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Self-Contained Localization of Ground Robotic Vehicle

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ABSTRACT

It is often important to obtain the real-time location of a small-sized ground robotic vehicle when it performs autonomous tasks either indoors or outdoors. We propose and implement LOBOT, a low-cost, self contained localization system for small-sized ground robotic vehicles. LOBOT provides accurate real-time, 3D positions in both indoor and outdoor environments. Unlike other localization schemes, LOBOT does not require external reference facilities, expensive hardware, careful tuning or strict calibration, and is capable of operating under various indoor and outdoor environments. LOBOT identifies the local relative movement through a set of integrated inexpensive sensors and well corrects the localization drift by infrequent GPS-augmentation. Our empirical experiments in various temporal and spatial scales show that LOBOT keeps the positioning error well under an accepted threshold.

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I. INTRODUCTION

Small-sized ground robotic vehicles 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 center. The robot is kept as small as possible to allow access through narrow passageways such as a tunnel. To fulfil these missions, the robotic vehicle often has to obtain its accurate localization in real time. Considering the difficulty or impossibility in frequent calibration or the management of external facilities, it is desirable to have a self-contained positioning system for the robot: ideally, the localization system should be completely integrated onto the robot instead of requiring external facilities to obtain the position; the system should work indoors and outdoors without any human involvement such as manual calibration or management. Meanwhile, the cost is expected to be as low as possible. Unpleasantness: Robots perform many tasks that are tedious and unpleasant, but necessary, such as welding.

There exist various localization schemes for ground robotic vehicles. 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. Additionally, the GPS operations consume power quickly. As an alternative, a localization system may use various waves including electromagnetic waves of various frequency (e.g., common Wi-Fi radio, ultra-wideband [1], RFID radio [2], Infrared [3]), laser beam [4], and ultrasound [5].

II. LITERATURE SURVEY

The first industrial modern robot was the unimates developed by George Devol and Joe Engelberger in the late 50’s and early 60’s. Engelberger formed unimation and was first to market robot and has been called the father of robotics. Modern industrial arm has increased in capability and performance through controller and language development, improved mechanisms, sensing, and drive systems. In the early to mid 80's the robot industry grew very fast.

"VISION-BASED MOBILE ROBOT LEARNING AND NAVIGATION"

It was developed in 2005. This research develops a vision-based learning mechanism for semi-autonomous mobile robot navigation. Laser-based localization, vision-based object detection and recognition, and route-based navigation techniques for a mobile robot have been integrated. Initially, the robot can localize itself in an indoor environment with its laser range finder. Then, a user can teleoperate the robot and point the objects of interest via a graphical user interface. In addition, the robot can automatically detect potential objects of interest. The objects are automatically recognized by the object recognition system using Neural Networks. If the robot cannot recognize an object, it asks the user to identify it. The user can ask the robot to navigate back autonomously to an object recognized or identified before. The human and robot can interact vocally via an integrated speech recognition and synthesis software component. The completed system has been successfully tested on a Pioneer 3-AT mobile robot [5].

"SEARCH AND RESCUE ROBOT"

This was developed in 2006 the centre for robot assisted search and rescue has developed a search and rescue robot which can be controlled for rescue operations. it edges forward ,climbs over a mound of debris ,then stops. Suddenly the rubber threads shifts from horizontal to vertical, raising the lens into a better advantage point to transmit images .it seems to have a mind of its own, even though every move is guided by a man 10 yards away with a remote control and laptop.

"HAZARDOUS GAS DETECTING METHOD APPLIED IN COAL MINE DETECTION ROBOT"

This was developed in 2011. As one of the largest coal production and consumption countries in the world, China is also one of the related accidents occurred frequently countries such as gas explosion, flood, breaking out of fire during the exploitation of coal mine. Coal Mine Detection Robot can be substituted or partial substituted for emergency workers to enter the mine shaft disaster site and detect hazardous gas and do some environmental exploration and surveying task. Coal Mine Detection Robot uses infra-red spectrum absorption way to detect methane, carbon monoxide and such gas simultaneously.

