



Obstacle Avoidance Robot

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Abstract : FPGAs (Field Programmable Gate Arrays) are widely used in real time tasks in recent years. The main advantage of FPGA based real time systems is its ability to handle concurrent tasks. The hardware description languages allow programmers to think in different ways. The ability to run concurrent tasks limits only by the hardware resources. This concurrency is very helpful in mobile robots. A robot with number of sensors and numbers of motors could be controlled concurrently with use of a single FPGA chip. So that, this is a small attempt to implement a mobile robot which avoids obstacles with use of range sensors and wheeled motors. The mobile robot platform can move forward, backward, turn right, left. With use of the three range sensors the robot avoids obstacles. The algorithm is developed using combinational logic. This obstacle avoidance system can be implemented in medical assertive devices, industrial robots and outdoor / indoor navigation robots. While a microprocessor could be used for real time systems, it lacks the ability to parallel data processing in time critical applications such as an obstacle avoidance system.

I. INTRODUCTION

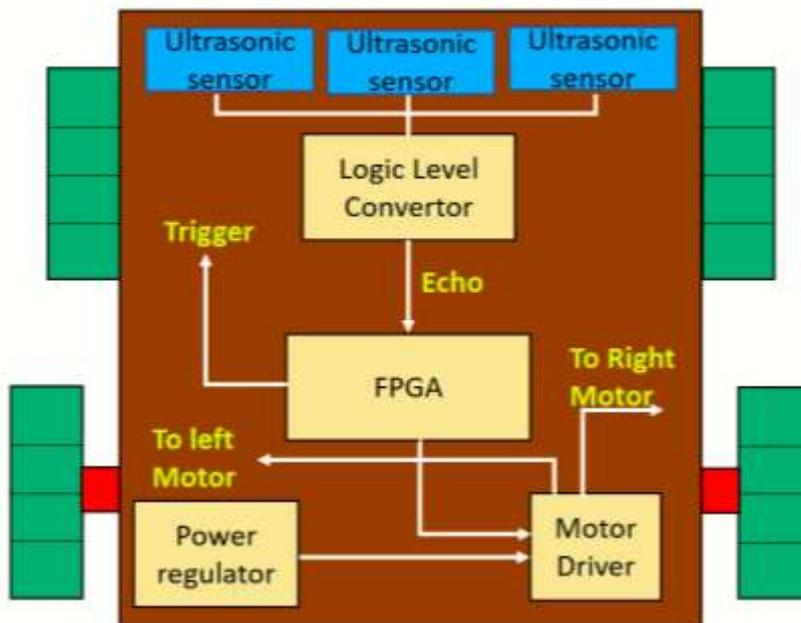
FPGAs (FIELD PROGRAMMABLE GATE ARRAYS) ARE WIDELY USED IN REAL TIME TASKS IN RECENT YEARS. THE MAIN ADVANTAGE OF FPGA BASED REAL TIME SYSTEMS IS ITS ABILITY TO HANDLE CONCURRENT TASKS. THE HARDWARE DESCRIPTION LANGUAGES ALLOW PROGRAMMERS TO THINK IN DIFFERENT WAYS. THE ABILITY TO RUN CONCURRENT TASKS LIMITS ONLY BY THE HARDWARE RESOURCES. THIS CONCURRENCY IS VERY HELPFUL IN MOBILE ROBOTS. A ROBOT WITH NUMBER OF SENSORS AND NUMBERS OF MOTORS COULD BE CONTROLLED CONCURRENTLY WITH USE OF A SINGLE FPGA CHIP.

SO THAT, THIS IS A SMALL ATTEMPT TO IMPLEMENT A MOBILE ROBOT WHICH AVOIDS OBSTACLES WITH USE OF RANGE SENSORS AND WHEELED MOTORS. THE MOBILE ROBOT PLATFORM CAN MOVE FORWARD, BACKWARD, TURN RIGHT, LEFT. WITH USE OF THE THREE RANGE SENSORS THE ROBOT AVOIDS OBSTACLES. THE ALGORITHM IS DEVELOPED USING COMBINATIONAL LOGIC. THIS OBSTACLE AVOIDANCE SYSTEM CAN BE IMPLEMENTED IN MEDICAL ASSERTIVE DEVICES, INDUSTRIAL ROBOTS AND OUTDOOR / INDOOR NAVIGATION ROBOTS. WHILE A MICROPROCESSOR COULD BE USED FOR REAL TIME SYSTEMS, IT LACKS THE ABILITY TO PARALLEL DATA PROCESSING IN TIME CRITICAL APPLICATIONS SUCH AS AN OBSTACLE AVOIDANCE SYSTEM.

