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Smart Detection of Cardiovascular Disease Using Gradient Descent Optimization

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Abstract— The main cause of death in the modern environment is heart disease. A requirement for improving the healthcare sector is a need to anticipate heart failure. The consistent and effective prevalence of heart failure varies based on previous knowledge and information accessible from similar medical contexts. Various technologies, in response to new observations or due to changes in interrelationships, can learn or adapt and modify functional dependencies all of these skills have gradient descent optimization (GDO). People have amazing models with good results in generalizability, contain little human involvement, and a small processing training process. The prognosis of cardiovascular disease, which affects the lives of millions of people, is one of the most significant based on machine learning systems. Patients with heart disease have many independent variables that can be used for diagnosis very effectively. To model variables, the proposed model uses the gradient descent optimization algorithm. The proposed SDCD-GDO system can replace expensive medical check-ups with smart detection of likely heart disease presence in patients. The use of medical datasets has impressed the worldwide attention of researchers. The proposed SDCD-GDO model is constructed based on true data gathered from the different sources and the proposed model achieved 94.4 percent accuracy in determining heart disease in the validation phase.

Keywords — Cardiovascular; smart detection; gradient descent optimization; GDO; SDCD-GDO

1. INTRODUCTION

Cardiovascular disease (CVD) is a cluster of heart and blood vessel disorders. (WHO) figures indicate that for people of both genders and all ages, heart disease is a leading cause of death. In total, 17.3 million deaths in 2013 were caused by CVD. 45 percent of all fatalities and 31.5 percent of all deaths globally are attributed to the disease. More deaths worldwide have been caused by CVD, which is twice as many as cancer-related diseases, in all communication, maternal, neonatal, and nutritional disorders [1].

The medical system has improved significantly over the past two decades and now has the power to improve the way healthcare is delivered. Although health services optimize patient monitoring activities and thereby boost patient workflow management, their effectiveness is still debatable in the clinical setting. The key objective is to review the present condition maintenance program and provide a comprehensive analysis of the findings in the area of intelligent healthcare systems [2].

In developed countries, heart disorder is on the rise. As one of the most common human diseases, the disease kills thousands of people every year and incurs tremendous social costs, including surgery and other systems of medical care. The long-term chances of people with the condition may be improved by early detection of the illness. To diagnose diseases, artificial neural networks (ANNs) are commonly used. In the context, terms of learning capacity, versatility, and parallel processing, ANN may be a suitable tool [3].

The risk of cardiovascular disease and premature death is increased by obesity. A large number of bio-biotic intermediaries that affect not only homeostasis but also body weight insulin resistance are released by Oedipus tissue. Arteriosclerosis. The early mechanisms, as well as the aspects in which nicotine increases dyslipidemia and decreases physical activity, and the adverse effects of obesity on heart health, have started to be understood [4].

The relation between periodontal and cardiovascular diseases has been examined by numerous studies, but their results are conflicting. To investigate the correlation between periodontitis and cardiovascular disease, meta-analyses were conducted. From seven databases, studies published between 1989 and 2007 were collected. Reports of retrospective studies (cohort, cross-sectional and case-control studies) have been identified in the participants involved and the correlation between sporadic disease and cardiovascular disease has been evaluated with confirmation of one of the following criteria: diagnostic coronary artery disease infarction, unstable angina, acute cardiac myocardial disease, death. For the study of meta-observational findings, sufficient recommendations were followed. Of the 215 epidemiological studies, 47 were findings, of which the meta-analysis approach could satisfy 29 subjects.

The arithmetic pool difficulty ratio was 2.35 (95 percent CI [1.87, 2.96], p <0.0001) from 22 scenario and bridge studies. The risk of developing heart disease in subjects with periodontal disease was found to be significantly higher (34%). (0.0001 In non-disease patients). These clinical studies indicate that the difficulty and risk of developing cardiovascular disease are greater in subjects with periodontal disease, but there is still research to be done to reduce the risk of heart disease associated with the treatment of periodontitis [5].

