Extended Abstract

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A Predicative Knowledge Based Irrigation Decision Through Artificial Neural Networks (ANN)

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1. Abstract

Knowledge is the key for human thoughts and decision making. Developing a knowledge based management system(KBS) to mimic human thought is a critical task in a way of capturing the knowledge. Knowledge is generated from the experience and take long time to learn, also domain based. In Agriculture specially in farm irrigation, the selection of proper irrigation system plays vital role in sustainable crop production by taking attention of scarcity of water. The selection of irrigation method depends on four dimensional areas which are soil, water atmosphere and crop. Traditionally in on-farm water management, the decision marking is based on the farmer's perspective and mostly leads to over irrigation or under irrigation. In this article, we trying to evaluate the performance of Artificial Neural Network (ANN) to capture the knowledge from various history of irrigation record and methods which are include fifteen irrigation parameters and four irrigation methods such as drip, sprinkler, border and furrow irrigation. The parameters are analysed and recorded in the data sheet with respective decision for ANN process. ANN is the key for used to classify the classes based on the attributes, therefore The five ANN classifier were selected for this study which are multilayer perceptron, support vector machine (SVM), J48 IBK and naive Bayesian. Thorough this study, the above five ANN classifiers were evaluated based on their performance by implementing the algorithm for predicative knowledge based to the irrigation decision. In the beginning of the study, more than twenty-five parameters were selected as attributes then they were reduced as sixteen considering weightage contribution to accuracy in irrigation decision. Based on the study, the multilayer perceptron shows the better performance with 99.7299 correctly identified instances as Irrigation decision, K = 0.996, MAE=0.0014 and RMSE=0.0186 than other four classifiers. Finally, the multilayer perceptron was selected to model the Predicative Knowledge Based System for Irrigation decision.

Keywords: Irrigation, diagnosis, classifier, artificial neural network, knowledge base, SVM, ANN, KBS

2. Introduction and research problem/issue

On-farm water management is the importance management practice in the farm which is the key factor to determine the total crop production and income of the farmers. The under-irrigation leads adverse effect on yield, in other side over irrigation cause wastage of water. Therefore, the irrigating of water has to satisfy balancing all aspect of a crop's need. Considering world irrigation needs, the scarcity of water emphasis to select the proper irrigation method that is suited to the appropriate filed condition but the problem is still existing to select a proper irrigation method. The experienced people will take quick decision on irrigation which cannot assure the rate of accuracy, but when it incorporated with literacy in irrigation leads to more clear and precise decision. Therefore, a system is needed to collect learned experience, store and analyse data and able to predict future occurrence which is called as Knowledge Based System(KBS).

A KBS is mimicking human brain and thought process to identify and classify the different classes with set of attributes matching same as brain doing the analysis based on experience learned from past (Krishna.G et al,2013). Classification of classes is not an easy task like as brain functioning, to perform the classification in computer science

we using the neural network classifier which are consist layers of artificial neurons to generate the summertime conclusion for a specific class based on provided attributes. Total five ANN classification procedure have been used for this performance based study which are multilayer perceptron, support vector machine (SVM), J48 IBK and naive Bayesian. Multilayer Perceptron is a nonlinear back propagation with one or more layers of neuron and SVM is a discriminative, supervised leaning and separating hyper plane algorithm. J48 is tree based decision tree use the greedy method for creating trees and IBk is using k-nearest neighbour for local approximation. Naive Bayesian classifier is developed on bayes conditional probability rule used for performing classification tasks (Singh.S & Kumar.V ,2013)

3. Research Methodology

For this study, more than hundred field were observed within Ampara, Batticaloa, Kandy and Nuwera-Eliya districts and field data were collected respective to their irrigation decision, some decisions were rejected by comparing with yield history and literacy on irrigation and randomly hundred irrigation decisions were collected which are equally distributed to drip, boarder, sprinkler and furrow irrigation methods. To the weightage for decision making form the collected data the sixteen attributed were collected which are soil type, soil infiltration rate, permanent wilting point, saturation point, field capacity, crop type, average crop root zone depth, crop growing stage, source of water, type of power, average rainfall in particular season, major season, wind speed, Temperature, farmer's income status and size of field. Based on above data facts, the attribute relation file format (arff) was created for further analysis. The developed data set was submitted to JAVA based open source data mining tool called WEKA (Fauzi.M.O &

ShanYau.T.M,2007) and all experiments were done with same hardware and software configurations. In same condition, dataset was analysed as unsupervised classification with two testing types such as 10-fold cross-validation and percentage split 66% (Arora.R & Suman ,2012). During the process of classification some portion of samples were used as testing, the remaining used as test data which leads to the algorithm test itself and train the sample for identification of particular class Irrigation method. The following flowchart shows the methodology of procedure.

