

An ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators

Technical field

The present invention relates to three-dimensional vehicle parking apparatus, in particular, relates to an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators.

Background

As well known, prosperous developments of society render personal cars more and more popular, which results in a serious parking problem in large- and middle-scale cities. Recently, many kinds of mechanical parking apparatuses have been developed to solve this problem. Among others, large-scale movable mechanical parking apparatuses of surface type and aisle-stacking mechanical parking apparatuses witness rapid developments. However, these costly apparatuses have some drawbacks, such as requiring high civil construction costs, presenting difficulties in repair and maintenance, and bringing about long operation time to park and access vehicles.

Chinese patent ZL 200620041779.2 discloses a vehicle parking and access device with a mechanical manipulator and holding frictional wheels, which comprises a movable mechanism provided to a movable trolley, a linkage to a vehicle carrying board and a running mechanism thereof. The movable mechanism comprises a locomotive motor fixed to the movable trolley, a gear driven by the locomotive motor, a rack engaged with the gear and a link rod connected with the rack. The linkage to the vehicle carrying board and the running mechanism comprises one or more movable brackets connected to the link rod and a frictional wheel arm device arranged on the movable bracket. The frictional wheel arm device can enter the frictional board installed at the bottom of the vehicle carrying board. Despite that the device as disclosed in this patent bears some advantages, it must be equipped with a vehicle carrying board and a comb-rack, resulting in an expensive and complex structure.

Summary of invention

The invention discloses an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators. A parking device employing the apparatus according to the invention dispenses with a vehicle carrying board and a comb-rack. Therefore, such a parking device has advantages of low civil construction cost, low device cost, short parking and access time and high maintainability.

To solve the above-mentioned technical problems, the technical solution according to the invention is characterized by an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, which apparatus comprises a longitudinally movable carriage provided with two full-floating mechanical manipulators symmetrically on each side thereof;

said longitudinally movable carriage comprises a bottom frame, an actuating motor for running mechanism, a driving wheel that supports the bottom frame, a transmission shaft for the driving wheel, and a driving gear for the driving wheel, wherein said bottom frame is provided with said actuating motors on each side thereof, and said actuating motors drive said driving wheels to rotate via said transmission shaft and said driving gear;

and said full-floating mechanical manipulator comprises a mechanical arm, a mechanical arm transmitting mechanism, a sliding board for pushing the mechanical manipulator, a rectilinear guiding rail and a swing-arm guiding groove that are provided respectively on the inner and outer sides of the longitudinal beam of said bottom frame of said carriage; four symmetrically arranged mechanical arms and two sliding boards are provided on either side of the line going through the middle points of the longitudinal beam of said bottom frame, with each of said two sliding boards is connected, on each side thereof, with a mechanical arm via a pin shaft; said two sliding boards on the same side are slidably engaged with said bottom frame of said carriage via the rectilinear guiding rail; the two sliding boards are provided with the mechanical arm transmitting mechanism therebetween; said mechanical arm transmitting mechanism, which slidably matches with said bottom frame via said rectilinear guiding rail as well, drive the two sliding boards on the same side to translate via a levorotatory ball screw and a dextrorotatory ball screw, respectively; each mechanical arm is provided with at least three rollers that can rotate freely; said rollers lift vehicle wheels up away from the ground when the mechanical arms catch and clamp the vehicle wheels; each mechanical arm is provided with idler wheels at the elbow portion on its inner end; said idler wheels at the elbow portion move along the curves of the swing-arm guiding grooves, and said sliding boards drive said mechanical arms to move.

In said ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, said transmitting mechanism is provided with at least four locking and pushing rods for detent paws; each sliding board is symmetrically provided with two detent paws thereunder; and in the situation that the mechanical arms catch the vehicle wheels, the locking and pushing rods push the detent paws to the effect that the four detent paws bear against the two longitudinal beams of said bottom frame to constitute a two-way locking state.

In said ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, said mechanical arms are provided with articulating pins at the elbow portion thereof; said longitudinal beam of said bottom frame is provided with swing-arm supporting wheel groups on the outer side thereof; and the outer end of said mechanical arm is capable of raising up about the articulating pin under the action of said swing-arm supporting wheel groups.

