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Mobile Hybrid Application Using Raspberry PI and Object VR Technique

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Abstract- Many people these days are visiting beauty parlors more frequently to change their hair styles. However the customers are only able to grade their finished style by viewing it from the front, not from the back or sides. This paper presents an application that uses virtual reality along with Raspberry Pi to create a video that captures the customer's entire hair style. This video can be viewed in all 360 degree angles and can be zoomed in and out to view specific features more accurately. By uploading the Object VR results to a pre-existing homepage, we allowed users to check their styles through their mobile devices while also creating a hybrid application that can manage all the files. By creating a file for the various hairstyles, the user can simply show the hairstylist the video taken from previous hair styles if they wish to go back to any previous styles. This allows the hairstylist to get a better picture of what the customer wants. The user can check their styles through the application and can also compare between different styles.

Keywords: Object VR, Raspberry Pi, Image synthesis, Mobile hybrid application.

Introduction

Every year many people visit the beauty parlor to check on the latest trends and to change their hair style to match the season. However the customers have difficulties assessing their hair from various angles. Hairstylists match the hair to the customer's looks to please the customer. However this is simply a two dimensional picture and does not capture the views from the side or back. There is a need for a system that can help customers to view their finished hair style from various angles.

To remedy this problem this paper presents an application that can produce a video that allows the user to view their style from various angles and can also save these files for future use. We used a Raspberry Pi along with a camera sensor to take images from various angles that were then combined. This completed view can also be viewed from the customer's mobile device. Multiple files can be saved for future reference in case the customer visits the beauty parlor again and wants to switch to the previous hair style. To accomplish this we used virtual reality technology. Virtual reality is used to replicate an environment that can stimulate physical presence is various different spaces [1]. There are two main methods to creating virtual reality. One method is panorama VR which shows an artificial construct from a fixed viewpoint. This method gives the user the feeling that he is standing in front of the area. Another method is the Object VR which overviews the object 360 degrees in a virtual setting [2]. Since we will be dealing with hair styles we will be using Object VR method. This method allows the user to experience 3D by giving the experience of rotating images within the video. The user can also zoom in or out of specific areas. Similar methods are being used in shopping malls where the customers can only view the object rather than interact with it, before they purchase it.

We can create the Object VR video to be able to uploaded on the homepage where the user can check it. This was accomplished by creating a hybrid application where the files can also be managed. Hybrid applications have the advantage of being able to be used in many different platforms. This allows the user to not visit the homepage and access the video files from the mobile device directly. Using our method the customer can view their finished hair style from various angles thus giving them a three dimensional feel for their new style. If there is anything that their wish to be fixed, it can be applied immediately. The customer can use their mobile device to view previous hair styles and if they want to revert to any previous styles, they simply have to show the file to the hairstylist, thus allowing the hairstylist to satisfy the customer more easily.

Related Work

A. Raspberry Pi

Raspberry Pi is a Linux-based ARM platform that can perform many of the functions of a PC, such as games or word processing [3, 4]. Its components include SoC, core, GPU, memory, GDMI, Ethernet, and audio. When the Ethernet port is plugged in, the Raspberry Pi can access the web [5]. Figure 1 shows the GPIO (General Purpose Input/Output), which allows the Raspberry Pi to interconnect with other software. We used a camera module to use the

Raspberry Pi to record video from certain angles. The camera can take both photos and videos and can be connected directly with the Raspberry Pi. Figure 2 shows the camera module connected to the CSI (Camera Serial Interface) connector [6].

