CHAPTER 7

SOFTWARE DEVELOPMENT FOR WEARABLE ELECTRONICS

7.1 INTRODUCTION

In this chapter, the software developed at the user end to monitor the wearer are conversed also the various communication methods used to interface the wearable electronic products to the remote end were discussed. Through this research work, the wearable electronics such as, teleintimation garment and smart shirt have been developed. To operate the garment in an effective manner, the various factors and data have to be collected, analysed and processed to operate the required sensors and processors. For this purpose software has been developed using Visual Basic and LabVIEW known as Soldier’s Status Monitoring (SSM) Software for monitoring applications. This chapter also discussed the software developed to track the soldier based on Global Positioning System (GPS) - General Packet Radio Service (GPRS) technology.

7.2 SOLDIERS STATUS MONITORING SOFTWARE USING VISUAL BASIC

The bullet wound signals and the soldier’s vital signals were transmitted to the soldier monitoring station at the remote end, where an observer will monitor the soldier’s status from the specially designed application software. The software contains the soldier’s physical, biological
data and the current bullet wound status. Communication between the soldier and the remote location was carried using GSM technology. The various sensors integrated in the teleintimation garment and the smart shirt has been connected to a central processing control unit in the garment. The processing unit is equipped with a computer chip containing firmware with a series of Soldier’s Status Decision Support (SSDS) algorithms. The SSDS algorithms process the sensory information so as to produce meaningful information for combat medics and commanders. Specifically, as a first step, a Inert, Alive or Unknown (IAU) status is estimated by these algorithms and transmitted to the field medic or elsewhere as part of a larger soldier status monitoring system.

### 7.2.1 Soldier’s Status Monitoring (SSM) Software

The remote end server is loaded with the soldiers monitoring application developed using Visual Basic software. At the server end, SSM provides the bullet information in numbers starting from 0 to 79 rows and columns information. This will give the graphical view of the exact bullet information. The graphical representation is divided into 10 blocks in rows and 10 blocks in column. Each block will represent 8 lines of row and column intersection. Thus the 80 lines from row and 80 lines from column are graphically separated. The screen shots of the developed application using VB 6.0 is shown below. Figure 7.1 shows the front view of the Soldier Status Monitoring software. After pressing the enter button, it will displays the soldier’s physical data as shown in Figure 7.2. The bullet wound intimation has been represented in the graphical matrix format, the matrix format will initially in black colour which indicates that there is no bullet penetration as shown in Figure 7.3.
Figure 7.1 Snapshot of Front View of SSM Software

Figure 7.2 Soldier’s Database of SSM Software
Whenever a soldier got bullet wounded, the vital signs from the smart shirt has been transmitted to the SSM through the telemonitoring system by means of GSM technology. The display of vital signs in the SSM is as shown in the Figure 7.4. The bullet wound in the teleintimation garment, the corresponding location is highlighted in the SSM in red colour. Figure 7.5 shows that teleintimation garment got penetrated with 16 bullets and in the text bar the row, column details date and time of penetration has been represented. From this information combat casualty unit can Inert, Alive or Unknown (IAU) status can be anticipated from the Soldier’s Status Monitoring software.

Figure 7.3 Number of Bullet Wound Intimation in Matrix Format
Figure 7.4 Display of Vital Signs from the Smart Shirt in the SSM

Figure 7.5 Bullet Wound in the Teleintimation Garment were Highlighted in the SSM
7.2.2 Location Evaluation of Bullet Wound Intimation

To count the number of bullet wounds in the soldier’s body, voltage level at the receiver end of the POF is continuously monitored. If any POF is interrupted between the transmitter and receiver end, logic high signal is given to the microcontroller. A variable with a count increment will be made in the microcontroller, and the counter variable has been incremented if any port gives a logic high signal. This count is taken as number of bullet penetration in the teleintimation garment. When there is no bullet wound, the microcontroller ports will be in logic low. Whenever there is a bullet wound in the teleintimation garment, the particular matrix coordinates will be affected. This information is used for locating the bullet penetration.

