IOT Framework Sensor Data Predicts Patient Health Concerns Throughout Testing

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Abstract - The health of humans has to be carefully examined on a regular basis and treated with the proper medications. Monitoring one's health on a preventative basis may help mitigate the symptoms of a variety of diseases. A wide array of wearable gadgets and health monitoring equipment are now available on the market as a direct result of the rapid expansion of technology over the course of the last few decades. Even highly skilled medical professionals have trouble determining the cause of a patient's illness just based on the patient's symptoms. The use of contemporary technology tools, such as the Internet of Things (IoT), machine learning, artificial intelligence, and big data, may make the work of doctors much simpler. These technologies can be used to investigate the underlying causes of disease and to determine the severity of the condition using contemporary algorithms. In this line of study, methods of machine learning are used to keep an eye on people's various health concerns. The UCI dataset is used for the early stages of training and validation of machine learning algorithms. During the phase of testing, an Internet of Things setup is used in order to determine the subject's temperature, blood pressure, and heart rate. Using the information gathered from sensors by the IoT framework, the testing stage attempts to anticipate any potential concerns with the current state of the patient's health. The information collected from Internet of Things (IoT) devices and stored in the cloud is subjected to statistical analysis in order to determine the accuracy percentage. In addition, the K-Nearest Neighbor algorithm beats other traditional classifiers, as shown by the data.

Key Words:RaspberryPi, Cloud,IoT

1. INTRODUCTION

Human beings have an inherent need for medical treatment. Care for one's health may be seen as the maintenance and enhancement of one's health via the diagnosis and prevention of illness. CT, MRI, PET, SPECT, and other diagnostic technologies may be applied to identify any ruptures or anomalies deep beneath the skin. In addition, it is possible to identify certain atypical disorders, such as a heart attack or epilepsy, even before the symptoms manifest themselves. There is a high demand for resources such as hospital beds, physicians, and nurses as a result of the continuously rising population and the unpredictability with which chronic illnesses spread across the society. This results in a high level of competition for these jobs. It should go without saying that a solution is necessary in order to reduce the strain placed on healthcare systems while at the same time preserving the

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highest possible level of care standards and quality. The Internet of Things (IoT) has been the subject of a significant amount of study in recent years due to its potential to reduce stress on healthcare delivery systems.On occasion, I am responsible for the monitoring of persons who have diabetes, in addition to those who have more specialized disorders such as Parkinson's disease.More research is being carried out with the intention of accomplishing a certain goal, such as facilitating the recovery process of patients by closely monitoring their progress at regular intervals. Even though not a great deal of study has been conducted on emergency healthcare, it has been mentioned in publications that are linked to this field. IoT healthcare-related concerns and technologies have been the subject of investigation in a wide range of publications. This in-depth analysis focuses on solutions that are currently on the market, potential applications, and problems that have not yet been resolved. The individual problems are analyzed in isolation, rather than being seen as parts of a larger system. In order to improve patient care and lower the overall cost of treatment, RFIDs were used in American hospitals. The physician could use a healthcare monitoring system to keep an eye on the patient's cardiac impulses in order to get a more accurate diagnostic of the patient's condition. Many different types of wearable technology have been suggested as viable options for wireless data transfer devices. In the field of medicine, the internet of things has a number of opportunities for improvement, but it also presents considerable challenges. Both IT administrators and healthcare administrators are worried about the administration of IoT devices and the security of data.

The development of artificial intelligence (AI) led to the creation of machine learning. By using artificial intelligence, we are able to build machines that are both more intelligent and superior. Machine learning is a method that allows for learning to occur automatically as a result of experience and examples. Rather of creating code, the data are entered into the generic algorithm, and the logic is constructed based on the data that is provided. Web searches, spam filtering, the placement of advertisements, stock trading, and a variety of other procedures all make use of machine learning. Machine learning, along with big data and cloud computing, achieves more relevance and respect as a result of its ability to analyze huge volumes of data and simplify the work of data scientists via the use of an automated process. In a variety of fields, including as the creative sciences, interpersonal organizations, business, biomolecular research, and security, extensive size beneficial sets are collected and evaluated.Traditional machine learning algorithms, for the most part, are built for data that will only be stored in memory. This is because memory is the only storage medium available. In spite of the fact that it is anticipated that gaining knowledge from such a vast quantity of data would result in enormous breakthroughs in scientific and technological fields, as well as improvements in the overall quality of our lives, it will also lead to fantastic experiences. Since these methods provide potential answers for extracting the information that is buried in the data, several data-intensive sectors, such as medicine, astronomy, biology, and others, have begun to embrace machine learning strategies in large numbers. These industries include those that deal with enormous amounts of data. According to a research conducted by the McKinsey Global Institute, machine learning will be the driving force behind the subsequent important wave of innovation.

