

Brain Tumor Detection Using Image Processing Technique from MRI Images Based on OTSU Algorithm

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Abstract: A brain Tumor is the formation of abnormal cells within the group of a layer of the brain. One out of twenty people with brain tumors loses their lives due to the tumor's failed detection. Well-trained physicians can spot these tumors through a series of examinations and MRI scans. However, some artifacts in the scan mislead them and misread the scan result. The project's main purpose is to find the brain tumors precisely despite the artifacts. The MRI (Magnetic Resonance Imaging) scan images of different patients at different stages are used to detect tumors. Another methodology propelled by edge division and morphological activity has been utilized to distinguish the suspicious region of tumors in exact. These techniques with different image processing methodologies include noise removal, filtering, segmentation, bounding box, tumor alone, tumor outline and detection. The brain tumor can be detected, and finding the tumor from an MRI scan is accomplished using MATLAB software.

Keywords: Brain Tumor, MRI, OTSU Threshold Segmentation

I. INTRODUCTION

A brain tumor is a cluster of abnormal mass of cells in the brain tissue that grows uncontrollably, seemingly unchecked by the mechanisms that control normal cells. It is the most complicated in our body. [1]-[3] The brain is encapsulated by the skull surrounding, which is making rigid. Symptoms are frequent headaches and migraines. An essential cerebrum tumor starts in our brain. Numerous essential cerebrum tumors are benign. An auxiliary cerebrum tumor, a metastatic brain tumor, happens when disease cells spread to our cerebrum from another organ, like the lung or breast. Brain tumors are frequently referred to as cancerous, also termed malignant or noncancerous, termed as benign cells in the brain. Brain tumor patients need to diagnosis at an early stage so that there is a chance to cure the brain tumor, but diagnosing more patients leads to difficulty.

This study evaluates and develops a technique to process MRI for brain tumors by using OTSU threshold segmentation. [4]-[5]. It is utilized to perform programmed image thresholding. The calculation returns a solitary power limit. Edge is different into two classes, frontal area and foundation. We convert a picture from grayscale into a binary image. [10]-[15] The processes of identifying brain tumors through MRI images can be categorized in preprocessing, image segmentation and image classification. It is done by using the MATLAB tool. [6]-[9]

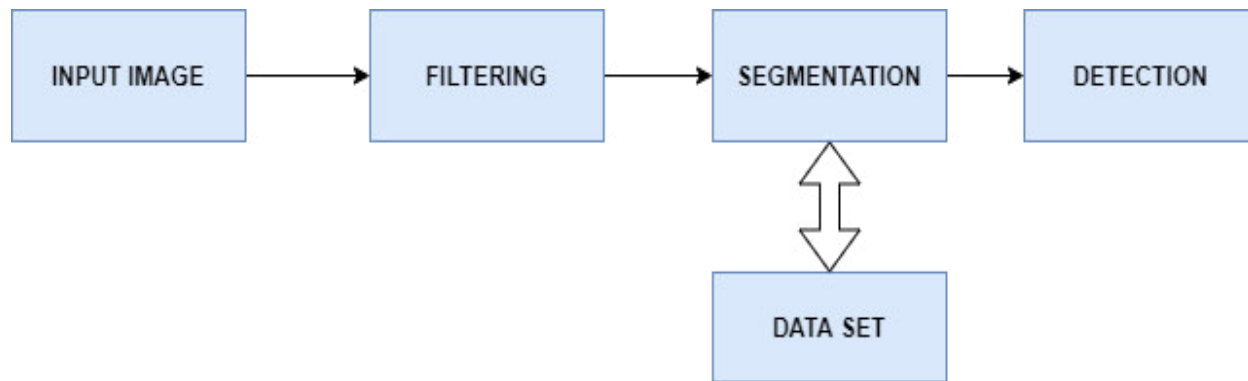


Fig. 1. Block Diagram of Brain Tumor Detection

This (Figure 1) block diagram represents the steps and procedure of brain tumor detection.

II. LITERATURE SURVEY

Pankag et al. [12], in their research, mathematical morphology play a vital role in providing a proper approach to maintain and analyze the images and signals. They have used this approach in many applications, such as object segmentation noise suppression [16]-[22].

Shahriar et al. [13] this study focus on an automated approach that enhances the initial stage to minimize the variation in greyscale color [23]-[27]. For better segmentation, unwanted noises are removed using filter operation [28].

Harmandeep et al. [14], in this research paper, the watershed algorithm has been used to compare the result and mat lab software was used to implement the algorithm [29]-[34]. However, the watershed algorithm detects benign tumors but not malignant tumors [35]-[38].

Kavitha et al. [17] approach an effective modified region technique for brain tumor detection. They have stated that this modified region growing includes orientation constraints in adding to intensity constraints [39]-[43]. A comparative study has been carried out between normal and modified region growing and proved that modified region growing achieves better results [44].

Sandeep Patel et al. [18] this research paper proposes a method that incorporates with preprocessing of MRI (Magnetic Resonance Imaging) images based on multiple Otsu thresholding and morphological operation [45]-[51]. A user-friendly GUI (Graphical User Interface) design has also been developed in their research for accurate detection and dimension of tumor identification [56].

Mohammed et al. [19] this research experimented with the effectiveness of geo-metrical and fusing texture in MRI for tumor classification [57]-[62]. The fast nonlocal mean method has been used to enhance the tumor region, and Otsu has been used for segmentation. Multiple features are acquired and merged into single-dimensional vectors for detection and found the features fusion method had a better result than individual features [63]-[67].

III. PROPOSED WORK

In this research work, the brain tumor has been detected using OTSU Threshold Segmentation [68]. The first process will be preprocessing the image, where the MRI (Magnetic Resonance Imaging) will be given as input. This sample image has been taken from various patients at various stages [69]-[70]. Since the MRI input image contains RGB (Red Blue Green), the RGB image will be converted into a grey image by using the greyscale algorithm. Then the brain image will be filtered by high pass filter, medium pass filter and Low pass filter [71]-[75]. Then OTSU Threshold segmentation will separate the image as foreground and background image, and then the image is converted into pixels [76]. After the conversion, it checks with binary value if the value is 1, the brain tumor has been detected. If the image value is 0, the brain tumor has not been detected. Then the morphological operation will happen, Where the erosion will remove pixels on object boundaries in brain images [77]-[81]. If brain MRI images are free from brain tumor means or brain tumor not detected means, it displays as brain tumor not found. The next process is the bounding box [82-95]. The brain tumor detected image would be shown in the rectangle box. The next process is tumor outline; the detected tumor will be shown as an image. The detected brain tumor will be indicated in the brightest color [96-111]. This detection and extraction process is done by using the MATLAB tool [112].

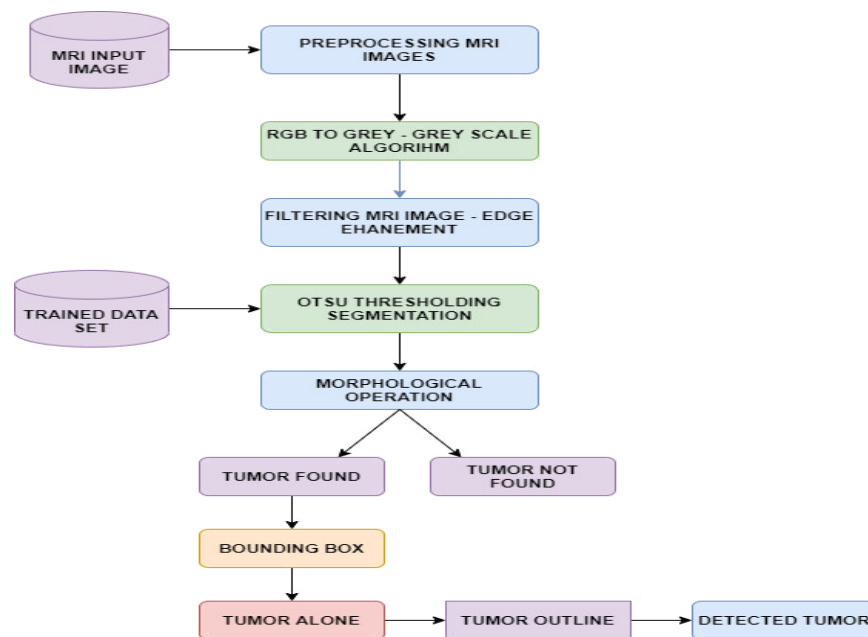


Fig. 2. Architecture Diagram of Brain Tumor Detection

This (figure 2) represents the procedure to detect the brain tumor from MRI.

Preprocessing Image

This is the initial step of image processing. It is utilized to help in improving the parameter of MRI images [113-119]. The input of MRI images can be a color image or a black and white image [120-129]. The parameter incorporates signal-to-noise ratio, enhancement in visual appearance of MR image, the evacuation of insignificant noise and foundation of undesired part, smoothing region of internal part, maintain significant edges [130-141]. In this process, the RGB images will be converted into greyscale images. Hence it is easy to find the tumor in the MRI scan image [142-159].

