Grid based Robot Navigation for Parking System

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***Abstract*—In today's world, the increasing reliance of people over personal vehicles for transport has led to shortage of parking spaces, especially in urban areas. The public pay-and-park spaces are not equipped with facilities to guide a car driver to an available parking slot. This leads to wastage of time for the car driver. To address this issue, the new system includes a guidance system consisting of a user application, an array of sensors, and navigation software. The user application also consists of a payment mechanism, as well as the option to retrieve the car.**

Keywords—Robot; navigation;guidance; grid-based maps

I. INTRODUCTION

The increase in the incomes of the general urban populace, has led to an exponential growth in the number of vehicles plying on the roads. This, in addition to, poor urban planning, has led to lot of problems, primarily the shortage of space for parking the vehicles. The public pay-and-park facilities do solve this problem to an extent, but since there exists no mechanism to inform the driver about an available parking slot, it leads to a lot of time wasted in finding the perfect slot to park the car. The proposed system intends to address this issue by equipping the car with tools that let the car park itself.

The tools include guiding software for the car along with an array of sensors, to detect the path as well as to detect any obstacles that lie in the path. The owner is provided with an application to select a parking slot from the list of available spots the application will also allow the user to pay for using the parking facility, as well as the option to retrieve the car. This will lead to a reduction in time required to park the car.

II. LITERATURE SURVEY

All the previous research in the field of grid based robot navigation involved different techniques to map the indoor environment before letting the robot to navigate. This paper [3] is an implementation for indoor environments wherein a laser range finder based localization algorithm is used for map based robot navigation. A list of vertexes is used to representthe sequence of grids and global map information for a navigation path .In order to globally localize the mobile robot a matched pattern is found between the set of vertexes from the map and the set of vertexes from range of data. [3]

HCTNavalgo, A* and Dijkstra's algorithms are implemented on grid based maps and then their obtained path lengths are compared. These three algorithms are well known for path finding on graph, but can also be adopted grid maps. The three algorithms have been implemented in a straight line until finds obstacle using ANSI – C language, and are optimized for low resource systems, especially low memory ones, so that they can be used in low cost robots. Experimental results demonstrate that HCTNav has a good potential for solving path planning in embedded systems with less computation resources, especially the memory. Hence, HCTNav can be a considered a good alternative for navigation in low cost robots. [4]

The paper [5] involves a novel, sensor-based biologically inspired neural network algorithm is proposed for real-time, collision-free navigation, and mapping of an autonomous mobile robot in an unknown environment. One of the major challenges in intelligent robot systems is real-time navigation and mapping of an autonomous robot. With the equipped sensors, the robot can only compute a limited range of surroundings even with grid map representation. The optimal real-time robot path is computed through the dynamic activity landscape of the neural network without any prior knowledge of the environment, and without any learning procedures. Therefore, it is computationally efficient.

The paper [1] includes the grids made up of black lines over a white surface is used to navigate the robot as a line following robot to reach its destination. This kind of robot should sense the line with its LED-LDR sensors that installed under the robot. Then, specific transition buses transmit the data to the processor. The processor then decides the appropriate commands and sends them to the driver, which will then be interpreted and followed by the line follower robot. The robot traverses entire grid in a defined manner until it detects any object in its way and if it detects any object, it goes to the start location via a shortest path from that location.Ultimately the robot will search the object in the Grid, pick that object and bring to destination position in minimum time.

Indoor autonomous navigation of a mobile robot is being implemented. There have been many researches on autonomous navigation system and many of them have been implemented for practical use. These algorithms are not easily accessible to users for practical usage. Sometimes, it is difficult for user to adapt algorithm components for navigation implementation. For example, though there are many algorithms available for obstacle avoidance, it is not easy to incorporate all the algorithms into navigation system software for practical implementation. This research includes one of the successful implementations of the indoor navigation which is practically feasible in the respect that it combines various aspects of robot navigation in a coherent manner.[2]

III. METHODOLOGY

The Arduino platform gives an arrangement of advanced and simple set of digital and analog input/output (I/O) pins that can interface to different peripherals boards and other circuits. The boards feature serial communication interfaces, including USB, for stacking programs from personal computers. Micro-controller takes the information from the IR sensors which rotate the wheels to move the car over the dark line with the assistance of engine driver IC. In this project Wi-Fi Module is used as a primary communication unit which is used to transfer the IR sensor readings to and from the parking spots and the car, to the database. The Parking Reservation System is a central system which comprises of Customer Application, Parking spot information details, database.We are going to use Infrared transmitters and Receivers for each parking slot. The IR Receivers are associated with AVR microcontroller. IR rays are obstructed when a car is parked in any parking slot. Consequently indicates inaccessibility of the spot.The Car proprietor is permitted to choose a free spot of his/her decision and the same selected spot is updated in the database.The car is guided to move on dark line followed by path calculation algorithm and obstacle detection algorithm. PRS notifies car owner after successful parking of the car. Retrievalof car is done by the car owner request after the successful payment of calculated parking fee.The Database is used to store the credentials of the user, information about Available/Unavailable parking spots, Fee payment records.Mobile Phone Application is used by car owner to Login into the System, which contains GUI for viewing available parking spots, parking spot selection, Parking Fee Payment and Car Retrieval Request.The Car is the primary unit which is consists of Arduino and other expansion boards with rotating wheels.**Sensor Unit:** The sensors set on the car are utilized to recognize the obstructions in the way and additionally to manage the car to take appropriate right or leftto follow the black line to reach allocated parking slot.Power supply unit is used to power up the Arduino board, sensors and other expansion boards.

