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Scan De Microbes Using MIT App Inventor

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Abstract:
The idea of bacterial scanning is realistic not only in operating rooms but also everywhere around human because bacteria and viruses grow everywhere. It is the job of individual and the community to always keep the environment hygiene. Several devices such as sterilizers, ultraviolet (UV) and autoclave are helpful to clean door handles, toilets, washbasins, railings, keyboards, seats, etc. However, those devices require either physical intact or chemical exposure to disinfect the areas without initial identification whether the bacteria are presence or not. If bacteria can be detected at the earliest time possible, preventive and initiative action can be taken, and harmful bacteria can be prevented from infecting towards any personal. Hence, the development of Scan De Microbes is intended to address this situation. This system was developed as a scanning device to indicate the accumulation of bacteria on user's hand where most interaction between a person and the surrounding is done by hand (i.e. eating, opening door, etc). The developed device is able to capture image of the hand which was illuminated by UV light under dark surrounding. Due to wide range of smart phone camera specification, all captured images were converted to a standard size image that acceptable for the application to process. The captured images later were processed and the orange color spot that appeared on the hand was calculated due to reaction of the bacteria with the hand. Results showed the estimated percentage of the accumulated bacteria on the hand from the processed images. The result page in the developed application was then displayed. This data later on can be saved and share wirelessly using Bluetooth of any apps available on the smartphone. Multiple images with different percentage of accumulated bacteria were tested using the application. The finding is conclusive and can be used as a preliminary accessor tool to investigate or detect any potential bacteria that already accumulate on the user's hand. This development may assist the user in global warfare with the invisible enemy known to man as germ or bacteria in order to improve the livelihood and well-being of humans.

Keywords: Bacteria; Ultraviolet; Image Processing; Application

1. Introduction

Scan De Microbes application was developed inspired by the laboratory device which main purpose is to detect germs on human's hands. This is because with the application of this device, the percentage of accumulated germ and bacteria can be obtained in a shorter time to get the result without taking any sample from human. Bacteria as *E. coli*, protozoa as amoeba and viruses are the common germs that frequently attached on hands from daily activities [1-2]. These bacteria are commonly known as pathogens and they are not good for the human body especially if the pathogen manages to gain access inside the human body [2]. Pathogens are dangerous creatures that may cause fatal to humans slowly. People should aware that hands are the main medium for the pathogens are likely spreading towards the surrounding [1-2].

Hence, the development of this project as an early diagnosis tools for tracking bacteria in the form of a mobile application. This mobile application required capturing an image of the subject, namely human hand under a specific setup. The subject hand has to be in a closed and dark environment, which a black curtain is used to cover the point of interest (POI). An ultraviolet (UV) light is used to illuminate the POI which then will reveal the accumulated germ and bacteria on the subject. Then the image of the illuminated POI then be captured and processed in the mobile application and produce a result. The result will show the percentage of accumulated germ and bacteria on the user's hand as well the location in which the germ is spotted on their hands. This process will take less than 5 minutes for each test. Rapid process of the project from capturing the image towards result being produce can provide insight toward user in a swift. The implementation of this project will increase the awareness on taking care of their hand's hygiene and also their family and this device can be a helper to avoid diseases from spreading.

2. Materials and Methods

2.1 Project development

A mobile application was developed for user interface to control and analyze the image capture. UV light and android phones are critical components need to be put in the dark area or within the black curtain for this project. The implementation of UV light was to form a bulking spot on a certain finger, as the bacteria can be seen clearly when it is under UV light [3-4]. The camera was used to view the bulking spot in the dark environment anywhere and at any time and to display it on the application screen and automatically save the results in the application inside the phone. Figure 1 shows the flowchart for the application designed. First, the application was opened by the user. Graphical

