Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 3, July 2021: 2923 - 2932

Research Article

Cardiovascular Risk Detection Using Cr-Hom Hybrid Optimization Algorithm And Machine Learning Techniques

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Abstract

Cardiovascular Disease Deaths Are Increasing Day By Day And Causes Very Serious Issues Among Human Rise. Recent Survey Report Demonstrates That The Death Rates Are Rapidly Increasing With Bases Of Many Health Issues. The Patients Who Are Effected With Kidney Disease Have Nearly 50 Percentage Of Chance To Cause Cardiovascular Problems. Most Of The Research Work Focuses Only On Predicting Risk Factors Of Kidney Diseases, Were This Papers Also Focuses On Factors Which Are Responsible For Cardiovascular Deaths. Early Prediction Of Such Problems May Solve Death Ratio Problems. A Proposed Hybrid Algorithmic Technique (Cr-Hom) Which Is Used For Predicting The Disease In Early Stage. Initial Stage Of Feature Extraction Process Is Carried Out With Modified Tug Of War (Mtw) Algorithm. The Process Not Only Selects The Necessary Features It Also Helps In Improving The Accuracy Of Proposed Algorithm. The Step Followed After Selecting The Necessary Feature Is Ruzzo Tompa Memetic Based Deep Neural Network (Rtm-Dnn), Which Is Very Useful In Classifying The Cardiovascular Risk Factors. The Proposed Cr-Hom Technique Can Analyze With Different Standard Datasets And Compare The Performance With Existing State-Of-Art Techniques In Terms Of Accuracy, Precision, F-Measure And Recall. The Proposed Algorithm's Performance Is Best Compared To That Of Other Existing Algorithms.

Keywords: Kidney Disease, Cardiovascular Disease, Tug Of War Algorithm, Rtm-Dnn, Hybrid Optimization.

1. Introduction

Problems With Integrated Optimization Include Finding The Appropriate Configuration From A Defined Set. A Comprehensive Search For Many Of These Issues Is Impossible. The Combination Of Possible Solutions Can Be Reduced To Unique Or Individual Aimed At The Best Solution. Some Common Problems With Integrated Optimization. Which Provides A Complete Redundant List Of Integrated Optimization Problems [1] [2]. We Know That There Are A Limited Number Of Solutions To The N-Queens Problem - This Would Be N = 8 In 92 Groups, But Interestingly From A Computationally Complex Point Of View, The Algorithm Approach Is More Efficient In Finding Any Solution, Or The Total Number Of Solutions. This Problem Can Be Used As An Experiment For Integrated Optimization Or For Other Issues To Analyze The Relevance Of Different Intelligent Methods [3]. The N-Queens Issue Is A Well-Known Example In The Field Of Artificial Intelligence. Due To The Complex Structure Of This Problem, It Is Used As An Experiment Or Development Of Stunning Approaches To Problem Resolving.

Various Attempts Have Been Made To Construct Diagnostics Using Echocardiography, But It Is Difficult For The Sonographer And Diagnostician To Pass On Information About The Stage Of The Examination And The Angle And Scope Of The Image [4]. At The National Center For Cerebral Palsy (Ncc), Neonates Are Suspected Of Having Congenital Heart Disease [6-10]. With This Method, The Vertical Probe Of The Body Axis Is Continuously Used During The Scan [11]. Therefore, The Sonographer And Diagnostician Will Know How To Perform The Test Before Starting This Procedure. An Experienced Physician Can Make A Diagnosis Based On Echocardiogram Images

Obtained From A Mental Image Of The 3-D Structure Of The Heart. However, Understanding The 3d Cardiac System From Echocardiogram Images Requires Experience And Skill [12].