Heart failure is one of the leading causes of death worldwide. The whole article gives a clear method for forecasting heart disease concerning medical evidence that describes the client's medical health status. The main idea of the proposed method is to find suitable machine learning techniques that achieve high precision for predicting heart disease. Two types of feature selection methods, heterogeneous feature selection, and relief are used for extracting main features from the dataset. Humans have compared four forms of machine learning techniques. Decided forest, vector machine assistance, classifier for decision trees, and logistics of regression classifier with chosen characteristics as well as complete functionality.

With machine learning, hyper-parameter tuning, and cross-validation to improve precision. The ability to manage Twitter data sources in which patient data is managed effectively is one of the essential strengths of the proposed framework. The framework is achieved by linking Apache Kafka as the device infrastructure with Apache Spark. The results show that on model 84.9, the random forest classification obtained the highest precision when exceeding other models [6].

Based on the 2010 Hospital Information System (SIRS) Report, cardiac disease is the main cause of death in Sri Lanka. The risk of death would be lowered by early diagnosis and treatment of heart disease. Consequently, by use of the methodology of Artificial Neural Networks (ANN) in the diagnosis of heart disease has been widely used and has achieved fair accuracy. In addition, in implementing the ANN technique, there are drawbacks, including a long training time, several parameters need to be tuned, the obtained may get stuck in local optimal, and the device combination must be distinguished solution [7].

2. LITERATURE REVIEW

To create software to change the method, researchers who diagnose heart disease specialize in healthcare. This study aims to use physio-deep learning neural networks and fuzzy laws to design an expert diagnostic system to make the right decisions in diagnosing heart disease. Our proposed approach is to provide the amount of uncertainty represented in the ambiguous rules in the knowledge base for the diagnosis of the heart disease domain, based on historical patient data. The recommended technique helps physicians make the correct decision to diagnose heart disease. In an information base that can greatly increase the consistency of the diagnosis of heart disease, all physician preferences can be changed. Experimental findings show that, relative to traditional neural networks, the proposed system is capable of diagnosing heart disease with high confidence in decision-making precision [8].

Many people in developed nations have suffered from heart disease over the past two decades. Early diagnosis of these diseases helps patients lower their risk of mortality and reduce the cost of care. The Fiji Logic Adaptive Genetic Algorithm (AGAFL) model aims to predict heart disease, helping medical professionals detect heart disease at an early stage. A modular set-based heart disease feature selection module and a fuzzy-based classification module are included in the model. By applying incorrect genetic algorithms, vague classification rules have been strengthened. Second, the main characteristics that cause heart disease are selected by theory to some degree. The second step is to use the hybrid AGAFL classification to predict heart illness. This experiment is conducted on datasets of UCI heart disease that are publicly accessible. A detailed experimental review demonstrates that the current approaches have been strengthened by our approach [9].

Heart disease is one of the world's leading causes of death and is regarded in middle and old age to be a serious disease. In particular, coronary artery disease is a common heart disease in which the risk of mortality is very high. Angiography is not always used as the best method of diagnosing coronary artery

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disease. On the other hand, higher costs and greater side effects are correlated with it. Therefore, to find alternative approaches, a lot of research has been conducted using machine learning and data mining. A highly precise hybrid method of diagnosing coronary artery disease is suggested here. In fact, by raising the initial weight using a genetic algorithm that recommends a better weight for the neural network, the proposed approach can increase the efficacy of the neural network by up to 10 percent. The model obtained accuracy, sensitivity, and descriptive rates of 93.85 percent, 97 percent, and 92 percent, respectively, using such a method [10].

Researchers have proposed a variety of instruments and techniques over the decades to develop successful systems to aid in medical decisions. In addition, new techniques and instruments are continually emerging and reflecting themselves. Diagnosis of heart disease is an important concern and several researchers have studied the development of smart, intelligent support systems for medical decision-making to enhance the qualifications of doctors. The proposed system presents a technique that uses software 9.1.3 based on SAS to diagnose heart disease. At the heart of the proposed scheme is the process of linking a neural network. The system builds new models, these pair-based approaches combine predictive values with later probabilities or multiple predecessor models. More efficient models can, therefore, be made. The proposed instrument, we experimented. In the experiments on Cleveland Cardiology Database results, we obtained a rating of 89.01 percent. In diagnosing heart disease, we also obtained sensitivity and descriptive values of 80.95 percent and 95.91 percent, respectively [11].

