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E-Mail :
editor.ijasem@gmail.com
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Decision Tree Classifier for the Analysis of Firework Industry Risk Factors

[1] P. Premchand, [2] K. Rishika,

[1]Assistant Professor, Megha Institute of Engineering & Technology for Women, Ghatkesar.
[2] MCA Student, Megha Institute of Engineering & Technology for Women, Ghatkesar.

Abstract—
With the nation's decision to include intellectual capacity into its industrial processes, data mining methods, big data, machine learning, and artificial intelligence are all becoming more important in the field of occupational health and safety prediction. The primary cause of mortality in the fireworks business has been fireworks-related accidents (FIAs), which have long been a major international issue. Some of the many factors associated with fireworks accidents—chemicals, facilities, transportation, temperature, friction, etc.—are more significant than others in determining the accident's severity. In order to put things right, the industry's performance may be improved by analyzing worker safety behavior or conducting risk assessments. Some important indicators of human health and safety may be identified and predicted with the use of analytical data mining techniques. This method was put to the test using a genuine dataset. This study uses decision tree classifier classification methods to forecast the risk factor in the fireworks industry relative to safety measures.

List of Terms: Data Mining Methods, Decision Tree Classifier, Risk Evaluation, and Employee Security.

INTRODUCTION

Subject Area (A) The city of Shivakasi in India's Vrindavan district was the country's top maker of iron and steel goods until China overtook it. Think about the safety of the city's about a thousand fireworks units' personnel. For the majority of the year, the weather in the Vridunagar area is scorching and dry, just right for making pyrotechnics. Since there is an abundance of inexpensive labor in this area, the only viable occupation for the locals is working in the fireworks business. The display of light, music, and smoke in fireworks is created by harmful compounds and dangerous chemicals. Perhaps more injuries occur in the production of pyrotechnics than in any other industry.

Figure:1: Employees at firework industry (Source: ajantafireworks.co.in)

Section A. Workplace Safety The liberty from danger, accident, risk, and individual safety is what the term "protection" means. Workers' safety is of the utmost concern, according to the Factories Act [1]. Preventing injuries and illnesses among workers via the implementation of safety measures and the upkeep of a healthy and stable work environment is the essence of occupational security [2]. Workplace accidents are a major issue in every industry. Worldwide, industrial risks are responsible for more than 317 million annual working deaths, according to estimates from the International Labor Organization (ILO) [3]. Part B: Datamining Data mining facilitates the extraction of relevant information from complex and massive datasets. Data mining methods are helpful for making predictions and analyzing data. Classification classifies the preset markers of groups using an unsupervised learning approach [4]. A variety of categorization algorithms are available, including decision trees, neural networks, genetic algorithms, and others. These methods may be used to build the model for categorization. Classification models like this are useful for looking into the past to see what the future holds [5]. Finding the optimal decision tree model for

evaluating the most important risk indicators in this industry using a decision tree classifier was the goal of this investigation.

LITERATURE SURVEY

A popular probabilistic classifier, the decision tree achieves remarkable parity among precision, efficiency, and correctness of facts [6]. The decision tree is a powerful tool for estimate and classification that has its roots in machine learning theory. The decision tree is computationally quick, works with data stated in different factor analyses, and does not require statistical assumptions, unlike many other statistical studies [7]. One apparent benefit of the decision tree is that its structures accurately portray the estimating process and the relative importance of the important explanatory factors [8]. The importance of data mining has been highlighted by research into the predictive power and interpretive potential of data mining tools for occupational risk management [9]. One area where the decision tree has shown to be quite helpful is in identifying potentially dangerous industrial workplace situations [10].

