Tech Brief

South Jersey Real-Time Motorist Information System

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BACKGROUND

- Philadelphia sits at the crossroads of the Mid Atlantic states and New England, 100 miles south of New York City and 55 miles west of the Atlantic Ocean. Its eastern boundary, the Delaware River that separates NJ and PA, with its access to the Atlantic Ocean, makes Philadelphia one of the most important commercial ports in the nation.
- Due to its proximity to the strong markets and population centers in Camden, New York City and Newark, Philadelphia is a densely populated central city to which a large number of people commute from the surrounding areas.

HERE'S THE PROBLEM

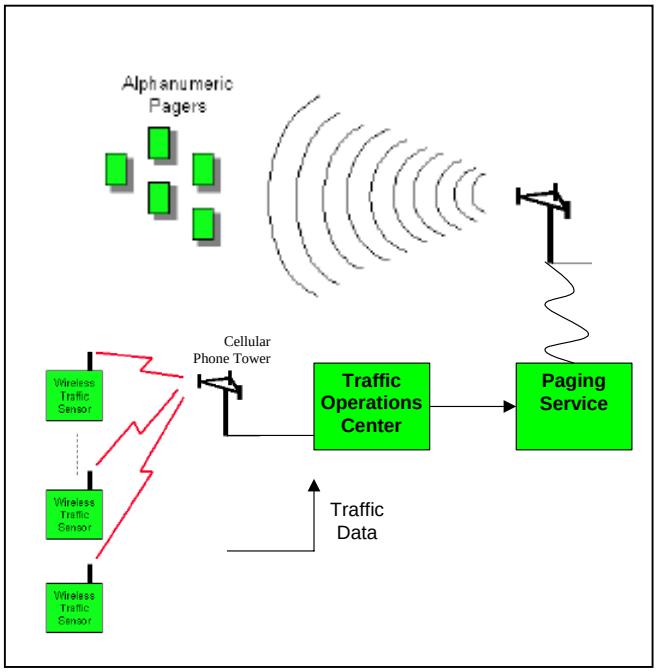
- The traffic originating from New Jersey to Philadelphia has mainly two alternative routes: Walt Whitman and Ben Franklin Bridges. From historical observations it is known that the highways that lead to one of these bridges tend to get highly congested.

AND, HERE'S THE SOLUTION

- Provide an effective real-time traffic advisory to be disseminated to motorists advising them to take the uncongested alternate route (in this case one of the two bridges) in the form of Variable Message Signs (VMS) or other more personalized means such as pagers.

BUT HOW CAN IT BE DONE?

- With the use traffic sensors, traffic volume can be measured and the data gathered can be transmitted to the traffic operation center. Traffic operations center computers can receive any high traffic volume alerts from these sensors and automatically transmit congestion alert to VMS structures or pagers. This idea is demonstrated in the figure below.



In order to come up with such a technology, NJDOT initiated this preliminary project.

THESE ARE OBJECTIVES…

- Develop an integrated and mobile surveillance system in the form of a self-sufficient box that consists of traffic sensor and communication system that is powered by batteries and solar panels.
- Install the traffic surveillance system along I-76 and I-676 that connect southern New Jersey and Philadelphia
- Deploy the system for acquiring / processing traffic congestion information
- Test the working of the system in terms of its long term performance
- Test the validity of traffic sensor data using ground truth data
- Disseminate traffic information to pagers
- Test the validity of the traffic information sent to pagers using commuter surveys
- Test the system performance using the micro simulation network developed in PARAMICS simulation software
- Develop new algorithms to predict travel times in real-time

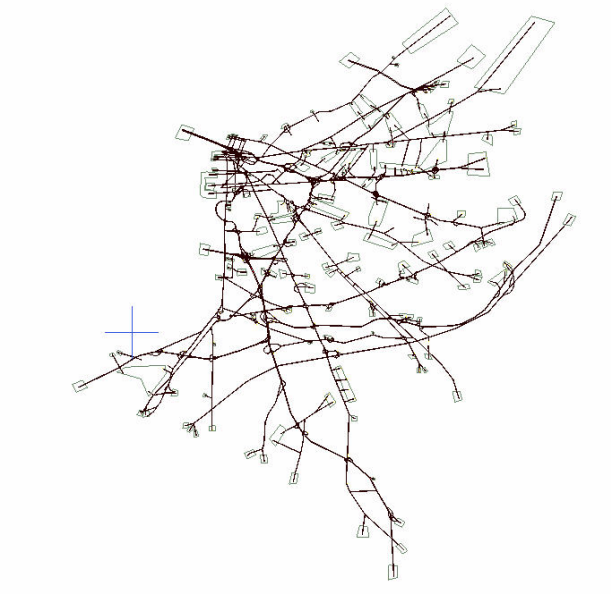
HERE IS WHAT WE DID…

- First, in collaboration with of L-3 communications Inc, 5 surveillance systems were designed, developed, and tested in the laboratory. Then, the best possible locations to install these systems were determined in close collaboration with NJDOT.

- With the technical help of L-3 communications Inc. and NJDOT, all 5 surveillance systems were installed and set-up for continuous communication with a server that is located in the traffic operations center.
- Next, in order to validate the validity of traffic sensor data, Rutgers researchers collected ground truth data at sensor locations using camcorders. Recorded traffic information was then processed at Rutgers Intelligent Transportation Systems (RITS) laboratory. Data obtained from counts and sensors were compared and the necessary modifications in sensor calibrations were done when any significant difference were detected.
- In order to measure the effectiveness of traffic information disseminated to pagers, RITS researchers conducted a survey for several commuters who were given pagers

to test the accuracy of the information given to them. Surveys were then used to test the effectiveness and the validity of traffic alerts. Surveys showed that the information provided by the surveillance system was reliable.

- Also, southern New Jersey highway network was developed in PARAMICS simulation software. The figure below shows the screen shot of this network. The generated network includes ~2000 nodes and ~4000 links. Link information such as number of lanes, highway type, speed limit, line width, etc. are entered using "NJDOT Straight Line Diagrams." Origin-Destination demand matrix provided by Delaware Valley Region Planning Committee (DFVRPC) is aggregated for the study network (137 zones).



The reason behind using a simulation tool was to evaluate the efficiency of the deployed system under various scenarios where certain links in the network are affected by incidents, and also to determine the best configuration of surveillance system to improve travel time estimations. The results showed that increasing the number of sensors does not always increase accuracy; but locating the sensors at the critical areas does. Thus, it is highly beneficial to model and analyze the study area with a micro-simulation tool before actually deploying these costly surveillance systems.

- Finally, a method for estimating and predicting short-term travel time was developed. Kalman filtering algorithm was applied for improving prediction accuracy. The evaluation results of this algorithm showed that the developed model could generate satisfactory results with the use of simulated output (e.g. 30-second and 5-minute travel times).

WHAT IS THE NEXT STEP?

- A follow up to this preliminary project can be the dissemination of the information collected by these and similar mobile sensors through VMS. The completed preliminary project dealt only with disseminating the location of congestion, not the alternative routes to be taken. This additional task requires a more detailed research and effort to advise the correct alternative route in a timely manner. Travel time on each possible alternative route should be predicted and the one with the minimum travel time should be advised to the motorists. The Kalman filter based travel time estimation algorithm developed as part of this project can be used for this purpose.

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