

Binking Application: Early Detection of Computer Vision Syndrome

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ABSTRACT

Policies regarding the use of gadgets are very necessary at this time, especially during the COVID-19 pandemic, because at this time people inevitably have to be willing to learn and use technology such as gadgets / smartphones in order to meet their respective needs, studying, buying goods, reading news and other things, without a policy in the use of this technology will certainly have a negative impact on users such as Computer Vision Syndrome, this journal aims to determine the impact of Computer Vision Syndrome and also create an eye blink detection program which aims to prevent and detect eye blinks so as to avoid the negative effects of Computer Vision Syndrome such as eye disorders. This research was conducted using four students of the Faculty of Electrical Engineering, Sam Ratulangi University as sample's data in making this Blink Detection program, the program was made through several references and several improvements until it was finally completed and the program could detect many eye blinks of gadget users and provide warnings to the user.

INTRODUCTION

In this modern era, very large and significant developments can be seen in the field of knowledge and technology, technologies that are developing and that are being created are increasingly sophisticated and where if humans cannot keep up with these technological developments then they will be left behind with the times. If you look at human activities at this time, you can see and conclude that all activities are inseparable from what is called technology, which, more specifically, is called a gadget/smartphone. According to Fathoni's opinion (2017) revealed that Gadgets are a very popular technology today, not only for adults but still children use gadgets. Many gadget products make children their target market, even including consumers who actively use gadgets. Gadgets are taken from a term in English which means a small electronic device with a variety of special functions. Gadget is an electronic tool that is used as a medium of information, learning media and as entertainment. The use of technology will have an impact on children both in a positive and negative way depending on how parents educate them. At this time it was also introduced with the name Industrial Revolution 4.0 which also shows the enormous development of the technology sector, the internet and gadgets which in this era can be said to be the basic ingredients of today's humans, without gadgets and the internet people will become restless and even stressed.

In 2020, all people in the world have been shocked by the COVID-19 virus which has been circulating from Wuhan (China) where this virus can attack the respiratory organs in humans and can even cause death, this is in an effort to prevent transmission of the COVID-19 virus this, the government has implemented rules to stay at home and which is usually known as "Stay At Home". With this regulation, most people, from children to adults, must carry out their activities such as working, shopping, and even studying online or through online media using gadgets, smartphones, laptops and other technologies, of course, with the rule of staying at home. Of course, people spend most of their time at home and based on a KPAI survey in July 2020 that most people spend most of their time using their smartphones, such as for school purposes, scrolling social media and even playing games. With such a large amount of time being spent on the use of technology such as this gadget, it is necessary to have policies and advice for users so that the development of this technology has a positive impact on many people and does not have the opposite effect. Excessive use of gadgets can cause negative effects such as Computer Vision Syndrome, where one of the biggest impacts is disturbance to the sense of sight (eyes). Prolonged vision of the eyes on the gadget screen will make the eyes tired and can even cause several diseases such as red eyes, tired eyes, blurred vision, dizziness, and even make the eyes feel sore like there is dust in it. Policies and the ability to make good use of technology will certainly avoid the influence of this Computer Vision Syndrome. This eye blink detection program was created because during a pandemic, people were required to work from home to prevent transmission of the COVID-19 virus. This makes most people's activities spent in front of a computer screen. This is what makes Computer Vision Syndrome (CVS) increasing. Computer Vision Syndrome or

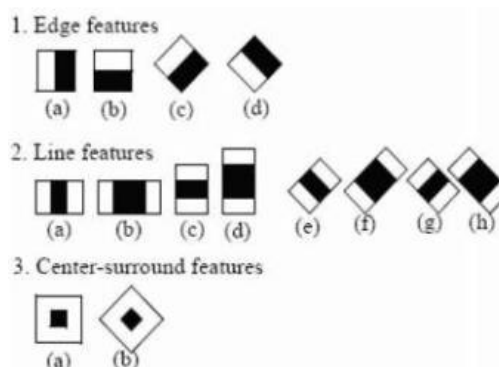
eye disorder syndrome is a health problem in the eyes caused by excessive activity or staring at the screen of a computer, tablet or cell phone for too long which can cause eye damage to the user.

The objectives of designing this program are: The blink detection program is intended as a reminder for users who have activities in front of the computer to maintain eye health.

