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ANALYSIS FOR THE PREDICTION OF THYROID DISEASE BY USING ICA AND OPTIMAL KERNEL SVM APPROACH

I. Kalaimani
Assistant Professor
Mahendra Engineering College for Women
Kumaramangalam, India.
kalai.ilangovan@gmail.com

Abstract

Thyroid Disease diagnosis is one of the exceptionally niggling and savage assignments since it needs loads of understanding and information. In the proposed work need to take 29 attributes and a few features are chosen with the assistance of Independent Component Analysis (ICA). It is handling step which helps in decreasing the dimensionality and along these lines expanding the accuracy and performance. ICA extracts the useful data from the database and named them as independent components. For computing, this feature vector the classification approach is used to classify the data as hypothyroid or hyperthyroid or some other else. In this system, Support Vector Machine (SVM) with multi-kernel is used as a classifier to distinguish the thyroid disease. Along these lines, the data are classified in effective way give precise data by using inspired optimization algorithm. These methodologies enable the user to can foresee and test their health with the symptoms. The proposed model will give high classification accuracy with less number of features contrast with other existing created model. The proposed model is implemented in the working stage of MATLAB.

Keywords: Thyroid disease; Classification; SVM; ICA;

1. Introduction

The thyroid is a relentless and complex infection happened in light of classless TSH (Thyroid Simulating Hormone) levels or may be brought on by the problems in thyroid organ itself. The thyroid gland is inclined to a few exceptionally unmistakable issues, some of which are to a great degree basic [1]. The thyroid hormones, Thyroxin (T4) and Triiodothyronine (T3) are tyrosine-based hormones created by the thyroid gland basically in charge of control of metabolism. The numbers 3 and 4 insinuate a number of particles of iodine in the hormones. Right when thyroid over produces and extremely secretes hormones, this condition is hyperthyroidism (overactive thyroid). The opposite circumstance when hormones are deficiently made and released is hypothyroidism (under powerful Thyroid) [2]. The signs of hypothyroid are melancholy, fatigue of body quality, tiredness, blockage, abundance weight, spasms, dry skin, sexual disarranges and fruitlessness. On the off chance that the expanded measure of thyroid hormones found in the blood, the body capacities will accelerate [6-8]. This condition is called hyperthyroidism. The side effects of hyperthyroid are apprehension, palpitation, depleted body quality, tremors, loss of weight, loose bowels, menstrual turmoil, and exophthalmia.

Thyroid Disease diagnosis is one of the exceptionally niggling and savage assignments since it needs loads of understanding and information [3]. On the off chance that this infection is distinguished in before organize; at that point, doctor can give appropriate treatment to the patients. The customary routes for conclusion thyroid sickness are specialist's examination or various blood tests. With early analysis and treatment, thyroid hormone substitution is a sheltered and successful treatment that can deal with one's side effects and counteract confusions [5]. These days, one of the fundamental issues to make challenges in medicine sciences by creating innovation is the disease diagnosis with high exactness. In this decade numerous cutting edge strategies and computational framework have been developed keeping in mind the end goal to encourage their operations [4].

2. Objectives

The targets of the proposal are given as takes after: To foresee the thyroid disease in light of their sorts with the assistance of ICA and Multi-kernel SVM classification strategies with high accuracy [16-20].

- To exhibit the classification of more critical components from the accessible dataset, this encourages the doctor to touch base at an exact diagnosis of Thyroid among the public [21-25].
- To find the optimal performance measurements, for example, accuracy, sensitivity, and specificity by utilizing inspired optimization systems [26-30].

3. Review of the status of research

Thyroid diseases are a standout amongst the most widely recognized endocrine disorders around the world. India as well, is no exemption. Thyroid disease influences 6.6% of the overall public. As indicated by a projection from different examinations on thyroid disease, it has been assessed that 42 million individuals in India experience the ill effects of thyroid diseases [7]. The investigation depends on in-house information gathered from more than 33 lakh adults criticize India from 2014-2016 and uncovered that around 32 percent of the Indian populace is experiencing different sorts of thyroid disorders. The issue was more common in women than men [8]. Around 26 percent of the women analyzed were found to have irregular TSH levels contrasted with 24 percent of the men. The commonness of hyperthyroidism is 0.5-2% in women and 0.1-0.2% in men, while hypothyroidism happens in 0.06-1.2% in women and 0.1-0.4% in men [9-10].

