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Automatic Park and retrieve assissted systems for automobiles using smartphone

[1,] S.Poornalakshmi, [2,] V.K.Daliya
[1,] *Embedded system technology, SRM University, Chennai, India*
[2,] *Department of ECE, SRM University, Chennai, India*

ABSTRACT

This paper proposes the design of a simple driverless car controlled by a Smartphone. The system takes control of the car and drives itself to a nearby parking space automatically and retrieves itself out of the parking space. When the auto park feature is started, the system searches for the empty parking lot with the help of ultrasonic sensors and parks the car once it finds the space. In retrieve mode the car drives itself out of the parking space to a fixed place where the user would normally be available or to the place where the user got out of it before the auto park process started. The user can start the car and control the movement of the car with the help of Smartphone to make it come to his present location irrespective of where he/she is available. Remote alert feature is automatically activated when the car is parked and detects any attempt to move the car till the retrieve feature is started with command from the user.

KEYWORDS: *Auto-park, Auto-retrieve, ultrasonic sensors, android application, MEMS compass, GSM*

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I. INTRODUCTION

Automatic parking systems are extensively researched now due to the rapid growing sophistication of driverless vehicles [1]. Time and cost are two important factors of human life, whether for an individual or a business. Urban life requires centralized public facilities. Shopping complexes are an important point of interest both for a city's inhabitants as well as for visitors. With the emergence of modern shopping complexes which provide a variety of services, more and more people are attracted to visit them. Among the various types of parking lots is multilevel parking, roadside[4][5], roadside with ticket and barrier gate and roadside with parking meter; of these, the multilevel parking lot is the most preferred. Most of the auto parking systems uses a user interface based systems where the user needs to choose the parking lot and then the car parks with the help of steering control. For a non user based systems a free space parking slot detection is employed where ultra sonic sensors are used. While most of the day- to-day vehicles rely upon automatic parking, driving the vehicle autonomously without the user interference is of interest now.

AVM (Around View Monitors) are gaining popularity for recognizing the parking slot marking and obstacles and displaying the image to the driver [2]. The camera id mounted on front of the bumper. The disadvantage associated with this kind of monitors is, the driver has to operate the car from within. Previous researches on this area have been presented based on various control approaches i.e. fuzzy logic control, neuro-fuzzy control, neural network and fuzzy gain scheduling method. Each mentioned approaches having its own advantages and disadvantages. Most of the approaches are quite costly due to sensors and other devices involved. For a driverless maneuver ultrasonic sensors can be used to detect the obstacle and identify the free space and park the car. Extensive researches are carried out in the area of path planning and maneuvering the car to the parking space.

This paper proposes such a kind of system where ultrasonic sensors are fitted onto the bumpers of the vehicle. These sensors are used to not only identify the parking slot but also to drive the vehicle out of the parking slot. The communication between the vehicle and the user can be accomplished by means of GSM network. There is no world without a Smartphone now. The command for operating the vehicle can be sent as a message from the user's mobile phone. The corresponding messages are received by the GSM modem fitted onto the vehicle and they are processed accordingly. The vehicle can be operated either manually or in an automatic mode by the user from a remote location. For this kind of operation it is assumes that there is a fixed parking slot such as multi level parking. The paper also attempts to implement the same with cost effectiveness.

II. LITETERATURE REVIEW

A. Vision based systems:

Vision based systems continuously monitor all the parking slots through cameras fixed at multiple points thus detecting available free slots. These cameras continuously capture images which are processed and observed for changes in the features thus detecting the presence of a car. The processing includes feature extraction and object identification. Based on the pixel data it is possible to detect the presence of a car. It only locates all the vacant slots available but cannot allot a slot to an incoming car. Detection methods based on cameras and image processing suffer from a lack of accuracy and can be affected by environmental or weather circumstances. Major problems of vision based parking detection systems include shadow effects, occlusion effects, vacillation of lighting conditions and perspective distortion.

B.Sensor Based Systems:

A common type of pavement embedded sensors can be installed to find vacant spaces. It requires expensive and disruptive maintenance work. Different factors play a role in choosing the proper sensor, including size, reliability, adaptation to environmental changes, robustness and cost. One type of embedded systems uses magnetic field sensors that measure changes in the magnetic flux to detect parking vehicles. These kind of sensors need to be employed at each parking slot which requires sensors attached with a processing unit and a transceiver. Radar sensors perform well in rugged weather conditions, but sometimes need to be equipped with additional sensors to detect parked vehicles. The sensors are usually connected through relays or programmed in PLCs. Ultrasonic sensors transmit sound waves between 25 kHz and 50 kHz. They use the reflected energy to analyze and detect the status of a parking space. Ultrasonic waves are emitted from the head of an ultrasonic vehicle detection sensor every 60 milliseconds, and the presence or absence of vehicles is determined by time differences between the emitted and received signals. Despite the low cost and easy installation of ultrasonic sensors, they do have some disadvantages, particularly sensitivity to temperature changes and extreme air turbulence.

