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The Conference is organized by the Military Academy "General Mihailo Apostolski"- Skopje associated member of the University "Goce Delcev" - Shtip, within the RADLI Project (Regional Advance Distributive Learning Initiative), supported by the Kingdom of Norway and implemented by the Jefferson Institute, USA.

The Conference has been immensely supported by the Ministry of Defence and the Armed Forces of the Republic of North Macedonia

Preface


Respected readers,

In front of you is the thematic Proceedings, as a collection of papers presented at the 2nd MILCON’19 Conference "Contemporary education based on ADL", organized on November 12th 2019, by the Military Academy "General MihailoApostolski" - Skopje associated member of the University "Goce Delcev" - Shtip, within the RADLI Project (Regional Advance Distributive Learning Initiative), supported by the Kingdom of Norway and implemented by the Jefferson Institute, USA.

The objective of the Conference was to gather educators and trainers from different countries in order to give us the opportunity to increase both knowledge and cooperation within all aspects of advance distributed learning - ADL. Hence, the Proceedings contain **32** papers focused on the contemporary trends in the use of information technology in a pedagogical way, as well as the best practices both from a theoretical point of view, but also from a practical aspect on the topics related to educational programs using blended learning, emerging learning technologies, multiplatform delivery of courseware, motivational and pedagogical learning strategies and other topics related to ADL. This international scientific conference gives us a wonderful opportunity for exchanging experience and knowledge between the scientific workers and the practitioners from North Macedonia, USA, Serbia, Poland, Slovenia, Bosna and Hercegovina and Norway.

The papers published in the Proceedings are written by eminent scholars as well as by members of the security system participating in the educational process of the army, police and other security services from different countries.

Each paper has been reviewed by international experts competent for the field to which the paper is related.

The data and information gained with the empirical research, as well as theoretical thoughts and comparative analyses in the Proceedings will give a significant contribution to the development of the use of ADL in a pedagogical way.

We wish to extend our gratitude to all authors and participants to the Conference, as well as to all those who contributed to, or supported the Conference, especially the Kingdom of Norway and the Jefferson Institute, as well as to the Ministry of Defense and the Armed Forces of the Republic of North Macedoniafor their immense support of the Conference.

Skopje, November 2019

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An autonomous mobile robot for obstacle avoidance

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Abstract. In this work ARDUINO UNO mobile robotis given, its specifications are given, the way it works, and the constituent elements.Before this, the terms robotics and mechatronics, the very beginings of them and their development are explained in detail.Finally, the software solution of the program that manages the robot is given, the program is presented, and the problems that we encountered in the realization of this project.

Introduction

Avoidance of obstacles is one of the most important aspects of mobile robotics. Without it, the robotic movement would be very inflexible and rigid. This paper proposes a robotic vehicle that has an intelligence built into it so that the vehicle will be all the time in function to avoid obstacles, or, to protect the robot from any physical damage. Here is a design of a robotic vehicle to avoid interference using ultrasonic motion sensors. We use the micro-controller (AT mega 328P) to achieve the desired operation. An ultrasonic sensor is used to detect any error, which sends the information directly to the controller. Depending on the received input signals, the micro-controller redirects the robot to move in an alternate direction by activating the engines that are bound to it by an arbiter for engines.

An autonomous mobile robot for avoiding obstacles is an intelligent device that can automatically bypass and overcome obstacles on its path. Avoidance of obstacles is a robot discipline in order to drive vehicles based on sensory information (information obtained from a sensor). The use of these methods in front of classic methods is a natural alternative when the script is dynamic and unpredictable behavior. In these cases, the environment does not remain unchanged, so the information from the sensor is used to detect changes that are subsequently adapted to the movement.
Later, the robot automatically scans the rest of the environment.

1.1 Arduino / Genuino uno

Arduino / Genuino Uno is a microcontroller board based on the ATmega328P microchip. It has 14 digital input / output pins, of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, USB connection, power plug, and a reset button. It contains everything you need to support the microcontroller, it simply connects to a computer with a USB cable or connects to an AC-to-DC adapter or battery. We can manage the Arduino / Genuino Uno without worrying too much about if we are doing something wrong, the worst case scenario that can happen is replacing the chip for a relatively low price.

"Uno" means "one" in the Italian language and was chosen to mark the release of Arduino Software (IDE) and version 1.0 of Arduino Software (IDE) which were the reference versions of Arduino, now evolved to newer editions.

The UNO board is the first in the series of USB Arduino boards and a reference model for the Arduino platform.