The commonness of thyroid disorders in the adult populace of Northeast Germany was checked by *Rehman Mehmood Khattak et al. 2016*. In the examination they explored the impacts of long haul IDD anticipation by looking at the pervasiveness of thyroid disorders in the vicinity of 2000 and 2010 (7 and 17 years after the start of the iodine stronghold program, individually) in view of populace based information. They showed a reduction in the pervasiveness of goiter in men and an expansion in middle serum TSH levels. Conversely, the pervasiveness of thyroid knobs expanded, yet this could in all likelihood be clarified by the better determination of the thyroid ultrasound gadget in SHIPTREND than in SHIP-0. The German health interview and examination reviewed for adults (DEGS 2008–2011) uncovered an uncommon reduction (61µg/L) in iodine discharge levels, looking at the outcomes (117µg/L) to the already led German health meeting and examination overview for youngsters and teenagers (KiGGS 2003–2006).

(Matteo Angelo Cannizzaro et al. 2016) had dissected the occurrence and clinical introduction of the thyroid diseases among the youthful and elderly populace in Italy. They chose 1362 patients who experienced thyroidectomy for various thyroid diseases from January 2008 to December 2014. The patients were separated into two gatherings, as per the age. The patients matured 65 years and over were incorporated into the gathering A, and the patients less than 65 years old years were incorporated into the gathering B. The examination demonstrated that in the elderly individuals have a diminished discharge and utilization of thyroid hormones. The symptomatology in the elderly is nonspecific and can make a postponement in the right diagnosis.

(Hee-Yeon Jung et al. 2014) had investigated the patients on support Peritoneal Dialysis (PD) were selected from a planned multicenter companion consider in Korea; their serum triiodothyronine, fT4, and thyroid-animating hormone levels were measured 12 months alienated. Patients with inimitable thyroid infection and that getting thyroid hormone replacement treatment were avoided from the examination. Among 235 PD patients, 31 (13.2%) deaths happened amid the mean follow-up time of 24 months. Infection (38.7%) was the most well-known reason for death. Lower basal fT4 levels were a free indicator of all-cause and infection-related passing (risk proportion [HR]=2.74, 95% certainty interim [CI] 1.27–5.90, P=0.01, and HR=6.33, 95% CI 1.16–34.64, P=0.03, separately). Longitudinally, patients with steadily bring down fT4 levels amid the 12-month time frame had fundamentally higher all-cause mortality than those with industriously more elevated amounts (HR=3.30, 95% CI 1.15–9.41, P=0.03).

Thyroid diseases are among the most well-known endocrine diseases in India. However information on the predominance of thyroid diseases in India is generally inadequate. North India detailed most extreme instances of hypothyroidism while the south and west zones announced instances of hyperthyroidism and its variations, according to the review done by SRL Diagnostics. While one out of ten adults in India experiences hypothyroidism, a current review led by Indian Thyroid Society portrays mindfulness for the illness positioned ninth when contrasted with other regular ailments.

(Deokar et al. 2016) had researched that the extent of different thyroid disorders in subjects going to a tertiary care center. This investigation was a review doctor's facility based examination, done from June 2014 – November 2014 (6 months) including 2076 subjects (250 guys and 1826 females) with doubt of thyroid issue who were subjected to thyroid capacity test. The most elevated number was in the 20-29 age gathering (34.29 %) and least number of the 60-69 age gatherings (5.1%). Out of 2076 with suspected thyroid issue, 77.84% (n=1616; 1442 F and 250 M) were classified as euthyroid. This examination recommended that the pervasiveness of thyroid disorders in this investigation populace is high and hypothyroidism is more typical than hyperthyroidism.

(Remya James et al. 2012) had studied two examination groups around Kerala in the pervasiveness of thyroid diseases. One investigation amass was from Ernakulam city and the other from Cherthala town. A sum of 1000 subjects (grown-ups) was reviewed. The investigations uncovered 53% and 37% of the aggregate studied subjects of Ernakulam and Cherthala are influenced by thyroid infection separately. The greater part of the subjects with thyroid infection in both the investigation group is following non-veggie food propensity. A large portion of them were diabetics, 28.30% of Ernakulam city and 40.54% of Cherthala town. In both the examination gatherings, a great many people were following homeopathic drug, the following being allopathy. Hardly any subjects were following ayurvedic medication.

(Ambika Gopalakrishnan Unnikrishnan et al. 2017) had announced the nationwide predominance of thyroid disorders, especially hypothyroidism, in adults dwelling in different urban communities that speak to various geological areas of India. Hypothyroidism was observed to be a typical type of thyroid brokenness influencing 10.9% of the examination populace. The commonness of undetected hypothyroidism was 3.47% i.e., just about 33% of the hypothyroid patients (186 out of 587) were analyzed interestingly over the span of study-related screening. A sum of 36 (0.67%, 95% CI, 0.45-0.89) members including 21 females (0.72%) were determined to have hyperthyroidism. There was no affiliation (P 0.05) amongst hyperthyroidism and age or sexual orientation. Subclinical hyperthyroidism was seen in 68 (1.27%, 95% CI, 0.96-1.56) patients. The rise of Kolkata as the most noticeably awful influenced city was unforeseen; especially as the city was set up to be iodine loaded over 10 years back. Gangetic bowl in West

Bengal, the commonness of hypothyroidism in 3814 subjects from all age groups was significantly higher (29%).

