The 2nd International Workshop on Artificial Intelligence & Internet of Things (A2IOT)
August 9-12, 2021, Leuven, Belgium

Impact of IoT devices in E-Health: A Review on IoT in the context of COVID-19 and its variants

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Abstract

Actually, COVID-19 and its variants present a big challenge for the public health security. COVID-19 is a new form of the coronaviruses characterized by a set of symptoms like laboratory and radiological symptoms, when the first case has confirmed in December 2019 in Wuhan City, as well as a new variant of this form has appeared in December 2020 in the United Kingdom. Internet of things (IoT) is a technological revolution employed in different areas in the aim to serve the asked purposes. The implementation of IoT solutions in healthcare area has several benefits such as reducing the cost of services and improving treatment results. In this paper, we present a review on the impact of IoT on this new health challenge (COVID-19 and its variants), we will focus this study on the impact of the use of IoT devices to reduce transmissions of COVID-19 and its variants.

Keywords: Coronavirus, COVID-19, Internet of Things, IoT devices, IoT applications ;

1. Introduction

Despite all advancement, healthcare is an area that constantly faces to a set of challenges, which involve to conduct further in-depth research and propose new solutions by using the new technologies. IoT has proven its

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efficiency and its important role in the development and improvement of healthcare services and their quality by developing a set of applications and services in the aim to solve many challenges in this area.

Internet of Things is the last revolution of Internet that allows communication between machines and Things. Thanks to this evolution, objects will become recognizable and intelligent by making or allowing decisions related to the context. Access to gathered information by other elements, or they could be components of complex services represents one of the functionalities of these objects. This transformation is concomitant with the emergence of the Internet for its communication capacity and its transition to IPv6 with an almost unlimited addressing capacity, increase of storage capacity that allow increased the amount of recorded data, lower access costs.

In this paper, we try to present a review on the effectiveness of IoT in the context of COVID-19 by giving an answer to the following question: can the use of connected devices help to reduce the transmission number of COVID-19 and COVID-19 variants?

In the following section, we define Coronaviruses, their forms, presentation of the last strains of these viruses and a set of cautions to take. Section three focused on the application of IoT in healthcare. Afterward we show the impact of using IoT devices to reduce the transmission of COVID-19 and its variants. Finally, In section 6 a conclusion.

2. Coronaviruses

Coronaviruses represent a large family of viruses that can infect humans and animals. Human coronaviruses mainly cause respiratory infection, ranging from the common cold to illness that is more serious. In 1960, the first case of human infection has been identified. New coronaviruses infections caused by charge or mutations in the virus can cause emerging diseases. They are eight forms of coronaviruses that can be divided in two categories:

- Less Sever:
  - 229E
  - NL63
  - OC43
  - MKU1
- More Sever:
  - SRAS-COV
  - MERS-COV
  - COVID-19
  - New COVID-19 variant

In Wuhan City on December 2019 a new type between more severe type of coronaviruses (SARS-COV, MERS-COV) has been appeared, which had named by the World Health Organization COVID-19 (Coronaviruses Disease 2019). It is an emerging virus which spread quickly by human-to-human transmission through respiratory droplets and contact transmission.

COVID-19 present a serious problem for public health security and become a global concern. This disease has different characteristics: epidemiological, clinical, biological and radiological. It caused a set of symptoms, which vary from middle to severe respiratory infection accompanied by fever, cough and breathe difficulties, and poses a great risk of complications for the elderly person and those with chronic illnesses. Differently to other viruses the incubation period of COVID-19 refers to the time from infection to clinical symptoms of the disease and may be as long as 14 days.

