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碩士論文

多重螢幕的文字分割顯示透過無線傳輸在手機裝置上的方



Method and implementation of displaying text on multiple
display devices on mobile phone

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中華民國九十七年一月

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摘要

現今手機裝置已經是日常生活中人人會接觸使用的通訊裝置，而透過更大頻寬或是更多樣化的網路服務，人們可以使用手機設備來存取越來越多豐富的網頁圖片甚至傳統的連線服務，諸如 Email，BBS 等等。而當今的手機顯示螢幕不管是黑白，灰階或是彩色螢幕手機，顯示螢幕的大小也許是 70*92，120*144，甚至 240*320 或是高階 684*480 的機種，其螢幕顯示的大小對於文字輸出顯示的能力依然是有限制，對於瀏覽傳統大量文字服務，或是有特別需求的文字/圖片，如果把具有特定行數列數或是寬高比的文字區塊/圖片進行重新換行縮放的顯示動作，對於使用者的閱讀經驗將會造成許多困惑與不便，實際的狀況就如使用 Console 去連結 BBS 或是 Email Server，其輸出的畫面必定為傳統的 Console 視窗，具有寬 80 個 ascii 字元寬度，高度 25 行的限制。

本篇論文是提出一個針對原始文字內容，經過讀取檔案，分析文字內容重新計算在多重手機陣列上的分割輸出，利用現今大部分手機已經具有的無線傳輸能力，把重新分配過但追求接近原始文字內容格式的資料分派輸出到多重手機的螢幕上作顯示，實做一個主控端手機控制所屬的附屬手機來共同即時顯示瀏覽單一文件的方法驗證。

本篇論文透過實作來驗證單一內容分割在多重手機陣列上顯示的可行性，期望推廣此分割顯示機制在未來更多多媒體手機上的操作與應用。



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ABSTRACT

In recent years, mobile phone have become a common communication device in our life, with more large bandwidth and more interesting network service, people can use their handset to access these service easily, such as HTTP, Email, Ftp event On-line game. Even from the low-end handset to high-end handset , these mobile phones' screen, display area from 70*92,120*144, 240*240 or 640*480, their display area are limited to various font size and network application. When use such device to view a content with mounts of word/picture with fixed lines/width, if handset force to re-arrange the layout of the text/picture, it will result to user have many reading confusion with the original content. A real case, when we open a console to connect to Email or BBS, the console screen is fixed at width of 80 ASCII chars in one line, and total 25 lines.

In this thesis, we propose a novel method of displaying text on multiple devices with socket, and implement the real work to prove the method can load a single content, display on different handsets, use the master device to browse and scroll up/down, view the full content on different handsets and display well simultaneously.

In this thesis, we prove the proposed algorithm by implementation. The results show that the proposed method provides a new mechanism to display text on multiple handsets, and the future applications on mobile phone.

致 謝

經過兩年多來的辛苦，一方面要兼顧職場工作上的專案進度，一方面也要繼續學校論文的進度，這一路上走了過來，經歷過的許多艱辛跟壓力，總算是完成了當初自己的心願，再次回到學校進修自己想要鑽研的領域以及完成自己想要的研究，雖然很多辛苦是默默的承受，很感謝也很感動，自己還是克服了，也完成了這一切。

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Chaper 1 Introduction

Nowadays, most mobile phone equip with connect to Internet with CSD/GPRS, event with 3G communication. People use mobile phones to connect to Internet to browse web pages, send/read Email/MMS, view photos and play on-line games. These applications bring a gorgeous reading experience to handset users.

But for some application, such as traditional console to open a connection to access email, ftp, even BBS(Bulletin Board system), the tradition console is defined as a text output area of width about 80 ASCII characters width and column of 25 lines. But to recent various mobile phones, with different display screens and different font types, their screen may not meet the requirement of display such a content, to fit displaying issue, application usually need to load the content, or lunch the application in a wrap width/height display layout, but it usually make a big confusion and trouble to mobile phones users. Not only the console applications, even other viewer , like web browser, picture views, photo editor, when user try to use their handset to view large page content, they often get some confusion about the original content when they got the re-arrange layout.

1.1 Traditional Console output

Base on the definition of the terminal window size, not matter in Windows, Unix, Linux, any operating system, the windows size is 80 characters in width, and 25 lines in height. In the terminal windows, all command send and response the result to local user. User can input any text command in the terminal windows to access remote data, act as a client and acquire any service such get web page data, receive email, login BBS to read news, transfer files with FTP protocol, or play on-line game such as MOD.

```

C:\WINDOWS\system32\cmd.exe - ftp ftp.isu.edu.tw
220- 本站提供以下軟體可供下載：
220- *****
220-
220- /pub/BeOS/      BeOS 作業系統
220- /pub/CPAN/     Perl 程式語言 <Comprehensive Perl Archive Network>
220- /pub/CPatch/   中文化軟體 <收集大量的 Windows 共享軟體與中文化程式>
220- /pub/Documents/ 各類文件收集
220- /pub/FreeBSD/  FreeBSD 作業系統
220- /pub/Game/     免費遊戲軟體
220- /pub/Hardware/ 硬體驅動程式
220- /pub/Linux/   Linux 作業系統
220- /pub/MsDownload/ 微軟相關軟體更新 <例如 Service Pack 等>
220- /pub/RFC/      Request for Comments <RFC 文件>
220- /pub/Solaris/  Solaris 作業系統
220- /pub/Yesterday/ 昨日小築完整 mirror <收集大量 Windows 相關軟體>
220- *****
220-
220- 另外，歡迎使用者多多利用 HTTP 的方式登入，一來有較佳的
220- 傳輸效能，介面功能也較為完善，您還可以利用檔案搜尋引擎
220- 快速找到您所需求的檔案，網址如下：
220-
220- http://ftp.isu.edu.tw
220
User <ftp.isu.edu.tw:(none)>:

```

Figure 1.1 To access FTP service by using traditional terminal console

```

Telnet 140.113.23.3
板主: secretary00 mille          郵差來送信          佈告: NCTU
(↑,↓)選擇 (←)讀信 (→)離開 (Ctrl-p)貼文章 (Tab)精華區 (g)主題閱讀 (h)輔助說明
(/,?)搜尋 (x)歡迎畫面 (v)投票 (d)刪除 (F)轉寄 (f)站內轉寄 (Ctrl-x)轉貼

```

編號	作者	日期	標題
3008	N AxlRose	1/26	[出租]新竹市科園社區(原龍山社區)雅房出租
3009	N redmist	1/26	[送] 組合式衣櫃及置物架
3010	N irvetta	1/26	幼幼幼幼有早餐摺!
3011	N minghoun	1/26	請支持讓全世界的孩子認識台灣活動
3012	N kikicat	1/26	徵振道網路轉讓
3013	N elsaliang	1/26	鄰近清大、交大、科學園區套雅房出租
3014	N jooky	1/26	賣 東京都 餐卷一張
3015	N jooky	1/26	賣 東京都 餐卷一張
3016	N wallaby	1/26	OLAY在免費送多元修護霜等等的產品~只有七天~
3017	N leafmab	1/26	[徵] 研究所生科考古題 ~ 生化&分子生物..
3018	N derjohng	1/26	【新竹售】傢俱家電出清
3019	N fairy	1/26	[售]大遠百專櫃黑色漆皮高跟鞋
3020	N fairy	1/26	[售]ettusais艾杜莎零毛孔保濕粉底液
3021	N newaccount	1/26	[請問] 今天綜合球館有開嗎?
3022	N OLED	1/26	急問:請問十一舍網路有通嗎?謝謝^^
3023	N OAmoney	1/26	24k好像下午停電到五點
3024	N dhol	1/26	八舍218 排骨便當便宜賣
3025	N jeremy32723	1/26	幼幼幼幼送點心
> 3026	N Maty	1/26	尋人 學號 9612815 9613619

Figure 1.2 To access BBS service by using traditional terminal console

1.2 Display Limitation Of Mobile Handset Device

Mobile phones from the basic function , just dial up and talk to other people, to the rich function about the play music, take snapshot by the attached camera, even equip with GPS to track their travel waypoint. No matter the low-end or hi-end device, their screens differ in width and height, their colors and pixels also are different to each others. By the way, the fonts display on the screen also differs, some handsets use only one fixed font style and size, but other handsets can change their font style to Italic, Bold or underline. But with these different display sizes, some display sizes , the columns and lines are usually less then the real layout of the web page, picture, or the terminal windows size, so application usually wrap the text, scale the picture , but the result are usually hard to read.

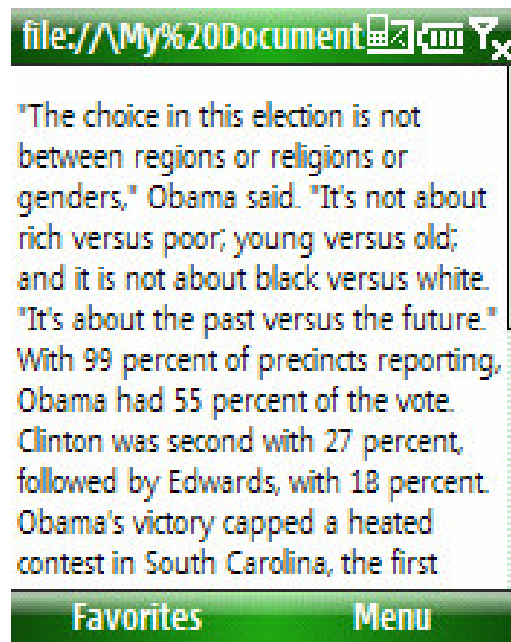


Figure 1.3 Wrap the text layout to meet the screen size for reading



Figure 1.4 Scale the picture to view in full screen mode

1.3 Motivation

When mobile phones are quipped with advanced modules such as WIFI, Bluetooth, IrDA , people can use these modules to access Internet services, to connect to other mobile phones , and with the common open platform, I want to connect two mobile phones together, display single document on these two display screens, to view synchronously on the devices. With the new protocol, user have two or more mobile phones can read document with a large virtual display screen.

With the handset wireless connection capabilities, I define the handshake of the display size of different model handset, and try to gather their different screen display as a large display. Try to open a document, and split the portion data on each device in the device group, make the view size and layout keep the original style the document present. Provide a handshake to connect two devices, a new protocol to negotiate handset display properties. With the split display mechanism, User can put two or even more device together as a big screen, use the physical wireless connection to act as server/client handsets, to operate

viewing one documents with the device array.

To split one document on multiple display devices, the idea come from the my work experience, when we development the email client to retrieve mail from the POP3 server, or send email with SMTP server, the terminal console size are much different in PC and on the handset, even the later development, I wish to use the console window to access BBS or other Internet services, but I feel hard to view the command text in my mobile handset, due to my small display size. So I try to construct the new idea and apply it to patent, and final I got the patent of US Patent No. 7242369, China Patent No. ZL 2005 1 0118170.0, Taiwan Patent No. I276991, but the real implementation is not realized due to the product schedule. Until now, most handsets may be implemented on base of Microsoft Windows Mobile OS, it provide a basic development with many APIs and user can build customized applications, with the new defined socket APIs, we can get an open environment to setup the connections, send/receive data, and my proposed protocol can implemented as a real module to run in the common handsets with the open API.



Chaper 2 The Proposed Method

In this chapter, I propose a novel method of displaying text on multiple devices, use sockets to connect two mobile phones, load contents and send commands to each device, to browse content simultaneously.

Display text on multiple display devices. The multiple display devices include a master device with a master display and at least one slave device with a slave display. The method includes establishing communications between the master device and the slave device, dividing the text into a first part and a second part based on a first display dimension of the master display and a second display dimension of the slave display, transmitting the second part to the slave device, and simultaneously displaying the first part on the master display and the second part on the slave display. For each individual line of text that is displayed on both the master display and the slave display, a fraction of text is displayed on the master display and a remaining fraction of text is displayed on the slave display.

The protocol consist four states, the initial state, the information change state, display mode change state, and final state. All commands in each states, are human readable text, each is prefixed with MTD, and next field is the role, and the final field is the operation name. The prototype of the command is MTD_role_operation, the detail description will list in the following.

2.1 Initial State

In the initial state, master and slave device initial their network layer and the socket modules, then master connect to slave, after setup the connection with slave, master send the MTD_MASTER_HELLO message to slave, slave receive the message and make decision with the message, if slave choose to reject the operation , slave will send back MTD_SLAVE_REJECT message to master, and the whole protocol just exit now. Other wise,

slave agree with the current operation and send back MTD_SLAVE_HELLO message to master.

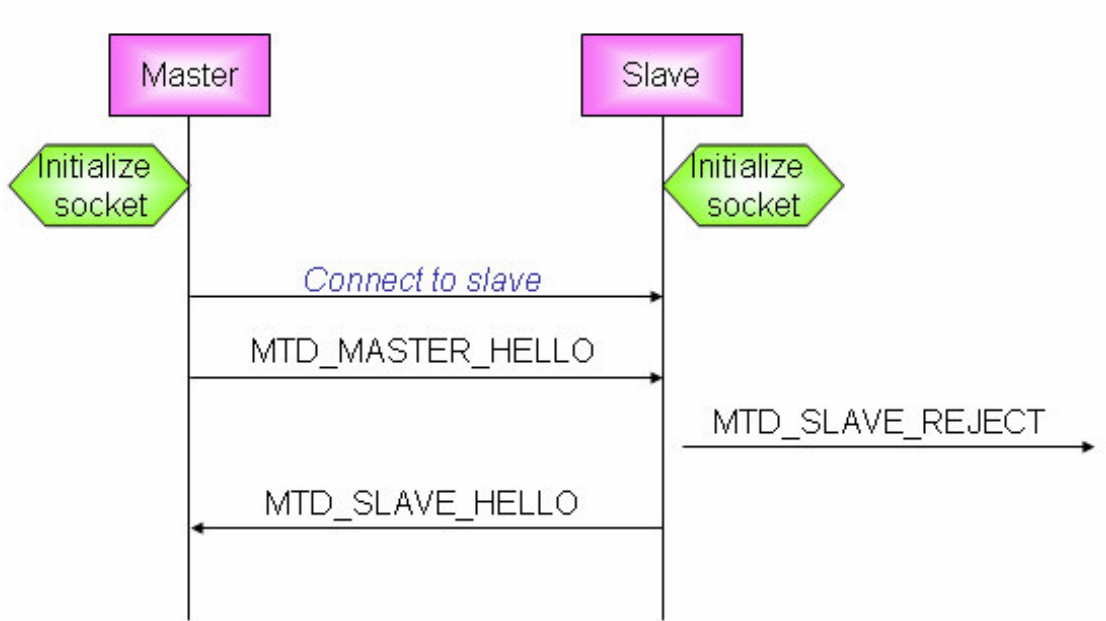


Figure 2.1 Flow chart of the initial state

2.2 Information change state

In the state, master and slave need to exchange the display information of their screen display screen and the data of document, master and slave query their local display screen size, then master send text data to slave, master send MTD_MASTER_DATASIZE_###, ### is the size of the documents, and send the raw data of the document to slave, slave get the size of the document and receive the full data of the documents, and just send back the local display information to master with command MTD_SLAVE_INFO_C###L###, ### means the width of the columns and the height of lines, after master gather the information of slave's device, master need to adjudge display area of each device, I just propose the simplest way to the adjustments, that is to combine the width of the two device , and choose the smaller height of the two devices, the reason just try to extend the virtual screen width as the sum of the two

device, and for the layout correction of the text displaying, the smaller height is the suitable result to view the documents.

After master make the adjustment of the display area, master send MTD_AREA_M####*###S####*### to slave, in the command, consist of master display ration and slave display ratio information.

