

An Intelligent Robot with Infinity Controls Making Life Easier for People with Disabilities and Aging

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Abstract: The evolution of technology, affecting all fields, requires artificial intelligence. In this article, this intelligence manifests itself in the creation of a system that can be used as a solution for different problems in different domains. For this purpose, we have created a control table with a robot brought by a control weapon via bluetooth. The control of the robot is based on the detection of the simple red color of the laser and the weapon is controlled according to the detection of the finger touch.

Key words: Baro 4WD, touchscreen, BLE Link—a bluetooth 4.0 module, folding webcam, visual studio, image processing.

1. Introduction

From the 1950s, robotics developed thanks to the rise of computer science and advances in artificial intelligence research. Machines controlled by computers, more and more autonomous and able to determine the behavior to adopt facing an event, are born [1].

Now robots are going to develop which looks like human and scientist are trying to put emotions in them [2].

Robots are poised to fill a growing number of roles in today's society, from factory automation to service applications to medical care and entertainment [3].

The relation of man to the robot has always been ambiguous: Man creates robots more and more advanced and autonomous to relieve themselves of tedious tasks, repetitive or dangerous [1].

The successful introduction of robotics into human environments will reduce fatigue, increase precision, and improve quality [4] and will rely on the development of competent and practical systems that are dependable, safe, and easy to use [4].

Assistance to disabled people is still a domain in which a lot of progress needs to be done. The more

severe the handicap is, more complex are the devices, implying increased efforts to simplify the interactions between man and these devices [5].

Artificial intelligence is the intelligence exhibited by machines or software. It is the subfield of computer science. Artificial intelligence is becoming a popular field in computer science as it has enhanced the human life in many areas [6]. As name implies artificial intelligence is making the machines like human that can think like human and can do the work like human [2].

Application areas of artificial intelligence is having a huge impact on various fields of life as expert system is widely used these days to solve the complex problems in various areas as science, engineering, business, medicine, weather forecasting [6] fault diagnosis, automatic configuration, artificial vision and pattern recognition, speech and language comprehension, supervision of industrial production systems, automatic planning of space missions.

The areas employing the technology of Artificial Intelligence have seen an increase in the quality and efficiency [6].

There are many AI research challenges: providing semantic Web technologies; extract knowledge from large masses of data; realize artificial systems that adapt to a changing environment; realize systems

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where intelligence is distributed among many artificial agents that interact; to be able to reason about time and space; develop robots that are autonomous or able to assist the human being in his tasks, alone or in a community; and above all, to scale, to confront the real problems, the data arriving continuously and in quantity [7].

The importance of embedded applications on image and video processing-used for faster performance-communication and cryptography domain has been taking a larger space in current research era [8]. A few years ago touchscreens were futuristic and only used in industrial applications. Today we do not even think twice before tapping or swapping a touchscreen around us [9]. A touchscreen is any monitor, based either on LCD (liquid crystal display) or CRT (cathode ray tube) technology that accepts direct onscreen input. The ability for direct onscreen input is facilitated by an external (light pen) or an internal device (touch overlay and controller) that relays the X, Y coordinates to the computer [10].

Touchscreen technology has the potential to replace most functions of the mouse and keyboard. The touchscreen interface is being used in a wide variety of applications to improve humancomputer interaction. As the technology advances, people may be able to operate computers without mice and keyboards [10].

It's easier for people to interact with a device using their finger than it is to point a mouse to the right location [9]. The touchscreen is an assistive technology. This interface can be beneficial to those that have difficulty in using other input devices such as a mouse or keyboard.

The ability to transform any surface in a touchscreen means lower costs, making the technology more cost effective [10].

2. Robot and Table Design

The project contains two parts:

- The robot “Barron 4WD”, including: the Arduino “Romeo V2-All in one Controller”, the Bluetooth

shield “BLE Link—A Bluetooth 4.0 module”, Lipo 2200mAh Battery, the weapon formed by a Pan and Tilt Kit, two Servos and Robot Gripper-Extra Width (Fig. 2).

