An Intelligent Hybrid Data Mining Method for Car-Parking Management

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Abstract: This paper presents using of intelligent data driven methods for developing of car parking systems. Finding a suitable, with the lowest traffic and cost, by considering people priority for parking place is presented. The Learning progress from previous behavior of the system is done. To obtain these goals first, a preprocessing phase by association rule mining method is performed. Rules by using support and confidence algorithms are selected. Then with applying these rules in the fuzzy resuming system, the system presents optimized park places. Finally experimental results present the benefits of using intelligent model in human systems against todays systems.

Keywords: Data-driven modeling; Car parking system; Data Mining; Fuzzy expert systems; Decision support systems.

1 Introduction

Parking the cars around critical places, such as hospitals is one of the most important problems in todays life. In recent years researchers are willing to solve this problem. According to being sensitive of solving this case, so it is necessary to design an intelligent system to manage parking places.

- Parking in sensitive places (entrance of the hospital, offices, important places, etc.) even for short times, cause to delay in patients transferring;
- Shortage of parking places for vehicles that take the patients to the hospitals;
- Problems that this case cause for the other cars.

There are several solutions to solving a bow problems; managing parking places using fuzzy inference systems [1], fuzzy expert systems in [2], car parking locator system [3], management system based on wireless sensor networks in [4] and [5][6], [7], [8], etc. The designed system by using several criterias and with effective combining of the data mining methods that learns from

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previous data and behaviors of the exits system. Obtained rules are used in the fuzzy inference system to make suitable decisions. With managing and organizing of Hospitals doctors, employees and customers, we can reduce the problems in hospitals. Also by using some rules, such as costs and priority we can manage them. Structure of the paper: in section 2 a brief of data mining methodology is presented, in section 3 fuzzy expert system is illustrated, section 4 describes methods, in section 5 the Experimental rules. In section 6 conclusion and future work are presented.

2 Data Mining

Today is using of intelligent methods for modeling and interpretation of many system are used. Since as mentioned the character of the proposed system is data-driven, in this case system’s data has an important role in the system identification the methods of data mining are useful in this data analysis. [9] Data mining as one of the important stage of knowledge discovery of data (KDD) is an iterative process within which progress is defined by discovery, through either automatic or manual methods.[?boissonnat]:

3 Fuzzy Expert systems

Central notion of fuzzy systems is that truth values (in fuzzy logic) or membership values (in fuzzy sets) are indicated by a value on the range [0.0, 1.0], with 0.0 representing absolute Falseness and 1.0 representing absolute Truth. A fuzzy set is an extension of an ordinary (crisp) set. Fuzzy set A is characterized by its membership function (x) is called the membership function of A. The set

\[ A = \{(u, \mu_A(u)) \mid u \in U\} \]

is called a fuzzy set in U [10].

\[ \mu_A : X \rightarrow [0,1] \]  

(1)

Fuzzy controllers and fuzzy reasoning have found particular applications in industrial systems which are very complex and cannot be modeled precisely even under various assumptions and approximations. Expert systems are one of the most successful solutions for artificial intelligence optimization problems. When domain knowledge of expert system is defined, the system can solve problems like an expert human and with having sets of facts, expert system gives results based on its knowledge [11]. There are two kinds of expert systems have applied to solve different problems: rule based expert systems and knowledge based expert systems. These systems expert can be created by own data or the rules. [11].

4 Case study

As mentioned before paying attention to problem significance about parking in critical places and to get better results at different park place and traffic control around hospitals, universities and busy places such as markets in large cities, causes to do several researches to solve this problem. By developing of technology and transportation systems and also by increasing the numbers of personal vehicles, researchers want to manage the parking lots and heavy traffic in busy places like hospitals, universities. This paper presents a data driven model as a fuzzy expert system to solve this problem.

4.1 Introduce Subject and Methods

This system has been designed to take better car parking places and traffic management by considering of different criteria. The designed system proposes a suitable park place with a special park code and place by getting the conditions. By taking attention to parameters, effect on the problem these criteria for the decision mechanism system are selected:

- If the ambulances or other vehicles want to park in the sensitive pleases, system lets them to park there for short time, but if they want to stay there for long time the system doesn’t let them;
- For the hospitals employees and doctors, system let them to park their car far from the sensitive places for hours;
- For ones which want to park near the sensitive places for minutes or so, the system determines low-cost for them;
- If all the places are full, the system shows a place outside of the hospital according to priority of customers.
As seen in this step, an algorithm used to normalization of raw data and then a preprocessing phase for initialization of the rules as system behaviors is done. In this step support and confidence calculation algorithm [9] for getting the rule frequency and accuracy measure is used [12]. After it obtained rules from this method is applied in the fuzzy inference system based on these rules. Finally we test our design over new test data to measure place and traffic load with the system.

4.2 Presented solution for management of parking the cars

This section of the paper illustrates the architecture and the algorithm of the system to solving mentioned problems. According to systems architecture system gets the behaviors of data as raw rules, in this step we have many rules which need to reduction or mining. To getting better results and because of difference in parameters, we executed for processing for all of data and then data range normalization of the data is performed.

5 Experimental results

For performing experiments, the designed system is applied in Sina Hospital of Tabriz. To getting apposite results system has used in three different condition; when the environment is quite (during mornings or nights), in busy condition (meeting times), normal times and the results is compared with human system and fuzzy expert system. We present the results comparing diagrams are shown in figures 4,5,6. With considering the values in figures 4,5,6 human system interests to park at sensitive and near to the sections of hospital and it causes the mentioned problems and also many empty parking places near the hospital are unsuitable . The illustrated results are shown; the presented system by using different criteria such as time, personal priority, cost and distance prevents crowding at sensitive parts.
Figure 5: Comparing results in simple mode for three systems.

Figure 6: Comparing results in normal mode for three systems.

Figure 7: Comparing results in busy mode for three systems.

Also figure 5 shows the systems in normal mode, as it is shown, human system interests to park near the sensitive palaces without attention to time and traffic jam but this systems can create a good balance with applying several criteria to better park strategy.

Finally figure 6 when systems in complex condition, the human system may select unsuitable places for park, but it designed system can manage the classified parking places.

6 Conclusions and Future Works

This research describes a hybrid data driven intelligent system for car parking management system with using of combined data mining methods over several problem criteria for finding better park place and reducing traffic jam up to 46.32 percent comparing with similar system and human system. We can use this system at fire station or police station to improve the speed of spatial activities. In future work we will use other intelligent methods to improving car parking quality and using mentioned methods over other critical places.

References