When a fiber is cut at the location (1,1) the location could be displayed. But at the same time when a bullet hit at the location (2,2) the new bullet wound location could be displayed. In addition to this two more locations (1,2) and (2,1) are also displayed even though there is no bullet penetration. This is because the location (1,1) got already wounded hence whenever another bullet hit at the different row or column, the previously wounded row and column are taken into account. This gives the false reading of the bullet location. To overcome this issue the bullet wound location in terms of rows and columns are displayed individually. A POF is removed at the row end which in turn counts the bullet and shows its location.

The POF woven into the teleintimation garment, send and receive the optical signals to the microcontroller circuit, which will tell the presence or absence of the bullet in a particular location. The number of POF lines required for the horizontal and vertical section is designed for an ideal measurement. It has been found that for the efficient number of bullet counts and bullet wound location it is necessary to have 80 POF lines with 0.5 cm distance each in vertical section. Also 80 POF lines with 0.5 cm in the
horizontal section are required. It is formed in the array format so as to detect the bullet wound location. The data received from the PIC microcontroller is in the form of hexadecimal values and this data vary from 00 to FF according to the bullet wound location and the presence of bullet. The Table 1 shows the bullet location with respect to the hexadecimal value.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Hexadecimal Value</th>
<th>Equivalent Binary Value</th>
<th>Bullet Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>00</td>
<td>0000 0000</td>
<td>No Bullet</td>
</tr>
<tr>
<td>2.</td>
<td>01</td>
<td>0000 0001</td>
<td>1 bullet at 0th location</td>
</tr>
<tr>
<td>3.</td>
<td>02</td>
<td>0000 0010</td>
<td>1 bullet at 1st location</td>
</tr>
<tr>
<td>4.</td>
<td>03</td>
<td>0000 0011</td>
<td>2 bullets at 0th and 1st location</td>
</tr>
<tr>
<td>5.</td>
<td>04</td>
<td>0000 0100</td>
<td>1 bullet at 2nd location</td>
</tr>
<tr>
<td>6.</td>
<td>05</td>
<td>0000 0101</td>
<td>2 bullets at 2nd and 0th location</td>
</tr>
<tr>
<td>7.</td>
<td>06</td>
<td>0000 0110</td>
<td>2 bullets at 2nd and 1st location</td>
</tr>
<tr>
<td>8.</td>
<td>07</td>
<td>0000 0111</td>
<td>3 bullets at 2nd, 1st and 0th location</td>
</tr>
<tr>
<td>9.</td>
<td>08</td>
<td>0000 1000</td>
<td>1 bullet at 3rd location</td>
</tr>
<tr>
<td>10.</td>
<td>09</td>
<td>0000 1001</td>
<td>2 bullets at 3rd and 0th location</td>
</tr>
<tr>
<td>11.</td>
<td>0A</td>
<td>0000 1010</td>
<td>2 bullets at 3rd and 1st location</td>
</tr>
<tr>
<td>12.</td>
<td>0B</td>
<td>0000 1011</td>
<td>3 bullets at 3rd, 1st and 0th location</td>
</tr>
<tr>
<td>13.</td>
<td>0C</td>
<td>0000 1100</td>
<td>2 bullets at 3rd and 2nd location</td>
</tr>
<tr>
<td>14.</td>
<td>0D</td>
<td>0000 1101</td>
<td>3 bullets at 3rd, 2nd and 0th location</td>
</tr>
<tr>
<td>15.</td>
<td>0E</td>
<td>0000 1110</td>
<td>3 bullets at 3rd, 2nd and 1st location</td>
</tr>
<tr>
<td>16.</td>
<td>0F</td>
<td>0000 1111</td>
<td>4 bullets at 3rd, 2nd, 1st and 0th location</td>
</tr>
</tbody>
</table>

7.3 SOLDIERS STATUS MONITORING SOFTWARE USING LabVIEW

The Soldier’s Status Monitoring (SSM) software has been created using LabVIEW software to monitor the place and number of bullet wound. The remote monitoring system is defined as a computer-controlled laboratory.
that can be accessed and controlled externally over some communication medium. The monitoring system is being processed and running on a LabVIEW platform with the ability to be monitored and controlled over the internet within a web browser. The teleintimation garment has been connected to the LabVIEW system using GSM technology.

