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Autonomous Vehicular Corridor using Artificial Intelligence

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Abstract: This project considers the operational impact of Autonomous Vehicles by creating a corridor using the latest network available. The behaviour of these vehicles entering the corridor is monitored at the macroscopic level by modifying the data which can be extracted from the vehicle. This data is made to learn using machine learning called the Time Series Neural Network and the data is used as a parameter to make the vehicles Autonomous. The project resolves the location, develops and demonstrates the collision avoidance of the vehicles using Artificial Intelligence. Autonomous means the vehicles will be able to learn to act accordingly without human intervention.
Keywords: **Autonomous Vehicles, Machine Learning, Time Series Neural Network, collision avoidance**

I. INTRODUCTION

Many modern cars are already capable of some level of autonomous operation, and self-driving prototypes have been tested on public roads in Europe, Japan, and the United States. These technologies have appeared on the market quickly, and their use is projected to accelerate in the future.[1] Autonomous driving promises a slew of advantages, including increased safety, less traffic, and less stress for passengers.

With advancements in technology, safety is also a concern where there is a lot of importance given to the safety of autonomous cars present on the roads.[6] With a great deal of advancement in technology, reliable, advanced communication, and verified interactions have to be designed. Four cases can be discussed in relation to this [4]: vehicles to the road-side infrastructure (V2I), communications of vehicles to other vehicles (V2V), vehicles to pedestrians (V2P),[5] and vehicles to the cellular network (V2N Together, these use cases are known as vehicles to everything (V2X).

This paper explains the methodologies which are diverged from the conventional method and position is determined using acceleration data extracted from the on-board device itself. The paper is mainly divided into 3 parts namely Android Studio, GSM Module and LabVIEW and MATLAB. The android studio part of the project is to develop an application that extracts the position details of the device. This basically acts as the transmitting end. It is basically a transmitting end. GSM module is used to receive the information sent from the android Application. LABVIEW is used to extract the data from the GSM module, automate the process. and to store the data or information in an excel file. Finally, the Matlab is used to train the data using a Neural Network and to get the desired results.

II. METHODOLOGY

Since the paper is about the Autonomous corridor which is relating to the movement of vehicles which will be in a particular direction with its own velocity and acceleration, there was a need to extract the acceleration of the particular vehicle.

A. Android Application

For the demonstration purpose an android phone was chosen instead of a vehicle. Here the android phone will act as a vehicle which will be subjected to being moved for the demonstration purpose. Every mobile phone will have MSME (Micro Electro- Mechanical system) based motion sensors. One of the sensors is the Accelerometer Sensor. So, there was a need for developing an android application which will be able to extract the values from the accelerometer sensor.

B. Accelerometer

An accelerometer is a type of electronic motion sensor which monitors the acceleration forces acting on an object to determine its position in space and track its movement. Acceleration, is a vector quantity, which is the rate of change of object's velocity. Here velocity is the displacement of the object divided by the change in time.

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An accelerometer's basic working principle is comparable to a dumped mass on a spring. When this device senses acceleration, the mass is displaced until the spring can easily move the mass at the same rate as the acceleration it sensed. The displacement value is then used to calculate the acceleration.