III. EXPERIMENTAL SETUP

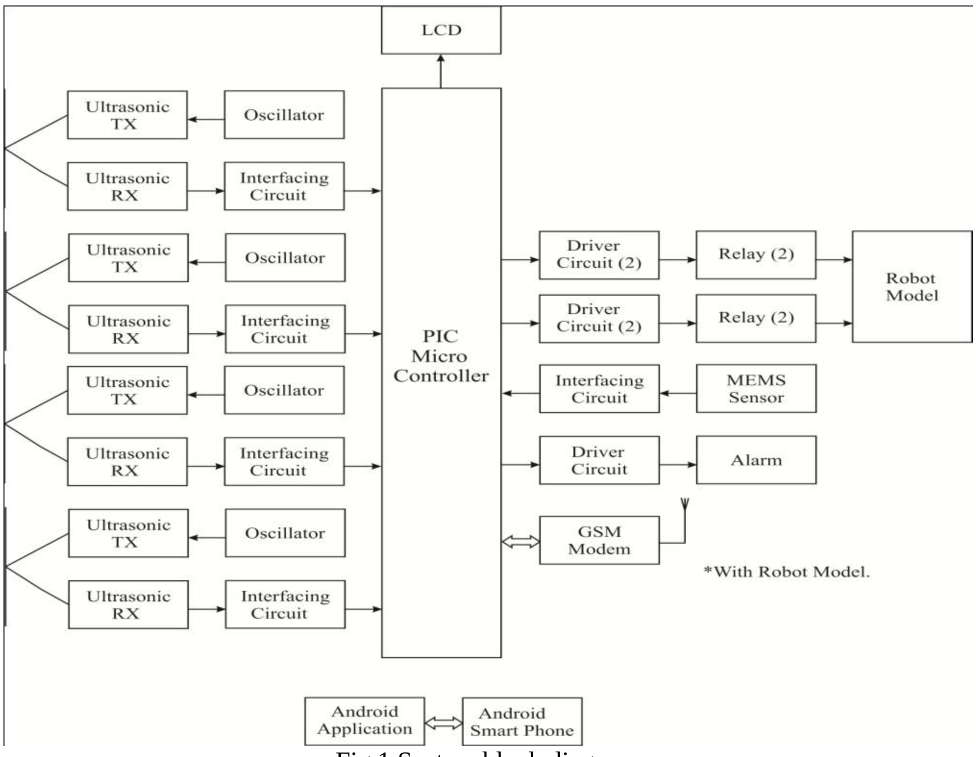

Fig.1 System block diagram

A. COMPONENTS OF THE SYSTEM:
(i) ULTRASONIC SENSOR HC-SR04:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,
(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound)/ 2

(ii) GSM:

The GSM technical specifications define the different elements within the GSM network architecture. It defines the different elements and the ways in which they interact to enable the overall system operation to be maintained. The GSM network architecture is now well established and with the other later cellular systems now established and other new ones being deployed, the basic GSM network architecture has been updated to interface to the network elements required by these systems. Despite the developments of the newer systems, the basic GSM system architecture has been maintained, and the network elements described below perform the same functions as they did when the original GSM system was launched in the early 1990s.GSM network architecture elements

(iii) ANDROID APPLICATION:

As Android continues to grow beyond smartphones, it will become the brains behind invisible, ubiquitous cloud-connected computing. These days the demand of smart phone is being increased and we have different types of client e.g. Touch Phone, tables, Note etc. The demands of the applications for these smart clients are constantly increasing and we have several operating systems for these smart clients e.g. Android, IOS and Windows etc.

B.SYSTEM IMPLEMENTATION

The system is implemented using the PIC 16F877A microcontroller for the design of a prototype of the proposed model. When the auto park feature is enabled, the steering control of the vehicle is prohibited to the driver. The four ultrasonic sensors are fitted on the front, sides and at the back of the bumper. These sensors probe the parking slot as the robotic model move in the parking space, detecting for any possible obstacle. The sensors always receive low to high pulse from the receiving end when there is no obstacle. When two low- pulse waves are detected, the space is meant to be free. The direction of the robotic model (of the car) is sensed using the MEMS compass orientation. When the car moves into the free parking space, the ultrasonic sensor probe for possible obstacle in order to park the car in a correct orientation and signals the sensor so that the wheels of the robot rotate accordingly.

