RBFNN CLASSIFIER ECG SIGNAL CLASSIFICATION FOR IRREGULAR HEARTBEAT

G. Prince Devaraj
Associate Professor,
Dept of IT,
Francis Xavier Engineering College,
Tirunelveli, India
princedevaraj.g@gmail.com

R.Ravi
Professor,
Dept of CSE,
Francis Xavier Engineering College,
Tirunelveli, India
fxhodcse@gmail.com

Abstract:

The pre-processing stage of ECG signal processing for the diagnosis of arrhythmia diseases is categorized in this research. As a result, the system's major tasks are the Gaussian filter-based baseline noise removal and the Hilbert's transform-based QRS amplitude detection. RBFNN classifier built on SVM is used to categorize the ECG data. This algorithm enhances the ECG categorized result's sensitivity, reliability, and efficiency. Utilizing Matlab software, this project is put into action.

Keywords— RBFNN, SVM, QRS

I. INTRODUCTION

The electrical function of the heart as captured by a skin electrode is reported by an electrocardiogram, a diagnostic tool [41-45]. Heartbeat shape and rate are indicators of cardiac health in humans. This signal, which is used to identify heart problems, is detected at the surface of the human body using a noninvasive procedure. An study of the recorded ECG waveform can be used to identify cardiac arrhythmia, which is any disturbance of heart rate or rhythm or changes in the morphological pattern [1-2]. The P-QRS-T wave's amplitude and duration provide important clues concerning the type of heart illness that is present. The electrical waveform is caused by the blood's Na+ and k+ ions depolarizing and repolarizing. ECG cannot provide details about the heart contraction or pumping [11-18].

II. LITERATURE SURVEY

TITLE: Heartbeat Classification Using Morphological and Dynamic Features of ECG Signals

AUTHOR: B.V.K. VijayaKuma, et all.

- ❖ This paper describes the classification of heartbeats using morphological and dynamic criteria [25].
- ❖ Each pulse is subjected to a separate application of the wavelet transform with ICA to obtain morphological information.
- ❖ From this, a thorough description of the morphology and dynamic operation of each of the internal organs of the body was derived [19-24].

Disadvantage:

- There is too much variation within species, and morphological characteristics cannot be tested.
- Convergence and hybridization issues.

TITLE: A Patient-Adapting Heartbeat Classifier Using ECG Morphology and Heartbeat Interval Features

AUTHOR: Philip de Chazal, et all.

- ❖ This work describes a classifier for patient-adapting heartbeats that uses ECG morphology & heartbeat interval features.
- ❖ Using a local classifier trained on a small sample size of the record under test and a global classification previously trained on a big dataset, a patient adaptive heartbeat classifier system is created [26-31].
- ❖ even though there's was a diminishing return, using a greater number of beats to train a local-classifier improved performance [3-4].
- ❖ Morphology is easy to use and is most frequently employed by individuals in general [6].

International Journal On Engineering Technology and Sciences – IJETS™
ISSN(P): 2349-3968, ISSN (O): 2349-3976
Volume X, Issue III, March - 2023

Disadvantage:

- Morphology studies are required for determining powdered herbs because this is an inherently [32-35].
- Subjective process.

III. EXISTING SYSTEM

The use of signal processing techniques for real-time ECG signal analysis is clear. However, the unpredictable the outdoors of the ECG signal is beyond the capabilities of conventional signal processing methods [36-37]. In this regard, this study introduces a novel method for effective modeling of the ECG signal in time-frequency space, namely intermittent orthogonal stock good transform with discrete cosine transform [7-10]. Using the method of principal component analysis, these time-frequency components are further condensed in lower dimensional space to describe the morphological properties of the ECG signal [5]. The last characteristic set, which is used for analyzing the ECG signals utilizing SVM, is created by computing the dynamic features in addition to the morphological ones and concatenating them [38-40].

IV. METHODOLOGY

Automatically classifying A cardiac cycle's worth of ECG elements make up the signal. For each heartbeat, characteristics pertaining to fiducially demonstrate intervals were taken into account. For every beating heart in the ECG signals, features pertaining to heartbeat intervals or ECG morphology were calculated as well individually.