In said ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, the two longitudinal beams of said bottom frame are provided with four driven wheels at the middle portion thereof.

In said ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, said bottom frame is provided with two horizontal guiding wheels under each end thereof; and a horizontal guiding rail, which matches the horizontal guiding wheels, is provided at the conveyer and the ground of the parking lot.

In said ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, the distance between the axes of the two corresponding mechanical arms before catching ranges from 2200 mm to 3100 mm.

Operation of the apparatus according to the invention is as following. The actuating motor for the running mechanism is started to allow the longitudinally movable carriage to assume the prescribed position under the vehicle chassis; then the transmitting mechanism for the two sets of mechanical manipulators is actuated so as to drive the sliding boards for the mechanical manipulators to move via associated levorotatory and dextrorotatory ball screws. The sliding boards in turn drive the four pairs of mechanical arms to move; and due to the guidance action of the curves at the both ends of the swing-arm guiding grooves on the idler wheels provided at the elbow portion of the mechanical arms, the mechanical arms are deployed. The transmitting mechanism then drives thus deployed mechanical arms to close up gradually. When either pair of mechanical arms touch the vehicle wheels, the pair of mechanical arms stop moving temporarily due to the drag presented by the vehicle wheels. Since the apparatus according to the present invention uses a full-floating mechanism, the other pair of mechanical arms and the transmitting mechanism approach the mechanical arms that have stopped moving until both two pairs of mechanical arms touch the vehicle wheels and the vehicle wheels are lifted up away from the ground due to the lifting actions of the rollers provided to the mechanical arms. At this time, the transmitting mechanism is stopped due to the action of the limit switch; whereas the detent paws under the sliding boards lock the relative position of the mechanical manipulators and the longitudinally movable carriage. After the four vehicle wheels are all lifted up, the actuating motor for the running mechanism is actuated in response to the corresponding program instructions such that the longitudinally movable carriage moves from the parking position to the conveyer, and the accessing action is finished. Since the mechanical manipulators are full-floating with respect to the longitudinally movable carriage, the inventive apparatus can automatically detect and catch the vehicle wheels as long as the vehicle wheels are located within the travelling stroke of the deployed mechanical arms.

The ultrathin vehicle parking and access apparatus according to the invention is a special vehicle parking and access mechanism, which can either be placed on a conveyer platform so as to constitute a movable mechanical parking device of surface type, or be arranged on a stacking apparatus so as to constitute an aisle-stacking mechanical parking device.

The parking apparatus according to the invention dispenses with a vehicle carrying board and a comb-rack, in this way the cost of the apparatus is lowered and the vehicle

parking and access can be expedited. On the other hand, a clear height of 1.65m between floor and ceiling suffices for the garage's need, thus the cost for civil constructions is decreased as well. The inventive apparatus can be employed in large-scale mechanical garages due to its simplicity in configuration and expediency in maintenance, therefore provides an economical, efficient and convenient solution to solve vehicle parking problems in cities.

Brief description of figures

Fig. 1 is a front view of an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to the invention;

Fig. 2 is a top view of an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to the invention;

Fig. 3 is a side view of an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to the invention;

Figs. 4a, 4b, 4c, 4d, and 4e show the deploying process of the mechanical manipulator, wherein Fig. 4a shows the state in which the swing-arm is fully retracted; Fig. 4b shows the state in which the swing-arm deploys to 45 degrees, a pair of idler wheels start to enter the guiding groove, and the other pair of idler wheels move along the curve of the guiding groove; Fig. 4c shows the state in which the swing-arm deploys to 85 degrees, the pair of idler wheels have largely enter the guiding groove, and the other pair of idler wheels continue to move along the curve of the guiding groove; Fig. 4d shows the state in which the swing-arm deploys fully, the pair of idler wheels have enter the guiding groove, and the other pair of idler wheels come out of the guiding groove; and Fig. 4e shows the front view of the swing-arm guiding groove;

Fig. 5 is a top view showing the state in which vehicle wheels are lifted up by the mechanical manipulators.

