**Smarty city Applications –Aarhus city Road data**

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Abstract

This report is to illustrate main steps involved in the creation of Smart City application using Aarhus city open dataset. This paper also explains how technology introduces smartness to all organizations and communities. The smart city strategy is an unavoidable trend in the future development of urban cities. This project mainly targets three main areas of Aarhus city road data set, which are Smart Travel plan, Smart parking, and Smart traffic. This paper also focuses on how cities benefit with digital infrastructure that produces Big Data and in turn, such data enables real-time analysis of city life. It also provides productive, competitive, open and transparent cities.  The target consumers are citizens and travelers to the city. The vision of the project is to demonstrate an integrated approach to improving travel, transportation, and parking

1. **Introduction**

Smart cities contain large volumes of data stored digitally and large numbers of objects connected online. Some smart services include Smart Mobility, Smart Education, Smart Finance, Smart Government, Water & Waste, Smart Energy, Smart Tourism, Smart Buildings, Smart Living, Smart safety, smart manufacturing, Smart Travel, Smart event management. Out of these, we focus primarily on three main development areas. Those are Travel, parking, and Traffic congestion.

The smart travel plan is an important part of the smart city strategy. Smartness concept applied to travelers before, during and after their trip. Destinations of tourism attractions could increase their competitiveness level.

Parking problems increases as the numbers of vehicles on the road are increasing day by day. Problems which arise due to insufficient parking space are driver frustration, air pollution, and traffic congestion. Creating Traffic Dash Board will provide many advantages to the user to utilize transport services in the day to day life. We also notice the performance within a city by integrating these areas with other smart city domains such as Event Management, pollution management, and smart transportation services.

Smart Travel

**Summarizing advantages**

This project describes how geographic and economic trends, changes in technology and city governance affects the people who travel today, and how they could affect travel industry in general in the future. We are going to use a rich set of advanced tools and libraries which are well suited for data analysis and Visualization like Spark, MapReduce and Tableau.

Smart Parking

Parking problems increase every day because the number of vehicles on the road increase consistently. Problems which arise due to insufficient parking space are:

1. Traffic congestion
2. Driver frustration
3. Air pollution.

The price for expanding parking area is extremely high. This kind of system helps to minimize traffic problems by finding a vacant space in a crowded parking garage.

Smart Traffic

User presented with Real-time information about traffic, parking conditions and transit options. Choosing better options minimizes traffic issues associated with major events. Information presented includes electronic signs, real-time warnings of incidents, traffic information boards and possible detours. The Traffic Planner is a web application for citizens. It can be used for obtaining user travel and parking recommendations

1. Contribution

We can use traffic and road data to design web application which integrates big data into the system. That will be used for travel planning for tourists for attending city events, Special attractions. We can integrate this application to another system that will provide traffic, Parking and event information. The complete application will contain map and GUI frontend developed with JavaScript and JSP. Backend data processing is done by the spark engine. Utilizing application server like tomcat we can present information to the user (Stakeholders) in real time. Hosting this application in AWS will provide cheaper solution instead maintaining own servers to launch.

1. Relevant Work

Other existing applications related to smart city and big data process information very efficiently. But the Application is lacking user-friendly GUI. This makes a big difference in usage of the application. Even though technology and architecture are up to date, lack of user friendliness is a big issue in most the cases. The application that we are going present will extend those capabilities provide the solution in a user friendly way.

1. Architecture

The growing popularity of Internet of Things and smart city applications, RDF stream processing increasing attention in the Semantic Web community. RDF is Resource Description Framework and it is a schema-less data model. It is one of the prime technologies of the Semantic Web and it is the current W3C standard for representing data on the web. As a result, many RSP engines have created, which will process semantically annotated data streams on the fly.

The idea is to connect travelers provide integrated payment options, the best mobility option and real-time travel information via a web app. Smart transportation systems are applications which, aim to provide services relating to different ways of transport and traffic management. And it also enables various users to be make safer use of transport networks.

