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Human movement detection and prediction for business analytics using machine learning

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Abstract
Machine learning is a branch of Artificial Intelligence, where the computer is fed a large amount of data and algorithms are written to help the computer learn by itself Machine learning is a branch of Artificial Intelligence, where the computer is fed a large amount of data and algorithms are written to help the computer learn by itself. In this project, ultrasonic sensors are mounted in different directions, which transmit and receive ultrasonic signals, thus detecting objects in their vicinity and measuring the distance of the target object with respect to the source. The distance is measured in real time continuously, stored in the database. This is replicated daily building an immense database. Using machine learning models such as logistic regression, the historical data stored in the database along with the run time data generated by the array of sensors is used to predict future events. These data are assessed as being of a categorical nature, and logistic regression therefore plays an important role. Ultrasonic range module HC— SR04 provides 2 cm— 400 cm non-contact measuring capability, range accuracy can reach 3 mm. This sensor is a common sensor used in many applications where distance measurement or sensing artifacts are needed.

Keywords: HC-SR04 Ultra Sonic Sensor, Artificial Intelligence, Machine Learning, Logistic Regression, Fuzzy Logic, Randomness, Probability

Introduction
Distance measurement without contact can be done using various strategies, in line with the chosen principle. In numerous applications, transmitters and receivers make use of infrared radiation, the space being measured using tactics of optical triangulation. Alternative ways of distance mensuration are supported by optical devices, a way of providing redoubled accuracy and exactitude. Motion detection of objects or living beings could be fascinating in several areas, like security devices, in radars, positioning of commercial robots, liquid levels in tanks, the depth of snow bankand car steering systems. Most of these applications require that the detection system be non-invasive and not disturb the detection area's normal work environment, devices or living beings.This involves the selection of discrete vectors for the transportation of information, with high immunity to all other factors except the state of motion.
Twenty first century is the era of data information and Intelligent Systems.

The data may be,

i. Historical knowledge.
ii. Gift knowledge.
iii. Knowledge obtained through prediction.

```
In [2]:

import pandas as pd
import numpy as np
import seaborn as sns
%matplotlib inline
import matplotlib.pyplot as plt
```

Fig.1. Libraries of Python Code

Literature Survey:

1."Moving object tracking system based on an automated ultrasonic detection algorithm":
It can be concluded that the ultrasonic sensors are used to calculate the motion for which its 2D co-ordinates are to be set.It helps to overcome the errors in calculation with respect to the programs that have been incorrectly developed.
2."Real Time Traffic Control Signal Using Fuzzy Logic":
Fuzzy Logic is used as a dynamic control device for enhanced traffic flow efficiency at each road intersection.

Methodology:

Ultrasonic sensors are mounted in different orientations that are attached to the Arduino board as shown in fig-2, the values are taken from the sensors to the Arduino IDE serial monitor. The values shown on the serial monitor are not valid for completion of any process. Using the PLX-DAQ, inclination to access the Arduino board's data to square out the sheet where the data is monitored and developed; Therefore an tendency to Jupyter Notebook where the Python code is written for testing and training is done on performing the prediction. Using these values we forecast performance which is more reliable and precise.

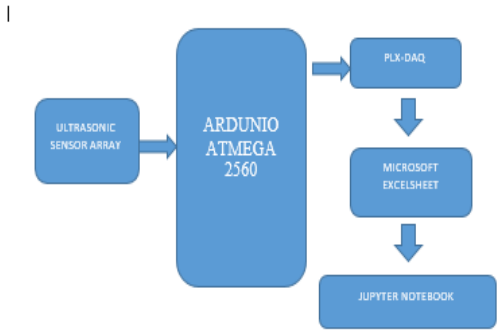


Fig-2: Diagram of the Proposed System

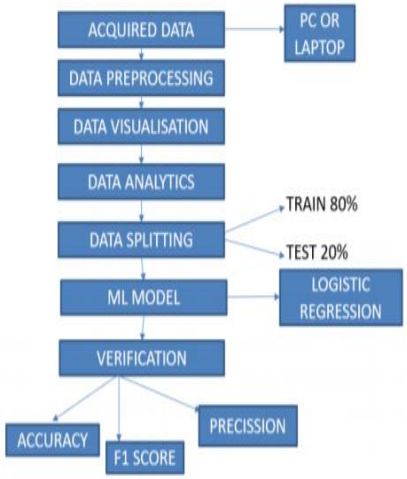


Fig-3 Flow Chart

Circuit Diagram:

