BANK NOTE AUTHENTIFICATION

INTRODUCTION

Authenticating whether a banknote is real or not is one of the most common tasks in the banking industry.

1.1overview:

Whenever you go to the bank to deposit some cash money, the cashier places banknotes in a machine which tells whether a banknote is real or not. This is a classification problem where we are given some input data and we have to classify the input into one of the several predefined categories. Rule-based as well as statistical techniques are commonly used for solving classification problems. Machine learning algorithms fall in the category of statistical techniques.

1.2purpose:

The purpose of the project is after analyzing various techniques used to detect forged banknotes, this paper presents banknote authentication for recognizing the banknote as genuine or fake by using supervised learning techniques.

Literature survey:

2.1Existing problem:

It has the major role in financial activities of every country . The study in evaluates different

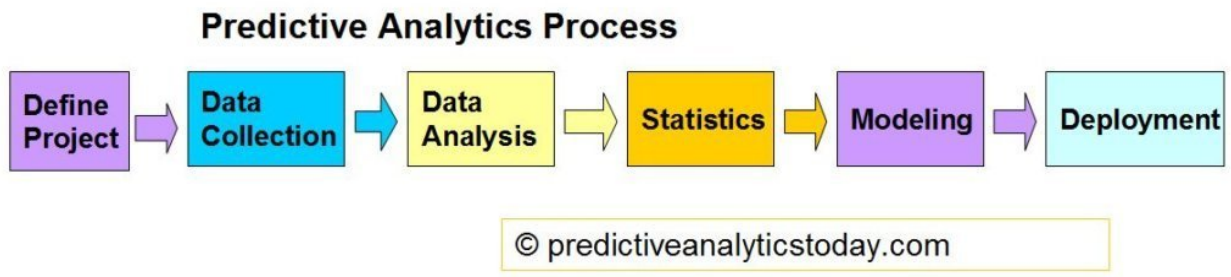
machine learning algorithms and concludes that Decision-Tree and MLP technique is best to classify a bank note. The features of the banknote are extracted using Fast Wavelet Transforms. Later, one-against-all classification approach was employed that classifies the note into four different categories: Genuine, High-Quality Forgery, Low-Quality Forgery, and Inappropriate ROI .Preserving genuineness of higher denomination is one of the critical issues.

2.2 proposed solution:

In the recent years, Soft computing techniques have been widely used to solve problems that are difficult to solve using conventional mathematical methods. Supervised learning techniques are widely used in classification problems. This paper evaluates supervised machine learning algorithms to classify genuine and fake notes, and compares algorithms on the basis of accuracy, sensitivity, and specificity. Consider someone wants to deposit money in the bank. The notes that are to be deposited are given to a human being to check for their authenticity.

