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LOBOT-LOW COST VIRTUAL MACHINE FOR LOCALIZATION

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ABSTRACT:

It is often important to obtain the real-time location of a vehicle when it performs autonomous tasks either indoors or outdoors. We propose and implement LOBOT, a low-cost, self-contained localization system for vehicle navigation. LOBOT provides accurate real-time, 3D positions in both indoor and outdoor environments. Our empirical experiments in various temporal and spatial scales show that LOBOT keeps the positioning error well under an accepted threshold. Additionally we provided solution to car parking management. One of the challenging problems for many vehicle owners in big cities is where to park their vehicles. If the parking slot is known in advance one can save precious time and fuel wastage. The user is informed about the parking slot availability at a particular parking location .The slot availability details are collected using an RFID system and are updated periodically into the database.

Keywords: LOBOT; RFID; Virtual machine; Vehicle navigation.

I. INTRODUCTION

The virtual machines have great potential to be deployed in situations that are either uncomfortable for humans or simply too tedious. For example, a robot may become part of industrial operations, or become part of a senior citizen’s life, or become a tour guide for an exhibition centre. The robot is kept as small as possible to allow access through narrow passageways such as a tunnel. These techniques normally utilize GPS, inertial sensors, radio signals, or visual processing. GPS often becomes inoperable in certain environments such as indoors or in wild forests. One of the benefits of performing localization on outdoors is the possibility of using GPS. GPS provides absolute position estimation (latitude and longitude), but with some limitations. One of the GPS limitations is that the precision of GPS estimation depends on the number of satellites detected by the sensors. In our experiments, the accuracy obtained was about 5m.Other limitations of GPS sensors are occasional inconstant signals, which creates a multi-patch effect and not available signals, usually due to the occlusion caused by tall buildings. In order to smooth pose estimation and avoid the effect of occlusion and multi-path, we developed a particle filter based GPS approximation algorithm.

II. RELATED WORK

One scheme, using GPS alone, it requires a lot of power. Another scheme, radio-based positioning requires proper calibration, a friendly environment and a set of external devices to generate or receive radio signals. This technology requires a set of external devices to generate or receive radio signal; as the reference nodes, these external devices should have known positions. The accuracy of the radio-based positioning strongly depends on the proper calibration of the reference devices and the target node, as well as a friendly radio environment. Maintaining such a positioning system can be costly and difficult in terms of additional hardware, intensive tuning, and environmental management. It is also vulnerable to interference from other signals, thus affecting the accuracy of positioning. A third scheme, the use of vision techniques, relies heavily on recognition of objects or shapes and often has restricted spatial and visual requirements. Additionally, those objects and shapes must be captured and loaded into a computer which, like GPS, requires a lot of power. The performance usually strongly depends on the environment in which the robot operates and the localization suffers frequent failure. A fourth scheme, inertial sensors, is part of the LOBOT design. Inertial sensors often are used to detect movement. However, previous methods of maintaining their accuracy have resulted in high cost and calibration difficulty.

III. PROPOSED SYSTEM

We propose a LOBOT, a low-cost, self-contained localization system for the vehicle. LOBOT identifies the real-time localization through a set of self-integrated inexpensive sensors including an accelerometer, a magnetic field sensor, several motor rotation sensors, and infrequent GPS-augmentation. It detects local relative position with a combination of the accelerometer, the magnetic field sensor and the motor rotation sensors. LOBOT invokes the GPS-augmentation to assist in identifying global location and correcting drifting errors if necessary.

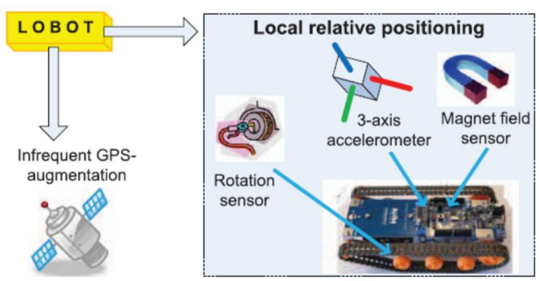

Figure 1: Design of LOBOT

LOBOT can be applied to both indoor and outdoor environments. LOBOT does not require any external facilities or prior information and it virtually needs no effort of external maintenance. LOBOT is free of many common requirements or issues raised in other localization schemes such as radio-based schemes and vision-technique-based schemes, such as expensive hardware, external reference facilities, careful tuning or strict calibration, and prior map information. It also has significant improvement in location precision over the purely-accelerometer-based approach.

