

GUI Development using EmWin Library Simulator for Two-Way Radio Embedded System

Harshitha U S¹, Ravikumar M N²

^{1,2}VTU University, Malnad College of Engineering, Salagame Road, 573202, Hassan

Abstract: Graphical User Interface is a visual way of interacting with the computer using the components like windows, icons, labels, radio buttons and text-boxes. GUI is a program interface that takes the advantage of the computer graphics capabilities to make the program easier to use. Now a day's graphical user interface is very much necessary in all devices like smart phone, smart watches and video games. Widgets are windows with object-type properties. They can react automatically to certain events. For example a button can appear in a different state if it is pressed. Widgets have properties which may be changed at any time during their existence. The paper is to develop a code to improve the Graphical User Interface using EmWin library for two way radio communication. The display of the two way radios is made up of thin film transistor liquid crystal display.

Keywords: EmWin Simulator, Microsoft visual studio 2010, Keil Micro vision

1. Introduction

A graphical user interface (GUI) is a human computer interface that uses windows, icons and menus and which can be manipulated by a mouse [1]. A Widget refers to a mini internet application that can be embedded into the website or blog. Creating a widget can be done in a simple way it is just a one line of code. There are two ways of creating a widget. One is direct creation and another is indirect creation. In direct creation function exist for each widget. In indirect creation it uses a dialog box creation and a structure which contains a pointer.

2. Block Diagram

The block diagram consists of Microcontroller, TFT LCD Controller, Keypad Matrix, Regulator, Battery, Amplifier, Speaker, MIC, RF Module and Antenna. Microcontroller is the main part of the device the code is dumped into the microcontroller. Here we use STM32F3103 Microcontroller.

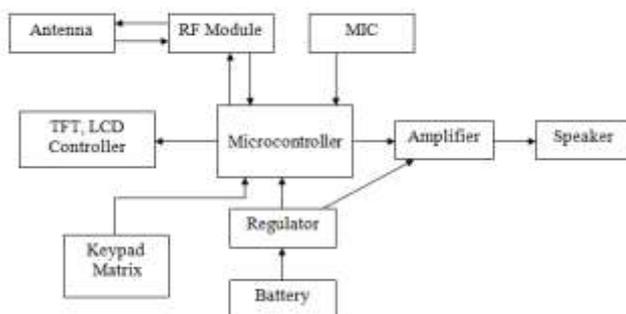


Figure 1: Block diagram of two way radio

2.1 Microcontroller (STM32F103)

Microcontroller contains the circuitry of Microprocessor and in addition it has built in RAM, ROM, timers, counters and I/O (Input/output) peripherals. Some of the features of STM32F103 Microcontroller are:

- ARM 32-bit Cortex M3 CPU Core

- 72 MHz maximum frequency.
- 64 or 128 Kbytes of Flash memory
- 20 Kbytes of SRAM
- 4-to-16 MHz crystal oscillator
- Low-power
- 2 x 12-bit, 1 μ s A/D converters (up to 16 channels)
- 7-channel DMA controller
- Peripherals supported: timers, ADC, SPIs, I2Cs and USARTs
- Serial wire debug (SWD) & JTAG interfaces
- 7 timers.

2.2 TFT LCD Controllers

The TFT LCD (Thin film transistor liquid crystal display) is a liquid crystal display that takes thin film transistor to improve the quality of image as contract and addressability [2]. The display consists of many dots that can be controlled individually. These dots are called pixels. Mainly there are two scales in display horizontal scale and vertical scale. X-axis is denoted as horizontal scale and Y-axis is denoted as vertical scale [3]. Combination of X and Y-value are called coordinates. By default the coordinates of the upper left corner of the display will be (0, 0). Always positive X-values will be to the right and positive Y-values to the down [3]. The below graph illustrates the coordinate system and directions of the X and Y- axis.

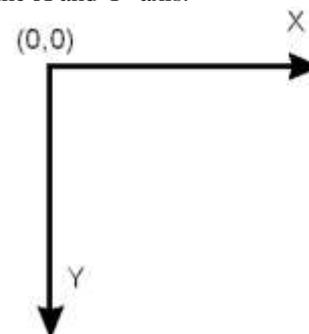


Figure 2: Screen and coordinates

The screen sizes of LCD display are

- xSizeLCD = 160
- ySizeLCD = 128
- xSizeWin = 160
- ySizeWin = 83
- xPosWin = 0
- yPosWin = 25

2.3 Regulator

A Regulator is an electronic device that provides a stable DC voltage independent of the load temperature, current and AC line voltage variations [8].

