CHAPTER 3

STUDY OF CELL PHONE MODELS FOR CONTROL ADAPTATION

3.1 Introduction:

There has been tremendous development in cell phone technology and cell phones have now been transformed from simple communication tool to powerful personal assistant with multimedia, GPRS and EDGE (Internet-access) capabilities (smart phones). All cell phones generally contain hardware or software modem for data communication through cellular networks. Many cell phones also have additional communication facilities like Bluetooth, Wi-Fi, Infra-red interfaces etc. Cell phones also have optional data link cable for interface to PC for Flash Programming, downloading of music tones, phone book / SIM memory entries back-up, etc. Most mobile phone manufacturers like Nokia, Siemens, Ericsson, and LG etc. also provide associated communication software (mostly in form of free downloads from Internet) to perform some of these tasks. For e.g., Nokia provides software “PC Suite” for accessing data for its range of mobile phone to PC (URL: http://www.nokia.com/pcsuite). This software was used to check whether data link between mobile and PC was working correctly or not. The popular technique for remote control using cell phone is to use short messaging service (SMS). In this approach, text message up to 160 characters can be transmitted or received by the user from the microcontroller system based on sensors conditions and desired output through serial communication using cell phone.

The various Nokia cell phone models which were studied for remote control applications are discussed (URL: http://www.forum.nokia.com/device).

3.1.1 Nokia Model 3310/ 3315:

In pre-Ph D research phase (year 2004-06), some simple popular Nokia models like 3310 & 3315 having simple call and messaging properties were studied. These models do not have any camera and display resolution range is 84 x 48 (monochrome) and 95 x 65 (monochrome) respectively with no GPRS, MMS and extra memory slots support. It was observed that these cell phones had software based modem and did not support AT commands. These models have F-Bus and M-bus connections that can be used to connect phone to a PC or microcontroller.
There are 4 gold pads under battery holder for the connection. M-Bus means multiplexed bus i.e. same pin is used for both transmitting and receiving data from phone. It is slow and only half duplex. Only two pins on the phone are used for this protocol – one data and one ground. M-Bus works at 9600 bps, 8 data bits, odd parity and one stop bit. For setting M-Bus operation, the data terminal pin (DTR) and request to send pin (RTS) pins must be cleared. F-Bus i.e. Fast Bus is the later high-speed full duplex bus. It uses one pin for transmitting data and one pin for receiving data plus the ground pin. It is fast and works at 115.2 kbps, 8 data-bits, no parity and one stop bit. For setting the F-Bus operation, DTR pin should be set and RTS pin should be cleared. A system was developed using PC and devices were controlled through parallel printer port and 3315 cell phone was connected to serial port through DAU-9P data cable using F-Bus Protocols.

**3.1.2 Nokia Model 3120**

This model was launched in 2004 and has screen resolution of 128 x 128 with 12-bit color depth. This cell phone model is one of early phones enabling Java ME support (MIDP 1.0) and belonged to Series 40 1st Edition Nokia OS platform. This model does not have any camera or memory slot but supports GPRS connection at 36 kbps.
This model also did not support AT commands. This model has 14-pin pop-port connector at bottom and DKU-5 cable was used to connect the model to USB port of PC. USB-to-serial Bridge software driver is used to emulate COM port and experimental work was carried out using F-BUS protocols for remote device control operation.

3.1.3 Nokia Model 6610

This cell phone model was quite popular during 2004-2008 in India. The model has screen resolution of 128 x 128 with 12-bit color depth. This cell phone model is one of early phones enabling Java ME support (MIDP 1.0) and belonged to Series 40 1st Edition Nokia OS platform. This model does not have any camera or memory slot but supports GPRS connection.
Nokia 6610 model supports most of AT commands related to messaging. This model has USB and infra red connectivity. DKU-5 cable with USB-to-serial converter is available for direct communication with microcontroller system. Therefore this model can be easily adopted as control system mobile for remote control applications. Majority of the experimentation work was carried out on this model.

3.1.4 Nokia Model 6681

This cell phone is an early Smartphone based on Symbian operating system. It was launched in 2005. The model has screen resolution of 176 x 208 with 18-bit color depth and 1.3 Megapixel camera. It belongs to S60 2nd Edition Feature Pack 2 category with enhanced features like Java ME MIDP 2.0 support, Bluetooth interface, MMC card, GPRS, EDGE support, etc.

![Nokia Model 6681](image.jpg)

This model does not provide full AT command support with exclusion of incoming message support command (AT + CNMI). The data link cable CA-42 is USB based, so direct connection to simple embedded system is not possible. However, due to virtual serial COM port emulation, PC based control system can be easily implemented.

3.1.5 Nokia Model 3500 classic

This Java enabled phone was announced in July 2007 and belongs to Series 40 3rd edition Nokia OS platform. The model has screen resolution of 128 x 160 with 18-bit color depth and 2.0 Megapixels camera. It has many features like Bluetooth interface 2.0+ EDR with various profiles support, SD micro card interface, etc.
However, this device does not support all AT commands related to messaging. Moreover, it is not possible to directly interface this cell phone to simple embedded system due to non-availability of RS232 serial connection. Instead it has mini USB interface which provides two separate serial ports for data and command interface in PC through drivers. The experimental work was carried out using this model through Bluetooth interface in SPP profile for remote monitoring.

3.1.6 Nokia Model 2700 classic

This cell phone is recent java enabled phone (January 2009) belonging to Series 40 5th edition Nokia OS platform. The model has screen resolution of 240 x 320 with 18-bit color depth and 2.0 Megapixels camera. It has many features like Bluetooth interface 2.0+ EDR with various profiles support, SD micro card interface, etc.
However, this device does not support all AT commands related to messaging. Moreover, it is not possible to directly interface this cell phone to simple embedded system due to non-availability of RS232 serial connection. Instead it has mini USB interface which provides two separate serial ports for data and command interface in PC through drivers. The experimental work was carried out using this model through Bluetooth interface in SPP profile for remote control and home automation applications.

3.2 Adaptation Methods for usage of cell phone for remote control:

It is observed that earlier Nokia cell phones belonging to 3310 generation and 3120 did not support AT commands and require F-bus based protocols for message transfer. Models 6610 and its derivatives can be easily adapted for remote control due to their AT command support for messaging and RS 232C communication support using converter. Later generation cell phones like 6681, 3500 and 2700 are provided with plenty of attractive features but their control adaption for embedded based remote control was rendered difficult due to lack of full AT commands support and absence of RS232C connectivity. Some tricks like downloading of Java application programs (MIDlets), Bluetooth based connections, automated control of control keys of cell phone were used to leverage these models for remote control. Nokia models were chosen for experimentation because of their highest market share. However, cell phone models of other manufacturers can also be molded in similar fashion for remote control. The unique advantages associated with this approach over GSM modem module are the relatively low cost of using discarded cell phone model, efficient
recycling or increasing life cycle of the product and low cost of replacement in case of problem. A casual market survey recently undertaken showed that all latest available cell phones are Java enabled with Bluetooth technology support. Therefore, leveraging these phones for remote control is easily feasible and there exists scope for more powerful communication strategies like GPRS based Internet monitoring, Wi-Fi interface between embedded system and cell phone, etc. Our major focus is on providing low cost solutions and so these newer generation cell phones were not considered for experimental work.