www.ijiarec.com

ISSN:2348-2079

Volume-9 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

Heart Disease Prediction Using Convolutional Neural Network In Deep Learning

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ABSTRACT

The diagnosis of heart disease has become a difficult medical task in the present medical research. This diagnosis depends on the detailed and precise analysis of the patient's clinical test data on an individual's health history. The enormous developments in the field of deep learning seek to create intelligent automated systems that help doctors both to predict and to determine the disease. Therefore, the Enhanced Deep learning assisted Convolutional Neural Network (EDCNN) has been proposed to assist and improve patient prognostics of heart disease. The EDCNN model is focused on a deeper architecture which covers multi-layer perceptron's model with regularization learning approaches. Therefore, prompted for alternative methods such as machine learning algorithms that could use non-invasive clinical data for the heart Disease diagnosis and assessing its severity. Furthermore, the system performance is validated with full features and minimized features. Hence, the reduction in the features affects the efficiency of classifiers in terms of processing time, and accuracy has been mathematically analyzed with test results. The EDCNN system has been implemented Platform for decision support systems which help doctors to effectively diagnose heart patient's information in cloud platforms anywhere in the world. The test results show compared to conventional approaches such as Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) based on the analysis the designed diagnostic system can efficiently determine the risk level of heart disease effectively. Test results show that a flexible design and subsequent tuning of EDCNN hyper parameters can achieve a precision.

Keywords: Convolutional Neural Network, Long Short-Term Memory, Bidirectional Long Short-Term Memory, Bidirectional Gated recurrent units.

INTRODUCTION

A convolutional neural network (CNN, or ConvNet) is a class of deep neural networks, most commonly applied to analyzing visual imagery. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture translation invariance characteristics. They have applications in image and video recognition, recommender systems, image classification, Image segmentation, medical image analysis, natural language processing, brain-computer interfaces, and financial timeries. CNNs are regularized versions of multilayer Perceptron's. Multilayer Perceptron's usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The "fully-connectedness" of these networks makes them prone to over fitting data. Typical ways of regularization include adding some form of magnitude measurement of weights to the loss function. CNNs take a different approach onwards regularization: they take advantage of the hierarchical pattern in data and assemble more complex patterns using smaller and simpler patterns.

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Therefore, on the scale of connectedness and complexity, CNNs are on the lower extreme. Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field. The receptive fields of different neurons partially overlap such that they cover the entire visual field. CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage.

HEART DISEASE

Illnesses under the coronary illness umbrella incorporate vein sicknesses, for example, coronary conduit infection; heart musicality issues (arrhythmias); and heart abandons you're brought into the world with (inherent heart deserts), among others. The expression "coronary illness" is regularly utilized reciprocally with the expression "cardiovascular infection." Cardiovascular sickness for the most part alludes to conditions that include limited or impeded veins. Other heart conditions, for example, those that influence your heart's muscle, valves or beat, additionally are viewed as types of coronary illness. Coronary Artery Disease (abbreviation CAD) this is an issue with the veins that convey blood to the heart muscle. In the event that these veins get minuscule, or in the event that they become impeded, blood can't move through them regularly. Since less blood is provided to the heart muscle, the muscle can't work at typical limit. The heart muscle can get debilitated and frail. Heart muscle can even bite the dust if blood stream stops. Obstructed courses in the heart are frequently brought about by smoking, elevated cholesterol, hypertension, diabetes, and acquired qualities from guardians. These issues harm the covering of the heart's veins and cause them to become limited or hindered completely. Congestive Heart Failure (CHF) this is a condition that implies that the heart isn't siphoning at ordinary levels. Two basic causes are a powerless or wiped out heart muscle and strange heart valves. The valves may not let enough blood through in light of the fact that they are excessively limited. Or then again the valve may "hole" and let blood stream in reverse (a misguided course) inside the heart. At the point when the heart valves don't work ordinarily, the heart muscle needs to accomplish additional work and it can get drained.