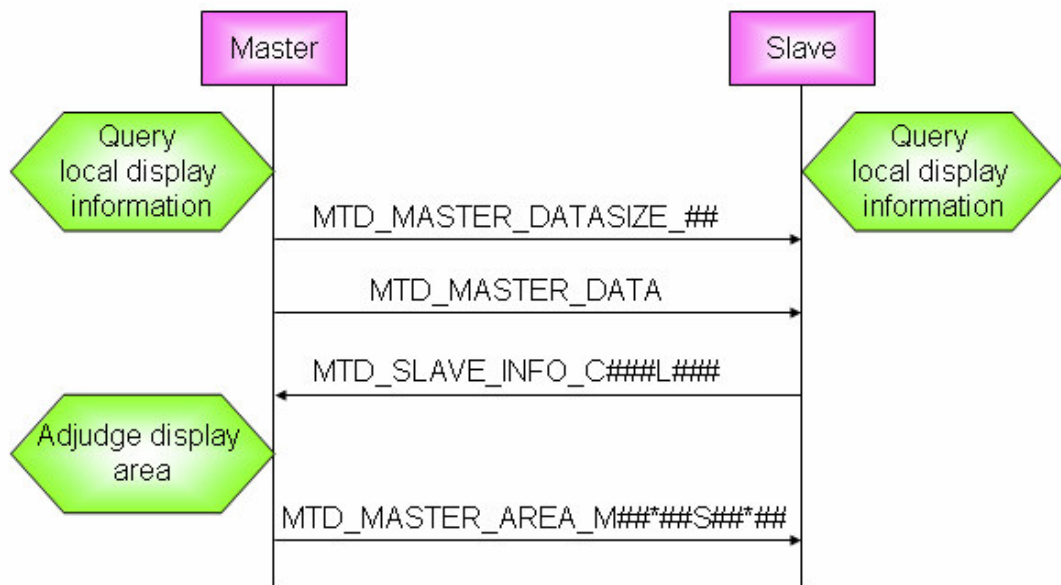


Figure 2.2 Flow chart of the information change state

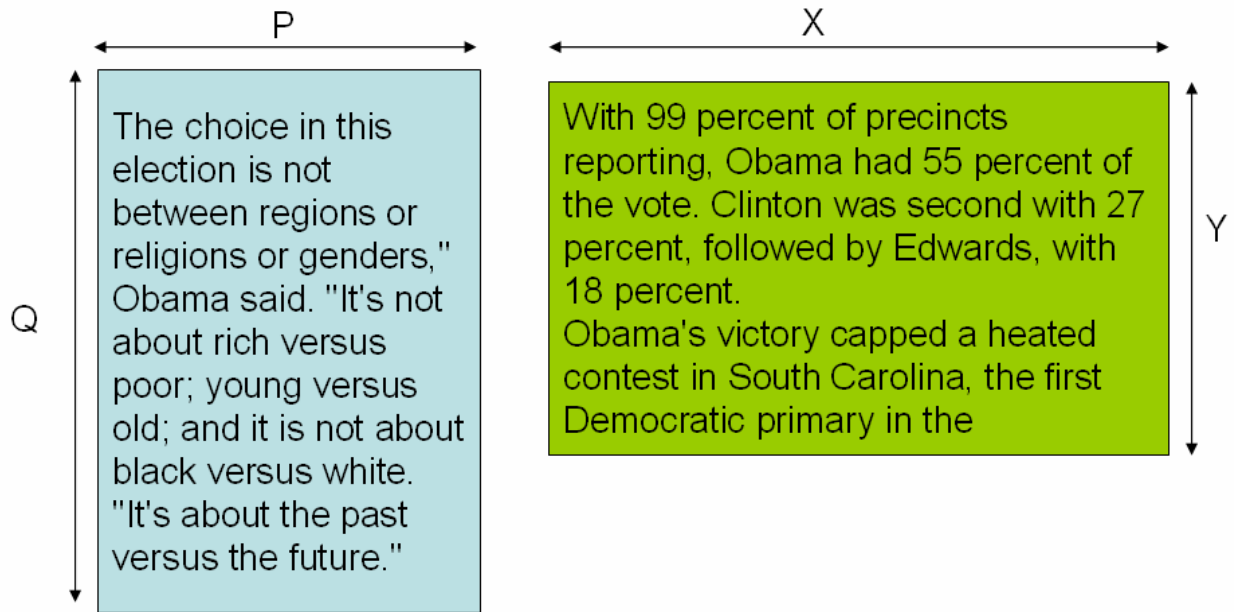


Figure 2.3 Simple adjustment of the display area

2.3 Display mode change state

After master and slave negotiate the final display ratio, master will send MTD_MASTER_CHANGEMODE command to slave, slave receive the command and ready to change to new display mode, just send back the MTD_SLAVE_CHANGE message to master. Master and slave will change to the new display mode in the current state, and user will see a new display mode on the two display device, and user can view or do any operation with the application.

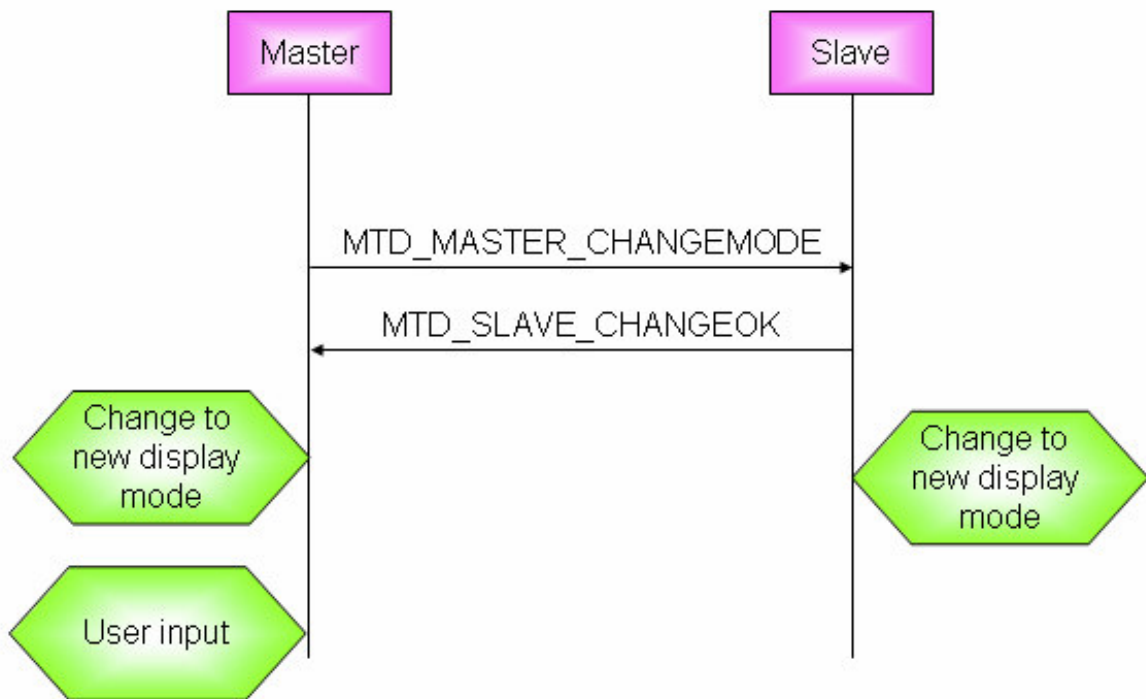
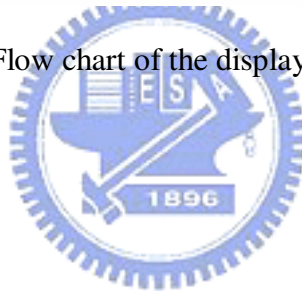


Figure 2.4 Flow chart of the display mode change state



2.4 Final state

When user want to exit the multiple display mode, user request the operation , and master will send MTD_MASTER_CLOSE command to slave, slave just response MTD_SLAVE_CLOSEOK message to master, master and slave need to close their socket and network functions gracefully and change their display mode to previous display mode, and the protocol just complete.

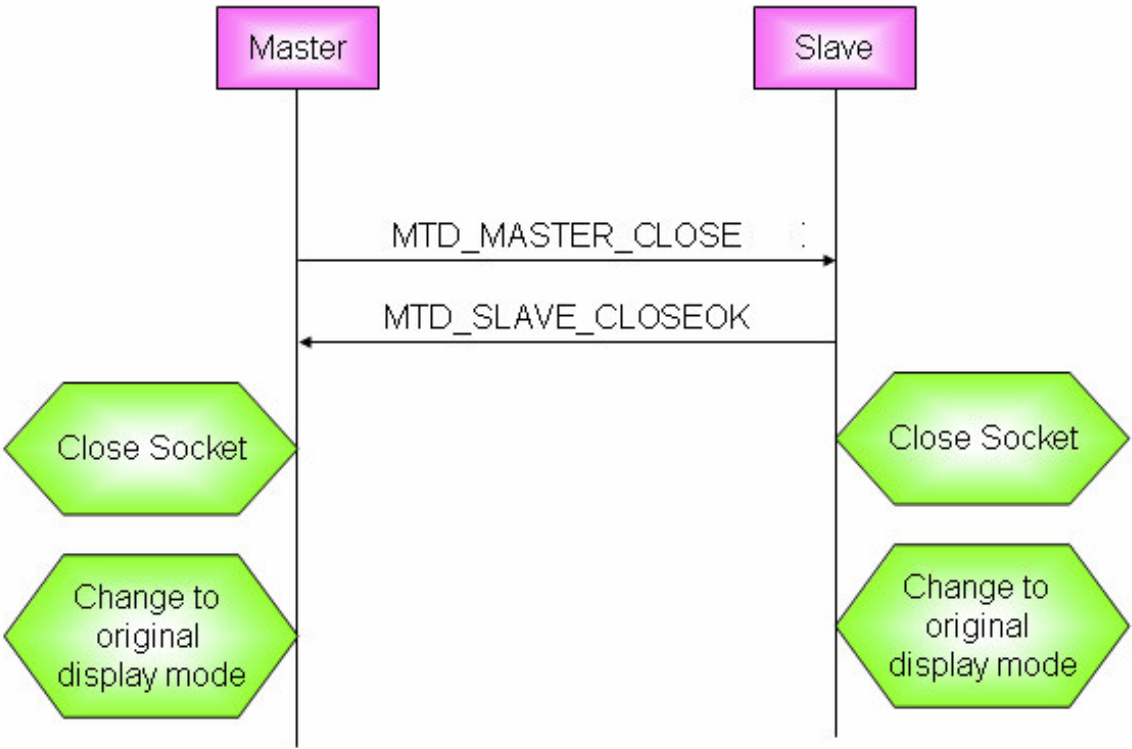


Figure 2.5 Flow chart of the final state

2.5 Multiple display examples

In the case, if we use two handset, one screen display is 30 columns and 15 lines, and the other handset is 35 columns and 20 lines, after open a documents about 80 columns and 25 lines, the message flow and view result are listed as following.