- Our table design with a Folding Webcam. The table is considered like a screen touch.

It is made simply of aluminum with brown glass plate (Figs.1a and 1b).

3. Components of Touchscreen

A basic touchscreen has three main components: a

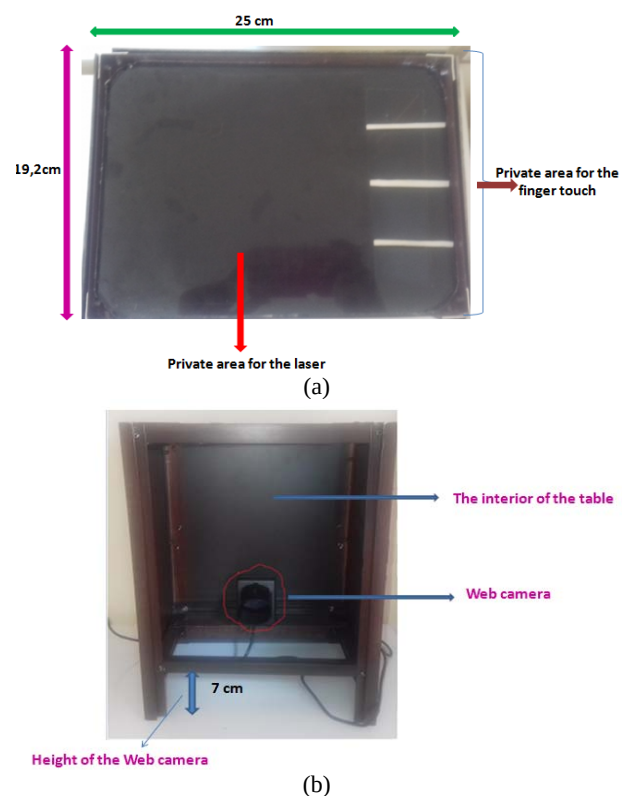


Fig. 1 Table design.

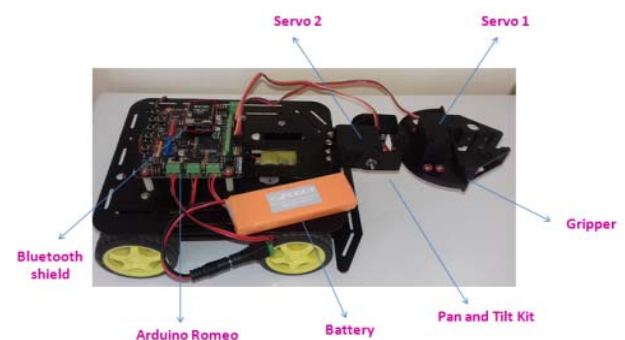


Fig. 2 Robot design.

touch sensor, a controller, and a software driver. The touchscreen is an input device, so it needs to be combined with a display and a PC or other device to make a complete touch input system [10].

(1) Touch Sensor

A touch screen sensor is a clear glass panel with a touch responsive surface. The touch sensor/panel is placed over a display screen so that the responsive area of the panel covers the viewable area of the video screen. The sensor generally has an electrical current or signal going through it and touching the screen causes a voltage or signal change. This voltage change is used to determine the location of the touch to the screen [10].

(2) Controller

The controller is a small PC card that connects between the touch sensor and the PC. It takes information from the touch sensor and translates it into information that PC can understand. The controller is usually installed inside the monitor for integrated monitors or it is housed in a plastic case for external touch addons/overlays. The controller determines what type of interface/connection you will need on the PC. Controllers are available that can connect to a Serial/COM port (PC) or to a USB port (PC or Macintosh). Specialized controllers are also available that work with DVD players and other devices [10].