2. IOT ARCHITECTURE FOR DISEASED ETECTION

Utilizing sensor networks, this system offers a framework for monitoring and managing patients in a healthcare setting. The design includes both software and hardware components in its implementation. A temperature sensor, a sensor for measuring blood pressure, a sensor for measuring heart rate, and a Raspberry Pi board are all included in the hardware category. Obtaining sensor data, putting that data away in the cloud, and then analyzing it in order to look for irregularities in the patient's condition are the steps that are included in the process.

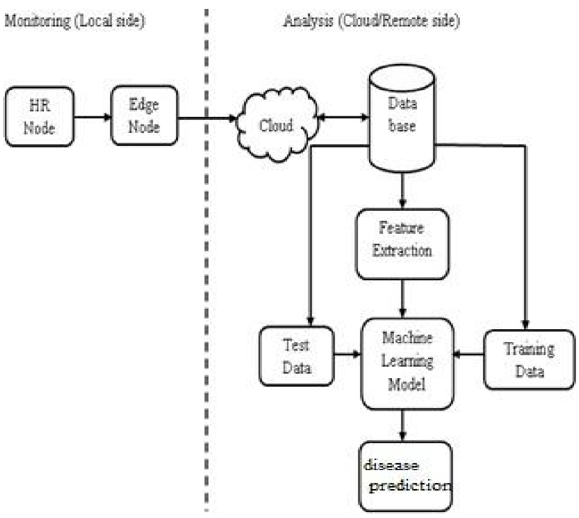

Fig. 1: Block Diagram

Many disorders may be traced back to previously unknown activities in various components of the body. The rapid acceleration of one's pulse rate is a possible side effect of the development of epileptic seizures in the brain. It is possible to use heart rate sensors in order to get a reading of the heart rate. At any given moment, one may do a calculation to determine their heart rate. A Raspberry Pi board is connected to the sensor, and this connection makes it possible to see the output data. Graphical representations of the values may be obtained by connecting a serial monitor or an LCD display to the system. All of the data that has been gathered is uploaded to the cloud since the amount of the data is so enormous. The data that is sent to the cloud is subjected to local analysis. The usual response of the heart rate to stressful circumstances is a slow but steady increase in that rate.

Raspbian jessi is a cloud operating system that is open source and is compatible with the Raspberry Pi device. It is a platform that allows users to upload data to the cloud by registering their real location. Users have access to the source code. The data that was gathered is put through machine learning algorithms so that any anomalies in the data may be identified. After that, the values from the cloud are brought in so that they may be evaluated. Before the system can make predictions, it has to be trained using some representative samples of data. Training a model with a significant amount of data is required before it can provide accurate predictions. More information used for training results in improved accuracy. It is important that the training dataset have information gathered from a large number of people in a variety of different environments. The dataset need to additionally include information gathered from persons of varying ages, in addition to information on both healthy and ill individuals.

The data that had been tested up to the previous session have to be included in the training dataset, and the data that needs to be tested are the data that are obtained at the instant they are acquired. The prediction is made by making use of both the initial training data as well as the data that is presented in the practical setting.

