INTERNET OF MEDICAL THINGS + ARTIFICIAL INTELLIGENCE INTERNET OF THINGS [loMT + loMT]

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Abstract:

The medical IoT (IoMT) is being amplified by the symbiotic growth of machine learning (ML) and artificial intelligence (AI). In processing large amounts of continuously streaming data from connected medical devices, doctors are able to reach actionable conclusions more quickly and reliably. The usage of the **Internet of Things (IoT)** in healthcare **(the industry, personal healthcare and healthcare payment applications)** has sharply increased across various specific Internet of Things use cases. At the same time we see how other healthcare IoT use cases are picking up speed and the connected healthcare reality is accelerating, even if hurdles remain.

Keywords: IoT (IoMT and (AI), Why combine IoT and Artificial Intelligence?,Categorizing Medical IoT Use Cases
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1. INTRODUCTION

The rise of the Internet of Things and Artificial Intelligence is critical to the digital transformation of modern healthcare as far as healthcare monitoring and delivery are concerned.

The pace and evolving changes in the segment of healthcare extend right across the spectrum – from the development of new treatments and medicines to the frontline delivery of innovative and paramount outpatient and emergency care. Surprisingly, it is at the frontline where the most amazing advancements are happening and where the advantages are registering in the biggest volumes.

It is no surprise that healthcare providers across the world are among the most prolific data generators, from drug trials to patient records. Medical practitioners and their industry partners are now finding it extremely easy and convenient to leverage data for making more informed decisions, thanks to the digitization of data as part of the initiatives toward electronic patient records. Already, this data is used in a wide range of ways for understanding historic events. Furthermore, it also demonstrates usefulness to understand and predict current and future trends as far as the healthcare sector is concerned.

This data, when paired with the latest Internet of Things and Artificial Intelligence algorithms, can be used for speeding up the otherwise complicated processes and functionalities of data. It can be used for driving reasoning and decision-making. It can be of great value to medical practitioners and support staff to get more informed insights on critical decisions, such as what equipment to invest in and how to supplement medical strategies.

Combining The IoT And AI In Healthcare The rise of the Internet of Things and Artificial Intelligence is critical to the digital transformation of modern healthcare as far as healthcare monitoring and delivery are concerned. Healthcare IoT devices, which are an additional source of rich data, also allow for more remotely managed and connected healthcare equipment. This equipment can feed data directly not only into individual patient records and treatment plans, but also into larger healthcare analytics systems driven by artificial intelligence.

Remote Data And Accurate Assessment

Growing demand for out-patient and at-home care along with connectivity advancements are also driving the use of devices powered by the IoT and AI. Today, privately-based medical insurers are making use of two-way smartphone applications for smartly connecting general practitioners with customers when it comes to initial consultation and diagnosis.

This serves as a cost-efficient option for avoiding a probably unnecessary in-person consultation for a minor ailment. The next steps ahead for this is to accurately and completely share vitals with medical practitioners on a real-time basis. This will be beneficial to enable multi-faceted telehealth services by making the use of affordable devices for interfacing users together. It also proves useful for data transmission through connected devices like monitors, pacemakers, and other devices.

Keeping Control Of Inventory

Beyond the patient, the Internet of Things is at the forefront of enhancing inventory management. The amount on replacing reusable hardware can be drastically reduced by tracking the whereabouts of

reusable and expensive medical equipment both in the homes of patients and in hospitals. Using the Radio-frequency identification (RFID) technology, equipment rental companies and hospitals can easily and accurately track and manage their medical equipment inventories.

It can also be used for tracking and managing other supplies like disposables and drugs. By doing this, inventory carrying costs can be dramatically reduced and there will be overall variable costs across different health bodies. This is primarily due to the fact that many misplaced or unreturned items just end up in the landfill.

