University of Puerto Rico
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CPR Electronic Teaching Assistant Mannequin Final Report

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ICOM 5047 – Computer Engineering Project Design Course
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Executive Summary

Cardiopulmonary resuscitation (CPR) is a practice used with unconscious victims of some type of trauma which has caused the heart to stop beating. It consists of a series of steps, primarily compressing the victim's chest to get the heart to pump blood, richly oxygenated, throughout the body.

CPR training is essential in many working environments, including jobs ranging from law enforcement to babysitting. However, if performed incorrectly, it can produce adverse effects. For this reason, the Red Cross provides training programs to certify the people that are capable of performing the procedure. In order to obtain the certification, the person has to pass a final practical exam which is performed using a CPR mannequin that simulates a person in need of CPR. Instructors want to be sure that the steps are learned correctly since what they learn may be used on a live person in the future.

In order to improve the techniques of teaching this exercise, we provide a more realistic way to perform the practical exam. Using a mannequin that is monitored and controlled by sensors, a microprocessor, and computer software in a personal computer, the test can be an experience near to real life. It doesn't relieve the CPR trainer from the responsibility of evaluating the student, but it is helpful in this task.

The market provides several CPR mannequins. CPR Savers & First Aid Supply offers a variety of CPR mannequin trainers, each with different features. The Ambu CPR Pal Training Mannequin also has a first aid kit and has a patented hygienic system that protects students and makes internal cleaning unnecessary. Some of the features that the mannequins have are that the airways open when the CPR mannequin's head is correctly positioned and the stomach inflation is indicated by a whistling sound.

MSR: Israel Center of Medical Simulation provides a CPR mannequin that is used in adult CPR training. Some features the mannequin has are natural airway obstruction, carotid pulse simulation, realistic chest compliance for chest compressions, and it allows head tilt lift. These features are basically the most relevant that companies offer in mannequin trainers. CPR Electronic Teaching Assistant Mannequin is more than that. The trainers that use CPR e-TAM will have an effective and accurate assistant, as well as a complete grading system for each student when they take a CPR test.

The only mannequin we were able to find that connects to a computer, AmbuMan, uses a USB connection and is able to retrieve data sent from the mannequin, which by itself is realistic, however gives no visual or audible feedback. Our mannequin, apart from having a wireless connection for better portability, is specialized for universities or other teaching institutions rather than strictly for certification, which is where the custom grading profiles differ from the AmbuMan software, and considering materials and development costs, is much more affordable, an important factor for public institutions.

To help in the task of preparing better trained people in CPR we accomplished the following objectives: created a tool to facilitate the job of the instructors by electronically monitoring students practicing CPR on a training mannequin. We provide hardware and software that identifies when a student is not following the correct CPR procedure by monitoring chest compressions, the victim's breathing and pulse, and the position of the victim's head using specialized software to configure the mannequin and display the data provided from the real time situation in the mannequin.

We adapted a mannequin by placing several push-button switches that provide information such as if the student verified the pulse of the mannequin and if the chest compression is adequate. A sound detector is being used to identify when air provided by the learner and to detect if the learner checks the consciousness. LED and buzzers are indicators of the status of the cable connections of the mannequin, if it has been resuscitated, if it's still unconscious, or if the learner failed the CPR process. We used a micro-controller to collect all the data from the different sensors and wirelessly transmit the information to a computer where the software application is running showing the status of the procedure being carried out.

The aforementioned software application was developed by us as well. We developed a graphical user interface (GUI) with useful information about the procedure such as the time duration of the session and if there have been any mistakes during the session. The application has a way to create a report of a training session. We used a relational database to store all the information being generated for future reference. It also has a feature to configure how many times the CPR procedure would have to be repeated to complete the session successfully. All this was deployed following the specifications established in the WBS and budget sections of this document.

Even though we wanted to make our system as real as possible, we know that it is not completely real due to some steps that are not possible to monitor. We don't simulate the pulse throughout the whole body. Also, we don't simulate the breathing of the mannequin after it has been revived. The mannequin doesn't have the ability to evaluate the student without any type of supervision.

The budget of the project was under the estimated budget at the time of the proposal. We bought all the components and miscellaneous materials needed to complete our project that we didn't presented at the proposal. (Appendix 1)

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Introduction

Our final report presents how EHS group developed an electronic teaching assistant mannequin in order to help instructors and professors teach CPR techniques. We present here a project that is very different from similar products on the market thanks to the comprehensive monitoring of *all* steps that are necessary in order to provide correct CPR assistance. The graphical user interface (GUI) developed was designed to easily manage groups and grades in a classroom in any institution. We also made the product as similar as possible to an unmodified CPR mannequin, even though ours contains several sensors.

