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An Autonomous Robot Framework for Path Finding and Obstacle Evasion

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***Abstract*— The modern growth of computer and its related hardware is consequence of the invention of the transistor. The advent of transistor principally revolutionized the hardware engineering by reducing the hardware size and increasing the efficiency. Now, we are swarmed in with the influx of sophisticated computer gadgets and communication devices, combining ingenious ideas and state of the art designs. When the history of world would be written surely out contemporary age would be called the age of science and technology. The marvels of science and technology has not only bewildered human minds but also brought convenience and quality to human life. Our project is continuation of this tradition of science. We have endeavored to design an autonomous path tracker vehicle. It has limitless possibilities of usage and it would certainly become a future workhorse. It can be used to detect the theft vehicles. Autonomous robot for path finding and obstacle evasion is a vehicle, which follows the path in two different ways, which are: i) Line Follower – It is a vehicle, which is used to follow the reflecting line drawn on the floor. It captures line position with IR sensors. The sensors will be mounted at front end of the robot, ii) Obstacle Handling – When an obstacle is appeared on the following line we will detect through a sensor.**

***Index Terms*— Robot, Path Tracking, Obstacle and Vehicle**

I. INTRODUCTION

AUTONOMOUS robot for path finding and obstacle evasion is a vehicle, which is used to follow the path autonomously. A typical approach for path finding is Autonomous Line Follower (ALF) [1], [3], [4] and such approach involves discrete logical symbols and continuous signal. In this paper, we present a new control approach based on symbols and this approach is incorporated so that a robot may follow a line or stripe. To sense the barriers and obstacles in surrounding, the robot comprises of various sensors such as a low-resolution sensor and an actuator [2]. Major issues investigated in this research were the control of robot so that the robot may follow a control stripe.

The autonomous robot for path finding and obstacle evasion is able to follow a control stripe sketched on the surface, robot is placed. The presented robot captures line position with IR sensors, while these sensors are escalated at the front of our robot. Several numbers of photo-reflectors can be used as IR sensors [5] or for imaging processing image sensors can also be used. The sensors with a high resolution are required to sense the path [11]. It will use steering mechanism that will steer the robot to track the line. There will be two line styles that a line follower can adapt, first is the white stripe on black surface and second is the black stripe on white surface. The autonomous robot for path finding and obstacle evasion will continue its movements if it does not find the edge of the line. However the robot will automatically stops if the edge of the line is ended.

When robot is moving and it detects an obstacle in the following path then it will decide what it does, either move move left, right or to stop.It will also handle the T-slot and same angle problem. A feed back system will also be provided by measuring the distance of the path followed/covered by the robot.

The rest of the paper is structured as the section 2 describes the related work done in the field of path finding/tracking and obstacle detection. The used approach that explains the presented approach for autonomous path finding and obstacle evasion is described in section 3. Section 4 presents the conclusions of the presented research in the paper with the possible future work.

II. LITERATURE REVIEW

A few path finding/tracking algorithms have been introduced in last two decades. Some of the famous algorithms are the Pure Pursuit [6]. [7] and the Follow the Carrot [8]. These algorithms utilize the spatial information for the sake of computation of the guiding commands and assist a robot in following a given path or stripe. However, both these algorithms do not often consider the actual curves of the target path/stripe. Due to this short coming of these both algorithms, they provide with less accuracy.

Vector pursuit [9] is another path tracking method that is based on a theory originally presented by R. S. Ball in the year 1900. The Ball's theory is typically employed to manifest the movement of an object with respect to the targeted coordinate system.

Another approach was also presented by T. Hellstrom [10]. The presented approach was using the recorded orientation and steering commands to decide the direction in which the robot moves. One type of vehicles are Automated Guided Vehicles (AGVs) [1], [3] those are outfitted with sensors and by using the sensors, such vehicles can follow a path. Such robot vehicles can be used for various purposes especially in factories in manufacturing plants, transportation purpose, etc. Such vehicles are not only cheap in cost but also more effective and efficient.

All the above discussed approaches, methods and algorithms are not efficient in terms of tracking the curved lines or paths. We aim to overcome this short coming of the existing approaches and present a new robust technique.

III. RESEARCH METHODOLOGY

This section presents a novel approach for path detection and obstacle evasion. The presented approach is based on a set of traced routs and commands for the guidance of robot. The presented approach uses algorithm that covers three typical actions and each action is accountable for the respective facet of path finding. Afterwards the result of the presented approach attainted from the simulated and physical autonomous robot are evaluate in comparison with the other available approaches used for constructing autonomous robots such as the Pure-Pursuit algorithm [6], [7] the Follow-the-Carrot algorithm [9] and the Recorded Orientation and Steering Commands algorithm [10]. The evaluation of results manifests that our approach is considerably perks up the efficiency and affectivity in the research domain of path finding. The architecture of the presented research is shown in figure1.

