An IoT Framework for Healthcare Monitoring System

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Abstract. As a result of the developments made in medical and technical aspects, the healthcare sector has been constantly evolving. Over the decades, healthcare has developed by using the best available PC technology. It has become an in-depth source of valuable analytical and analysis data. The health aspects of the person need to be monitored with the utmost concern and treated with appropriate medications. Proactive monitoring of one's health can cure and prevent several diseases. In recent decades, technology has evolved to its height due to the availability of many wearable devices and health tracking gadgets on the market. Expert doctors also find it difficult to estimate the disease from the symptoms seen from the diseased, but using advanced technical tools such as the Internet of Things (IoT), cloud/edge computing, machine learning and AI along with Big Data will make it much easier for doctors to dig out and describe the root cause of the disease and predict its severity using modern algorithms. The objective is to be able to extract relevant and important information from the massive data usually produced in IOT devices by the front-end sensor frameworks and few intelligences that could be included in the front-end module itself to allow the front-end to make a decision based on data priority.

1. Introduction

The fundamental component of our lives is healthcare. The conservation and enhancement of health by prevention and diagnosis of diseases is healthcare and security. With the aid of diagnostic equipment such as CT, MRI, PET, SPECT etc., any ruptures or anomalies that are present deep under the skin are also diagnosed; it is also possible to detect such abnormal conditions such as heart attack, epilepsy, long before they occur. The steady growth in the population and also the unpredictable spread of chronic diseases among the masses have placed a strain on modern healthcare systems, and the demand for services from hospital beds to doctors and nurses is therefore extremely high. A solution is clearly needed to reduce the burden on healthcare systems while preserving the quality of health care at its optimum level. The Internet of Things (IoT) may be a possible solution for reducing healthcare system pressures and has thus been the primary focus of recent research.

IoT (Internet of Things) is a platform that offers solutions for reality using sensors, network connectivity, computation and big data. For optimum control and efficiency, these types of solutions and systems are built. IoT is a technology that has made advances in related technologies such as sensors, communications and computing. Any leaf node system capable of "sensing" environments that can compute and can be addressed through a wireless network by a network address that enables solutions to be built that map "real life" entities to a corresponding virtual entity. Using available communication technologies, these virtual objects can interact with each other and keep the "real life" individual updated about the state of "things". As part of this framework/solution, a control
mechanism is used between the "real life" entities and the virtual objects as well. The IoT model contains an end-node system that can communicate through a communication channel with a back-end computer/data centre (Generally Wireless). The communication medium for live data typically uses IoT protocols such as MQTT/CoAP as they are better suited to the model. Messages from Data and Control can be conveniently shared between the IoT endpoint and the Data Center Server. Using different sensors that depend on the domain of interest and receive information/instructions from the backend to perform actions, the ambient condition information can be given by the endpoint system to a Data Centre. Generally speaking, the Back-End Servers are strong computational tools and could use computer-intensive algorithms to process data/information obtained from end-point devices.

2. Literature Review
In India, with the implementation of IT, a survey was conducted to track the functioning of different medical centres and also to enhance healthcare delivery. The study showed that patient records were not properly maintained in many of the hospitals; more or less sponsored paper notes were also patient referrals among different hospitals. As services were not available to reliably estimate the history of the patient, the quality of healthcare was inefficient. The survey found that with the aid of information technology, healthcare services could be strengthened, primarily using electronic health records (EHRs).