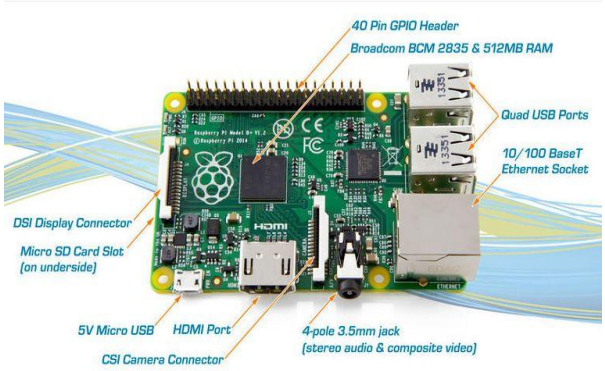


Fig.1. Typical Raspberry Pi configuration

Fig.2. Camera module

B. Object VR

The object VR involves taking photos of an object from the same distance around it but at different angles. The images are then used to synthesize a video that shows the 360-degree view of the object. The images are taken by changing the angle by a fixed value [7]. These images are sequenced so that the object seems to be rotating 360 degrees. Using this technology, the user can rewind and review a certain portion and also zoom in and out to see the object more clearly.

We used Object2VR software to perform the object VR. This program can change JPEG, PNG, TIFF, PSD, and QuickTime files into VR source files [8]. Zoom in/out functions are supported in the software. The implementation of object VR was based on the Android platform, which enables the use of HTML5 and Flash files, as shown in Table 1.

Flash for Android uses Adobe software but was only supported up to Android version 4.0. Therefore, to use Flash in an Android version above 4.0, we first used Dolphin Browser. However, most Flash applications are programmed for use on a PC and may therefore not function correctly on mobile devices. Based on this, we decided to use HTML instead of Flash.

TABLE.1. Comparison of Android and iOS implementation

	Android	**iOS**
Flash(swf)	O	X
HTML5	O	O
Quick Time	X	O

C. Mobile hybrid applications

An application that runs on mobile devices can be implemented in many different methods. The implementation of applications can be divided into three categories: native applications, web applications, and hybrid applications. Figure 3 shows the composition of each category [9].

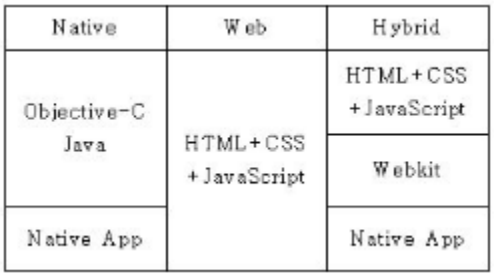


Fig.3. Categories of applications

Native applications must be developed in a specific operating system environment using Objective-C or JAVA. Therefore, a native application can only be run in the operating system for which it was developed. For example, an application that can be run in Android cannot be used in the iOS operating system. Web applications use mobile web browsers by remotely accessing mobile web servers. These applications can be made using HTML, CSS, or JavaScript. Therefore, they are similar to looking at a PC webpage using a smartphone. We used a hybrid application, which is more efficient during implementation because it can be run on different platforms and use many different languages. Also, since the application creates a native application and uses web technology, it has the strengths of both native and web applications while fixing their weaknesses.

Figure 4 illustrates WebKit, which is the basic framework of a web browser. By using WebKit and a hybrid application framework, we can implement functions such as GPS or alarms. Beginners could have a hard time developing applications, but hybrid applications using Phonegap or Appspresso are easier to develop compared to previous frameworks. We used Phonegap in this study, which cannot provide information given by a mobile device. Therefore, we must use a Phonegap API to use the information provided [10, 11].

Proposed Application

This section discusses the implementation of the proposed application. We put an object on top of a spinning wheel and used the camera module attached to the Raspberry Pi to

maintain a distance and rotate the object by a set angle. We performed object VR by arranging the images in order so that when put together they would look three dimensional. The resulting file can be uploaded to a webpage and linked to a mobile device, where the user can examine the object while zooming in or out. The user can view the object fully or examine specific parts. Figure 4 shows the implementation of the algorithm as a block diagram.