We have tried to achieve the two types of path tracking. Firstly we try to follow the path which is given in the form of reflecting or black line and secondly a path is given by the vehicle driven by the user and then another vehicle will follow this path.

We have divided our whole project in two parts which are given below:

i) Line Follower

ii) Obstacle Handling

A. Line Follower

It is a vehicle, which is used to follow the reflecting line drawn on the floor. It captures line position with IR sensors. The sensors will be mounted at front end of the robot [10]. In line following part we have tried to achieve that a vehicle should move on a path given by reflecting line. This line can be given on the ground or on paper and then vehicle is left free on that line. Vehicle will itself follow the line sensing it through sensors built on it. As mentioned in abstract that this vehicle will follow a particular line which may be a colored or reflecting line with respect to your project. We have used in our project a reflecting line so a general algorithm for this is given in coming topic.

Automated Line Detector has two parts; one is hardware and other is software. In the hardware we have used the following components for the construction of Line Detector:

i. Rx, Tx optocouplers
ii. H-bridge
iii. A T89C51 Microcontroller
iv. LM324 N

For the implementation we have used the algorithm given below.

- if current is passing from left sensor which is a optocoupler then the current will pass to the left motor and vehicle will turn left
- if current is passing from right sensor then the right motor will turn on and vehicle will turn right
- if no current is passing then it means no reflecting surface is present and vehicle will stop

B. Obstacle Handling

When an obstacle is appeared on the following line we will detect through a sensor. All the distance covered by the robot will be displayed on the LCD screen using the encoder and U-shaped sensors [12].

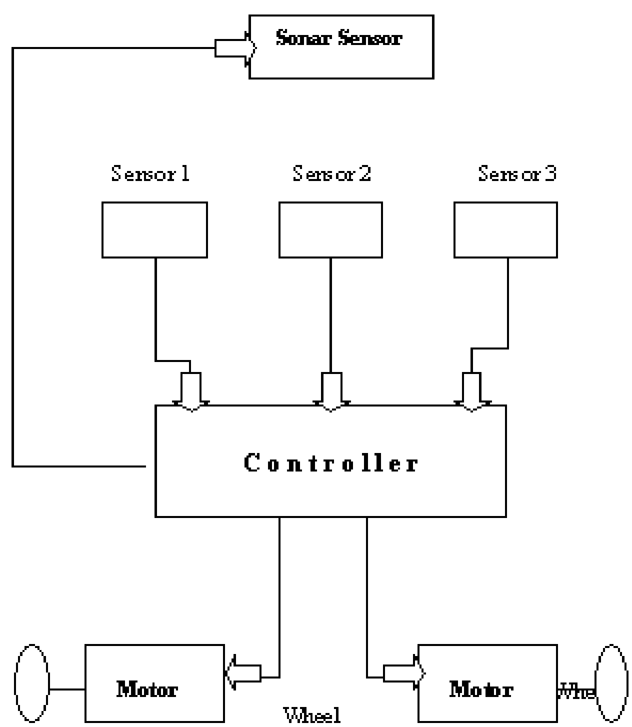

Fig. Proposed System Architectural Diagram

C. Technical Specifications

This vehicle consists of the following components:

- Vehicle body
- Microcontroller
- Dc motors for driving the robot
- Sonar sensors to detect the objects in front of the vehicle
- Relays for driving the motors