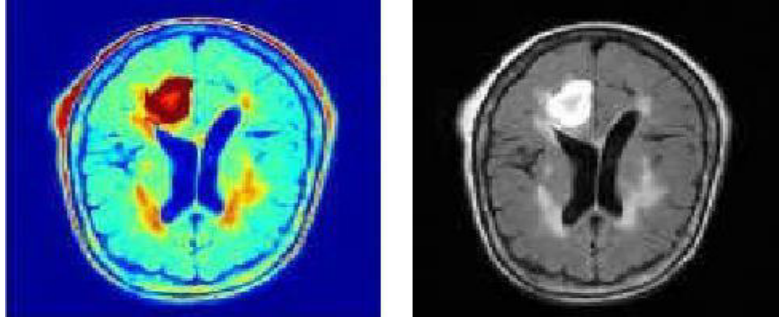


Fig. 3. RGB Image to Greyscale Image

This (figure 3) represents that the RGB (Red Blue Green) image has been converted into a greyscale image [160-171].

Filtered Image

In this process, the image gets filtered by removing the noise and the skull striping and making smoothing, sharpening, and edge enhancement [172-185].

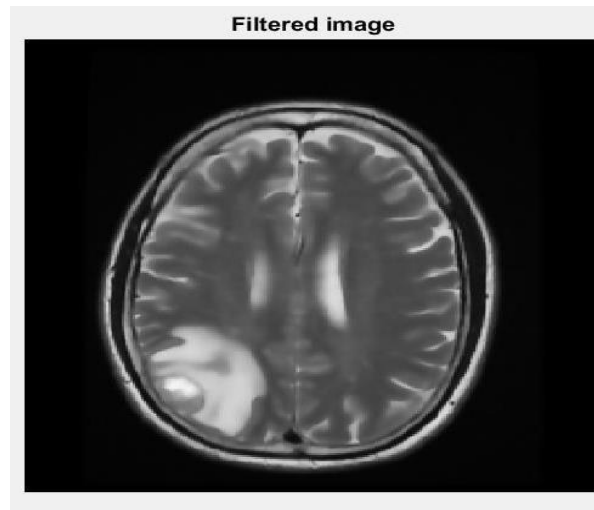


Fig. 4. Filtered Brain Tumor Image of MRI Images

This (figure 4) represents the filtered brain image that has been filtered so that the brain tumor can be viewed with accuracy.

OTSU Thresholding Segmentation Algorithm

STEP1: Functions of inputs and output

STEP2: Histogram is a 256*256 2D method of the histogram of the grayscale value and the average grayscale image value of the pair [186-191].

STEP 3: Total is the value of number pairs present in the given image. It is found by the value of a number of the 2D- method histogram bins at each direction [192-198].

