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Robot Navigation System with RFID and Sensors

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Abstract: **- The paper proposed 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 corresponding to the real environment is used for robot navigation. The robot goes along the ways, and turn to the right direction at each intersection of the hallways. The robot navigation system can be used in real life and does efficient work. 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. The robot consists of the mechanical part, a computer, a RFID reader and an antenna, and ultrasonic sensors. The mechanical part is a platform with wheels and motors which is controlled by the microcontroller. The RFID integrator is connected to the micro controller via UART serial port. The ultrasonic sensors are attached to the sides of the robot and used to measure the distance to walls. Since the area where tags can be detected at intersections is quite large, the robot has to use ultrasonic sensors to determine when to turn without collision to the wall. And the sensors will keep robot out of collision when the hallway is not straight. The data from the RFID integrator and ultrasonic sensors via serial ports and sending orders to the microcontroller to impact on the movement of the robot.**

Keywords**- Robot Navigation System, RFID, Ultrasonic sensor.**

1. 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 present 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. Infrared sensors are characterized by high sensitivity, low cost and are widely used. But, these sensors can generate false alarm signals if heating systems are active or temperature change speed exceeds some threshold level. Moreover, infrared sensors appreciably lose sensitivity if small insects penetrate the sensor lens. Ultrasound motion detection sensors are characterized by small power consumption, suitable cost and high sensitivity. That it why this kind of sensor is commonly used in home, office and car security systems. Existing ultrasound sensors consist of multiple passive and active components and are relatively complicated for production and testing. Sensors often times require a laborious tuning process.

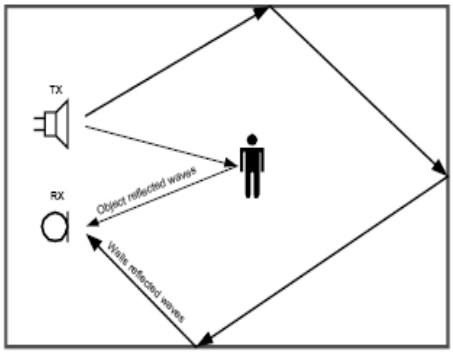

Fig.1. Basic Sensor Operation Principle

The ultrasound transmitter TX is emitting ultrasound waves into sensor ambient space continuously. These waves are reflecting from various objects and are reaching ultrasound receiver RX. There is a constant interference figure if no moving objects are in the placement.

Any moving object changes the level and phase of the reflected signal, which modifies the summed received signal level. Most low cost sensors (car security systems, for instance) perform reflected signal amplitude analysis to detect moving objects. In spite of implementation simplicity, this detection method is characterized by a high sensitivity to noise signals. For example, heterogeneous airflows, sensor vibrations, room window and door deformations, and gusts can change the interference figure and generate false alarm signals.

Better noise resistance may be obtained if the receive sensor is performing reflected signal frequency analysis instead of amplitude examination. The reflected signal spectrum emulates a Doppler Effect. Frequency components of the moving object speed vector have a component in the direction of ultrasound radiation propagation. Because ultrasound waves reflect from the windows, walls, furniture etc., the sensor can

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detect object movements in any direction. To implement this principle, the sensor must perform selection and processing of Doppler Effect frequency shift to detect moving objects.

The air condition systems, heat generators, and refrigerators typically include movable parts, which can cause device vibrations that generate high-frequency Doppler components in the reflected ultrasound signal. The heterogeneous variable temperature airflows are characterized by different ultrasound propagation speed that can raise low-frequency Doppler components in the reflected signal. That is why the noise resistant motion detection sensor should limit the Doppler signals' frequency range from lower and upper bounds to satisfactory false-alarm free operation. The ultrasound motion detection sensor has been developed in compliance with operation principles considered above.

2. PULSE WIDTH MODULATOR

The PWM is based on the standard timer block and inherits all of its features, although only the PWM function is pinned out on the LPC2141/42/44/46/48. The timer is designed to count cycles of the peripheral clock (PCLK) and optionally generate interrupts or perform other actions when specified timer values occur, based on seven match registers. The PWM function is also based on match register events. The ability to separately control rising and falling edge locations allows the PWM to be used for more applications. For instance, multi-phase motor control typically requires three non-overlapping PWM outputs with individual control of all three pulse widths and positions. Two match registers can be used to provide a single edge controlled PWM output.