We were focused on completing the objectives that were mentioned in the project proposal. Because of this, the GUI has been designed to include classroom management, such as the option to manage students, sections, and courses. It has a tutorial session to explain to the user how to use the software and the integration with the mannequin. Also, it has the training session to perform the test or practice the CPR procedure. The program is able to receive, process, and display the information coming in from the sensors in an easy-to-understand manner in real time.

In the hardware area, a CPR mannequin was modified in order to allow us to place several sensors to monitor which action was performed while performing CPR. Using the 8051F340 microprocessor we pull the data from the sensors and transmit it to the PC using the UART. The PC receives the data using the serial port and a TTL232 cable. Using Zigbee technology the microprocessor transmits to the PC's serial port wireless.

In order to provide a quality system, we used some testing techniques that have been documented (appendix). Stress testing had to be done to the placement of the sensors in order to test the strength of them. The budget of the project and hours worked by the resources of the project are similar to the estimation presented in the proposal. The report concludes with the deliverable of the fully functional system, test report, user manual and this report.

Design Criteria and Specifications

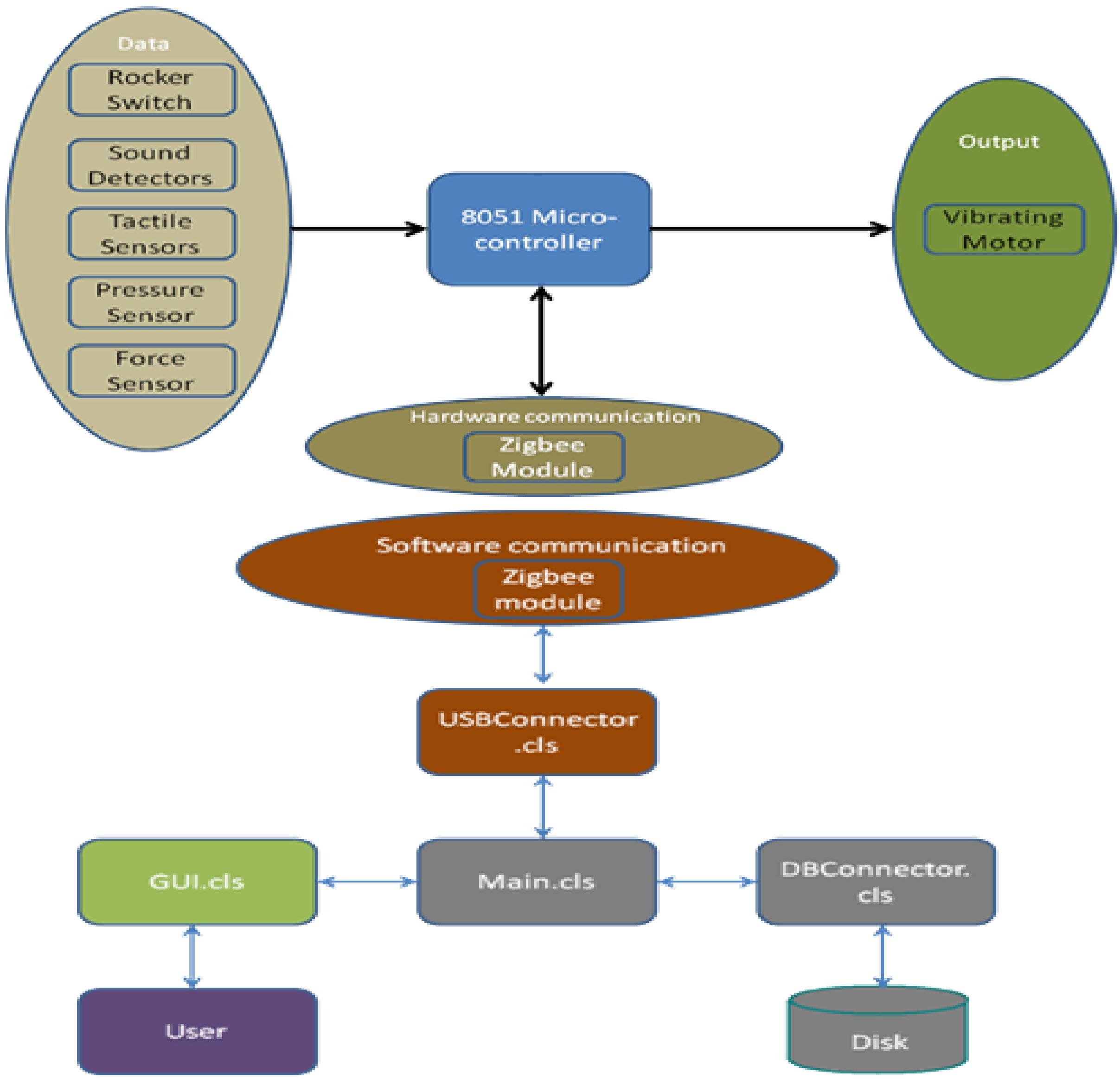

Figure 1

Hardware Specifications

Mannequin: We bought a CPR Prompt® TMAN1 Adult/Child CPR training mannequin. We used the Adult mannequin for our prototype version of the product.

Microcontroller: We used the 8051F340 development kit from Silabs Company. This microcontroller has 2 ADC from which we used both. It also has 4 ports, from which we use 2 of them. For a more detailed description of the hardware configuration, please make reference to the schematic at the Appendix.

Sensors:

We installed in the mannequin the following sensors:

- Sound detector sensor, for consciences check.
- Pressure sensor, in order to verify the rescue breathing.
- Force sensor, in order to see if the student gives the chest compressions.

Power: The power we used to turn on the mannequin comes from 4 AA batteries that are inside the hardware box located in the back of the mannequin. The voltage is 6 V.

Other components: The mannequin also contains a wireless Zigbee module that allows the wireless communication both ways between the mannequin and the computer were the software is installed.

Software Specifications

Our software for the CPR eTAM mannequin was developed using the C# programming language, using Visual Studio 2008 Express Edition. For more detailed software architecture refer to the appendix in part number five.

When we began to design our project, our first objective was to make an electronic CPR mannequin as close as possible to reality. For this reason, we did not want to alter the CPR process sequence in any form possible. That was our primary objective and the design criterion was always based on that decision. The mannequin and the software needed to be easy for a professor and a student to use. We also designed the software taking into consideration universities and institutions of learning criteria for courses and students managing. We also wanted to make a mannequin that no matter the number of sensors it had inserted, it would look as close as possible to a person, so the aesthetics was also a part of the design criteria we took into consideration.

