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VEHICLE NAVIGATION AND OBSTACLE DETECTION SYSTEM USING RFID AND GSM

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ABSTRACT

An autonomous mobile vehicle needs to be developed to allow the vehicle to reach the desired destination using tracking and obstacle detection schemes. This paper concentrates on the vehicle navigation and obstacle detection. Vehicle navigation is carried out using Radio Frequency Identification (RFID) technology. It is used to navigate the vehicle from source to destination. The obstacle detection is carried out using ultrasonic sensor. If any obstacles are detected, the information is sent to the operator who navigates the vehicle through Global System for Mobile communication (GSM). The entire system is controlled by an efficient low cost version of PIC microcontroller (16F877A). On the whole, the system suits well for industrial goods transportation. The wireless technology plays the vital role in this automation system.

Keywords: *GSM, RFID, PIC Microcontroller, Ultrasonic Sensor, Vehicle Navigation.*

1. INTRODUCTION

Nowadays industries / power plants which have complex infrastructure and machineries face many problems in transportation of goods or raw materials. To reach such destinations an RFID based solution can be employed. The transportation is automated using wireless and sensor technologies. The operator can stay static and navigate his vehicle from remote location. RFID is rated as one of the most promising and significant RTLS (RFID Transportation Location System) in industries and other applied areas. It can be deployed in different applications and in various functionalities. RFID is a non-contact automatic identification technique, by which radio frequency can identify the object and obtain relevant data without human involvement. PIC18F4550 is used for autonomous mobile car [1]. PIC16F877A is used in this system, because of its low cost while compared with PIC18F4550.

The car navigation and obstacle detection system include three modules; RFID based navigation module, Obstacle detection module and message sending module. RFID technology is used for automatic navigation of the car from source to destination. Ultrasonic sensor used in this system helps in obstacle detection and the wireless technology is used for making communication with the base station. GSM (Global System for Mobile communication) is the wireless technology used in this system. SIM300 type GSM modem is used in this system. It has a separate AT command set. AT commands are used for providing commands to the GSM.

2. OVER VIEW OF SYSTEM FRAMEWORK

RFID systems play a key role in managing of stocks, transportation and parcel tracking. The key component of an RFID system is the tag and the reader. The functional characteristics of the tags are divided into active and passive classes. Passive tags are much cheaper than the active tags because in active tag the external source is to be given. Passive tags are used as it is cheaper because there is no need of external source. In industries, to convey the goods from one section to another section autonomous car is used. RFID is the component, to work in the autonomous car. The RFID reader is placed in autonomous vehicle and RFID tag is placed in each post. The ultrasonic sensor is used to detect the obstacles if any in the path. While transferring the goods, if any obstacles are found, the ultrasonic sensor will detect and send the message to the server. The process of sending the message will be done by GSM [2]. Once the message is sent to GSM, the corresponding person will check and remove the obstacles. Also when the vehicle reaches the destination, an indication will be sent to the base

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station, informing that the vehicle has reached the destination.

3. PROTOTYPE DESIGN

Fig. 1 shows the prototype of the vehicle navigation and obstacle detection system.

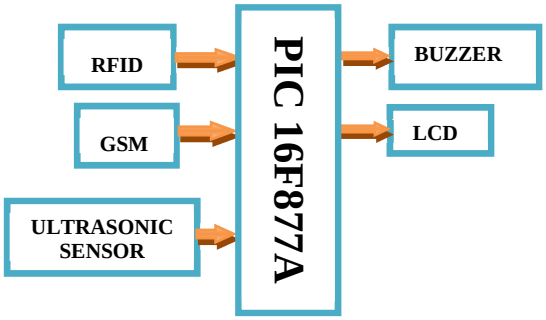

Fig. 1 Prototype

3.1RFID:

RFID is the term used to describe the system which will transmit the identity of the person or an object. RFID contains RFID tag and reader. Each RFID tag will be having a unique code, which is predefined in the controller and the system will validate the code and necessary operations are carried out.