Heart failure, the rarest heart disorder, is (CHD). It can be hard to diagnose the most severe form of congenital heart disease in a child, congenital heart disease (CCHD). The introduction of CCHD testing using blood oxygen significantly improves detection rates in clinical conditions. In Morocco, we conducted an experimental study on early heart disease screening for newborns. The report, which included innocent children released between March 2019 and January 2020, was carried out at the Mohammed VI University Hospital maternity ward in Morocco. The procedure was performed on 8013 / 10,451 (76.7 percent) asymptomatic neonates. 7998 cases (99.82 percent) passed the screening test, according to the algorithm, including one inconclusive test that was replicated an hour ago and was ordinary. Fifteen newborns (0.18 percent) missed the screening test: five CCHDs, five false positives, and five non-critical CHDs. At 2 months of age, one true rejection case was identified. Proposed findings enable us to improve CCHD screening by incorporating pulse oximetry into the common treatment panel for newborn babies [12, 13].

Computational intelligence techniques like fuzzy system [14, 15], artificial neural network [16], swarm intelligence [17] and evolutionary computing [18] like genetic algorithm [19, 20], DE, Island GA [21], Island DE [22, 23], classifier [24], and SVM [25] are strong candidate solutions in the field of smart city [26], wireless communication, and so on.

3. METHODLOGY

An appropriate machine learning technique was chosen from some factor analysis model in MATLAB. To monitor the presence of a broad data source or to evaluate the probability of having cardiovascular disease. Using Lab-view software, a continuous glucose tracking device architecture then is suggested. In the data acquisition layer, the data collection has its roots, which exist as crude information. The raw data is then passed on to another layer, which is called the preprocessing layer. The raw data goes through the handling, merging, and normalization in the pre-processing layer. The portable standard was employed to exclude irregularities from the data which is done in the previous layers termed as a pre-processing layer and the application layer, two more layers, namely; prediction layer and performance evaluation layer, are used to perform which are shown in figure 1.

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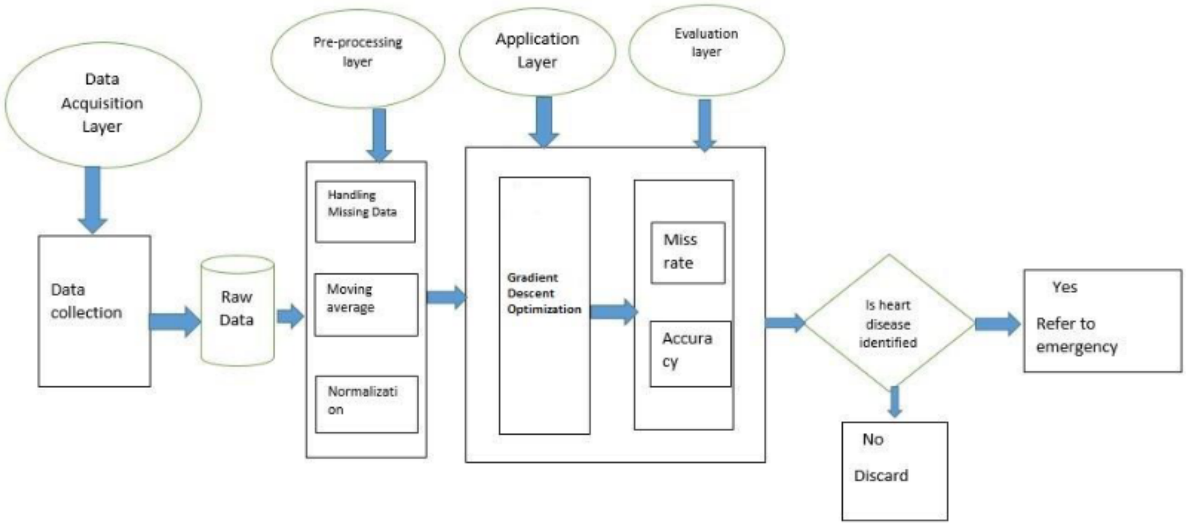

