Moving Target Detection and Locking with Moving Camera

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***Abstract*—Visual Detection and tracking of human body movement is a key technology in several areas. Because of many potentially important applications "Looking at People" is currently one of the most active application domains in computer vision. This trend is motivated by a large range of application such as, Security Surveillance and HCI (Human Computer Interaction). In this paper, we propose a design for the detection and tracking of the moving object. This is system based on the two main parts. One is the software and other is the hardware. In software part the algorithm is implemented, which detects the object, if the object move and goes out of the focus then the signal goes to the hardware which rotate the camera in that direction and track the object continually. We will assume that the motion of the tracked object will be constant and camera will be tracked up to 180 degree. The main goal of the paper is to implement an efficient and fast human detection and tracking algorithm and interface it with hardware.**

***Keywords*—Detection, Tracking, Moving Target, Computer Vision, Surveillance, Image Subtraction and HARR Algorithm**

I. INTRODUCTION

In this paper, we implement such system which detects the moving object and camera will tracked the targeted object.

Tracking of the object is very major in the field of the digital image processing. In the field of computer vision there are many applications like face detection, recognition, human gesture and finding the specific person in the public place by the camera.

In the previous security system there are many usages of CCTV cameras. These cameras only send the video to the control room and capture only the specific view either the people walk in the corridors and in monitored areas. This paper plays the important role in the security and improves the surveillance activity. We improve the surveillance by making the camera more intelligent through the software.

The rest of the paper is organized as follows: In section II, we introduce a motivational example, and formally define the problem. An overview of related work is presented in section III. We describe our system modeling in section IV and general architecture design & implementation in section V. The results are described in section VI and finally section VII concludes the paper.

II. MOTIVATIONAL EXAMPLE

Now a day's security is the main issue in the field of the surveillance. There is much type of the setups for monitoring the prohibited areas; there are controls rooms having many screens seeing different views from different sight and number of human resource are need to view the static scene. Although a camera is cheap but human resource to observe the output is very expensive.

According to the study of US institute of justice only a single person can pay attention to more than 4 cameras and after only 20 minutes of watching the monitor screen, attention of most people fall below acceptable levels. After that fact these security cameras still used in banks, stores and in parking lots.

But there is still some improvement is needed in software side that software is very much intelligent to foresee the behavior of the human and its suspicious activity.

So we want to develop such an intelligent system that is combined with visual event detection method to analyze movement, detect it and tracked it intelligently.

III. RELATED WORK

Advantages and disadvantages of two common algorithms frequently used in the moving target detection: background subtraction method and frame difference method are analyzed and compared in this paper. Then based on the background subtraction method, a moving target detection algorithm is proposed. The background image used to process the next frame image is generated through superposition of the current frame image and the current background image with a certain probability. This algorithm makes the objects which stay long time to be a part of the background after a certain period of time, but not be detected as a part of foreground. The experimental results show that this algorithm can detect moving targets more effectively and precisely [1], [10]-[17].

We learn that how color images represent in the 3D matrix and how this matrix converted in to 2D matrix. Then we learn various techniques, how to manipulate the values of the matrix conversion of the image in gray scale form RGB.

Then we learn the techniques of object detection form the images for this we learn how to apply morphological filters on the image to detect a foreground object form the background

and then we choose the specific algorithm for our proposed work.

First we work on the background subtraction technique. The background subtraction is the most efficient algorithm which detects the foreground object from the background. This algorithm is most efficient in terms of processing and illumination changes. Background subtraction is very resistive in illumination changes because in detection of the desired object many light changes occurs and difficult to detect the foreground object.

There are many challenges in developing a good frame differencing algorithm for object detection. First, it must be robust against changes in illumination. Second, it should avoid detecting non-stationary background objects such as moving leaves, rain, snow, and shadows cast by moving objects [2].

If we talk about the human body, then main thing is comes in our mind that, what is the main feature of the human body. How people recognize the face of each other. Then we moved to that algorithm with recognize the main features of the face like nose, eyes, mouth etc.