CARDIO VASCULAR DISEASE (CVD)

Cardiovascular illness (CVD) is a class of infections that include the heart or veins. CVD incorporates coronary conduit infections (CAD, for example, angina and myocardial localized necrosis (generally known as a respiratory failure). Other CVDs incorporate stroke, cardiovascular breakdown, hypertensive coronary illness, rheumatic coronary illness, cardiomyopathy, irregular heart rhythms, inherent coronary illness, valvular coronary illness, carditis, aortic aneurysms, fringe course sickness, thromboembolic infection, and venous apoplexy. The hidden components shift contingent upon the infection. Coronary vein infection, stroke, and fringe supply route illness include atherosclerosis. Rheumatic coronary illness may follow untreated throat. It is assessed that up to 90% of CVD might be preventable. Counteraction of CVD includes improving danger factors through: smart dieting, work out, shirking of tobacco smoke and restricting liquor consumption .Treating hazard factors, for example, hypertension, blood lipids and diabetes is likewise advantageous. Treating individuals who have strep throat with anti-infection agents can diminish the danger of rheumatic coronary illness. The utilization of anti-inflammatory medicine in individuals, who are generally sound, is of indistinct advantage.

LITERATURE SURVEY

A SYSTEMATIC LITERATURE REVIEW ON CARDIOVASCULAR DISORDER IDENTIFICATION USING KNOWLEDGE MINING AND MACHINE LEARNING METHOD

Aleksei Dudchenko, Matthias Ganzinge et al., has proposed in this paper it could be seen in the previous decades that Machine Learning (ML) has a huge variety of possible implementations in medicine and can be of great use. Nevertheless, cardiovascular diseases cause about a third of the total global deaths. Does ML work in the cardiology domain and what is the current progress in this regard? To answer this question, we present a systematic review aiming at 1) identifying studies where machine learning algorithms were applied in the domain of cardiology; 2) providing an overview based on the existing literature about the state-of-the-art ML algorithms applied in cardiology. For organizing this review, we adopted the PRISMA statement. We used PubMed as the search engine and identified the search keywords as “Machine Learning”, “Data Mining”,

"Cardiology", and "Cardiovascular" in combinations. Scientific articles and conference papers published between 2013-2017 reporting about implementations of ML algorithms in the domain of cardiology have been included in this review. In total, 27 relevant papers were included. We examined four aspects: the aims of ML systems, the methods, datasets, and evaluation metrics. The major part of the paper was aimed at predicting the risk of mortality.

INTELLIGENT MACHINE LEARNING APPROACH FOR EFFECTIVE RECOGNITION OF DIABETES IN E-HEALTHCARE USING CLINICAL DATA

Amin Ul Haq , , Jian Ping Li et al., has proposed in this paper significant attention has been paid to the accurate detection of diabetes. It is a big challenge for the research community to develop a diagnosis system to detect diabetes in a successful way in the e-healthcare environment. Machine learning techniques have an emerging role in healthcare services by delivering a system to analyze the medical data for diagnosis of diseases. The existing diagnosis systems have some drawbacks, such as high computation time, and low prediction accuracy. To handle these issues, we have proposed a diagnosis system using machine learning methods for the detection of diabetes. The proposed method has been tested on the diabetes data set which is a clinical dataset designed from patient's clinical history. Further, model validation methods, such as hold out, K-fold, leave one subject out and performance evaluation metrics, includes accuracy, specificity, sensitivity, F1-score, receiver operating characteristic curve, and execution time have been used to check the validity of the proposed system. We have proposed a filter method based on the Decision Tree (Iterative Dichotomiser 3) algorithm for highly important feature selection. Two ensemble learning algorithms, Ada Boost and Random Forest, are also used for feature selection and we also compared the classifier performance with wrapper based feature selection algorithms.

HEART DISEASE PREDICTION SYSTEM USING MODEL OF MACHINE LEARNING AND SEQUENTIAL BACKWARD SELECTION ALGORITHM FOR FEATURES SELECTION

Amin Ul Haq, Jianping Li et al., has proposed in this paper Detection of Heart Disease (HD) by using models of machine learning (ML) is very effective in early stages. The HD treatment and recovery is effective if detected the disease at initial stages. HD identification by machine learning (ML) techniques has been developed to assist the physicians. In this study we proposed an Identification system by using ML models to classify the HD and healthy subjects. Sequential backward selection of feature algorithm was used to select more appropriate features to increase the classification accuracy and reduced the computational time of predictive system. Cleveland heart disease dataset was for evaluation of the system. The dataset 70% used for training and remaining for validation. The proposed system performances have been measured by using evaluation metrics. The experimental results shows that Sequential Backward Selection (SBS) algorithms choose appropriate features and these features increase the accuracy using K-Nearest Neighbor supervised machine learning classifier. The good accuracy of this study suggests that the proposed model will effectively identify the HD and healthy subjects.