Probability Greedy Heuristics Include Determining The Probability Based On Information About The Quality Of The Solution Previously Obtained [13]. They Can Be Used For Static And Dynamic Integrated Optimization Tasks [14]. Since The Ant Method Is Based On The Movement Of The Ant To A Lesser Extent, Such An Approach Is The Best Way To Find Logical Solutions To Optimization Problems That Allow Graphical Interpretation, Including Finding The Optimal Path For Self-Organizing Networks [15]. The Amount Of Pheromones In The Bow And The Residual Energy Of The Chin Are Suggested To Be Used As Control Factors. Optimization Problems That Can Be Solved In Algorithms For Wireless Touch Networks Through "Natural Computing" [16] And Appropriate Literature Analysis. Since Dynamic Topography Is A Specialty Of Self-Organizing Networks, It Develops On The Basis Of Autonomous Nodes. Optimization Is The Process Of Achieving Effective Results In A Particular Situation In A Variety Of Areas, Including Design, Construction, And Maintenance [17]. From Them, Engineers Need To Make Decisions That Reduce Effort And Maximize Achievement. It Has Several Approaches To Solve Various Optimization Problems Such As Traveling Salesman Problem (Tsp) [18], Vehicle Routing Problem (Vrp) [19] And Limited Optimization. Now, Companies, Institutions And Businesses Are Facing Difficulties. Machines Serving A Given Customer. Similarly, Vehicle Route Optimization Provides Optimal Routes To Armada And Serves Customers In Multiple Locations According To Specific Limitations [20].

2. Related Works

Lafta Et Al. [21] Have Proposed An Effective Medical Referral System With The Fourier Transform Accelerated Machine Learning Ensemble Model Is Recommended For Patients With Chronic Heart Disease To Make Relevant Recommendations Regarding The Need For A Medical Examination The Next Day Whether Or Not To Analyze Their Medical Data. Breaks The Input Order Of Sliding Windows Based On Patient Time Range Data Using Fourier Conversion To Recover Frequency Information. Javeed Et Al. [22] Have Proposed A Step-By-Step Search Algorithm, The Diagnostic System Is Compatible. Two Types Of Tests Are Performed To Assess The Accuracy Of The Proposed Method. In The First Experiment, Only One Random Forest Model Was Developed, And In The Second Experiment, A Random Forest Model Based On Rsa Was Developed. Tests Are Performed Using The Heart Failure Database Called The Cleveland Database. The Proposed Method Is More Efficient And Sophisticated Than The Traditional Random Forest Model, As It Offers 3.3% More Accuracy Than The Traditional Random Forest Model, While Using Only 7 Features. In Addition, The Specific Method Shows Better Results Than The Other Five Levels Of Art Machine Training.

Mohan Et Al. [23] Have Proposed A New Method Aimed At Finding Key Features Using Machine Learning Techniques Improves The Accuracy Of Cardiac Prognosis. The Prediction Model Comes With A Combination Of Different Characteristics And Several Known Classification Techniques. We Will Develop Comprehensive Performance Measures With 88.7% Accuracy Using The Hybrid Random Forest With A Linear Model (Hrflm). Chen Et Al. [24] Have Proposed A New Two-Step Forecasting Framework For Ecg Signal Processing, Global Classification Identifies Acute Anomalies (Red Signals) Compared To The Global Classification Signal. Normal Signal Samples Are Subjected To Further Deviation Analysis, While Lighter And More Informative Signal Conversion Detectors Are Detected And Called Yellow Signals.

Chang Et Al. [25] Have Proposed It Uses The Newly Proposed Xgbsvm Hybrid Model To Predict That Hypertensive Patients Will Develop Hypertension Within Three Years. Final Testing With This Model, Patients With Hypertension Can Be Diagnosed With High Blood Pressure For Up To 3 Years And Subjected To Targeted Immunotherapy, Thus Reducing Their Mental, Physical, And Financial Burden. This Article Demonstrates That Machine Learning Can Be Used Successfully In The Field Of Biomedicine, With Strong Real Importance And Research Value.