The placement and configuration of the sensors was done taking into consideration the fact that we wanted to minimize any deviations from the true CPR procedure as much as we can, which meant that we could not complicate the interaction with the mannequin, because that would make the system less realistic. This situation, however, was unavoidable with the choice of microcontroller, and one step does require extra interaction.

Environmental factors in the design were also taken into consideration. For example, we tried to select sensors and parts that do not contain harmful materials to the environment and make the disposal of the mannequin as easy as possible.

Legal considerations were also analyzed in order to make a good design. We comply with the FCC interference policy, and we provided a notice regarding CPR issues, clarifying to the user that use of the product does not imply CPR certification.

Implementation Tools

Visual Studio express edition 2008

Testing Tools

We used the NUnit Tool, to make testing of software modules in order to see if they worked or not, and fix them.

Also test cases were done in order prove software and hardware integrity under normal or hard circumstances. The documented test cases can be found separately.

Limitations and Constraints

As with other systems, ours has limitations related to budget, time, and other constraints. For example, our product has some limitations regarding the monitoring of the CPR steps. The software cannot evaluate if the compressions were made with the correct or incorrect angle, or if the student bent the elbows when he gave the compressions, or if the student verified the breathing for the 5 seconds. Therefore, up to this point, instructor supervision is needed in order to perform a complete evaluation of the process in detail.

Also, in order to determine consciousness, there cannot be much ambient sound, because the system will detect it as the user trying to determine consciousness

Also, the mannequin cannot be move randomly too much, because of the box that is located in the back of the mannequin. If the product was constructed professionally in a production line, this problem could be solved easily.

During the design and implementation process, our system was affected because of how we were going to monitor all aspects of the CPR process, without complicating the steps of it. For example, in the selection of the sensors we were using, we took into consideration a lot of factors: size, sensor interfacing, time response, and some others. A major limitation is the fact that certain steps require a certain timeframe to complete, for example, when lifting the head, the student is supposed to look, listen, and feel if the victim is breathing. Since the sequence is hardwired into the system, we decided to ignore any sensor inputs after the student does the required action until the required time passed, due to erroneous readings from the software, which could confuse the student. Another limitation is that we needed to place push buttons in order to activate some of the sensors at the desired moment on the CPR process, so this limitation was our approach to solve the problem that the software was not able to decide which sensor was the one in use. It was difficult to find solutions to these problems, but we surpassed all of them, always having in mind our main objective.