The association between Artificial Intelligence, Healthcare, and the Internet of Things is promoting medical and other health bodies to benefit like never before. Great times are indeed ahead in the healthcare sector, thanks to this association. Find out how NetObjex platforms can assist you to drive the best of the Internet of Things and Artificial Intelligence for your healthcare requirements by contacting us now at 1 (855) 928-2283 or info@netobjex.com.

10 examples of the Internet of Things in healthcare

1. Cancer treatment

In June 2018, data was presented at the ASCO Annual Meeting from a randomised clinical trial of 357 patients receiving treatment for head and neck cancer. The trial used a Bluetooth-enabled weight scale and blood pressure cuff, together with a symptom-tracking app, to send updates to patients' physicians on symptoms and responses to treatment every weekday.

The patients who used this smart monitoring system, known as CYCORE, experienced less severe symptoms related to both the cancer and its treatment when compared to a control group of patients who carried on with regular weekly physician visits (with no additional monitoring). Bruce E. Johnson, President of ASCO (the American Society of Clinical Oncology), said that the smart technology "helped simplify care for both patients and their care providers by enabling emerging side effects to be identified and addressed quickly and efficiently to ease the burden of treatment."

The study demonstrates the potential benefits of smart technology when it comes to improving patient contact with physicians, and monitoring of patients' conditions, in a way that causes minimal interference with their daily lives. As Richard Cooper, Head of Digital at AXA PPP Healthcare, told Econsultancy in an interview about the future of health tech,

"Some of the developments we see have stopped people being tied to their house, or kept them from being regularly in hospital.

"They're solving what are in some cases quite simple problems, and giving people that quality of life back. … Technology makes your interaction with your medical professional much more powerful and useful, and puts you more in control."

2. Smart continuous glucose monitoring (CGM) and insulin pens

Diabetes has proven to be a fertile ground for the development of smart devices, as a condition that affects roughly one in ten adults, and one that requires continual monitoring and administration of treatment.

A Continuous Glucose Monitor (CGM) is a device that helps diabetics to continuously monitor their blood glucose levels for several days at a time, by taking readings at regular intervals. The first CGM system was approved by the US Food and Drug Administration (FDA) in 1999, and in recent years, a number of smart CGMs have hit the market.

Smart CGMs like Eversense and Freestyle Libre send data on blood glucose levels to an app on iPhone, Android or Apple Watch, allowing the wearer to easily check their information and detect trends. The FreeStyle LibreLink app also allows for remote monitoring by caregivers, which could include the parents of diabetic children or the relatives of elderly patients.

These devices are even starting to become available on the NHS: on World Diabetes Day 2018 (14th November), the NHS announced that it would be making the FreeStyle Libre smart CGM available on prescription to Type 1 Diabetes sufferers. It estimated that this would increase the percentage of diabetes patients who have access to smart CGM devices in England from 3-5% to 20-25%.

Another smart device currently improving the lives of diabetes patients is the smart insulin pen. Smart insulin pens – or pen caps – like Gocap, InPen and Esysta have the ability to automatically record the time, amount and type of insulin injected in a dose, and recommend the correct type of insulin injection at the right time.

The devices interact with a smartphone app that can store long-term data, help diabetes patients calculate their insulin dose, and even (in the case of the Gocap) allow patients to record their meals and blood sugar levels, to see how their food and insulin intake are affecting their blood sugar.

3. Closed-loop (automated) insulin delivery

One of the most fascinating areas in IoT medicine is the open-source initiative OpenAPS, which stands for Open Artificial Pancreas System. OpenAPS is a type of closed-loop insulin delivery system, which differs from a CGM in that as well as gauging the amount of glucose in a patient's bloodstream, it also delivers insulin – thus "closing the loop".

OpenAPS was started in 2015 by Dana Lewis and her husband Scott Leibrand, who hacked Dana's CGM and her insulin pump in order to automate the delivery of insulin into her system. Using the data feed from the CGM and a Raspberry Pi computer, their own software completes the loop and continuously alters the amount of insulin Dana's pump delivers.