An ultrasonic sensor has the main purpose of measuring the distance to an object using ultrasonic sound waves. It is composed primarily of 4 pins (i.e. VCC, Trigger, Echo, Ground). The VCC pin will control the system and will be attached to the Associate's + 5V board in Nursing Arduino. Trigger pin functions as Associate in Nursing input pin and has to be set to 10us high, so it initializes the measurement of sound waves and is connected strongly to the Associate in Nursing Arduino board transmitter pins. Echo pin serves as Associate in Nursing output pin and it goes high for a certain period of time that could be capable of the time taken for the supersonic sound waves to return to the system until Associate in Nursing is identified as an obstacle.It is attached severely to Associate's receiver pins in Nursing Arduino board as shown in fig-5.The ground pin attaches to the board's reference pin.This board is integrated with an Arduino IDE, so that the output can be programmed and executed.

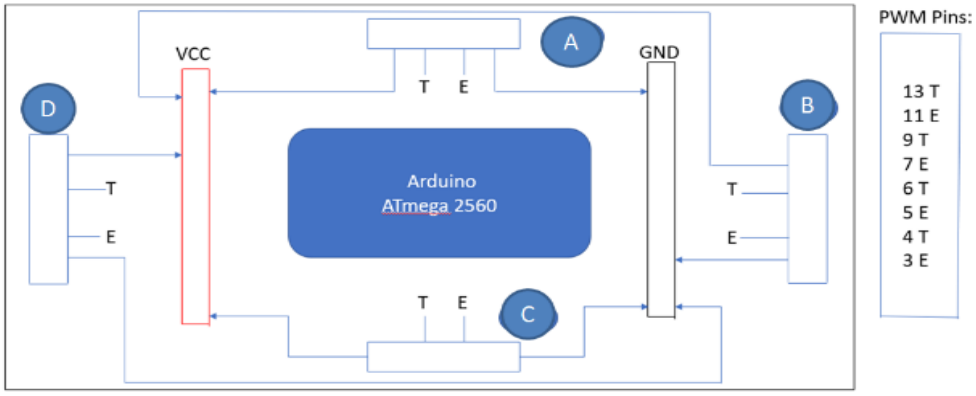


Fig 4 – Layout Diagram