Ali Et Al. [26] Have Proposed Focuses On Both, I.E. Adjust Features, Eliminate Problems Caused By The Predicted Model, I.E. Avoid And Match Problems, Which Can Perform Better On The Data Set, I.E. Training Data

And Test Data. Incompatible Network Configurations And Incompatible Features Often Lead To The Relevance Of Training Data. To Eliminate Incompatible Characteristics, We Suggest The Use Of A Search Statistical Model, While Optimized Deep Neural Network (Dnn) Search, Using A Complete Search Strategy.

The Strength Of The Proposed Hybrid Model, Known As Performance 2-Dnn, Will Be Evaluated In Comparison With Traditional An And Dnn Models, Which Are Another Level Of Art Machine Study And Previously Announced Methods For Predicting Heart Disease. The Proposed Model Achieves 93.33% Forecast Accuracy. The Results Obtained Are Excellent Compared To The Previously Announced Methods. Studies Show That They Can Be Used By Doctors To Accurately Diagnose Heart Disease.

Pasha Et Al. [27] Have Proposed A Novel Feature Reduction (Nfr) Model Is Integrated With The Ml And Tm Algorithms To Reduce Error And Improve Performance. The Specific Nfr Model Has Two Approaches, And The Auc Is Used In Addition To Accuracy To Predict Strong And Effective Disease Risk. The First Approach Is Based On The Effectiveness Evaluation Process, Which Reduces The Features Depending On The Progress Of The Auc And Works To Achieve The Optimal Subgroup, Which Further Facilitates The Prediction Along With The Accuracy Of The Evaluation Measurement.

Sarmah Et Al. [28] Have Proposed Hd Detection Method With Dlmnn Classifier Is Recommended. Experimental Results Are Evaluated According To Specific And Current Methods. Three Comparisons Were Made With Specific Methods Used In Dc, Data Transmission, And Prognosis. The Specific Mha Used In Dc Gives The Highest Cr Values And May Take Some Time For Dc. Xiao Et Al. [29] Have Proposed A Advanced 3d U-Net For Coronary Artery Department The Traditional Neural Network Is Based On An In-Depth Study Algorithm And Is Used With Multiple Data Sets Without Background And Equator.

Pan Et Al. [30] Have Proposed The Checks System Performance With Full Features And Minimal Features. Therefore, The Decrease In Characteristics Affects The Performance Of Class Fires During Processing And Can Be Analyzed Mathematically Using Accuracy Test Results. The Edcnn System Of Decision Support Systems Is Implemented On The Internet Of Medical Things Platform (Iomt), Which Allows Clinics To Effectively Place Information On Heart Patients On Cloud Platforms Around The World. Based On The Artificial Neural Network (Ann), Deep Neural Network (Dnn), Ensemble Deep Learning-Based Smart Healthcare System (Edl-Shs), And Recurrent Neural Network (Rn) .N, The Diagnostic System For Neural Network Analysis Can Effectively Determine The Risk Of Heart Disease. Experimental Results Show That Flexible Design And Subsequent Edcnn Hyper Parameters Can Achieve Accuracy Of Up To 99.1%.

3. Proposed Cr-Hom Technique

The Research Work Emphasize Is Based On Data Mining, And The Classification Techniques In Health Informatics To Detect Chronic Kidney Disease (Ckd). Self-Adaptive Bat Optimization Algorithm Is Novel Meta-Heuristics Algorithm, Which Selects The Most Optimum Features, Which Contribute More To The Result, Which Reduces The Computation Time And Increases The Accuracy. The Key Contributions Of This Paper Are:

1. Our Proposed Model Is Used For The Prediction Of Heart Disease In Which First We Introduce The Tug Of War Algorithm For The Feature Extraction And Selection.
2. Then, We Propose The Ruzzo-Tompa Memetic Based On Deep Neural Network Algorithm For The Process Of Classifying The Diseases.

