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Motion Detection and Prediction Using ML: Logistic Regression

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Abstract: Machine Learning is a subset of Artificial Intelligence (AI). Huge set of data is provided to the machine which is trained using any of the Machine Learning algorithms. In this paper we acquire data from real-time motion sensors continuously over a long period of time. Along with historical data stored in the database, the present runtime data is analysed and used to train the machine. The machine is provided with enough data to learn for itself creating a predictive model with a particular accuracy. Ultrasonic sensors are mounted at different orientations, continuously gathering data of the ether. The data acquired is then analysed, visualized and used for future predictions/ conclusions. Accuracy check is carried out to verify the exactness of the predicted data.

Keywords: Data Analytics & Machine Learning, Data pre-processing, Logistic regression, precision, F1 score, categorical values, visualization, an array of ultrasonic sensors is placed at different orientations

I.INTRODUCTION

21st century is the era of data, information, and Intelligent Systems. The data could be

i. Historical data
ii. Present data
iii. Data obtained through prediction

Machine Learning algorithms are designed to work on the provided data to make predictions accordingly. Logistic regression is one such Machine Learning algorithm used to model the probabilities for classification problems with two possible outcomes. It is an extension of Linear Regression model for classification problems. It can be defined as

$logistic(\eta) = 1/(1+exp(-\eta))$

```
In [2]:
import pandas as pd
import numpy as np
import seaborn as sns
%matplotlib inline
import matplotlib.pyplot as plt
```

Figure 3 shows the Python code to import libraries.

II.MOTIVATION

Motion detection of objects or living beings might be interesting in many domains, such as security devices, radars, the positioning of industrial robots, vehicular traffic density and auto guidance system. Most of these applications require that the detection system to be non-invasive and do not disturb the normal work environment, devices or living beings in the area of detection. This involves the choice of discrete vectors for information transport, with high immunity to all other factors. [1]

III.PROBLEM STATEMENT

An array of ultrasonic sensors is placed at different orientations collecting data for a particular interval of time. The acquired sensor values are subjected to pre-processing, data analytics and visualization. The prepared data needs to be fed to the machine, for it to learn. A prediction model to be designed using logistic regression and checked for accuracy, F1 score and precision.

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IV.BLOCK DIAGRAM

Figure 1 shows the block diagram of the proposed system. The sensors S1, S2, S3 and S4 are placed in an array at different orientations. More sensors could be added to obtain better result. An ultrasonic sensor continuously records data and is moved to the database. The data can be pre-processed before storing or formatted after, on the excel sheet.

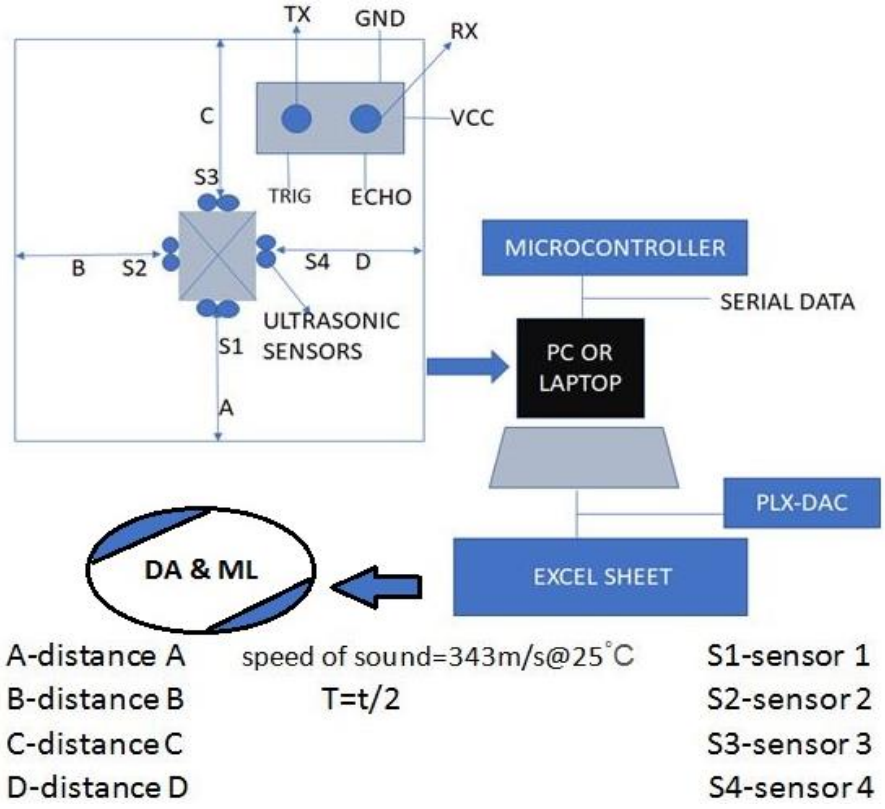

Figure 1 shows the block diagram of the proposed system.

```
In [10]:
df.isnull()
Out[10]:
```

	code	Sales in thousands	year resalevalue	Vehicle type	Price in thousands	Engine size	Horsepower
0	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False
5	False	False	False	False	False	False	False
6	False	False	False	False	False	False	False

Figure 4 shows the Python code to check for NaN.

