CHAPTER TWO

LITERATURE REVIEW

2.1 Literature review

In order to design and develop an obstacles avoidance robot by using fuzzy logic controller, extensive research on the fuzzy controller need to be fulfilled. This section will discuss previous studies that have been accomplished by other researchers in the same area.

"Mobile Robot Obstacle Avoidance in a Computerized Travel Aid for the Blind" .In this paper a mobile robot obstacle avoidance system has been converted successfully to a navigation aid for the blind. Instead of transmitting electronic signals to the robot motion controllers, the obstacle avoidance system relays information to the user by transmitting stereophonic signals. These signals provide spatial information about the location of objects in space, or guiding information for the recommended travel direction and speed. [3]

"Obstacle Avoidance Robot Applying Fuzzy Control System". In this project primarily addresses the design and implementation of fuzzy logic based controller for obstacles avoidance robot. Some techniques, sensors and controller have been applied to fulfill the requirements of the robot. The robot is able to interact with unknown environment using a reactive strategy determined by the sensors information. The obstacle avoidance controller is two inputs and two outputs system. The inputs are two proximity measurement of the obstacles distance, and the outputs are the velocities of the two wheels. The robot is driven by two independent DC motors. The ultrasonic sensors are mounted at left, front and right side of the mobile robot. It can detect the obstacles within the range 3 cm to 300 cm. The kinematic model was developed to control the movement of the robot's wheels. The detection of the obstacles by the sensors activates the controller which simply attempts to avoid the robot with the obstacles. Once the robot avoids the obstacles, the robot will keep sense for the new environment. Based on these signals, the controller control the velocity of left and right wheels thus making the robot to move forward and turning at the same time, i.e., the robot avoid the obstacle by turn left with left motor velocity is 6.57 cm/s, right motor velocity is 8.29 cm/s and angular velocity is 0.066154 rad/s when the obstacle detected from left sensor is 100 cm, right sensor is 100 cm and front sensor is 50 cm. Different obstacles distance orientation also been tested and the robot response is working as expected.[4]

"A Design & Implementation of Collision Avoidance System (CAS) for Automobiles using Embedded System". In this paper use advance ideas such as pre-crash sensing, ultrasonic sensor is used to sense the object in front of Based on the signal received from the ultrasonic sensor the micro controller unit sends a signal to the braking unit for applying the brake automatically as per .[5]

"Neural Control System in Obstacle Avoidance in Mobile Robots Using Ultrasonic sensors". In this paper represents a neural control system in mobile robots in obstacle avoidance, which have the ability to work with imprecise information. [6]

"Obstacle Avoidance of Autonomous Mobile Robot using Stereo Vision Sensor"**.** In this paper they develop a real time obstacle avoidance system for autonomous mobile robots using a stereo vision sensor.

An obstacle detection method is proposed. It is based on stereo measurement without any search of the corresponding points to match them.[7]

“Obstacle Detection and Avoidance by a Mobile Robot”. In this paper, deals with detection and avoidance of the various obstacles found in an environment, it was found that given a number of obstacles, the robot is able to detect and avoid the obstacle with an average accuracy of 86.62%.[8]

“Exploring Unknown Environments with Mobile Robots using Coverage Maps”. In this paper they introduce coverage maps as a new way of representing the environment of a mobile robot. [9]

“Efficient Mechanisms using ARDUINO to Control Robots”. In this paper describes the different methods of controlling a robot. The joystick controlled robot, mobile controlled robot and laptop controlled robot are manually controlled robot while the obstacle avoider robot and line follower robot are automatically controlled using proximity sensors. [10]

2.2 System Component

This section will discuss about components that had been used included Ultrasonic sensor, microcontroller ATMEGA 16, DC Motor, Liquid crystal display and L293D IC.

2.2.1 Microcontroller and Microprocessor

As shown in figure 2-1, microcontroller is a highly integrated chip that contains all the components comprises a controller. As shown in figure 2.1it includes a CPU, RAM, some form of ROM, I/O ports, and timers.

Unlike a general- purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task; to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production costs.

Microcontrollers are sometimes called embedded microcontrollers. This just means that they are part of an embedded system; that is, one part of a larger device or system. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.

