

## Development of Android Application to Capture Images by Using Wi-Fi Direct

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**Abstract:** Despite the performance improvements of cameras in a phone, software using cameras are not improved. It is because most of software were developed by using a single smart phone. This study proposes an application to take a remote picture by using two smart phones. One is used as a remote camera for capturing image while the other controls to take a picture while viewing the image transmitted from a remote camera. The system uses the Wi-Fi Direct to send images to other smart phones. The proposed system is designed on the Android. To develop the proposed system we use technologies to control a camera, thread to enhance the performance and Wi-Fi Direct to communicate the image and the commands. One smart phone is used as server and the other is used as client. The server continues to capture a screen shot from a camera and transmits it to other smart phone. The client sequentially receives the transferred image and displays it on the screen. The task to capture the image and the task to send the image in the server are completely separated. It is more efficient to perform in parallel, rather than performing the two operations in sequence. The two threads are created and one only captures an image and the other thread only transmits the captured image. The same problem exists in the client which for the tasks to receive and display images they were also carried out in parallel. To overcome the limitations of the applications to captures the remote images with single smart phone we proposed the application with two smart phones by using Wi-Fi Direct.

**Key words:** Android, camera, Wi-Fi Direct, thread, camera and transmits, phones

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### INTRODUCTION

One of the features most used smart phone takes a photograph with the camera. In particular, the communication through the picture to the development of Internet and SNS is rapidly spreading (Bianchi, 2015). As the result, various camera application such as “Candy camera”, “Photo wonder” and “Camera 360” has been released. Most of them are concentrated in the ability to calibrate the picture (Dawn *et al.*, 2016). Recent trends in the fashion between lovers or friends in the SNS are fashionable the snapshot taking the body using a tripod and camera timer. To take a snapshot by using these methods, it is inconvenient to set the camera timer and use the remote control by using Bluetooth. In order to minimize such inconvenience, this study proposes a system for taking a snapshot, using the two smart phones. One is used for the purpose of to taking pictures by fixing on a tripod and the other is used for the purpose of checking picture to be currently taken and of instructing to take a picture.

Smart phone can be used for various purposes to mount a variety of functions. In which the camera is being used in the most diverse and increasingly also being upgraded performance (Mathew *et al.*, 2011; Longfei *et al.*, 2014). Smart phones without cameras are useless one and it means that to take pictures on a smart

phone is situated in a very important function. Smart phone manufacturers made a lot of effort to improve the performance of the camera and have developed a number of advanced technologies. Despite the rapid performance improvements of such cameras, software using a camera is not greatly improved. Still a lot of people increase their arms or ask others in order to take the picture of their face. This is because most of the software was developed to take picture by using a single smart phone.

Recently, a smart phone essentially embeds devices for communicating with another smart phones. A typical device is Bluetooth. But Bluetooth devices are many limitations in terms of the access distance and the transmission speed (Erina and Potorti, 2005). Recently, there is a trend mount Wi-Fi Direct (Erina and Potorti, 2005; Hadiks *et al.*, 2014) on most smart phone as the device to overcome the limitation of the Bluetooth. Wi-Fi Direct, initially called Wi-Fi P2P is a Wi-Fi standard enabling devices to easily connect with each other without requiring a wireless access point. One advantage of Wi-Fi Direct is the ability to connect devices even if they are from different manufacturers (Hadiks *et al.*, 2014). Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

In this study, we introduce the development of application that overcomes the limitations of the camera function of the smart phone by using the function of the Wi-Fi Direct. The proposed application is using the two smart phones. One is used as a remote camera for taking remote image while the other controls to take a picture while viewing the image transmitted from a remote camera. The system uses the Wi-Fi Direct to send images to other smart phones in a smart phone. In order to develop the proposed system we use technologies to control a camera, thread to enhance the performance and Wi-Fi Direct to send the image and the commands. The proposed system is designed on Android system. It implies that the proposed system has been designed in consideration of the characteristics of the thread and Wi-Fi Direct in the Android.

