Study for Intelligent Guide System Using Soft Computing

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Abstract. GPS navigation system has been begun to install to the car since the 1990's. The early system was road guide but it is giving much serviceableness to user because various functions are added by the development of various techniques. However the growth of the most important guide thing of navigation system is yet not conspicuous. In this paper, intelligent guide system that infers information of various recommended road and can guide suitable road to personal tendency was proposed. By using fuzzy logic, it updates user's driving tendency at regular intervals and infers road state. Also path breakaway inference system that learns user's movement path and can secure personal security was proposed by using GPS information.

Keywords: Road guide system, Personal security, Fuzzy logic, Neural network.

1 Introduction

Modern society expanded to information society based on industrial society. Much technologies with expansion of information society has developed and it has used to human's convenience. Currently, one of technology that gives much assistance in human's life is car navigation system[1][2]. Many cars are installing navigation system and its market is more and more extending. These phenomenon is because navigation provides various functions as well as road guide[3][4]. There functions are because of development of communications network and operation ability of many data that are used to navigation such as CPU. These phenomenon will be more and more expanded and will develop continuously with concept of telematics[5][6]. Present navigation system has been decided by map engine composed from one-side algorithm of company and user's a driving pattern or a mental state has been disregarded. Also developer certainly needs to add individual tendency or character because a lot of electronic equipment is growing with thinking of personalization, characteristic and intelligence. Also personal security is becoming much issue because the society is complicated by fast industrialization and the information age. So we constituted hierarchical fuzzy structure that infer personal driving tendency by using fuzzy logic to accomplish path recommendation method in this paper[7]. And path condition is inferred by fuzzy logic using the information of recommended paths. By comparison of outputs, we proposed intelligent guide system that can infer

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suitable path to user. Also personal security system that can inform personal situation using user's position information was proposed. It separates pattern of movement paths or tracks and it learns user's life path through user's position information[8].

2 Structure of Intelligent Guide System

System that used in the paper consists of road guide system and personal security system(Fig 1). In the paper, road guide system is composed of module that performs driving pattern inference and road state inference. Personal security system is formed into path learning module and breakaway inference module. The system does easily correction and addition of algorithm because each part is composed by module.

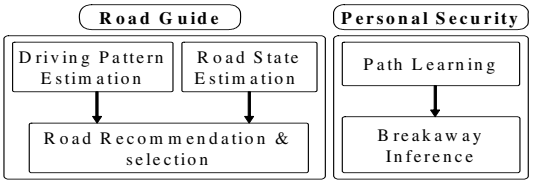


Fig. 1. Structure of intelligent guide system

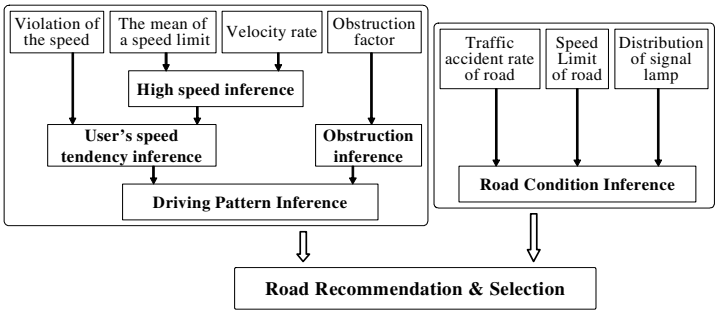


Fig. 2. Structure of Road Guide System

Driving pattern inference modules is composed of speed tendency inference module and obstruction factor inference module. Driving pattern inference module outputs result by using structure of hierarchical fuzzy logic. Road condition inference module gets output from real road environment and geographical information. Because driving pattern continuously change, it is not fixed system but updating system according to pattern attitude of driver. Path learning module consists of algorithm of movement path data collection using GPS, path data scale algorithm and path learning algorithm using neural network. Path data gets movement path from a certain distance and uses vector computation method.

3 Algorithm of Intelligent Guide System

The proposed algorithm is composed of driving pattern inference, road condition inference, path learning inference and path breakaway inference.