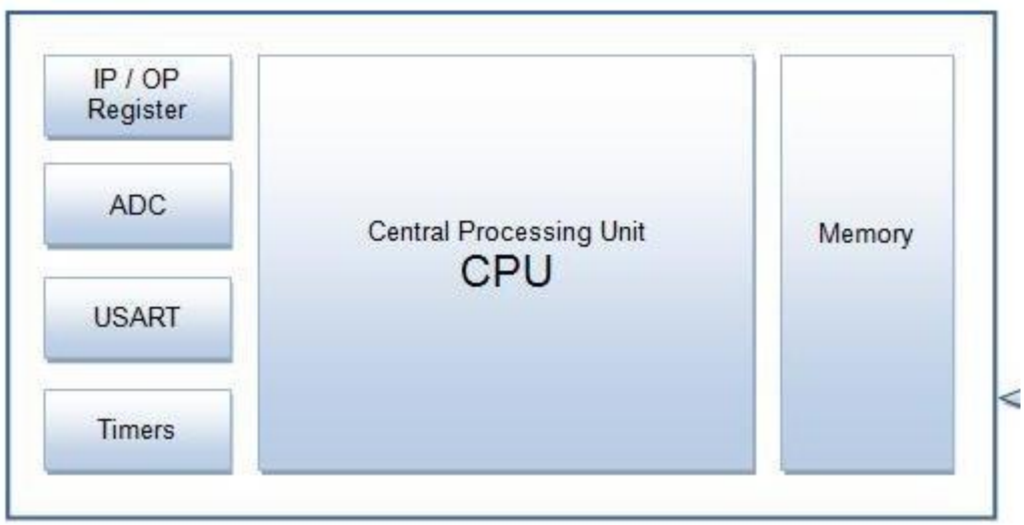

Figure 2-1: The Block Diagram of Microcontroller.

A microprocessor, sometimes called a *logic chip*, is a computer processor on a microchip. The microprocessor contains all, or most of, the central processing unit (CPU) functions and is the "engine" that goes into motion when you turn your computer on. A microprocessor is designed to perform arithmetic and logic operations that make use of small numberholding areas called registers. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that is part of the microprocessor design.

The term microprocessor and microcontroller have always been confused with each other. Both of them have been designed for real time application. They share many common features and at the same time they have significant differences. Both the IC's i.e., the microprocessor and microcontroller cannot be distinguished by looking at them.

Table 2-1: Comparison between Microcontroller and Microprocessor

Microprocessor	**microcontroller**
A microprocessor is a chip that dependent on the chip of many functions.	A microcontroller is a single chip micro-computer that has everything in –built
A microprocessor contains ALU register and control circuit.	A contains the circuitry of a microcontroller and has built in RAM, ROM I/O devices, timers and counter.
They have large memory address space.	They have small memory address space
Design is very flexible.	Design is less flexible
A microprocessor based system required more hardware.	Microcontroller based system required less hardware

In this project, Atmega16 is used as a controller.

2.2.3 AVR Microcontroller (Atmega16)

As shown in figure 2-2, AVR also known as Advanced Virtual RISC is a customized Harvard architecture 8 bit RISC solitary chip micro-controller. It was invented in the year 1966 by Atmel. Harvard architecture signifies that program & data are amassed in different spaces and are used simultaneously. It was one of the foremost micro-controller families to employ on-chip flash memory basically for storing program, as contrasting to one time programmable EPROM, EEPROM or ROM, utilized by other micro-controllers at the same time. Flash memory is a non-volatile (constant on power down) programmable memory.

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

2.3.1 Features of Atmega16

1. High-performance, Low-power.
2. Advanced RISC Architecture.
3. High Endurance Non-volatile Memory segments.
4. JTAG (IEEE std. 1149.1 Compliant) Interface.
5. Real Time Counter with Separate Oscillator.
6. Four PWM Channels.
7. 8-channel, 10-bit ADC.
8. Power-on Reset and Programmable Brown-out Detection.
9. Internal Calibrated RC Oscillator.
10. External and Internal Interrupt Sources.

11.32 Programmable I/O Lines.

12.(4.5 - 5.5V).

13.(0 - 16 MHz).

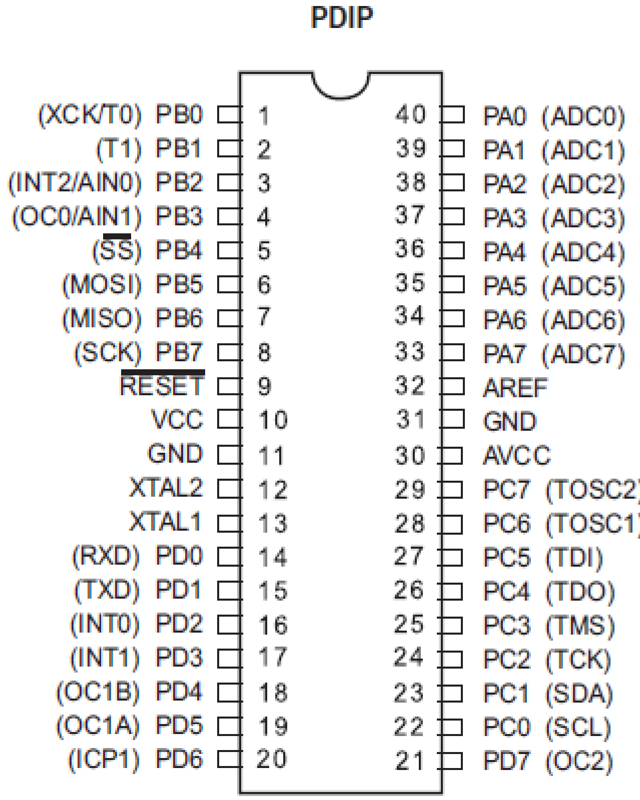

Figure: 2-2 Pins out ATMEGA 16

Table 2-2: ATMEGA 16 pins layout.