We developed a prototype of the LOBOT system and conducted various field evaluations. The empirical results indicate the satisfactory performance of LOBOT. In car parking system, Entry-point and exit-point of the parking-slots will be under control with RFID readers, labels and barriers. Personnel costs will be reduced considerably using this technology. Entry-point and exit-point will be handled in a fast manner by without stopping the cars so that the traffic jam problem will be avoided during these processes. There will be no need for the drivers to stop the car at the circulation points and the parking tickets will be out of usage during Entry-point and exit-point. Because we have added recharge module, therefore user has to register into the system and they will get message of balance on their mobile. This system will avoid the ticket-jamming problems for the ticket processing machines as well. Vehicle owners will not have to make any payments at each Entry-point if so there will be a faster traffic flow. Because of using this proposed system there won't be any waiting during Entry-point and exit-points and hence the pollution problem will be avoided. Automated parking certainly reduces the total cost of the RFID parking system infrastructure without re-modifying the existing hardware.

TRAVEL DISTANCE

After inferring the instantaneous orientation of the robotic vehicle, we also need to know the momentary travel distance so as to compute the momentary relative movement.

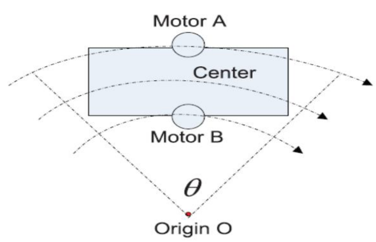

Figure 2: (a) Forward direction

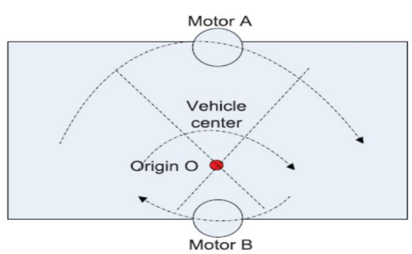

Figure 2: (b) Reverse direction

The rotation sensor attached to a motor continually measures the rotating angle. Another important issue we need to address relates to the way the robotic vehicle operates its motors. It is common that a robotic vehicle may make turns or follow a curved path through adjusting its two sides of motors at different speeds and even in reverse direction. The travel distance of the robotic vehicle can be approximated by the average of the two side motor's travel distance. A motor may rotate either forward or backward; it rotates forward (backward) in an attempt to move the vehicle forward (backward). Correspondingly, in addition to the absolute distance measured, each reading of rotation sensor is assigned a sign: positive for forward rotation and negative for backward rotation. An inertial navigation system is a navigation aid that uses a computer, motion sensors and rotation sensors to continuously calculate via dead reckoning the position, orientation, and velocity (direction and speed of movement) of a moving

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object without the need for external references. Initially we have to set the latitude and longitude values by using keypad. After that motor will start to move. Current values of Latitude and Longitude displayed in terms of degrees. LCD provides user interface and also displays status information. Here LOBOT is operated by using two motors. These motors are connected to driver IC (L293d) for navigation. Database is an EEPROM which stores location name and its coordinates. Area finder is a switch pad where we can get location information by pressing corresponding switch. Microcontroller gets the input from switch and search the location and distance on its database (EEPROM). LCD display shows distance information from vehicle's standing place. Driver circuit consists of L293D IC to drive the vehicle. Rotation sensor calculates vehicle speed information. From that speed and direction of vehicle we can generate Latitude and Longitude values and displayed in LCD. RFID Tag is also attached with vehicle unit which is used for car parking system.

PARKING UNIT

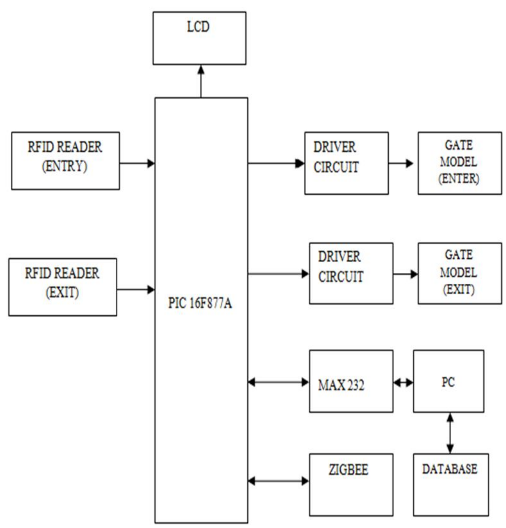

Figure 3: Parking unit

RFID-based automatic vehicle parking system, the vehicle owner has to first register the vehicle with the parking owner and get the RFID tag. When the car has to be parked, the RFID tag is placed near the RFID reader, which is installed near the entry gate of the parking lot. As soon as the RFID tag is read by the reader, the system automatically deducts the specified amount from the RFID tag and the entry gate boomer opens to allow the car inside the parking area.

At the same time, the parking counter increments by one. Similarly, the door is opened at the exit gate and the parking counter decremented. The system also offers the facility to recharge the amount for each RFID tag. No manual processing is involved. In addition, the system provides security.

IV. CONCLUSION

The hardware devices LOBOT uses are easily available at low cost. We developed a prototype of LOBOT and conducted extensive field experiments. The empirical experiments of various temporal and spatial scales with LOBOT verified its accuracy. In contrast to the accelerometer- based approach, LOBOT succeeds in maintaining low cumulative error. Thus the human intervention is reduced in automated parking system by LOBOT.

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