Virtual Panel based Projector Control System Using Image Processing

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Abstract-This paper present an idea which focuses on cost reduction and provide the quality of service in the field of technology-aided teaching or smart teaching ,for this propose we are using raspberry pi as main processing unit and USB camera used as input unit ,this system used for power point and portable document file , To control power point and pdf we are using USB camera and output of camera will again processed by OpenCV .This system will reduce the power consume as compare to other modern portable electronic device laptop , desktop and smart TV and it will work some as the computer . Work will Compared with traditional projector control system, the new one.

Keywords-*OpenCV,Raspberry pi, frame detection ,mouse event.*

I. INTRODUCTION

If you are talking about Ng standard of education system in developing and under development country the quality of education is not up to mark due to lack of modern education equipment, because these equipment are so costly and not possible in such a poor economics problem to provide in everyeducational institution. In the past two decades, there is lot of research work on intelligent teaching systems (smart teaching) have been developed to improve quality of teaching service and to reduce cost. Technology is now integral part schools and colleges, these day students being taught using PowerPoint slides and Portable Document Files (PDF), giving better insights into the subject matter. For this, prerequisites include computer / laptop that need to be connected to projectors and portable devices like pen drive. One notices the following inefficiencies in this practice:

1. Requirement of a desktop/laptop for each and every class, resulting in increased cost.

2. Lager power is needed for the traditional computer system.

Thus, there arises a need to create a device which promises to reduce the overall cost as well as eliminates the need to carry a portable device every time to the class .these projector systems are so costly and not so portable if we have to use single system it in different department. Our work is based on image processing concept frame detection algorithm and Raspberry Pi by which we have developed a projector control system who will replace the need computer or laptop for it .

Raspberry pi is a single board computer used for the real time application and reduce complexity of system. for testing practicality of our system we applied it on different background color of presentation board, from different viewing distances and that too by different cameras. . This paper is divided into seven sections. Section II contains previous work related to fog removal, detailed explanation of proposed work and defogging algorithm explained in sections III and IV, experiment its results and discussion in section V, conclusion and required references are placed in section VI and VII respectively.

II. RELATED WORK

Frame detection from video sequences is an important part of research in last two decade, since it can be used in many regions of real time application such as human-machine interface applications, intelligent video surveillance, motion analysis, and so on. Moving object detection is the basis of moving object identification and tracking. Although a lot of studies have been conducted in recent years, the subject is still challenging [1,2,3].

Currently, the main detection algorithms include frame detection algorithm method, statistical learning method, background subtraction method and optical flow method Method. Optical flow method is the most complex algorithm it is mainly used for the design of critical real time system because we have complete the task in time limit .It take more time than other methods, and statistical learning method needs many training or testing samples to get the accurate results and also has much computational complexity. These two methods are not suitable for real-time processing. Background subtraction method is extremely sensitive to the changes of light. Frame difference method is simple and easy to implement, and results are also accurate enough for soft real system, because the

changes taking place in the background brightness cause misjudgment [4,5,6,7]. That why we are using the frame detection for projector control system.

III. PROPOSED WORK

Fig.1 shown below shows proposed system's block diagram. In that camera is used to capture live video , raspberry pi used as processing unit and for image processing and to interface projector by HDMI.

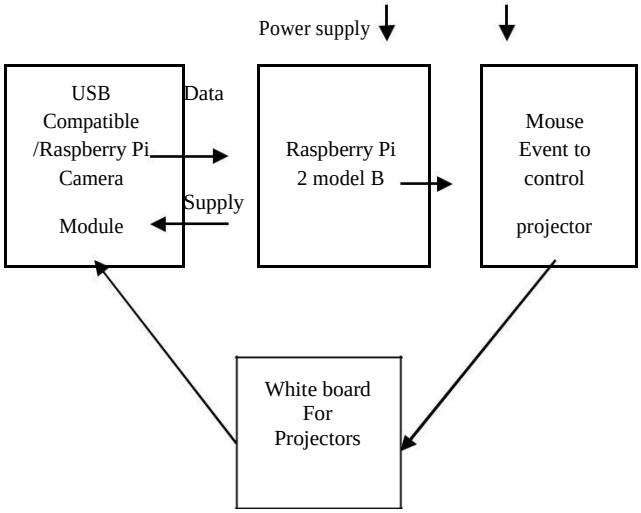


Fig. 1: Block diagram of Proposed System.

