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Cognizance of Vehicle Position and Moving using UHF RFID Tags

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Abstract - The cognizance means to detect the moving position of a robot at the particular point. In this method, the detection is to be done with the help of radio-frequency identification (RFID) tags. RFID tags are used in this method are of ultrahigh frequency (UHF). The indoor environmental area where different goods are distributed this method would be useful there. The RFID reader with identical configuration has been attached to a robot which is used to identify the location with the help of RFID tags. The signal received from RFID reader is used to acknowledge the accurate location and to give the direction to robot to move further at end point. This method proves the effectiveness in accurately estimating the vehicle position and giving the direction upto the last point.

Keywords- PIC controller, radio-frequency identification (RFID) passive tags, RFID reader module, ultrahigh frequency (UHF) RFID reader, wireless communication .

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I. INTRODUCTION

The ultrahigh frequency (UHF) passive radio-frequency identification (RFID) technology provides a direct response to the needs of the supply chain management. When products affixed with UHF passive RFID tags are released, they travel from manufacturing plants to warehouses to retail shops; that are mobile vehicle travels from starting position to end position. Nowadays it is must to detect the current location of such products in real time. In real-life applications, since most products are shipped on "Global Positioning System" tracked vehicles, their locations can be readily identified while they are enroute. However, in order to identify the current locations of such products in an indoor environment, one needs to either manually record their exact locations or locate the indoor vehicles carrying such products. Generally, to identify momentary locations of such vehicles, odometry[1] is widely used. Odometry enables a vehicle to estimate the total distance traveled from a starting point. However, odometry is often inaccurate since estimation errors accumulate over time without corrections by external reference signals. Thus, there has been a growing interest in supplementing odometry to improve the localization of mobile vehicles, particularly by using Tags [1]–[8]. The Tag operates by receiving signal from RFID reader, and the responding reader can simply recognize the presence or absence of a Tag within its reading zone by receiving the received signal strength indicator (RSSI) or read rate from the Tag [9]–[14].

The robot carrying RFID and microcontroller will move in a path specified to robot. Along their path many RFID card will be placed then and there. A vehicle has a RFID reader at the bottom, moves over the tags. When the vehicle passes through the tag, the respective card is read and the position of robot will be displayed on LCD and their route will be continuously monitored in PC.

[1] *:- Odometry is the use of data from motion sensors to estimate change in position over time. Odometry is used by some robots, whether they be legged or wheeled, to estimate their position relative to a starting location. The word odometry is composed from the Greek words odos (meaning "route") and metron (meaning "measure").*

Transmission will take place via wireless communication medium. If the robot chooses a different path where RFID reader cannot read the particular card, then it will send a command to the robot for the correct path. The distance between two tags and between tag and vehicle should be within the sensing area of the RFID reader.

The rest of the paper is organized as follows. Section II describes related work. The proposed method, about microcontroller and RFID is described in the system model, Section III. Section IV gives idea about the set up of the project named as flowchart. Section V states about conclusion and future work.

II. RELATED WORK

In an endeavor to enhance efficiency and safety in transport systems, research is being done in RFID applications in smart E-parking, toll collection, virtual route tracking, digital traffic light control and with some other RFID applications. Several designs of such systems are given in the following literature:-

M. Yu in 2011 implemented active RFID tag based system for automatically identifying running vehicles on roads and collecting their data. The design principles and the architecture of the system includes active electronic tags and reading equipment (readers and antennas), the monitoring base station deployment, the two-layered network construction, and the monitoring software. The system used electronic tag and reading base station is based on SCM C8051F920; it is a low power high-speed general with a 24.5MHz oscillator, and a programmable flash memory. The effectiveness and efficiency of the system is analyzed. The system will have wide applications in traffic IOT (Internet of Things) to support traffic monitoring, traffic flow statistics, traffic scheduling, and special vehicle tracking.

Iswanjono in 2011 proposed an algorithm for predicting the speed of traffic light violators. The traffic light system is equipped RFID reader as the main tool for identifying the

vehicle's RFID tags. The simulation by Scilab simulator gives evidence of violation and prediction of vehicle flow. The violation can detect if the vehicle's IDs have moved from one RFID reader to the others. A randomization generates vehicle IDs, vehicle numbers and vehicle branch destination that can show the function of RFID reader to detect tags. From the simulation conducted, the algorithm is able to predict the speed of traffic light violators ranging from 5 km/h up to 80 km/h in real-time.