7.3.1 LabVIEW

LabVIEW is virtual instrumentation software from National Instruments. LabVIEW programs are called virtual instruments, or VIs, because their appearance and operation imitate physical instruments, such as oscilloscope and multimeter. LabVIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data, as well as tools to troubleshoot the programming code. LabVIEW VI’s contain three components, namely (a) Front panel (b) Block diagram and (c) Icon and connector pane. Front panel contains controls and indicators. Controls are knobs, push buttons, dials, and other input devices. Indicators are graphs, LEDs, and other displays. The block diagram contains code to control the front panel objects. In some ways, the block diagram resembles a flowchart. An icon is a graphical representation of a VI which can contain text, images, or a combination of both used to identify it as a subVI on the block diagram of the VI. The connector pane is a set of terminals that correspond to the controls and indicators of that VI, similar to the parameter list of a function call in text-based programming languages.

LabVIEW has been used to communicate with the teleintimation garment by using data acquisition card. LabVIEW has built-in features for connecting any application to the web using the LabVIEW Web Server and software standards such as TCP/IP networking and ActiveX.
7.3.2 Implementation of LabVIEW based SSM software

The implementation of LabVIEW based software on teleintimation garment has been done with the help of integrating the teleintimation garment with microcontroller through an interface to LabVIEW based SSM software. The interface is specific that it contains components to control and measure parameters of the teleintimation garment. LabVIEW uses TCP/IP to communicate with Ethernet controller which in turn uses Serial Peripheral Interface (SPI) and interrupts to communicate with microcontroller. The client invokes LabVIEW program corresponding to the teleintimation garment through internet as a web page.

The LabVIEW run time engine displays the front panel with controls and indicators and displays in matrix format as well as in text, the number and the place of the bullet wound. The signals from the teleintimation garment have been given to the data acquisition card using GSM technology. The ethernet controller used in this setup is ENC28J60 from Microchip, Inc. The main advantage is that it is a 28 pin package, which simplifies the design and reduces the overall board space when compared to conventional ethernet controllers containing more than 80 pins. This Ethernet controller also employs the industry-standard SPI serial interface, which only requires four lines to interface to the host microcontroller.

7.3.3 Integration of Teleintimation Garment and SSM Software

The microcontroller used for this design is an 8 bit PIC18F-series microcontroller for applications including instrumentation and monitoring, data acquisition, power conditioning, environmental monitoring, telecom and consumer audio/video applications. It provides SPI interface through which the Ethernet controller is interfaced. It also eliminates the requirement of a standard PC by its computing power just sufficient for these types of applications making it a cost effective solution. The interface contains
components like ADCs, DACs, counters, relays, sensors to measure voltage, current, speed and power electronic components to control parameters of the experimental setup. The interface components are not specific and differ as per requirements of individual experimental setup.

TCP/IP (Transmission Control Protocol/Internet Protocol) stack has to be implemented in the microcontroller to connect it to the local server. The microcontroller has to be programmed simultaneously to transmit and receive data to the local server while it is driving the experimental setup. The microcontroller supports MPLAB compiler tools and HI-TECH PICC C compiler for program development. The microcontroller can be programmed to work in power down mode when there is no request for the experiments.