Theoretical Analysis

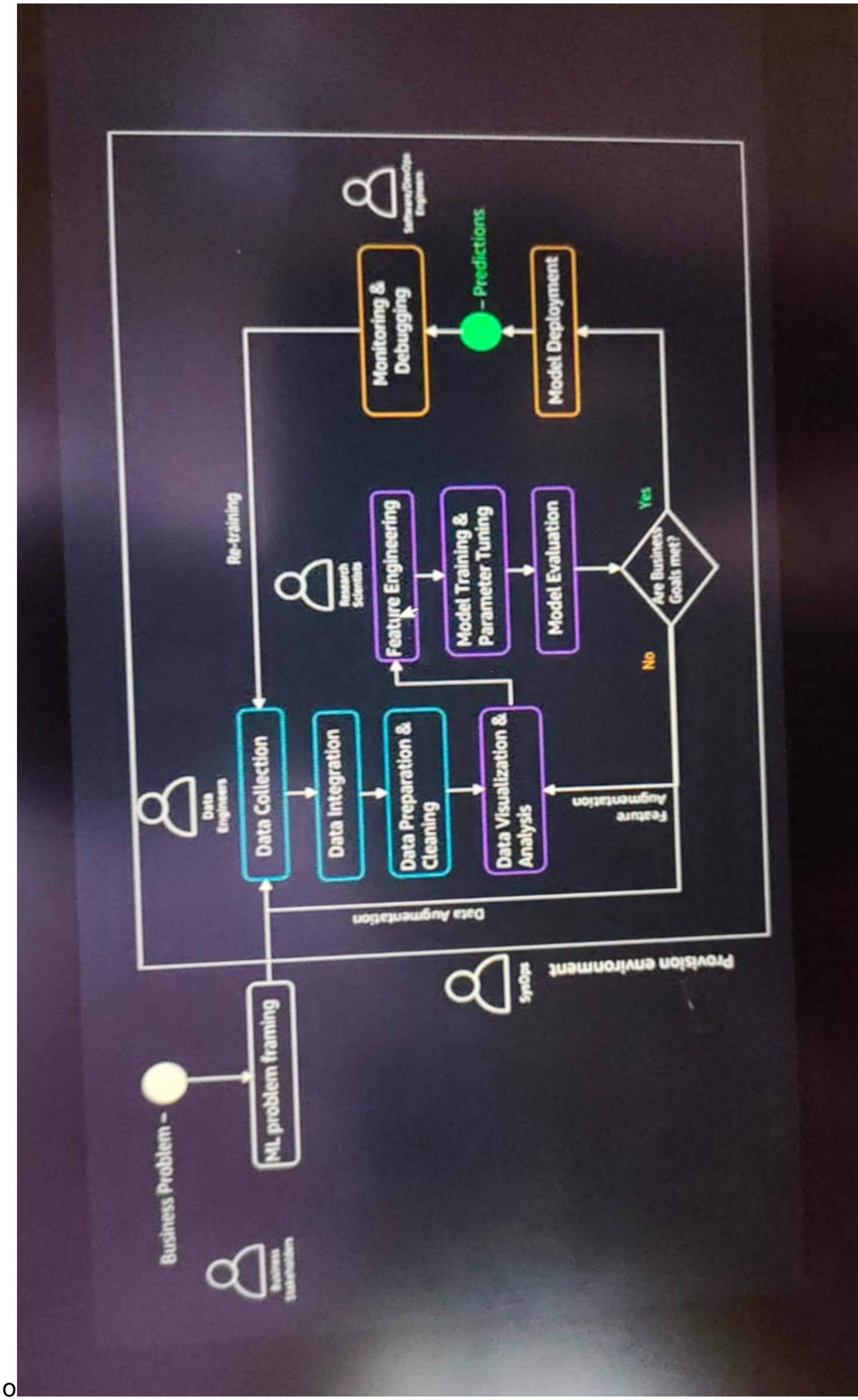
3.1 Block Diagram:



