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SONAR ROCK VERSUS MINE PREDICTION USING MACHINE LEARNING

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ABSTRACT

Generally, it is impossible task to detect the underwater objects manually. The discovery of rocks and minerals would have been very difficult past the development of the SONAR technique, which relays on certain parameters to be able to detect the obstacle or the surface is a rock or a mine. The aim is to predict metal or rock objects from sonar return data. This prediction can be done using Logistic Regression algorithm. There are two types of sonar technology used, passive (listening to the sound emitted by vessels in the ocean) and active (emitting pulses and listening for their echoes).

The main concern of analysis in the field of machine learning is being to form a scheduled computational machine for the categorizing the forecast of the objects, based on the attainable information. The outcome of proposed framework is to detect objects under water which helps to predict the triggered sound waves reflect back from what surface: Rock or a Mine. The dataset has been collected from UCI Repository.

We are using Machine Learning and Algorithmic concepts such as Logistic Regression, K-nearest neighbor [KNN], C-means Clustering extensively to pre-process the data which helps in data visualization.

I. INTRODUCTION

The main idea of **Sonar Rock Vs Mine Prediction** is to distinguish between metal substance (mines) and materials that are mineral ores (rocks) by using SONAR signals, which is an acronym for **So**und **Na**vigation and **R**anging.

It is a technique based on the principle of reflection of ultrasonic sound waves. These waves propagate through water and reflect on hitting the ocean bed or any object obstructing its path. It uses sound waves to detect objects underwater. Machine learning-based tactics, and deep learning-based approaches have applications in detecting sonar signals and hence targets.

The main aim is to emanate a machine learning algorithmic characteristics (Logical Regression Algorithm), which can figure out if the target of the sound wave is either a rock or a mine.

Sonar (sound navigation and ranging) is a technique based on principle of reflection of ultrasonic sound waves. These waves propagate through water and reflect on hitting the ocean bed or any object obstructing its path and recognize it.

- Let`s look at few objectives and Constraints.
  - Logistic Regression must be a supervised learning algorithm.
  - Locate underwater hazards to navigation.
  - Model should be trained by learning from the dataset.
  - Submarine needs to predict whether it is crossing a rock or mine.

PROBLEMSTATEMENT

Underwater Mine usage by the naval defence system provides great security but also possesses a threat to the marine life and submarine vessels as the mines can be easily mistaken for rocks. We need a much more accurate system to predict the object as it is very dangerous if a mistake is made.

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II. LITERATURESURVEY

- Dura, Esther, et al. "Active learning for detection of mine-like objects in side-scan sonar imagery." IEEE Journal of Oceanic Engineering 30.2:360-371 (2005).

Detection of mine-like targets using side-scan sonar imagery is complicated by the variability of the target, clutter, and background signatures. Specifically, the strong dependence of the data on environmental conditions vitiates the assumption that one may perform a priori algorithm training using separate side-scan sonar data collected previously.

- Sri Ramya Yaramasu, underwater mine & rock prediction by evaluation of Machine Learning Algorithms Fourier transform, wavelet transform, limit cycle, etc. are signal processing methods applicable for an underwater acoustic signal. Machine Learning enables the processing of sonar signals and target detection. It is a subfield of artificial intelligence which tells machines how to manipulate data more proficiently. The three stages of Machine Learning are **taking some data as input, extracting features,** and **predicting new pattern**s..
- Baida's Abdul-Qader Techniques for classification sonar: rocks vs mines

This work is concerned with a process of distinguishing between metal cylinder (mines) and materials that have a cylindrical shape (rocks) by usingsonar images or signals. Three techniques were used. They were :Neural Networks, Adaptive Neuro-Fuzzy Inference Systemand k-Nearest Neighbor, by using(before and after)one of the most feature selection procedure widely used which is called Sequential forward selection (SFS)

III. EXISTINGSYSTEM

- The existing system, This technique relays on certain parameters to be able to detect the obstacle or the surface is a rock or a mine.In general, it is an impossible task to detect the underwater objects manually The discovery of rocks and minerals would have been very difficult past the development of the SONAR technique.
- Disadvantages

1. The accuracy will be very low.
2. Quality of detection becomes a major issue.
3. It fails whenever if the distance is too large.
4. Explosive that explodes when some objects in contact with it.

