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Human Movement Detection and Prediction Using Data Analytics and Machine Learning

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Abstract: Artificial Intelligence is the emerging branch of Computer Science which deals with the development of algorithms that can simulate or recreate 'HUMAN MIND' like capabilities. Machine learning is a subset of Artificial Intelligence. Large datasets are provided to the machine, thereby training the same for/at different situations. Machine learning is mainly used in behavioural analysis, prediction of sequences and real-time/real-world environment simulation. Historical and present run-time data is used to train the machine. Motion detection of living beings or objects of interest is essential in many domains. Many devices such as security devices, radars, the positioning of industrial robots, vehicular motion, and traffic density meter make use of this phenomenon. High immunity to all other factors other than the sensed data is a very big challenge and a huge motivation.

Keywords: Artificial Intelligence (AI), Machine Learning, Data Analytics, behavioural analysis, Logistic regression, accuracy, precision, and F1 score, Motion detection of living beings or objects of interest and security devices

I.INTRODUCTION

Artificial Intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. Machine learning algorithms are broadly classified into Supervised Learning, Unsupervised Learning and Reinforcement Learning. Out of three algorithms, Supervised Learning has been implied here. This algorithm consists of target variable which is to be predicted from a given set of predictors. The training process continues until the model achieves a desired level of accuracy on the training data. Examples of Supervised Learning are Logistic Regression, Linear Regression and Decision Tree etc. ML algorithms are capable of learning from data; they can enhance themselves by learning new heuristics or can themselves write other algorithms. Machine learning is an application of Artificial Intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.The machine is capable of learning by itself after training. An array of ultrasonic sensors is placed at different orientations, continuously gathering data of the ether. The datasheet which is huge needs analysis, pre-processing and visualization. Various conclusions can be drawn from the dataset. The predictions made can be analysed in the future and also to check the accuracy of future models. Any entity carrying out business in 21st century will have thousands of visitors, transactions and security concerns. We have to address the above factors to maximise profit and security of those business entities. Each parameter of the above must be recorded on a daily basis.

The outcome of such measurement is a huge data set. The data could be

- Historic data.
- Present run-time data.
- Predicted data.

II.LITERATURE SURVEY

1. "Moving object tracking method based on ultrasonic automatic detection algorithm"

It can be inferred that the ultrasonic sensors are used to measure the motion for which its 2D coordinates are to be positioned. It helps to resolve the measurement errors with regards to the improperly created programs. The algorithms are designed to automatically track the motion objects.

2. "Real time traffic control signal using fuzzy logic"

Fuzzy logic is used as control system which is dynamic in nature for the better performance of the flow of traffic at every road intersection.

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III.PROBLEM STATEMENT

With reference to the above literature survey, through this paper one such effort is made as to analyse the behaviour and movement of people in a shopping mall. [1]. This would result in business analysis and recording of behavioural data of real-time shoppers/visitors to a specific mall. Ultrasonic sensor array is placed at different orientations capturing data for a large interval of time in a shopping mall. The people visiting the shopping mall trigger the ultrasonic sensor array as a result cameras are switched ON and record for a certain interval. The acquired sensor values are pre-processed, visualised and prepared for machine learning predictions. A prediction model to be designed using logistic regression and its accuracy, precision.

IV.METHODOLOGY

Figure 1 shows the block diagram of proposed ultrasonic movement detection system. Ultrasonic sensor of the type SR04 is used in this model. The range of this sensor goes up to 400 cm. The four sensors S1, S2, S3 and S4 are placed in an array at different orientations facing the objects /people of interest.The transmitter of the sensors trigger ultrasonic waves continuously with very less delay and the receivers continuously receive the rebounded sound waves travelling at 342 m/s. The time taken by the sound waves for its one complete journey from the Tx and the Rx is recorded and by using the general formula,

*d=s*t*

d-distance, s-speed, t-time

The distance at that instant is mapped using a microcontroller like Arduino Mega 2560.The results are well tabulated and stored in the database for building a ML model capable of predictions of future instances.

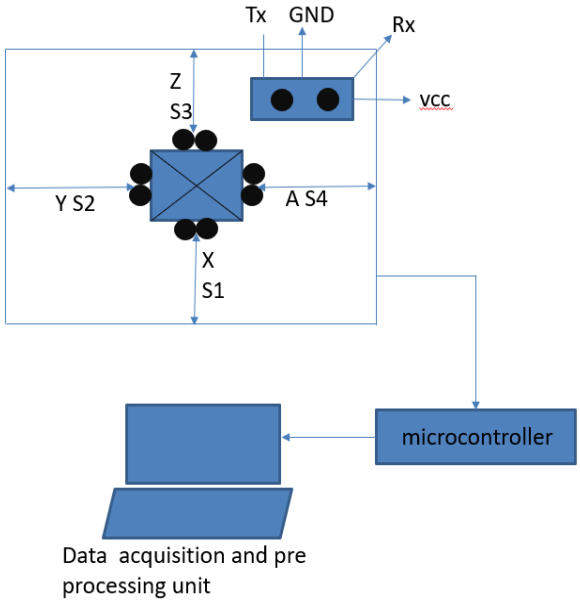

Figure 1 shows the block diagram of proposed ultrasonic movement detection system.