Driving pattern inference algorithm used user's moving information and map information to learn user's real driving pattern. Input value is the moving time, the speed limit, the movement distance, weight about time, obstruction factor and distribution of signal lamp. Violation of the speed(eq.1), the mean of a speed limit(eq.2), velocity rate(eq.3) and obstruction factor(eq.4) was showed to the next part. *WT* is weight about time. *MS* is mean of speed. *Dis* is Distance. *OT* is obstacle number.

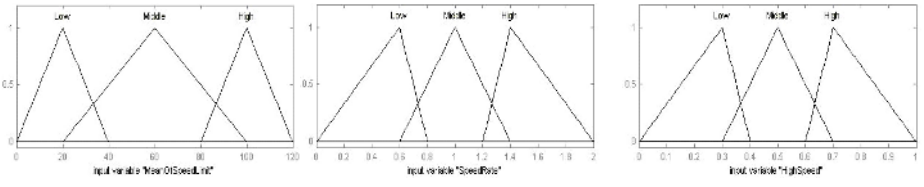
$$Vis(n) = \frac{MS(n)}{MSL(n) + WT_1} \tag{1}$$

$$MSL(n) = \frac{MSL(n-1) \times Dis(n-1)}{Dis(n)} + \frac{\Delta MSL_{n-1}^{n} \times \Delta Dis_{n-1}^{n}}{Dis(n)} \tag{2}$$

$$VL(n) = \frac{MS(n)}{MSL(n) + WT_2} \tag{3}$$

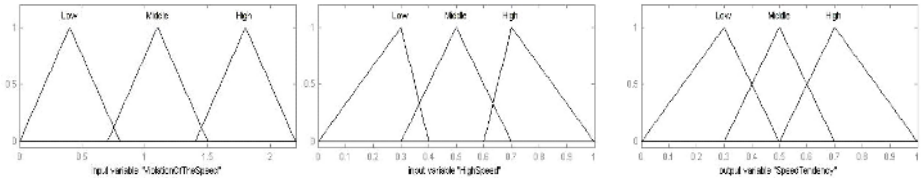
$$OF(n) = \frac{ON}{Dis(n)} \times 600 \tag{4}$$

Fuzzy reasoning consists of premise and consequent. The premise of the high speed inference is the mean of a speed limit and the velocity rate(Fig. 3). The speed tendency acquires output by the high speed and the violation of speed(Fig. 4). The premise of user's driving pattern reasoning uses the obstruction factor and the speed tendency(Fig 5).



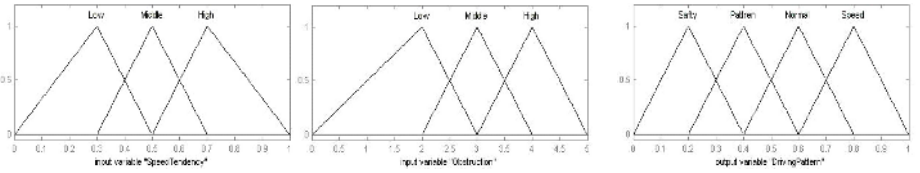
(a) (b) (c)

Fig. 3. Membership function that used to high speed reasoning: (a) Premise-Speed limit, (b) Premise-The velocity rate, (c) Consequent-High speed



(a) (b) (c)

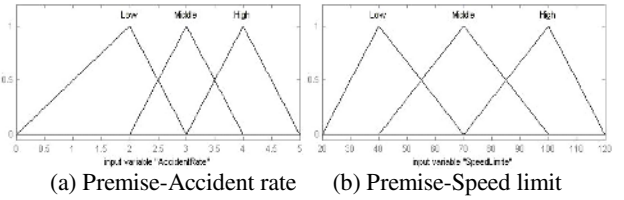
Fig. 4. Membership function that used to user's speed ten dency reasoning: (a) Premise-High speed, (b) Premise-The violation of speed, (c) Consequent-Speed tendency