Fig. 6 is a front view showing the state in which the vehicle is lifted up by the ultrathin vehicle parking and access apparatus according to the invention;

Figs. 7a and 7b show the relationship between the mechanical arm and the supporting wheel group for the mechanical arm, wherein Fig. 7a is a structural view showing the state in which the swing-arm and the supporting wheels do not contact with each other; and Fig. 7b is a structural view showing the state in which the swing-arm and the supporting wheels contact with each other and the swing-arm is lifted up.

Reference numerals

1 a longitudinally movable carriage; 2 a full-floating mechanical manipulator; 3 a bottom frame of the longitudinally movable carriage; 4 a swing-arm guiding groove; 5

a rectilinear rail; 6 an actuating motor for the running mechanism; 7 a transmission shaft for the driving wheel; 8 a horizontal guiding wheel; 9 a driving wheel; 10 a driving gear for the driving wheel; 11 a swing-arm supporting wheel group; 12 a mechanical arm; 13 a roller; 14 an articulating pin at the elbow portion of the mechanical arm; 15 an idler wheel at the elbow portion of the mechanical arm; 16 a dextrorotatory ball screw; 17 a locking and pushing rod for detent paws; 18 a mechanical arm transmitting mechanism; 19 a levorotatory ball screw; 20 a sliding board for pushing the mechanical manipulator; 21 a detent paw; 22 a driven wheel; 23 a horizontal guiding rail; 24 a pin shaft connecting the sliding board and the mechanical arm

Embodiments

Hereinafter, the invention is described in details with reference to the figures.

As shown in Figs. 1-7, an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to the invention comprises a longitudinally movable carriage 1 and two independent sets of full-floating mechanical manipulators 2 provided symmetrically on the left and right sides of the carriage 1.

The longitudinally movable carriage 1 comprises a bottom frame 3, an actuating motor 6 for the running mechanism, a driving wheel 9, a transmission shaft 7 for the driving wheel, a driving gear 10 for the driving wheel, a driven wheel 22 and a horizontal guiding wheel 8. The bottom frame 3 is a rectangular frame, constructed by two longer longitudinal beams and two shorter transverse beams. Each longitudinal beam is provided with rectilinear rails 5 and swing-arm guiding grooves 4 on the inner side and the outer side thereof, respectively. The parking and access apparatus according to the invention is symmetrical with respect to the connecting line going through middle points of the longitudinal beams. Thus, only the structure on one side is described hereinafter.

The actuating motor 6 is arranged on one side of the bottom frame 3, and the housing of the motor 6 is fixed to the inner side of the longitudinal beam. The transmission shaft 7 is rotatably connected between the two longitudinal beams of the bottom frame 3, and is geared with driving gears 10 at the proximity of both ends. The axis of the driving gear 10 is fixed relative to the axis of the driving wheel 9 such that the driving gear 10 and the driving wheel 9 can rotate synchronically. The actuating motor 6 drives, via the transmission shaft 7, four driving wheels 9 to roll. The bottom frame 3 is provided with four driven wheels 22 at the middle of longitudinal beams so as to facilitate the longitudinally movable carriage 1 to cross the gap between the conveyer and the ground of parking lot, thus special means for compensating the gap is dispensed with. In this way, the structure is simplified and the time that would otherwise be taken to park and access vehicle is reduced. Meanwhile, the bending momentum exerting on the bottom frame 3 is largely decreased, such that the bottom frame 3 can be constituted by profiled steel with small cross sectional areas, thus

leading to an ultrathin apparatus.

Four horizontal guiding wheels 8 are installed under the bottom frame 3 at the corners thereof. As shown in Fig. 3, a horizontal guiding rail 23, which matches the horizontal guiding wheels 8, is installed at the conveyer and the ground of the parking lot. In this way, the running direction of the longitudinally movable carriage 1 is free of deflecting and the vehicle can be conveyed smoothly.

