Virtual Network Computing- A Technique to Control Android Phones Remotely

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Abstract: Virtual Network Computing (VNC) is popular tool for graphical desktop sharing system which is used to control another computer remotely. Multiple clients may connect to a VNC server at the same time. Popular uses for this technology include remote technical support and accessing files on one's work computer from one's home computer, or vice versa. It makes use of Remote Frame Buffer protocol (RFB). RFB is a simple protocol for remote access to Graphical User Interface. VNC is an ultra-thin client system which is based on a simple display protocol. It is platform-independent. With the help of VNC one can achieve mobile computing without requiring the user to carry any hardware. This paper proposes a new architecture for remote control and access of android mobile devices .Which allows sharing of displays between android mobile phone and computers. This should be done within Wi-Fi range irrespective of various platforms. The image of the desktop is compressed before transmission. A modified region algorithm is used to reduce the encoding time of screen image and increase the screen update rate. A number of video encoders are integrated into a prototype system.

Keywords:–Android, Remote Frame Buffer, Virtual Network Computing, Wi-Fi.

1. Introduction

A mobile phone (also known as a cellular phone, cell phone, and a hand phone) is a device that can make calls and receive calls over a radio link while moving around a wide geographic area. In addition to telephony, modern mobile phones also support a wide variety of other services such as text messaging, MMS(Multimedia Messaging Service*)*, email, Internet access, short-range wireless communications (infrared, Bluetooth), business applications, gaming and photography. Mobile phones that offer these and more general computing capabilities are referred to as smart phones. These features are same as the one which were previously provided by computer system architecture. VNC [1]-[4] is platform independent which consists of VNC client and server for many GUI based operating system. It is based on thin client architecture. A VNC system consists of a client, a server, and a communication protocol. The VNC server is the program on the machine that shares its screen.

Figure 1: Basic Architecture

The server passively allows the client to take control of it. The VNC client (or viewer) is the program that watches, controls, and interacts with the server. The client controls the server. The VNC protocol (RFB) is very simple, based on one graphic primitive from server to client ("Put a rectangle of pixel data at the specified X,Y position") and event messages from client to server.VNC server can handle multiple clients at the same time. It uses Remote Frame Buffer protocol to communicate or share information between client and server.

This should be performed within the Wi-Fi range. Now-a-days there are many applications available for sharing the desktop between two or more PCs. This paper focuses on remote controlling of android device through remote PC and also access the android device. It can be used for file transfer, file handling and managing between client and server. It can also be used in customer care services and any software company. Some features of this application include downloading and uploading files, installing applications and starting applications etc. It can also be used to carry out remote sessions or conferences.

Proposed architecture is provided in section 2. Section 3 focuses on design implementation of proposed system. Section 4 explains different encoding techniques. Section 5 explains algorithm used to increase the transfer rate. Section 6 describes system implementation which gives detail information about RFB protocol and region detection algorithm. Section 7 shows experiment. Various applications are given in section 8. Finally, sect ion 9 concludes the paper.

2. Proposed Architecture

Today, android phones have boosted the market. With the development of android phones, there is great improvement in the functionalities of mobile phones. Many applications including Java games, reading and sending emails, browsing web pages etc. can now be easily performed using android mobile phones. Because of these functionalities we have proposed the use of mobile phones to remotely control computers. Virtual Network Computing is a graphical desktop sharing system. It uses RFB protocol to remotely control the display of another device. This can be done through network. It is used to capture a mouse and keyword events of the remote device for controlling functionality. It relays the graphical screen updates back to the connected device. A VNC system consists of three main things: a client, a server and a communication protocol. The mobile device acts as server that accepts the connections from different clients. The client layer is responsible for interacting between the control equipment and monitored device.

3. Implementation Design

3.1 Remote visualization service

The main function of VNC server is to share the graphic information with the client layer. The VNC service should be configured in such manner that it makes use of Tight encoding. This will be helpful to achieve smooth display. The display will be smooth even if the network is slow. The client makes request to the server with connection parameters and establishes a connection. The client layer requests the server to show the display of device. A raw display can be used as alternative if the server does not support the VNC system.

3.2 Application management service

Application Management service is used for centralized management of applications. The client layer can access the information about the applications and also modify the same. This would enable to perform software updates on all monitored devices. For Example, the client can request the server to install an application and the server has to install the application sent by the client.

3.3 Service and process management service

There are number of processes running on a device at any instance of time. This task could use resources badly to complete its task. The server is used to give information about these processes and services and the client layer is responsible to manage these processes and services.

3.4 File system management service

In computing, the main function of a file system is to store and retrieve the information. Most of the devices require the transfer of files between different systems. File system management service is used to provide a central location for sharing files between both systems. The client can also add files into the device, for example to make some data available to users or update the files. The server will allow the client to update, add, perform any operations related to file or remove file.

3.5 Device status service

Device status service is used to check the status of a device. It provides the general information of the device to the clients. Using this, user can determine the device that requires immediate attention. For example, server could notify a client about a problem.

