

Implementation of Machine Learning approaches in 5G for Healthcare Management

Abstract:

5G is the forthcoming revolution of mobile technology. The features and its usability are much beyond the expectation of a normal human being. A 5G network will be able to analyze historical data patterns and conversation, allowing for more efficient transmission of data at all the times. It supports wide range of bandwidth radio channels. Also it can able to support the speed up to 10Gbps. 5G Wi-Fi technology will offer contiguous and consistent coverage which is called as “wider area mobility in true sense”. The huge volume of big data is generated by IoT devices in healthcare environment. 5G system based on Machine Learning techniques to remotely provide a high-quality and continuous monitoring of the patient’s health situations. Machine Learning is ideally suited to unite with 5G networks because it requires massive amounts of data to predict activity accurately. At the same time 5G can transmit higher volumes of data faster than current networks.

Keywords: Healthcare- Internet of Things-5G cellular network-5G architectures-5G challenges-Machine Learning-ML techniques.

Introduction:

Healthcare:

Healthcare is undergoing a rapid transformation from traditional hospital and specialist focused approach to a distributed patient-centric approach. Advances in several technologies fuel this rapid transformation of healthcare vertical. Among various technologies, communication technologies have enabled to deliver personalized and remote healthcare services. At present, healthcare widely use an existing 4G network and other communication technologies for smart healthcare applications and are continually evolving to accommodate the needs of future intelligent healthcare applications. As the smart healthcare market expands the number of applications connecting to the network will generate data that will vary in size and formats. This will place complex demands on the network in terms of bandwidth, data rate and latency, among other factors. As this smart healthcare market matures, the connectivity needs for a large number of devices and machines with sensor-based applications in hospitals will necessitate the need to implement Massive-Machine Type Communication. Further use cases such as remote surgeries and Tactile Internet will spur the need for Ultra Reliability and Low Latency Communications or Critical Machine Type Communication. Existing communication technologies are unable to fulfill the complex and dynamic need that is put on the communication networks by the diverse smart healthcare applications.

Therefore, the emerging 5G network is expected to support smart healthcare applications, which can fulfill most of the requirements such as ultra-low latency, high bandwidth, ultra-high reliability, high density and high energy efficiency. 5G and IoT devices which are expected to increase cellular coverage, network performance and address security related concerns.

Internet of Things (IoT):

It is a dynamic network infrastructure which has the capability of self-configuration on the bases of interoperable and standard communication protocol. In other words, IoT is flexible, complex and dynamic network infrastructure that connects anyone, anything, anytime, anywhere for any services. The IoT has numerous applications in healthcare from remote monitoring to smart sensors and medical devices integration.