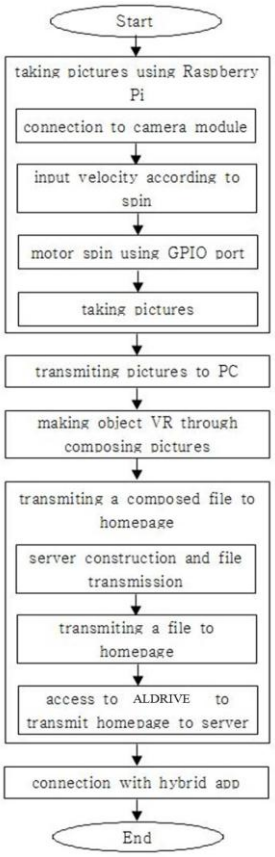


Fig.4. The overall flow configuration for proposed application

A. Data acquisition and transmission using Raspberry Pi

To take photos, we installed a Linux operating system on the Raspberry Pi and connected the camera module to the CSI connector. We encoded the speed and then set the module to take and send an image. Then, we used the GPIO port to rotate the spinning wheel at a constant velocity. As the wheel rotates 360 degrees, the Raspberry Pi takes photos of the object. Figure 5 shows the source code for rotating the motor.

The motor operates by using N and S poles represented by the numbers 1 and 0 in the "seq" variable. "range(8)" signifies that the object will be rotating by a 45-degree angle 8 times. The motor can be rotated based on the pin number in the "controlpin" variable and the "seq" variable.

Figure 6 shows the results from taking images of an object while rotating by 0 and 90 degrees. We used a program called Al Drive to transfer the images taken by the Raspberry Pi to a PC. Al Drive allows files to be transferred between a server and client [12].

```
import time
import picamera
import os
import RPi.GPIO as GPIO
import sys

GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.IN)
ControlPin = [17,22,23,24]

for pin in ControlPin:
        GPIO.setup(pin, GPIO.OUT)

GPIO.output(pin,0)
seq = [
       [1,0,0,0],
       [1,1,0,0],
       [0,1,0,0],
       [0,1,1,0],
       [0,0,1,0],
       [0,0,1,1],
       [0,0,0,1],
       [1,0,0,1]
       ]

with picamera.PiCamera() as picam:
        picam.rotation=0
        picam.start_preview()
        GPIO.wait_for_edge(18, GPIO.FALLING)
        for i in range(8):
                time.sleep(1)
                picam.capture('turnhair/%s_%d.jpg'
                for i in range(64):
                        for halfstep in range(8):
                                for pin in range(4):
                                        GPIO.output(ControlPin[pin], seq[halfstep][pin])
                                time.sleep(0.001)

        GPIO.cleanup()
        picam.stop_preview()
        picam.close()
```

Fig.5. Source code of rotating the motor for data acquisition

(a) (b)

Fig.6. Examples of photos with (a) 0 and (b) 90 degrees of stepper motor rotation

B. Image synthesis and server settlement

To see a three-dimensional view of images taken by the Raspberry Pi, we must synthesize the images. We used Object2vr software to perform object VR on the images taken. We selected HTML5 as the output format and then set the effects for the image format, brightness, zoom, and rotation. Then, we selected the Enable HTML file and ggpkg.ggt from the "Template" section. GGPKG (The Garden Gnome Package) is a package format for website management systems and can easily upload files to a homepage. After clicking "OK" after setting everything up, object VR is applied to the target object. The files can be manipulated by homepage management software such as Dreamweaver [13]. A server is needed to save and view Object2vr files. We used Object2vr, which provides an environment to create a personal server. The server is accessed with Al Drive [14].

C. Homepage generation and file upload

A homepage is needed to upload files created through Object2vr. We used WordPress to create the homepage, which supports GGPKG of the Object2vr program. WordPress is an open source platform that uses the PHP language and can manage homepages through plugins and themes after creation [15]. To use Object2vr files in WordPress, we need the GGPKG import and JSON API (JavaScript Object Notation Application Programming Interface) plugins. JSON is a data exchange format that is

useful when reading and writing text. It is needed when displaying information on the homepage in the hybrid application. When using the GGPKG plugin, the ggpkg files created by Object2vr can be uploaded directly. Using the Al Drive program, we can access the create server and send and control the completed homepage to the server computer.