4. Encoding Techniques

RFB is a simple protocol which can be used to access to Graphical User Interface remotely. As it works at frame buffer level it is applicable to all windowing systems and applications The RFB protocol can operate over any reliable transport, either byte stream or message based. The RFB protocol performs its functions by responding to the request from client about specific onscreen rectangle and then server responds in the form of the update. This consists of an encoding or the difference between the moment of the request and the last time the client requested data about this rectangle [7]. This leads to high consumption of bandwidth and consequent delay in the process for sending information. To tackle this problem, different encoding techniques have been developed. The data will be sent in the form of rectangle of pixels. Every rectangle of pixel data is prefixed by a header providing with the position of rectangle on the screen, the width and height of the rectangle and type of encoding used. This encoding type gives detailed information about the encoding of pixel data. The data then follows using specified encoding. These encoding techniques are useful to specify the way to transfer the graphical information. When the client wants to establish communication with server, both sides must first agree upon the encoding type to be used before proceeding further. If the client requires a non-existent encoding, the server will appropriate the next encoding available. There are six basic types of VNC encoding techniques used such as RAW, RRE, CoRRE, Hextile, Zlib and Tight.

4.1 RAW

This is the simplest of all encoding type. In RAW encoding, the data contains width and height pixel value. The server sends all graphical pixels to the client. This pixels are in the form of width*height pixel values (where width and height are the width and height of rectangle). The values represent each pixel in left-to-right scan line order. It requires minimum process time and gives very high performance when the server and the client are on the same machine. The performance is reduced if the client is hosted in a remote device as it requires transferring large amount of data. This encoding technique must be supported by all the clients.

4.2 RRE

RRE stands for Rise and Run-length encoding. It consists of grouping consecutive identical pixel in order to send only the information of one pixel and the number of replications of that pixel. RRE encoded rectangles arrive at client in a form which can be rendered immediately and effectively by the simplest of graphics engine. RRE works by partitioning the rectangle of pixel data into rectangular sub-regions. Each of these sub-regions consists of pixel of single value and its union compromises the original rectangular region. It is used when large blocks of same color exists.

4.3 CoRRE

CoRRE stands for Compact Rise and Run-length encoding. It is a minor variation on RRE. It uses a maximum of 255x255 pixel rectangles. This allows for single-byte values to be used so that the packet size can be reduced. This is in general more efficient, because the savings from sending 1-byte values generally outweighs the losses from the (relatively rare) cases where very large regions are painted the same color.

4.4 Hextile

Hextile is also a variation of RRE. As the name suggest, it divides the rectangle into 16*16 tiles. It allows the dimensions of the sub-rectangles to be specified in 4 bits each, 16 bits in total. In this, the rectangle is split into tiles starting at the top left going in left to right, top to bottom order. The width of last tile in each row will be correspondingly smaller if the width of the whole rectangle is not an exact multiple of 16. Similarly, if the height of the whole rectangle is not an exact multiple of 16 then the height of each tile in the final row will also be smaller.

4.5 Zlib

Zlib is used to reduce the size of packet as much as possible. This is done by compressing the information. But this technique has disadvantage that it requires more amount of CPU processing. This method is used when the VNC server does not work with the Tight encoding.

4.6 Tight

Tight encoding is a combination of the JPEG and Zlib compression mechanisms. In this the data is preprocessed to maximize the compression ratio and minimize CPU consumption. This method is also effective for slow network.

5. Algorithm

To detect the modified regions the precise prediction of modified pixel location is very important. This is done in order to reduce the time. For this, we hierarchically determine the pixel location for comparison. This can be achieved using the algorithm as described below.
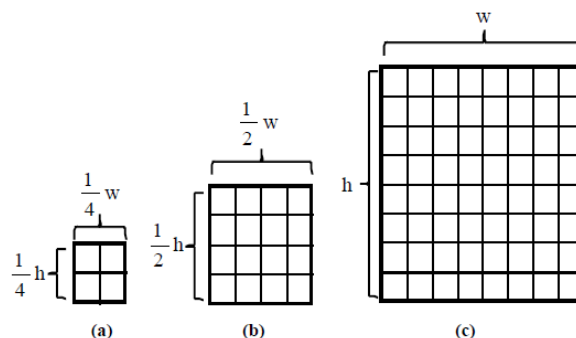
5.1 Hierarchical region detection algorithm

Figure 2: Hierarchical region detection algorithm

This algorithm works by consequently down-sampling the unit rectangle. In step (a), the unit rectangle is down-sampled by a factor of 4 in both horizontal and vertical direction. Then pixel comparison is done in a raster scan order. If it detects a modified pixel then the corresponding unit block is a code block, otherwise it goes to step (b). In this step, the unit rectangle is down-sampled by a factor of 2 and again the pixels are compared. If a modified pixel is detected then the unit rectangle is a code block. Otherwise in step (c), the remaining pixels are compared in the same way as mentioned above. If no modified pixel is determined, the corresponding unit rectangle is determined as a skip block.