4. Methodology

4.1 Database Collection

The data which is required for this examination is the thyroid dataset .This dataset has been downloaded from the University of California at Irvine (UCI) machine learning repository to exhibit the strategy. Attribute can be Boolean or continuous esteemed. Thyroid information comprise of both hypothyroid and hyperthyroid data. In this data set contains 7547 records in which there are absolutely 30 attributes. In our exploration work we have taken just 29 characteristics which will be utilized to classify the data [26-30].

4.2 Attribute Selection

Attribute selection is the way of expelling the repetitive attributes that are regarded superfluous to the data mining task [31-34]. The goal of attribute selection is along these lines to look for a commendable arrangement of attributes that create practically identical classification results to the situation when every one of the attributes is utilized [35-38]. Moreover, a littler arrangement of attributes additionally makes less confounded patterns, which are effortlessly conceivable, and even envisioned by humans [39-42].

Disease diagnosis assumes a noteworthy part and it is imperative for the restorative field. For the most part disease diagnosis is finished by and relies on specialist's understanding and information [43-48]. Diagnosis depends on signs, side effects and physical examination of the patient. As of late, Thyroid illness is one such sickness and expectation of which is a troublesome angle without a computer innovation [49-52]. On the off chance that this disease is distinguished in before the stage, at that point doctor can give legitimate treatment to the patients [55-58]. Data Mining is assuming an essential part in anticipating numerous diseases. Classification is one the most noteworthy Technique in Data Mining. Data Mining Technique is

for the most part utilized as a part of healthcare associations for basic leadership, diagnosing the ailment and giving better treatment to the patients [60-63].

4.3 Proposed Work

In our technique, the work is prepared in view of three phases: Pre-Processing, Feature selection, classification. The pre-preparing step is the vital stride as the data in the database contain excess and noisy data so by examination of data, it can perform data cleaning, data integration top off missing esteems, the expulsion of repetitive data because taking care of missing value and excess data would prompt off base output [64-68]. This will prompt brilliant outcomes and lessened expenses for data mining [69-79]. The subsequent investigation might be utilized as a direct classifier or, all the more ordinarily, for dimensionality reduction before classification. In this work need to take 29 attributes and a few features are chosen with the assistance of Independent Component Analysis (ICA). It is handling step which helps in decreasing the dimensionality and along these lines expanding the accuracy and performance. ICA extracts the useful data from the database and named them as independent components. For computing, this feature vector the classification approach is used to classify the data as hypothyroid or hyperthyroid or some other else. In this system, Support Vector Machine (SVM) with multi-kernel is used as a classifier to distinguish the thyroid disease. Along these lines, the data are classified in effective way give precise data by using inspired optimization algorithm. These methodologies enable the user to can foresee and test their health with the symptoms. The proposed model will give high classification accuracy with less number of features contrast with other existing created model. The proposed model is implemented in the working stage of MATLAB.

5. Conclusion

The present examination will investigate the thyroid disease prediction with the assistance of data mining methods and classification strategies. These advancements will anticipate the disease with performance metrics i.e. accuracy, sensitivity, and specificity contrasted with existing philosophies. The classification systems can order the thyroid diseases according to the sorts with high accuracy. It will help the specialists for the expectation of thyroid disease prior and this will be diminished the death rate and hazard life.

References

[1] Shaik Razia and Narasinga Rao, "Machine Learning Techniques for Thyroid Disease Diagnosis - A Review", Indian Journal of Science and Technology, Vol.9, No.28, pp.1-9, 2016.

[2] Nain Woo, Su-Kang Kim, Seong Ho Kang, "Multi-immunoreaction-based dual-color capillary electrophoresis for enhanced diagnostic reliability of thyroid gland disease", Journal of Chromatography, Vol.1509, pp.153-162, 2017.

[3] Yoichi Hayashi, "Synergy effects between grafting and subdivision in Re-RX with J48graft for the diagnosis of thyroid disease", Journal of Knowledge-basedSystems, pp.1-13, 2017.

[4] Hedda L. Köhling, Sue F. Plummer, Julian R. Marchesi, Kelly S. Davidge, Marian Ludgate, "The microbiota and autoimmunity: Their role in thyroid autoimmune diseases", Journal of Clinical Immunology, pp.1-48, 2017.