V. PROPOSED SYSTEM

The use of signal processing techniques for electrocardiography signal analysis in real time is clear. However, due to the ECG signal's non-stationary nature, conventional methods for signal processing are ineffective. This study introduces a novel method for effectively representing the ECG signal in time-frequency space: discrete orthogonal stocks nicely transform employing discrete cosine transform. Through principal component analysis, these time-frequency components are further condensed in lower dimensional space to describe the morphological properties of the ECG signal. The last characteristic set, which is created by computing the dynamic features and concatenating them with the morphological features, is then used to categorise the ECG signals using an RBFNN-based SVM. Particle swarm optimisation approach is used to increase classification performance. Figure 1 shows the block diagram of proposed Method.

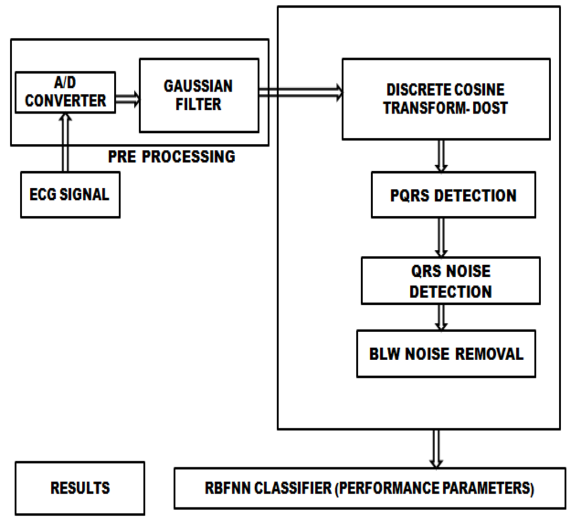

Figure 1: Block Diagram of Proposed Method

VI. WORKING

As shown in Fig. 1, the proposed technique for this project's analysis of ECG data is divided into four stages: processing, R-peak detection, extraction of features, then classification. Figure 2 shows the Reconstruction Analysis using Hilbert Transform.

PCA is used to express these morphological features in a more compact dimensional space. The SVM classifier's parameters are optimized using the RBFNN method. Figure 3 shows the P,Q,R,S,T Interval Identification.

VII. RESULTS

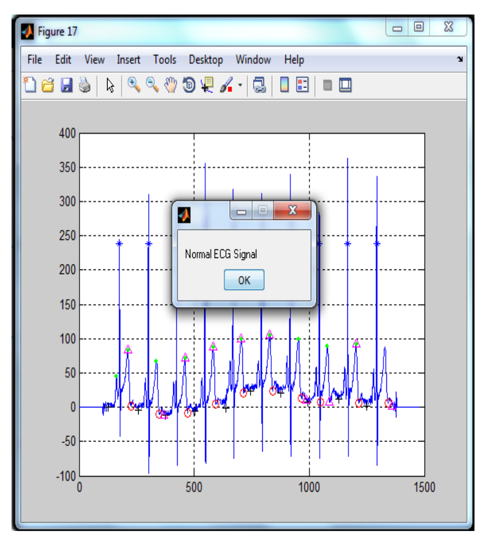

Figure 2: Reconstruction Analysis using Hilbert Transform (Reconstruction)

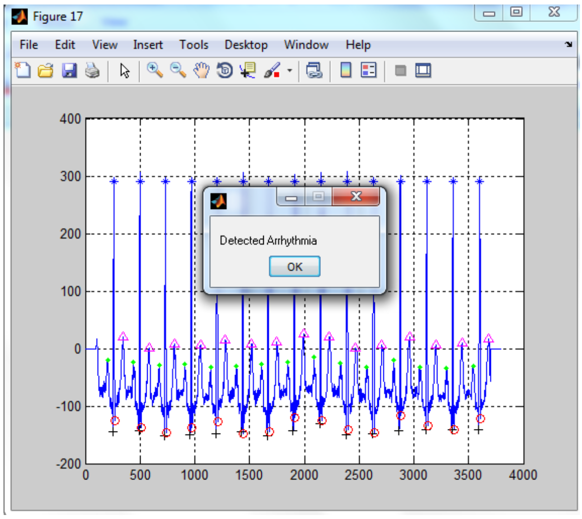

Figure 3. P,Q,R,S,T Interval Identification

VIII. CONCLUSION

Heart problems can be accurately detected by the ECG signal. As a diagnostic aid to help the doctor analyze cardiac problems, the MLP neural network or RBF neural network classifications are provided. The size and caliber of the set used for training, the effectiveness of the extracted feature set, and the parameters selected for representing the input are all important variables that affect how accurate the tools are. According to the experimental findings, the MLP BP NN obtains sensitivity of 96.2% for SVEBs and 95.2% for VEBs, respectively. The RBF NN displays sensitivity for SVEBs & VEBs of 85.4% and 97.6%, respectively, for the same amount of test sets. As a result, the MLP neural network performs better than the RBF neural network.