ALGORITHM

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sout=imresize(inp,[256,256]);
t0=60;
th=t0+((max(inp(:))+min(inp(:)))/2); for
i=1:1:size(inp,1)
    for j=1:1:size(inp,2)
        if inp(i,j)>th
            sout(i,j)=1;
        else
            sout(i,j)=0;
        end
    end
end
end

```

This algorithm will return an image of thresholding intensity which separates pixels into two forms such as foreground images and background images. Image pixel can be divided as minimum and maximum. It checks with the condition as the intensity of the input image is greater than the threshold value than the brain tumors detected. If the intensity of input is lesser than the threshold value, then the brain tumors not found.

IV. Segmentation Accuracy

Table 1. Segmentation Accuracy of Existing Method and Proposed Method

Algorithm	MRI1	MRI2	MRI3	MRI4	MRI5
OTSU	94.85	94.55	91.89	96.21	93.6
AC	83.45	79.98	83.67	87.23	83.56
FCM	87.54	75.34	85.97	86.54	75.52

Whereas

MRI – Magnetic Resonance Imaging

AC – Active Contour

FCM- Fuzzy C-means

Table 2. Sensitivity Accuracy of Existing Method and Proposed Method

Algorithm	MRI1	MRI2	MRI3	MRI4	MRI5
OTSU	83.57	83.89	83.43	87.21	90.36
AC	79.45	74.9	73.89	73.76	86.45
FCM	77.54	88.91	82.27	78.92	72.32

This graph indicates the experimental effects of the proposed algorithm in distinguishing different brain tissues and the differentiation with various techniques. The MRI IMAGES of the BRAIN are downloaded from the Brain Web data set. Around 20 images are used for testing the proposed algorithm (tables 1 and 2). However, the consequences of 10 photos are supplied within the paper. The encouraged segmentation method is evaluated using the measures segmentation accuracy and sensitivity.

Bounding Box

In advanced image handling, the bounding box is just the directions of the line that completely encases a computerized image when it's put over a page, a material, a screen or other comparative bi-dimensional background. In this process, the tumor is detected, and it indicates by the rectangular bounded form

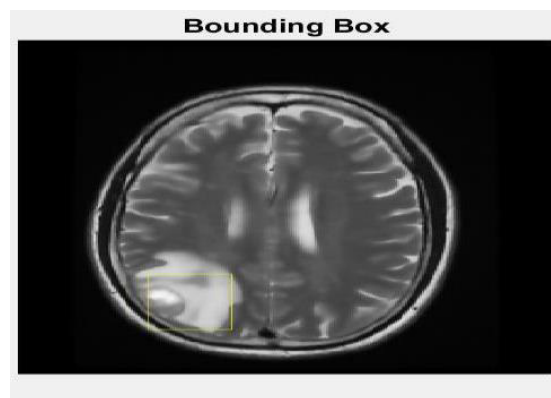


Fig. 5. Bounding Box of Brain Tumor Image

This (figure 5) represents the bounded rectangle in the brain tumor image, which has been found and marked as a rectangular box.

Tumor Outline

In this process, the tumor alone is indicated by eliminating the other part of the images; by analyzing this process, the tumor can be easily seen in the images.

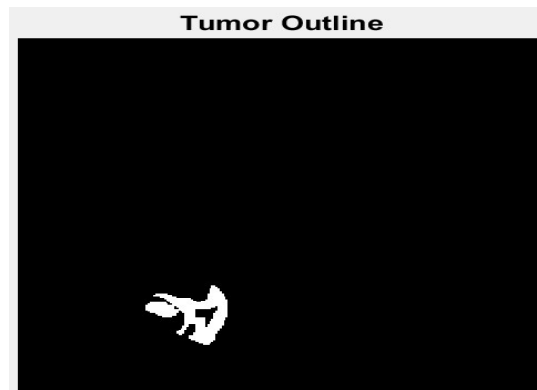


Fig. 6. Brain Tumor Outline

This (figure 6) represents the brain tumor image of outline displayed only the detected tumor outline.

Detected Tumor

Finally, the brain tumor is detected and indicated by the brightest color. If the test person is free from the tumor, the result shows as the tumor was not found.

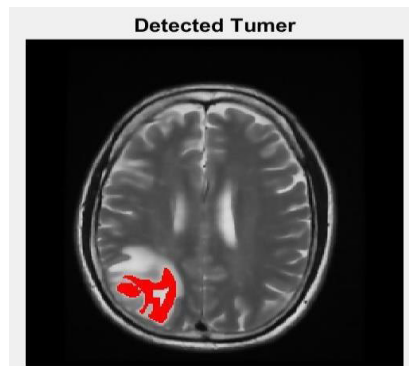


Fig. 7. Brain Tumor Detection

This (figure 7) represents the brain tumor detection in the brightest color to easily identify the affected part.

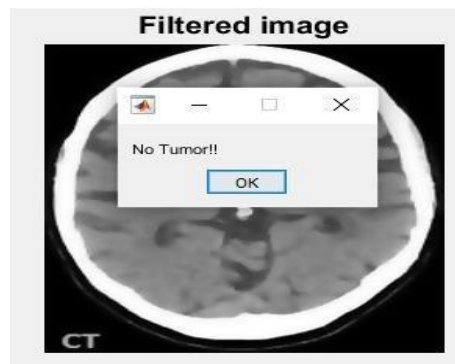


Fig. 8. Brain Tumor Is Not Found

This (figure 8) represents the brain image of the tumor is not found; the MRI image of the patient is free from a brain tumor, so it is displayed as not found.

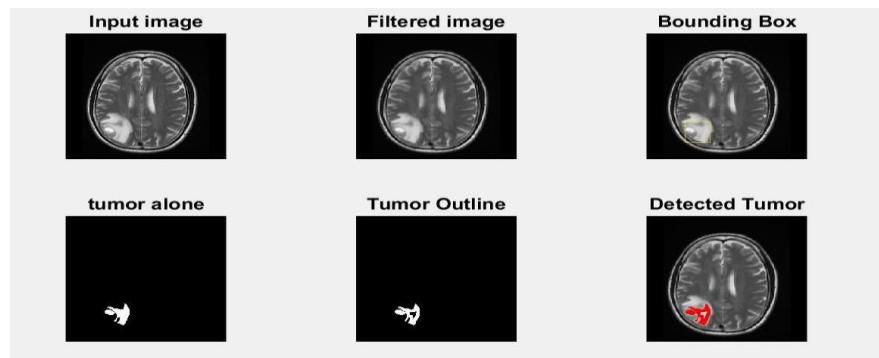


Fig. 9. Detection and Extraction of Brain Tumor

This (figure 9) represent each process of extraction and detection of brain tumor

V. CONCLUSION

In this paper, we have detected the brain tumor by following the process of preprocessing, converting RGB to grey image, filtering and segmentation. The MRI images of different patients at different stages dissect the brain tumor. By analyzing the MRI (Magnetic Resonance Imaging) images of the brain, we detected the tumor using OTSU Threshold Segmentation Algorithm by following the procedure of preprocessing, RGB (Red Green Blue) to Grey conversion, Filtering, Bounding Box, Segmentation and Detection. There are two types of a brain tumor which are malignant (cancerous); this tumor may grow rapidly, and it spreads throughout the parts of the brain, so it is important to recognize the kinds of cerebrum tumor and favorable (non-dangerous) this tumor develops and harm the pieces of the cerebrum gradually. After detecting the brain tumor type, we can add the parameters to find them.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

REFERENCES

1. Arunkumar, N., et al. "Fully automatic model-based segmentation and classification approach for MRI brain tumor using artificial neural networks." *Concurrency and Computation: Practice and Experience* 32.1 (2020): e4962.
2. Borole, Vipin Y., Sunil S. Nimbhore, and Dr. Seema S. Kawthekar. "Image processing techniques for brain tumor detection: A review." *International Journal of Emerging Trends & Technology in Computer Science* 4 (2), (2015): 1-14.
3. Kapoor, Luxit, and Sanjeev Thakur. "A survey on brain tumor detection using image processing techniques." 2017 7th International Conference on Cloud Computing, Data Science & Engineering-

Confluence. IEEE, 2017.

4. Kaur, Harmandeep, and Manish Mittal. "Region based image segmentation for brain tumor detection." *International Journal of Engineering and Management Research (IJEMR)* 6.4 (2016): 31-34.
5. Kavitha, A. R., C. Chellamuthu, and Kavim Rupa. "An efficient approach for brain tumour detection based on modified region growing and neural network in MRI images." 2012 international conference on Computing, Electronics and Electrical Technologies (ICCEET). IEEE, 2012.
6. Saini, Pankaj Kr, and Mohinder Singh. "Brain tumor detection in medical imaging using MATLAB." *International Research Journal of Engineering and Technology* 2.02 (2015): 191-196.
7. Sazzad, TM Shahriar, et al. "Development of automated brain tumor identification using mri images." 2019 International Conference on Electrical, Computer and Communication Engineering (ECCE). IEEE, 2019.
8. Sharma, Anshika, Sushil Kumar, and Shailendra Narayan Singh. "Brain tumor segmentation using DE embedded OTSU method and neural network." *Multidimensional Systems and Signal Processing* 30.3 (2019): 1263-1291.
9. Vijay, Vasupradha, A. R. Kavitha, and S. Roselene Rebecca. "Automated brain tumor segmentation and detection in MRI using enhanced Darwinian particle swarm optimization (EDPSO)." *Procedia Computer Science* 92 (2016): 475-480.
10. Vijn, Surbhi, Shilpi Sharma, and Prashant Gaurav. "Brain tumor segmentation using OTSU embedded adaptive particle swarm optimization method and convolutional neural network." *Data visualization and knowledge engineering*. Springer, Cham, 2020. 171- 194.
11. S. K. Chakarvarti, V. Kumar and S. Kumar, "Galvanic-fabrication of CdS microstructures using nuclear track filter membranes," *Journal of materials science*, vol. 40, no.2, p. 503, 2005.
12. V. Kumar, S. Kumar and S. K. Chakarvarti, "Morphology and time resolved photoluminescence of electrochemically synthesized zinc oxide nanowires", *Journal of Materials Science: Materials in Electronics*, vol. 21, no. 12, p. 1277, 2010.
13. S. Kumar, V. Kumar, M. L. Sharma and S. K. Chakarvarti, "Electrochemical synthesis of metallic micro-rose having petals in nanometer dimensions", *Superlattices and Microstructures*, vol. 43, no.4, p. 324, 2008.
14. S. Kumar, V. Kumar, S. K. Sharma, and S. K. Chakarvarti, "Large scale synthesis of cadmium selenide nanowires using template synthesis technique and their characterization", *Superlattices and Microstructures*, vol.48, no.1, p. 66, 2010.
15. H. Singh, V. Kumar, H. C. Jeon, T. W. Kang and S Kumar, "Structural, optical and electrical properties of Ni doped ZnO nanostructures synthesized by solution combustion method", *Journal of Materials Science: Materials in Electronics*, vol. 29, no.2, p. 1327, 2018.
16. S. S. Bhogal, V. Kumar, S. S. Dhami and B. S. Pabla, "Preparation and properties of electrodeposited Ni-TiO₂ composite coating", *Journal of Electrochemical Science and Engineering*, vol. 5, no.1, p. 37, 2015.
17. V. Kumar, S. Kumar, S. Kumar and S. K. Chakarvarti, "Optical studies of electrochemically synthesized CdS nanowires", *Journal of Materials Science: Materials in Electronics*, vol. 22, no. 4, p. 335, 2011.
18. R. Garg, V. Kumar, D. Kumar and S. K. Chakarvarti, "Electrical transport through micro porous track etch membranes of same porosity", *Modern Physics Letters B*, vol. 26, no.31, p. 1250209, 2012.

19. V. Kumar and S. Kumar, "Synthesis and characterization of ZnO nanoparticles using combustion method", AIP Conference Proceedings vol. 1393, no.1, p. 331,2011.