7.3.4 Soldier’s Status Monitoring Software

The important aspects that should be taken into account by the software in developing SSM software are restricting access to authorized users and handling multiple simultaneous users. To prevent unauthorized access to the facility, user identification has to be implemented with LabVIEW. Multiple users can be easily handled by LabVIEW remote panels. A LabVIEW program can be enabled for remote control through a common web browser without any additional programming. The user interface for the application shows up in the web browser and is fully accessible by the remote user. The acquisition is still occurring on the host computer, but the remote user has total control and identical application functionality. To reduce confusion, only one client can control the application at a time, but the client can pass control easily among the various clients at run-time. At any time during this process, the operator of the host machine can assume control of the application back from the client currently in control. As only data is transmitted back and forth, the bandwidth requirement is minimal. Once connected to the SSM software, the soldier’s status will automatically be in a monitoring state.
7.3.5 Server Operation

Visual feedback is an excellent way to monitor the status of the soldier. Visual Feedback can be added to a remote laboratory in many different ways. One can choose to embed the live images into the actual VI front panel, place the picture on the web page created by LabVIEW, or use a separate web page to display the picture. It consists of option to choose the communication port from the teleintimation garment to the remote end software. Also it consists of matrix format indication the location of the bullet wound, normally the matrix coordinates will be in green colour, once the soldier got bullet wounded, the matrix coordinates will be changed to red colour. Apart from this SSM indicates the location and number of bullet wound in text message. The screen shots of the front view of the LabVIEW based SSM software is shown in Figure 7.6.

![Bullet Wound Intimation](image)

Figure 7.6 Front View of Bullet Wound Intimation – LabVIEW Based SSM Software
7.3.6 Location Evaluation Using LabVIEW based SSM Software

To locate the number of bullet wound and place of the bullet wound in the teleintimation garment, IR transmitter and receiver is used for transmitting and receiving the signals. When the signal got interrupted, meaning, physically the POF got because of the bullet penetration, the signals has been sent to the LabVIEW based SSM through the microcontroller. The testing of teleintimation fabric integrated with LabVIEW based SSM software kit is shown in Figure 7.7.

If any POF is interrupted between the transmitter and receiver end, logic high signal is given to the microcontroller. A variable with a count increment will be made in the microcontroller, and the counter variable has been incremented if any port gives a logic high signal. This count is taken as number of bullet penetration in the teleintimation garment. The POF woven into the teleintimation garment, send and receive the optical signals to the microcontroller circuit, which will tell the presence or absence of the bullet in a particular location. Figure 7.8 shows the screen shots of the LabVIEW based SSM software showing bullet penetration in matrix as well as in text format.

The implementation of LabVIEW based SSM software is essential because the huge investments made in replicating valuable resources can be diverted for other purposes. The advantage of having such software is that they provide a network of resources which can be utilized efficiently.
Figure 7.7  Testing of Teleintimation Fabric using LabVIEW based SSM software Kit

Figure 7.8  Bullet Wound Intimation in Matrix and Text Format –SSM Software
7.4 COMMUNICATION SYSTEM BETWEEN THE GARMENT AND SSM SOFTWARE

The communication between the wearable electronic products, smart shirt and the teleintimation garment to the remote end has been processed using GSM technology for transmitting the vital signs and bullet wound intimation signals. The vital signs were measure and transmitted to the remote station by using telemonitoring system. In the telemonitoring system, the measured vital signs, temperature, respiration rate and pulse rate were sent to microcontroller unit and the microcontroller sends these signals to the modem (mobile) through RS 232 cable. The signal received from the remote end is connected to the server with the receiver circuitry, which employs RS 232 connection method. The remote station SSM can receive these data by using mobile phone and know the status of the wearer.

In the teleintimation garment, the method of addressing a transmitter is to address a location on the user’s body, e.g., “a wound on the left arm.” GSM module is used to send the information to remote station if the controller finds any break in optical cable. The various communication methods were tested to send the vital signals to the remote end server. The RF transmission technique is limited to short distance communication, whereas, the mobile communication technique uses long distance signal transmission irrespective of the distance. From the tests it was found that the mobile communication technique provides the optimum way of signal transmission. The cut in the optical signal from the POF is transmitted by GSM module. The received signal is send to the server PC through RS232 cable. The row and column information is received in the HyperTerminal window of the server. The data receiving methods are programmed using VB 6.0 in such a way that the row and column information were received in a sequential manner.
7.5 GPRS BASED SOLDIER TRACKING SYSTEM

The system proposes a low cost object tracking system using Global Positioning System (GPS) and General Packet Radio Service (GPRS). The current Short Message Service (SMS) technology is costlier when compared to GPRS technology. GPRS also enjoys the advantages of faster and continuous data transmission. This system uses a Telit-GM-862GPS module to track the location details like latitude, longitude, speed, altitude and accuracy, in a specific data format known as National Marine Engineering Association (NMEA) protocol. From this location data, these systems extract the details in a format that can be processed using 16F877 PIC microcontroller.