REFERENCES

[1] R. Acharya, J. S. Suri, J. A.E. Spaan and S .M. Krishnan, *Advances in Cardiac Signal Processing*, springer, pp. 1-50.

[2] W. J. Germann and C. L. Standield, “Principles of H uman Physiology,” Benjamin Cummings, San Francisco, 2002.

[3] G. P. Devaraj, R. Kabilan, J. Z. Gabriel, U. Muthuraman, N. Muthukumaran and R. Swetha, "Design and Analysis of Modified Pre-Charge Sensing Circuit for STT-MRAM," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), 2021, pp. 507-511, doi: 10.1109/ICICV50876.2021.9388516.

[4] U. Muthuraman, R. Ravi, G. P. Devaraj, J. M. Esther, R. Kabilan and J. Z. Gabriel, "Embedded Sensor-based Construction Health Warning System for Civil Structures & Advanced Networking Techniques using IoT," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 1002-1006, doi: 10.1109/ICSCDS53736.2022.9760793.

[5] R. Kabilan and N. Muthukumaran, "A Neuromorphic Model for Image Recognition using SNN," 2021 6th International Conference on Inventive Computation Technologies (ICICT), 2021, pp. 720-725, doi: 10.1109/ICICT50816.2021.9358663.

[6] J. Zahariya Gabriel, R. Kabilan, G. Prince Devaraj and U. Muthuraman, "Facial Authentication System by Combining of Feature Extraction using Raspberry Pi," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), 2021, pp. 1142-1145, doi: 10.1109/ICICV50876.2021.9388396.

[7] J. Z. Gabriel, U. Muthuraman, R. Kabilan, G. P. Devaraj, R. Ravi and J. M. Esther, "Waiting Line Conscious Scheduling for OFDMA Networks, using JSFRA Formulation," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 754-759, doi: 10.1109/ICSCDS53736.2022.9760949.

[8] J. M. Esther, J. Z. Gabriel, R. Ravi, U. Muthuraman, G. P. Devaraj and R. Kabilan, "Increased Energy Efficiency of MANETs Through DEL-CMAC Protocol on Network," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 1122-1126, doi: 10.1109/ICSCDS53736.2022.9760930.

[9] R. Kabilan, V. Chandran, J. Yogapriya, Alagar Karthick, Priyesh P. Gandhi, V. Mohanavel, Robbi Rahim, S. Manoharan, "Short-Term Power Prediction of Building Integrated Photovoltaic (BIPV) System Based on Machine Learning Algorithms", International Journal of Photoenergy, vol. 2021, Article ID 5582418, 11

pages, 2021.

[10] N. Muthukumaran, N. R. G. Prasath and R. Kabilan, "Driver Sleepiness Detection Using Deep Learning Convolution Neural Network Classifier," 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2019, pp. 386-390, doi: 10.1109/I-SMAC47947.2019.9032698.

[11] R. Ravi, G. P. Devaraj, J. M. Esther, R. Kabilan, Z. Gabriel and U. Muthuraman, "Malicious Finding and Validation Scheme Using New Enhanced Adaptive Ack," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 1220-1224, doi: 10.1109/ICSCDS53736.2022.9760753.

[12] R. M. Pandeeswari, R. Kabilan, T. M. Januanbumani, J. Rejoni, A. Ramya and S. J. Jothi, "Data Backups and Error Finding by Residue Quotient Code for Testing Applications," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 637-641, doi: 10.1109/ICSCDS53736.2022.9760940.

[13] Kabilan, R., Ravi, R., Zahariya Gabriel, J and Mallika Pandeeswari, R, “Empowering Radio Resource Allocation to Multicast Transmission System Using Low Complexity Algorithm in OFDM System”, Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp 111–121.

