Improving Performance of Projector with the Protection of the Eyes while using a Smart Board

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ABSTRACT

One of the most important problems that a teacher faces when using a smart board in the teaching process is the fall of a strong light beam from the projector on their faces and bodies. The focus of this light is harmful to the human eye, which leads to temporary blindness when it falls directly on the eye. It also leads to harmful side effects. The light falling on the presenter body will make the picture on the screen looks unprofessional and unclear and distract the attention of the students. Solving this problem will led to better lectures delivering for both the teachers and the student.

In this study, a system is designed to track the movement of the teacher using an infrared transmitter that is attached to the teacher's freshness or head cap. Electronic signals directed to an infrared receiver are installed on the front of the projector device in order to send these signals to the computer for analysis according to the proposed algorithms to determine the teacher face position. A black shade square) is placed in the designated and displayed on the smart board where the lighting will decrease on the face and eyes of the teacher, as this shade will be moving with the movement of the transmitter. This method aims to protect the teacher's eyes from the harmful strong light.

Keyword: projector, protect the eyes, Luminas, IR-Cam, Image Detection.

تحسين أداء جهاز عرض البيانات مع حماية العين أثناء استخدام السبورة الذكية

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الملخص

من أهم المشاكل التي يواجهها المعلم عند استخدام السبورة الذكية في عملية التدريس هي سقوط أشعاع الضوء القوية من جهاز العرض على وجوههم وأجسادهم. تركيز هذا الضوء ضار بالعين البشرية مما يؤدي إلى العمى المؤقت عندما تسقط مباشرة على العين. كما أنه يؤدي إلى آثار جانبية ضارة. الضوء الذي يسقط على جسم مقدم العرض سيجعل الصورة على الشاشة تبدو غير مهنية وغير واضحة ويشتت انتباه الطلاب. سيؤدي حل هذه المشكلة إلى تقديم محاضرات أفضل لكل من المعلمين والطالب.

في هذه الدراسة، تم تصميم نظام لتتبع حركة المعلم باستخدام جهاز إرسال الأشعة تحت الحمراء (LED) المرتبط بنضارة المعلم أو غطاء الرأس. يتم تثبيت الإشارات الإلكترونية الموجهة إلى مستقبل الأشعة تحت الحمراء في الجزء الأمامي من جهاز العرض من أجل إرسال هذه الإشارات إلى الكمبيوتر لتحليلها وفقًا للخوارزميات المقترحة لتحديد موضع وجه المعلم. يتم وضع مربع الظل الأسود على السبورة الذكية حيث تنخفض الإضاءة على وجه وعين المعلم وسيتحرك هذا الظل مع حركة المرسل. تهدف هذه الطريقة إلى حماية عيون المعلم من الضوء القوي الضار.

الكلمات المفتاحية: جهاز عرض، حماية العينين، شدة الاضاءة، كاميرا الأشعة تحت الحمراء، كشف الصور

Introduction:

Several sties focus on how to solve problems using the projector, and among these problems are the different dimensions and measurements of the scene when moving the projector from one place to another. One of the solutions is to put a camera for the scene and return a Data to correct the amount of displacement and deviation of this scene using ready-made algorithms and others suggested New algorithms [1-7].

We discuss the use of invisible infrared imaging techniques to solve the problem of light fall on the user's face. [8-10]

This study focuses on converting the projector from a traditional data projector into an interactive educational medium. The smart board uses a projector to display the data from computer, mobile or tablets. There is a distance (w) between the projector and the whiteboard that increases and decreases according to the display area or the specifications of the projector device, the teacher can move in this distance to explain the lessons on the smart board, See figure (1).

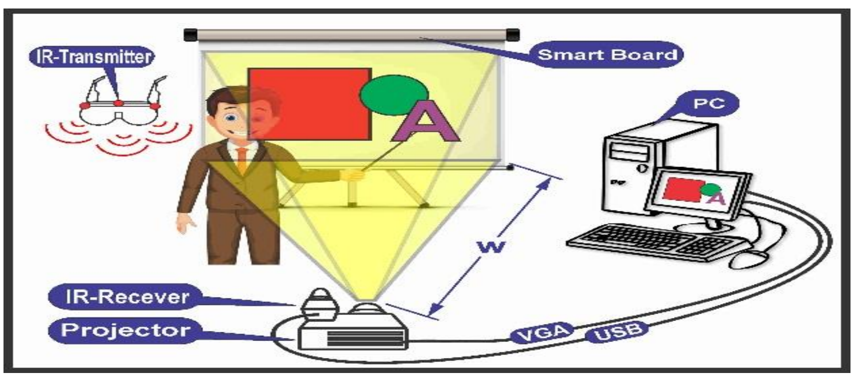

Figure 1: System diagram

When the teacher is in the display zone between the projector and the board, the projector images will fall on the teacher face and body and not on the board. The intensity of this light is very high (2000-5000 ANSI) according to the specifications of the projector. In some cases, that contain a group of loud or moving colors.