D. System link with hybrid application

If we create a user-friendly homepage through the hybrid application, distribution to Android and iOS is possible [11]. The hybrid application supports HTML, CSS, and JavaScript languages but does not support PHP, which was used to make the homepage. Since WordPress is a PHP file, the file data must be extracted and sent to an HTML-based homepage. There are two methods in transferring the data files, JSON and xml, but we used the JSON method. The standard procedure when extracting word files is to use the json_encode() function. However, we can simply use the JSON API plugin to extract the JSON file. From this data, we can move the data address to jquery and then use the data. We can view the extracted JSON file by transferring it to the Phonegap program and view the homepage through the hybrid application [16].

(a)

(b)

Fig.7. (a) Overall system configuration and (b) data capture using Raspberry Pi

Experimental Results

We implemented our experiment using the Raspberry Pi, the connected camera module, and a stepper motor that is rotated by the Raspberry Pi. We used a doll to simulate a person's hairstyle on top of the stepper motor. The images taken were sent to a laptop, which processed the images and uploaded the finished product to the homepage. Figure 7(a) shows the entire configuration of the experiment, and Figure 7(b) shows the equipment used for the image capturing. The camera module attached to the tripod recognizes the doll while the motor rotates it at a constant velocity.

A. Data acquisition and transmission

Figure 8 shows images of the doll's head taken by the Raspberry Pi. By taking photos at 45-degree intervals, we obtained 8 images. Figures 9 and 10 show the results of using the Al drive to transfer photos taken by the Raspberry Pi to a PC. Once these files are sent to the laptop, object VR can be implemented.