Experimental investigations

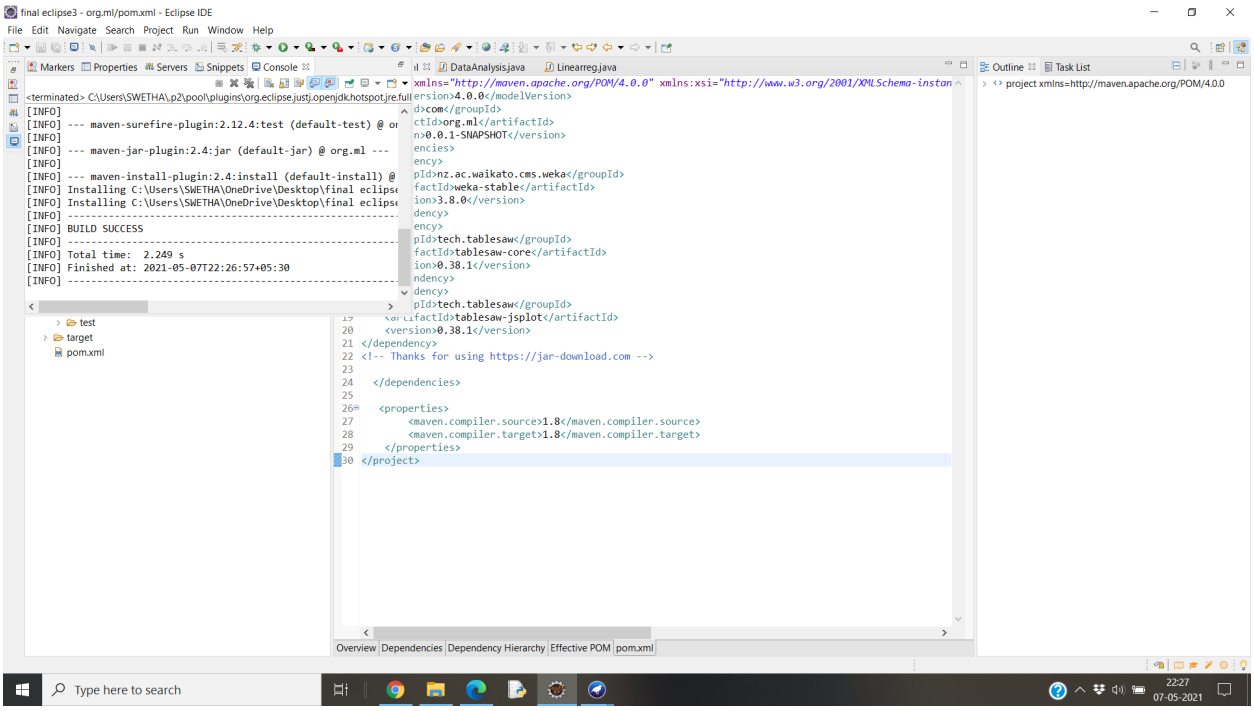
Banknotes are one of the most important assets of a country. Some miscreants introduce fake notes which bear a resemblance to original note to create discrepancies of the money in the financial market. It is difficult for humans to tell true and fake banknotes apart especially because they have a lot of similar features. Fake notes are created with precision, hence there is need for an efficient algorithm which accurately predicts whether a banknote is genuine or not. This paper proposes machine learning techniques to evaluate authentication of banknotes. Supervised learning algorithms such as Back propagation Neural Network (BPN) and Support Vector Machine (SVM) are used for differentiating genuine banknotes from fake ones. The study also shows the comparison of these algorithms in classification of banknotes.