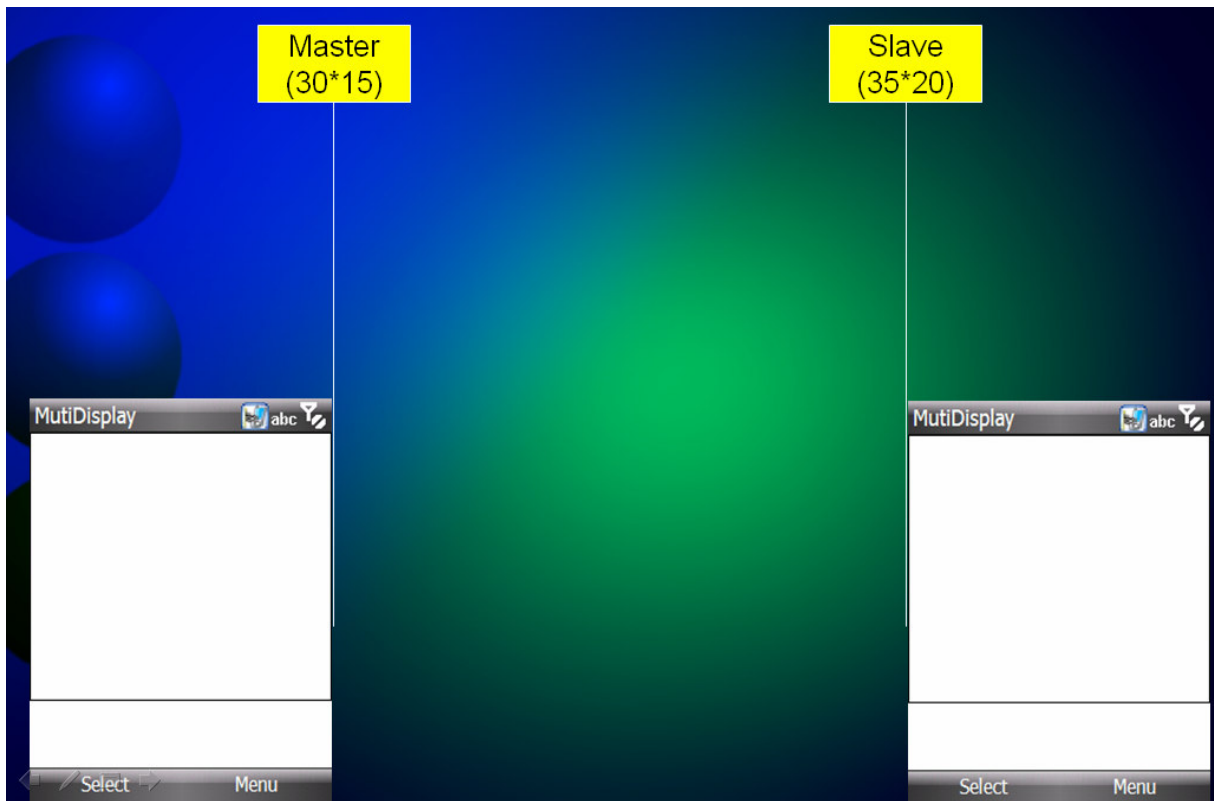


Figure 2.6 Two handsets with different display size

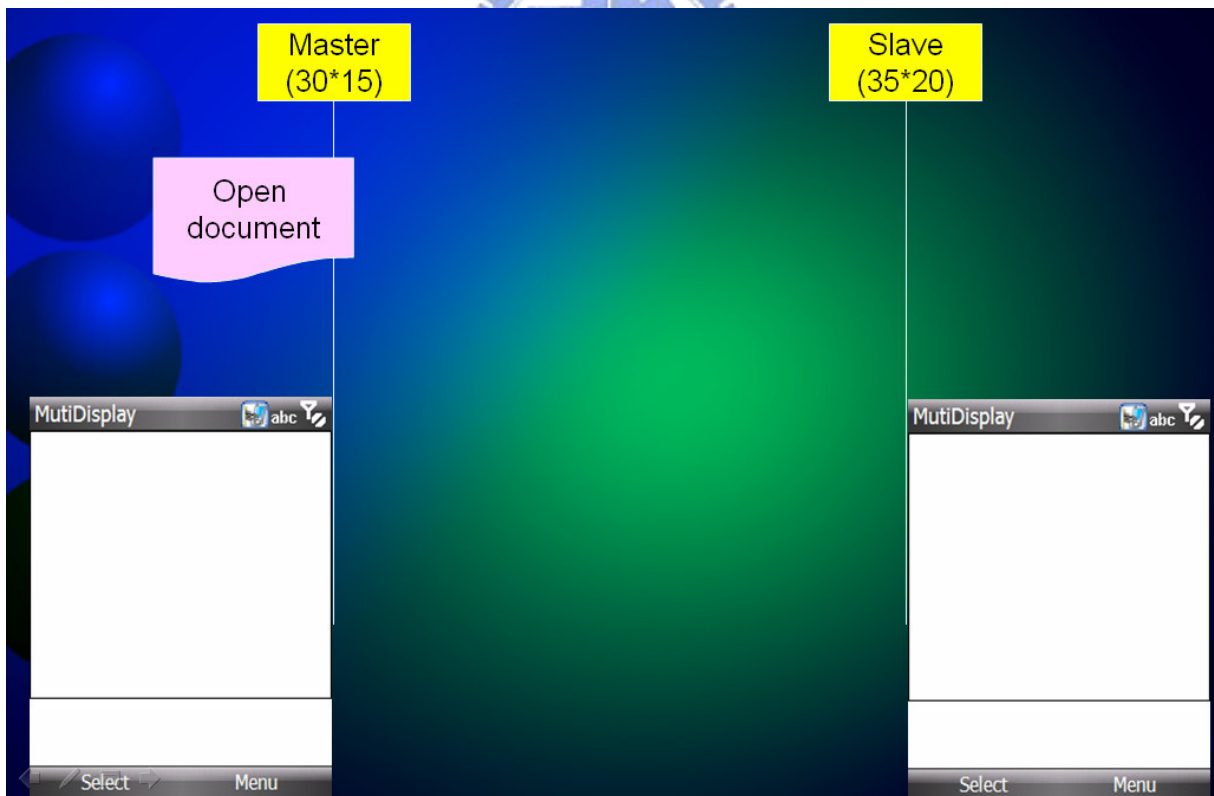


Figure 2.7 Open document on master device

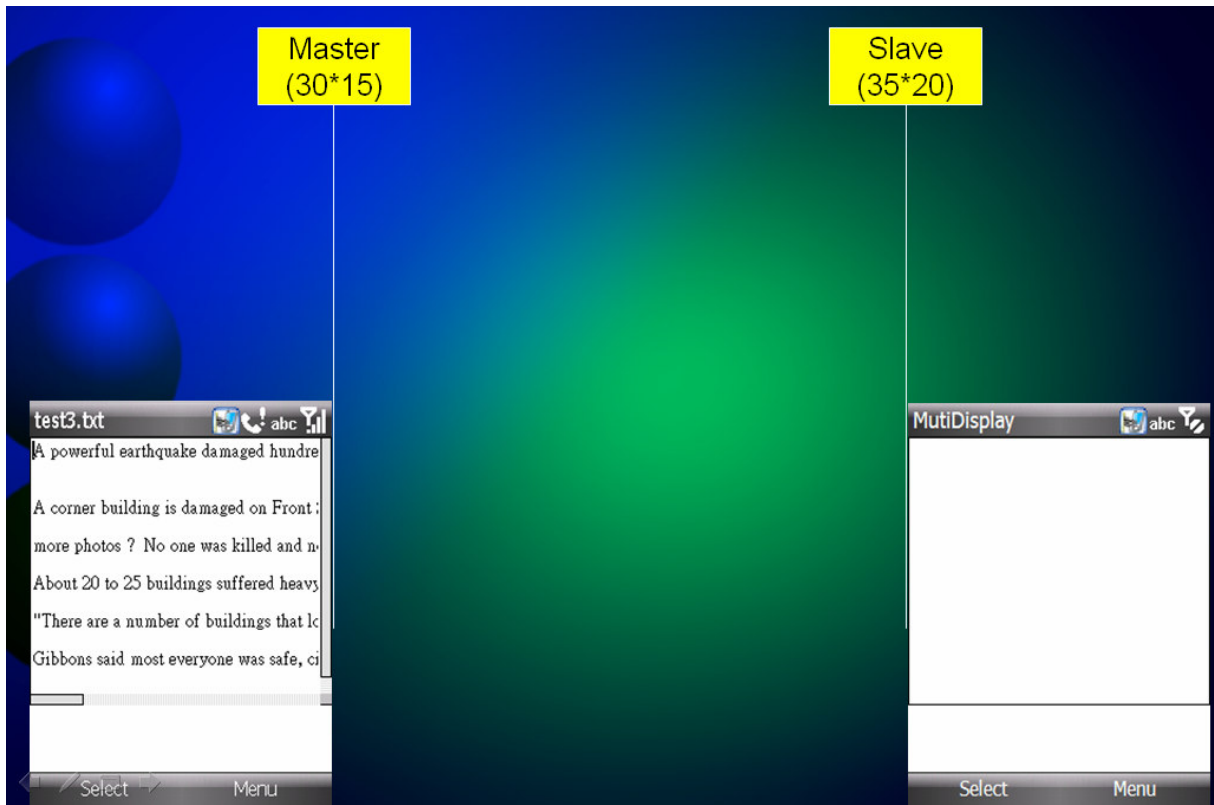


Figure 2.8 Master display the text in original display mode

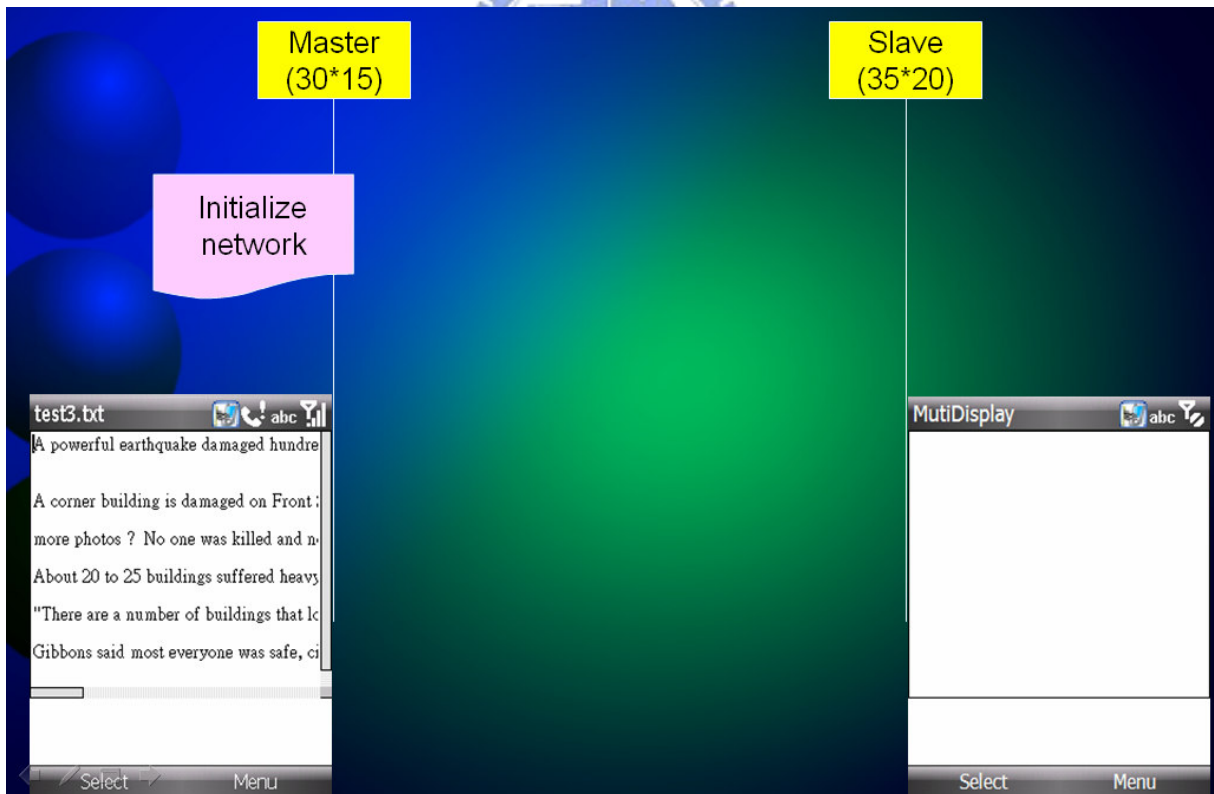


Figure 2.9 Master initial the network layer

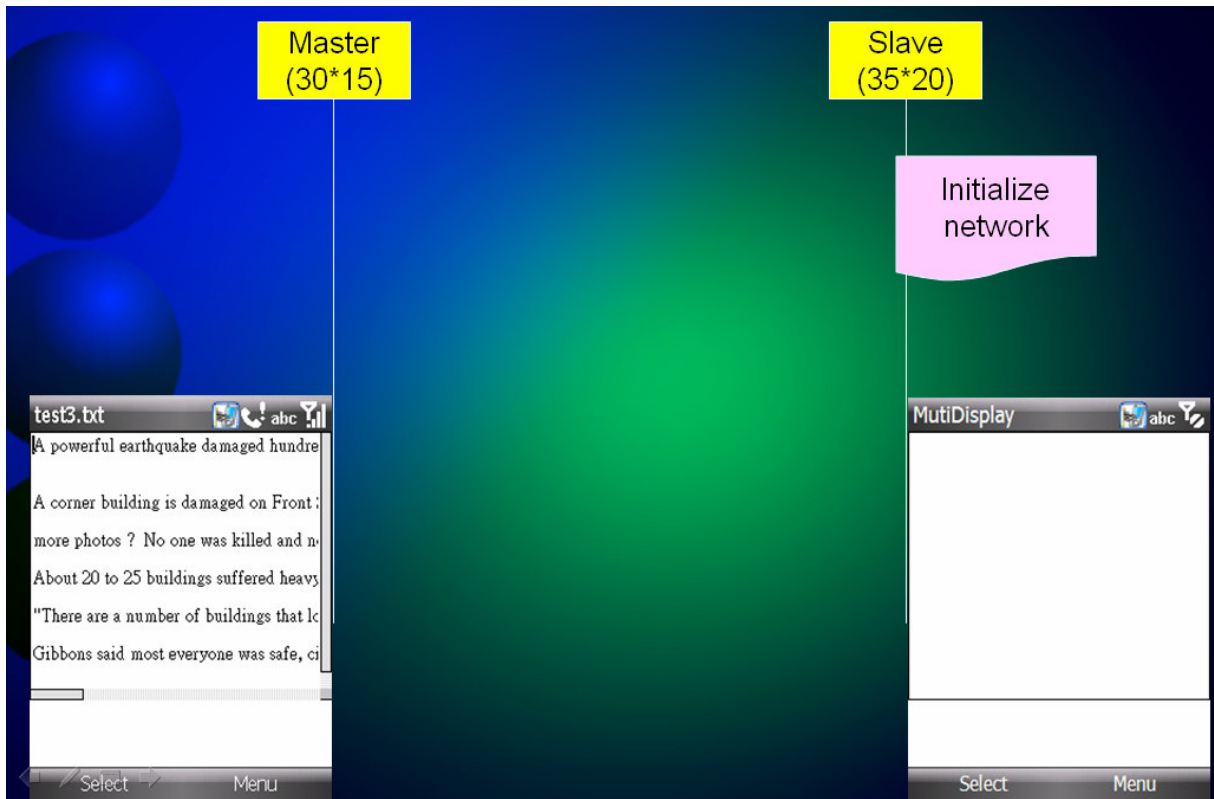


Figure 2.10 Slave initial the network layer

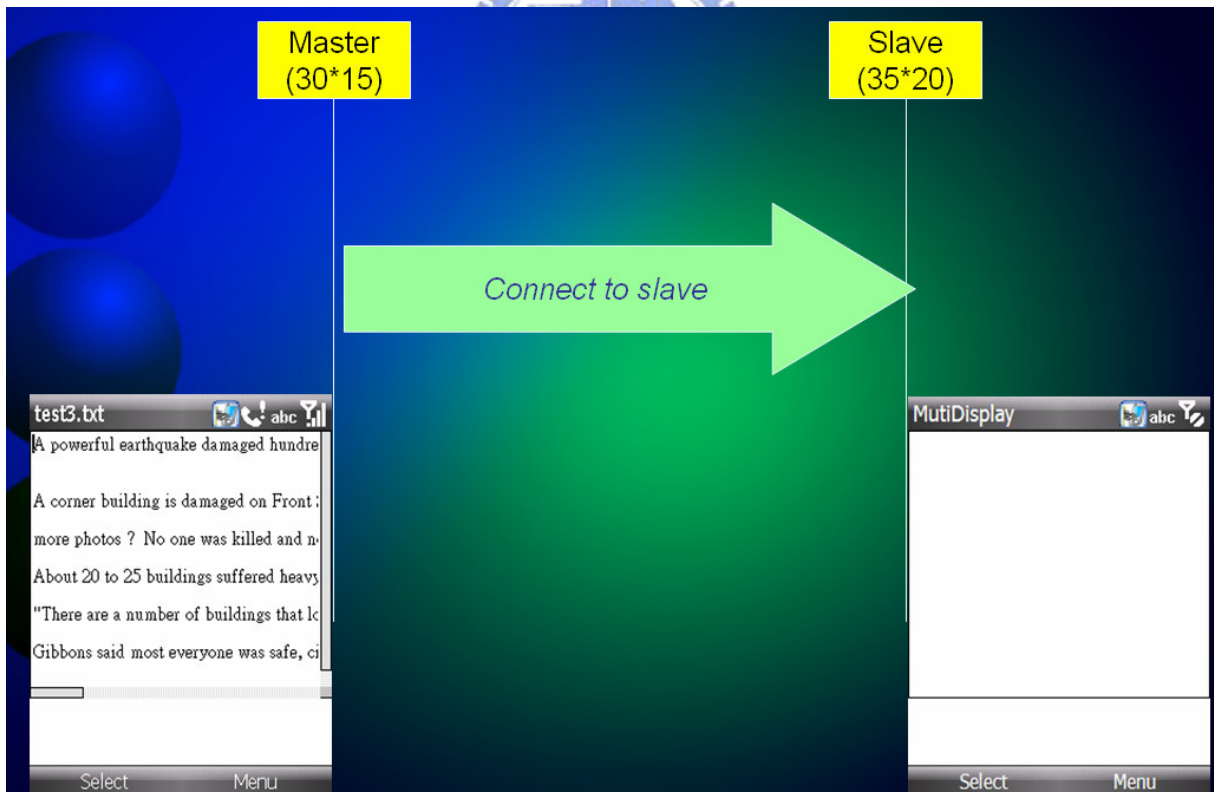


Figure 2.11 Master connect to slave



Figure 2.12 Master send HELLO message to slave

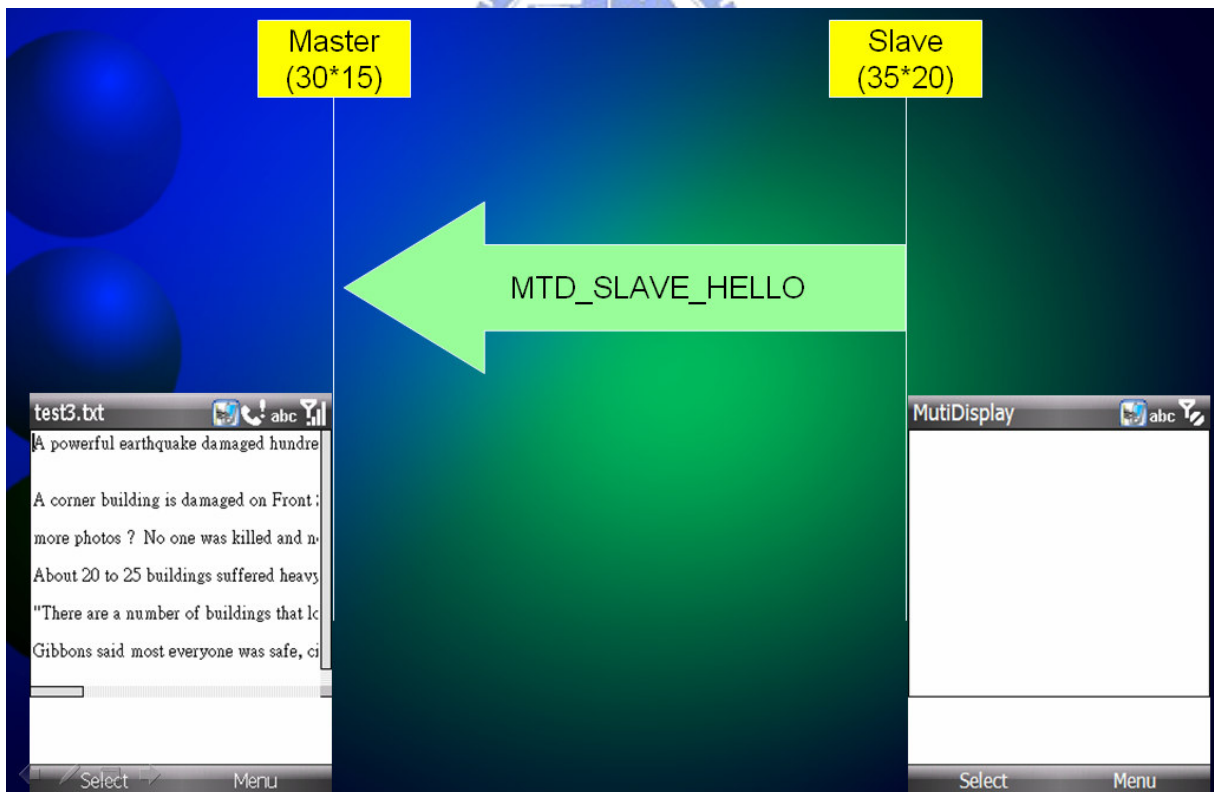


Figure 2.13 Slave response with HELLO message

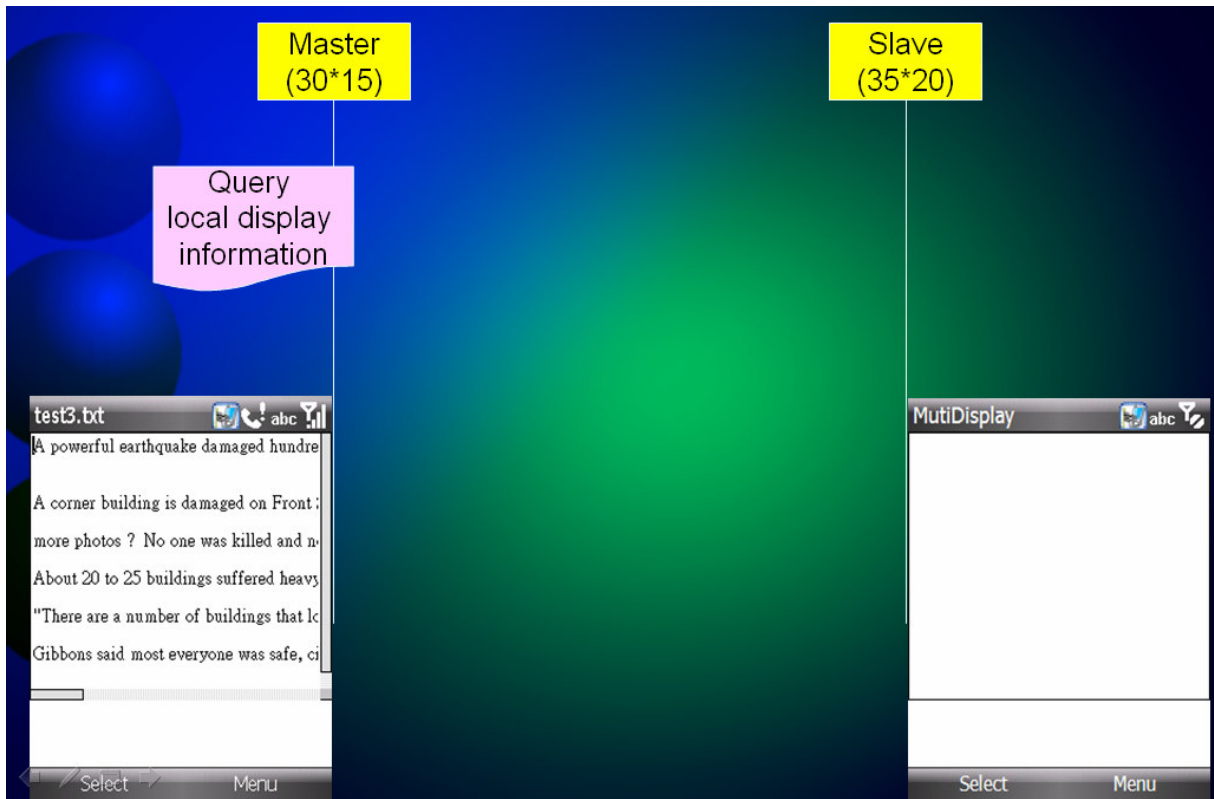


Figure 2.14 Master query local display information

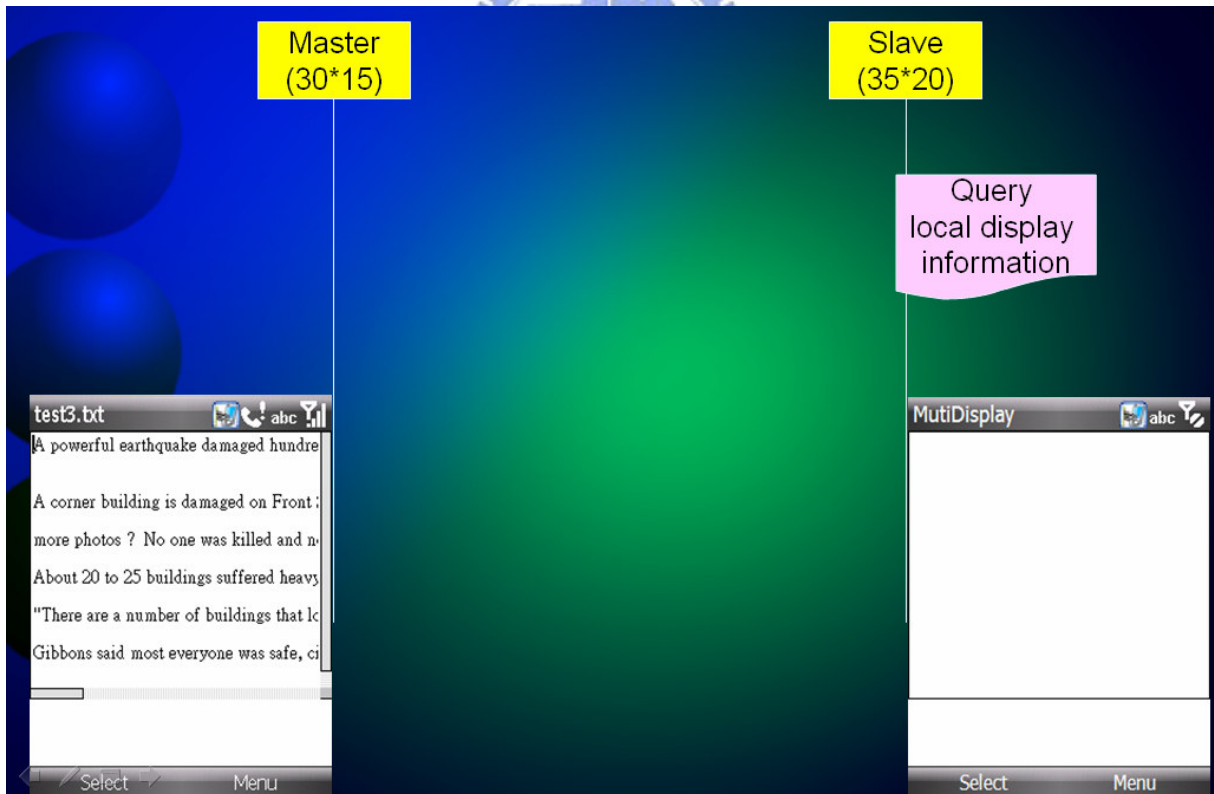


Figure 2.15 Slave query local display information



Figure 2.16 Master send data size message to slave

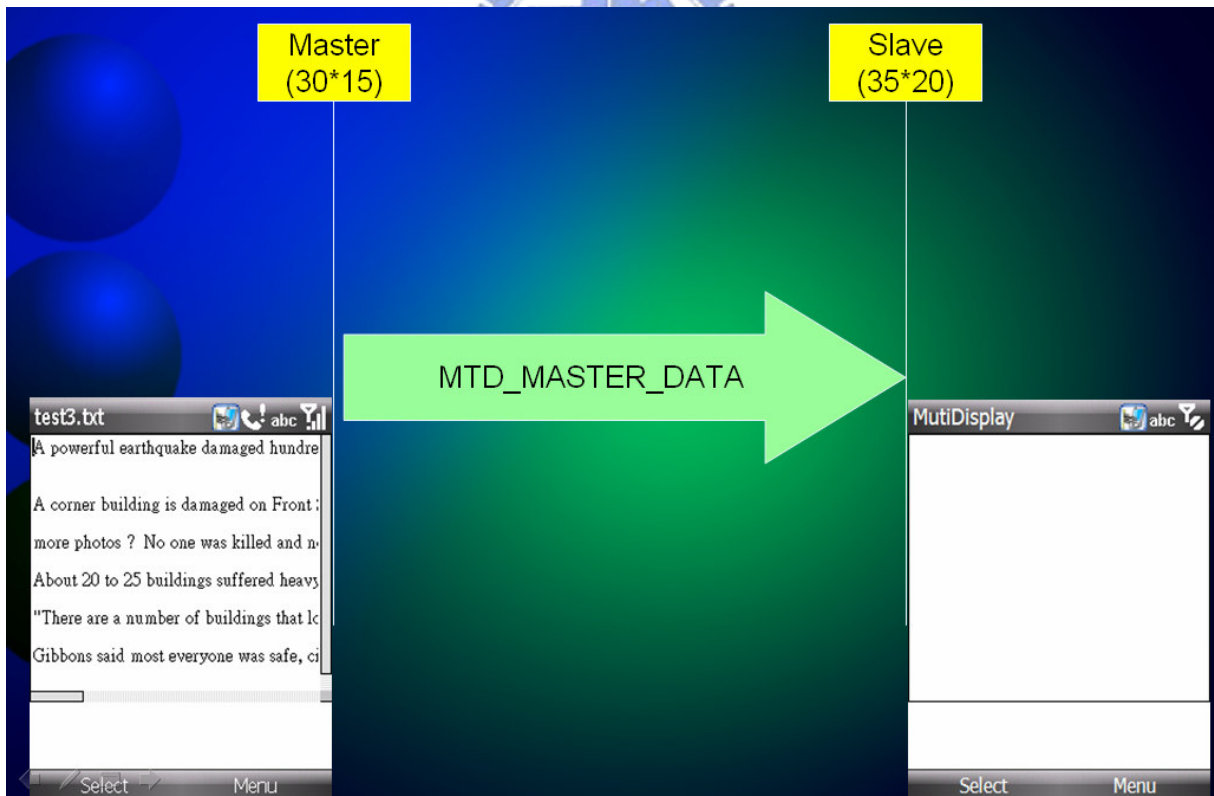


Figure 2.17 Master send raw data of text to slave

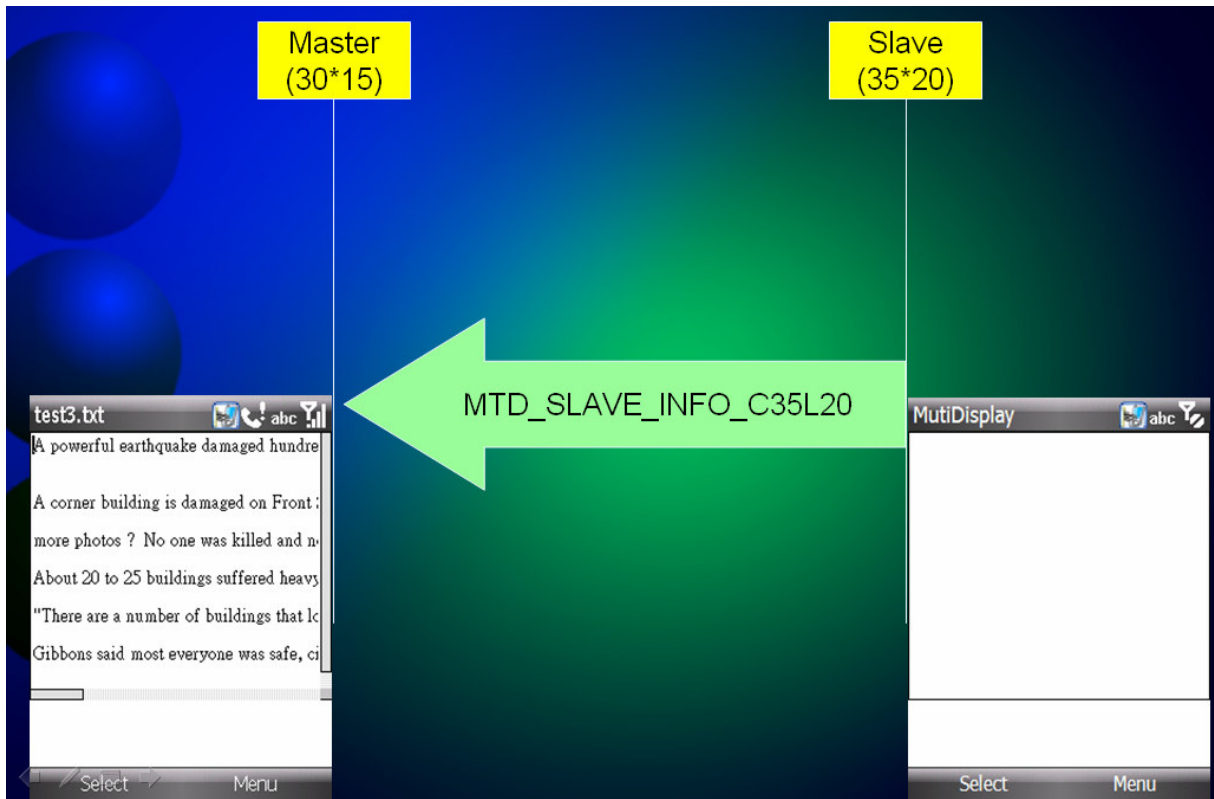


Figure 2.18 Slave send local display information to master

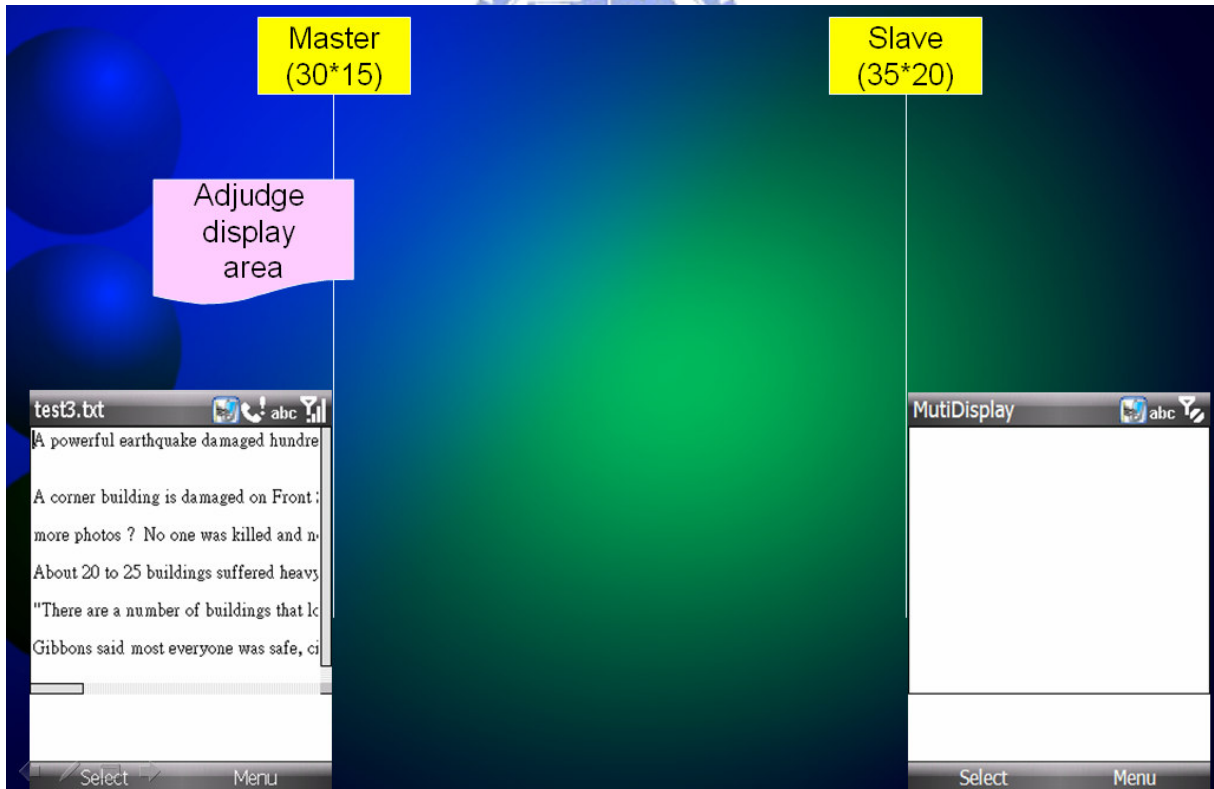


Figure 2.19 Master adjudge display area of each device

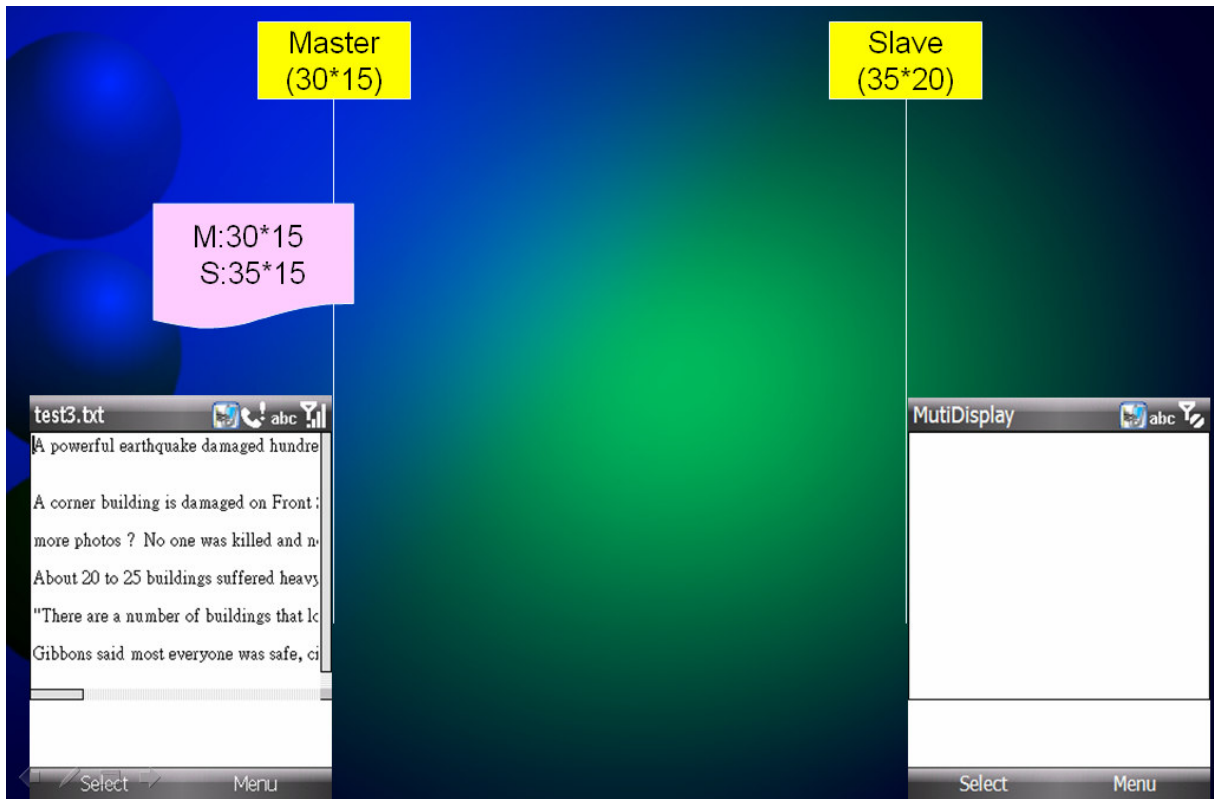


Figure 2.20 The result is Master: 30*15, and slave: 35*15

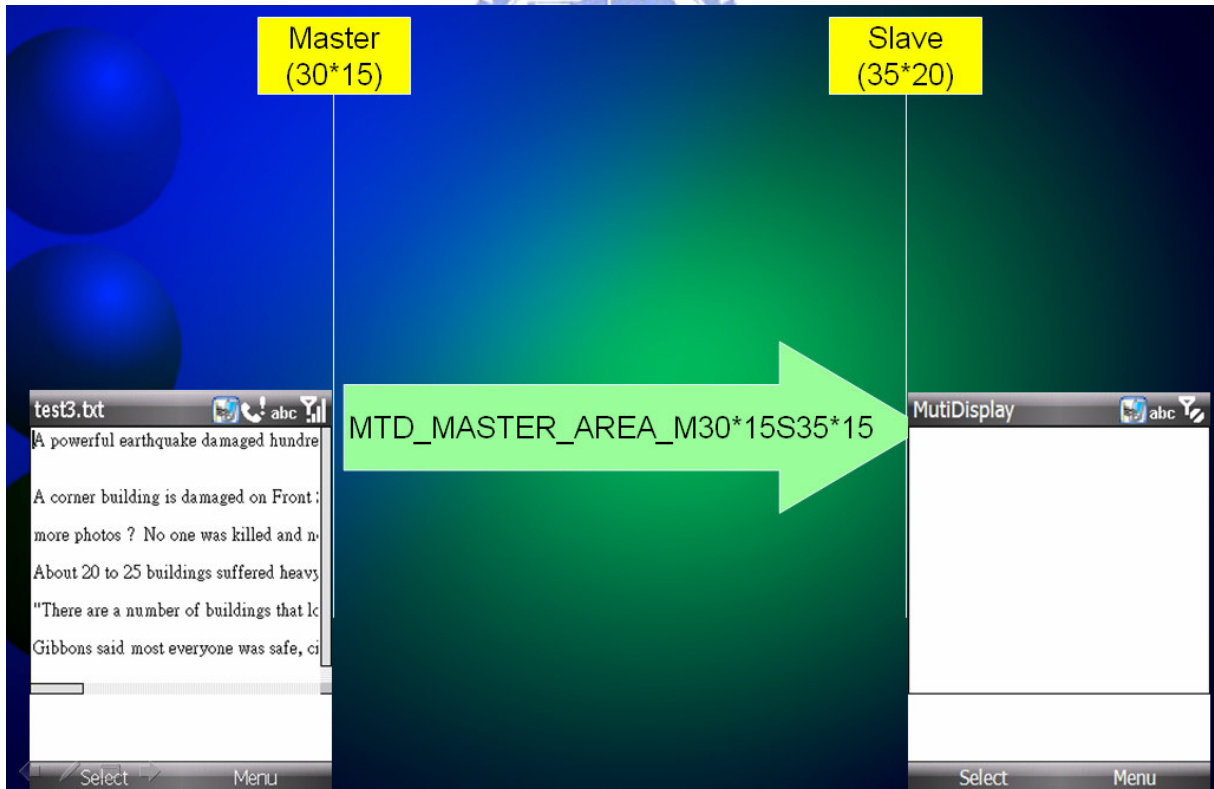


