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ARDUINO BASED OBSTACLE AVOIDING CAR ROBOT

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ABSTRACT

This project describes about an obstacle avoidance robot vehicle which is controlled by ultrasonic sensor. The robot is made using ultrasonic sensor and it is controlled by Arduino microcontroller. Ultrasonic sensor fixed in front portion of the robot vehicle. The sensor gets the data from surrounding area through mounted sensors on the robot. The sensor is sense the obstacle and deviate its path to choose an obstacle free path. The sensor will be send the data to the controller is compared with controller to decide the movement of the robot Wheel. The robot wheel movement and direction will be based on the sensing of the ultrasonic sensor and also using a wheel encoder. This vehicle is used for detecting obstacle and avoiding the collision.

Now day ' s many industries are using robots due to their high level of performance and reliability and which is a great help for human beings. The obstacle avoidance robotics is used for detecting obstacle and avoiding the collision. This is an autonomous robot. The design of obstacle avoidance robot requires the integration of many sensors according to their task. The obstacle detection is primary requirement of this Autonomous robot. The robot gets the information from surrounding area through mounted sensors on the Robot. Some sensing devices used for obstacle detection like bump sensor, infrared sensor, ultrasonic sensor etc. Ultrasonic sensor is most suitable for obstacle detection and it is of low cost and has high ranging capability. Arduino robot that can be controlled by an android mobile or tablet, with the help of an android app that can be downloaded from Google Play store. The android application gets connected to the bluetooth module and sends desired commands. This app controlled robot is capable to move in any direction. Though there are lots of similar apps out there, we have programmed this project to be used with ANDROID app.

CHAPTER-I INTRODUCTION

The project is designed to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. An Arduino Uno is used to achieve the desired operation. A robot is a machine that can perform task automatically. Robotics is generally a combination of computational intelligence and physical machines (motors). Computational intelligence involves the programmed instructions . The project proposes robotic vehicle that has an intelligence built in it such that it guides itself whenever an obstacle comes ahead of it. This robotic vehicle is built, using an Arduino UNO. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the Arduino.

In today' s world robotics is a fast growing and interesting field. robot has sufficient intelligence to cover the maximum area of provided space. Autonomous Intelligent Robots are robots that can perform desired tasks in unstructured environments without continuous human guidance. The obstacle detection is primary requirement of this autonomous robot. The robot gets the information from surrounding area through mounted sensors on the robot.

CHAPTER-2 SPECIALITIES OFULTRASOUND TECHNOLOGY

The ultrasonic sensor is one of the best technique which is used for sense for obstacle. The Ultrasonic sensor module " HC-SR04" works on "Echo" concept which is something you get when sound reflects back after reaches the surface. The travelling time of ultrasonic wave s is 343m/s. This much of speed is meticulous for MCU's in microcontroller to measure accurately. Practically the waves reflect back from the surface located 4 meters away in 15 ns . The ultrasonic wave does not affect the humans. The ultrasonic sensor is mostly used for distance measurement application. These sensors are able to detect the barriers present in front of them. Ultrasonic sensors generate sound waves with higher frequencies that humans cannot perceive, making them ideal for quiet environments. They do not consume much electricity, are simple in design, and are relatively inexpensive. The basic block diagram is shown in fig. 2.1.

