Performance Evaluation of Surrounding Image Display in Smart Glasses using Image Overlay Method

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***Abstract*—In order to overcome the problem of blind spots, this paper proposed to install multiple cameras on cars in an annular way and display the transmitted captured road images on smart glasses so that the driver can access images taken from blind angles without needing to check the rear mirror. Moreover, this paper proposed an image overlay method for overlaying images taken from multiple visual blind angles, allowing the driver to read images to improve driving convenience and safety.**

Keywords: Image Overlay; Smart Glasses;

I. INTRODUCTION

In recent years, along with technological progress and the emphasis on driving safety, comprehensive systems and sensors have been developed for vehicles. More and more smart systems have been applied on cars, including lane departure warning systems, blind spot detection, and cruise control systems [1]-[6]. Furthermore, people have begun to attach great importance to drive recorders recently. Because drive recorders only focus on the front image, they are rarely installed on all four sides and the rear. For the rear, people usually refer to the car rear-view mirror. However, the driving visual field includes not only the front and rear fields but also the left and right fields, as well as blind angles which are the primary causes leading to accidents. In order to reduce accidents caused by blind spots, this paper proposed a system in which surrounding images are captured by multiple cameras covering blind angles and displayed by multiple windows to the driver on a device installed in the car. But this is inconvenient for the driver. In view of this issue, this study then proposed an image overlay method to overlay the images taken from multiple visual blind angles and allow the driver to read the images on smart glasses directly in order to enhance driving convenience and safety. This paper is organized as follows: Section II describes the surrounding image overlay in smart wearable devices. Section III discusses the system implementation and experimental results. Section IV presents the conclusions of this paper.

II. SURROUNDING IMAGE OVERLAY IN SMART WEARABLE DEVICES

This paper proposed to install multiple cameras on cars in an annular way and display the transmitted captured road images on wearable devices through an image overlay method so that the driver can access images taken from blind angles without needing to check the rear mirror. Raspberry pi and client-side images are the resource used for the surrounding image on the car roof. This system can continuously transmit the surrounding image to the server and save it. The images taken by cameras installed on blind spots of the car can form a client-side image using raspberry pi and be constantly uploaded to the server. However, when installing the cameras, there are details for consideration. In addition to the basic visual fields, we also need to be concerned with the stability of the cameras and their shooting angles for later image processing. The transmission-side image uses an image transmission and storage method consisting of multiple cameras, and on the server-side is a smart wearable device. The image transmission and storage method is crucial. If there are biases, the system might process the wrong images. The network instability when cars are moving is another issue that needs to be discussed later. The work of the image-overlay side is to overlay the images obtained from the server on the server-side into a surrounding image that the user can watch when driving. This system requires a high level of scheduling and planning to avoid any decrease of efficiency caused by the occupancy of the CPU with, for example, image uploading, staggered overlay and so on. The work of the image-display end is to display the images the user wants to watch on the wearable device. The image display is easily affected by the condition inside and outside the car when using a wearable device. For example, the size of the image and environment luminance and so on can affect the driver's ability to use the images when wearing the device. Thus, we need to overcome this kind of influence by further calculation and improvement in order to better coordinate the user and the wearable device.

III. System Implementation and Experimental Results

As shown in Figure 1, the system architecture consists of three parts. For the smart wearable devices, it is the surrounding overlay image display. For the image, the storage-end of the image server is responsible for receiving, classifying and storing images, then synchronizing the images, coordinating signals and executing the storage of the overlay images between the smart wearable device and the camera node. For the camera node, the camera-end will access the camera image and transmit images to the server-end. In this test, we adopted six camera nodes to execute the access to multiple images, we captured images from a 70-degree angle, and then we overlaid the images taken from a 54-degree angle and 8-degree angle. This image is then transmitted for multithreading of the server to store and overlay images. This test is categorized according to image sizes of 240 p, 480 p and 720 p.

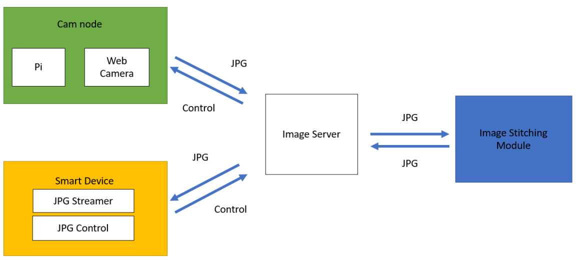

Figure 1: System Architecture


Figure 2: Feature Points of Images


Figure 3: Illustration of Image Overlay

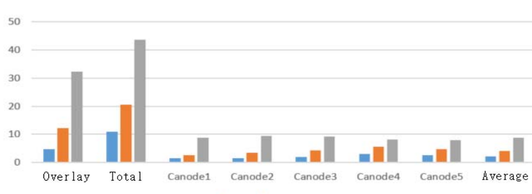

Figure 4: Transmission and Number of Overlay Sheets


Figure 5: Implementation Systems

The camera node is launched and then initialized; that is, the image size is confirmed. Then it is connected to the image server and constantly transmits real-time images. When the angles are unchanged, the camera node can skip image matching as shown in Figure 2. Usually, after executing feature point matching one time, in the other tests, we can do sample overlay directly the first time and overlay the images as shown in Figure 3. We carried out three kinds of tests in this experiment. We did image overlay tests according to the image size and through constantly stored images to calculate the sum of the number of transmitted and overlay sheets every second. According to the number of transmitted and overlay sheets shown in the statistical chart of Figure 4, when the image quality is 240 p, there are 8 sheets taken in each camera. The total number of transmitted sheets is 43 and the total number of overlay sheets is 32. When the image quality is 320 p, 4 sheets are taken. The total number of transmitted sheets is 20 and the total number of overlay sheets is 12. When the image quality is 720 p, 2 sheets are taken. The total number of transmitted sheets is 10 and the total number of overlay sheets is 4.

IV. Conclusion

According to the results obtained from actual road tests, the image overlay method provides better image stitching efficiency. Nevertheless, the image transmission is through a 4G network and it might have an upper limit of the bandwidth. In the future, we will use image processing to decrease the size of the image to accelerate the transmission speed.

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