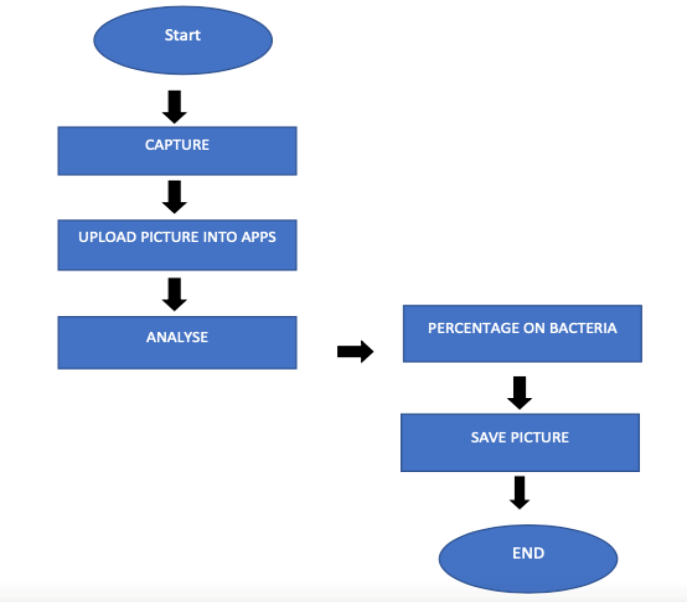

Figure 1. Flow chart

User Interface (GUI) default page which the 'Home' page containing the following tabs; the scanning page which are the camera, the result page, and the history. After the user opens the application, the user needs to go to the scanning page, which open the camera. When the camera was ready, the user's hand was fitted into the image layout on application, so that the camera captured the intended point of interest (POI). On the other side, this procedure was aided by UV light, Glo germ, and black curtain or dark environment. Two different images of the subject were captured, the image of subject was illuminated under UV light and without the illumination of UV light.

The image without the UV light illumination was taken using mobile phone flash and was used as image reference. Then the image processor that was coded inside the coding in the application will do the image comparison and calculate the area of the difference in light reflection. After the calculation was done, the image which contained the accumulated bacteria was seen as a white spot with the calculated percentage area of bacteria on the user's hand. Then, it was recorded on the history page which can be reviewed later by the user.

Figure 2 shows the block diagram for this project. In this block diagram, UV light was used to form the bulking spot at a certain finger since bacteria can be seen when it is under UV light. The camera on the phone was used to view the bulking spot in the designated area and capture an image of the bacteria on the subject. This process can be done by the user by entering the scanning page and turn the camera towards the hands vertically. Hence the image of the hand was in the portrait position for optimizing the analyses and accurate result as shown in Figure 3.

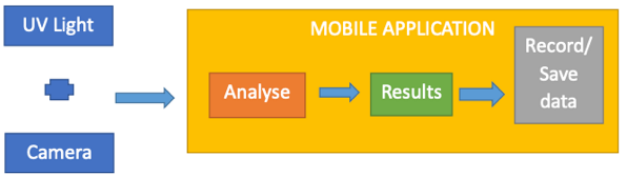

Figure 2. Block diagram

Figure 3. Hand placing

The image was processed by the application. The coding in the application was take its place to analyzing all the data and calculating the data that being processed. After all of this were processed is done (less than a minute), then the image with accumulated bacteria spot appeared on the application and show the percentage of the area of bacteria on the user's hand. The data were shown on the result page and the file can be exported. The file will record the data onto the application without the image because the image takes more space in phone's memory. The user can also put remarks on specific data in the history such as where the image is taken or when the image is taken so that the user can be cautious towards the place that they had visited before.

2.2 Hardware development

Smart phones with embedded camera were required as it will need to install and make use the develop application. Next hardware required is UV Light which was used with the application to illuminate the subject POI. UV light referred to the region of the electromagnetic spectrum between visible light and X-rays, with a wavelength falling between 400 and 10 nanometers [5]. In addition, UV light was used to detect things otherwise invisible to the naked eyes. A UV light and a specially formulated hand lotion which is Glo Germ (Moab, Utah) have helped the user better visualize, the lotion glows under a black light, showing where washing or cleaning has failed to remove the simulated germs [4].

Dark environment was required for the capturing the optimum image of the POI due to the data were calculated based on the reflective light produce from the illumination of UV light toward the germ. To ensure accurate reading, external source of light was avoided. Therefore, to achieve such result, the dark environment was simulated by using black curtain that was enough to fit the subject's hand alongside with the attached with UV light to eliminate light from external source. This approach makes the application mobile can be used almost everywhere in any surrounding regardless the condition offers around the user.

2.3 Software development

MIT App Inventor was used for the development of the application that being used in this project. The MIT App Inventor is a block-based programming to create of a complex, high-impact apps which required less time that the traditional programming environment [6]. The apps can have a simple first app up and running in less than 30 minutes which enable all people regardless of age and background to move from technology consumption to technology creation.

