INTERNET OF MEDICAL THINGS (IoMT): A SUCCINCT STUDY

Abstract

The term Internet of Things refers to a group of devices interconnected with each other to form a network capable of communicating, collecting and exchanging information, analyzing and processing it so that it is capable of rapid interaction and remote control without human intervention. It was called by this name for the possibility of linking anything and everything from people and devices together over the Internet and IOT has been used in many areas where any of the monitoring devices related to cars, heart, or transceivers can collect information and transmit it with any other device on the same network. Among the important areas that the Internet of things deals with is the health care field for its ability to share data Patients with doctors and hospitals, especially in cases that require rapid medical intervention, so we can say that the Internet of Medical Things will constitute a revolution in the field of health care due to the enormous possibilities that can provide through the ability to exchange information, provide accuracy, and increase reliability and productivity if we are able to deal with challenges And control the risks that may be exposed.

Key Words: Internet of Medical Things, wearable device, Internet of Things, Artificial intelligence.

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I. INTRODUCTION

An evolutionary concept that includes a comprehensive set of hardware, software, networks, and software that work together to obtain desired outcomes in healthcare is referred as Internet of Medical Things. It is considered an integral part of the Internet of Things and includes the following core components: Sensors, communication networks, the Internet, data processing software, and user interface [6,7].

Sensors designed to provide healthcare and monitor patients such as heart rate monitors, brain stimulation devices, blood pressure monitors, microchips implanted in the body to monitor the functioning of the digestive system, and other devices designed to monitor the movement and performance of the human body begin by collecting therequired data from its environment The data is then sent to the cloud, which is a network of super servers where communication between sensors and servers is carried out in multiple ways, including wireless internet, smart phones, Bluetooth, satellites, etc., and after this data reaches the cloud, the servers process it using specialized data analysis software. The simplicity or complexity of the processing depends on the amount and type of data it receives, and then the resulting health information is sent to the end user in the form of a specific alert that modifies or changes the sensors, knowing that the modification can be done automatically without human intervention, as this entire process provides Important information about the health of the human body and its current and future condition, which contributes to In addition to following up on the user's medical condition, predicting many diseases before they occur, as well as contributing to the treatment of many diseases [9,10].

II. LITERATURE REVIEW

The following table 1 shows a study on the objectives, advantages and challenges that are suggested by various researchers in the medical Internet of Things.

Table 1: Research objectives, advantages and challenges on Internet of Medical Things

Title of the research paper	Objectives	Advantages	Limitations
Breast Cancer Detection in the IOT Health Environment Using Modified Recursive Feature Selection [1]	This paper aims to the use of the modified recursive feature selection algorithm and the SVM classifier for early diagnosis of breast cancer and the possibility of integrating it into a healthy IoT environment.	Gain the best features for breast cancer diagnosis and achieve high accuracy with a SVM classifier and the ability to easily integrate this system into a healthy IoT environment	The research suggests using other algorithms to select features and using deep learning to get higher accuracy.

The potential for artificial intelligence in healthcare[3]	This paper explains the advantages of artificial intelligence and its ability to provide health care, and some of the obstacles that can prevent its rapid application	The research paper talks about the future of artificial intelligence and its potential to improve healthcare and discusses challenges	The research lacks a deep study to deal with the challenges of AI in healthcare.
The Development of IoT Tele-	The research provides an advanced framework for remote insomnia disorder	Developa framework for remote sleep	The researchers provided an explanation of the
Insomnia Framework to Monitor Sleep Disorder[2]	testing that saves convenience, time, and cost for both patients and clinicians, and enhances access to patients in remote countries.	disorder testing, which is useful especially for people living in remote countries who do not have the appropriate laboratories and expert doctors, which helps to communicate and conduct appropriate care remotely	framework steps in general without addressing the strategy of storing data in files
A secure energy-efficient routing protocol for disease data transmission using IoMT [4]	The research aims to give a comprehensive idea about how to test the architecture of the Internet of Things	The research demonstrates several levels of IoT testing to ensure its reliability when applied on a large scale	The research proposes an in- depth study of all levels of testing and testing them in practice
The architecture of an innovative smart T-shirt based on the Internet of Medical Things paradigm [5]	The general structure of a wearable smart shirt capable of providing distinguished health services was described and proposed as one of the important applications in the medical Internet of Things	The research presented a study on the advantages of the proposed model, including integrating data from several sensors, compressing them, and detecting anomalies based on artificial intelligence techniques.	The research lacks practical implementation, as researchers suggest studying the electronic components required to implement these proposed devices in the future and creating models for them