The current project aims to develop a decision-making support system for the detection of heart disease using the best accuracy and efficiency data mining technique between naive Bayes, SVM, simple linear regression, random forest, and Artificial neural network (ANN), etc. By using many variables of the cardiovascular system, the risk of being affected by heart disease can be calculated. Comparative study of selected machine learning algorithms has been shown to extract the algorithm with the greatest precision in the detection and prediction of heart disease. The medical parameters are taken as feedback by this algorithm and show the likelihood of being affected by heart disease as output. The framework includes the system and design of a web-based android device to detect heart disease using an effective machine learning technique. It might represent a very powerful tool for diagnosing heart disease for doctors, patients, and medical students. For the prognosis of fatal biological illnesses and conditions such as heart attack, 24 hours of patient health monitoring after transfer from acute care is required. The patient can insert the meeting targets of cardiovascular disease from anywhere on the online application using this application and view the risk profile of obtaining cardiovascular disease. Throughout the psychiatrist's diagnosed report, all variables that are not legitimate will be obtainable although there are some variables such as the type of chest pain and activity angina that must be continuously personality either by the physician and entered manually on the online application. If the application detects any fatal situation, the patient can communicate via video call with any physician, and any able to register physician related to heart disease can be found by placing his contact information in the search field. For a feed-forward neural network, a gradient descent optimization is being used to train the single hidden layer. In comparison, the gradient descent optimization spontaneously enabled different learning methods such as back-propagation input weights. In iterative mode, GDO changes output weights, and input weights remain the same. GDO can learn efficiently and rapidly. The GDO methodology features several hidden layers feed-forward machine learning, such as z hidden layer neurons and Z records training dataset(¥m, €m).

For the mathematical GDO, Eq. (01) presents the input layer, and Eq. (02) represents the output of the first layer:

$$m_i = h_1 + \sum_{j=1}^{n} (\beta_{ji} * z_j)$$

$$\gamma_i = \frac{1}{1+e^{-m_i}}, \text{where } i = 1, 2, 3 \ldots, z. \quad (02)$$

The following is the feedforward propagation for the second layer to the output layer in Eq. (03):

$$m_{lk} = h^n + \sum_{i=1}^{m} (x_{ik} * \gamma_i) \quad (03)$$

The activation feature of the output layer is indicated in Eq. (04):

$$\gamma_l{}^n = \frac{1}{1 + e^{-m_l^{n-1}}} \quad \text{where } l = 2, 3 \ldots z, \quad (04)$$

$$m_l = h^n + \sum_{i=1}^{m} (x_{jk} * \gamma_i) \ \text{Where } n = 1, 2, 3 \ldots \ldots k. \quad (05)$$

The error in backpropagation is written as follows in Eq. (06):

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$$Er = \frac{1}{2}\sum_{l}(\text{expected}_l - \text{calculated}_l)^2,$$

The proposed model has been implemented in the Mat-lab 2019 tool. There are 303 samples in the dataset that are Classified via the algorithm of GDO. The model is evaluated using different statistical parameters containing accuracy and miss rate.

These parameters can be expressed as:

$$Accuracy = \frac{true\ positive + false\ negative}{total\ instances} \quad (07)$$

$$Miss\ rate = \frac{true\ negative + false\ positive}{total\ instances} \quad (08)$$

The SD-CVD- GDO approach was used, and the outcomes acquired can be found in tables 4.1 and 4.2. Training accuracy of the proposed GDO system with hidden layers during the prediction of CVD diagnosis in training is shown in table 4.1. As can be seen from the table, we take 70% of the information (303 samples) for training from the dataset. The proposed model has two anticipated yields not detect (0) and Detect (1). Not detect (0) results showed that the patient not has CVD disease and Detect (1) results showed CVD disease. The total number of 303 information appears in table 4.1 which expected the

area in which the Sentiments Analysis on emojis is performed.

output of 120 not detect and 130 detect. In the wake of applying a training sample on 250 data samples, we get the result of 02 samples wrong detect and 128 samples of correct detect. In the wake of contrasting and expected output and result that got after applying the proposed methodology, it tends to appear in Table 1. The consequence of our proposed methodology amid training is 95.20% accurate and the miss rate is 4.8%. In this proposed technique, we get 120 not detect output while the normal output is 10 not detect samples and 110 detect samples.

