ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.6

Image Processing Based Enemy Scan and Shoot

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Abstract:
The objective of this paper is to minimize human casualties in terrorist attack such as 26/11. The idea is to design a robot having a wireless camera mounted on it, so that it can monitor enemy remotely when required. Since human life is always precious, these robots are the replacement of soldiers in war areas. This robot can also be used in star hotels, shopping malls, jewelry show rooms, etc where there can be threat from intruders or terrorists.

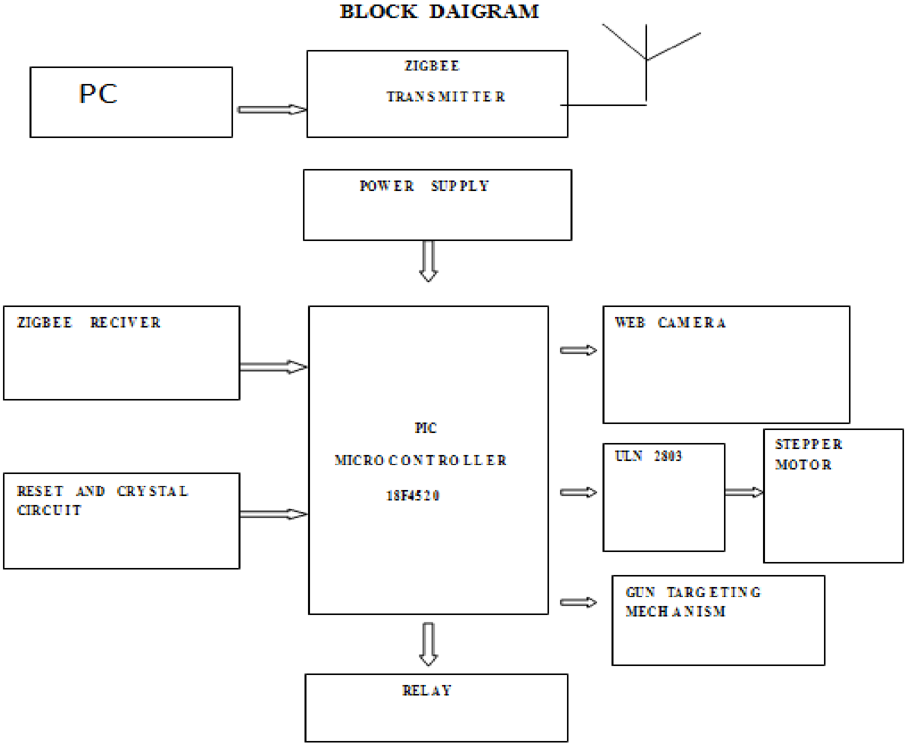
Keywords: MATLAB, IMAGE PROCESSING, PIC CONTROLLER

1.1 INTRODUCTION:

In these days, security is the major issue for all over the world. Security is very important in order to protect vulnerable and valueable assets such as a person, dwelling, community and nation from any harm. International security issue are also very important especially border and coast security to any country. The people of national security agencies, maritime security organization, military forces and other forces sacrifice their lives to protect their country people. The lives of forces are also very precious like another lives. So by using advance technologies, the forces can protect their nation superiorly with minimum life losses. In the modern era, computer based security equipment are very popular among forces because they are more advance and safe for themselves. For example, the drone technology which is controlled automatically by the computer. In this technology, target is selected and hit by using computer based algorithms including the image processing techniques. The availability of high quality and inexpensive video cameras and the increasing need of automated video analysis has generated a great deal of interest in the area of motion detection, object tracking and object targeting. Another existing application is air Defence Gun which is mounted on the device at the top of the army tanks which automatically tracks and shoots low flying equipped vehicles. Our system is a combination of sentry guns and drone technology. But, the difference is that, it is used on the Earth and it is implemented by the gun not on an aircraft. The gun automatically aims and fires at the targets which are detected by using image processing algorithms. We first select the object, and then the gun starts the tracking process according to the movement of camera. Once it aims the target object then the gun fires automatically at the targeted object.