Z. Feng in 2010 designed the vehicle path recognition based on RFID and an Electronic Toll Collection (ETC) system of expressway. The ETC system will toll collection without parking, also census traffic flow and audit road maintenance fees. It uses 920MHz passive RFID tag as carrier to identify actual vehicle path. High-speed long-distance UHF reader is installed in all sections of the monitoring points and highway entrances and exits, so as to automatically read the electronic tag information carried by the vehicles pass through the marking station, so that the system can record the driving path.

III. SYSTEM MODELLING

The Figure 1 represents the working of vehicle recognition automatically. In this application; microcontroller, RFID reader and RFID tags are important key necessities. Microcontroller used in the system is PIC16F877A. PIC 16F877A microcontroller works as a controlling unit of complete project. In the project, robot is implemented using microcontroller, motor driver IC and motors. RFID tags are distributed in the ground as per the path. When vehicle moves along with RFID reader are used for the positioning purpose. RFID reader is to be placed on a mobile vehicle / robot along with microcontroller. Keys are interfaced with microcontroller to give destination location. Microcontroller is programmed in such a way that if any key is pressed; microcontroller will get to know about the destination location. As per the path programmed in microcontroller, robot will be driven checking out RFID tags. Robot follows the path of RFID until the destination tag is reached.

In the project, a method of disbursed Tags for the purposes of locating and tracking a vehicle while overcoming environmental obstacles. The proposed method uses a two-reader detection model and the likelihood position estimation method to identify the location of a target vehicle. Using this approach, robust global positioning of the vehicle can be acquired even in extremely challenging and dynamic environments.

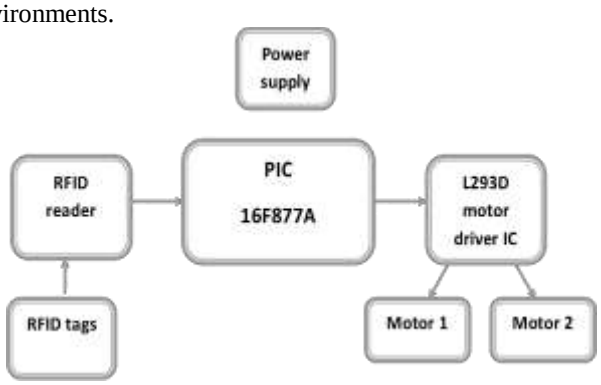

Figure 1. Schematic of the Project

A. PIC16F877A MICROCONTROLLER

Figure 2 shows the pin diagram of PIC16F877A microcontroller.

Figure 2. Pin Diagram of PIC16F877A

The name PIC initially refers to "programmable interface controller". PIC is the family of Harvard architecture microcontroller made by micro chip technology derived from the PIC 164. This microcontroller is a 10-bit, up to 8-channel Analog-to-Digital Converter (A/D) and also has Brown-Out Reset (BOR). It also consists of Analog Comparator module with two analog comparators and Comparator outputs are externally accessible. PIC16F877A is a programmable on-chip voltage reference (VREF) module means programmable input multiplexing from device inputs and internal voltage reference. In PIC16F877A there are three timers. Those are: time0, timer1, timer2. Out of that, timer0 is a 8-bit timer/counter with 8-bit prescaler, timer1 is a 16-bit timer/counter with prescaler whereas timer2 is 8-bit timer/counter with 8-bit period register, prescaler and postscaler. There are capture, compare, PWM modules. Capture is 16-bit, maximum resolution is 12.5 ns. Compare is 16-bit, maximum resolution is 200 ns. PWM maximum resolution is 10-bit. PIC16F877A also has Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave) and Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection.

PIC16F877A has 100,000 erase/write cycle Enhanced Flash program memory, 1,000,000 erase/write cycle Data EEPROM memory, single supply of 5V In-Circuit Serial Programming™ (ICSP™) via two pins and Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation. This microcontroller is a self-reprogrammable under software control and also programmable code protection is available. Power saving Sleep mode can be also considered as a main feature of this microcontroller.

Because of all these features, PIC are popular with both industrial developers and hobbyists due to their low cost ,wild availability, large user based, extensive collection of application notes , availability of low cost or free development tools and serial programming.

