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AI-based Smart Healthcare Disease Diagnosis: Analysis & Design of New Model

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Abstract

Recently the provision of healthcare is considered one of the basic societal obligations. Nowadays, the healthcare systems are expanding at a rapid pace. For predicting the risk of diseases, different machine learning algorithms are used in several studies. Most of these algorithms are focused on a single disease, for example, to predict diabetes or cancer disease. Also due to digitization, a lot of data are being produced in the healthcare sector. This data can be studied, analyzed, and used for predictions in using Machine Learning (ML), Artificial Intelligence (AI), and Deep Learning (DL) strategies. To facilitate a common system to diagnose multiple diseases, a smart healthcare diagnosis system has been proposed in this research. The users can choose a disease prediction and give input and see if the person is suffering from that specific disease or not. The proposed methodology is also designed to predict multiple diseases using various intelligence-based learning strategies.

Keywords

Smart Healthcare, Machine Learning, Soft Computing, Disease Diagnosis, Deep Learning

1. Introduction

Recent healthcare sectors are facing two major issues, firstly, the lack of medical consultants and secondly the increase in expenditure on healthcare. If 80% of doctor's availability is assumed then the current doctor to population ratio is 1:854 [1]. Healthcare expenditure is also increasing every year. Also due to digitization, a lot of data are being produced in the healthcare sector. This data can be studied, analyzed, and used for predictions in using Machine Learning (ML), Artificial Intelligence (AI), and Deep Learning (DL) strategies [2-5]. The integration of healthcare services with ML results in smart healthcare which helps to deal with the stated major issues [6-10].

2. Literature Survey of Recent Healthcare Disease Diagnosis Methods

ML and DL algorithms are being applied in the healthcare sector in different ways. It helps to detect the disease's pattern and also to diagnose the disease. In the existing systems, there are many ML and DL prediction models are applied that predict a particular disease based on the symptoms. These existing models are focused on the prediction of a single disease. If a person wants to check for multiple diseases, then the person has to find the other prediction models for every disease which results in a time-consuming process.

A multi-disease prediction model is proposed instead of various single disease prediction models [1]. The proposed model consists of different disease prediction models that are integrated using Flask API. The primary focus is on analyzing diabetes and predicting heart and cancer diseases using several ML and DL methods. After generating the individual models, the behaviors are saved using the Python pickling technique and are finally integrated using Flask API. The dif-

ferent SVM techniques are applied for disease predictions in the healthcare monitoring system [2]. The diagnosis time is reduced by using SVM techniques compared to the manual diagnosis performed in hospitals. The chi-square distribution is applied in the feature selection.

The dimensionality reduction and feature selection methods are applied to detect heart issues [3]. Two different models are trained and compared. In the first model, the principal component analysis (PCA) is directly applied to the raw data to train the model with the resultant data. In the second model instead of using PCA directly on the raw data, the Chi-square and PCA (CHI-PCA) are combined. The chi-square feature selection is applied with the raw data and then the important features are selected. Then the PCA is applied and the model is trained. It has been observed that the second model achieved 98% accuracy. The classification algorithms such as Random Forest (RF), neural networks, and k-nearest neighbors (KNN) are designed and evaluated using the chronic kidney disease dataset (CKD) [4]. The attribute selection is implemented using the wrapper and the embedded methods. The wrapper approach is applied to the induction algorithm and in the embedded approach is applied the Least Absolute Shrinkage and Selection Operator (LASSO).

Different decision tree algorithms such as RF and random trees are applied to predict kidney disease [5]. It is observed that RF has produced 100% accuracy. It has also been verified that J48, RandomTree, and Decision Stump are reducing the computational time. The four convolutional neural networks (CNN) ResNet18, SqueezeNet, ResNet50, and DenseNet-121 are applied to identify the COVID-19 disease using the chest X-ray images [6]. These methods are evaluated based on the sensitivity, different curves, and matrices and produced 98% accuracy. Some of the CNN Models like VGG19 and U-Net are used to classify the X-ray images as negative or positive [7]. The model is proposed to segment the lung images, remove irrelevant surroundings, train the classification and analyze the heat maps. The model has achieved 97% accuracy.

