International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

A Inference Model for Environment Detection using IoT and SVM

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Abstract - *Today internet is getting faster and cheap to use with the introduction of 4G. This aspect can be used to connect the human with the machine using Internet of Things (IoT) concept. IoT can be used in vast applications that can be used to simplify the needs of human beings. The IoT can be implemented in fields like Smart cities, homes, healthcare etc. It can become an integral part of our system if analyzed properly and used intelligently. Today millions of devices daily use smartphones which can be integrated with the IoT to build smart applications with the help of cloud as central medium of communication between a IoT based device and the smartphone of a user. But with IoT there is a problem as it generates large amount of data every which is not easy to analyze by a human. It overflows a cloud space with unnecessary data. So we thought of designing a project which will decrease the large amount of data generated by the IoT device and that is sent to the cloud. So a smart inference filter will be designed which will filter the amount of data that is sent to the cloud. The data originating from a IoT device can be analyzed by using machine learning approach and Support Vector Machine (SVM) algorithm. Only the harmful categorized data by the SVM will be sent to the cloud and the whole on thus decreasing the amount of data sent to the cloud tremendously. Thus only the needed data that is to be viewed by the concerned authority will be sent to the cloud which can be viewed on a smartphone. The concerned authority than can take steps to improve the environment condition.*

***Key Words*: IoT, MQ2, MQ7, ESP8266, Android, Arduino, Spreadsheet, SVM, Cloud, Smartphone.**

1. INTRODUCTION

Humans have a limited capacity of grasping and analyzing the large amount of data that can be generated and hammered by day to day IoT devices. However, sensors connected to a IoT Device can collect a large amount of data that has to be analyzed for proper decision making by a given application. This forms the heart of Internet of Things (IoT) concept. Thus with the help of inference model and machine learning a large amount of data can be analyzed and help in easy decision making. Thus IoT can become a integral part of various services such as smart buildings, intelligent transport systems, industrial automation, pervasive healthcare, smart grid, self-driving vehicles, smart cities, etc. thus promising a revolution in social and industrial sectors and the way they can be handled for better productivity.

The growth of IoT is jaw dropping and ever increasing. As per the study in 2016 there were more than 17 billion devices and which will increase and cross 50 billion mark by 2020 more than six times the human population. This will lead to explosion of data that will be generated by IoT Devices. This amount of data cannot be handled by cloud services if uploaded fully. However, the Inference models trained and applied with machine learning will decrease the amount of data sent to the cloud tremendously. Thus various machine learning approaches has to be implemented and studied to decrease the load on the cloud which is heart of a IoT revolution. Thus our project will be organized into steps such as

1) Literature Survey which will explain the existing works and their limitations.

2) Proposed System which will explain the steps to achieve a successful implementation.

3) Results and Discussion which will explain the outcomes of the project.

4) Conclusion which will explain the overall achievement of the project.

5) References which will list the papers that are to be referred.

2. REVIEW OF LITERATURE

This topic describes the fundamentals of IOT model. It helps in understanding various ideas put forward by various technical papers published by various publishers.

A. M. Nia etal. [1] authored a paper which studies the security related to Internet of Things (IoT), also referred to as the Internet of Objects, is viewed as a translating approach for providing numerous services. This paper explains how cyber-attacks on various IoT structures have increased and how loss of data and money increased. The first goal of this paper was to, brief describe three widely-known IoT reference models and dene security in the context of IoT platform. Secondly the applications that arise from the use of IoT and potential motivations of the attackers who target this new architecture where discussed briefly. Third different attacks and threats that arise from the use of IoT where discussed briefly. Fourth, be possible security measures that can avoid attacks where discussed briefly. The drawback of this paper is that it only concentrates on security and not on cloud as well.

Dhananjay Singh etal. [2] authored a paper which studies Internet-of-Things (IoT) and present a approach which will make it more smart and intelligent. This paper presents a unique model for IoT with the help of Semantic Fusion Model (SFM). This SFM model introduces the use of Smart Semantic framework to extract and analyze the processed information from sensor networks and the data generated by it. It introduces a smart embedded system is having linguistic logic and linguistic value based Information to make the system an intelligent system and smarter than the those explained in the paper. This paper also discussion IoT applications, services, visual aspect and challenges for IoT using RFID, 6lowpan and sensor networks. The drawback of this paper is that it only concentrates on embedded systems not on cloud as well.

