# OBJECT POSITION COMMAND IN A PLAN BY IMAGE ANALYSIS

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**Abstract:** Always wanted to find solutions to act in dangerous areas, hardly accessible, where human intervention is difficult or even impossible because of existing dangers. Thus, with the help of robotics systems auto ordered or ordered from a distance will avoid such problems, should not direct human action. Such systems can avoid obstacles, sinks, it orientation is based on each situation occur again to reach the destination set.

## Introduction

One of the most important aspects in the evolution of the human is to use tools to simplify the physical work. In this category fall and robots, they are occupying a privileged position because of their complexity.

By the work's achievement is presented such a device is moving in a certain area by radio command from the computer. Choosing the solution of transmission by radio waves indicate a number of advantages such as fast installation, reduced maintenance costs, flexibility in management, mobility and stability. Temptation of an order without fire is extremely high: no holes in walls, wires and cables from many other unpleasant situations. One of the areas of use of the project would conduct ground for the movement of a device (robot) used for automatic recognition, repair, rescue, etc.. through surveillance of aircraft, helicopter or even satellite.

## The structure and working principle

The system proposed includes several functional blocks as distinct but interrelated structure, as in the figure below (figure 1):

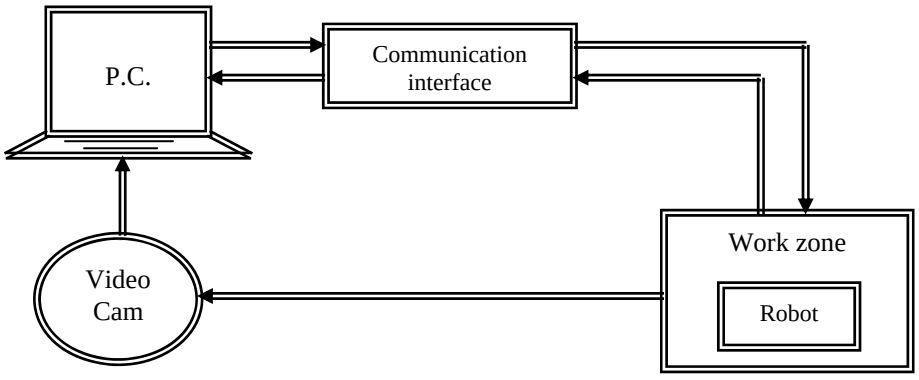


**Fig.1 System principle structure**

Work area is monitored by a video camera that is connected to a computer specialist and transmitting images to it. Computer processing images, make calculations and sends signals through the serial port interface to a communication device. The device receives commands sent by computer to read and perform the movement, with transmission to the various computer information, such as confirmation of receipt of data by the robot and validity of their data from sensors, etc

The ultimate objective is to move a robot in an arbitrarily chosen point in the picture from the camera after a calculated trajectory and generated automatically by computer. There are also necessary corrections of the deviations of the calculated trajectory of the robot, is due sinks area of action or intervention of various external factors

**Structure**

To handle the theoretical aspect of the component system is based on the detailed layout block, shown in Figure 2:

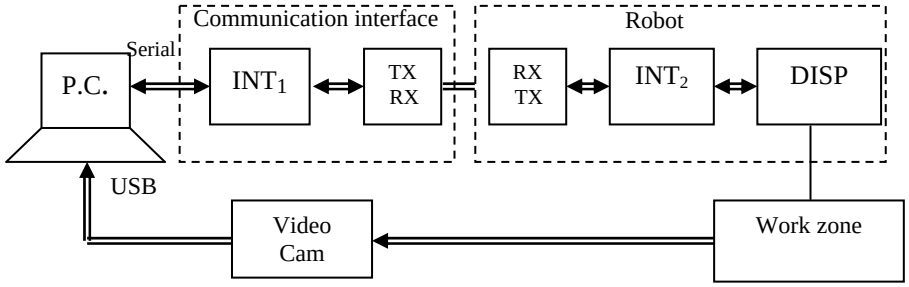


**Fig.2 Block shematic**

The following details the issues on each block constituent part of presenting constructive and functional particularities.

Communication interface consists of two blocks namely: INT1 (interface 1) - represents the link between the computer module and transmission of commands, the reception of data from the device and block TX / RX which is represented by modules emission - reception.

The robot has three parts: DISP (device) - representing all the mechanisms (engines, couple); INT2 (interface 2) - the link between engines and training module of receiving orders and the transmission of data RX / TX that is the receiver modules-emission, additional modules of the interface communication.