Automating insulin delivery offers a number of benefits that can change the lives of diabetics. By monitoring an individual's blood glucose levels and

automatically adjusting the amount of insulin delivered into their system, the APS helps to keep blood glucose within a safe range, preventing extreme highs and lows (otherwise known as hyperglycaemia – excessively high glucose – and hypoglycaemia – excessively low glucose).

The automatic delivery of insulin also allows diabetics to sleep through the night without the danger of their blood sugar dropping (also known as night-time hypoglycaemia).

Although OpenAPS is not an "out of the box" solution and requires people to be willing to build their own system, it is attracting a growing community of diabetics who are using its free and open-source technology to hack their insulin delivery. The OpenAPS website declares that, "As of January 15, 2018, there are more than (n=1)*1,078+ individuals around the world with various types of DIY closed loop implementations."

The OpenAPS community aren't the only ones to have had this idea. In 2013, Bryan Mazlish, a father with a wife and young son who both have Type 1 Diabetes, created the first automated and cloud-connected closed-loop artificial pancreas device. In 2014, he founded SmartLoop Labs – now known as Bigfoot Biomedical – to scale and commercialise the development of an automated insulin delivery system based on his invention.

The company is currently preparing for a pivotal trial of its solution, details of which are due to be announced in "late 2018 or early 2019". Bigfoot currently anticipates that its automated system will be launched commercially in 2020, pending FDA review and approval.

4. Connected inhalers

Like diabetes, asthma is a condition that impacts the lives of hundreds of millions of people across the world. Smart technology is beginning to give them increased insight into and control over their symptoms and treatment, thanks to connected inhalers.

The biggest producer of smart inhaler technology is Propeller Health. Rather than producing entire inhalers, Propeller has created a sensor that attaches to an inhaler or bluetooth spirometer. It connects up to an app and helps people with asthma and COPD (Chronic Obstructive Pulmonary Disease, which includes emphysema and chronic bronchitis) understand what might be causing their symptoms, track uses of rescue medication, and also provides allergen forecasts.

The company was founded in 2010, and in 2014 received FDA clearance for two sensors designed to work with inhalers from major pharma companies: GlaxoSmithKline's Diskus inhaler, and the Respimat inhaler from Boehringer Ingelheim. Since then, Propeller has continued to collaborate with a number of major producers of inhalers, and now says that its sensor "works with most inhalers and leading bluetooth spirometers".

One of the benefits of using a connected inhaler is improved adherence – in other words, medication is taken more consistently and more often. The Propeller sensor generates reports on inhaler use that can be shared with a patient's doctor, and show whether they are using it as often as is prescribed. For patients, this provides motivation and also clarity, showing how the use of their inhaler is directly improving their condition.

How AI is transforming healthcare

5. Ingestible sensors

Proteus Digital Health and its ingestible sensors are another example of how smart medicine can monitor adherence. According to a study by the World Health Organisation in 2003, 50% of medicines are not taken as directed.

Proteus' system is one effort to reduce this figure: the company has created pills that dissolve in the stomach and produce a small signal that is picked up by a sensor worn on the body. The data is then relayed to a smartphone app, confirming that the patient has taken their medication as directed.

Proteus has so far trialled the system with pills for treating uncontrolled hypertension and Type 2 Diabetes, and antipsychotic medication. In late 2017, ABILIFY MYCITE – an antipsychotic medication created by Proteus and Otsuka Pharmaceutical Co. – became the first FDA-approved drug with a digital tracking system.

As with connected inhalers, ingestible sensors can help to track and improve how regularly patients take their medication, as well as allowing them to have a more informed dialogue with their physician about treatment. While the idea of taking pills with a sensor might seem invasive, the system is opt-in on the part of patients, and they can discontinue sharing some types of information, or opt out of the program altogether, at any time.

6. Connected contact lenses

Medical smart contact lenses are an ambitious application of the Internet of Things in a healthcare context. While the concept has a great deal of potential, so far, the science hasn't always managed to live up to expectations.