3.1 Tug Of War Optimization (Two)

A.Kaveh Recently Introduced The Tug Of War Optimization Algorithm. This Algorithm Is Built On The Principle Of Tug Of War Between Two Groups [32]. The Author Developed First-Class Physics About Groups And Their Relationships. With These Principles In Mind, Tug Of War Optimization Is Developed In The Following Steps:
Step 1 Initialization: The Initial Population Is Created As Resulting:

$$W_n^0 = P_b + rand * (M_b - P_b), \qquad \text{N=1,…., N} \tag{1}$$

Where W_n^0 The Initial Value Of The n^{th} Candidate Solution, And N Is The Number Of Candidates. The Upper And Lower Bound Of The Search Space Are Shown By, M_b And P_b, Respectively.

Step 2 Weight Assignment: Each Solution Candidate Is A Team In The Competition, And The Weight Of Each Candidate Must Be Determined Against The Others. The Weight Of Each Item Can Be Calculated As Follows:

$$X_n = \frac{G_n - G_{worst}}{G_{best} - G_{worst}} + 1, \qquad \text{N=1,…., N} \tag{2}$$

Where X_n Is The Weight Of n^{th} Team, And Its Fitness Value Is Shown By G_n. At Present Iteration, The Best And Worst Value Of The Fitness Function Among Populations Are Given By G_{best}, And G_{worst}, Respectively.

Step 3 Competition And Displacement: Each Team Has A Shift After Competing With Each Other.

The Displacement Can Be Given As Resulting Equation:

$$\Delta W_n = \sum_{k=1}^{N} \Delta W_{nk}, \tag{3}$$

$$\Delta W_{nk} = \frac{1}{2} d_{nk} \Delta e^2 + \alpha\beta(M_b - P_b) * rand, \tag{4}$$

Where ΔW_{nk} Is The Displacement Of The n^{th} Candidate, And ΔW_{nk} Is The Displacement Of The n^{th} Candidate In Competition With The k^{th} Candidate. The Factor A Is Proportional Factor, And B Is A Factor Between (0, 1]. The Parameter d_{nk} Is The Acceleration Of The n^{th} Candidate In Comparison With The k^{th} Candidate, And Can Be Computed As Following:

$$d_{nk} = f_{nk} * \frac{G_{e,nk}}{X_n \mu}, \tag{5}$$

$$f_{nk} = W_k - W_n, \tag{6}$$

$$G_{e,nk} = G_{g,nk} - X_n \mu, \tag{7}$$

Where f_{nk} Is Gravitational Acceleration Constant, And $G_{e,nk}$ Is Resultant Force Affecting Factor. The Pulling Force Between n^{th} And k^{th} Teams Is Given By $G_{g,nk}$, And Is The Maximum Of Two Values ($X_n \mu$, $X_k \mu$).

Step 4 New Generation: The Innovative Candidates Is Calculated By Resulting Formula:

$$W_n^{NEW} = W_n^{OLD} + \Delta W_n \quad . \tag{8}$$

Step 5 Termination: When Some Stop Conditions Occur, Stop The System And Provide The Best Solution, Otherwise Go To Step 2.

The Steps Mentioned Above Are Used In The Statistical Model (3). The Practical Implementation Of The Response Can Change The Way This Candidate Is Considered For Updating The Material Space. Suppose A Graphical Design Is Chosen To Determine The Fact Related To The Importance Of Physical Activity. Given This Definition, Equation (3) Can Be Expressed As Follows:

$$\Delta W_{nk} = \frac{1}{2} d_{nk} \Delta e^2 + \xi_{nk} * (M_b - P_b), \tag{9}$$

Where ξ_{nk} Is The Chaotic Factor And It Is Calculated As

$$\xi_{nk} = \Xi(G_n - G_k), \tag{10}$$

Where The Chaotic Map Is Shown By Function Ξ. The Description And Well-Known Chaotic Maps Are Studied In The Resulting Section.

