How to Cite:
Acharya, R., Gupta, A., & Kapila, D. (2022). Systematic review on brain tumour and heart detection using machine learning and deep learning techniques. *International Journal of Health Sciences*, *6*(S1), 8499–8510. https://doi.org/10.53730/ijhs.v6nS1.6845

Systematic review on brain tumour and heart detection using machine learning and deep learning techniques

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***Abstract*---**Machine Learning and Deep Learning play a vital role in detection of both brain tumour and heart disease. Now a day's large number of patients are struggling from the both the illness. With the help of technology doctors can keep the patients out of the danger. We have used many methodologies to detect both the disease. In this research paper we have covered many techniques to detect the disease and also talked about their respective results.

***Keywords*---**brain tumour, machine learning, deep learning.

Introduction

A brain tumour is a growth of abnormal brain cells that can turn cancerous. The most common method of detecting brain malignancies is with magnetic resonance imaging (MRI) scans. The information contained in MRI images pertains to abnormal tissue development in the brain. Machine learning and [1] Deep Learning were used in a number of studies to detect tumour cells. ANN and CNN are used in this study to distinguish between normal and malignant brain. The neural network can obtain information thanks to a collection of data used in the learning process. There will be only one layer to install and remove, despite the fact that there may be multiple hidden levels. Throughout the learning process, weight and bias are applied to the neurons of each layer based on the input characteristics and previous layers. [2]The model is trained based on the

functionality used in the input components and the hidden layers, where more learning takes place in order to produce the desired output. Because ANN works through fully integrated layers, when additional processing is required, such as in this study, the image is used as input and[3] CNN is used as well. In CNN, the term "convolutional" refers to a mathematical line function (convolutional neural network). The image size of each CNN layer is reduced without sacrificing training information. Convolve, maxpooling, droupout, flatten, and dense are among the processing methods used to create the model. This study compares the performance of the ANN and CNN models when applied to an MRI database of brain tumours, and then develops a self-explanatory design for them.

Radiology is a wide field that necessitates a deeper understanding of medical science in order to diagnose cancers properly. As a result, the demand for a tumour screening programme outnumbers the supply of qualified radiologists. [4]Using magnetic resonance imaging, biomedical image processing makes it easier to locate and detect brain tumours. As a result, the radiology department has gained traction in the imaging-based research of brain tumours. Many studies into the aetiology of brain tumours have been conducted, however the results have been equivocal In this case, combining the k-means integration methodology with FCM approaches results in a successful separation approach. [5]The incorporation of k-means, as well as the short-term calculation of FCM, will benefit this technique and help to enhance accuracy. In the early examination of brain tumours, Amato et al. employed mathematical morphological reconstruction (MMR) to do systematic PC-assisted detection. With the help of the MATLAB application and the Core 2 Duo code configuration, the recommended technique was developed. To begin, the image is enhanced using a pre-processing approach. After that, the separation is used to rule out the tumour border region. [6][7]This proposed software's main purpose is to assist human specialists or surgeons in identifying patients in less time.

Medical diagnosis utilising image processing and machine learning is one of the most pressing challenges for artificial intelligence systems.[8] Reseachers present a machine learning strategy for identifying whether or not an MRI image of the brain has a tumour in this paper. According to the findings, such an approach is quite promising. Reserahcers propose a software for transforming fresh brain MRI scans into tumour and tumor-free images in this research. This should be accomplished without the need of humans. Before they can apply a few types of categories, they need to pre-process a few picture features including colour, region of interest, image file extension, and comparison level. [9]Researchers used two well-known tools to accomplish this: ImageJ and MATLAB were used in their study. The most relevant and distinguishing sections of the processed pictures were then extracted. We'll go over ten different features in this part. Finally, employing four different division methods, we use WEKA 3.6 to calculate accuracy / memory, F rating, proportion of properly separated photos, and time spent creating each model.

