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DESIGN OF INTELLIGENT GPS NAVIGATION SYSTEM FOR BUS MONITORING AND STATION REPORTING

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ABSTRACT

Nowadays, easily observe many peoples standing on the bus station in order to get their desired BUS but sometimes it take too much time for them to wait because many times there may be a traffic jam or some other problem with the Bus to reach at right at time. In this paper a new intelligent bus movement monitoring system and station reporting system based on GPS and RF Transceivers is presented. The neural networks is used to process raw, uncorrected signals received by GPS receiver, which is used to correct the raw signal and to obtain highly accurate position coordinate data. The neural network is trained with a particular GPS receiver. In addition to some fundamental functions such as real-time monitoring, some featured functions can tightly be combined to make the system compatible with the daily operations of any public transport scheme. The proposed method will surely improve the average accuracy of GPS signal reception at the bus station which led people to take decision either to wait for Bus or not.

Keywords: GPS, Bus Monitoring, RBFNN

INTRODUCTION

Passenger at the bus station had been the victims for long time especially in the big cities where the public transport facilities are not compatible with the city's problem. Public traffic facilities (Liu, 2008, Niu, 2008) with high-tech and intelligence system have been a standard to estimate the development of the country and its international image. Nowadays, passengers want to get the clear information of the station like the estimated time of arrival of bus etc. The traditional display of several parameters (Mazidi et al., 2008) using GPS data had been the part of many papers & projects for the real time monitoring (EI-Rabbany, 2002) but there is no progress observed to manage the accuracy & getting optimum calculation by the modern technology cooperation like radial basis neural network (Haykin, 2001). An intelligent, automated vehicle monitoring system [Liu, 2008, Niu, 2008] can provide individual vehicle data such as velocity, acceleration, spacing, and headway. This can lead to better traffic flow modeling and a better understanding of driver behavior. Neural networks containing radial basis functions can be used in many of the same situations in which back-propagation networks (Kumar. 2005) are used but the edge goes to RBF because RBF neurons provide fast learning and straightforward implementation (Haykin, 2001).

This paper presents the design of a stand-alone single board microcontroller (Mazidi et al., 2008) that is equipped with GPS and RF Transceiver modules**.** The microcontroller is installed in the vehicle and one of the RF transceiver antennas is placed in the transportation's head-quarter or at the bus station. While the vehicle is on the move; the vehicle's real-time parameters (EI-Rabbany, 2002) such as the estimated time of arrival, the delivery date and time, the shipping origin and release date, finding the last location and event etc,(Qin and Xing, 2008) could be observed. Although many researchers have addressed and proposed monitoring systems (Zhang, 2006; Liu and Wang; 2006 and Lundberg, 2001) to track vehicle or critical moving objects but still the accuracy is the big question mark. For the optimum calculation and accuracy, this paper suggests using the magic's of neural network (Kumar, 2005). A Graphical User Interface (GUI) and software management package are also developed using MATLAB etc to monitor and maintain the system.This paper organizes, second section introduce bus monitoring system and GPS system. Third section contains the proposed system and its smart error reduction techniques with implementations. Finally the forth section talks about the expected result and fifth one gives the conclusion.

THEORETICAL BACKGROUND

Bus monitoring System

This paper propose a system to mount the GPS on the Bus (EI-Rabbany, 2002; Zhang, 2006) transmitting the GPS signals at the Bus Station by RF transceivers. This system would be able to expect the time as well position to display on the LCD at Bus station in the convenient way for the persons come to Bus, which requires core software used for programming the setup and creating a replica of the real network.

Regarding GPS system

The GPS system consists of 24 satellites in orbit around the earth, positioning is available 24 hours a day all around the world. The launch of GPS satellites has continued and the number of usable satellites reached 27 in 1996, and generally 28 or 29 in recent years. Therefore, a sufficient number of satellites are available even if some satellites are not always usable. The satellites are arranged in six orbital planes that have an inclination angle of 55 degrees relative to the earth's equator. The satellites complete one orbit in about 11 hours and 58minutes, and trace a track approximately once a day (23 hour56 minutes) on the earth. Although satellite constellation changes through a day, more than 8 satellites are usable above the horizontal if 24 satellites are in operation. Although conditions change according to the position of the earth, a sufficient number of satellites can be used. Furthermore, the satellite signal is not apt to degrade in poor weather conditions.