3.2. Ruzzo-Tompa Memetic Based Deep Neural Network

In Many Cases, Researchers Divide The Subject Of In-Depth Research Into Four Categories: Boltzmann Machines, Auto Sparse, Neural Network Energy, And Auto Encoder (Guo Et Al. 2016) [33]. Groundnut Taxonomy Using The Deep Convolutional Neural Network (Dcnn). Therefore, A Neural Network Conversion Based On Training And Test Groups Is Most Effective. There Are A Wide Range Of Components In The Dcnn Structure. It Is Often Used On The Front And Back To Connect The Training Process. First, The Main Purpose Of Moving The Parts Is To Get An Accurate Picture Of The Current Variation Of Each Component, The Weight Of The Movement, And The Application. The Use Of The First Part Seems Optional When Considering The Lines, Angles, Edges, And Bottom Positions. Uses Moderate, High-Gloss, High-Performance Materials (Lecun Et Al. 2015). The Budget Report Identifies The Real Name Of The Land From The Price Of The Loss, But The Rules Of The Side Depend On The Nature Of The Loss. With Steps, All The Paragraphs Are Simple And The Next Is Planned. After That, The Front And Back Steps Are Always Closed For Further Training [34].

Mathematically, Numerical Calculations, And Algorithms Are Based On The Function Of Form Change. Mathematically, The Algebraic Topography Of Changes Refers To The Application Of Functional Changes Such As ‘M’ And ‘N’, Respectively, Where $m * n$ Are The Two Real Complex Number Convolutions (Lin Et Al. 2013) And The Numerical Term Of Convolution Is Expressed In Eq. (11).

$$(m * n)(i) = \int_{-\infty}^{+\infty} m(i - j) n(j) dj \tag{11}$$

Algebraic Communication, Distribution, And Society Complement The Transitional Movement From Visual Properties To The Storage Of Geometric Images. Therefore, Three Types Of Property Transfers Are Considered As Follows:

The Expressions Of Commutativity And Distributivity Are Described In Eqs. (12) And (13).

$$m * n = n * m \tag{12}$$

$$m * (n + k) = (m * n) + (m * k) \tag{13}$$

The Expressions Of Associativity And Scalar Multiplication Associativity Are Noted In Eqs. (14) And (5).

$$m * (n * k) = (m * n) * k \tag{14}$$

$$l(m * n) = (lm) * n \tag{15}$$

However, The Deep Learning And The Number Of Cascaded Kernels Can Be Used Within Dcnn. Therefore, The Functionality Of The Map Form Is Protected Separately, And The Work Takes Place Within The Flow. Accordingly, The Size Of The Matrix May Indicate An Important Difference. Therefore, Most Combinations In The Matrix And Other Networks Have The Same Limitations. A Set Of Records Describe Genetic Records. The Use Of Business Applications Is Designed To Take Into Account Further Additions In The Process Of Interpreting The Applications In The Unit. Thus, The Discrete Convolutional Process Is Described In Eq. (16).

$$(m * n)(a) = \int_{x=-\infty}^{\infty} m(a-x)n(x)dj \tag{16}$$

Validates The Validation Function By Using The Function Number In The Field Image, Image Processing And Kernel Representation. Each Component Image Adds To The Change In The Functioning Of The Neighboring Community With The Kernel Used For The Weight-Bearing Activity. However, Image Formation And Critical Pixel Values Are Determined Using The Same Number Of Kernels And The Same Pixel Image Values. In General, The Dcnn Structure Consists Of Four Main Components: The Convolution Layer, Pooling Layer, Relu Layer, And Fully Connecter Layers.

