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Robot Navigation using RFID and Sensors with Pick and Place Arm

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Abstract:

The paper introduced a method enable robot to navigate in indoor space is indicated. The system use RFID tags as landmarks to locate the robot. A topological map according to the real environment is used for robot navigation. The robot goes along the ways, and move to the right direction at each intersection of the hallways. The robot navigation system can be used in real life and do efficient work. In this paper, we have added the pick and place feature in the robotic section. The robot can go and pick a particular object or a product in a warehouse and place it in a particular place.

Keywords:

Robot Navigation System, Pick and place arm.

1. Introduction:

This paper describes a navigation system for mobile robots which are assumed to move autonomously to a given goal in man-made environments such as hallways in a building. The main part of our navigation system is global path planning and local path planning. A significant function of the global path planning is to dictate a direction to a goal at a particular place such as the intersection of two hallways in a building. The local path planning plays a role of moving the robot along walls keeping away the obstacles. The navigation system, therefore, requires a mechanism for recognizing such particular places in the building and pinpointing them on a world map that gives course directions to a goal. Additionally, it requires a function of causing a free space map in a hallway. Two common approaches to global path planning are metric-based and landmark-based navigation.

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Metric-based navigation relies on metric maps of the environment, resulting in navigation plans such as move forward five meters, turn right ninety degrees and move forward another eight meters. For positionsensing schemes, this approach depends on deadreckoning based on information about the motion of the robot derived from the wheel encoders, or exact position estimation using the global positioning system (GPS). These metric data are, however, likely to be corrupted by sensor noise and this navigation method is vulnerable to inaccuracies in position estimates. To avoid reliance on error-prone metric data, an alternative approach is landmark-based navigation. Landmark-based navigation relies on topological maps whose nodes correspond to landmarks (locally distinctive places) such as corridor junctions or doors. Map edges indicate how the landmarks connect and how the robot should navigate between them. A typical landmark-based navigation plan might be to move forward to the junction, turn into the corridor on the right, move to its end, and stop.

This may demand a complete absence of metric data and then the method does not depend on geometric accuracy. It has evident analogies with human spatial perception, so it is easy to make a map of the environment. In addition, topological representations refrain from the potentially massive storage costs associated with metric representations. One problem to be answered in the landmark-based approach is to decide what are suitable for landmarks in the environment. Landmarks should be a particular one and easy to recognize without special costs. In a building intersection, corners, and doors are very critical places for navigation and they could be a landmark.



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However, they are often tediously parallel and suffer from difficult of occasionally sensors not being able to seperate between similar landmarks, such as different doors of the same size. This can guide to both inefficiency and errors. Although such landmarks with an artificial sign could be reliable and useful, coloured marks on walls would need special image processing to extract them from the scene. This would entail a complicated and costly process. Therefore, we propose а technique using passive Radio Frequency IDentification (RFID) tags as a landmark. The RFID tags are a passive, non-contact, read-only memory system and can supply a unique number for identification of the location. The tag data can be study from one meter away via electromagnetic waves. The tags are pasted on walls at particular places in a building. Robots just proceed by the tags. The tags allow the addition of location information at remarkable speeds without the error-free control of robot locations for sensing the tags.

The passive RFID tags do not need an on-board power supply like a battery and produce controlling power from the received electromagnetic waves. The tags are very light and fine. They therefore can be embedded simply in the environment and offer a virtually unbounded operational lifetime. Preprints of the 18th IFAC World Congress Milano (Italy) August 28 -September 2, 2011 Copyright by the International Federation of Automatic Control (IFAC) 1084 Manmade environments such as hallways are usually constructed with vertical planes (walls, pillars, and doors) and a horizontal plane (a floor area). In our method the RFID tags are fixed sparsely on walls.

The precise positions of the tags in a hallway are not known. Also, the robot is not conscious of the length of hallways. The robot just follows the walls of hallways until it finds a tag. It is crucial that a mobile robot be able to realign itself relative to a wall and then proceed if it becomes disoriented due to obstacles on the floor, unlocked doors or pillars. Such local path planning requires knowing where vertical planes are in the scene or where an free space is on the floor. Range-sensing makes it possible to get such geometrical information on objects on the floor. Sizeable effort has been invested to the development of methods for extracting geometrical information from scenes. Range-sensing for the navigation of mobile robots is typically done by stereo vision, wherein, for example, line segments are used as features to determine correlating pairs in two images. Stereo vision systems can manufacture the 3D location of the corresponding pairs. This is a costly process. Sonar range finders are also possible to sense distance to a wall and measuring the orientation of a robot with esteem to the wall. The data processing is very easy and speedy. However, they are apt to overlook smallscale, thin objects in hallways due to low spatial resolution. Therefore, we adopt a compact laser span scanner to get geometrical information. The laser range scanner can create 2D maps of the proximity to nearby objects both extremely fast and with adequate resolution. Image processing for extracting free space from the 2D map can be done in a small computer mounted on a robot.

2. LITERATURE SURVEY

Technologies and resources

According to literature, in most of the studies, RFID systems are used for localization of robots alternative using it for navigation purposes. A navigation system based on RFID as artificial landmarks was presented by Kubitz et al. In this strategy, the global position of the tags, class of environment, tags unique identification data and other optional data are stored as the global date in the tag memory. A simple control architecture based on the movement states of the robots were employed to make the robot to reach the within landmark its topological workspace. Similarly, Tsukiyama proposed a navigation system in man-made environments, such as indoor environments, with RFID tags as fake landmarks. The mobile robot used in this system was equipped with a RFID tag sensor, a controller and a vision system.