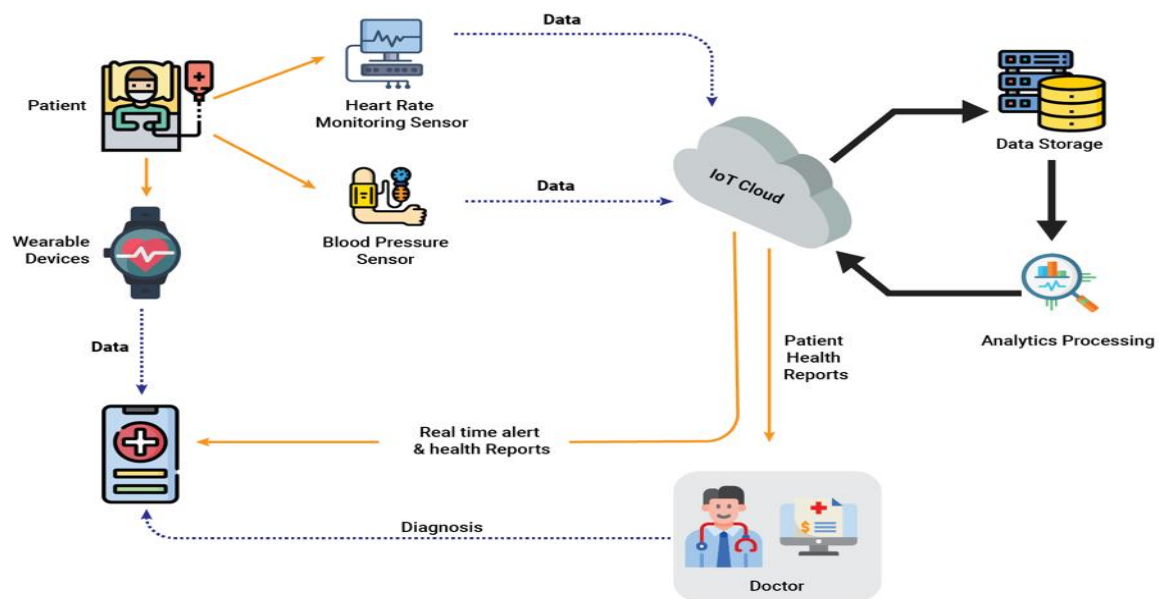


Fig: IoT is transforming the healthcare industry.

5G Technology:

5G technology is expected to provide a new frequency bands along with the wider spectral bandwidth per frequency channel. Due to the potential increase in mobile traffic and the rapid expansion of communication infrastructures, 4G can no longer meet the actual needs of users. In order to improve quality of services and reach user satisfaction, 5G technology is used.

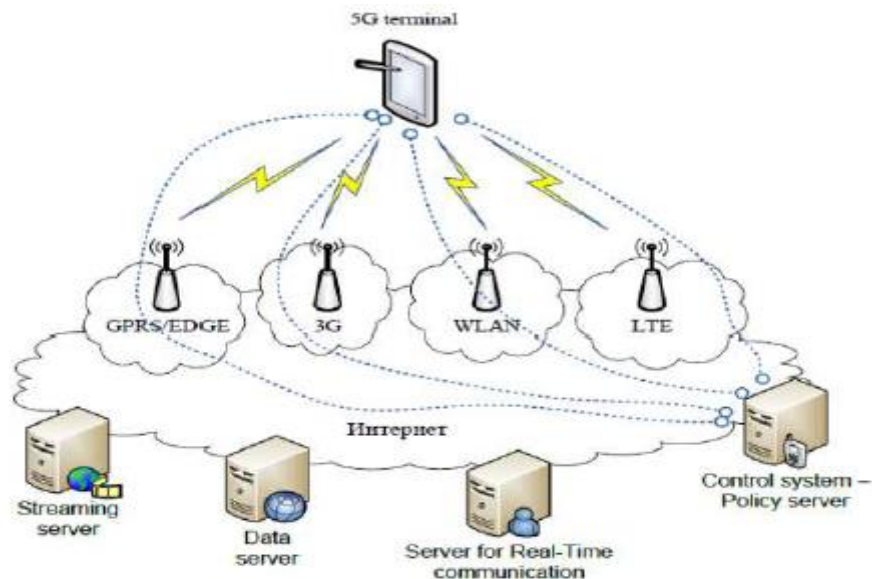


Fig1: Simple 5G network architecture

5G is also advanced in terms of

- High increased peak bit rate.
- Larger data volume per unit area.
- High capacity to allow more devices connectivity concurrently and instantaneously.
- Lower battery consumption.
- Larger number of supporting devices.
- Lower cost of infrastructural development.
- Higher reliability of the communications.

The response to 5G requirements, for instance low latency, fast data transmission, high throughput is expected to serve a large range of applications. Some applications which are improve by 5G.

- Internet of Things
- M2M communication
- Internet of Vehicles.
- Health care
- Smart Grid.
- Smart homes and smart societies.
- Internet Tactile.

5G technologies are designed to provide incredible and remarkable data capabilities, unhindered call volumes and immeasurable data broadcast within the latest mobile operating system. 5G has also big challenges to deal with following.

- Technological Challenges
 - Inter-cell interference
 - Efficient Medium Access Control
 - Traffic Management

- Common Challenges
 - Multiple services
 - Infrastructure
 - Communication, navigation and sensing
 - Security and privacy
 - Legislation of cyber law

The huge volume of big data is generated by IoT devices in healthcare environment. 5G system based on ML techniques to remotely provide a high-quality and continuous monitoring of the patient's health situations and supply treatment services.

