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A Survey for Cardiovascular diseases detection using angiograms and FFR Image Segmentation

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Abstract— **Heart related (Cardiovascular) disease is a emerging threaten disease for survival for human world. Early detection of the same type of diesease is need of the time. Various research has been performed for the same problem. Researchers tried with various method and datasets. Various methods based on Medical Images and Clinical data are performed. Main purpose of these research is for benefit of all human kind. Stenosis in the Coronary Arteries (CA) can be determined by using the Coronary Cineangiogram (CCA). It comes under the invasive image modality. CCA is the most cost-effective method to justly detect and predict the stenosis as well as it is a fundamental diagnostic approach for assessing vascular malfunction. Image processing is also a novel method vastly used in disease diagnosis in medical field. Angiograms and FFR based research papers are used in this review to study the image processing techniques including pre-processing, segmentation, features extraction and classification methods.**

Keywords—Heart Disease, Machine Learning

I. INTRODUCTION

Integration of clinical decision support with computer-based patient records could reduce medical errors, enhance patient safety, decrease unwanted practice variation, and improve patient outcome. This suggestion is promising as prediction modeling and analysis tools, e.g., machine learning, have the potential to generate a knowledge-rich environment which can help to significantly improve the quality of clinical decisions in the field of Heart Disease.

II. APPROACHES TO HEART DISEASE ANALYSIS

A. Machine Learning Techniques

Machine Learning is an impressive technique in recent era for Medical research. Based on historical data various methods of Machine Learning are able to predict the probability of various disease. Main parts of the this type of work is Prediction.

At Health Catalyst, we use a data management platform to analyze data, and retrieve it in real time for physicians to help make treatment decisions. At the same time the doctor sees the patient and inserts the symptoms, data, and test results into the EMR, there are screening screens that look at all about the patient, and motivate the physician with useful information for diagnosing, ordering tests, or proposing preventive tests. In the long run, the power will reach all aspects of medicine as we get used data, better integrated. We will be able to include large data sets that can be analyzed and compared in real time to provide all kinds of information to the provider and the patient.

B. Data Mining Techniques

Data mining holds great potential for the healthcare industry to enable health systems to systematically use data and analytics to identify inefficiencies and best practices that improve care and reduce costs. Some experts believe the opportunities to improve care and reduce costs concurrently could apply to as much as 30% of overall healthcare spending. This could be a win/win overall. But due to the complexity of healthcare and a slower rate of technology adoption, our industry lags behind these others in implementing effective data mining and analytic strategies

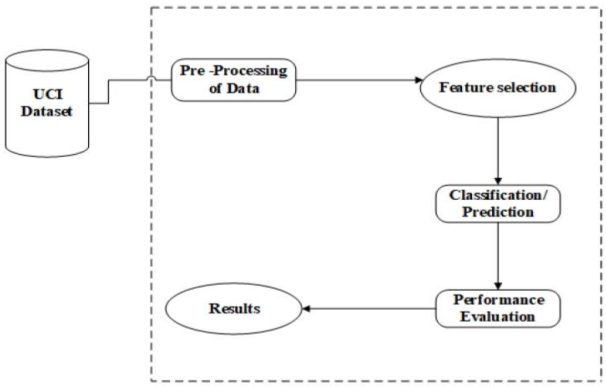

Figure 1 Basic Framework [1]

III. RELATED WORKS

We have reviewed some research work related to heart disease prediction. In research work Cardiovascular diseases prediction and detection using Image Processing Techniques [1] by Sadheera Mahanama which is published in Research Gate- 2020, they have applied HBWHP. They have recommend the same method because it can be used for a limited stenosis scale to improve angiography. Frangi boat expansion filter and regional separation can be concluded as the best partition due to its accuracy. Algorithms can be used in the partition phase as a final step. The K-Nearest Neighbor algorithm has demonstrated its suitability for category purposes with precision. The width of the vessel can be calculated more accurately and easily if

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you use the ship's tracking system. Earth stabilization is one of the best ways to get an accurate response during a diagnosis because it has proven 97.45% accuracy. FFR is an expensive method but offers high accuracy in measurements. Angiograms are low cost and offer excellent visibility. Following Figure 2.0 shows the basic flow for their system.