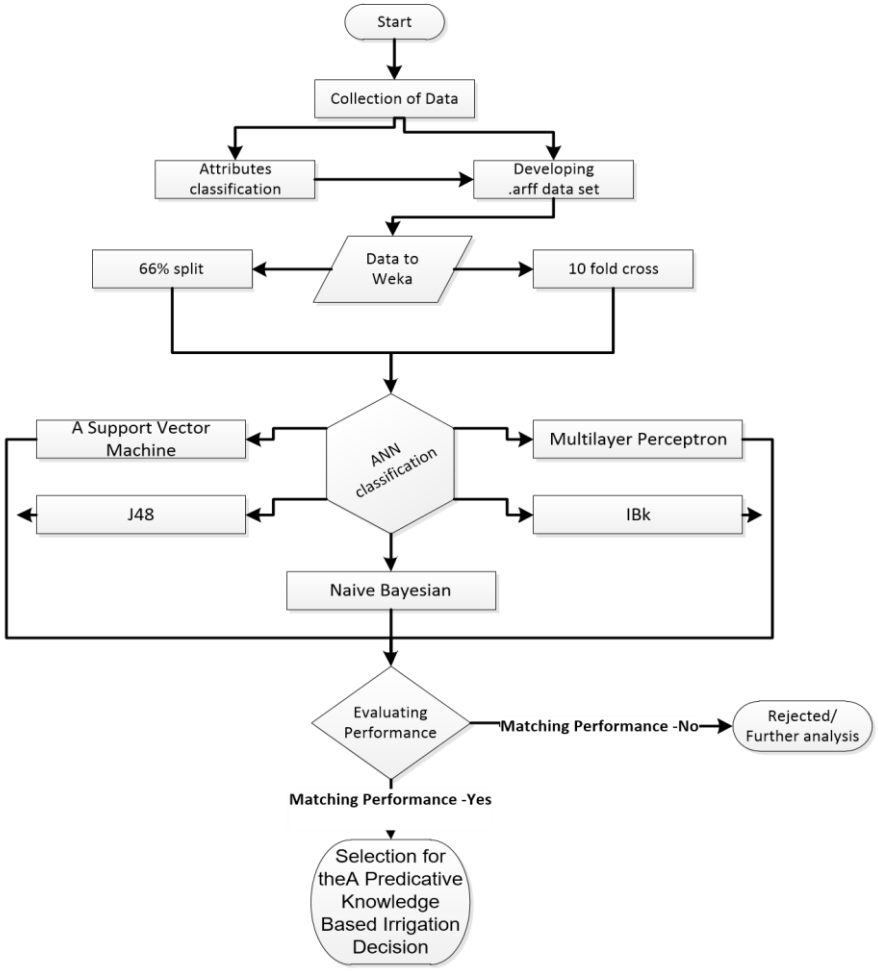
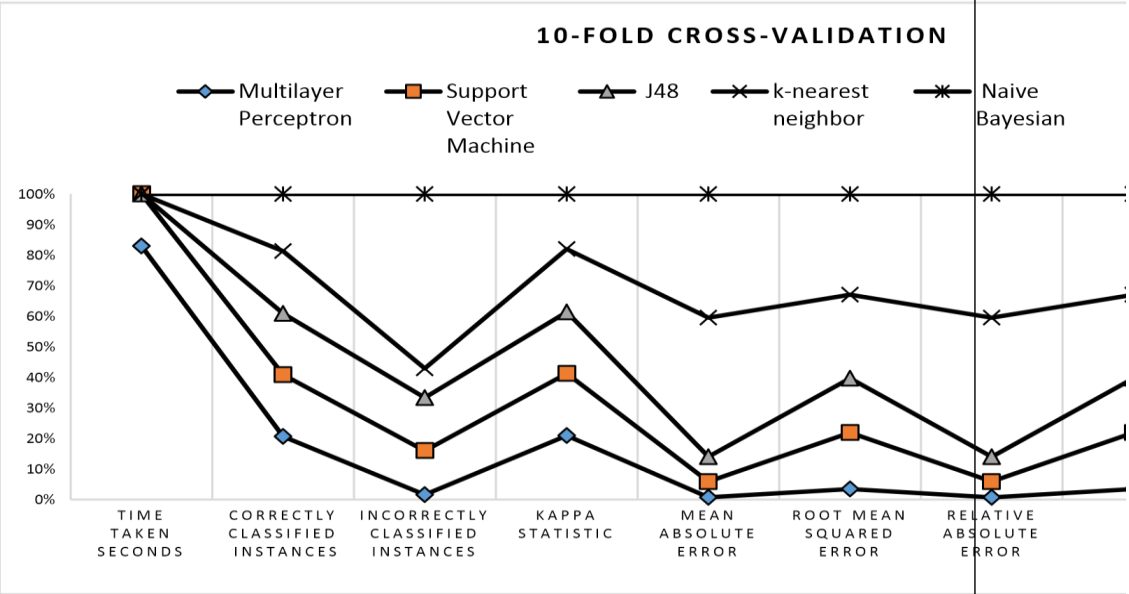


