

Target Training and Shooting Evaluation System for Live Target

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Abstract—The project “Target Training and Shooting Evaluation System for Live Target” is basically a Real-time scoring system for live fire training. In this project there will be two players wearing two different color jackets. Each player will have a gun with camera mounted on it. The trigger of the gun whenever pressed by any player will send a signal to the microcontroller attached to the corresponding gun. On receiving the trigger signal the microcontroller will further send a signal to the computer using serial com port. When the computer receives the signal from the gun, MATLAB will capture the image of the video at that instant. If the color of the opponent’s jacket is found in the center of the image Point will be added to the shooter score.

I. INTRODUCTION

The main flaw of traditional way to train shooting athletes is that the reaction is hard to be evaluated without live firing. We will form real time one on one target training and shooting that can help athletes do more quality than quantity work. We have formed and implemented a computer aided shooting training and instructing system which is based on image processing. Target Training and Shooting Evaluation System for Live Target is like A First Person Shooting Game (MOHAA) in real life[13].

Working

In this project there will be two players wearing two different color jackets.

Each player will have a gun on which a camera is mounted. Whenever the trigger is pressed by any player it will send a signal to the microcontroller Atmega16 which is attached to the corresponding gun. On receiving the trigger signal the microcontroller will further send a signal to the computer using serial com port. After receiving signal from the gun, MATLAB will capture the image of the video at that instant.

If the color of the opponent’s jacket is found in the center of the image, then it will raise the output [1] shown in figure 1(a) and (b).



Fig 1 (a): Target Training and Shooting Evaluation System



Fig 1 (b): Target Training and Shooting Evaluation System with player1 score

II. PARACTICAL IMPLEMENTATION

It can be used to develop a shooting training environment for the Trainees of the armed forces without going directly to the field with real weapons with some minor modifications this project can be used to build a robot that can shoot targets with accuracy. In high security areas it can be used as surveillance cameras with guns. Where the cameras keep on shriveling and

the guard can shoot anyone in the building while sitting in the monitor room. It can be used to make Automatic Aircraft Shooting Guns [1].

III. ARCHITECTURE OVERVIEW

The design of the intended product is explained graphically with the help of a block diagram shown figure 2. The diagram explains the overall interactions of the modules and their placements.

Block Diagram

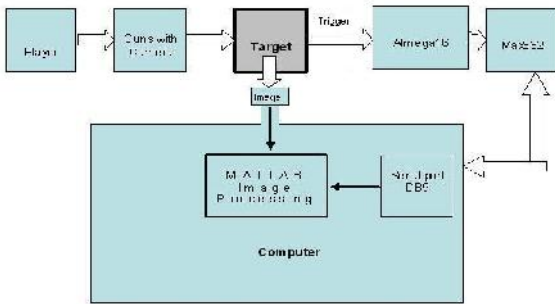


Fig 2: Block Diagram

IV. DESIGN DESCRIPTION

Power Supply

Microcontroller and other circuitry Operate using DC voltages so we use DC 9 volts battery and if we want to use AC power supply we can connect a step down transformer that convert 220 volts AC to 9 volts DC.

Step Down Transfer

Step down is a certain type of transformer device that is designed to reduce electrical voltage. It converts electrical voltage from a high level to the lower level shown in figure 3.

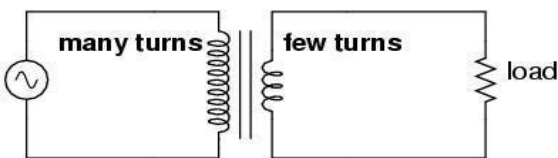


Fig 3: Step-down Transformer

Bridge Rectifier

A bridge rectifier is used to convert AC voltage into the DC Voltages. A bridge rectifier consists of four diodes in a bridge arrangement. This is a widely used configuration, to achieve full-wave rectification. For both negative and positive parts of the AC signal receive from the transformer, there is a forward path through the diode bridge. While one set of diodes is reverse biases, the other set is forward biased explained in figure 4 (a) and (b)[12].