(3) Software Driver

The driver is a software update for the PC system that allows the touch screen and computer to work together. It tells the computer's operating system how to interpret the touch event information that is sent from the controller. Some equipment such as thin client terminals, DVD players, and specialized computer systems either do not use software drivers or they have their own built-in touch screen driver [10].

In our project, we do not use any touch sensor. The detection of touch is made by image capture via camera. The system does not contain any controller. We only use a folding webcam connecting via serial port to our pc. And the software used in our project is the VISUAL STUDIO.

Our touch screen is a table of aluminum (high: 35 cm, brown glass plate: length: 25cm, width: 19.2cm).

We know that all new touch screens are made of different materials and small devices very sensitive, which makes their maintenance very difficult as well as sometimes impossible.

If we compare our touch screen with one of the most simple screen, "a simple low cost Touchscreen to Control Home Automation System" [11].

Their project needs 3 components:

(1) Touchscreen device

In this section we will describe the design of the touchscreen. At first, some laser beams are arranged closely with vertical axis and on the opposite site of the same axis some photo resistors are placed with the line of sight of the laser beams. Photo resistors act as sensors. Now the same things are done with horizontal axis. Fig. 4 shows the diagram of the proposed touchscreen.

(2) Required Software Development

Software components are required to receive data from the touchscreen and process the data to extract



Fig. 3 Components of touch screen.

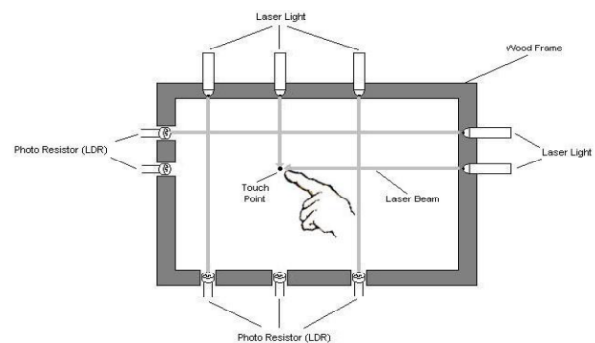


Fig. 4 Description of touch screen design.

information relevant to determine whether a touch occurs or not. The information is extracted to determine the location of the touch and make decision to send command to the output component. Fig. 5 summarizes the general design of the software component.

(3) Interfacing of output circuit

Output circuits are connected with the desired electrical devices. To design the output circuit we have used relay switch. A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. The interfacing circuit for four electrical devices is shown in e Fig. 6.

Many such projects have been created. In each new innovation we wish to achieve our goals. Different advantages characterize our project.

In the case of normal screens, it is necessary to replace the deteriorated devices. This operation is very complicated and requires a lot of precision. In our project, we are far from these problems.

Our project does not require a complicated maintenance. It is sufficient to change the glass plate in

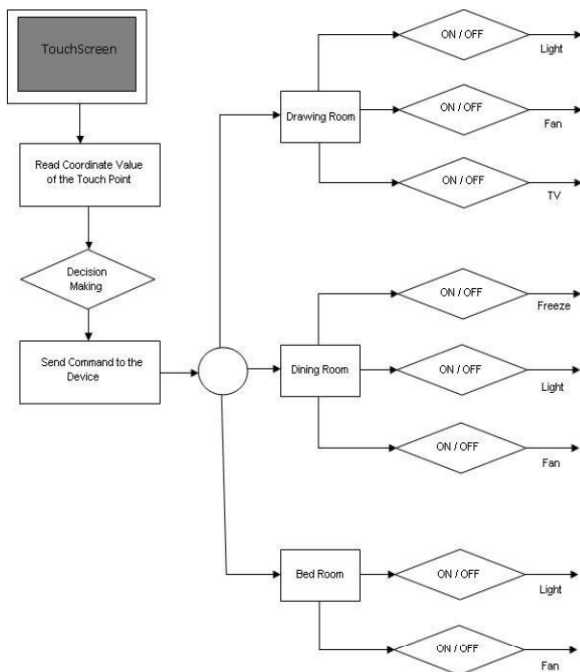


Fig. 5 Design of software component.