### Literature review

**Camera applications:** Smart phone can be used for various purposes to mount a variety of functions. Specially, the camera is being used in the most diverse and increasingly also being upgraded performance. Smart phones without cameras are useless one and it means that to take pictures on a smart phone is situated in a very important function. Smart phone camera was generally recognized that it has lack rather than a digital camera in the basic performance. However, the image sensor technology is improved and various camera features are being developed in order to enhance the quality of photos taken with a smart phone camera and it may give a considerable impact on the digital camera market (Sarat and Ravi, 2016). The camera is a very important factor in the smart phone and it never be even smaller as a criterion in choosing a smart phone. Smart phone manufacturers made a lot of effort to improve the performance of the camera and have developed a number of advanced technologies. In general, smart phones has two cameras which there is mounted one each on the front and back. Mounted camera looks into a little different depending on the smart phone model but as considering high-end flagship smart phone criteria, it has 1300-1600 million pixels, supporting full HD ~4 K video recording for rear camera and 2-megapixel also supporting full HD movie recording for front camera (Sundaram *et al.*, 2015; Varma *et al.*, 2016). Due to the development of the smart phone camera also it changes the digital camera market which births to the result to get easily a good quality camera. Consumers are able to use a lot of camera for better performance and ultimately may lead to the result that the quality of the overall digital image data increases.

Despite the rapid performance improvements of such cameras, software using a camera is not greatly



Fig. 1: “Auto cam lite” for i-Phone

improved. Still a lot of people increase their arms or ask others in order to take their face. This is because most of the software was developed to take picture by using a single smart phone. In order to solve this problem, people use the camera bar or use with a tripod and timer like traditional method. In the case of the former, there is a limitation with respect to the length of the bar. In the case of the latter, it is not easy for people to control the camera, seeing the scene of the camera. To solve the problem, the application for the i-Phone app was released “Auto Cam Lite” in order to improve the inconvenience of having to use the remote control to place the camera timer using Bluetooth. However, as shown in Fig. 1, this application is not only a function to take a look at the role of a smart phone to take the picture while one of the other smart phone sends the instruction to take a picture by pressing the button. Because of such a disadvantage, it did not attract popular with the public.

**Wi-Fi Direct:** Wi-Fi Direct, initially called Wi-Fi P2P is a Wi-Fi standard enabling devices to easily connect with each other without requiring a wireless access point. It is useful for everything from internet browsing to file transfer and to communicate with one or more devices simultaneously at typical Wi-Fi speeds (Hadiks *et al.*, 2014). One advantage of Wi-Fi Direct is the ability to connect devices even if they are from different manufacturers. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

Wi-Fi device helps through more simple and easy connection so that users can take advantage of the output, sharing, synchronization and display. It is possible to connect directly each other without access to the existing network to mobile phones, cameras, anytime and anywhere by directly connecting a printer, PC, game machine or the like and sends the content to share applications. It is possible to connect not only one to one

but also simultaneous connection of multiple devices and can store the information for 1 time connection so that it forms automatically the link when two devices are close. In worldwide, the connection and sharing music, videos, photos and creation of documents are increasing rapidly. For millennial generation to refer to young people between 18-29 years of age in the United States, they are saving an average of 2,400 kinds of music, video and photo files on a digital device. This growth trend is appearing in the same generation of China, Japan and Korea. These generations to come together around a digital camera to view photos of friends and family gathered around a laptop or mobile device also enjoy the movie. Now, using Wi-Fi Direct products they connect with each other to their own devices to share photos, games and videos. Using it, people can be seen comfortably by using the monitor or TV. By applying P2P technology in the Wi-Fi Alliance specifications and certification and testing program and introducing a new interchange technology combines the unique features. P2P connection technology for consumers will be further expanded. According to a recent survey, US consumers send and receive instant messages and share the photos with friends and family and it uses a monitor or TV to view your photos as well as mobile devices in addition to video chatting with the aim of enjoying video games in many places other than home, public transportation, etc. In order to do them all, it showed that they want to connect directly to each other. These results were the same in China, Japan and Korea. In this study, we develop the application in Android to take a remote picture by using Wi-Fi Direct technology.

In the traditional Wi-Fi setup, devices require a gateway to connect to each other, one which we call the Wireless Access Point or WAP and Wi-Fi Router hub serves as this gateway (Daniel *et al.*, 2013; Beom and Choo, 2015). The Wi-Fi Direct technology eliminates the need of this separate access point by providing the two devices involved in the connection with their own limited access points. The protocol which is used for this Wi-Fi Direct setup is known as the Wi-Fi Protected Setup (WPS) protocol. WPS standards thus make connecting two devices using Wi-Fi Direct much easier than connecting two devices using the legacy Wi-Fi connections. Essentially, the Wi-Fi Direct setup includes the use of software within the devices which are to be connected to create Software Access Points or Soft AP. These Soft APs allow the devices to function both as the access point for the Wi-Fi connection as well as the client which uses this connection. Many of these software or apps are freely available such as “Super

Table 1: Features of Bluetooth and Wi-Fi Direct

Items	Bluetooth	Wi-Fi Direct
Access distance	200-300 feet	600 feet
Maximum speed	25 Mbps	250 Mbps
Security	AES 128 bit encryption	AES 256 bit encryption
Compatibility	Bluetooth devices	Wi-Fi direct capabilities
Availability	Relatively cheap set means that manufacturers can include Bluetooth in their devices without any excessive hassles	Most new Android devices come with Wi-Fi Direct features

Beam”, “Wi-Fi Shoot!”, etc. Now that we have a general idea on how Wi-Fi Direct actually works, let us have a look at Wi-Fi Direct, Bluetooth 4.0 and some related factors and try to understand why Wi-Fi Direct is considered to be the better option among these two.