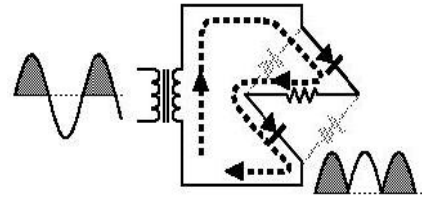


Fig 4: (a) Positive signal Rectification

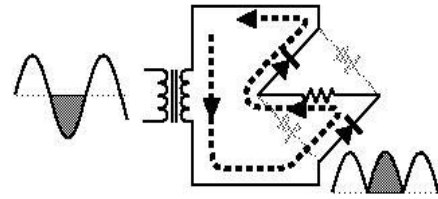


Fig 4: (b) Negative signal Rectification

Voltage Regulator 7805

The 78L05 is a 5 Volts regulator. Input given can vary from 7.5 V to 15 V and output we get is 5 volts shown in figure 5.

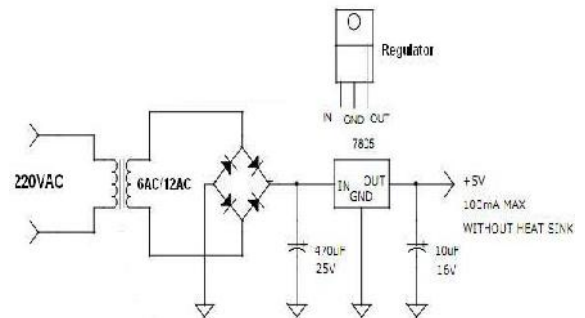


Fig 5: Complete Circuit Diagram of Power supply for 220VAC into 5VDC

Atmega 16 Overview

- ATmega16 shown in figure 6 is an 8-bit microcontroller with high performance
- 40 pin microcontroller
- It is a Atmel's Mega AVR family with low power consumption
- The architecture of the Atmega16 is RISC (Reduced Instruction Set Computing) architecture
- It has 131 powerful instructions
- Most of the instructions execute in one machine

cycle

- 16 MHz is the maximum frequency of Atmega16
- ATmega16 has programmable 16 KB flash memory
- 1KB of static RAM
- 512 Bytes of EEPROM
- The endurance cycle of EEPROM and flash memory is 100,000 and 10,000 and respectively
- 32 I/O (input/output) lines which are divided into 4 ports.

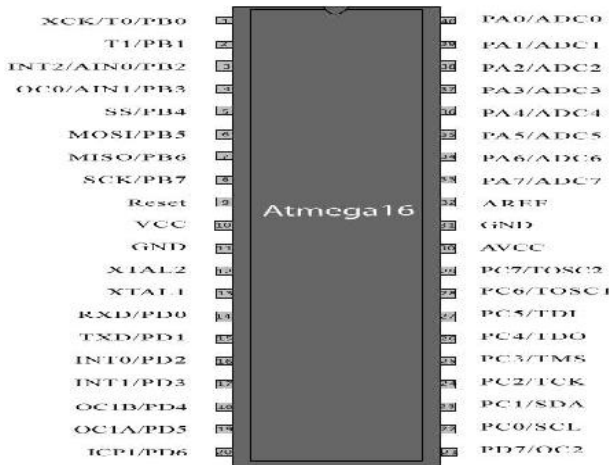


Fig 6: Atmega16 Pin Diagram

MATLAB for image processing

Working with images in MATLAB, some things must be to keep in mind such as using the right format, loading an image, how to display an image, saving the data as different data types, conversion image formats, etc. Different commands are used for these processing. Some of these commands require to have installed with MATLAB the *Image processing tool box*. To find out that this tool is install or not simply type VER at the MATLAB prompt. This command shows list of tool boxes that are installed with the MATLAB [8].

Image formate supported by Matlab

The following image formats are MATLAB supported following image formats

JPEG, HDF, PCX, BMP, XWB, TIFF

Most images on the Internet are a JPEG image that is the name for one of the very widely used standards for compression for images. For example, an image with the JPEG format will be written name as MYIMAGE.JPG.

If an image is stored as a JPEG-image on your computer we firstly read it into MATLAB. However, in order to start working with an image, we must convert it into a different format. There are five formats

Gray scale image, Binary image, RGB image, Indexed image, Multi-frame image
Image format conversion

Different commands are used for these processing. Some of these commands require to have installed with MATLAB the *Image processing tool box*. To find out that this tool is install or not simply type VER at the MATLAB command prompt. This command shows list of tool boxes that are installed with the MATLAB listed in table 1[9].