[5] Prasad · T. Srinivasa Rao, Surendra Prasad Babu, "Thyroid disease diagnosis via hybrid architecture composing rough data sets theory and machine learning algorithms", Journal of soft computing, Vol.20, No.3, pp.1179-1189, 2016.

[6] Nazari Kousarrizi, F.Seiti, and M. Teshnehlab, "An Experimental Comparative Study on Thyroid Disease Diagnosis Based on Feature Subset Selection and Classification ", International Journal of Electrical & Computer Sciences IJECS-IJENS, Vol. 12 No: 01, pp.13-19, 2012.

[7] Rasitha Banu, "Predicting Thyroid Disease using Linear Discriminant Analysis (LDA) Data Mining Technique", Journal of Communications on Applied Electronics, Vol.4, No.12, pp.4-7, 2016.

[8] DEEPTHI GURRAM AND NARASINGA RAO, "MODELING ON THYROID DIAGNOSIS USING MACHINE LEARNING APPROACHES – A REVIEW", International Journal of Pharma and Bio Sciences, Vol.7, No.2, pp.679-686, 2016.

[9] Prerana, Parveen Sehgal, "Comparative Study of GD, LM and SCG Method of Neural Network for Thyroid Disease Diagnosis", International Journal of Applied Research, Vol.1, No. 10, pp.34-39, 2015.

[10] GEETHA, CAPT. S. SANTHOSH BABOO, "EFFICIENT THYROID DISEASE CLASSIFICATION USING DIFFERENTIAL EVOLUTION WITH SVM ", Journal of Theoretical and Applied Information Technology, Vol.88, No.3, pp.410-422, 2016.

[11] Rehman Mehmood Khattak, Till Ittermann, Matthias Nauck, Harald Below and Henry Völzke, "Monitoring the prevalence of thyroid disorders in the adult population of Northeast Germany", Article: Population Health Metrics, pp.1-11, 2016.

[12] Matteo Angelo Cannizzaro,Antonino Buffone, Salvatore Lo Bianco, Valeriya Okatyeva, Dario Cavallaro, Valerio Caruso, Pietro Caglià, "The thyroid disease in the elderly: our experience", Journal of surgery, pp.1-7, 2015.

[13] Hee-Yeon Jung, Jang-Hee Cho, Hye Min Jang, Yon Su Kim, Shin-Wook Kang, "Free Thyroxine Level as an Independent Predictor of Infection-Related Mortality in Patients on Peritoneal Dialysis: A Prospective Multicenter Cohort Study", Article of PLoS one, pp.1-16, 2014.

[14] Deokar, Nagdeote, Lanje, and Basutkar, "Prevalence of Thyroid Disorders in a Tertiary Care Center", Journal of current research, Vol.8, No.9, pp.26-31, 2016.

[15] Remya James and Vineeth Kumar, "Study on the Prevalence of Thyroid Diseases in Ernakulam City and Cherthala Town of Kerala State, India", International Journal of Scientific and Research Publications, Vol.2, No.2, pp.1-3, 2012.

[16] M. MUTHUKUMAR, Dr.T. RAVICHANDRAN," Enhanced Database Compression and Decompression Techniques for Performance Improvement", 2013, State Level Seminar on "EMERGING TRENDS AND ISSUES", Kongu Arts and Science Collegs. ERODE

[17] K.Karthikeyan M Muthukumar, Senthil Pandian, "Analyzing and Improving the Performance of Decision Database with Enhanced Momentous Data Types", Asia Journal of Information Technology, Volume: 16, Issue.9, Page(s): 699-705, 2017.

[18] Lakshmanaprabu, S. K., Shankar, K., Ilayaraja, M., Nasir, A. W., Vijayakumar, V., & Chilamkurti, N. (2019). Random forest for big data classification in the internet of things using optimal features. International Journal of Machine Learning and Cybernetics, 1-10. https://doi.org/10.1007/s13042-018-00916-z

[19] H. R. Boveiri, M. Elhoseny, A-COA: an adaptive cuckoo optimization algorithm for continuous and combinatorial optimization, Neural Computing and Applications, (2018). https://doi.org/10.1007/s00521-018-3928-9

[20] Haidi Rao, Xianzhang Shi, Ahoussou Kouassi Rodrigue, Juanjuan Feng, Yingchun Xia, Mohamed Elhoseny, Xiaohui Yuan, Lichuan Gu. Feature selection based on artificial bee colony and gradient boosting decision tree. Applied Soft Computing, 2018. https://doi.org/10.1016/j.asoc.2018.10.036

[21] Shankar, K., Lakshmanaprabu, S. K., Gupta, D., Khanna, A., & de Albuquerque, V. H. C. Adaptive optimal multi key based encryption for digital image security. Concurrency and Computation: Practice and Experience, e5122. https://doi.org/10.1002/cpe.5122

[22] Murugesan, M., & Ravichandran, T. (2012). Performance Enhancement Evaluation in Database Decompression Using HIRAC Algorithm. International Journal of Computer Science Issues (IJCSI), 9(6), 35.