METHODOLOGY

1. Haar Cascade Classifier

The method used in this program is the haar cascade classifier (Jati, 2015). Haar like feature or commonly known as Haar Cascade Classifier is a rectangular (square) feature that gives specific indications for objects or images. Haar-like features have the principle of recognizing objects based on the simple value of the feature but not the pixel value of the object image. The advantage of this method is that it only depends on the number of pixels in a square, not each pixel value of an image, making the computation very fast. This method is a method that uses a statistical model (classifier). To detect objects in images, the Haar cascade classifier will combine four main keys, namely Haar like feature, Integral Image, Adaboost learning and Cascade Classifier.



Haar Feature is a feature which is based on Haar Wavelet. The Haar wavelet is a single square wave (one high interval and one low interval) which is for two dimensions, one light and one dark. Furthermore, box combinations are used for better detection of visual objects. Each Haar-like feature consists of a combination of black and white squares.

$$f(x) = \text{SumBlack rectangle} - \text{SumWhite rectangle}$$

The Haar cascade classifier has a feature, namely the Haar filter, which calculates by subtracting the average pixel in the dark area from the average pixel in the bright area. If the results of the calculation get a difference value that is above the threshold or threshold value, then it can be said that the feature exists. The value of the Haar-like feature is the difference between the sum of the gray level pixel values in the black box area and the white box area. where for boxes on Haar like features can be calculated quickly using "integral image". Integral Image is used to efficiently determine the presence or absence of hundreds of Haar features in an image and at different scales.

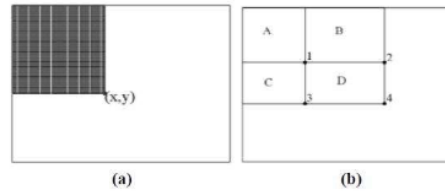
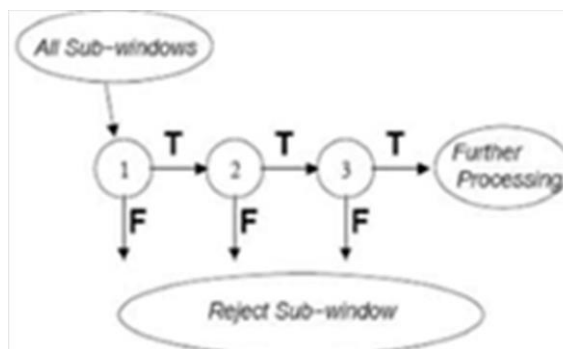


Figure 2. Integral Image

As shown by the image above after integration, the value at the pixel location (x,y) contains the sum of all the pixels within the rectangular area from the top left to the location (x,y) or the shaded area. Dividing the values in (x,y) by the area of the rectangle can be used to get the average pixel value in the rectangle.



Where $ii(x,y)$ is integral image and $i(x,y)$ is the original image. A method for combining complex classifiers in a multilevel structure that can increase the speed of object detection by focusing on only probable image areas.

$$ii(x,y) = \sum_{x' \leq x, y' \leq y} i(x',y')$$

Figure 3. Cascade Classifier

2. Image Data

The image data used is real-time webcam results. Retrieval of real-time data using a webcam where the distance between the object and the webcam is $\pm 40 - 60$ cm, the position of the head is straight facing the front of the webcam and the position of the light source is from the front.

3. Face Detection

After the main data is obtained, namely real-time webcam data, the next thing to do is face detection with the haar cascade classifier using the haarcascade_frontalface_default.xml file. The area of face detection is marked in green.

4. Eye Detection

After the face has been successfully detected, the next thing to do is eye detection with the haar cascade classifier using the haarcascade_eye_tree_eyeglasses.xml file. Then, eye detection is continued by using ROI (Region of Interest) to mark that the eye detection area is only within the previously detected face area. The area of eye detection is marked in blue.

RESULTS

The final results obtained from the blink detection program are as follows:

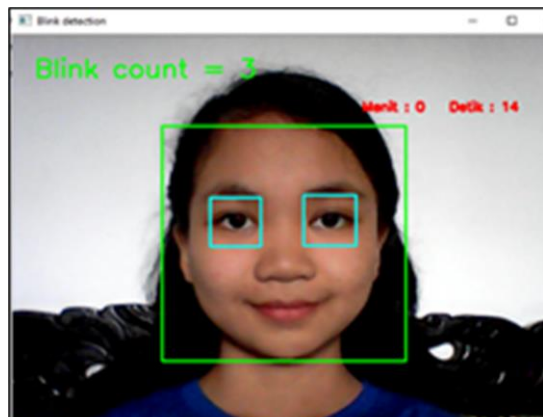


Figure 4 Blink detection program

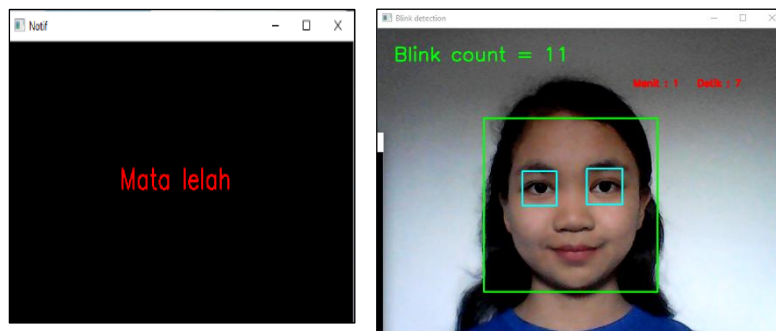


Figure 5 Tired Eyes

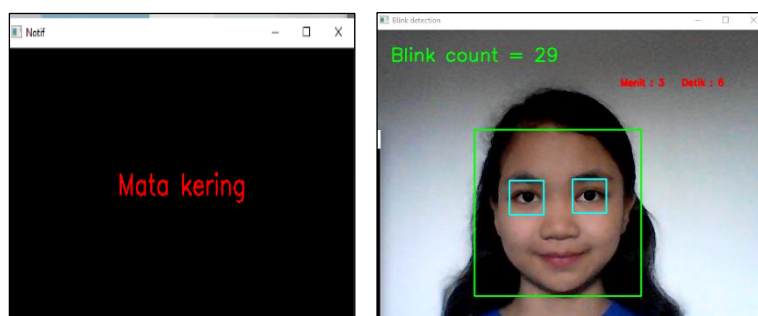


Figure 6. Dry Eyes

The program successfully detects faces, eyes and eye blinks using the same time at the same time. When the number of eye blinks is less than 15 blinks in 1 minute, the eyes are declared in a tired eye condition so the program will display a tired eye notification, conversely if the number of eye blinks is more than 20 in 1 minute then the eyes are declared in a dry eye condition so the program will display a dry eye notification.

DISCUSSION

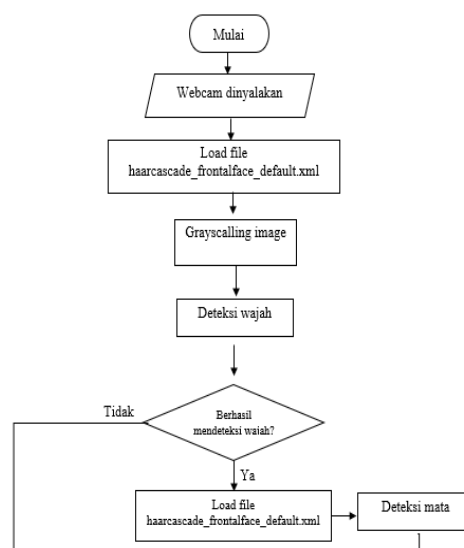
a. Definition

An eye blink detection program is a program used to detect eye blinks and count the number of eye blinks adjusted to a specified time. Where if the number of detected eye blinks counts as much as less than 15 blinks within 1 minute then the program will declare the eyes in a tired condition and will display a tired eye notification. Conversely, if the number of eye blinks detected counts for more than 20 blinks in a period of 1 minute, the program will state that the eyes are in a dry eye condition and will display a dry eye notification. The calculation of the number of blinks is taken from eye health data where in general, the eyes will blink 15-20 blinks in 1 minute, and tired eyes usually have a number of blinks that is less than half to 3 times the normal number of blinks while tired eyes will has a number of blinks that exceeds the number of blinks of the eye in general.

b. Program Development

The initial stage of the blink detection program can detect faces and eyes from photos and videos. The second stage of the program was developed to be able to detect eye blinks using a webcam. Then the program continued to experience improvement and development and was successful in the end being able to detect faces, blinking eyes and notifications for tired eyes and dry eyes that had been adjusted to the number of eye blinks. The next stage is trials using hats, masks, face shields, headsets, goggles, and helmets. The blink detection program continues to develop until finally the blink detection program can run using time. The end result of the eye blink detection program is that the program detects faces and eyes and then counts the number of eye blinks and adjusts to predetermined conditions to display notifications of tired eyes and dry eyes.

c. How the program Works



When the program is run, the program will start by detecting the user's face using the haar cascade classifier method via the `haarcascade_frontalface_default.xml` file with the cascade classifier. Cascade classifier itself is a method that contains a set of xml files that contain opencv data that is used to detect objects. Faces that have been successfully detected will be marked with a green rectangle in the face area.

