Robot Navigation System With RFID And UltrasonicSensors

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***Abstract*—The paper proposed a new navigation method for indoor mobile robots. The robot system is composed of a Radio Frequency Identification (RFID) tag sensor, a laser range scanner, and a mobile platform and Ultrasonic sensors. The RFID tags are used as landmarks for global path planning and the topological relation map which shows the connection of scattered tags through the environment is used as course instructions to a goal. The robot will move automatically along the hallways using the scanned range data until a tag is found and then refers to the topological map for the next movement. The technique proposed by us would be useful for real-world robotic applications such as intelligent navigation for motorized wheelchairs, surveillance and security purposes and in Nuclear power plants where humans are prone to harmful radiations.**

Keywords- Robot Navigation System, RFID, Ultrasonic sensors, Topological maps, Mobile platform, Indoor mobile robots.

I. INTRODUCTION

Navigation services which usually depend on GNSS are limited to be used in open areas with satellite signals.
If the users or robots are about to move in buildings, another approach must be used to navigate accurately.
In our approach Radio Frequency Identification (RFID) is used to determine the location indoors.
In RFID positioning there are two common approaches to estimate the location. One method is based on signal strength
We take received signal strength indication (RSSI) which presents the power of received signal as the measurement.
Then the position is computed with certain methods based on the measurements. Several methods have been studied, such as RFID location fingerprinting, cell-based positioning, and the way using ranges to the tags calculated with RSSI.
Another particular method to estimate the location is based on the landmarks. In the landmark-based navigation, landmarks are required to be set in the building, usually on certain doors and corners.
A topological map with nodes corresponding to the landmarks isused to do the navigation.

II. SYSTEM ANALYSIS

A. Existing System

In existing system robotic is more expensive and not compact and here It has been predicted that indoor mobile robots will be human-friendly robots that interact with people.
To ensure the safety and stability of human robot interaction, more accurate and precise mobile robot localization systems are essential. The classical system for mobile robots uses dead reckoning sensors such as GPS and gyroscopes
So due to advancement in the technology, every system is becoming simple and with less cost. So in order to achieve the operation we are designing the system using the new technology RFID which is very cheap and effective.

B. Drawbacks

In the existing system, the accuracy of the robot navigation is very less.
More sensors are necessary to move the robot automatically.

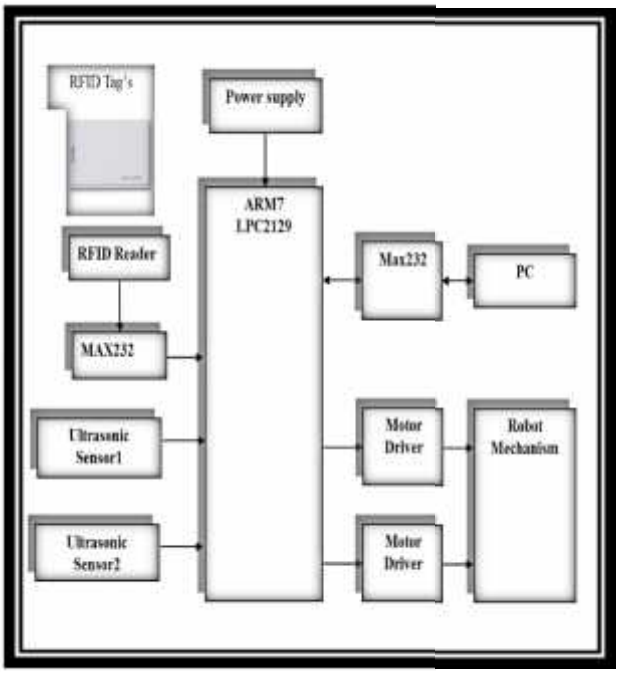
C. Conclusion

By using this type of existing system, we cannot accurately move the robot in the desired direction.
The accuracy of the robot navigation is very less. Hence we go for the proposed system.

