Intelligent Stereo Garage Based on UV Sampling Algorithm

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Abstract—*Nowadays motor vehicle ownership is huge and continues to increase, and the demand for parking spaces has become a major social problem, which also involves the use of contemporary land resources. The traditional parking lot limits the effective use of land resources, and parking difficult problem causes a lot of troubles to people's life, government management and urban construction. Therefore, this paper designs a stereo garage system based on UV sampling algorithm for motor vehicles in old community public space. Using pre-set program, vehicles are accessed through electronic control machinery and other means to realize intelligent parking. It is not only improves the utilization rate of land resources, but also solves parking difficult problem.*

Keywords—*Parking difficult problem, Stereo garage, UV sampling algorithm, Intelligent parking*

I. INTRODUCTION

With the continuous rising of people's living standards, the car has gradually become an essential means of transport for people to travel. Meanwhile, the car ownership is increasing causing the parking issue gradually sharp. It requires continuous improvement of the garage design that the old garage occupies large space and is inflexible. The demand for parking space has become a major social problem, which also poses a new challenge to the utilization of land resources. The traditional parking lot has a low utilization rate of land resources, while the state of parking difficult problem is more and more serious, especially in Shanghai, Chongqing and other large first tier cities. Parking difficult problem has caused a lot of troubles to people's life, government management and urban construction. Compared with traditional parking garage, the project establishes a three-dimensional garage by automatic and intelligent technology, meeting requirements of convenience, beauty, modernization and safety. This design can use land resources more effectively to solve the problem of parking difficult problem in the community, and better serves the society. The automatic and intelligent three-dimensional garage can expand people's understanding of the garage from plane to space, and increase the utilization rate of space effectively solving the problem of tight urban parking space.

II. OPERATING PRINCIPLE

A. *Overall Structure*

The vehicle garage system shown in Fig.1 is set up by UV sampling algorithm[1], including mobile terminal A, garage terminal B and stereo garage C. the garage terminal connects both mobile terminal and stereo garage. When the car owner needs to park or pick up the car, he sends the request

message to garage terminal through mobile terminal. According the real-time states of the three-dimensional garage transmitted by the detection equipment, the UV sampling algorithm is used to control the action of stereo garage, to realize the vehicle entry or exit.

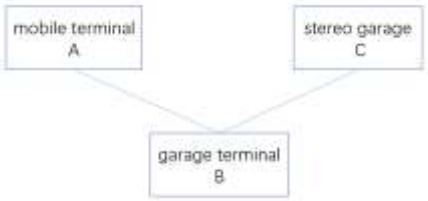

Fig.1 Garage system

B. The Structure Design of Stereo Garage

As shown in Fig.2-5, three-dimensional garage C includes garage frame, foundation frame, first traffic floor 6, elevator, parking plate 10, elevator lifting device and detection equipment. Garage frame is built on the ground while foundation frame is underground. First traffic floor 6 is set for passage of vehicles at the bottom of garage frame. Elevator connected with garage terminal in frame can accurately control the vehicle entrance moving in X, Y, or Z direction. There are enough parking plates appropriately equipped on one or both sides of the elevator in frame for vehicles. The elevator lifting system is placed in the foundation frame[2] connected with the elevator and garage terminal. The detection device in frame is connected with the garage terminal, observing the real-time status. When garage terminal receives the request message sent by the mobile terminal, the vehicle can enter or exit garage through UV sampling algorithm on the basis of the real-time status transmitted by the detection device.

C. Garage Frame

The garage frame consists of a top plate 1 and a number of garage support columns 2. The top plate 1 is erected on the ground through the garage support columns 2. The foundation frame is composed of the underground support plate 9 and quite a few underground support columns 8. The underground support plate 9 and underground support columns 8 construct a rectangular framework.

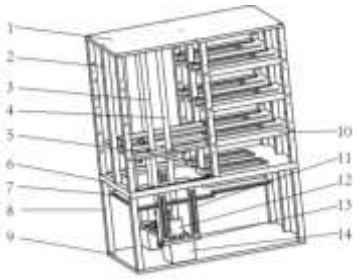

Fig.2 Garage Frame

1-Top plate; 2-Garage support column; 3-Optical axis; 4-Screw rod; 5-Elevator main body; 6-Traffic floor; 7-Base plate; 8-Underground support column; 9-Underground support plate; 10-Parking plate; 11-Motor support column; 12-Flange coupling; 13-Motor support plate; 14-42 Step motor

