ISSN 2320 - 2602

Volume 9 No.7, July 2020

International Journal of Advances in Computer Science and Technology

Available Online at http://www.warse.org/IJACST/static/pdf/file/ijacst03972020.pdf

https://doi.org/10.30534/ijacst/2020/03972020

Disaster Management using IOT and Machine Learning using K Means Clustering Algorithm

Akhil M Anil[1], Benjamin A Jacob[2], Ashik Kurian Joseph[3], Akhil Krishnan[4], Chris Chettissery[5]

1Mangalam college of engineering, India, akhilmanil0@gmail.com

2Mangalam college of engineering, India, benjikottayam@gmail.com

3Mangalam college of engineering, India, ashikkj244@gmail.com

4Mangalam college of engineering, India, akhilkrishnan295@gmail.com

5Mangalam college of engineering, India, chrisphilip08@gmail.com

ABSTRACT

When a disaster occurs the first one to get affected will be the common people belonging to that area. Due to heavy traffic in the cellular networks they may not be able to contact the rescue team[1]. Best thing we can do is that we can find an alternative to contact the rescue team.[3] Our proposed tool is an IOT device which sends the present location along with some weather parameters (say Temperature, Humidity etc.) and this information can be stored to any cloud platform such as 'Thingspeak'.[2] For a rescue team to efficiently act according to the situation Since in a disaster situation there will be multiple requests and they need to handle all these requests and they need ensure the safety of each and everyone. For that they need to categorize the available data on the basis of risk. For that we have Machine Learning model which uses the different parameters which we get from the device such as humidity, Temperature etc and along with that we need to analyse the previous weather records at that location using any website which provides weather dataset and all these information is given as input to the machine learning model and predicting the 'Risk Factor' and thus we can rescue the victim with high risk first to those with low risk.[4]

Key Words: Disaster Management, IoT, Machine Learning, K means clustering.

1. INTRODUCTION

Collecting and sharing disaster information is the most important activity to support decision making in rescue processes. This interest comes from the increasing number of disasters all over the world, causing loss of a huge number of lives and properties and the ease of using this new and cheap technology. Different environmental parameters can be detected with the help of sensors such as the atmosphere humidity and temperature. Along with this, the position of the victim will also be tracked.We store this information in any of these clouds and the team assigned for rescue purposes can access these information from the cloud and they need to categorize these information based on risk factor.

For that purpose we need to develop a machine learning model which predicts the risk factor.[4] This model uses the parameters which is fetched from the device, Inorder to get maximum accuracy for the model we need to analyse the previous weather records at that location as latitude and longitude will be collected from our device and by using any website which provides weather dataset we fetch more weather parameters of the location and predict the 'Risk Factor'.[4]

2. BASIC CONCEPTS

An IOT device which can be used when any disaster occurs and by using a machine learning model to predict 'Risk Factor'.

IOT:The **Internet of things** (**IoT**) is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.[5]

Machine Learning: **Machine learning** (**ML**) is the study of computer algorithms that improve automatically through experience. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training set", in order to make predictions or decisions without being explicitly programmed to do so.[6]

Unsupervised Learning: **Unsupervised learning** is a type of **machine learning** algorithm used to draw

inferences from datasets consisting of input data without labeled responses. The most common **unsupervised learning** method is cluster analysis, which is used for exploratory data analysis to find hidden patterns or grouping in data.[6]

Disaster Management: **Disaster management** refers to the conservation of lives and property during natural or man-made disasters. Disaster management plans are multi-layered and are planned to address issues such as floods, hurricanes, fires, mass failure of utilities, rapid spread of disease and droughts. India is especially vulnerable to natural disasters because of its unique geo-climatic condition, having recurrent floods, droughts, cyclones, earthquakes, and landslides.[7]

3. RELATED WORK

There are many works which uses the IOT for building similar projects for disaster management which includes sending and receiving of SMS using cellular data.[3]But at the time of any disaster, the traffic in the network increases and there is a chance of network crash. So we must opt for any other technology. As we all know that the emergence of IOT technology is increasing day by day, so why can't we opt IOT for disaster management purposes. There are many challenges in opting the IOT technology as we need to consider different prospects when designing a system which uses IOT.[1] Even if we overcome the problem of network traffic, there are a lot of challenges ahead of us. If such a system is developed and every person has this system and we need to monitor each and every system and ensure the system is working properly and in an emergency situation it needs to send the information to the cloud and the rescue team must access the system.