[23] Elhoseny, M., Shankar, K., Lakshmanaprabu, S. K., Maseleno, A., & Arunkumar, N. (2018). Hybrid optimization with cryptography encryption for medical image security in Internet of Things. Neural Computing and Applications, 1-15. https://doi.org/10.1007/s00521-018-3801-x

[24] Ambika Gopalakrishnan Unnikrishnan, Sanjay Kalra, Rakesh Kumar Sahay, Ganapathi Bantwal, Mathew John, Neeraj Tewari, "Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India", Indian Journal of Endocrinology and Metabolism, Vol.17, No.4, pp.647-653, 2017.

[25] Uthayakumar, J., Metawa, N., Shankar, K., & Lakshmanaprabu, S. K. (2018). Intelligent hybrid model for financial crisis prediction using machine learning techniques. Information Systems and e-Business Management, 1-29. https://doi.org/10.1007/s10257-018-0388-9

[26] Shankar, K., & Eswaran, P. (2015). ECC based image encryption scheme with aid of optimization technique using differential evolution algorithm. Int J Appl Eng Res, 10(55), 1841-5.

[27] Lydia, E. L., Kumar, P. K., Shankar, K., Lakshmanaprabu, S. K., Vidhyavathi, R. M., & Maseleno, A. (2018). Charismatic Document Clustering Through Novel K-Means Non-negative Matrix Factorization (KNMF) Algorithm Using Key Phrase Extraction. International Journal of Parallel Programming, 1-19.

[28] Shankar, K., Lakshmanaprabu, S. K., Gupta, D., Maseleno, A., & de Albuquerque, V. H. C. (2018). Optimal feature-based multi-kernel SVM approach for thyroid disease classification. The Journal of Supercomputing, 1-16.

[29] Dr.Muthukumar Murugesan, Dr. K. Karthikeyan, Dr.K. Sivakumar, "Analyzing Integral Components of SQL Server Databases Muthukumar Murugesan", International Journal of Applied Engineering Research (IJAER), Volume: 10, Issue.9, Page(s): 24189-24200, 2015.

[30] Maseleno, A., Tang, A. Y., Mahmoud, M. A., Othman, M., & Shankar, K. (2018). Big Data and E-Learning in Education 4.0. INTERNATIONAL JOURNAL OF COMPUTER SCIENCE AND NETWORK SECURITY, 18(5), 171-174.

[31] Amin, M. M., Maseleno, A., Shankar, K., Perumal, E., Vidhyavathi, R. M., & Lakshmanaprabu, S. K. (2018). Active Database System Approach and Rule Based in the Development of Academic Information System. International Journal of Engineering & Technology, 7(2.26), 95-101.

[32] Aminudin, N., Sundari, E., Shankar, K., Deepalakshmi, P., Fauzi, R. I., & Maseleno, A. (2018). Weighted Product and Its Application to Measure Employee Performance. International Journal of Engineering & Technology, 7(2.26), 102-108.

[33] Irviani, R., & Muslihudin, M. (2018). Nur algorithm on data encryption and decryption. International Journal of Engineering & Technology, 7(2.26), 109-118.

[34] Putra, D. A., Jasmi, K. A., Basiron, B., Huda, M., Maseleno, A., Shankar, K., & Aminudin, N. (2018). Tactical Steps for E-Government Development. International Journal of Pure and Applied Mathematics, 119(15), 2251-2258.

[35] Uthayakumar, J., Metawa, N., Shankar, K., & Lakshmanaprabu, S. K. (2018). Financial crisis prediction model using ant colony optimization. International Journal of Information Management. https://doi.org/10.1016/j.ijinfomgt.2018.12.001

[36] Muthukumar, M., & Ravichandran, T. (2012). Optimizing and enhancing parallel multi storage backup compression for real-time database systems. International Journal of Computer Technology and Applications, 3(4).

[37] Sugiyarti, E., Jasmi, K. A., Basiron, B., Huda, M., Shankar, K., & Maseleno, A. (2018). Decision support system of scholarship grantee selection using data mining. International Journal of Pure and Applied Mathematics, 119(15), 2239-2249.