3. Analysis of Recent Healthcare Disease Diagnosis Methods

The different soft computing models have been recently developed to diagnose classical diseases. The performance of these different algorithms depends on several characteristics. The primary characteristics are the scale of training and testing datasets, imbalance of datasets, and missing values. It has also been experimentally analyzed that the highly imbalanced datasets result in unstable predictions by the model. The most important ML algorithms used for cardiovascular and kidney diseases are SVM, RF classifier, Naïve Bayes and KNN. Similarly, for the COVID-19 predictions, the self-implemented CNN and VGG-16 models are mostly used. The pre-trained models achieved 95% accuracy in the classification. The techniques such as linear and polynomial SVM, and SVM-Radial bias kernel are applied to predict kidney, and heart disease and are observed that the SVM-Radial bias kernel produced good accuracy [1]. RF has produced good accuracy and it has been observed that hemoglobin and albumin are highly predictive attributes for CKD [4].

4. Need for AI-based Smart Healthcare Disease Diagnosis Model

AI-based smart healthcare disease diagnosis model is required to diagnose multiple diseases on a common platform. Hence it is required to develop the individual models initially using different soft computing strategies and then these models are to be integrated using the Flask API. There is a need to focus primarily on some specific diseases like cardiovascular, kidney, and COVID-19 predictions. The cardiovascular and kidney diseases are predicted using ML algorithms and COVID-19 prediction is to be done using DL strategies. Hence there is a need to train these models and each of these models will be evaluated based on the performance metrics. These models will be implemented in Python using sklearn and TensorFlow libraries.

5. Design of New AI-based Smart Healthcare Disease Diagnosis Model

Since there is a need for an AI-based smart health care model, initially the different datasets are to be collected for all the three disease predictions – the cardiovascular, kidney, and COVID-19 diseases. The design of the new AI-based smart healthcare model is sketched in Figure 1. The model involves the main operations – data cleaning and analysis, data transformation, feature selection, model building, training of the different models, and performance metrics evaluation.

6. Conclusions & Future Work

The recent trends in healthcare diagnosis models are explored in this research. The need for AI-based smart healthcare disease diagnosis to predict multiple diseases on a common platform is explored. The design of the new model is proposed. In the proposed model, the individual architectures will be trained for cardiovascular, kidney, and COVID-19diseases.

The following are the future work:

- These architectures will be integrated using Flask API.
- Predictions will be done according to the inputs given by the user.
- Once the user chooses a disease prediction option the corresponding model will be executed and the predictions will be computed and analyzed using different evolutionary, approximation methods and recommendation systems [11-33].

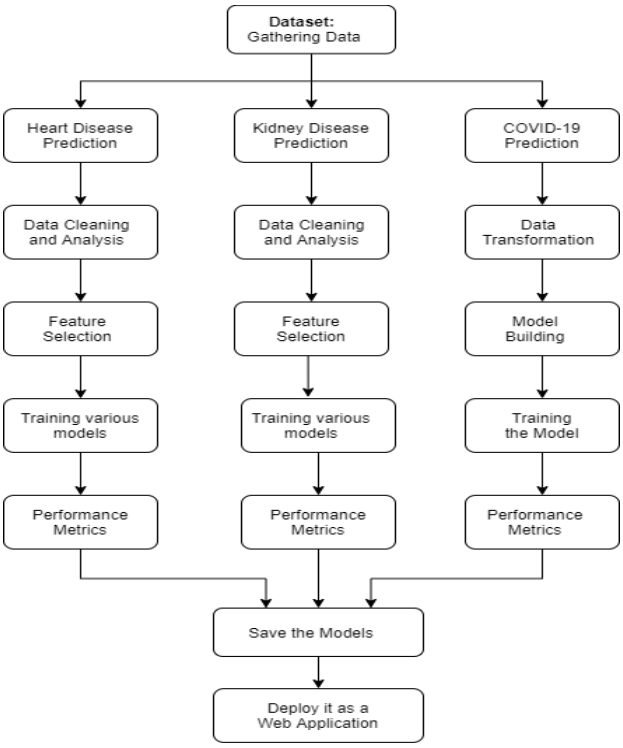

Figure 1. New AI-based smart healthcare model.

References

[1] Yaganteeswarudu, A. Multi Disease Prediction Model by using Machine Learning and Flask API. In 2020 5th International Conference on Communication and Electronics Systems (ICCES) (pp. 1242-1246). June 2020.

