Wireless control vehicle via Playstation 2 controller

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ABSTRACT: This article presents a study about the modification of a model vehicle, operated via a Playstation 2 wireless controller. The modified vehicle contains a DC motor for the rear wheels (forward and reverse) and a DC motor on the front wheels (drive right and left). The movements of the two motors are controlled by an ARDUINO V3 microcontroller, which communicates wirelessly with the PS2 controller, from which the operator can operate the vehicle. An ultrasonic sensor has been added to the construction, in order to avoid the vehicle colliding with stable or unstable obstacles.

INTRODUCTION

Small scale remote control vehicles are widely known and widely used in modelling and children's games. Their use, however, has not been confined to that and specially modified remotely operated vehicles are used by:

- The army (mine defusing vehicles).
- The police (bomb defusing vehicles).
- The fire brigade (vehicles which move in collapsed buildings, aiming to find survivors).
- Big companies (remote control cranes).

In the above examples, one can see the necessity of using remote control vehicles for carrying out certain tasks. They can be used in situations where human life is endangered or in order to reduce the risk of injury to humans. In such cases, it is important to remember that the response between the command handler and the controlled vehicle has to be fast and accurate, and even a minor failure could have tragic consequences.

In the study outlined in this article, the objective was to build a controller to execute the basic movements of a remote control vehicle, with relatively good response and precision in the movements, while keeping the cost of construction low. For this reason, a mass production remote control vehicle was used, and a widely available low-cost controller. The accuracy of the controller and the transceiver are reasonable in comparison with the high cost specialised vehicles.

HISTORICAL DATA

In 1898, Nikola Tesla applied the radio waves to direct movements of a robot-boat in a pool of water for the first time. Radio waves were unknown in 1898. Tesla constructed a special boat with an antenna, which received the radio waves transmitted by the command post [1]. Those radio waves were received by a special radiosensitive device called coherer, which transmitted the radio waves into mechanical movements of the boat's propellers. Tesla changed the boat's direction with manually operated controls on the command post.

The first remote controlled vehicles were created for military use. Teletanks were a series of wireless remotely controlled unmanned tanks produced in the Soviet Union in the 1930s and early 1940s. They saw their first combat use in the Winter War, at the start of World War II. A teletank is controlled by radio from a control tank at a distance of 500 - 1,500 metres, the two constituting of a *telemechanical group*. Teletanks were used by the Soviet Red Army in the Winter War, fielding at least two teletank battalions at the beginning of the War.

In the entertainment business, in 1966, an Italian company *Elettronica Giocattoli* produced the first small scale radio controlled car, a Ferrari 250 lm. In the field of video games. Officially the first wireless controller gaming device was the CX-42 for the Atari 2600.

DETERMINATION OF THE REMOTE CONTROL

By the term remote control, it is meant the control from a distance of one or more machines. More specifically, a remote controlled vehicle is defined as a vehicle, which is controlled by a means which does not restrict its movement with external media, such as wiring between controller and vehicle.

A remote controlled vehicle is directed by a robot, but vehicle movements are always controlled by humans and the vehicle will not move if it does not receive any initiative to move.

TYPES OF REMOTE CONTROLLED VEHICLES

Radio controlled vehicles vary and differ according to the applications used, so there cannot be clear separation between different types. In this article, vehicles have been classified according to their size:

- Small- and very small-sized vehicles, which are used mainly in modelling and for entertainment use.
- Medium-sized vehicles used in scientific applications, in the security forces and in the army.
- Large-sized vehicles and large payload vehicles which are used by major industries.