The principle of gas survey meter of infra-red spectrum is according to the selectively absorption of infrared radiation by the mash gas, CO to achieve the detection of their concentration. The advantages of this kind of hazardous gas detecting are: simultaneously and rapidly detecting methane, CO and high sensitivity, good selectivity and fast response. Otherwise, it is easy to be taken by robot due to its simple and light structure, have a lager detection range and probe is not easy failure to be poisoning and aging [6].

III. PROPOSED SYSTEM

The Proposed system comprised the following Modules:

SENSORS

1. Supply Voltage: +5V DC
2. Proximity Sensor

POWER SUPPLY

The circuit diagram of power supply which gives output of 5V, as only that much is required for Microprocessor and Robot. The +5 volt power supply is based on the commercial 7805 voltage regulator IC. This IC contains all the circuitry needed to accept any input voltage from 8 to 18 volts and produce a steady +5 volt output, accurate to within 5% (0.25 volt). It also contains current-limiting circuitry and thermal overload protection, so that the IC won't be damaged in case of excessive load current; it will reduce its output voltage instead. The advantage of a bridge rectifier is you don't need a centre tap on the secondary of the transformer. A further but significant advantage is that the ripple frequency at the output is twice the line frequency (i.e. 50Hz) and makes filtering somewhat easier. The use of capacitor c1, c2, c3 and c4 is to make signal ripple free. The two capacitor used before the regulator is to make ac signal ripple free and then later which we are using is for safety, if incase there is a ripple left after regulating, then c3 and c4 will remove it.

RF-TRANSMITTER

The circuit comprises the R.F transmitter and R.F receiver pair to transfer the code data encoded by the integrated circuit HT-12E and decode by the other integrated circuit HT-12D.

The data then decoded is passed to the integrated circuit L298N which further drives the motors in either directions.

RF-RECIVER

The circuit comprises mainly the RF receiving and data decoding section and motor driving section. The RF firstly received by the receiver data is passed to data decoding section and is done by HT-12D through 10 DIP switches.

The forward and reverse motion of the motors is controlled by key pressed from the transmitter. This motion is governed by IC L298N.

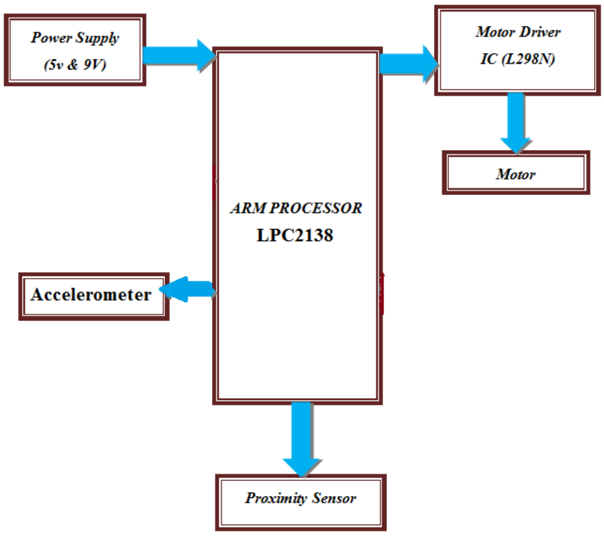

Fig 1. Block diagram of Self-Contained Localization of Small-Sized Ground Robotic Vehicle.

IV. ADVANTAGE AND APPLICATION

Advantages

1) The hardware devices LOBOT uses are easily available at low cost.

2) It virtually requires no external devices or external facility management and that it needs no prior information. Unlike other localization schemes such as radio-based solutions, LOBOT does not require external reference facilities, expensive hardware, careful tuning or strict calibration.

3) Additionally, LOBOT applies to both indoor and outdoor environments and realizes satisfactory performance.

Applications

1) A robot may become part of industrial operations, or become part of a citizen's life.

2) It also can become part of a tour guide for an exhibition centre.

3) It allows access through narrow passageways such as tunnels.

V. CONCLUSION

We propose LOBOT a low-cost, self-contained, accurate localization system for small-sized ground robotic vehicle. It localizes a robotic vehicle with a hybrid approach consisting of infrequent absolute positioning through a GPS. By Bluetooth and RF transceiver it becomes easy for communication and controlling the robot. We can use Wi-Fi and implement LOBOT in future. Additionally, LOBOT applies to both indoor and outdoor environments and realizes satisfactory performance.

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