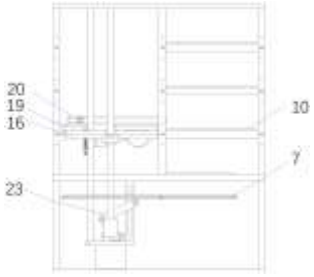

Fig.3 Back of Garage

7-Base plate; 10-Parking plate; 16-Z plate; 19-Y plate; 20-X plate; 23-Crank

D. Elevator Lifting Device

The elevator is made up of an elevator main body 5 and a screw rod 4, while the elevator main body 5 is connected with the elevator lifting device through the screw rod 4. The elevator main body 5 in Fig.4 includes Z-plate 16, Y-plate 19 and Z-plate 20 successively arranged from bottom to top. The Z-plate 16 is provided with a screw nut 15 linked to screw rod 4, and a y-drive

instrument driving the movement of y-plate 19. The Y-plate 19 is provided with an X-drive instrument driving the movement of X-plate 20. The X driving instrument comprises a first steering gear 17 and a first straight tooth 18, while the Y driving instrument comprises a second steering gear 22 and a second straight tooth 21. In this case, the gear 17 and 22 adopt the 360-degree SG90 steering gear.

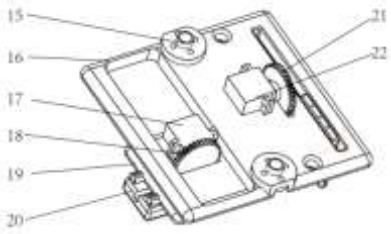

Fig.4 Elevator main body
15-Screw nut; 16-Z plate;
17,22-360-degree SG90 steering gear;
18,21-Straight tooth; 19-Y plate; 20-X plate

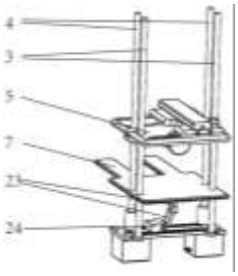

Fig.5 Elevator lifting structure
3-Optical axis; 4-Screw rod; 5-Elevator main body;
7-Base plate; 23-Crank;
24-180-degree SG90 steering gear

The elevator lifting device in Fig.5 is a composite made up of step motor 14, motor support column 11 and motor support plate 13. Step motor 14 is located between the first traffic floor 6 and the foundation frame through motor support column 11 and motor support plate 13. Step motor provides power for the rotation of screw rod 4[3], connected with the elevator through flange coupling 12 and garage terminal communication. There are two step motors which are locked by motor support column 11 and motor support plate 13. The step motor mentioned adopts 42 step motors[4].

E. Garage Terminal

Arduino single-chip micro-computer in garage terminal is equipped with a program with UV sampling algorithm as the main body. Garage terminal detects and controls the overall operation of the garage through external sensors, 42 step motor drive and SG90 steering gear[5]. When the garage terminal receives the message that the owner needs to park, it uses fast reading function of the algorithm to search spare parking space in garage and the corresponding details. When garage terminal finds out that parking is allowed in garage, the algorithm outputs message through the single-chip micro-computer, and controls the elevator to store the car in the specified location.

F. Testing System

Detection equipment includes thermal image sensor, pressure sensor, and ultrasonic sensor and so on. The thermal image sensor set up on the first traffic floor 6 is used to measure whether there are pedestrians in garage. The pressure sensor on the same floor is used to sense whether it is overloaded. If overloaded, the alarm signal is sent out through the safe circuit in garage terminal. The ultrasonic sensor is used to locate the position of empty parking place[6]. Thus garage terminal can control the operation of garage by real-time garage status from detection device.

In addition, App implanted in the mobile terminal can send information to the garage terminal, and it is convenient to store or pick up car through App reservation.

G. Control System Design

Sensor system: first, judge whether there is a car on the first floor of the garage, and

then carry out follow-up operation accordingly. The system is mainly based on infrared sensors, fit up with ultrasonic sensors.

Transmission system: the rise and fall of elevator is realized by the transmission system mainly relies on screw rod, cooperated with gear rack and power system.

Control system: the car is moved in and out by control the automatic system. Arduino single-chip microcomputer is mainly used to complete the automatic operation.

Power system: the rotation is converted by 42 step motor and SG90 steering gear to linear motion to complete the operation.

III. EXPERIMENTAL RESULTS

The user can use the mobile operating system to achieve the function of vehicle pick-up or storage.

When the car needs parking and entering the garage, the mobile terminal is used to make an appointment, and the garage terminal warns pedestrians around the garage. When there is no one and a vacancy in the garage sensed by the thermal image sensor, the garage terminal will feed back the information to the corresponding mobile phone. After receiving the information, the user gives a command for auto-start outside garage to park the car in the designated position.

The pick-up process is the opposite of the storage process.

IV. CONCLUSION

It is a trend to make full use of parking space and build a multi-layer stereo garage. The parking garage established in this paper is programmed by UV algorithm and accessed by automatic system. The design has much advantage such as small occupational room, completely closed structure, unmanned operation and convenience and so on. The design of garage reduces the construction funds, and also traffic accidents caused by curb parking, which greatly lightens the load of people and improves the security.

ACKNOWLEDGMENT

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