[2] Harimoorthy, K., Thangavelu, M. (2021). Multi-disease prediction model using improved SVM-radial bias technique in healthcare monitoring system. Journal of Ambient Intelligence and Humanized Computing, 12(3), 3715-3723.

[3] Gárate-Escamila, A. K., El Hassani, A. H., Andrès, E. (2020). Classification models for heart disease prediction using feature selection and PCA. Informatics in Medicine Unlocked, 19, 100330.

[4] Salekin, A., Stankovic, J. (2016, October). Detection of chronic kidney disease and selecting important predictive attributes. In 2016 IEEE International Conference on Healthcare Informatics (ICHI) (pp. 262-270). IEEE.

[5] Pasadana, I. A., Hartama, D., Zarlis, M., Sianipar, A. S., Munandar, A., Baeha, S., Alam, A. R. M. (2019, August). Chronic kidney disease prediction by using different decision tree techniques. In Journal of Physics: Conference Series (Vol. 1255, No. 1, p. 012024). IOP Publishing.

[6] Minaee, S., Kafieh, R., Sonka, M., Yazdani, S., & Soufi, G. J. (2020). Deep-covid: Predicting covid-19 from chest x-ray images using deep transfer learning. Medical image analysis, 65, 101794.

[7] Arias-Garzón, D., Alzate-Grisales, J. A., Orozco-Arias, S., Arteaga-Arteaga, H. B., Bravo-Ortiz, M. A., Mora-Rubio, A. Tabares -Soto, R. (2021). COVID-19 detection in X-ray images using convolutional neural networks. Machine Learning with Applications, 6, 100138.

[8] Bashir, S., Khan, Z. S., Khan, F. H., Anjum, A., & Bashir, K. (2019, January). Improving heart disease prediction using feature selection approaches. In 2019 16th International Bhurban Conference on Applied Sciences and Technology (IBCAST) (pp. 619-623). IEEE.

[9] Jain, R., Gupta, M., Taneja, S., Hemanth, D. J. (2021). Deep learning based detection and analysis of COVID-19 on chest X-ray images. Applied Intelligence, 51(3), 1690-1700.

[10] Zoabi, Y., Deri-Rozov, S., Shomron, N. (2021). Machine learning-based prediction of COVID-19 diagnosis based on symptoms. npj Digital Medicine, 4(1), 1-5.

[11] Bhaskaran, S.; Marappan, R.; Santhi, B. Design and Analysis of a Cluster-Based Intelligent Hybrid Recommendation System for E-Learning Applications. Mathematics 2021, 9, 197. https://doi.org/10.3390/math9020197.

[12] Marappan, R., Sethumadhavan, G. Solving Graph Coloring Problem Using Divide and Conquer-Based Turbulent Particle Swarm

Optimization. Arab J Sci Eng (2021). https://doi.org/10.1007/s13369-021-06323-x.

[13] Bhaskaran, S.; Marappan, R.; Santhi, B. Design and Comparative Analysis of New Personalized Recommender Algorithms with Specific Features for Large Scale Datasets. Mathematics, 2020, 8, 1106. https://doi.org/10.3390/math8071106.

[14] Marappan, R.; Sethumadhavan, G. Complexity Analysis and Stochastic Convergence of Some Well-known Evolutionary Operators for Solving Graph Coloring Problem. Mathematics 2020, 8, 303. https://doi.org/10.3390/math8030303.

[15] N. S. Anand, R. Marappan and G. Sethumadhavan. "Performance Analysis of SAR Image Speckle Filters and its Recent Challenges," 2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2018, pp. 1-4, doi: 10.1109/ICCIC.2018.8782425.

[16] Marappan, R., Sethumadhavan, G. Solution to Graph Coloring Using Genetic and Tabu Search Procedures. Arab J Sci Eng 43, 525-542 (2018). https://doi.org/10.1007/s13369-017-2686-9.

[17] R. Marappan and G. Sethumadhavan, "Solving channel allocation problem using new genetic algorithm with clique partitioning method," 2016 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2016, pp. 1-4, doi: 10.1109/ICCIC.2016.7919671.

[18] R. Marappan and G. Sethumadhavan. "Solution to graph coloring problem using divide and conquer based genetic method," 2016 International Conference on Information Communication and Embedded Systems (ICICES), 2016, pp. 1-5. doi: 10.1109/ICICES.2016.7518911.