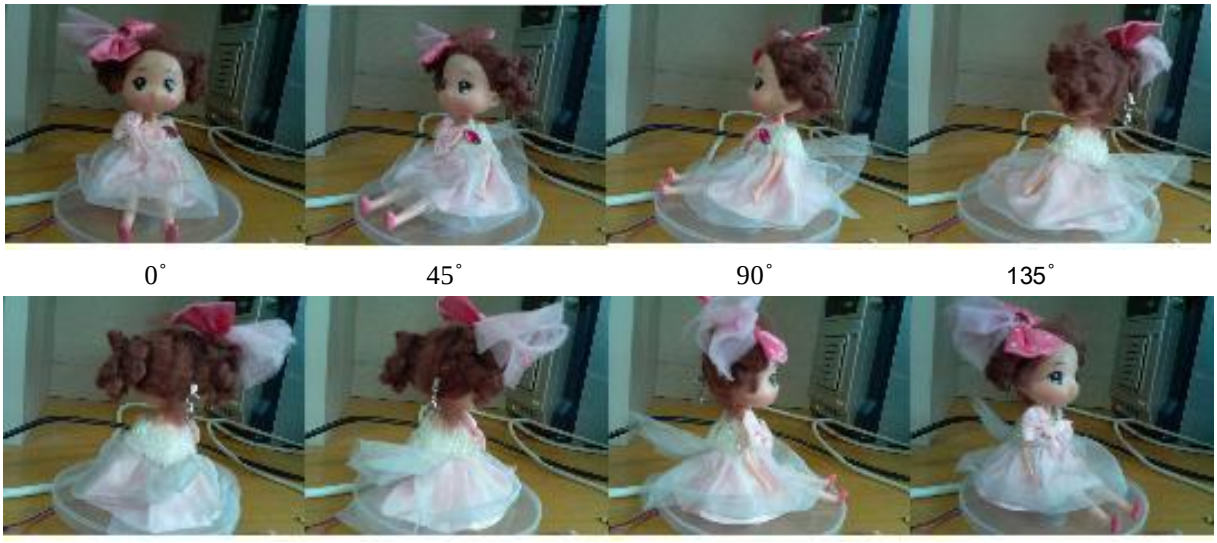


Fig.8. Various images taken with 45-degree intervals on a stepper motor

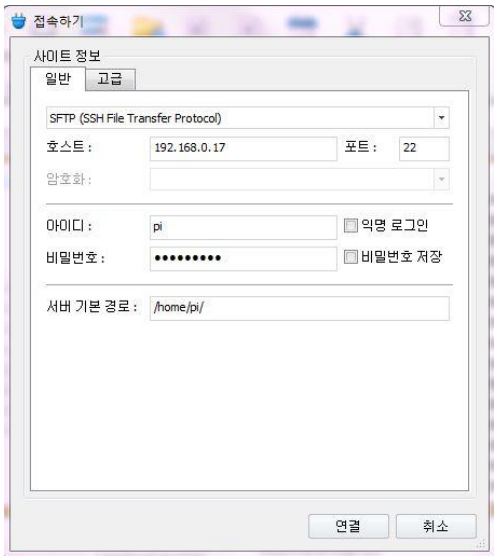


Fig. 9. Screen shot of login for file transmission program

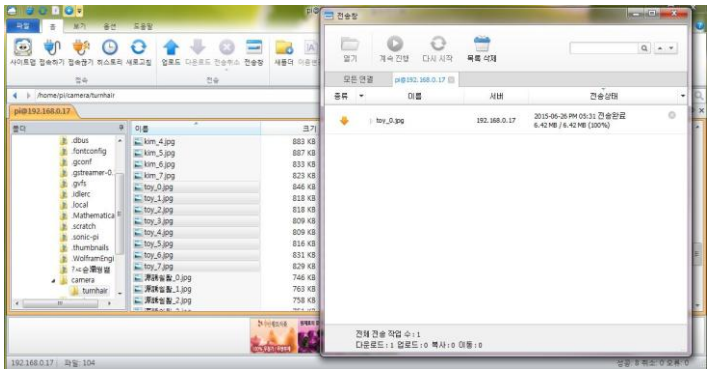


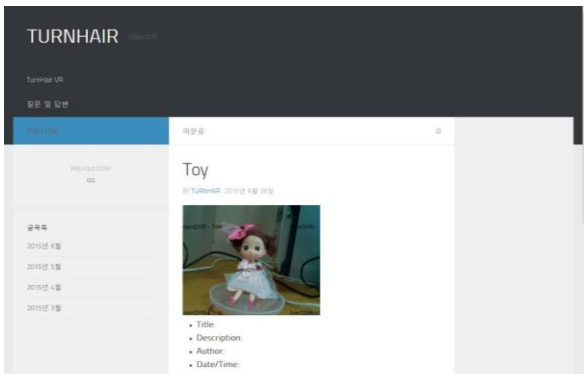
Fig.10. File transmission

B. Data synthesis and app display

By running the video using the Object2vr program, the ggpkg file can be viewed in three dimensions, as in Figure 11. To render the video more smoothly, we need more images. If the angle between shots is reduced, more images can be taken while rotating 360 degrees. This results in a more natural-feeling video that contains more accurate details of the object.

Fig.11. Screen shot of Object2vr program implementing GGPKG file

Figure 12(a) shows the Object VR file uploaded to the homepage. Figure 12(b) shows the uploaded file being run through the hybrid application installed on a mobile device. Once the video is uploaded to the homepage, the video can be played from any mobile device. If users search for their name in the search function, the video, date, and description of the hairstyle for that day will be shown.



(a)

(b)

Fig.12. Implementation results: (a) Image uploading on homepage and (b) an example of displaying an uploaded file on a mobile terminal

Conclusion

This paper introduced a method to help people check their new hairstyle after visiting a hair stylist. We used the Raspberry Pi to take images of a person's hairstyle and created a three-dimensional view from the images using object VR technology. Using object VR, we can zoom in and out and rotate the object, as well as search for certain videos saved in personal mobile devices.

When implementing object VR, we only used images that were parallel to each other. We used a hybrid application that can easily show the Object2vr file through the homepage on mobile devices. A hair salon can save

previous hairstyles of customers and allow them to see different versions of their hair through authentication. This allows a customer to have a more realistic look at potential hairstyles rather than simply looking at pictures of celebrity hairstyles. This can also help promote and advertise the hair salon.

Currently, there is a machine that can implement object VR perpendicularly, which is very helpful. However, it is very expensive, so we will look into using the Raspberry Pi to take images perpendicularly. By doing so, we may be able to take images of what a hairstyle looks like from the top view, which may help us create a more realistic three-dimensional implementation of object VR. Also, we will look into changing our application format from a hybrid application to a native application.

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