The full-floating mechanical manipulator 2 comprises a mechanical arm transmitting mechanism 18, a sliding board 20 for pushing the mechanical manipulator, a mechanical arm 12, rollers 13 provided on the mechanical arm, an articulating pin 14 provided at the elbow portion of the mechanical arm, idler wheels 15 provided at the elbow portion of the mechanical arm, swing-arm supporting wheel groups 11 provided to the bottom frame of the carriage on outer sides of the longitudinal beams, a swing-arm guiding groove 4 provided to the bottom frame of the carriage on the outer side of the longitudinal beam, a rectilinear guiding rail 5 provided to the bottom frame on the inner side of the longitudinal beam, detent paws 21 provided under the sliding board, and locking and pushing rods 17 for detent paws. There are provided four mechanical arms 12 on the left or right portion of the bottom frame, two of which on the one side are symmetrical to the other two on the other side with respect to the line going through the middle points of the short beams. The opposing two mechanical arms 12 are provided with a sliding board 20 therebetween. These two mechanical arms 12 are connected to the both ends of the sliding board 20, respectively, via pin shafts 24. Two symmetrical sliding boards 20 arranged on the left or right portion slidably match with the bottom frame 3 through the rectilinear guiding rails 5. The mechanical arm transmitting mechanism 18, which is provided between the two sliding boards 20, slidably match with the bottom frame 3 through the rectilinear guiding rails 5 as well. The both ends of the output shaft of the transmitting mechanism 18 are fixed with a dextrorotatory ball screw 16 and a levorotatory ball screw 19, respectively. The dextrorotatory ball screw 16 and the levorotatory ball screw 19 are threadedly connected to a sliding board 20, respectively. In this way the transmitting mechanism 18 drives the sliding board 20 to translate via the levorotatory ball screw 19 and the dextrorotatory ball screw 16.

Each mechanical arm 12 is provided with at least three rollers 13 that can rotate freely. After the mechanical arms 12 deploy and catch vehicle wheels, the rollers capable of free rotation can lift the vehicle wheels up away from the ground. Each mechanical arm 12 is provided, at the inner end, with two pairs of idler wheels 15 at the elbow portion thereof. When the two sliding boards 20 move toward each other, the sliding boards 20 drive the mechanical arms 12 to move, meanwhile the idler wheels 15 is guided by the curves at the both ends of the swing-arm guiding grooves 4, such that the mechanical arms 12 deploy as shown in Fig. 4. When the two sliding boards 20 move apart from each other, the mechanical arms 12 retract as the idler wheels 15 are guided

by the curves at the both ends of the swing-arm guiding grooves 4.

When the sliding boards 20 for pushing the mechanical manipulator drive the four mechanical arms 12 to move, the mechanical arms 12 deploy due to the guidance of curves at the both ends of the swing-arm guiding grooves 4 to the idler wheels 15. The mechanical arms 12 move toward each other under the driving action of the transmitting mechanism after they deploy. When either pair of mechanical arms come into contact with the vehicle wheels, the pair of mechanical arms will stop moving temporarily due to the drag presented by the vehicle wheels. Since the apparatus according to the present invention is a full-floating mechanism, the other pair of mechanical arms and the transmitting mechanism close up with respect to the mechanical arms that have stopped moving until both two pairs of mechanical arms touch the vehicle wheels and the vehicle wheels are lifted up away from the ground due to actions of the rollers 13 provided to the mechanical arms 12. Since the mechanical arms are full-floating with respect to the longitudinally movable carriage, the inventive apparatus can automatically detect and catch the vehicle wheels as long as the vehicle wheels are located within the travelling stroke of the deployed mechanical arms. The vehicles with a wheel base ranging from 2200 mm to 3100 mm and with a chassis height clearance more than 100 mm may be caught by the inventive apparatus.

The transmitting mechanism 18 for mechanical arms is further provided with at least four locking and pushing rods 17 for detent paws. Each sliding board 20 is symmetrically provided with two detent paws thereunder. When the mechanical arms 12 catch the vehicle wheels, the locking and pushing rods 17 will push the detent paws 21 to bear against the two longitudinal beams of the bottom frame 3 so as to constitute a secure two-way locking state. At this time, the mechanical manipulators transit from the floating state relative to the bottom frame to a locking state such that the longitudinally movable carriage and the vehicle are immobily engaged with each other and can move together. In this way a stable and secure conveyance can be realized.