*Work Area* does not present a special construction, and *Video Cam* depends on the environment and working conditions in the system.

**Layout – Robot**

The system is made up by work area, the robot-device and communication interface with the computer.

Work area represents the coverage of the device and must be build so must have a solid color background in order to not create confusion when processing images.

Above the area is mounted surveillance video camera. Through it is take pictures of the area, the images that represent information in terms of giving a command, which is also the information side. Camera is connected to the computer via the USB port. For this implementation to use a webcam, Trust 120 SpaceCAM, resolution 640x480, up to 30 fps.

Robot-device is a mechanism that can move in a plan. For it was used a plate-shape square textolite 17x17cm size. These was pierced in the center and were we mount a release bearing. On this plate textolite we mount an electric motor that has provided a support system so as to be mobile to the plate. The disc is made all from textolite and has in it turn perforated

a hole for bearing. Between disc and electric motor adapter is mounted a pressure bearing which, because of its shape, allows to assemble the system to support the disc without blocking the movement toward the plate.

Transverse to the disc has been achieved a cutting and a wheel was mounted fixed with it. The wheel is to move the entire device-robot, being involved by a motor-reducer system that is mounted on the disc. Involve the wheel is achieved through direct contact with the reducer axle, both wheel and reducer is provided with rubber rings.

Reducer is built open, without protection housing and is made up with two serrated wheels which carried a report of processing 15 / 1. Reducer engine is a DC motor which is fed to 9V.

On the disc were mounted second metal rings, concentric, through which supplies the engine used in reducer drive. These rings are in contact with a brush, fixed by the structure of the robot, which carried out the link between electric motor and electronic circuits command. In the structure of the robot, on the textolite board used as a base, was mount a DC motor that drive disc through a belt with the direction of the robot.

In the four corners of the base have mounted "foot" made of metallic material in the form round with thread, and the head of one is mounted a ball.

Also in the structure of the robot-device are included the command and control circuits. "Brain" of the robot-microcontroller AT89C2051 is produced by Atmel.

In the next picture is presented scheme electronic robot with a composition: AT89C2051 integrated circuit, which manages the device-control robot, with the necessary auxiliary circuit.