Viola and Jones [3] introduced a method to accurately and rapidly detect faces within an image. This technique can be adapted to accurately detect facial features. However, the area of the image being analyzed for a facial feature needs to be regionalized to the location with the highest probability of containing the feature. By regionalizing the detection area, false positives are eliminated and the speed of detection is increased due to the reduction of the area examined.

Using a 1.2GHz AMD processor to analyze a 320 by 240 image, a frame rate of 3 frames per second was achieved. Since a frame rate of 5 frames per second was achieved in facial detection only by [4] using a much faster processor, regionalization provides a tremendous increase in efficiency in facial feature detection.

IV. SYSTEM MODELING

First to explore all the entity used in the project and defines their relationship with each other. For making the product, it consists of two parts first one is software and other one is hardware. The software holds the algorithm which detects the human feature and sends the command to the hardware that if the human move right then it rotate the camera right side or vice versa.

Depending on the nature of the project we have used waterfall model. The waterfall model is a sequential design process, often used in software development processes, in which progress is seen as flowing steadily downwards (like a waterfall) through the phase of conception, initiation, analysis, design, construction, testing and maintenance. It is best suitable for projects in which requirements are fully understood and one phase is done after the other in a linear manner. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In waterfall model phases do not overlap.

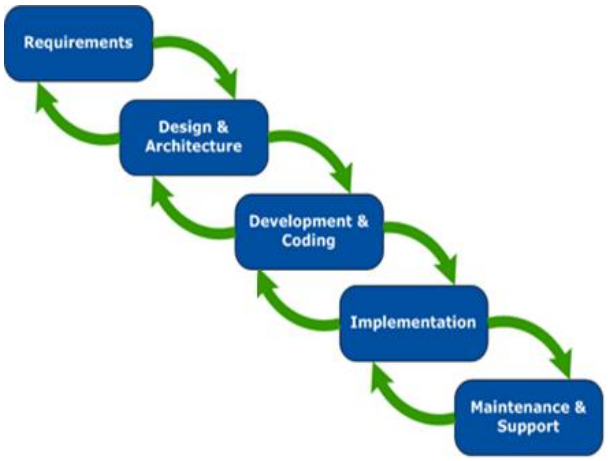

Fig. 1: Water Fall Model

V. ARCHITECTURE AND IMPLEMENTATION

The system design and architecture overview have been illustrated in Fig. 1 and Fig. 2.

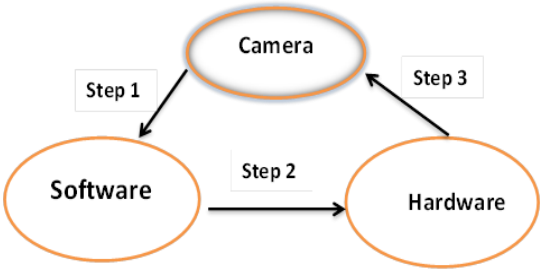

Fig. 2: Design overview

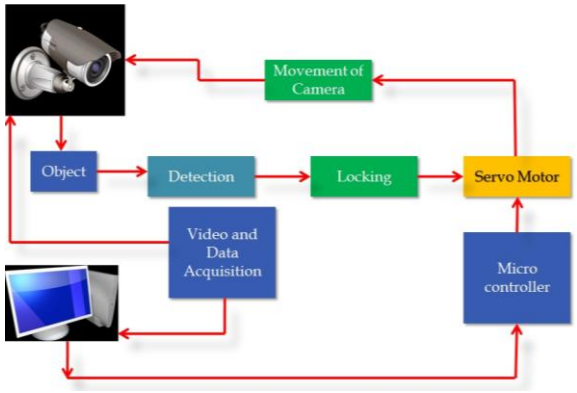

Fig. 3: System Architecture

For capturing the video stream, we use the camera (webcam). The camera is connected to PC and sends the stream to the software for processing. The camera has the following features.

