



ANALYTICS AND VISUALIZATION FOR DETECTING THE STREET LIGHT FAILURES ACROSS THE CITY

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Abstract

“Detecting The Street Light Failures Across A City” is a is an automated system which automates the streetlight. The main aim is to analyse the Pattern of Street light and to reduce the power consumption. The street light will be turned on when there is dark otherwise the lights will be switched OFF. With advancement of technology, things are becoming simpler and easier for everyone in the world today. To reduce the human work Automation plays an important role in the world economy and in daily experience and is mainly used in control systems and information technologies. Automatic systems are being preferred over manual system. The system application in street light control for each lamp will reduce the usage of electricity and maintenance cost, and increase the lifetime of street light.

I. Introduction

“Detecting The Street Light Failures Across A City” is a simple and powerful concept, where we search a location based on Google maps, and then based on street it switches ON and OFF the street light automatically. In this system manual works are removed. Street lights can be fitted with sensors to turn on and off, based on the luminosity. If it gets dark earlier in the day, the light can go on automatically. They also have a specific location on a map, with a latitude/longitude value. It automatically switches ON/ OFF lights based on the luminosity of Sunlight the objective of this project is to remotely control the street lights using a software. There are tens of thousands of street lights across any city. These street lights are controlled centrally in some cities, and locally in others. Many times, we see problems like street lights not switched on, some failing

repeatedly, some being on during the day etc. These lead to increased consumption in many cases, and calls to the electricity agencies.

II. Literature Survey

“Detecting The Street Light Failures Across A City” is all about to control the power consumptions of streetlights and eliminating manpower. During daytime there is no requirement of street lights so that the street light will be off until the light level is low. In the present generation human has become too busy, and is unable to find time even to switch off the lights whenever not necessary. Hengyu Wu, Minli Tang proposed about the core technology of streetlight control system based on AT89S52 single-chip microcomputer .It integrates a power consumption .Gong Siliang describes a remote streetlight monitoring system based on wireless sensor network. The system can set to run in automatic mode. Main advantages of street lighting includes: prevention of accidents and increase in safety.

III. Proposed System

- The objective of this project is to remotely control the street lights, where we have programs to generate data for luminosity, along with the latitude and longitude of the location.
- We use simulated random data to set the light to ON/OFF based on the luminosity values (if it becomes dark the light needs to be turned on.
If there is more natural light, then the street light goes off).
- We use analytical tools to visualize the data - on a map. To show which lights are on, off - and the ability to filter them.
- The visualization should be refreshed to reflect the new status. Visualization can be

on a map of the area.

IV. Approach

A. Visualization

Visualizations can help us in two different ways:

Communication and exploration we don't know anything about our data, and investigating it in its raw form will be impractical sometimes.

We can use data visualization to present the data in a form more suitable for exploration. The main approach used for visualization data is by using an open source charting library i. e D3.js

D3 stands for Data-Driven Documents. The word "document" in D3 refers to the DOM.

D3.js is a JavaScript library used to create interactive visualizations in the browser., It's the parsed and rendered HTML and CSS.

D3 helps to bring data using HTML, SVG, and CSS.

For drawing charts there are two different ways in D3.js

a) Through CSV format

- i. Using MYSQL-to-CSV Converter. convert mysql data to csv format using queries.
- ii. Using html code write program to draw chart.

b) Through Ajax

Here we need to follow the steps for drawing the charts:

- i. First connect php with mysql and get data from data base. We get the data in json format as:

```
{
  "date": "2018-02-18", "status": "null", "co": "4" },
  {"date": "2018-03-06", "status": "off", "co": "1" },
  {"date": "2018-03-07", "status": "on", "co": "2" }
```

- ii. Using Ajax you can call php file and get data from database.
- iii. Refresh API everytime for 1 sec using basic javascript.

Here the output will be:

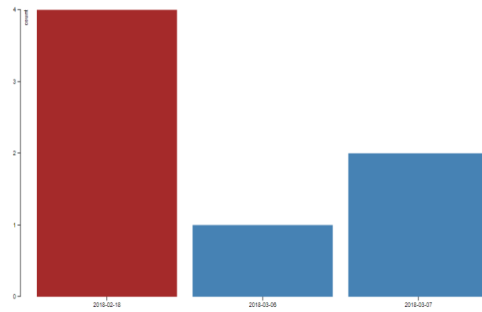


Fig 1: showing the area having the count of most failures.

B. Analytics

Analysing the data can be done using the technique called as 'Data Science'. Data Science is the principle that is used to find the hidden patterns in the data. Data Science is primarily used for prediction & decision. 'R' is the tool that is used for Data Science. In this we are using the approach 'k-means clustering algorithm'.

