

Design of seamless communication channel for IoT equipped quarantine centers Post Covid 19 Outbreak

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Abstract— In the last few decades, our population has grown at a tremendous rate. This unsustainably high rate of growth becomes a major issue for healthcare centers. Not only are they already quite limited in numbers, but their own rate of growth is nowhere close to the population growth rate. Thus, due to these mentioned factors, there now exists a tremendous demand for Industrial health IoT services post COVID 19 outbreaks. These services involve a patient getting treatment within the comfort of their own home environment. To do this, an existing healthcare center can very well be transformed into an Industrial health IoT service center. This can be achieved with the help of various emerging, modern technologies such as IoT, which stands for 'Internet of Things'. This model is based upon the overall health of a patient and involves realizing symptoms with the help of mobile devices and multichannel technology. The main idea behind this project is to introduce a set of systems to support a patient and his/her family. Thus, we can increase the independence of a patient, and can provide a lot of support to families of critically-ill patients. These systems are skilled enough to understand various changes in bodily functions and can easily relate them to various diseases. They can also prescribe medications accordingly and automatically.

Keywords— *HealthIoT, body sensor network, Low power network, MQTT, health care model post covid-19, communication channel*

Chapter 1. Introduction

After corona virus outbreak, hundreds of thousands of people are quarantined and their health is being constantly monitored. As it is essential to maintain social distancing but due to regularly monitoring the health parameters of patients by medical staff. Members of medical staff are at huge risk to getting corona virus. By saluting to their determination, this paper attempts to create a communication channel that is easy to set up and can gather vital information of patients without putting members of medical teams putting at great risk.

In recent years, the change in the population has led to changes in the healthcare field [18]. This has happened by special attention and recent emerging technologies for developing home care and Industrial health IoT services.

It is very easy to suggest IoT as a combating technological weapon to fight against COVID 19. However, IoT is very expensive and it is not at all feasible to use all the sensors on a patient and his/her family every time. It is also very time consuming and expensive to create a communication channel to gather all the information without any delay or errors.

With this objective, this paper proposes an architecture to create a robust and simultaneously a flexible system which can interact with humans and its environment to recognize various bodily changes and identify upcoming health problems

CHAPTER 2: RELATED WORK DONE

A detail introduction about Alzheimer's disease, its symptoms and causes are given in [1][3]. In [3] also mentions various hormonal changes in patients and general medicine prescribed to them in such conditions. In [4] a detail use of IoT in health care is mentioned. [4] also mentions various benefits, disadvantages and future options in this field. In [4] various data is collected from many sources and is analysed to find out future demands of this Industrial health IoT and home health care services.

In [5] various sensors are compared according to their size, pervasiveness, efficiency and effectiveness. Also, in [5] a brief outline is given about the working of various sensors and their cost is compared with their effectiveness.

In [6] tested various sensors to find their workability in real world because sensors in real world can be fragile and non-functionable. They compared data rate and proximity of their working.

In paper [7] they mentioned related disease and problems faced by Alzheimer's disease patients. In Industrial health IoT care services it's very important to understand that systems must robust and can interact with both user and user's home environment. In [9] its shows creation of various applications and appliances that can react with user environment.

In [8], tongue detection and various other biometrics are explained in detail and its various uses are also mentioned. In

[10] motion detection sensors are discussed and they are analysed to find best suited devices.

When it comes to IoT, its sensors and devices are out in real world open for all. That's why they are vulnerable to attacks and eavesdropping. In paper [11] [12] [13] various methods for security is given. This will not only protect patient's privacy but will also enhance doctor patient confidentiality. In [20],[21] and [22] a detailed comparison of MQTT, CoAP and AMQP is given and their implementation and security aspects are also covered.