The idea of this study is summarized by making a shadow that obscures the lighting on the face and body of the teacher and is moving with the teacher’s movement at the same time and the color of this shade is black resulting from making the weight of basic colors (RGB) equal to zero [11-13].

1- Hardwar Requirements:

The main parts of this system are a projector, a smart board, and a computer. The infrared is chosen Due to being not harmful and considered beneficial to the body [14]. There are medical devices that use infrared to treat the skin]. It has a wavelength spectrum close to the frequencies of visible light, as in Figure (2), which shows the location of infrared waves with the rest of the waves in terms of frequency and wavelength [15,16].

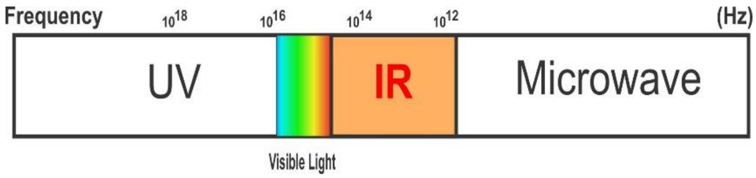

Figure 2: Spectrum Waves

Receiving device: A camera for night photography, which is an infrared camera, is placed on the front of the projector, and it depicts the pictures on the smart board, the lens of the camera should depict the scene larger than the circumference of the smart board [17]. This camera is not affected by what will be displayed on the board and does not visualize any movement in front of it because it contains a filter for visible rays. This camera only captures infrared radiation transmitted by the transmitter. A computer camera was used after removing the infrared filter from the front of its lens and replacing it with a filter to prevent visible light spectrum such as the special interior (floppy disk) or a film tape. See figure (3).

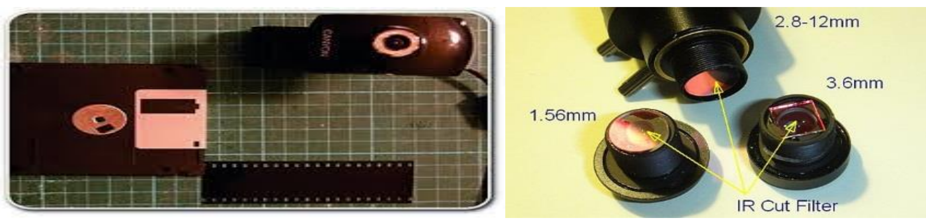

Figure 3: Converting camera filters

There are many types of cameras with many specifications. We used a 5 mega pixel camera, and 15 frames per second [18], from a USB type to Connection, for easy installation inside the projector and showing the lens only.

Transmitter: The transmitter is very simple and lightweight. It is an electronic oscillator circuit with an electric power source and an operating switch and an infrared (IR-LED) source where the type used in the TV remote control devices was used. See Figure 4.

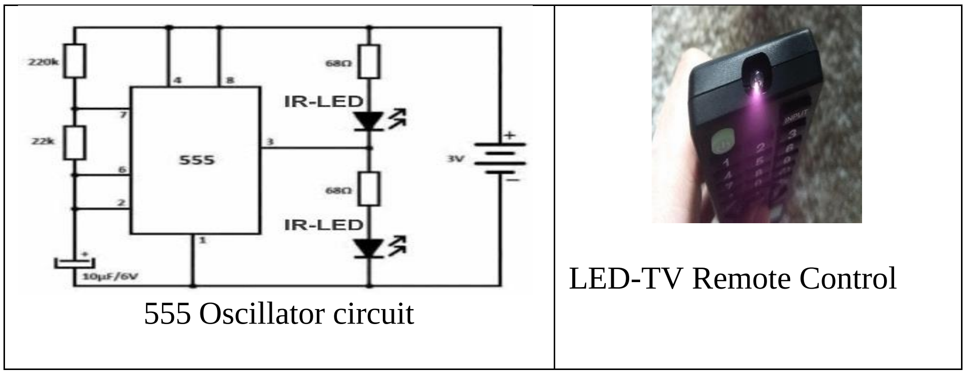

Figure 4: Transmitter Circuit.