Algorithmic steps for k-means clustering

Let $X = \{x_1, x_2, x_3, \dots, x_n\}$ be the set of data points and $V = \{v_1, v_2, \dots, v_c\}$ be the set of centers.

- 1) Randomly select 'c' cluster centers.
- 2) Calculate the distance between each data point and cluster centers.
- 3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers..
- 4) Recalculate the new cluster center using:

$$v_i = \left(\frac{1}{c_i} \right) \sum_{j=1}^{c_i} x_j$$
 where, 'c_i' represents the number of data points in ith cluster.
- 5) Recalculate the distance between each data point and new obtained cluster centers.
- 6) If no data point was reassigned then stop, otherwise repeat from step 3).

Fig 2:K-Means clustering Algorithm

i) `locations<-read.csv("E:/sample/locat.csv")`
View(locations)

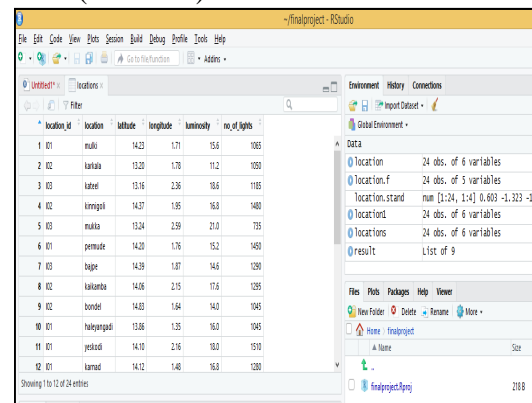


Fig 3: Load the locat.csv file

This csv file contains six fields. They are location_id, location, latitude, longitude, luminosity, no_of_lights.

ii) location.f=location

Create the copy of the dataset. In that we perform clustering, so that the original dataset will not be affected.

iii) location.f\$location_id=NULL

View(location)

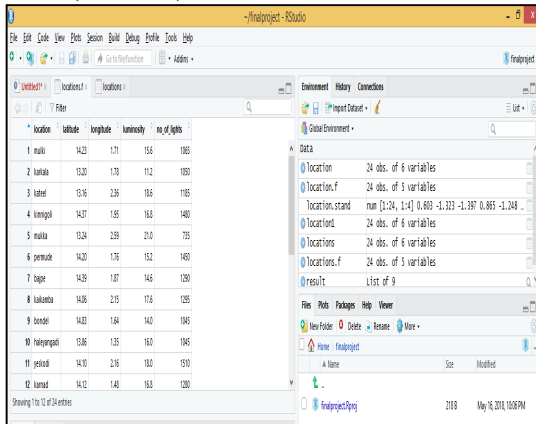


Fig 4: The column location_id is not used for clustering, so remove that particular column.

iii) locations.stand<-scale(locations.f[-1])

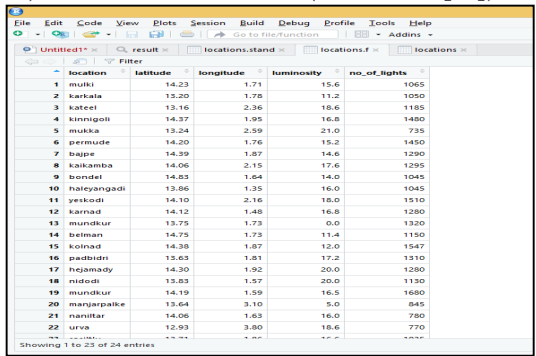


Fig 5: Each column contains different scale, so it is very difficult to compare when they are in different scale, so normalize the data. Normalization is done, so that we can compare different columns.

iv) result<- kmeans(locations.stand,3)

Here we are performing the clustering. In this we are redefining the number of clusters. Here we are considering the number of clusters as 3. In this we need k=3 because we have 3 location id.

The algorithm works in such a way that it comes with 3 means. It allocates each row with different means nearest value. It keeps adjusting it such a way that it cannot improve the design, so trial and error goes on multiple times.

v) attributes(result)

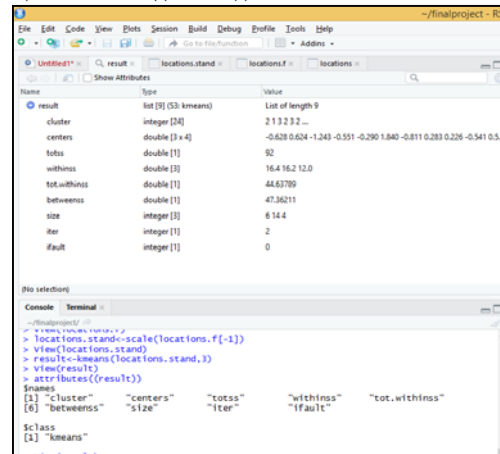


Fig 6: In this we are displaying the attributes of the result. In clustering we require 'centers'.
v) result\$centers