IV. PROPOSED SYSTEM

- The basic idea is to predict if the substance is a metal or rock from sonar returned data.There are two types of sonar technology used passive (listening to the sound emitted by vessels in the ocean) and active (emitting pulses and listening for their echoes).
- This Prediction can be done using Machine Learning Algorithm namely logistic Regression Algorithm. The main advantage is we can predict from a longer distance and the accuracy is high .
- We have proposed a predictive system to give accurate results and outcomes.
- We utilized the dataset from "Analysis of Hidden Units in a Layered Network
- Trained to Classify Sonar Targets" by R. Paul Gorman and Terrence J. Sejnowski.
- They employed SONAR to perform trials in a simulated region with metal cylinders in place of mines. The object was struck with sonar signals from 60 various angles, and the results were recorded. The dataset is then trained to the evaluated models.
- The Sonar output frequencies are sent into the predictive system as input.

THE WORKFLOW

First of all, we need to collect the SONAR data. In the laboratory, an experiment may be done in which the SONAR is used to send and receive the signal bounced back from some metal cylinders and rocks because the mine will be made of metals. The scientists collect the SONAR data obtained from the metal cylinder and rock.

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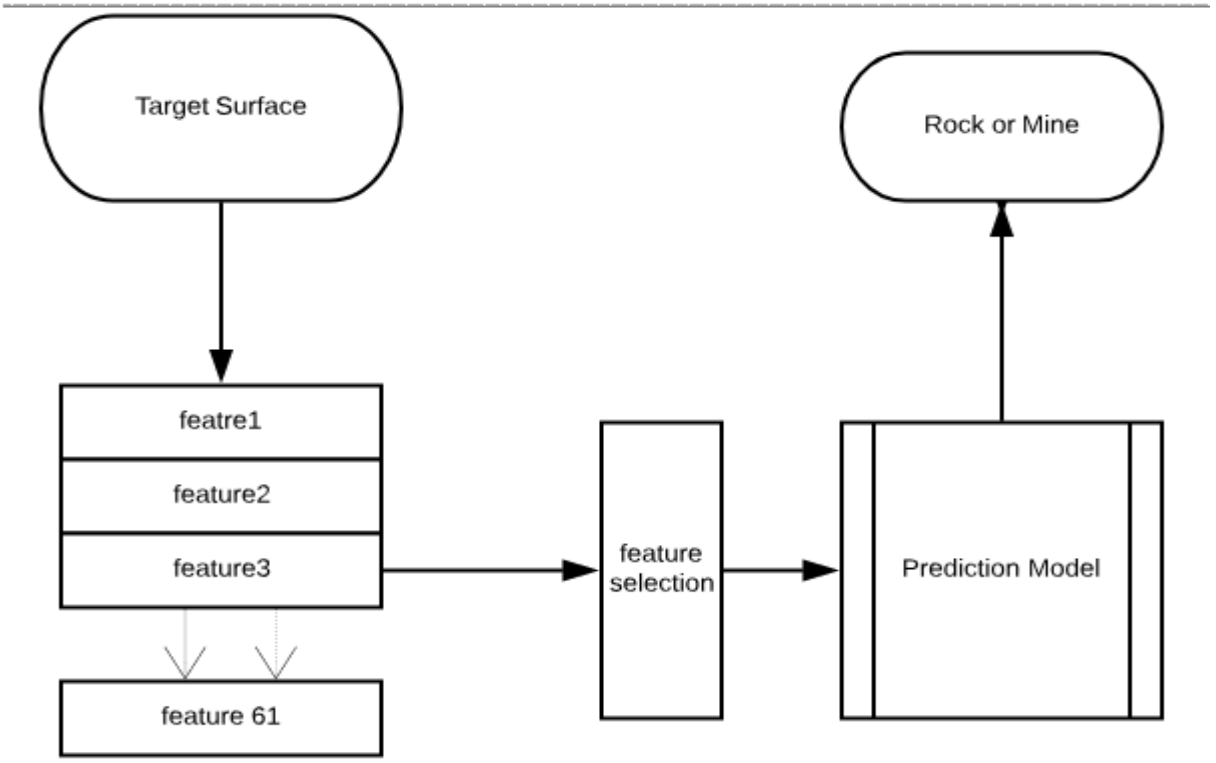
When we have the dataset, we shall process the data. Because the data may not be used directly, we must preprocess the data. After that, the data will be split into the training and test data. Then, we will feed the dataset of SONAR data to our Machine Learning model. As mentioned above, the logistic regression model is used because this model works very well for binary classification problem, and this problem is a binary classification problem due to a fact that we are going to predict whether the object on the seabed is the mine or rock. The next step is that logistic regression model will be trained by learning from the dataset.