The 555 function is to make square waves with a fixed frequency (1kHz) that is converted to infrared (IR-LED) and sent to the receiver. The power source for this circuit is two (3V) batteries [19]. This small-sized circuit (IR-LED) is installed on the eyeglass or on a cap, as shown in Figure

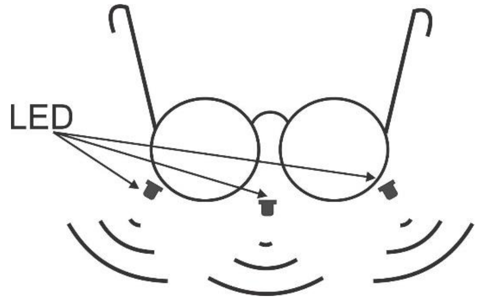

Figure 5: Transmitter LED Distribution

More than one IR-LED is used and distributed over more than one angle.
The benefit of using more than one IR-LED is
1. Each IR-LED will be sent in a different angle to cover the largest possible area of the face.
2. To draw a virtual straight line between IR-LED right & IR-LED lift, this line helps to know the face diameter measurement. Because the face size will be variable, depending on the user's distance from the camera, and it will also differ by the magnification of the viewing area.
3. Increased reliability and sensitivity in data acquisition by the recipient.
1- Software System: The image matrix is acquired from the infrared camera and represented by a two-dimensional gray scale matrix [IR], meaning that each pixel of this matrix ranges from 0-255 degrees. The process of converting the matrix to black and white is represented by the following flowchart, the value of IR-matrix is set "1" when the threshold equal 200 else value of IR-matrix is reset "0". see figure (6).

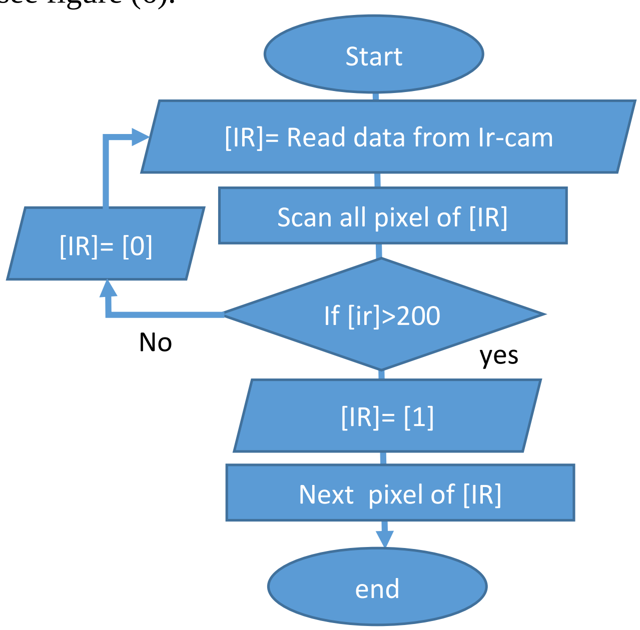

Figure 6: Flow chart convert gray scale to black and Wight matrix

All values of the new array [IR] are equal to (0) when there are no transmission signals to The camera the received image will be black. If the transmitter is turned on and its position is in front of the camera, the camera will take pictures that contain a bright white point that represents the location of the transmitter and its values will be 1 and the rest of the image will be black and its values are Zero [20]. The transmitter coordinates and location are determined with respect to the new IR array's dimensions and coordinates [IR]. These values are stored in the Result Array [RS] which represents the coordinate point on the X axis and Y axis only. The values of this matrix are updated as the transmitter moves from one place to another, represented by the movement of the eyeglasses that the teacher wears.