Requirements

Recommended Hardware requirements

4x AA batteries

120V 60Hz wall outlet

Computer with USB port

Connect the cables. Each cable is identified with a color that is matched with its paired connection socket.

Recommended Software requirements

Windows XP

2 Gb of ram

20 Mb hard drive

Server with MySQL support

Methods and approach to the solution

Project Management

Time

The time of the project was in phase according to Gantt chart presented in the proposal. We extend the second phase one day looking for more quality in the software. Instead of that, the third phase finish 2 days earlier, so we dedicate these days to testing. No extra hours were needed to complete the project, inclusive vacations was given in holy week. For more information refer to the appendix.

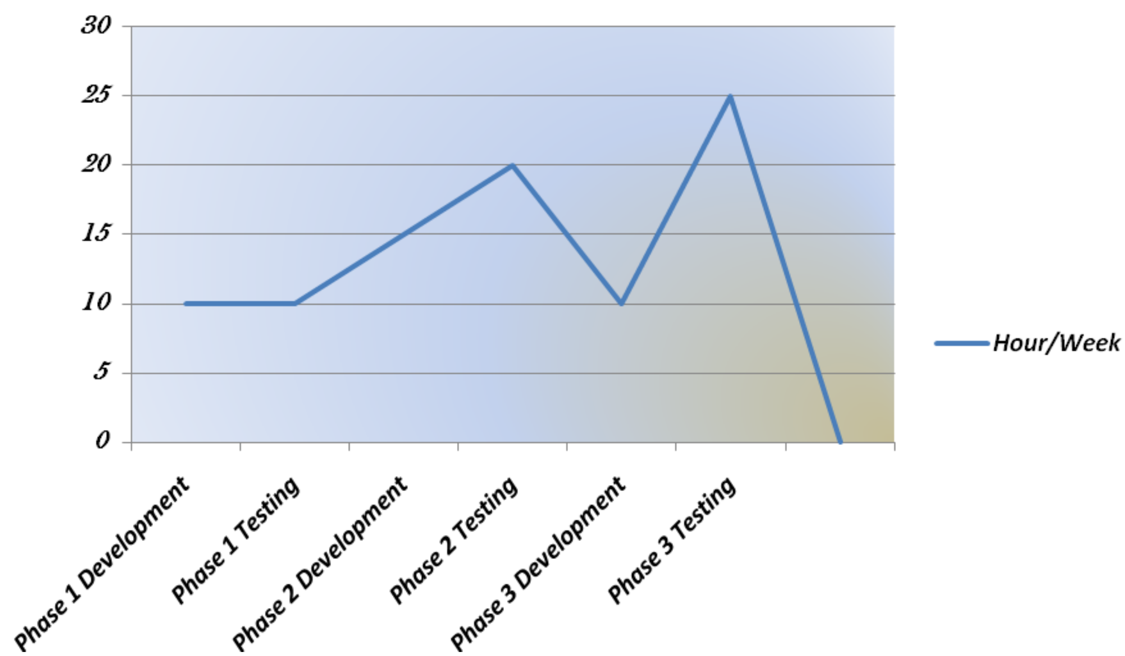

Figure 2

Resources

The resources of the project were the same of the start. Three software engineers and two hardware engineers was the division of the resources. They dedicate the estipulate hours by week to the project, or if not they make it later. Juan Gorritz and Edvier Cabassa were in the software team. Arelis Perez and José Lombay were in hardware team. Jomar Rosario was the project manager and the liaison between software and hardware teams.

Cost

The budget was similar to the one that was proposed. Please refer to the budget analysis section.

Phases of CPReTAM

Phase 1: How to (Tutorial)

This phase was introductive. We developed software and hardware to demonstrate our design. The deliverable for this part was the tutorial session of the software, three of the sensors interfacing with the microprocessor and the microprocessor with the computer. The tutorial involves how to use the software, the configurations and the application of the CPR to the mannequin.

The general design of the application was done by one of the software developers and accepted by the rest of the team. Once the design was established, the creation of each form was done, mostly undeveloped (to be done in the next phases).

The main task for this phase was the interactive how-to for performing CPR, which consisted of a series of steps, and an option to carry out those steps on the mannequin, receiving feedback from the application if they were done correctly.

