The NEC e606 Third Generation Mobile Communication Handset

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***Abstract* - This paper looks at the operation and design of the NEC e606 Third Generation (3G) mobile phone handset from a user perspective. To the user the operation and ease of navigation through the many features of the handset are important when purchasing a new, more complex mobile phone. In this paper the e606 is also used to represent other 3G phones currently on the market as they are expected to have similar features. Two e606 handsets were used to test the quality of the images, video recordings and the video call feature; a primary characteristic of all 3G handsets.**

Keywords- NEC, e606, 3G, handset, image, video, quality

I. Introduction

The NEC e606 is the world's first dual mode 2G/3G device [1] enabling the handset to operate with 2G features when outside the 3G network scope. With an upload speed of 64kbps and maximum download of 384kbps [1] depending on network environment capabilities, it is a powerful little device also capable of acting as a modem via a USB connection or using Bluetooth(TM) technology [2]. To enable the handset to send and receive video calls the e606 uses Wideband Code Division Multiple Access (W-CDMA) adopted in Australia as a standard for 3G.

II. Physical Analysis

A. External handset inspection and feel.

The e606 has a modern look and feel to it with its streamlined exterior. When fully opened, the handset is quite long and unstable to hold. The top half of the handset (the screen and cameras) feels heavy when handling, giving the impression the handset will tip over. When placing the handset on a level surface, it must be adjusted for stability. Closed, the handset is quite bulky (109mm long, 53mm wide, 32mm thick) and feels heavier than newer 2.5G models at 145g.

III. Features and design

A. The e606 can support graphics for a variety of uses.

From a user perspective the e606 handset has an impressive 65,536, 16 bit colour screen 35*43mm in size at 132*162 pixels. This is a sure drawcard for any customer purchasing a mobile phone, as the colour gives the phone a more friendly and modern look. In today's fashion conscious society this could make the 3G handsets a popular choice. Another feature of the e606 is its ability to access news, sport, weather and other information when on the move. It supports proprietary HTTP v1.1, WML v1.2 and xHTML [2]. From a serious user's point-of-view this may be a useful feature as the handsets are smaller than a laptop and may be used to read important or urgent emails away from the office. This feature is, however, limited by the size of the screen and cost of using the service.

The most anticipated feature of 3G phones is their ability to send and receive video, images and sound in a variety of formats. They can also record video and sound to be stored on the e606 handset or downloaded to a PC. Video recordings and calls as well as image files can be set to record/operate at three different quality levels; low, medium and high. The e606 can support a number of image formats including JPG, GIF, BMP and video formats including MPEG4 at size 176*144 [3]. The e606 has a dual-camera option we found quite useful and easy to set. The handset user can choose to record an image of themselves or away from themselves without turning the handset as illustrated in Figure1. Unfortunately when recording a video file the maximum recording time is 12 seconds [4].

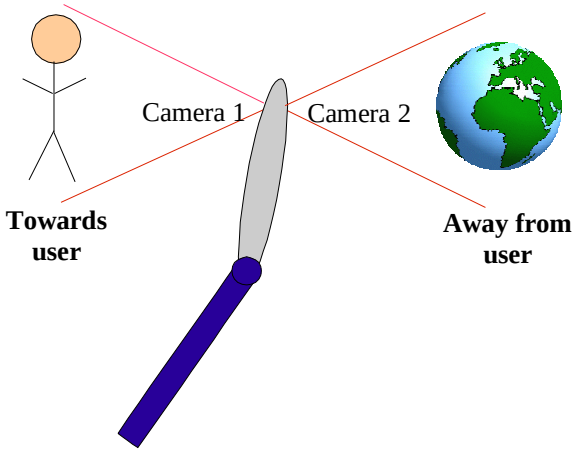

Figure 1 The e606 Handset Has Two Cameras

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The e606 has the ability to support Java(TM) Version MIDP (Mobile Information Device Profile) 1.0.3 [2] applications for gaming purposes. According to "3" [6] for all 3G handsets a license must be obtained for each game, expiring after a certain amount of time or after a certain number of plays. A non-licensed game requires the user to pay a fee each time they play the game. Unfortunately there are no game samples in the handset when first purchased and they must be downloaded. It would be beneficial if there were a minimum number of games pre-installed on the phone so that users could play 'out of the box'.