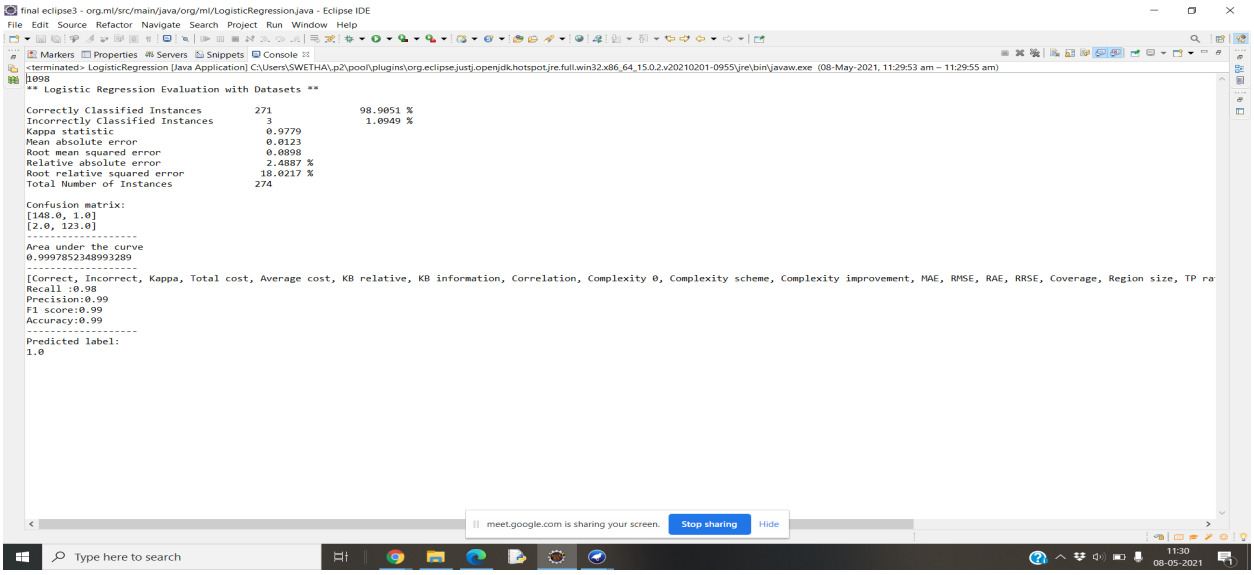
flowchart


Business Problem
ML problem framing
Business Stakeholders
Provision environment
SysOps
Data Augmentation
Data Engineers
Data Collection
Data Integration
Data Preparation & Cleaning
Data Visualization & Analysis
Feature Augmentation
Re-training
Research Scientists
Feature Engineering
Model Training & Parameter Tuning
Model Evaluation
Are Business Goals met?
No
Yes
Model Deployment
Predictions
Monitoring & Debugging

\\\\\\\flo fl

result


final eclipse3 - org.ml/pom.xml - Eclipse IDE
File Edit Navigate Search Project Run Window Help
Markers Properties Servers Snippets Console
<terminated> C:\Users\SWETHA\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full
[INFO]
[INFO] --- maven-surefire-plugin:2.12.4:test (default-test) @ or
[INFO]
[INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ org.ml ---
[INFO]
[INFO] --- maven-install-plugin:2.4:install (default-install) @
[INFO] Installing C:\Users\SWETHA\OneDrive\Desktop\final eclips
[INFO] Installing C:\Users\SWETHA\OneDrive\Desktop\final eclips
[INFO] --
[INFO] BUILD SUCCESS
[INFO] --
[INFO] Total time: 2.249 s
[INFO] Finished at: 2021-05-07T22:26:57+05:30
[INFO] --
test
target
pom.xml
DataAnalysis.java
Linearreg.java
xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instan
ersion>4.0.0</modelVersion>
d>com</groupId>
ctId>org.ml</artifactId>
n>0.0.1-SNAPSHOT</version>
encies>
ency>
pId>nz.ac.waikato.cms.weka</groupId>
factId>weka-stable</artifactId>
ion>3.8.0</version>
dency>
ency>
pId>tech.tablesaw</groupId>
factId>tablesaw-core</artifactId>
ion>0.38.1</version>
ndency>
dency>
pId>tech.tablesaw</groupId>
<artifactId>tablesaw-jsplot</artifactId>
<version>0.38.1</version>
</dependency>
<!-- Thanks for using https://jar-download.com -->
</dependencies>
<properties>
<maven.compiler.source>1.8</maven.compiler.source>
<maven.compiler.target>1.8</maven.compiler.target>
</properties>
</project>
Overview Dependencies Dependency Hierarchy Effective POM pom.xml
Outline Task List
project xmlns=http://maven.apache.org/POM/4.0.0
Type here to search
22:27
07-05-2021


final eclipse3 - org.ml/src/main/java/org/ml/LogisticRegression.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Markers Properties Servers Snippets Console
<terminated> LogisticRegression [Java Application] C:\Users\SWETHA\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_15.0.2.v20210201-0955\jre\bin\javaw.exe (08-May-2021, 11:29:53 am – 11:29:55 am)
1098
** Logistic Regression Evaluation with Datasets **
Correctly Classified Instances 271 98.9051 %
Incorrectly Classified Instances 3 1.0949 %
Kappa statistic 0.9779
Mean absolute error 0.0123
Root mean squared error 0.0898
Relative absolute error 2.4887 %
Root relative squared error 18.0217 %
Total Number of Instances 274
Confusion matrix:
[148.0, 1.0]
[2.0, 123.0]
Area under the curve
0.9997852348993289
[Correct, Incorrect, Kappa, Total cost, Average cost, KB relative, KB information, Correlation, Complexity 0, Complexity scheme, Complexity improvement, MAE, RMSE, RAE, RRSE, Coverage, Region size, TP ra
Recall :0.98
Precision:0.99
F1 score:0.99
Accuracy:0.99
Predicted label:
1.0
meet.google.com is sharing your screen.
Stop sharing
Hide
Type here to search
11:30
08-05-2021