This study[11] article discusses a method that uses computer-based techniques to identify tumours and discriminate tumour kinds in MRI scans of various patients using the Convolution Neural Network Algorithm. Several imaging approaches, such as image categorization, image augmentation, and feature

removal, are used to scan brain tumours in MRI images of cancer patients. [12] The four procedures involved in diagnosing a brain tumour using Image Processing technologies are Pre-Image Processing, Image Separation, Feature Extraction, and Editing. To improve the detection and isolation of brain tumours in MRI images, image processing and neural network approaches were used. Heart disease is a term used to describe a range of conditions that affect your heart. According to data from the World Health Organization, cardiovascular illnesses are the leading cause of death worldwide, accounting for 17.9 million fatalities per year.

Heart disease is exacerbated by high cholesterol, obesity, high triglyceride levels, hypertension, and other harmful habits. [13] Sleep disturbances, a slight increase and fall in heart rate (irregular heartbeat), swollen legs, and, in rare cases, rapid weight gain of 1-2 kg per day are all signs. All of these symptoms are similar to those of other diseases, such as those that afflict the elderly, making it difficult to detect; yet, it will result in a fatality in the not-too-distant future. Over time, though, more study data and hospital patient records become available. [14] To diagnose the disease and categorise or predict the repercussions, we may utilise a variety of machine learning and deep learning models. Machine learning algorithms can quickly analyse any genetic data. Knowledge can be taught to models.

Cardiovascular illnesses have recently surpassed cancer as the leading cause of death worldwide. According to the World Health Organization, 17.9 million people die each year from cardiovascular diseases, with coronary artery disease and cerebral stroke accounting for 80% of these deaths. Heart disease is caused by a variety of variables, including personal and professional behaviours, as well as inherent vulnerability. Tobacco use, excessive alcohol and caffeine use, stress, and physical inactivity, as well as physiological concerns such as obesity, hypertension, high blood cholesterol, and pre-existing cardiac abnormalities, are all common causes of heart disease. The ability to diagnose cardiac disease quickly, accurately, and precisely is essential for taking preventative measures to avoid negative consequences.

The most serious issue in the world of medical sciences today is the provision of high-quality services, as well as efficient and accurate prognosis. The latter problem can be overcome by using Data Mining and Machine Learning to automate the procedure. [15] Data mining is a technique for extracting useful information from massive amounts of unstructured data. It entails employing a range of technologies to analyse patterns in large amounts of data. It also needs efficient data collecting, storage, and processing on a computer. Machine Learning (ML) is a subset of data mining that works swiftly with vast amounts of well-formatted data. Machine learning may be used to diagnose, identify, and forecast a wide range of ailments in the medical industry.

Against discover the most accurate model, the XGBoost ensemble approach is compared to Logistic Regression, Nave Bayes, Support Vector Machine, K-Nearest Neighbor, Decision Tree, Random Forest, and the XGBoost ensemble approach. The UCI repository's heart disease dataset is used in this study. In this work, the existing categorization approaches are investigated and contrasted. In addition,

the study considers the scope of future research as well as a variety of options for improvement. Machine learning incorporates a number of different classifiers, and it is gaining popularity by the day. Methods for predicting and determining the accuracy of a prediction include supervised, unsupervised, and ensemble learning. That information can be applied to our HDPS effort, which will assist a significant number of people. Cardiovascular diseases relate to a multitude of ailments that can harm the heart and circulatory system, and they are very widespread these days.

Machine learning methodologies to detect brain tumor and prediction heart diesases

Various approaches are used for predating brain tumor as well as heart disease. In the brain tumour database, two ANN and CNN algorithms are applied, and their performance in image classification is evaluated.

P Gokila Brindha ,M Kavinraj. et.al -Seven layers make up the ANN model used in this scenario by the researhcers. The first layer is a flat layer that transforms 256x256x3 images into identical one-sided members. The next five layers are thick layers with 128,256,512,256, and 128 neurons in each layer, respectively, with the goal of acting as a relax. The last dense layer with activating function is a sigmoid outgoing layer with one neuron representing two classes, and these five layers function as hidden layers.