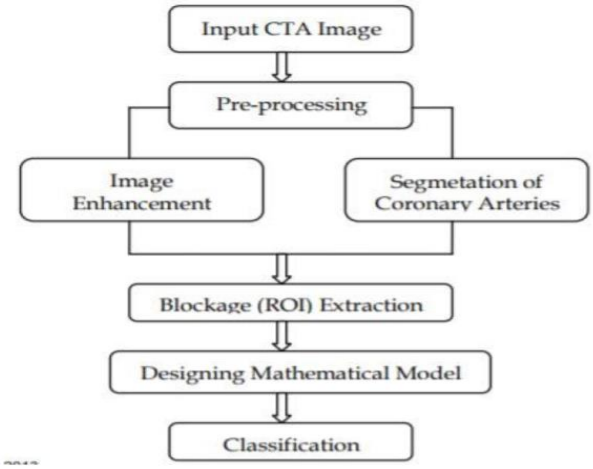

Figure 2 Basic Flow for Classification

Paper 2: Simultaneous Multi-Structure Segmentation of the Heart and

Peripheral Tissues in Contrast Enhanced Cardiac Computed Tomography

Angiography [2]

Authors : Vy Bui, Sujata M. Shanbhag, Oscar Levine al

Publication and Year :IEEE 2020

In another research work Simultaneous Multi-Structure Segmentation of the Heart and Peripheral Tissues in Contrast Enhanced Cardiac Computed Tomography Angiography [2] by authors Vy Bui, Sujata M. Shanbhag, Oscar Levine al is published in IEEE 2020. In their research work, the researcher introduces a completely automated approach to the multi-atlas integrated approach to the correction of the heart label and its heart-related structures. This method also automatically separates the other

intrathoracic surrounding structures from CTA images. The evaluation of the proportions of this proposed method was performed in 36 studies with a general reference found in the division of the specialist manual into the various cardiac structures. Quality assessments are also done by expert students to obtain 120 points for the default categories. Measurement results showed a total dice of 0.93, a Hausdorff range of 7.94 mm, and mean a distance of more than 1.03 mm between the automatic and hand-made heart structures. Visual testing obtained excellent points for automatic isolation. The average processing time was 2.79 minutes. Our results show the proposed automated framework greatly improves the accuracy and speed of computing in a standardized multi-atlas system, and provides a complete and reliable multi-site classification of CTA images that are important for clinical use.

We have also reviewed an research work Direct Quantification of Coronary Artery Stenosis through Hierarchical Attentive Multi-view Learning[3] by Dong Zhang, Guang Yang, Shu Zhao, Yangping Zhang, Dhanjoo Ghista, Heye Zhang which is published in IEEE 2020. They have proposed a prestigious multiview study model (HEAL) to achieve a specific number of coronary artery stenosis, without intermediate separation or reconstruction. We have built a diverse learning model to read the corresponding details of stenosis from different perspectives. For this purpose, a listening block of the intra-view hierarchical block is proposed to learn the discriminatory details of stenosis. In addition, the stenosis representation study module is developed to exclude multi-scale features from the keyword concept consideration for clinical practice. Finally, morphological indicators are considered directly based on the embedding of a multiview element. An in-depth exploratory study of a multidisciplinary clinical database containing 228 subjects demonstrates the height of our HEAL compared to nine comparative methods, including direct measurement methods and multi-view learning methods. The test results show a better clinical agreement between global truth and prediction, which gives their proposed approach greater potential for effective intraoperative treatment of coronary artery disease.