Figure 2.21 Master send display area message to slave

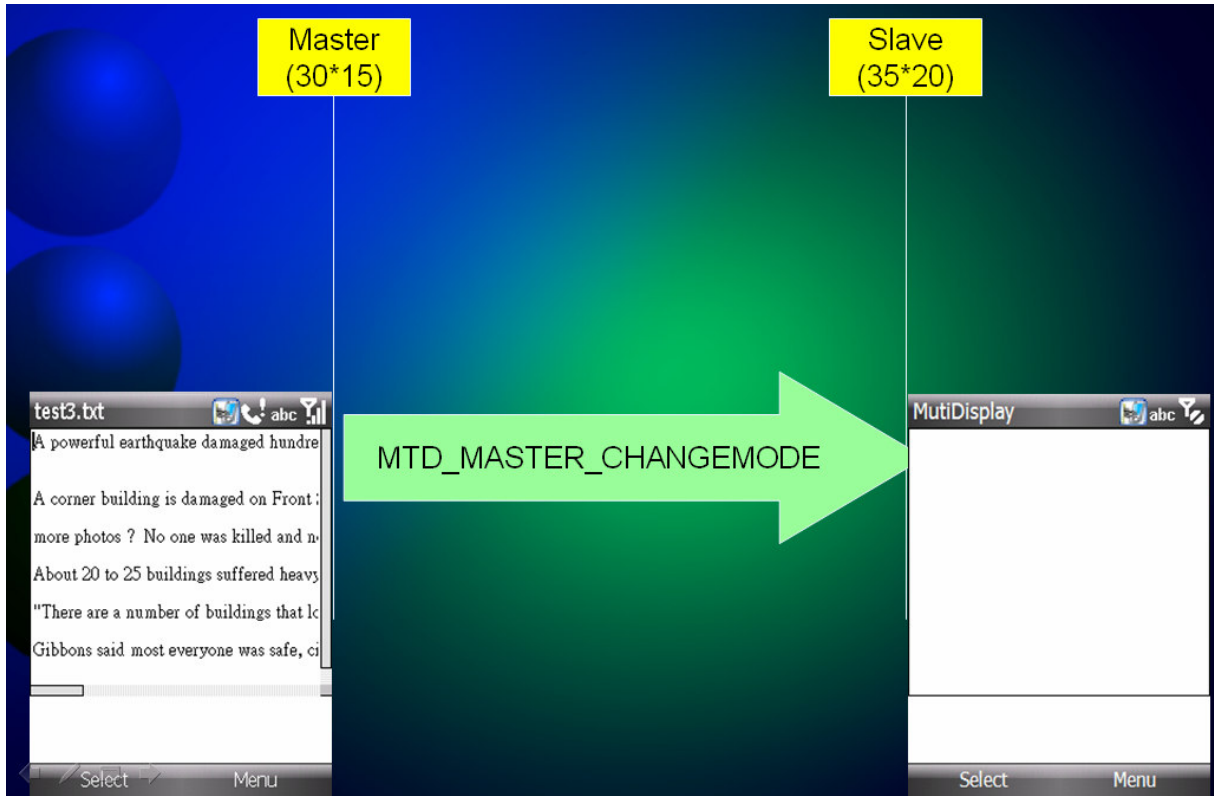


Figure 2.22 Master send CHANGEMODE message to slave

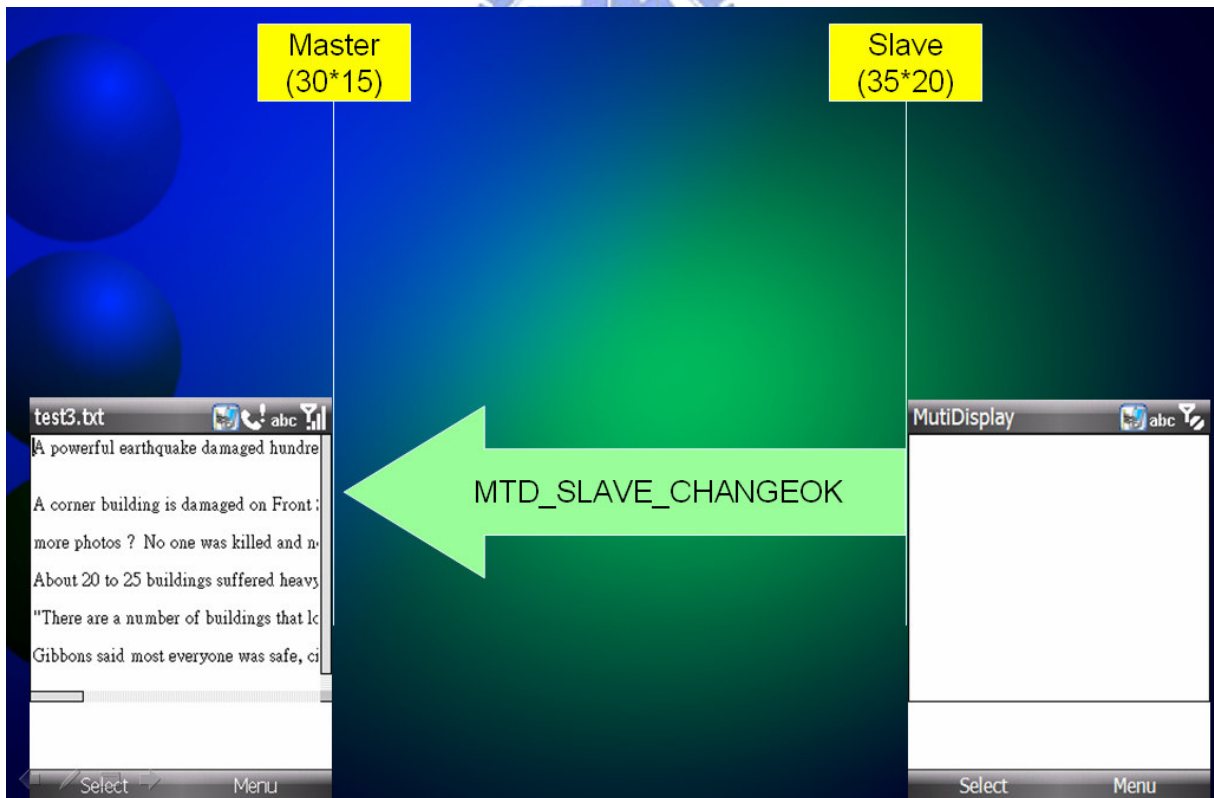


Figure 2.23 Slave response with CHANGEOK message to master

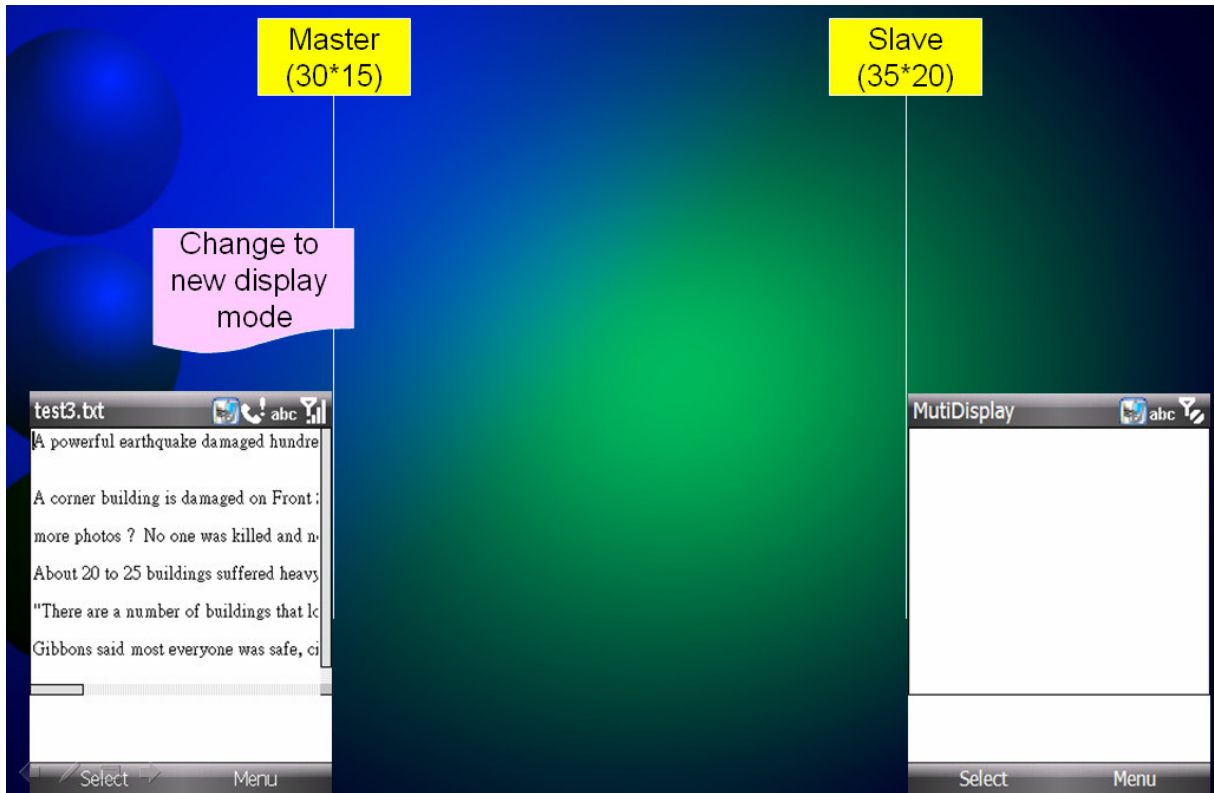


Figure 2.24 Master change to new display mode

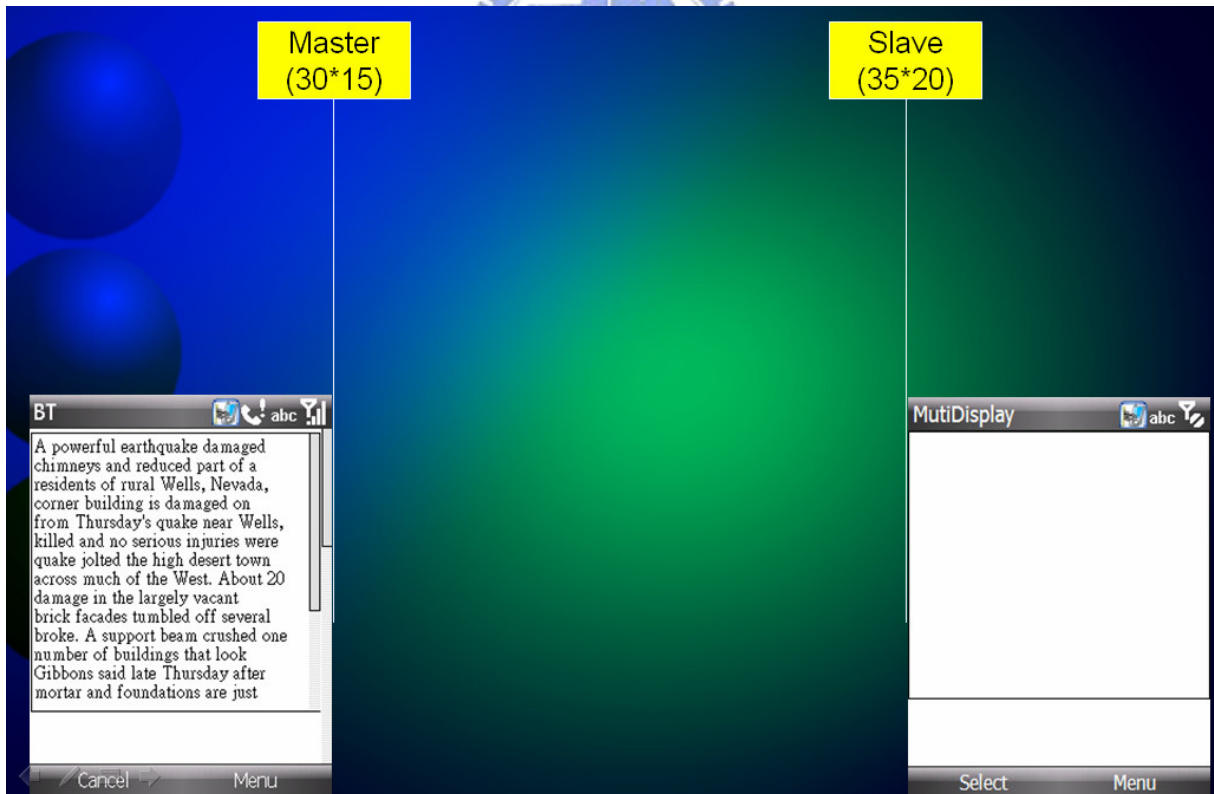


Figure 2.24 Master display the partial text on the screen

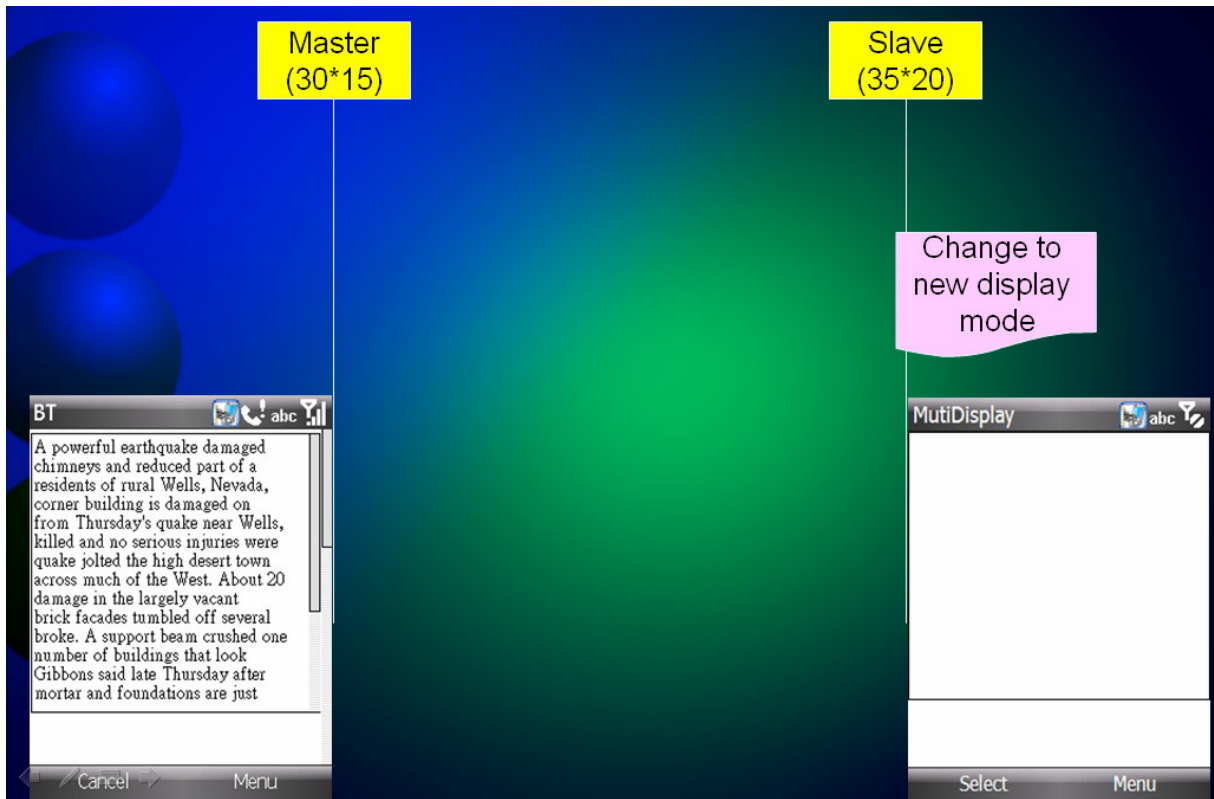


Figure 2.25 Slave change to new display mode

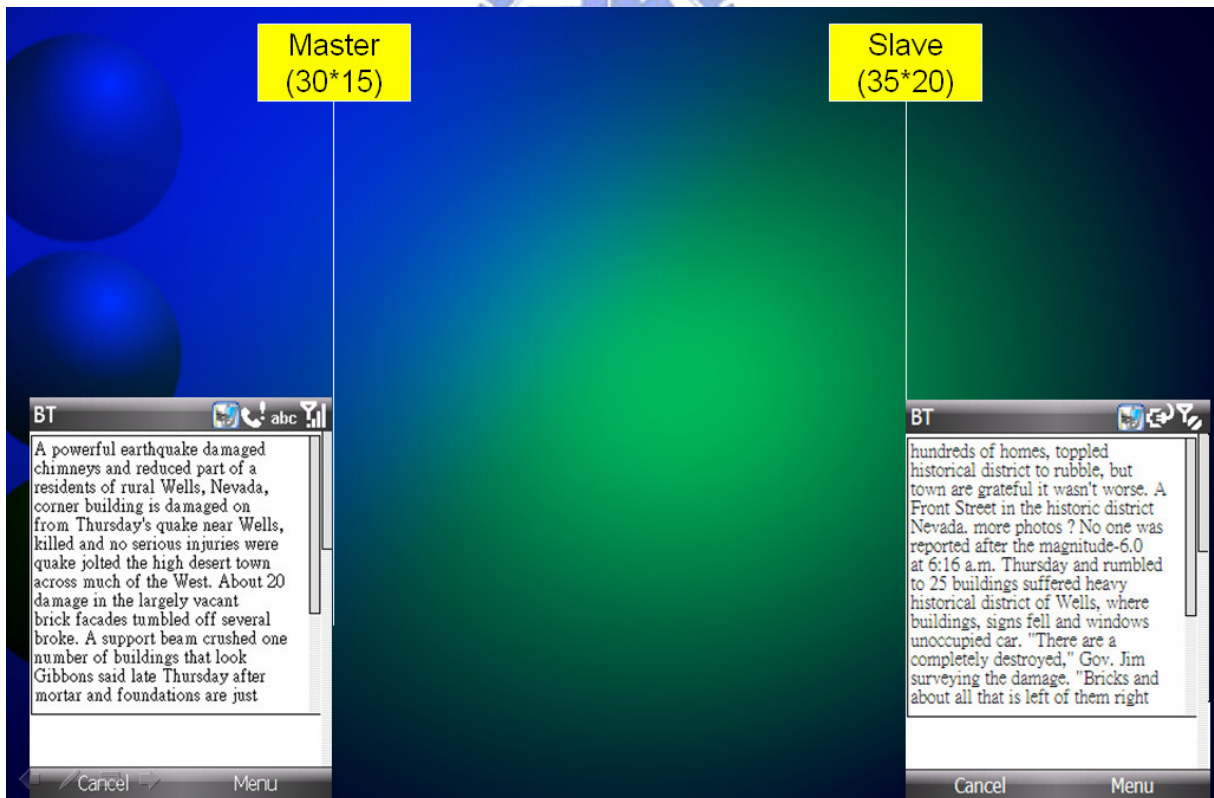


Figure 2.26 Slave display partial text on the screen

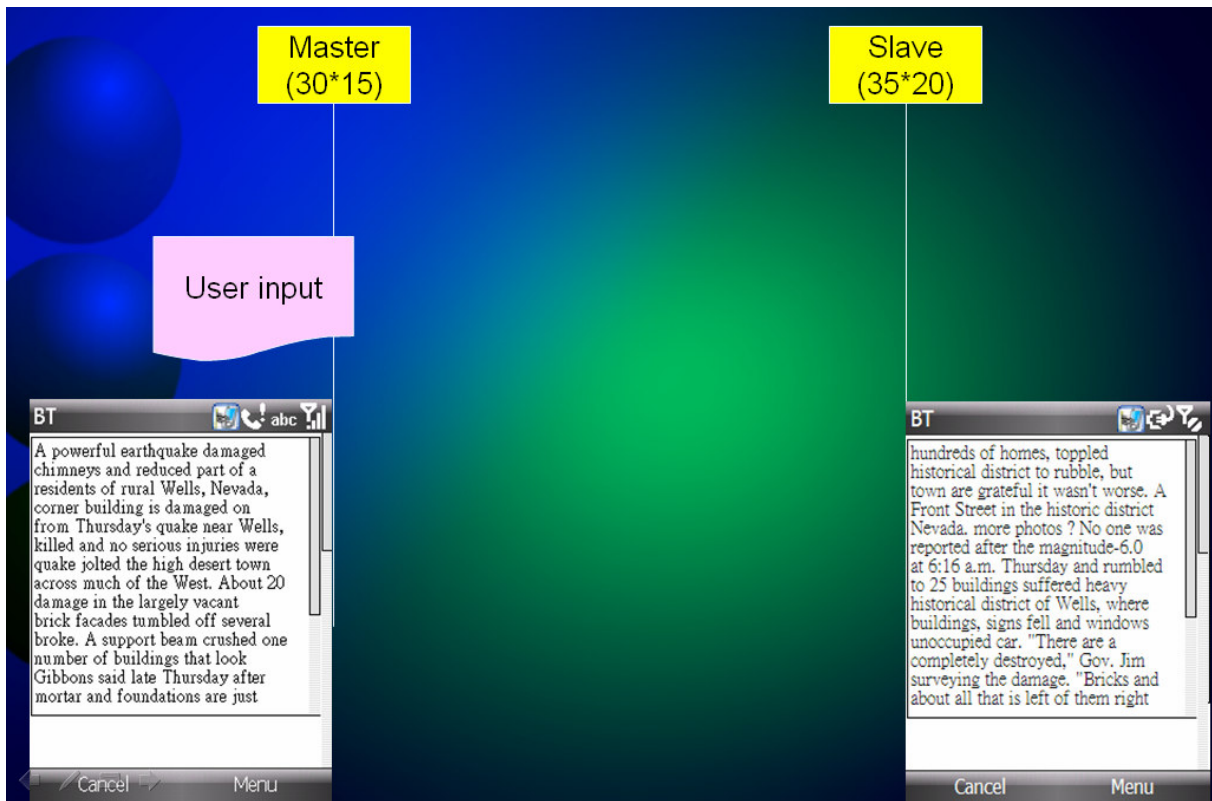


Figure 2.27 User view and input with device

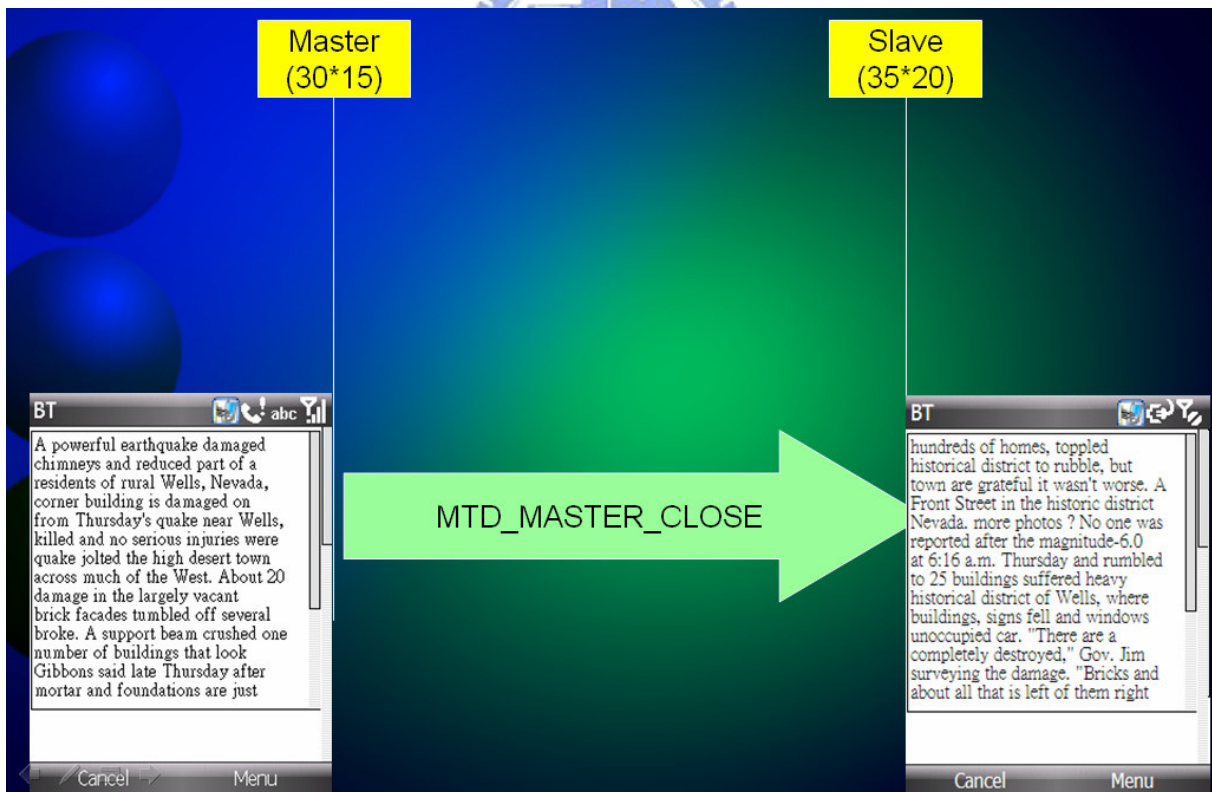


Figure 2.28 Master send CLOSURE message to slave

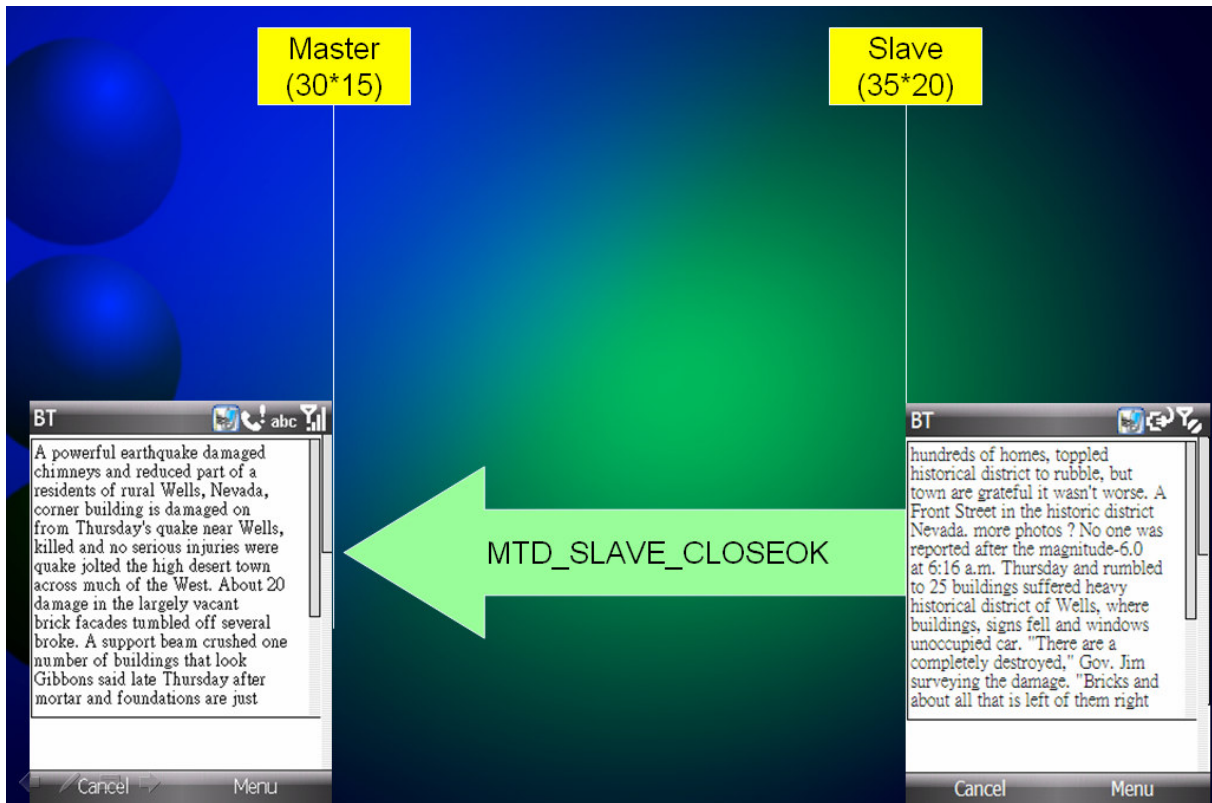


Figure 2.29 Slave response with CLOSEOK message

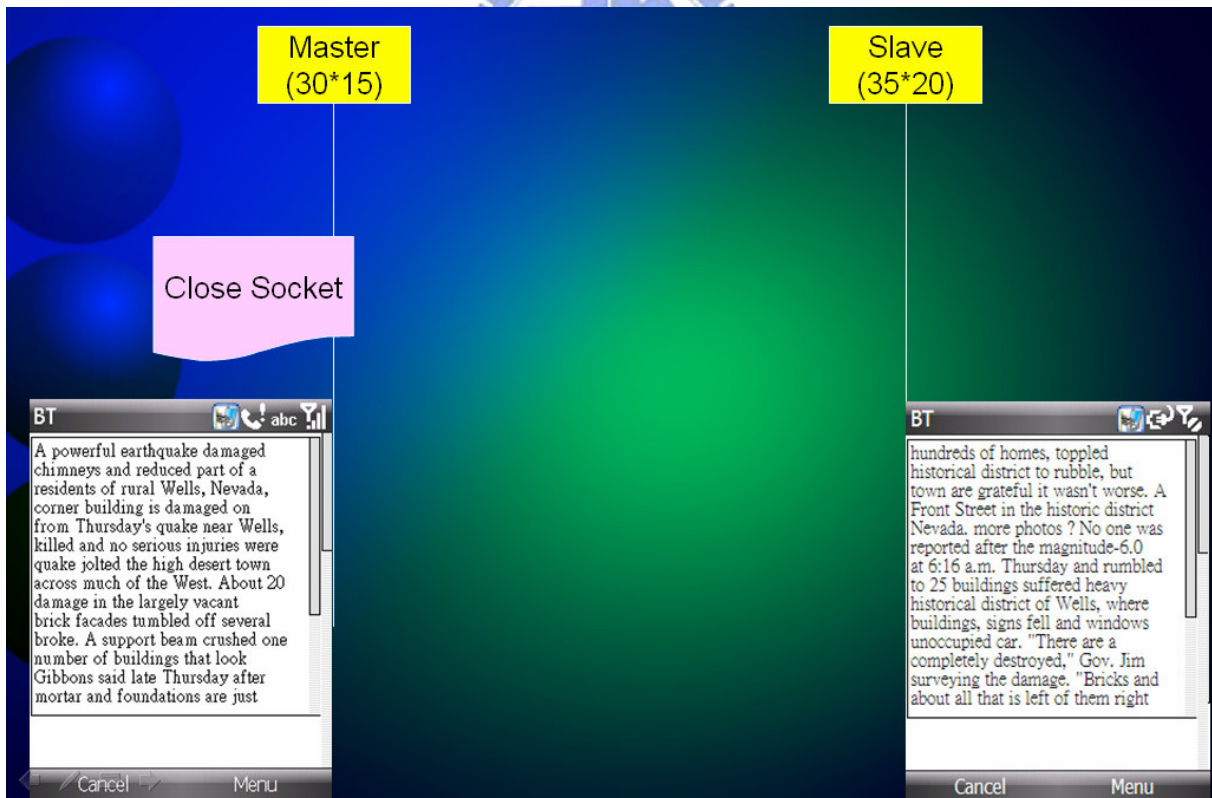


Figure 2.30 Master close socket and network

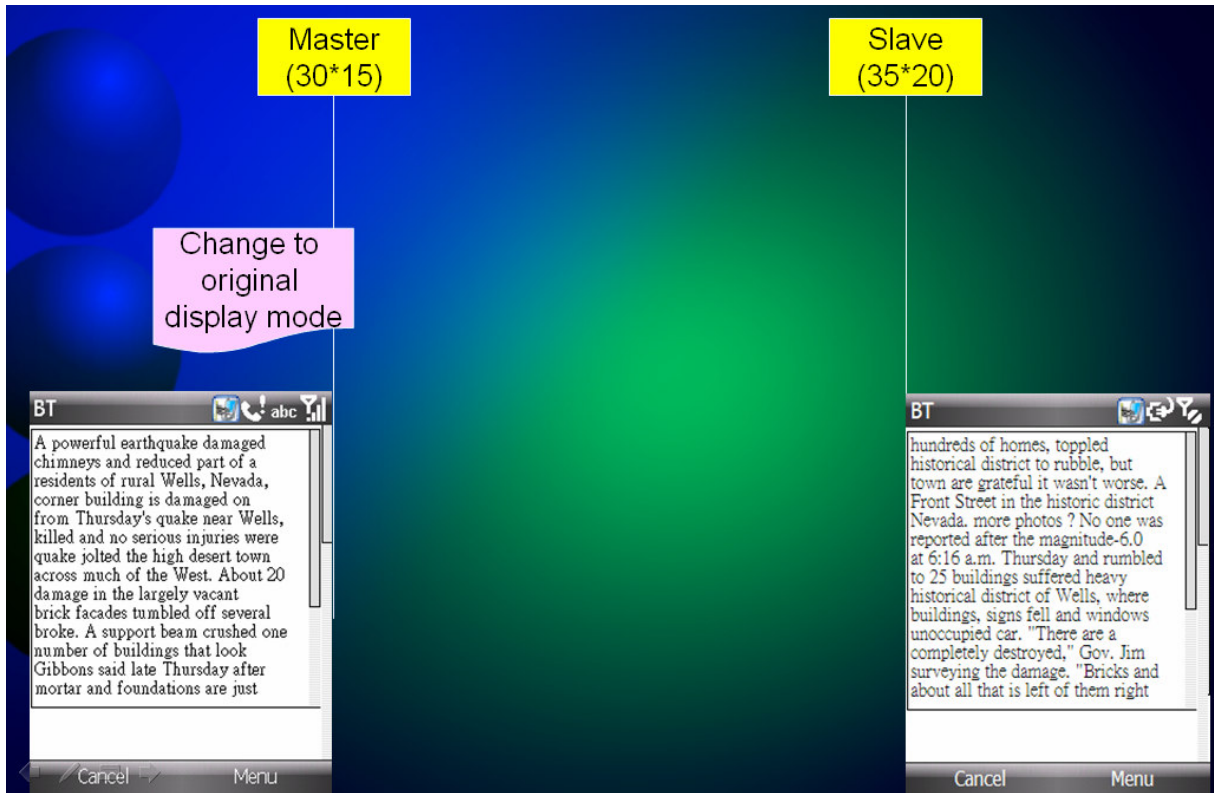


Figure 2.31 Master change to original display mode

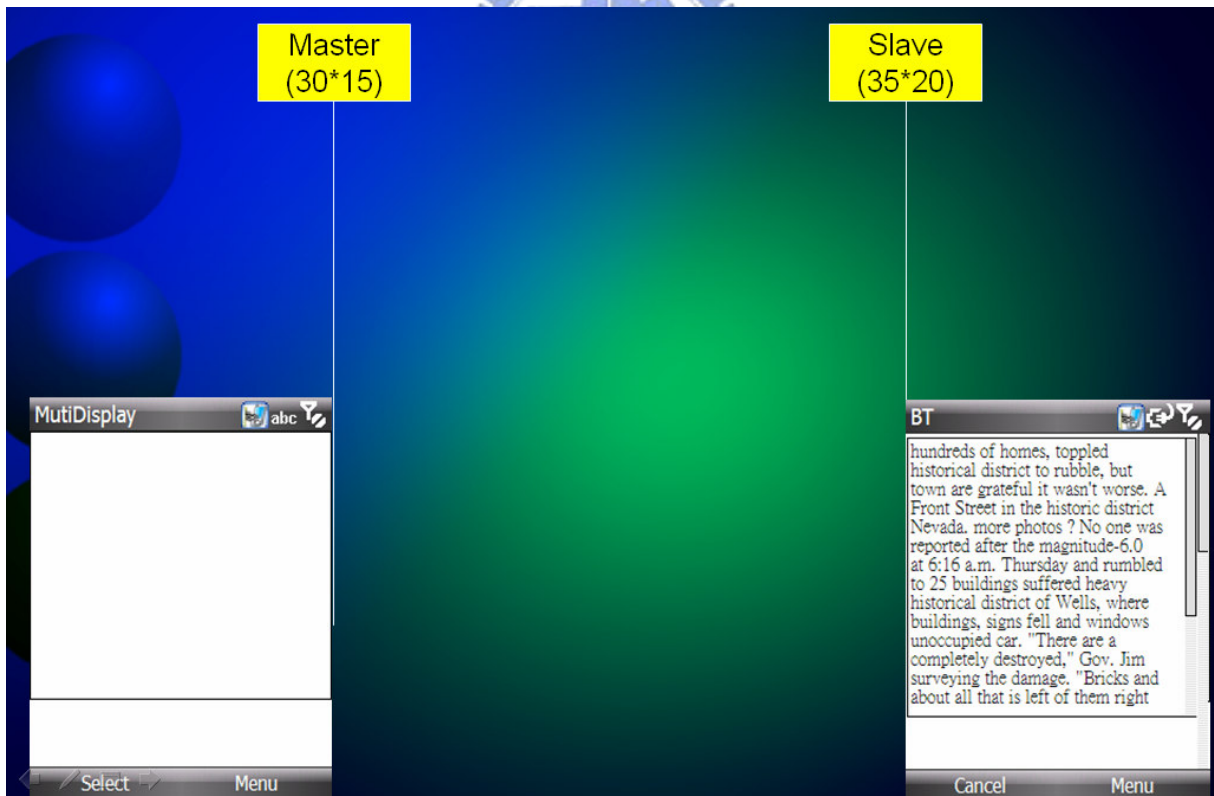


Figure 2.32 Master display in previous display mode

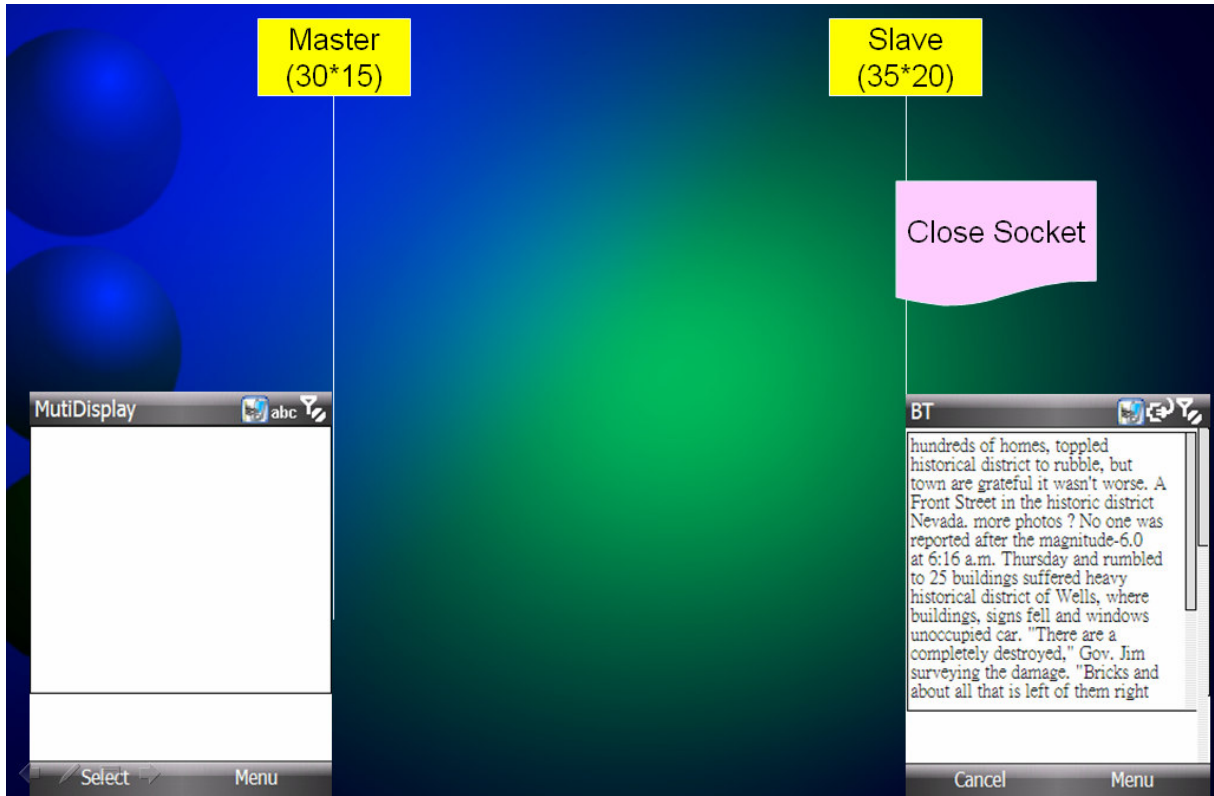


Figure 2.33 Slave close socket and network

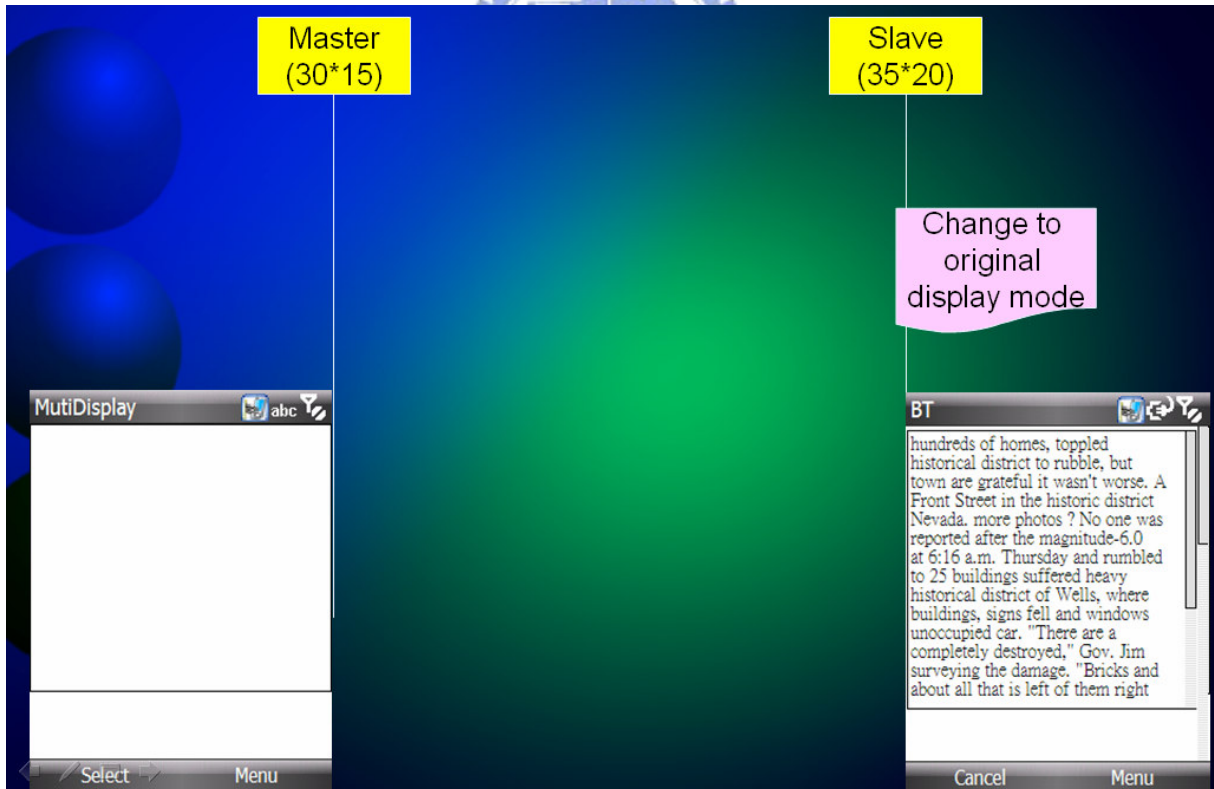


