IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Special Issue-14, May 2019 E-ISSN: 2347-2693

Smart Speed Limit Sign Board for Changing Weather Conditions

Abhishek Rai[1*], Farooque Azam[2], Anshul Kumar[3], Abhinav Bajpai[4], Ankesh Gaurav[5]

[1,2,3,4,5]School of Computing & Information Tech., REVA University, Karnataka, India

[*]*Corresponding Author: raigon48@gmail.com, Tel.: +91-9686072900*

DOI: https://doi.org/10.26438/ijcse/v7si14.424428 | Available online at: www.ijcseonline.org

***Abstract*—**Digital road sign boards are an advanced solution for today's static road sign boards which are incapable of handling dynamic situations under changing weather conditions. Internet of things (IoT) technology has enabled the interconnectivity between remotely distributed devices and can be centrally monitored and controlled. These digital roads sign boards can be accessed and controlled remotely using centralized control center. The speed limit of a particular road will be updated according to current weather conditions like rain, fog etc. The proposed system has been implemented using raspberry pi, matrix display and weather API.

***Keywords*—** Internet of things (IoT), raspberry pi, matrix display

I. INTRODUCTION

The Global status report on road safety 2015 by World Health Organisation (WHO) indicates that the number of deaths due to road accidents has reached up to 1.25 million per year. Rates of accident due to bad weather and over speeding has always been a problem [5]. Traditional way of displaying the speed limits are static speed limit boards deployed on roads and speed limits are fixed and does not take the weather conditions into consideration [6]. Another kind is a digital sign board extensively used in most of the public places to grab the attention of the public. It's an easy mode of conveying information and the information displayed can be changed according to the need [2]. These sign boards can be actively deployed in a smart city to serve as a part of traffic management system. A smart speed limit digital board which is adaptive to the changing weather conditions can help in reducing accidents due to over speeding in harsh weather conditions. These smart speed limit boards are interconnected and centrally manageable [4].

Rest of the paper is organised as follows, Section I contains introduction of the proposed work, Section II contains related work where all the previous related works are discussed, Section III contains Methodology where the proposed system is described, Section IV contains results and discussion where result of the work is discussed and at the end acknowledgement and all the references of the previous work is given.

In Smart speed limit boards, the optimal speed limit for a road is decided by considering the weather conditions provided by the OpenWeatherMap API.

II. RELATED WORK

A smart city incorporates several smart elements like smart governance, smart transportation, smart home etc. to reduce natural resource consumption wastage, overall costs and enhancing the quality of living for its citizens. [3].

C.M. Sunny et.al. [5] discuss about the rate of accidents happening all over Kerala in different districts. Data about previously happened accidents is taken and based on that the chances of accidents are predicted so that preventive measures can be taken. This approach towards avoiding accidents is not real time and does not rectify the faults in traffic management system due to which accidents occur. Our proposed work rectifies the loop holes in present traffic management system.

S.D. Jadhav et.al. [4] discuss about electronic notice board which is controlled using IoT. The message is sent using SMS gateway which is then displayed on the board. This makes notice board more dynamic and changes are done in real time. This notice board is restricted for public announcements and does not contribute in traffic management. Our proposed work nullifies this limitation.

S. Alase et.al.[2] has developed digital signage board which can be accessed remotely and used to display advertisements. This project has used Raspberry PI 3 for processing data. A network of multiple digital sign boards can be installed and controlled remotely from single server.

Y. Qian et.al. [6] has discussed about using the dash board camera to analyze the road weather condition and alerting the driver about the possible upcoming difficulties. However, this project is restricted to cars those are equipped with a

dash board camera and is not suitable for a normal car and motor bikes. Our work does not require the vehicle to be quipped by any special components and can be used by all type of traffic in general.

In our proposed work, we are going to discuss a smart limit sign board for changing weather conditions. It will give flexibility in curbing the accident because of bad weather conditions viz. storm, thunder, heavy rain (>0.30in/hr). This noble work has not been carried out as per author's best knowledge.

III. METHODOLOGY

The main aim of this project is to contribute towards smart transportation based on weather data which can help in reducing congestion and accidents by making the speed limit sign boards adaptive. This board is not restricted to displaying speed limit and can be used for multiple signs. This is the plus point of having a matrix display. IoT is the key technology used here for the deployment of this model. There are different level of IoT levels and their deployment schemes [1]. In this case we are using IoT level-2 for deployment. This level has multiple node that performs the computation locally. Data is stored in the cloud and the application runs on the device itself. An application is used by the server to send instruction to be performed by these nodes. This server also monitors the nodes and performs analysis.