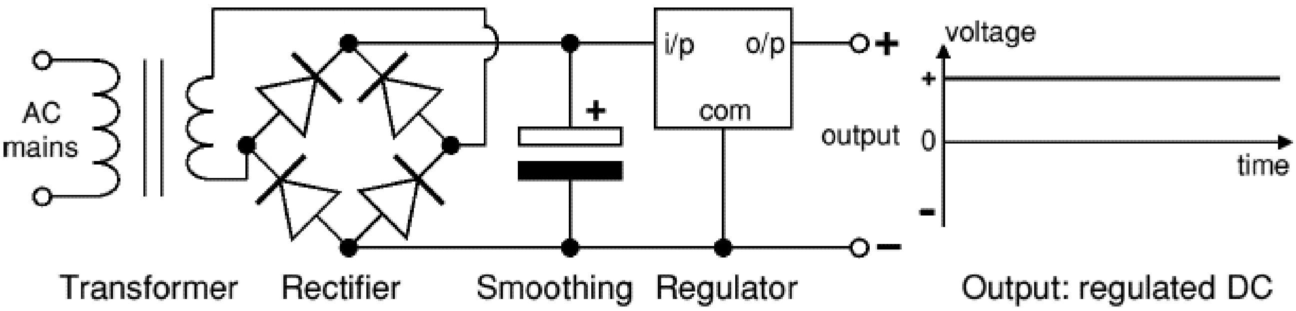
1.1.2. System Model:

The working is divided into 4 parts. First part is to process the video signal using MATLAB in computer. The second part is to select the target. The third part consists of microcontroller based control unit which is used to control the stepper motor. Finally, the last part is to control the movement of gun.



1.2. POWER SUPPLY

Transformer + Rectifier + Smoothing + Regulator



There are many types of power supplies. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function. The power supplies used in our project, Digital Control of Three-Phase Induction Motor are +5V and+12V. These power supplies can be designed by a simple circuit arrangement consisting of bridge rectifier (here we used diodes connected in bridge arrangement called the Diode Bridge), Capacitive or inductive filter, regulator (7812 for +12V and 7805 for +5V), resistor and Light Emitting Diode (LED) and transformer.

1.3.ZIGBEE

ZigBee is a kind of low speed short distance transmission wireless network protocol, the bottom is to use IEEE802.15.4 standard media access layer and physical layer. Main features low speed, low power, low cost, support a large number of network nodes, and support a variety of network topology, low complexity, fast, reliable, safe. ZigBee protocol layer from the bottom up respectively for the physical layer (PHY), media access (MAC) layer, network layer (NWK), application layer (APL), etc.

Features/Benefits

• ZigBee/mesh and proprietary peer-to-peer mesh topologies
• 2.4 GHz for worldwide deployment
• Fully interoperable with other Digi Drop-in Networking products, including gateways,
device adapters and extenders
• Common XBee footprint for a variety of RF modules
• Low-power sleep modes
• Multiple antenna options
• Industrial temperature rating(-40° C to 85° C)

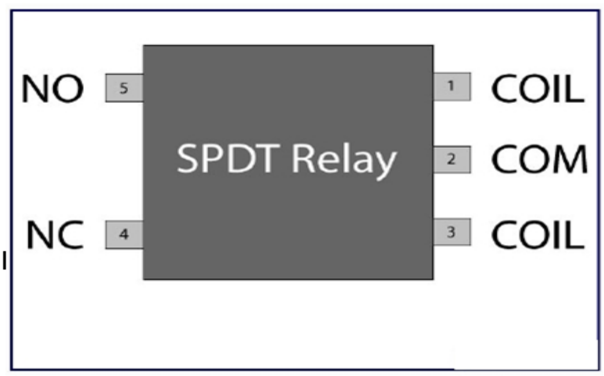
zigbee specification

Platform	Xbee-net2.5	Xbee pro-net 2.5
Data rate	250 kbps	250kbps
Range(indoor)	40M	1km
Range(outdoor)	120M	1.6km
Sensitivity	-97dbm	-102dbm