Radial basis Neural Network

Over the last few years, more sophisticated types of neurons & activation functions have been introduced in order to solve different sorts of practical problems **[**Kumar, 2005**]**. In particularly, Radial basis neurons (Kumar, 2005; Haykin, 2001) have proved very use full for many systems and applications. These neurons are so called Radial basis activation function. The above equation presents the most often used form for such a function.

$$f(x) = exp\ (-\|x - t\|^2)$$

where, x is the n-dimensional vector of input signal, t is a constant vector in the same direction while ‖ is Euclidean norm in the n-dimensional space and Practically f(x) shows how close vector 'x' is to vector 't' in n-dimensional space.

The overall System

In the proposed system, the Bus operator has to be input some current data like Bus unique ID and Map etc. and surely provide the output to the Bus station for example GPS map display of the current location of Bus through wireless. An MCU containing GPS and RF is mounted on the bus to get the GPS data and its efficient wireless transmission with implementation of accuracy using NN while another MCU containing RF and DISPLAY, is mounted at the bus station. The system hardware block diagram is shown in Figure 1.

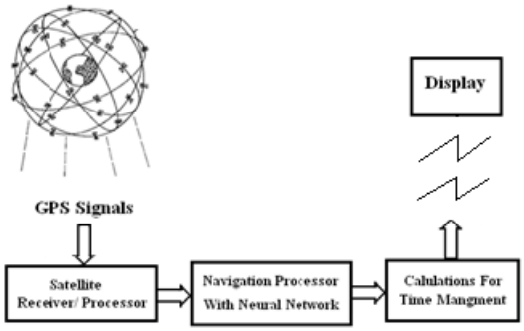

Figure 1: Bus monitoring system

METHODOLOGY

The proposed system

A GPS receiver comprising: a satellite receiver/processor having an input receiving input signals from at least one GPS satellite and an output providing satellite-related navigation information; and a neural network having an input receiving the satellite-related information to obtain an output signal representative of receiver-related navigation information; wherein the neural network comprises one of the adaptive learning [Kumar, 2005] for the error reduction and optimum calculation.

Analysis of GPS data using MCU

In the practical monitoring system using GPS, we can set certain time intervals to update Latitude, Longitude and Time data according to need in order to get the space positioning data (Qin and Xing, 2008). The GPS module used follows the NMEA0183 protocols. In this most of the navigational systems, the positioning data we are concerned about such as latitude and longitude, speed, time can gain from the "$GPRMC" frame which GPS receiver sends to the MCU .So our bus positioning data can easily be selected by using this frame. Output baud rate is 4800 Porter. MCU communicate data with GPS module by serial port. This is the standard asynchronous communication mode. Set the same baud rate of MCU with GPS output baud rate, then GPS module will sent positioning data to MCU

by serial port. We can allow MCU receive and store data, and then bus location will be calculated.

Error reduction methodology

In order to reduce the errors and optimum calculation, this system presents the simple and intelligent method, called Map Matching Method. It is described in three steps, firstly it will restore the bus location signals received by GPS in the Map Coordinate. Secondly, it identifies the unique ID no. of Bus or road segment, being trained by NN, and then obtain the spatial data of the special code no. been defined. Finally, it calculate the nearest point from the bus position to the road segments or to the Bus Station and find the remaining distance and time required to reach at Stop by the principle as follow

$$min\left(\sqrt{(X - X_i)^2 + (Y - Y_i)^2}\right) \quad (1)$$

where (X, Y) refers to the GPS coordinates of bus and（Xi, Yi ）refers to one point on the road segment. (Will be trained to NN)

RBFNN implementation

The network with RBF neurons provides fast learning and straight forward implementation (Kumar, 2005). For the purpose being, this paper comprises the implementation of RBFNN on the traditional GPS navigation and station reporting system. The coordinates utilized in the Map matching method, described above, will be the input to the RBF neurons In the prescribed NN with RBF, the comparison of input vectors to stored training vector can be done quickly if non-Euclidean distances are calculated with no multiplication as shown in Figure 2.