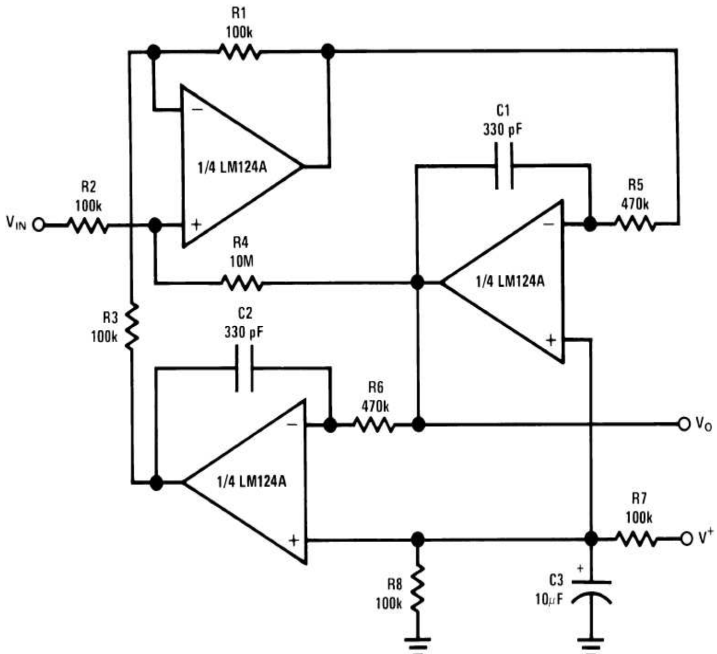

Fig.2. LM324 Circuit Diagram

D. Testing

The following tests are performed during the execution of the project:

- Handling the T-Slot problem [13]
- Moving the robot at 45 degree
- When a line ends then robot will move backward, left or right according the condition given by our program

E. Difficulty Encountered

- Not exact measurement of the sensing ability of the sensor
- Problem Handling the T-Slot
- Controlling the speed of the motors
- Object detecting ability of the sonar sensor

F. Microcontroller

A microcontroller is a computer-on-a-chip, or, if you prefer, a single-chip computer. *Micro* suggests that the device is small, and *controller* tells you that the device might be used to control objects, processes, or events. Another term to describe a microcontroller is *embedded controller,* [14] because the microcontroller and its support circuits are often built into, or embedded in, the devices they control.

1). Proteus Diagrams

Fig. 3, Fig. 4 and Fig. 5 show the circuits diagrams for (Optocoupler and LM324), [15] (Line Follower and Microcontroller) [16], and (Optocoupler) [17], respectively.

2). LM324 Features and Applications

The Fig. 2 shows the different components of *LM324.*

i). Features

- Operation from single or dual supply
- Unity gain bandwidth
- DC voltage gain
- bias current
- offset current
- offset voltage

ii). Applications

- Summing amplifiers
- Multivibrators
- Oscillators
- Transducer amplifier
- DC gain blocks

IV. CONCLUSIONS

Following are always an important in every era of life. We have tried to achieve this in autonomous path tracker it will track the path in following two ways.

- A line follower will follow a reflecting line by sensing it through sensors and control the vehicle on the path which is given by user through reflecting line on ground or on anything else. Secondly it will detect the obstacles using ultra-sonic sensors and cross over them and again will come on the path given by reflecting line.
- A vehicle will following an ascender that will send the path to the follower, follower will follow that path. This is done using storing the signal values and particular time for which a value is retained is stored in the memory of controller and when there is no signal interrupt from user then all of the data from memory contents is sent to the memory of the other controller. Then this data is executed by the follower which results in following the same path that is followed by the leader vehicle.

- *Future Enhancements*

Enhancements can be made with every perspective. Vehicles can be provided with Cameras to send not only path but also the nature of the path. Through camera it will send the visualization about the path. Through visualization it will also cover up the moving objects and then all control can be put up through these cameras and enhancement due to moving objects can be achieved.