Table-1: Image format conversion commands

OPERATION	MATLAB COMMANDS
Convert between intensity formats to binary format.	dither()
Convert between intensity formats to indexed format.	gray2ind()
Convert between intensity formats to intensity format.	ind2gray()
Convert between intensity formats to RGB format.	Ind2rgb
Convert between matrixes to intensity format by scaling.	mat2gray
Convert between RGB formats to intensity formats.	rgb2gray
Convert between RGB formats to indexed formats.	rgb2ind

Interface Atmega 16 with max232

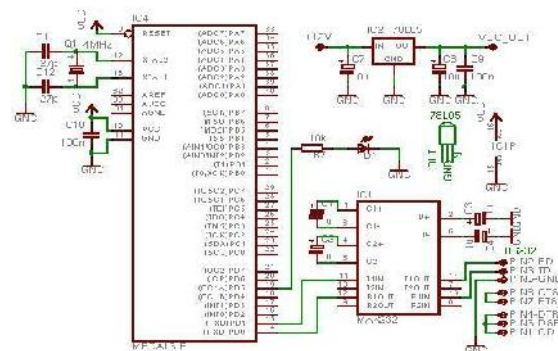


Fig 7: Interface Atmega16 with Max23

V. SERIAL COMMUNICATION

Serial communication is method of transmitting data between a computer and another computer or any peripheral devices such as a programmable instrument, a modem, a printer, or any other scientific instrument. Serial communication uses a transmitter and a receiver, transmitter sends data one bit at a time to a receiver over a single communication line. When the rate or speed of transferring data is slower than this method is being used. And also when we want to transfer data in a longer distance. In serial communication only a cable is required to connect two Pc's together and it needs no extra hardware. This is also a reason why it is commonly used process. Most of the computers have either one or may have more than one serial port as in figure 8.

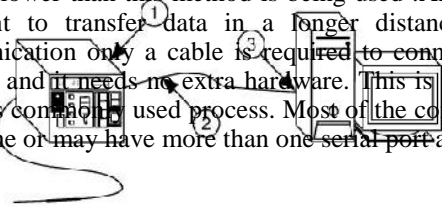


Fig 8: A device performing serial communication through a serial cable.

When a character is transmitted serially, it is put into a character frame. This frame includes a start bit which is followed by data bits. Then next comes to the parity bit which is an optional one followed by a stop bit or bits.

the serial port interface standards

Many different standards of serial port communication are available. Discussing the most common, TIA/EIA-232C standard specifies the serial port interface published by Telecommunications Industry Association. RS-232 is the abbreviation for Recommended Standard number 232. It describes the original standard for serial port interface. The RS-232 standard consists of characteristics of electrical signal such as voltage levels. Also consists of interface mechanical characteristics such as connectors. Functional description of interchange circuits like each electrical signal functions, and some techniques for common kinds of terminal to modem connections. There are also some other EIA serial communications standards available like RS 423, RS 449 and RS 442 which relates to RS 232 standard.

the serial port interface standards

Following four parameters must be specified for serial communication.

- Baud rate of transmission.

Baud rate is a parameter for measuring how fast the data is moving between devices which use serial communication. In this type of coding scheme, the baud rate is same as maximum number of bits of information also including control bits that are transmitted per second

- Number of data bits encoding character.

Data bits are transmitted through the inverted logic. The bits are transmitted from LSB (least significant bit) to MSB (most significant bit). Order of transmission of bits in inverted logic is from upside down and backwards. Data bits are read in character frame from right to left. Read 1 for -ve voltage and 0 for +ve voltage. This produces 1101101 in binary or 6D in hex. Converting it into ASCII shows that the letter is m

- Sense of the optional parity bit.

Data bits are transmitted through the inverted logic. The bits are transmitted from LSB (least significant bit) to MSB (most significant bit). Order of transmission of bits in inverted logic is from upside down and backwards. Data bits are read in character frame from right to left. Read 1 for -ve voltage and 0 for +ve voltage. This produces 1101101 in binary or 6D in hex. Converting it into ASCII shows that the letter is m

- Number of stop bits.

An optional bit named as parity bit follows data bits in the character frame. If present, the parity bit also follows inverted logic method that is 1 for -ve voltage and 0 for +ve voltage. Parity bit is included for simply error handling. This must be decided earlier that parity of the transmission must be even or odd. If the bit is selected odd then the transmitter sets parity bit in order to makes an odd number of ones between the data bits and the parity bit. Odd parity is used in transmission. The parity bit is set 0, because there are 5 ones present in data bits and an already placed odd number. The table 4.1 shows the types of parity checking.

Stop Bits

Stop bits are last part of character frame. Stop bits are 1, 1.5, or 2 bits and are always represented by negative voltage. The line stays in negative (MARK) condition until no further characters are transmitted. If there are any further character frames the transmission of the next frame is declared by a start bit of positive (SPACE) voltage the remaining bits frame the data bits they are called as framing bits [6].