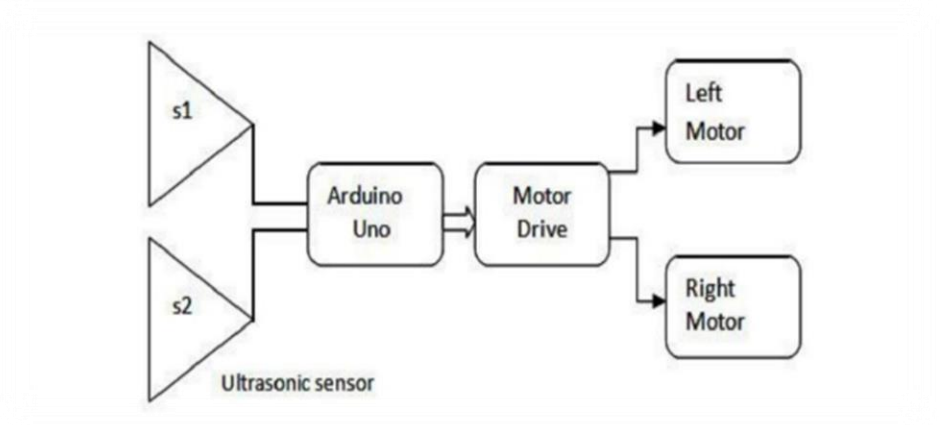

Fig 2.1: Basic Block diagram

CHAPTER-3 SOFTWARE DESIGN

In our project the output from the ultrasonic sensor is given to the Arduino Uno controller as an input to process them according to codes which are actually embedded into the controller to provide the desired output. The circuit diagram for the process is shown in Fig.2.

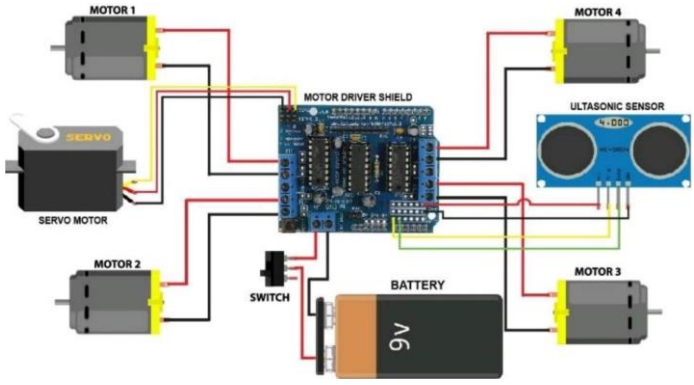

Fig 3.1: Circuit diagram of obstacle sensing robot process

3.1. Timing Diagram

The Timing diagram is shown below in Fig.3. 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 40kHz sound wave and detector detects 40kHz sound wave and sends electrical signal back to the microcontroller.

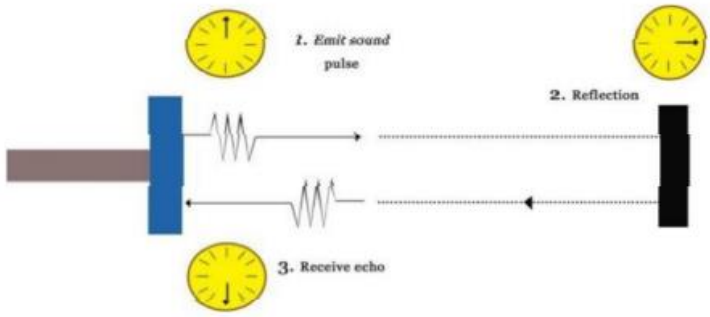

Fig 3.2: Timing Diagram

3.2 Block Diagram

Here we are going with Arduino controller use 12V power supply for running Arduino board. Arduino Uno used is ATMe ga328P controller. It is controlled using C programming. The feature of Arduino is includes wire and wireless controlling with sensor and relay. It is also controlling with wired and wireless system Using Android with Bluetooth, **GSM,** etc. Robot work basically this feature:

An Arduino Uno is used to achieve the desired operation. A robot is a machine that can perform task automatically or with guidance. This robotic vehicle is built, using an Arduino Uno . An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the Arduino. The robot gets the information from surrounding area through mounted sensors on the robot. Ultrasonic sensor is most suitable for obstacle detection and it is of low cost and has high ranging capability.

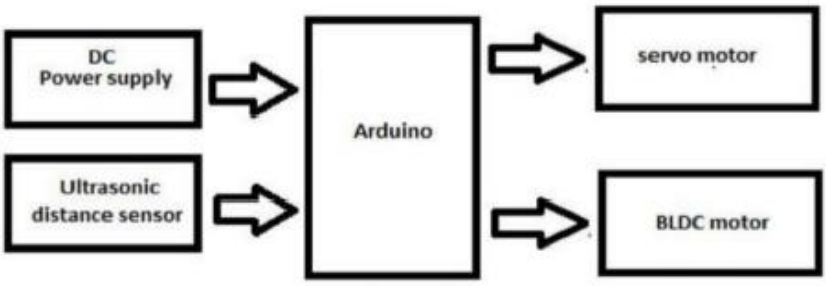

Fig 3.3: Block Diagram

CHAPTER-4 CIRCUIT DESCRIPTION

The circuit is excited by 9V power supply, the HC-SRO4 module is connected to the port A of the 8051series, and the motor is also connected to the port A via relay switch. The circuit diagram isshown in Fig. 5.