In 2014, Google Life Sciences (now known as Verily, a subsidiary of Google's parent company Alphabet) announced it would be developing a smart contact lens that could measure tear glucose and provide an early warning system for diabetics to alert them when their blood glucose levels had dropped or risen beyond a certain threshold. It partnered with Alcon, the eyecare division of pharmaceutical company Novartis, for the project.

However, the project attracted a great deal of scepticism from researchers who believed that the idea of measuring blood glucose levels via tears wasn't scientifically sound – and ultimately, they were proven correct. After a lengthy period with no real news about project developments, in November 2018 Verily confirmed that the project was being shelved.

But other medical applications for smart contact lenses might prove more successful. Verily is still working on two smart lens programs with Alcon,

which aim to treat presbyopia (long-sightedness caused by a loss of elasticity in the lens of an eye) and cataract surgery recovery.
Swiss company Sensimed has also developed a noninvasive smart contact lens called Triggerfish, which automatically records changes in eye dimensions that can lead to glaucoma. First developed in 2010, Triggerfish is now CE-marked and FDA-approved, meaning it is approved for marketing and sale in Europe and the U.S., and was approved for sale in Japan in September 2018.

7. The Apple Watch app that monitors depression

Wearable technology doesn't always have to be designed with a medical use in mind to have healthcare benefits. Takeda Pharmaceuticals U.S.A. and Cognition Kit Limited, a platform for measuring cognitive health, collaborated in 2017 to explore the use of an Apple Watch app for monitoring and assessing patients with Major Depressive Disorder (MDD).
The results from the exploratory study were presented in November 2017 at pharma and biotech conference CNS Summit.
The study found a very high level of compliance with the app, which participants used daily to monitor their mood and cognition. The app's daily assessments were also found to correspond with more in-depth and objective cognition tests and patient-reported outcomes, showing that cognitive tests delivered via an app can still be robust and reliable.
While the study was only an exploratory pilot, it has demonstrated the potential for wearable tech to be used to assess the effects of depression in real-time. Like other smart medical devices that gather data, the Apple Watch app could also give patients and healthcare professionals more insight into their condition, and enable more informed conversations about care.

8. Coagulation testing

In 2016, Roche launched a Bluetooth-enabled coagulation system that allows patients to check how quickly their blood clots.
This is the first device of its kind for anticoagulated patients, with self-testing shown to help patients stay within their therapeutic range and lower the risk of stroke or bleeding.
Being able to transmit results to healthcare providers means fewer visits to the clinic. The device also allows patients to add comments to their results, reminds them to test, and flags the results in relation to the target range.

9. Apple's ResearchKit and Parkinson's Disease

In 2018, Apple added a new 'Movement Disorder API' to its open-source Research Kit API, which allows Apple Watches to monitor Parkinson's Disease symptoms.
Normally symptoms are monitored by a physician at a clinic via physical diagnostic tests, and patients are encouraged to keep a diary in order to give a broader insight into symptoms over time. The API aims to make that process automatic and continuous.
An app on a connected iPhone can present the data in a graph, giving daily and hourly breakdowns, as well as minute-by-minute symptom fluctuation.
Apple's ResearchKit has also been used in a number of different health studies, including an arthritis study carried out in partnership with GSK, and an epilepsy study that used sensors in the Apple Watch to detect the onset and duration of seizures.
Apple is keen to tout the potential for its apps to aid with medical research and care, and to that end, in 2017 it launched CareKit, an open-source framework designed to help developers to create apps for managing medical conditions. Unlike HealthKit, which is aimed more at general fitness and wellbeing, CareKit can be used to design apps with a specific medical purpose – so watch this space for more medical innovations that make use of iPhone and Apple Watch technology.

