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Remote Health Monitoring IoT Framework using Machine Learning Prediction and Advanced Artificial Intelligence (AI) Model

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Abstract

Real intervention and treatment standards drew attention to remote health monitoring frameworks. Remote monitoring frameworks for disease detection at an early stage are opposed by most conventional works. Even so, it ran into issues like increased operational complexity, higher resource costs, inaccurate predictions, longer data collection times, and a lower convergence rate. A remote health monitoring framework that uses artificial intelligence (AI) to predict heart disease and diabetes from medical datasets is the goal of this project. Patients' health data is collected via smart devices, and the resulting data is then combined using a variety of nodes, including a detection node, a visualisation node, and a prognostic node. People with long-term illnesses (such as the elderly and disabled) are in such greater demand than ever before that a new approach to healthcare delivery is essential. In the evolved paradigm, conventional physical medical services foundations like clinics, nursing homes, and long haul care offices will be old. Due to recent advancements in modern technology, such as artificial intelligence (AI) and machine learning (ML), the smart healthcare system has become increasingly necessary (ML). This paper will discuss wearable and smartphone technologies, AI for medical diagnostics, and assistive structures, including social robots, that have been created for the surrounding upheld living climate. The review presents programming reconciliation structures that are urgent for consolidating information examination and other man-made consciousness instruments to develop brilliant medical care frameworks (AI).

Keywords: Health Monitoring ,Internet of things, Big data, Point of source, AI.

I. Introduction

IoT is causing a logistical prototype transfer. Logistics companies use sensors to track and manage shipments. They also use sensitive external data like traffic scenarios, accidents, and natural disasters.

However, data collection and processing from heterogeneous sources results in several issues due to data variety and velocity. Furthermore, data processing is also considered to be challenging utilizing traditional logistic mechanisms. Hence, it becomes vital for any logistics establishment to keep track of the location of its objects, its working and so on. Hence, tracking is therefore said to be much easier with the effective implementation of IoT in logistics.

A hybrid framework called, IBRIDIA [1] was designed with the objective of processing massive data volume in a batch and real time manner. The framework combined functions involving different data preparation and processing, outputting to a clustered dataset. Followed by which an analytical engine was utilized to conduct predictive analytics. Followed by which the data processing model was performed via machine learning algorithms, utilizing, Johnson's hierarchical clustering algorithm.

With the modified form, incremental grouping of text messages were also formed based on their similar characteristics, therefore contributing to accuracy. However, the execution time was found to be higher. With the objective of minimizing the execution time, in this work, logistics map reduce framework is designed, followed by which, Self Organized Lorentz Haversine Routing model is structured, that identified optimal routes with minimal overhead in a timely manner.

Big data created by the Internet of Things has transformed Intelligent Transport Systems (ITS) technology (IoT). ITS should apply AI to build big-data-driven smart traffic management concerns for effective decision-making. Using unsupervised incremental machine learning, [2]'s STMP was created.

The STMP on one hand integrated heterogeneous big data streams and on the other hand differentiated between repeated and non-repeated traffic events, forecasting traffic flow and optimized traffic control decisions, therefore reducing average waiting time. Despite improvement found in the average waiting time, however, the error rate was not analyzed. To reduce the error rate in this work, Differentiable Rectified Neural Dispatching model is proposed that back propagates the weight with the objective of reducing the error rate, therefore contributing towards improved true positive rate.

[3] presents state-of-the-art methods for massive IoT data analytics and explains the relationship between them. A novel architecture for IoT data analytics, techniques, and big data mining was also introduced. With businesses embracing IoT, one of the important difficulties to address is merging IoT by picking the correct use case, monitoring, and making implementation decisions. [4] designed smart factory transformation from outdated manufacturing. [5] presents IoT-based predictive analytics for information consumption utilising SCDA. [6] introduced a two-layer architecture for evaluating IoT big data that extracted high-level events in the first layer and considered uncertainty using Bayesian in the second layer to improve prediction quality and accuracy. This considers route optimality and scalable, efficient dispatching. Different IoT systems use different protocols[7], and developing a map-reduced best route and dispatch with a high delivery rate for massive IoT data is a challenging and important task.