After the program has successfully detected a face, the next program will detect the eyes. Eyes will be detected by the haar cascade classifier method using the `haarcascade_eye_tree_eyeglasses.xml` file with the cascade classifier. The eye to be detected will use RoI (Region of Interest) where RoI functions to divide the original frame captured by the camera into several parts. Region of Interest is used to mark that the eye detection area is only within the face area that has been detected before. The area of eye detection is marked with a Tosca colored rectangle.

After the eye has been successfully detected, the next step is eye blink detection. Eyes that have been successfully detected will be a reference for detecting eye blinks. The detected eye is in an open condition, if the eye is closed, the eye will be detected as a blink. So that every time the eyes are closed, the eyes will be detected as a blink and every time a blink is detected, the number of blinks will also increase.

Blinking is a normal reflex movement that functions to moisten the eyeballs with eye fluids produced by the tear glands. The average person blinks as much as 15 to 20 blinks per minute or equal to 4 seconds for one blink. But when you stare at the gadget screen, the number of blinks can be reduced by half to 3 times. This is what causes the eyes to be in a tired eye condition. If your eyes are dry, they will blink more than the average eye blink, which is 15 to 20 blinks per minute because there will be more blinks to moisten dry eyeballs with tear glands.

Furthermore, the eye blink detection will be adjusted to the conditions determined based on the number of blinks and the time specified. The first condition is tired eyes, if the eyes blink less than 15 blinks within 1 minute, a tired eye notification will appear. The second condition is dry eyes, if the eyes blink more than 20 blinks within 1 minute a dry eye notification will appear.

d. Blink detection program accuracy

Percobaan	Jumlah tidak terdeteksi	% Akurasi
Kacamata	1	98,4%
Masker	24	60 %
Topi	1	98,4%
Headphone	1	98,4%

Helm	6	90%
Face Shield	5	91,7%

$$100\% - \frac{\Sigma \text{Tidak Terdeteksi}}{60} \times 100\%$$

$$\% \text{ Akurasi Kacamata} = 100\% - \frac{1}{60} \times 100\% = 91,7\%$$

$$\% \text{ Akurasi Masker} = 100\% - \frac{24}{60} \times 100\% = 60\%$$

$$\% \text{ Akurasi Topi} = 100\% - \frac{1}{60} \times 100\% = 98,4\%$$

$$\% \text{ Akurasi Headphone} = 100\% - \frac{1}{60} \times 100\% = 98,4\%$$

$$\% \text{ Akurasi Helm} = 100\% - \frac{6}{60} \times 100\% = 90\%$$

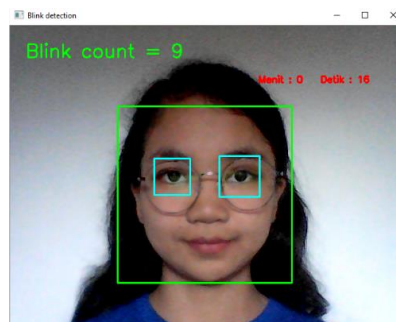
$$\% \text{ Akurasi Face Shield} = 100\% - \frac{5}{60} \times 100\% = 91,7\%$$

From the table of accuracy of the blink detection program within 1 minute, it shows that the highest accuracy results were found in the hat and headphone experiment, namely 98.4%. This means that the program can run properly if most of the face area is not blocked by objects.

d. Blink detection program trial

1. Glasses

Figure 7. Glasses experiment



2. Masks

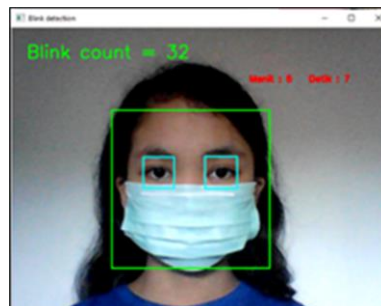


Figure 8. Masks Experiment

Experiments using masks in the eye blink detection program can be seen that the program can be successful in detecting faces and eyes so that the eye blink detection program can still be running. This is because the principle of

Haar-like features is to recognize an object based on the simple value of the feature but not the pixel value of the object image. Haar cascade has a feature to subtract the average pixel in dark areas from the average pixel in bright areas. In general, the eye area will be darker in color while the cheek area will be lighter in color. By using the Haar-Like feature, it is possible to detect the eye area and the cheek area based on the results of calculating the difference in the dark and light color pixels. However, if you use a mask, the program can sometimes detect faces and sometimes it is still difficult to detect faces. This is because, as previously discussed, there are differences in the color of the dark areas and bright areas that are used to calculate the haar cascade classifier feature in detecting objects, namely faces. So it can be concluded that light has an effect on detecting faces when using a mask.