In order to diagnosis heart disease an efficient diagnosis system has been proposed in this study. SBS feature selection algorithm was used to select more appropriate features to increase the classification accuracy and reduced the computational time of predictive system. Cleveland heart disease dataset was in this study and 70% for training and 30 % for testing of the dataset. The accuracy metric used for performance evaluation of the system. The experimental results shows that the use of SBS algorithm to choose the appropriate number of features that can be used for better classification accuracy using K-Nearest Neighbor. Additionally, 90 % classification accuracy on six number of reduced features set was obtained by the proposed system. The better classification accuracy of the proposed technique suggests that the proposed method could be used to correctly classify HD and healthy people.

EXISTING SYSTEM

In Existing medical systems, including hospital management systems and decision making systems, focus on collecting and mining the entire medical data. The entire patient records are loaded and all factors are considered Existing systems have failed to utilize and understand the importance of misdiagnosis. A very important attribute which interconnects and addresses all these issues. Mining the misdiagnosis attribute is the key because the first diagnosis by the users would have already covered all the underlying variables like patient's medical history, climatic

conditions, neighborhood, and various other factors, Allowing the user to just concentrate on either missed variables like hidden symptoms, prevailing conditions, complications, etc., or heart Diseases that are similar to the one already diagnosed.

DISADVANTAGES

- Existing systems have failed to utilize and understand the importance of misdiagnosis.
- Lack in categorization.
- Poor decision making support.
- High in computational complexity.
- Cannot able to support large databases.

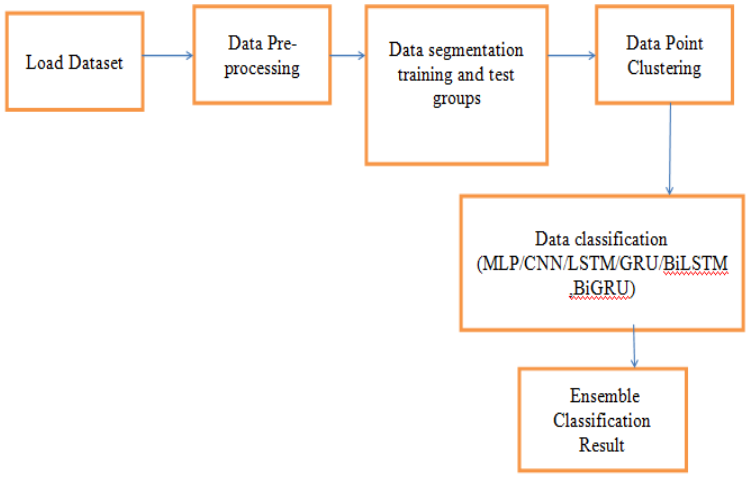
PROPOSED SYSTEM

Hence, the reduction in the features affects the efficiency of classifiers in terms of processing time, and accuracy has been mathematically analyzed with test results. The EDCNN system has been implemented Platform for decision support systems which helps doctors to effectively diagnose heart patient's information in cloud platforms anywhere in the world. The test results show compared to conventional approaches approaches such as Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) based on the analysis the designed diagnostic system can efficiently determine the risk level of heart disease effectively. Test results show that a flexible design and subsequent tuning of EDCNN hyper parameters can achieve a precision. The subsequent performance of the deep learning methods is assessed for the diagnosis of cardiovascular disease in terms of performance measures, including the probability of error in the classification, diagnostic accuracy, precision, sensitivity, specificity.

Advantages

- It is easy to extract signatures from individual data instances, as their structures just collect the symptoms that enough to scaling samples.
- Can easily predict the heart Disease level and severity easily using range level of queries.
- The probability of vocabulary gap between diverse health seekers makes the data more consistent compared to other formats of health data.
- It is possible heart Diseases ranked according to the number of symptoms matched in the database.
- The CNN functions as a feature extractor block due to the beat classification problem.
- The final activations obtaining from the last convolution layer are used as inputs in a network.
- A batch normalization layer and an activation function follow the basic convolutional layer using a mathematical convolutional process.