20. S. Kumar, S. Taneja, S. Banyal, M. Singhal, V. Kumar, S. Sahare, S. L. Lee and R K Choubey, "Bio-synthesised Silver Nanoparticle-Conjugated l-Cysteine Ceiled Mn: ZnS Quantum Dots for Eco-friendly Biosensor and Antimicrobial Applications", Journal of Electronic Materials vol. 50 , no.7, p. 3986, 2021.
21. H. Singh and V. Kumar, "Effect of Ni doping on the photovoltaic conversion efficiency of ZnO nanostructured dye sensitized solar cells", International Journal of Scientific Research in Physics and Applied Sciences, vol. 6, no.3, p. 50, 2018.
22. V. Kumar, S. Arora, S. Kumar, T. W. Kang and H. C. Jeon, "Annealing led conversion from polypyrrole to carbon nitride nanowires and the fabrication of highly efficient ammonia sensing device", Journal of Materials Science: Materials in Electronics, vol. 28, no.23, p. 17791, 2017.
23. S. Neha and V. Kumar, "Microstrip Patch Antenna with cross-slot for UHF RFID Handheld Reader Applications", International Journal of Electrical & Electronics Engineering, vol. 1, no.4, p. 30, 2014.
24. V. Kumar, R. Singh and S. K. Chakarvarti, "Novel electroless template based synthesis of silver microtubules and their characterization", Digest Journal of Nanomaterials and Biostructures, vol. 2, no. 1, p. 163, 2007.
25. S. Tomar, S. Gupta, S. Mukherjee, A. Singh, S. Kumar, V. Kumar and R. K. Choubey, "Optical properties of Silica capped Mn doped ZnS quantum dots", Physica Scripta, vol. 96, no. 6, p. 065802, 2021.
26. V. Kumar, D. Raj, S. K. Chakarvarti, R. K. Choubey and S. Kumar, "Solvothermal growth of ultrathin nonporous nickel oxide nanosheets for ethanol sensing", Journal of Materials Science: Materials in Electronics, vol. 32, no.1, p. 818, 2021.
27. V. Kumar, H. Singh and S. Kumar, "Synthesis and characterization of ZnO nanostructured film for optoelectronic applications", AIP Conference Proceedings vol. 1661, no.1, p. 080010, 2015.
28. K. Kumari, V. Kumar and K. Singh, "Non-lithographic fabrication of Ni-Se heterojunction nanowires and their electrical characterization", Advances in Research, vol. 2, no.6, pp. 332, 2014
29. Roy, V., Shukla, P. K., Gupta, A. K., Goel, V., Shukla, P. K., & Shukla, S. (2021). Taxonomy on EEG Artifacts Removal Methods, Issues, and Healthcare Applications. Journal of Organizational and End User Computing (JOEUC), 33(1), 19-46.
30. Shukla Prashant Kumar, Sandhu Jasminder Kaur, Ahirwar Anamika, Ghai Deepika, Maheshwary Priti, Shukla Piyush Kumar (2021). Multiobjective Genetic Algorithm and Convolutional Neural Network Based COVID-19 Identification in Chest X-Ray Images, Mathematical Problems in Engineering, vol. 2021, Article ID 7804540, 9 pages.
31. Rathore, N.K., Jain, N.K., Shukla, P.K. et al (2021). Image Forgery Detection Using Singular Value Decomposition with Some Attacks. Natl. Acad. Sci. Lett. 44, 331–338.
32. Stalin Shalini, Roy Vandana, Shukla Prashant Kumar, Zaguia Atef, Khan Mohammad Monirujjaman, Shukla Piyush Kumar, Jain Anurag (2021). A Machine Learning-Based Big EEG Data Artifact Detection and Wavelet-Based Removal: An Empirical Approach, Mathematical Problems in Engineering, vol. 2021, Article ID 2942808, 11 pages.
33. Shukla Piyush Kumar, Roy Vandana, Shukla Prashant Kumar, Chaturvedi Anoop Kumar, Saxena Aumreesh Kumar, Maheshwari Manish, Pal Parashu Ram (2021). An Advanced EEG Motion

- Artifacts Eradication Algorithm, *The Computer Journal*, bxab170,
34. Pandit Shraddha, Shukla Piyush Kumar, Tiwari Akhilesh, Shukla Prashant Kumar, Maheshwari Manish, Dubey Rachana (2020). Review of video compression techniques based on fractal transform function and swarm intelligence. *International Journal of Modern Physics B*, Vol. 34, No. 08, 2050061 (2020).
 35. Joshi Shubham, Stalin Shalini, Shukla Prashant Kumar, Shukla Piyush Kumar, Bhatt Ruby, Bhadoria Rajan Singh, Tiwari Basant (2021). Unified Authentication and Access Control for Future Mobile Communication-Based Lightweight IoT Systems Using Blockchain. *Wireless Communications and Mobile Computing*, vol. 2021, Article ID 8621230, 12.
 36. Sathya M., Jeyaselvi M., Krishnasamy Lalitha, Hazzazi Mohammad Mazyad, Shukla Prashant Kumar, Shukla Piyush Kumar, Nuagah Stephen Jeswinde (2021). A Novel, Efficient, and Secure Anomaly Detection Technique Using DWU-ODBN for IoT-Enabled Multimedia Communication Systems. *Wireless Communications and Mobile Computing*, vol. 2021, Article ID 4989410, 12.
 37. Shukla Prashant Kumar, Shukla Piyush Kumar, Bhatele Mukta, Chaturvedi Anoop Kumar, Sharma Poonam, Rizvi Murtaza Abbas, Pathak Yadunath (2021). A Novel Machine Learning Model to Predict the Staying Time of International Migrants. *International Journal on Artificial Intelligence Tools*, Vol. 30, No. 02, 2150002 (2021).
 38. Janarthanan Ramadoss, Maheshwari Uma, Shukla Prashant Kumar, Shukla Piyush Kumar, Mirjalili Seyedali, Kumar Manoj (2021). Intelligent Detection of the PV Faults Based on Artificial Neural Network and Type 2 Fuzzy Systems. *Energies* 2021, 14(20), 6584,
 39. Khambra Geetanjali, Shukla Prashant (2021). Novel machine learning applications on fly ash based concrete: An overview. *Materials Today: Proceedings*, July 2021, 2214-7853,
 40. Shukla, P. K., Sharma, L., Bhatele, K. R., Sharma, P., & Shukla, P. (2015). Design, Architecture, and Security Issues in Wireless Sensor Networks. In K. Lakhtaria (Ed.), *Next Generation Wireless Network Security and Privacy* (pp. 211-237). IGI Global.
 41. Ahirwar, D., Shukla, P. K., Bhatele, K. R., Shukla, P., & Goyal, S. (2015). Intrusion Detection and Tolerance in Next Generation Wireless Network. In K. Lakhtaria (Ed.), *Next Generation Wireless Network Security and Privacy* (pp. 313-335). IGI Global.
 42. N. Jayashri and K. Kalaiselvi, "Cloud Cryptography for Cloud Data Analytics in IOT", in *Machine Learning Approach For Cloud Data Analytics In IOT*, Sachi Nandan Mohanty, Jyotir Moy Chatterjee, Monika Mangla, Suneeta Satpathy, and Sirisha Potluri, Eds. Scrivener publishing:(wiley publications), p. 119-142, 2021.
 43. K. Kalaiselvi and N. Jayashri, "A Pragmatic Knowledge Engineering approach for integrating Knowledge Management with Ubiquitous Computing", *Journal of Advanced Research in Dynamical & Control Systems*, vol. 13, p. 440-444, 2017.
 44. Raja Adeel Ahmed, Kaliyaperumal Karthikeyan, Mungamuru Nirmala and Sreedhar Appalabatl., "The Hallucination of Autonomic Computing without Swapping Contemporary Information Technology Atmosphere", *International Journal of Engineering Research and Industrial Applications*, Vol.4, No. I (2011),pp.411-422.
 45. Kaliyaperumal Karthikeyan, Balu Srinivasulu, Mungamuru Nirmala, Sreedhar Appalabatl., "Key Technologies and Frameworks of 4th Generation Mobile Communication System", *International Journal of Multidisciplinary Research and Advances in Engineering*, Vol 3 , No II, (2011), pp 237-250.

46. Manickkam Sathiyamoorthy, M.Senthil Kumar, Kuppusamy Balakannan, Kaliyaperumal Karthikeyan ,” International Journal of Multidisciplinary Research and Advances in Engineering, “Reduction of total dissolved solids (TDS) in textile dye effluent by biological process”, Vol.3, No: 1, (2011), pp. 309-321.
47. Manickkam Sathiyamoorthy, Thanappan Subash, M.Senthil Kumar, Kuppusamy Balakannan, Kaliyaperumal Karthikeyan,” International Journal of Engineering Research and Industrial Applications, “Utilization of waste rubber tires as an additional ingredients of concrete mixtures”, Vol. 4, No: I, (2011), pp.335-350.
48. Sreedhar Appalabatl, Kaliyaperumal Karthikeyan, Mungamuru Nirmala, “A Tailor Made Process for Monitoring and Controlling the Pc-To-Pc Communication”., International Journal of Research and Reviews in Computer Science, Vol 2, No 2, (2011), pp 431-436
49. Mungamuru Nirmala, Kaliyaperumal Karthikeyan, Sreedhar Appalabatl, Raja Adeel Ahmed., “Image Interpretation Based On Similarity Measures of Visual Content Descriptors – An insight”, International Journal of Computer Science and Emerging Technologies, Vol 2, Issue 2, (2011), pp 242-248.
50. Kaliyaperumal Karthikeyan ,V.Umadevi Chezhian, Thanappan Subash ,” International Journal of Computer Science and Emerging Technologies, “Comparison of Two Proactive Protocols: OLSR and TBRPF Using the RNS (Relay Node Set) Framework”, E-Vol.2, Issue 2, [2011], pp.no:324-329
51. Srinivasan Kannan, Kaliyaperumal Karthikeyan, Kannan Pushpalatha,” International Journal of Engineering Research and Industrial Applications, “A Proposed Network for the College Information Resource Centers in Bhutan”, Vol.4, No. II (2011), pp 229-238.
52. Kaliyaperumal Karthikeyan, Balu Srinivasulu,” International Journal of Research and Reviews in Computer Science, “Overview of the Method and Process of Nano Technology Development Systems”, Vol.2, No.II, [2011], pp.no:4436.
