

A Review on IoT and Health Care: The Smarter Way to a Better Health Management

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Abstract— Today, innovative healthcare solutions are becoming widely introduced in medical organizations enabling healthcare providers to reduce costs, improve patient treatment and optimize workflow. Mobile applications, smart devices, biosensors, wearable's, home virtual assistants, block chain-based electronic medical record systems, predictive analytics and web health portals represent a new stage in the healthcare environment. IoT has brought to bear on healthcare whether it's activity tracking for Cancer treatment or reminder to take medicine. IoT is changing the game for most industries and healthcare. It will literally take over health in the next decade. From personal fitness trackers to surgical robots, IoT is powerful enough to bring innovation and more efficient technology to the healthcare ecosystem. There is an overwhelming amount of data that is still unused by healthcare organizations. This not only increases the cost to that organization, but it makes patient's life difficult as well. There are still many untouched problems of healthcare industry which need a solution. Since there is an increased competition in the healthcare sector, more competitors are entering to leave a 'global' footprint which increases the cost of service.

Keywords: Internet of Things, Health Care, Services, Applications, Architectures, Security, Technologies, Industries, Policies and Challenges

I. INTRODUCTION

It is clear that there's no other field with more potential for IoT than healthcare. A smart technology is high in demand since healthcare seeks to address a wide range of challenges. IoT Healthcare solution is a proven catalyst for a planned change in the industry. It will not only improve patient outcomes and efficiency, but will reduce operational costs. This includes enhanced medical imaging, at-home healthcare, real-time tracking analytics, seamless data sharing among patient and service providers, remote patient monitoring etc. IoT healthcare solution integrated with devices and smart phones can deliver brilliant healthcare experiences which are precise, personalized and well-connected. The intermediary components will be intelligent enough to communicate within themselves without human intervention. IoT healthcare will improve sectors like patient monitoring, clinical operations, connected imaging, workflow management and medicine development

II. CHALLENGES OF IOT IN HEALTHCARE

IoT has the potential to help physicians with overwhelming data which can improve their treatment. But there are certain limitations to IoT adoption in the healthcare industry. Since a lot of data is managed with, the possible challenges that may put things at risk.

A. Breaching of Security

Healthcare organizations like hospitals, clinics and private healthcare bodies need to store personal health information. While a majority of healthcare organizations ensure that any kind of sensitive data is stored securely and is encrypted, none have a complete control over the safety since data is open to a third party. Even with the upgraded security measures implemented by OS providers and mobile manufacturers, security remains an issue among many users and app developers.

B. Multiple Device Integration

If a person has diabetes, chances are there that the person is also suffering from heart disease. Now the person has to use separate devices to monitor diabetes and heart condition which means multiple devices need to integrate to collect a group of data. Since there are different device manufacturers with their standard set of protocols, it can complicate that information grouping. This lack of uniformity reduces the success rate of IoT implementation in healthcare.

C. Deriving Proper Results from an enormous amount of Data

Collecting a vast amount of data is definitely a painful task and hence associated with complexities. Healthcare organizations need to identify actionable and valuable data to proceed further. With a big amount of data creates disturbance. Hence there is a lack of quality in decision making based on that data. So, it's important to have secured IoT healthcare solution that refines data and analytics program.

D. Complexity in Mobile Systems

Aside from security, mobile operating systems also create an issue in terms of app development. To prevent data leakage and to fix bugs, OS providers make their mobile ecosystem complex, which greatly affects the development app process. Developers need to make their applications simple and easy-to-use while building it on a complex platform.

E. User Engagement

To maintain a strong relationship with users, developers need to keep them well informed and engaged. This process is also very important in enhancing the digital medical experiences of patients. There's a need to ensure quality and transparency across all types of users from doctors and medical departments to patients in order to improve user satisfaction scores.

III. RELATION OF USE CASES TO REQUIREMENTS OF IOT

A. Remote Patient Healthcare

Many patients lose their lives because of absence of timely prompt medical assistance. The distance of hospitalization can be one issue and sometimes there is no one present physically with the patients. There are some people who do not get right medical attention to monitor their health or take their pills. So, remote health monitoring if done right can aid in faster healing in patients and also avoid fatal situations. With the use of IoT healthcare solution, patient data can be collected remotely and analyzed further. It will be more practical than relying on hospitalizations. There are remote patient monitoring solutions which collect very important health data in real-time. It will further generate alerts and in app notifications which will let the healthcare provider know the patient condition even when they are away from hospitals. There's an interconnected and secured database which stores medical records collected from different IoT devices. The information is easily available to the healthcare service providers like doctors and caretakers, reducing multiple forms fill-ups and data entry from consumer's end. There will be devices that will do the hard job of analyzing patient health and reduce their stay at hospitals. The moment when an interruption happens, the associated mobile app will send an alert to family members and health providers.

B. Real-Time Location System (RTLS) and Services

In RTLS, an active or passive tag is attached to the caregiver, patient and equipment. It can be directly integrated to ID card of the hospital staff, equipment and IDs of patients. A major number of hospitals are using this to track staffs, patients and devices. With this, a nurse can be called, check electronic medical records of a patient track, manage and maintain, medical devices and transfer of patient and discharge is possible. Hospitals can have huge output by attaching an RTLS tag to their wheelchairs and caregivers can find the closest through their Smartphone app. It gives a complete access to control everything that is happening in a hospital on their app. If a patient is waiting in a queue for more than 10 minutes, an alert will pop up in the caregiver's app. Then hospital staff can check with the patient and do the needful. Hospital staffs can track all the medical devices, even they are kept out of sight.