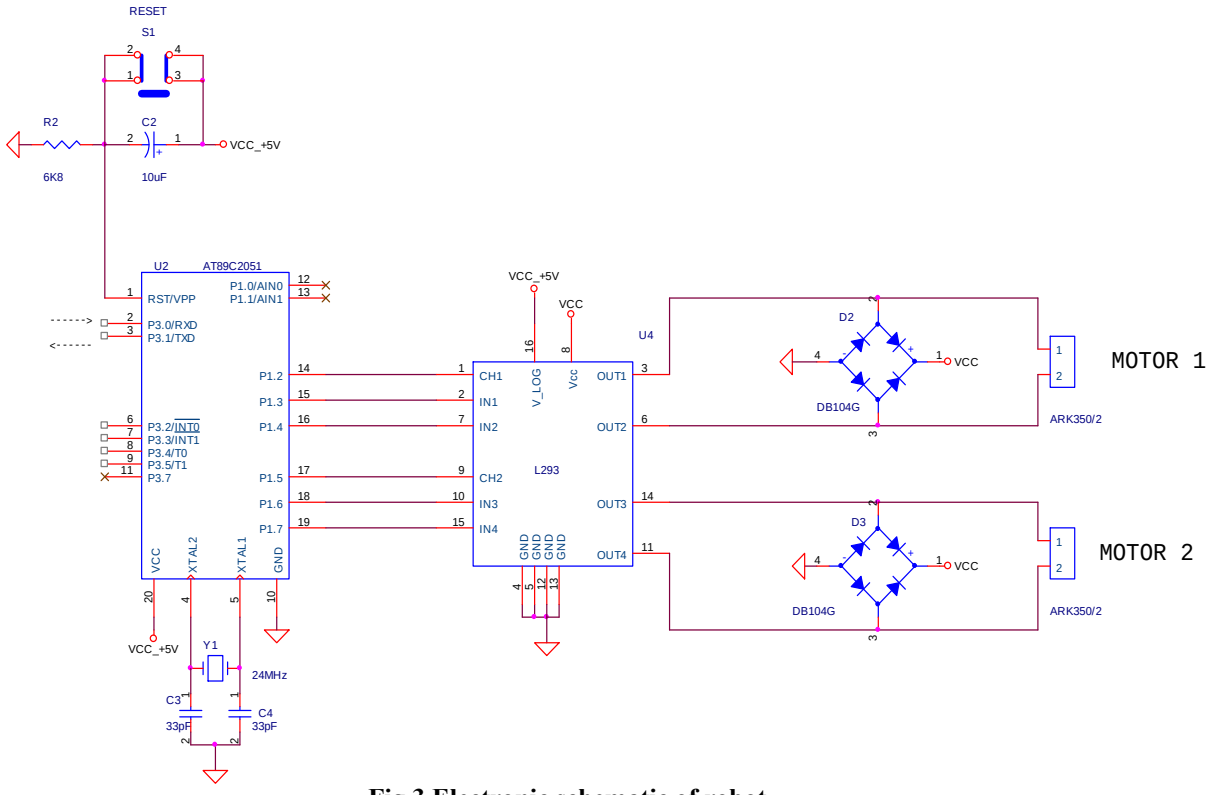


**Fig.3 Electronic schematic of robot**

P1 port lines of microcontroller were used to command L293 integrated circuit. L293 is a driver capable of distributing current to 1A of output per channel. Each channel is ordered by a logic gate TTL (Transistor Transistor Logic). A separate source of tension which maintains logic gate is used in order to operate at a low voltage to reduce losses. L293 has 16-pin (picture above) and uses the four central pin to lead the heat from the radiator cooling.

This supports an integrated circuit voltage power engines connected, VS, the maximum 36V, and the voltage levels for logical vss, up to 36V. The maximum voltage accepted for entry, VI, it is up to 7V.

In the electronic scheme that was used to ordering the device-robot presented were used for each engine, instead of limiting diodes (as appearing in the scheme above), two bridges of diodes which were mounted in such a way that to have the same effect, but reduced the number of routes on wiring.

In the scheme of electronic device-robot, shown above, is not provided and the communication with a microcontroller devices. It may indicate that the robot can be programmed to perform certain movements without supervision from the outside or may have a connection to a computer, for example, to indicate which commands you need to perform.

A very simple connection to the microcontroller is to use lines of the series. On these lines may be a direct connection with the serial port of your computer, either by fire or by radio waves. Wishing robot-like device to be independent (without any external physical connection - cables, wires) has implemented a radio communication between the device and computer-robot.

**Radio communication**

The link between computer and the travel is done by radio communication interface.

Emission and reception modules using radio transmission and reception products company Laipac the TLP315, RLP315, TLP433 and RLP433. These modules operating at the frequency of 315 MHz and 433.92 MHz. TLP (circuit used for broadcasting) can be powered from a voltage between 2V and 12V, the current maximum absorbed in the blood supply of 2V is 1.64 mA, and the case for the power voltage 12V is 19.4 mA. RLP (circuit used for the reception) can be powered from a voltage between 3.3 V and 6V.

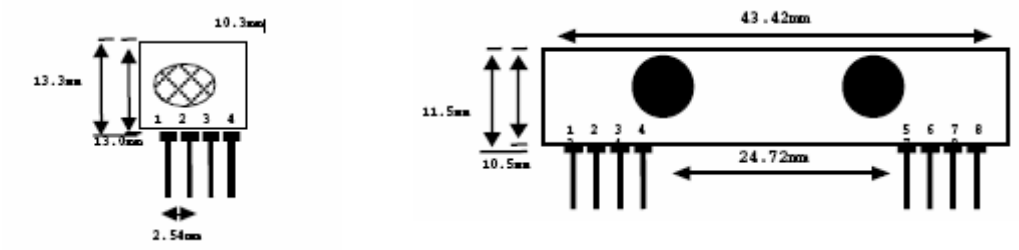


**Fig.4. Pins configuration for TLP and RLP modules**

Pins description for transmission and reception modules is as follows:

a) TLP:

pine 1 - GND

pine 2 - Input data

pine 3 - voltage - VDC

pine 4 - Antenna

b) RLP:

pine 1 - GND

pine 2 - Output data

pine 3 - Exit Test

pine 4 - voltage - VDC

pine 5 - voltage – VDC

pine 6 - GND

pine 7 - GND

pine 8 - Antenna

These modules work using the amplitude modulation. Allow a data transfer rate between 512bps and 200kbps. A big advantage of these modules is that enable transmission, and reception of digital, without the need for converting analog-digital or digital-analog. Unlike analog transmission, digital transmission presents high immunity to noise, requires a few circuits for communications. Thus, communication between two digital devices can be achieved using very simple modules, the only condition being that the serial could work. The modules are used size reduced, and we need the other circuits than to adapt logical levels.

