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RESEARCH REVIEW ON IOT IN HEALTHCARE

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Abstract—Health monitoring system plays a vital role in healthcare. IoT technology is still growing technology which is used to connect devices to internet. Thus we can send patient data to cloud make the data available using internet so that doctor can reach virtually to patient without going physically and vice versa. Here in this paper, we have discussed services and application of IoMT in health monitoring system. Major challenges are also highlights in this paper. Referring to patient health data, it is consider as the crucial and sensitive data so encryption technique for data protection is also discussed.

Keywords—Challenges in IoT, Data protection, Encryption, IoT technology, IoMT, Health Monitoring System.

I. INTRODUCTION

In today's world, 5 technologies are growing speedily includes: Internet of things, 5G, Cloud Computing, Artificial Intelligence, Blockchain and distributed ledger. Here our focus is on IoT. In simple words, IoT is a technology in which devices are connected to virtual platform through internet. IoT enables real time data gain, data transfer, device connectivity, to control end user application. With the quick development of web innovation and communication technology, our every day schedules are progressively focused on virtual world [1].

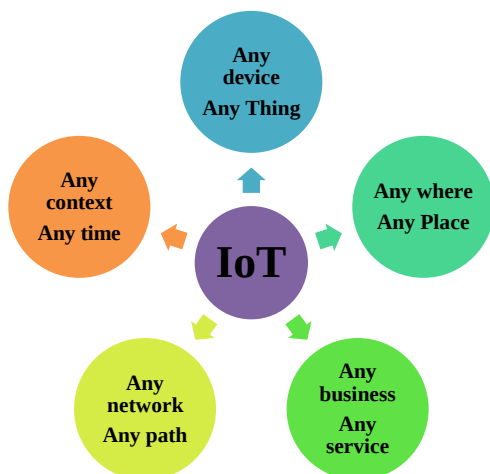


Fig. Brief overview of definition of Internet of Things

If we consider healthcare unit then the term IoMT (Internet of Medical Things), basically used in the healthcare application which consists of connected devices that sense vital data of human physiological parameter in real time. IoMT is most promising or better way in healthcare applications since it causes patients to deal with their very own illness and get help in most crisis case by means of portable devices [2].

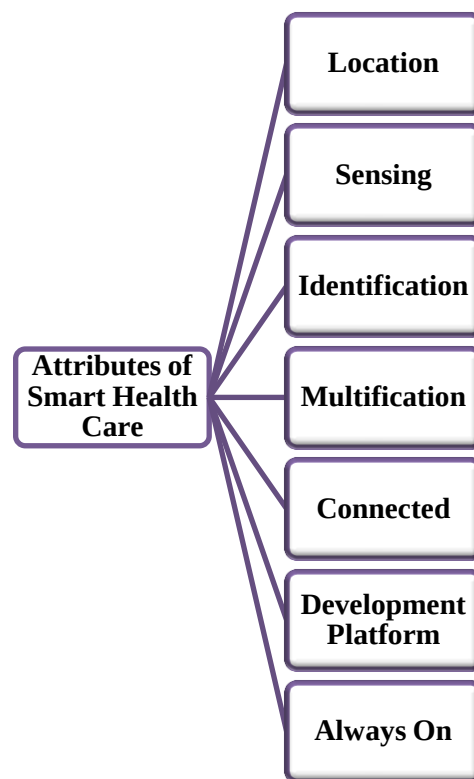


Fig. 2 Attributes of Smart Health Care

It is foreseen that the demand of personal healthcare aid increasing rapidly. The provision of IoT in health monitoring system using cell phones is referred as M-HEALTH which consists of sensing of data, analyzing of data, storing of data through various sources like devices, biomedical sensors or medical specialty acquisition systems. But most of these gadgets/system and applications are not intended to deal with



the security and privacy attacks and it builds a ton of security and protection issues in the IoT systems, for example, access control, authentication etc. [3].

II. LITERATURE SURVEY

Alasmari et al. [4] has talks about the patient's sensitive data is the most basic data that ought to be guarded in safe hands and the difficulties and study of security and protection with reference to Iot. Later he discussed on risk on using cloud and solution of it.

Farooq [11] gave a far reaching outline of the IoT situation and surveys its empowering innovations and the sensor systems. Additionally, it portrays a six-layered engineering of IoT and calls attention to the related key difficulties.

Gupta et al. [12] discussed about various security threats in wireless network and gave detailed survey on it. Attacks are based on access control attacks, authentication attacks, confidentiality attacks etc.

Ilyas et al [14] talked about a number of applications of WSN for sensible attention and also discussed future analysis associated with applications of wireless device networks in attention and future research directions.

Talpur et al. [15] discussed the primarily role of IoT in health monitoring system and the participation of IoT between the helpful research and present sensible applications.

Dziak at el. [16] designed a methodology approach for IoT based information system for healthcare application for indoor and outdoor use. This approach was approved with detailed study of genuine situations where there is a requirement for supporting older individuals, particularly those of restricted mobility living alone.