There are many systems focused on monitoring water level remotely using wireless sensor networks. The project also utilizes Global System for Mobile communication(GSM) and Short Message Service (SMS) to relay data from sensors to computers or directly alert the respective victim's through their mobile phone.[4]In this case all the victims will receive the SMS but what about the rescue processes? Using this SMS how they can save themselves and their family. These all questions arrieses.

So we need to develop a system which is capable of identifying and also helping the rescue team be used.

For that we embed intelligence in the system. For that we can use any machine learning models which can be implemented using any of the programming languages like python. We can either use supervised learning, unsupervised learning or reinforcement learning for the development of the machine learning model. If the output set is already with the dataset provided we can use supervised learning and if output is undefined, in that case we can use unsupervised learning.

4. PROPOSED WORK

Here we can divide our work into two different phases, i.e, IOT device design phase and the machine learning model development phase.

For the IOT device design phase we need to design the hardware components & it's connections, choose a platform to store our data securely, codes for uploading information to the cloud as well as from the cloud. We can use an Arduino uno as the development board and ESP8266 wifi module to connect with the device. Modules for Weather parameters like temperature and humidity can be added to the board. Modules for location can also be added into the board.

We can use any cloud platforms like 'Thingspeak' for storing the fetched information from the device. We need to develop code for arduino to function as our need and also communicate properly with the cloud platform.

For the machine learning model development phase we need to develop an algorithm which uses the datas from the device and other parameters of the present location to predict the 'Risk Factor' for each and every one. For that first we need to collect the parameters from our device along with latitude and longitude from our cloud platform and using that latitude and longitude we need to collect other parameters like cloud cover, precipitation level, wind speed, atmospheric pressure etc. from the web.

We can use K-means clustering[7] for training the model. In Order to train the model with maximum accuracy we need to use certain methods listed below so that we get more accurate data:

1. Data Preprocessing
   It is used for training the model more efficiently. If our dataset contains any categorical value we need to convert it into digit.

2. Normalization
   Since our dataset contains values in different ranges(i.e, pressure in range of 1000+ and cloud cover is range of 0-2) it's very difficult to train our model as it will affect the accuracy of the model, so we need to convert these into a fixed scale. This process is known as Normalization.

3. Dimensionality Reduction
   We can use principle component analysis for dimensionality reduction. All of the features associated with the dataset are mixed up and

reduced to a minimum features or components. Using these features we train the machine learning model.

After these steps using the minimum components after the dimensionality reduction by the K Means clustering we develop a certain number of clusters. After the training procedures are over we need to predict the 'Risk Factor'.

5. SYSTEM ARCHITECTURE

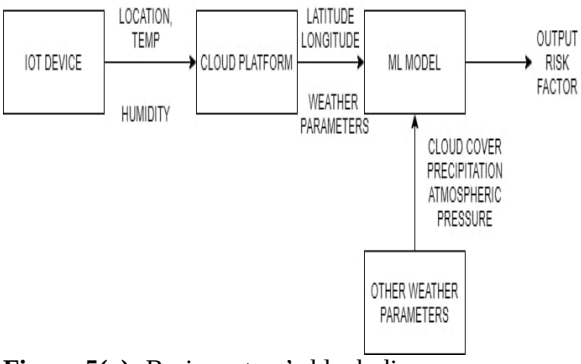


Figure 5(a): Basic system's block diagram

The system architecture consist of 3 main blocks:
IOT device, Cloud platform and ML model.
The IOT device has some hardware components and we need to write the code for the communication with the cloud. Different components used in this system are as follows:

1. Arduino uno:
   The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller.
2. DHT11 :
   It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. he warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.
3. ESP8266:
   ESP8266 is an UART-WiFi transparent transmission module with ultralow power consumption, specially designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.
4. GPS Module NEO06MV2:
   The NEO-6 module series is a family of stand-alone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact architecture and power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints.
   The IOT device has 3 connections, one with the dht module, one with the esp module and one with the gps module.