Advantages and Disadvantages

Advantages of proposed soltution:

1. They are used in many of the financial transactions happening all over the world each and every day.
2. Although the paper used for the purpose of issuing the Banknote itself is worthless physically, it represents the value that is mentioned on its face. Also, these certificates are much lighter and more practical to carry around than piles of gold and silver, which makes it easy to use by the parties.
3. All the banknotes include the security features in them, which reduce the risk of forging. This makes it safe for the person holding the Banknote.

Disadvatages of proposed solution:

1. Banknotes are less durable, especially when compared with the coins as even if the metal coins get melt in a fire, gets submerged undersea for many of the years, than also they have some value if they are recovered. This is not the case with the banknotes as they will lose their value in those cases.
2. Before the national currencies and the efficient clearing houses, only the issuing bank can redeem the banknotes at its face value, which even cannot be discounted by the other branch of the bank. This was a very time-consuming process and required lots of effort for the person holding the Banknote.

Applications

1.Ticket counter in the metro station.verifies the money is fake or real.
2.used in cash counting machines.
3.Manufacturing or issue costs. Coins are produced by industrial manufacturing methods that process the precious or semi-precious metals, and require additions of alloy for hardness and wear resistance. By contrast, bank notes are printed paper (or polymer), and typically have a higher cost of issue, especially in larger denominations, compared with coins of the same value.

4.Wear costs. Banknotes don't lose economic value by wear, since, even if they are in poor condition, they are still a legally valid claim on the issuing bank. However, banks of issue do have to pay the cost of replacing banknotes in poor condition and paper notes wear out much faster than coins.
5.Cost of transport. Coins can be expensive to transport for high value transactions, but banknotes can be issued in large denominations that are lighter than the equivalent value in coins.

Conclusion

Extensive experiments have been performed on banknotes dataset using both the models to find the best model suitable for classification of the notes. ROC and other metrics have been calculated to compare the performances of both the techniques. The result shows that back-propagation neural network outperforms support vector machine and gives 100% success rate. These techniques are an efficient way of solving the problem for all bankingmachines that accept all types of notes. In future, this work can be extended by categorizing the notes into different categories as Genuine, Low-Quality forgery, High-Quality forgery, Inappropriate ROI

Future scope

: Machines available today are not only fake note detector but they provide an extra facility of counting them. This
feature can be added with our device that would make it as most reliable counterfeit currency detector along with
counting feature that would be helpful for banking purpose. This project discussed a technique for verifying Indian
paper currency. This project is an effort to suggest an approach for extracting characteristic of Indian paper currency.
Approach suggested from the beginning of image acquisition to converting it to gray scale image and up to the word
segmentation has been stated. The work will surely be very useful for minimizing the counterfeit currency. In Future,
Mobile app can be developed which would be useful for normal as well as visually impaired persons, the same system
can be developed for the remaining Indian currency notes and other country's currency notes. Also the app's interface
can be further modified as per the user requirements. This will increase its utilization by increasing its user network
since India is going to establish the largest digital network in the world in the coming years.

