

Study of Smart Parking System

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Abstract

Mechatronics system is the key infrastructure of the country. Now-a-days scarcity of land area increases with increase in the implementation of vehicle because of which parking problem become predominant. These problems include area congestion, traffic jam, road width decrement and increased rate of accidents. By accurate parking we can resolve half of the parking. This paper introduces the design and study of Multi level vehicle Parking system which occupies less land space and contains large number of vehicles as well as we are discussing the problems exist in the parking system and its betterment. A good parking system not only minimise the wastage of space but also reduces fuel too.

Keywords: mechatronics; multi-level car Parking; Intelligent Transportation System (ITS).

1. INTRODUCTION

Now-a-days scarcity of land area increases with increase in the implementation of vehicle because of which parking problem become predominant which has caused a lot of parking related problems. [1]. The search for the parking space is a time consuming process which not only affects the economic activities' efficiency, but also the social interactions and cost [2]. Human errors are the major source of traffic accidents, therefore building in-car technologies for checking the parking lot, avoiding accidents and guidance to the parking facility is turning out to be an integral area for research. The objective of such technologies is the reduction of the burden on driver, improvement of the traffic capacity, and provision of reliable and secure car functions [3]. The parking meters which rely on coins or tokens is an inefficient system as it requires man power for management of the parking and exact change for paying the parking charges [4]. Parking control and enforcement systems provide efficient and effective monitoring of meter and it also keeps a check on any violations of the parking lot. This results in best possible use of the parking space for increasing the revenue. However, it requires man power which needs some capital [5]. Currently used parking system is not an efficient one; as the drivers are allowed to park without any restriction [6], and the parking facility cannot be used to its full extent. The Intelligent Parking service, a part of Intelligent Transportation System (ITS), gives rise to different parking facilities on the basis of new functions they provide. This service not only manages the internal operations of the parking facility, but it is also designed to work with different aspects related to the parking facility.

- The services which the Intelligent Parking System should provide in the future are
- The parking availability information system and parking reservation system should provide advanced navigation services.
- The mobile electric commerce system and a continuously working gate system should collect the toll charges electrically.
- An automated navigation system should assist in safe driving.
- An in-facility navigation system should provide the best possible traffic management. Active security for the safety of cars.
- Provision of strong functions for facilitating administrators and managers in management of the parking facility.

The latest advancement in intelligent parking service is the parking space negotiation system which is much different than the parking information system. Parking space negotiation system uses the linking and integration of the parking facilities which results in negotiation and coordinates between the in-vehicle information system and parking facility. This system initializes the negotiation process for the parking charges, the advance reservation of the parking lot, search for the best possible path from the current position to the parking facility and then to the destination. The parking information system along with the parking space negotiation system laid the foundation for the smart parking service and it can counter all the traffic related issues working hand in hand with each other.

The rest of paper comprises of various methods used for designing an intelligent parking service and will provide an insight into the methodology of economic analysis for such system.

2. VARIOUS TECHNIQUES PROPOSED FOR SMART PARKING SYSTEM

Following are the techniques for realizing an effective smart Parking System are given below.

- Expert System
- Fuzzy Logic Based System
- Wireless Sensor Based Systems

- GPS Based Systems

2.1 EXPERT SYSTEMS

Expert Systems or Agent based technologies can solve the problems associated with distributed and complex traffic environment. They are also considered to be the main weapon for laying the foundation of automation mechanism for the Parking Negotiation and Guidance System [7]. Multi-Agent system is used for representation of system with elements which show intelligence, autonomy, and degree of interaction either with each other or with environment [8]. Mobile agent can be used for an active, stable and quick negotiation between cars and parking facilities. The movement of the agent helps in shorter negotiation time and decreases the amount of data to be transmitted over the wireless network.

A multi-agent system called agent-based intelligent parking negotiation and guidance system (ABIPNGS) combines mobile agent technology with multi-agent systems and utilizes both stationary and mobile agents.

A multi-phase navigation technique which relies on two-layer traffic map is used for parking routes negotiation and direction in [8]. Through the brilliance, adjustability, and co-action of agents, the entire service environment can automatically perform the search for the park, bargain the parking fee, book the parking lot, negotiate the parking route and direct to the facility.

Distributed active parking guidance information system (APGIS). It also presents a multi-functional agent system called intelligent system for autonomous robots, which deals with modeling, planning and coordination functions of a mobile robot.

2.2 FUZZY LOGIC BASED SYSTEMS

If there is a process resulting from the human error, then a system which supports the operator; safely and efficiently is fuzzy logic based system. This system works by

- Detecting
- Motion Planning, and
- Supplying information

For the sake of training and testing, a car driving simulator is combined with the Gen So Yeager Fuzzy Neural Network. The Neuro-fuzzy system has the ability to reason like human beings as well as it has expert knowledge.

For reduction of the calculation time, an FPGA based fuzzy logic controller (FLC) is used. FLC can be utilized for designing an automatic car back parallel which has FPGA based controller and gives a fuzzy approach for control of backward movement of truck and trailer in dynamic environment.