Figure 2.34 Slave change to original display mode

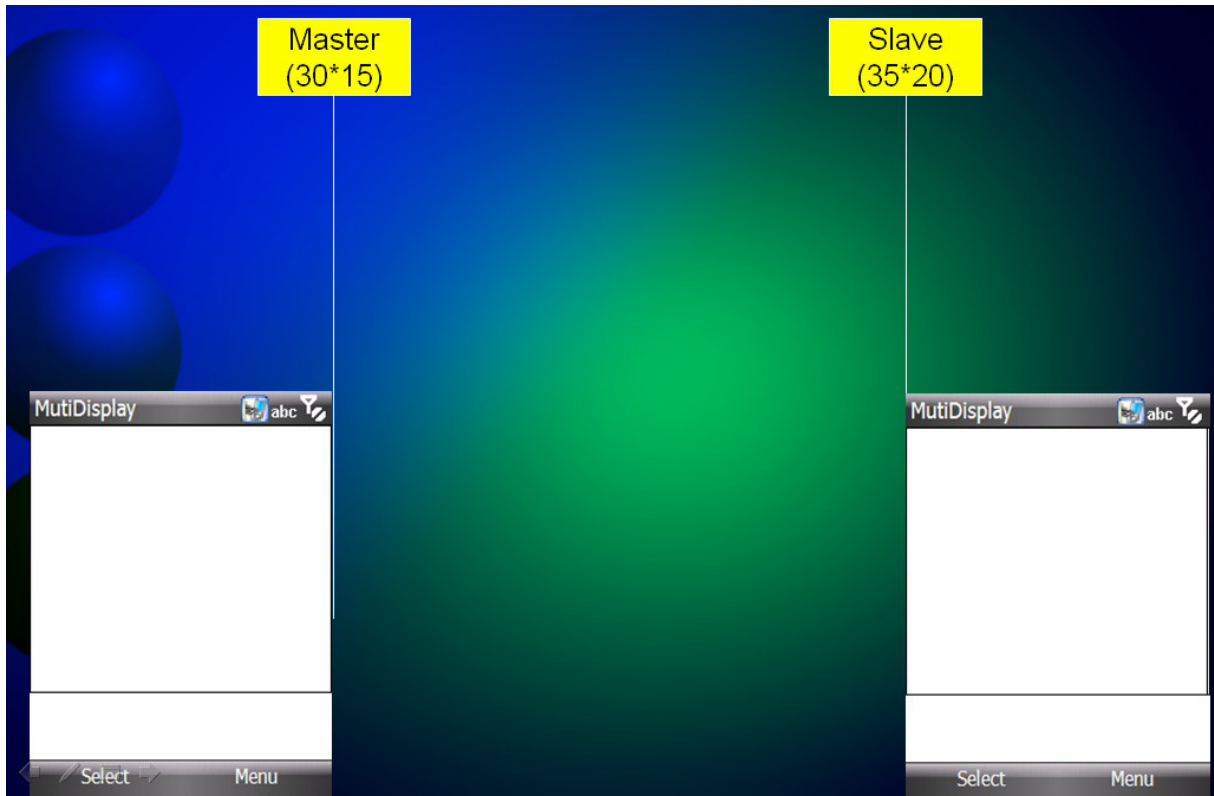


Figure 2.35 Slave display in previous display mode



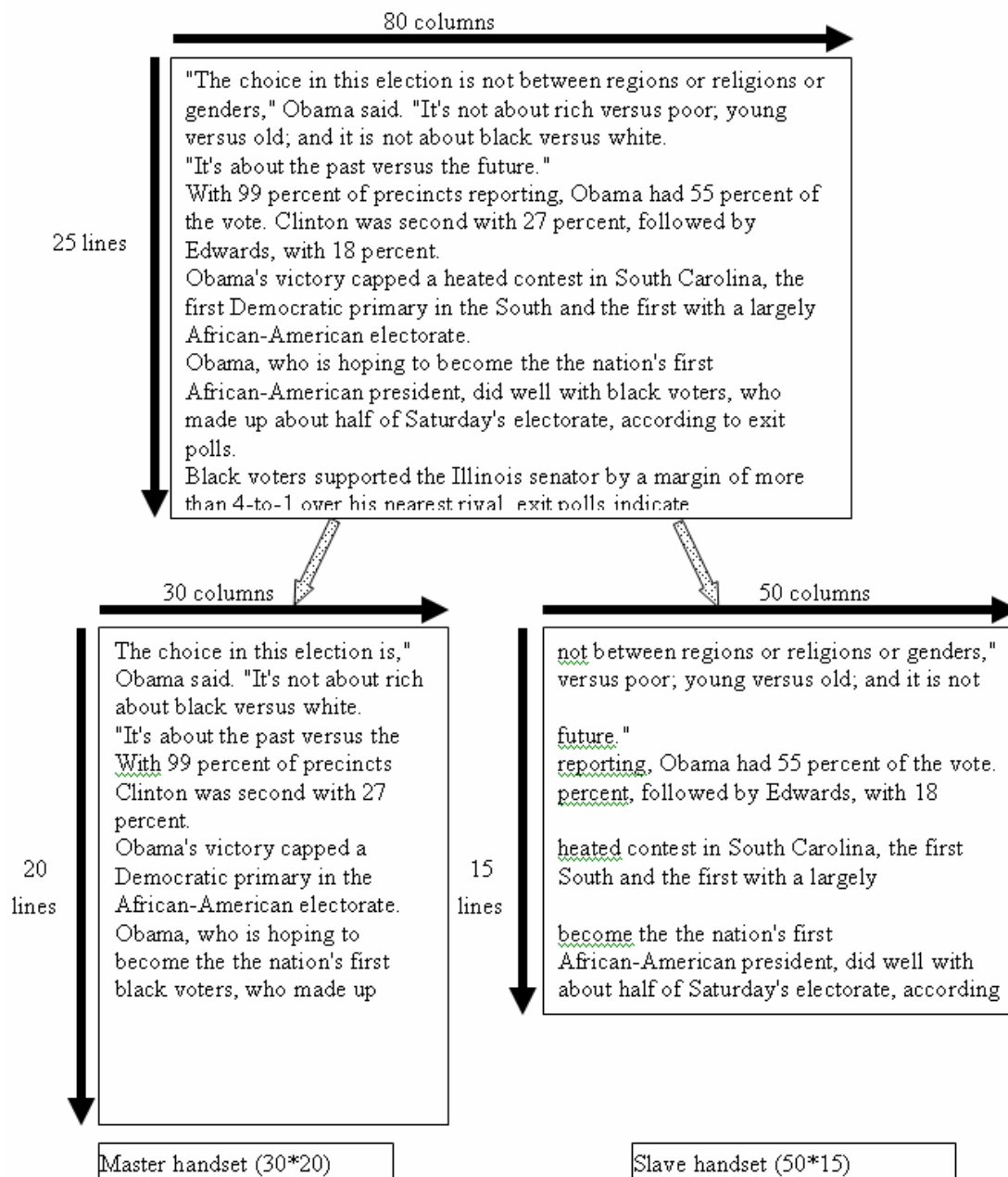


Figure 2.36 Another example of display text on multiple display devices

Chaper 3 Development Environment

In this chapter, our proposed protocol is implemented on real mobile phone and simulator. We choose VC2005 and Windows Mobile 6 SDK to develop the application on the WM6 handset. With WM6 simulator and two real WM6 mobile phones, we implement our method on the real target device and verify the mechanism.

3.1 Software Architecture

The view of the software architecture, program first gather the display information, the information contains the local display size, and will negotiate in the later handshake. After gather information, program setup the wireless connection, it base on the windows socket API, the physical layer may be WIFI or Bluetooth, even the IR transmitter. To setup up network, also need to invoke BSD like socket API, such as `listen()`, `bind()`, `accept()`, `send()` and `recv()`. To catch command in a independent process, create a persistent thread, in the thread will send/receive command data, according to input command, master and slave handset will response to various action, like scroll page of text display, refresh screen. In the final step, when user requests to exit the protocol, send close command. When the thread receives close command, just finalize network functionality, and graceful exit the protocol.