In the validation phase accuracy of the proposed SD-CVD-GDO system during the prediction of CVD diagnosis in the validation phase is shown in table 2. As can be seen from the table, we take 94.45% of the information (53 samples) for validation from the dataset. Two anticipated results do not detect (0) and detect (1). Not detect (0) results showed that the patient not has CVD disease and detect (1) results showed the patient have CVD disease. In table 2 it appears on 53 information tests, the proposed model has expected the output of 29 correctly detected samples and 01 wrongly predicted samples. The expected output of 23 correctly not detected samples are 21 and wrongly predicted samples are 02. In this study, observed that GDO testing accuracy is higher than others, either the maximum or the average and the best values of GDO testing accuracy are higher than another system model. Mat-lab devices are used to clone the result as shown in figure 3 which represents training accuracy and miss rate, validation is calculated.

Table 1 Decision matrix of Proposed SD-CVD-GDO Training phase

Inputs (N = 250) No. of Instances		**Output**	
Input	130 Positive	128	02
	120 Negative	10	110

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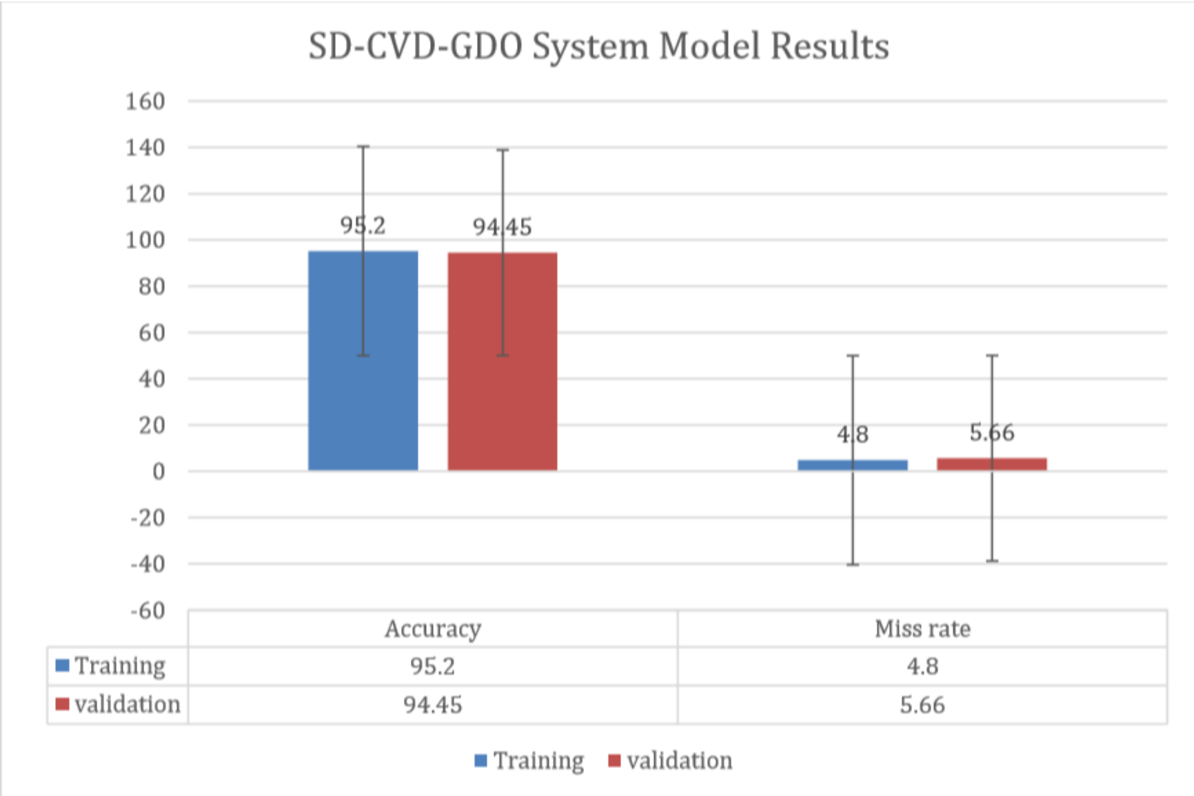
Table 2 Decision matrix of Proposed SD-CVD-GDO validation phase