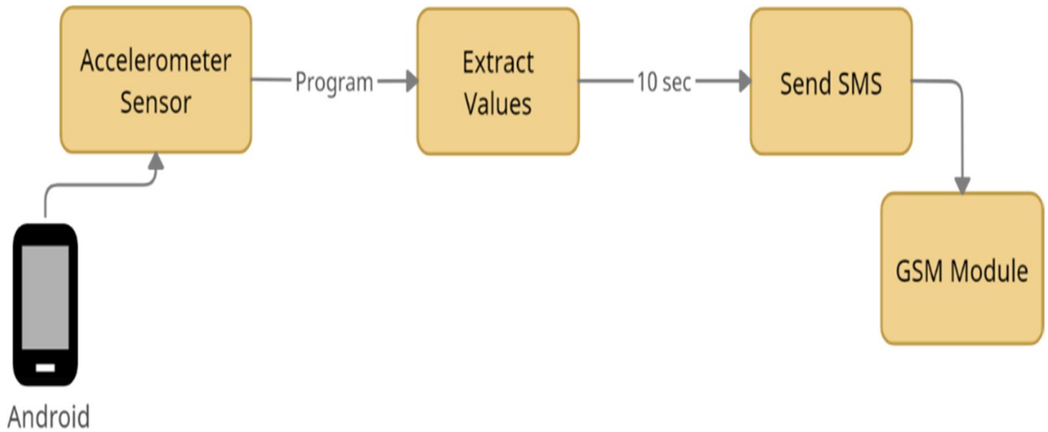

Fig. 1 Block diagram of Android Application

The accelerometer in the android phone will give the acceleration values in the 3-coordinate system that is X, Y, and Z axis.
By writing a program, the information or the values of the accelerometer sensor is extracted and stored and displayed.
After extracting the acceleration values from the sensor, a thread is created in a handler to take the values of the accelerometerwithin a time window of 100 milliseconds. A list of size 10 is created. At every 100 milliseconds the values of the X, Y and Z coordinates at that instant is extracted and stored it in the list respectively. An integrator function is introduced and the values in the list will be integrated individually for X, Y and Z axis. The integrated values of X, Y and Z coordinates will be sent as an SMS to the GSM module and this process continues for every 1 second.

The Integrator function used here is the trapezoidal integration rule. The formula for this integration is given as:

$h = \frac{(b-a)}{N}$, where h = segment height, n = step size

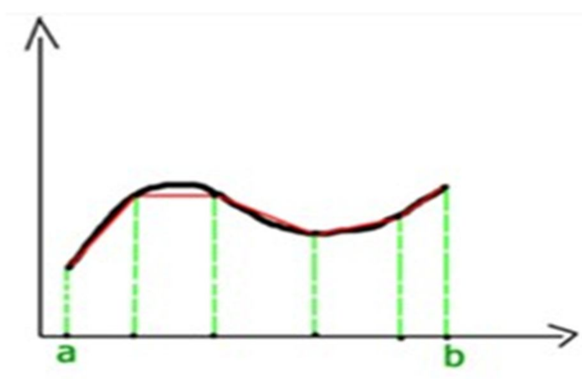

Fig. 2 Trapezoidal Integration Graph.

Therefore, the value of integral is given by: $\int_a^b f(x)dx = \frac{b-a}{2n}[f(a) + 2\{\sum_{i=1}^{n-1} f(a+ih)\} + f(b)]$

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By Integrating, the acceleration value of X, Y and Z axis is converted to velocity and this velocity is sent as SMS to a SIM800A GSM module.

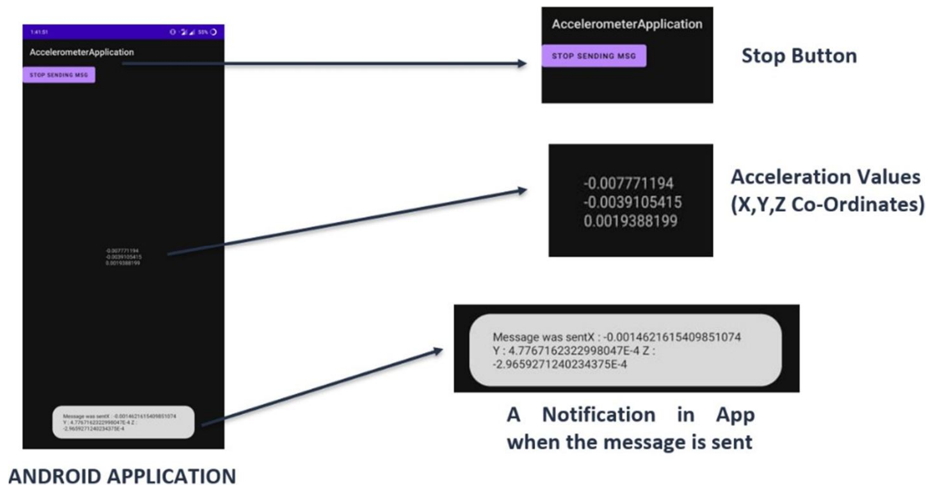

Fig. 3 Android Application

C. LabVIEW

The GSM module interacts with the computer using the RS 232 Port through AT commands. The incoming messages from the android application will be read using LabVIEW [8] in which a dedicated application is created for automated reading and storing of data.