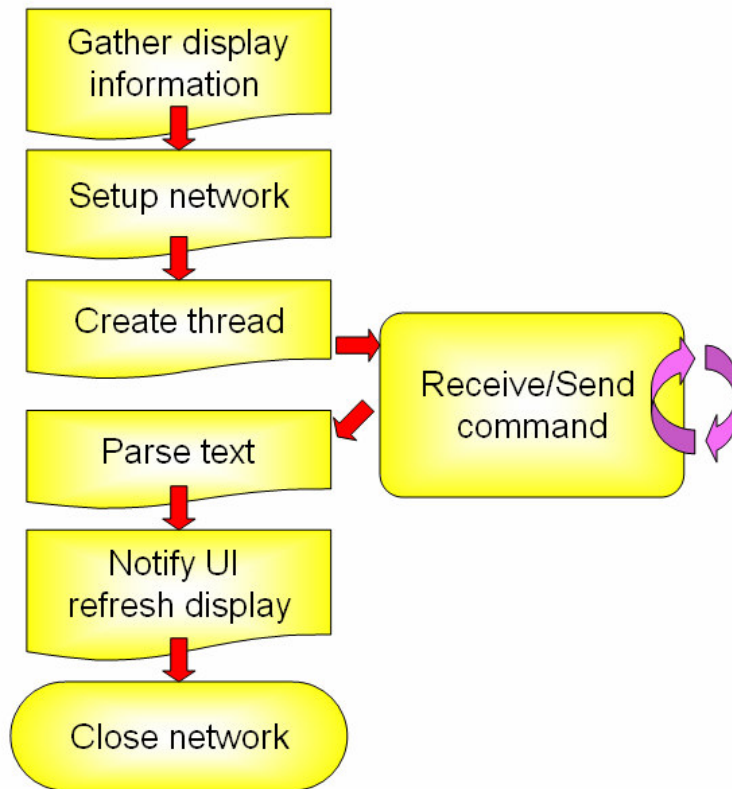


Figure 3.1 Software architecture of the implementation

3.2 User Interface

To acquire user operation, program design a simple user interface, for the use to setup network connection, Bluetooth configuration, and a working area to output debug message, and the main window to display text on master and slave device.

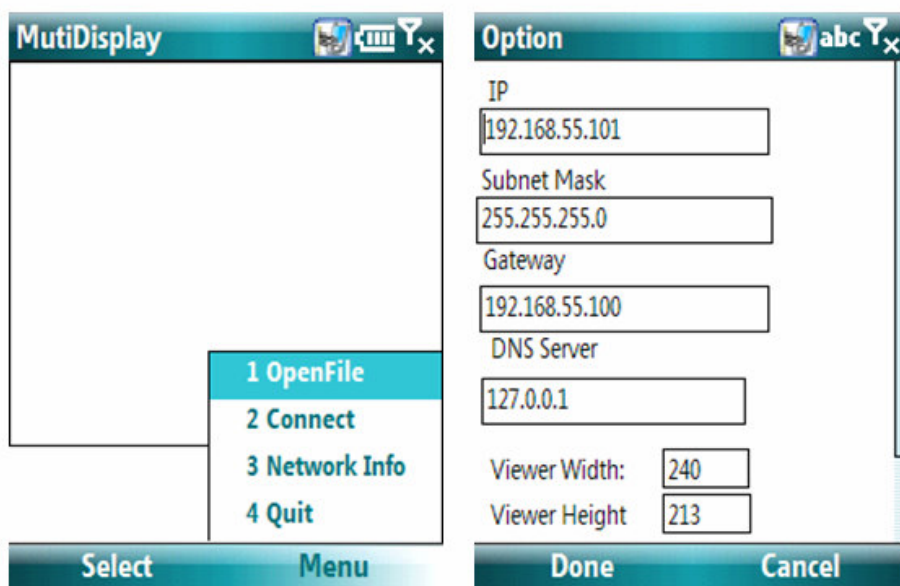


Figure 3.2 AP Main UI and get network information on WM6 QVGA handset

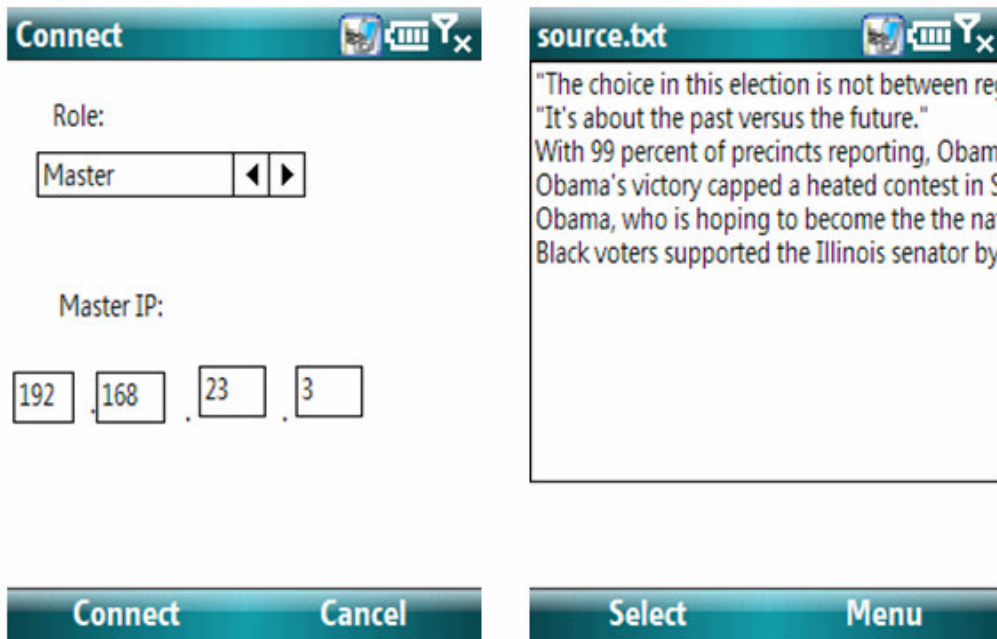


Figure 3.3 Connection setting and load document on WM6 QVGA handset

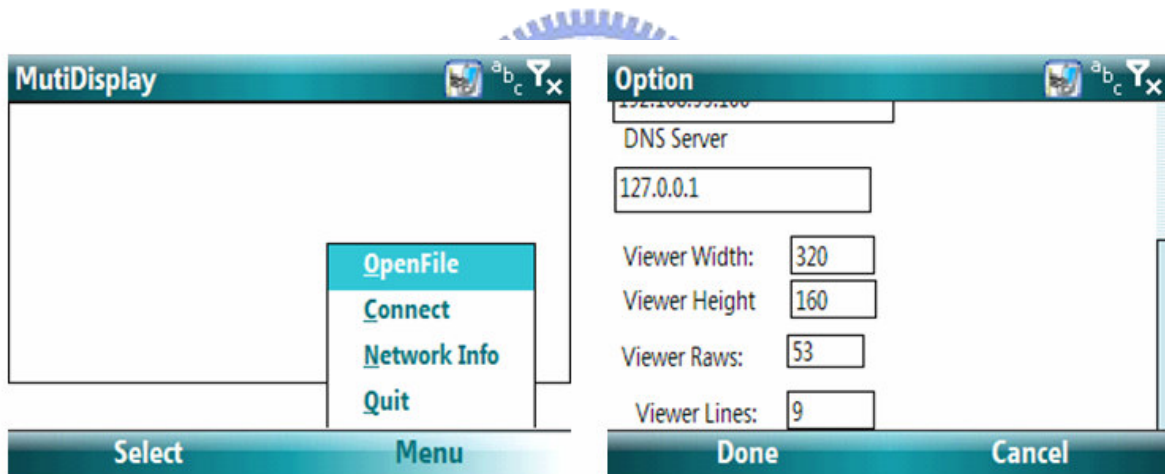


Figure 3.4 AP Main UI and get network information on WM6 Landscape QVGA handset

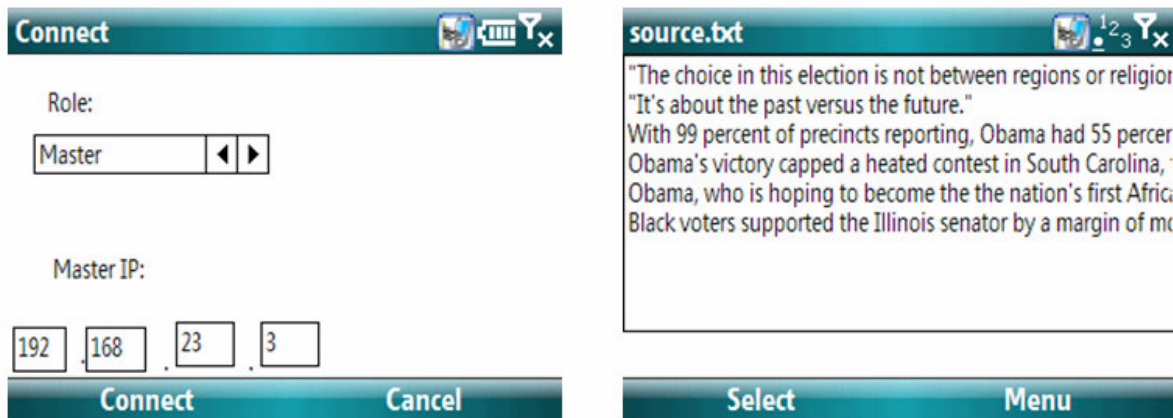


Figure 3.5 Connection setting and load document on WM6 Landscape QVGA handset

3.3 Enhancements and Applications

In our protocol and the implementation, just process the simplest content about pure text data. But lot of multimedia contents, such as graphic data (BMP, JPEG, GIF), vector file (Flash) or movie clips (AVI, MPEG, 3GP) files. With applying our proposed protocol, we can communicate two