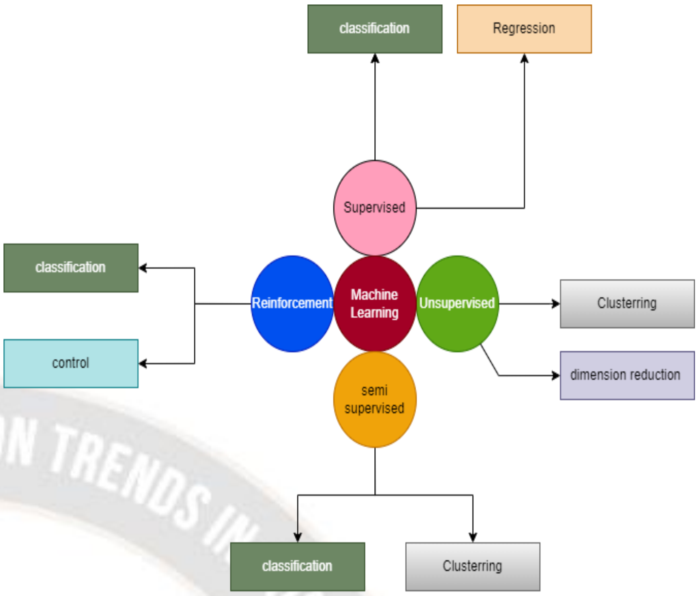

Fig. 1 machine learning classification

II. Related works

With the aid of health prediction systems, hospitals can more easily move outpatients into facilities that are less congested. Increase the number of people who receive medical care. They do this. Sudden shifts in the flow of patients through hospitals are a problem that can be addressed by a health prediction system. [8] The need for healthcare services in many hospitals is driven by ambulance arrivals during natural disasters and motor vehicle accidents, as well as routine outpatient demand. While nearby facilities may have more patients, hospitals without real-time data on patient flow may have difficulty meeting demand. Internet of Things (IoT) connects virtual computers with real-world objects to enable communication between them. It makes use of cutting-edge microprocessor chips to collect data in real time.

Consider that healthcare is the diagnosis and prevention of disease with the goal of improving and preserving one's health. SPECT, PET, MRI, and CT scans are examples of diagnostic instruments examine abnormalities or ruptures that occur below the skin's surface. Such abnormalities as epilepsy and heart attack can be tracked, as well. Modern healthcare facilities are being stretched to their limits because of the rising population and the unpredictable spread of chronic diseases. An excessive amount of nurses, doctors, and hospital beds are all in high demand [9]. Because of this, it is necessary to reduce the strain on healthcare systems while still maintaining the high standards of care provided [10]. With the assistance of the Internet of Things (IoT), we may be able to lessen the burden on healthcare systems. RFID systems, for example, are used in healthcare facilities to lower costs and improve the quality of care. Healthcare monitoring systems make it possible for doctors to keep track of patients' heartbeats and make an precise analysis [5]. In an effort to ensure that connectionless data can be reliably transmitted, a diversity of IoT devices has been developed. IoT in healthcare has many advantages, but both IT and medical professionals are concerned about data security [11]. There have been an increasing number of studies examining how to ensure the integrity of medical data by integrating IoT and machine learning (ML). The Internet of Things (IoT) has ushered in a new era in healthcare, allowing professionals to build proactive relationships with their patients. IoT combined with machine learning analyses emergency care requirements in order to build a strategy for dealing with the problem throughout various seasons. It's common for waiting rooms in outpatient clinics to be overcrowded [12]. There is a wide range of illness among the people who visit hospitals, some of which necessitate immediate medical attention. Adding insult to injury, patients in dire need of medical attention face even longer wait times. Hospital staffing shortages in developing countries exacerbate the problem. Many patients have to go home without receiving any medical treatment because hospitals are so overcrowded.