The system uses USB camera as an image input device. It takes operating power from raspberry pi and sends video data through connected USB cable. One can use raspberry pi's special camera module it is available in market but it its bit costly. So this prototype uses USB webcam to serve as video input device.

It is know that to control projector we are using mouse, keyboard or wireless remote, for this we need an additional Person or speaker (Teacher) have go near computer to control it ,But it effect the monument speaker focus of student .Image processing based Virtual mouse is a solution for present device for projector control, for that we are using the frame detection or change detection algorithm and calculated change in particular region if change is above the threshold value then need mouse event will take place . used frame detection algorithm are explained in detail in section III.

Raspberry pi is a low powered, portable minicomputer module. It has 4 USB ports, VGA support for connecting display screen and special port for raspberry pi camera module. It uses Linux based operating system. It provides C/C++/ python programming language support. OpenCV had provided special support packages for running simulink modules on raspberry pi hardware. In that it has provided video capturing and display modules in the form of Simulink blocks. This prototype uses these modules to get video input from attached usb camera and to display image on screen . Work flow of the proposed system is shown in fig. 2.

Major focus of this system is to reduce the cost by replacing the need of computer or laptop by raspberry based system for example if we are having five department in any college then we needed at-least five computer if the prices of a computer is 25000 means total cost is nearly 125000 (5 X 25000) , but this large investment is inefficient we can use this in other R&D work which is more beneficial for students.

Table I. Price needed for this system

Sr.No	Item description	Price (Rs)
1.	Raspberry pi	Rs 3000 /-
2.	Raspberry pi case	Rs 300 /-
3.	HDMI cable	Rs 250 /-
4.	Power source	Rs 200 /-
5.	SD card	Rs 300 /-
6.	Camera 25(MP)	Rs 300 /-
	Total	Rs 4350 /-

This implies that the present cost will be cut by 80%, which would indeed prove to be a successful attempt to save huge amount of money for any institute. Thus, taking cost into consideration the proposed system proves to be relevant. Additionally, it provides the same services as the current system does. Thus, the working model of the proposed system would reduce the overall cost involved without compromising on the services it offers.

IV. THE PROPOSED FRAME DETECTION ALGORITHM

The frame detection algorithm is based on observation of every frame[4,5,6]. For frame detection algorithm we are consider image as matrix where each element having a value in range in (0-255) , camera which are using here it process 25 frame /sec

T = 60/25 = 2.4 micro sec

This very small time duration for practical real time system and system will become so sensitive for environment Condi station produces the unknown output. To overcome this problem we consider T0 , T49 time interval for processing to get desirable output

T0 = frame 0

T49 = frame 49

After calculating the difference of frames we need to upgrade the value of T0 and T49

T0 = frame 49

T49 = frame 49 + next 49^{th} frame

This makes our system recursive so that system will continues monitor video and preforms needed operation