1.4. RELAY

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb. A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

Pin Diagram:

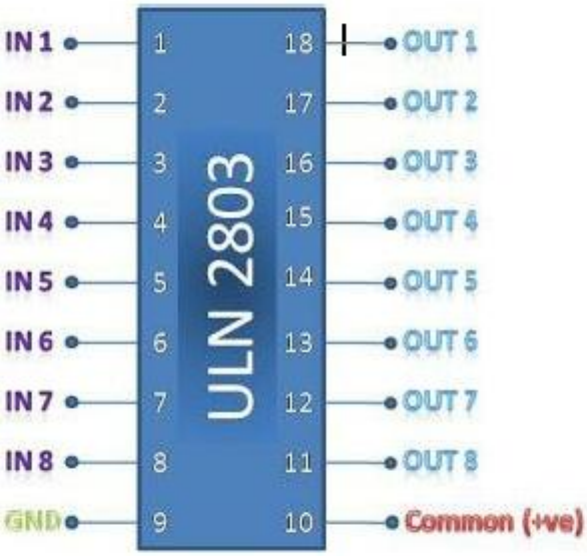


1.5.ULN 2803

MAXIMUM RATINGS (T_A = 25°C and rating apply to any one device in the package, unless otherwise noted.)

Rating	Symbol	Value	Unit
Output Voltage	V_O	50	V
Input Voltage (Except ULN2801)	V_I	30	V
Collector Current – Continuous	I_C	500	mA
Base Current – Continuous	I_B	25	mA
Operating Ambient Temperature Range	T_A	0 to +70	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C
Junction Temperature	T_J	125	°C

$R_{\theta JA}$ = 55°C/W
Do not exceed maximum current limit per driver.



(ULN 2803 specification)
The eight NPN Darlington connected transistors in this family of arrays are ideally suited for interfacing between low logic level digital circuitry (such as TTL, CMOS or PMOS/NMOS) and the higher current/voltage requirements of lamps, relays, printer hammers or other similar loads for abroad range of computer, industrial, and consumer applications. All devices feature open– collector outputs and freewheeling clamp diodes for transient suppression.

1.6. STEPPER MOTOR

Stepper motors are electromagnetic incremental devices that convert electric pulses to shaft
motion(rotation). These motors rotate a specific number of degrees as a respond to each input electric pulse. Typical types of stepper motors can rotate 2°, 2.5°, 5°, 7.5°, and 15° per input electrical pulse. Rotor position sensors or sensor less feedback based techniques can be used to regulate the output response according to the input reference command. Stepper motors offers many attractive features such as
• Available resolutions ranging from several steps up to 400 steps (or higher) per revolution.
• Several horsepower ratings.
• Ability to track signals as fast as 1200 pulses per second. Stepper motors have many industrial applications such as
• Printers.• Disk Drives.• Machine Tools.
• Robotics.
• Tape Drives

1.7. GUN TARGETING MECHANISM

1.7.1.System Model

The work is divided into 4 parts. The first part is to process the video signal using Matlab in computer. The second part is to select the target. The third part consists of microcontroller based control unit which is used to control the stepper motor. Finally, the last part is to control the movement of gun. The overall block diagram of the proposed system is illustrated below.

1.7.2.Processing of Video Signal

The first step is the processing of video signal by using Matlab software. The computer takes the video from the camera, process the video signal and then displays its contents on the LCD or monitor. The digital video is then converted into the composite video format. This raw digital data is further processed to produce the YCbCr (luminosity and chrominance) components of each frame. It is also introduced to change the pixels consequently to show it on VGA (Video Graphics Array). The next part explains the procedure to select the target.