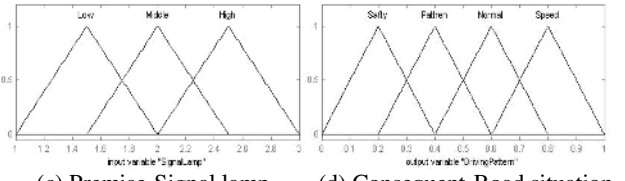
(a) (b) (c)

Fig. 5. Membership function that used to user's driving pattern reasoning: (a) Premise-Speed tendency, (b) Premise-Obstruction factor, (c) Consequent-User's driving pattern

Road condition inference module reasons the geographical information of road recommended. The traffic accident rate, the speed limit and the distribution of signal lamp is calculated by information of the traffic accident, the speed limit, the movement distance and the signal lamp number. Road situation is gained by fuzzy reasoning.



(a) Premise-Accident rate (b) Premise-Speed limit



(c) Premise-Signal lamp (d) Consequent-Road situation

Fig. 6. Membership function that used to road situation reasoning

Paths are learned to get safety from the abduction or the accident by chase of user's driving path. First, data of path learning divided into two types. It is path and non-path. Collection of learning data gains from data variation about distance and uses vector computation method.

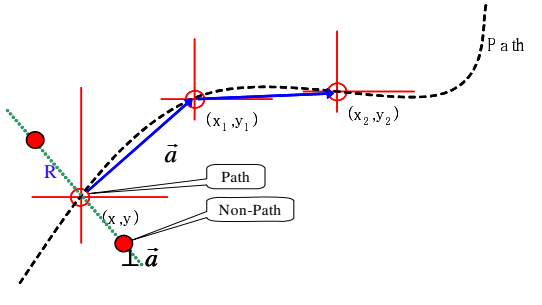


Fig. 7. Gain method of learning data

The personal security system calculates $\vec{a}$ and computes coordinates(a_1,b_1) that distant of two point is 'R' in $\perp \vec{a}$. The calculated data did scale from '-1' to '1'. Path learning used neural network and back-propagation algorithm[9][10]. Output is path, non-path and undecided.

After learning movement path, the personal security system reasons path breakaway by using user's position information. Range of path breakaway reasoning is described in equation 5.

$$\begin{cases} If\ \ O_i \geq 0.7,\ \ O_i\ is\ classified\ to\ ON \\ If\ \ O_i \leq 0.3,\ O_i\ is\ classified\ to\ OFF \\ \quad Otherwise,\ \ O_i\ is\ "undecided \end{cases} \tag{5}$$

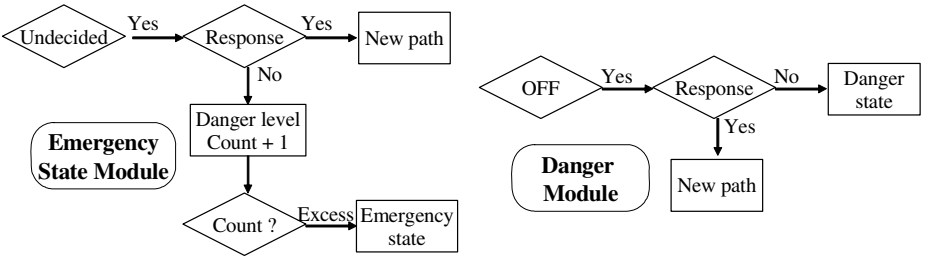


Fig. 8. Flow chart of emergency module and danger module

The path breakaway inference is composed of module of emergency condition and danger condition. The goal of emergency module transmits position information to administrator as user intention for assistance request of other people. When user is not response about breakaway degree and approval, the danger module transmits warning. If user was no response until the last warning, this module considers that user is at danger condition and it has function that informs information and condition to the police.

4 Simulation and Result

We performed simulation that applies method proposed by programming. Inputs used information that can easily get to navigation. This system set up data of virtual map for simulation and we set necessary information in the map. Simulation device used PDA(Personal digital assistant) that is portable.