The processed information is then sent to GPRS module which employs RS-232 logic, whereas PIC-16F877 uses TTL logic. Hence, to interface these two, MAX-232 is employed to convert the logic levels. The system then sends the processed information to a web server containing database created using Microsoft Access, for storing the location details so as to allow the user to view the present and past positions of a target object on Google Map through Internet. A web application has been developed using ASP.NET, MYSQL, and Google Earth Geographical Information Service to track wounded soldiers and also to track military vehicles.

7.5.1 Schematic Diagram of Soldier Tracking System

The system consists of two parts the tracking device and the database server. The schematic of the soldier tracking system is as shown in Figure 7.9. The tracking device is attached to the soldier and it gets the position from GPS satellite in real-time. Then the signals sends the position information to the International Mobile Equipment Identity (IMEI) number as its own identity to the server. The data is checked for validity and the valid
data is saved into the database. When a user wants to track the soldier, the user can log into the service provider’s website and get the live/recorded position of the soldier on the Google Map.

![Schematic of the Soldier Tracking System](image)

**Figure 7.9 Schematic of the Soldier Tracking System**

The tracking device is compatible with 850 MHz / 900 MHz / 1800 MHz / 1900 MHz frequencies of cellular networks. This device is capable of working in any GSM network around the world and it consists of 3-5 MB volatile and non volatile memory in order to store the data received from satellites to be stored. The size of the mobile device is small, since the device operates without any external controller. High sensitive GPS receiver capability and built-in SIM card holder, make the system compact and power efficient. Also the system support complete standard AT command set plus custom AT command set in order to make the data transfer through the protocol via a GSM network.

After turning on the device, the network is automatically initialized. Then it gets the GPS data in NMEA 0183 format and adds it with its own
unique IMEI number. It then tries to connect to GPRS. If it fails due to GPRS unavailability, then it logs the data in the non-volatile memory and waits for a certain fixed period of time. After that, it tries to connect to the GPRS again. After establishing the GPRS connection, it connects to the service provider’s server using the HTTP protocol. After successful connection, the GPS data with IMEI number is sent to the server as a string. After a certain time period it checks the availability of GPRS and connects to the HTTP server and then current location of the device is sent. In this way the device communicates with the server and sends the location. The purpose of the microcontroller is to process the information received from satellites via NMEA protocol and converts it into a format that can be used by the Google Maps. This is to be sent via GSM network to the web server already created. These operations are shown in the form of a flowchart in Figure 7.10.

![Flowchart of Operations in the Hardware](image-url)

**Figure 7.10 Flow of Operations in the Hardware**
7.5.2 Methodology for Soldier Tracking System

The interfacing of the GPS/GPRS module and the PIC microcontroller is done by using MAX-232 ICs which converts RS-232 logic to the TTL logic and vice versa. This is because PIC microcontroller and almost all digital devices use TTL/CMOS logic whereas GPS/GPRS module considered here uses RS-232 logic. A 2 X 16 LCD display has been used display latitude and longitude of the device and an indication that the GPS device is receiving the data from satellite and another indication which shows the message is sent via GPRS. The SIM card and a 2G/EDGE/3G GSM network with high speed circuit switching capability have been used for tracking application. The program developed in the microcontroller with AT commands to access the required online server and this server can be located anywhere in the world.

The .NET server has been used since it can provide multiple accesses, so that multiple users can access the data and receive the required information and process it further. To view the current position of the soldier a web-based application has been developed. Using this Web application, user can view the live position of the soldier and also the past position by selecting a specific date and time interval. An example of a packet of information sent via NMEA protocol and received using GPS device is shown here.