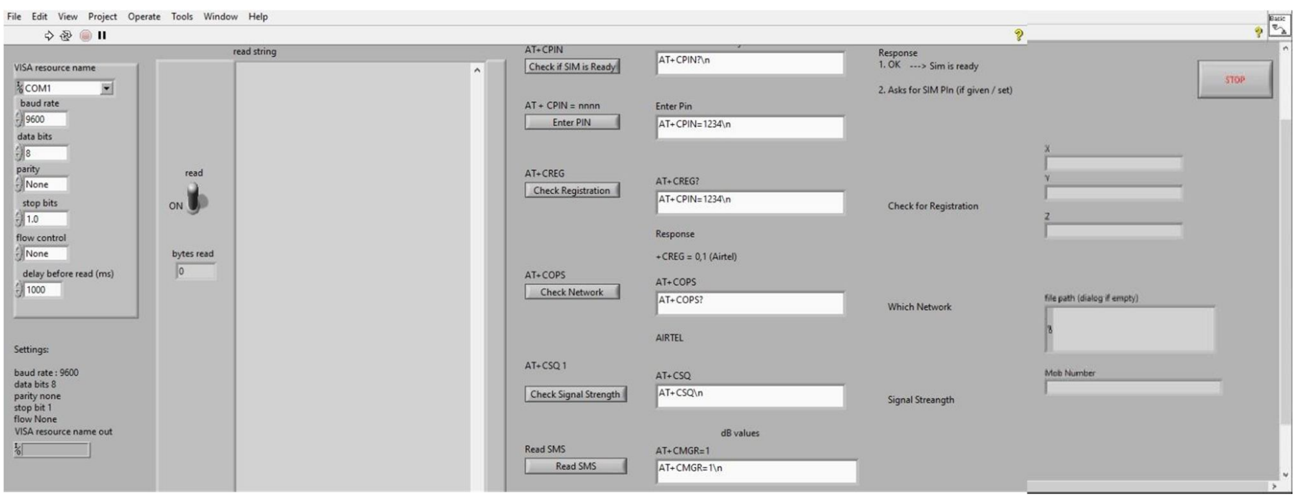

Fig. 4 LabVIEW Front Panel

The strategy of application built is that there will be multiple messages that will be sent and read by the application. Hence the messages need to be filtered for the use of the project. Messages sent will have a particular format to them and this is taken asan advantage. The program will first check the format which will already be defined and only if the format is matched will the data be accessed and processed, else the message will be deleted. The messages sent from the Android application will have the format of "X: , Y: , Z: ". Only if the message contains this format will the program read the contents and store the data. All the three conditions must be satisfied in order for the program to read it. Once the values are read, they will be displayed in the dialogue box individually as X, Y and Z. Once this is done, the data will be stored in a predefined path location in the format of an excel file. The program can simultaneously process data from multiple devices and create different files under the name of therespective mobile number from which the data is being sent. The data will be updated as when the newer coordinates are sent. The program is designed in such a way that the first message is always read and deleted after storing the data so as to differentiatedata from different devices.

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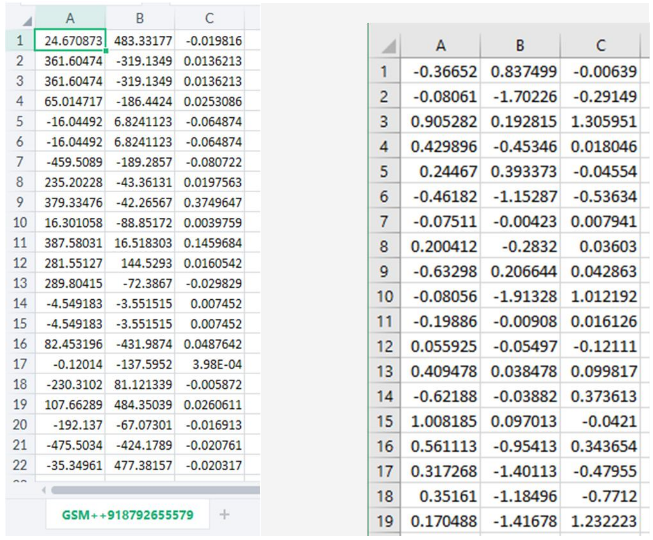
D. Matlab



	A	B	C
1	24.670873	483.33177	-0.019816
2	361.60474	-319.1349	0.0136213
3	361.60474	-319.1349	0.0136213
4	65.014717	-186.4424	0.0253086
5	-16.04492	6.8241123	-0.064874
6	-16.04492	6.8241123	-0.064874
7	-459.5089	-189.2857	-0.080722
8	235.20228	-43.36131	0.0197563
9	379.33476	-42.26567	0.3749647
10	16.301058	-88.85172	0.0039759
11	387.58031	16.518303	0.1459684
12	281.55127	144.5293	0.0160542
13	289.80415	-72.3867	-0.029829
14	-4.549183	-3.551515	0.007452
15	-4.549183	-3.551515	0.007452
16	82.453196	-431.9874	0.0487642
17	-0.12014	-137.5952	3.98E-04
18	-230.3102	81.121339	-0.005872
19	107.66289	484.35039	0.0260611
20	-192.137	-67.07301	-0.016913
21	-475.5034	-424.1789	-0.020761
22	-35.34961	477.38157	-0.020317