Figure 2 shows the work flow diagram. The process can be achieved by the following stages:

1. Acquisition of data from sensor array and storing it in the database.
2. The acquired data would contain missing values, redundant entries, which may be noisy and/or out of scale. The data must be pre-processed or treated before analysis or visualization. [2]. [3].
3. Data analytics is the science of analysing raw data in order to make conclusions about that information. The techniques and processes of data analytics have been automated into mechanical processes and algorithms that work over raw data. The prepared data is now eligible for data analytics and visualization. Graphs and statistical formulas enhance the process of prediction. [4].
4. Correlation is carried out using a heatmap. The data is split into test and train using a particular randomness factor 'X' and a fixed splitting ratio.
5. A predictive model is designed using logistic regression. Logistic regression is a statistical model that in its basic form uses logistic function to model a binary dependent variables. The hypothesis of logistic regression tends logistic function to limit the cost function between 0 and 1. [5].
6. Accuracy, precision, recall and F1 score of the model is verified. Figure 3 shows the sensor layout of the project.

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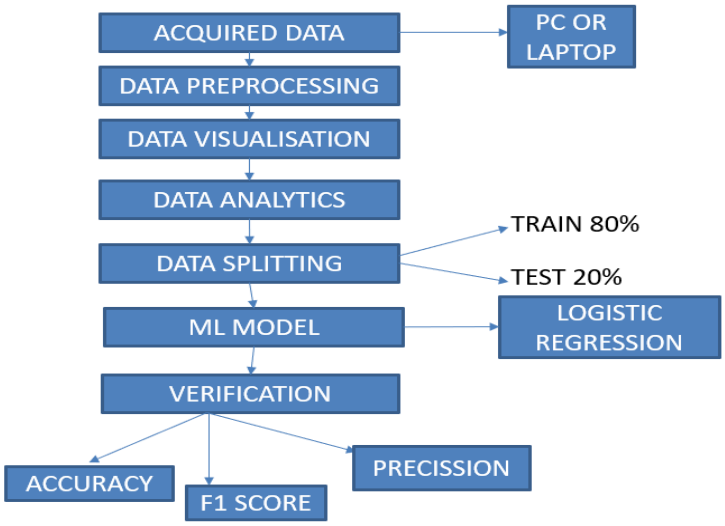

Figure 2 shows the work flow diagram of our approach.

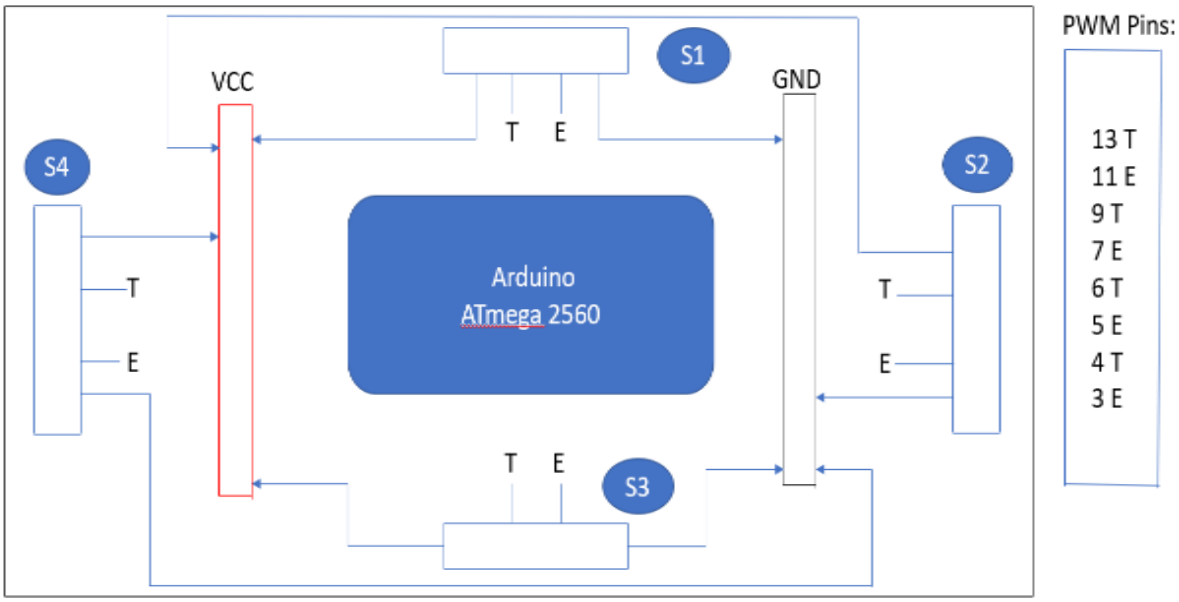

Figure 3 shows the sensor layout

V.CONCLUSION

Using the above concepts and hardware implementations, motion of objects or living beings are detected using ultrasonic sensors. Future motion is predicted using historic and present data from models of logistic regression .The randomness of the data is predicted using fuzzy logic of machine learning. Massive quantities of data can be analysed using data analytics.

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