One match register (MR0) controls the PWM cycle rate, by resetting the count upon match. The other match register controls the PWM edge position. Additional single edge controlled PWM outputs require only one match register each, since the repetition rate is the same for all PWM outputs. Multiple single edge controlled PWM outputs will all have a rising edge at the beginning of each PWM cycle, when an MR0 match occurs. Three match registers can be used to provide a PWM output with both edges controlled. Again, the MR0 match register controls the PWM cycle rate. The other match registers control the two PWM edge positions. Additional double edge controlled PWM outputs require only two match registers each, since the repetition rate is the same for all PWM outputs. With double edge controlled PWM outputs, specific match registers control the rising and falling edge of the output. This allows both positive going PWM pulses (when the rising edge occurs prior to the falling edge), and negative going PWM pulses (when the falling edge occurs prior to the rising edge).

RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

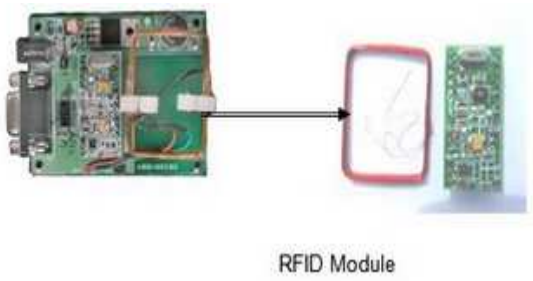

Fig.2. Basic RFID Module

An RFID system consists of two separate components: a tag and a reader. Tags are analogous to barcode labels and come in different shapes and sizes. The tag contains an antenna connected to a small microchip containing up to two kilobytes of data. The reader or scanner functions similarly to a barcode scanner. However, while a barcode scanner uses a laser beam to scan the barcode, an RFID scanner uses electromagnetic waves. To transmit these waves, the scanner uses an antenna that transmits a signal communicating with the tags antenna. The tag's antenna receives data from the scanner and transmits its particular chip information to the scanner.

The data on the chip is usually stored in one of two types of memory. The most common is Read-Only Memory (ROM), as its name suggests, read-only memory cannot be altered once programmed onto the chip during the manufacturing process. The second type of memory is Read/Write Memory, though it is also programmed during the manufacturing process, it can later be altered by certain devices.

3. RESULT

It is simple to use and low cost, yet powerful flash microcontroller programmer for the Atmel 89 series. It will Program, Read and Verify Code Data, Write Lock Bits, Erase and Blank Check. All fuse and lock bits are programmable. This programmer has intelligent onboard firmware and connects to the serial port. It can be used with any type of computer and requires no special hardware. All that is needed is a serial communication ports which all computers have.

All devices have signature bytes that the programmer reads to automatically identify the chip. No need to select the device type, just plug it in and go! All devices also have a number of lock bits to provide various levels of software and programming protection. These lock bits are fully programmable using this programmer. Lock bits are useful to protect the program to be read back from microcontroller only allowing erase to reprogram the microcontroller. The programmer connects to a host computer using a standard

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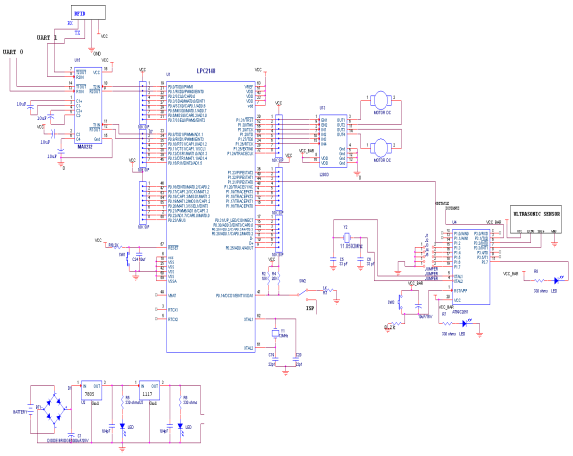
RS232 serial port. All the programming 'intelligence' is built into the programmer so you do not need any special hardware to run it. Programmer comes with window based software for easy programming of the devices.



Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

4. 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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