According to [1] more than 70 000 confirmed cases on Feb 17, 2020 in every province of mainland China as well as 27 other countries and regions. The authors of [23] say that in Italy the first case not directly connected with China has been discovered on 20 February 2020 and on 18 March 2020 it presents in terms of the most affected country: the second on the word and the first in Europe with 35 713 confirmed cases. All data show that COVID-19 spread quickly, respiratory droplets and contact transmission can transmit it. Until now they are no specific treatments or vaccines for this disease, which make necessary to take strict measures to prevent and contain the epidemic, including social distancing, closure of businesses and schools, prohibitions of travel and going outdoor [23]

People can catch COVID-19 if they breathe in these droplets from a person infected with the virus. These droplets can stay on objects or any surfaces around the person such as tables, doorknobs and handrails. The Corona virus can live on the surface for long time depending upon the material of the surface. People get infected when they come in contact with Covid-19 patient, surface or objects. [29]

Coronaviruses are constantly changing and when we talk about a pandemic, we must always control them since a major mutation can have consequences. On December 2020 a new strain of coronavirus has detected in United Kingdom. This strain is more contagious and to face it, reinforced restrictive measures must be taken by all.

Recently various vaccines of these viruses has appeared and several countries started to vaccinate their citizens but they did not attain a global immunization. In order to reduce spread of coronavirus, risk of infection with this virus and protect vulnerable and fragile groups in the population, it is necessary to take a certain number of precautions like:

- Avoid contact with sick people
- Wear a mask
- Wash your hands frequently
- Avoid touching your eyes, nose or mouth
- Strict isolation

Covid-19 has a very painful impact on the mankind. It has destroyed the living of mankind. It has changed the way we interact with each other in the society. Almost all the sectors like industry, education etc were affected because of it [29]

3. Internet of Things in Healthcare

According to Carlos Jaime, health is an extraordinary outlet for IoT. By gaining visibility on their various flows and activities, hospitals can optimize their management and improve patient care. IoT is also interesting in terms of traceability of the drug circuit outside the hospital. Via connected pills, or connected medical packaging, the different actors of the care path will be able to know if a patient is taking the prescribed treatment or not. [12]

Fagroud et al [12] show in their work that healthcare is ranked among the first fields of application of IoT in terms of scientific research, which can be divided on 3 categories: state of the art, new application and challenges resolution.

Internet of Things can solve a set of challenges in health field like hospital management and permanent patient monitoring. Nowadays, several IoT applications has developed for example:

- H2, it is a tensiometer delivered to all people suffering from hypertension of a complicated and annoying follow-up.
- Smart Hospital for Monitoring of patients and hospital staff
- Medical Fridges to Control the conditions inside freezers for storing vaccines, drugs and organic elements
- Home Monitoring system for elderly age : monitoring of elderly people at home by doctors, which offers a reduction in hospital costs

The use of IoT solutions in healthcare present a set of benefits and risks:

- The benefits are:
  - improve the quality of life and patient safety thanks to continuous discreet surveillance and remote assessments
  - allow to individuals to manage their own health with more autonomy and proactivity on their well-being and pathology
  - improve prevention thanks to an incredible amount of data and make the health system more efficient while reducing costs
  - Cost optimization of patient care in hospital and reduction of stock shortages thanks to remote monitoring and automatic management of equipment stock

- Risks:
  - the information collected by these "objects" is exposed to cyberattacks by hackers in search of this precious health data
  - insecure devices vulnerable to all kinds of malware or attacks can be exploited with risks of physical damage
  - constitute as many breaches in the care system to which they are integrated and increase the safety risk of medical devices
  - the spread of low-end medical devices violating the protection and safety regulations of the basic functionalities on which the lives of users depend

4. Technological solutions to resolve COVID-19 issues

The rapid spread of COVID-19 strains make the work of medical staff increasingly difficult and hard. In order to help medical staff and control the spread of these viruses, several technological solutions has developed.