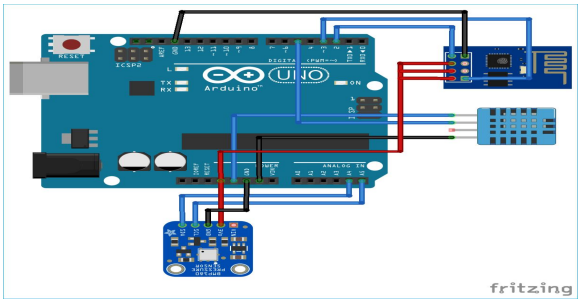


Figure 5(b): Connection of arduino with different modules for weather data

We can use cloud platforms like 'Thingspeak', we need to upload the sense data to the cloud and we need to retrieve data which is used for input for machine learning model.

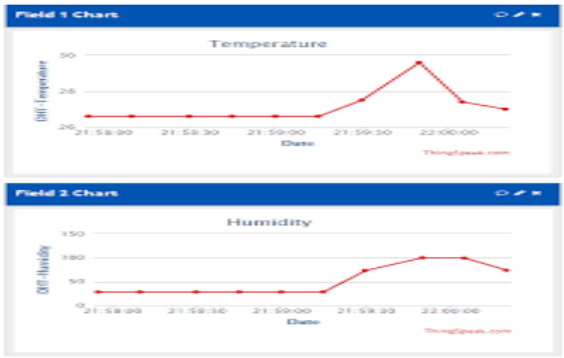


Figure 5(c): figure shows the sensed data field in thingspeak cloud platform.

Machine learning model deal with the prediction of 'Risk Factor'. Since the risk factor is not included in our dataset we can use 'unsupervised learning'. In order to get maximum efficiency we need to perform various preprocessing in our dataset.

Python has many packages for performing data preprocessing such as 'sklearn'. The input from the device is given as input to the ml model. Initially the model will collect more information of the present location using the location provided by the device. Then it will create a dataset and it will perform operations like Data Preprocessing, Normalization,

Dimensionality Reduction.Then we will train the data using the dataset and predict the 'Risk Factor'.[9]

6. EXPERIMENT AND RESULTS

The IOT device can be used by anyone and the cloud platform is accessed by dedicated members of the rescue team. The device can be used by anyone and in an emergency situation like natural disasters, we can activate the device and after the device is activated it automatically sends weather parameters to the cloud platform.

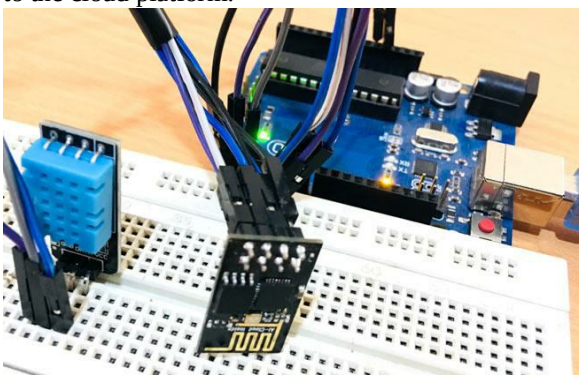


Figure 6(a): Shows the modules connected to the IOT device.

The rescue team will have to access the cloud storage and they can view these parameters. Since in a disaster situation there will be multiple requests and they need to handle all these requests and they need ensure the safety of each and everyone. For that they need to categorize the available data on the basis of risk. For this purpose the rescue team will give these data to a machine learning model.

