Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **11(2),** 1-8, May **(2022)** *Res. J. Engineering Sci.*

Remote Control System using Motion Detection

Shubhika Mishra, Ritika Sharma, N. Devaki Sai Kiran, V.Venkat Prabhat, Anuj Kumar Pandit and Mousam Sharma
Bhilai Institute of Technology Durg, CG, India
shubhikamishra67@gmail.com

Available online at: www.isca.in, www.isca.me
Received 3rd September 2021, revised 20th May 2022, accepted 26th May 2022

Abstract

Using computer vision we would deal with universal remote control system .For dealing with the required purpose two stages are there: motion and skin color detection with the help of control commands. For these detection we take help of camera which focuses the movement of region of hand and analyses hand segment region by counting open fingers .Expected outcome gives good result by detecting correct gestures by counting open fingers. By using such features we can achieve accurate and robust performance end results.

Keywords: Computer Vision, Gesture, Human-Machine Interaction, Open Finger Counting, Remote Control.

Introduction

Home automation are mostly based on infrared remote controllers[1]. But now problem arises for finding appropriate Controller for the system. For replacement of this technology use of voice recognition or gesture recognition can be used[2-4].

Voice recognition devices are already there in the use for various automation devices[5]. Voice recognition sometimes fails to cancel surrounding noise and performance of device deteriorates[6,7]. For achieving accuracy use of gesture, hand recognition will make the process easier and more accurate result will be obtained. For hand gestures recognition hand gloves, markers are used.

Process

Remote control mode senses movement of hand and controls device as per that unique hand gestures are recognized by the exotic hand region by using pointing hand, 3-dimensional analysis is done with the help of cameras[6,7]. Obtaining complete 3-dimensional gesture is not possible. So we use frequency parameter for setting remote control in neural network helps to recognize gesture and to extract the complete knowledge about shape features, pointed towards object of by using appliance as reference. Pointing menus are displayed on television screen which can be controlled using suitable command.

Cameras play vital role in focusing hand Gestures. As this is the best device to use as investment cost is low from performance point of view. When camera senses hand movements, remote control mode activates[10]. Camera adjusts its focus either as zoom in or zoom out and analyses in hand regions. Control command counts number of open fingers using state transitions procedure. Speed of processing is fairly sufficient for our operations.

Experimental Setup: Following figure depicts organization of setup. When users wave hands to command for the required purpose towards camera, camera analyses image sequence and compares with the interactive menus (example - Television, radio, volume, brightness, channel etc.) displaying on menu. For menu display LED monitor can be used[2,10].

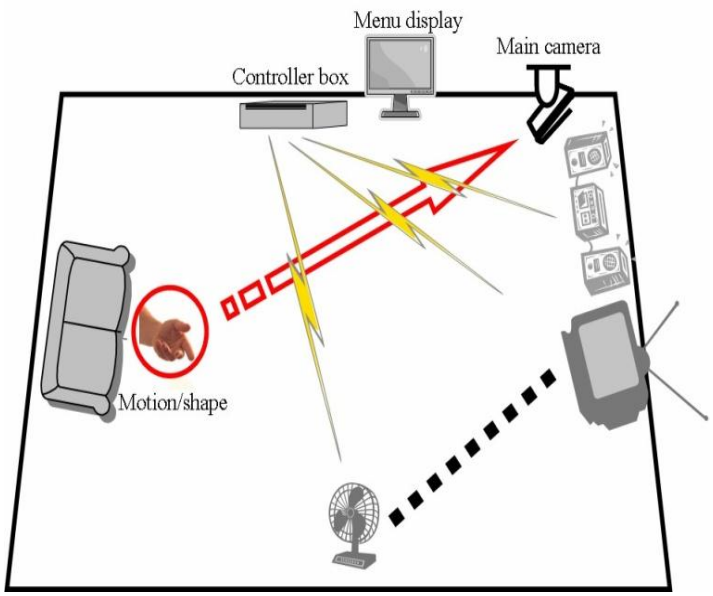

Figure-1: Setup for Controlling Appliances[1].

Execution Process: Following figure illustrate the complete procedure of execution process. Procedure started with zooming out of camera to capture maximum view frame. System begins with initializing r° = false where [If] implies remote control mode at instantaneous time when camera detects proper control motion, [If] turns true and process begins[1]. Camera focusses on motion and color information for detection of hand gestures.