Dae-Man Han etal. [3] explains the use of WPAN, WSN and ZigBee networks. This paper designs and explains smart home device descriptions and standard practices for demand response and load management "Smart Energy" applications needed in a smart energy based residential or light commercial environment using ZigBee networks. It explains the design and implementation of control application domains included in this initial version are sensing device control, pricing and demand response and load control applications etc. In this paper they design and implement a smart home interfaces and device definitions to allow interoperability among ZigBee devices produced by various manufacturers of electrical equipment, meters, and smart energy enabling products. It introduces and implements the proposed home energy control systems design that provides intelligent services for users and we demonstrate its implementation using a real testbed. The drawback of this paper is that it only concentrates on ZigBee devices and ZigBee networks and not on cloud as well.

Nomusa DLODLO etal. [4] authored a paper which mainly concentrates on building smart cities. This paper explains the implementation and design of smart cities applications as applied to the domains of smart transport, smart tourism and recreation, smart health, crime prevention and community safety, governance, monitoring and infrastructure, disaster management, environment management, refuse collection and sewer management, smart homes and smart energy and thus handling the day to day and improving the user experience of IoT devices. The paper presents a technical solution for energy control and comfort in a home for proof of concept of a smart city infrastructure application using IoT devices. It demonstrates how smart applications can manage energy control and comfort in a room that has a varied number of people and electrical appliances, with each being a source of heat and having a separate IoT device to handle it. The drawback of this paper is that it only concentrates on building smart homes and not on cloud that has to handle the data to achieve it.

Praveen Kumar etal. [5] authored a paper which mainly concentrates on monitoring and control of appliances that can be used in a Smart Home. This paper explains a technique of home automation technology which provides provides smart monitoring and control of the home appliances as well as door permission system to differentiate between a owner and visitor of a home. This paper implements control and monitoring the status i.e. ON/OFF of the appliances thus implementing Internet, electrical switch, and GUI. Using the technology and implementation of the concept of this paper, the consumer can reduce the wastage of electrical power by regular monitoring of home appliances or the proper ON/OFF scheduling of the devices. The drawback of this paper is that it only concentrates on building smart homes and not on cloud that has to handle the data to achieve it.

Igor Miladinovic etal. [6] authored a paper which mainly concentrates on to provide a new architecture to cope with the expected increase in data generation by IoT devices. Network function virtualization (NFV) provides the architecture necessary for IoT services by enabling the automated control, management and orchestration of network resources using Web. The drawback of this paper is that it only concentrates on sending all the data to web and the data is not inferred to send only the needed data.

Lu´ıs N´obrega etal. [7] authored a paper which mainly proposes an animal behavior monitoring platform, based on IoT technologies and its use. In this paper the animals are monitored and all the data is sent to the cloud. The drawback of this paper is that it only concentrates on sending all the data to web and the data is not inferred to send only the needed data.

Dweepayan Mishra etal. [8] authored a paper which mainly proposes a programmed water system with framework for the terrains which will reduce manual labor and optimizing water usage increasing productivity of crops. The data from the sensors are sent to the cloud. The drawback of this paper is that it only concentrates on sending all the data to web and the data is not infered to send only the needed data.

Preeti Yadav etal. [9] authored a paper which mainlyproposed a framework for brilliant city improvement in lightof IoT utilizing the investigation of Huge Information The data from the sensors are sent to the cloud. The drawback of this paper is that it only concentrates on sending all the data to web and the data is not inferred to send only the needed data.

Sai Sreekar Siddula etal. [10] authored a paper hich mainly proposes a novel idea of collecting and sharingreal-time information about water levels to an authorized central command center through far field communication. The data from the sensors are sent to the cloud. The drawback of this paper is that it only concentrates on sending all the data to

web and the data is not inferred to send only the needed data.