[14] Bhumi Bhatt, PurviKalani, NayanabenParmar, NikunjShingala (June 2015) ‘Smart Vehicle Security System Using GSM & GPS’, International Journal Of Engineering And Computer Science, ISSN:2319 – 7242, Vol 4, Issue 6.

[15] Fan. X, Xu. W, Chen. H, and L. Liu, “CCSMOMS: A Composite Communication Scheme for Mobile Object Management System”, in Proc. 20th International Conference on Advanced Information Networking and Applications, Vienna, 2006, pp. 235–239.

[16] U. Muthuraman and R. Kabilan, "A High Power EV Charger based on Modified Bridgeless LUO Converter for Electric Vehicle," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), 2021, pp. 512-515, doi: 10.1109/ICICV50876.2021.9388385.

[17] C. Selsi Aulvina and R. Kabilan, "LOW Power and Area Efficient Borrow Save adder Design," 2018 International Conference on Smart Systems and Inventive Technology (ICSSIT), 2018, pp. 339-342, doi: 10.1109/ICSSIT.2018.8748832.

[18] R. Kabilan, R. Ravi, J. M. Esther, U. Muthuraman, J. Z. Gabriel and G. P. Devaraj, "Constructing Effective UVM Testbench By Using DRAM Memory Controllers," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 1034-1038, doi: 10.1109/ICAIS53314.2022.9742986.

[19] G. P. Devaraj, R. Kabilan, U. Muthuraman, J. Z. Gabriel, J. M. Esther and R. Ravi, "Multipurpose Intellectual Home Area Network Using Smart Phone," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 1464-1469, doi: 10.1109/ICAIS53314.2022.9742955.

[20] R. Kabilan, E. K. Devi, R. M. Bhuvaneshwari, S. Jothika, R. Gayathiri and R. Mallika Pandeeswari, "GPS Localization for Enhancement of Military Fence Unit," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 811-816, doi: 10.1109/ICAIS53314.2022.9742959.

[21] Hsiao. W. C. M, and S. K. J. Chang, “The Optimal Location Update Strategy of Cellular Network Based Traffic Information System”, in Proc. Intelligent Transportation Systems Conference, Toronto, 2006, pp. 248-253.

[22] Hapsari. A. T, E.Y. Syamsudin, and I. Pramana, “Design of Vehicle Position Tracking System Using Short Message Services And Its Implementation on FPGA”, in Proc. Conference on Asia South Pacific Design Automation, Shanghai, China, 2005.

[23] R. M. Pandeeswari, K. Deepthyka, M. Abinaya, V. Deepa, R. Kabilan and J. Glorintha, "Fast Evolutionary Algorithm based Identifying Surgically Distorted Face for Surveillance Application," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 516-521, doi: 10.1109/ICSCDS53736.2022.9760978.

[24] Ravi, R., Mallika Pandeeswari, R., Kabilan, R and Shargunam, S, “Overcrowding Cell Interference Detection and Mitigation in a Multiple Networking Environment”, Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp.