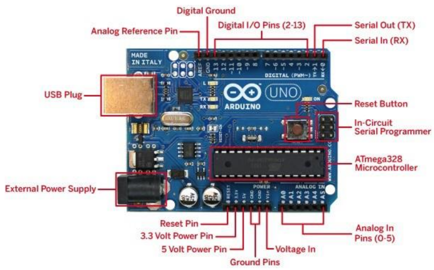

Figure 1. ARDUINO UNO table

In our project, the same ARDUINO UNO board is used as the main element.

1.2 Ultrasonic sensor

The audio waves emitted by the transducer are reflected by the object and returned to the transducer. After broadcasting the sound waves, the ultrasonic sensor will switch to the receive mode. The time spent between broadcasting and receiving is proportional to the distance of the object from the sensor.

An ultrasonic sensor is a device that uses an electrically-mechanical transformation of energy to measure the distance from the sensor to the object. Ultrasonic waves are longitudinal waves traveling as a series of compresses and extensions in the direction of the direction from which it originates from the source.

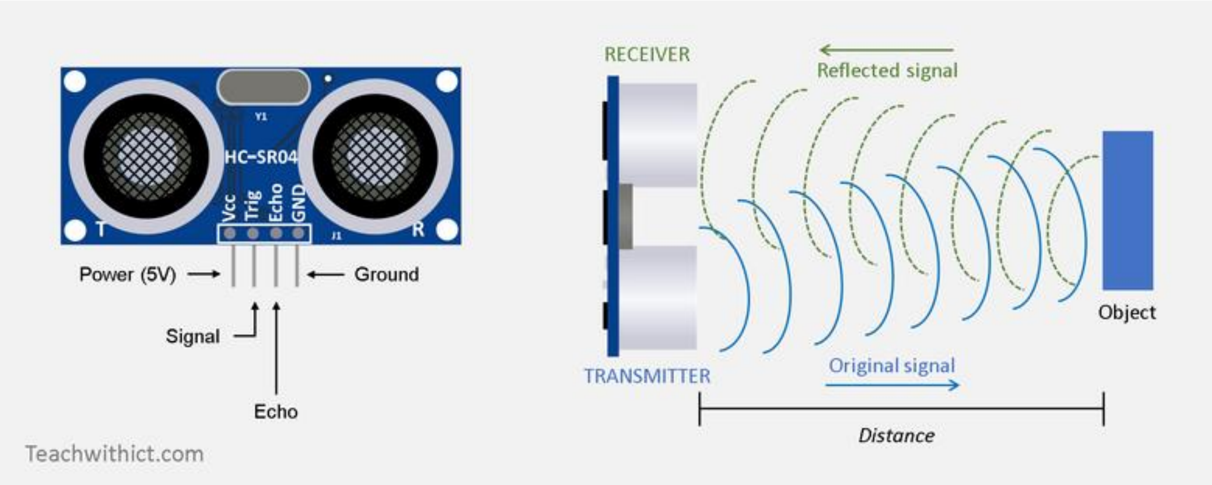

Figure 2. Principle of operation of the ultrasonic sensor

This sensor has 4 pins: VCC, Trig, Echo and GND.

Vcc represents the input voltage.
Trigrefers to the wave that is released.
Echo refers to the return wave.
GNDis themass.

In our project, one such sensor for detecting obstacles is used, and it is placed on the forehead of the robot.

1.3 Driver for engines (L293D)

The L293D is a typical DC motor or IC driver, which enables the DC motor to be operated in any direction. The L293D is a 16-pin IC, which can control a set of two DC motors simultaneously in either direction. This means that we can control two DC motors with one L293D IC.

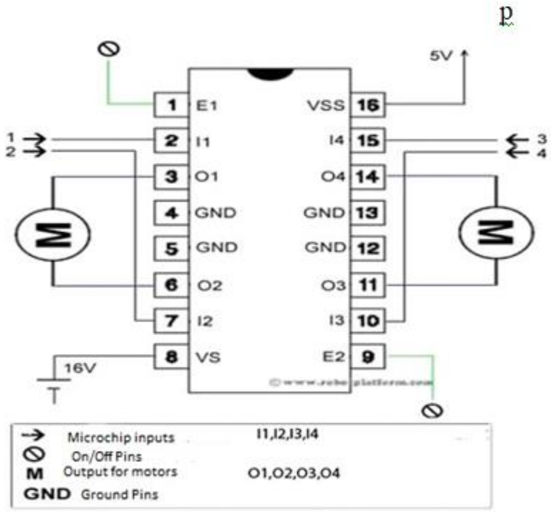

Figure 3. Engine driver schematic (L293D)

The motor driver receives a low current control signal, but provides a larger current signal, and thus acts as a current amplifier. The L293D is a motor driver that allows the movement of two one-way motors either forward or reverse.