3. ARCHITECTURE

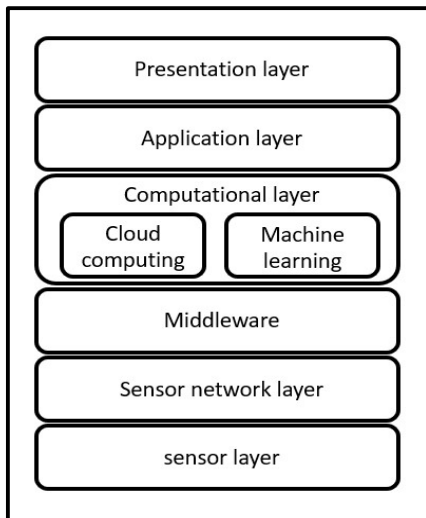


Figure .1. Architecture

In Figure [1], we show an architecture for IoT in Healthcare Industry.

- The Sensor Layer is consisting of different type of wearable, namely wireless sensors and ambient sensors. they provide vital patient health measures during emergency including pulse rate, blood oxygen, heart rate, body temperature and muscle activity which is required to diagnose patient condition. With the wide availability and advancement in sensor devices the wear ability of sensors is increased for long duration which enhances the accuracy of patient health.
- The Sensor Node Network, collects all the patient data and ambient information from various sensors. This wireless sensor network which makes use of any short-range communication standards like BLE and Zigbee [20] communication layer allows the transmission of patient health data from various wearable or ambient sensors to the server or directly to the user's smartphone.
- The Middleware layer consists of many software components for application of healthcare it is very useful to handle many tasks solutions. Ubiquitous computing is

the necessary objective to connect healthcare system with Internet of things. Interoperability of such devices needs standardization of heterogeneous system. Middleware act as sandwich software between devices and applications to provide specific service to developers so that they focus more on quality of service. To connect this proposed architecture for industrial health IoT, there are several different data protocols to choose from. The choice depends upon scope of implementation and sensors being used. We have studied and examined different IoT data protocols for our proposed architecture. To provide seamless connectivity over the network, it is important to take care of maximum interoperability between devices and applications. MQTT is a modern, lightweight protocol designed to overcome any challenges that we face while connecting physical devices like sensors, activators, phones and tablets, with software. Due to the same reason, MQTT protocol is an ideal form of M2M communications in industrial health IoT. MQTT also conserve battery power of connected devices more than any other protocol

Hence, Middleware provides an Application Programming Interface (API) for data communication and management, for machine learning, security and privacy. HealthIIoT middleware faces many challenges like Interoperability, scalability, big data analytics, context detection, security and privacy.

- The Computational layer combines all data coming from various sensors devices and providing a uniform reference model to store and manage the sensitive patient data at the data layer. The data coming from sensor layer are differentiate here according to their usefulness for monitoring patient vital signs and it makes a challenging task of extraction the relevant data from whole data coming from all various kind of sensor devices. Cloud technologies has achieving a greater benefit for maintaining, processing and analysing of big data. In healthcare industry cloud technology basically provides three primary services software, Platform and Infrastructure Services. Software as a service enables healthcare providers to work with health data and perform another significant task. In healthcare, patient data and value of its vital sign need to be stored. Finally, Machine learning is applied to determine the patient's condition by applying machine learning algorithms.
- The application layer: It's the highest abstraction layers in proposed architecture. It contains various protocols and methods needed by users to simplify the entire technology so that it can be easily used by old aged people who are not usually exposed to the technology and other smart devices and wearable sensors. It will provide

basic facilities such as login, naming network devices, error control, taking commands from users and coordinate with other lower layers, provide mapping to find various objects and help patients to set timing for medicines.

- **Presentation layer:** It's the second layer in proposed architecture and it take care of syntax and semantics of networks. It performs various operations such as conversion of user input data in bits in images, videos and other info graphics into EBCDIC (extended binary coded decimal interchange code). It's also performed work of encryption using various algorithms thereby increasing the security of the systems. While performing encryption it's also performs jobs of exchanging keys between communicating devices. In any given case, data limits get exceeded this layer perform compression task so that data can be transmitted seamlessly.