[38] Susilowati, T., Jasmi, K. A., Basiron, B., Huda, M., Shankar, K., Maseleno, A., & Julia, A.(2018). Determination of Scholarship Recipients Using Simple Additive Weighting Method. International Journal of Pure and Applied Mathematics, 119(15), 2231-2238.

[39] Lydia, E. L., Shankar, K., Ilayaraja, M., & Kumar, K. S. Technological Solutions for Health Care Protection and Services Through Internet Of Things (IoT). International Journal of Pure and Applied Mathematics, 118(7), 277-283.

[40] Noura Metawaa, M. Kabir Hassana, and Mohamed Elhoseny. Genetic algorithm based model for optimizing bank lending decisions. Expert Systems with Applications, 2017, 80, pp, 75–82.

[41] Lydia, E. L., Shankar, K., Pamina, J., & Raja, J. B. Correlating NoSQL Databases With a Relational Database: Performance and Space. International Journal of Pure and Applied Mathematics, 118(7), 235-244.

[42] Muthukumar, M., & Ravichandran, T. Optimizing multi storage parallel backup for real time database systems. IJESAT, ISSN, 2250-3676.

[43] Tarek Gaber, Sarah Abdelwahab, Mohamed Elhoseny, Aboul Ella Hassanien, Trust-based secure clustering in WSN-based intelligent transportation systems, Computer Networks, (2018), 146, pp. 151-158.

[44] Muslihudin, M., Wanti, R., Hardono, N., Shankar, K., Ilayaraja, M., Maseleno, A., ... & Mukodimah, S. (2018). Prediction of Layer Chicken Disease using Fuzzy Analytical Hierarcy Process. International Journal of Engineering & Technology, 7(2.26), 90-94.

[45] K. Shankar and P.Eswaran. “A Secure Visual Secret Share (VSS) Creation Scheme in Visual Cryptography using Elliptic Curve Cryptography with Optimization Technique”. Australian Journal of Basic and Applied Sciences. Volume: 9, Issue.36, Page(s): 150-163, 2015.

[46] Ashraf Darwish, Aboul Ella Hassanien, Mohamed Elhoseny, Arun Kumar Sangaiah, Khan Muhammad, The Impact of the Hybrid Platform of Internet of Things and Cloud Computing on Healthcare Systems: Opportunities, Challenges, and Open Problems, Journal of Ambient Intelligence and Humanized Computing, (2017), pp.1-16. https://doi.org/10.1007/s12652-017-0659-1

[47] Mohamed Elhoseny, Ahmed Abdelaziz, Ahmed Salama, AM Riad, Arun Kumar Sangaiah, Khan Muhammad, A Hybrid Model of Internet of Things and Cloud

Computing to Manage Big Data in Health Services Applications, Future Generation Computer Systems, 86, (2018), pp.1383-1394.

[48] Shankar, K. (2017). Prediction of Most Risk Factors in Hepatitis Disease using Apriori Algorithm. RESEARCH JOURNAL OF PHARMACEUTICAL BIOLOGICAL AND CHEMICAL SCIENCES, 8(5), 477-484.

[49] I.S. Farahat, A.S. Tolba, Mohamed Elhoseny, Waleed Eladrosy, A secure real-time internet of medical smart things (IOMST), Computers & Electrical Engineering, (2018), 72, pp. 455-467.

[50] Mohamed Elhoseny, Gustavo Ramírez-González, Osama M. Abu-Elnasr, Shihab A. Shawkat, Arunkumar N, Ahmed Farouk, Secure Medical Data Transmission Model for IoT-based Healthcare Systems, IEEE Access, (2018), 6, pp. 20596 - 20608.

[51] Karthikeyan, K., Sunder, R., Shankar, K., Lakshmanaprabu, S. K., Vijayakumar, V., Elhoseny, M., & Manogaran, G. (2018). Energy consumption analysis of Virtual Machine migration in cloud using hybrid swarm optimization (ABC–BA). The Journal of Supercomputing, 1-17.

[52] Lakshmanaprabu, S. K., Shankar, K., Khanna, A., Gupta, D., Rodrigues, J. J., Pinheiro, P. R., & De Albuquerque, V. H. C. (2018). Effective Features to Classify Big Data Using Social Internet of Things. IEEE Access, 6, 24196-24204.

[53] Mohamed Elhoseny, Xiaohui Yuan, Hamdy K El-Minir, and AM Riad, " Extending self-organizing network availability using genetic algorithm", In 2014 International Conference on Computing, Communication and Networking Technologies (ICCCNT), (2014),pp, 11-13.