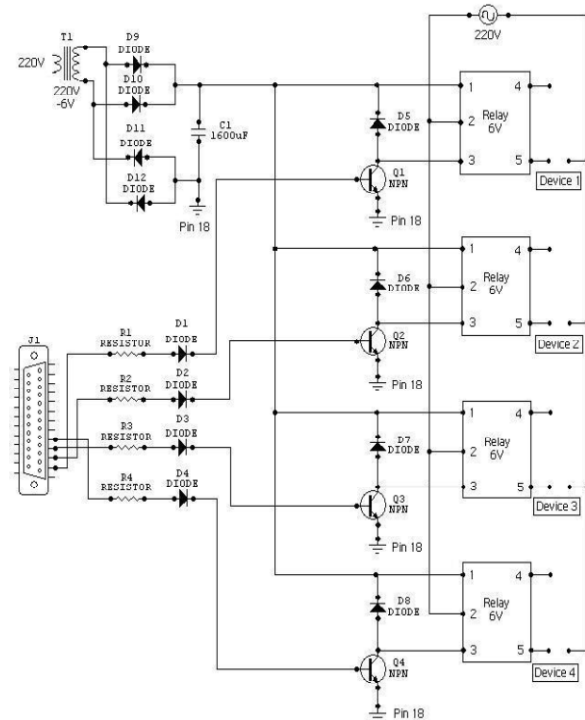


Fig. 6 Interfacing circuit for four electrical devices.

the event of breakage or a replacement of the broken camera.

As well as the realization of table is very easy and simple contrary to the normal screens. They require very thin and precise welding because imprecision causes operational problems.

This table considered as a screen touch, economically does not cost expensive. Even if we compare it by the cheapest touch in the world, (Momomo Ebook reader smart with card slot Extended 7inch Touch Screen digital E-book+recording +Video+MP3 music Wifi player (41.90\$), 12 Inch Resistive Touch Screen Monitor with HDMI DVI USB (98.0\$), 21.5" Pcap Open Frame Touch Monitor, Kiosk Touch Screen Monitor(300\$)) it costs only 15\$ and with low weight.

On the other hand, the remote control is simply a laser. It is not a professional laser. It is one that we can buy at 3\$. You can never find a remote control at this price, easy to use, and does not need maintenance. Note that it is easier to use a laser than using any other remote control like a mouse for example to point to the right location, especially for the handicaps.

And we know that colors are very varied. We use this variety to maximize the number of input. Infinity of commands using simple input, it is one of our goals.

We need this simplicity especially for the disabled and those suffering from mental and physical problems.

4. Description of the System

In our project, we control 2 parts: the robot and the weapon. This control is done with the table considered like a touch screen.

It is divided into two areas, the first one to control the robot via the red color of the laser, and the second one to control the weapon via the finger.

When we detect the laser red color, then we identify the direction of the robot.

The position of the red color (value of x and y) indicates the direction to be follow ($dx > 0$ to the right, $dx < 0$ to the left, $dy > 0$ to the front, $dy < 0$ to backward).

The input is only this red color. But the robot commands are multiples:

Forward, backward, to right, to left, forward to the right, forward to the left, backward to the right and backward to the left (Fig. 7).

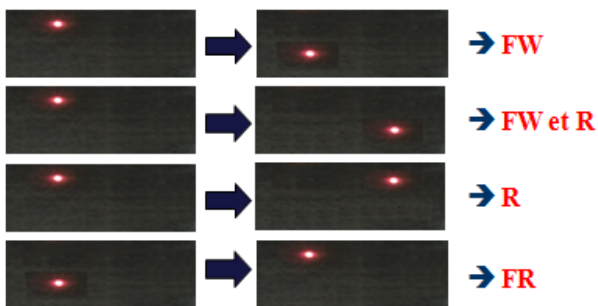


Fig. 7 Detection of red color.