6. System Implementation

6.1 RFB Protocol

RFB is a thin client protocol. RFB is used to remotely access graphical user interface. This protocol also makes the client stateless. It means that if a client disconnects from a given server and subsequently reconnects to that same server, the state of the user interface is preserved. It makes the interface to the user's applications completely mobile. Wherever suitable network connectivity exists, the user can access their own personal applications, and the state of these applications is preserved between accesses from different locations. This provides the user with a familiar, uniform view of the computing infrastructure wherever they go. Fig. describes the communication between an RFB client and RFB server.
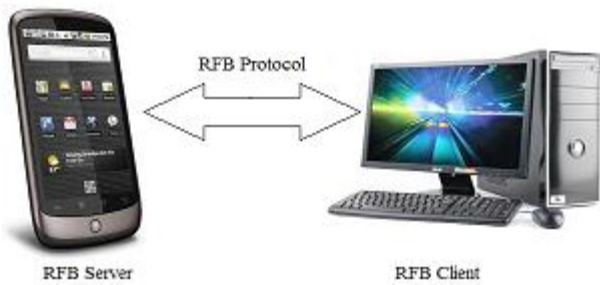
Figure 3: RFB Protocol

6.2 RFB Protocol Procedure

The Virtual Network Computing software is a client/server application. It enables the user to view, monitor and take control of other application on a different host. The prototype system is built on mobile operating system platform. This has been popularly used for mobile devices like smart phones, tablet PC's.
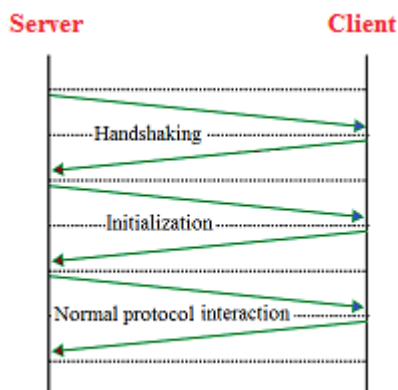

Figure 4: The RFB protocol procedures

It consist of VNC server and VNC clients. The server and client are connected using TCP/IP. The connection is established over Wi-Fi network.

RFB [6] is used to remotely access graphical user interface. There are 3 phases RFB protocol as illustrated in figure 4. In the first phase when the server and client establish the connection, the server sends the protocol version message to the client. This is called handshaking phase. Both client and server agree upon security types by exchanging security message. The second phase is initialization phase. When server receives the clientInit message from client it sends the serverInit message and the connection is initialized between them. This message informs the client about the width and height of the server's frame buffer. It also gives information about its pixel format and device name. The third and the last phase is normal protocol interaction. The client sends the server messages such as SetPixelFormat and SetEncoding messages. Various encoding methods are used which comprise of RAW, RRE, CoRRE, Hextile, Zlib, and Tight. After agreeing upon encoding methods the client sends FramebufferUpdateRequset message to the server. The server sends its screen to the client only when it receives update message from the client.
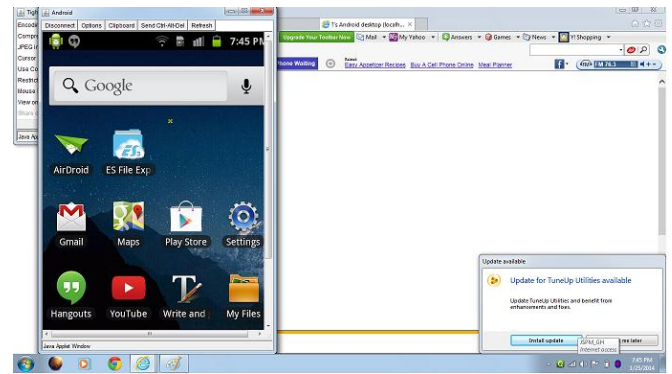
7. Experiment

Figure 5: Remote display of device

The fig shows the display of android phone on client side. VNC allows watching the device and controlling it graphically. The user can control use the device directly. As shown in figure 5, the client offers some features to interact with the device.

8. Application

VNC is one such application that helps in catering the imperative facilities for performing specific applications on a remote machine. VNC is reliable software for remote assistance, administration, remote desktop sharing and IT help desk. It can also be used in distance education from any place in the world. VNC connected users can chat with other users connected at the same time, or with a host computer user. It also enables connected users to transfer files in either direction or also share with other users connected at the same time. VNC also finds its applications in customer care service. Any processing or computation can be initiated or halted.

9. Conclusion

The Virtual Network Computing is client/server architecture. VNC is an ultra-thin system based on an elementary display protocol. It enables the user to view, monitor and take control of other application on a different host. This application is developed to perform remote control of android device. It is used to enhance remote desktop in by screen sharing and file transfer. This is achieved using RFB protocol. At client side, the region detection algorithm is used to consequently increase screen updates. With the increase in the use of android, this architecture will be used for computers, tablet PCs and other many handheld devices. It enables the user to view, monitor and take control of other application on a different host.

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