10. ADAMM Asthma Monitor

ADAMM is a wearable smart asthma monitor that purports to detect the symptoms of an asthma attack before its onset, allowing the wearer to manage it before the attack gets worse.
It vibrates to notify the person wearing it of an impending asthma attack, and can also send a text message to a designated carer at the same time. Other features of the device include inhaler detection – the device can detect and track inhaler use, if the patient can't remember whether they've used one – and voice journaling to record things like changes, feelings and behaviours.
It also has an algorithm technology that learns what 'normal' is for the wearer over time, allowing it to better understand when something has changed.
ADAMM works in conjunction with an app and web portal, helping asthma patients to set medication reminders, view data from the device, and remind themselves of their treatment plan.
The device was originally expected to achieve FDA clearance and be released for consumers at the end of 2017, but hasn't yet been cleared, showing that these devices can sometimes take a long time to come to market even once developed. However, a study on patient health monitoring platforms that incorporate IoT devices published in July 2018 mentions that ADAMM is "expected to receive FDA clearance soon".

2. Why combine IoT and Artificial Intelligence?

It works both ways — IoT and AI need each other. The Internet of things implies handling very large volumes of data which has to be made sense of and put to work. Thus, the IoT-related functions can and should be enhanced by AI algorithms to make the experiences truly meaningful for users and/or customers. Well, what kind of meaning does AI provide to IoT?
Since IoT is a young technology that connects the gazillions of smart devices, it does have imperfections. For instance, such criteria as accuracy and speed of IoT data transmission are yet to be improved. Plus, an artificial intelligence system not

only mimics the human way of performing tasks but it is also learning from what it patterns itself from. This mechanism of self-improvement is of the essence to AI. Speaking in general terms, Artificial Intelligence has much for IoT to take advantage of. In the narrow sense, it is applied as the AI software embedded within IoT devices and augmenting fog or edge computing solutions to bring intelligence to IoT. As a result, smart devices generate such a huge amount of rapidly analyzed sensor data that it cannot help but fuel Machine Learning increasing the intelligence of the physical things.

Artificial intelligence and IoT in healthcare

When it comes to combining AI and IoT in healthcare, chances are together they will improve operational efficiency in this field. Tracking (collecting), monitoring (analyzing), control, optimization (training), and automation (modeling, predicting) — these are the key steps that provide for the smart and efficient application of AI algorithms in IoT devices.

Acting in concert, they can reduce the burden of administrative work for clinical staff. Having clinical workflows improved, medical officers will be able to spend more time with the patients and the healthcare service-delivery is consequently bound to take a more patient-centric approach.

Therefore, the main use cases of AI-enabled IoT are the following:

Medical staff, patients, and inventory tracking

Chronic disease management

Drug management

Emergency room wait time reduction

Remote health control

IoT operational principles in the medical field

Longing to know what the outcome of such an innovative approach might be is reasonable, albeit non-essential. The best way to explain why one needs to use AI-enabled IoT in healthcare

2. RELATED WORKS:

Categorizing Medical IoT Use Cases

1. Diagnostics

How can medical IoT devices improve diagnostics? Devices that track bodily metrics that could indicate medical conditions like diabetes and atrial fibrillation are becoming increasingly available. Key medical parameters like blood chemistry, blood pressure, brain activity and pain levels can be gathered on a continuous basis.This can help detect early signs of disease onset or activity, improving responses. Causal indicators can be closely tracked with the right targeted sensors, once disease proclivity or risk factor have been identified. Even the most recent version of Apple Watch 4 has been declared as a class 2 medical device, because of features like heart rhythm monitoring and fall detection.

Image Credit: Apple

It must be said that most consumer-oriented devices have not gone through the FDA regulatory process to be qualified as a medical device.

2. Recuperation

Postoperative recovery time for patients is a significant part of the procedure cost, and minimizing that is an essential element of cost reduction. For instance, for a total knee replacement, hospitalization is about two days in the US compared to four to five days in National Health Services (NHS) in the U.K. Beyond the hospital, there is a need to reduce time at an SNF (Skilled Nursing Facility) and Physiotherapy. This can be accomplished by using wearable sensors that assist with exercise, compliance and remote monitoring for issues that might result in revisions if not dealt with timely.