- Fame rate is 30 fps
- 2.0 mega pixel
- Automatic white balance

System requirements

- Windows XP/SP2/VISTA/Win7
- Pentium 450 Mhz
- Ram 256 MB D RAM
- USB 2.0

Software:

In this section the face detection algorithm is implemented named "HAAR" which is feature base algorithm. By using this algorithm we find the sharp feature of the human body like eyes, nose, mouth and shoulders. By getting these features the human is detect, if the human moves and go out of the focus then a signal is send to the hardware to tracked the human body and then software continues its processing again. The software job is only to detect the human.

Tools/Software

- Matlab
- Visual studio
- Language C# (Emgu CV)

Hardware:

In the hardware section, micro controller receives the signal form the software and decide the rotation of the camera whether to move left side or right side. The software is communicating with hardware through serial communication. the controller sends the signal to the servo motor which rotates the camera in the required direction. The rotation of the camera will be 180 degree.

Tools/ software

- MpLab
- Cc compiler
- Proteus
- Burner

Software Implementation:

The main requirement of the software is the implementation of the efficient algorithm for human detection. Firstly we implement the background subtraction for motion detection in Matlab but due the real time processing and dynamic background issue we change our detection algorithm to HAAR Feature detection algorithm. We implement the HAAR feature algorithm in Emgu CV which detects the feature of the human face.

What is the GOAL?

- Real Time Computation
- High Detection Rate

Real time computation

Human Computer Interface (HCI) should meet the requirements of real-time, accuracy and robustness.

High Detection rate

High detection rate means that the margin of false detection is very low and also the detection is very fast.

Why do we care about speed?

- Robotics needs a real-time face detector.
- Thousands upon thousands of images in the album
- Animal vision systems are both fast and accurate
- Security system

Why use HARR?

Due the high detection rate and fast real time computation we use this algorithm. Although many different algorithms exist to perform face detection, each has its own weaknesses and strengths. Some use flesh tones, some use contours, and other are even more complex involving templates, neural networks, or filters. These algorithms suffer from the same problem; they are computationally expensive [5].

An image is basically composed of the different intensity values and color. Processing on these pixels for the face detection is very difficult and time consuming because of the wide variation of shapes and different skin tone. Pixels required reprocessing for scaling and precision. Viola and Jones devised an algorithm, called Haar Classifiers, to rapidly

Detect any object, including human faces, using AdaBoost classifier cascades that are based on Haar-like features and not pixels [6].

Hardware Implementation:

The hardware section of the project is mainly consists of three major Modules as given below:

1. Power Supply Circuit
2. Max 232 Circuit
3. Microcontroller Circuit

The complete circuit diagram is given below:

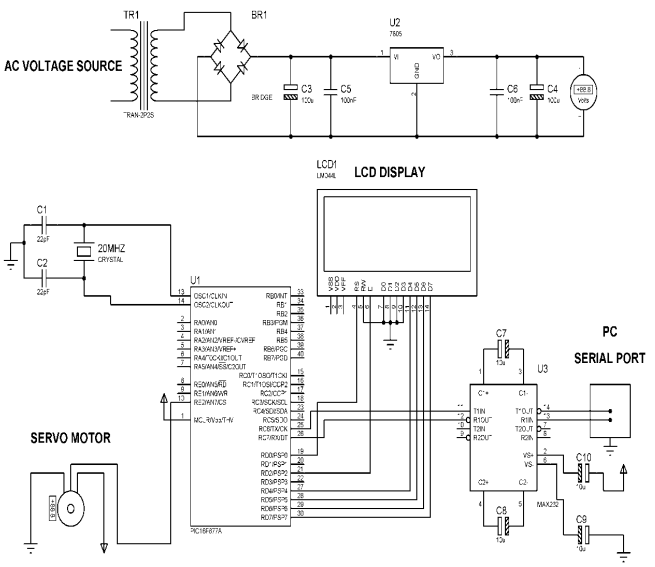

Fig. 4: Hardware circuit diagram

Hardware work procedure

The above Circuit diagram work as following procedure

- •220v AC from main power supply is step-down 12v AC by using step down Transformer.
- •12v AC then passed from full wave Rectifier Bridge to convert 12v AC in 12v DC ripples.
- •12 v DC ripples passed through 100uf capacitor to remove ripples and we get pure 12v DC.
- •As there is some noise left which is removed by passing 12v DC again through 100uf capacitor.
- •As we required 5v Dc to run whole microcontroller circuit so we passed 12v DC through LM7805 voltage regulator which covert 12v DC to 5v DC.
- •This 5v DC is given to Microcontroller, Max 232and Lcd.