The mechanical arms 12 are further provided, at the elbow portion thereof, with articulating pins 14 about which the outer ends of the mechanical arms 12 may swing upward. Thus, when the mechanical arms retract, the outer ends of the mechanical arms 12 can be raised upward due to the swing-arm supporting wheel groups 11 provided to the bottom frame on outer sides of the longitudinal beams, as shown in Fig. 7. In this way the outer ends of the mechanical arms is lifted up away from the ground to avoid friction therebetween.

While description has been made in connection with the best mode of an ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators

according to the invention, it can not be deemed to be limiting upon the invention. It will be obvious to those skilled in the art that various equivalences, changes and modifications may be made therein without departing from the present invention.

Claims

1. An ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators, comprising a longitudinally movable carriage, characterized in that,

said longitudinally movable carriage is symmetrically provided with full-floating mechanical manipulators on each side thereof;

said longitudinally movable carriage comprises a bottom frame, an actuating motor for running mechanism, a driving wheel that supports the bottom frame, a transmission shaft for the driving wheel, and a driving gear for the driving wheel, wherein said bottom frame is provided with said actuating motors on each side thereof, and said actuating motors drive said driving wheels to rotate via said transmission shaft and said driving gear;

said full-floating mechanical manipulator comprises a mechanical arm, a mechanical arm transmitting mechanism, a sliding board for pushing mechanical manipulators, a rectilinear guiding rail provided on the inner side of a longitudinal beam of said bottom frame, and a swing-arm guiding groove provided on the outer side of the longitudinal beam of said bottom frame;

wherein four symmetrically arranged mechanical arms and two sliding boards are provided on either side of the line going through the middle points of the longitudinal beams of said bottom frame, with each of said two sliding boards is connected, on each side thereof, with a mechanical arm via a pin shaft;

said two sliding boards on the same side are slidably engaged with said bottom frame via the rectilinear guiding rail; the two sliding boards are provided with the mechanical arm transmitting mechanism therebetween; said mechanical arm transmitting mechanism, which slidably matches with said bottom frame via said rectilinear guiding rail as well, drive the two sliding boards on the same side to translate via a levorotatory ball screw and a dextrorotatory ball screw, respectively;

each mechanical arm is provided with at least three rollers that can rotate freely; said rollers lift vehicle wheels up away from the ground when the mechanical arms catch and clamp the vehicle wheels;

each mechanical arm is provided with idler wheels at the elbow portion on its inner end; said idler wheels move along the curves of the swing-arm guiding grooves, and said sliding boards drive said mechanical arms to move.

2. The ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to claim 1, characterized in that,

said transmitting mechanism is provided with at least four locking and pushing rods for detent paws; each sliding board is symmetrically provided with two detent paws thereunder; and in the situation that the mechanical arms catch the vehicle wheels, the locking and pushing rods push the detent paws to bear against the two longitudinal beams of said bottom frame so as to constitute a two-way locking state.

3. The ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to claim 1, characterized in that,

said mechanical arm is provided with an articulating pin at the elbow portion thereof; said longitudinal beam of said bottom frame is provided with swing-arm supporting wheel groups on the outer side thereof; and the outer end of said mechanical arm is capable of rising up about the articulating pin under the action of said swing-arm supporting wheel groups.

4. The ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to claim 1, characterized in that,

the two longitudinal beams of said bottom frame are provided with four driven wheels at the middle portion thereof.

5. The ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to claim 1 or 4, characterized in that,

said bottom frame is provided with two horizontal guiding wheels under each end thereof; and a horizontal guiding rail, which matches the horizontal guiding wheels, is provided at a conveyer and the ground of the parking lot.

6. The ultrathin vehicle parking and access apparatus with full-floating mechanical manipulators according to claim 1, characterized in that,

the distance between the axes of the two corresponding mechanical arms before catching ranges from 2200 mm to 3100 mm.