Service Path Guidance System is based on speed information

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Abstract - This paper presents the Traffic information system that based on an embedded WinCE board which has GPS and HSDPA. This system is able to overcome the limit of area using the Internet service which other systems can't provide. When the embedded board receives data about the geometric and vehicle speed information, it transmits to the server via HSDPA/the Internet. The server receives and processes it for the path services. And also we present the path guidance algorithm which is based on the speed information. These algorithm responds to the dynamical traffic condition through updating traffic information. Especially, we suggest a Traffic Status Variable in each branch which represents each road's traffic status. This Traffic Status Variable contains speed, road grade: we separate the road three groups as speed limitation: and past speed data - for example, week rush hour of each road. In addition, the data of cross about left-turn or right-turn can update. Those elements is consisted Traffic Status Variable.

1. Introduction

Traffic information service system which is used of the present time has lots of problems and limit. The existing traffic information is gathered by manpower, which means currently system does not serve real time. This one is hard to grasp traffic density analysis and time series analysis in the downtown, and then it has limitation that authenticity secure of suitable road capacity analyzes, as a result it can't provide traffic jam control information. These reasons make hard to apply to establish the policy of road. In this paper we suggest the system which is able to dynamically response via GPS, HSDPA, and Traffic Status Variable for traffic status.

2. System structure

2.1 GPS, HSDPA, and Embedded board (WinCE)

This paper uses GPS, HSDPA, and Embedded Board (WinCE) for communicating between embedded board and web server. HSDPA is five times faster than 1xEV-DO (2.54Mbp/s), thus we can serve the map which has specific geographical data, and even the car navigation doesn't have the map user can download a map through high speed HSDPA. This paper uses one of GPS data format NMEA 0183, specifically 'GPRMC (Global Positioning Recommended Minimum Specific GPS/TRANST data). An abbreviation shows the hint: this data provides speed and date. So, we take GPRMC data in NMEA 0183 sentences and transmit the server through HSDPA network.

2.2 Web Server

[Table1] displays traffic information system structure. It shows resource of embedded board and property of the server. The part of server uses MySQL for handling received the GP

S data from embedded board and providing necessary information for end-user. [Figure1] shows the composition of the entire system.

<table>
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<th>Table 1 Traffic information System Environment</th>
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[Figure1] System Architecture

3. Algorithm

3.1 Dijkstra Algorithm

Dijkstra's algorithm, named after its discoverer, Dutch computer scientist Edsger Dijkstra, is a greedy algorithm that solves the single-source shortest path problem for a directed graph with non-negative edge weights.

1. function Dijkstra(Graph, source)  // Initialization
2. for each vertex v in Graph:
3.     dist[v] = infinity
4.     previous[v] = undefined
5.     dist[source] = 0  // Distance from s to s
6.     Q = new priority queue
7.     while Q is not empty:  // The main loop
8.         u = extract_min(Q)  // Remove best vertex from priority queue
9.         for each neighbor v of u:  // Relax (v, w)
10.            if dist[v] > dist[u] + length(u, v)
11.               dist[v] = dist[u] + length(u, v)
12.               previous[v] = u

[Figure2] Dijkstra Algorithm Pseudocode

In this paper, we use this algorithm for finding the shortest route, and also adapting Traffic Status Variable.

3.2 Traffic Status Variable

This variable is based on speed data of each branch. This speed data is not just composed recent speed data, but also
past speed data record. This past data record can give more guarantees the path guidance, as like Monday morning rush hour is harder than the other days. Road's speed limitation is also important in this variable. Even the speed data recorded high in the server if the speed limitation is lower than speed data, we can't get an assurance this path. Therefore we separate three grades: over 90km/h, 80~60km/h, under 50km/h. These also represent express way, main road and branch road.

So, we combine these elements

\[ T_n = t_n + C_1t_{old,n} + C_2R_n \]

\( T_n \): Traffic Status Variable
\( t_n \): branch passing time \((b_j/v_{passing\ velocity\ of\ each\ branch})\)
\( t_{old,n} \): recorded branch passing time
\( R_n \): road grade
\( C_1, C_2 \): proportional factor

4. Experiment

4.1 Sample Map

We set up a sample map from Shin-chon rotary to Hap-jeo rotary for test this system. At first we get the log of GPS by car. Below figure3 shows the whole sample map and simplification map graph.

![Figure 3] Sample Map and Graph

And we make a label each node and branch. Below tables 2 display each node and branch data.

5. Conclusion

In this paper, we shows the system that response dynamically traffic status. Embedded Board, GPS and HSDPA are consisting of remote path guidance system. Web server record speed data and calculate each road's Traffic Status Variable. Therefore, we verify this system and algorithm are able to dynamically react.

6. Reference

[1] Yonghu-Jang, "Develop dynamic road flow information is based on GPS", 2006. 5

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