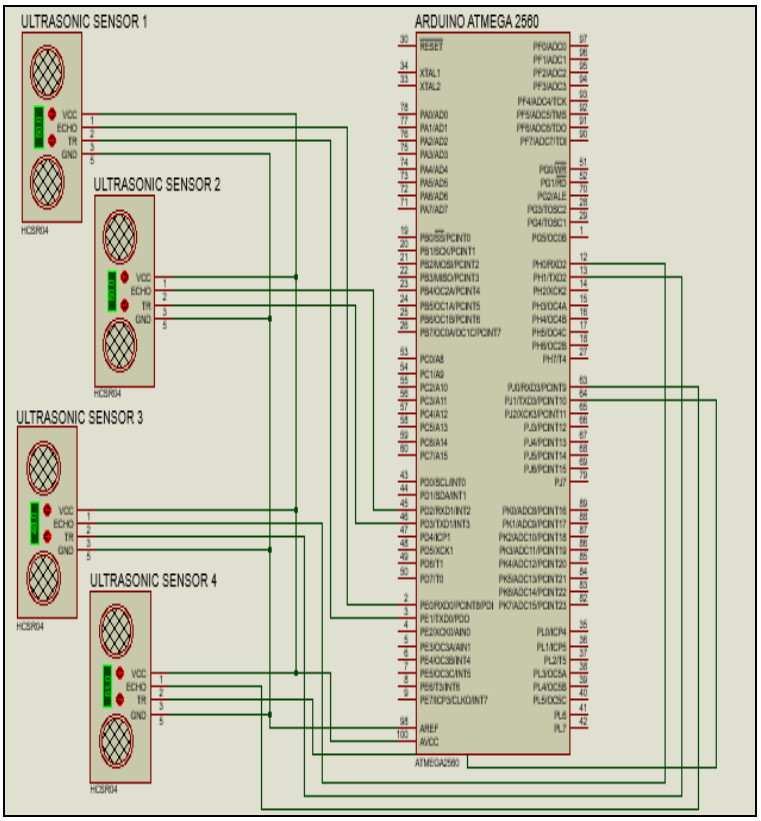


Fig-5- Circuit diagram of the Proposed System

Result Analysis:

The ultrasonic sensors are positioned at various orientations.You have to flash Arduino code on to the Arduino ATmega board.The data is then processed from the sensor into the Excel sheet in real time.The data was obtained with respect to time using PLX-DAQ.Since the distance values are collected in the Excel sheet, the corresponding values are formatted into 0's and 1's and then, after coding in Excel, are formatted to fuzzy values.Then, the following procedures are performed using Python code in the Anakonda Navigator Software.

1.Data Acquisition:

1. The data is acquired from the Excel sheet and is as shown below.

Based on the acquired Distance, Format and Fuzzy logic values, the following graphs can plotted.

1. Distance A,B,C,D plot
2. Distance vs Format plot
3. Fuzzy logic plot of Distance A,B,C,D
4. Fuzzy vs Format plot
5. Format vs Fuzzy plot
6. Distance vs Fuzzy plot
7. Distance vs Format plot

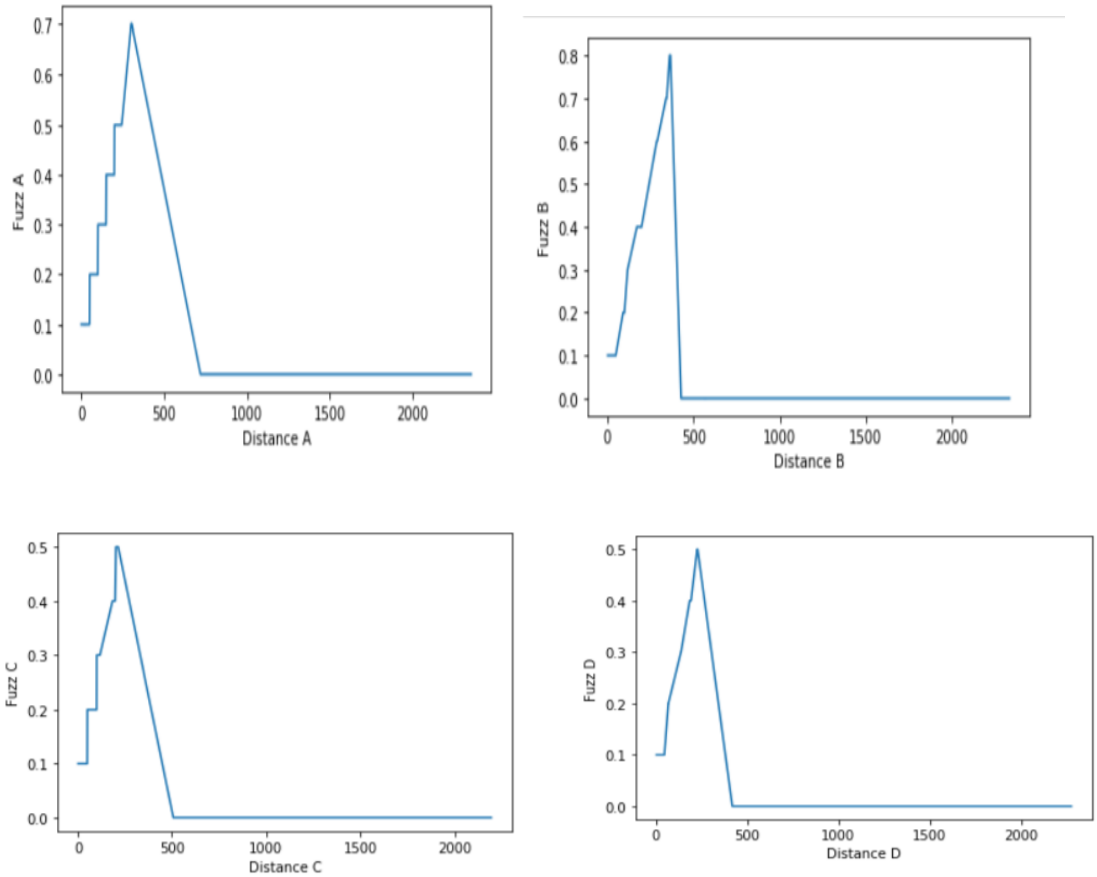
Out[2]:

	Current Time	Distance A	Distance B	Distance C	Distance D	Format A	Format B	Format C	Format D	Fu
0	13:41:51	0.00	480.01	24.04	31.28	1	0	1	1	(
1	13:41:51	37.64	341.70	23.51	31.16	1	1	1	1	(
2	13:41:52	39.31	478.83	23.19	31.11	1	0	1	1	(
3	13:41:52	37.08	466.22	23.51	17.89	1	0	1	1	(
4	13:41:52	37.51	480.90	24.47	17.37	1	0	1	1	(
...	...	...	...	...	...	...	...	...	...	
3032	13:56:33	47.81	363.67	73.47	6.74	1	1	1	1	(
3033	13:56:33	47.97	563.15	74.43	7.85	1	0	1	1	(
3034	13:56:34	49.10	466.87	74.74	6.98	1	0	1	1	(
3035	13:56:34	39.51	562.83	110.51	8.42	1	0	1	1	(
3036	13:56:34	20.03	464.20	80.33	8.80	1	0	1	1	(

3037 rows × 13 columns

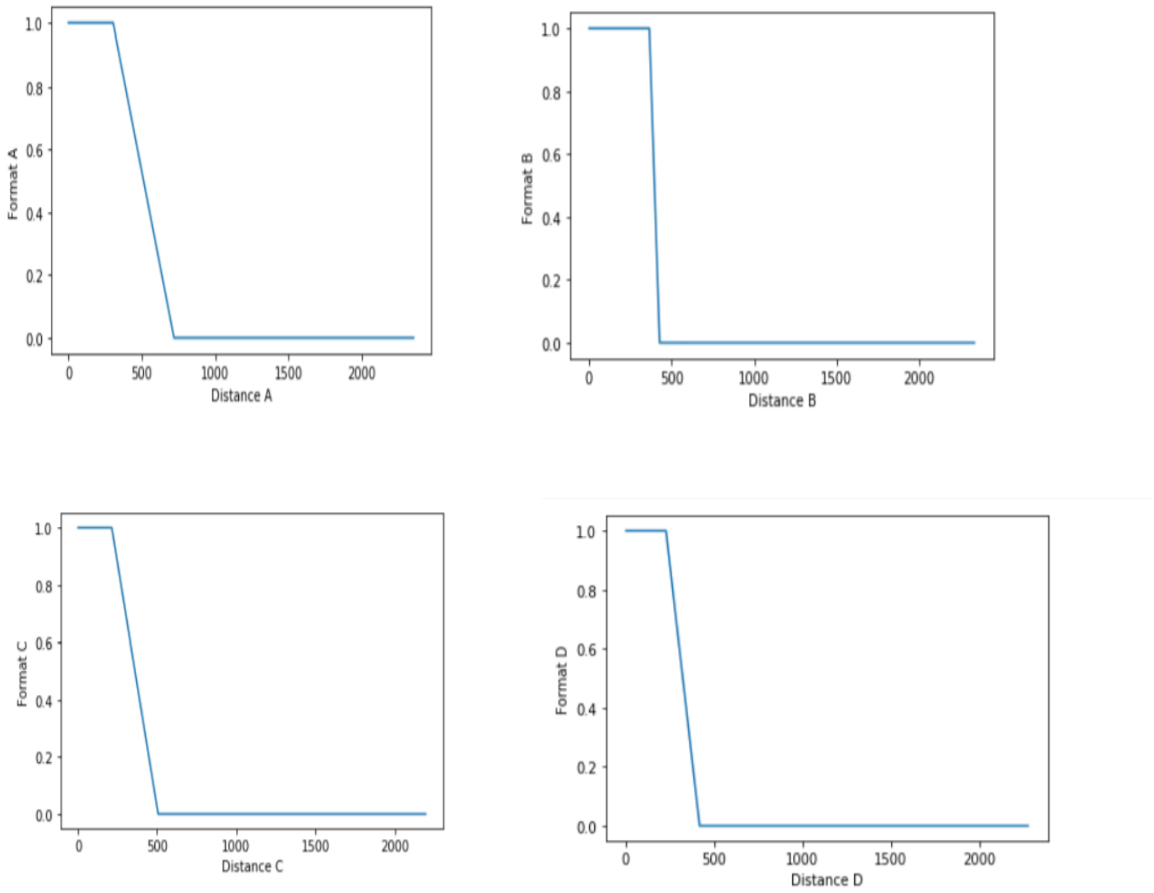
Fig 6. Data Acquired

Distance Vs Fuzzy Plots for various parameters are as shown:



The Distance vs Fuzzy plot has step graph with a pointed peak because it the values are more precise which ranges 0.0-0.5.

Distance Vs Format plots for various parameters are as shown:



The Distance vs Format plot graph has straight line because the values are less precise which ranges from 0.0-1.0.

2.Data Pre-processing:

The data acquired can contain several values of tangentiality and lack.Data cleaning and obtaining the missing values can handle the same by writing python code.It contains many steps that were already explained in the preceding chapter.You can also access the freezed data by passing a given python file.

3. Data Visualization:

The data being processed is depicted graphically in images.This is called Visualisation of the Data.The following table of data is obtained after pre-processing of the data.It is based on Clustering and Regression.

