ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

NCRICT-2017

Ahalia School of Engineering and Technology

Vol. 6, Special Issue 4, March 2017

Simultaneous Localization and Mapping

Swathy.M.P[1], Neeraja Narayanan[2], Najiya.M[3]

B.Tech, ECE Department, SIMAT, Vavanoor, Palakkad, India[1,2,3]

Abstract: SLAM stands for the acronym Simultaneous Localization And Mapping. It is a solution to the mapping problem for a mobile robot moving in an unknown indoor environment. Here we are trying to solve this problem in a relatively easy and cost eff ective way by using an ultrasonic sensor. While a robot enters into an unknown environment the first problem it face is that it doesnt know anything about the particular environment ie, in which direction it should proceed and is there any obstacle. So at first the robot senses its environment in an angle of 180 degree using its ultrasonic sensor which is mounted on a servo motor, which uses a time of flight principle. After sensing the environment for obstacles, for the rotation motion if necessary, we use a wheel sensor. All the updation of landmarks and rotation conditions are controlled by the program in the microcontroller. For mapping we use simple X-Y coordinates which is done in MATLAB which will be obtained as the output on PC with the help of BLUETOOTH as an interface with microcontroller.

Keywords: SLAM, Human surveillance, Landmarks, wheeled-indoor robot, Navigation.

I. INTRODUCTION

SLAM (Simultaneous Localization And Mapping) is concerned with the problem of building a map of unknown indoor or outdoor environment from a sequence of noisy landmarks measurements obtained from various exteroceptive sensors by a mobile robot while at the same time navigating the environment using the respective map. SLAM consists of multiple parts which are Landmark Extraction, Data Association, State Estimation, State Update and Landmark Update. There are many ways to solve each of smaller parts. Determining the location of objects in the environment is an instance of mapping and establishing the robot position with respect to these objects is an example of localization. Currently, the use of sensors to scan the unfamiliar environment and recognize obstacles in autonomous mobile devices is often implemented. This system can detect each object nearby mobile devices and create the environment map. Chosen recognition method depends in the type of sensors and control software. This technology can be used in various industries, such as in mapping an unknown or partially unfamiliar environment and also to control the shape of parts, respectively of unknown objects in the automotive industry as parking sensors.

SLAM is used by selfcontrolled robots and vehicles to create maps in an unfamiliar environment or to update maps in a familiar environment (previous known map) and also to record their actual position. Simultaneous localization and mapping (SLAM) is therefore defined as the problem of building a map while at the same time localizing the robot within that map. In practice, these two problems cannot be solved independently of each other. Before a robot can answer the question of what the environment looks like given a set of observations, it needs to know from which locations these observations have been made. At the same time, it is hard to estimate the current position of a vehicle without a map. Most solutions suppose that initial position of the robot is known and only it is a partial knowledge of the area. SLAM is defined as an example of model building leading to a new map or improvement of existing maps at the same time positioning the robot on the map. In practice this means that the answers to two basic questions can be answered independently. Before the robot can contribute to answering these questions must know Its own kinematics and how to separate the collected data from important information. Exact estimation of the robot location without a map or without actual direction is very difficult.

A solution to SLAM problem would allow a robot to make map without any human assistance. SLAM can be implemented in many ways. First of all there is a huge amount of diff erent hardware that can be used. Secondly SLAM is more like a concept than a single algorithm. There are many steps involved in SLAM and these diff erent steps can be implemented using a number of diff erent algorithms.The hardware of the robot is quite important. To do SLAM there is the need for a mobile robot and a range measurement device. The mobile robots we consider are wheeled indoor robots.

II. PROBEM DEFINITION

The first problem in SLAM is that the robot is found in an unknown environment. It does not know where it is placed .So with the help of ultrasonic sensors, the environment along with their obstacles are sensed .Next comes is the problem of rotation. We use 90 degree rotation in order to avoid the complexity.SLAM is not served as a compact

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

NCRICT-2017

Ahalia School of Engineering and Technology

Vol. 6, Special Issue 4, March 2017

solution, but like a lot of concepts that contribute to the results. If the next repetition of the construction of maps is created from measured distance and direction with uncertainty (limited accuracydriven sensors and additional ambient noise), then any properties added to the map will contain corresponding errors. As they grow over time and movement, errors will accumulates and cumulatively distort the map, the robot's lost ability to determine sufficient accuracy in your current position and direction. There are different techniques to compensate these errors, such as recognizing parts of the map and connect two instances of the same part merged into one.
Another problem to be addressed is that of estimating an accurate position of the device, while creating an incremental navigation map with the observed features. These observations are obtained through the mentioned ultrasonic sensor, which allows estimation of the relative positions between the features and the deviceAnother problem faced by SLAM is the complexity due to the increasing number of obstacles .This may cause difficulty in mapping. If we use Kalman filters calculation will be more complex and unable to be understood. Hence as an alternate solution we use simple X-Y co-ordinate for easy mapping.It also deals with unmanned surveillance and they can be overcome with the above sensors. This is applicable for indoor mapping. Futher we must incorporate necessary measures for both ,hardware and software part. As concerned with software inorder to avoid complexity we use Eagle software and programming is done using Embedded C.