3.2 Ultrasonic sensor:

The purpose of ultrasonic sensor is used to identify any obstacle in the path. Compared to passive infrared sensor, the ultrasonic sensor will have high range, so it will easily identify the obstacles in the path. Ultrasonic sensor operating at 40 kHz frequency is used in this system and the estimated range is 4.5 feet. Long range ultrasonic sensors are also available and can be used as per the application needs. Ultrasonic sensors are very effective and easily available.

3.3 GSM:

SIM 300 type GSM is used in the three band frequency which is activated with the help of AT command. GSM is used to send the data to the corresponding person when the obstacles are found.

3.4 PIC Microcontroller:

PIC16F877A series controller is an 8 bit controller. It is a RISC architecture. It is highly available and is a very effective controller when compared to earlier versions. It has an inbuilt 8-channel ADC. Port A and E are multi functionality ports which can be used for I/O. PIC16F877A series controller is highly available and very cost effective.

4. DESIGN PROCESS

The design and implementation of GSM based car navigation and obstacles detection is done through RFID. RFID consists of tag and reader. RFID reader is placed in autonomous vehicle and the RFID tag in the post. The RFID tag has the EPIC (Electronic Product Identification Code) which is unique. The EPIC code is predefined in the controller and the coding is written in embedded C. The software used for writing the code is MPLAB4IDE. The tag details are predefined in microcontroller. The autonomous vehicle moves toward left, right, forward, backward, and reverse, stop and start by using the RFID. All the goods are loaded in the autonomous vehicle .The vehicle moves according to the navigation direction as per the RFID tag used. For each and every process separate RFID tags are used. Earlier this autonomous vehicle is used for autonomous land experiments like obstacle detection and avoids collision[4]. The ultrasonic module has input and output pins and the output pin is connected to RC0 pin of the microcontroller. If any obstacle is found in the path, the ultrasonic sensor detects it and the information is sent to the corresponding person through GSM. The vehicle terminal system communicates with each other via GSM short messages by “At + CMGS” command[5]. GSM is interfaced with PIC microcontroller with the help of RS-232. The GSM RX is directly connected to TX of PIC microcontroller. In GSM, TX is connected with 1A of NAND gate. The 1B of NAND gate is connected to controller port pin. The RFID TX is connected to 2A of NAND gate and 2B is connected with controller port pin. RFID reader is used to interrogate an RFID tag. The reader has an antenna that emits radio waves; the tag responds by sending back its data. RFID tag is placed in each goods. RFID communicates with TX and Rx. The TX is connected to 3A and 3B is connected to any one of the port pin of microcontroller. 3Y is connected with 4A and 4B of NAND gate. 4Y is connected to IC2 SN74CH00 of 1A and 1Y of previous IC1 SN74CH00 is connected with 1Yi and Yi is connected with RXD pin of PIC. Fig.2 shows the overall flow of the system.