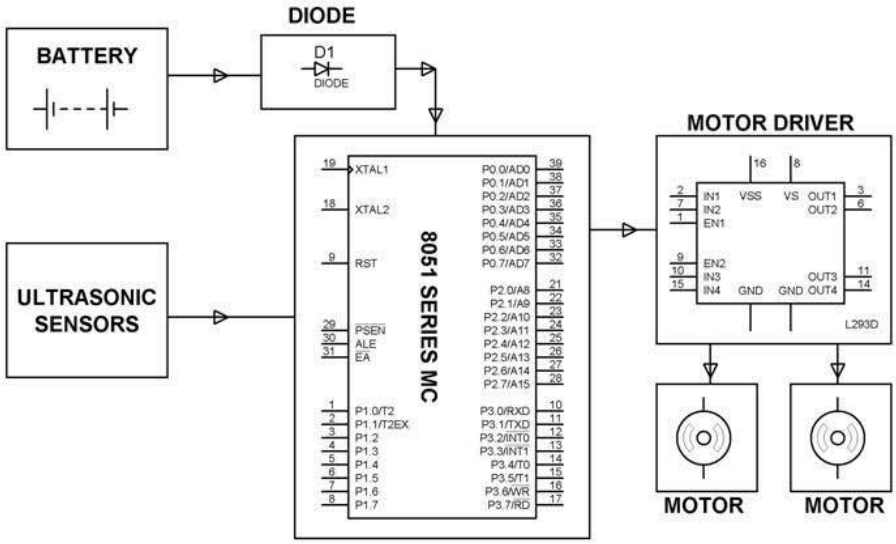

Fig 4.1:Circuit diagram for ultrasonic sensor and controller using Arduino controller

4.1. ULTRASONIC SENSOR HC-SR04

The ultrasonic sensor 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. There are many application use ultrasonic sensors like instruction alarm system, automatic door openers etc. The ultrasonic sensor is very compact and has a very high performance. It has both the transmitter and receiver. It consists of four pins Vee pin to offer a 5V supply to the sensor, trigger pin give a TTL pulses (15us), echo pin to get the output from the sensor and ground pin. Ultrasonic sensor HC-SR04 is shown in Fig. 6.

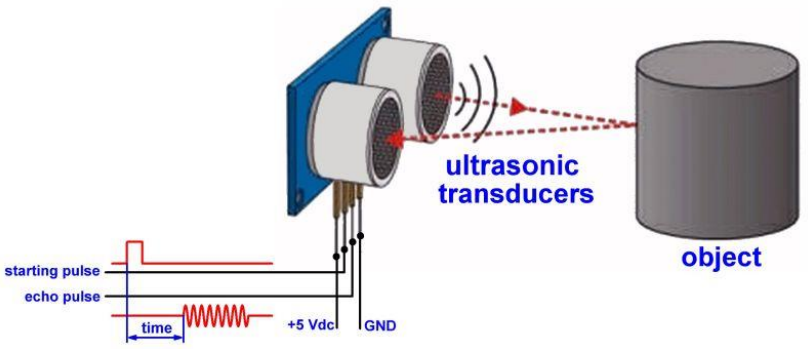

Fig 4.2: Ultrasonic Sensor HC-SR04

4.2. MOTOR DRIVE MODULE (L298D)

The L298N H-bridge module can be used with motors that have a voltage of between 5 and 35v de. With the module used in this tutorial, there is also an on board 5V regulator, so if your supply voltage is up to 12V you can also source 5V from the board. The Motor drive module diagram as shown in fig. 7.