REMOTE CONTROLLED CARS AND APPLICATIONS

As mentioned earlier, remote controlled vehicles were developed and first used by the army, although they are best known in the entertainment sector (small remote controlled cars). However, they are found in numerous applications in many other fields, including:

- Science: the remote controlled vehicles have a great contribution to make in the field of science. They have enabled scientists to collect scientific data in environments where under other circumstances, it would not have been possible to move. For example, data collection in environments with high concentrations of chemicals or radiation, working in the oceans' depths, and even in space exploration.
- Army and police: specially equipped remote controlled vehicles are used by security forces to neutralise explosives. In the army, vehicles equipped with cameras provide an image of areas where soldiers either do not have access or are dangerous.
- Industry: remote controlled vehicles used by major industries for transporting heavy parts and products within the industry (with electric motors) or longer distances (with diesel motors). The advantages of these vehicles are:

  - Maximising the transport space as there is no driving cab.
  - Large transfer capabilities. These specialty vehicles can carry items weighing up to 1,200 tons.
  - Greater flexibility in tight spaces compared with conventional vehicles, as the majority of these vehicles are capable of rotation through 360°.
  - Low noise levels within the industry, because the motion is achieved using motors powered by heavy batteries.
  - Maximise operator safety as the operator is located at a distance from the transported object.
  - Optimal handling and movement in space, as the operator-driver have a complete picture of the space and the object being carried.

- Recreation and hobbies: small-scale remote controlled vehicles have long been popular among modellers. These remote controlled vehicles span wide ranges in price and sophistication. There are many types of remote controlled vehicles or gasoline or electric. These include on-road cars, off road vehicles, ships, aeroplanes and even helicopters.
- Other uses: in the Olympic Games in London in 2012, for the first time, one saw small remote controlled vehicles used for transportation of javelins, hammers, discs and shot putts for their respective events. More specifically, the vehicles transported the objects from the drop point back to the throw line. These vehicles carrying weight to eight (8) pounds and had sufficient power to run for 35 minutes.

TYPES OF MOTORS

For the movement of such vehicles, two kinds of engines are used: internal combustion engines and electric motors [2]. Any type of motor has advantages and disadvantages which determine if the type of engine to be used for the movement of vehicles is suitable or not. With internal combustion engines, the fuel may be petrol, nitromethanolth (especially in modelling) or a fuel mixture. With electric motors, the following types are distinguished:

- DC motors;
- Stepper motors;
- Servo motors.

TYPES OF SENSORS

Vehicles, which are used for specific applications and purposes can have additional sensors, such as:

- Gas sensor - detects dangerous gasses;
- Infrared sensor - locating persons trapped in debris or in total darkness;
- Gieger-Muller radiation sensor - checks, measures and notifies the levels of radioactivity;
- Ultrasonic sensor - used in remote controlled vehicles for obstacle avoidance, which are not visible by the operator;
- Metal detector - used primarily by the army in minesweeper vehicles.

DETAILED DESCRIPTION OF THE CONSTRUCTION

The construction consists of the vehicle's chassis, which features four wheels, with the rear wheels providing the forwards and backwards movements and the front wheels, the movements right and left (Figure 1). The movement and direction of the vehicle is achieved by using two DC motors [2].

The engines take the proper operating voltage from a power supply circuit. This circuit consists of two L293D chips, which take commands from the microcontroller. The direction commands are given by a remote control (type Playstation 2) [3][4]. The remote control transmits the commands at the appropriate radio frequency to the transceiver, which is mounted in the vehicle and connected to the microcontroller [5].

Also, there is an ultrasonic sensor at the front of the vehicle in which it is determined at a certain operating distance. The transducer operating voltage is 5V, which is supplied by an L7805 voltage regulator. The control signal and the input signal of this are lead to the controller. The controller board is an Arduino Uno R3, with an Atmel AVR (ATmega328) integrated microcontroller. In the wireless controller, cross keys were used to move forwards, backwards, left and right and the four keys from the right side of the wireless controller for specified uses.

More specifically, by pressing a key, the operator sends control signals to the transceiver, which, in turn, directs an appropriate signal to the controller. Then, the controller interprets this signal and sends an operating signal to the appropriate motor. Furthermore, the ultrasonic sensor sends a signal to the controller and blocks the operation of the motors, if incorrect distances have been assumed.

Figure 1: The Playstation 2 controller and the remote controlled vehicle.