System Model



METHODOLOGY

MODULES

- DATA VISUALIZATION AND PRE-PROCESSING
- RISK PREDICTION
- CLASSIFICATION ALGORITHMS
  - MLP classification
  - CNN classification
  - LSTM classification
  - GRU classification
  - BiLSTM classification
  - BiGRU classification
- ENSEMBLE CLASSIFICATION REPORT

DATASET

The Wisconsin Prognostic Cleave Land Train Dataset is downloaded from the UCI Machine Learning Repository website and saved as a text file. This file is then imported into Excel spreadsheet and the values are saved with the corresponding attributes as column headers. The missing values are replaced with appropriate values. The ID of the patient cases does not contribute to the classifier performance. Hence it is removed and the outcome attribute defines the target or dependent variable thus reducing the feature set size to 33 attributes. The algorithmic techniques applied for feature relevance analysis and classification are elaborately presented in the following sections. The dataset has been preprocessed for efficient use by the classifier techniques such as delete of missing values, regular scalar, or Min and Max Scalar.

RISK PREDICTION

Default hazard is the opportunity that organizations or people will be not able to make the necessary installments on their obligation commitments. At the end of the day, credit default hazard is the likelihood that in the event that you loan cash, quite possibly they won't have the option to give the cash back on schedule. It provides reproducible and objective diagnosis, and hence can be a valuable adjunct tool in clinical practices. Results are comparably, promising and therefore the proposed method will be helpful in disease diagnostics. To alleviate the effect of default hazard, banks frequently force charges that relate to the account holder's degree of default hazard. A more significant level of danger prompts a higher required return. Then the data are clustered using Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) using all the features of CAD data. Risk forecast instruments are created to recognize patients in danger and to encourage doctor dynamic. The consequence of the expectation models can be utilized to choose the most fitting/suggested strategy. An investigation of exhibited that the usage of a danger forecast device encouraged doctors in getting more mindful of the results, in getting more educated on danger factors and to have a more inspirational demeanor toward preemptive administration.

CLASSIFICATION ALGORITHMS

Designed deep learning algorithms are focused on a deep multi-layer interpretation of system and design regulation. Further, the diagnosis pattern is used to detect if patients have heart disease based on the training model The performance has been validated for precision, the error probability, specificity, sensitivity, accuracy. To order sex (target class) utilizing hair length as highlight boundary, we could prepare a model utilizing any grouping calculations to concoct some arrangement of limit conditions that can be utilized to separate the male and female sexes utilizing hair length as the preparation include. In sex characterization case the limit condition could the best possible hair length esteem. Then the data are clustered using Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) using all the features of CAD data. Further, a remote patient monitoring (RPM) platform is proposed, that is skillful enough to screen the patient typically with assistance To collect information about the patients' health parameters such as pulse, ECG and blood pressure and send a crisis warning to the caretaker with his or her actual condition and complete remedial details. Here the Feature selection is needed for deep learning assistance because sometimes non-relevant features affect the deep learning classification efficiency. The selection of features increases the precision of classification and reduces the model time. The DL algorithms have been used for selecting features, and a multi-layer perceptron algorithm has been utilized for binary classification problems.

ENSEMBLE CLASSIFICATION REPORT

EDCNN has been proposed for the early prediction of heart disease and diagnosis. The UCI

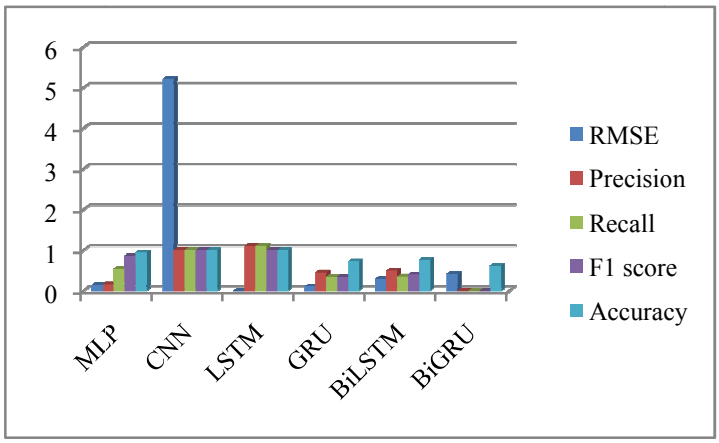
repository dataset has been utilized for the diagnosis purpose, and CNN classifier and multi-layer perceptron (MLP), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU)module has been used to classify basic ECG heartbeats for feature extraction. The CNN functions as a feature extractor block due to the beat classification problem. The final activations obtaining from the last convolution layer are used as inputs in a network. A batch normalization layer and an activation function follow the basic convolutional layer using a mathematical convolutional process We utilize the preparation dataset to improve limit conditions that could be utilized to decide each target class. When the limit conditions are resolved, the following assignment is to foresee the objective class. In bunching, the thought isn't to foresee the objective class as in order, it's additionally attempting to assemble the comparative sort of things by thinking about the most fulfilled condition, all the things in a similar gathering should be comparable and ought no two distinctive gathering things to not be comparative Experiment results demonstrate the superiority of the proposed method with regard to prediction accuracy of Ensemble classification report with the features selected by ensemble, we need only a few clinical data to apply this model. The accuracy can be further increased with more data instances.