1.7.3.Target Selection

The target selection starts with the motion detection, which is used as pre-processing algorithm in most of the object tracking applications (J. S. Lai et al., 2008). There are different algorithms used for motion analysis but here we used background subtraction to estimate the amount of motion in each frame. Background subtraction is conducted by using background estimation process (A. Mittal et al., 2004) which starts with the grey scaling and smoothing techniques in order to remove noise and improve sharpness. To produce delay between present and forthcoming frames, a buffer is used to store the reference image for 30 seconds. Meantime another image is captured from upcoming frame and both are subtracted with each other in order to estimate the background and foreground motions. The difference of both frames is a raw foreground image which is refined further. The raw foreground image is then converted from intensity image to binary format by applying the threshold value. By performing many experiments we selected the threshold value as „0.2", which means that in binary image if the value is greater than 0.2, it will be treated as „1" otherwise „0". The threshold process is explained in figure below The threshold image after the background subtraction process is illustrated in figure 4. The foreground is represented by „1" white pixels and background as „0", black areas. The binary image is then further processed by using morphological operations. The morphological operation is a process of image dilation and erosion techniques. The steps include the scanning of pixels from left to right direction and analyzing all pixels which are connected with foreground and background orientations. Those pixels whose neighbors are connected with foreground are considered as a part of foreground and those connected with background are considered as background pixels. A four by four (3x3) matrix is used to analyze the connected pixels. This 3x3 matrix is compared with each 3x3 pixels of the binary image. If the neighboring pixel is „1" then the other four pixels will also be treated as „1" and if the neighboring pixel is „0" then the corresponding four pixels will be considered as „0‟. The process of dilation and erosion is explained in figure 5 below. In order to differentiate the detected objects with each other, we labeled them as object „1‟ or object „2‟ by giving different values to them as explained in table below. Then we applied blob analysis to connect all part of the object by filling the empty spaces inside the object. A 4x4 matrix of „1s‟ is used as the blob factor which was put on the labeled matrix previously. Then the neighbor of the foreground will be marked as „1‟ and the neighbor of background will be marked as „0‟ as shown in figure 8. After tracking the location and shape of the objects as discussed above, the next step is to track the movement of objects by using the micro-controller unit, which is explained in next section.

1.7.4.Micro-Controller Unit

The heart of the controlling unit is the PIC18F4520 micro-controller. As explained in the above section, the location of the suspected object is determined by the image processing algorithm. When the object is detected, the micro-controller performs two functions. First is to activate the peripheral devices such as alarm, hooter and spotlight to indicate the presence of the object. It is achieved by using relays. Secondly, to take the decision in order to control the movement of the gun, which is also achieved by using relays. The relays are connected to the micro-controller unit, when the object is detected; the micro-controller unit sends the high signal to the relay which activates the peripheral devices. To control the movement of the gun, we extracted the X and Y co-ordinates and forward it serially to the Matlab for further processing. Then the controller takes the decision according to the coordinates, how much the gun should rotate. The decision to shoot the object is also made by the microcontroller. We also applied two modes of controlling. The first is automated control mode and the second is the manual control mode. In automated control mode, the system works automatically and it will take self-decision (either shoot the person who is detected or not). There is no need of any one to monitor or to supervise in this mode. The system is also trained in order to recognize the person. In automated mode, it will shoot only that person which has an unauthorized entry to that point. Whereas, in manual mode, the decision to shoot will be taken by the person who is monitoring the system. The next section explains the controlling of stepper motor to control the movement of the gun.