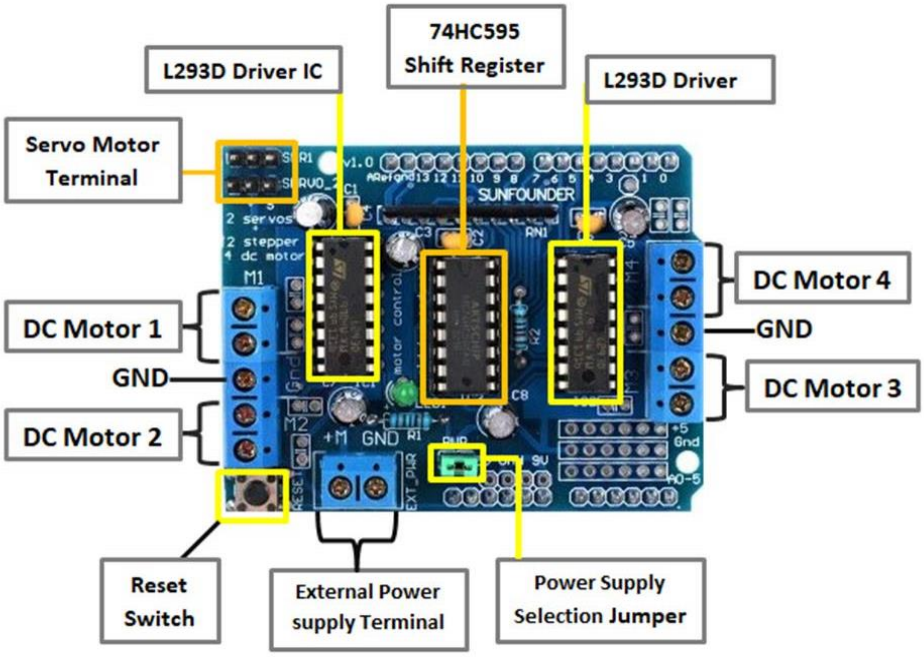

Fig 4.3: Motor drive module diagram

4.3. CONTROLLING DC MOTORS

H-Bridge L298N module is used to control one or two DC Motors is quite easy. First connect each motor to the motor A And B connections on the L298N. If you' re using two motors For a robot (etc) ensure that the polarity of the motors is the Same on both inputs. Next connect your power supply - the Positive to pin 4 on the module and negative/GND to pin 5. If You supply is up to 12V you can leave in the 12V jumper and 5V will be available from pin 6 on the module. This can be Fed to your Arduino's 5V pin to power it from the motors Power supply . Don' t forget to connect Arduino GND to pin 5 On the module as well to complete the circuit. Now you will need six digital output pins on your Arduino, Two of which need to be PWM (pulse - width Modulation) Pins. PWM pins are denoted by the tilde ("~") next to the pin Number, for example finally, connect the Arduino digital Output pins to the driver module. In our example we have Two DC motors, so digital pins D9, D8, D7 and D6 will be Connect to the pins INl, IN2, IN# and IN4 respectively. Then Connect DlO to module pin 7 and D5 to module pin 12.The Motor direction is controlled by sending a HIGH or LOW Signal to the drive for each motor or channel. However the motors will not turn until a HIGH is set to the Enable pin and they can be turned off with a low to the same Pin. However if you need to control the speed of the motors, The PWM signal from the digital pin connected to the enable Pin can take care of it.

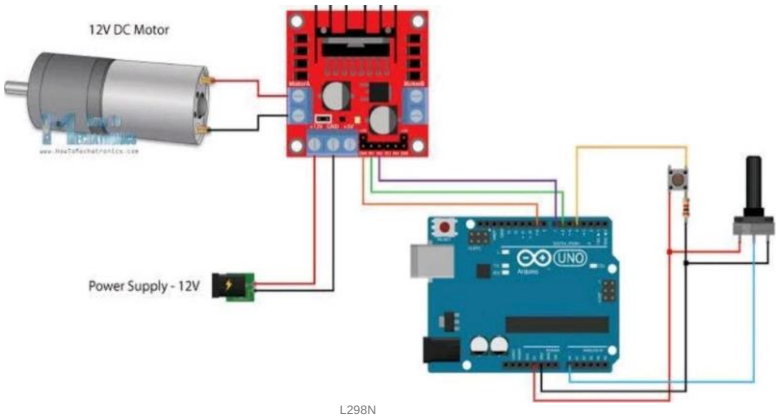

Fig 4.4: Controlling DC Motor Connection

4.4 SERVO MOTOR

Servo Motor are also called Control motors. They are used in feedback control systems as output actuators and does not use for continuous energy conversion. The principle of the Servomotor is similar to that of the other electromagnetic motor, but the construction and the operation are different. Their power rating varies from a fraction of a watt to a few hundred watts. The rotor inertia of the motors is low and have a high speed of response. The rotor of the Motor has the long length and smaller diameter. They operate at very low speed and sometimes even at the zero speed. The servo motor is widely used in radar and computers, robot, machine tool, tracking and guidance systems, processing controlling, etc.