It is clear for new Wi-Fi Direct to replace conventional Bluetooth. This is because when using Bluetooth, it requires the additional technologies for controlling Bluetooth device while it can only use the conventional TCP/IP technology when using Wi-Fi Direct. In addition, Wi-Fi Direct is twice times longer than Bluetooth for accessing distance and it is 10 times faster than Bluetooth for transmitting speed. Table 1 explains the features of Bluetooth and Wi-Fi Direct.

## MATERIALS AND METHODS

### Development of proposed application

**Design:** The proposed system uses two smart phones. One continuously captures images and then sends it to the other smart phone. The other receives immediately the picture and displays it screen in order to see the scene. Two start phones run concurrently the proposed application and communicate each by each by using Wi-Fi Direct. Wi-Fi supports TCP/IP. So one of the smart phone is a server and the other is operated as a client. The server-side unit takes to a device for taking images successively and sends to the client-side device. In Android threads are divided into two main types. One is the main thread and the other is a general thread. In the main thread, it is designed for Android user interface. It is the only reason why only the main thread is to allow access to GUI. It implies that conversely any common thread also do not access any components of GUI. For this reason, the main thread can only take a picture in the server-side unit. To reflect this in the design of the system, the main thread continually is to capture an image and the sub thread sends the taken image to the client unit. The two threads operate in a client device such as the main thread and the sub thread. The sub-thread receives continuously the images from the server unit and then sends them to the main thread. The main thread in the client unit receives the images from the sub thread

and displays them on the screen so that the user checks his/her snapshot taking the body and moves his/her position. Finally, the user gives the instruction to take picture the main thread in the client unit. Then, the main thread sends the instruction to the sub-thread in the server unit. At the server unit and client unit, the picture is stored permanently.

## RESULTS AND DISCUSSION

Figure 2 shows the design of the activities with user interfaces. The system consists of four activities. Two smart phones have the same software so that any one of them can be as the server or the client units. Activity 1 is responsible for the connection of Wi-Fi Direct. It has a function to find devices existing in the range to Wi-Fi Direct for connections. It displays a list of connected devices available through this function and to select the device user wants. When user clicks the connect button for the selected device, it connects this device to the selected devices with TCP/IP and goes to activity 2. In activity 2, it determines whether this device is in operation as the server or the client. If the device is determined by the server it will run through activity 3. In activity 3, it firstly activates the built-in camera and then waits for request of the image transmission from the client. When it receives the transmission request from the client, it captures the image from camera and transmits the image to the client. If the device is determined by the client it will run through activity 4. In activity 4, it awaits a user's instruction and requests the transmission of images to the server. It displays images received from the server to the screen. According to user's command, it determines whether it continues to request the transmission or save the last image or quit the operation.