VCC	DIGITAL SUPPLY VOLTAGE
GND	Ground
Port A	Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port
Port B	Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit)
Port C	Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit)
Port D	Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit)
RESET	Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running
XTAL1	Input to the inverting Oscillator amplifier and input to the internal clock operating circuit
XTAL2	Output from the inverting Oscillator amplifier
AVCC	AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter
AREF	AREF is the analog reference pin for the A/D Converter

2.2.4 Ultrasonic sensor

The ultrasonic sensor as shown in figure 2-3, is used for obstacle detection. Ultrasonic sensor transmits the ultrasonic waves from its sensor head and again receives the ultrasonic waves reflected from an object.

Figure 2-3: Ultrasonic sensors.

There are many applications use ultrasonic sensors like instruction alarm systems, automatic door openers etc. The ultrasonic sensor is very compact and has a very high performance.

2.4.1 Working Principle

As introduced in figure 2-4, the ultrasonic sensor emits the short and high frequency signal. These propagate in the air at the velocity of sound. If they hit any object, then they reflect back echo signal to the sensor. The ultrasonic sensor consists of a multi vibrator, fixed to the base. The multi vibrator is combination of a resonator and vibrator. The resonator delivers ultrasonic wave generated by the vibration. The ultrasonic sensor actually consists of two parts; the emitter which produces a 40 kHz sound wave and detector detects 40 kHz sound wave and sends electrical signal back to the microcontroller.

The ultrasonic sensor enables the robot to virtually see and recognize object, avoid obstacles, measure distance. The operating range of ultrasonic sensor is 10 cm to 30 cm.

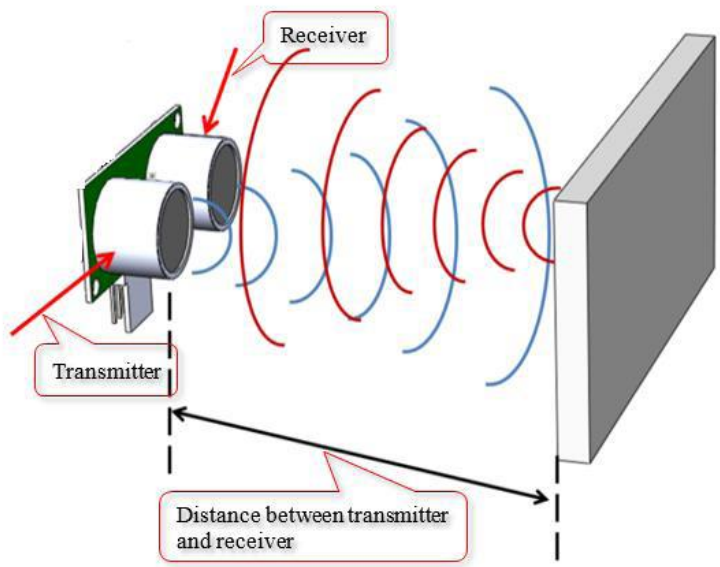

Figure 2-4: Principle work of ultrasonic sensor.

2.4.2 The advantages of Ultrasonic sensor

1. The output value is linear with the distance between the sensor and target.
2. Sensor response is not dependent on the colors, transparency of object, optical reflection properties, or by the surface texture of the object.
3. These sensors are designed for contact-free detection.

4. A sensor with digital (ON/OFF) outputs has excellent repeat sensing accuracy.
5. Accurate detection even of small objects.
6. Ultrasonic sensors can work in critical conditions such as dirt and dust.
7. They are available in cuboids or cylinder forms, which is better for a freedom design.

2.4.3 The disadvantages of Ultrasonic sensor

1. Ultrasonic sensor must view a high density surface for good results. A soft surface like foam and cloth has low density and absorb the sound waves emitted by the sensor.
2. Could have false responds for some loud noises such as air hoses.
3. The ultrasonic sensor has a response time with a fraction less than types of sensors.
4. An ultrasonic sensor has a minimum sensing distance, which should be taken into consideration when you choose the sensor.
5. Some changes in the environment can affect the response of the sensor (temperature, humidity, pressure ,etc)

2.5 DC motor

As shown in figure 2-5, DC power systems are not very common in the contemporary engineering practice. However, DC motors have been used in industrial applications for years Coupled with a DC drive, DC motors provide very precise control DC motors can be used with conveyors, elevators, extruders, marine applications, material handling, paper, plastics, rubber, steel, and textile applications, automobile, aircraft, and portable electronics.The DC motors have many advantages:

1. It is easy to control their speed in a wide range; their torque-speed characteristic has, historically, been easier to tailor than that of all AC motor categories. This is why most traction and servo motors have been DC machines. For example, motors for driving rail vehicles were, until recently, exclusively DC machines.
2. Their reduced overall dimensions permit a considerable space saving which let the manufacturer of the machines or of plants not to be conditioned by the exaggerated dimensions of circular motors.

DC motor used in this project is the small car (toy car) with a capacity of 5volt.

Figure 2-5: DC motor 5V.

2.6 Liquid Crystal Display (LCD)

A 16*2 character line LCD module is a parallel port module. An atmega16 program must interact with the outside world using input and output devices that communicate directly with the human being. One of the most common devices attached to an atmega16 MC is an LCD display.