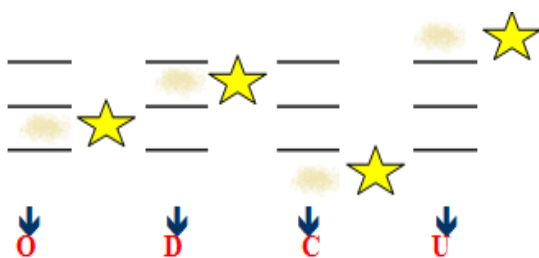


Fig. 8 Detection of finger print.

A single entry is used to control the weapon. Our finger touch is also the only input.

According to the finger position on the suitable area, the weapon performs four functions: opening, closing, up and down (Fig. 8).

5. Design in Visual Studio

It was important to create an easy-to-use system especially for people with mental or physical disabilities. In this case, we approve that our project eliminates the problem of disability and it does not demand a lot of effort to be applied.

The system is as following:

In the “Form.cs [Design]” window, we created our model:

- A serialPort1 to set the bluetooth shield.
- A textbox containing the “COM” accessible, below which a label “Puerto serial”.
- A textbox containing the “9600” transmission speed, below which a “Baudrate” label.
- A “connect” button to make the bluetooth accessible (serial-Port1.Open()).
- Four buttons for the different directions of the robot, controlled via bluetooth, and a stop button that stops any command.
- A pictureBox1, of size 320; 240. And a WebCamCapture of height 240, width 320 and TimeToCapture 100.

In addition, two buttons:

- a “Start” button: which allows the beginning of the capture of the video.
- a “Stop” button: which allows the capture of the video to stop.

The system starts capturing the video. It was now necessary to detect the red color of the laser. For this purpose, we created a bit-map, named “b”. In this bitmap, the color detection was done according to RGB (the three colors: red, green and blue (their values from 0 to 255)).

The programming for the robot to be controlled according to the red color of the laser starts from here.

First of all, it was necessary that each time we move the laser, we specify the coordinates of the detected point.

Then, we added a “textbox”, in which it was specified x and y, each time we clicked the button “test-filter”, with a button “clear” which allows each time to delete the coordinates.

We specify the margin of each of the small areas considered for the weapon on the table by detailing the values of i and j of each.

We insisted on the white color of this area ($r = 255$, $g = 255$, $b = 255$), in which we could easily detect the pixels of our fingers. A small “textbox” allowed us to detect the presence of a key or its absence, on the same “timer” of the webcam, with 3 buttons: “start”, for the initialization of the timer, “stop” for his stop and “clear1” to empty the contents of the textbox.

6. Process and Operation

Operation begins with an image capture. Necessarily, one applies a normalization of luminosity and a filtering of the colors in order to get rid of the parasites.

It needs detection, recording, and then decision of order according to the obtained values.

Let us add here that the red color of the laser is only one of the various inputs that can be used.

For example, a green color is detected on the same detection zone. It works as follows: by drawing a complete turn on the table by the green laser, the robot in this case actually turns a complete turn.

This value will be saved in the databases and then read to be ordered.

Now it's a capture to area of the key. The correlation with the previous image indicates the command to be executed.

From here, a different command can apply.

Other than the finger touch, one can enjoy the application of different colors on the fingers to vary the controls.