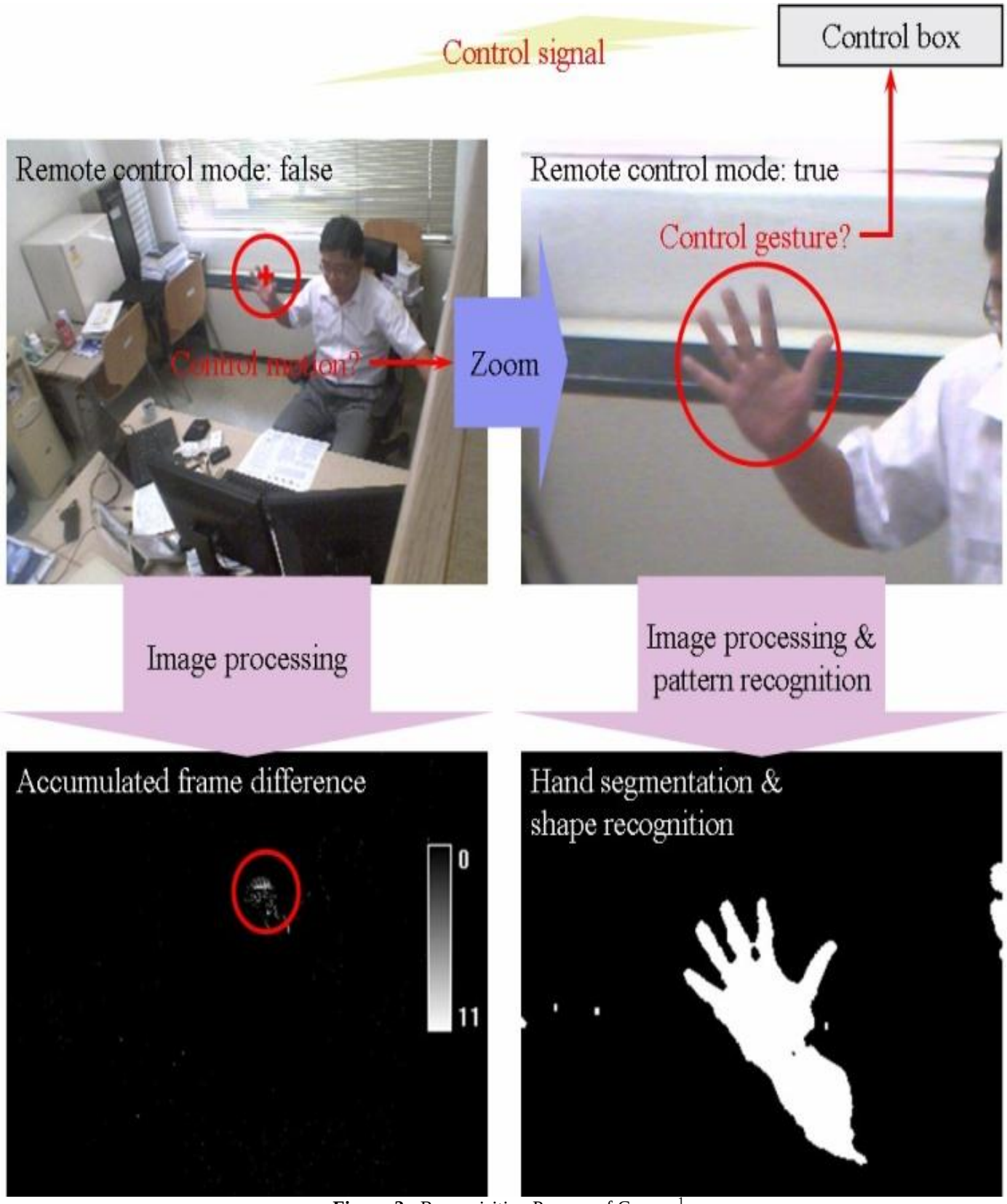

Figure-2: Recognisition Process of Camera[1].

