

Autonomous Turret System Using Background Subtraction Algorithm

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ABSTRACT

Automation is the use of machine, control system which makes the human work easier. There is a clear need of system which can automatically detect the enemy and take the actions as per situation. There are some highly restricted areas where a civilian or any undefined person entry is restricted and at such place if the unknown entry is found then that are considered as severe crime. At such places there is requirement of a human commando whose job is to keep the track of certain area in order to keep the track of the same. But there human cannot be focused all the time as he requires rest. And that problem is recovered with the shifts. In the shift after some time person who is keeping the track is changed this also leads in unfocused work. Another problem is that human in such area have the danger with his life which is also overcome in this system As human seating at remote position could keep the track. The work can be done manually or automatically. This system is an automatic, area protective, anti-personnel sentry turret with integral capability of differentiating friend and enemy. The system proposed prototype uses a standard webcam connected to a notebook computer running custom software in order to detect and track movement sources within the systems field-of-view. This data is used to position a pair of servo motors in order to aim gun at the moving target. The IFF capability is achieved using one independent system. For the targets who are attired in the designated safe color scheme will be allowed to pass unharmed. There is a clear need for such a system in certain military applications, as no similar product is currently available. The only other systems capable of fulfilling the same function are of very limited utility and much more time consuming to set up. Specifically currently available systems are very ineffective indoors and are almost entirely indiscriminate in their operation. Both of these failures are addressed by this system. Current weapon-ed robotic systems are too expensive for use by law enforcement agencies.

Keyword: - Object tracking, gun control, target selection, camera controlling, image processing.

1. INTRODUCTION

Security and defense is of great concern in military and defense system. Autonomous sentry gun provides them with good protection without any need of human interaction. The main aim of this project is to design an automatic turret system. A system is to be developed which protect specific area. That system should be some what have intelligence that can differentiate between friend and enemy. System that should be autonomous which requires less user interaction. The system proposed prototype uses a standard webcam connected to a notebook computer running custom software in order to detect and track movement sources within the systems field-of-view. This data is used to position a pair of servo motors in order to aim gun at the moving target. The IFF capability is achieved using one independent system. For the targets who are attired in the designated safe color scheme will be allowed to pass unharmed.

2. FUNCTIONAL DESCRIPTION

The functions of the various working components are given below:

2.1 Arduino uno

Arduino uno is a microcontroller chipset mounted on a board which works with ATmega328p. There are total 14 digital input and output pins, it also have 6 analog inputs, it also have 16mhz of quartz crystal, It also have USB port mounted on board, it have 1 power jack for power supply, and a reset button for resetting the board. It has 13 built in LED, a flash memory of 32kb. It operates on 5v volt. It requires arduino IDE to work with arduino board. It includes every required thing to support the microcontroller. For starting it only the need is to connect arduino board to computer with a USB cable.



Fig -1: Arduino Uno

2.2 Processing IDE

Processing is open source computer programming language and integrated development environment built to work with electronic devices such as microcontroller. The processing environment consists of compiler, display window, and text editor. It allows us to create software within a proper designed set of constraints. The Processing Development Environment (PDE) makes it simpler to write programs in processing language. Text editors are use to write programs in processing language and can be executed by tapping on Run button. In Processing IDE, a code written by user is called a sketch. Sketchbook is used to store sketches, which is folder in computer. Processing provides us with different programming modes which allows us or make it possible to deploy processing code on various platforms. The current default programming mode is Java mode.

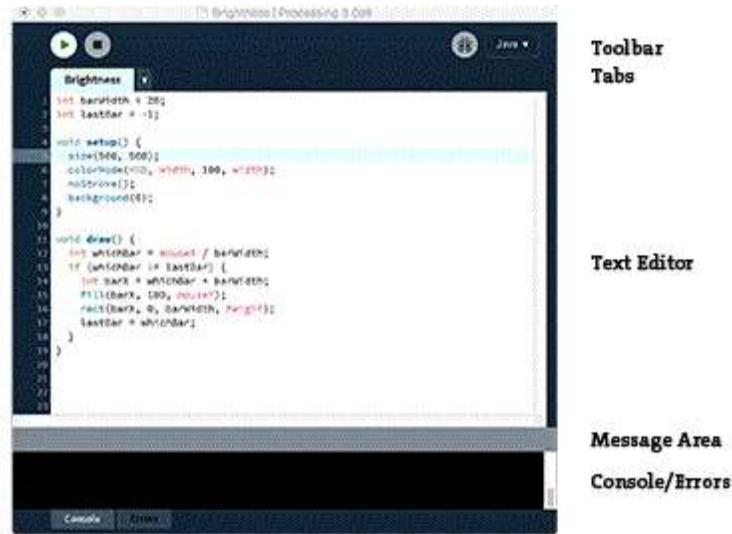


Fig -2:Processing IDE User interface.