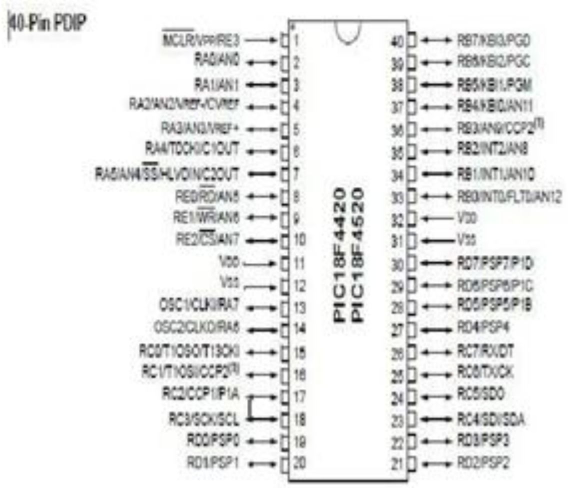
1.7.5. Stepper Motor Controlling Gun

After the detection of any unauthorized object, the gun starts tracking that object. The co- ordinates of the object are already sent to the computer earlier which tracks the co-ordinates of the target and send the new location to the micro-controller unit. Then the micro-controller unit controls the movement of the gun through the stepper motor. To track the object, the gun is able to move in x-y plane which is achieved by mounting the gun on tripod stand. We used two stepper motors having the power rating of 5.6 watts with the steep angle of 0.02 degree. One controls the movement of gun in horizontal direction and the other for vertical orientation. To move the gun to the desired position on the x-y plane, the current position of the gun is very necessary to be known, so encoders are used to find the current position of the gun. On the basis of the current position, the microcontroller sends the information to the stepper motor about the position of the object. The main function of the motor is to rotate the gun according to the object. If object moves left side than motor moves anti-clock wise until the position of gun comes to centre of the detected object and if object moves right side than motor moves clock wise until position of gun comes to centre of the detected object.

1.7.6.Working of the System

This system is designed to track the suspected object in real time and provide security by means of peripherals attached to this system. The working of the system consists of several steps which includes the processing of video signal from camera. The video is first converted into the raw digital format and then its luminance part is extracted by applying image processing algorithms. Then each frame is compared with the previous frame in order to detect the motion in the current frame. It is done by using background subtraction method. In this work, we applied scaling and smoothing techniques to remove noise and to improve the sharpness of the image. Then we calculated the difference image by subtracting the background information. Then the resultant raw binary image is further processed by using morphological operations which results in the detection of multiple objects. Then we applied blob analysis to connect all parts of the detected image. The next step was to determine the coordinates of the selected target which is achieved by sending the information to the micro-controller based system which compares the coordinates of the current frame with the previous one. Micro-controller then performs two functions; one is to activate the peripheral devices and the second is to take the decision in order to move the gun to the desired location. Once the target is selected, the microcontroller controls the movement of the gun by using the stepper motor. After the object is tracked, the decision to shoot the target is achieved manually or automatically by using microcontroller based.

1.8. MICROCONTROLLER PIC 18F4520



Power Management Features

- Run: CPU on, Peripherals on
- Idle: CPU off, Peripherals on
- Sleep: CPU off, Peripherals off
- Ultra Low 50nA Input Leakage
- Run mode Currents Down to 11 µA Typical
- Idle mode Currents Down to 2.5 µA Typical
- Sleep mode Current Down to 100 nA Typical
- Timer1 Oscillator: 900 nA, 32 kHz, 2V
- Watchdog Timer: 1.4 µA, 2V Typical
- Two-Speed Oscillator Start-up

Flexible Oscillator Structure

- Four Crystal modes, up to 40 MHz
- 4x Phase Lock Loop (PLL) – Available for Crystaland Internal Oscillators

• Two External RC modes, up to 4 MHz
• Two External Clock modes, up to 40 MHz
• Internal Oscillator Block:
- Fast wake from Sleep and Idle, 1 μs typical
- 8 use-selectable frequencies, from 31 kHz to8 MHz
- Provides a complete range of clock speeds from 31 kHz to 32 MHz when used with PLL
- User-tunable to compensate for frequency drift
• Secondary Oscillator using Timer1 @ 32 kH