Out[35]:

	Distance A	Distance B	Distance C	Distance D	Format A	Format B	Format C	Format I
Distance A	1.000000	-0.001808	-0.008647	0.019618	-0.960440	0.000262	0.002979	-0.02076
Distance B	-0.001808	1.000000	-0.013040	-0.001958	0.001122	-0.482062	0.002417	-0.00095
Distance C	-0.008647	-0.013040	1.000000	-0.021660	0.014493	-0.053365	-0.906954	0.01851
Distance D	0.019618	-0.001958	-0.021660	1.000000	0.002433	-0.017673	0.007665	-0.99307
Format A	-0.960440	0.001122	0.014493	0.002433	1.000000	0.012161	-0.012340	-0.00191
Format B	0.000262	-0.482062	-0.053365	-0.017673	0.012161	1.000000	0.067554	0.02199
Format C	0.002979	0.002417	-0.906954	0.007665	-0.012340	0.067554	1.000000	-0.00301
Format D	-0.020761	-0.000950	0.018519	-0.993073	-0.001913	0.021993	-0.003012	1.00000
Fuzz A	0.045923	-0.013165	-0.015122	0.106249	0.147288	0.071379	0.002442	-0.10701
Fuzz B	0.009886	-0.316523	-0.057785	0.011189	0.008521	0.890466	0.063525	-0.01094
Fuzz C	0.032918	0.011167	-0.581394	0.045412	-0.024504	0.068902	0.673331	-0.04499
Fuzz D	-0.041180	-0.059916	-0.044936	-0.508916	0.011905	0.115885	0.056492	0.54670

Fig 7. Pre-processed Data

The image below is the representation of cleaned data in graph. These types of images allow users to quickly display and understand the data analytics. This is done to check the co-relationship between the data as to how values relate to each other and to themselves. The maximum negative and positive values are the strong co-relationship and the values equal to zero and close are the weak co-relationship. The sign shows the direction the values change in. If it differs positively, then it is in the first quadrant.