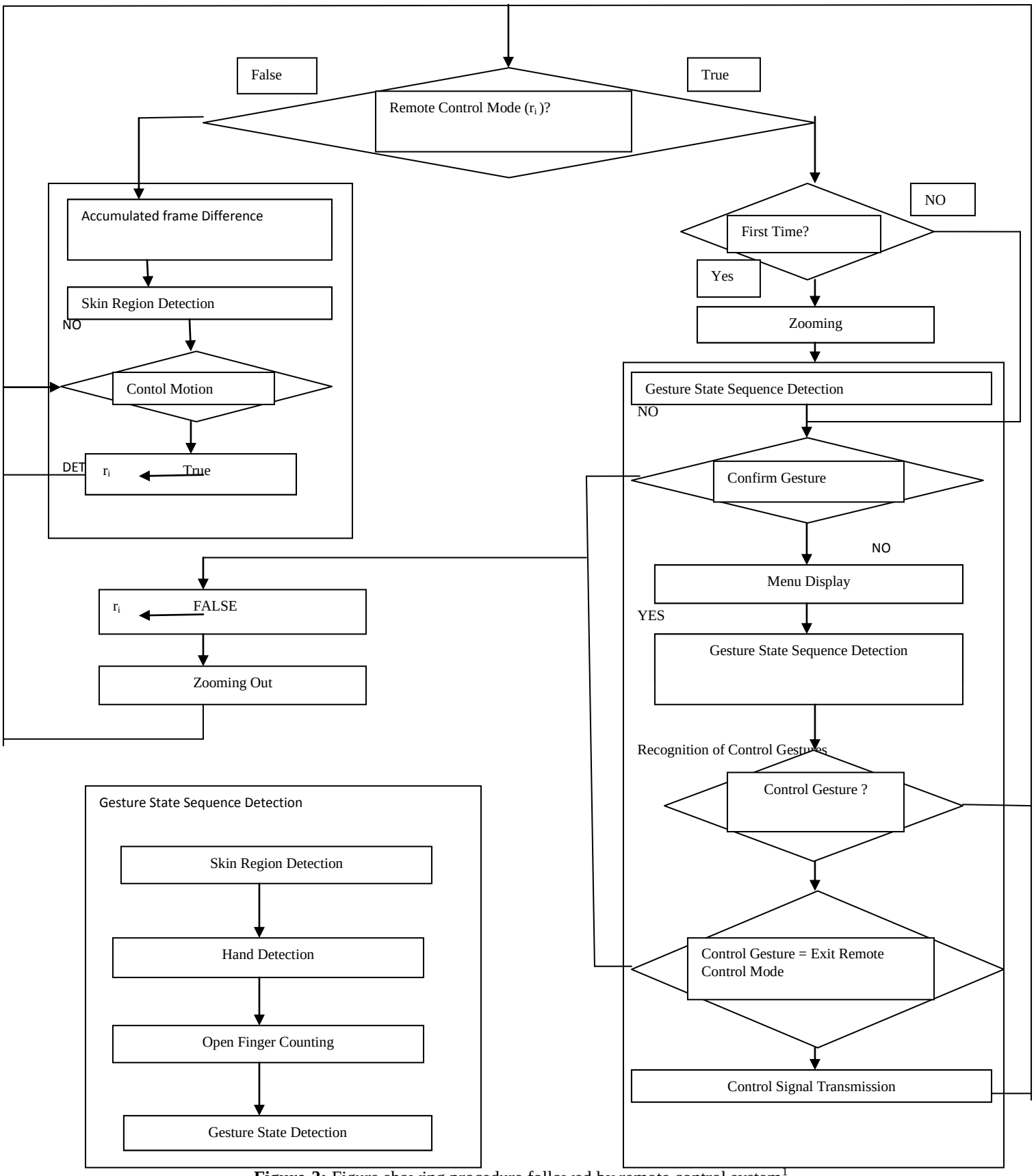

Figure-3: Figure showing procedure followed by remote control system[1].

Detection of the Control Mode: When rt = false, that is remote control mode is off, if movement of moving hands are requested, then movement of hand is detected and remote control mode senses gesture. When gesture is obtained a single movement is compared in different frames. For accurate results we take into account of frame difference. Frame difference defined by

$AD_{t-1}(x,y)+1$ if $I_t(x,y)-I_{t-1}(x,y) > \square_d$
$AD_{t-1}(x,y)-1$ otherwise

Where I_t defines the image intensity at time t, and d a threshold. Pixels of moving images (hand gestures) are defined by ADt. Suitable region for movement detection M is selected by pixels having large value of ADt given by

1 if $AD_t(X,y) > \square_d$
0 otherwise

Where m denotes a threshold. As different frames are used for single hand movement, so there are numerous frame difference is accounted as per illuminations difference. To avoid much differences we'll define skin color region S_t which is defined as,

$S_t(X,y) =$ 1 if min (R (X,y) – G (X,y), R (X,y) – B(X,y)) > □
0 otherwise

Where R_t denotes red components, G_t denotes green components and B_t denotes blue components, As shown in Figure-4, it defines differences of skin regions motion regions and accumulated frame difference of moving region by comparing with skin color regions. Control motion region determines regions of motion associated with skin color. We use the following condition

$$(B^i_S \cap B^k_M) / B^i_S > \square$$

Where B^i_s denotes the i[th] label of S_t, B^k_m denotes the k[th] label of M_t, and □ denotes a threshold.[1]

When conditions are all accurate as per labelled region, remote control mode activates i.e. *rt* = true, and the gesture states are detected with control commands being taken into account. When desired hand gestures are not captured in a particular time frame, *rt* sets to false mode, then the camera finally zooms out.

Identification process of control gestures

When remote control mode detects specified control motion, camera zooms in or out for focusing on hand gestures. Camera focuses on skin color and open finger number. After counting open fingers gesture state is defined. Gesture state is defined as open finger count by obtaining hand shape.

