Obstacle Avoidace Robot Using LabView

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ABSTRACT

The concept of path planning and collision avoidance are two of the most common theories applied for designing and developing in advanced autonomous robotics applications. NI LabView makes it possible to implement real-time processor for obstacle avoidance. The obstacle avoidance strategy ensures that the robot whenever senses the obstacle stops without being collided and moves freely when path is free, but sometimes there exists a probability that once the path is found free and the robot starts moving, then within a fraction of milliseconds, the robot again sense the obstacle and it stops. This continuous swing of stop and run within a very small period of time may cause heavy burden on the system leading to malfunctioning of the components of the system. This paper deals with overcoming this drawback in a way that even after the robot calculates the path is free then also it will wait for a specific amount of time before running it. So as to confirm that if again the sensor detects the obstacle within that specified period then robot don't need to transit its state suddenly thus avoiding continuous transition of run and stop. Thus it reduces the heavy burden on the system.

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1. INTRODUCTION

In this era robotic navigation and its control has provided various real life application without which we can't imagine of doing work regularly as these robot reduces human effort and time consume. Robotics is becoming an essential component of engineering and scientific system. In recent years, service-oriented robotics has become the area of robotics by predicting for the future work in rapid growth for developing. It immediately raises the trend toward controlling the function of working by giving new generation of robots capable of in human-centered environments, participating and helping them in their daily life. Such robotics systems need to be capable of learning to use their visual form to communicate and react by involving to their users [1]. The robot can accomplish its intended task in reaching its target avoiding any collision for static and dynamic environments. The service robot also should have intelligence to offer the service to human by navigating the intelligent models [2]. The use of robotics for such crucial applications requires that various types of complex operations related to navigation, sensing, computation and communication are performed effectively [3]. Robotic is built on fundamentals like transducer characterization, motion control, data acquisition, kinematics, path planning etc. [4]. The important issue for a robot by exploring it and making them capable of learning in unknown environments. The learning of accurate map models in practical is limited by many factors [5, 6]. Active-learning supplement to robot and multiple capabilities for experimental purpose can be provided by the National. Instrument (NI) LabView Robotics Kits and LabView [7]. Vision resource theory on image processing techniques, information on how LabView and the NI Vision toolkit handle each technique, is presented in the book [8]. This provides hardware and software that engineers and scientists use to design, prototype, deploy systems for test, control and embedded application.

Robotic navigation and its control mainly deal with real-time obstacle avoidance. Besides the advantages, robotic navigation control has some areas in which it is lagging behind to reach it perfection. Robot has sufficient intelligent to cover the maximum area. Robot uses ultrasonic sensor to detect the obstacle in between the path and avoid them to complete its objective [9]. In this paper it deals with the sensing capability of the robot provided a particular specified value that act as a threshold distance for the obstacle detection so that it can avoid the collision implemented in LabView software.

2. PROPOSE DESIGN METHODOLOGY

The NI Labview robotics kit includes DaNI; an assembled robot with frame, wheels, drives train, motors, transducers, computer and wiring. DaNI 2.0 hardware portion of the Labview robotics starter kit that is used in our experiment, is an out of the box mobile robot platform with sensors, motor NI 9632 Single Board reconfigurable I/O (SbRIO) computer mounted on the top of a pitsco TETRIX erector robotics shown Figure.1. The NI Single Board R10 is an embedded deployment platform that integrates a real time processor, reconfigurable field-programmable gate array (FPGA) [7].