B. Other noteable features of the e606.

The e606 contains features of typical 2G phones plus extras; such as searching through the contact list by memory number, phone number, address etc. It also has some features that are largely cosmetic. For example, when the handset is ringing, the external LED can be made to flash in different patterns and three different colours (blue, red or purple). The keypad light always remains blue but follows the same flashing pattern chosen.

An excellent feature of the e606 is its memory capabilities. It has a 32MB memory to store contact details with a maximum list of 500 [3]. It also has the ability to hold 7 audio play lists each containing up to 20 60 second files with a maximum capacity of 100 files total. It could also hold 7 video playlists containing 20 files each with a maximum capacity of 100. These figures depend on the size of the files stored in the handset. As with all computer technology we may expect the memory capacity of later versions of the e606 to be larger (for example, the NEC e808 has 64MB of memory).

IV. Handset operation

A. The ease of scrolling through the menu and submenus of the e606 and changing settings.

It is obvious from scrolling through the handset menus that the e606, as other 3G phones, are built on current 2.5G operations. The basic layout of the e606 appears to be of similar design to a 2.5G mobile phone, though the extra features make navigation more complex. When testing its features we found the e606 to be somewhat confusing and changing a setting was sometimes quite tedious. The two user manuals provided with the e606 were very helpful and step-by-step, although some problems required both manuals to be cross-referenced simultaneously.

We also tried changing certain phone settings without consulting the user manual(s) to test the ability of the user to do so without any documentation. This proved to be quite difficult in some cases (for example changing the polyphonic ringtone) and required a significant amount of trial and error.

After some time spent 'playing' with the handset it became easier to navigate through the phone out of habit. This was partly due to the fact that the handset appears to be built on 2.5G navigation design. A negative feature encountered is the slow response time of the handset to user key touch.

V. File transfer and image quality

A. Comparing the image and video quality before and after transfer to and from a PC.

The quality of the images taken with the e606 were quite high on the handset itself. The images were sharp and clear if taken while stationary, although we observed that the refresh rate of the camera was slow. Moving the e606 handset while taking a video recording would create a blurry picture. Recording while holding the e606 in one position resulted in video of substantial quality but slightly broken flow.

The next step was to transfer the images and video recordings to a PC. The e606 software was very user-friendly to install with the handset using a USB port to connect to the PC. There was some difficulty encountered with transferring the files to the PC and vice versa. When attempting to transfer files the software would timeout and the transfer cancel. Unfortunately the software did not inform the user of the exact problem, and although the manuals provided adequate information in terms of file transfer, they provided no clues as to what might be causing any problems encountered. The Software Manual document on the software CD was consulted and it was found that each e606 uses a different COM port to connect to the PC which must be specified during loading of the e606 software. To solve this we checked the hardware list on the PC to find the NEC 606 UBS OBEX COM port used.

Transferring the files from the handset to the PC was as simple as specifying the action to take, the destination of the file(s) and typing a password into both the e606 and the software. The transfer rate to and from the e606 took only a few seconds for a set of both images and videos.

When the image files transferred from the handset to the PC were observed on the PC they were more blurred and larger when compared to the same image on the handset. Reducing the image from the default resulted in a sharper picture. Comparing the low, medium and high quality images (as set before taking a photograph using the e606) there was a visible difference between the low quality and high quality image. Also, the lower the quality setting on the handset when the image was taken, the smaller the file size. On the handset itself the quality settings did not make much difference from a user perspective. An interesting observation was that the images were slightly blurred around the edges but sharper in the center. When transferring an image from the PC to the e606, the compression of the e606 produced an image of higher quality on the handset than on the PC screen.