Thus, to overcome and make the civilians more aware about the COVID-19 pandemic, the government of India has launched a smartphone application named as ArogyaSetu, which is aimed to develop a connection between the important possible healthcare services and the people of India. Similarly, in China, the mobile application called as Close Contact (English translation) is launched for its civilians. This application tells the app holder about the closeness to the corona-positive person. So that the extra care can be taken while moving outside. USA government is soon going to launch a similar kind of mobile application for its civilians at the end of April 2020. [16]

After China, Taiwan was the most predictable to have more number of cases of COVID-19. However, Taiwan quickly militarized and instituted specific methodologies for any possible coronavirus case identification, suppression, and resource provision to guard the health of the community. Taiwan provided and integrated its national health insurance database with its immigration department and took catalogue to instigate the creation of big data for analytics; it generated real-time warnings during a clinical visit based on travel antiquity and medical symptoms to aid case identification. They have also made use of this latest technology, which includes scanning of QR code, connected reporting of transport history, etc. for the possible identification of the infected ones [16].

Several IoT applications has been proposed between the technological solutions that serve to resolve COVID-19 issues and control the spread of this disease like Health Care System which serve to monitor body temperature, pulse rate and saturated oxygen level.

The proposed IoT applications offers several advantages such as:
- identify symptoms and provides better treatment rapidly for an infected patient
- real-time information related to any emergency
- Proper monitoring
- quick and effective medical intervention
- workload reduction
- Rapid COVID-19 strains screening

Despite the various advantages of using IoT in the context of COVID-19 strains, they are several issues like:
- Security and privacy of data
- Data network integration between the devices involved and protocols
- Handling IoT devices by old and not educated people
- Internet connection
- Power failure

5. Impact of the use of IoT devices to reduce coronavirus transmissions

Current health situation caused by the spread of covid-19 and its variants present a big problematic due to the increasing of infected patients day by day globally. There is a vast need to utilize the well adequate and organized facilities offered with the Internet of Things methodology. [22]

Using IoT devices can help to reduce the number of transmissions by:

• Avoid contact:

The respiratory droplets (expelled from the nose or mouth when a person coughs or sneezes) inhaling from a sick person can persist on surfaces and objects which contract the COVID-19 if someone touch these objects or surfaces and then touch their eyes, nose or mouth.

The use of IoT devices allows the elimination of direct contact with objects, for example, a connected holder and a liquid soap bottle. We can also sterilize our objects in an automatic and frequency way by using connected sprayer.

• Move minimization:

High volume and frequency of movement of people in their cities and from city to other and between cities represent an obvious cause for the wide and spread of the disease.

Using connected robot can be the best solution to reduce the frequency of movement because these robots can be used in different services like delivery and reception.

• Prediction of new cases:

The major symptoms to predict COVID-19 are fever, cough and fatigue. To allow an automatic control the nick of people , for example we can install in some spaces of the school a connected device which can measure the temperature and also can recognize if the person is tired or cough.

• Road Precision:

Global Positioning System (GPS) developed by the United States Department of Defense for military and start to be used by civil in 2000. It represent a system that allow to their users to know his position at anytime and anywhere on the surface or near the surface of the earth with unprecedented precision.

Today a set of IoT devices include GPS that make their use an efficient solution to know the journey of peoples (confirmed people infected by COVID-19) and also precision of distance for ambulance move.

6. Conclusion

Internet of Things has demonstrated in recent months its effectiveness in solving some problems of COVID diseases. The use of IoT medical devices allows real-time and remote monitoring of Covid patients and people in self-quarantine. IoT allow handling all cases in appropriately and smartly way which provides enhanced services to the patient and health care. Intelligent monitoring of infected cases allows rapid intervention in emergencies and limit the spread of this viruses. Analyzing data gathered from the IoT devices by using statistical-based method can serve to predict upcoming situation of these diseases and help design a better environment to fight with these diseases.

We have presented in this paper a study on the effect of using IoT devices to reduce the transmission number of COVID-19 and COVID-19 variants because the main way to transmit this virus is human transmission. In future, we wish to release an experimental study on the effect of using IoT devices in the context of COVID-19 and its variants (patient monitoring and fight ageist the pandemic) by using a set of connected devices.

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