EXPERIMENTAL RESULTS

AI strategy called the danger forecast arrangement for hazard factors for cardiovascular sickness. It tries to improve the prescient precision of cardiopathy hazard with a supposed outfit approach. Affiliated arrangement gives high precision and high adaptability, even in the treatment of unstructured information, contrasted with customary order. The prescient capacity has been tried and achievability of the cardiovascular numerical model in Heart Failure patients to improve the chance of making the mathematic recipe to identify the likelihood of coronary illness events. The Cleveland Heart Disease Data found in the UCI AI store includes 14 elements assessed on 303 individuals who have coronary sickness. Individuals had been accumulated into five levels of coronary sickness. The information about the contamination status is in the Heart Disease target instructive assortment. Three data diagrams with 303 discernments on the going with 14 variables.

Algorithm	RMSE	Precision	Recall	F1 score	Accuracy
MLP	0.1410	0.1622	0.5422	0.8556	0.9455
CNN	5.2066	1.0	1.0	1.0	1.0
LSTM	0.0	1.1	1.1	1.0	1.0
GRU	0.1043	0.451	0.348	0.3492	0.728
BiLSTM	0.289	0.499	0.3517	0.4011	0.768
BiGRU	0.4124	0.0	0.0	0.0	0.615

Algorithm Classification Report



Graphical Representation Algorithm Classification

The credits of Cleveland informational collection are age, sex, cp - chest torment. Type (regular angina, atypical angina, non-angina torture, asymptomatic), trestbps laying circulatory strain on affirmation, cholserum cholesterol, fbs fasting glucose, rest ecg resting ECG result, thalch most noteworthy heartbeat refined, old apex - ST misery impelled by training related to rest, inclination of the zenith practice ST Segment, ca - number of fluoroscopy concealed vessels, thal reversible defect and class (crippled/healthy).After incorporate lessening step we go tony seven risk factors: cp, thalch, exang, old apex, incline, ca, thal. The test outcomes show contrasted with regular methodologies approaches, for example, Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) in view of the examination the planned analytic framework can productively decide the danger level of coronary illness adequately.

CONCLUSION

The test outcomes show contrasted with regular methodologies approaches, for example, Multi-Layer Perceptron's (MLP), Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM) Gated recurrent units (GRU), Bidirectional Long Short-Term Memory (BiLSTM), Bidirectional Gated recurrent units (BiGRU) in view of the examination the planned analytic framework can productively decide the danger level of coronary illness adequately. Evaluate the integrated model on each complete data, and the confusion matrices returned. Comparing, it can be found that the integrated model improves the performance of the component models MPL(0.9), CNN(1.0), LSTM(1.0), GRU(0.7), BiLSTM(0.7), BiGRU(0.6). The proposed EDCNN model has end up being a valuable device in the discovery of coronary illness in clinical experts. An extra phase of highlight choice was proposed to improve precision. The dataset is isolated into a preparation set and a test set, and the preparation informational index is utilized to frame singular classifiers. With the test informational collection, the proficiency of the classifiers is tried. The models would thus be able to be used to help patients and medical care experts around the planet in supporting both worldwide and general wellbeing, especially in non-industrial nations and in asset obliged zones with less heart experts accessible. The presentation has additionally improved by the procedures of highlight choice. The component determination methods have added to the precision of the profound learning calculations. In future, advance man-made consciousness has been intended to join to improve the accuracy further.

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