C. Creating a vast physician network with IoT Healthcare solution

For a quality treatment in healthcare, a team of professionals is needed who can work closely with each other. With IoT technology, creating a strong network of such professionals is possible. There will be a virtual network of doctors and physicians which is accessible through mobile apps. IoT whether implemented in hospitals or private healthcare bodies can create a network of highly qualified professional doctors across the country. Patients can get real-time advice and treatment right from their smart healthcare app.

D. Hand Hygiene Compliance

With IoT healthcare solution, customers can now get alerts whenever someone doesn't maintain hands clean. The hygiene monitoring system works in real-time. If the

caregiver approaches patient's bed without his washed hands, the app will make the device buzz. Detection of hygiene is possible with Hygiene dispensers which has the RTLS (Real Time Location system) sensors. It will detect the entrance of the caregiver and if staff uses the dispenser or not. All hand hygiene information is trackable. Clinician's ID and his location will be forwarded to the higher authorities if hands are not cleaned.

IV. BENEFITS OF IOT IN HEALTHCARE SOLUTION

A. Decreased Equipped Cost

Real-time health monitoring can cut down a lot of time visiting healthcare centers. Home care facility can significantly cut down on unnecessary hospital expenses and frequent readmissions. Also, patients can stay at their place and get monitored unless there is no serious illness.

B. Decreased Errors in Data Handling

Accurate data value to generate accurate 'data-driven' decisions it produces minimized errors hence reducing waste.

C. Better Treatment Leading to Better Health

Concerned healthcare authorities can deliver well-informed decisions as there are reduced errors, since the treatment is proper evidence-based, it results in punctual and better results. Hence healthy patient is the major advantage of IoT in healthcare.

D. Better Patient Experience

The connected system with the IoT highlighting on the exact condition of patients, the treatments are more positive. Accuracy increases in diagnosis enhanced treatments and better involvement by physicians which results in high trust among patients. This also leads to higher trust in the healthcare organizations.

E. Sensors & Smart Devices

Sensor technologies such as wearable sensors and devices provide many benefits for health management. Accurate reading and interpretation of indicators with the possibility of connecting sensors to mobile devices enables medical centers to replace heavy medical equipment with smaller devices.

F. Biosensors

Biosensors are the most important elements of the healthcare digital transformation. Different range of biosensors transmits medical information over a wireless network to mobile and web applications. Biosensors also can help users in their everyday life by collecting data about all their physical activities, sleep and overall health. Biosensors can enable users to measure glucose levels, arterial pressure, heart rate, oxygen level, pulse, blood alcohol level and alert users and doctors if some health issues or problems are detected.

G. Patient Health Portals

Patient health portals have become an essential part of healthcare organizations. Helping provide improved customer service and optimizing operations like request processing and appointment scheduling, they facilitate the life of both doctors and patients.

H. Machine Learning Applications

Machine learning has great advantages for the healthcare industry. Machine learning applications can help medical organizations improve customer service, extract value from large data amounts, efficiently analyze medical records and enhance patient treatment.

I. Blockchain Based Initiatives

Blockchain technology can be successfully used in many other industries. It has various applications and healthcare providers can significantly benefit from using it too. Safe data storage, protected transactions, secure data exchanges between healthcare organizations, immutable data record and transparent data flow are all advantages of using blockchain integration.

V. SECURING IOT INFRASTRUCTURE

IoT presents amazing opportunities for businesses, but it also introduces key challenges. An IoT solution brings together the risks of a cyber communications with those of the physical world. To address these new risks, securing IoT infrastructure end-to-end from physical devices to services and data in the cloud is needed.

The three components of a secure IoT solution

A. Device Security

Reduce the challenge of securely connecting billions of physically distributed IoT devices with secure device provisioning and authentication.

B. Connection Security

Connecting IoT devices over the Internet can create threats to data reliability and privacy. It is important to ensure all data transmitted between local devices and the cloud is encrypted.

C. Cloud Security

Security is built into the Microsoft Azure cloud, from the ground up, to keep data and insights secure when it reaches the cloud.

VI. SECURE HARDWARE SUPPORT FOR IOT DEPLOYMENT

Issues with security are use of secure hardware, level of security and how much security is really needed. The assurance to secure IoT deployments worldwide is difficult because it is a journey and never an endpoint. Challenges emerge, vulnerabilities evolve and solutions age thereby triggering the need for renewal if it is needed to maintain a desired level of security. Securing deployment as desired comprises planning, architecture and execution main phases. For IoT, these are further broken down into sub-phases to include design assessment, risk assessment, model assessment, development and deployment as shown in Figure 1. The decision process at each phase is equally essential, the process must take all other phases into consideration for optimal efficacy. This is especially true when choosing the right secure hardware, also known as secure silicon or Hardware Secure Module (HSM), to secure an IoT deployment.

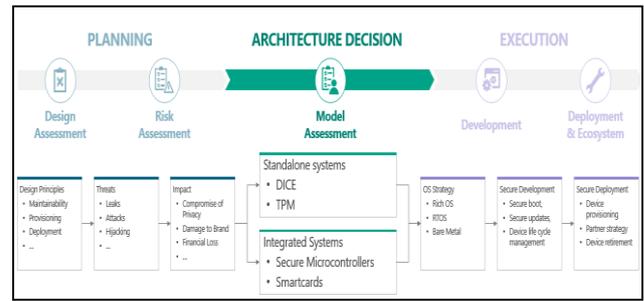


Fig. 1: The IoT Security Lifecycle

Hardware security modules protect cryptographic keys and operations. Hardware-based security can reduce the risk of device duplicate, can improve supply-chain security and can bootstrap secure and reliable device enrollment using the Device Provisioning Service.

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