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4.1Flow Diagram

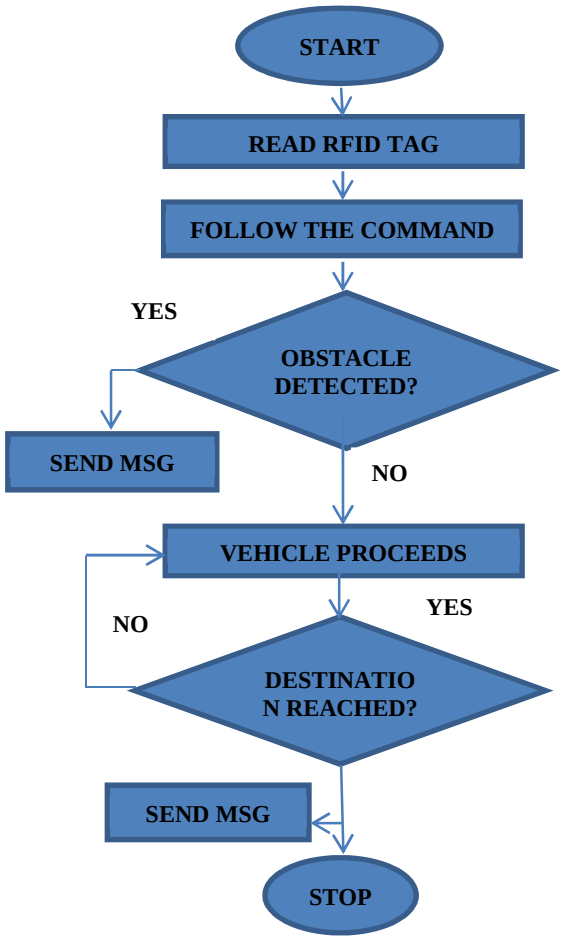

Fig. 2 System Flow Diagram

5. RESULTS AND EXPERIMENTS

Fig. 3 shows the prototype of car navigation and obstacle detection using RFID and ultrasonic sensor. This process is used in industries to carry the goods from one section to another section. It is an autonomous vehicle. In this prototype the RFID tag, RFID reader and ultrasonic sensor are used. Fig. 4 shows the Reading of a tag. Each RFID tag has EPIC code. The EPIC code has unified identify code. From that RFID tag, the vehicle moves forward, backward, left or right. These results show that the autonomous vehicle start to move and it will read the tag. The RFID reader placed in the vehicle and tag placed in lamp post. Fig. 5 shows that the vehicle moves in the forward direction based on the information in the RFID tag. Tags unified code will be predefined in the microcontroller. In the unified code, there is a predefined set that indicates whether the vehicle moves forward, backward, left or right. The prototype shows the vehicle moving in the forwarded direction.

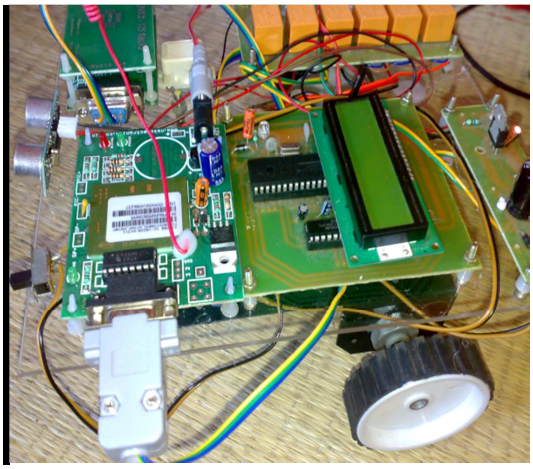

Fig. 3 Prototype of car navigation

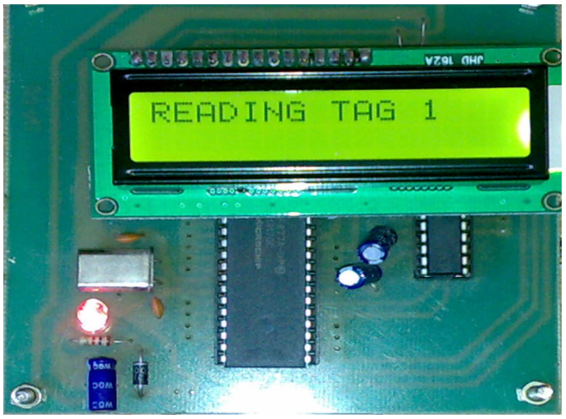

Fig. 4 Prototype of Reading the tag

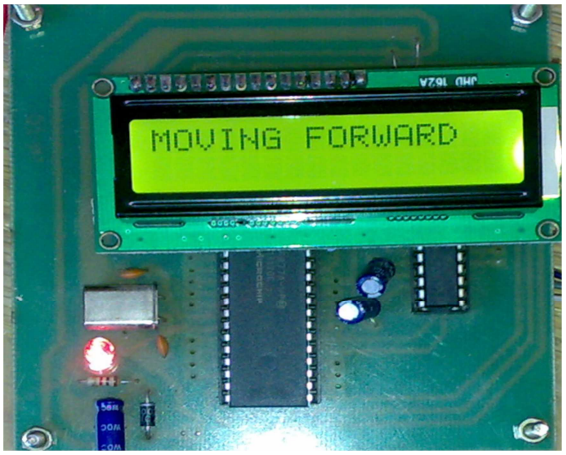

Fig. 5 Prototype of vehicle direction

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Fig. 6 Prototype of obstacle detection