GSM++918792655579

	A	B	C
1	-0.36652	0.837499	-0.00639
2	-0.08061	-1.70226	-0.29149
3	0.905282	0.192815	1.305951
4	0.429896	-0.45346	0.018046
5	0.24467	0.393373	-0.04554
6	-0.46182	-1.15287	-0.53634
7	-0.07511	-0.00423	0.007941
8	0.200412	-0.2832	0.03603
9	-0.63298	0.206644	0.042863
10	-0.08056	-1.91328	1.012192
11	-0.19886	-0.00908	0.016126
12	0.055925	-0.05497	-0.12111
13	0.409478	0.038478	0.099817
14	-0.62188	-0.03882	0.373613
15	1.008185	0.097013	-0.0421
16	0.561113	-0.95413	0.343654
17	0.317268	-1.40113	-0.47955
18	0.35161	-1.18496	-0.7712
19	0.170488	-1.41678	1.232223

Fig. 5 Velocity Coordinates

As mentioned earlier in the report, the velocity of the device is obtained from the android application in the form of X, Y and Z coordinates. These coordinates are integrated again to get the position coordinates.

The saved file containing the data will be imported into matlab for further processing. The data stored as a worksheet will have rows and columns to which we have to align a time reference. The data in each coordinate will be imported individually andgiven the time reference. This means that the number of rows are aligned with columns along with the time step of the arriving message which is done with the “Time= [0:1: size(X)-1].*10” command.

A simulink model[9] is then used to integrate the data to obtain the position values. A 3-dimensional plot is used to plot the movement of the device.

III.RESULTS

Fig. 6 X,Y,Z Position Coordinates

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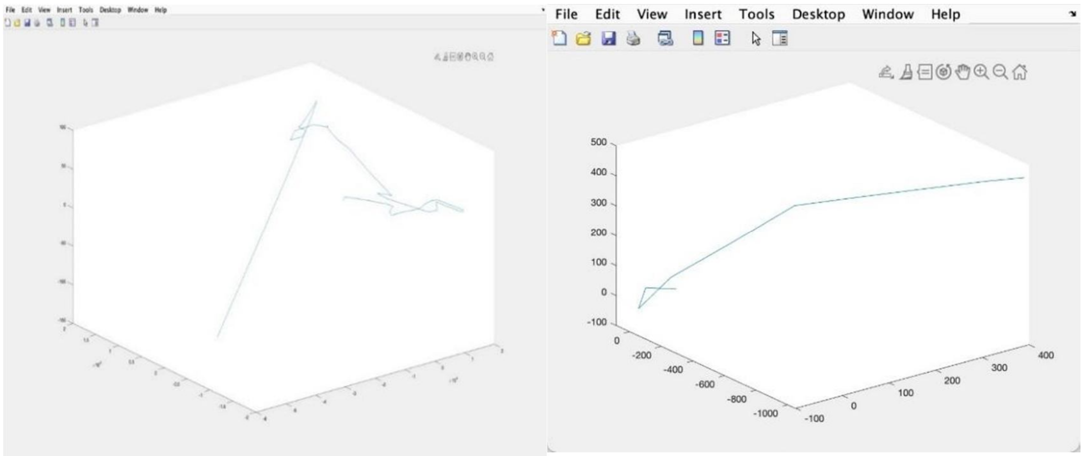

Fig. 7 Position Plot

IV. FUTURE SCOPE

Once the position coordinates are obtained from Simulink, the data is used as reference. A training data set should be created in accordance with the reference data set and values are forced as a reaction to a particular anomaly. This way the neural network is trained to handle situations by recreating possible situations. The position coordinates which are obtained from the Simulink are given as an input to the Time Series Clustering model.[7]

Time series clustering model is chosen here because the change in the system happens with respect to time. This way we can keep the number of inputs to the minimum. Once the data is trained, the model must predict the next course of action so as to avoid the obstacle.