C Imthyaz Sheriff, Twaseef Naqishbandi, Angelina Geetha suggested a reference system that incorporates and leverages in a very overly seamless way the advantages of BigData Analytics, Complex Event Management and Internet of Things. It is a holistic approach for healthcare informatics and study. [1]

The possibilities of combining cloud or edge computing and ML paradigms into a Distributed Computing based IOT Architecture were explored and proposed by Dr S. Mohan Kumar and Darpan Majumder. Within the front-end module itself, some artificial intelligence could be included to allow it to make a decision based on data priority and could be supported by a backend IOT server to achieve this. [2]

Ravi Kishore Kodali, Govinda Swamy and Boppana Laksh suggested a combination of M-Health, which uses mobile computing, medical sensors and communication technologies. It introduces various wireless technologies such as GPRS, WLAN, ZigBee, Bluetooth and IOT used in m-health and discusses a range of issues and potential implementation problems in these fields from the healthcare point of view.[3]

D.M. Jeya Priyadharsan, K. Kabin Sanjay, S. Kathiresan, K. Kiran Karthik, K. Siva Prasath, suggested ML algorithms to keep track of a human being's health conditions.

The training phase and validation phase of machine learning algorithms are carried out using the UCI dataset and the evaluation phase is performed using IoT by collecting heart rate, blood pressure and temperature. In this point, the sensor information gathered via the IoT is used to predict any anomalies in the health condition. In order to measure the accuracy of the prediction percentage, statistical analysis is performed from accumulated data in the cloud from the IoT unit. Also, other traditional classifiers outperform the findings obtained from the K-Nearest Neighbor. [4]

As a suitable and appropriate self-management model for perpetual illness, such as hypertension, heftiness, diabetes using WBAN IEEE, IOT, Dharmendra Singh Rajput and Rakesh Gour suggested the IoT Platform for human services. It focuses on a way to deal with health conditions of individuals living in remote areas or away from physicians, and thus IOT provides those individuals with the lifeline. Major efforts are made via this paper to synchronise data from the sensors to the cloud and can be accessed through mobile application. [5]
3. An IOT framework for healthcare monitoring system

In addition to communication between humans and information systems, this paper proposes an IoT structure for healthcare that will be able to track and provide healthcare informatics and analytics solutions where informatics deals with storing, processing, accessing, communicating information. Informatics and analytics rely on visualisation to communicate and exchange data and insights respectively.

The main objective of this project is to design an architecture based on IOT for health problems such as diabetics, heart monitoring system, pulse measurement, everyday activity. The surveillance framework for healthcare is a fundamental basis for achieving comprehensive, reliable and safe health monitoring. Sensor data/information is uploaded to the cloud and exchanged with others. Data obtained from sensors can also be accessed via a smart phone.

Figure 1. An IOT Framework for Healthcare Monitoring Systems

3.1 Internet of Things (IoT)

It is expected that the Internet of Things (IoT) will bring fundamental improvements to the way tracking and data capture occurs. The nature of IoT is distinctly recognisable devices or objects with the ability to connect dynamically to a network, interact, and cooperate effectively. Such intelligent entities can collect and exchange data with each other and with the cloud. This allows real life events to be tracked and data collected and new data sources to be processed quicker and more reliably. Devices such as personal health monitors, hospital life support devices, environment tracking devices for life style monitoring, smart home devices, smart work devices and others will be part of the IoT ecosystem and provide Healthcare Informatics and Analytics system with real-time data/events.

3.2. Data Stores

Collectively, data stores refer to data stores such as transactional databases, organisational databases, information bases, domain-specific databases, in-memory girders, wide data stores, temporary caches, etc. Related information is accessible as electronic health records for the healthcare domain (EHR).

4. Algorithms

In recent year more focus is given on parameter findings and optimization using different paradigm which include semisupervised, reinforcement learning, deep learning and parallel computing.

4.1 K-nearest Neighbour Classifier

KNN non-parametric supervised learning technique in which, with the aid of training set, the data is categorised into a given category and the predictions are made for a new instance (x) by ransacking
through the complete training set for the 'K' most related cases that are neighbours and then summarising the output variables for those K cases.

4.2 Decision Tree Algorithm
This algorithm's goal is to make a training model by referring data deduced from prior data which is used to predict class or value of target variables. A decision tree doesn't require normalization of data and doesn't require scaling of data as well.