Muhammad Arif, F. Ajesh et.al The CNN sequence model is made up of several layers made by the researchers. The inset image has been resized to 256x256 pixels. The convolve layer is applied to the inserted image with the remaining as activation, simultaneous editing, which means the output images are identical to the input image, and there are a total of 32,32,64,128,256 convolve layers. A 20 percent drop is the greatest combination of a 2x2 window size and a stop function. The flatten technique is used to transform features into identical members of a single place.

Mahmoud Al-Ayyoub, Ghaith Husari, Ahmad Alabed-alaziz suggested this study project which gathers the first photographic site; images are enhanced by thresholding, morphological performance, and geographic completeness. After that, the BWT method is used to partition the plant area. To extract features, the GLCM algorithm is employed.

Parmar Ankita et. al proposed the genetic algorithm is used to pick attributes. Finally, CNN and SVM Nave Bayes, an SVM-based SVM division, correctly separated the image. The database for this research contains 27 MRI scans of the human brain. The human brain is depicted in seven of the photos, while brain tumours are depicted in the other twenty. The photos were mostly found through Google searches, as it appears that finding such images in local hospitals is proving to be more difficult than anticipated.

Harshit Jindal, Sarthak Agrawal et. al -This study looks into a number of machine learning techniques, including K nearest neighbours (KNN), Logistic

Regression, and Random Forest Classifiers, all of which can help practitioners and medical analysts diagnose heart disease more accurately.

Rohit Bharti, Aditya Khamparia et. al - The heart disease prediction procedure includes reviewing journals, published articles, and recent data on cardiovascular illness. When using the first approach, Random Forest is 76.7 percent correct, Logistic Regression is 83.64 percent correct, KNeighbors is 82.27 percent correct, Support Vector Machine is 84.09 percent correct, Decision Tree is 75.0 percent correct, and XGBoost is 70.0 percent correct. In this case, SVM has the highest accuracy, which is achieved by utilising cross-validation and grid search to find the best parameters, or by using hyperparameters. In the second technique, Random Forest has an accuracy of 88 percent, Logistic Regression has an accuracy of 85.9%, KNeighbors has an accuracy of 79.69 percent, Support Vector Machine has an accuracy of 84.26 percent, Decision Tree has an accuracy of 76.35 percent, and XGBoost has an accuracy of 71.1 percent. Random Forest comes out on top, with an F1 score of 86.5 percent and a precision of 88.4 percent. Using the same conditions as before, deep learning generates an accuracy of 86.8% and an evaluation accuracy of 81.9 percent, which is better than the first technique.

Pooja Anbuselvan et. al The goal of this research is to examine the accuracy of several categorization algorithms in predicting whether or not a patient would acquire heart disease. Logistic Regression, Nave Bayes, Support Vector Machine, K-Nearest Neighbor, Decision Tree, Random Forest, and XGBoost were employed on the UCI dataset. The data was separated into training and test sets, and the models were trained and their accuracy assessed. Algorithm Accuracy 75.41 percent of the time, we apply logistic regression. Nave Bayes Machine to Support Vectors: 77.05 percent 7.377 percentage point K-Nearest Neighbor: 57.83 percent The Decision Tree took up 77.05 percent of the time. The Random Forest took up 86.89 percent of the time. 78.69.

V.V. Ramalingam, Ayantan Dandapath, M Karthik Raja-The main purpose of this project is to develop a number of data mining algorithms that may be used to accurately forecast cardiac sickness, with the goal of attaining efficient and reliable prediction with fewer characteristics and tests. The data was pre-processed before being utilised in the model, with Random Forest (86.89 percent) and XGBoost being the most efficient methods (78.69 percent). The accuracy of K-Nearest Neighbor, on the other hand, was the lowest, at 57.83 percent. Other data mining techniques can be added to this study, such as time series, clustering and association rules, and other ensemble techniques. Two or more similar but independent analytical models are employed in ensemble modelling, and the results are integrated into a single model. To obtain an accuracy of 94.12 percent, TahiraMahboob et al. used an ensemble of SVM, KNN, and ANN. To demonstrate this, Saba Bashir et al. used Nave Bayes, Decision Trees, and Support Vectors. For the UCI heart disease dataset, machine classifiers obtained an accuracy of 82 percent, a sensitivity of 74 percent, and a specificity of 93 percent. An ensemble model consisted of Gini Index, SVM, and Nave Bayes classifiers was built with 98 percent accuracy. Syncope disease can be predicted using this method.