Fig 4.5: Servo Motor

4.5 ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P(datasheet). It has 14 digital input/output pins Of which 6 can be used as PWM outputs, 6 Analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack an ICSP Header and a reset button.

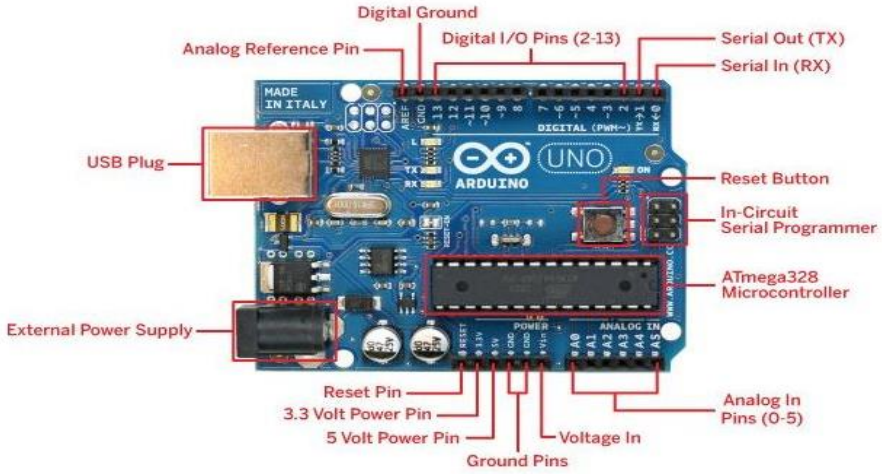

Fig 4.6 Arduino Uno Configuration

4.5.1. ATMEGA 328P-PU

Atmega328 is a single chip microcontroller created by ATMEL in the mega AUR family A common alternative to the ATmega328 is the "Pico power" ATmega328P. The most Common implementation of this is on the popular Arduino Development platform, namely the Arduino UNO or Arduino Nano models.

4.5.2. Key Parameter

Atmega328P-PU Key parameters as shown in table. 4.1

Table -1: Key parameter

PARAMETER	VALUE
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz
Flash memory	32 kB
SRAM	2 kB
EEPROM	1 kB
Pin count	28-pin PDIP, MLF,32-pin TQFP, MLF
Maximum operating frequency	20 MHz
Number of touch channel	16
Hardware Q Touch Acquisition	No
Maximum I/O pins	23
External interrupts	2
USB Interface	No
USB Speed	-

4.5.3. ATMEGA 328P pin diagram

Atmega328 P is a 28 pin microcontroller. It has 14 digital 1/0 Pins, of which 6 can be used as **PWM** outputs and 6 Analog Input pins. These1/0 pins account for 20 of the pins. The pin Configuration is shown in Fig. 10.