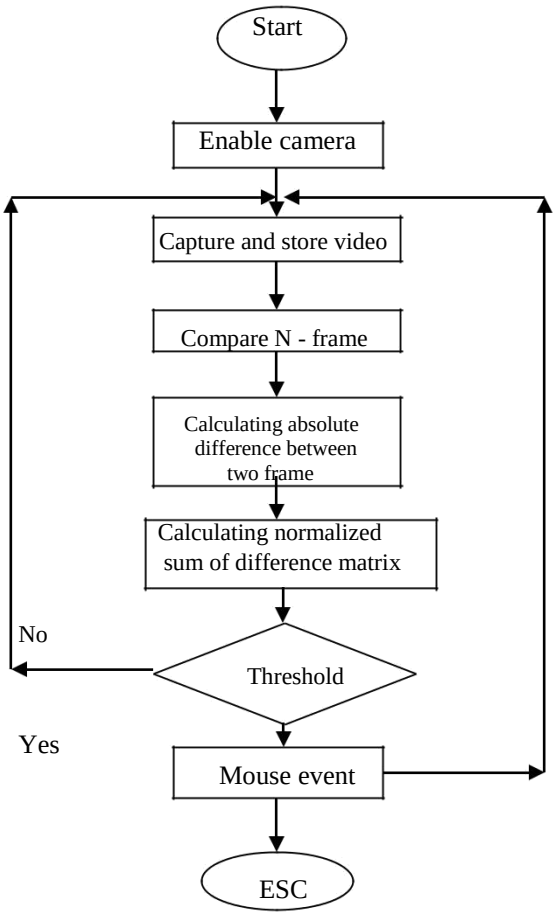


Fig. 2: Work flow of proposed system

A. Frame Difference Method

[7]Frame difference method is also called change detection or frame subtraction. It is referring to a very small time interval t of the image before and after the pixel on the time difference, and then thresholding to extract the image change fig 3 shows the flow for it.The specific method of calculation of difference image I_K between the k^{th} frames with the k-1 the frame image f_{k-1} is differential, the negative differential and fully differential, the corresponding formula is a follows.

$$I_k = a_K - a_{k-1} \text{ if } (a_k - a_{k-1}) > 0 \text{ 0 else}$$

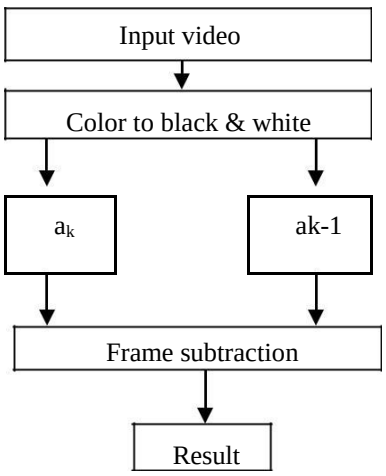


Fig.3: Frame detection algorithm

B. Calculating nomalizied sum

In this system very are going to make a control panel on white board which having following keys over it

1. NEXT
2. EXIT

- When speaker will cover any one of these keys then appropriate action will take place.
- We mainly using the change detection algorithm for this device

T0 = frame at time zero;

T49 = frame at time 50;

Image = T0 [axb] – T49 [axb]

Function used in OpenCV to find complete difference of two matrix of same size

Image = absdiff (T0, T49)

To generate any signal, we must need a single variable for that we have to find complete sum of elements. Sum to element of matrix are not done by the conventional method of matrix and arrangement. To find the sum, we have to divide this process in two parts.

1. We have to find the sum of elements in a row.
2. Then we have to find all above sum of element of row.

For that we use the matrix summing method ny for loop.

$Row_1 = \sum$
$Row_2 = \sum$
$Row_m = \sum$

Where n is the number of elements in each row and m this number of row in matrix.

C.Complete sum of Row element

In second step we will sum all sum value of element sum

$Sum = Row_1 + Row_2 + Row_3 + \ldots\ldots\ldots\ldots Row_n$

If the value is large than particular value, it will execute the mouse to generate different mouse functions like left click, right click and scrolling function.

D.Mouse event to control projector

When the value of threshold is above 500 then raspberry pi will take the needed action for it. There are two methods to generate mouse like left click or exit

1. Write device driver for raspberry pi to do mouse events like left click.

2. Use the library present in OpenCV, like auto function, pyauto so we can directly use it or we can change these function as per our need ,that's why we using this method for generating mouse event . So for this system we use second method which make it user friendly.

V. EXPERIMENT, RESULTS AND DISCUSSION

In this section demonstration of hardware prototype along with qualitative and quantitative analysis of frame detection algorithm For experimentation raspberry Pi 2 model B is used as processing unit with specifications: ARM7 Quad Core processor, frequency of operation is 900 MHz with 1GB RAM. In software part coding is done in OpenCV and for its we are using python for coding , Python is high level language and it is object ordinated language . Prototype takes 0.7 seconds to process image of size 320x240 and 1 seconds for 640x480 sizes. Hardware setup of prototype is shown in fig.3.

Rraspberry pi made this system portable, low cost, low power even though it has its own limitations like low frequency of operation and available RAM size.

B. Demonstration of prototype:

For the Demonstration we are using the special type arrangement for it we are computer desktop in place of projector and it is connected to it by HDMI to VGA converter. And we are using the white board at place of 8 meter away from the system . Images of demonstration of practical testing are shown in fig.