If this differs in the direction of the negative, then it is in the second quadrant. The likelihood that the predictions made from Machine Learning will be high when there is a strong co-relationship, hence the accuracy, precision, recall and f1 score will be high, and vice versa. The dark colored regions suggest good co-relationships with the negative. There will be no corelationship for the neutral interest. If a person moves in one direction in this project and then takes another path during 0.1, there will be two choices that the person could make. It could be left or right, whatever. If the next Fuzzy value of the logic is 0.1, then the individual is right. If the next fluffy logic value is 0.2, then the person will be taken left.

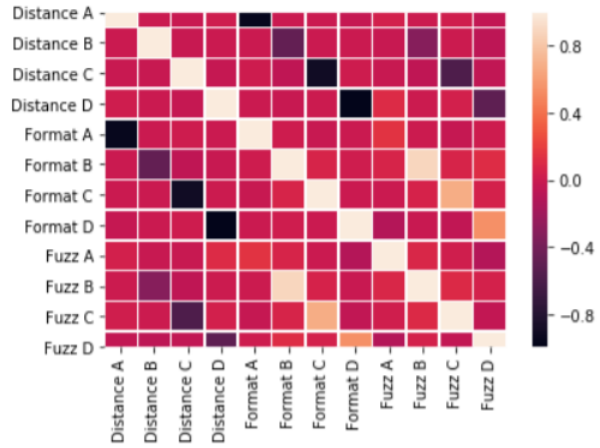


Fig 8-Heat Map

4.Data Splitting:

Here the data is splitted into two parts, 70% data is used for training and 30% for testing with the help of python code using Heat map analysis as explained above.

```
In [58]:
X1_train
Out[58]:
```

	Distance A	Distance B	Distance C	Distance D	Format B	Format C	Format D	Fuzz A	Fuzz B	Fuzz C	F
2294	26.24	465.25	28.06	8.08	0	1	1	0.1	0.0	0.1	
1153	7.12	193.45	20.85	67.33	1	1	1	0.1	0.4	0.1	
457	39.41	463.62	19.23	15.52	0	1	1	0.1	0.0	0.1	
2431	23.26	561.85	28.07	11.54	0	1	1	0.1	0.0	0.1	
2681	38.55	503.40	92.06	7.80	0	1	1	0.1	0.0	0.2	
...	...	...	...	...	...	...	...	...	...	...	
2763	34.27	504.57	581.54	7.82	0	0	1	0.1	0.0	0.0	
905	32.10	9.06	2118.81	30.73	1	0	1	0.1	0.1	0.0	
1096	5.37	194.74	20.41	66.94	1	1	1	0.1	0.4	0.1	
235	16.02	565.25	9.26	5.23	0	1	1	0.1	0.0	0.1	
1061	160.20	361.54	21.28	5.85	1	1	1	0.4	0.8	0.1	

2125 rows × 11 columns

Fig 9.Format Training

```
In [62]:
X1_test
Out[62]:
```

	Distance A	Distance B	Distance C	Distance D	Format B	Format C	Format D	Fuzz A	Fuzz B	Fuzz C	F
6	37.13	480.11	23.63	16.94	0	1	1	0.1	0.0	0.1	
1159	7.00	564.27	20.43	67.40	0	1	1	0.1	0.0	0.1	
1852	27.97	562.31	103.79	12.30	0	1	1	0.1	0.0	0.3	
2783	37.90	363.80	581.63	7.92	1	0	1	0.1	0.8	0.0	
825	68.46	563.93	14.75	30.87	0	1	1	0.2	0.0	0.1	
...	...	...	...	...	...	...	...	...	...	...	
2626	36.84	503.06	87.53	33.13	0	1	1	0.1	0.0	0.2	
877	33.89	565.54	4.94	19.04	0	1	1	0.1	0.0	0.1	
2836	105.97	363.65	580.66	7.82	1	0	1	0.3	0.8	0.0	
1260	65.43	194.28	11.76	5.44	1	1	1	0.2	0.4	0.1	
2425	25.26	364.32	27.97	32.69	1	1	1	0.1	0.8	0.1	