3. PROPOSED METHODOLOGY

In the traditional system all the data from the sensors are sent to the cloud. Due to this there is congestion as large amount of data reaches cloud every few seconds. So to avoid this we propose a inference model which will only send the data which is of a certain parameter to the cloud and not the whole one using machine learning with IoT.

3.1 Architecture

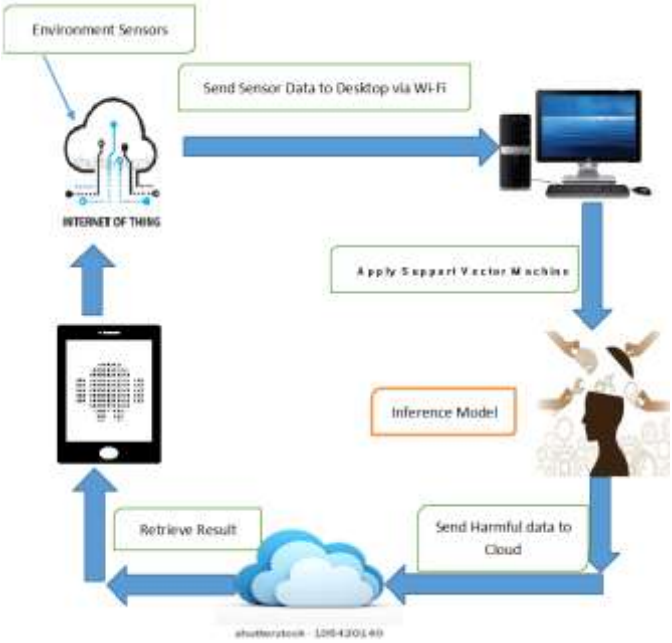

Fig -1: Proposed System Architecture

First figure shows the proposed system architecture which see in brief as follows:

1) Sensors: Here various environment detection sensorsare connected to Adriano Board.

2) IoT: Here sensor data is gathered from the sensors and sent to Arduino.

3) Wi-Fi: Here a Wi-Fi communication of client server is made between Arduino and Desktop using Esp8266 module and the sensor data is sent from Arduino to Server for further analysis.

4) Desktop: Here the Sensor data is received and the data is shown on desktop as shown below.

5) Training Dataset: Here the training dataset is generated using two class harmful and healthy.

6) Testing Dataset: Here the testing dataset is generated using two classes harmful and healthy.

7) SVM: Here machine learning algorithm SVM is applied on training and testing datasets and the environment parameters are found.

8) Upload: Here of the environment parameters are under harmful category than only the data is end on the cloud for the concerned authority to view it.

9) Mobile: Here the harmful data can be viewed by the user and necessary command is sent to the IoT.

3.2 Algorithm

In machine learning, support vector machines (SVMs, also support vector networks are supervised learning and non-supervised learning classification types. Given a set of training examples, each marked as belonging to one or the other of two categories specified while training. An SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classification problem. An SVM model is a representation of the training data as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible in two planes. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on respective planes.

- Start
- Initialize Sensors and Arduino
- Read Sensors Data
- Send Readings to Desktop

  if(send success==0)

  then

  -Return to Step 3.

  else

  -Store Readings

  -Continue
- Generate Training Dataset

  -Enter readings for Safe Class.

  -Enter readings for Unsafe Class.

  - Create Training dataset.
- Apply SVM

-Read Training Dataset

-Read Sensor data from variable

-Generate Testing Dataset

-Apply SVM

-Get Precision of SVM

if(Pre>Pre1)

then

-Data safe

else if(Pre<Pre1)

-Data unsafe

-View Results

-Send Results to Cloud

-View SMS Alert

- View Unsafe Readings

-Login in Mobile App.

-View Unsafe Readings

- Close

3.3 Mathematical Model

Set theory applied to the project :

1> IoT :-

Set (I)={ I0,I1,I2,I3,I4,I5 }

I0? I = Configure Arduino and Esp8266.

I1? I = Fetch Sensor data.

I2? I = Configure Wi-Fi.

I3? I = Send Sensor Data.

I4? I = Receive Command.

I5? I = Perform command using Arduino.