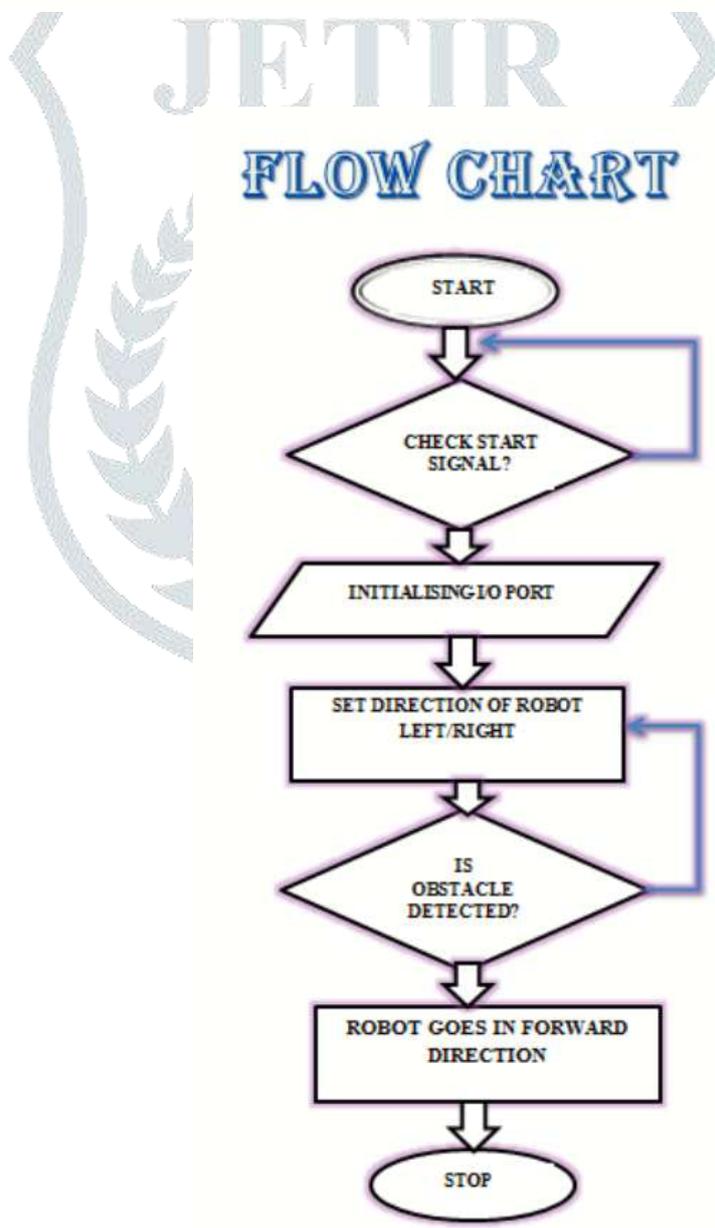
II. FPGA

THE FPGA DEVELOPMENT BOARD USED IN THIS MINI PROJECT IS THE ALTERA EP2C5T144C8N – EP2C5 MINI BOARD. IT IS A DEVELOPMENT BOARD WITHOUT INTEGRATED PERIPHERALS. IT IS OPERATED FROM A 50MHZ CRYSTAL OSCILLATOR. THERE ARE 89 I/O PINS. THE FPGA DEVELOPMENT BOARD IS RESPONSIBLE FOR GENERATING THE PWM SIGNAL, TAKING READINGS FROM THE ULTRASONIC SENSOR AND MOVEMENT OF THE MOTORS.