Sensors can track various critical metrics and alert caregivers to respond in time. Sensors combined with telemedicine make it even easier to help speed up recovery. Knowing what patients are doing in between visits can help speed up the recovery time for post-surgical procedures. In fact, a collaboration between Geisinger System and Force Therapeutics over three years has resulted in significantly improved outcomes. That includes a 30 percent reduction in hospital length of stay, a 56 percent reduction in skilled nursing facility utilization, as well as an 18 percent reduction in readmissions, reports Greg Slabodkin in Health Data Management.

3. Chronic Care

Sensors that track bodily parameters are getting increasingly sophisticated with blood pressure, glucose levels, sweat and even tear analysis. The benefit is not only in terms of logistics but also in terms of the frequency of data capture as compared to standardized tests. Mobility sensors can help improve gait and form in case of chronic degenerative diseases like rheumatoid arthritis. Another category of IoMT device application is in the monitoring and response of patients to treatment compliance. In chronic care specifically, poor outcomes and extended recovery can be avoided by measurement and monitoring ideally suited to IoT devices.

4.METHODOLOGIES:

IoT operational principles in the medical field

Longing to know what the outcome of such an innovative approach might be is reasonable, albeit non-essential. The best way to explain why one needs to use AI-enabled IoT in healthcare is to provide a more detailed analysis of the IoT operational principles enabling a more nuanced understanding of potential fields of its application in the healthcare system.

1. **Devices with physical interfaces to/from the real world.**

Fundamentally, in healthcare, any service a client requests is related to the physical world. Besides, the use of services involves the physical interaction of caregivers, patients, and the devices as such. These connected devices as robotics in medicine interact with the physical environment through multiple physical interfaces. Developing intuitive physical interfaces with different communication technologies (i.e. Bluetooth, NFC, WiFi, USB) is thus bound to level up the quality of this interaction, lead to a better information flow among IoT robots and improved service representation and tracking for people. The reason is that, given an IoT-based solution, the physical interfaces can create wireless networks. Apparently, the IoT nodes that stand behind certain sensor devices are being grouped together in such a way to get devices easily connected to the Internet architecture and to get exchange processes well-established.

2. **Structured data input through sensors.**

IoT technology produces wireless sensor networks. As previously stated, these networks are successfully bridging the physical and digital worlds. What prevents the performance of the data exchange between these two worlds from becoming a mess is the structured information flow. Input data is collected by the sensor devices and sent to the data control center for further feedback. There might be several data channels involved in parallel, nevertheless, multiple sensor data collection is executed with minimal latency. Also, despite the fact that the number of data sources is typically enormously large, the data records remain small and well-structured due to the edge analytics while high dynamism of IoT devices allows deducing missing information from the neighboring gadgets to fill the gaps.

3. **Tiny input/output devices**

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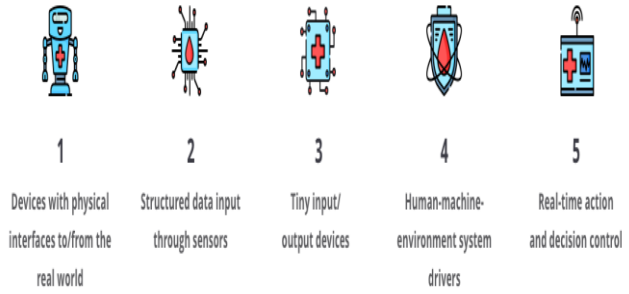
There are certain requirements for the appearance and size of the physical IO devices. Moreover, the requirements should be adjusted to the environmental conditions in which the device is operating. So, in contrast to human interfaces that need relatively big input/output devices, physical interfaces of IoT devices receive input through sensors (which are tiny due to the use of micro-electromechanical systems (MEMS) technology) and send data back to mobile/cloud computers through wired or wireless interfaces. Consequently, there is not only a need in, but there is also a real possibility of having the size of sensors as well as the IO devices reduced. Consider such instances as implanted heart-rhythm monitors and devices continuously measuring and monitoring biochemical data.