71–82.
[25] R. Kabilan, R. MallikaPandeeswari, N. Lalitha, E. Kanmanikarthiga, C. Karthica and L. M. H. Sharon, "Soldier Friendly Smart And Intelligent Robot On War Field," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 666-671, doi: 10.1109/ICAIS53314.2022.9742909.
[26] Kishore. T. K, T. S. Vardhan, and N. L. Narayana, "Vehicle Tracking Using a Reliable Embedded Data Acquisition Sysytem With GPS and GSM", Int. Journal of Computer Science and Network Security, vol. 10, no. 2, pp. 286-291, 2010.
[27] Kulkarni. V, and L. N. K. Rao, "Embedded Car Security System on Face Detection". in Proc. 2nd National Conference on Information and Communication Technology, New York,2011, no. 40.
[28] Lita. I, I. B. Cioc and D. A. Visan, "A New Approach of Automobile Localization System Using GPS and GSM/GPRS Transmission," in Proc. Int. Spring Seminar on Electronics Technology, 2006, pp. 115- 119.
[29] Wolf. M, Weimerskirch. A, and Wollinger. T, "State of the art: Embedding security in vehicles", EURASIP Journal on Embedded Systems, 2007, pp. 1-16.
[30] Kabilan, R., Ravi, R., Shargunam, S and Mallika Pandeeswari, R, "A Baseband Transceiver for MIMO-OFDMA in Spatial Multiplexing Using Modified V-BLAST Algorithm", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp. 83–94.
[31] R. P. Janani, K. L. Narayanan, R. S. Krishnan, P. Kannan, R. Kabilan and N. Muthukumaran, "Intelligent Drowsiness and Illness Detection Assist System for Drivers," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 1150-1155, doi: 10.1109/ICAIS53314.2022.9743075.
[32] Kabilan, R., Ravi, R and Shargunam, S, "Improving the Performance of Cooperative Transmission Protocol Using Bidirectional Relays and Multi User Detection", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp. 29–45.
[33] H. Lang, J. Pfeiffer and J. Maguire, "Using on-chip test pattern compression for full scan SoC designs," Proceedings International Test Conference 2000 (IEEE Cat. No.00CH37159), 2000, pp. 638-643, doi: 10.1109/TEST.2000.894258.
[34] R. Kabilan, G. P. Devaraj, U. Muthuraman, N. Muthukumaran, J. Z. Gabriel and R. Swetha, "Efficient Color Image Segmentation Using Fastmap Algorithm," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), 2021, pp. 1134-1141, doi: 10.1109/ICICV50876.2021.9388470.
[35] Z. Du, P. Jaromersky, Y. Chiang and N. Memon, "Out-of-Core Progressive Lossless Compression and Selective Decompression of Large Triangle Meshes," 2009 Data Compression Conference, 2009, pp. 420-429, doi: 10.1109/DCC.2009.73.
[36] R. Kabilan., Ravi R., Rajakumar G., Esther Leethiya Rani S., Mini Minar V. C. 'An Improved VLSI architecture using wavelet filter bank for blur image applications', ARPN Journal of Engineering and Applied Sciences, Vol. 10, no. 6, April 2015.
[37] A. Dzhagaryan, A. Milenkovic and M. Burtscher, "Energy efficiency of lossless data compression on a mobile device: An experimental evaluation," 2013 IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), 2013, pp. 126-127, doi: 10.1109/ISPASS.2013.6557156.
[38] R. Kabilan., Ravi R., Rajakumar G., Esther Leethiya Rani S., Mini Minar V. C. 'A combined face recognition approach based on LPD and LVP', ARPN Journal of Engineering and Applied Sciences, Vol. 10, no. 6, April 2015.
[39] R. Kabilan., T. P. Kumar., R. Suman., M. S. Revathy., T. Chitravel., R. Ravi, 'Fabrication and characterization of electro-deposited Cu2ZnSnS4 thin film absorber layer for solar power engineering applications', Chalcogenide Letters, 2019, 16(3), pp. 137–141. Annexure I Journal.
[40] Kabilan, R., Ravi, R and Shargunam, S, "High Performance Fiber-Wireless Uplink for CDMA 5G Networks Communication", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp. 13–27.
[41] Ravi, R., Zahariya Gabriel, J., Kabilan, R and Mallika Pandeeswari, R, "Hardware Implementation of OFDM Transceiver Using Simulink Blocks for MIMO Systems", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless

Communications, River Publishers, 2022, pp. 95–110.

[42] Kabilan, R., Ravi, R., Shargunam, S and Mallika Pandeeswari, R, "VLSI Implementation on MIMO Structure Using Modified Sphere Decoding Algorithms", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp. 59–69.

[43] Ravi, R., Kabilan, R., Shargunam, S and Mallika Pandeeswari, R, "Joint Relay-source Escalation for SINR Maximization in Multi Relay Networks and Multi Antenna", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp. 47–58.

[44] Kabilan, R and Ravi, R, "Speech Signal Extraction from Transmitted Signal Using Multilevel Mixed Signal", Smart Antennas, Electromagnetic Interference and Microwave Antennas for Wireless Communications, River Publishers, 2022, pp 1–11.

[45] Pandeeswari, R.M., Kabilan, R., Januanbumani, T.M., ...Ramya, A and Jothi, S.J, "Data Backups and Error Finding by Residue Quotient Code for Testing Applications", International Conference on Sustainable Computing and Data Communication Systems, ICSCDS 2022 - Proceedings, 2022, pp. 637–641