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Design and Development of Real Time Self Navigation Robot for Agricultural Activities

Prajwalasimha S N

Assistant Professor, Dept. of ECE, ATME College of Engineering, Mysore, Karnataka, India

ABSTRACT: Modern technology has shown the world that anything can be automated to meet the needs with a concern to the cost, quality and quantity. The technology of automation has given yeoman service to the sectors like Industries, Medical, Communication and Transportation but comparatively less to the agricultural sector. The paper deals with the development of prototype navigator which can do few agricultural activities on its own. Two microcontrollers with 64KB of flash memory are used, one for the selection and display of area and other for the navigation purpose. Ultrasonic sensor is used for the obstacle detection.

KEYWORDS: Automation, Microcontroller, Ultrasonic sensor, Flash memory, Navigation.

I. INTRODUCTION

Human being is considered to be the most intelligent animal on this earth, as he can think. Basically he is a trier and development oriented. This is the reason why he has been depending much on nature, makes use of naturally available resources to the maximum extent. During early days he was carrying out almost all his day to day activities by himself. He realized this as laborious and used men for his assistance. He thought of improving the quantity and heaviness of the work. So he started using animals in place of men for the work like transportation, material shifting, agriculture etc. After sometime he became kind enough to the animals to reduce the load by developing simple mechanisms. So he made Industrial revolution. As a result he invented different types of machines to help him in carrying out his day to day activities with improved quantity and quality. He is innovator started thinking on improving the technology so as to make the machines to work on its own in a way he wanted it to be and called this as automation. By this he developed machines to increase the productivity without affecting the quality and the cost.

Some researchers [1] have made an attempt to develop automated guided vehicle systems (AGVS) which uses infrared sensors to detect the obstacles. There will be no specific path for these vehicles. If it finds the obstacle, it takes the deviation and starts moving in the cleared path.

In most of the agricultural activates path specification plays a vital role. The AVGS should be developed in such a way that as soon as it detects the obstacle on its path, it should perform some activity to clear the path without taking the deviation. As infrared sensors are less efficient for outdoor applications, they are replaced by ultrasonic sensors to detect the obstacles.

II. LITERATURE REVIEW

Path planning is a major issue in automated navigation. Meha Sharma, Rewa Sharma, Gaurangi Kaushik and Swati Jha[1] have proposed an obstacle detection algorithm which plays a major role in path planning. Komal and Nirmal Singh Grewal[2] have designed an ultrasonic sensor based object detection system. Ter-Feng Wu, Pu-sheng Tsai, Nien-Tsu Hu and Jen-Yang Chen[3] have proposed real time obstacle avoidance system for mobile robot. Shu-Yin Chiang, Chi-An Wei and Ching-Yi Chen[4] have proposed real time vision and motion detection system for mobile robot. S.G.M. Hossain, Muhammad Yakut Ali, Hasnat Jain and Md. Zahurul Haq[5] have developed automated guided vehicle for industrial applications. Matthias Wißing, Frank Künemund, Daniel Heß and Christof Röhrig[6] have developed Hybrid navigation system for automated guided vehicle. Wu Xing, Lou Peihuang, Cai Qixiang, Zhou Chidong, Shen ke and Jin chen[7] have designed automated guided vehicle for material transportation in industrial applications. Jihong Liu, Qianqian Wang and Rui He[8] have described different guiding techniques for AGVS.

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III. METHODOLOGY

Real Time Self Navigation Robot consists two P89V51RD2 Microcontrollers, 4X4 Key pads,7–Segment display units, one Ultrasonic sensor and motor controller circuit as shown in fig.1. The motor controller circuit consists of a L293D driver and two high torque 60 rpm DC motors.

A. HARDWARE DESCRIPTION

µc1: Port 1 is made as input port. Two 4X4 key pads are interfaced to Port 1, one for the selection of length and other for the breadth selection. Port 0 and Port 2 are used as output ports. Two Seven segment display units are interfaced to Port 0 and Port 2 respectively in to display selected length and breadth. Port 3 is used as output port in order to send data about the selected area to µc2.