The system consists of a matrix display which is connected to the raspberry pi 3. The raspberry pi 3 board is connected to the Internet with the help of a router providing the remote accessibility. The weather data is accessed for a particular location where the speed limit board is located with the help of its latitude and longitude. Here, an application programming interface (API) call is made to the open weather map which sends the current weather report of the area in JSON format. Important information is extracted from it like rainfall density, fog density etc. These values are fed to the k-means [7] clustering algorithm which performs clustering and helps in determining the suitable speed for driving on road in this condition. The k-means algorithm is imported from sklearn package of Python. New speed is updated on the display board and database when there is change in weather condition.

K-means algorithm is a clustering algorithm which when fed with a dataset returns centroid of k clusters. In our work we imported K-means algorithm from sklearn library. We used a random data of hourly rain and fed it to the algorithm by giving the k value as 4. The algorithm returned 4 centroids. The centroids returned by the algorithm are shown in Fig-1. Now, for every new rain value we find Euclidean distance from all the four centroids to find the closest centroid and classified the rain value depending on the closest centroid. Based on that the algorithm decides the optimum speed.

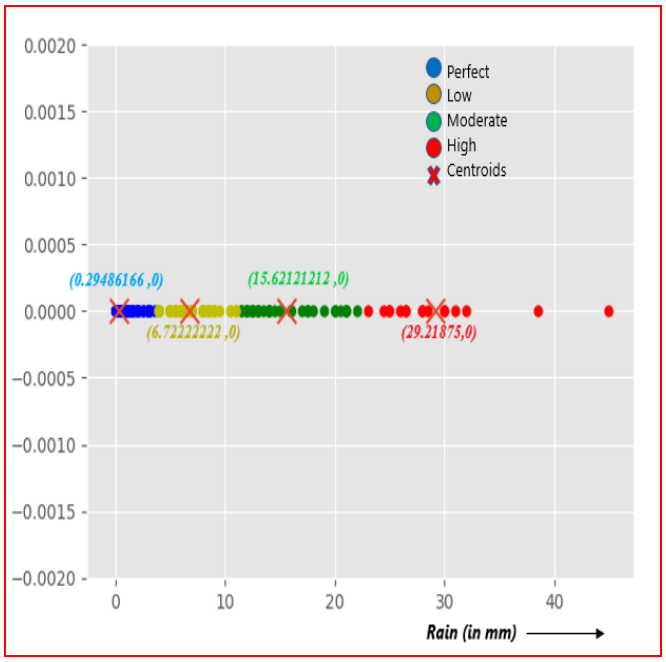

Figure 1. Plot obtained from K-means algorithm

Functionalities like checking current state, displaying alert signs, changing the function of digital sign board is done using an application on server side. The application requires username and password for authentication. Only an authorized user which in this case Traffic Police Department will have access to it. After getting the access to the application user can control what is required to be displayed on the board from the control room. The alert messages is given more preference over the speed limit board. The control room can be used to monitor traffic and use these digital sign boards functionality to release congestion by rerouting the traffic using the road sign boards.

OpenWeatherMap is an online serve provides the current weather data, forecasts and historical data to various users and developers. It takes data from various weather stations and processes it to provide accurate weather forecasts and weather maps. It provide an API call which sends data in JSON/XML format as shown in figure-1. Data for particular place can be accessed by providing geographic coordinates.

Python is the primary language used for the development of this project. It is a minimalistic language with relatively few keywords and has very few syntactical constructions compared to other languages. Python has wide library support and runs on various platforms like Windows, Linux, etc.


```
{"coord":{"lon":139,"lat":35},
"sys":{"country":"JP","sunrise":1369769524,"sunset":1369821049},
"weather":[{"id":804,"main":"clouds","description":"overcast clouds","icon":"04n"}],
"main":{"temp":289.5,"humidity":89,"pressure":1013,"temp_min":287.04,"temp_max":292.
"wind":{"speed":7.31,"deg":187.002},
"rain":{"3h":0},
"clouds":{"all":92},
"dt":1369824698,
"id":1851632,
"name":"Shuzenji",
"cod":200}
```


Figure 2. Sample Weather data from openweathermap api in JSON format updated every 3 hrs.

Multiple signs boards being used can be controlled from a single control room. The basic diagram of the project looks like as shown in the figure-2.