Bibilography

1.Chhotu Kumar and Anil Kumar Dudyala, "Banknote Authentication using Decision Tree rules and Machine Learning Techniques", International Conference on Advances in Computer

Engineering and Applications(ICACEA), 2015.
2. Eugen Gillich and Volker Lohweg, “Banknote Authentication”, 2014
3. Sigeru Omatu, Michifumi Yoshioka and Yoshihisa Kosaka, “Bank Note Classification Using Neural Networks”, IEEE, 2007.
4. Swati V. Walke and Prof. Dr. D. M. Chandwadkar, “Counterfeit Currency Recognition Using SVM With Note to Coin Exchanger”, International Journal of Modern Trends in Engineering and Research, July 2015.
5. Sharmishta Desai, Shraddha Kabade, Apurva Bakshi, Apeksha Gunjal, Meghana Yeole, “Implementation of Multiple Kernel Support Vector Machine for Automatic Recognition and Classification of Counterfeit Notes”, International Journal of Scientific & Engineering Research, October-2014.
6. Masato Aoba, Tetsuo Kikuchi, and Yoshiyasu Takefuji, “Euro Banknote Recognition System Using a Threelayered Perceptron and RBF Networks”, IPSJ Transactions on Mathematical Modeling and it's

Appendix

sourse code:

```
package org.ml ;

import java.util.Arrays;

import weka.classifiers.Classifier;
import weka.classifiers.evaluation.Evaluation;
import weka.core.Instance;
import weka.core.Instances;
import weka.core.converters.ConverterUtils.DataSource;

public class LogisticRegression {

	public static Instances getInstances (String filename)
	{

		DataSource source;
		Instances dataset = null;
		try {
```

```
                source = new DataSource(filename);
                dataset = source.getDataSet();
                dataset.setClassIndex(dataset.numAttributes()-1);


            } catch (Exception e) {
                // TODO Auto-generated catch block
                e.printStackTrace();

            }

            return dataset;
        }

        public static void main(String[] args) throws Exception{

            Instances train_data =
getInstances("C:\\Users\\SWETHA\\OneDrive\\Desktop\\final
eclipse3\\org.ml\\src\\main\\java\\org\\ml\\data_banknote_authentication_training1.arff");
            Instances test_data =
getInstances("C:\\Users\\SWETHA\\OneDrive\\Desktop\\final
eclipse3\\org.ml\\src\\main\\java\\org\\ml\\data_banknote_authentication_testing1.arff");
            System.out.println(train_data.size());

            /** Classifier here is Linear Regression */
            Classifier classifier = new weka.classifiers.functions.Logistic();
            /** */
            classifier.buildClassifier(train_data);


            /**
             * train the alogorithm with the training data and evaluate the
             * algorithm with testing data
             */
            Evaluation eval = new Evaluation(train_data);
            eval.evaluateModel(classifier, test_data);
            /** Print the algorithm summary */
            System.out.println("** Logistic Regression Evaluation with Datasets **");
```

```
                System.out.println(eval.toSummaryString());
//              System.out.print(" the expression for the input data as per alogorithm is ");
//              System.out.println(classifier);

                double confusion[][] = eval.confusionMatrix();
                System.out.println("Confusion matrix:");
                for (double[] row : confusion)
                        System.out.println(     Arrays.toString(row));
                System.out.println("-----------------");

                System.out.println("Area under the curve");
                System.out.println( eval.areaUnderROC(0));
                System.out.println("-----------------");

                System.out.println(eval.getAllEvaluationMetricNames());

                System.out.print("Recall :");
                System.out.println(Math.round(eval.recall(1)*100.0)/100.0);

                System.out.print("Precision:");
                System.out.println(Math.round(eval.precision(1)*100.0)/100.0);
                System.out.print("F1 score:");
                System.out.println(Math.round(eval.fMeasure(1)*100.0)/100.0);

                System.out.print("Accuracy:");
                double acc = eval.correct()/(eval.correct()+ eval.incorrect());
                System.out.println(Math.round(acc*100.0)/100.0);


                System.out.println("-----------------");
                Instance predicationDataSet = test_data.get(2);
                double value = classifier.classifyInstance(predicationDataSet);
                /** Prediction Output */
                System.out.println("Predicted label:");
                System.out.print(value);


        }
```

}

Logistic regression predicts the actual value.