handsets, negotiate display capability, and with a suitable engine to decode such multimedia contents, we can split the presentation on two or more heterogeneous mobile devices. And develop more fantasy applications, for example, a group mobile phones grouped as a huge TV wall, displaying a interesting movie synchronously, or design a funny mobile KTV service, using two handsets, one act as the master device, the other act as the slave device. They both playback the same music, but just display the different lyric on each device, and the users can held such device to sing a romantic love song with together.

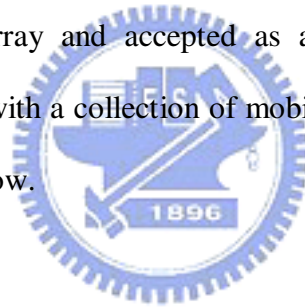


Figure 3.6 Multiple display application – mobile KTV service

Chaper 4 Conclusion

In this thesis, we propose a novel method of displaying content on multiple devices, with the protocol we calculate two different handset display capabilities, and calculate the text content properties to figure out a best display dispatching on mobile phones, setup the connection between heterogeneous devices, display contents and operate with view/page-up/page-down, the content display action simultaneously on different devices. I also implement the server/client application on device to verify our mechanism work well on the real products.

In this thesis, we only consider loading single text content and display that on two heterogeneous mobile phones, we just prove the concept can be implemented on nowadays mobile phones with limited wireless connection capability, the protocol and mechanism can be extend to multiple device array and accepted as a transport module, to view more complicated multimedia content with a collection of mobile phones, event the hot application such as on-line game or movie show.



Reference

- [1] Wai Yip Lum, and Francis C.M. Lau, “User-Centric Adaptation of Structured Web Documents for Small Devices, ” Advanced Information Networking and Applications 19th International Conference, pp. 507- 512, 2005.
- [2] Vatsa, R. and Kumar, V, “Role of media transformation in multimedia messaging, ” Personal Wireless Communications, pp. 258-262, 2005.
- [3] Hongjiang Zhang, and Wei-Ying Ma, “Adaptive content delivery on mobile Internet across multiple form factors, ” Multimedia Modelling Conference, pp. 5-7, 2004.
- [4] Won-Ho Choi, Dong-Gi Im ,and Min-Soo Jung, “An advanced Java mobile browser using a box model to display the contents, ” Virtual Environments, Human-Computer Interfaces and Measurement Systems, pp. 31-35, 2004.
- [5] US Patent, US 7242369 B2: Method of displaying text on multiple display devices, 2007.
- [6] MSDN online help web page: <http://msdn2.microsoft.com/en-us/default.aspx>