Jaymin Patel, Prof.TejalUpadhyay, Dr. Samir Patel el. Al -J48 is an open source Java implementation of the C4.5 algorithm in the WEKA tool. This approach employs decreased-error pruning and an avaricious strategy to create decision trees for classification. The decision tree is constructed by reviewing data hubs, which are used to determine the size of existing highlights. The J48 algorithm is an extension of the ID3 algorithm that may result in the formation of a tiny tree. Pruning is an important strategy to utilise in tree construction because of outliers, and it also tackles the issue of overfitting. Small groups of instances may occur in datasets that are not precisely described; pruning may be used to accurately categorise them. Logistic Model Tree is the classifier for building logistic model trees, which are composed of a decision tree structure with a logistic regression function at the leaves. The technique can manage parallel and multi-class target variables, numeric and nominal attributes, and missing qualities. Like in a decision tree, the tested attributes are associated with each inner node. The node has k child nodes for nominal attributes with k values, and the instances are sorted down based on the value of the attribute. The node has two child nodes for numeric attributes, and the attributes of the tested value are compared to a threshold (the instances are ranked down based on the threshold). The success of a system like the one presented in this study is dependent on an effective classification algorithm that can properly synthesise new pictures into existing ones. A tumour group and a tumour group without tumours This is accomplished by recognising certain patterns in the specified feature values in order to discriminate between these two sorts of pictures.

Literature Review Findings

1. CNN is widely regarded as one of the most effective methods for analysing picture data. CNN creates predictions by lowering image size while retaining the necessary information. The ANN model developed here achieves 65.21 percent test accuracy, which may be improved by giving additional picture data. Image enhancing methods, as well as ANN and CNN performance analyses, may be used to achieve the same results. The model created here is based on the route and error mechanism. In the future, development strategies can be utilised to establish how many layers and filters can be employed in the model. CNN will be used in the database from now on if it shows to be the best approach to forecast the presence of a brain tumour.
2. Because of the intricacy of the pictures, as well as the absence of anatomical models that adequately reflect the potential faults in each component, medical image fragmentation is a challenging challenge. This proposed strategy works best in the initial size of collection and collecting centres. The categorization is performed with precision and at a low computation speed utilising BWT approaches. To isolate brain tissue, this function suggests a method that requires non-invasive human input. The major goal of this suggested software is to help human specialists or surgeons identify patients in less time. When compared to contemporary technologies, the test results reveal 98.5 percent accuracy. Calculation time, system complexity, and memory space requirements for creating algorithms may all be decreased further. The same technology may be used to detect and study diseases in different sections of the body (kidneys, liver, lungs, etc.). Different sophisticated dividers can be employed in future study to increase accuracy by integrating highly effective distinguishing and extraction approaches

with real-time imaging and clinical situations utilising a large collection of data encompassing a wide range of conditions. The results are presented in the four categories stated above in this section. In specifically, we illustrate the following in each section.

1. Percentage of photos that are well-separated.
2. The quantity of memory.
3. Accuracy is important.
4. F-Measurement value

All partition methods were tested using a commonly recognised ten-step verification procedure. The results of these tests are shown in the table below. Reserachers put these figures in an integrated 2D column to have a closer look at them. It will be easy to compare various algorithms this way. As the results show, the neural network (NN) method outperforms all other algorithms in terms of accuracy and memory. Lazy-IBk surprised everyone by coming in second place in accuracy and memory. Furthermore, it outperforms all other F-Measure value computations and achieves greater accuracy than NN. J48 and Nave Bayes had very low accuracy and memory ratings. According to the J48 resolution tree, the mean grey matter and the Int were the most relevant characteristics employed in the separation. Overcrowding. KNN, Random Forest, SVC, Decision used tree for the diagnosis of patients with heart disease. More accurate technique , saves a lot of money (i.e. it's less expensive and faster than previous algorithms). Furthermore, KNN and Logistic Regression both have the same maximum accuracy. Authors may infer that our accuracy has increased as a result of the expanded medical information they used from the dataset, which is 88.5 percent, which is greater than or nearly equivalent to accuracies reported in previous research. Furthermore, the findings suggest that Logistic Regression and KNN outperform Random Forest Classifier in the classification challenge.