To rotate the motor clockwise or counterclockwise, the voltage should change its direction. The H-bridge is a circuit that allows the voltage to change in positive or negative, and in turn, the motor rotates in the same direction.

In its own mode, it can simultaneously operate two DC motors forward, as well as reverse. Engine operation can be controlled with pins [2, 7] and [10, 15]. The logic signal for input 00 or 11 will stop the engine. The logic signal 01 will rotate clockwise, while the logic signal 10 rotates the motor counterclockwise.

In this project for avoidance of obstacles, two engines with a power of 12V DC and 200 revolutions per minute are used.

The used motor has a diameter of 6mm with internal holes. The internal holes are for easy fastening of the wheels using screws. It is easy to use and a relatively cheap robot application engine.

In our project, two samples of the DC engine are used as shown on the picture.

2.1 Robot programming

The control panel is used to communicate with the computer, using a serial communicator (USB connection). An adapter for data transfer is used.

Programming is not hard at all, it is based on the programming language C, which requires the installation of arduino software (IDE), later everything that remains is the construction of the program, which may be the most complex segment of the entire project.

At first, we need the key points around which the program itself will run, the robot's goal is to remain "unharmed" in the movement, which means avoiding the obstacles around it, which is provided by the key robot algorithms below, and later they are written in the programming language of the robot module.

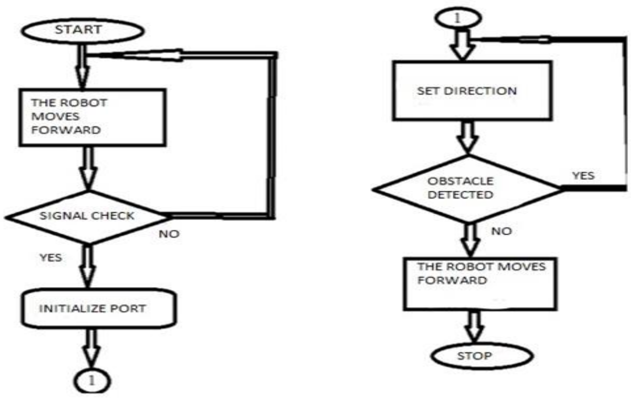

Figure 4. Algorithm

2.2. Algorithm

The following steps are written for the robot itself:
Step 1. An artificial intelligent robot collects information about the situation using sensors.
Step 2. The robot then compares this information with the initial information.
Step 3. The robot then decides on the meaning of the information, compares and determines whether a reaction is needed.
Step 4 The robot predicts what action will be most appropriate on the basis of the information collected.
Step 5. The robot then performs appropriate action and moves accordingly.
Step 6. The robot returns to step no 1.

It remains to describe the program in detail:

#include <AFMotor.h>// insert motor library	**The first command represents the motor driver library, i.e. the <AFMotor.h> library that was previously installed.**
#define trigPin 12 // define pin for triger sensor **#define echoPin 13 //define echo pin**	The second two commands define which pins will be active on the adruino board for the sensor.

AF_DCMotor motor1(1,MOTOR12_64KHZ); // Set the motors
AF_DCMotor motor2(2, MOTOR12_8KHZ);
	With these commands we adjust the pulse-width modulation, that is, with its help, the digital signal that we get at the output becomes analogous, suitable for the engine.

Serial.begin(9600); // begin communication	With this command we start communication with 9600 bits per second.
pinMode(trigPin, OUTPUT); **pinMode(echoPin, INPUT)**	This command sets the pin of the sensor as a sender, while the echo pin as an input.
motor1.setSpeed(105) **motor2.setSpeed(105)**	This command sets engine speeds (rpm).

long duration, distance;	We begin searching the space.
digitalWrite(trigPin, LOW);	We send the sender pin to the low level.
delayMicroseconds(2)	We add a delay of 2 milliseconds which contributes to stabilization of the signal.
digitalWrite(trigPin, HIGH);	This time we put the pin of a high-level sender.
digitalWrite(trigPin, LOW	After a pause, we send it back to the low level again
duration = pulseIn(echoPin, HIGH)	On the variable duration we set the value of echo pin, i.e. time.
distance = (duration/2) / 29.1;	We convert the time received from echo pin to centimeters.
if (distance < 25)	If the distance is less than 20 centimeters
Serial.println ("obstacle detected "); **Serial.println ("details for the obstacle");** **Serial.print (distance);** **Serial.print (" CM!");//** **Serial.println ("obstacle detected, starting to turn");** **Serial.println (" turn");**	The following functions are printed
motor1.run(FORWARD **motor2.run (BACKWARD);**	We set the functions for the engines, thus naming the direction of motion of the robot
motor1.run(FORWARD) **motor2.run(FORWARD);**	If the condition is satisfied, the robot has not noticed any obstacles and continues forwards.