3. PROPOSED SYSTEM

In the system that is being suggested, the microcontroller is going to be responsible for data acquisition and analysis from the sensor network. The

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findings that were suggested are now being stored in the cloud. Data that has been processed may be retrieved from the cloud and evaluated if necessary. Once again, the cloud is used to store the data that was researched, and it is this data that physicians may access. The results, in addition to the current status of the patient, have been posted on the website of the medical facility. The block schematic for the whole arrangement may be seen in Figure 2. It is possible to single out three primary subsystems throughout the whole system. The health monitoring system, the health status prediction system, and the emergency alarm system are the three primary components of the strategy. Since the method addresses concerns relating to health, it is imperative that the information gathered and processed be maintained in strict confidence. The use of encryption techniques helps to maintain privacy and safety inside the system while also contributing to its overall credibility.

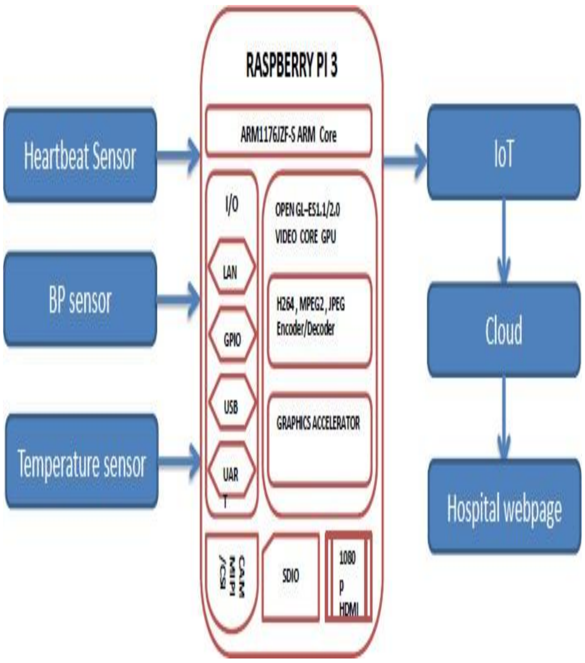

Fig 2: Block diagram

The Internet of Things is enabled via the system's hardware components, which are located inside the health monitoring module. This module is used to collect the patient's health data using a variety of sensors. In this scenario, the Raspberry Pi serves as a centralized server to which all of the sensors are linked by way of the GPIO pins or, if the output of the sensors is analog while the Raspberry Pi only processes digital data, by way of an analog-to-digital converter such as the MCP3008 board.

The ability to forecast a patient's current state of health is one of the most intriguing aspects of the proposed system. In this section of the program, the information on the patient's health that was acquired from the sensory nodes is stored in the database. The KNN classifier, which classifies the many different health disorders that may be found in humans, is used in the process of evaluating the data included in the database. The classifier makes accurate classifications and requires little to no human rechecking.

The use of an algorithm that uses machine learning broadens the scope of this issue. Data mining approaches, which make use of machine learning algorithms, accurately display the suggested system's illness prediction methodology, which may replicate the competency of experienced medical professionals.

4. MACHINE LEARNING ALGORITHMS FOR HEALTH STATE PREDICTION

It is possible to do an analysis of the dataset using machine learning techniques. A classification methodology, also known as a classifier, is a methodical approach to the construction of classification models using input data sets as the starting point. Methods of machine learning include decision tree classifiers, rule-based classifiers, adaboost classifiers, neural networks, support vector machines, least squares regression, KNN classifiers, and Naive Bayes classifiers. Other methods include support vector machines and least squares regression. Each method includes a learning strategy that must be followed in order to locate a model that faithfully depicts the relationship that exists in the input data between the class label and the attribute set. The model that is used by a learning algorithm should be able to accurately predict the class labels of records that it has never seen before while also providing a good match for the data that is being input. Any learning algorithm's principal objective is to produce models with a high level of generalization capacity as its end result. The dataset used for health monitoring is trained with the help of machine learning techniques, and further analysis is conducted depending on the training. This method makes use of the K-Nearest Neighbor classifier to accomplish its goals.

A. K-Nearest Neighbour (KNN) classifier:

Knn is a method of non-parametric supervised learning that uses the training set to classify data. This approach was developed by Andrew Ng. A new instance (x) may be predicted by first identifying the K cases (neighbors) that are the most comparable over the whole of the training set, and then summing the output variables for those K examples. This process is repeated until a new instance (x) can be predicted. This represents the mode class value that is associated with the categorization. Using a database that contains many groups of data points, it will attempt to make a prediction about the categorization of a new sample point. The following is a list of the phases involved in the categorization process:

Training phase: Using the training instances, a model is constructed and refined. Discovering associations between targets and predictors is one of the tasks performed by the classification algorithm. A model provides a concise summary of the relationships.