Once the car is parked and locked, a message is sent to the corresponding user's mobile number via GSM modem that is embedded into the electronic control unit of the car. If at any case the car is tend to move, the change in the direction of the MEMS compass is detected. This movement detection message is sent to the user about any theft attack.

For the retrieval of the driverless car, the mode of control car can be either automatic or manual. This mode of is selected by the user from the android application that is available on his/her Smartphone. If the manual mode is selected, the direction of the car movement is selected from the android application. The android application is exclusively developed for this purpose. The corresponding selection is sent to the GSM modem of the car driven remotely using the Smartphone to any descried location. The accuracy of the maneuver depends on the condition of the roadway where the car is driven.

If the auto mode is selected, the probing is done using the ultrasonic sensors in the usual way of obstacle detection .The car is driven either to the location where it was originally left by the auto park mode or car can be drove to a pre-defined location by tracking through GPS tracking.

IV. RESULTS AND DISCUSSION

Experiment result for the prototype implement is shown below. The designed prototype can be installed to the dashboard of the car. When the car is parked a message is sent to the mobile no shown in Fig.2(a) .When the movement is detected a movement detection message shown in Fig.2(b) is also sent.

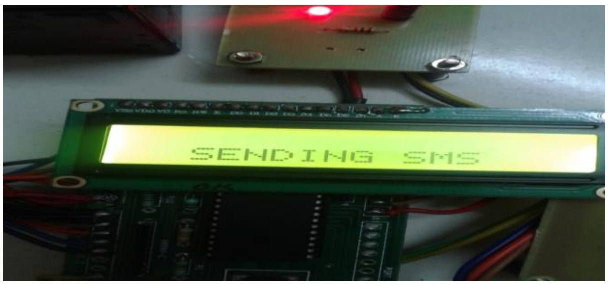

Fig 2 (a) Sending SMS to the mobile number

Fig.2 (b) Sending movement detection message

The mode of the robot is selected through the android application (Fig.3) that is developed. When the manual mode is selected, the movements are transferred through the GSM network .The timeliness of the message sent depends upon the accuracy of the GSM network over which the messages are sent. These messages are received on the Smartphone of the user shown in Fig.4.

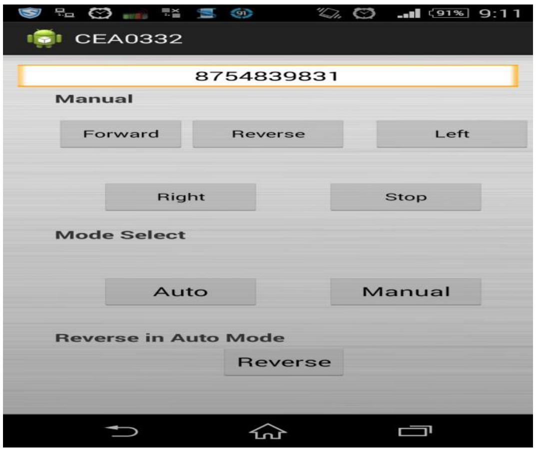

Fig.3 Android application

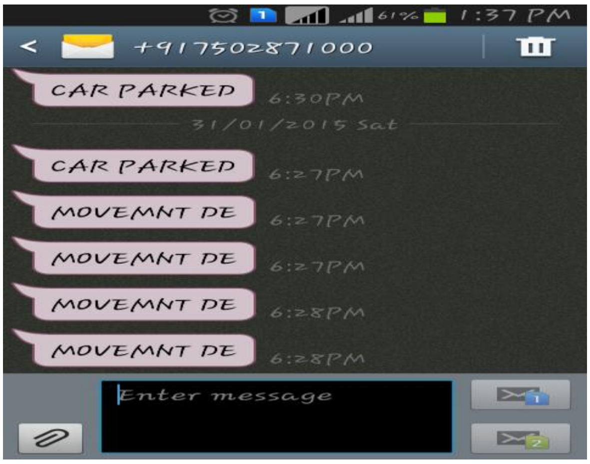

Fig.4 Message received at the user end

V. CONCLUSION

An Automatic Park Assist technology that helps a car to steer itself into a parking space with little input from the user. With emerging trends in technology this would serve the purpose of conservation in man power and it could help a long way in improving the standard of the automobile technology by providing a driverless car. In real time GPS components

could be integrated onto the car system that could trace the owner wherever he is with the help of a GSM modem and drive itself to the concerned place using GPS navigation system technology. The system is safe, secure and easy for drivers.

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