Man-made reasoning incorporates AI as one of its subfields. Since clinical information has been digitized, AI assumes a significant part in the finding of numerous illnesses, including malignant growth. Over the most recent decade, medical services specialists have investigated an assortment of AI procedures. These techniques work in two ways: first, they track down irregularities, and afterward they group them as harmless or destructive. The initial step gives semantic data by grouping every pixel/voxel as having a place with a dubious sore or not, and the subsequent stage considers further examination or evaluation of the distinguished/portioned peculiarities, coming full circle in a characterization of hurtful or not. The Internet of Things (IoT) is a truly progressive organization of organizations. Since the Internet of Things (IoT) associates everything, it opens up additional opportunities for assembling, agribusiness, the economy, and medical care. In any country, clinical benefits are quite possibly the most serious social and financial test.Executives, physicians, analysts, and other specialists in the field of human services are under constant pressure to adapt to societal and business expectations that are constantly changing. The number of vulnerable people living in their homes or in distant places has increased exponentially, including the elderly, crippled, and those with long-term illnesses. Remote patient monitoring is becoming more widespread as a result of this. The question of how to give suitable treatment outside of a therapeutic institution while keeping high quality standards is now being debated. Electronic medical service administrations must be accessible at all times and from any location using a system that can handle large amounts of data.

III. Proposed Method

As the Internet of Things (sensors, machines, and devices) generate enormous amount of data per second, in this work cloud computing environment is used that assists in logistics data storage and analysis, therefore receiving maximum advantage of an IoT infrastructure. In several applications, different types of actions are said to be triggered based on certain predefined conditions or feedback from the acquired data. Also, there arises a requirement for Intelligent IoT devices, to create automated smart applications with automated resource allocation, communication, and network operation.

Internet of things (IOT) corresponds to the network of a vehicle, physical devices and so on that is highly embedded with sensors, network connectivity and so on. The sensors hence are utilized in a manner to acquire and interchange the data between the devices. Therefore, the implementation of logistics establishment with IOT hence disseminate the information and details regarding shipment in a more quick and swift manner to the point of consumption.

Deploying Artificial Intelligence (AI) techniques via Machine Learning (ML) algorithms in an IoT infrastructure results in significant improvements, to name certain applications include, congestion control, optimal resource allocation, decision making and so on. Besides, with the increase in the number of devices, data collected also increases hence, dealing with big data is very customary in IoT applications. Several AI techniques via ML algorithms assist concerning effectively and efficiently with big data, and in this work, Self-organized Lorentz Haversine Routing and Differentiable Rectified Neural Dispatching (SLHR-DRND) method is designed. The elaborate design of SLHR-DRND is explained in the following sections.

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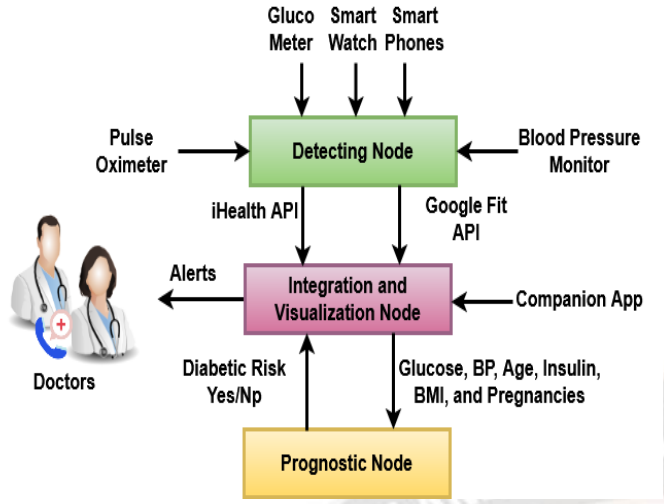

Fig 2. Smart remote healthcare framework

The various types of nodes that can be found in this framework are:

1. Patients' medical data is collected from smart devices by this node's primary function, which is detection.
2. As a result, the visualisation node gathers and displays all of the medical data that has been collected from various sources.
3. In this node, a subset of features extracted from health care data using intelligent classifier to make disease predictions.