Another research work Coronary Arteries Segmentation based on 3D FCN with Attention Gate and Level Set Function [4] is published by Ms.Vidya.M, Mr. Dilip Kumar.S, Mr. S.Logesh Kumar, Ms.S.Pavithra, Ms.R.Aishvarya in IEEE 2018. In their work they propose a shared framework for the fragmentation of the cardiac CTA based on in-depth learning and a traditional approach. A fully integrated 3D network (FCN) is used to study the 3D semantic features of blood vessels, providing an excellent first point setting at the traditional level. In addition, a gateway to attention is installed throughout the network, aimed at increasing vessels and compressing inactive regions. The output of 3D FCN with a focus gate is developed at a set level to smooth the border to better align the true global distinction. of separation than Vanilla 3D FCN intuitively and quantitively

In research work Analysis and Classification of Stenosis Severity from Coronary Angiogram Images[5] by Ms.Vidya.M, Mr. Dilip Kumar.S, Mr. S.Logesh Kumar, Ms.S.Pavithra, Ms.R.Aishvarya, they have presented a method of coronary tissue classification and lumen segmentation and an initial prototype method for stenosis detection from images and quantification. From the dye diffusion graph which is plotted, it is inferred that the dye diffuses uniformly with greater intensity in the regular subject than the stenotic patient. Hence, the proposed method is capable of performing complete, robust, and

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accurate extraction of coronary arteries. On further works, the percentage of stenosis can be detected by using Computer Aided Diagnosis method which gives faster and automatic diagnosis.

In research work A vessel length-based method to compute coronary fractional flow reserve from optical coherence tomography images by Kyung Eun Lee1, Seo Ho Lee1, Eun-Seok Shin and Eun Bo Shim which is published in Biomedical Engineering Journal in 2017. In their research they have a fast and accurate method that combined a computational fluid dynamics (CFD) model of an OCT based region of interest (ROI) with a lumped parameter model (LPM) of the coronary microvasculature and veins. Here, the LPM was based on vessel lengths extracted from

coronary X-ray angiography (CAG) images. Based on a vessel length-based approach, they described a theoretical formulation for the total resistance of the LPM from a three dimensional (3D) CFD model of the ROI. As a result they presented present calculated examples of FFR from OCT images. To validate the OCT-based FFR calculation (OCT–FFR) clinically, they compared the computed OCT–FFR values for 17 vessels of 13 patients with clinically measured FFR (M-FFR) values.

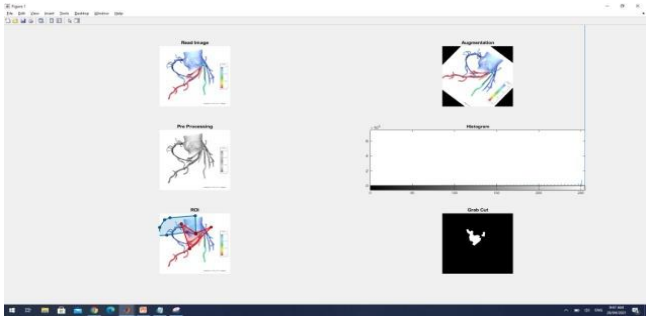
After reviewing many research work related to Classification of Alzheimer Disease, we have summarized like: In recent years, many researchers have done a good work in the field of Medical Images in Stenosis Classification and segmentation, but still there is a scope to get better result. We can apply Multiple Images Sources like Angiography and FFR in same system.

IV. SCOPE OF METHODOLOGY

As Image processing is widely used in Health Care Systems,

Segmentation in FFR and Angiogram Images can lead a better Decision for Health Care Team.

V. IMPLEMENTATION DETAILS



VI. RESULTS SUMMARY

Method Name	Accuracy Achieved
Base K-Nearest	90.20
Proposed Modified Method	91.53

VII. CONCLUSION AND FUTURE WORK

We have reviewed the work related to Heart Disease prediction using various methods. Too much work has been done with various methods but still there is chance to apply new methods or changing the way in current methods are applied. There are chance to improve the result. Among methods those we have reviewed we have identified Hessian Matrices based preprocessing with K-Means and KNN may provide better result.

In future the implementation based on various work is to be done for accurate result analysis.

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