A two-stage scenario called longitudinal and lateral movements is used for finding the proper parking lot

2.3 WIRELESS SENSOR BASED SYSTEMS

A number of low cost sensor nodes make up a Wireless Sensor Network (WSN). Different types of sensors, computation units and storage devices are present on each node. For collecting, processing and transmitting information.. The system consists of low-cost wireless sensors which are installed in a car parking facility. Each parking space has a sensor node for detecting and checking the occupation of the parking facility. Sensor node is used for detecting the status of the parking field, which is forwarded regularly to the database through the installed wireless sensor and its gateway [9]. For performing various management functions such as, finding unoccupied parking lot, auto-toll, management of security and statistic report; the data base is accessed by the upper layer management system. All the data of the sensors is processed in networking environment, which is then posted on web. This information can then be retrieved by the user from internet. Automobile sensors are installed on both sides of the road and onto the road bed for retrieving the required information of the vehicles. These systems are not architected for car parking management, though they are effective for checking traffic and road condition.

There are other solutions as well that focuses on the use of sensor technologies (magnetometers and video cameras, etc) for parking lot applications. However, magnetometers are sensitive to environmental issues; which results in an inaccurate detections at times.

The nodes sleep at regular intervals and are woken up by the internal microcontroller for gathering parking related information and communicating with other sensors. This periodic sleeping also helps in saving power

2.4 GPS BASED SYSTEMS

The information about the location and availability of a parking space near the destination is provided to the drivers by the current GPS-based vehicle navigation system. The information of the current state of the parking facility is provided. That's why they can't guarantee a parking lot when the driver reaches the facility. Poisson process is used for modeling the availability of a parking lot. An intelligent algorithm which helps the driver in choosing the slot with maximum probability of being vacant is presented in [10]. Various methods and different cities were used for demonstrating these issues. It also highlighted different challenges of on-street parking such as peer-to-peer exchange

and storage of parking information.

Chon et al. [11] presented a location based system called NAPA (Nearest Available Parking lot Application). This system helps in locating the parking lots on campus or areas like airports, but it doesn't provide any information about the availability of vacancy.

2.5 VEHICULAR COMMUNICATION SYSTEMS

A new smart parking technique based on vehicular communication for large parking lots. This scheme provides the real-time parking navigation service, intelligent antitheft protection, and friendly parking information dissemination to the driver. The scheme is called SPARK and is defined by using parking lot RSUs for closely observing and managing the whole parking facility using VANET communication technology [12]. SPARK scheme makes the following contributions.

- It provides real time parking navigation to the drivers for finding the vacant parking space, saving fuel and time.
- It provides VANET-based intelligent anti-theft protection. Due to this, all the parked cars at the parking facility are guarded by the parking facility's RSUs. Any car which tries to leave the parking facility illegally will be detected by the RSU.
- It arranges friendly parking information distribution service to all the mobile cars.

2.6 OTHER MISCELLANEOUS TECHNIQUES

A parking reservation service for reserving a vacant parking spot via the internet. This system utilizes the internet for a quick and easy search for the vacant lot. By using it together with a smart card, the system also provides recognition and payments services to the driver. In [13], a multilevel driver assistance system for assisting in the parking process is proposed. A parking assistance system along with parking administration system, and employed sensor systems are mentioned as well. A general architecture of a driver assistance system which relies on path planning and Human-Machine interface (HMI) modules is presented as well.

An ultrasonic sensor array system which has group-sensor firing intervals is developed as well. A complete contactless sensory coverage of the whole workspace can be provided by using a binaural approach to the CLMR. The posture of the mobile robot in the parking facility can be obtained through proposed heuristic controller.

A wireless based parking service will not only provide intelligent parking services, but it will also eliminate mis-parking. To provide an intelligent and automatic parking service, the presented system will use sensor technologies along with wireless network.

Table 1 gives a summary of the various approaches that have been discussed and Summary of relevant techniques for intelligent parking systems.

S. No	Different Technologies	Features	Services Provided
1.	Agent Based	Dynamic distribution and complex Traffic environment	Bargaining, parking guidance and route negotiation etc.
2.	Fuzzy Based	Human-like intelligence and expertise	Intelligent parking methods e.g. parallel parking and perpendicular parking etc.
3.	Wireless Sensor Based	Low cost implementation with lower power consumption	Detection and monitoring of the parking facility etc.
4.	GPS Based	Real time location based information and guidance towards destination	Provides information about the locality and availability of parking facility
5.	Vehicular Communication	Provision of parking information distribution service for mobile vehicles	Antitheft protection, real time parking navigation service etc

3. ECONOMIC ANALYSIS OF SMART CAR PARKING SYSTEMS

Economic analysis is the core study for assessing and exploring the project's feasibility. It plays an important role in deciding whether to start the project or not. Economic Analysis can be used to minimize risks and improve investment efficiency. The role of economic analysis is minimizing the risks and improving the investment efficiency. As smart parking service can decrease the impact of uneven distribution of parking in different parking facilities. The economic

analysis aims at:

- Reduction of negative impacts of parking services.
- Reduction of investment.
- Increasing the social, economic and environmental benefits of the parking facility.

4. CONCLUSION

In this paper, various systems that provide intelligent parking services are discussed. These systems can counter the parking problems that arise due to the unavailability of a reliable, efficient and modern Parking system. The use of different modern techniques such as Expert Systems, wireless sensor based, fuzzy based, GPS based, Vehicular communication based and Vision based can reduce the parking related issues. Such system can help the economic, social and safety based aspects of the society. It also helps in preserving the environment, fuel and time. The economic analysis can help us find the feasible project so that we can have a better parking system without making the economy suffer. Future work should be done for integrating different technologies together in order to achieve a system which is the most efficient, reliable, secure and inexpensive. The economic analysis should be done both quantitatively and qualitatively. After the economic analysis is done, then the project can be finalized.

5. REFERENCES

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