We measured real driving tendency information of user that has various driving pattern and used to simulation. The next process set up virtual map and is process that gain user's driving pattern. This simulator can output driving pattern after it determines and moves path that can get pattern value. User's tendency agreed with simulation result.

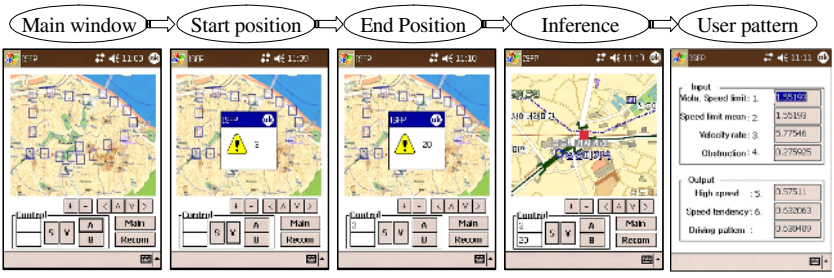


Fig. 9. Simulation for driving pattern inference

If user selects information of a start point and an arrival point, this simulation recommends suitable roads. This simulator evaluates each read from information of recommended roads. It arranges roads as similar ranking of user's pattern from comparison driving pattern value with road condition value. It recommends the last road, after user selects the one of recommended roads. The last road is suitable road at user pattern or road the time required is little.

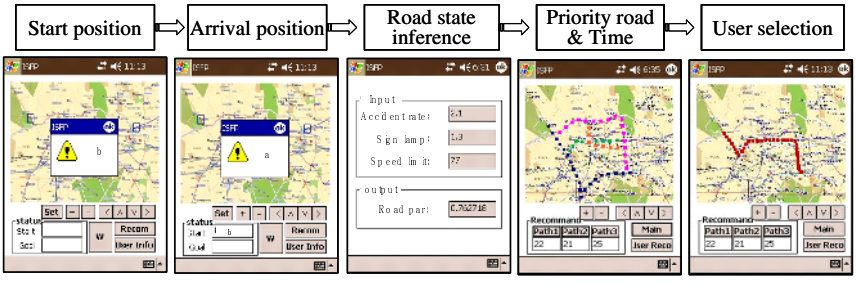


Fig. 10. Simulation of road condition and road recommendation

The data that receive from GPS was learned by neural network through pre-process and data scale. We simulated the road learning, breakaway inference, new path learning and add function of new road using virtual map in PDA.

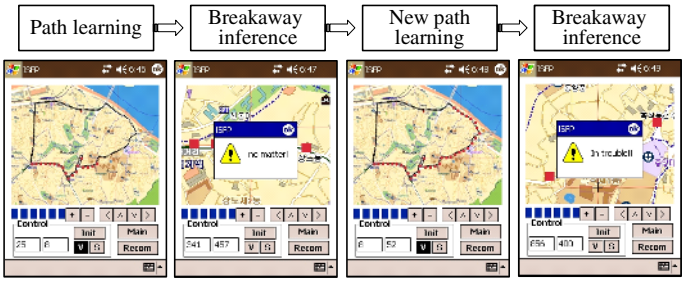


Fig. 11. Simulation for learning and breakaway inference

5 Conclusion

In this paper, we proposed intelligent guide system that can recommend new road and can guarantee personal security. Important factor of this paper is recommendation of suitable road that considers the character of driver, the times of driving and the condition of road. Also this study extended range of road selection by recommendation of various roads to user. It learn path of user and can accomplish personal security by reasoning of breakaway. In this paper, proposed algorithm can easily apply to real navigation. Also this system can easily add inputs that need to reasoning process because of modules structure. Addition of input is possible according to development of every technique and this can make more elaborate system. Specially, if car information of telematics is used to this guide system, intelligent guide system can be more necessary to user.

The next work will become study of various algorithms that is necessary at driving. Also it will be study of intelligent guide system that help more drivers by supply of a mental condition, car information, traffic information and weather information.

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