MATERIALSANDMETHODS

The most recent retrospective study was conducted in the fireworks business in Sivakasi, Tamil Nadu. An industrial complex that used potentially harmful chemicals was the site of the study. As a result, an explosion occurs. Prioritizing safety measures is crucial in order to reduce the risk of injury and death. A. Dataset The following information is derived from 157 records that were filled out by the employees: name, age, gender, experience, safety measures, risk factors (such as first aid and fire service), and questionnaires. Two numerical, four textual, and eight categorical values make up the dataset's fourteen attributes. The decision tree is trained and tested on separate portions of the whole dataset, which are 70 percent and 30 percent, respectively. Here, the methods of the traditional KDD approach will be put into practice. Data and information preparation initiates the method, which is defined by the development of the classification problem and culminates in the suggested model and analysis. B. Making a Decline Decision Tree Classifier is an effective and widely used input picture. The categorization problem is addressed by using a simple idea. An attribute test is represented by an internal node in a decision tree, a test result by a branch, and a class name by a terminal node. The decision tree resembles a tree diagram. [11]. C. Secret Agent It's a rare combination of a robust development tool with the data discovery, immersive implementation, deep analysis, and stunning visualization tools of a science kit [12]. Spyder is a scientific environment written in Python that is free and open source and developed by and for scientists, engineers, and data analysts. D. Datapreprocessing Data preprocessing is an important part of data mining. Data efficiency is strongly correlated to the quality of the results. Missing values were applied using the random forest technique in the results. E. Selecting characteristics To increase prediction accuracy and decrease model overfitting, feature selection is a technique for picking out a subset of certain features or attributes to use as dependent variables in a statistical model [13].

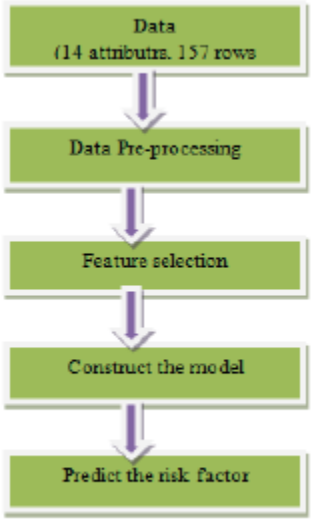

Figure 2: Proposed methodology

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Classification and Regression Tree is a regularly been utilizing decision tree classification approach. It is a multivariate statistical strategy that might be utilized for both regression and classification by categorizing numerical dependent variables, respectively [14].

RESULTANDDISCUSSION

A. Classifying data frames:

There are two datasets, X and Y. X is for safety measures, with an emphasis on things like fire services, personal protective equipment, and first aid. The values in X should be 1. Very well, 2. Above average and 3. Not good. A potential risk factor is the Y values. According to the respondent, the fireworks industry is known for its high level of risk. Here, no risk factor is deemed to be zero, and the value of risk factors is one.

```
    #splitting it into X and Y data
X = data[['First aid1','Fireservice1','PPE1']]
Y = data[['Risk factor1']]
#executing the decision tree classifier
dt = tree.DecisionTreeClassifier()
dt = dt.fit(X, Y)
#Importing the libraries to visualize the decision tree
import pydotplus
#import collections
from IPython.display import Image
data_feature_names = [ 'First aid1', 'Fireservice1' ,'PPE1' ]
dot_data = tree.export_graphviz(dt,
feature_names=data_feature_names, out_file=None)
graph = pydotplus.graph_from_dot_data(dot_data)
 Image(graph.create_png())
#Prediction using Decision tree algorithm
prediction = dt.predict([[0,0, 1]])
```

Result analysis:

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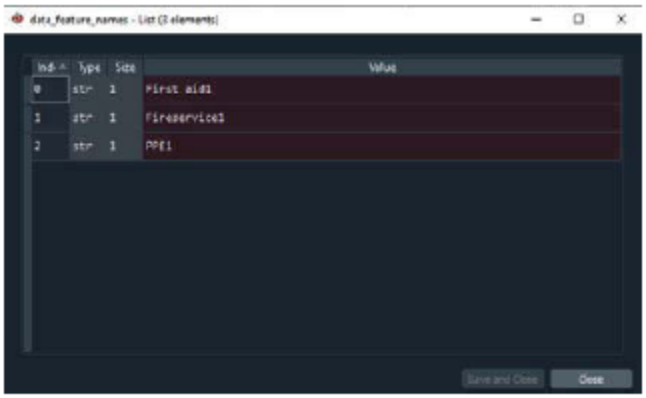