µc2: Port 2 and Port 3 are made as input ports. The data coming from the Port 3 of µc1 is split into two halves and sent to Port 2 and Port 3 of µc2. Port 0 is made as input port and ultrasonic sensor is interfaced to this port. Remaining pins of Port 0 can be used to interface more number of ultrasonic sensors for the effective obstacle detection. Port 1 is used as output port and motor controller circuit is interfaced to this port.

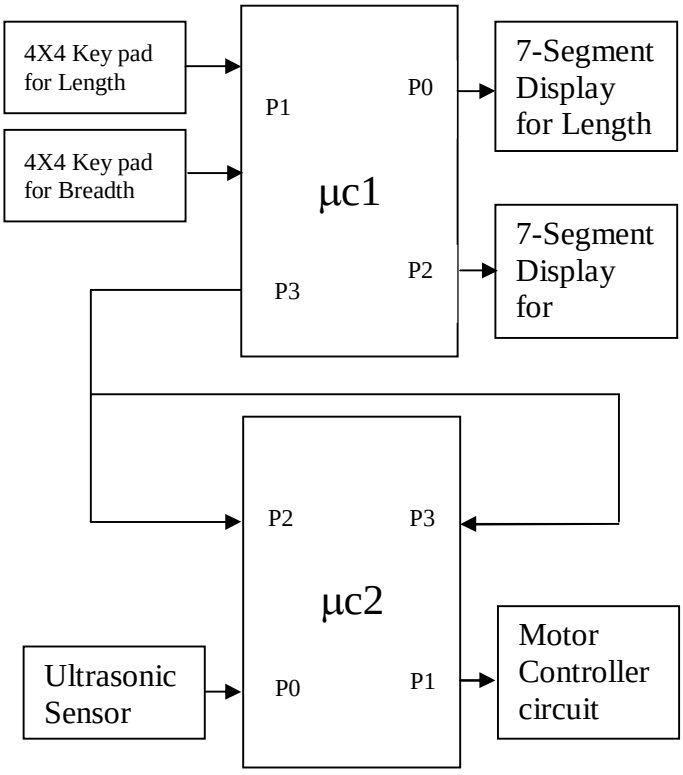

Fig.1. Block Diagram of Real Time Self Navigation Robot

Motor Controller Circuit*:* IC L293D is connected to Port 1 of µc2. Two DC motors are connected to L293D. In order to drive DC geared motors, the voltage and current ratings provided by the output ports of microcontroller is not just sufficient. To pull-up the voltage and current ratings L293D is adopted. Among these two motors one is made to rotate in clockwise and other in anticlockwise direction in order to provide movement to the robot.

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B. PRINCIPLE OF OPERATION

After selecting the required length and breadth, the vehicle moves in forward direction till it attains the selected length. After attaining the selected length, timer gets reset and the vehicle takes a right turn. Timer starts, vehicle moves in forward direction for a distance of 0.5 metre after which timer resets. Vehicle takes right turn and timer starts. Vehicle moves in forward direction till it attains the selected length after which timer resets. Vehicle takes left turn. Timer starts, vehicle moves in forward direction for a distance of 0.5 metre after which the timer resets. Vehicle takes left turn. Timer starts, vehicle moves in forward direction till it attains the selected length after which timer resets. This way the vehicle covers the selected length and breadth by splitting the selected breadth in multiples of 0.5 metre. Fig.2 shows the path followed by the robot in order to cover the selected area. While the vehicle is in forward motion, if it senses any obstacle along the path, it automatically holds its motion till the obstacle is cleared from the path. A buzzer is also provided with the sensor. It sounds when the obstacle is sensed by the ultrasonic sensor.