The Shadow mask: The primary colors are RGB (Read, Green, Blue), and each of these colors has a color intensity from 0 to 255 that represents the intensity of the color. As for white, it is the result of mixing all these light colors, where the value of red is 255, as well as green and blue. For the black color, the value of all these colors will be zero. To carry out practical tests and Analyze them on this system, the specifications of the projector used in terms of luminous intensity, brightness or optical density measured in ANSI unit called Lumens must be known. In this study a projector was used by PINQ Model MX503 which has the following specifications: -

13000:1 Contrast Ratio

2700 ANSI Lumens

Native XGA Resolution (1024x768)

Display Type: DLP x 1

Throw Ratio: 1.86:1 - 2.04:1 (D: W)

Projector Size: 4.50" x 11.30" x 9.20" (HxWxD)

The Shadow rectangle mask that will cover the teacher's head is a dark color and the lowest possible light intensity, so the lighting intensity and brightness of all primary and secondary colors are analyzed and the amount of Lumens is analyzed.

By designing an HTML web page containing all the colors as shown below: >html dir="rtl"><head>/head><body<

>table border="1" width="100%" id="table1" height="100%<"

> tr><td bgcolor="#000000"></td<

>td bgcolor="#FFFFFF"></td<

>td bgcolor="#0000FF"></td<

>td bgcolor="#00FF00"></td<

>td bgcolor="#FF0000"></td< />tr></table></body></html<

When testing this sample of colors on the projector and measuring the amount of Lumens for each color separately, it can be noticed that white has the most light intensity and is more effective than the rest of the colors on the human eye. See Figure (7).

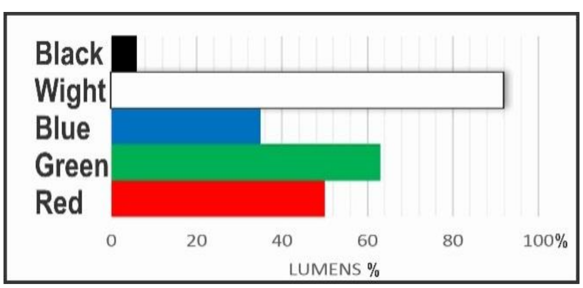

Figure 7: Lumens of General Colors

As for the black color, it has the lowest light intensity, and for this reason the mask was chosen in the black color. For the shape of the mask, it will be in the form of a circle that surrounds the teacher's head.

Data Acquisition and Analyses:

The images are taken from the IR-CAM and represented by a matrix of dimensions [200 * 150IR=] where ¼ represents the size of the projector screen which measures 800 * 600, meaning that the size of the camera image is a quarter of the size of the projector screen, in order to speed up the processing process, and reduce the delay time without affecting the accuracy of the face mask, the camera depicts many patterns of transmitter motion, and a sample is taken at coordinates of {40,70} point As shown in Figure (8).

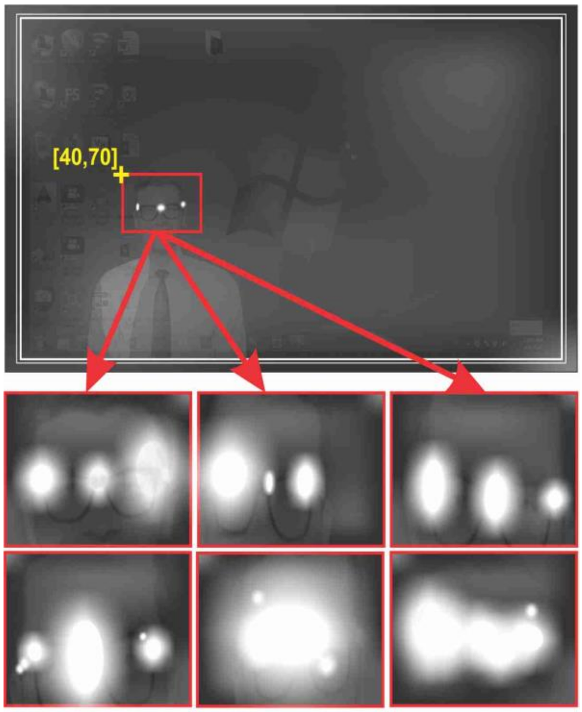

Figure 8: Image Acquisition from IR-Cam

The images acquired by the infrared camera differ, because the transmitter is mobile and not fixed, so some of these samples have more than one bright spot depending on the angle and direction of the transmitter, and these bright points may have different light intensity due to the proximity and distance of the transmitter from Camera lens. Reflection and refraction of infrared radiation may generate fake images that increase the percentage of noise in the acquired data. On the other hand, if the camera lens does not detect such images, this indicates that the transmitter is not working or that the transmitter is outside the camera lens. The following diagram shows how to handle data for this system,