The architecture of the system shown in Fig 1. Spark will be used for data processing.

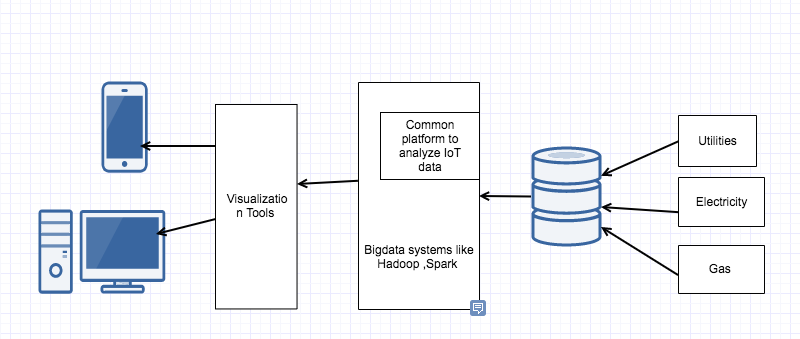


Fig:1

1. Data

Aarhus city traffic data is a collection of datasets of vehicle traffic, observed between two points for a set duration of time over a period of 6 months. There are 449 observation points. The data is available in CSV format and semantically annotated format(TTL) using the city pulse information model. which show information about the data streams, position of each of the two sensors in the dataset, distance in meters, type of road, etc. As technology becomes cheaper and cheaper, access to data becomes available to anyone. Powerful tools and technology is not only available for the wealthiest, but large parts of the population can get access to it.

**Meta Data:**

* POINT\_1\_STREET
* DURATION\_IN\_SEC
* POINT\_1\_NAME
* POINT\_1\_CITY
* POINT\_2\_NAME
* POINT\_2\_LNG
* NDT\_IN\_KMH
* POINT\_2\_POSTAL\_CODE
* POINT\_2\_COUNTRY
* POINT\_1\_STREET\_NUMBER
* ORGANISATION
* POINT\_1\_LAT
* POINT\_2\_LAT
* POINT\_1\_POSTAL\_CODE
* POINT\_2\_STREET\_NUMBER
* extID
* ROAD\_TYPE
* POINT\_1\_LNG
* REPORT\_ID
* POINT\_1\_COUNTRY
* DISTANCE\_IN\_METERS
* REPORT\_NAME
* RBA\_ID
* \_id

**Data:**

1. status,
2. AvgMeasuredTime,
3. avgSpeed exitID,
4. medianMeasuredTime,
5. TIMESTAMP,
6. vehicleCount,
7. \_id,
8. REPORT\_ID



Fig2

This information stored in two data sets. One is meta data other one is actual data. Each record in dataset is observation of how many vehicles passed between two points and its average speed with in five-minute interval. Meta data consists of geographic details such as Latitude and longitude of each road and exit information. These two datasets can be combined with report\_ID. By running analytics on this data we will be able to find out some patterns trends of traffic in past for different situations like different weather conditions, in major city events, peak times, holiday period. If Real time streaming is possible for more useful information and can be presented to the user which make their travel plans better which ultimately supports city tourism.

1. Method:

Advancement in Semantic Technologies for IoT have created great possibility for rendering IoT-enabled services in smart cities. Smart parking sensor detects vehicles parked in the parking spaces. Magnetic detection system established in parking lots provide information about availability parking spots. The device can also be placed directly on the road surface and vehicles placed near sensor will provide road side parking information. This simple technology could be applied to monitor vehicles in a parking garage. This way the system can inform drivers about the number of available parking spaces. This information shown in dashboard will provide city tourists also able to park without any trouble.