[54] Hamid Reza Boveiri, Raouf Khayami, Mohamed Elhoseny, M. Gunasekaran. An efficient Swarm-Intelligence approach for task scheduling in cloud-based internet of things applications, Journal of Ambient Intelligence and Humanized Computing, 2018. https://doi.org/10.1007/s12652-018-1071-1

[55] Shankar, K., Elhoseny, M., Lakshmanaprabu, S. K., Ilayaraja, M., Vidhyavathi, R. M., Elsoud, M. A., & Alkhambashi, M. (2018). Optimal feature level fusion based ANFIS classifier for brain MRI image classification. Concurrency Computat Pract Exper, e4887.

[56] Mohamed Elhoseny, Noura Metawa and Aboul Ella Hassanien, An automated information system to ensure quality in higher education institutions, Proceedings of

12th International Computer Engineering Conference (ICENCO), IEEE, 2016, pp, 196 - 201, https://doi.org/10.1109/ICENCO.2016.7856468

[57] Murugesan, M., & Ravichandran, T. (2013). Evaluate database compression performance and parallel backup. International Journal of Database Management Systems, 5(4), 17.

[58] Mohamed Elhoseny, Noura Metawa, Ashraf Darwish, and Aboul Ella Hassanien, Intelligent Information System to Ensure Quality in Higher Education Institutions, Towards an Automated E-University, International Journal of Computational Intelligence Studies, (2017), 6(2/3), pp. 115-149.

[59] Gupta, D., Khanna, A., Shankar, K., Furtado, V., & Rodrigues, J. J. Efficient artificial fish swarm based clustering approach on mobility aware energy-efficient for MANET. Transactions on Emerging Telecommunications Technologies, e3524. https://doi.org/10.1002/ett.3524 e3524

[60] Mohamed Elhoseny, K. Shankar, S. K. Lakshmanaprabu, Andino Maseleno, N. Arunkumar. Hybrid optimization with cryptography encryption for medical image security in Internet of Things. Neural Computing and Applications. 2018. https://doi.org/10.1007/s00521-018-3801-x

[61] Shankar, K., & Lakshmanaprabu, S. K. (2018). Optimal key based homomorphic encryption for color image security aid of ant lion optimization algorithm. International Journal of Engineering & Technology, 7(1.9), 22-27.

[62] Ahmed E Hassan, Mohamed E Ibrahim, Designing quality e-learning environments for higher education, Educational Research, 1(6):186-197, 2010.

[63] Mahmud Kandel, Ahmed E Hassan, Aziza S Asem, Mohamed E Ibrahim, UML Analysis for Quality Assurance Management System for Higher Education, International Journal of Engineering Science and Technology, (2010), 2(4), pp. 417-432.

[64] Lakshmanaprabu, S. K., Mohanty, S. N., Shankar, K., Arunkumar, N., & Ramirez, G. (2019). Optimal deep learning model for classification of lung cancer on CT images. Future Generation Computer Systems, 92, 374-382.

[65] Ahmed Abdelaziza, Mohamed Elhoseny, Ahmed S. Salama, A.M. Riad, A Machine Learning Model for Improving Healthcare services on Cloud Computing Environment, Measurement, (2018), 119, pp. 117-128.

[66] Murugesan, C., & Ravichandran, T. (2013). Real time database compression optimization using iterative length compression algorithm. In Int. Conf. on Computer Science and Information Technology, USA (pp. 99-105).

[67] Shankar, K., Elhoseny, M., Chelvi, E. D., Lakshmanaprabu, S. K., & Wu, W. (2018). An Efficient Optimal Key Based Chaos Function for Medical Image Security. IEEE Access, 6, 77145-77154.

[68] Alaa Tharwat, Mohamed Elhoseny, AboulElla Hassanien, Thomas Gabel, and N. Arun kumar Intelligent Beziér Curve-based Path Planning Model Using Chaotic Particle Swarm Optimization Algorithm, Cluster Computing, (2018), pp. 1-22. https://doi.org/10.1007/s10586-018-2360-3

[69] Avudaiappan, T., Balasubramanian, R., Pandiyan, S. S., Saravanan, M., Lakshmanaprabu, S. K., & Shankar, K. (2018). Medical image security using dual encryption with oppositional based optimization algorithm. Journal of medical systems, 42(11), 208.

[70] El-Shorbagy MA, Elhoseny M, Hassanien AE, Ahmed SH. A novel PSO algorithm for dynamic wireless sensor network multiobjective optimization problem. Transactions on Emerging Telecommunications Technologies. (2018);e3523. https://doi.org/10.1002/ett.3523

[71] Mohamed Elhoseny, Khaled Elleithy, Hamdi Elminir, Xiaohui Yuan, and Alaa Riad. Dynamic Clustering of Heterogeneous Wireless Sensor Networks using a Genetic Algorithm, Towards Balancing Energy Exhaustion. International Journal of Scientific & Engineering Research, (2015), 6(8), pp, 1243-1252.