Interfacing modules for radio broadcasting and reception with the computer was used integrated circuit MAX232.

In the next picture is presented scheme of electronic communication computer-radio module.

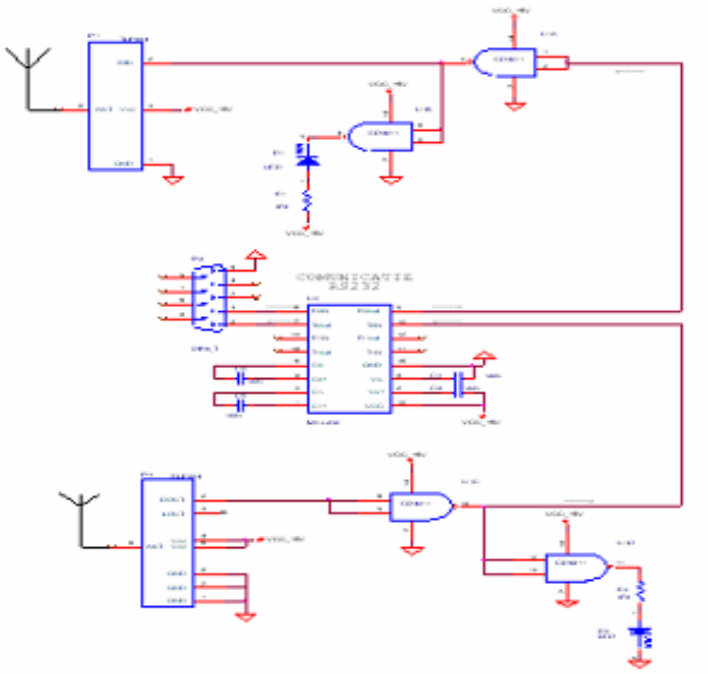

**Fig.5. Communication schematic PC – Radio modules**

MAX 232 is a level converter Charge-Pump specialized circuit. It converts logical levels received at the input to necessary levels for the output circuits: converts logical levels ±12V received from serial port of computer, into TTL logic levels of 0÷5V needed for almost all integrated numerical circuits; converted logical levels 0÷5V received from the integrated circuits from outside into logical levels ±12V necessary for PC serial port.

For signaling that are issued or that it receives on those lines were mounted leduri. In robot-circuit device was added and the broadcasting / radio so that communication can take place.

As power supply to the interface with a computer was used transformer 220V - 6V as a diode bridge and a circuit for stabilizing voltage 5V, L7805.

For device-power circuits, the robot was used only stabilizer circuit voltage of 5V, because it is connected to the 9V batteries.

**Drive algorithm. Operation**

To automatically drive of a robotic device available with a video camera and an interface for communication with it, an algorithm has been adopted and is widely described in this paragraph.

Camera captures images of the area in which is the robotic device. The image is viewed on the computer as a matrix whose size depends on the cameras resolution. Each element of the matrix corresponds with one pixel in the image and is composed of four bytes; in the first three bytes is the R, G, B (red, green, blue) values of the pixel in question. Once captured the image, it is subject to a transformation that facilitates further processing.

Wishing to coordinate the movement of robotic device throughout the area, the area that is monitored by video camera, you must first detect the position of objects in the captured picture. For this we can use the following two methods:

- first method uses a value threshold;
- second method used in processing RGB-HSV.

Using the threshold method involves the following steps: first, the picture turns into shades of gray, depending on the R, G and B. It sets a threshold value (threshold) and based on this value is divided picture thus: gray values that exceed the value of threshold, turns into the background color (white), and values that are below the threshold turns into a black object (black).

This method applies generally in situations where the background color is uniform and very different from that of the object, in order to do the best to separate the background from object.

A second method uses image transformation from RGB into HSV (Hue, Saturation, Value). This transformation is done in the following way: the values of R, G and B to determine the maximum and notes MAX and MIN recorded with the minimum of these values.