53. A.Balasuadhakar, Kaliyaperumal Karthikeyan, S.K.Manju Bargavi,” International Journal of Computer Science & Emerging Technologies “Computer Aided Measuring Instrument using Resistor as a Transducer”, Vol.2, No: 5 [2011], pp.no:264-269.
54. Żywiołek, J.; Rosak-Szyrocka, J.; Jereb, B. Barriers to Knowledge Sharing in the Field of Information Security. *Management Systems in Production Engineering* 2021, 29, 114–119, doi:10.2478/mspe-2021-0015.
55. Żywiołek, J.; Rosak-Szyrocka, J.; Mrowiec, M., Knowledge Management in Households about Energy Saving as Part of the Awareness of Sustainable Development. In: *Energies* 2021, 14 (24), S. 8207.
56. Żywiołek, J.; Schiavone, F. Perception of the Quality of Smart City Solutions as a Sense of Residents’ Safety. *Energies* 2021, 14, 5511.
57. Żywiołek, J.; Schiavone, F. The Value of data sets in Information and Knowledge Management as a Threat to Information Security, Garcia-Perez, Alexeis; Simkin, Lyndon (red.). *European Conference on Knowledge Management;2021*, pp 882–891.
58. Żywiołek, J.; Nedeliakova, E. Analysis of the information security system when ordering furniture online: Sustainability of Forest-Based Industries in the Global Economy (red.) JELACIC Denis. In 2020 ; pp 95–99.
59. Żywiołek, J. Monitoring of information security system elements in the metallurgical enterprises. *MATEC Web Conf.* 2018, 183, 1007.

60. M.S Almahirah, V. N.S, M.Jahan,S. Sharma, and S. Kumar, "Role of Market Microstructure in Maintaining Economic Development." *Empirical Economics Letters*, vol. 20, no.2,2021
61. N.R Nayak, S. Kumar, D. Gupta, A. Suri, M. Naved and M. Soni, " Network mining techniques to analyze the risk of the occupational accident via bayesian network." *International Journal of System Assurance Engineering and Management*,2022
62. S. Kumar, "Relevance of Buddhist Philosophy in Modern Management Theory," *Psychology and Education*, vol. 58, no. 3, pp. 2104–2111, 2021
63. S. Kumar, P. K Baag, and S. K. V, "Impact of ESG Integration on Equity Performance between Developed and Developing Economy: Evidence from S and P 500 and NIFTY 50.," *Empirical Economics Letters*, vol. 20, no.4,2021
64. S. Kumar, P. K Baag, and S. K. V, "Financial Engineering and Quantitative Risk Analytics", *SYBGEN Learning*, vol.1,no.1. pp. 01-360, 2021
65. A.Kakti, S.Kumar, N.K. John, V. V Ratna, S. Afzal, and A.D Gupta, " Impact of Patients Approach towards Healthcare Costs on their perception towards Health: An Empirical Study." *Tobacco Regulatory Science*, vol. 7, no. 6-1, pp 7380-7390, 2021
66. C. Blázquez, P. Álvarez, N. Bronfman and J. Espinosa, "Factores que influncian la motivación de escolares por las áreas tecnológicas e ingeniería.", *Calidad en la Educación*, no. 31, p. 46, 2009.
67. Espinosa-Cristia, J. Feregrino and P. Isla, "Emerging, and old, dilemmas for food security in Latin America", *Journal of Public Affairs*, vol. 19, no. 3, p. e1999, 2019.
68. A. Vega-Muñoz, P. González-Gómez-del-Miño and J. Espinosa-Cristia, "Recognizing New Trends in Brain Drain Studies in the Framework of Global Sustainability", *Sustainability*, vol. 13, no. 6, p. 3195, 2021.
69. J J. Espinosa-Cristia, "Gestionando la innovación desde la óptica de los estudios de ciencia, tecnología y sociedad: por una perspectiva constructivista y crítica de la gestión de la innovación", *Cadernos EBAPE.BR*, vol. 17, no. 1, pp. 68-83, 2019.
70. N. Contreras-Barraza, J. Espinosa-Cristia, G. Salazar-Sepulveda and A. Vega-Muñoz, "Entrepreneurial Intention: A Gender Study in Business and Economics Students from Chile", *Sustainability*, vol. 13, no. 9, p. 4693, 2021.
71. A. Vega-Muñoz, G. Salazar-Sepulveda, J. Espinosa-Cristia and J. Sanhueza-Vergara, "How to Measure Environmental Performance in Ports", *Sustainability*, vol. 13, no. 7, p. 4035, 2021.
72. N. Contreras-Barraza, J. Espinosa-Cristia, G. Salazar-Sepulveda, A. Vega-Muñoz and A. Ariza-Montes, "A Scientometric Systematic Review of Entrepreneurial Wellbeing Knowledge Production", *Frontiers in Psychology*, vol. 12, 2021.
73. O. Bernasconi and J. Espinosa-Cristia, "No Politics, No Society: Questioning The Justification Of Entrepreneurship In Chilean Public Policies", *Revista de Administração de Empresas*, vol. 60, no. 2, pp. 131-143, 2020. Available: 10.1590/s0034-759020200206.
74. J. Espinosa-Cristia and J. Alarcón, "TransBank POS machines and bill receipts: Socio-technical mediations in the normalization of tipping [Máquinas POS de TransBank y boletas: Mediaciones sociotécnicas en la normalización de las propinas]", *Psicoperspectivas. Individuo y Sociedad*, vol. 18, no. 2, 2019. Available: 10.5027/psicoperspectivas-vol18-issue2-fulltext-1675.
75. J. Garrido Wainer, J. Espinosa, N. Hirmas and N. Trujillo, "Free-viewing as experimental system to test the Temporal Correlation Hypothesis: A case of theory-generative experimental practice", *Studies*

- in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences, vol. 83, p. 101307, 2020.
76. G. Roland, S. Kumaraperumal, S.Kumar, A.D. Gupta, S. Afzal, and M. Suryakumar, "PCA (Principal Component Analysis) Approach towards Identifying the Factors Determining the Medication Behavior of Indian Patients: An Empirical Study." Tobacco Regulatory Science, vol. 7, no. 6-1, pp 7391-7401, 2021
 77. S.Kumar and P.K. Baag, "Ethics Erosion in Capital Market: Lehman Brothers' Case Study of Repo 105," in AIMS-18, March 4, 2021, India, AIMS Texas USA, A1872-Final.pdf (aims-international.org)
 78. S.Kumar and P.K. Baag, "Erosion of Ethics in Credit Derivatives: A Case Study," in AIMS-18, March 4, 2021, India, AIMS India & Texas USA, A1873-Final.pdf (aims-international.org)
 79. Tawfiq A. Al- asadi and Ahmed J. Obaid, 2016. An efficient web usage mining algorithm based on log file data, Journal of Theoretical and Applied Information Technology, Vol. 16, Vol. 92, No. 2: 215-224.
 80. Tawfiq A. Al-asadi, Ahmed J. Obaid, Rahmat Hidayat, Ts. Azizul Azhar Ramli, 2017. A Survey on Web Mining Techniques and Applications, International Journal on Advanced Science Engineering and Information Technology, Vol. 7, No. 4: 1178-1184.
 81. Tawfiq A. Al-Asadi, Ahmed J. Obaid, Ahmed A. Alkhayat, 2017. Proposed Method for Web Pages Clustering Using Latent Semantic Analysis, Journal of Engineering and Applied Science, Vol. 12, No. 8: 8270-8277.
 82. Shakir Khan and Arun Sharma, "Moodle Based LMS and Open Source Software (OSS) Efficiency in E-Learning", International Journal of Computer Science & Engineering Technology, Vol. 3, No. 4, pp. 50-60, 2012.
 83. Mohammed AlAjmi, Arun Sharma and Shakir Khan, "Growing Cloud Computing Efficiency", International Journal of Advanced Computer Science and Applications, Vol. 3, No. 5, pp. 172-176, 2012.
 84. Shakir Khan, Arun Sharma, Abu Sarwar Zamani and Ali Akhtar, "Data Mining for Security Purpose & Its Solitude Suggestions", International Journal of Scientific & Technology Research, Vol. 1, No. 7, pp. 1-4, 2012. <http://www.ijstr.org/final-print/August2012/Data-Mining-for-Security-Purpose-&-its-Solitude-Suggestions.pdf>
 85. S. Khan, "An Inter-Operability And Open Source Problem For Integrated Library System (Koha) And Digital Library (Dspace) As Single System", Edulearn17 Proceedings, 2017, pp. 7041-7047.
 86. S. Khan, M. Alajmi, "The Role Of Open Source Technology In Development Of E-Learning Education", Edulearn17 Proceedings, 2017, Pp. 7056-7061.
 87. H. Lumapenet and N. Andoy, "Influence of the Family on the Pupils' Reading Performance", 7th CEBU International Conference on Civil, Agricultural, Biological and Environmental Sciences Sept. 21-22, 2017 Cebu (Philippines), page 15-19, 2017.
 88. C. Kalipa and H. Lumapenet, "Customary Practices and Authorities in Conflict Resolution towards Peace Building of the Sultans, Rajahs, and Datus of Buayan Sultanates in Southern Philippines", International Journal of All Research Education and Scientific Methods, Volume 9, Issue 12, page 155-169, 2021.
 89. T. Guiamalon and P. Hariraya, "The K-12 Senior High School Program: The Case of Laboratory High School, Cotabato City State Polytechnic College, South Central Mindanao, Philippines", International

Journal of Advances in Social Sciences, Volume 7, Issue 19, page 391-399, 2021.T

90. T. Guiamalon, S.A.Alon, and S. Camsa, "Teachers Issues and Concerns on the Use of Modular Learning Modality", IJASOS- International E-Journal of Advances in Social Sciences, Vol. VII, Issue 20, page 457-469, 2021.
91. Jalil, N.A., P Prapinit, M Melan, AB Mustaffa (2019). Adoption of Business Intelligence- Technological, Individual and Supply Chain Efficiency. Proceedings of the 2019 International Conference on Machine Learning, Big Data and Business Intelligence. Year: 2019, Volume: 1, Pages: 67-73.