III. SERVICES AND APPLICATION OF IOT IN HEALTHCARE

To check the condition of a patient about their health parameter, tiny medical devices are either planted in body or it might join externally. It may be well noted that services are developer/engineer driven while applications are client driven thus we can say services are design to develop applications while applications are straightforwardly used by client i.e Patient. To define various services and applications of IoT in medical world, terms are as follows:

A. Ambient Assisted Living (AAL)

Ambient assisted living coordinates straightforward with ambient insight technologies and home automation bringing about a cognizant framework. An IoT platform steam-powered by artificial intelligence that may address the health care of aging and disable person may be referred as AMBIENT ASSISTED LIVING. The aim of this service is to give independency to oldies in their own home in a simple and safer way. For Iot based AAL, communication, security & privacy, control and automation is proposed in [5].

B. Children Health Information (CHL)

Bringing issues of emotional, behavioral, or mental

health problems of kids and needs of proper children health examination or their nutrition they gain, the service of CHI i.e children health information came into existence. Various CHO services are developed to motivate kids to gain knowledge of what type of nutrition they have to take or other children related issue also with the help parents, teacher, guardian etc.

C. Tele-Health

Information from system devices is enlisted at the doctor's workplace. Aggregation and process the patient's specific information which permits health care automation that analyzes current record against past record continuously decides the longer term course to manage the patient. Tele-health is nothing but to access healthcare facilities from PC, Phones etc from any place. This service is very much in demand and various applications are available in a market example: Heart beat counter, calorie burner, cardiac information etc physiological parameters are sensed by smart watch. Many researchers are working on it, Some are proposed in [6] [7].

D. Some applications:

Applications includes various real time health monitoring biomedical embedded system which is able to detect ECG signal [8] [9], heart rate , body temperature [10], accelerometer, blood pressure, arterial saturation of oxygen, blood glucose levels etc. so that abnormality occur, it can measure and detect easily. Hence, this framework system allows aid suppliers to watch the medical condition of the subject and now give applicable services. In this classification of uses, most examinations and models share the same functionalities and properties, for example, collect, capture, store and send data in terms of fundamental signs. Also, these applications face similar difficulties.

IV. MAJOR CHALLENGES IN HEALTH MONITORING SYSTEM

A. Security and privacy

Without thinking about security necessities usually makes patients liable to privacy troubles when deploying wireless technology in health monitoring system. The transfer of information over a internet can cause threats to patient's data. Conventional network includes:

- (i) Availability
- (ii) Integrity
- (iii) Confidentiality
- (iv) Access control
- (v) Authentication

The security necessities in health monitoring system are same as the conventional network. Security is a critical issue in health monitoring system. Existing cryptographic methods should be used to provide patient's data protection in opposition to attacks because health monitoring system deals with sensitive data.



B. Power consumption

Energy/power consumption is also major concern along with data security. Health monitoring system should use devices , protocols of low power consumption so that it will save energy for further use. As health monitoring system uses various biosensors and devices, we should take it in concern about devices, protocols, communication gateway's power consumption choices. So developing a green IoT is challenging.

C. Accurate and continuous monitoring

Patient like chronic disease, they always needs constant monitoring so if any abnormal activity occur, system can detect abnormality on that time.

D. Storage capacity

As using the IoT technologies, we have limited storage capacity to store or save patient's data. Storage capacity is also increasing day by day but instead of this, we also make sure that large amount of subject's data can be store in minimum place. Compression of the data is best option for this. It can be lossy or lossless compression of data. In medical field, lossless compression technique should be considered because medical data is very sensitive, minor change can cause many problems.

E. Standardization

In the case of healthcare, there are numerous sellers that make a various vary of product and devices new sellers keep on joining this promising innovative race In any case, they ave not followed standard rules and guidelines for compatible interfaces and protocols across devices then this raises problem of standardization i.e create issue in exchange and change of information. Electronic health record is an another standardization problem where various management bodies are together.

F. Data Transmission

A typical challenge in the improvement or development of health monitoring system, particularly in wireless body area network applications, is that the choice technique for transferring sensor information to back-end servers for process and analysis. In networking, there is total number four category in which data transmission is classified are as follows:

1. *Multicast*
2. *Broadcast*
3. *Unicast*
4. *Anycast*

Anycast data transmission suffers lower traffic because it automatically find nearby receiver. In unicast, data packets are sent to single receiver thus it has least traffic but it takes time to find new receiver when main receiver fails. In multicast and broadcast both suffer maximum traffic because it sent data packets to multiple receiver. There are unit broader concerns arising including transmission technologies, determinative the number of transmitted information, regular packet size,

transmission frequencies. All of these concerns have a serious impact on the system's effectiveness, availableness, network traffic and energy consumption.