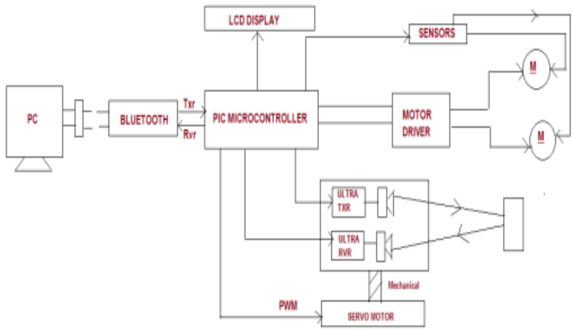
III. SLAM

Simultaneous localization and mapping (SLAM) is concerned with the problem of building map of an unknown indoor environment without any human surveillance.In recent years, several techniques has been introduced for this purpose.Here we use ultrasonic sensor instead of cameras,sonar based system and all.In the proposed system what happens is that if a SLAM is exposed to an unknown indoor environment,the ultrasonic sensor sends a signal to the environment and notes the time taken for its reflected signal.Using this time information it measures the distance of the obstacle.

A. Fundementals

Here we use a PIC microcontroller for controlling all the actions.In the microcontroller program,we already set a limit for which the robot should be rotated to avoid the collision of robot with the obstacle and also the servo is set with 90 degree rotation. The ultrasonic sensor sends a signal to the environment and notes the time taken for its reflected signal.Using this time information it measures the distance of the obstacle. Ultrasonic sensor uses time of flight principle.While rotation is being performed ,it gives preference for right side ie,first it checks to the right direction and if there exists any obstacle in its limit it checks for the left side and continues this process.It continues this process till it reaches the destination.At each rotation point, the landmarks are updated in the microcontroller. At last by using these landmark information a map is created with the help of a simple X-Y coordinate system done using MATLAB programming which can be used in any kind of study or information collection.

B. Block Diagram of SLAM



Here we uses a PIC Microcontroller which initializes other components such as motor drivers,ultrasonic sensor,wheel sensors, servo motor,bluetooth module and LCD display.It mainly the controls the entire activity of SLAM.Ultrasonic sensor is mount on servo motor which is mainly used to detect the obstacle depending upon the distance from it.ie,it uses time of flight principle.Servo motor is used for controlled angular rotation in 180 degree which is not possible with a regular DC motor.Here servomotor takes a 90 degree rotation for right and a 180 degree rotation for left.Motor driver which is a current amplifier, which amplifies the low current from the microcontroller to a high current by which two motors can be simultaneously driven, is used to drive the two DC stepper motors which mainly used for the movement of robot in particular direction as instructed by the microcontroller.
Here wheel sensors are attached to two DC motors in order to have correct rotation of wheels.A bluetooth module is also attached which interfaces microcontroller with PC. UART can be used as an interface but it has a limitation that it is wired hence bluetooth is used. An LCD is used to display several parameters during the motion of the robot i.e, it displays necessary informations. Depending upon the datas obtained from different components the updation of obstacle is done in the microcontroller and those datas are given to PC via bluetooth where a mapis created using simple X-Y coordinates in MATLAB. This map is viewed in a PC as an output and can be considered for future use.

C. Working of SLAM

The whole system is initialized in the beginning .This initialization signal is given by the microcontroller to all

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

NCRICT-2017

Ahalia School of Engineering and Technology

Vol. 6, Special Issue 4, March 2017

the components. Then the microcontroller first sends the command to the ultrasonic sensor.The ultrasonic sensor is mounted on a servo motor. The ultrasonic sensor senses the entire surrounding of 180 degree angle for detection of obstacles(90 degrees in each direction). If in case of obstacles, the signal from ultrasonic hits the obstacles and reflects back. This signal is detected bythe microcontroller .If there is no obstacles the motor drives the motor in accordance and takes a forward movement.

The first preference is given in the right direction. If there is no obstacles the object moves in forward direction. In case of any obstacles further only the servo motor rotates and ultrasonic sensor senses for obstacles and if there is no obstacles SLAM takes the left direction and then forward movement.

The process of sensing the surrounding and further movement is repeated until the destination is reached. In accordance of the datas that are obtained and thereby the BLUETOOTH sends the data into the PC and mapping is done simultaneously.

IV.RESULT

The system is designed successfully for creating map of an indoor environment without any human surveillance. The multiple parts that are Landmark Extraction, Data Association, State Estimation, State Update and Landmark Update are effectively done.