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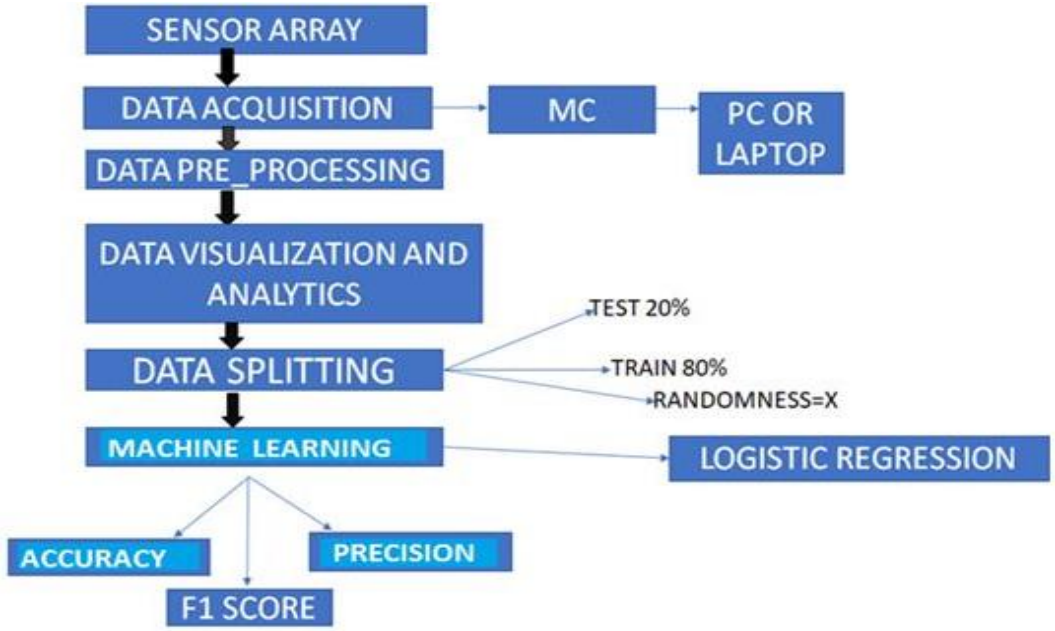

Figure 2 shows the work flow diagram of the project.

```
In [20]:
from sklearn.model_selection import train_test_split

In [77]:
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=12)
```

Figure 5 shows the python code to split the data set into train and test data.

```
In [82]:
from sklearn.linear_model import LogisticRegression

In [85]:
logmodel= LogisticRegression()
logmodel.fit(X_train,y_train)
```

Figure 6 shows logistic regression on given data set.

V.METHODOLOGY

Figure 2 shows the work flow diagram of the project. The work process can be achieved in the following steps

i. Data acquisition from the sensor array and storing in the database. Figure 3 shows the Python code to import libraries. [2]
ii. The data may contain noise, NaN values, and information that should be treated before analysis or visualization. This is called data pre-processing. Figure 4 shows the Python code to check for NaN. [3]
iii. The pre-processed data is now eligible for data analytics and data visualization. Graphs and statistical formulas enhance the process of AI.
iv. Heatmap analysis is done for knowledge of correlation. The data is split into train and test using a particular randomness factor 'X'. Figure 5 shows the python code to split the data set into train and test data. [4]
v. A predictive model is designed using Logistic regression and its accuracy is verified. Figure 6 shows logistic regression on given data set. [5]

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VI.CONCLUSION

Motion detection is a simple task because of the improvement in the sensor technology and with ever increasing accuracy of the same. The major challenge that we have encountered is the prediction of motion of any object with the existing data and runtime data. This can be done by Machine Learning algorithms which allow the machines to learn on their own. Logistic regression is one such Machine Learning algorithm used to model the probabilities for classification problems with two possible outcomes. Ultrasonic sensors were mounted at different orientations, continuously gathering data of the ether. The data acquired is then analysed, visualized and used for future predictions/ conclusions.

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BIOGRAPHY

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