III. INTERNET OF THINGS PROTOCOLS

IoT protocols are the language through which IoT equipment communicates with each other so that we can obtain useful and meaningful information, whereby sensors, devices, gateways, servers and user applications can exchange data in an orderly, efficient and useful way [8,10].

1. **Constrained Application Protocol** (**CoAP**): One of the protocols is the Internet of Things important for its security features. It is a one-to-one protocol used to transfer informationbetween the server and the client. It uses the User Datagram protocol to establish a secure connection between endpoints, allowing broadcast and multicasting. It is an open standard designed by HTFE similar to AFH that uses DTLs over UDP. Useful and suitable for compute- constrained, low-power devices It provides asynchronous communication mechanisms, is simple in analysis, has a low load, has caching and proxy capabilities, and a protocol that allows devices to communicate with each other to find appropriate data transfer methods by providing internal support for content negotiation Sharing of resources But we note that in some restricted devices some DTLS cipher suites may not be available as there may be some complex cipher suites that the restricted devices cannot manage due to insufficient resources, it is considered the most suitable protocol for state transfer models.

2. **MQTT (MQTelemetryTransport):** Anopensource standard that provides asynchronous communication mechanisms designed for lightweight M2M communications. Developed by IBM, it provides flexibility and serves as a binary data pipe. It is a multi-to-multiple communication protocol for passing messages between multiple clients through a central intermediary that separates producer and consumer By allowing clients to post and having the intermediary decide where to route and copy messages it acts as a communications bus for live data.

3. **OneM2M:** is a machine-to-machine service layer that enables IoT applications to communicate as they can be embedded in software and hardware to connect devices across different sectors.

4. **ZigBee:** is a low-data and low-power wireless network typically used in industrial settings that enables smart devices to communicate with each other securely

5. **Data Distribution Service (DDS):** An open, scalable and highly efficient standard for the Internet of Things that supports real-time M2M communications.

6. **LiteOS:** An operating system that serves as a development platform for smart devices and supports wearables, smartphones, smart manufacturing applications, and more.

7. **IPv6 over Low Energy Wireless Personal Area Networks (6LoWPAN):** is an open standard whereby this standard can connect to the Internet by any low energy radio such as Bluetooth, Z- Wave, etc.

IV. BENEFITS OF THE INTERNET OF MEDICAL THINGS

1. **Recording Local Activities:** Due to the capabilities that the system provides us with collecting information and recording reports, we can learn more about diseases and how the body interacts with medicines, and thus we can learn how to deal with these diseases, treat them, and prevent them.

2. **Objective Reporting:** The sensors and devices in record the current condition of the patient and report his actual activity so that we can obtain an actual and objective assessment ofthe stages of the disease and the efficiency of treatment according to the devices instead of relying only on asking the patient about his condition and his personal reports.

3. **Reducing Human Error:** Automation will reduce human error and fraud in healthcare homes and hospitals.

4. **Remote Monitoring:** The accuracy of the patient's summary will not only be relied upon, but there will be a patient "report card" with the health care provider, thus knowing the patient's compliance with treatment.

5. **Precision Treatment**: The advanced devices enable us to direct the stimulation to a specific target of the body so that we achieve a high level of accuracy and this helps reduce unwanted side effects and facilitate the treatment process.