The Final Stage Of The Cardiac Process Is Performed Using A Deep Neural Network. Prior To The Implementation Of The Classification Steps, The Information Already Learned Is Stored In The Database Due To Training To Improve The Number Of Correct Classifications. During The Training Process, A Lot Of Information Is Used To Improve The Accuracy Of The Predictions To Understand The Connection From The Database To The Object [35]. As Usual Deep Learning Communication Uses Three Layers: Direct, Hidden, Project Parts, And Hidden Communication Using Up To 150 Digits, Which Simplifies The Shape Of The Heart. Due To The Efficient Use Of Hidden Components, Time-Adjusting Components Do Not Require Appropriate Features To Re-Learn. Train Them To Create A Better Classification Of Activities Stored In The Database. Finally, The Heart Disease Related Appearance Of The New Material Based On A Neural Network Operating On A Multi-Layer Lead Network Is Shown In The Diagram, But Simple (S-Cell) And Complex (C-Cell). These Cells Make Important Changes Because They Can Be Put To Good Use In A Bunch Of Useful Activities Without Having To Wait For Information. This Method Uses A Lot Of Cell-Dependent Network Communication, But Only Uses Components That Provide Input From The Image, Which Closes The Hub. In Each Case, The Relationship Between The S-Cell And The C-Cell First Penetrates To Another Location And The S-Cell Activates The C-Cell And Responds To The Group. Waves In Each Room, They Come With Visual Indicators Used By A Program To Ensure Accuracy. This Process Uses A Slow Motion Display Of A Range Of Such Functions,

$$F(i) = \frac{i}{1+i} \tag{17}$$

In Eqn (1), i Is Defined As Input Features. According To The Activation Function, The Output Value Of Each Input Is Estimated As Follows:

$$p_y = F_J\left(\sum_{x=1}^{Y_y} W_1(x,y) i_x\right) \qquad y = 1,2,3 \ldots Y_J \tag{18}$$

In Eq. (2) p_y Is Represented As Output Of The Network, W Is The Weight Value Of Layer Input And i Is The Input Of The Network. Includes Training Data Stored In The Established Project Implementation Data Center. If The Relationship Between Testing And Training Is Considered As Follows:

$$q_J(I,K) = MAX\left\{SUP_{i\in I}\ INF_{j\in K}\ q(i,j), SUP_{j\in K}\ INF_{i\in I}\ q(i,j)\right\} \quad (19)$$

In Eq. (3), Sup- Supremum, Inf- Infimum - $q_J(I,K)$ Equivalence Between Training And Visual Examinations. With Respect To Features Of Equal Importance, The Unusual Form Is Well Predicted. If The Same High Value Is Considered As An Abnormal Form And The Lower Equivalence View Is Considered As A Normal Form. This Process Is Still Ongoing To Effectively Monitor Heart Disease.

4. Experimental Results And Discussion

This Work Is Implemented On Spyder Ide. Spyder Can Integrate With Number Of Packages In Stack Which Can Run On Windows Of 64 Bits. The Anaconda Navigator Is Installed For Running The Spyder Software. The Proposed Cr-Hom Scheme Is Used For The Early Prediction And Detection Of The Cardiovascular Risk Factors Using Kidney Disease Patients. This Scheme Can Analyze Various Datasets And Provide The Efficient And Precise Detection Of The Cardiovascular Risk Factors Using The Kidney Disease Patients. The Classification Algorithms Are Compared Experimentally Based On Accuracy, Precision, F-Measure, Recall, Sensitivity And Specificity.

4.1. Dataset Description

Here, The Kidney Disease Patient Dataset Is Extracted From The Uci Repository. This Dataset Includes 270 Patients' Records With 30 Attributes. All These 27 Attributes Are Vital Attributes That Are Connected To Kidney Disease Patients. Out Of These 30 Attributes, We Use Only 27 Attributes To Develop Our Predictive Model.