III. PROPOSED SYSTEM

We estimate the position of the mobile robot through the matching of the RFID tags unique ID.
The global position of the mobile robot as obtained from the RFID system is always estimated without reference to any obstacles.
The proposed system utilizes RFID based localization without using GPS receiver.
The RFID tags are patched in floor and the robot has the RFID reader connected to it. Whenever the RFID reader nears a tag, it reads the data from the tag. The position coordinate of the tag is previously stored in the PC. According to the data received from tag, position coordinate is estimated.The robot navigates in a fixed path.
The ultrasonic sensors were placed at either side of the robot to avoid collision at walls.
ARM7 processor reads the RFID tag data and passes to the PC through serial port.In PC VB application compares the RFID data with predefined route map.According to the landmark and position coordinate the robot navigates through the fixed path.

IV. BLOCK DIAGRAM



V. SPECIFICATION OF THE PROPOSED SYSTEM

No. of Units
A. Power supply unit
B. Microcontroller Unit
C. Sensor unit
D. Communication Unit
E. Device Driver Unit
F. Mechanical Unit
G. Software Unit

A. The Power Supply unit

The supply of 5V DC is given to the system which is converted from 230V AC supply. Firstly, the step down transformer will be used here for converting the 230V AC into 12V AC. The microcontroller will support only the DC supply, so the AC supply will be converted into DC using the bridge rectifier. The output of the rectifier will have ripples so we are using the 2200uf capacitor for filtering those ripples.

The output from the filter is given to the 7805 voltage regulator which will convert the 12V DC into 5V DC. The output from the regulator will be filtered using the 1000uf capacitor, so the pure 5V DC is getting as the output from the power supply unit. Here we are using the PIC microcontroller which will be capable of getting the supply of 5V DC so we have to convert the 230V AC supply into 5V DC supply.

B.Microcontroller Unit

ARM7 LPC2129

The ARM7 LPC2129 is a microcontroller based on the ARM7 TDMI architecture. This microcontroller is used to sense the large amount of RFID tags, in which it has to store the more amount of database. This much amount of database cannot be stored in the ordinary microcontroller.

C. Sensing Unit

The sensing unit in our project consists of RFID tags and the ultrasonic sensors.

C.1. RFID tags

The RFID tags will consists a unique number for each and every tag. Whenever the tag reaches the RFID reader section. Due to the electromagnetic waves, the data from the tag will be passed to the RFID reader that will further given to the arm controller for further processing.

C.2. Ultrasonic Sensor

The ultrasonic sensor is used to find the obstacles present in the location. It will generate the ultrasonic waves whenever the robot moves near to the obstacle the waves will be reflected back and the ultrasonic receiver will detect it and interrupts the microcontroller.

D.Communication Unit

D.1.UART

UART is a universal asynchronous receiver transmitter in which the data will be passed to the PC by using this protocol. This protocol consists one stop bit, one start bit, 8 data bits.

E. Device Driver Unit

E.1.Motor Driving

ULN2003

The motors of our robot will be controlled by using the driving circuit in which the ULN2003 driver IC will be used to provide the proper current rating to the motor. The sinking current of the ULN driver is around 500ma

F.Mechanical Unit

The robot used here is two-axis Robot. The wheels of the robot is designed such that it can make the robot to move in forward, backward, turn left or turn right. The robot has a flat metal body mounted with 12V DC motors. The rotation of the DC motor will make the wheel to rotate.

G. SOFTWARE UNIT

Software is used to compile the coding of the desired application for the corresponding embedded system.

G.1. KEIL uvision3:

This is the embedded C compiler which is compatible for the 8051 microcontroller to compile the code.

Keil Software adds, macro assemblers,C compilers, real-time kernels, debuggers, simulators, integrated environments, and evaluation boards for the 8051, 251, ARM, and XC16x/C16x/ST10 microcontroller families.