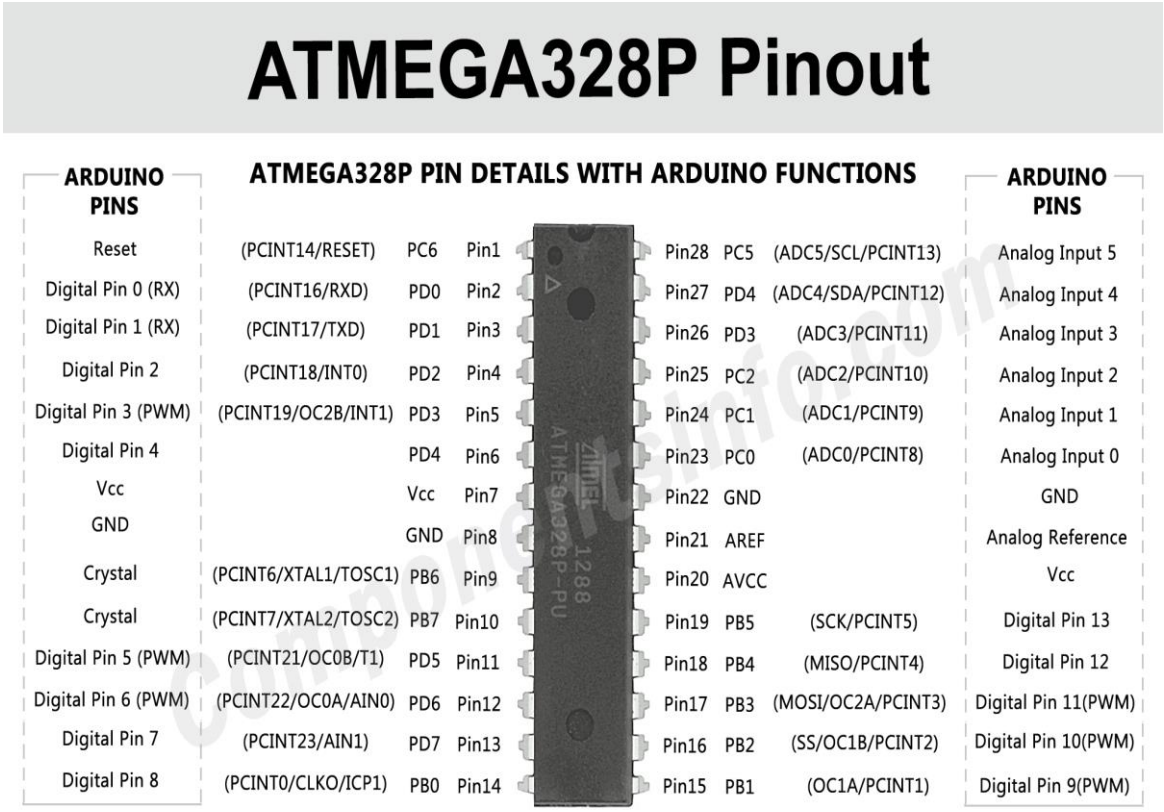

Fig 4.7: Pin configuration of Atmega328P-PU Microcontroller

CHAPTER-5 HARDWARE & SOFTWARE IMPLEMENTATION

5.1 Hardware model

Thus we prepared our hardware model consisting Arduino, 12v power supply, Ultrasonic sensor and LED. Using probe wires to interconnected the Ultrasonic sensor and LED. 12v Adapter is use to give power supply to Arduino board. Sensor connected to the Arduino board at input interfacing. LED at output interfacing. Object take near to the sensor and sensor sense to object. LED glow when object near to sensor and OFF when object away from sensor.

5.1 Software Implementation

The system was implemented in C++ using the Arduino software. Figure-13 shows the flowchart of the Robot at initialization of the sensors which becomes active when the motor is actuated to move in the forward direction simultaneously. The ultrasonic transmits a sound at 37 KHz and then waits to receive a corresponding echo from the sent signal.