Fig. 6 explains about the obstacle detection if any obstacle found in the path. The ultrasonic sensor will get activated and the vehicle moves slightly in backward direction. When the vehicle stops, a message is sent through GSM.

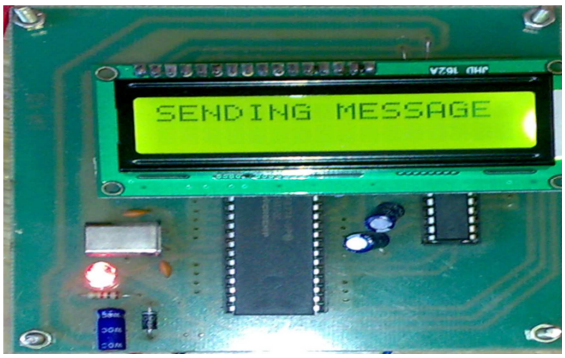

Fig. 7 Prototype of sending message to GSM

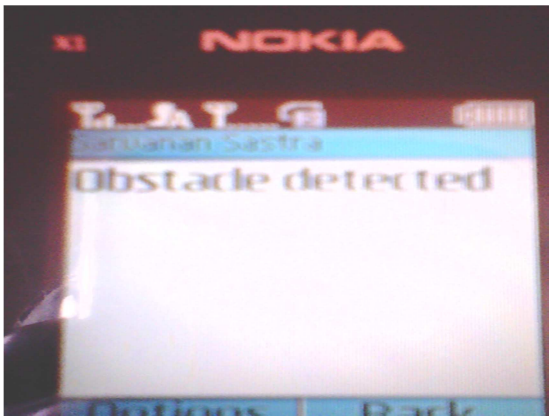

Fig.8 Message delivered to particular user that the obstacles detected

Fig.7 shows the message sent through GSM in this prototype. When the vehicle moves from one section to another section, the ultrasonic sensor will detect any obstacles and sends a message found the ultrasonic sensor will send the message through GSM. Fig. 8 shows the message delivered to particular user.

6. CONCLUSION

This work solves the issues in autonomous vehicle used in industries to transfer the goods from one section to another section. The experimentation results are very successful and can be easily implemented in real time. This can be extended further using Global Positioning System (GPS) and neural networks concept. On the whole, this system proves to be very effective in unmanned transportation for industrial applications.

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REFERENCES

[1]. Jen-HaoTeng, Kuo-Yi Hsiao, Shang-Wen Luan, Rong-CengLeou, Shun-Yu Chan. "RFID-based Autonomous Mobile Car", 8th IEEE International Conference on Industrial Informatics, 2010, pp417-422.

[2]. L. Armesto, J. Tornero "Automation of Industrial Vehicles: A Vision-based Line Tracking Application" IEEE Conference on Emerging Technologies & Factory Automation, 2009, pp 1-7.

[3]. Balasubramanian, K. Arunkumar, R. Jayachandran, J. Jayapal, V.Chundatt, B.A. Freeman, J.D., "Object Recognition and Obstacle Avoidance Robot", Chinese Control and Decision Conference, 2009, pp 3002-3006.

[4]. Yu-feng Du, Bill Schiller, Don Krantz, Craig Shankwitz and Max Donath ALX "Autonomous Vehicle Guidance for Roadway Following and Obstacle Avoidance",IEEE International Conference on Systems, Man and Cybernetics, 1995, pp 364-370.

[5]. SIEMENS Mobile, TC35i Hardware Interface Description V01.03, http://www.siemens.com.