4. **Human-machine-environment system drivers**

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Evidently, human-machine interaction refers to the process of communication between people and automated systems. However, the Internet of things is built on the foundation of a more complex relationship among the human, machine, and environment. In healthcare, the environment is a highly important parameter that implies the sum of physical and social factors; and the real-time monitoring of the environmental factor is even more critical for this industry once the IoT technology is in operation.

IoT sensors, most of which are wireless, are connecting small communities of devices. But without considering all three factors, there is no sense in this connection. One should not then ignore the fact that IoT systems are made by people and for people to be applied in certain contexts. Therefore, the psychological and physiological states, emotions, actions, and intentions of a person — IoT data generated by multi-modal sensors — should be, consequently, used as inferrable information and made sense of relying on the powers of Artificial Intelligence.

5. **Real-time action and decision control.**

One of the main advantages the interoperability of AI and IoT is bringing is that there is a chance to keep track of what is going on and to react upon it on the spot. It means the shift toward active patient involvement, customized treatment plans real-time adjustment and a more intelligent approach to data management. Real-time analysis is only possible when a stream of data is continuous. However, it is hardly possible that a system doing complex processing can cope with the nearly continuous data stream from multiple sensors. It is a real-time AI system that can reduce the amount of data and enable intelligent data management.

Eventually, embedded AI technology will be of paramount priority for IoT systems, especially in healthcare. Importantly, the desirable action here is

making sense of the data at the edge, close to the device, with the edge and fog computing. Again, data analysis performed at the edge instead of a centralized location (i.e. a cloud server or a data center) enables a near real-time analysis right on the IoT devices. Generally speaking, AI algorithms' processing data from various IoT smart sensors on the edge suggests advancement of maintenance and monitoring.Healthcare cybersecurity challenges with IoT Despite all the evident benefits that the use of IoT is furnishing, the technology is also challenging the data security, which is an integral part of the healthcare infrastructure. The point here is that the unstructured data residing outside organized databases (i.e. electronic records and reports) is most difficult to arrange with the help of traditional algorithms and therefore to protect. It is the powerful learning algorithms that are more than likely to contribute much to solving the problem with data analysis. Yet, having data organized does not mean having it protected from cyber threats.

Thus, the best measure one can take is to drive standards around IoT ecosystems. IoT devices and applications are usually programmed to access both private and sensitive data vulnerable before malware. In view of this, the privacy rule stated in the Health Insurance Portability and Accountability Act (HIPAA) will protect such health information and such regulations as the EU General Data Protection Regulation (GDPR) will obligate the offenders to carry financial penalties for data misuse. Handling multiple complex systems through AI-enabled IoT will no doubt generate advanced experiences for all involved in the healthcare system. Still, health care must be delivered in a safe way.

5. CONCLUSION*:*

Billions of connected devices are generating tons of health-related sensor data. Eventually, an improvement of data organizing processes is needed. The use of different forms of artificial intelligence as advanced predictive algorithms is bound to create smarter environments where human-machine interaction will become more efficient and safe. Incorporation of IoT into the process of management of healthcare organization everyday operations is the reality. Personalized client-oriented service-delivery equipped with the powers of the Internet of things, Artificial Intelligence, edge, and fog computing is the aim to be reached in the course of time.