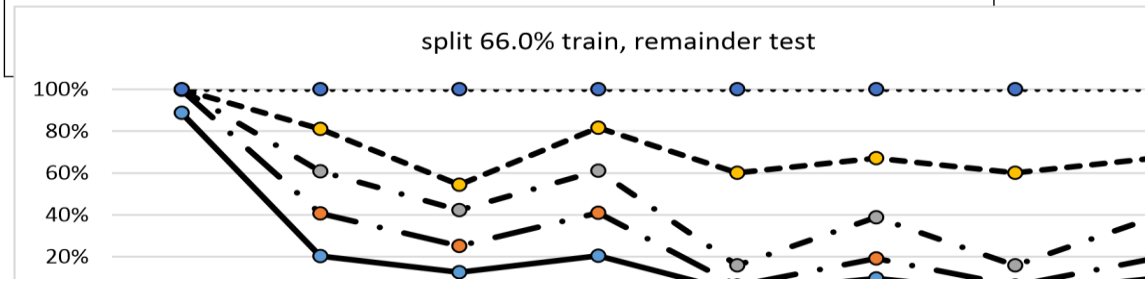
Figure 1: Methodology

4. Results and findings

The data sets have been submitted to a set of classification algorithms of Weka. Certain comparative studies were conducted and following factors were derived. Under this study, we have used two types of test mode which are 10-fold cross-validation and percentage split 66%.



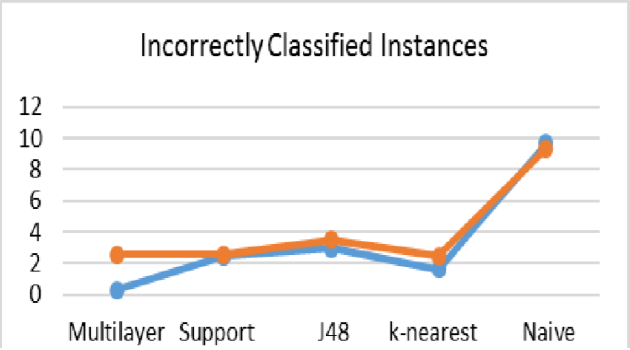
Graph 1 Results summary of 10-fold cross validation

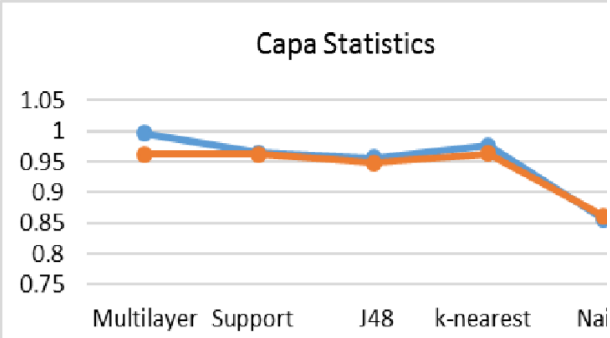


Graph 2 Results summary of 66% split

From the data process the eight parameters (see the Graph 1 and 2) were evaluated against the five ANN algorithms to classify four irrigation method. The parameters are Time taken seconds, Correctl y Classified, Instances Incorrectly Classified Instances, Kappa statistic, mean absolute error, Root mean squared error, Relative absolute error and Root relative squared error.

Consider ing the Correctly identified irrigation decisions (instances) are show ing better results under cross validation test mode. All together all classifier shows relatively similar results except the naive Bayesian classifier. It gives better results under the 66% split test mode (Graph 2).





Graph 3 Graph 4

Capa statistics coefficient is measuring of inter- agreement between the ANN classifiers and results shown between 0.81–0.99 which is almost perfect agreement between the classifiers. (Graph 4).

In overall, the testing mode the 10-fold cross validation shows high performance than 66% parentage split. In both testing mode multilayer perceptron showing high performance in correctly identifying classes than SVM but it is showing poor performance in time taken to classify the classes. According to the time the K –nearest neighbour and naïve Bayesian were performed with high performance but still poor in class identification. However, the selection of algorithm for implementation of KBS not only based on the running time, also depend on the nature of data and domain. In this study we mainly focused the accuracy of classification rather than the running of algorithms due to importance of identification irrigation decision. Anyhow still we need a human interaction to get the 100% of accuracy in implementation.

5. Conclusions, implications and significance

Based on this performance evaluation study multilayer perceptron shows the better performance with 99.7 correctly identified instances, K = 0.996, MAE=0.0014 and RMSE=0.0186 with 10-fold cross validation test mode than other four classifiers. Therefore, the multilayer perceptron was selected to implement the Predicative knowledge base for Irrigation decision and this will be feed to the KBS as knowledge from this base the irrigation decision will be derived from appropriate attribute combination.

6. References (Selected)

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