3. Hat

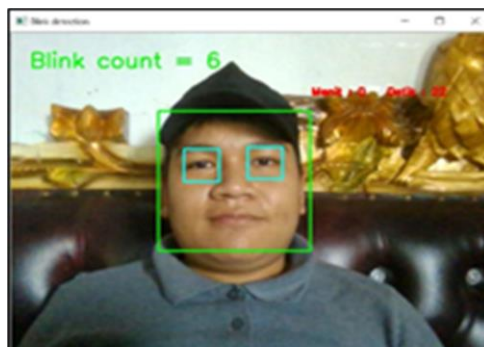


Figure 9. Has Experiment

The next experiment uses a hat. It can be seen in Figure 9 that the blink detection program can also run well and successfully detect faces, eyes and eye blinks even though the forehead is blocked by a hat. This is because the shape of the face can be seen clearly and the program can still detect faces properly, therefore the blink detection program can run well.

4. Headphones



Figure 10. Headphones Experiment

The next experiment was in which the sample used headphones as the next object, as can be seen in Figure 10. In this figure, the eye blink detection program can detect the face and both eyes properly, even though both ears and around the user's face are covered by the headphones and hair. This is because the shape of the face and eyes can be seen and detected clearly by the program

even though some parts are covered so that the "Eye Blink Detection" program can run properly.

5. Helm

6.

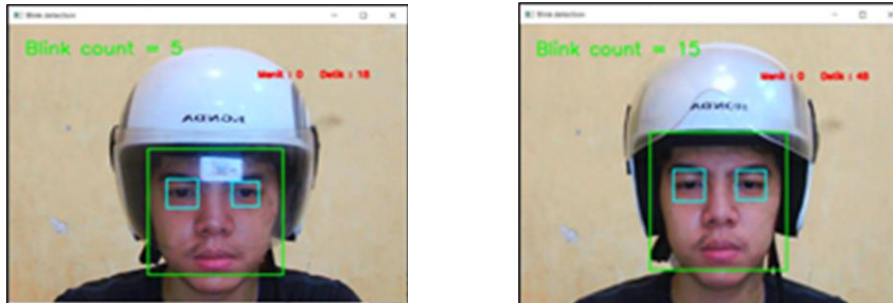


Figure 11. Helmet Experiment

The next program experiment is to use a helmet as can be seen in Figure 11 where when using a helmet (left), the eye blink detection program can also detect the face and also both eyes of the user sample because the user's shape and face are still clearly visible and detected. when the sample user uses / lowers the helmet glass (right) the program can still detect the face and both eyes clearly but sometimes the program's detection can be disrupted due to light reflection which in this case is the reflection of light from the laptop onto the glass which can block objects eyes so that it cannot be detected by the program.

7. Face-shield

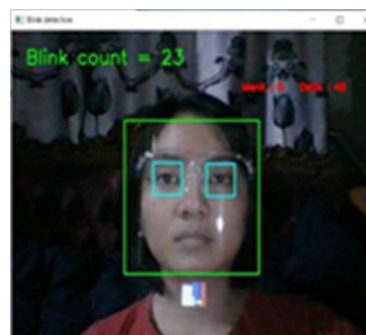


Figure 12. Face-shield Experiment

Faces can be detected properly when users use face shields. Eye blinks can be detected accurately.

CONCLUSIONS

1. The haar cascade method is a method used to detect eye blinks.
2. This eye detection program is a program to count the blinks that are made in one minute, and can provide a notification if the blinks that are made are not in a normal number.
3. This program can detect blinking when the user is wearing a hat, helmet, goggles, faceshield, mask, and headphones.
4. In eye detection the level of accuracy will be slightly low when the user wears a mask while for hats, helmets, glasses, faceshields, and

headphones, the level of accuracy is high so that this program can detect blinks precisely

RECOMMENDATIONS

Suggestions for application development are adding features to the program so that it can be more useful and attractive. So that this program can be useful and can be used by many people because considering that nowadays, more and more people are doing activities in front of computers and gadgets causing disruption to eye health.

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