V. SOME AREAS OF THE HEALTH INTERNET OF THINGS

1. **Health Sensing and Monitoring:** One of the challenges in societies is an aging population, where we have to take care of health care for elderly people, but the high cost of nursing and health care homes prevents access to adequate care, so the ability to make elderly people live at home for as long as possible is an opportunity to reduce cost and obtain For a better way of life, the development of this field is important as an enabler for the development of IoT technologies. And now there are many companies around the world that manufacture wearable devices that monitor the surrounding environment as well as monitor the vital signs of the patient and the ability to create an integrated system that integrates artificial intelligence technologies with sensors and monitoring and create the necessary response revolution in the world of health [10,11].

2. **Robots:** Robots are smart devices that provide useful assistance in the field of health care, especially by assisting in patient monitoring and thus ensuring high levels of patient care, as they are able to collect information from sensors, process it, monitor system performance, and provide human-assisted control, and we will notice in the days The coming is an increasing and smarter development in the field of assistive robotic capabilities, which helps to bridge the gap in the lack of working and qualified people and health care professionals, especially in routine operations such as delivery of consumables or sample routing, and it is expected to increase reliance on robots in the field of health care so that they By collecting important information and dealing with the patient's condition, including the provision of artificial intelligence applications and smart handling, and providing more resources with urgent health issues.

3. **Monitor and Kill Pathogens:** It is worth noting that many pathogens spread widely on

hospital surfaces and in the air, despite the strict procedures that hospitals try to follow to clean and prevent their spread. Humans, especially pathogens with specific genetic characteristics, although thistechnology is in its early stages, but Internet of things technologies are being developed so that sensors can detect pathogens and send this data to the infrastructure for analysis, isolate affected people, and use intelligence techniques to take advantage of This information deals with the pathogen and destroy it as quickly as possible.

4. **Artificial Intelligence:** Artificial intelligence techniques promise to obtain a smarter integrated system, as intelligence techniques use huge amounts of data that reach them from sensors to predict the onset of health problems and accidents, which may provide early detection of many diseases and thus accelerate and increase the possibility of the healing process in addition to preventing many diseases Through early dealing with data that shows the daily practices carried out by the human being.

VI. CHALLENGES AND RISKS OF USING THE INTERNET OF MEDICAL THINGS

Despite the great benefits and the revolution that the Internet of Medical Things can make in our lives, there are many challenges and risks that can put our personal information and even our lives at risk. Therefore, strict legal policies must be available to regulate this work, where the negatives are minimized and the positives are maximized. to the highest extent [7,8,11,13].

1. **Privacy Risks:** IoT devices can collect user data over and over again, as they can record, track and store the user's physical condition and whereabouts, and there are many questions about who can access this information and how they can use it, for example, when using modern pacemakers that enable us to regulate heart rate The heart of the patient and the treatment of many cases of heart failure, but it is also possible to use the information we receive from these devices to spy on the patient.

2. **Security Risks:** lthough IoT devices and IoT devices share the same security flaws, the risks that medical IoT devices can cause are much greater due to the nature of these devices and the quality of the data they collect, as security holes and hacker manipulation of devices can cause injuries that may reach to death

3. **Ethical Risk:** Hacking people's data and violating their privacy is considered an unethical act that raises concern, but the Internet of Medical Things raises more ethical concerns, especially because of the inequality between humans in terms of their social, class, racial and other status and threats to personal independence that they can be exposed to, especially in authoritarian regimes. There are still many questions about people owning their data and whether they can opt out of having their data collected or ensure that this information is not used against them.

Some applications that support the Internet of Medical Things

- **QardioCore:** a monitor that can be worn in a regular lifestyle that provides continuous data on the ECG. This data helps in monitoring the physical condition of pa-

tients and sends information about conditions such as heart problems, diabetes and weight gain to health centers without the need for physical visits

- **Zanthion:** a medical alert system that monitors a patient's health through a series of sensors worn as jewelry or clothing, sending an alert if the patient has remained still for a long time or the patient has fallen out of bed to family and friends for assistance

- Kinsa's smart thermometer maps human disease through data collection, detects disease and provides analysis for better care.