912 rows × 11 columns

Fig 10.Format Testing

5.Prediction:

The python code is written on the basis of the obtained 'heat map'.It will generate the expected performance that is then compared to the actual data in order to check the accuracy.If the actual as well as the predicted values are the same, the output is more accurate and accurate.

```
In [75]:
predictions_1
Out[75]:
array([1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
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       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1,
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       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1], dtype=int64)
```

Fig 11. Predictions of tested Data.

Conclusion:

Detection of motion is a simple task due to the improvement of the sensor technology and the ever increasing precision of the same.This project was aimed at designing and implementing an

Ultrasonic Distance Measurement device and predicting the future.The goal of this project was to design and implement ultrasonic distance measuring device, and to predict the longer term.A system is developed as described during this report which will calculate the space of the tracked object.

The machine can measure the obstruction space with adequate precision in respect to the need for an ultrasonic sensor, this device has the ability to connect with other peripherals if used as a secondary device and can also communicate with the Computer via its interface.This offers a cost-effective coffee solution for distance measurements of non-contact types.The main challenge he has encountered is predicting movement of any object with the data and runtime data prevailing.

The average learning algorithms that enable the machines to find out on their own will do this.Logistic regression is one such Machine Learning algorithm that aims to model with two possible outcomes the possibilities for classification problems.Ultrasonic sensors were installed at various orientations, collecting ether data on a continuous basis.Afterwards, the information collected is processed, visualized and used for possible predictions/ conclusions.

Future Scope:

Ultrasonic sensors can detect objects which dwell within the range of 30 degrees or less.To beat this, we're going to use a rotating ultrasonic sensor that could be powered by a 1.8 degree stepper motor per stage, giving 200 angular samples.The echo represents the amplitude of the received signal, and is plotted to distinguish it from the one with a lower angle.Another aspect is ultrasonic sensors that detect not only the people but also the metallic bodies, vehicles and any other object that comes within their range.So, these highly-equipped sensors are required to beat.

References:

[1] Moving object tracking method based on ultrasonic automatic detection algorithm, Damei Fu ; Zhihong Zhao, 2016 Sixth International Conference on Information Science and Technology (ICIST).

[2] Object recognition using horizontal array of ultrasonic sensor, Apurva Rajendra Patkar ; Pankaj P. Tasgaonkar, 2016 International Conference on Communication and Signal Processing (ICCSP).

[3] Moving object detection and direction-finding with HC-SR04 ultrasonic linear array, Karzan A. Raza ; Wrya Monnet, 2019 International Engineering Conference (IEC).

[4] Real time traffic signal control using fuzzy logic controller: review, Sweta Pandey ; Pratistha Mathur ; Tejashri Patil2017 1st International Conference on Intelligent Systems and Information Management (ICISIM).k9i

[5] A comparative analysis on linear regression and support vector regression- DOI:10.1109/GET.2016.7916627- https://ieeexplore.ieee.org/abstract/document/7916627.

[6] DONGXin-yuan GU Li-ehen, JU Xiao,"Application analysis on ultrasonicresonator in sensor ranging"Transducer and Microsystems technologies, vol63, no. 1 pp.1-9,jan 2014

[7] A Large scale analysis of Logistic Regression: Asymptotic Performance and New Insights-Xiaoyi Mai, Zhenyu Liao,Romain Couillet-2019 IEEE International Conferenceon Acostics and Signal processing.

[8] A comparative analysis on linear regression and support vector regression- DOI:10.1109/GET.2016.7916627https://ieeexplore.ieee.org/abstract/document/7916627.

[9] Marius Valerian Paulet, Andrei Salceanu, Oana Maria Neacsu, "Ultrasonic Radar",2016IEEE,//ieeexplore.ieee.org/document/7781400.