Figure 3: Data frame of X data

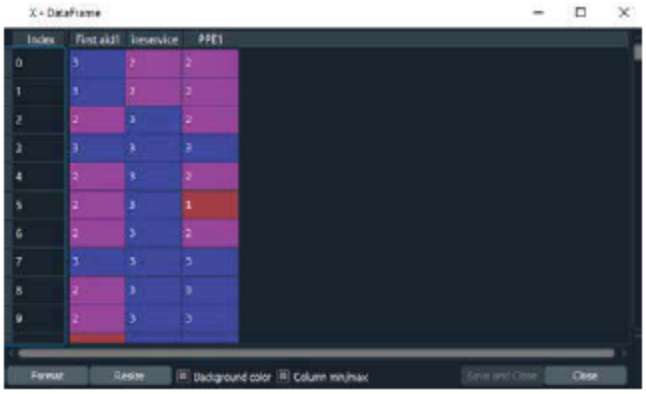

Figure4: Values among X data

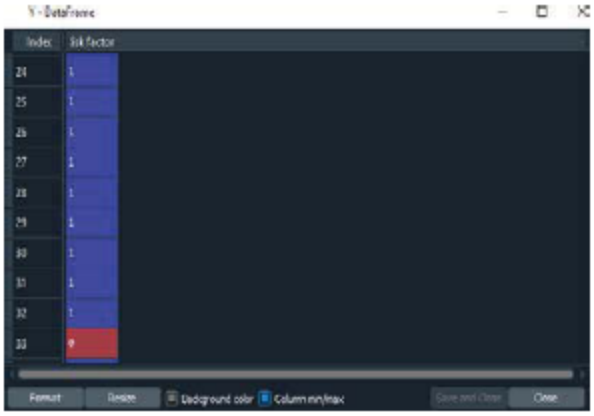

Figure 5: Values among Y data

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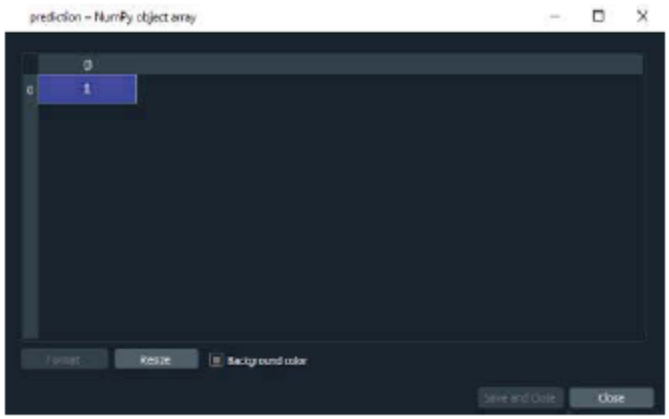

Figure 6: Prediction of risk factor

Fig 7: Decision tree evaluation of risk factor

CONCLUSION AND DISCUSSION

The Factories Act of 1948 establishes safety standards for the pyrotechnics sector. Within the factory, it prohibits the usage of power. A number of provisions pertaining to the production of cracker fuses, as well as regulations for the proper maintenance of dwellings, protective attire, and the employment of women, are included in the Act. The following are examples of human mistakes that might cause fireworks-related accidents: [15] • Iron knives are not to be used for cutting fuses. • Crushed crackers are to be dried on the floor. • Workers are allowed to work outside the shed. • Overloading chemicals during the filling phase. • Hazardous processing of chemicals that are not needed. The making of illicit crackers The use of prohibited substances like potassium

chlorate The use of plastic sheets Pay close attention to this lack of care and adhere to the safety protocols set forth by the government; doing so will assist to lessen the dangers associated with these sectors.

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