SGPGGA:160223.999,2345.3522N,09022.0288E,2.4,33.9,3,51.30,1.62,0.87,090408,06

After accepting the IMEI and NMEA data from the device by the web server, a method is used for tokenizing all the particular data as shown in Figure 7.11. This is done after verifying the IMEI number of the device and the NMEA formatted data have been converted to the decimal format. After converting NMEA formatted data, the decimal latitude 2345.3522N is converted into 23.755895 and the longitude 09022.0288E has been converted
The Spherical law of cosines is used to find out the device’s location. This formula is used generally for computing great-circle distances between two pairs of coordinates on a sphere. Spherical law of cosines given in equation (7.1),

\[ d = R \cdot a \cos (\cos (\text{lat}_1) \cdot \cos (\text{lat}_2) \cdot \cos (\text{lng}_2 - \text{lng}_1) + \sin (\text{lat}_1) \cdot \sin (\text{lat}_2)) \]  

(7.1)

Here, \( d \) is the distance between two coordinates (\text{lat}_1, \text{lng}_2) and (\text{lat}_2, \text{lng}_2). Live tracking of the soldier is the major part of this web application. This enables the user to view the live position on the map.

![Figure 7.11 Operation Flow on the Server Side](image)

Google Map Satellite version is used to locate the position. After Logging in, user will automatically be redirected to tracking web page, in this page Asynchronous JavaScript and XML (AJAX) function is used to fetch the new
position from the server. This is done at fixed intervals in order to update it on the map without reloading the whole page repeatedly. Data is retrieved using the XML Http request object that is available to scripting languages running in modern browsers, or, alternatively, through the use of Remote Scripting in browsers that do not support XML Http Request.

PIC-16F877 microcontroller controls all the operations taking place in the soldier tracking system. Figure 7.12 shows the different blocks used in the soldier tracking system. It is programmed in such a way that it gets the required data from GPS/GPRS module and then extracts required information like latitude and longitude and is then given back to the GPS/GPRS module, then this GPS/GPRS module sends the extracted information to the web server in which these information are stored in a database. From this web server, end-user can easily view the location details of the selected soldier and also the required locations can be mapped on to the Google Maps. The hardware unit of the system is as shown in Figure 7.13.

![Figure 7.12 Block Diagram of the Soldier Tracking System](image-url)
The PIC 16F877 microcontroller is interfaced to 16 pin LCD Connector which is then connected to a LCD display for displaying the current location of the unit containing the GPS module. Initially, after GPS location data is received by the TelitGM862GPS module the information like latitude, longitude, speed and altitude are extracted using PIC-16F877. Pin number 26 and pin number 27 of PIC-16F877, which are RX and TX, are used for the purpose of receiving required information from Telit-GM862GPS module. This information is the data packet of GPGGA string of the NMEA protocol used for GPS communication, received by the GPS part of the module. This is sent via TX pin to the PIC-16F877, which is programmed to extract information such as latitude and longitude. This data sent to the GPRS part of the TelitGM862GPS module which is then to be sent to the web server for storing the data. This interfacing of PIC microcontroller and LCD displays these extracted values of latitude and longitude of the current position of the soldier.

Figure 7.13 GPS/GPRS Based Soldier Tracking System
7.5.3 **Hyper-Terminal Testing of AT Commands**

The AT commands which are to be provided by the PIC are manually provided using the Hyper-Terminal in a PC for testing purposes. The following shows the experimental results of AT commands tested using HYPER-TERMINAL. In this research work GPS based service developed and provided by United States Department of Defense is used for the tracking purposes. It provides accurate, three-dimensional information of the location as well as precision velocities and timing services. A web application for plotting the location of the soldier has been developed using .NET, Visual Studio, MYSQL, and Google Earth. Google Earth has Google maps embedded within it and it uses a .kml file for location mapping. The application gets the values of latitude and longitude from the database created already in the web server and then creates a corresponding .kml file with the obtained latitude and longitude values. This .kml file is then used by Google Earth and the location is plotted.