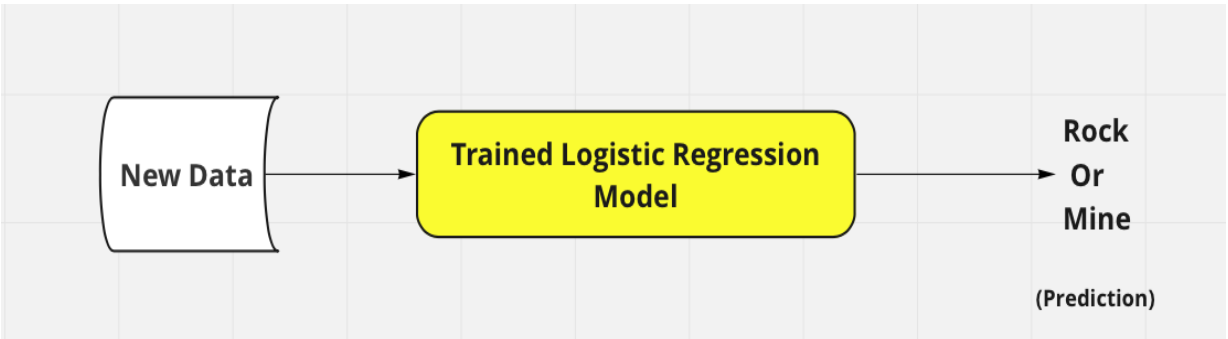
Thus, the workflow is shown by the following process:

- SONAR Data --> Data preprocessing --> Train test split --> Logistic Regression model
- New Data --> Trained Logistic Regression model --> Rock (R) or Mine (M)



V. RESULT AND CONCLUSION

The accuracy of predicting the object whether it is a rock or mine is higher using Logistic Regression than other algorithms. Why Logistic Regression Model? Because, this model works very well for Binary Classification Problem. It is a Binary Classification Problem (Rock or a Mine). This is a Supervised Learning Algorithm.



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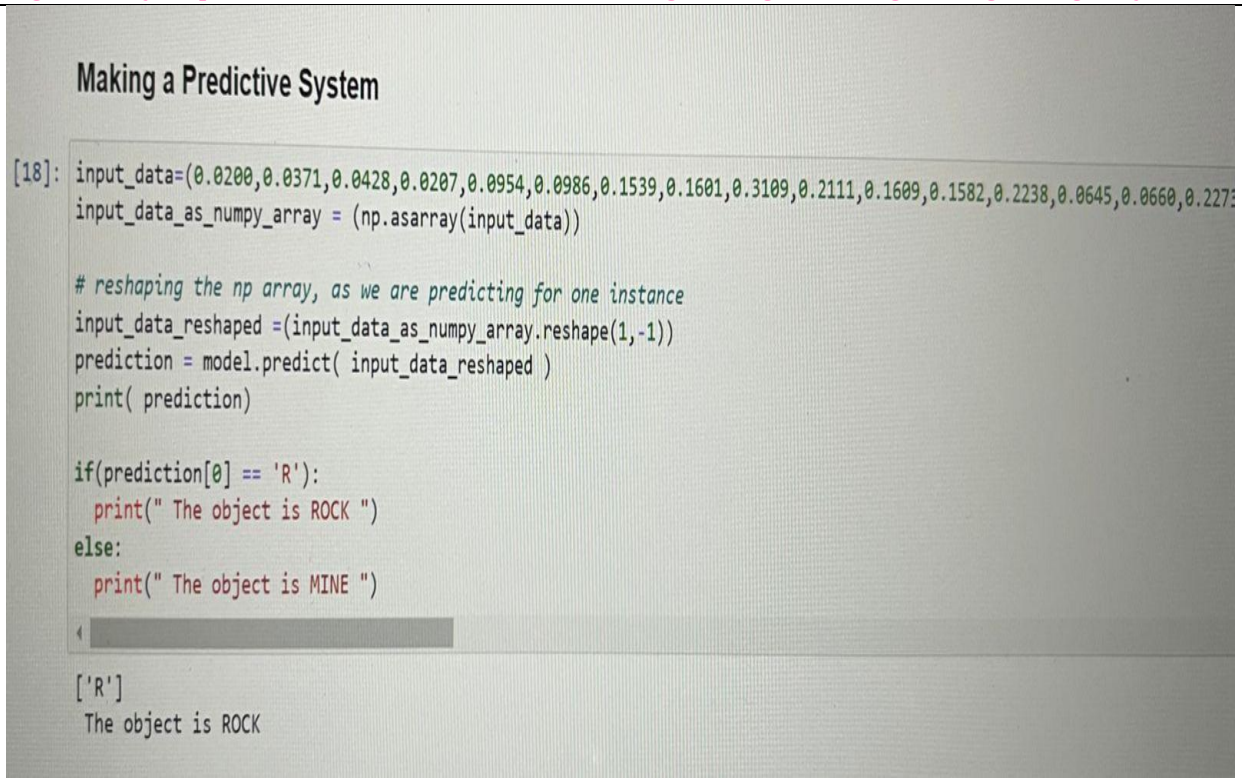

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