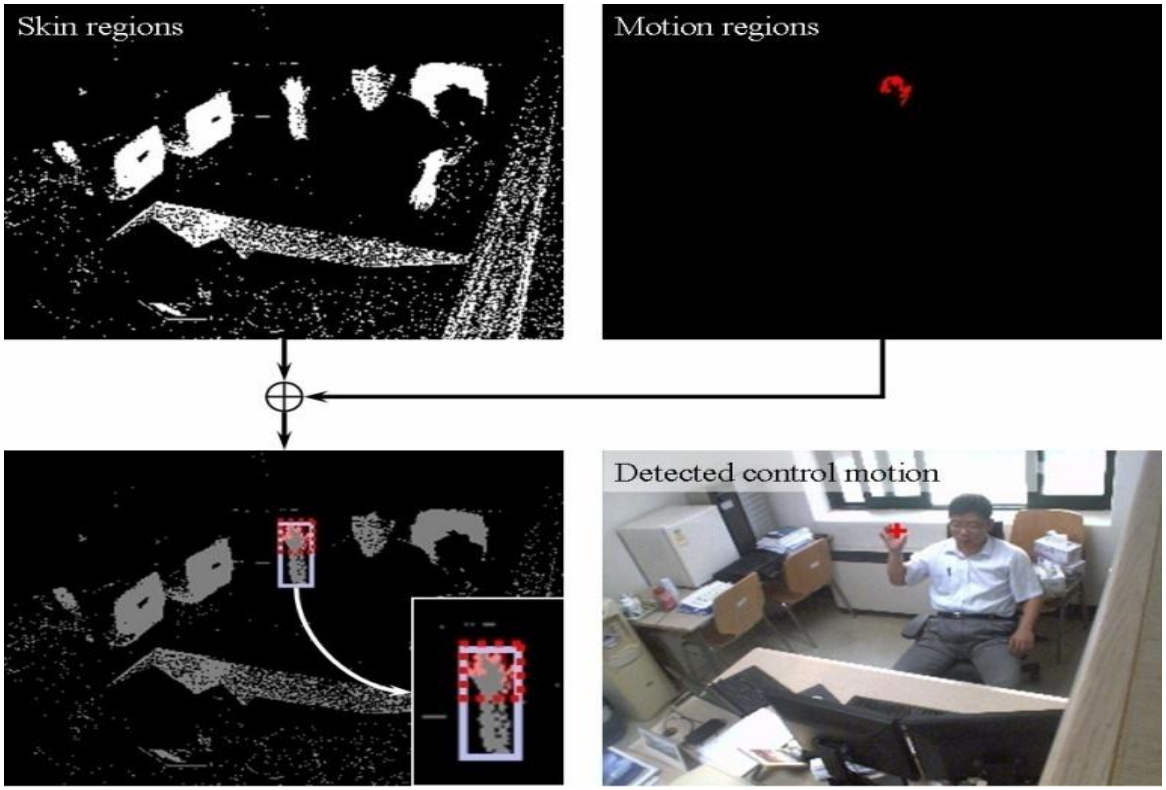

Figure-4: Detection system for skin colour[15]

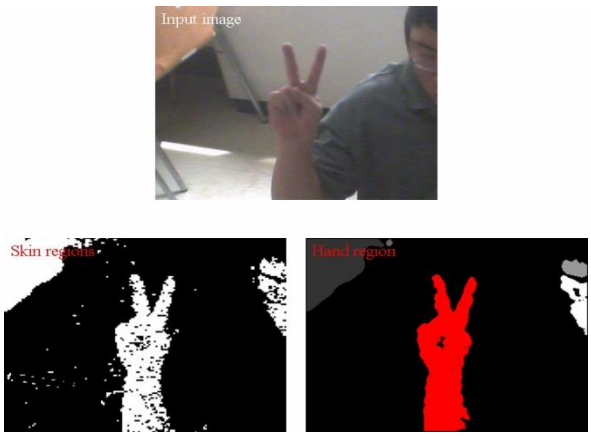

Figure-5: Figure showing hand gestures detected[1]

As the hand gestures are recognized, number of open fingers are counted by detecting finger tips, which are accounted with high curvature. For this we are going to use cosine function to measure curvature. . Using C as boundary point set, p, L, p, p = (x, y), L, p of the hand shape. The k-vectors at the point p_i are define as

$\mathbf{a}_{ik}$ = (xi + k, yi + k).

$\mathbf{b}_{ik}$ = (xi −k, yi − k)

The k-cosine, which is the cosine of the angle between $\mathbf{a}_{ik}$ and $\mathbf{b}_{ik,}$ is given by

$$cos\ n\frac{k}{i} = \frac{a_{ik.}b_{ik}}{|a_{ik.}||b_{ik}|}$$

Finger tips are represented by local maxima of k-cosine. Valley are measured by taking distance from centroid.
For finger tips counting condition is defined as

$di > (di - k + di + k) / 2$

Figure-6 clearly depicting how color combinations are used to count open finger and valley. Gestures states account open finger counting. There may be chances of hazy images because of poor illuminations. So we will refer different frames for single hand gestures and considering skin color we'll get final output of gesture indicated[6-8].