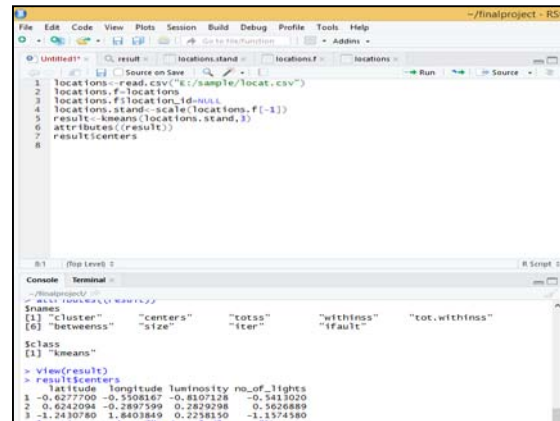


Fig 7: This displays the centers of each cluster.

vi) table(locations\$location_id,result\$cluster)

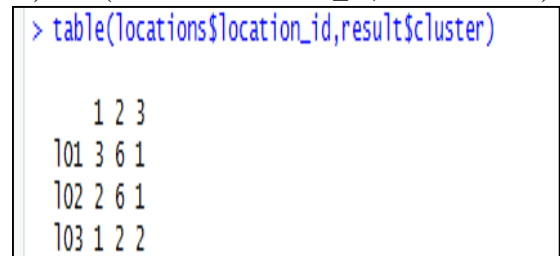


Fig 8: Here we are checking how the clustering is done, so compare original dataset with result. Each row has a cluster, it maps.

vii) plot(luminosity~no_of_lights,location)

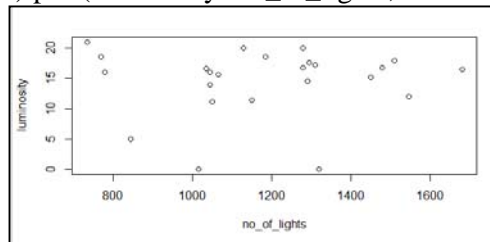


Fig 9: At the end plot the scatter graph.

V. Result & Discussion

In this we have performed two sets of experiments to investigate (i) Analytics i.e done using Data Science using R and open source Analytics tools (ii) Data Visualization is done using open source charting Libraries. Visualization and Analytics can be used to answer common questions like :

Q1) When are failures most frequent in a specific area ?

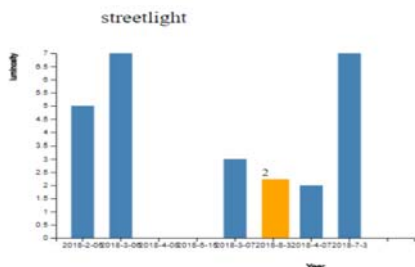


Fig 10: Bar chart showing failure in specific area.

Q2) Which area has the most failures in a given time?

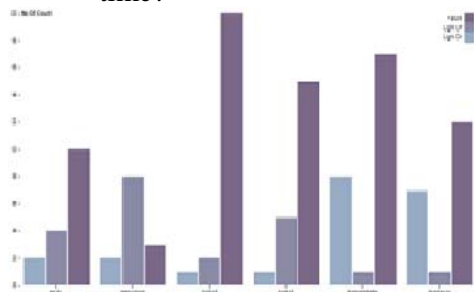


Fig 11: Stacked Bar chart showing the work condition over area.

Q3) In any given month, how many failures occur? Where?



Fig 12: Bar chart showing failure in specific area.

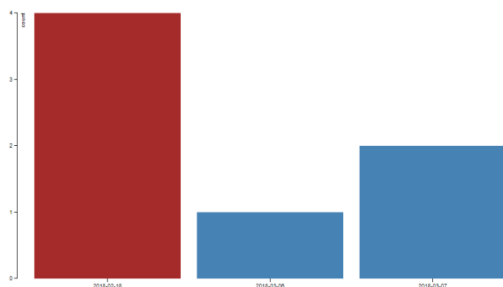


Fig 13: Bar chart showing failure in specific area.

VI. Conclusion

In “Detecting The Street Light Failures Across A City”, it integrates new technologies offering ease of maintenance and energy savings.

The proposed system is suitable for street light in rural as well as urban areas.

It is capable of taking corrective actions in case of unprecedented events of climatic changes.

It prevents unnecessary wastage of electricity, due to manual switching of streetlights.

The future scope is An Android app can be developed to control the street lights remotely (by just updating the value in the database).

References

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