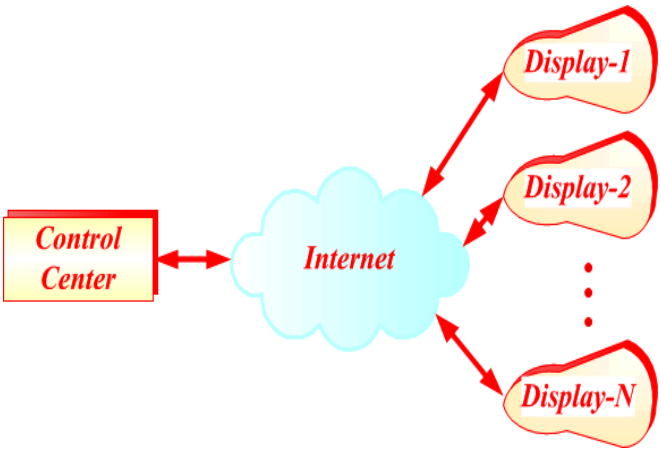

Figure 3. Block diagram of the proposed system

Figure-3 shows the flowchart for how the speed is updated based on the weather. Front end of this project is made up of a Raspberry PI 3 board [8], matrix display and a network connection. This raspberry pi runs a python script which gets the speed limit value decided by taking the weather conditions into consideration and updates it on the display unit every hour or depending on the situation.

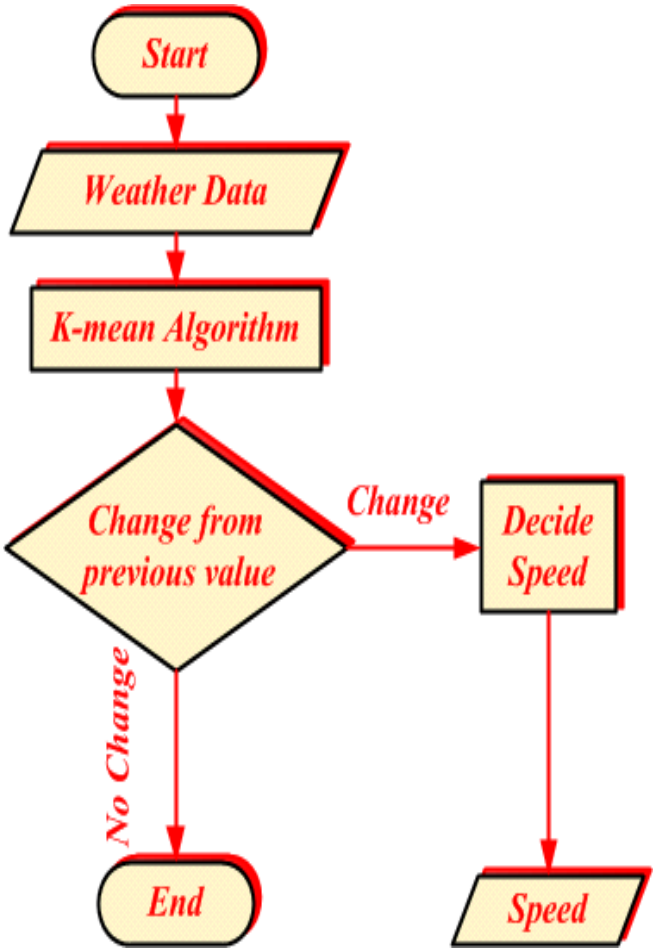

Figure 4. Flow diagram of Speed decision based on current weather condition

The decided message is converted into a matrix display code and is sent to the display unit. Back end of this project is a GUI made by using python Tkinter module which facilitates interaction with individual sign boards. The backend (control room) helps to send action to be performed by the sign board like manually updating of the speed limit, activating automatic speed decision by getting weather update, sending emergency alerts and checking display status. The status of each device is maintained in a real time database which store the current updates of device. In this case firebase by google clouds is used to the store the data. Firebase is a NoSQL database which gives the functionality of storing unstructured data. Data is sent/received using API calls to the firebase.

IV. RESULTS AND DISCUSSION

A better alternative for traditional static speed limit sign boards and other sign boards is proposed. These dynamic digital road signboards are more reliable, cost effective and contribute towards safety of people. Making them adaptive to

weather conditions will make it display a speed which is suitable for that particular road condition can reduce the rate of accidents.

The following are the results obtained from the implementation of this project. Figure-4 shows the automatic updating of the speed limit whenever weather changes. The speed is changed on the basis of following table (Table-1):

Table-1: Classification of speed limit based on rain density

S. No.	Rain Density (mm)	Category	Speed Limit (km/hr.)
1.	0-3	Negligible	100
2.	3.1-7	Light	80
3.	7.1-21	Moderate	60
4.	>21	Heavy	40

In the given Fig-5, we can see the speed limit changed to 40 km/h when rain density increased to 22 mm.