• The model is assessed using a test sample that has known class labels but did not use these labels throughout the training process.

• During the application phase, using the model, classify newly collected data using labels that have not yet been determined.

Figure 3 depicts the process that the Knn classifier goes through.

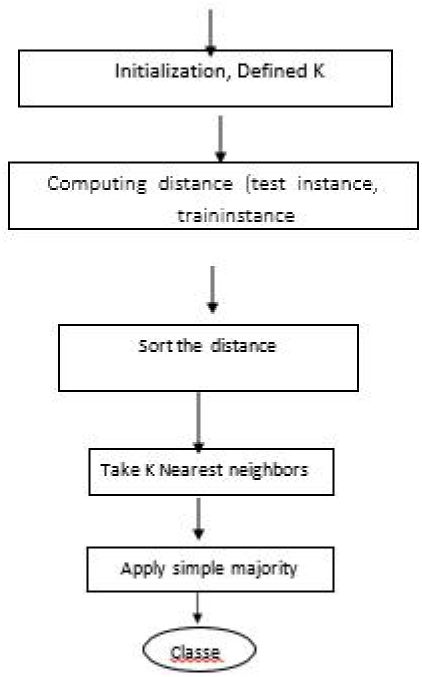

Fig 3: Flow of the classifier

B. K-Nearest neighbour algorithm:

The Knn classification method is shown with a concrete example here. Take a look at Figure 4, in which the white and orange circles each represent a different kind of audience. There are a total of twenty-six different practice examples. It is necessary to make a forecast for the blue circles. The Euclidean distance and the K value of three are two examples of similarity metrics that may be used to determine the similarity in the distance.

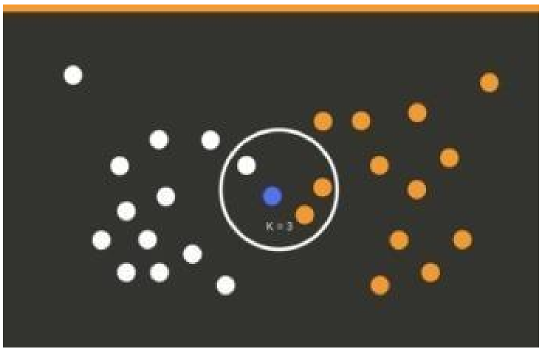

Fig4:Sample Daigram

When the similarity score is low, it indicates that the classes are quite close together. The distance is determined based on the picture, and further calculations result in the placement of smaller circles inside the larger circle.

Take into consideration a configuration consisting of "n" training samples, with xi serving as the training data point. There is a distribution of classes beginning with the letter "c" among the training data points. The goal is to determine the new data point's classification using KNN as a predictive tool. Determine the distance, in terms of Euclidean space, that separates the newly added data point from each of the training data points as the initial stage in the process.

To provide a score that does not become down with increasing distance. Applying a filter to the sorted list in order to find the "K" values with the lowest total while supposing that "K" has a positive value. It is now possible to access the top K distances.

The k-closest neighbor class is comprised of the nearest neighbor instance as its member. The value of k is denoted by the expression "k = 1." In this particular instance, the new data point target class will be designated to the data point that is geographically located closest to the original point.

Figuring out what value K should have in the K-nearest neighbor approach is the most challenging part of the challenge. A low K value indicates that there will be a greater effect from noise on the outcome, which increases the likelihood of overfitting occurring. The basic idea behind KNN, which is that points that are close together may belong to the same class, is undercut when a high number of K is used, since this makes computing more difficult. Use the straightforward equation k = n(1/2) to get the value of k.

Cross-Validation is a method that might be used by us in order to improve the findings. Using the cross-validation method, we could put the KNN algorithm through its paces with a variety of different K values. It's possible that the model with the greatest level of precision should be your first pick.