Under the formulas below, the resulting H, S and V:

$$H = \begin{cases} 60 \times \frac{G-B}{MAX-MIN} + 0, & \text{if } MAX = R \\ & \text{and } G \geq B \\ 60 \times \frac{G-B}{MAX-MIN} + 360, & \text{if } MAX = R \\ & \text{and } G < B \\ 60 \times \frac{B-R}{MAX-MIN} + 120, & \text{if } MAX = G \\ 60 \times \frac{R-G}{MAX-MIN} + 240, & \text{if } MAX = B \end{cases}$$

$$S = \frac{MAX - MIN}{MAX}$$

$$V = MAX$$

The color tone (H) varies between 0 and 359, indicating the degree angle in the circle where the color tone is located.

The color saturation (S) is between 0 and 255 and the higher, the color is more intense for small amounts, the color tends toward white.

The color value (V) is between 0 and 255 and for higher values the color is more pure, and for smaller values, approaching the color black. For example, for S = 0 and V variable to obtain shades of gray.

We use this method to identify the device-robot in different lighting situations, so the program can control the device.

The image thus processed, it scans pixel by pixel and stores only those pixels that have the same color as that selected or resulting from detection object. In fact, it saves the

coordinates of these pixels in vectors for the x axis and the y axis. It makes an arithmetic average of these coordinates and determines the coordinates of the focus point of the detected object.

If we wish to toggle the robot-device to another point in image, click on the image in that point. In this regard, the program calculates the distance from the point where is the subject to the final point, point target chosen. Calculating the speed helps to determine the speed of movement of the robot. As much as the distance between object and target point is higher than the speed is higher. As we approach to the "target", the distance becomes less and the speed decreases in order to precisely position.

To control the direction of movement we trace, virtually, a trajectory from the point of departure, in which is found the device, at the target point, what emerges from the calculations. In the next figure is represented graphically by determining the desired trajectory.

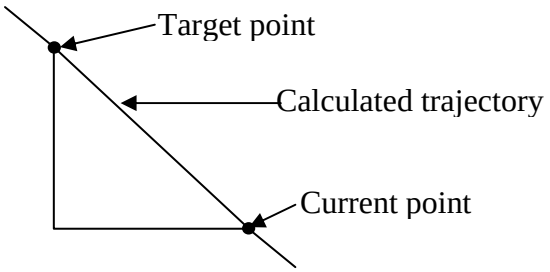


**Fig.6. Calculating the trajectory**

The previous coordinates of the object center are stored in number by 20 points, it is necessary to calculate the trajectory of object. This trajectory is calculated as the arithmetic average of coordinates of earlier points, each point having multiplied coordinates by a number of increasingly smaller, depending on the distance of the current point. This weighting is made to the coordinates of a point left behind with more positions will not affect too much calculation of object trajectory.

Depending on the direction of movement, the trajectory of the object, and the direction we should move, calculated trajectory, is calculating the angle between them. If the angle between the two trajectories is more than 180º then the object must be move to the left, and if the angle is less than 180º, must be move to the left. With both the angle approaching of 180º the speed of movement to the left is greater. If the angle is near by 180º, the speed to the right is greater.

## Conclusions

The project is a future in the supervision and control mechanisms, facilitate labor rights in the production of finished in time, cost and performance features.

The point of departure of this work has been to order a mobile device using images taken from a video camera and wireless transmitting commands.

How the underlying wireless communication has been outlined above.

One of the issues related to radio communication occurred when we attempte a direct connection to TTL circuits. The signals transmitted and received were erroneous. Studying the documentation was found the following fact: the maximum current for modules data lines are very low, around 200μA. To correct this problem have been used CMOS circuits, having in it structure NAND logic gates that were used as reverse gate. Another reason for which was used as a gate CMOS as reverse gate is that the communication lines of computer and microcontroller to stay active in logic “1”, which would mean that all the radio stations operate continuously.

When the receiver/transmitter modules have logic “1” on data line, its transmitting, and on “0” logic, remained in stand-by and received continuous, without transmitting data.

Was done a reverse to transmitter and to receiver, and was obtained as a module to send a signal only when data entry “0” logic. So, for the bilateral communication we have connected two pairs of modules for different frequencies (315 and 433) to not interfere with each other.

Another problem occurred when were connected the electric engines. Because of the electromagnetic field created around the engines that are PWM controlled, one of the modules of the reception was block.

Resolving this issue has come to change the modules from robot-device with one from the computer interface.

Experimental was found that each module has its peculiarities of operation and assembly.

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