Gesture states are taken in proper sequence which is shown in below figure. These gestures are stored in the sequence there are obtained and by using control commands, state sequences are defined.[1]

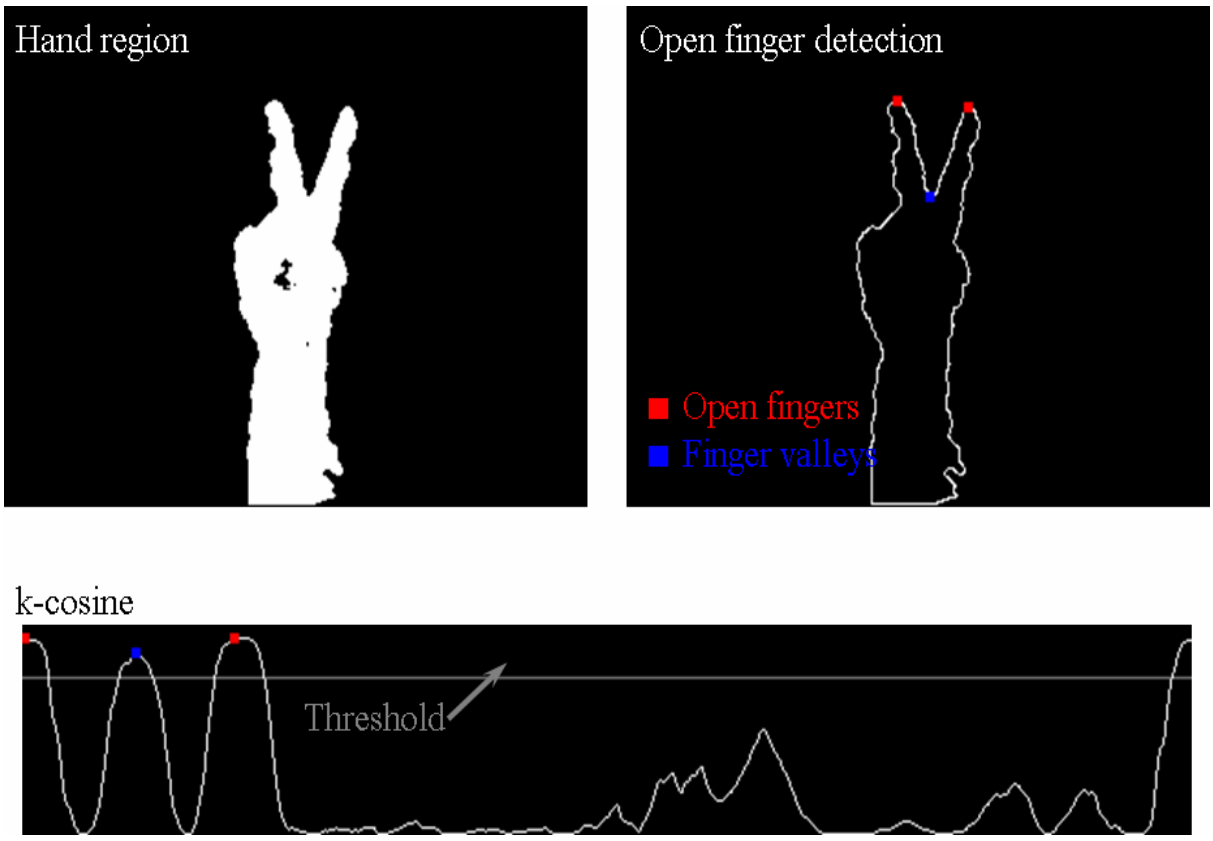

Figure-6: Open finger detection[1]