4. FRAMEWORK

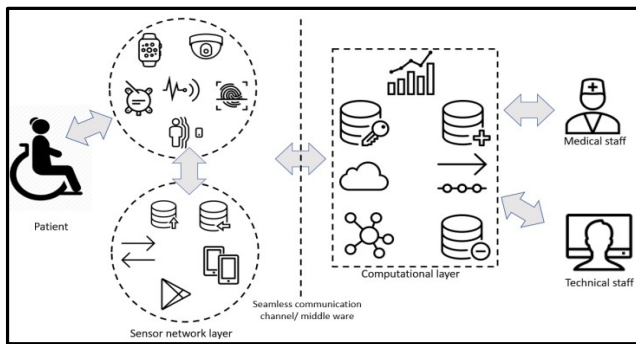


Figure .2. framework

In figure [2] a symbolic representation of entire model along with devices used are given: -

- **Sensor network layer:** its basic operation is to maintain simple and easy to understand apps so that they can assist patient as well as can also inform patient's family. It shows topic-based notification such as pill reminders, alerts, diet plans, exercise routines and various other tasks. It connects itself with sensors and performs various tasks to ensure sensors are healthy and are working properly. It also contains to detect faults in sensors. It performs all the tasks required in the field of creating and maintaining networks to ensure seamless communication.
- **Computational layer:** this layer performs all the computational works in order to make the entire system non-pervasive and robust in nature. It provides In-cloud storage facilities and failure tolerance, so that data will neither be lost nor it be tempered. It also computes

various values from data and create various graphs to help medical staff. It also communicates with medical staff and provide technical support from technical side. It also ensures that firmware is updated and are performing at best level.

- **Medical staff consists** trained doctors and nurses to assist patients at anytime and anywhere. To provide this kind of service it is necessary to create a chain of patients all over the world and include various hospitals. This will ensure seamless services
- **Technical staff:** this consists of computer technicians and highly trained and experienced computer engineers. This will provide strength to system. Technical team will ensure seamless services at any time. Team will also perform operations like updating of system firmware, increase performance of system, etc.

5. RESULTS

	MQTT	CoAP	AMQP ¹
Structure	flexible	rigid	flexible
Transport layer	TCP	UDP	JMS
Header size	2	4	Contains 5 types of frames
Device Suitability	Light weight ²	Light weight	Heavy weight
Mode of communication	Publish - subscribe	Client - server (command to client)	Publish - subscribe
Security	Good	Better	Best
Environment	open	Close (Suitable for home)	open

Table 1 – comparison between various protocols

In IoT, there are 3 protocols suitable for Industrial health IoT care services and comparison between them are shown in table [1]. According to table it can said that MQTT will be most suitable protocol for Industrial health IoT services. AMQP is even better than MQTT however it is made for heavy devices and in the field industrial health IoT installing this protocol will be very expensive. CoAP is another great protocol for light weight devices however it is made for confined environment such as homes and the scope industrial health IoT is a lot more. Therefore, we can say that MQTT is best suitable protocol for industrial health IoT

6. Conclusion and Future work

In an era of technological abundance, we've found a way of bringing together different frameworks of networking like Bluetooth, Wi-Fi, sensors Zigbee, BLE and a lot more. These non-similar architectures will work seamlessly to aid people in medical field. Whether it is monitoring someone's pulse rate, blood sugar or stress levels on an hourly basis, IoT

in health care Centres is the future. It ensures safety of our loved ones and takes medical care and facilities to a whole new level.

This paper connects sensors and various wearable measuring devices to the middle where software components so that with the help of advanced machine learning and cloud computing in zero-time, patient's overall health is measured and conveyed to their doctors in real time basis. Thus, architecture also contains a provision for API so that software is scalable and patient specific. It also ensures interoperability, Big Data analysis and context detection, security and privacy. This architecture is useful in monitoring patient's vital signs and extract relevant data coming from different devices and sensors to measure overall health of a patient. We conclude that IoT can bring a lot to the table when it comes to advanced medical facilities. It will also be beneficial for both patients and doctors to be in constant touch with each other. It will save time and money required for check-ups and conducting tests.

This paper also focuses on protocol used for the industrial health IoT. From the results and architecture, we can say that MQTT is best suitable protocol because of its wide scope and support for light weight devices. MQTT will also be very helpful in increasing battery life.

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