[72] Singhal, N., Sinha, P., Agarwal, N., & Murugesan, M. (2011). U.S. Patent Application No. 12/819,774.

[73] Shankar, K., Elhoseny, M., Kumar, R. S., Lakshmanaprabu, S. K., & Yuan, X. (2018). Secret image sharing scheme with encrypted shadow images using optimal homomorphic encryption technique. Journal of Ambient Intelligence and Humanized Computing, 1-13. https://doi.org/10.1007/s12652-018-1161-0

[74] Muthukumar Murugesan, D. K. K. (2016). Business intelligence market trends and growth in enterprise business. International Journal on Recent and Innovation Trends in Computing and Communication, 4(3), 188-192.

[75] Lakshmanaprabu, S. K., Shankar, K., Gupta, D., Khanna, A., Rodrigues, J. J., Pinheiro, P. R., & de Albuquerque, V. H. C. (2018). Ranking analysis for online customer reviews of products using opinion mining with clustering. Complexity, 2018.

[76] Xiaohui Yuan, Daniel Li, Deepankar Mohapatra, Mohamed Elhoseny. Automatic removal of complex shadows from indoor videos using transfer learning and dynamic thresholding. Computers and Electrical Engineering, 2017, 70, pp, 813-825.

[77] Farahat I.S., Tolba A.S., Elhoseny M., Eladrosy W. Data Security and Challenges in Smart Cities. In: Hassanien A., Elhoseny M., Ahmed S., Singh A. (eds) Security in Smart Cities: Models, Applications, and Challenges. Lecture Notes in Intelligent Transportation and Infrastructure. Springer, Cham, 2019. https://doi.org/10.1007/978-3-030-01560-2_6

[78] Murugesan, M., Karthikeyan, K., & Sivakumar, K. (2015). Novel investigation methodologies to identify the SQL server query performance. Indian Journal of Science and Technology, 8(27).

[79] Maseleno, A., Tang, A. Y., Mahmoud, M. A., Othman, M., Negoro, S. Y., Boukri, S.,& Muslihudin, M. The Application of Decision Support System by Using Fuzzy Saw Method in Determining the Feasibility of Electrical Installations in Customer's House. International Journal of Pure and Applied Mathematics, 119(16).

[80] Raja, J. Beschi, S. Chenthur Pandian, and J. Pamina. "Certificate revocation mechanism in mobile ADHOC grid architecture." Int. J. Comput. Sci. Trends Technol 5 (2017): 125-130.

[81] Lydia, E. Laxmi, K. Shankar, J. Pamina, and J. Beschi Raja. "Correlating NoSQL Databases With a Relational Database: Performance and Space." International Journal of Pure and Applied Mathematics 118, no. 7: 235-244.

[82] Raja, J. Beschi, and K. Vivek Rabinson. "Iaas for Private and Public Cloud using Openstack." International Journal of Engineering 5.04 (2016).

[83] Raja, J. Beschi, and V. Vetriselvi. "Mobile Ad Hoc Grid Architecture Based On Mobility of Nodes." International Journal of Innovative Research in Computer and Communication Engineering 2 (2014): 49-55.

[84] Deepa, V., A. Jenifa, and J. Pamina. "APPROACHES BASED ON DATA MINING IN NATURAL LANGUAGE PROCESSING." International Journal Of Emerging Technology And Innovative Engineering 4.2 (2018).

[85] Sree, GM Apurva, S. Ashika, S. Karthi, V. Sathesh, M. Shankar, and J. Pamina. "CHURN PREDICTION IN TELECOM USING CLASSIFICATION ALGORITHMS." International Journal of Emerging Technology and Innovative Engineering 5.2 (2019).

[86] Raja, Beschi & Jeyakumar, Pamina & Panchapakesan, Madhavan & Kumar, Sampath. (2018). MARKET BEHAVIOR ANALYSIS USING DESCRIPTIVE APPROACH. International Journal of Pure and Applied Mathematics. 118. 171-176.

[87] J.Pamina, J.Beschi Raja. “SURVEY ON DEEP LEARNING ALGORITHMS”. International Journal of Emerging Technology and Innovative Engineering 5.1 (2019).

[88] V Akhila, M Krithikaa, A.K Pavithra, K.G Adhipathy, J. Pamina."ANALYSING THE BEHAVIOUR OF CUSTOMERS TO PREDICT CHURN IN TELECOM SECTOR." International Journal of Emerging Technology and Innovative Engineering 5.2 (2019).