Fig. 3: Hardware setup of prototype

C. Testing Result for frame detection algorithm

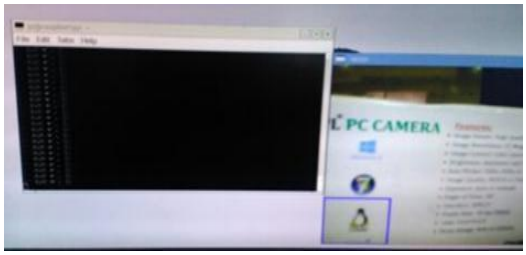


Fig 6(a) image after frame detection

TESTING RESULTS

Table no .1

Background Color	Hits 0-5 feet	Miss 0-5 feet	ṅ	Hits 5-10 feet	Miss 5-10 feet
White	6	4	0.6	6	4
Black	8	2	0.8	10	0
Blue	8	2	0.8	10	0
Skin	2	8	0.2	0	0

The table no .1 will explain effect different colors of power point presentation on white board , we have divide whole testing into parts on basics of distance between board and camera five feet distance and 10 feet distance, we using four different color. For Demonstration we are using the special type arrangement for it we are computer desktop in place of projector and it is connected to it by HDMI to VGA converter. In above result we find that system is response for dark color efficiency nearly greater 70% and for lighter color efficiency nearly less 20%. Performance of system also depend on distance between board and camera graph no 1. Show relation between distance and efficiency graph show that if distance is small in range of 0- 7 meter efficiency is low as the distance increase efficiency will increase (7-15)meter. if again the distance is increase above 15 feet then number of miss increase and efficiency is reduce , to get proper function of system should be so that camera will take complete it will take white board in complete focus . we have to consider these following parameter while using this system otherwise system will not work up to mark.

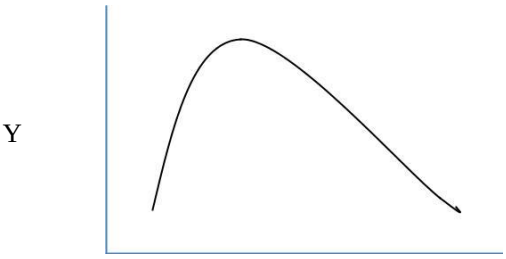
To control the projector system we needed only small area of that board, so have crop that region form main image and all the next operation will take in that particular region, due to small area of operation speed will increase. We are using the camera with night vision so are able to work even in low light.

Fig .4: Demonstration of practical testing

1. Light intensity should be constant in room or in hall where the system is used.
2. We must consider the effect shadow.

3. 3. Effect of speaker movement whiles his presentation.
To overcome this problem we have make following change in code, in code added new function is called Thresholding function, by Thresholding we can easily remove all above effect as know that image is matrix where each element represents pixel. Pixel value is always in between (0-255) where 0 represent white and 255 represent black. if there is considerable change if frame then pixel value will change 0 to 150 , if any Pixel having value in range of (0 – 149) then can easily discard that pixel form that region ,by which the functionality of system is improved .

Image = Threshold (image, 150)
Output image after thresholding only having value pixel 150 and above only, all environmental effect is removed.



V. DISCUSSION AND CONCLUSION

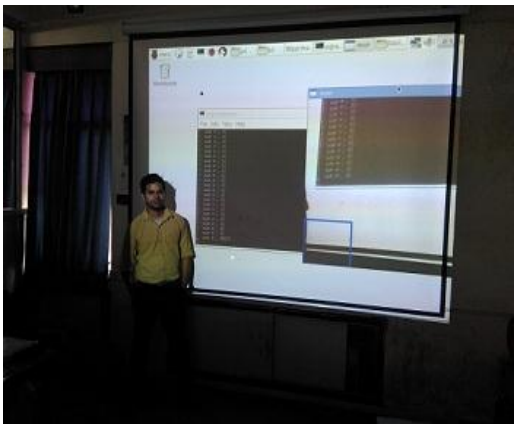


Fig 7: (image with projector screen)

Proposed system is portable as compare to desktop /laptop, this system reduces the expenditure over projector system a up to 80%. Raspberry pi having the Ethernet port by which we can easily excess system by remote location, it also reduces the need of power up to 60 % . Raspberry pi need only 5 volt and 2 amps for operations mean we can perform operation by battery there is no need constant ac supply for it. Rraspberry pi is satisfactorily served a platform for video processing and removed dependency on fat size CPU.

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