B. RFID TAGS

RFID is an abbreviation of Radio Frequency Identification. In the family of Automatic Identification and Data Capture (AIDC) technologies, out of many members RFID is one of the member. RFID tags are fast also the purpose of them is to identify objects. RFID tags can be passive or active. RFID tags are available in a wide variety of sizes, shapes and forms. RFID tags is consists of a miniscule microchip and antenna. RFID mainly consists of two main components:- The Interrogator or known as RFID Reader and the Transponder (tag). Interrogator is the component used to transmit and receive the signal attached to the object (transponder). Figure 3 shows the typical RFID system. The communication between the RFID Reader and tags is to be done wirelessly; means the communication between interrogator and transponder do not require a line of vision between the devices. The RFID Reader emits a low-power radio wave field and used to power up the tag so as to pass on any information that is contained on the chip.

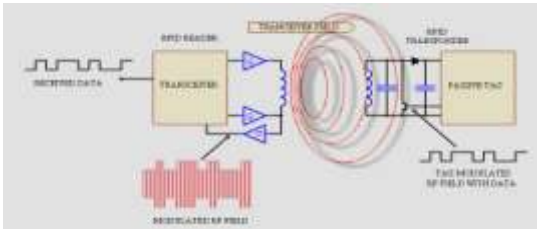

Figure 3. Typical RFID System

Passive tags are smaller, lighter and less expensive when compared with active tags. These tags can be applied to objects in harsh environments, maintenance free and will last for years. These transponders are only activated within the range of an RFID Reader and the reason why passive tags are used in this system. The frequency range for UHF RFID tag is varying in between 400-1200MHz.

C. RFID READER

RFID uses radio waves for identification and tracking. Figure 4 shows 125 KHz RFID reader module. The operating frequency is 125 KHz. This module can be interfaced with computer serially through DB9 connector. This interfacing can also be done with microcontroller via onboard connectors. As shown in figure, buzzer and LED are used for detection of card. The purpose of this is to detect the number or location of robot where robot is present. The supply voltage for this RFID reader should be in the range from 9V to 12V DC. The operating current is 50mA.

Figure 4. 125KHz RFID Reader Module

IV. FLOWCHART OF THE SYSTEM

Figure 5 shows the flowchart of the system.

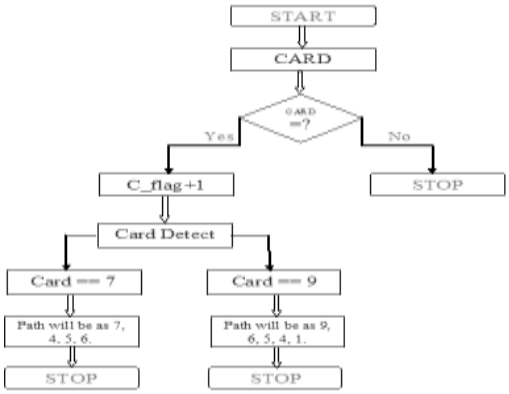

Figure 5. Flowchart of the System

From the flowchart, about the position of the vehicle as 1, 2, 3, 4, 5, 6, 7, 8, 9 is given. And according to the position two paths are followed. First path is from position 7,4,5,6 and second path is from positions 9, 6,5,4,1.

V. CONCLUSION and FUTURE WORK

This system is used to detect and move from starting position to the last position. In this method detection or location of robot is to be done with the help of RFID reader attached to it. RFID tags are distributed in the ground. After that, predefined correct path which is set into the microcontroller is given to the vehicle to reach the destination along with correct path. Finally, using the Tag location, the vehicle's location is corrected.

This system with RFID can be used for many applications such as an Automated electronic toll stations where vehicles can be identified and can be passed without having to stop and their accounts can be debited. Another user of this application is to Identify and monitor railcars and containers, with the help of RFID tags farmers can track their animals also it helps to identify animals in case they lost.

This system can be used in many applications such as homeland security, employee identification, gaining entrance and controlling access of vehicles to buildings, gated communities, corporate campuses and airports. Also this application can be used for waste management, automatic parking, ski lift access, traffic management, tracking of library books.

Coming growth in the area of RFID will come from area of real-time location systems (RTLS), asset management, baggage handling and cash less payment systems. The area like retail, logistics, warehousing and manufacturing will also get the benefit from an increase in supply chain visibility that RFID can create.

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