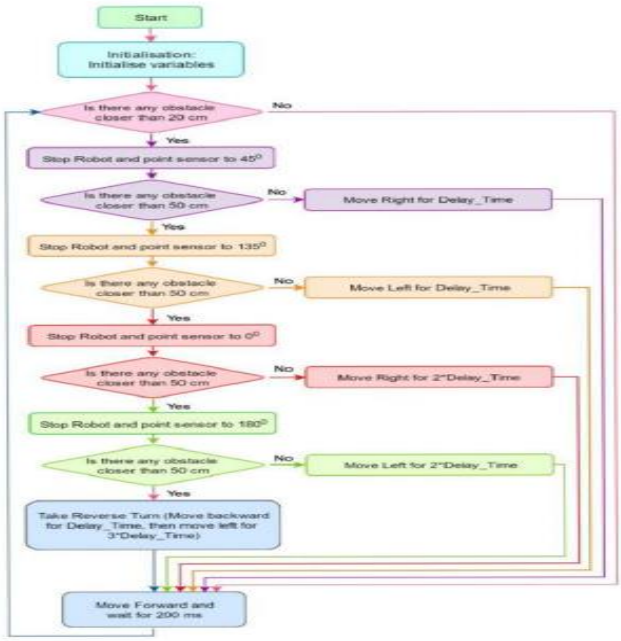

Fig 5.2: Flow chart of the developed system

CHAPTER-6 WORKING PRINCIPLE

Before going to working of the project, it is important to understand how the ultrasonic sensor works. The basic principle behind the working of ultrasonic sensor is as follows: Using an external trigger signal, the Trig pin on ultrasonic sensor is made logic high for at least lOμs. A sonic burst from the transmitter module is sent. This consists of 8 pulses of 40KHz. The signals return back after hitting a surface and the receiver detects this signal. The Echo pin is high from the time of sending the signal and receiving it. This time can be converted to distance using appropriate calculations. The aim of this project is to implement an obstacle avoiding robot using ultrasonic sensor and Arduino. All the connections are made as per the circuit diagram. The working of the project is explained below. When the robot is powered on, both the motors of the robot will run normally and the robot moves forward. During this time, the ultrasonic sensor continuously calculate the distance between the robot and the reflective surface. This information is processed by the Arduino. If the distance between the robot and the obstacle is less than 15cm, the Robot stops and scans in left and right directions for new distance using Servo Motor and Ultrasonic Sensor. If the distance towards the left side is more than that of the right side, the robot will prepare for a left turn. But first, it backs up a little bit and then activates the Left Wheel Motor in reversed in direction. Similarly, if the right distance is more than that of the left distance, the Robot prepares right rotation. This process continues forever and the robot keeps on moving without hitting any obstacle.

The obstacle avoidance robotic vehicle uses ultrasonic Sensors for its movements. A microcontroller of 8051 family Is used to achieve the desired operation. The motors are Connected through motor driver IC microcontroller. The ultrasonic sensor is attached in front of the robot. Whenever the robot is going on the desired path the Ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head. Whenever an obstacle comes ahead of it the ultrasonic waves are reflected back from an object and that information is passed to the Microcontroller.

The microcontroller controls the motors Left, right, back, front based on ultrasonic signals. In order to Control the speed of each motor pulse width modulation is used **(PWM).**

6.1 Advantages

1. It can be used as a movable Surveillance System.
2. It can be controlled remotely.
3. It does not require Man Power.
4. can be used for critical application like flood, bomb disposal, Fire, Terrorist attack, Earthquake, Spying.

6.2 Drawbacks of existing system

1. It is time consuming project.
2. It is use for short distance only.
3. It is not in human control.
4. It is not recommended to keep the range very long because this would cause the robot tokeep moving forward and backward as it senses obstacle, even far away from it.

6.3 Application

1. This robot can be use for pick and place the require object by giving directions to the robotbut IR pair should by replace depending upon the application.
2. By doing extra things, it can be used in army application.
3. Automatic change over's of traffic signals.
4. Intruder alarm system.
5. Counting instruments access switches parking meters.
6. Back sonar of automobiles.

6.4 Scope

1. Work for an extended period of time without intervention from human or a need forpower supply.
2. Avoid situations that are harmful.
3. The designed mobile robot will be able to avoid obstacle perfectly like programmed.
4. If the current project is interfaced with a camera robot can be driven beyond line of sight & range become practically unlimited as networks have very large range.
5. By adding temperature sensor, water tank and making some change in programming wecan use this robot as fire fighting robot.

CHAPTER-7 CONCLUSIONS

The above Arduino controller and ultrasonic sensor were studied and the HcSR-04 ultrasonic sensor was selected, as the controlling result are satisfying for its use in the Automobile prototype system bring developed. It was used to sense the obstacle and avoidance them. On successful implementation of obstacle avoidance algorithm was successfully carried out too with minimal errors, by coding the algorithm in python. Obstacle avoidance is a very good application to be used in vehicle preventing many accidents and loss of life.

Enormous amount of work has been done on wireless gesture controlling of robots. In this paper, various methodologies have been analysed and reviewed with their merits and demerits under various operational and functional strategies. Thus, it can be concluded that features like user friendly interface, light weight and portability of android OS based smart phone has overtaken the sophistication of technologies like programmable glove, static cameras etc., making them obsolete. Although recent researches in this field have made wireless gesture controlling a ubiquitous phenomenon, it needs to acquire more focus in relevant areas of applications like home appliances, wheelchairs, artificial nurses, table top screens etc. in a collaborative manner.

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