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# Fuzzy Logic based Obstacle Avoidance System

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**Abstract—***The paper demonstrates a following robot with omni-directional wheel, which is able to take action to avoid obstacles. The robot design is based on fuzzy theory. Fuzzy theory was applied to tune the motor revolution, and correct path deviation issues encountered when the robot is moving. The ultrasonic distance sensor mounted on the robot is used to estimate the distance to obstacles. If an obstacle is encountered, the correlation function is evaluated and the robot avoids the obstacle autonomously using the most appropriate mode. The effectiveness of the proposed approach was verified through several experiments, which demonstrates the feasibility of a fuzzy path tracker as well as the extensible collision avoidance system.*

**Keywords***: Fuzzy theory, ultrasonic sensors, obstacle-avoidance, PIC16F877A Microcontroller, LM293D Motor Driver*

## 1. INTRODUCTION

In this Innovative project we are going to present Fuzzy logic based Ultrasonic Distance sensor and display it on LCD. Many times it happens that two vehicles move one after the another and due to fog and other reasons it is not feasible to exactly locate the distance of the vehicle moving in front so for that our project is, it has three section, Ultrasonic transmitter section, Ultrasonic receiver section, and microcontroller interface section. The transmitter section transmits ultrasonic wave Generated by IC4049. the transmitter and receiver is placed in such a way that in normal condition when there is no any moving object the wave transmitted by transmitter does not receive on receiver. In case of any moving object in path of transmitted beam, the transmitted beam reflects towards ultrasonic receiver. Thus, causing receiver circuit to create a pulse to acknowledge microcontroller about identified moving object. The microcontroller check incoming input pulse and display warning the distance on LCD. This transmitter section sends a signal and receiver receives it after particular time, thus in this way we calculate the distance between the two objects.[6]

## 2. OBSTACLE AVOIDANCE SYSTEM

In robotics, obstacle avoidance is the task of satisfying some control objective subject to non-intersection or non-collision position constraints. Normally obstacle avoidance is considered to be distinct from path planning in that one is usually implemented as a reactive control law while the other involves the pre-computation of an obstacle free-path which a controller will then guide a robot along. [4]

### 2.1. Basic Principle

The basic principle of sonar is to generate a pulse of sound and then electronically listen for the echoes created when the sound wave hits an object and is reflected back. By timing how long it takes for the echo to return, an accurate estimate can be made of the distance to the object. The sound pulse generated by the SRF05 is ultrasonic, meaning that it is above the range of human hearing. While lower frequencies could be used in this type of application, higher frequencies perform better for short range, high precision needs.[3]

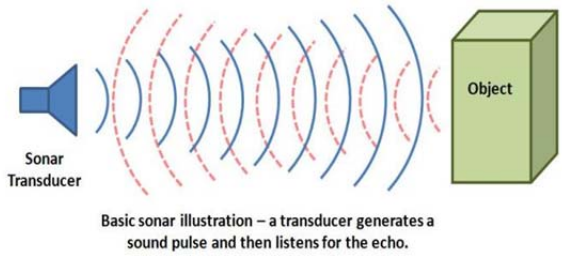


**Fig. 1 Basic Sonar Illustration**

## 3. FUZZY LOGIC

For the obstacle avoidance algorithm, a fuzzy logic system was chosen. There are two main reasons why a fuzzy logic system was chosen, the first is due to the ultrasonic sensors that are being used, and the second is because of processing requirements. Ultrasonic sensors in a distance ranging system such as the one being used in this application are notorious for providing imprecise data, using a fuzzy logic system aids is ensuring that this lack of precision has minimal effects on the overall functionality of the program. One of the main considerations for the implementation of this application was the processing speed of the micro-controller and thus the reaction time of the robot, with this in mind, it was necessary

to minimize the number of instructions and calculations required. Many obstacle avoidance techniques not using a fuzzy logic system, work by dividing the area surrounding the robot into a grid pattern then calculating the probability of an obstacle being present in each square of the grid based on the sensor data.Thesemethods require a vast number of calculations and so significantly increase the response time of the robot. Fuzzy logic requires much fewer calculations and so is more suited for this application.The output of the sensor kit is either high or low, no ranging data is provided from the kit, this is con-ducted in the software of the project. [3], [6]