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Further, RFID placing principles and localization techniques were also elaborated in Bouet and Dos Santos. Even though, in most of the cases the RFID tags are used to identify the trajectory of the robot and it is necessary to estimate the range between the tags and the reader correctly, in order to guide the robot in the desired direction. Therefore, it is necessary to have a fail proof range evaluation technique and cost effective hardware for the system design.

3. IMPLEMENTATION:



From the above figure, we can see that the robot moves in the direction according to the RFID tag shown near the RFID reader. This system can be controlled by Bluetooth also. Selection switch is used to select which way the the robot has to be selected, either the RFID mode or the Bluetooth mode. The status of the robot will be displayed on LCD. If the tag shown is not the correct one then the buzzer alerts. There is also pick and place arm in the robot which can pick the selected product in warehouses

4. RELATED WORK:

This system consists of ARM-7 microcontroller which is the main controlling part of the system. RFID tags are shown near the RFID reader to select the prescribed product. The Bluetooth module is also used as another option to select the direction in which the robot has to move to pick the product in a warehouse. The brief introduction of different modules used in this project is discussed below:

RFID:

RADIO FREQUENCY IDENTIFICATION uses a semiconductor (micro-chip) in a tag or label to transmit stored data when the tag or label is exposed to radio waves of the correct frequency.

The Elements of an RFID System

RFID systems fundamentally consist of four elements:

- The RFID tags.
- The RFID readers
- The antennas and choice of radio characteristics,
- The computer network (if any) that is used to connect the readers.

RFID Tags

The tag is the primary building block of RFID. Each tag consists of an antenna and a small silicon chip that contains a radio receiver, a radio modulator for forwarding a response back to the reader, control logic, some amount of memory, and a power system. The power system can be entirely powered by the incoming RF signal, in which case the tag is known as a passive tag. Alternatively, the tag's power system can have a battery, in which case the tag is known as an active tag.



The primary advantages of operative tags are their reading range and reliability. With the proper antenna on the reader and the tag, a 915MHz tag can be scan from a distance of 100 feet or more. The tags also tend to be more reliable because they do not require a continuous radio signal to power their electronics.



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Readers

The RFID reader sends a pulse of radio energy to the tag and hears for the tag's response. The tag detects this energy and sends back a response that contains the tag's serial number and may be other information as well. In simple RFID systems, the reader's pulse of energy functioned as an on-off switch; in additional sophisticated systems, the reader's RF signal can contain commands to the tag, instructions to read or write memory that the tag contains, and even passwords.Historically, RFID readers were planned to read only a particular type of tag, but so-called multimode readers that can read many dissimilar kinds of tags are becoming increasingly popular.



Bluetooth:



'Bluetooth', the short-range radio linkage technology designed to "connect" an array of devices including mobile phones, PC's, and PDA's, and the strategic decisions that Motorola should make in incorporating this nascent technology into its product portfolio. The motive of this paper will be to provide a high-level overview of the technology to the head of Motorola's Communications Enterprise, and produce this corporate officer to be strategically and functionally conversant in the technology with subordinates that have direct responsibility for integrating Bluetooth into

Volume No: 3 (2016), Issue No: 8 (August) www.ijmetmr.com Motorola's product lines. The first sections of the paper point the background of the Bluetooth technology and its associated Special-Interest Group, or SIG, (a conglomeration of firms that has sought to reduce market uncertainty, thereby expediting the diffusion of Bluetooth devices). Bluetooth's perceived strengths over other wireless connectivity technologies are also discussed and some macro-level threats that may impede Bluetooth diffusion are outlined. The remainder of the paper details potential Bluetooth markets (in terms of consumer and corporate applications) and examines Motorola's current Bluetooth product offerings (a cell phone battery and computer PCMCIA card each enabled with a Bluetooth chip). Finally, the paper provides guidance for Motorola's Bluetooth application development strategies regarding the applications outlined in the SIG's specifications, namely emphasizing those applications that leverage existing complementary assets, and those that are critical to Bluetooth adoption regardless of prior expertise.

DC Motor:

A dc motor uses electrical energy to create mechanical energy, very generally through the interaction of magnetic fields and current-containing conductors. The reverse process, producing electrical energy from mechanical energy, is carried out by an alternator, source or dynamo. Many types of electric motors can be run as sources, and vice verse. The input of a DC motor is current/voltage and its output is torque (speed).



DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stable part that



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includes coils of wire called the field coils. The stationary part is also called up the stator. Figure shows a depict of a distinctive DC motor, Figure shows a picture of a DC armature, and Figure shows a picture of a distinctive stator. From the picture you can see the armature is build of coils of wire wrapped around the core, and the core has an covered shaft that rotates on charges. You should also observe that the ends of each coil of wire on the armature are finished at one end of the armature. The outcome points are called the commutator, and this is where's brushes produce electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

LCD: One of the most usual devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the multiple microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

ARM7:

This generation established the Thumb 16-bit instruction set providing improved code density compared to previous designs. The most widely used ARM7 designs execute the ARMv4T architecture, but some implement ARMv3 or ARMv5TEJ. ARM7TDMI has 37 registers (31 GPR and 6 SPR). All these designs use Von Neumann architecture, thus the few versions comprising a cache do not change the data and instruction caches.

Some ARM7 cores are obsolete. One historically significant model, the ARM7DI is notable for having established JTAG based on-chip debugging; the preceding ARM6 cores did not support it. The "D" represented a JTAG TAP for debugging; the "I" denoted an ICEBreaker debug module supporting hardware breakpoints and watch points, and letting the structure be stalled for debugging. Subsequent cores included and enhanced this support.

Bluetooth Mode

Basic 16x 2 Characters LCD



Figure 1: LCD Pin diagram





Pick and Place Feature:

This robot has an added feature i.e., pick and place option. The robot can pick the object and place the object at a required place using DC Motors.

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It was very knowledge gaining and helpful for the further research to be done in future.

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