The Smart Tourism or Smart travel destinations concept emerges from the development of Smart Cities. With the help Event or Tourism destinations management system travels plans could be determined via maps and Dashboard like city pulse. Users are guided by the routes which they can access and type of transportation, schedule of events plan for a complete day activity. Traffic congestions also determined with an elaborative explanation about chances of caught in the traffic. The Idea of the app is to provide options like the type of user and activity they want perform with the application. If the person is traveler want to plan for his/her day for attend an event in the application will guide him with all access points. Possibility of difficult situations. And any disaster situation exit routes are planned and warned people with proper exit routes.

1. Conclusion

Over few decades, there has been increase in sensor integration into city traffic. Traffic cameras GPS from vehicles and radar are common data sources in our daily lives. In addition to these smart phones can act as sensors. Cell phone carries cell location data every day in entire city. Citizens can use this data from these sources able to make better travel decisions. Vehicles currently equipped with advanced technology traffic conditions can be exchanged and extract vehicle locations. In many Data rich transportation system, sensors collect user information and analyzed. When all these advancements are properly used with advanced tools like Spark, Hadoop which will provide so much chance to improve further in future. These superior systems process data in distributed and resilient manner which takes days before now become able to process in minutes or hours at least. Also utilizing advancements data science improvements in model building in areas such as Machine learning and datamining also open doors improvement in citizen’s life. Going further smart city concept is one of many such use cases in next decades. Human resources also now available compared to earlier makes these technologies improve further.

1. References
2. Muhammad Intizar Ali, Feng Gao and Alessandra Mileo, **"CityBench: A Configurable Benchmark to Evaluate RSP Engines Using Smart City Datasets"**, The Semantic Web - ISWC 2015 - 14th International Semantic Web Conference, October 11-15, 2015, Bethlehem, PA, USA.
3. Stefan Bischof, Athanasios Karapantelakis, Cosmin-Septimiu Nechifor, Amit Sheth, Alessandra Mileo and Payam Barnaghi, **"Semantic Modeling of Smart City Data"**, Position Paper in W3C Workshop on the Web of Things: Enablers and services for an open Web of Devices, 25-26 June 2014, Berlin, Germany
4. R. Tönjes, P. Barnaghi, M. Ali, A. Mileo, M. Hauswirth, F. Ganz, S. Ganea, B. Kjærgaard, D. Kuemper, S. Nechifor, D. Puiu, A. Sheth, V. Tsiatsis, L. Vestergaard, **"Real Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications"**, poster session, European Conference on Networks and Communications 2014.
5. Sefki Kolozali, Maria Bermudez-Edo, Daniel Puschmann, Frieder Ganz, Payam Barnaghi, **"A Knowledge-based Approach for Real-Time IoT Data Stream Annotation and Processing"**, in Proc. of the 2014 IEEE International Conference on Internet of Things (iThings 2014), Taipei, Taiwan, September 2014
6. W3C Semantic Sensor Networks Incubator Group (SSN-XG). http://www.w3.org/2005/incubator/ssn/.
7. J. Andrea. Envisioning the next-generation of functional testing tools. Software, IEEE, 24(3):58–66, 2007.
8. D. Anicic, P. Fodor, S. Rudolph, and N. Stojanovic. Ep-sparql: a unified language for event processing and stream reasoning. In Proceedings of the 20th international conference on World wide web, pages 635–644. ACM, 2011.
9. D. F. Barbieri, D. Braga, S. Ceri, E. Della Valle, and M. Grossniklaus. C-sparql: Sparql for continuous querying. In Proceedings of the 18th international conference on World wide web, pages 1061–1062. ACM, 2009.
10. P. Barnaghi, S. Meissner, M. Presser, and K. Moessner. Sense and sens ability: Semantic data modelling for sensor networks. In Conference Proceedings of ICT Mobile Summit 2009, 2009.
11. http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6740844
12. .http://www.iotsens.com/sensors\_en/smart-parking-sensor-road-surface

1. <http://www.ijetae.com/files/Volume3Issue4/IJETAE_0413_32.pdf>
2. https://github.com/CityPulse/CityPulse-City-Dashboard.
3. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.681.7105&rep=rep1&type=pdf>.