VI. CONNECTING TWO DEVICES WITH A SERIAL CABEL

The RS-232 standard defines a device that uses serial cables for their communication. Dividing them into two categories as the Data Terminal Equipment DTE and Data Circuit-Terminating Equipment DCE These terms are used for finding the direction of the signals on the pins and also for the pin out for the connectors on device. It also reflects RS-232 as standard for communication between computer terminal and modem. DCE are devices like modem, plotter, and TA adapter. And DTE are devices like a computer or terminal. Talking about speed firstly, referring to the terminal speed. It is the speed between modem and computer that is (DTE to DCE). This speed is faster than the DCE to DCE speed. Called as line speed, DCE to DCE is the link between modems. Commonly used modems in today's time are 28.8K or 33.6K modems so the DCE to DCE speed is expected to be either 28.8K or 33.6K. Keeping the same consideration in mind for the high speeds of the modem the DTE to DCE speed is

expected to be about 115,200 BPS. However communication programs which we are using have DCE to DTE speeds settings. And the speed is 9.6 KBPS, 144 KBPS etc. and also the modem speed. Suppose for the transferring of a text file in DCE to DCE at the speed 28.8K the modem compresses it and the actual transfer is at 115.2 KBPS between computers and thus have a DCE- DTE speed of 115.2 KBPS. This is the reason why DCE - DTE speed must be much higher than the modem's connection speed [7][11].

VII. MAX 232 (VOLTAGE LEVEL CONVERTER)

USART is only used for transferring data from PIC to PIC microcontroller only. However to transfer it from PIC to PC addition of another component is required. Max 232 is used to do transmission while staying in RS 232 protocol and is also used for conversion of voltage level from USART to RS232. Because RS232 uses different voltage levels than USART which operates in 0-5 volts range, Max 232 is used. RS232 is different as it uses voltages below -5 volts for the logic level "1". And for logic level "0" it uses above 5 volts. This conversion is done by MAX 232 as MAX 232 itself operate on 5 volts.

Transmission from USART to Computer

When data is being transmitted from USART to computer then pins used are: Pin 10 or Pin 11 is connected to the output of USART. Pin 14 or Pin transmit information to the computer. We have connected Pin 10 of MAX 232 with our microcontrollers Pin number 26. This will carry the information which is transmitted to the computer connected to the output of USART. Pin 7 will transmit this information to the PC by converting the voltage level that is suitable to RS 232. This Pin is connected to the PC end with Pin 3 of DB9 connector.

Transmission from Computer to USART

When data is being transmitted from computer to USART then pins used are Pin 9 or Pin 12 is connected to transmit data to USART. Pin 13 or Pin 8 are connected to the information coming from computer. The information coming from PC is transmitted through the Pin 8 of MAX 232. We have connected this to pin number 2 of DB9 connector. Again the process of voltage conversion is performed but this time around it is converted according to specification of USART shown in figure 9. The voltage level conversion is already described in previous sections. Pin 9 is connected to Pin 25 of microcontroller .It transmits the incoming data from PC to USART.

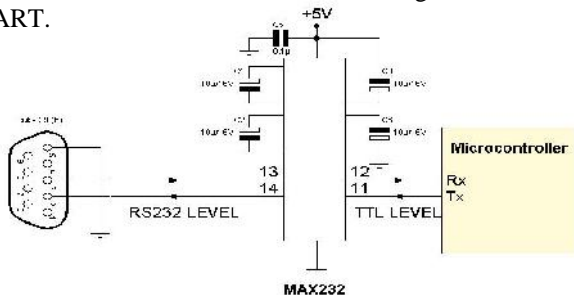


Fig 9: Serial communication between microcontroller and computer

VIII. HARDWARE IMPLEMENTATION

In this project the aim is to send a trigger signal from gun to computer where the video is being made and at the time when the trigger is pressed the image is captured for giving this trigger to the computer we must have an interfacing so serial interfacing is used. We made our Hardware such that it can give trigger signal from gun to computer (MATLAB) using serial communication instead of parallel communication.

Circuit equipment's

- DB9 connector
- Microcontrollers
- Max232 IC
- Capacitors
- Resistors
- LED
- Reset button

Max232 IC

It is used for voltage level conversion as the microcontroller and computer operate at different voltage levels.

Capacitors

In our hardware capacitors are used for removing ripples and for coupling.

LED

LED is used just for indication that the supply is on.