EDUCATIONAL USE

Simple construction can easily be used for educational purposes. The materials are readily available and at low cost. More specifically, students can be provided with a vehicle with an Arduino microcontroller. Students having a basic vehicle can add components and sensory control devices depending on the application required, e.g. automatic parking.

The ability to add sensors is provided by the microcontroller by means of digital and analogue ports. In terms of software, the Arduino programming language is easy to learn and simple to use.

The Arduino microcontroller is also an open source application and many applications have been developed using Arduino. Students, therefore, have the ability to understand its use. With this educational platform, students will be able to understand the use of electronic components and how to connect them. They will also be able understand how to connect sensors to the microcontroller and programming them. Finally, they will be able to construct an integrated control system that responds to operations and to external stimuli e.g. fire detecting vehicle.

RESULTS

This article outlines the partial construction of a remote control vehicle via a wireless gaming console controller, both software and hardware. The construction aimed to create a platform for both educational and entertainment purposes, but at the lowest possible cost. This construction can be used for educational purposes at the programming, and use of microcontrollers and accessories (sensors, LEDs, etc).

The use of the Arduino microcontroller and choosing a financially-viable vehicle as the basis of this construction enables the creation of many such vehicles. Thus, each vehicle can present variations in both the code level and at the level of construction (sensors, etc), depending on the requirements and capabilities of each user. After tests conducted on the vehicle, it was found that it responded instantly to handling instructions, and at a fairly long range (10 metres). It also provided satisfactory time autonomy of 10 to 15 minutes.

ADVANTAGES-DISADVANTAGES

Advantages

Comparing the construction outlined here with high-tech electric remote control vehicles and materials that are used in their manufacture shows this vehicle to be much cheaper. The basic difference is the use of a plastic chassis without additional features, such as suspension, addition of which would double the cost. Another difference is the remote control unit that was used, which is game console. Here again the costs are lower while superior in handling capabilities, as it offers 15 buttons, which means it can expand the functions of the vehicle, while conventional controls are limited to two basic control buttons.

Finally, the microcontroller used allows for low construction costs without reducing handling capacity. Through a simple programming language, it provides the opportunity to intervene in the operations of the vehicle and offers great flexibility in terms of the control and scalability of the construction due to the digital and analogue ports and serial communication. With this vehicle, it is possible to add additional components like sensors, LEDs or a clamshell.

Disadvantages

This construction, however, presents certain drawbacks. Time autonomy is limited because the vehicle’s power source comes from conventional batteries. Also, the plastic construction of the chassis has low resistance in collisions, and the absence of suspension and tyres limits the movement abilities of the vehicle on abnormal terrains. Finally, another disadvantage is that the front wheels overheat.

IMPROVEMENT ABILITIES

As mentioned above, the chassis of the vehicle limits the ability to move in soils (clay, rocky, sloping). This could be improved by using a more resilient chassis and by adding suspension and larger wheels with hard rubber. A further improvement could be made in torque and speed, with the use of a more powerful DC motor for the rear wheels. The main improvement that could be made in the construction is the use of a controller with more digital and analogue ports. This would enable the adding of more sensors and functional components.

CONCLUSIONS

This article was written after one cohort of students had completed the course on automation at the Technological Education Institute of Piraeus. In accordance with the curriculum of the Department of Automation, the duration of studies is eight semesters, of which seven include theoretical classroom and laboratory courses, tutorials and seminars, as well as preparation work and studies and, finally, the preparation of thesis. The eighth semester includes traineeships in occupational areas. The purpose of preparing the dissertation is for the student to be able to apply the knowledge gained during his studies and go from the general to the specific, specialising on a particular object.

Before the final selection of the test object and writing the dissertation, the student undertakes a literature review in order to obtain further knowledge on the subject. Information sources include books, scientific articles, conference proceedings, dissertations, postgraduate dissertations, theses and in special cases, Web sites. Finally, according to the

programme of study, the student must be able to present his or her work. During the presentation, the student should be able to speak clearly on the issue that he/she has been working on. They should also be able to answer comprehensive questions from the audience.

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