2.4 Amplifier

Amplifier is an electronic device that increases the power of a signal. An amplifier uses electric power supply to increase the amplitude of a signal [7].

2.5 RF Module and Antenna

RF module (Radio frequency module) is a electronic device used to transmit and receive radio signals between two device. In an embedded system it is used to communicate with another device wirelessly [10]. Antenna is the interface between radio waves propagating through space and electric current moving in metal conductors, used with a transmitter or receiver [9].

3. Graphical User Interface

The graphical user interface is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation instead of text-based user interfaces typed command labels or text navigation [8]. A control element in a graphical user interface is an element of interaction, such as a button or a scroll bar [11]. Controls are software components that a computer user interacts through direct manipulation to read or edit information about an application [11].

3.1 Widgets

Widgets are windows with object-type properties. They can react automatically to certain events. For example a button can appear in a different state if it is pressed. Widgets have properties which may be changed at any time during their existence. Widgets are of many types some of the examples for widgets are edit box, scroll bar, list view multiedit, list box, progress bar and multipage.



Figure 3: GUI Widgets

In 2 way radio display there will be 3 parts

- 1) Upper area
- 2) Mid area
- 3) Bottom area

1. Upper Area

Upper area consists of notification symbol like battery status, Message, Bluetooth notification icons

2. Mid Area

Mid area consists of channel number, zone number. If we press up key channel number select from 1 to 10. If we press right key zone number select from 1 to 4

3. Bottom area

Bottom area consists of menu and zones.

3.2 Creating call back function

The behavior of windows and widgets in EmWin is defined in their callback function. Callback function is very much necessary in EmWin if the functionality of a window needs to be enhanced or if the behavior of the widget has to be changed to meet the custom needs, it is recommended to change the internal callback function [3]. This is done in a few steps.

Step 1: Creating a custom callback function.

The first step is to implement a prototype function.
void Callback(WM_MESSAGE*pMsg); [3].

Step 2: Messages

The second step is to implement a reaction to certain message. The easy way to callback the custom callback function to make use of case / switch condition [3]. This makes it easily to add or remove one specific message code , without affecting another. The parameter pMsg contains the Id of the message (pMsg->MsgId) [3].

Step 3: Processing the default callback

The third step is to make sure all messages which are not handled by the custom callback function are handled by the internal default callback function [3]. This can be done by using case condition / case of the switch to call the internal callback function. Internal callback is different for each type

of window. The internal callback functions for widgets are named <WIDGET>_Callback(). All other types of windows use the function WM_DefaultProc() for message handling [3].

```
switch(pMsg-> MsgId)
{
case WM_CREATE:
-
-
break;
case WM_PAINT:
-
-
break;
case WM_SIZE:
-
-
break;
default:
<WIDGET>_Callback(pMsg);
}
```

Step 4: Setting the custom callback function.

At last we should set the newly created callback function to be used by a window or widget. This can be done with a simple call WM_SetCallback() [3].

3.3 Convert CSV file to byte array for Multilanguage

In this project we can use multiple languages like English, Chinese and Korean.

- Create Excel file.
- Enter the multi language string in excel file.
- Choose save as in the Excel Menu and save to ".csv".
- Open the Ultraedit and choose save as and select to 'utf8' format, Save file
- .utf8 file is created in MultiLang folder
- Run Bin2C.exe select and convert .utf8 to .c
- Open .c with ultraedit

4. Software Used

Software is one of the main things in every project. In each project there will be different type of software used based on their requirement. In this project we are mainly using 2 types of software. Firstly we will write code in Microsoft visual studio 2010 using EmWin library then we will dump that code to device by using Keil micro vision IDE

4.1 Microsoft Visual Studio 2010

Microsoft visual studio 2010 is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs as well as mobile apps, web services web apps and web sites [4]. Visual studio uses Microsoft software platforms such as Windows forms, Windows API, Windows Silverlight and Windows presentation foundation [4]. Some of the criteria used in Microsoft visual studio are as follows.