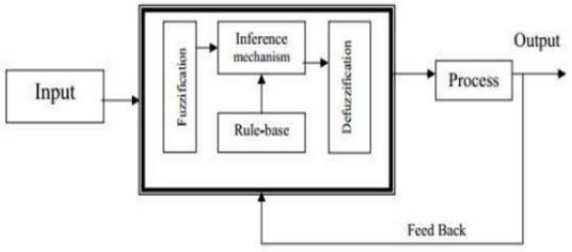


**Fig. 2: Block Diagram of Fuzzy Logic**

## 4. HARDWARE DESIGN

### 4.1. TRANFORMER

Transformers convert AC electricity from one voltage to another with a little loss of power. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high voltage to a safer low voltage. [5]

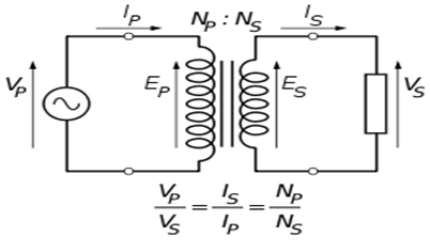


**Fig. 3: The ideal transformer as a circuit element**

### 4.2. Voltage Regulator 7805

The LM78XX/LM78XXA series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a Wide range of applications. Each type employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be used with externalcomponents to obtain adjustable voltages and currents. [5]

### 4.3 Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid statediodes, vacuum tube diodes, mercury arc valves, and other components. The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification. In positive half cycleonly two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.[6]

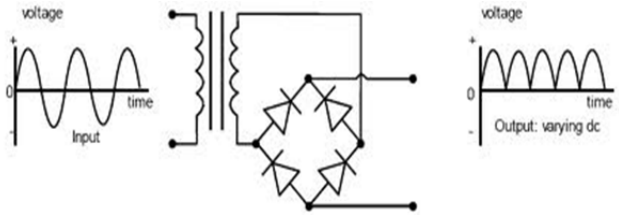


**Fig. 4: Circuit of a Bridge Rectifier**

### 4.4 Filters

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and smoothens the D.C. Output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage. The simple capacitor filter is the most basic type of power supply filter. The use of this filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes that require very little load current from the supply. This filter is also used in circuits where the power-supply ripple frequency is not critical and can be relatively high. Below figure can show how the capacitor changes and discharges.[6]

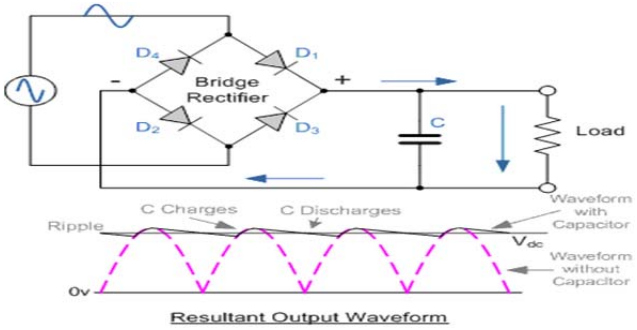


**Fig. 5 Filter Output**

### 4.5 Liquid Crystal Display

This is the example for the Parallel Port. This example doesn't use the Bi-directional feature found on newer ports, thus it should work with most, if not all Parallel Ports. It however doesn't show the use of the Status Port as an input for a 16 Character x 2 Line LCD Module to the Parallel Port. These LCD Modules are very common these days, and are quite simple to work with, as all the logic required running them is on board. [7]

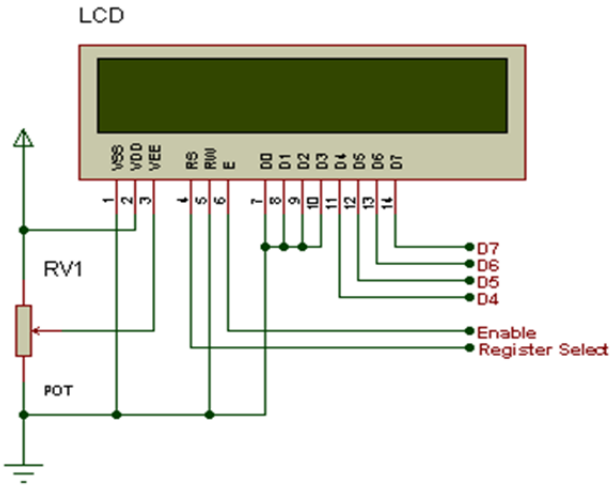


**Fig. 6 LCD Circuit Diagram**

### 4.6 Microcontroller PIC16F877A

The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, serial programming, and re-programmable Flash-memory capability. [1], [2], [7]