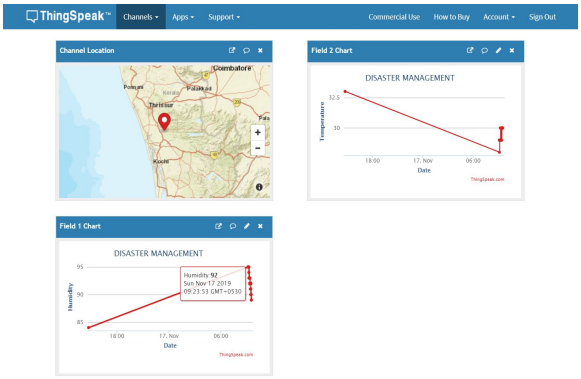


Figure 6(b): Figure shows the sensed data from the IOT device.

The machine learning model fetches the data from the thingspeak platform using the API provided by the platform. Along with that it fetches more weather information from the 'Weatherstack' using the REST API provided by the website.[9]

For proper analysis of the data we perform different operations on the data as we mentioned earlier. We create a heatmap using the dataset which will give the correlation with each component in the dataset.

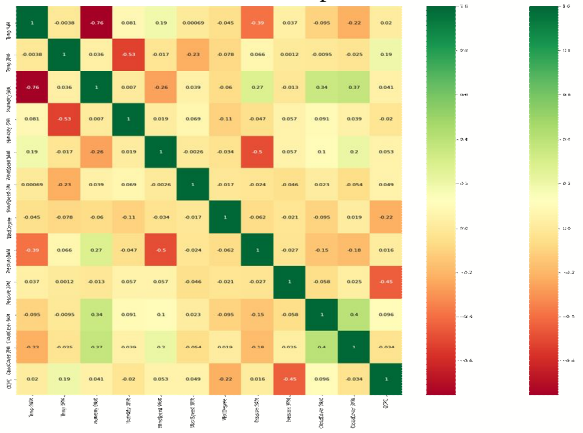
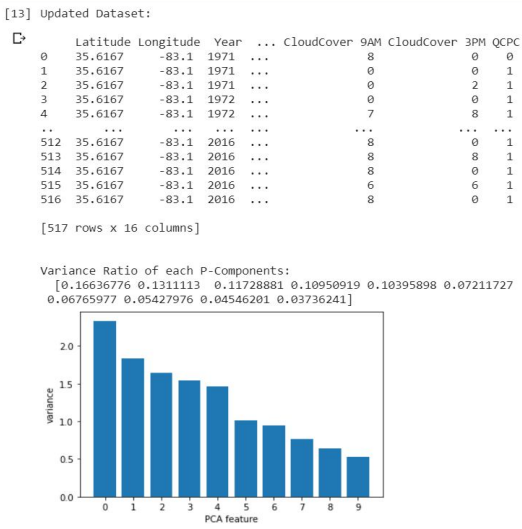


Figure 6(a): Heat Map predicted by ML model.

Heat Map is a combination of different features and from the heat map we can see that the cell with green colour indicates that its x-y axis relation is very high. After the heat map is created ML model will perform Data Preprocessing, Normalization, Dimensionality Reduction.[10]



```
[13] Updated Dataset:

     Latitude Longitude  Year  ... CloudCover 9AM CloudCover 3PM QCPC
0     35.6167     -83.1  1971  ...             8             0    0
1     35.6167     -83.1  1971  ...             0             0    1
2     35.6167     -83.1  1971  ...             0             2    1
3     35.6167     -83.1  1972  ...             0             0    1
4     35.6167     -83.1  1972  ...             7             8    1
..        ...       ...   ...  ...           ...           ...  ...
512   35.6167     -83.1  2016  ...             8             0    1
513   35.6167     -83.1  2016  ...             8             8    1
514   35.6167     -83.1  2016  ...             8             0    1
515   35.6167     -83.1  2016  ...             6             6    1
516   35.6167     -83.1  2016  ...             8             0    1

[517 rows x 16 columns]


Variance Ratio of each P-Components:
  [0.16636776 0.1311113  0.11728881 0.10950919 0.10395898 0.07211727
 0.06765977 0.05427976 0.04546201 0.03736241]
```


Figure 6(b): output after data preprocessing stage.