- Computer that has a 1.6GHz or faster processor.
- 1 GB (32 Bit) or 2 GB (64 Bit) RAM (Add 512 MB if running in a virtual machine)

- 3GB of available hard disk space.
- DirectX 9 capable video card running at 1024 x 768 or higher-resolution display.

4.2 EmWin Library

EmWin embedded graphics library is a high performance library developed by SEGGER Microcontroller. It is offered by NXP Semiconductor in library form for free commercial use with NXP microcontrollers [6]. The software offered by NXP includes the Window Manager module including the Memory Devices module for flicker- free animation, the antialiasing module for smooth display the GUI Builder, the VNC Server and the font converter [6]. Some of the criteria used in EmWin library are as follows.

- EmWin basic color package
- Widgets/ Window manager
- Memory device module
- Anti-aliasing module
- VNC server
- Bitmap converter
- Font converter
- Windows-based simulation environment

4.3 The Keil Micro Vision

Keil Micro Vision IDE the toolsets provide powerful, easy to learn environment and easy to use for developing embedded applications. They include some components to create, debug and assembler the C/C++ source files and incorporate simulation for microcontrollers and related peripherals. The RTX RTOS Kernel helps to implement complex and time-critical software [5]. Some of the criteria used in Keil Micro vision are as follows.

- 1 GHz 32-bit or 64-bit processor
- 1 GB of system memory (RAM)
- 2 GB of available disk space
- 32 and 64 bit operating system

5. Results

5.1 LISTBOX: List box widget

The function of widgets is to select one element of a list. A list box can be created as a child window which is attached to a parent window. If the list box item is selected the list item gets highlighted so there should be a input focus to the list box. The size of the list box can be change by changing the y position value.



Figure 4: Edit Widget

5.2 MULTIEDIT: Multi line text widgets

The main purpose of multi edit widget is to edit text with multiple lines. We can use as a display static text as well as simple text editor. In multi edit we attach a scroll bar by using scroll bar we can move the text up and down.



Figure 5: Multi Edit Widget

5.3 EDIT: Edit Widget

Edit widgets are used to edit a simple text or numbers. We can attach this edit box to a list box for example to store name, number of the contact. We can redraw the character, number by using paint function.



Figure 6: Edit Box Widget

5.4 CHECKBOX: Checkbox Widget

Check box is used to check whether the window is on or off, enable or disable high or low. It may be check or unchecked. The box will appear gray if it is disabled.



Figure 7: Check Box Widget

6. Conclusion

After doing this project we are able to know how to write embedded C code by using EmWin library and also how to create widgets like edit box, list box, progress bar, list view. We are able to work in Microsoft visual studio, Keil micro vision IDE and how to dump a code to an embedded device. At last we integrated a beautiful GUI working embedded device for two way radios with TFT Display.

References

- [1] https://en.wikipedia.org/wiki/Graphical_user_interface
- [2] https://en.wikipedia.org/wiki/Thin-film_transistor_liquid-crystal_display
- [3] https://www.segger.com/downloads/emwin/UM03001_emWin5.pdf
- [4] https://en.wikipedia.org/wiki/Microsoft_Visual_Studio
- [5] <https://www.keil.com/product/brochures/uv4.pdf>

- [6] <https://www.nxp.com/pages/emwin-graphics-library:EMWIN-GRAPHICS-LIBRARY>
- [7] <https://en.wikipedia.org/wiki/Amplifier>
- [8] https://en.wikipedia.org/wiki/Voltage_regulator
- [9] [https://en.wikipedia.org/wiki/Antenna_\(radio\)](https://en.wikipedia.org/wiki/Antenna_(radio))
- [10] https://en.wikipedia.org/wiki/RF_module
- [11] [https://en.wikipedia.org/wiki/Widget_\(GUI\)](https://en.wikipedia.org/wiki/Widget_(GUI))

Author Profile



Ms. Harshitha U S is a P.G Scholar in Digital Electronic and Communication System at Malnad College of Engineering, Hassan.



Mr. RaviKumar M N is an Associate Professor in Department of Electronics & Communication at Malnad College of Engineering, Hassan.