V. CONCLUSIONS

The connected and automated vehicle (CAV) is a game-changing technology that has the potential to drastically alter our daily lives. Benefits could include fewer emergency room visits, lower automobile insurance costs, and smaller traffic enforcement departments. Ride-sharing with self-driving vehicles may have a higher impact on available properties in densely crowded locations. Experts in machine learning, technology, and the automotive industry have declared plans for autonomous vehicles to be deployed over the next five years.[3] This is no longer a “if” question, but rather a “when” question. As the area explores new methods to connect cities, autonomous vehicle technology must be a significant component in any transportation plan.

VI. ACKNOWLEDGMENT

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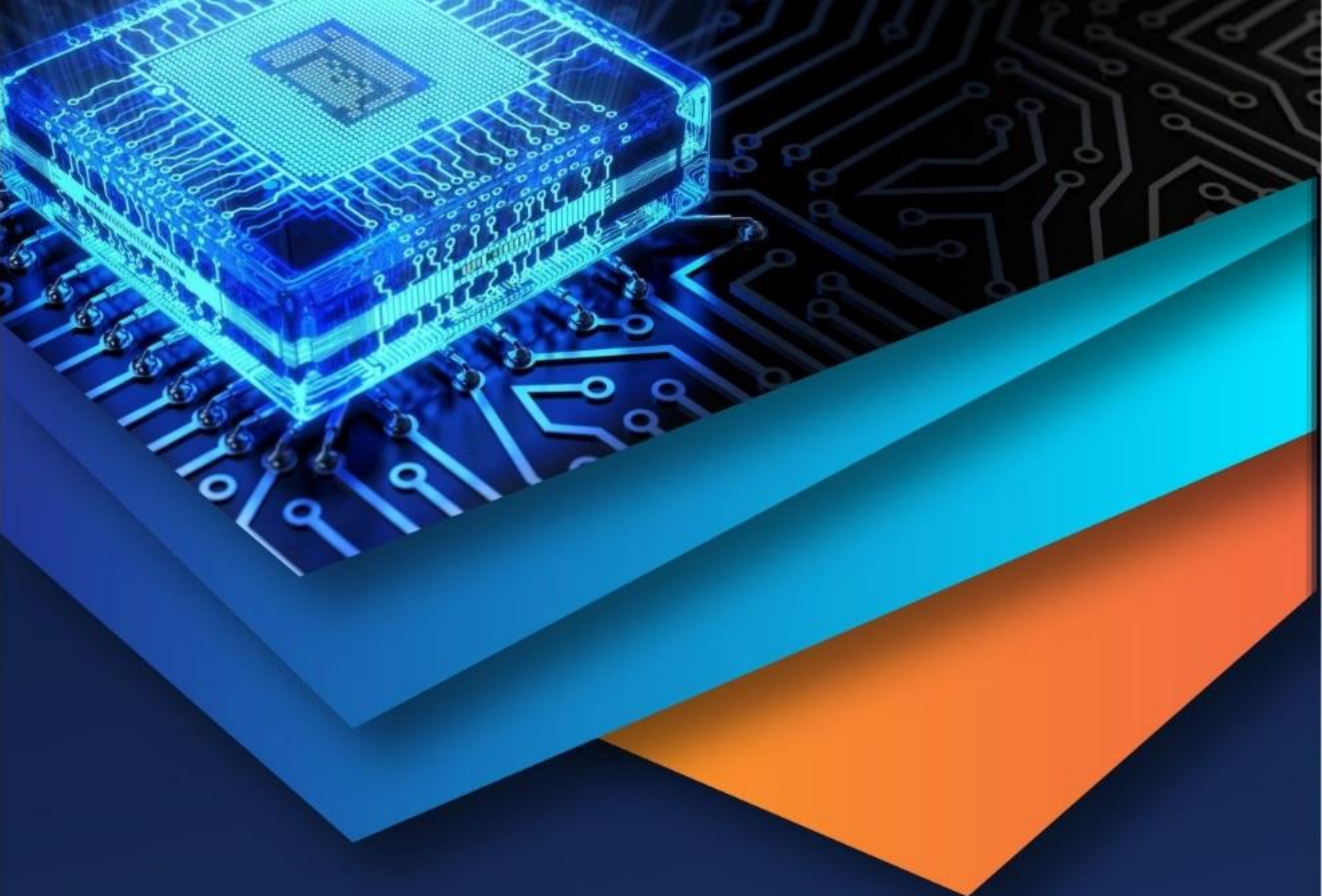

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