4.3 K-Means Algorithm
It is mainly used to identify similarities that can be partitioned into 'k' clusters between 'n' data points. This k-means algorithm works for in-memory knowledge, but for out-of-memory occupant datasets, it could be efficiently extended.
5. Comparative Analysis of Algorithm

The efficiency of various algorithms for machine learning depends on the dataset's features. Three ML algorithms are used to evaluate the given dataset. They are: Decision tree algorithm, KNN algorithm and K-means algorithm. As observed in the analysis represented in Figure above, the accuracy is more for decision tree algorithm than the others. Accuracy is defined as the ratio of the number of precise estimates to the total number of input samples given. The accuracy of the algorithm is influenced by many major factors and one of those factors is the mean. If any value within the dataset is found to be unacceptable, such values may be replaced by mean values. Mean is inversely proportional to accuracy and mean should be small to get higher accuracy. The above figure demonstrates the relationship between accuracy and mean. Also, with the decision tree algorithm, the data set is more accurate, making the accuracy higher. The accuracy of the decision tree algorithm is 76.4 present, which is 5.3 present greater than the algorithm for k-means and 7.83 present greater than the algorithm for KNN.

6. Hardware details

6.1. Body temperature sensor

This is the DS18B20 sensor, a digital thermometer that provides an alarm feature for 9-bit to 12-bit Celsius temperature measurements that transmits data over a 1-Wire bus that needs only 1 data line (and ground) by definition for communication with a central microprocessor.
6.2 Pulse Sensor

It is a well-designed Arduino uno heart rate sensor that can be used by learners, musicians, athletes, designers, and game & mobile developers who simply want to integrate live heart rate data into their projects. The sensor clips to a fingertip or earlobe and, with some wires, plugs right into Arduino.

6.3 Arduino Uno

Arduino is a prototyping phase for open source gadgets that takes into account adaptable, easy-to-use equipment and programming. For specialists, fashioners, specialists, and anyone involved in creating intelligent products or circumstances, it is useful.

7. Applications

7.1 Remote Monitoring

Remote control of health is a critical IoT application. You will be able to provide reliable healthcare information to people who are in desperate need of assistance by surveillance. Many individuals die every day because they do not receive timely and prompt medical care. Through the use of IoT, the sensor-equipped systems alert the health care providers concerned when there is some improvement in an individual's vital functions. These machines will be capable of applying complex
algorithms and then evaluating them in order to get adequate care and medical attention for the patient. In cloud storage, the stored data will be. Patients will dramatically reduce the duration of hospital stay and maybe, even hospital re-admission, by remote monitoring.

7.2 Real Time Location Services

Physicians can use current location services with the aid of IoT and keep an eye on the devices used to treat patients. The medical staff may often keep the equipment outside, making it difficult for them to look out when another medical staff arrives on the scene. Sensors can be tagged with medical devices, such as wheelchairs, scales, defibrillators, nebulizers, pumps or monitoring equipment, and IoT can be easily found.

7.3 Enhanced chronic diseases monitoring

With the help of IoT-powered wearable, sensors, Data analytics and the mobile battle against chronic diseases have become more successful and available, so long periods of time must be tracked and evaluated for health conditions. In this way, patterns in disease fluctuations can be identified and juxtaposed in order to be handled more effectively.

8. Conclusion

The health related symptoms of human if left unnoticed will cause serious issues and even cause danger to their life. Automating the monitoring of heath parameters through IoT is discussed as novel solution. Technology plays the key role in health care not just for sensory devices but also in communication, recording and display device. It’s very much important to observe various medical parameter sand post operational days. Hence the newest trend in Healthcare communication method is using IOT and Machine learning techniques. IoT acts as a catalyst for the health care and plays prominent role in wide selection of health care applications. For this type of IoT platform that is based on continuous monitoring of human heath parameters, machine learning algorithms had played a major role. Above comparative analysis showed accuracy rates higher for DST and K-Means and thus we can conclude that they are reliable models for biomedical applications.

9. References

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