### 4.7 Motor Driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller. There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.[7]

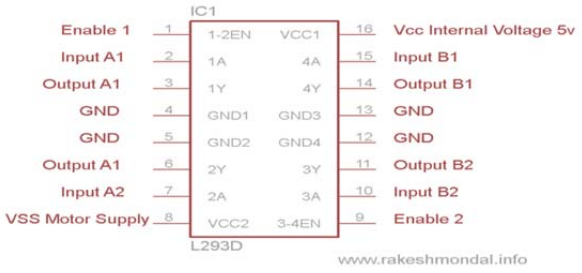


**Fig. 7: Pin Configuration of Motor Driver**

### 4.8 ULTRASONIC SENSOR

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone). [5]

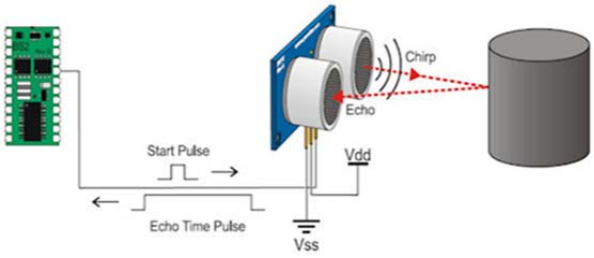


**Fig. 8: UltrasonicSensor Working**

## 5. CIRCUIT DIAGRAM

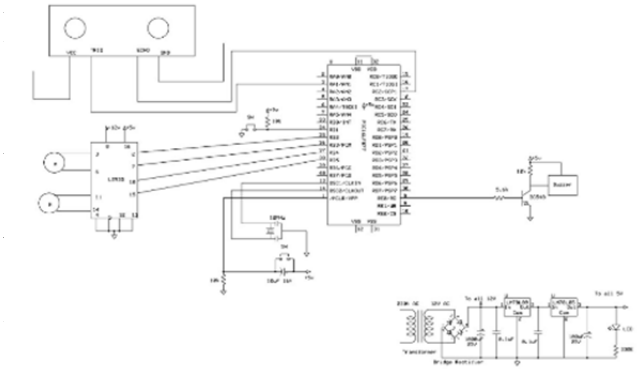

**Fig. 9 Working of the Circuit [3], [4], [6], [7]**

## 6. CONCLUSION

In this study, omni-directional wheel was used to develop a robot capable of omni-directional movement. The robot offers improved mobility as it utilizes lateral movement over rotational movement by utilizing the omni-directional wheel design. The robot was tested in various mobile modes in a complex environment, and was able to compensate for path deviations through motor encoder compensation based on fuzzy logic theory. The robot was also able to avoid all obstacles in its path autonomously by employing ultrasonic distance sensors with an obstacle-avoidance algorithm. The aim of implementing omni-directional motion control for a three-wheeled autonomous robot was achieved. The robot offers high mobility, motion path correction, and an obstacle avoidance capability. This robot system is suitable for libraries, supermarkets, airports, hospitals and similar scenarios.

## REFERENCES

[1] "*The PIC Microcontroller and Embedded systems*" by Muhammad Ali Mazidi andJanice GillispieMazidi , Pearson Education.

[2] PIC16F877A Data Sheets.

[3] www.microchip.com

[4] G W. Lucas, "A Tutorial and Elementary Trajectory Model for the Differential Steering System of Robot Wheel Actuators", *The Rossum Project*, 2001.

[5] G. Dudek, M. Jenkin, "Computational Principles of Mobile Robotics", *New York:Cambridge University Press, 2000.*

[6] Xi Li 1, and Byung-Jae Choi1, 1 School of Electronic Engineering Daegu University, *Jillyang Gyeongsan-city Gyeonbuk,KOREA*

[7] R. Brooks, "A robust layered control system for a mobile robot", *IEEE Trans. Robotics Automat*, vol. RA-2, pp. 14-23, Feb. 1986.

[8] . Surmann, Hartmut, Huser, Jörg, Peters, Huser, Liliane, "A Fuzzy System for Indoor Mobile Robot Navigation", *Proc. of the Fourth IEEE Int. Conf. on Fuzzy Systems*, pp. 83-86, 20–24.03.1995.