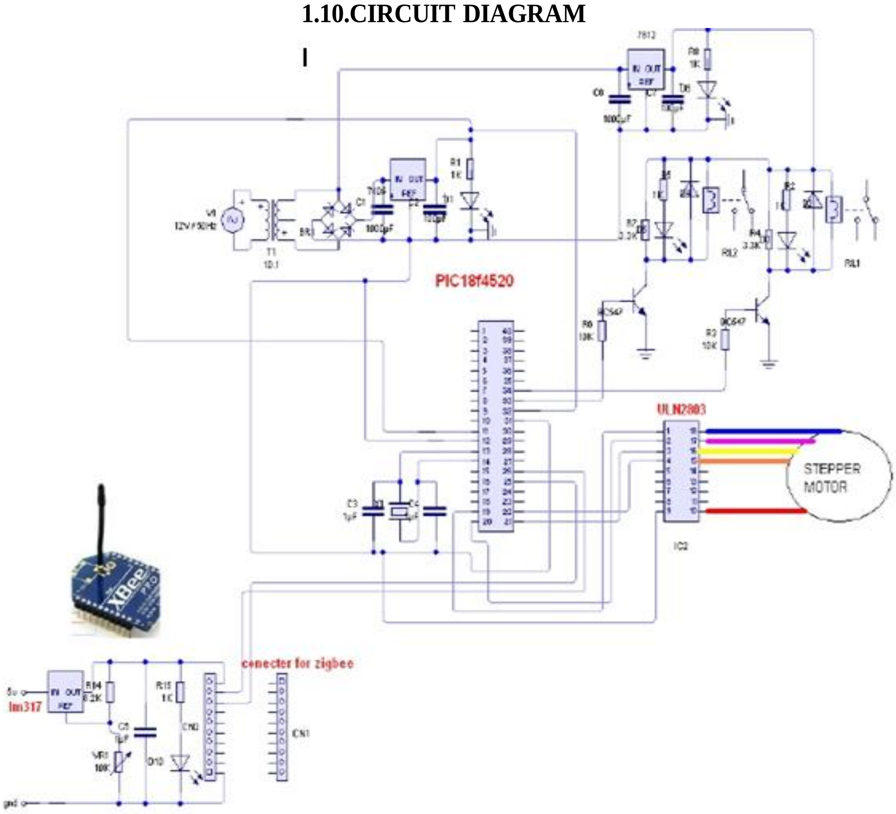
Special Microcontroller Features

• C Compiler Optimized Architecture:- Optional extended instruction set designed to
optimize re-entrant code
• 100,000 Erase/Write Cycle Enhanced Flash Program Memory Typical
• 1,000,000 Erase/Write Cycle Data EEPROM Memory Typical
• Flash/Data EEPROM Retention: 100 Years Typical
• Self-Programmable under Software Control
• Priority Levels for Interrupts
• 8 x 8 Single-Cycle Hardware Multiplier
• Extended Watchdog Timer (WDT):- Programmable period from 4 ms to 131s
• Single-Supply 5V In-Circuit Serial Programming™ (ICSP™) via Two Pins
• In-Circuit Debug (ICD) via Two Pins
• Wide Operating Voltage Range: 2.0V to 5.5VProgrammable Brown-out Reset (BOR) with
Software Enable Option

1.9.WEB CAMERA

Specification	
Image sensor	1/7' CMOS sensor
Image resolution	640*480&30 mp
Frame rate	Up to 30 fps
Image control	Brightness contrast ,Hue,saturation,white balance
Image flip	Horizontal & vertical
Monitor type	CRT &LCD
Environment	Indoor &outdoor
Focus distance	4cm-infinity
Lens view angle	54 degree
i/o interface	USB 2.0
Image format	RGB24,1420
Power consumption	160mw

1.10.CIRCUIT DIAGRAM



1.11. CONCLUSION

The theme of the work is to design the automated security system for surveillance operation s.The system is designed by using image processing algorithms in order to select, track and hit the target. In this work, the image processing algorithms are designed and implemented in computer based system where as for future development, tis robot can also beused in star hotels, shopping malls, jewellery showrooms ,etc where there can be threat from intruders or terrorists.

1.12. REFERENCES

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