Development of the application required the app to familiarize with type of image capture and needed to be analyze in specific method. This was done by uploading multiple sample image to the trained our image classification to recognize

the feature exist on the subject and recognize the POI. Status of the training can be tracked with the progress bar. Any modification toward the model was altered accordingly according to the training outcome.

After the training was completed, next phase was to test the model by adding multiple images into the develop apps. The method was similar to during training phase. There were many errors in acquiring the result of the analyses due to lack of precision and accuracy of the model being developed in the early stage. Hence in this phase, the accuracy and precision of the model were corrected in the apps by adjusting the "Label Correctness" and "Confidence Graph" which were the features exist in the MIT App Inventor. The "Label Correctness" is to determine either the image uploading to the app is correct image or not and the "Confidence Graph" is to determine the accuracy of the image upload. If there are any irregularities towards the model, certain adjustment needs to done towards the existing model. This process was done repeatedly using multiple sample images until accurate and precise outcome were obtained from the model developed.

An image was represented by its dimensions (height and width) based on the number of pixels. This pixel was a point on the image that takes on a specific shade, color or capacity. It also represented RGB which is the pixel is made up of 3 integers between 0 to 255 (the integers represent the intensity of red, green and blue). On other hand, image processing is the process of transforming an image into digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. This app used the recognition method which is it will distinguish or detect objects in the image.

2.4 Image processing code

This image processing method was used in an application that was created using MIT App Inventor software. After the system had been calibrated repeatedly, the picture was analyzed by the obtained equation. The coding and the function are explained in Figure 4 and 5.

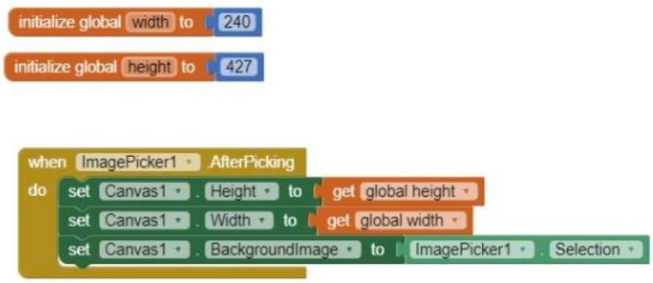

Figure 4. Select hand image coding

Figure 4 shows the coding to select the hand image function. Once the picked image was chosen, the image was resize into a suitable size which had set to global width and height to allow fast calculation of the pixel.

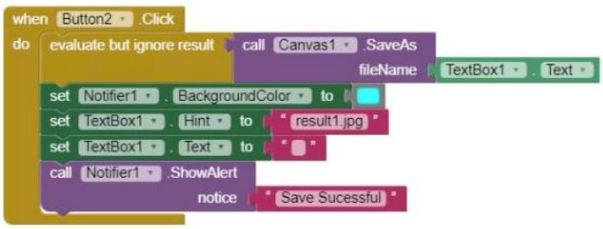

Figure 5. Save hand image coding

Figure 5 shows the coding to save the result function. After the image was processed, the user named the file at 'TextBox1'. It depends on the user to name it but if the user did not name it was automatically saved as result1.jpg. Figure 6 shows the coding to calculate average functions for the orange and red colors.