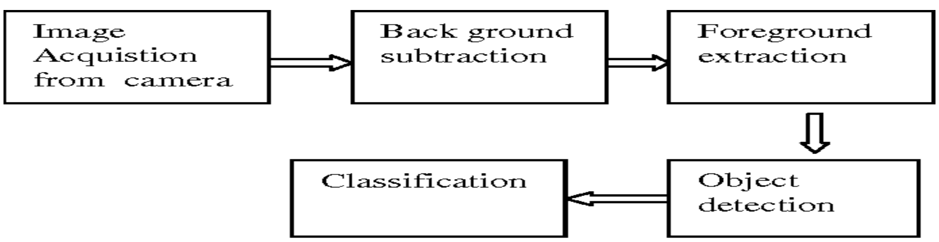

Figure 9: block Diagram of Images Detection

The images acquired from the infrared camera are processed, the unwanted image background is deleted, and the noise is removed.

Using a Gaussian Filter Remove the noise

Most edge recognition results are handily influenced by clamor and can make a bogus edge discovery. Gaussian channel is one of the most productive strategies that can be utilized to sift through commotion, and it tends to be performed by the accompanying equations: [21].

$$g(m,n) = G_\sigma(m,n) * f(m,n) \qquad \text{...............} \quad (1)$$

$$G_\sigma = \frac{1}{\sqrt{2\pi\sigma^2}} exp\left(-\frac{m^2+n^2}{2\sigma^2}\right) \qquad \text{...............} \quad (2)$$

Compute image intensity gradients:

The edge gradient can be performed by Equation

$$M(n,n) = \sqrt{g_m^2(m,n) + g_n^2(m,n)} \qquad \text{...............} \quad (3)$$

$$\theta(m,n) = tan^{-1}[g_n(m,n)/g_m(m,n)] \qquad \text{...............} \quad (4)$$

Where, g(n) the vertical direction, g(m) the horizontal direction. Applying a threshold to the edge gradient(M), to suppress the noise and keep the element of the detected edge (T) by Equation

$$M_T(m,n) = \begin{cases} M(m,n) & \text{if } M(m,n) > T \\ 0 & \text{otherwise} \end{cases} \qquad \text{...............} \quad (5)$$

Non-maximum pixels in the edge's suppression

This progression expects to the edge edges in MT, by contrasting the non-zero MT (m, n) esteem with its two neighbors' qualities along the slope bearing. In situations where the MT (m, n) isn't the best worth, at that point the MT (m, n) is set to zero, or it keeps the estimation of MT(m,n) with no change.

Table 1. Comparison for different tracking methods.

Tracking Methods/ ype of tracking	Number of objects tracked	Occlusion Handling	Optimal	Notes
Kalman Filter/ Point tracking	single	ok	ok	Can track points in images which are noisy.
Particle Filter / Point tracking	multiple	ok	ok	Ideal outcomes when assessment of the picture happens at the theory object position
Mean shift/ Kernel Tracking	single	partial	-	Applicable for situations with dominant colors.
Cam Shift / Kernel Tracking	single	-	-	Cannot be applied to complex scenes.
KLT tracker/ Kernel Tracking	single	ok	ok	Time efficient, robust occlusions.
Template Matching/ Kernel Tracking	single	partial	-	Not suitable for complex templates.
Tracking/ Contour	multiple	ok	ok	It is difficult to handle entry and exit of objects.

Conclusions:

Solving the intense light problem on the teacher's eye using a photographic camera and using faces detection algorithms is an impractical idea. It includes many problems such as the camera's lack of distinguishing the real teacher's image from the faces image that may appear in the scenes of the show. There will be an overlap in the images of faces and not to distinguish between them. The photographic camera is also affected by the surrounding lighting and the light of the projector as well, the choice in this study is to use a new and different way to define the face of the teacher and avoid the fall of the intense light on him, by converting the web cam to infrared imaging, where the image of the teacher, the smart whiteboard, the surrounding room and the images will disappear. The scene regardless of its content and details. The infrared camera only picks up what the transmitter infrared is destined for, thus eliminating the problem of distinguishing faces and getting rid of complex algorithms and reducing the time of analysis to the least possible. The analysis Loofah two-dimensional balloon black and white is much easier to recognize faces technique using RGB arrays and high accuracy. Rather, this method of analysis acquires greater speed and reliability. This study is not limited to one type of projector but is applicable to all types and all specifications. Another advantage of this system is the low cost estimated at only $25.

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