2.2 Robot simulation

In the simulation below we can physically see the robot's behavior around the environment, that is, the robot itself has no prior goal, or point to reach, but its sole task is to avoid any obstacle while remaining intact. The picture below shows that the robot initially has no obstacles and therefore continues straight, at its first obstacle, it changes its direction, and after passing the obstacle it continues its straight line.

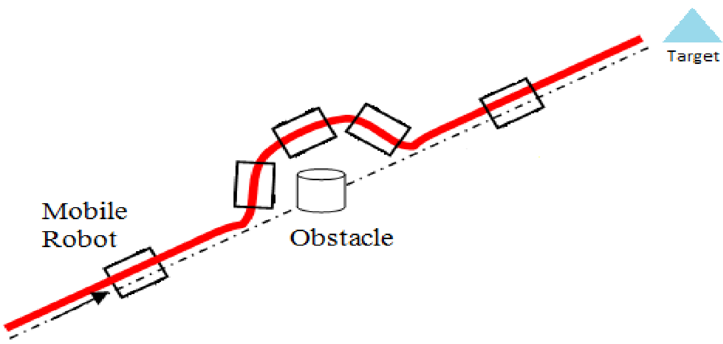

Figure 5. Simulation

The picture below shows more paths a robot can choose when avoiding an obstacle, these paths usually depend on the environment for which they are planned, and also how largeis the surface it will move on**.**
In case there are more obstacles around the robot, this must be taken into consideration when programming, to reduce the robot's visible space, thereby helping the robot to get closer to the objects and thus create more room for maneuver. Otherwise, in a situation where the robot is in a space with fewer obstacles, it is desirable to adjust the sensors to read from a distance, which can further increase the speed of the robot and thus its efficiency.

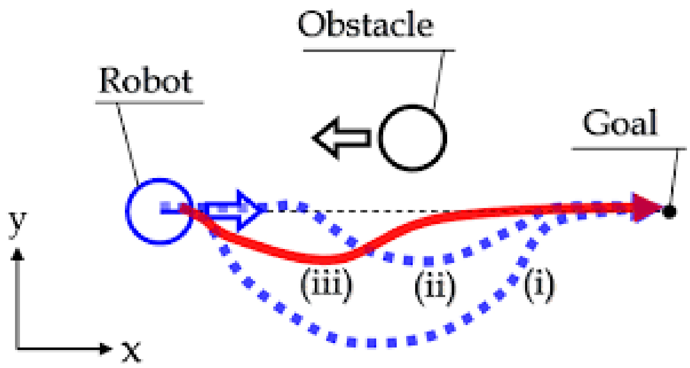

Figure 6. Different paths

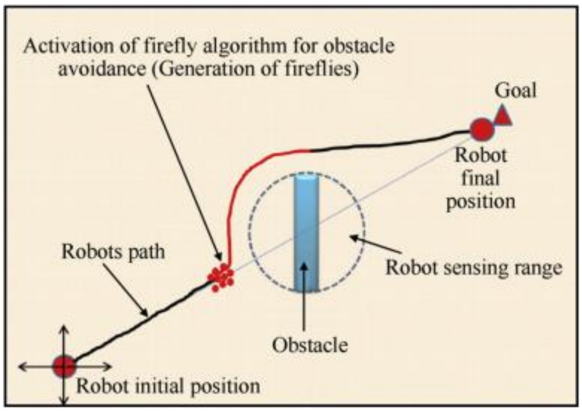

Figure 7. Simulation

Conclusion

As we can conclude, the outcome of the thesis is simple, the autonomous robot controlled by a computer moving around revealing the obstacles on its path, and avoiding them.

The robot emits ultrasonic waves through the ultrasonic emitter, and receives the ultrasonic receiver back for a certain time interval, if there are obstacles and ultrasonic waves colliding with them, then the brain of the robot (microcontroller) will calculate the distance, and analogously it will react to the situation.

This work can be further expanded and used to design alternative technical solutions based on the required specific requirements. This is a small step in forming a completely mobile and autonomous robot that would be able to perform other tasks.

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