92. Jalil, N.A., Hwang, H.J. (2019). Technological-centric business intelligence: Critical success factors. International Journal of Innovation, Creativity and Change, Volume 5, Issue 2, August, 2019, Pages 1499 to 1516.
93. Nasir Abdul Jalil and Koay Kian Yeik. 2019. Systems, Design and Technologies Anxieties Towards Use of Self-service Checkout. In Proceedings of the 2019 3rd International Conference on Education and E-Learning (ICEEL 2019). Association for Computing Machinery, New York, NY, USA, 122–127.
94. B. Singh, N. A. Jalil, D. K. Sharma, S. R, K. Kumar and D. Jebakumar immanuel, "Computational systems overview and Random Process with Theoretical analysis," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 1999-2005.
95. Roy Setiawan, Luigi Pio Leonardo Cavaliere, KartikeyKoti, Gabriel Ayodeji Ogunmola, N. A. Jalil, M. Kalyan Chakravarthi, S. Suman Rajest, R. Regin, Sonia Singh, "The Artificial Intelligence and Inventory Effect on Banking Industrial Performance" Turkish Online Journal of Qualitative Inquiry. Volume 12, Issue 6, July, 2021: 8100-8125.
96. Roespinoedji, D., Juniati, S., Hasan, H., Jalil, N.A., Shamsudin, M.F., 2019. Experimenting the long-haul association between components of consuming renewable energy: ARDL method with special reference to Malaysia. Int. J. Energy Econ. Policy 9, 453–460.
97. D. K. Sharma, N. A. Jalil, V. K. Nassa, S. R. Vadyala, L. S. Senthamil and T. N, "Deep learning Applications to classify Cross-Topic Natural Language Texts Based on Their Argumentative Form," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), 2021, pp. 1580-1586.
98. D. K. Sharma, N. A. Jalil, R. Regin, S. S. Rajest, R. K. Tummala and T. N, "Predicting Network Congestion with Machine Learning," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), 2021, pp. 1574-1579.
99. Nasir Abdul Jalil and Mikkay Wong Ei Leen. 2021. Learning Analytics in Higher Education: The Student Expectations of Learning Analytics. In 2021 5th International Conference on Education and E-Learning (ICEEL 2021). Association for Computing Machinery, New York, NY, USA, 249–254.
100. R. Taher, S. Hameed, and Q. Ali. "Study for Ionizing Radiation Safety Awareness among Patients in Erbil Hospitals" International Journal of Enhanced Research in Science Technology & Engineering vol.3, no.10, p. 41, 46, 2014.
101. S. Hameed, Q. Ali, and R. T. Essa, "Assessment of Ionizing Radiation Protection Awareness among Radiation Workers in Erbil Hospitals". Journal of Medical and Pharmaceutical Sciences , vol.1, no.3 , p. 25,19. 2017.
102. B. Al-Rawi, and, S. Aljanabi, "Modeling the Physical Properties of ZnO Nanoparticles with Selective Hydrogen Using DFT". International Journal of Nanoscience, vol. 20, no. 1, p. 2150011-

- 375, 2021.
103. B. Al-Rawi, S. Hameed, and M. Alsaadi, "Simulation of Electronic Structure and some Properties of CdTe Crystals Using DFT". In *Materials Science Forum*, Trans Tech Publications Ltd Vol. 1021, p. 1-10, 2021
 104. AL Kareem, S. Hameed, and S. Ali. "Evaluation of Noise Levels and Vibrations at Cement Factories That Represent a Condition Monitory for The Performance of Machines", In *Mesopotamia Environmental Journal* ,Vol. 5, no. 3, P. 56, 63, 2020.
 105. The linguistic structure in the Iraqi civil laws "Nasser, N. S.", *QZJ*, vol.6, no.2, pp. 578-598, 2021.
 106. The Effect of the Arabic Language on Legal Text Legislation, "Nasir, N. S.", *Journal of Al-Frahedis Arts*, vol.12, no.42 II, pp. 84-101, 2020.
 107. The connotations of the word (light) in the Holy Qur'an and books of faces and analogies, "Nasir, N. S.", *journal of the college of basic education*, vol.21, no.92, pp.1-24, 2016.
 108. The meaning of the word and its development in the proverb, "Nasir, N. S.", *QZJ*, vol. 3, no. 1, pp. 822–845, Mar. 2018.
 109. Samara Jasima, Vinnaras Nithyanantham, The Teacher's Role On Motivation In Phonetic Sounds Learning For The School Children, *Turkish Online Journal of Qualitative Inquiry (TOJQI)*, Vol: 12(6), 1054-1060, 2021.
 110. Suren Akram Hamanajm & Vinnaras Nithyanantham, A Study on Gender Discrimination among the University Students in Kurdistan, *Psychology and Education*, Vol. 57 No. 9 (2020): Volume 57 No. 9 (2020).
 111. Vinnaras Nithyanantham and N. Rekha, Level of Interpersonal Relationship among the Women Student-Teachers in Iraq, *International Journal of Psychosocial Rehabilitation*, Vol:24(5), 2585-2591, 2020.
 112. Salem, Mohamed, Awang Jusoh, N. Rumzi N. Idris, Himadry Shekhar Das, and Ibrahim Alhamrouni. "Resonant power converters with respect to passive storage (LC) elements and control techniques—An overview." *Renewable and Sustainable Energy Reviews* 91 (2018): 504-520.
 113. Bughneda, A., M. Salem, M. Alhuyi Nazari, D. Ishak, M. Kamarol, and S. Alatai. "Resonant Power Converters for Renewable Energy Applications: A Comprehensive Review. *Front.*" *Energy Res* 10 (2022): 846067.
 114. Salem, Mohamed, Awang Jusoh, Mohamed Dahidah, Dahaman Ishak, Anna Richelli, Ibrahim Alhamroni, and Mohamad Kamarol. "Improved topology of three-phase series resonant DC-DC boost converter with variable frequency control." *Alexandria Engineering Journal* 61, no. 2 (2022): 1701-1713.
 115. Muftah, Magdi G., Mohamed Salem, Khlid Ben Hamad, and Mohamad Kamarol. "Open-loop control of a grid-tied multilevel inverter interfacing a fuel cell stack." In *2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe)*, pp. 1-6. IEEE, 2021.
 116. Alatai, Salah, Mohamed Salem, Dahaman Ishak, Ali Bughneda, Mohamad Kamarol, and Doudou N. Luta. "Cascaded Multi-Level Inverter for Battery Charging-Discharging using Buck-Boost Switch." In *2021 IEEE Industrial Electronics and Applications Conference (IEACon)*, pp. 108-112. IEEE, 2021.
 117. Bughneda, Ali, Mohamed Salem, Dahaman Ishak, Salah Alatai, Mohamad Kamarol, and Khlid Ben

- Hamad. "Modified Five-level Inverter for PV Energy system with Reduced Switch Count." In 2021 IEEE Industrial Electronics and Applications Conference (IEACon), pp. 103-107. IEEE, 2021.
118. Alatai, Salah, Mohamed Salem, Dahaman Ishak, Himadry Shekhar Das, Mohammad Alhuyi Nazari, Ali Bughneda, and Mohamad Kamarol. "A Review on State-of-the-Art Power Converters: Bidirectional, Resonant, Multilevel Converters and Their Derivatives." *Applied Sciences* 11, no. 21 (2021): 10172.
119. Alatai, Salah, Mohamed Salem, Dahaman Ishak, Ali Bughneda, Mohamad Kamarol, and Doudou N. Luta. "Phase-Shifted LLC Resonant DC-DC Converter for Battery Charging Application." In 2021 IEEE Conference on Energy Conversion (CENCON), pp. 1-5. IEEE, 2021.
120. Bughneda, Ali, Mohamed Salem, Dahaman Ishak, Salah Alatai, Mohamad Kamarol, and Khlid Ben Hamad. "A Single-Phase Multilevel Inverter with Reduced Switch Count for Solar PV Application." In 2021 IEEE Conference on Energy Conversion (CENCON), pp. 1-6. IEEE, 2021.
121. Salem, Mohamed, Vigna K. Ramachandaramurthy, Awang Jusoh, Sanjeevikumar Padmanaban, Mohamad Kamarol, Jiashen Teh, and Dahaman Ishak. "Three-phase series resonant DC-DC boost converter with double LLC resonant tanks and variable frequency control." *IEEE Access* 8 (2020): 22386-22399.
122. Salem, Mohamed, Vigna K. Ramachandaramurthy, P. Sanjeevikumar, Zbigniew Leonowicz, and Venkata Yamasu. "Full bridge LLC resonant three-phase interleaved multi converter for HV applications." In 2019 IEEE International Conference on Environment and Electrical Engineering and 2019 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe), pp. 1-6. IEEE, 2019.
123. Salem, Mohamed, Awang Jusoh, N. Rumzi N. Idris, and Ibrahim Alhamrouni. "Comparison of LCL resonant converter with fixed frequency, and variable frequency controllers." In 2017 IEEE Conference on Energy Conversion (CENCON), pp. 84-89. IEEE, 2017.
124. Salem, Mohamed, Awang Jusoh, N. Rumzi N. Idris, Chee Wei Tan, and Ibrahim Alhamrouni. "Phase-shifted series resonant DC-DC converter for wide load variations using variable frequency control." In 2017 IEEE Conference on Energy Conversion (CENCON), pp. 329-333. IEEE, 2017.
125. Priya Tyagi, Satish Kumar Sharma, Kumar, P. (2018). Evaluation of antihyperlipidemic activity of ethanolic root extract of *Glycyrrhiza glabra*. *J of Drug Delivery and therapeutics*, 8(6), 120-124.
126. Thomas, M., Khan, K., Sharma, S., Singh, L., Upadhyay, M. (2013). In Vitro Evaluation of Anti-Microbial and Anti-Oxidant Activity of *Emblica Officinalis* Juice Powder. *Advances in Pharmacology and Pharmacy*, 1(1), 9-12.
127. Yadav, J., Sharma, S., Singh L., Singh, T. (2013). An Overview on *Moringa Oleifera*: A Potential Medicinal Herb. *Journal of Drug Discovery and Therapeutics*, 1(7), 100-105.