Testing our answer against all of the many potential values of k may be the most effective course of action at times; this depends on the circumstances.

The techniques for classifying things may be divided up into three distinct categories, which are as follows:

Parametric, non-parametric, and parametric classifiers that are parametric and semi-parametric both need precise information about the structure of the data in the training set in order to function properly. It might be difficult to satisfy all of these requirements in many situations. One of the non-parametric classifiers that were taken into consideration was KNN.

Data were arbitrarily divided into training, cross-validation, and testing groups before being analyzed. In the experiment, a K value range of 1 to 15 was used, which corresponds to 98.02 percent. When K is equal to 1, the performance is at its very finest.

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C. Advantages of K-nearest neighbors algorithm:

- Knn is an easy system to work with, and it processes data rapidly when dealing with small training data sets. • Asymptotically, performance approaches that of the Bayes Classifier.

- It is not necessary to have any previous knowledge of the data structure that is included in the training set. If the new training pattern is introduced to the existing training set, there is no need for extra training.

D. Limitation to K-nearest neighbors' algorithm:

- When the training set is large, it may take a lot of space.
- For every test data, the distance should be computed between test data and all the training data. Thus a lot of time may be needed for the testing.

5. PERFORMANCE ANALYSIS & DISCUSSION

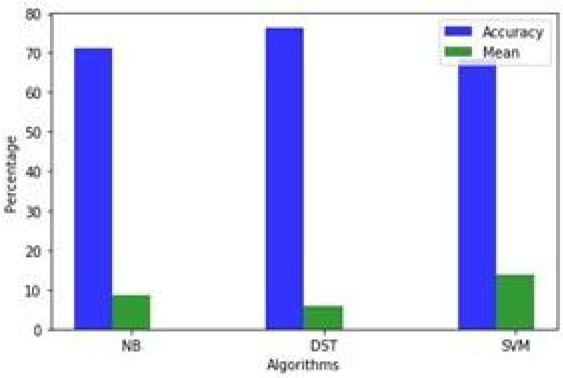

Fig 5: Performance of various machine learning algorithms for Epilepsy detection using train and test ratio of 8:2

The characteristics of the dataset have an impact on the efficiency with which particular machine learning algorithms function. Three different algorithms—the decision tree algorithm, the naive bayes algorithm, and the support vector machine algorithm—are used to do an analysis on the dataset that is being given. The findings of the study that are shown in Figure indicate that the decision tree approach is superior to the others in terms of precision. The accuracy of a prediction may be determined by comparing the total number of input samples to the proportion of correctly anticipated occurrences. The accuracy of an algorithm may be affected by a range of key aspects, and mean is one of those elements. It is possible to utilize the mean values in lieu of any other values in the dataset that were determined to be inaccurate. The link between accuracy and mean is a negative one. A number with a low mean is recommended since it increases precision. The correlation between accuracy and mean may be shown in Figure 1. The decision tree method also improves the reliability of the dataset, which results in an improvement in accuracy. It has been discovered that the accuracy of the decision tree approach is 76.4%, which is 5.3% greater than the accuracy achieved by the naive bayes algorithm and 7.83% higher than the accuracy achieved by the support vector machine.

6. CONCLUSIONS

Unnoticed elements that affect human health may lead to major problems and even put a person's life in jeopardy. As a potential novel approach, the Internet of Things (IoT) is being examined for its potential to automate the ongoing monitoring of various health markers. Technology is vital in the healthcare industry not just for the equipment used for sensory processing, but also for the devices used for communication, recording, and display. During and after surgery, there are a number of medical parameters that need to be examined. As a direct consequence of this, the most recent trend in healthcare communication techniques that are based on machine learning and the Internet of

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Things. The internet of things is providing a significant boost to the development of a variety of applications in the medical field. The UCI dataset is used for the early stages of training and validation of machine learning algorithms. Using the information gathered from sensors by the IoT framework, the testing step makes predictions about any problems. The information collected from Internet of Things (IoT) devices and stored in the cloud is subjected to statistical analysis in order to determine the accuracy percentage. Machine learning strategies were an important component of this sort of Internet of Things platform-based continuous monitoring of human health data.

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