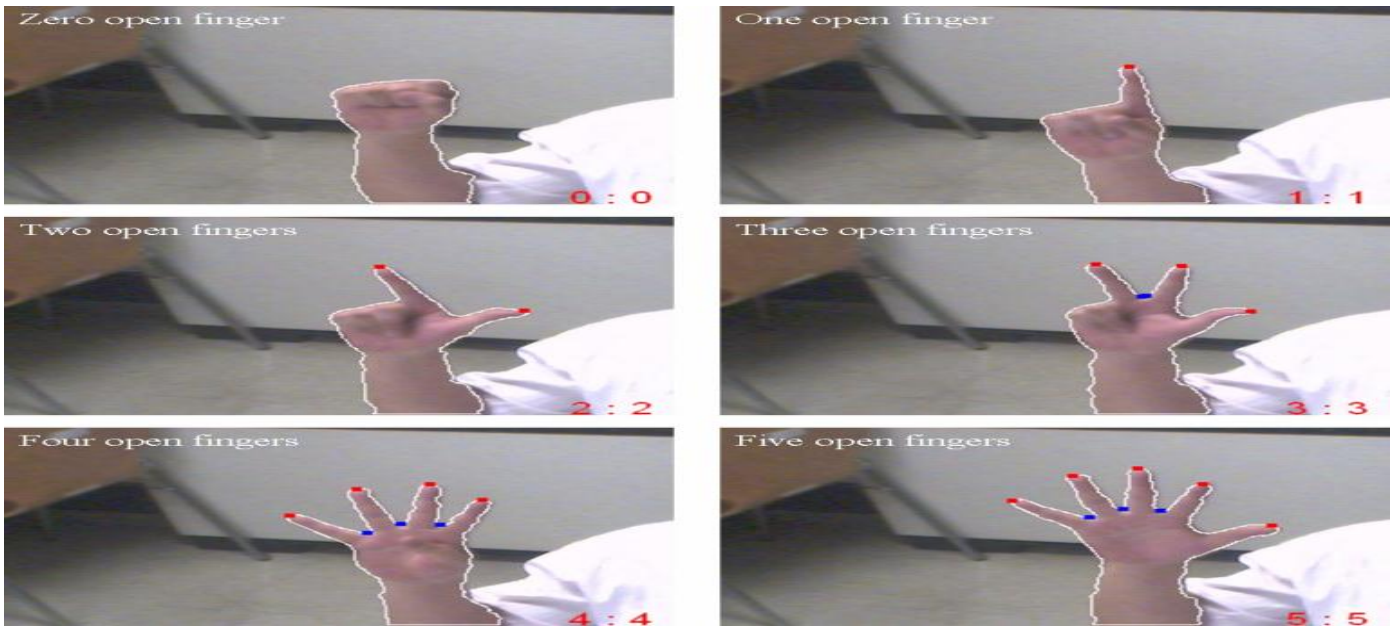

Figure-7: Finger detection[1]

Table-1: Example of Gesture State Sequence and Control

Gesture State Sequence (Number of Open Fingers)	**COMMANDS**
1 → 0	Select 1
2 → 0	Select 2
3 → 0	Select 3
4 → 0	Select 4
1 → 5 → 0	Previous menu
2 → 5 → 0	exit remote control mode

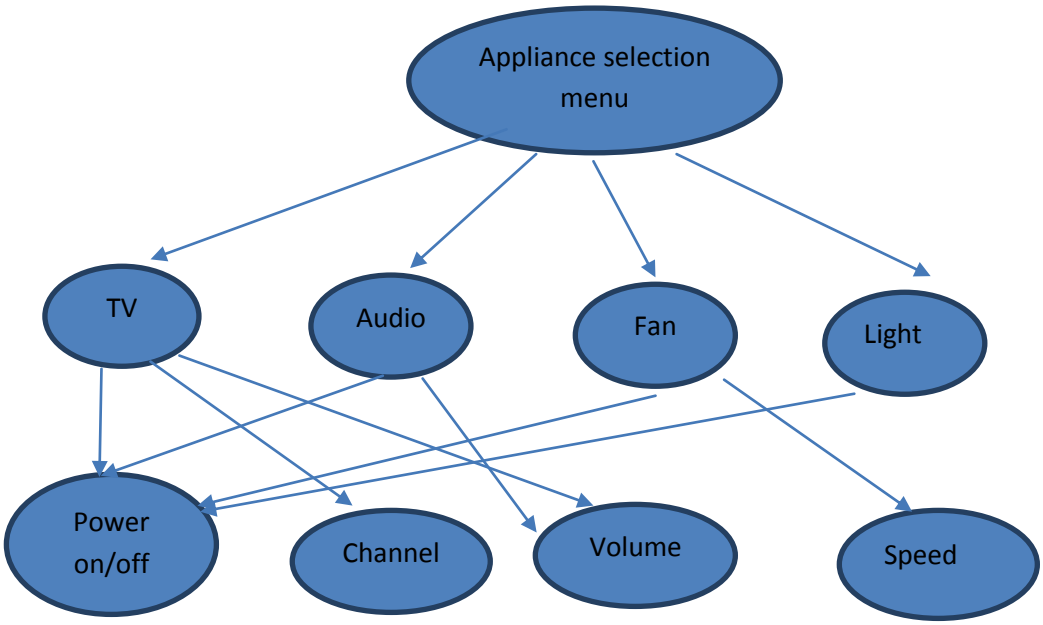

Figure-8: Example of menu hierarchy.

Expected results

Following figure depicts the detection of remote control mode. Red Cross is signifying maximum detected motion region by camera and left top number indicates number of different frames detected for single wave by camera.