128. Mishra, S., Sharma, S., Chauhan, D., Singh, L., Singh, T. (2013). "An Overview on Herbal Medicines as Diuretics with Scientific Evidence". *Scholars Journal of Applied Medical Sciences*, 1(3), 209-214.
129. Thomas, M., Sharma, S., Singh, L. (2013). Perspectives of *Amla*: A Wonder Herb. *Journal of Drug Discovery and Therapeutics*, 1(9), 59-64.
130. Singh, S., Khan, K., Sharma, S., Singh, L. (2014). In Vitro Assessment of Antimicrobial and Antioxidant Activity of Various Extracts of *Hamelia Patens*. *J of Chemical and Pharmaceutical Sciences*, 7(2), 147-153.

131. Singh, S., Sharma, S., Singh L. (2013). An Overview of NSAIDs Used in Anti-Inflammatory and Analgesic Activity and Prevention of Gastrointestinal Damage. *Journal of Drug Discovery & Therapeutics*, 1(8), 41-51.
132. Werku Etafa, Getahun Fetensa, Reta Tsegaye, Bizuneh Wakuma, Sundararajan Vasantha Kumari, Getu Bayisa, et al, "Neonatal sepsis risk factors in public hospitals in Wollega zones, Ethiopia: case control study," *PAMJ - One Health*, vol. 7, no. 2, p.1-13, 2022.
133. S.Vasanthakumari, "Writing research proposal," *World Journal of Advanced Research and Reviews*, vol. 10, no.01, p.184-190, 2021.
134. S.Vasanthakumari, "Soft skills and its application in work place," *World Journal of Advanced Research and Reviews*, vol. 03, no.02, p.66-72, 2019.
135. S.Vasanthakumari, "Mental Health Preparedness for School Children during COVID-19 Pandemic," *International Journal of Scientific Research*, vol. 10, no.05, p.1-4, 2021.
136. E. Murugan and S. Arumugam, "New dendrimer functionalized multi-walled carbon nanotube hybrids for bone tissue engineering," *RSC advances*, vol. 4 no. 67, p. 35428, 2014.
137. E. Murugan and R. Rangasamy, "Development of stable pollution free TiO₂/Au nanoparticle immobilized green photo catalyst for degradation of methyl orange," *Journal of Biomedical Nanotechnology*, vol. 7, no.1, p. 225, 2011.
138. A. Siva and E. Murugan, "Syntheses of new dimeric-Cinchona alkaloid as a chiral phase transfer catalysts for the alkylation of Schiff base," *Journal of Molecular Catalysis A: Chemical*, vol. 241, no. 1-2, p. 111, 2005.
139. E. Murugan and V. Gopi, "Amphiphilic multiwalled carbon nanotube polymer hybrid with improved conductivity and dispersibility produced by functionalization with poly(vinylbenzyl) triethylammonium chloride," *The Journal of Physical Chemistry C*, vol. 115, no.40, p. 19897, 2011.
140. A. Siva and E. Murugan, "New trimeric Cinchona alkaloid-based quaternary ammonium salts as efficient chiral phase transfer catalysts for enantioselective synthesis of α -amino acids," *Journal of Molecular Catalysis A: Chemical*, vol. 248, no.1-2, p. 1, 2006.
141. E. Murugan, D.P.G. Rani and V. Yogaraj, "Drug delivery investigations of quaternised poly (propylene imine) dendrimer using nimesulide as a model drug *Colloids and Surfaces B: Biointerfaces*," vol. 114, p. 121, 2014.
142. A. Siva and E. Murugan, "Synthesis and characterization of novel multi-site phase transfer catalyst and its catalytic efficiency for dichlorocarbene addition to citral," *Journal of Molecular Catalysis A: Chemical*, vol. 241, no.1-2, p.101, 2005.
143. E. Murugan and P. Gopinath, "Synthesis and characterization of novel bead-shaped insoluble polymer-supported tri-site phase transfer catalyst and its efficiency in N-alkylation of pyrrole," *Applied Catalysis A: General*, vol. 319, p. 72, 2007.
144. E. Murugan, D. P. Geetha Rani, K. Srinivasan, and J. Muthumary, "New surface hydroxylated and internally quaternised poly (propylene imine) dendrimers as efficient biocompatible drug carriers of norfloxacin," *Expert Opinion on Drug Delivery*, vol. 10 no.10, p. 1319, 2013.
145. E. Murugan, P. Gopinath, V. Shanmugayya, and N. Mathivanan, "Antibacterial activity of novel insoluble bead-shaped polymer-supported multiquaternary ammonium salts," *Journal of applied polymer science*, vol. 117, no.6, p. 3673, 2010.
146. E. Murugan, and A. Siva, "Synthesis of asymmetric n-arylaziridine derivatives using a new chiral

- phase-transfer catalyst,” *Synthesis*, vol. 2005 no.12, p. 2022, 2005.
147. T. Balakrishnan and E. Murugan, “Preparation and spectroscopic characterization of surface-enriched (with active sites) polymer-supported phase-transfer catalysts and their efficiency in organic addition reactions: A kinetic study,” *Journal of Polymer Science Part A: Polymer Chemistry*, vol. 41, no.2, p. 347, 2003.
148. E. Murugan, and A. Siva, “Preparation of a novel soluble multi-site phase transfer catalyst and the kinetic study for the C-alkylation of α -pinene,” *Journal of Molecular Catalysis A: Chemical*, vol. 235, no. 1-2, p. 220, 2005.
149. S. Santhoshkumar and E. Murugan, “Rationally designed SERS AgNPs/GO/g-CN nanohybrids to detect methylene blue and Hg²⁺ ions in aqueous solution,” *Applied Surface Science*, vol. 553, p. 149544, 2021.
150. E. Murugan, S. Santhoshkumar, S. Govindaraju and M. Palanichamy, “Silver nanoparticles decorated g-C₃N₄: An efficient SERS substrate for monitoring catalytic reduction and selective Hg²⁺ ions detection,” *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, vol. 246, 119036, 2021.
151. E. Murugan, S. Santhosh Kumar, K. M. Reshna and S. Govindaraju, “Highly sensitive, stable g-CN decorated with AgNPs for SERS sensing of toluidine blue and catalytic reduction of crystal violet,” *Journal of materials science*, vol. 54, no.7, p. 5294, 2019.
152. E. Murugan, J. N. Jebaranjitham and A. Usha, “Synthesis of polymer-supported dendritic palladium nanoparticle catalysts for Suzuki coupling reaction,” *Applied Nanoscience*, vol. 2, no.3, p. 211, 2012.
153. E. Murugan, S. Arumugam and P. Panneerselvam, “New nanohybrids from poly (propylene imine) dendrimer stabilized silver nanoparticles on multiwalled carbon nanotubes for effective catalytic and antimicrobial applications,” *International Journal of Polymeric Materials and Polymeric Biomaterials*, vol. 65 no. 3, p. 111, 2016.
154. E. Murugan and I. Pakrudheen, “Efficient amphiphilic poly (propylene imine) dendrimer encapsulated ruthenium nanoparticles for sensing and catalysis applications,” *Science of Advanced Materials*, vol. 7, no. 5, p. 891, 2015.
155. E. Murugan, and G. Tamizharasu, “Synthesis and characterization of new soluble multisite phase transfer catalysts and their catalysis in free radical polymerization of methylmethacrylate aided by ultrasound-A kinetic study,” *Journal of applied polymer science*, vol. 125, no. 1, p. 263, 2012.
156. E. Murugan, R. Rangasamy, and I. Pakrudheen, “Efficient amphiphilic poly (propyleneimine) dendrimer stabilized gold nanoparticle catalysts for aqueous phase reduction of nitrobenzene,” *Science of Advanced Materials*, vol. 4, no. 11, p. 1103, 2012.
157. A. Ramesh, P. Tamizhdurai, S. Gopinath, K. Sureshkumar, E. Murugan and K. Shanthi, “Facile synthesis of core-shell nanocomposites Au catalysts towards abatement of environmental pollutant Rhodamine B,” *Heliyon*, vol. 5, no. 1, p. e01005, 2019.
158. E. Murugan, J. N. Jebaranjitham, K. J. Raman, A. Mandal, D. Geethalakshmi, M. Dharmendra Kumar, and A. Saravanakumar, “Insoluble dendrimer-grafted poly (vinylimidazole) microbeads stabilized with mono/bimetallic nanoparticle catalysts for effective degradation of malachite green,” *New Journal of Chemistry*, vol. 41, no.19, p. 10860, 2017.
159. E. Murugan and I. Pakrudheen, New amphiphilic poly (quaternary ammonium) dendrimer catalyst for effective reduction of citronellal, *Applied Catalysis A: General*, vol. 439, p. 142, 2012.

160. M. Raja and G. G. Lakshmi Priya, "Using virtual reality and augmented reality with ICT tools for enhancing quality in the changing academic environment in COVID-19 pandemic: An empirical study," in *Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19*, Cham: Springer International Publishing, 2022, pp. 467–482.
161. M. Raja and G. G. L. Priya, "An analysis of Virtual Reality usage through a descriptive research analysis on school students' experiences: A study from India," *Int. j. early child. spec. educ.*, vol. 13, no. 2, pp. 990–1005, 2021.
162. M. Raja, K. Srinivasan, and S. Syed-Abdul, "Preoperative virtual reality based intelligent approach for minimizing patient anxiety levels," in *2019 IEEE International Conference on Consumer Electronics - Taiwan (ICCE-TW)*, 2019.
163. M. Raja and G. G. Lakshmi Priya, "Sentiment and emotions extraction on teaching–learning from home (TLFH) and impact of online academic activities in India," *Mater. Today*, 2021.
164. M. Raja and G. G. L. Priya, "Conceptual origins, technological advancements, and impacts of using Virtual Reality technology in education," *Webology*, vol. 18, no. 2, pp. 116–134, 2021.