[19] R. Marappan and G. Sethumadhavan. "Divide and conquer based genetic method for solving channel allocation," 2016 International Conference on Information Communication and Embedded Systems (ICICES), 2016, pp. 1-5. doi: 10.1109/ICICES.2016.7518914.

[20] Solving Fixed Channel Allocation using Hybrid Evolutionary Method. Raja Marappan, Gopalakrishnan Sethumadhavan MATEC Web of Conferences, 57, 02015 (2016). DOI: 10.1051/matecconf/20165702015.

[21] Marappan, R., & Sethumadhavan, G. (2015). Solving graph coloring problem for large graphs. Global Journal of Pure and Applied Mathematics, 11(4), 2487-2494.

[22] Marappan, R., & Sethumadhavan, G. (2015). Solution to Graph Coloring Problem using Evolutionary Optimization through Symmetry-Breaking Approach. International Journal of Applied Engineering Research, 10(10), 26573-26580.

[23] Marappan, R., & Sethumadhavan, G. (2015). Solution to graph coloring problem using heuristics and recursive backtracking. International Journal of Applied Engineering Research, 10(10), 25939-25944.

[24] G. Sethumadhavan and R. Marappan. "A genetic algorithm for graph coloring using single parent conflict gene crossover and mutation with conflict gene removal procedure," 2013 IEEE International Conference on Computational Intelligence and Computing Research, 2013, pp. 1-6. doi: 10.1109/ICCIC.2013.6724190.

[25] R. Marappan and G. Sethumadhavan. "A New Genetic Algorithm for Graph Coloring," 2013 Fifth International Conference on Computational Intelligence, Modelling and Simulation, 2013, pp. 49-54. doi: 10.1109/CIMSim.2013.17.

[26] Raja Marappan, Gopalakrishnan Sethumadhavan, R.K. Srihari. New approximation algorithms for solving graph coloring problem—An experimental approach, Perspectives in Science, Volume 8, 2016, Pages 384-387, ISSN 2213-0209. https://doi.org/10.1016/j.pisc.2016.04.083.

[27] Raja Marappan, Gopalakrishnan Sethumadhavan, U. Harimoorthy. Solving channel allocation problem using new genetic operators—An experimental approach, Perspectives in Science, Volume 8, 2016, Pages 409-411, ISSN 2213-0209. https://doi.org/10.1016/j.pisc.2016.04.091.

[28] S. Balakrishnan, Tamilarasi Suresh, Raja Marappan. Analysis of Recent Trends in Solving NP Problems with New Research Directions Using Evolutionary Methods. International Journal of Research Publication and Reviews, Vol (2), Issue (8), (2021) Page 1429-1435.

[29] S. Bhaskaran; Raja Marappan. New Personalized Recommendation System for E-Learning. AshEse Journal of Physical Science. Vol. 5(5), pp. 063-067, August, 2021 ISSN: 2059-7827. DOI: http://www.ashese.co.uk/ajps-v5-issue-5/new-personalized-recommendation-system-for-e-learning.

[30] S. Balakrishnan, Tamilarasi Suresh, Raja Marappan. (2021). A New Multi-Objective Evolutionary Approach to Graph Coloring and Channel Allocation Problems. Journal of Applied Mathematics and Computation, 5(4), 252-263. DOI: http://dx.doi.org/10.26855/jamc.2021.12.003.

[31] Raja Marappan. A New Multi-Objective Optimization in Solving Graph Coloring and Wireless Networks Channels Allocation Problems. Int. J. Advanced Networking and Applications, Volume: 13, Issue: 02, Pages: 4891-4895 (2021).

[32] Raja Marappan, S. Bhaskaran, N. Aakaash, S. Mathu Mitha. (2022). Analysis of COVID-19 Prediction Models: Design & Analysis of New Machine Learning Approach. Journal of Applied Mathematics and Computation, 6(1), 121-126. DOI: http://dx.doi.org/10.26855/jamc.2022.03.013.

[33] Raja Marappan, S. Bhaskaran, S. Ashwadh, H. Aathi Raj. (2022). Extraction of Drug Review Polarity Using Sentimental Analysis. Journal of Applied Mathematics and Computation, 6(2), 167-177. DOI: http://dx.doi.org/10.26855/jamc.2022.06.001.