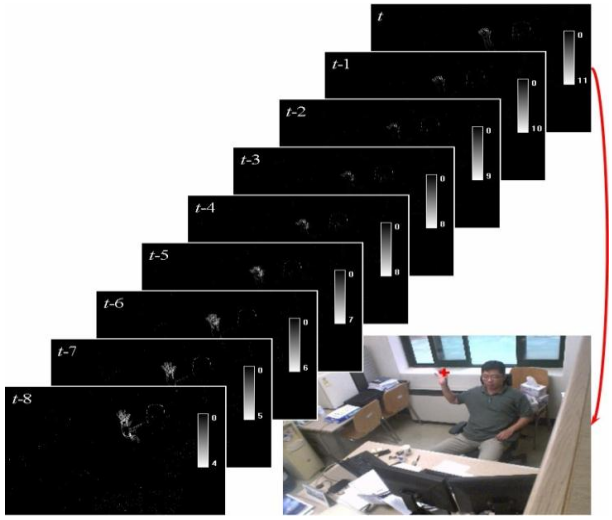

Figure-10: Different frame a captured during remote control mode detection[1]

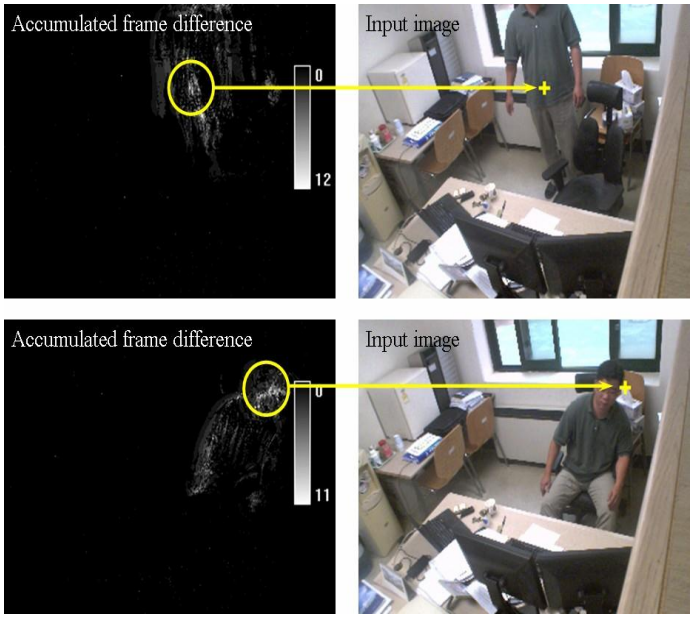

Figure-11: Frame difference capturing method[1]

In the above figure it is showing how different frames obtained can be accumulated for difference and processing for control mode takes place.