The sensing of ultrasonic sensor in an angle of 90 degree in both right as well as left directions helps to identify the presence of obstacle at that particular environment. Since ultrasonic is mounted on a servo motor it can be rotated easily. Controlled rotation is made possible with use of a wheel encoder attached with wheels. Thus the efficient map is creted depending on the path traced by the mobile robot. Here the mapping is done with the help of MALAB programming and a Bluetooth module is used as an interface between laptop and PIC 16F873 microcontroller. The map is creted accoerding to the movement of the robot in that indoor environment and the obstacles are indicated accordingly.

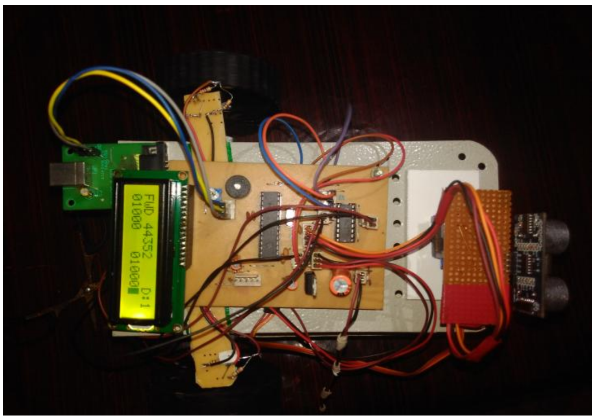


Fig: Hardware of SLAM

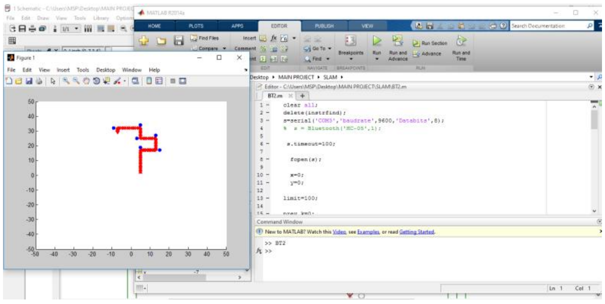


Fig: Screenshot of the mapping of SLAM done in MATLAB along with the indication of obstacles.

V. CONCLUSION

The SLAM presented here is used for mapping of an unknown indoor location .This is mainly used for the application featuring the unmanned surveillance. We have presented the various phases of our project. We adopted the X-y co-ordinate based Map modeling and an integration approach in which ultrasonic sensor is combined. The mapping of X-Y co-ordinate system is done using MATLAB. The indication of obstacles is also done .The mapping process is simultaneously shown in the PC where the interfacing in done using BLUETOOTH. The software and hardware working is done simultaneously. The programming of SLAM is done in embedded C that enhances a practical and an easy adoption of already existing mapping methods. The localization and mapping of an unknown environment is done using SLAM successfully.

REFERENCES

[1] G. Dissanayake, P.Newman, S. Clark, H. F. Durrant-Whyte and M. Csorba,"Solution to the Simultaneous Localization and Map Building (SLAM) Problem",IEEE Transactions on Robotics and Automation, vol. 17 (3), pp. 229241, 2001.

[2] M. Montemerlo and S. Thrun,"Simultaneous localization and mapping with unknown data association using FastSLAM",in Proceedings of the IEEE International Conference on Robotics and Automation (ICRA '03), vol. 2, pp. 1985-1991, 2003

[3] T. Bailey,"Constrained Initialization for Bearing-Only SLAM", IEEE Tnternational Conference on Robotics and Automation, 2003.

[4] S. Thrun, W. Burgard, D. Fox, "A real-time algorithm for mobile robot mapping with applications to multi-robot and 3D Mapping", IEEE International Conference on Robotics and Automation. San Francisco, Apr. 2000, pp. 321-328

[5] J. R. Asensio, J. M. M. Montiel, L. Montano," Navigation Among Obstacles By the Cooperation of Trinocular Stereo Vision System and Laser Rangefinder",In 3rd IFAC Symposium on Intelligent Autonomous Vehicles, Madrid, Spain, pp. 456 - 461, March, 1998.

[6] S. Ikeda, J. Miura,"3D Indoor Environment Modeling by a Mobile Robot with Omnidirectional Stereo and Laser Range Finder,", presented at IEEE International Conference on Intelligent Robots and Systems, Beijing, 2006, pp.3435-3440.

[7] J.E. Guivant and E. M. Nebot,"Optimization of the simultaneous localization and map-building algorithm for real-time implementation,", IEEE Trans. Robot. Autom, vol. 17, no. 3, pp. 242-257, May 2001..

[8] M. Montemerlo, S. Thrun, D. Koller, B. Wegbreit,"Fast-SLAM 2.0: An improved particle filtering algorithm for simultaneous localization and mapping that provably converges,",In Proc. Int. Joint Conf. Artif. Intell.pp. 11511156, 2003.

[9] Zongying Shi, Zhibin Liu, Xianliang Wu, Wenli Xu,"Feature selection for reliable data association in visual SLAM",Robotics and Automation Magazine, 2006,(2):99-110.