Inputs (N = 53) No. of Instances		Output	
Input	30 Positive	29	01
	23 Negative	02	21



4. CONCLUSION

Diagnosing heart disease that affects the lives of millions of people is one of the most significant applications of machine learning systems. Large quantities of data are produced by the medical sector that doctors cannot crack and use effectively. In addition, GDO is effective in solving complex medical tasks or using datasets to create insights. In a wide variety of medical problems such as diagnosis, likelihood, and intervention, gradient descent optimization has emerged as a more reliable and efficient technology. Gradient descent optimization is a method of representation learning consisting of layers that transform the data, thus revealing hierarchical relationships and structures. The benefits and limitations of applying cardiovascular disease using GDO, which are also generally applicable in medicine, while proposing certain guidelines as the most feasible for clinical use. The GDO is used in this work to model heart disease from real-time datasets. Compared to other Leven- berg Marquardt models, Bayesian regularization, and scaled conjugate gradient methods, the proposed work provides better performance with effective precision. The proposed GDO model outcomes indicate that in assessing heart disease, this architecture has around 95.20% Accuracy on training and 94.45% on the validation phase which is better than existing approaches.

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https://doi.org/10.54692/lgurjcsit.2022.06003334

REFERENCE

[1] World Health Organization. (2016). World health statistics 2016: monitoring health for the SDGs sustainable development goals. World Health Organization.

[2] Selzer, R. H., Mack, W. J., Lee, P. L., Kwong-Fu, H., & Hodis, H. N. (2001). Improved common carotid elasticity and intima-media thickness measurements from computer analysis of sequential ultrasound frames. Atherosclerosis, 154(1), 185-193.

[3] Zebardast, B., Rashidi, R., Hasanpour, T., & Gharehchopogh, F. S. (2014). Artificial neural network models for diagnosing heart disease: a brief review. International Journal of Academic Research, 6(3), 73-78.

[4] Kannel, W. B., & McGee, D. L. (1979). Diabetes and cardiovascular disease: the Framingham study. Jama, 241(19), 2035-2038.

[5] Blaizot, A., Vergnes, J. N., Nuwwareh, S., Amar, J., & Sixou, M. (2009). Periodontal diseases and cardiovascular events: meta-analysis of observational studies. International dental journal, 59(4), 197-209.

[6] Nilashi, M., Ahmadi, H., Manaf, A. A., Rashid, T. A., Samad, S., Shahmoradi, L., & Akbari, E. (2020). Coronary heart disease diagnosis through self-organizing map and fuzzy support vector machine with incremental updates. International Journal of Fuzzy Systems, 1-13.

[7] Slitine, N. E. I., Bennaoui, F., Sable, C. A., Martin, G. R., Hom, L. A., Fadel, A., & Maoulainine, F. M. R. (2020). Pulse oximetry and congenital heart disease screening: Results of the first pilot study in Morocco. International journal of neonatal screening, 6(3).

[8] Van Pham, H. (2020). A proposal of expert system using deep learning neural networks and fuzzy rules for diagnosing heart disease. In Frontiers in intelligent computing: theory and applications (pp. 189-198). Springer, Singapore.

[9] Reddy, G. T., Reddy, M. P. K., Lakshmanna, K., Rajput, D. S., Kaluri, R., & Srivastava, G. (2020). Hybrid genetic algorithm and a fuzzy logic classifier for heart disease diagnosis. Evolutionary Intelligence, 13(2), 185-196.

[10] Arabasadi, Z., Alizadehsani, R., Roshanzamir, M., Moosaei, H., & Yarifard, A. A. (2017). Computer aided decision making for heart disease detection using hybrid neural network-Genetic algorithm. Computer methods and programs in biomedicine, 141, 19-26.

[11] Das, R., Turkoglu, I., & Sengur, A. (2009). Effective diagnosis of heart disease through neural networks ensembles. Expert systems with applications, 36(4), 7675-7680.

[12] Slitine, N. E. I., Bennaoui, F., Sable, C. A., Martin, G. R., Hom, L. A., Fadel, A., & Maoulainine, F. M. R. (2020). Pulse oximetry and congenital heart disease screening: Results of the first pilot study in Morocco. International journal of neonatal screening, 6(3).