After all these training is done we move to the evaluation stage of the model. PCA creates and maps the dataset with the datas collected from cloud and website. Thus creating a Scatter Diagram using 1st & 2nd P-Components.

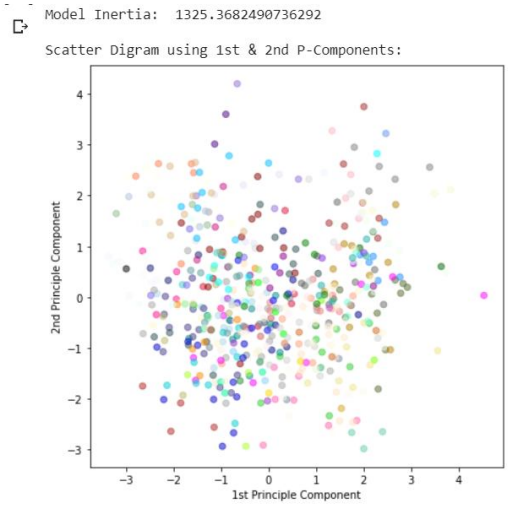


Figure 6(c): output after evaluation stage.3

7. CONCLUSION

Disasters are something that cause damage of property and loss of life. The prevention and cure of these disasters is known as disaster management.This is a plan that outlines what hazards your business is at risk of facing, what you can do to avoid or manage them and how to get your business back up and running should a disaster strike. The conclusion of your disaster management plan reiterates the salient points and provides actionable takeaway.

ACKNOWLEDGEMENT

The authors wish to thank principal Dr. Manoj George, Dr. Vinodh P Vijayan H.O.D- Computer Science Department, Mr. Chris Chettiserry for the proper guidance, valuable support, and helpful comments during the proofreading.

REFERENCES

[1]Internet of Things for Disaster Management: State-of-the-Art and Prospects. PARTHA PRATIM RAY1, MITHUN MUKHERJEE2, (Member, IEEE), AND LEI SHU2,3, (Senior Member, IEEE)
DOI: 10.1109/ACCESS.2017.2752174
[2]An “Internet of Things” Vision of the Flood Monitoring Problem.Massimo Ancona*, Andrea Dellacasa*, Giorgio Delzanno*, Andrea La Camera* and Ivano Rellini†*DIBRIS, University of Genoa Genoa, Italy AMBIENT 2015 : The Fifth International Conference on Ambient Computing, Applications, Services and Technologies
[3] Corporative Flood Detection Using GSMD via SMS. DOI: 10.1109/ITSIM.2008.4632045
[4] Flood Forecasting System Based on Integrated Big and Crowdsource Data by Using Machine Learning Techniques.
Supattra Puttinaovarat ; Paramate Horkaew
DOI: 10.1109/ACCESS.2019.2963819
[5] Rouse, Margaret (2019). "internet of things (IoT)". IOT Agenda. Retrieved 14 August 2019.
[6] http://www.cs.cmu.edu/~tom/mlbook.html
[7] "NDMA Vision", National Disaster Management Authority (India)
[8]THE DESIGN OF A SENSOR NETWORK BASED ON IOT TECHNOLOGY FOR LANDSLIDE HAZARD ASSESSMENTR. Morello, C. De Capua and M. Lugarà
[9]Detection of flood disaster system based on IoT, big data and convolutional deep neural networkM. Anbarasan a, BalaAnand Muthu b,*,C.B. Sivaparthipan c, Revathi Sundarasekar d
[10]Integrated machine learning methods with resampling algorithms for flood susceptibility prediction Esmaeel Dodangeh, Bahram Choubin, Ahmad Najafi Eigdir, Narjes Nabipour, Mehdi Panahi, Shahaboddin Shamshirband, Amir Mosavi