REFERENCES:

1) Internet of Medical Things (IoMT) Market Size, Share & Industry Analysis, By Product Type (Stationary Medical Devices, Implanted Medical Devices, Wearable External Medical Devices), By Application (Telemedicine, Medication Management, Patient Monitoring, Others), By End User (Healthcare Providers, Patients, Government Authorities, Others) and Regional Forecast, 2019-2026
2) Artificial Intelligence (AI) Market Size, Share and Global Trend by Component (Hardware, Software, Services), By Technology (Computer Vision, Machine Learning, Natural Language Processing, Others), By Industry Vertical (BFSI, Healthcare, Manufacturing, Retail, IT & Telecom, Government, Others) and Geography Forecast till 2026
3) Cyber Security Market Size, Share & Industry Analysis, By Solution (Network Security, Cloud Application Security, End-point Security, Secure Web Gateway, Internet Security), By Deployment Type (Cloud and On Premise), By Enterprise Size (Small & Medium Enterprise and Large Enterprise), By End-Use (BFSI, IT and Telecommunications, Retail, Healthcare, Government, Manufacturing) and Region Forecast, 2020-2027
4) Internet of Things (IoT) Market Size, Share and Industry Analysis By Platform (Device Management, Application Management, Network Management), By Software & Services (Software Solution, Services), By End-Use Industry (BFSI, Retail, Governments, Healthcare, Others) And Regional Forecast, 2019 – 2026
5) Big Data Technology Market Size, Share & Industry Analysis, By Offering (Solution, Services), By Deployment (On-Premise, Cloud, Hybrid), By Application (Customer Analytics, Operational Analytics, Fraud Detection and Compliance, Enterprise Data Warehouse Optimization, Others), By End Use Industry (BFSI, Retail, Manufacturing, IT and Telecom, Government, Healthcare, Utility, Others) and Regional Forecast, 2019-2026
6) Over The Top (OTT) Services Market Size, Share & Industry Analysis, By Service (Online OTT Services, Managed OTT Services), By Type (OTT Communication Services, OTT Media Services, and OTT Applications Services), By Platform (Smartphones, Smart TV, Laptops Desktops and Tablets and Others), and Regional Forecast, 2019-2026
7) Connected Agriculture Market Size, Share & Industry Analysis, By Component (Solutions, Services), By Application (Pre-Production Management, In-Production Management, Post-Production Management) and Regional Forecast, 2019-2026
8) Endpoint Security Market Size, Share and Global Trend By Component (Software, Services), By Deployment (On-Premise, Cloud), By Enterprise Size (Large Enterprises, Small & Medium Enterprises), By End-Use Industry (BFSI, Telecom & IT, Retail, Healthcare, Government & Public Sector, Transportation, and Others) and Geography Forecast, 2019-2026
9) Smart Building Market Size, Share & Industry Analysis, By Component (Solution, Services), By Application (Residential, Commercial) and Regional Forecast, 2019-2026
10) Vertical Farming Market Size, Share & Industry Analysis, By Type (Hydroponics, Aeroponics, and Aquaponics), By Structure (Building-Based, Shipping-Container), By Component (Lighting System, Irrigation and Fertigation System, Climate Control, Sensors, and Others) and Regional Forecast, 2019-2026
11) Virtual Reality Market Size, Share & Industry Analysis, By Offering (Hardware, Software), By Technology (Nonimmersive, Semi-Immersive), By Industry Vertical (Gaming & Entertainment Media, Healthcare, Education, Automotive, Aerospace & Defense, Manufacturing), By Application (Training & Simulation, Educational, Attraction, Research & Development) and Regional Forecast, 2019 – 2026
12) Blockchain Technology Market Size, Share and Industry Analysis by Product Type (Vertical Solutions, Blockchain-as-a-Service), Deployment, Industry Vertical (BFSI, Energy & Utilities, Government, Healthcare and Life Sciences, Manufacturing, Telecom, Media & Ent., Retail & Consumer Goods, Travel and Transportation), and Regional Forecast 2018-2025
13) Home Automation Market Size, Share and Industry Analysis by Product Type (Luxury, Mainstream, Managed, DIY, Do It Yourself Home Automation System), Application (Safety and Security, Lighting, Entertainment, Heating, Ventilation and Air

conditioning), Networking Technology (Wired & Wireless) and Regional Forecast 2018-2025