III. BLOCK DIAGRAM



IV. FLOW CHART



V. A PROJECT IMPLEMENTATION

1. WORKING

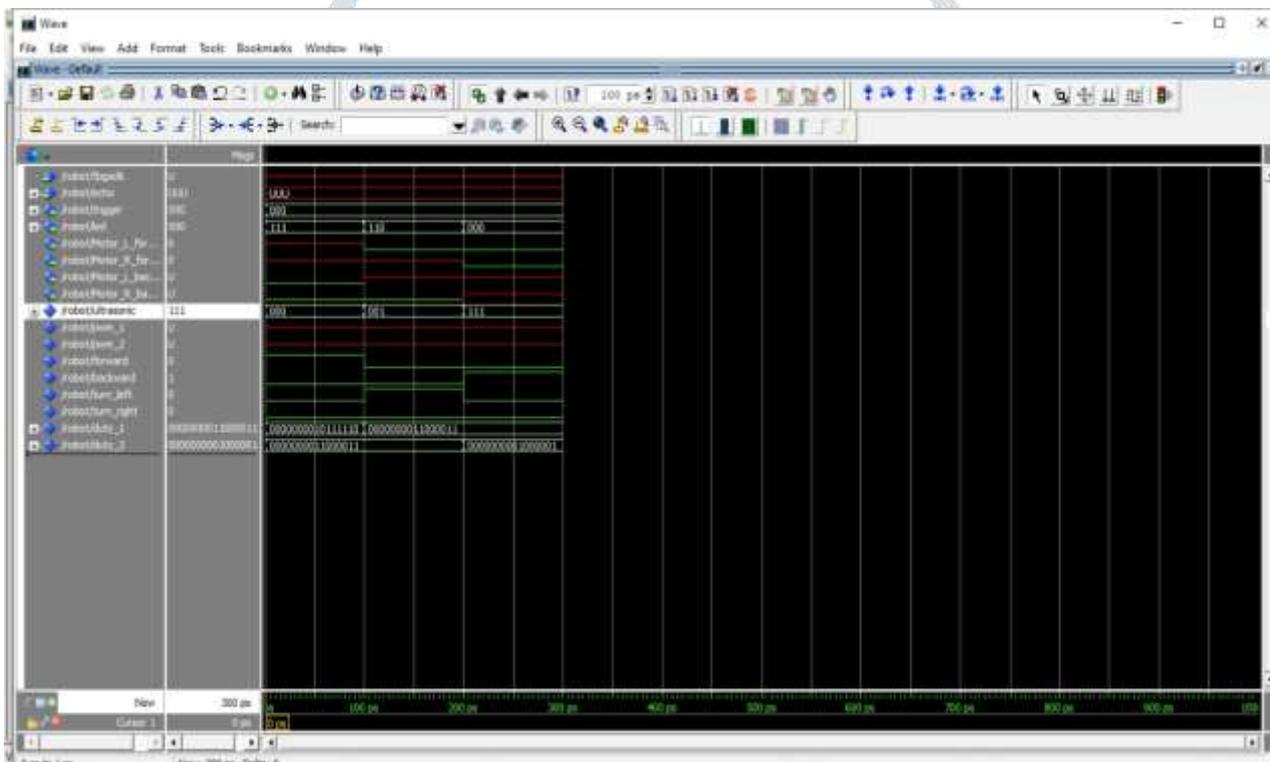
The obstacle avoidance robotic vehicle uses ultrasonic sensors for its movements. The motors are connected through the motor driver IC to the FPGA board. The ultrasonic sensor is attached in front of the robot. Whenever the robot is going on the desired path the ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head. Whenever an obstacle comes ahead of it the ultrasonic waves are reflected from an object and that information is passed to the FPGA board. The FPGA board controls the motors left, right, back, front, based on ultrasonic signals. To control the speed of each motor pulse width modulation is used (PWM).

2. A RESULT

Simulation Results: Wave Forms

The below figure shows the Wave form.

As the robot is switched ON, 1st it will check either start signal is received or not ,if not then the program counter will not go to the next address it will remains on the same address until it get a negative signal. Then the robot continuously check any obstacle in path, if there is no obstacle then robot will go straight. If any obstacle will found in left side then the controller send a command to the motor drive to stop the right motor & move the left motor and just opposite as obstacle found in right side.



3.1 ADVANTAGES

- o Obstacle avoidance robot is design to allow robot to navigate in unknown environment by avoiding collisions.
- o Obstacle avoiding robot senses obstacles in the path, avoids it and resumes its running.
- o We have make use of sensors to achieve this objective.

3.2 DISADVANTAGES

- o Real-time obstacle avoidance is one of the key issues to successful applications of mobile robot systems.
- o A disadvantage with obstacle avoidance based on edge detecting is the need of the robot to stop in front of an obstacle in order to allow for a more accurate measurement.

3.3 APPLICATION

- o Obstacle avoiding robots can be used in almost all mobile robot navigation systems.
- o They can be used for household work like automatic vacuum cleaning.
- o They can also be used in dangerous environments, where human penetration could be fatal.

4. CONCLUSION

From this study, a walking robot that achieved the stated objectives had been developed. This robot is able to produce the basic walking movements using two gearmotors. We developed the robot with a very good intelligence which is easily capable to sense the obstacle and by processing the signal coming from the sensor it is perfectly avoiding the obstacle coming in between the path. Robot take the left or right or the forward movement in according to the sensing signal with the help of the two gear motor which makes the movement of the robot smooth. In future, the sensing range can be increased by increasing the sensor quality with the help of ultrasonic sensor or the IR signal spread all over the provide area.

5. REFERENCES

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