A patient's prognosis after being diagnosed with heart illness, demonstrating that KNN and Logistic Regression are superior in disease diagnosis. When using the first strategy, the accuracy of the Random Forest is 76.7 percent, Logistic Regression is 83.64 percent, KNeighbors is 82.27 percent, Support Vector Machine is 84.09 percent, Decision Tree is 75.0 percent, and XGBoost is 70.0 percent. SVM has the highest accuracy in this case, which is obtained by using cross-validation and grid search to determine the best parameters, or using hyperparameter tuning. Because there are outliers, the robust standard scalar is used after picking the features (feature selection) and scaling the data. Random Forest has an accuracy of 88 percent, Logistic Regression has an accuracy of 85.9 percent, KNeighbors has an accuracy of 79.69 percent, Support Vector Machine has an accuracy of 84.26 percent, Decision Tree has an accuracy of 76.35 percent, and XGBoost has an accuracy of 71.1 percent. Then, with the same parameters as before, deep learning is applied to create an accuracy of 86.8 percent and an evaluation accuracy of 81.9 percent, both of which are higher than before.

Using the Second Methodology (Doing Feature Selection and No Outliers Detection) 76.7 percent accuracy was achieved. Because there are outliers, the robust standard scalar is used after picking the features (feature selection) and scaling the data. Random Forest has an accuracy of 88 percent, Logistic

Regression has an accuracy of 85.9 percent, KNeighbors has an accuracy of 79.69 percent, Support Vector Machine has an accuracy of 84.26 percent, Decision Tree has an accuracy of 76.35 percent, and XGBoost has an accuracy of 71.1 percent. Then, using the same parameters as before, deep learning is used to create an accuracy of 86.8 percent and an assessment accuracy of 81.9 percent, both of which are higher than before. Using the Third Methodology (by Doing Feature Selection and Outliers Detection)

This method normalises the dataset, performs feature selection, and addresses outliers with the Isolation Forest. Random Forest has an accuracy of 80.3 percent, Logistic Regression has an accuracy of 83.31 percent, KNeighbors has an accuracy of 84.86 percent, Support Vector Machine has an accuracy of 83.29 percent, Decision Tree has an accuracy of 82.33 percent, and XGBoost has an accuracy of 71.4 percent.

The purpose of this study is to compare the results of various classification algorithms in order to identify the most accurate algorithm for predicting whether or not a patient will develop heart disease. Logistic Regression, Nave Bayes, Support Vector Machine, K-Nearest Neighbor, Decision Tree, Random Forest, and XGBoost algorithms were used on the UCI dataset. The dataset was divided into training and test data, and the models were trained and the accuracy was measured. Algorithm Accuracy Logistic Regression is a technique for predicting the outcome of 74.14 percent Support Vector Machine 77.05 percent Nave Bayes K-Nearest Neighbor (73.77 percent), Decision Tree (57.83 percent), and Random Forest (77.05 percent) XGBoost 78.69 percent 86.89 percent. The main goal is to establish several data mining approaches that can be used to accurately forecast cardiac disease. It could be argued that machine learning algorithms have a lot of potential in terms of forecasting cardiovascular or heart-related disorders. Each of the aforementioned algorithms has performed admirably in some circumstances while failing miserably in others. When used with PCA, alternating decision trees have performed exceptionally well, but decision trees have performed poorly in other circumstances, possibly due to overfitting. The J48 tree technique was chosen to be the best classifier for heart disease prediction based on the results of the studies since it has the highest accuracy and requires the least amount of time to construct. The J48 approach with reduced error trimming has the highest accuracy, followed by LMT and Random Forest algorithms, according to researchers. It was also discovered that pruning J48 for fewer errors improves performance, whereas not pruning improves performance.