IV. IMPLEMENTATION

The following steps list down the implementation plan of the proposed system, which can be seen in Fig. 1.

- *User-Application Interaction*

The user first starts the application to login/register into the system. The system provides a list of available parking to the user through the application. An alert notification is sent to the user once the car has been parked. When the user returns to retrieve the car, the system then calculates the parking fees based on the duration of parking. The user then pays the parking fees.A record is generated and stored in the database. A detailed report is generated based on the manager's request and the report is sent to the user via the application.

- *Car - Parking Reservation System (PRS) Interaction*

The system guides the car tomove on black line to self-driven to the chosen parking slot by using path calculation and obstacle detection sub systems. Among different paths the shortest path is chosen to reach selected parking slot. On encountering an obstacle on the way the path is changed accordingly. The current status of the car is tracked by PRS in real time.The car is guided by the system from the parking slot to the user after the payment process is completed.

- *Parking Slot – PRS Interactions*

The records of available/unavailable parking slots are updated in real time in central PRS. Once the car has allocated a parking slot among available parking slots, it is marked as an reserved slot for other users. Parking slot is made unavailable after successful paring of a car. The real time number of available, parking slots is shown to user. Once the car is retrieved from parking slot it is again made available for other users. The parking fee calculation is made on the basis of the time for which a parking slot is being unavailable.

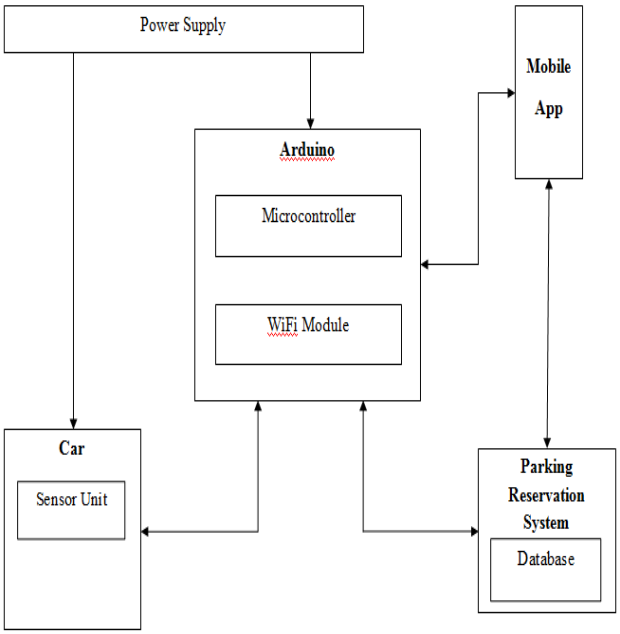

Fig. 1. System Block Diagram

V. CONCLUSION

With the traditional car parking system, depending upon the availability of the system, the drivers are required to park the cars themselves.To resolve the problems of existing system, we propose this new approach. The proposed system will solve the problems related to traditional parking system. This paper represents the implementation of Automatic car parking system which comprises of ArduinoATmega Microcontroller, IR sensors, Wi-Fi module, Desktop & Mobile Applications. This system aims to ease the parking process, by letting the driver choose the parking slot and letting the car park itself by tracing the path and detecting the obstacles. Thus, parking hassles of the car drivers in populated cities will be reduced considerably by this system.

REFERENCES

[1] Ankita Saxena.1 and AbhinavSaxena. 2 "A New Generation Grid Solver Robot System for Object Picking using Shortest Path**"** *International Conference on Emerging Trends in Electrical Engineering and Energy Management (ICETEEEM-2012)* 978-1-4673-4634-4/12 ©2012 IEEE pg no. 445-449

[2] Nak Yong Ko.1, Sung Woo Noh.2 and Yong Seon Moon.3 "Implementing Indoor Navigation of a Mobile Robot" *2013 13th International Conference on Control, Automation and Systems (ICCAS 2013)* Oct. 20-23, 2013 in Kimdaejung Convention Center,Gwangju, Korea.

[3] Shung Han Cho.1 and Sangjin Hong.2 "Map Based Indoor Robot Navigation and Localization Using Laser Range Finder" *2010 11th Int. Conf. Control, Automation, Robotics and Vision* Singapore, 7-10th December 2010.

[4] NafiseOsati Eraghi.1, Fernando López-Colino.2, Angel de Castro.3 and Javier Garrido.4"Path Length Comparison In Grid Maps Of Planning Algorithms" *Spanish MinisteriodeCiencia e Innovacion under project TEC2009-09871* 978-1-4799-5743-9/14 ©2014 IEEE.

[5] Chaomin Luo.1, Jiyong Gao.2, Xinde Li.3, Hongwei Mo.4 and Qimi Jiang.5 "Sensor-based Autonomous Robot Navigation under Unknown Environments with Grid Map Representation" *Natural Science Foundation of China (No. 61175091)* 978-1-4799-4458-3/14 ©2014 IEEE