Machine Learning:

It is a collection of methods that allows computers to be able to learn, automate and optimize using large data sets that cannot be used systematically by humans. Without ML, network operators will not be able to efficiently delivering 5G services with its various requirements. ML approaches have the potential to automatically to learn the system experience, predict future scenarios and to adapt to fluctuating environments. In 5G systems, that are multiple parameters and complex multi-variable scenarios, the pattern of learning will take different categories for each kind of problem and within each stage of the learning model.

Machine Learning approaches are classified into three main categories.

- Supervised Learning(SL)
- Unsupervised Learning(UL)
- Reinforcement Learning(RL)

Other Categories:

- Markov Models
- Heuristics
- Controllers.

Each ML category can be divided into several sub-classes dealing with very specific algorithm that will be applied in cellular networks.

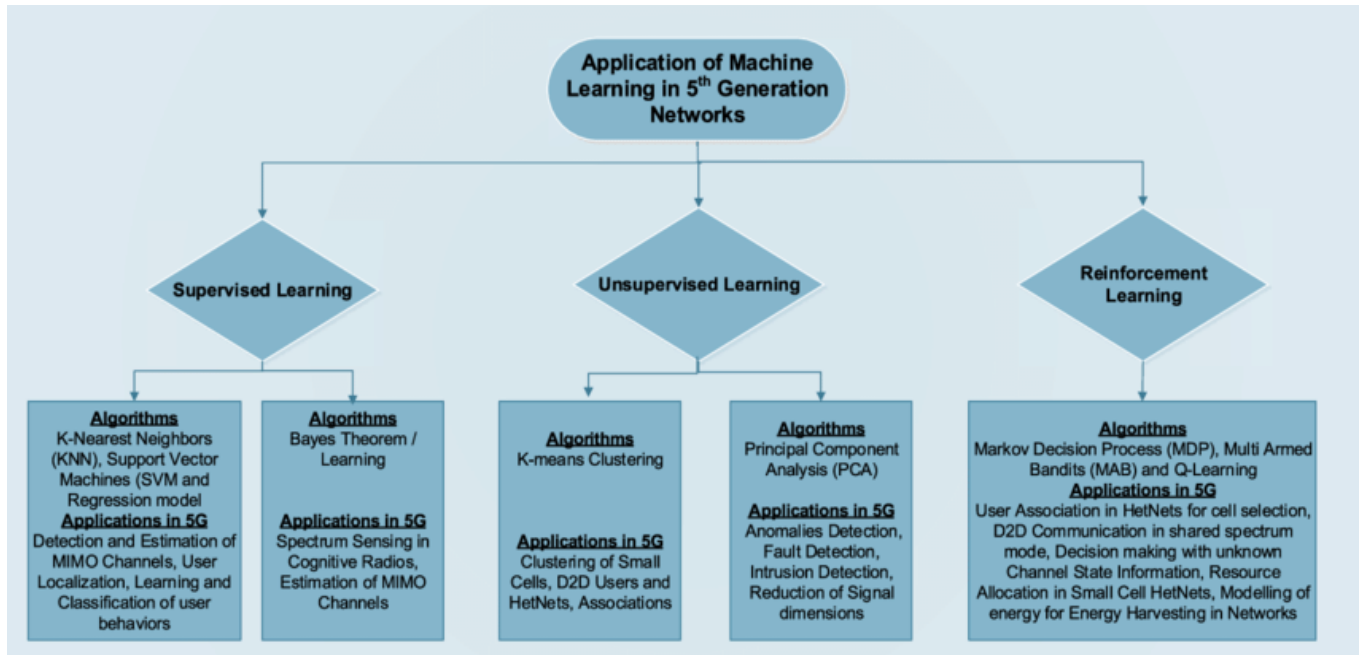


Fig: Machine Learning Techniques

Objective:

To apply Machine Learning (ML) in 5G network to early detect heart diseases. Respiratory rate, heart rate, blood pressure and systolic range and body temperature parameters help to indicate the heart disease. It proposes scalable three levels architecture based on IoT which is interconnected. To store and process the enormous amount of data generated by the health monitoring system based on IoT. The sensor data collection using the 5G network, storing of the huge volume of portable IoT sensor data in the cloud and development of the logistic regression-based prediction model in case of heart diseases.

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