3.1 Remote health monitoring framework

To start with the involvement of big data and also not all the data are required for further processing, in this work, with the route chunk as input, the output unique ID with the corresponding number of hops are obtained as aggregated results via shuffle. Here, the unique ID and number of hops (i.e. segments) are obtained from the Cargo 2000 dataset. The block diagram of the Unique ID Hop Map Reduce generator framework is shown below.

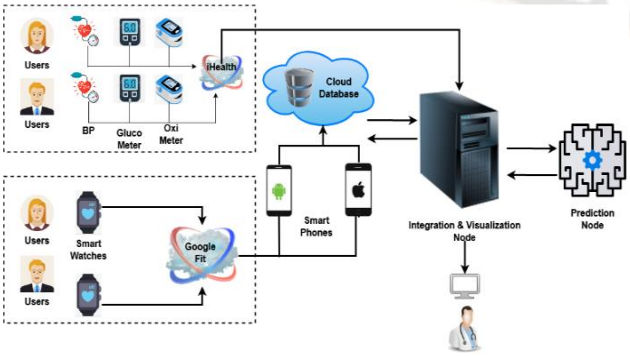

Figure 3: Confusion matrix of LSTM-CNN model

Table 1: The performance of the LSTM-CNN model

	Precision	Recall	F1-Score
0.0	1.00	0.99	0.99
1.0	0.99	1.00	0.99
Macro Average	0.99	0.99	0.99
Weighted Average	0.99	0.99	0.99

```
Model: "sequential_20"
_________________________________________________________________
Layer (type)                Output Shape              Param #
=================================================================
lstm_58 (LSTM)              (None, None, 16)          2048
_________________________________________________________________
dropout_73 (Dropout)        (None, None, 16)          0
_________________________________________________________________
lstm_59 (LSTM)              (None, None, 32)          6272
_________________________________________________________________
dropout_74 (Dropout)        (None, None, 32)          0
_________________________________________________________________
lstm_60 (LSTM)              (None, 64)                24832
_________________________________________________________________
dropout_75 (Dropout)        (None, 64)                0
_________________________________________________________________
dense_93 (Dense)            (None, 1024)              66560
_________________________________________________________________
dense_94 (Dense)            (None, 512)               524800
_________________________________________________________________
dropout_76 (Dropout)        (None, 512)               0
_________________________________________________________________
dense_95 (Dense)            (None, 256)               131328
_________________________________________________________________
dropout_77 (Dropout)        (None, 256)               0
_________________________________________________________________
dense_96 (Dense)            (None, 8)                 2056
_________________________________________________________________
dense_97 (Dense)            (None, 1)                 9
=================================================================
Total params: 757,905
Trainable params: 757,905
Non-trainable params: 0
_________________________________________________________________
```

Figure 4: Summary of LSTM-CNN model

The LSTM-CNN model is designed with two return sequences for the true condition and one return sequence for the false condition of LSTM. The model is ensembled with the five dense layers and produces high accuracy. The dropout is defined as 0.1 after every LSTM layer. The summary of the proposed model is shown in the figure 76. The model is trained till 23 epochs, and the batch size is formulated as 64. The tailored approach produces exceptional model performance as features are reduced to 15 using recursive feature elimination based on the random forest classifier's intrinsic function, which reduces the overfitting problem, complexity, and computation time.

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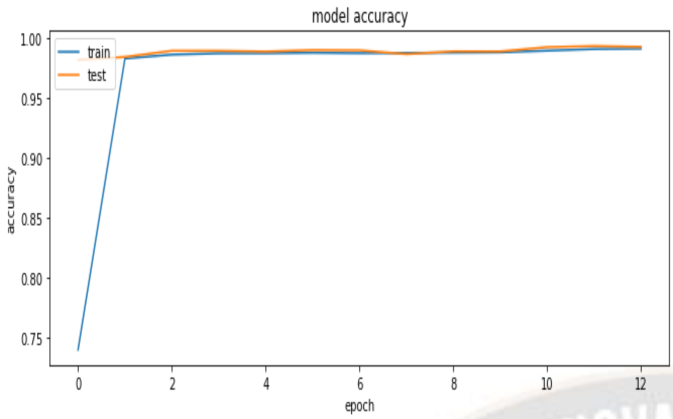

Figure 5: The model accuracy plot

To make the tailored LSTM-CNN model more novel we use techniques like pre-processing of data, logical feature selection, model selection and reasoning, and K-fold cross-validation To validate the model's performance, evaluation metrics like recall, precision, and F1 score are used, as shown in table 3. The accuracy of the model is shown here in a comparison between training and testing datasets. Anomaly detection and prevention are made incredibly easy thanks to the model's exceptional performance in all tests. In order to detect intrusions with greater reliability, the proposed IDPS can process a large amount of network traffic data, and it will issue genuine warnings as a result of this.