One of the main issues in this phase was maintaining a responsive user interface while the program was waiting for an input from the mannequin. This was solved using one of C#'s threading operations, which would allow the user interface to be updated while another time-consuming operation was taking place.

Phase 2: Training

This is the main part of the project. It allows the professor to view in real time what the student is doing in real time. It involves a continuous pulling of the sensor's data and processing of it. The deliverable of this phase was the training software and the mannequin with all the sensors placed. Also the database classes and setup had to be done in preperation for the next phase.

The approach to solving this problem began with the knowledge that in order to maintain the responsive user interface, this section would have to be multithreaded. The process, however, was going to need an option to be stopped, so we couldn't use the same approach used for the phase one tutorial. The solution came in the form of one of C#'s threading objects, the Background Worker class. This class allowed for a simple way of running the time-consuming process (pulling sensor data), reporting back to the user interface (for updating information), and running some method when the process was completed.

The Background Worker allowed us to run the training session maintaining a responsive interface, the new issue was to process the CPR procedure correctly, taking into consideration the grading schemes, and a visual representation of what the system was waiting for. The worker class allowed us to solve all of these issues at once. An Array List was created with the correct steps of the CPR procedure, and the serial port monitor would compare each input with the current position in the sequence. Every second, the worker would receive a numerical percentage of progress, where the interface was updated. We used this method to our benefit, sending information about what the user entered, which picture needed to be placed as the visual representation, and whether or not the input entered was correct or not.

The major issue in this phase was the synchronization of the worker thread with the application thread. Many times, the worker thread would work faster than the main thread, resulting in erroneous sensor data processing. The issue was solved taking the serial data reader outside of the DoWork method of the worker.

Phase 3: Report and configuration

The report is an important feature of our product. It provides the results of the students of each session divided by sections and courses. This software has several options to configure such as the port and the evaluation grading scheme. In this phase we also set up the wireless communication between the microprocessor and the computer.

The main issues in this phase were the manipulation and preparation of the data in order to be saved in the database. The structure of the database we were using had to be modified to include session and cycle data, which we decided to change due to the design of the report. The report displays a table of all the students in the chosen section as well as the grades and average they have for the past five sessions they have completed. The report was generated as an HTML file in the program directory. The manipulation of the HTML code was done using C#, which would add data dynamically as it received the information from the database.

Please refer to the appendix where you can view the full Gantt chart.

Testing

Unit Testing

To get verified and quality software we use techniques like unit testing. Using Visual Studio to develop the code and the NUnit Framework, we performed several unit test to the CPRETAM source code. (Please refer to the CPRETAM Test Procedure attached in the appendix)

Stress Testing

Stress testing was applied to the mannequin to see if the sensor placement was strong and in the right position.

Test Cases

We developed 12 test cases to test the quality and validate the CPRETAM software. This also helps us to identify bugs to fix. This document has proof of every test that was performed to each part of the CPR eTAM software; even the communication with the hardware was documented.

Team

Resources

For the development of CPR e-TAM, EHS Group has three Level I Software Engineers and two Level I Hardware Engineers. The work of the project began on January 14, 2009 and finishes on May 14, 2009.