Autor	Technique	Accuracy	Conclusion
P Gokila Brindha ,M Kavinraj , P Manivasakam and P Prasanth.	ANN and CNN	91.3%	Brain tumor detection was performed using machine learning algorithms and in-depth learning. In this paper ANN and CNN are used to differentiate between normal brain and tumor.

Muhammad Arif, F. Ajesh, Shermin Shamsudheen, Oana Geman ,Diana Izdrui ,and Dragos Vicoveanu.	GLCM algorithm, SVM Naïve Bayes, SVM based BOV class , CNN class.	98.5%	Brain tumor detection was performed using Machine Learning and In-Depth Learning algorithms.
Mahmoud Al-Ayyoub, Ghaith Husari, Ahmad Alabed-alaziz.	Artificial Neural Network, Tree J48, Naıve Bayes, Lazy-IBk.	82.65%	Algorithms for analyzing and classifying medical images have received a lot of attention recently. The tests were present on this task show that after pre-screening the MRI images, the neural network segregation algorithm was advanced. Lazy-IBk performed very well and came in second. Naıve Bayes as well The J48 decision tree has come to an end.
Parmar Ankita.	CNN	72.69%	In this system author detect whether the tumor is present or not when the tumor is present and the model returns yes otherwise it returns no.
Parmar Ankita.	VGG 16	85.54%	The result of comparing VGG 16 is much more accurate than CNN.
Harshit Jindal, Sarthak Agrawal, Rishabh Khera, Rachna Jain and Preeti Nagrath	KNN, Logistic Regression, Random Forest Classifier	88.5%	It predicts people who will develop cardiovascular disease by extracting the patient medical history that leads to a deadly heart disease from a dataset that contains patients' medical history, such as chest pain, sugar level, blood pressure, and so on. This Heart Disease Detection System aids a patient based on clinical information from a previous heart disease diagnosis.

Rohit Bharti, Aditya Khamparia , Mohammad Shabaz, Gaurav Dhiman, Sagar Pande and Parneet Singh	Machine learning And Deep learning	75% - 95%	Three strategies are proposed, each of which included a comparative study and yielded promising results. Authors came to the conclusion that machine learning methods performed better in this study. Many academics have previously proposed that we should employ machine learning when the dataset is small, which this work proves.
Pooja Anbuselvan	Logistic Regression NaÃ¯ve Bayes Support Vector Machine K-Nearest Neighbor Decision Tree Random Forest XGBoost	75.41% 77.05% 73.77% 57.83% 77.05% 86.89% 78.69%	Except for the KNN algorithms in the model, all of the algorithms performed admirably.
V.V. Ramalingam, Ayantan Dandapath, M Karthik Raja	Naïve Bayes SVM K – Nearest Neighbour Decision Tree Random Forest Ensemble Model	84% 93.5% 87.5% 92% 97% 94%-98%	In different situations, each model performs differently. Each model is based on the data set.
Jaymin Patel, Prof.TejalUpadhyay, Dr. Samir Patel	J48 algorithm LMT algorithm	56.76% 55.77%	After analysing the experimental findings, it was determined that the J48 tree technique is the best classifier for heart disease prediction because it has the highest accuracy and takes the least amount of time to construct. Authors can plainly observe that the J48 method with reduced error trimming has the highest accuracy, followed by LMT and Random Forest algorithms.

Conclusion

Among the many life-threatening diseases that exist, a brain tumour and heart diseases are the most deadly. Tumour detection is first accomplished using MRI, BIOPSY, SPINAL TAPE TEST, ANNINOGARM, and other comparable procedures. All of these examinations are not only uncomfortable, but also costly. As a result, for early identification and classification of tumours, a brain tumour detection and classification system is necessary. In this paper, Authors will look at and examine existing systems in order to find the most efficient and effective solutions. Tumors have a complex and variable structure, making categorization challenging.

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