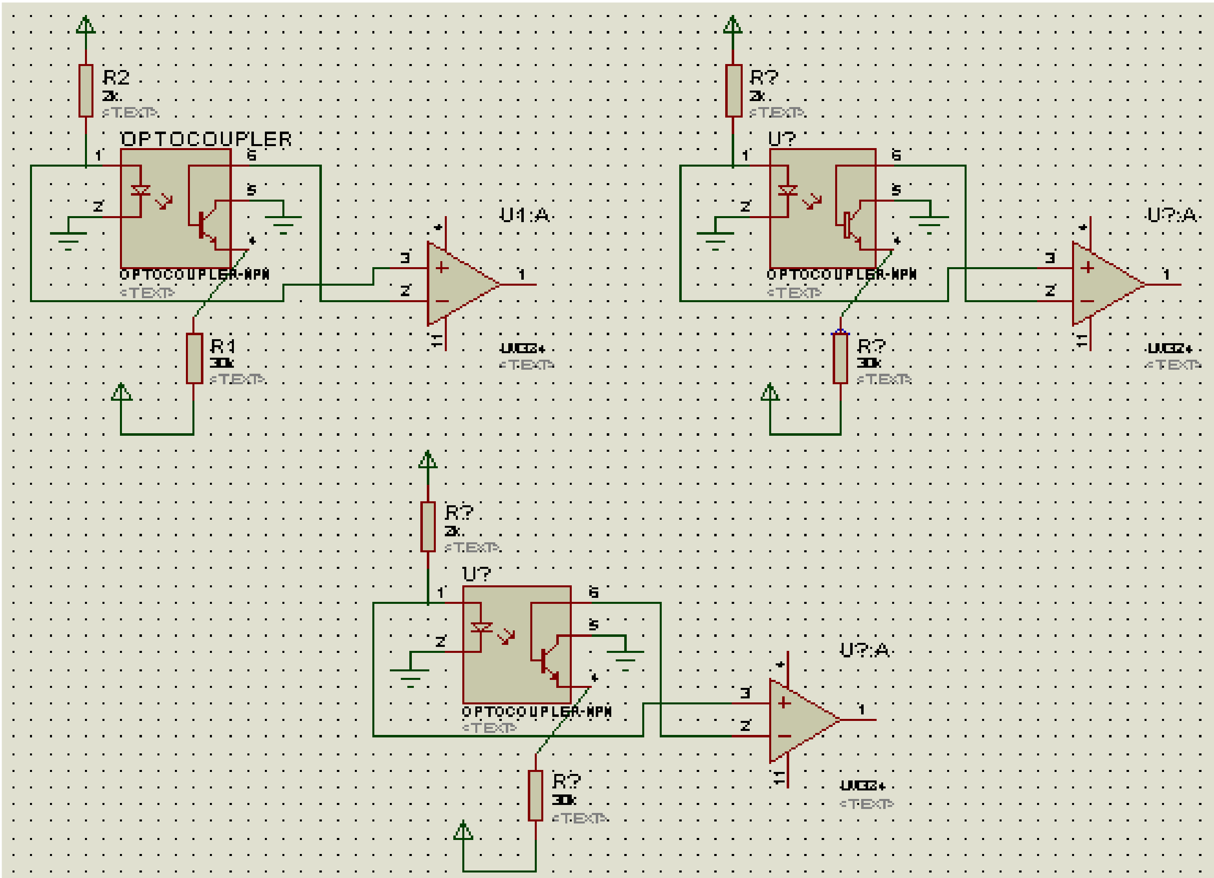

Fig. 3. Optocoupler and LM324 Diagram

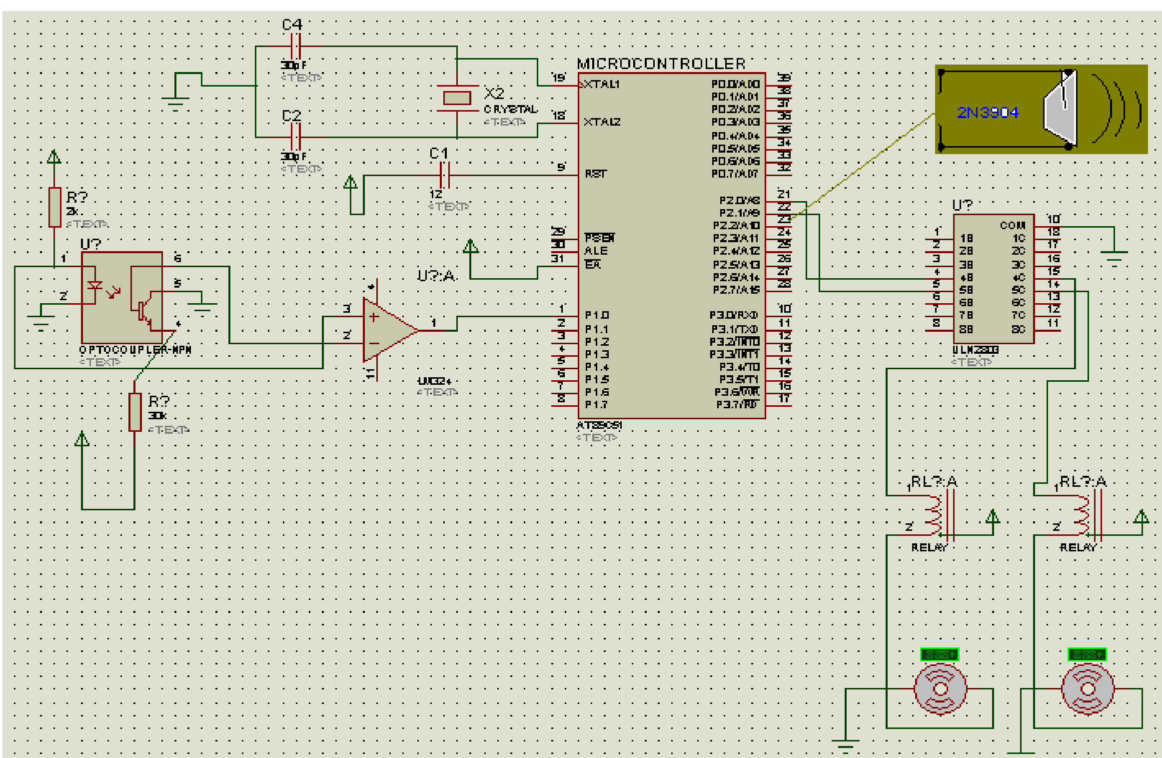

Fig.4. Line Following Diagram