G. Data Protection

The protection of captured health information from different sensors furthermore, gadgets from unlawful access are critical. Accordingly, stringent approaches and specialized safety efforts ought to be presented to impart patient's information with approved users and organization. Challenges for data protection includes: physical security, secure routing, data transparency, security of handling Iot big data etc.

H. Data Portability

Another hindrance that impacts some human services associations' eagerness to receive cloud computing is the worry with respect to the capacity to change to another cloud seller or back to the human services association without disturbing tasks or acquainting clashing cases with the information. It is very challenging to jump to a new cloud service provider. This risk features the requirement for supplier understandings that address termination rights, rights to get to and recover information at whenever, end help with moving to another supplier also, "fix periods" to enable break of agreement to be helped before the supplier ends or suspends administrations.

V. SECURITY THREATS

Attacks based on access control attack, Authentication attack and availability attack are as follows:-

A. Access control attack (ACA)

ACA happen in the systems which needs an expert to regulate access to a specific region and assets in a PC based system containing some valuable data. These attacks attempt to penetrate the wireless network by mistreatment wireless native space network access control like access point MAC filters and WI-FI port access controls. Its includes attacks like Rogue Access Points, MAC) spoofing etc [12].

B. Authentication Attacks

These attacks can be utilized by the attackers to de-confirm the client's private identities and certifications by taking it and use them to get to other private administrations or systems.

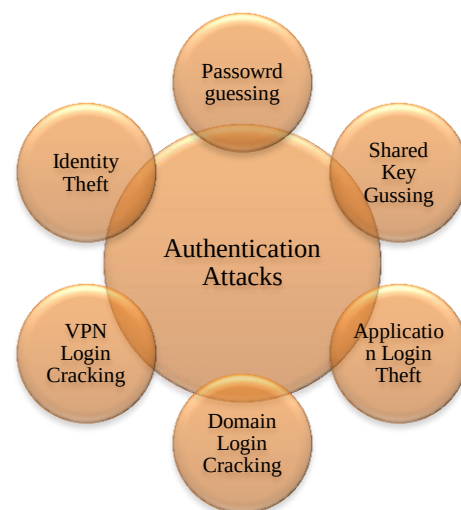




Fig. 3 discussed the various authentication attacks.

Fig. 3 Authentication Attacks

C. Availability Attacks

This is the very serious network security attacks. It includes Denial of Services. This kind of attack is executed by exploiting the CSMA technique method by making a channel seem occupied. This should be possible incidentally or purposely. Generally, network interference is done by attacker with the use of RF signal generator to jam the transmitter.

VI. CRYPTOGRAPHY SOLUTION FOR DATA PROTECTION

One of the top concerns for IoT based health monitoring system is the data security. Cryptography is also referred as encryption. Cryptography is that the study of mathematical techniques for all aspects of knowledge security. The conversion of information into a code for transmission over a public network, which means, the initial text is became a coded equivalent known as “cipher text” through associate degree coding rule. The cipher text is decrypted at the receiving finish and turned back to plaintext. We can secure the sensitive patient’s health data using cryptography. Generally cryptography is categorized into two ways: asymmetric and symmetric cryptography.

A. Symmetric cryptography

Symmetric encryption is a kind of encryption where just a single key (a mystery key) is utilized to both encode and decode electronic data. The elements conveying by means of symmetric encryption must trade the key with the goal that it very well may be utilized in the unscrambling procedure. In a simple language, symmetric cryptography used only single key for encryption and decryption of data. Thus when plain text converts into cipher text and vice versa, only one secret key is used. Example: AES, DES, DES3, DES, TWOFISH etc

B. Asymmetric Cryptography

Two different keys are used in asymmetric cryptography i.e public key and private key. Public key is used by anyone who wants to send data but one that person can decrypt the data that has private key. Only receiver has a private key to decrypt data. Examples of this cryptography are Diffie hellmen, RSA, Elgamal Encryption Algorithm, ECC, DSA etc. One of famous and most used algorithm is RSA (Rivest Shamir Adleman). RSA is one of the best cryptographic algorithms in present use that ensures secure communication over networks because of its long key generation manner [13].

Algorithm for RSA is as follows:

Key generation:

- Compute two prime number i.e p and q where $p \neq q$.
- Calculate modulus n i.e $n = p * q$.
- Calculate phi ϕ where $\phi = (p - 1)(q - 1)$

- Calculate exponent e where $e \neq$ factor of n and satisfy equation $1 < e < \phi(n)$

Encryption and decryption algorithm

- Obtain public key (n, e) and represent the plaintext message as a positive integer m.
- Compute the cipher text $c = m^e \pmod{n}$.
- Using private key (n, d) to compute $m = cd \pmod{n}$.
- Extract the plaintext from the integer representative m.

VII. CONCLUSION

In this paper, we have discussed overview related to application and challenges in IoT in healthcare. Researchers are working towards a digitized healthcare system by using the available healthcare services and medical resources.

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