G.2. SOFTWARE USED

Microsoft Visual Studio 2010

Microsoft .NET Framework 4.0

Microsoft SQL server 2005

VI. CIRCUIT DIAGRAM

VII. GIVEN INPUT AND OUTPUT

A. Power Supply Unit

Given Input**:**

230V, 5A, 50 Hz AC Supply

Expected Output**:**

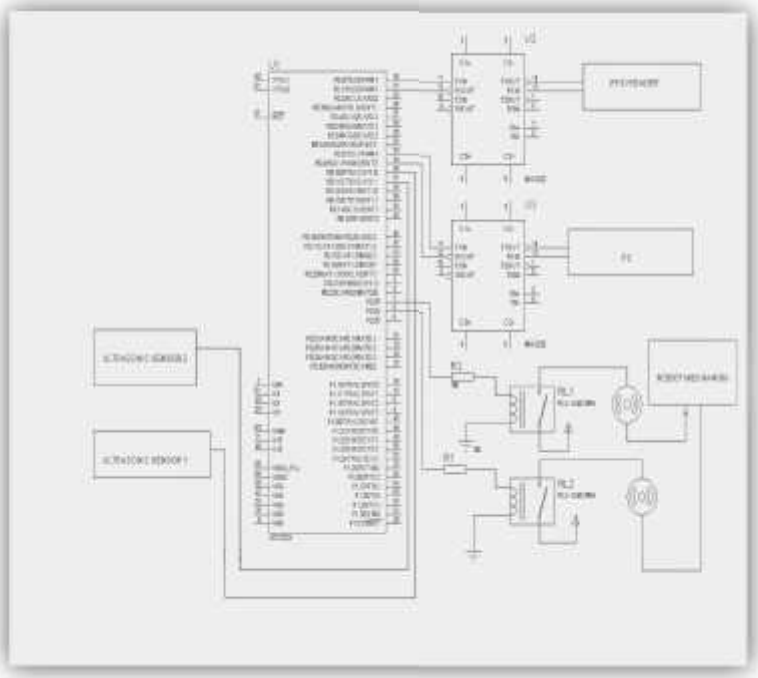
12V, 500mA- 1A, DC Voltage

B. Microcontroller Unit

LPC2129 Microcontroller**:**

Given Input:

The RFID reader obtains the RFID tag ID and inputs it to the Microcontroller through its serial port. Also the ultrasonic sensor provides its sensed value as input to the



Microcontroller's ADC Pin**.**
Expected Output:
The Microcontroller outputs the received RFID tag Value to the PC and process the RFID information. Based on the RFID information the Microcontroller controls the Robot.
With the help of Ultrasonic Sensor the Robot is maintained in a fixed path.

C. Sensor Unit

Ultrasonic Sensor:
Given Input:
The reflected ultrasonic waves, emitted from the ultrasonic Transmitter are given as input to the Ultrasonic receiver.
Expected Output:
The variation in the Pulsed Output is the output expected from the Sensor.

D.Communication Unit

RFID:
Given Input:
The RFID Tag is the input to the RFID reader.
Expected Output:
The RFID reader reads the Tag values and outputs it to the Microcontroller through Serial Port

E.Device Driver Unit

Motor Driver:
Given Input:
The input to motor driver is the triggering voltage from port pin of Microcontroller.
Expected Output:
The output of the motor driver is either ground or device supply based on the triggering level.

F. Mechanical Unit

Robot:
Given Input:
The Motors in the Robot section receives the input through relay from the Microcontroller.
Expected Output:
The motor present in the robot is switched ON or OFF according to the triggering input.

VIII. ADVANTAGES

The robot can be navigated without using GPS receiver. It can able to obtain the position of the mobile robot without any constraint from the environment.
The core part of the system is the RFID system and the ultrasonic sensors, which enable the robot to locate itself and move without mistakes

IX. APPLICTION

A. Security and Surveillance

These types of robots are very much useful in the security and surveillance purpose areas where there is a need for the robot to move according the direction specified by the user.

B. In Nuclear Power Plants

They can also be used in nuclear power plant where there is always a risk for humans for getting exposed to harmful radiations

X. FUTURE ENHANCEMENT

Here we are demonstrating the project by using a prototype with limited actions and performance. If we want to implement in the real world we can do it by using the advanced technology and by better designing, we can achieve it.

XI. CONCLUSION

An automatic robot inside the building can complete many tasks efficiently. We proposed a robot system which makes the robot able to navigate around the building. The core part of the system is the RFID system and the ultrasonic sensors, which enable the robot to locate itself and move without mistakes. We also use a topological map of the building plan, which makes the robot find out a proper route quickly. This approach is a practical and feasible way to create a robot with navigation function.

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