Hierarchy

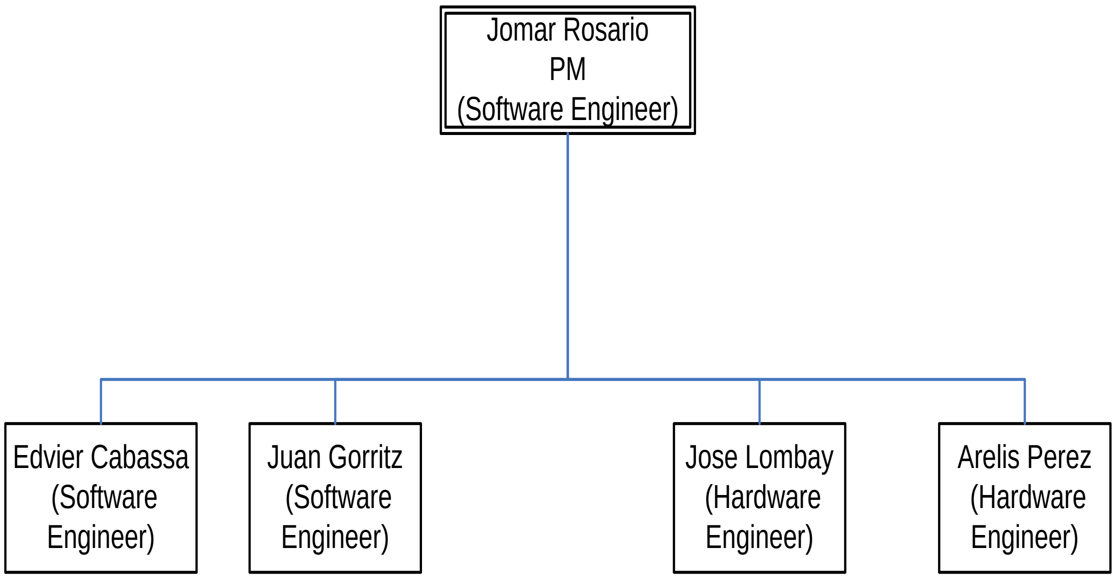

Figure 3

Tasks

We divided the project into three phases and each phase into three main tasks, which are Software, Hardware, and Microprocessor. Subtasks were assigned to the resources of each department. Is also important to mention that all tasks were completed by the specified end date. Please refer to the Gantt chart in the appendix.

Change requests

There were very few changes to the proposed plan. The following are listed below:

- Database file encryption
- Read/write a configuration file
- Pressure sensor changed to a sound detector

The change request forms can be found separately.

Other activities

In order to maintain a positive work environment, we used some group time to socialize outside of work. Activities such as dinners, video games, and desserts were share. Market overview

Results and Discussion

The whole purpose of this project is to facilitate the trainer's task in giving and evaluating CPR training sessions to students, it is not intended that this product replace the RED CROSS CPR certification, the trainers, or any other methods for teaching CPR; the use of this product does not imply that you are certified to give CPR. In order for this product to be usable in the United States all the radio and telecommunications components have to be FCC compliant. The component list of the project has been revised to have FCC compliant Zigbee modules. After an evaluation of possible environmental issues due to the design and creation of this project, we agree that there are no issues, besides the disposal of the mannequin with the sensors. In this case, it is considered the responsibility of the person who bought the mannequin to dispose it in a green way.

We had to do some changes during the development of our system due to limited resources and problems with some of the components used. Initially, we intended to use a pressure sensor where we could approximate the amount of air provided by the student, when providing “breaths” at the training session, but the pressure sensor was not working consistently. We solved that problem by utilizing a sound detector to detect the air flowing, but as a trade-off we cannot measure the pressure of the breathing. This solution allowed us to simplify our circuit, since we used the same sound detector for the consciousness check at the mannequin.

Another problem encountered while the creation of our system was related with the force sensor. At first we thought that by placing the sensor on the chest of the mannequin would be enough to measure the force of the compression, but given to the structure of the spring utilized by the mannequin, we were not able to do so. We fixed that by placing a small solid platform over the sensor, which directed most of the force produced by the compression to the sensor.

We also encountered some problems with the application. Initially we were instantiating every form when we were calling it. That caused the program to slow down and use a lot of resources every time a new window was created. We fixed that by replacing all the methods that initialized the forms by methods that hid and showed the forms instead of recreating them.

Market overview

As mentioned previously, the purpose of this system is to monitor and evaluate CPR sessions as well as maintain an up-to-date database with the results of either a student or a group of students. The current user is a physical education professor who has been working with the team throughout the development of the system. He gives a first aid course where the teaching of CPR is a requisite. Branching off from the current user, a single CPR instructor, potential users include entire institutions, both public and private. The procedure has been confirmed as being correct by the current user, and therefore could be used as a tool for helping official CPR training facilities as well. Basically, any instructor who teaches, or will teach, CPR anywhere can be considered as a potential user. In order to use the full functionality of the system, however, the user will need access to a server where the database can be stored.

Competition in the market includes several varieties of CPR mannequins, including the Prestan CPR mannequin, the Lifeform Basic Buddy mannequin, CPR Prompt's Basic Life Support mannequin (the mannequin used in our system), Ambu's Advanced and Basic Life Support CPR mannequin, and a few others [1].

The Prestan CPR mannequin [2] features optional real-time feedback regarding the rate of chest compressions, as well as a clicker mechanism in the chest which informs the user if the compressions are with the right force. Our system does have the chest compression clicker but does not have a real-time compression rate monitor, however the software application measures the time of each procedure, which can be cross-referenced with how much time it should take (two minutes for five cycles of CPR).

The Lifeform Basic Buddy mannequin [3] is lightweight and portable, and very economical. Our modified mannequin has the same features as this mannequin, as well as the additional clicker in the chest to offer feedback of chest compression force.