Figure 5. Data format of the status of a device in database

With reference to Fig.4, device003 is the device id, action is command given to raspberry pi for internal usage, default is the default speed limit value, latitude and longitude are location specifiers of a particular device, message is what actually going to display on the board, rain density is the amount of rain in mm for 3 hours.

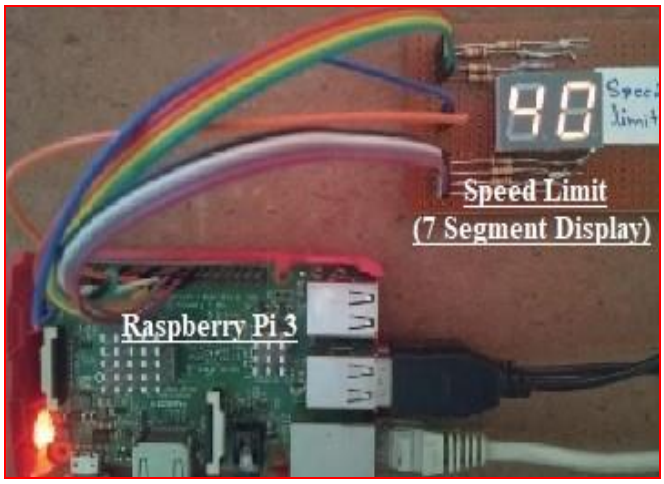

Figure 6. Hardware setup showing auto update of speed

The same board can even be used to display an emergency message based on circumstances. Moreover, these signboards are highly visible and can be used for multiple other signs as well. Maintenance cost is also less as it consists simple circuits and a display unit. Using IoT technology all the boards are interconnected and made centrally manageable. This makes it easy to rectify the errors as they can be accessed remotely. Hence, it overcomes all the major short comings of the traditional static sign boards.

V. CONCLUSION AND FUTURE SCOPE

As the world is moving towards smart technologies, every electronic device in this world is becoming smart. The application of IoT is prevalent in every domain. We made an effort to make road sign boards smart in order to improve the road safety by embedding the concepts of IoT. This project has changed the static speed limit sign boards to smart by making them adaptive to weather conditions.

The major short coming of our project is the unavailability of real time weather data for a particular place where the board is to be installed.

Hence as a part of future scope, this work can be extended to a larger scale by taking help of Government agencies such as meteorological dept. to provide real time weather data.

This board can be used not only for speed limit sign boards but also in traffic control during emergency situations.

ACKNOWLEDGEMENT

We sincerely thank our guide Prof. Farooque Azam for his valuable guidance throughout the project. This project would not have been possible without his support. We would like to thank our Director, Dr. Sunil Kumar S Manvi for continuous motivation.

REFERENCES

[1] A. Bahga, V. Madisetti, "*Internet of Things a Hands-on Approach",* Universities Press Private Limited, India, pp. 42-51, 2018.

[2] S. Alase, V. Chinchur, "*IoT Based Digital Signage Board using Raspberry PI 3"*, International Research Journal of Engineering and Technology, Vol. 4, Issue. 5, pp. 310-313, 2017.

[3] Kamanashis Biswas Vallipuram Muthukkumarasamy, "Securing Smart Cities Using Blockchain Technology", In Proceedings of 2nd IEEE International Conference on Data Science and Systems, pp. 1392-1393, 2016.

[4] S.D. Jadhav, Y. Mistry, "*IoT Based Electronic Notice Board*", International Journal of Current Engineering and Scientific Research, Vol. 4, Issue.11, pp. 73-76, 2017.

[5] C.M. Sunny, Nithya S., Sinshi K.S., Vidya V.M.D., Aiswaria L.K.G., Anjana S., T.K. Manojkumar, "Forecasting of Road Accident in Kerala: A Case Study", In Proceedings of IEEE International Conference on Data Science and Engineering, pp. 1-5, 2018.

[6] Y. Qian, E.J. Almazan, J.H. Elder, "Evaluating Features and Classifiers for Road Weather Condition", In Proceedings of IEEE International Conference on Image Processing (ICIP), pp. 4403-4407, 2016.

[7] Z. Huang, "Extensions to the k-Means Algorithms for Clustering Large Data Sets with Categorical Values," Data Ming and Knowledge Discovery, vol. 2, no. 3, pp. 283-304, 1998.

[8] S.K. Riyazhussain, C.R.S. Lokesh, P. Vamsikrishna, G. Rohan, "Raspberry Pi controlled Traffic Density monitoring system", In Proceedings of IEEE International Conference on Wireless Comunications, Signal Processing and Networking (WiSPNET), pp. 1178-1181, 2016.