2> Machine Learning :-

Set (M)={ I2,M0,M1,M2,M3,M4,M5,M6 }

I2? M = Configure Wi-Fi.

M0? M = Get Sensor data.

M1? M = Generate a testing set

M2? M = Create a instance of SVM using Weka

M3? M = Train and test SVM

M4? M = get statistics

M5? M = fetch precision

M6? M = Send Command

Fig -2: Set Theory

Second figure shows the Mathematical model with two sets and the entities in it

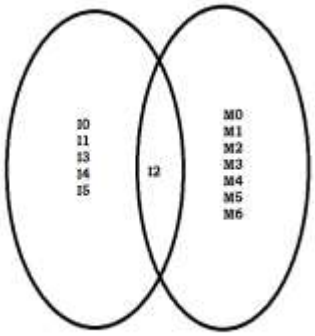

Fig -3: Venn Diagram for Intersection of Sets

Third figure shows the Intersection of two sets in the form of vein diagram

4. RESULT ANALYSIS AND DISCUSSION

4.1 Results of Sensor data on Desktop

Fig-4: Sensor Data on Desktop

1) Desktop: Fourth figure shows how the data will be retrieved from the Arduino side via Wi-Fi and how it will be visible on the desktop side.

Fig-5:To see environment readings click on view environment readings

4.2 Discussion for MQ2 and MQ7 sensor data

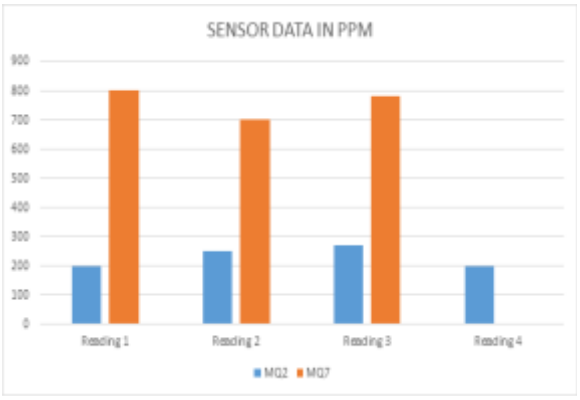

Fig -6: MQ2 and MQ7 Sensor data with four readings

1) Bar-Chat: Fifth figure shows the data via Bar-Chart which will be seen on the Desktop side. The data is in PPM which is reading for the sensor attached.

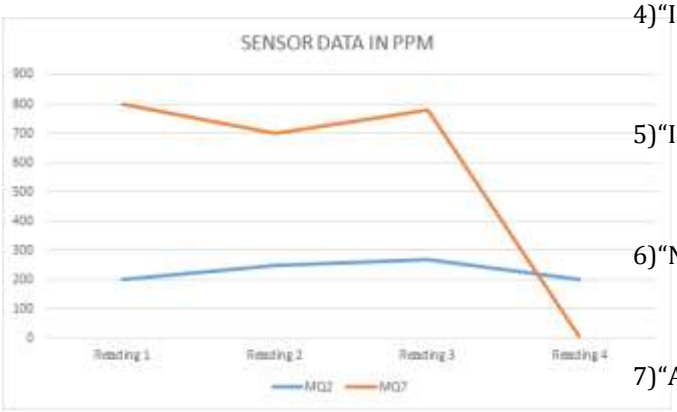

Fig -7: MQ2 and MQ7 Sensor data with four readings

2) Line-Chat: Sixth figure shows the data via Line-Chart which will be seen on the Desktop side. The data is in PPM which is reading for the sensor attached.

5. CONCLUSION

In this paper, we have studied various concepts that have been used by other users and thus developing a unique IoT inference model using IoT, Machine Learning, Cloud Computing and Smart phone together as new architecture. This project mainly concentrates on detecting the environment around us taking in to account two parameters mainly Healthy environment and Harmful environment. We are going to assemble various data from sensors connected to IoT and then analyze the data. If the data is found harmful than only it will be sent to the cloud for concerned authorities to view it on the smart phone. Thus it will decrease the amount of data sent to the cloud and full blown inference model for data on the cloud. The main drawback of this framework is that if the sensors does not properly take readings it will create a failure of the system.

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