Radial basis functions tend to be embedded in a two layer neural network where each hidden computing unit has a radial activated function. Radial basis functions use radically symmetric computing elements and radically bounded transfer functions in the hidden layer. The output units implement a weighted sum of outputs from the hidden unit to form their outputs. In pattern classification as required for the simple example, the inputs represent feature entries while each output corresponds to a class. The hidden units correspond to subclasses.

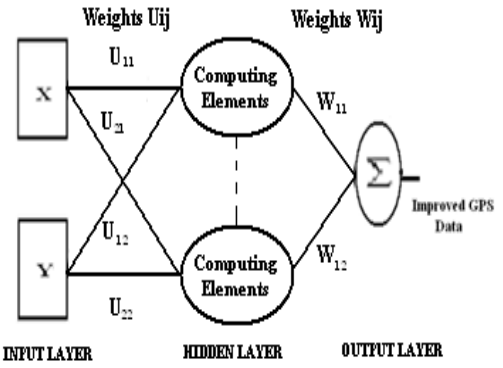

Figure 2: Error redaction by using RBFNN

Flow chart for Training algorithm

Figure 3 schematically showed in flow chart form, one example implementation for training the neural network to reach a desired level of accuracy when producing the output. Flow chart in Figure 3 includes receiving timing information from the GPS, calculate average by the Preprocessor and forward to the NN as its Input. Then the neural network provides an output O, which is combined with data from the GPS and an average of that data is determined. The output O from the neural network in this paper is divided by the output data from the GPS and the result is then divided by the average of the output data available. The resulting information is provided for neural network training to determine how much neural network processing is required to achieve a desired level of accuracy. The amount of training will depend upon the amount of accuracy required and the amount of data that is provided to the neural network. The neural network preferably is trained, using known techniques, until sufficiently accurate results are obtained.

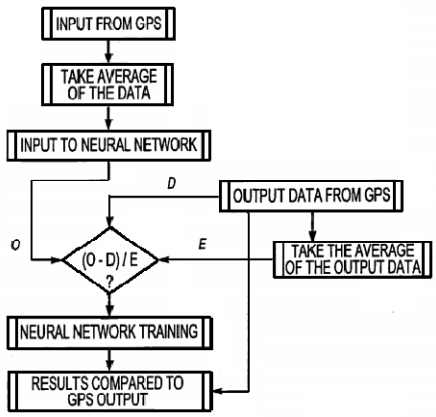

Figure 3: Flow chart for training NN

Experimental Results

The design phase contains a system to mount the GPS on the Bus. The stand alone GPS containing system receives the raw signal. The neural network based core software process the parameters and transmit the GPS signals at the Bus Station by RF transceivers. Implementation and maintenance of management information system are as important as system design and development. This system would be able to expect the time as well position to display on the LCD at Bus station by in the convenient way for the persons come to Bus. By improving the GPS positioning via software implemented RBFNN, overall hybrid positioning accuracy has been greatly improved too and hence the accuracy of such hybrid positioning method will out performs the other proposed methods in metropolitan areas. Based on our trial data, the accuracy shown +/- 3.79m with 96% confident, as shown in Figure 4.

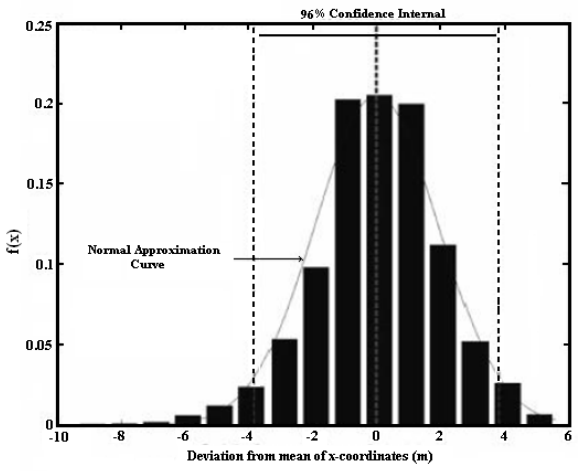

Figure 4: Expected Accuracy Graph

CONCLUSION

This paper investigates the GPS based Bus monitoring system using Radial basis function Neural network for the enhanced navigational performance and error reduction in monitoring and station reporting system Meanwhile, an algorithm adopting temporal evaluation of the state transition matrix is employed for the velocity and position errors compensation via MATLAB. With few workload of processing, this technique is quite feasible.

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