[13] Siddiqui, S. Y., Athar, A., Khan, M. A., Abbas, S., Saeed, Y., Khan, M. F., & Hussain, M. (2020). Modelling, simulation and optimization of diagnosis cardiovascular disease using computational intelligence approaches. Journal of Medical Imaging and Health Informatics, 10(5), 1005-1022.

[14] S. Hussain, S. Abbas, T. Sohail, M. Adnan Khan, and A. Athar, "Estimating virtual trust of cognitive agents using multi layered socio-fuzzy inference system," Journal of Intelligent & Fuzzy Systems, vol. 37, no. 2, pp. 2769–2784, 2019.

[15] A. Fatima, M. A. Khan, S. Abbas, M. Waqas, L. Anum, and M. Asif, "Evaluation of planet factors of smart city through multi-layer fuzzy logic (MFL)," Ne ISC International Journal of Information Security, vol. 11, no. 3, pp. 51–58, 2019.

[16] S. Y. Siddiqui, S. A. Hussnain, A. H. Siddiqui et al., "Diagnosis of arthritis using adaptive hierarchical Mamdani fuzzy type-1 expert system," ICST Transactions on Scalable Information Systems, Article ID 161439, 2019.

[17] A. Atta, S. Abbas, M. A. Khan, G. Ahmed, and U. Farooq, "An adaptive approach: smart traffic congestion control system," Journal of King Saud University-Computer and Information Sciences, 2018.

[18] M. A. Khan, M. Umair, M. A. Saleem, M. N. Ali, and S. Abbas, "CDE using improved opposite based swarm optimization for MIMO systems," Journal of Intelligent & Fuzzy Systems, vol. 37, no. 1, pp. 687–692, 2019.

[19] M. A. Khan, M. Umair, and M. A. S. Choudhry, "GA based adaptive receiver for MC-CDMA system," Turkish Journal of Electrical Engineering & Computer Sciences, vol. 23, no. 1, pp. 2267–2277, 2015.

[20] M. A. Khan, M. Umair, and M. A. S. Choudry,

https://doi.org/10.54692/lgurjcsit.2022.06003334

"Island differential evolution based adaptive receiver for MC-CDMA system," in Proceedings of the 2015 International Conference on Information and Communication Technologies (ICICT), pp. 1–6, IEEE, Karachi, Pakistan, December 2015.
[21] M. N. Ali, M. A. Khan, M. Adeel, and M. Amir, "Genetic algorithm based adaptive receiver for MC-CDMA system with variation in mutation operator," International Journal of Computer Science and Information Security, vol. 14, no. 9, p. 296, 2016.
[22] M. Umair, M. A. Khan, and M. A. S. Choudry, "Island genetic algorithm based MUD for MC-CDMA system," in Proceedings of the 2015 International Conference on Information and Communication Technologies (ICICT), pp. 1–6, IEEE, Karachi, Pakistan, December 2015.
[23] M. Umair, M. A. Khan, and M. A. S. Choudry, "GA backing to STBC based MC-CDMA systems," in Proceedings of the 2013 4th International Conference on Intelligent Systems, Modelling and Simulation, pp. 503–506, IEEE, Bangkok,)ailand, January 2013.
[24] I. Kashif, A. K. Muhammad, A. Sagheer, H. Zahid, and F. Areej, "Intelligent transportation system (ITS) for smartcities using Mamdani fuzzy inference system," International Journal of Advanced Computer Science and Applications (IJACSA), vol. 9, no. 2, pp. 94–105, 2018.
[25] A. M. Alqudah, H. M. S. Algharib, A. M. S. Algharib, and H. M. S. Algharib, "Computer aided diagnosis system for automatic two stages classification of breast mass in digital mammogram images," Biomedical Engineering: Applications, Basis and Communications, vol. 31, no. 1, Article ID 1950007, 2019.
[26] A. Alqudah and A. M. Alqudah, "Sliding window based support vector machine system for classification of breast cancer using histopathological microscopic images," IETE Journal of Research, pp. 1–9, 2019. [50] H. Wang, Z. Zhang, and T. Taleb, "Editorial: special issue on security and privacy of IoT," World Wide Web, vol. 21, no. 1, pp. 1–6, 2018.