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An Approach on Indoor Robot Localization Technique with Diagonalised Positioning of Ultrasonic Sensors

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Abstract: ***A low cost implementation method has been presented here to determine the position and orientation of the robots in any indoor environments. The system has used two ultrasonic transmitters placed diagonally opposite at a particular angle on the robots & distance estimation technique has applied to locate the robot pose. The system consists of two ultrasonic receivers, one infrared transmitter, a controller placed on the robot at one side and an ultrasonic transmitter and an infrared receiver on other side of the localization system. The ultrasonic transmitters (TX's) are attached to the ceiling at known positions. A suitable data transmission using diagonalization technique has been implemented to avoid the wiring harness. The controller placed on the robot equipped with Bluetooth module has used to send the localization data to an Android mobile. An android application has been developed to plot the localization data on the Mobile Phones.***

Keywords: robots, indoor environment, transmitters, android, mobile, ultrasonic

1. Introduction

The indoor location information is important for a heating, ventilating, and air conditioning system, illumination adjustment, humidity control, robot service, and so on. Many researches discuss indoor human and robot localization systems; however, most of these systems has a very much expensive implementation. For many tasks, it is necessary for robots to have some knowledge of where they or other robots are. In the past, this has mainly been done on the global level, where a supervisor tracks the robots' positions, and informs them if they need information about their locations or the location of others. However, in a completely distributed system, it is infeasible to have a single global supervisor, if the system is to be arbitrarily scalable and robust. Global localization could still be accomplished using GPS techniques, but GPS is not available everywhere, which would limit the operational environment of the system. Therefore, it is impossible to do localization of agents in a global fashion for these systems. The alternative approach is to do localization locally of the robots, which should be accomplished in a very cost effective manner.

2. Literature Survey

Suitable sensory systems, including proprioceptive and exteroceptive types, are vital for the task of localization for robots. Using proprioceptive sensors, such as an inertial navigation system (sensing acceleration and angular velocity components)[3], [4] or odometry (sensing rotation angles of wheels) [5], most mobile robots estimate their internal information. Exteroceptive sensory systems, such as ultrasonic sensors, laser range finders (LRFs) (or light detection and ranging devices), or vision sensors, have given alternative techniques to address the aforementioned limitation by providing external information about the environment around the robot. Utilizing these sensory systems, the pose of the robot can be determined using external measurements (distances, angles, or both) to the distinct features, landmarks, or beacons in the environment. Self-localization methods can be applied when the positions of the features are known and all external measurements correspond to the same robot pose. *Trilateration* using the distances to three or more other known features [12], [13] or *triangulation* using angles along with known landmarks [14], [15] are widely used as representative examples of self-localization methods.

This study considers how self-localization algorithms can be used to provide an accurate estimation of the pose of a moving robot that can be incorporated into the EKF process. Seong and Byung [1] has proposed an dynamic ultrasonic hybrid localization system for autonomous navigation of indoor mobile robots using multiple ultrasonic distance measurements and an extended Kalman filter. Font and Batlle proposed a two-step estimator, which is composed of triangulation and the angular-state EKF, given odometry and angular measurements from a laser sensor on a robot and three retro reflectors [22]. Lee *et al. p*resented the two KFs (an EKF with distance and position state and a linear KF with the position state/observation) and a combination method using several trilateration methods [23]. They used odometry and distance measurements between three beacons and a listener on the robot measurements from a laser sensor on a on a robot and three retro reflectors [22]. Lee et al. presented the two KFs (an EKF with distance and position state and a linear KF with the position state/observation) and a combination method using several trilateration methods [23]. Here in this paper we investigate a low cost technique avoiding the trilateration methods, replacing the costly Zigbee transceivers with infrared transceivers. The system is implemented with two ultrasonic receivers placed at an angle of 45 degree on the diagonal opposite ends apart at 200mm.

3. System Description

Two ultrasonic receivers and an infrared transmitter has been placed diagonally on the opposite ends at a distance of 200mm at an angle of 45 degrees. Transmitters consist of an ultrasonic transmitter and an infrared receiver placed at the same height. On the startup the infrared transmitters on the robot side will send pulsating infrared signals of frequency 400 KHz to the transmitter. These infrared signals are received at the transmitter side enables the ultrasonic transmitter to send ultrasonic signals to the robot. Thus the transmitter coming in the robot range only will get activated and send the ultrasonic signals. The distance between the two unknown points will be calculated from the time of flight of the signal received. From the distance we can obtain the co-ordinate value of R1 and R2. These two receivers are placed on the diagonal of a square . So the center point of the robot can be obtained by mid point theorem. The obtained distance is send to Android mobile and various operations of the robot at any given distance can be controlled through the mobile.

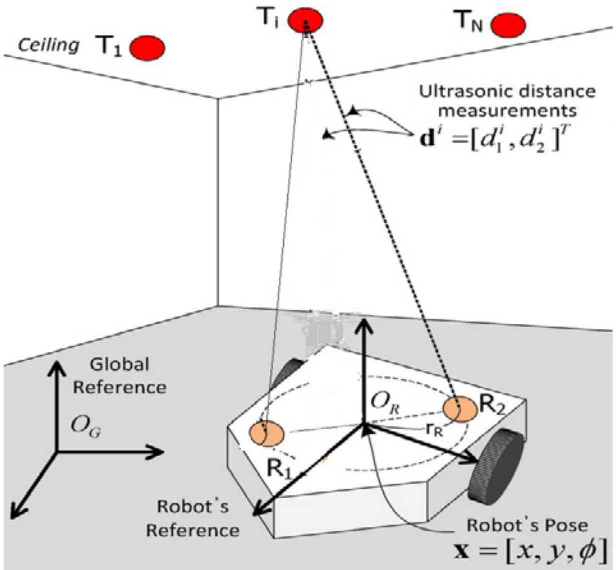

Figure1: Localization subsystem using ultrasonic sensors.

4. Conclusion

It has been observed that a low cost effectivemethod for localization being implemented using two ultrasonic sensors. The localization data has been send throughBluetooth linkavoiding the wiring harness with mobile phone acting as a low cost, flexible data acquisition system.

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