Microcontroller

It is used for USART. For interfacing the gun trigger with computer via Atmega16 the circuit made is given in the diagram below figure 10[1].

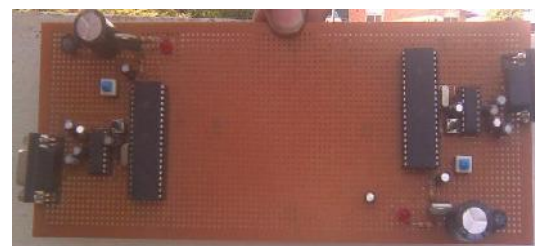


Fig-10: Hardware for interfacing gun with Atmega16

IX. SOFTWARE IMPLEMENTATION

The major work in this project was of software MATLAB is used for image processing color detection is done in MATLAB. Color detection comprises many steps as given in flow chart shown in figure 11.

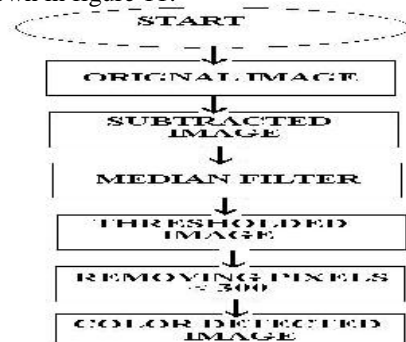


Fig-11: Flow chart of image processing
Image Capture In Matlab

Image is captured using command
`data = getsnapshot(vid);`



Fig-12: Image captured in Matlab

Color Subtraction

Then the next step for tracking red, green or blue objects in real time is that we have to subtract the red, green or blue component from the grayscale image to extract the red, green or blue components in the image. For subtracting red we use the following command shown in figure 13.

```
diff_im=imsubtract(data(:,:,1), rgb2gray(data));
```



Fig-13: color subtraction

Filterd Image

Median filter was used for filtering out noise using the following command shown in figure 14
`diff_im = medfilt2(diff_im, [3 3]);`



Fig-14: Filtered Image

Threshold Image

Then convert the resulting grayscale image using following command as it is for 18% threshold level as in figure 15[10].

```
diff_im = im2bw(diff_im,0.18);
```

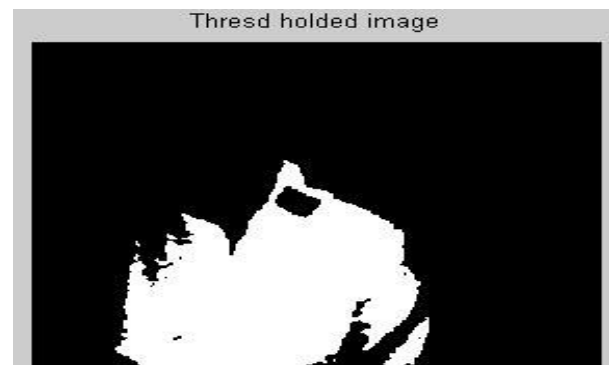


Fig-15: Threshold Image

Removing Pixals

Then remove all those pixels less than 300px using command `diff_im = bwareaopen(diff_im,300);` then check 8 point connectivity and Label all the connected components in the image in figure 16[8].

```
bw = bwlabel(diff_im, 8);
```



Fig-16: Removing Pixels

Target Locked

Now we do the image blob analysis. We get a set of properties for each labeled region as in figure 17.

```
stats = regionprops(bw, 'BoundingBox', 'Centroid');
```

This is a loop to bound the red objects in a rectangular box.

```
for object = 1:length(stats)
```

```
bb = stats(object).BoundingBox;
bc = stats(object).Centroid;

rectangle('Position',bb,'EdgeColor','r','LineWidth',2)
plot(bc(1),bc(2), '-m+')

a=text(bc(1)+15,bc(2), strcat('X: ', num2str(round(bc(1))), ' Y: ',
num2str(round(bc(2)))); set(a, 'FontName', 'Arial',
'FontWeight', 'bold', 'FontSize', 12, 'Color', 'yellow')
```



Fig-17: Target Locked

CONCLUSION

It can be used as a powerful weapon, if it replaces Human soldiers with machines. With minor modifications this project can be used to build a robot that can shoot targets with accuracy. In high security zones it can be used as surveillance cameras with guns. Where the cameras keep on shriveling and the guard can shoot anyone in the building while sitting in the monitor room. It can be used to make Automatic Aircraft Shooting Guns.

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