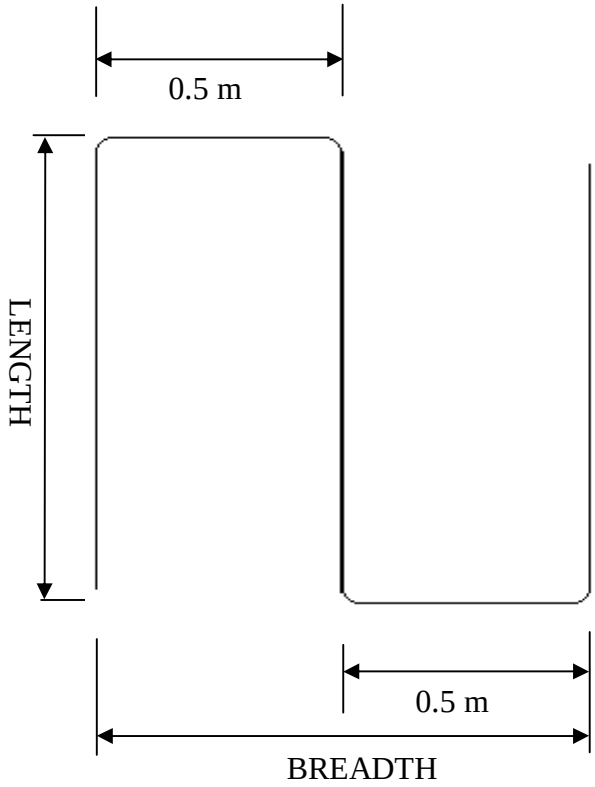

Fig. 2 Path followed by the Robot

C. SOFTWARE DESCRIPTION

Keil Micro-Vision software is to develop the program. Flash Magic software is used to download the program on to the microcontroller chip.

Algorithm

- Initialize the μc1 for obtaining data from the key switches.
- The value of length is selected by pressing the key switches provided for the length selection, otherwise wait until the selection.
- Initialize the seven segment display for length.
- Display the selected value of length.
- The value of breadth is selected by pressing the key switches provided for the breadth selection, otherwise wait until the selection.
- Initialize the seven segment display for breadth.
- Display the selected value of breadth.

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- Initialize μc2 for obtaining data from μc1.
- Initialize the motor controller circuit.
- Data sequence is provided for the motor controller by the μc2.
- Keep on monitoring the P0.0 of μc2. If it is high, send 0000 to the motor controller. Wait until P0.0 becomes low and then continue.
- The timer of μc2 is stopped. The 0000 sequence is sent to the motor controller.

IV. CONCLUSION AND FUTURE SCOPE

A systematic step by step approach in designing the microcontroller based system of this real time self navigation robot for the accurate repetition of the parameters such as selection of length and breadth by keys and the corresponding seven segment display, covering the given length and breadth, sensing the obstacle and alarming through the buzzer have been followed carefully. The results obtained after repeated number of cross checks have shown that the system performance is quite reliable and accurate. This system can overcome a few short comings of the existing systems by reducing the overheads and at the same time provides a flexible and diversity in application. The performance of the system can be further improved in terms of energy consumption by providing solar panel of required capacity, so that battery can be used as standby.

V. REAL TIME PICTURE

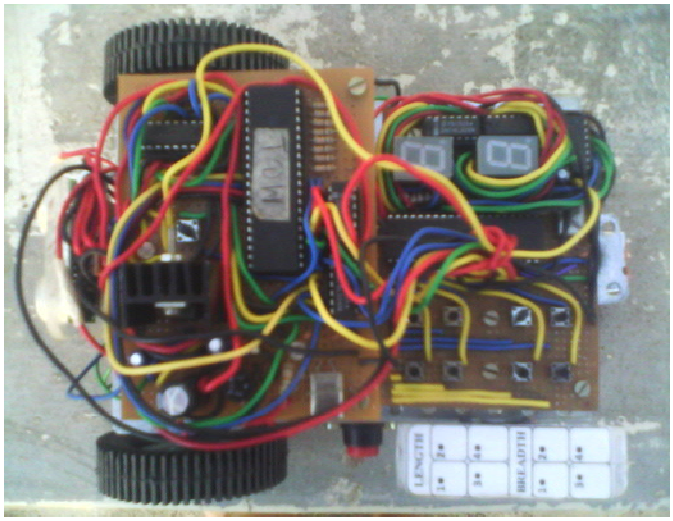

Fig.3 Pictorial view of Real Time Self Navigation Robot

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