- **Chrono Therapeutics:** Produces medical labels that deliver drugs through the skin outside of times when the patient has symptoms and thus adjusts delivery levels depending on what is required

- **Apple Watch:** It is a watch that monitors the heart rate and gives an alert to the patient in case of irregularity to consult the doctor as soon as possible. It can also detect falls and automatically calls the emergency with sending the patient's location. It also records all the data to help the wearer prevent many diseases such as clots hearty

- **UroSense:** a catheter device that monitors patients' core temperature and urine output, helping to create better prevention and treatment plans.

Figure 1: Some applications that support the Internet of Medical Things

VII. CONCLUSION

An overview of the medical Internet of things, its structure, applications, benefits and risks was presented, where the ability of the medical Internet of things to improve patient care through continuous monitoring of the health status of users, as well as its ability to predict diseases that can affect the patient depending on the knowledge of the user's lifestyle and environment was presented. And avoiding pathogens and thus preventing them, as more will be learned about diseases and their treatment methods by collecting and analyzing the huge amount of data, despite the risks and challenges faced by the Internet of Medical Things, but it is necessary to reduce them to a minimum due to the enormous benefits that we will reap. When handled properly.

REFERENCES

[1] Memon, Muhammad Hammad, et al. "Breast cancer detection in the IOT health environment using modified recursive feature selection." *wireless communications and mobile computing* 2019 (2019).
[2] Azman, Novi, et al. "The development of IoT tele-insomnia framework to monitor sleep disorder." *Internasional Journal of Advanced Trends in Computer Science and Engineering* 8.6 (2019): 2831-2839.
[3] Davenport, Thomas, and Ravi Kalakota. "The potential for artificial intelligence in healthcare." *Future healthcare journal* 6.2 (2019): 94.
[4] Singh, Samayveer, et al. "A secure energy-efficient routing protocol for disease data transmission using IoMT." *Computers and Electrical Engineering* 101 (2022): 108113.
[5] Balestrieri, Eulalia, et al. "The architecture of an innovative smart T-shirt based on the Internet of Medical Things paradigm." *2019 IEEE International symposium on medical measurements and applications (MeMeA)*. IEEE, 2019.
[6] Joyia, Gulraiz J., et al. "Internet of medical things (IoMT): Applications, benefits and future challenges in healthcare domain." *J. Commun.* 12.4 (2017): 240-247.
[7] Haghi, Mostafa, and Thomas M. Deserno. "General conceptual framework of future wearables in healthcare: Unified, unique, ubiquitous, and unobtrusive (U4) for customized quantified output." *Chemosensors* 8.3 (2020): 85.
[8] Singh, Samayveer, et al. "A secure energy-efficient routing protocol for disease data transmission using IoMT." *Computers and Electrical Engineering* 101 (2022): 108113.
[9] Aman, Azana Hafizah Mohd, et al. "IoMT amid COVID-19 pandemic: Application, architecture, technology, and security." *Journal of Network and Computer Applications* 174 (2021): 102886.
[10] Dwivedi, Ruby, Divya Mehrotra, and Shaleen Chandra. "Potential of Internet of Medical Things (IoMT) applications in building a smart healthcare system: A systematic review." Journal of oral biology and craniofacial research (2021)
[11] Islam, SM Riazul, et al. "The internet of things for health care: a comprehensive survey." *IEEE access* 3 (2015): 678-708.
[12] Gatouillat, Arthur, et al. "Internet of medical things: A review of recent contributions dealing with cyber-physical systems in medicine." *IEEE internet of things journal* 5.5 (2018): 3810-3822.
[13] Arzo, Sisay Tadesse, et al. "A theoretical discussion and survey of network automation for iot: Challenges and opportunity." IEEE Internet of Things Journal 8.15 (2021): 12021-12045.