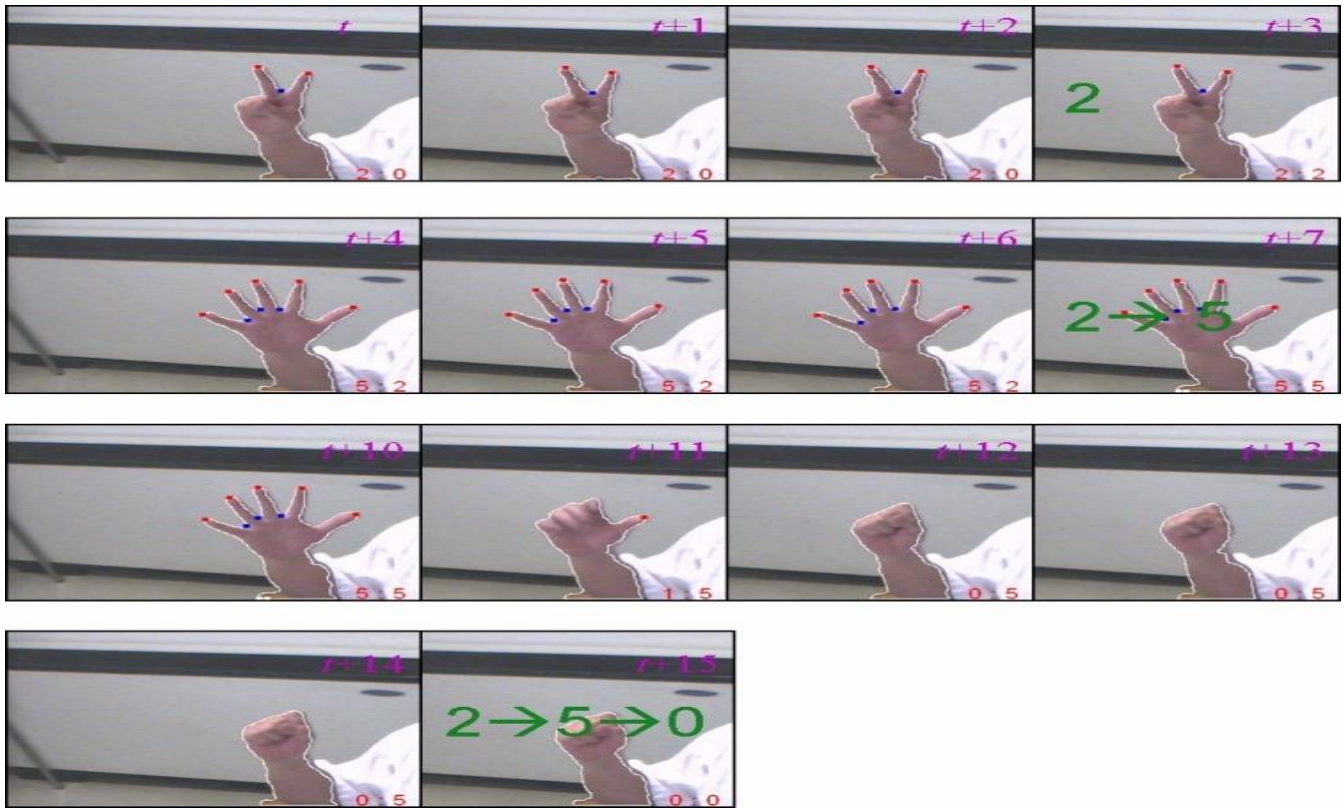

Figure-12: Figure showing counting open finger and valley[1]

From above figure we can clearly observe how we can give commands to camera in hierarchy. Suppose as per above example we want to give input 2, 5, 0. We need to give input in chain. Firstly, we give input showing two open fingers where two open finger is counted with blue and a valley with red. Camera captures this state and compares using frame difference finally 2 is taken in interactive menu. After this it waits for another input as we show fingers 5 same as in 2 open fingers, here also counting is accounted here five open fingers and four valleys are taken into consideration which is fed as input to control command. Finally when no fingers are accounted we come out of loop and our desired process is done. Using this procedure open fingers are counted and interactive menus are chosen.

Conclusion

We studied about Remote Control System for controlling electronic devices using waving hands by analyzing hand gesture. For avoiding false initialization we will be selecting different skin colors and camera will detect motion and using the proper algorithm as per discussed with help in desired controlling of appliances. Remote Control System will guarantee robust operating condition with good performance with low cost investment.

References

1. Daeho Lee and Youngtae Park (2009). Vision-based remote control system by motion detection and open finger counting. *IEEE Transactions on consumer Electronics*, 55(4), 2308-2313.

2. K. M. Fludd, W. Pruehsner and J. D. Enderie (2001). Multi remote appliance controller. *Proc. IEEE 27th Annual Northeast Bioengineering Conf.*, 87-88.

3. K. Fujita, H. Kuwano, T. Tsuzuki, Y. Ono and T. Ishihara. A new digital TV interface employing speech recognition. *IEEE Trans. Consumer Electron.*, 49(3), 765-769.

4. H. Jiang, Z. Han, P. Scucces, R. Robidoux and Y. Sun, (2000). Voice-activated environmental control system for persons with disabilities. *Proc. IEEE 26th Annual Northeast Bioengineering Conf.*, 167-168.

5. J. Do, J. J. Jung, S. H. Jung, H. Jang and Z. Bien (2006). Advanced soft remote control system using hand gestures. *MICAI (Advances in Artificial Intelligence), LNAI*, vol. 4293, 745-755.

6. D.J. Sturman and D. Zeltzer (1994). A survey of glove-based input. *IEEE Comp. Graph. Appl.*, 14(1), 30-39.

7. Tran, N. X., Phan, H., Dinh, V. V., Ellen, J., Berg, B., Lum, J., ... & Duffy, L. (2009). Wireless data glove for gesture-based robotic control. In International Conference on Human-Computer Interaction, 271-280. Springer, Berlin, Heidelberg.

8. T. Baudel and M. Baudouin-Lafon (1993). Charade: remote control of objects using free-hand gestures. *Communications of the ACM*, 36(7), 28-35.

9. Premaratne P. and Nguyen Q. (2007). Consumer electronics control system based on hand gesture moment invariants. *IET Computer Vision*, 1(1), 35-41.

10. Colombo C., Bimbo A. D. and Valli A. (2003). Visual capture and understanding of hand pointing actions in a 3-D environment. *IEEE Trans. Syst. Man Cybern. B*, 33(4), 677-686.

11. Sato S. and Sakane S. (2000). A human-robot interface an interactive hand pointer that projects a mark in the real work space. *Proc. 2000 IEEE int. Conf. Robotics & Automation*, 589-595.

12. Kohler M. (1996). Vision based remote control in intelligent home environments. *3D Image Analysis and Synthesis*, 147-154.

13. Bretzner L., Laptev I., Lindeberg T., Lenman S. and Sundblad Y. (2001). A prototype system for computer vision based human computer interaction. *Technical report*, ISRN KTH/NA/P-01/09-SE, 2001.

14. Sappa A. D., Dornaika F., Ponsa D., Geronimo D. and Lopez A. (2008). An efficient approach to onboard stereo vision system pose estimation. *IEEE Trans. Intell. Transp. Syst.*, 9(3), 476-490.

15. Saxena A., Schulte J. and Ng A. Y. (2007). Depth estimation using monocular and stereo cues. *Int. Joint Conf. on Artificial Intelligence*.