúde, D.G.: A Saúde dos Portugueses.Perspetiva 2015 (2015)
19. Tuan Nguyen Gia, Amir-Mohammad Rahmani, T.W.P.L., Tenhunen, H.: Fault Tolerant and Scalable IoT-based Architecture for Health Monitoring. In: IEEE Access (2015)
20. V. M. Rohokale, N.R.P., Prasad, R.: A cooperative Internet of Things (IoT) for rural healthcare monitoring and control. In: Proc. Int. Conf.Wireless Commun., Veh. Technol., Inf. Theory Aerosp. Electron. Syst. Technol. (Wireless VITAE),. pp. 1–6 (2011)
21. W.-Y. Chung, Y.D.L., Jung, S.J.: A cooperative Internet of Things (IoT) for rural healthcare monitoring and control. In: A wireless sensor network compatible wearable u-healthcare monitoring system using integrated ECG, accelerometer and SpO2. pp. 1529–1532 (2008)
22. W. Zhao, C.W., Nakahira, Y.: Medical Application On IoT. In: International Conference on Computer Theory and Applications (ICCTA). pp. 660–665 (2011)

23. Windriver.com: White Paper: Security in the Internet of Things - Lessons from the Past for the Connected Future (2013)
24. Y. J. Fan, Y. H. Yin, L.D.X.Y.Z., Wu, F.: IoT-based smart rehabilitation system. In: IEEE Trans. Ind. In format. pp. 1568–1577 (2014)