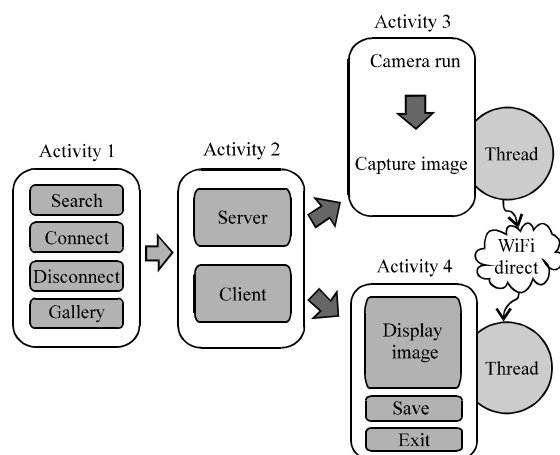


Fig. 2: Design of activities and user interface

**Implementation:** The proposed application must first recognize the device to connect with each other before each device connected to each other. At this time, using a frame called “probe” of the data link layer, it is scattered around the devices of the probe request frames to request information relating to the Wi-Fi Direct. The request frame and the response frame use the name as a basic service set (SSID). Devices exchange basic information such as a response frame to the request frame, the device name or a Wi-Fi Direct mode. By selecting the one device of the devices to form a network group, a software wireless connection device is built. The wireless access device is the group owner serving as the start and end of the communication. Therefore, to make the functions of Wi-Fi Direct, it must be negotiated with other Wi-Fi Direct devices and provide the ability to form a group owner. To join the network group, it performs a connection request to the group owner by using the same method to connect to the wireless access device. In order to allow the authorization, group owner is authenticated using approval button of the user, rather than for a password for the authentication operation. These features are called as PBC (Push Button Configuration). Unlike Bluetooth, Wi-Fi device communicates with the client using the IP address. Therefore, if it is determined in the Wi-Fi Direct to the group owner, it will deploy an IP address to a client like a regular access to their wireless connection. Algorithm is the algorithm for TCP/IP connection with Wi-Fi Direct which is developed in the proposed application.

### Algorithm for TCP/IP connection with Wi-Fi Direct:

#### Wi-Fi Direct Setup

1. Create the instance of WifIP2p Manager
2. Initialize Wi-Fi Direct
3. Register Broadcast Receiver
4. Search devices with Wi-Fi Direct and select a device
5. Request the connection through Wi-Fi Direct
6. Create server socket or socket

The two smartphones are first connected to a TCP/IP using the Wi-Fi Direct previously described. Since, two smartphones are connected to a network, one must continue to capture a screen shot from a camera and transmits it to other smart phone as the server. Other smartphone sequentially receives the transferred image, and displays it on the screen. This is the same as real-time relay system in the camera and the image output device are connected wirelessly. If the user commands to save, it stores the image transmitted in the most recently to the external card. Algorithm represents an algorithm for two smart phones.

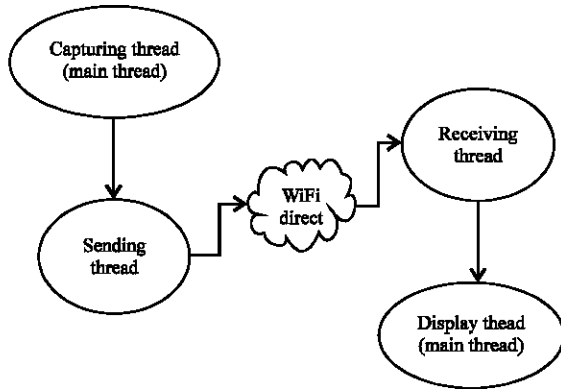


Fig. 3: Threads in the server and the client

#### Algorithms for server and client:

1. Searches the client device by using WiFi Direct
2. Connects the client by using TCP/IP
3. Receives the command to send images from the client
4. Captures the image from camera
5. Sends the captured image "quit", exits
6. As receiving the command
7. Repeats the step 3

#### Algorithm for the client:

1. Requests the connect by using WiFi Direct
2. Connects the client by using TCP/IP
3. Requests the image captured by the camera
4. Receives the transmitted image
5. Display the image on the screen
6. If the user commands "save", saves it to the external card
7. If the user commands "quit", sends the command to the server and exits
8. Repeats the step 3

The task to capture the image and the task to send the image are completely separated in the algorithm for the server. Therefore, it is more efficient to perform in parallel, rather than performing the two operations in sequence. In other words, it is also possible to capture a new image during transmitting the image which was captured just shortly before. To do this, the thread technology of Android is used in this study. The two threads are created, and one only captures an image and the other thread only transmits the captured image. The same problem exists in the algorithm for the client. In other words, for the tasks to receive and display images they can be also carried out in parallel. In this study, we implemented two threads, one is only to receive the image and the other is to display image on the screen.

Figure 3 shows those threads in the proposed systems where the main threads are the thread for user interface in Android. In Android, the main thread only captures the image from the camera and displays the image to the screen. Conversely main thread can never gain access to network resources. The handshake protocol was applied between the sending thread and the receiving thread which is not shown in Fig. 3.

## CONCLUSION

In this study, we proposed the development of the application on the Android which takes a picture by using two smart phones. Because the remote phone sends continuously the scene to the phone, the user can take a picture confirming the scene to be stored. To do this we used the Wi-Fi Direct network supplied by Android. Smart phone can be used for various purposes to mount a variety of functions. Specially, the camera is being used in the most diverse and increasingly also being upgraded performance. Despite the rapid performance improvements of such cameras, software using a camera is not greatly improved. Still a lot of people increase their arms or ask others in order to take the picture of their face. This is because most of the software was developed to take picture by using a single smart phone. Recently a smart phone essentially embeds devices for communicating with another smart phones. There is a trend mount Wi-Fi Direct on most smart phone as the device to overcome the limitation of the Bluetooth. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

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