2.3 Servo motor

A servomotor is a rotating actuator that make user to control in angular position. It contains motor coupled to a sensor which is required to give position of the servo head. Servo motors are being used more now-a-days as compared to previous decades and are used in many fields. By seeing at servo motors it looks compact but has much more power and is very less energy effective. All it features allows to operate on remotely controlled appliances. Application of servo motor is in large field of area which includes robotics, food services, manufacturing, industrial application.



Fig -3:Servo motor.

3. IMPLEMENTATION DETAILS

The system proposed prototype uses a standard webcam connected to a notebook computer running custom software in which is build in Java programming language. This software package job is to detect the motion in the field and concurrently detect enemy/friend. In order to detect movement, each frame of the video must be compared its previous frame. Any differences between the frames can be considered movement. After all instance of movement have been detected, a list of rectangles will be created. These rectangles surround local areas of movement, for instance a person moving in a hallway. After receiving the list of rectangles, the largest rectangle (based upon surface area) will be displayed on the video. After displaying the rectangle, the system will mark the object as a significant source of movement.

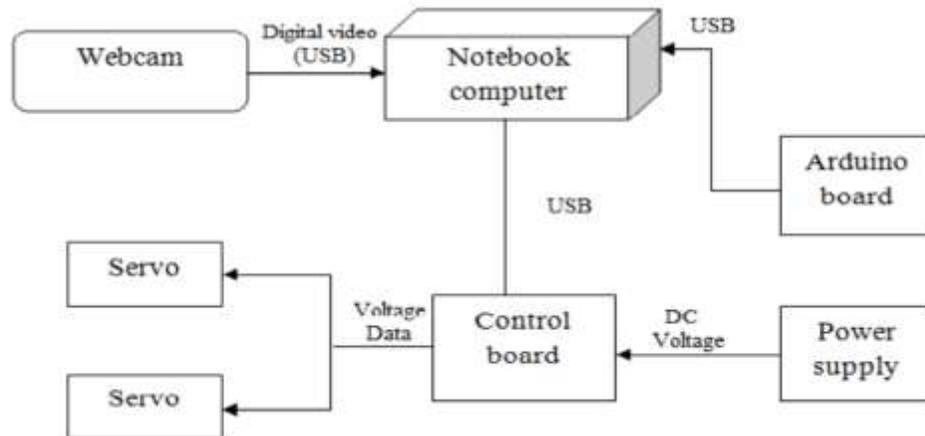


Fig -4: Implementation details.

4. ALGORITHM

Algorithms used in this system are as follow:

4.1 Background Subtraction algorithm

It is also known as Foreground detection technique. In the field of image processing and computer vision where in an image foreground is extracted for further processing. Conventional approaches in background subtraction are as follows:

- Frame Differencing: Background image is initialized it will be referred as reference frame. And background image will be subtracted with current image. In both frames pixel by pixel (x, y) are compared and subtracted. In this stage where a pixel of location (x, y) in the present working image $I(x, y)$ is set as foreground pixels and if $|I(x, y) - B(x, y)| > td$ is true where threshold is denoted by td .
- Segmentation: After the subtraction is done. Segmentation principle are applied on that subtracted image. The segmentation can be applied using following expression:

$$M_k(x, y) = 1 \text{ for } |I_k(x, y) - B_{k-1}(x, y)| > t$$
- Median filter.

4.2 Blob detection algorithm

Blob detection algorithm is use to detect object in frame. It compares frame to frame to determine changing pixels. After the changing pixels are detected it encapsulate pixels in fixed shape. Then by using blob dimension centroid is calculated. Blob detection algorithm works using several parameters which are as follow:-

- Thresholding : In this source image is converted into several binary images by using thresholding source image with threshold value starting at $minthreshold$. Incrementation of these thresholds are done by $thresholdstep$ till $maxthreshold$, so the threshold calculated as follow:-
 1. $Minthreshold$ is first threshold.
 2. $Minthreshold + thresholdstep$ is second
 3. $Minthreshold + twice\ thresholdstep$ and so on.
- Grouping : In this connected pixels are grouped in fixed shape which is referred as blob.
- Centroid calculation: center point of new merged blob is calculated and returned.

5. Applications

- Law enforcement for defense of prohibited area from enemy combatants.
- Defense sector where military bases needs protection.

- Government sectors where security is main purpose.
- Human detection and tracking in unauthorized area.
- In wildlife sanctuaries, for protection against hunters

6. CONCLUSION AND FUTURE WORK

In this paper, we are designing an autonomous turret system which monitor the war field / risky area and terrorist activities and saves soldier's lives. This design performs better than other low cost designs using similar hardware, but grants performance comparable to designs using expensive hardware and sensors.

Further extension can be done easily. Future extension can be detection of enemy at night using infrared camera and more extension of human detection using pi sensors.

7. REFERENCES

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