The web application created includes a first page, by the name default.aspx, which provides features for the users to login, as shown in Figure 7.14. There is a ‘LOGIN’ button, which when clicked, checks the authenticity of the username and password. If the username and/or password do not match with those values in the database, it displays an error message. If the values of username and password match exactly with those of the values in the database, then the user will be redirected to the main page.

The main page has a drop-down list, a ‘go’ button and a grid display as the main controls. The soldier whose position has to be located can be selected from the drop-down list. The ‘go’ button when clicked displays the details of the location of the selected soldier. This is done by using SQL commands for filtering the information about the selected soldier from the
database. There is a ‘load’ button which when clicked, loads the entire database, showing the location details of all the soldiers. The preferred location can now be plotted on Google maps using the ‘plot’ button. An example of plotting of the location of Soldiers in Google Maps is shown in Figure 7.15(a) and (b). Also, these values of the latitude and longitude of the current location is displayed in the LCD unit is shown in Figure 7.16, similarly the latitude and longitude of the current location will be displayed in the webpage as shown in Figure 7.17.

Figure 7.14 Front Page of Soldier Monitoring System
Figure 7.15 (a) Location of Soldier in Google Maps

Figure 7.15 (b) Location of Soldier in Google Maps
Figure 7.16 Longitude and latitude of the current location

Figure 7.17 Tracked Details in the Web Page of SSM System
In the current scenario, safety measures to the soldiers are one of the important factors. In addition to the protection of the soldiers during combat situation, monitoring them using GSM and gathering their health status and bullet wound information is important. The developed teleintimation garment gives the bullet wound and location of a soldier at the remote end server from the Soldier Status Monitoring system. The signal from the garment is transmitted to the remote end with RF and GSM communication technique. Soldier’s Status Monitoring (SSM) Software gives the physiological details and Inert, Alive or Unknown (IAU) status of the soldier.

Apart from this a low cost tracking system using GPS/ GPRS of a GSM network, suitable for wide range of applications like soldier tracking in defence fields has been developed. The combination of the GPS and GPRS provides continuous and real time tracking. The cost is much lower compared to SMS based tracking systems currently available in the market. It is expected that the full implementation of the proposed system would ultimately replace the traditional and costly SMS based tracking systems. Also, having a single module for both GPS and GPRS purposes and using a PIC microcontroller instead of an external controller has made the overall size of the unit, smaller and hence makes it compact.

7.6 CONCLUSION

In this chapter the software developed at the user end to monitor the wearer are conversed also the various communication methods used to interface the wearable electronic products to the remote end were discussed. Whenever a soldier got bullet wounded, the vital signs from the smart shirt has been transmitted to the Soldier’s Status Monitoring (SSM) software through the telemonitoring system by means of GSM technology.
In the telemonitoring system, the measured vital signs, temperature, respiration rate and pulse rate were sent to microcontroller unit and the microcontroller sends these signals to the modem (mobile) through RS 232 cable. The signal received from the remote end is connected to the server with the receiver circuitry, which employs RS 232 connection method. The remote station SSM can receive these data by using mobile phone and know the status of the wearer.

In the teleintimation garment, GSM module is used to send the information to remote station if the controller finds any break in optical cable. The various communication methods were tested to send the vital signals to the remote end server. The RF transmission technique is limited to short distance communication, whereas, the mobile communication technique uses long distance signal transmission irrespective of the distance. From the tests it was found that the mobile communication technique provides the optimum way of signal transmission. The cut in the optical signal from the POF is transmitted by GSM module. The received signal is send to the server PC through RS232 cable. The row and column information is received in the HyperTerminal window of the server. The bullet wound in the teleintimation garment, the corresponding location is highlighted in the software developed by using Visual Basic and LabVIEW. The data receiving methods are programmed using VB 6.0 and LabVIEW, in such a way that the row and column information were received in a sequential manner. From this information combat casualty unit can Inert, Alive or Unknown (IAU) status can be anticipated from the Soldier’s Status Monitoring software.

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