As expected, the video recordings transferred to the PC were blurred when viewing action and there was no

audible sound due to the media player (QuickTime 6.3) used. When the QuickTime 3GPP supplement was downloaded and used, the sound was audible and clear. Although all recordings were blurry, the high quality recordings were visibly clearer during the times the handset was held stationary. QuickTime indicated the sample rate of all low, medium and high quality video sound as 8kHz using a mono channel and AMR Narrowband Compression. The resolution of all videos was 176*144 pixels. When comparing the quality of the video recordings on the handset and the same files on the PC, the handset recordings were significantly clearer and sharper. QuickTime also indicated that the video recordings were 11.29 seconds in length, not 12 seconds as claimed by other sources.

The next step was to investigate whether there is a connection between the video file size and the amount of movement and sound in front of the camera during recording. Three high movement video recordings were made and three still recordings in a very quiet environment were made. They were then compared in file size on the PC. It was found that the high movement files were almost four times larger compared to the still videos. This is due to the nature of video compression; the recording stores changes in the image over time, so when the camera moves (or objects in view of the camera move) more information needs to be stored in the video file. We decided to test if the presence or absence of loud noise in the e606 environment had any impact on the file size. We then took another recording with loud noises around the e606 and found that the file produced was in fact the same size or very close to the recording taken under 'quiet' conditions (for all three quality settings). Three more recordings were taken in a room with intense fluorescent lighting and an audible air conditioning unit. For all three quality settings, the size of the files increased by 7-17kb.

Samples of images and video taken with the e606 can be found at http://caia.swin.edu.au/reports/030703A/images.html

VI. Handset communication

A. *Observing the quality of video calls from one e606 to another.*

During a video call, several different settings were used to compare the quality of the video perceived by the user. The e606 was originally set on low quality then medium and high with the user only watching the user on the other handset then with their picture also shown. The low quality video appeared to have a better refresh rate but the image itself would break up if the sender moved their phone. The difference between the low and medium, or the medium and high quality images was not as apparent as the difference between the low and high quality video. The high quality video had what appeared to be a slower refresh rate. According to the e606 manual [3], the higher the video quality, the slower the video transfer. The quality difference between the user watching themselves than that of the video received was much higher. There was also no visible change in the quality of the video received if the user were to watch themselves while video calling. Changing other variables such as muting the handset, turning the user camera off while watching the caller or vice versa, had no apparent effect on video quality.

VII. Features not tested

The e606 has many features and possible settings that were not documented in this paper. Some of these included features not specific to the handset's '3G' functionality such as profiles, ringtunes, SMS and voice talk as they are all available on 2.5G models. Other features not tested in the analysis are the handset functioning as a modem using Bluetooth(TM) or a USB connection, information services, Java(TM) games, voice calls (including those to and from 2G/2.5G handsets), video calling a user at a PC talking on a webcam and moving in and out of the 3G network while testing the handsets.

VIII. Conclusion

This paper concentrated on the NEC e606 3G mobile handset from the point of view of a technically inclined consumer (the author is currently a 3rd year Engineering student). While testing features of the handset we concluded that due to the many features, 3G handsets in general may be overwhelming to use at first. They also have many features that do not have a practical purpose such as changing the theme colour of the screen. This leads us to believe that 3G handsets are more of an expensive toy rather than a necessity and their design is based on attracting users with their many 'cool' features. This however is understandable, since the technology must break users away from the already established and popular 2G/2.5G markets.

The most anticipated feature of 3G handsets is their ability to send and receive video calls. The video calls made in this analysis and the recordings/images studied showed them to be of reasonably high quality but for the fact that the video and recordings are subject to breaking up and blurriness.

It was interesting to note that the quality of the still video recordings appeared to have no apparent connection with the size of the files. If noise is not the factor that increases the size of the file then what could be causing this slight difference in file size? Also, why is it that a still recording file in the same room would be the same size (or very close to) when recorded in a silent environment compared to a noisy environment? These questions should lead to further study into the compression techniques used within the e606 under intensely controlled environments and its performance in various settings. To an average user these small variations in file size and quality may not be an issue.

Since 3G is relatively new in Australia it would be interesting to see how the market reacts to this new technology in coming months and the feedback it receives from customers using the service.

IX. References

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