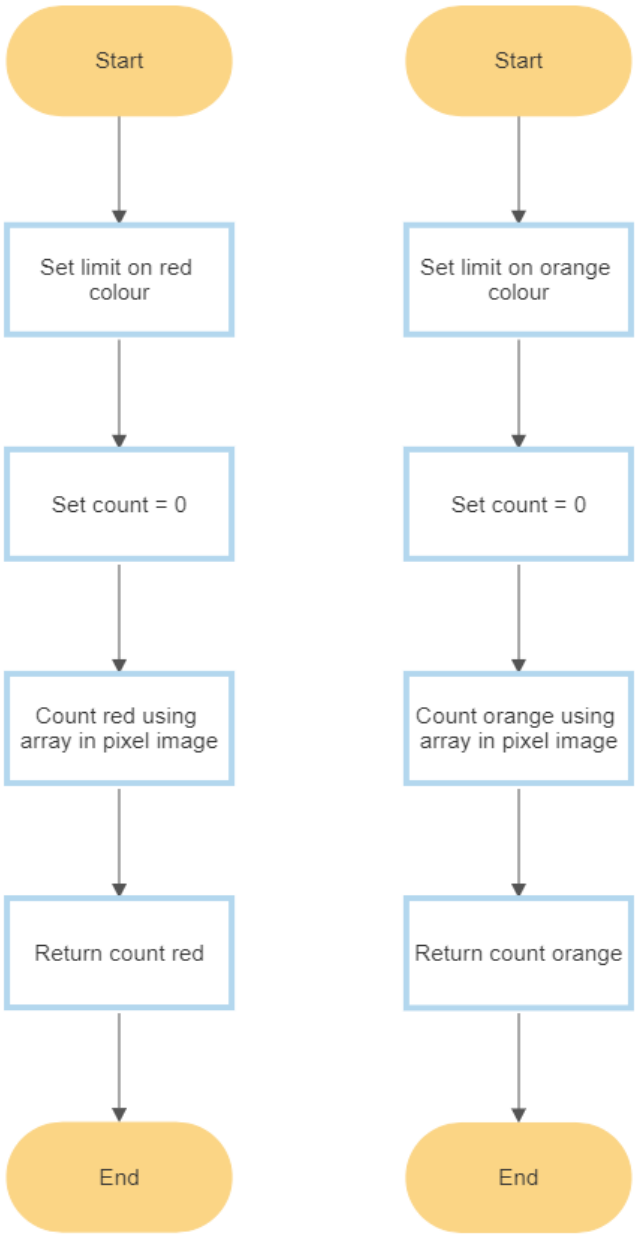

Figure 6. Calculate average function 1 coding

Iteratively, each pixel was checked if it contains orange or red color n count it. After that, the total count red or orange was divided with the total number of pixels in the image to calculate the approximate area of the orange or red pixel obtain from the image. Size of the capture image was according to the camera specification on the smartphone. Varieties of smartphone model in the market produce different sizes of image which will affect the model that had been developed. Hence, the image was scaled into standardize image that is suitable to the model create using the following equation obtained during calibration process:

$$y = 0.0002x^2 + 0.3697x - 0.3645 \quad (1)$$

3. Results and Discussion

3.1 Scan De Microbes application and its working

Scan De Microbes application was created using MIT app inventor. This application was used to evaluate the percentage of bacteria that existed using the image processing and image recognition method in our project. This application obtains an image from the gallery apps which has been taken in the black box with the aid of ultraviolet (UV) light. Images that were captured by the smartphone's camera in the application are in JPEG format. The JPEG file format, also known as Joint Photography Expert Graphics.

3.2 Analysis of image processing method

This project was tested in three different subjects using the developed project. The three subject's hand with Glo Germ lotion was placed under illumination of UV light and the image was captured and analyzed using the apps. Result from the apps for those three subjects as shown as in Table 1.