CPR Prompt's Basic Life Support mannequin [4] is the one chosen for modification by us. It provides the force feedback for chest compressions through the clicker mechanism, and provided an easy environment for adding the sensors for monitoring.

Ambu offers a lifelike torso or full body mannequin with a rich feature set, including mouth-to-nose rescue breathing, adjustable chest stiffness, realistic anatomy, and more. The Ambu Man [5] torso and full body also have the ability to interact with a computer interface (through a software application). Similar to our application, an instructor can view real-time data from the mannequin, however with our system; every step in the CPR procedure is monitored whereas in the Ambu software evaluated a limited number of steps. Our software also allows the instructor to assign a grading system to deduct a specific number of points for each step in the process, and saves the information not for just one session, as does the Ambu software, but for the past five sessions.

Budget Analysis

The project has total cost $387.50. Although we bought materials that are not estimated in the proposal, we do not exceed the stipulated amount presented in the proposal. The calculated amount to spend for hardware components was $394.76. We had to buy materials that are not detailed and calculated in the hardware budget. To maintain the budget low and balanced, we acquire the microcontroller donated from *Silicon labs*. Also we receive the refund of the mannequin shipping for the amount of $66.50, lowering the budget amount. The cost of hardware components are detailed in the following table.

Component	***Amount***
Mannequin	$94.45
Push Buttons	20.08
Sound Detector	25.59
Cable (jumpers)	10.46
Case	6.20
Rocker switch	3.73
Batteries	3.20
Xbee, Sound Sensor	160.78
Little Mike Outfit	12.70
Miscellaneous	50.31
Total	**$387.50**

Table 1

This chart shows the total cost of the hardware components and the cost estimated in the proposal.

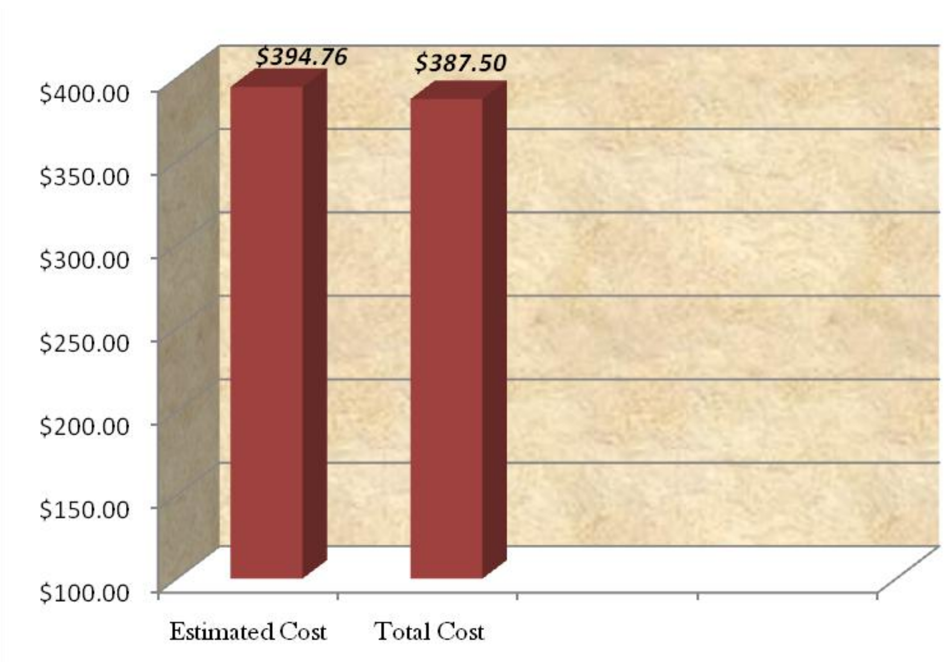

Figure 4

Legal Considerations

The whole purpose of this project is to facilitate the trainer's task in giving and evaluating CPR training sessions to students, it is not intended that this product replace the RED CROSS CPR certification, the trainers or any other methods for teaching CPR, the use of this product does not imply that you are certified to give CPR.

In order for this product to be usable in the United States all the radio and telecommunications components have to be FCC compliant. The component list of the project has been revised to have FCC compliant Zigbee modules.