For example, the blue color applied to one of the fingers in one of the specified areas means that the

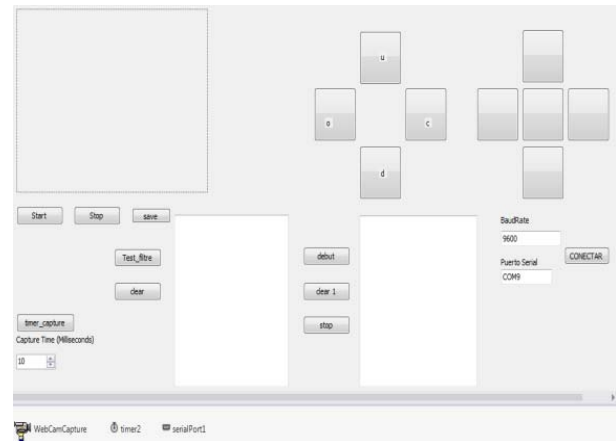


Fig. 9 Visual studio design.

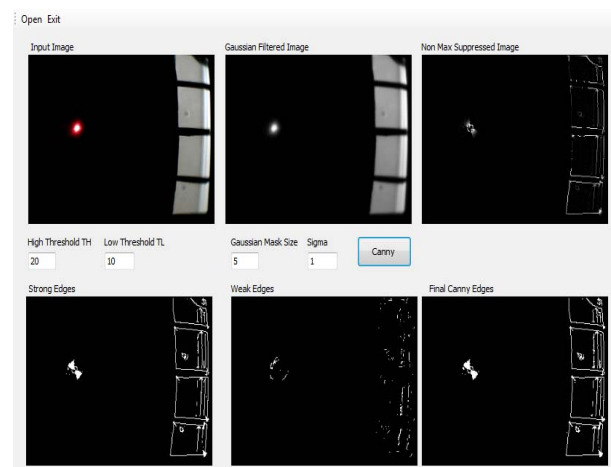


Fig. 10 System process.

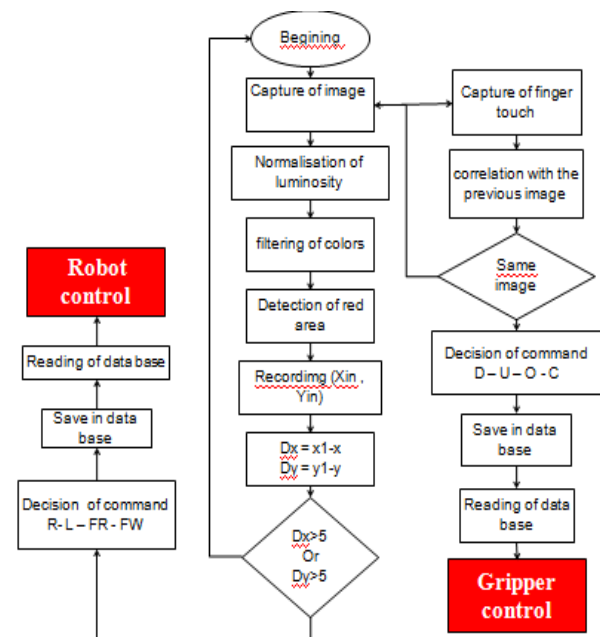


Fig. 11 Filter system.

weapon must rotate 180°.

We have four areas on the table. These four areas used for the simple touch of the finger, different colors and different areas in parallel with different colors.

7. Treatment and Filtration

One of the biggest problems was the parasites caused by the light.

The use of different types of filter, improves the detection and the color distinction necessary to use to control the robot. Such a treatment ensures a good quality/function essential to realize the concept. And to have great results, it is still necessary to eliminate the parasites caused by the reflection camera. So we use insulating layers.

8. Conclusions

End of our project, we have a robot ensuring a good report, quality/cost. We enjoy a simple entry “the color” and a simple “touch of the finger” to order and remotely a robot uses to facilitate life especially for handicaps. Solving the problem of disability was one of the goals. All this is in a simple, enforceable, secure system.

Such a project is used in different fields. It can be used as a service for handicaps; it makes their daily life easy by staying in their place.

It can be used to shorten the time needed to perform multiple tasks at the same time, especially in large factories where the number of workers can be reduced.

And by replacing the camera with a satellite, we can control the robot from one place to another.

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