Table 1. Percentage of bacteria

Subject A	Subject B
A	0 %
B	50 %
C	90 %

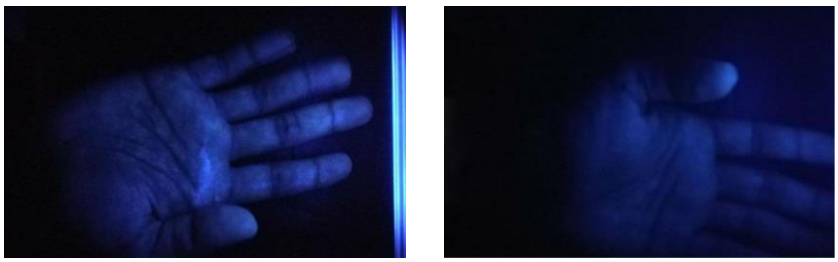

Figure 7. The percentage of bacteria that existed on subject a was 0%

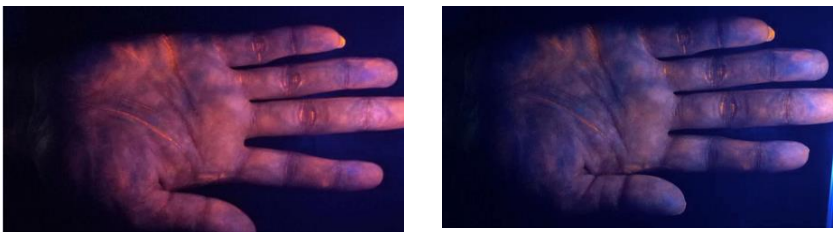

Figure 8. The Percentage of bacteria that existed on subject b was 50%

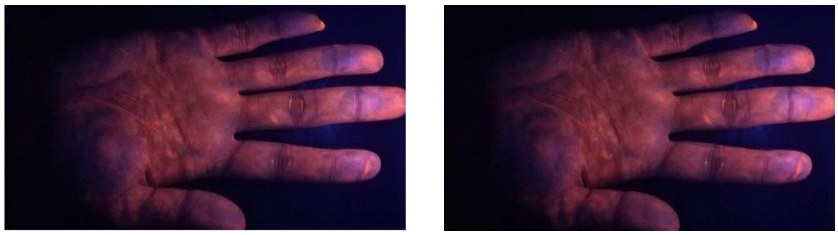

Figure 9. The percentage of bacteria that existed on subject c was 90%

Figure 7 to Figure 9 show the result for 0%, 50% and 90% illumination of bacteria respectively. Illumination of germs is shown as orange spots under UV light. The image is clearly show that the distribution of the bacteria on hand can be seen visually different.

3.3 Analysis of the percentage of bacteria that existed

Table 2. Coordinate

X	Y
7	2
11	4
206	80
230	90
220	100

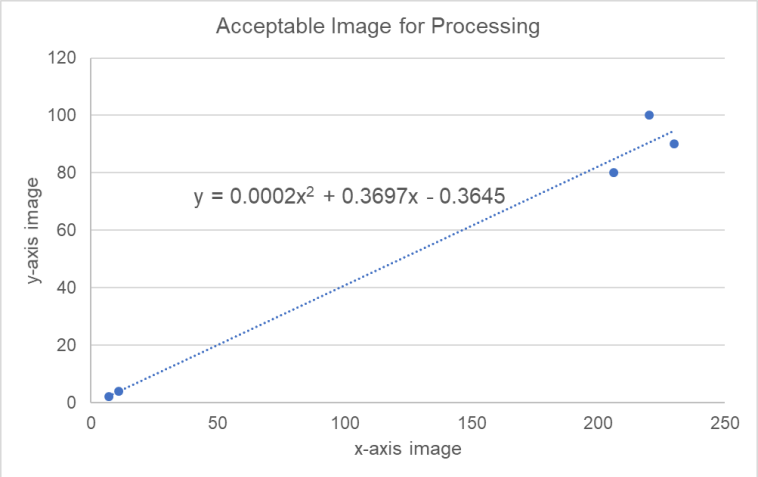

Figure 10. Coordinate evaluation for optimum image

During development, the position of the hand plays a vital role in obtaining a reliable result. Therefore, several settings were being tested for a certain hand position to capture the image. Table 2 shows the coordinate of which reference point was assigned onto the hand to determine the hand position. Image of the hand for each coordinate later on be captured and analyzed to determine the optimum position of the hand (Figure 10). This result then is being program into the apps to ensure almost every type, sizes and optimum position of the hand can be analyze by the apps. Hence, the apps is suitable to be used by everyone.

This system able to identify the best position for each hand either with germ or reference hand. Thus, ensuring the functionality and reliability of the Apps. Stimulated bacteria are used in testing the device which highlighted that the bacteria and can be captured and quantified by the apps. The stimulated bacteria apply on hands were put in the black box which were illuminated by the UV light thus showing the formation of orange bulk on the hands [3]. Later, image of the hand was viewed and captured by the smartphone camera under those condition and sent to the apps for further analysis. Bacteria percentage value was displayed on the screen after the analyses that represents the bacteria existed on the hand's segment during image being captured. Comparison between the reference image and the capture image were done to determine the percentage of bacteria existed on hand for that particular subject.

4. Conclusion

In this challenging situation which people starting to aware about the potential of infection and microbes disease, the Scan De Microbes is a system develop to be complemented and be part of the solution to the current situation. Scan De Microbes is a low cost and effective early detection method in determine cleanliness of the hand from bacteria. This apps do not require any sample being taken from the subject. Besides that, the hardware requires to fully utilize the usage of Scan De Microbes is already owned by almost everyone which is the smartphone. User only need to acquire UV light and dark surrounding to fully utilize the Scan De Microbes. This device can prevent us from waiting too long for the

result when doing some lab tests for a common type of bacteria on hands. Using this device, people will have more awareness on taking care of their hand's hygiene and also their family and this device can be a helper to avoid diseases from spreading.

Acknowledgment

None

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