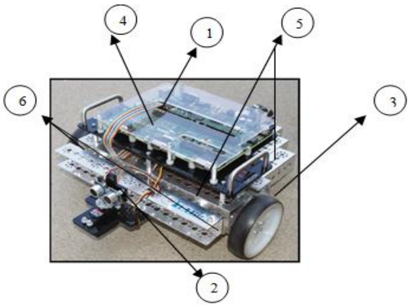

Figure 1. Robotics Kit

Here, Figure 1. Components of LabView Robotics Starter Kit Robot: 1.Single-Board RIO controller, 2. Ultrasonic sensor, 3. Motor, 4. NI SbRIO computer 5. Pitsco TETRIX frame, 6. 2DC motor with quadrature encoders. Single Board RIO products which contain integrated FPGA targets are directly connected to the I/O modules that access sensor and actuators data. FPGA automatically communicate with input-output i.e. I/O modules and provide deterministic input output (I/O) to the real time processor. Robotics systems acquire data about the environment around them with ultrasonic sensors such as laser range finders and move through the use of actuators. On the starter kit robot, the distance sensor detects obstacle in the path of the robot by which a servo pans the sensor back and forth. Based on the outputs generated by the ultrasonic sensor, the real-time processor provides a pulse width modulation signal to the drive motors for the robot. The velocity of the motors can be defined in terms of both rotation per min (RPM) or radians/sec.

3. PROPOSE OBSTACLE AVOIDANCE IMPLEMENTATION

The LabView robotic platform provides us a software development solution for designing our obstacle avoidance strategy for robot. NI LabView is graphical programming language which involve two windows are block diagrams for writing all the codes in a program and front panel for displaying all the outputs by providing user control. VI establishes a reference to the program that runs on the SbRIO FPGA that creates a link between characterized VI so they can exchange data. FPGA automatically communicates with input/output (I/O) modules and provides system as real time processor, which acquires the data from the ultrasonic transducer. The sensor is physically wired to a terminal on the SbRIO that passes the data to the FPGA. Software configures the FPGA to communicate the data over the SbRIO bus to the real-time processor [7]. On the Starter Kit 2.0 robot, desired program is deployed on the FPGA (field-programmable gate array) to look at the data from the distance sensors and adjust the drive motors according to which it runs deterministically so that the robot avoids obstacles.

To demonstrate the functioning of the obstacle avoidance robot we have proposed a block diagram shown in figure.2 and figure.3 involving circuit and its various interconnections. The block diagram in figure.2 starts with the initialize Starter Kit 2.0 that communicates with the ultrasonic sensor. The ultrasonic sensor continuously acquires data about the environment around them and generates output signals whenever it sensed any obstacle in its forward path. The obstacle is defined by the sensor in a way that a comparator will compare the distance sensed by the ultrasonic sensor with a user specified threshold distance for avoidance of collision. We have used a case structure of True or False for analyzing the output of comparator. If the sensor distance is greater than the threshold distance then True case continues. Inside the True case a velocity provider owning palette is placed that specifies the right and left velocity of the motor so that robot could move.