Table 1 Comparison Between Existing And Proposed Model With Different Classifiers

Classifiers	Accuracy	Precision	Sensitivity	Specificity	F-Measure	Recall
Cr-Hom	96.3	92.0	89.7	84.8	94.1	96.1
Rtpc-Achd	94.2	95.2	91.4	84.7	80.9	95.0
Rf	94.7	90.7	90.9	97.4	82.7	77.8
J48	93.6	97.6	92.5	93.5	95.5	86.1
Smo	89.2	94.2	92.7	94.5	89.1	98.1

Table 1. Analyzes The Performance Of Early Detection And Prediction Technique For Cardiovascular Risk Using Kidney Disease Patient. The Illustration Explained In The Table Are Very Clear In Accessing The Accuracy Contains Of Proposed Algorithm. The Accuracy Of The Proposed Cr-Hom Is 96.3 And Least Accuracy Is Observed In Smo Classifier. The Criteria Such As Precision, Sensitivity, Specificity, F- Measure And Recall Are Also Observed With Various Testing Iterations. The Main Motive Of The Research Concentrates In Accuracy Bases.

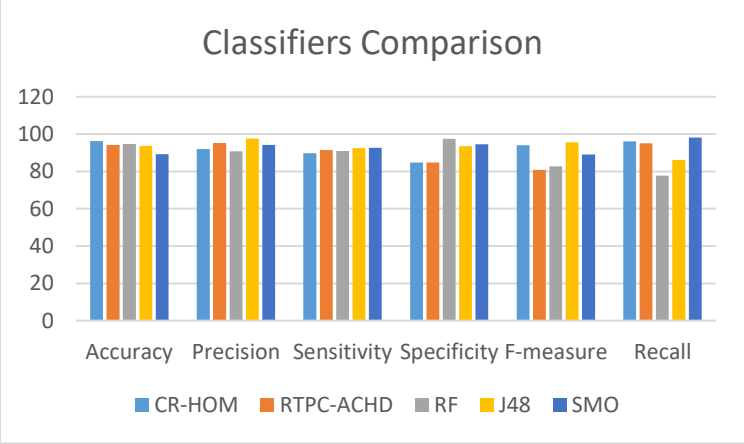

Figure 1. Comparison Of Classifiers With Various Contains

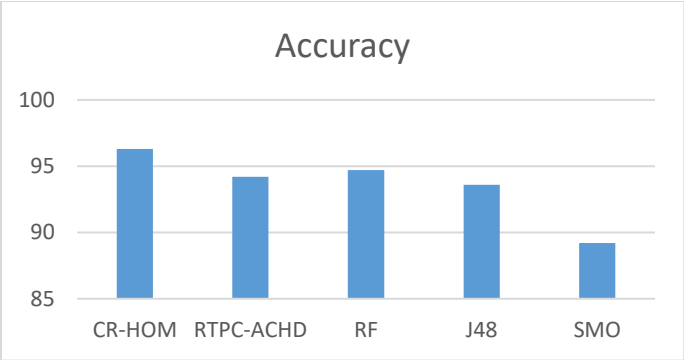

Figure 2. Comparison Of Accuracy Among Classifiers

5. Conclusion

The Proposed Cr-Hom Technique, Which Is Used For Early Detection And Prediction For Cardiovascular Risk Using Kidney Disease Patient Is A Hybrid Techniques Used In This Research Work. The Optimization Algorithm Is Used To Extract Features From The Kidney Disease And Then Select The Optimal Feature Among The Various Features That Have Been Extracted For Improving The Accuracy Of The Prediction. The Deep Neural Network Classifier Is Used To Classify The Cardiovascular Risk Factors. The Proposed Technique Examines With Various Datasets And Compare The Performance With Existing State-Of-Art Techniques. Medical Institutes Can Use This Technique For The Improved Detection And Prediction Of The Cardiovascular Risk Factors Based On The Kidney Disease Patients Using The Optimization Technique And Machine Learning Algorithms. The Experimental Results Depicts That The Proposed Technique Improves The Predictive Accuracy Than The Other Existing Techniques. The Precision Of Proposed Cr-Hom Technique Is 28.79% Improved Compared To Existing Techniques. The Outcomes Of Experiment Also Observed That, The F-Measure Of Proposed Cr-Hom Technique Is 12.98% Improved Compared To That Of Existing Techniques. The Recall Of Proposed Cr-Hom Technique Is 18.78% Improved Compared To Existing Techniques.

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