165. S. Venkatasubramanian, D. A. Suhasini, and D. C. Vennila, "An Energy Efficient Clustering Algorithm in Mobile Adhoc Network Using Ticket Id Based Clustering Manager," *International Journal of Computer Science and Network Security*, vol. 21, no. 7, pp. 341–349, Jul. 2021.
166. Venkatasubramanian, S., Suhasini, A. and Vennila, C., "An Efficient Route Optimization Using Ticket-ID Based Routing Management System (T-ID BRM)". *Wireless Personal Communications*, pp.1-20, 2021
167. S. Venkatasubramanian, A. Suhasini, C. Vennila, "Efficient Multipath Zone-Based Routing in MANET Using (TID-ZMGR) Ticked-ID Based Zone Manager", *International Journal of Computer Networks and Applications (IJCNA)*, 8(4), PP: 435- 443, 2021.
168. Venkatasubramanian, S.. "Optimized Gaming based Multipath Routing Protocol with QoS Support for High-Speed MANET", *International Journal of Advanced Research in Science, Communication and Technology*. vol. 9, No. 1, ,pp.62-73, September , 2021.
169. Venkatasubramanian.S., "A Chaotic Salp Swarm Feature Selection Algorithm for Apple and Tomato Plant Leaf Disease Detection", *International Journal of Advanced Trends in Computer Science and Engineering*, 10(5), pp.3037–3045,2021.
170. Suman Rajest S, P. Suresh, "21st Century Learners' Student-Centered Learning Various Stages" in *International Conference, Age and Content in Journey of Language by VISTAS (Tamil Department)*, Volume: I, Issue I, April 2018, Page No.: 474-492. (International Conference Paper)
171. Suman Rajest S, P. Suresh, "American Postmodern Novelist Thomas Pynchon's The Crying of Lot 49: Structure and Absurd Realism" in *Proceedings of the IOSRD, 73rd International Conference on Future Trends in Engineering and Business*, Volume: 73, May 2018, Page No.: 32-41.
172. Suman Rajest S, P. Suresh, "The "Four Cs" Education For 21st Century's Learners" in *Research Guru Online Journal of Multidisciplinary Subjects*, Volume: XII, Issue I, June 2018, Page No.: 888-900.
173. Jerusha Angelene Christabel G, Suman Rajest S, "A Short Review on Fragmented Narration in Select Works of Sarnath Banerjee", *American Journal of Social and Humanitarian Research*, Vol. 3 No. 4, pp. 12-31, (2022).
174. Rajest, D. S. S., & G, J. A. C. (2022). A Brief on Past and Present a Tug of War in the Select Works

- of Kurt Vonnegut. *Central Asian Journal of Literature, Philosophy And Culture*, 3(4), 59-79.
175. G, J. A. C., & Rajest, D. S. (2022). *Fragmented Narration in Corridor's Thematic, Language and Imagery*. *Central Asian Journal Of Arts And Design*, 3(4), 15-37.
176. S.venkatasubramanian, "Multistage Optimized Fuzzy Based Intrusion Detection protocol for NIDS in MANET", *International Journal Of Innovative Research In Technology*, Volume 8 Issue 6, November, pp.301-311, 2021.
177. S.Venkatasubramanian,K., Senthil Kumar & J, Gnana & M, Ayeesha. "IoT and AI Based Recognition and Classification of Covid 19 Persons in Public Place", *Turkish Online Journal of Qualitative Inquiry*. 12. pp.7098-7110, 2021.
178. Srinivasan, Venkatasubramanian, "Detection of black hole attack using honeypot agent-based scheme with deep learning technique on MANET", *Ingénierie des Systèmes d'Information*, Vol. 26, No. 6, pp. 549-557., 2021.<https://doi.org/10.18280/isi.260605>.
179. S.venkatasubramanian, "Correlation Distance Based Greedy Perimeter Stateless Routing Algorithm for Wireless Sensor Networks", *Int. J. Advanced Networking and Applications* Volume: 13 Issue: 03 pp. 4962-4970,2021.
180. S.Venkatasubramanian, "Ambulatory Monitoring of Maternal and Fetal using Deep Convolution Generative Adversarial Network for Smart Health Care IoT System" *International Journal of Advanced Computer Science and Applications(IJACSA)*, 13(1), 2022.
181. S. Venkatasubramanian, D. A. Suhasini, and D. Vennila, "A Review on Machine Learning Techniques for QoS in WSN", *IJAST*, vol. 28, no. 9, pp. 169 - 178, Oct. 2019.
182. Venkatasubramanian.S, et al. (2017). *A Cross Layer Supported Non-Reservation Based Approach For Qos Provisioning In Mobile Ad Hoc Networks*. *International Journal of Innovative Research in Science and Engineering*, vol.3, No.2, 184-189.
183. A. J. Obaid, T. Chatterjee and A. Bhattacharya, "Semantic Web and Web Page Clustering Algorithms: A Landscape View," *EAI Endorsed Transactions on Energy Web*, vol. 8, no. 33, 2020.
184. Azmi Shawkat Abdulbaqi, Ahmed J. Obaid & Alyaa Hashem Mohammed (2021) ECG signals recruitment to implement a new technique for medical image encryption, *Journal of Discrete Mathematical Sciences and Cryptography*, 24:6, 1663-1673.
185. D Datta, S Mishra, SS Rajest, (2020) "Quantification of tolerance limits of engineering system using uncertainty modeling for sustainable energy" *International Journal of Intelligent Networks*, Vol.1, 2020, pp.1-8,
186. K.K.D. Ramesh, G. Kiran Kumar, K. Swapna, Debabrata Datta, and S. Suman Rajest, "A Review of Medical Image Segmentation Algorithms", *EAI Endorsed Transactions on Pervasive Health and Technology*, 2021, doi: 10.4108/eai.12-4-2021.169184
187. Lavanya, K., J Obaid, A., Sumaiya Thaseen, I., Abhishek, K., Saboo, K., Paturkar, R. (2020). *Terrain Mapping of LandSat8 Images using MNF and Classifying Soil Properties using Ensemble Modelling*. *International Journal of Nonlinear Analysis and Applications*, 11(Special Issue), 527-541. doi: 10.22075/ijnaa.2020.4750
188. Leo Willyanto Santoso, Bhopendra Singh, S. Suman Rajest, R. Regin, Karrar Hameed Kadhim (2021), "A Genetic Programming Approach to Binary Classification Problem" *EAI Endorsed Transactions on Energy*, Vol.8, no. 31, pp. 1-8.
189. Manaa, Mehdi Ebady; Obaid, Ahmed J; Dosh, Mohammed Hussein, 2021. *Unsupervised Approach*

for Email Spam Filtering using Data Mining, EAI Endorsed Transactions on Energy Web, DOI: 10.4108/eai.9-3-2021.168962.

190. Obaid A.J. (2021) Critical Research on the Novel Progressive, JOKER an Opportunistic Routing Protocol Technology for Enhancing the Network Performance for Multimedia Communications. In: Kumar R., Quang N.H., Kumar Solanki V., Cardona M., Pattnaik P.K. (eds) Research in Intelligent and Computing in Engineering. Advances in Intelligent Systems and Computing, vol 1254. Springer, Singapore. https://doi.org/10.1007/978-981-15-7527-3_36
191. Obaid A.J., Alghurabi K.A., Albermany S.A.K., Sharma S. (2021) Improving Extreme Learning Machine Accuracy Utilizing Genetic Algorithm for Intrusion Detection Purposes. In: Kumar R., Quang N.H., Kumar Solanki V., Cardona M., Pattnaik P.K. (eds) Research in Intelligent and Computing in Engineering. Advances in Intelligent Systems and Computing, vol 1254. Springer, Singapore.
192. Obaid A.J., Sharma S. (2021) Data-Mining Based Novel Neural-Networks-Hierarchical Attention Structures for Obtaining an Optimal Efficiency. In: Favorskaya M.N., Peng SL., Simic M., Alhadidi B., Pal S. (eds) Intelligent Computing Paradigm and Cutting-edge Technologies. ICICCT 2020. Learning and Analytics in Intelligent Systems, vol 21. Springer, Cham.
193. R. Harini, R. Janani, S. Keerthana, S. Madhubala and S. Venkatasubramanian, "Sign Language Translation," 2020 6th International Conference on Advanced Computing and Communication Systems, 2020, pp. 883-886.
194. R. Regin, S. Suman Rajest and Bhopendra Singh, "Fault Detection in Wireless Sensor Network Based on Deep Learning Algorithms", EAI Endorsed Transactions on Scalable Information Systems, 2021, <https://eudl.eu/doi/10.4108/eai.3-5-2021.169578>
195. S. Suman Rajest Dr. Bhopendra Singh, P. Kavitha, R. Regin, Dr.K. Praghash, S. Sujatha, "Optimized Node Clustering based on Received Signal Strength with Particle Ordered-filter Routing Used in VANET" Webology, Vol.17, No.2, pp. 262-277, 2020.
196. S. Venkatasubramanian, "Fruit-Fly Algorithm Based Dynamic Source Routing Algorithm for Energy Efficient Multipath Routing in MANET," 2022 International Conference on Computer Communication and Informatics, 2022, pp. 01-08.
197. Singh, H., Singh, J., Sharma, S., Dwivedi, S. P., & Obaid, A. (2021). Comparative Performance of Copper, Graphite, Brass and Aluminium/Graphite- Based Different Tool Electrodes for Optimizing the Material Removal Rate during Die-Sinking EDM of Stir-Casted, Al6061/SiC- MMCs for Sustainable Manufacturing and Energy Applicatio. Journal of Green Engineering, 11(1), 922-938.
198. Venkatasubramanian, S., Suhasini, A., Vennila, C. "QoS Provisioning in MANET Using Fuzzy-Based Multifactor Multipath Routing Metric". In proceedings of Sustainable Communication Networks and Application. Lecture Notes on Data Engineering and Communications Technologies, vol 93. Springer, Singapore.