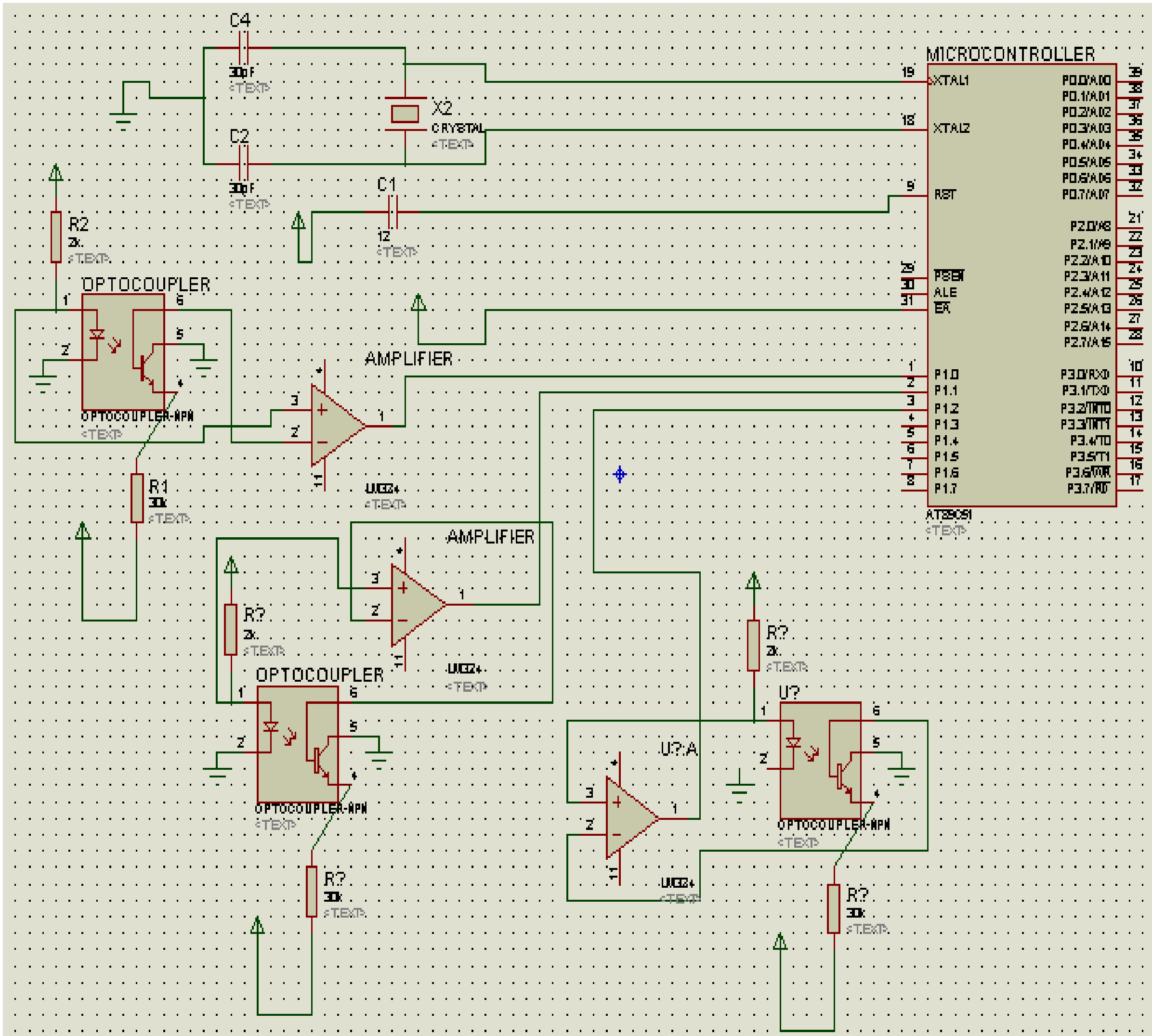

Fig. 5. Microcontroller and Optocoupler Diagram

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