Table 4 displays the results of the proposed model's intrusion detection using cutting-edge techniques and hybrid techniques. The comparison shows that the proposed model generates accurate results. As shown in the figure 9, the proposed model produces high accuracy. Sun et al. (2020) designed the model based on CNN and LSTM having an accuracy of 98.67% [38]. However, the author only used the weight optimization method to process the dataset, whereas the proposed model also contains the PCA, further enhances the model accuracy. The proposed model delivers the highest accuracy with minimum memory utilization. The performance of proposed model is validated through various evaluation measures such as precision, recall, and F1-score other than accuracy and every measure clarified the high performance of model. The selection of appropriate data pre-processing techniques, features extraction, and combination of CNN-LSTM improve the model performance significantly. The implementation of PCA reduce the dimensionality of dataset and subsequently important features are extracted through intrinsic method by implementing random forest classifier.

Table 2: The comparison of the proposed model with conventional models

Models	**Technique**	**Accuracy**
Yin et al., 2017 [39]	RNN	97.09%
Khan et al., 2019 [27]	Spark ML + Conv-LSTM	97.29%
Lee et al., 2019 [34]	AE-CGAN	95.38%
Vinayakumar et al., 2019 [35]	SHIA	93.5%
Ieracitano et al., 2020 [36]	AE_{50}	84.21%
Sun et al., 2020 [38]	CNN+LSTM	98.67%
Proposed Model	RFE-PCA + LSTM-CNN	99.27%

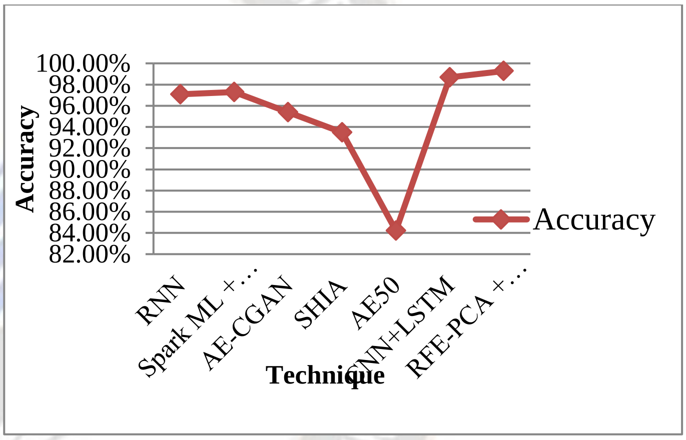

Figure 6: The comparison of the proposed model with conventional models

IV. Conclusion

purpose of this research was to offer a new framework for remote health monitoring that makes use of cutting-edge AI approaches for forecasting the various kinds of sickness. The ability to remotely monitor the health condition of patients for the purpose of disease identification and accurate diagnosis is the primary contribution made by this research. In this infrastructure, the one-time authentication is carried out in order to fuse the medical information that was gathered from the sensors. Then, the mobile application will be able to easily extract the necessary data from the cloud platforms. As a result, the user will not be required to enter their data, which is one of the primary advantages of using this system. The GoogleFit cloud service, which keeps the medical information of patients collected through smart devices, is leveraged in this model for the purpose of achieving this objective. In addition, the various sorts of nodes, including as detecting nodes, visualisation nodes, and prognostic nodes, are utilised in order to include the medical information that was collected from the various sources. During the process of disease prediction, the medical datasets that are being used are preprocessed and normalised at the beginning state in order to improve the performance of the classifier.

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