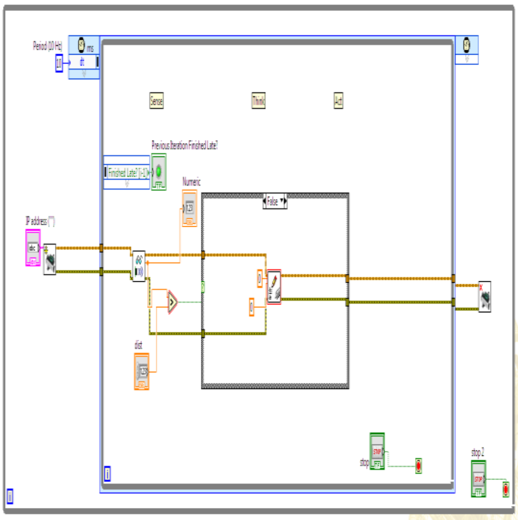

Figure 2. Simple Block Diagram for Obstacle Avoidance

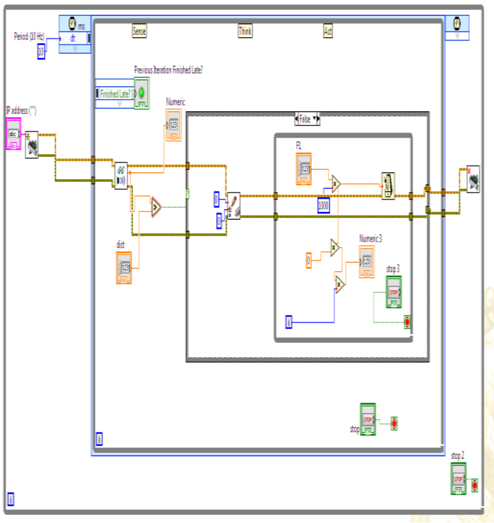

Figure 3. Block Diagram with Timer for Obstacle Avoidance

The motor runs in forward direction until the obstacle is sensed within the threshold range. As when the obstacle is detected then instantly motor stops running which is within false case. In False case, the owning palette is provided with zero left and right velocity so that the motor stops. All these processes have to be placed inside the while loop for continuous iteration. Initialize Starter Kit 2.0 (SbRIO-9632), sensor distance comparator case structure and close Starter Kit have to be wired for getting the output signal that has to be passed to the I/O. So that program can be embedded in the FPGA for the desired work.

The block diagram of Figure 2 has drawbacks in overcoming the malfunction of the components due to its overburden over the system caused by its continuous transition i.e. run and stop within a very small period of time. The block diagram Figure 3 rectifies this drawback. Here inside the False case, a while loop is introduce within which timer circuit is placed. Measured time interval i.e. F1 is user defined which have to be multiply by the factor of 1000 to get the timer interval in millisecond is shown in Figure 2.

Wait until Next ns multiple element is calculating the waiting time of robot when the obstacle remove from the path then instantaneously this robot waits until countdown ends. After finishing of this countdown waiting time, the motor startup and robot run in the forward path. As shown in the figure.3, the iteration counter is connected to the multiplier for getting the elapsed time. Figure 3 removes the demerits of Figure 2 as Figure 3 introduce the timer which makes it easy and removes the burden of robot as in transition process of case structure in fraction of seconds.

4. FLOW CHAT

The distance sensor of the Starter Kit 2.0 robot read the obstacle data acquired about the environment and drives the motor accordingly. The distance sensor detects the obstacle if it is within the range of a user defined threshold distance. If the sensor range ‘m’ is greater than the threshold distance‘d’ then the sensor detects the obstacle and motor stops running. It will continue to remain in its off-state until the sensor senses the free path. Once the sensing range is beyond the threshold distance and as the path become free then the robot tends to move but in order to reduce the burden over the system due to continuous run and stop, a timer is set such that even after the sensor detects removal of obstacle i.e. free path after the obstacle is out of the coverage range instead of continuous movement. The robot waits for certain specified time before running time (given by the user) in order to avoid the sudden transition if on-state and off-state i.e. run and stop respectively which may takes place if after detection of free path, again the obstacle appears within a fraction of seconds which may cause overburden on the components of the system.

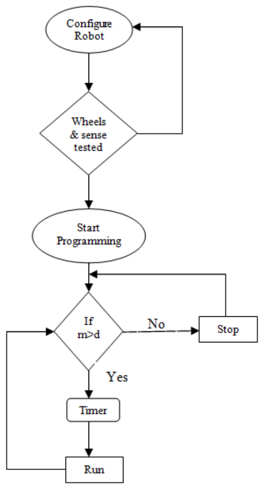

Figure 4. Propose Flow Chat

Here, m= detected range & d= threshold distance.

5. CONCLUSION

Obstacle avoidance strategy by detecting the obstacle in the path is important in scientific exploration and emergency environment. Continuous detection of environment is needed which is done by the ultrasonic sensor. In this paper, proposed two block diagrams for obstacle avoidance i.e. Figure 2 and Figure 3. Here Figure 3 is the alternate block diagram of Figure 2 for the proper functioning of the system by reducing the damage to its components. Continuous swing of stop and run as obstacle might come in the path within fraction of seconds which can be overcome by placing a waiting time circuit. This obstacle avoidance waiting time block will flourish in upcoming years for avoidance of collision by detecting the forward path without hardening in the elements in case of instantaneous transition state.

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