- We required 6v DC to run servo motor so we passed 12v DC through LM317 Voltage Regulator we adjust the output voltage to 6v DC by using variable Resistor.
- PC is connected with microcontroller through Max 232 Serial Communicator.

VI. RESULTS

Matlab Testing Results:

Fig. 5: Original Image

Fig. 6: Grey Scale Image

After applying different basic operation on grey scale image we get,

Fig. 7: Erode operation

Fig. 8: Filled region operation

Fig. 9: Final result

Fig. 10: Detection result

Fig. 11: Tracking result

VII. CONCLUSION & FUTURE WORK

The main purpose of the paper was to implement an efficient and fast detection and Tracking algorithm and interfacing it with moving camera. We implement Haar algorithm for detection and interface it with moving camera. But still a great improvement can be made for future work. The system is capable of detection a single moving object and locking it with moving Camera. Camera movement is 180 degree Horizontal.

Our system can detect and track single object the work can be extended for multiple object detection and tracking in future work. Also in future work camera movement, can be extended to 180-degree tilt movement.

REFERENCES

[1] Yangquan Yu ; Coll. of Comput. Sci. & Technol., Jilin Univ., Changchun, China ; Chunguang Zhou ; Lan Huang ; Zhezhou Yu, "A Moving Target Detection Algorithm Based on the Dynamic Background," Computational Intelligence and Software Engineering, 2009. CiSE 2009. International Conference.

[2] Karan Gupta, And Anjali V. Kulkarni (2008), Implementation of an Automated Single Camera Object Tracking System Using Frame Differencing and Dynamic Template Matching.

[3] Viola, P. and Jones, M. Rapid object detection using boosted cascade of simple features. IEEE Conference on Computer Vision and Pattern Recognition, 2001.

[4] Lienhart, R. and Maydt, J. An extended set of Haar-like features for rapid object detection. IEEE ICIP 2002, Vol. 1, pp. 900-903, Sep. 2002.

[5] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[6] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[7] Y.A.Adediran, Applied Electricity, Finon Associates, Minna Nigeria, 1997, pp. 99.

[8] A.K Theraja and B.L Theraja, A textbook of Electrical Technology, 23rd Edition, by S. Chand.

[9] Tutorial & Reference for 8052, http://www.8052.com. pp27

[10] PIC Microcontrollers for beginners, www.MicroElektronika.com, chapter2.html.

[11] Y. Ke and R. Sukthankar. Pca-sift: A more distinctive representation for local image descriptors. CVPR, Washington, DC, USA, pages 66–75, 2004.

[12] D. G. Lowe. Distinctive image features from scale-invariant keypoints. IJCV, 60(2):91–110, 2004.

[13] R. K. McConnell. Method of and apparatus for pattern recognition, January 1986. U.S. Patent No. 4,567,610.

[14] K. Mikolajczyk and C. Schmid. A performance evaluation of local descriptors. PAMI, 2004. Accepted.

[15] K. Mikolajczyk and C. Schmid. Scale and affine invariant interest point detectors. IJCV, 60(1): pp. 63-86, 2004.

[16] K. Mikolajczyk, C. Schmid, and A. Zisserman. Human detection based on a probabilistic assembly of robust part detectors. The 8th ECCV, Prague, Czech Republic, Vol. I, pp. 69-81, 2004.

[17] A. Mohan, C. Papageorgiou, and T. Poggio. Example-based object detection in images by components. PAMI, 23(4): pp. 349-361, April 2001.