Conclusion

As a group, our methods and approach to solve problems were good. We maintain during all the development phases the main objectives of our project, and when problems arise, as a group we tried to find a practical and good solution as engineers. An example of this was the moment that the selection for the sensors came. Was difficult to select a sensor to simulate the conscience checking, after a long debate of how to solve it, we implement an idea that was accepted by the entire group. So, as a conclusion our project was successful and it met with our expectations in part of the way and methods we used, our organization, and attachments to the Gantt chart and time schedule.

The technical aspect of project was well thought out and implemented. From the beginning, the plan was to have two software developers, two hardware developers, and one member to interface the two. This resulted in a very efficient development process, where two to five tasks could be under development concurrently (one task in software, one in hardware, or each developer working on one specific task). The development of the project was divided into three phases, where the main concepts were incorporated into the first phase, allowing for easier implementation in the following phases. The interactive how-to allowed for the serial communication with the mannequin, which also introduced multi-threading into the project. Since the basic principles were touched in phase one, phase two, being the most difficult, went more smoothly than expected. There were several small bugs that were preventing the program from working as proposed, but team-based testing, as well as documented tests, provided fairly quick fixes.

Economically, our group stayed on track. The resources used did not exceed the estimated budget, even though some issues arose concerning the mannequin. The construction of a replacement mannequin for phase one was done using cheap materials with the knowledge that we only needed something temporary until the real mannequin arrived.

Based on the feedback of our client, he forecast a good market future if this product is commercialized, so, as part of our future work, will be, talk to companies of CPR mannequins and first aid to negotiate the production of our product

We believe our product has no ethical issues, but a disclaimer is provide in the user's manual, as apart part of our responsibility, we warn the users ,that our product does not intend to substitute the advice and teaching of a certified CPR instructor. Also custom grading schemes are provided to allow flexibility to the user; the way he or she chooses to use it is out of our control.

From a legal perspective, the system complies with the FCC policy of product interference, because our product contains a wireless module. Also disclaimers have been produced concerning legal issues that could arise. The software application clearly states that use of the program does not imply certification in the CPR procedure. Other legal aspects regarding CPR are the responsibility of the user.

Regarding environmental issues, after a careful analysis of the materials used, we don't believe that there are any materials that are hazardous to the environment. The hardware aspect does however utilize plastic and foam, therefore methods for recycling should be researched prior to disposing of the mannequin.

In a social aspect, the system was designed to be easily available and usable by the general population. Users young and old should be able to use the program without any difficulty. All possible problems the user could experience are documented in the user manual in case he or she needs help with any specific function. Also the hardwired tutorials help the user learn the basic functions of the software application. The hardware team assured that mounting the mannequin correctly was made as simple as possible, using colored tabs to indicate connections.

Future Work

CRP eTAM is a project that can be improved in several ways. Adding some functionality in software and changing others in hardware can result in a better product which is what we are looking for.

Software

For the CPR eTAM software we expect to release some patches that will add functionality to the program. One thing that our customer asked us is for an evaluation sheet to allow the instructor to make check hand position, bent elbows, etc. Another thing that we are prepared to implement in the future is the mannequin recognition and the connection wizard. This will provide a way to connect the software to several mannequins simultaneously.

Hardware

Many improvements can be done in this area looking for more stable sensor outputs and better simulation of reality. We want to place a sound detector with better accuracy in the output (a more reliable detector), a microprocessor with more ADC's would also help to improve the hardware. The hardware could also provide a better, more realistic experience using tactile sensors instead of push buttons.

Acknowledgements

Professor Frank Mendoza, UPR Mayaguez, for his continual support throughout the development cycle.

Zygote Media Group, Inc, for providing the initial image that was used in the creation of the official EHS logo and splash screen. Image copyright 2007.

Silicon labs (Silabs), for being generous enough to donate four microprocessor development boards just in case.

Professors Nayda Santiago, Manuel Rodriguez, and Fernando Vega for their professional guidance.

All the teaching assistants for their ideas, opinions, and help.

Jose Rodriguez aka Dices, for his suggestion to use a sound detector instead of a pressure sensor for the rescue breaths, and other general help.

Jose Bermejo, for providing the “Pass” and “Fail” audio clips for the end of a graded CPR session.

To our families, friends, and significant others who had to suffer our complaints throughout the development of the system.

References

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Appendix

Appendix 1

Basic table of the initial cost presented at the proposal.

Component	***Amount***
Mannequin	$94.45
Push Buttons	20.08
Sound Detector	25.59
Cable (jumpers)	10.46
Case	6.20
Rocker switch	3.73
Batteries	3.20
Miscellaneous	23.07
Total	$188.78

Table 2

Appendix 2

Hardware schematic

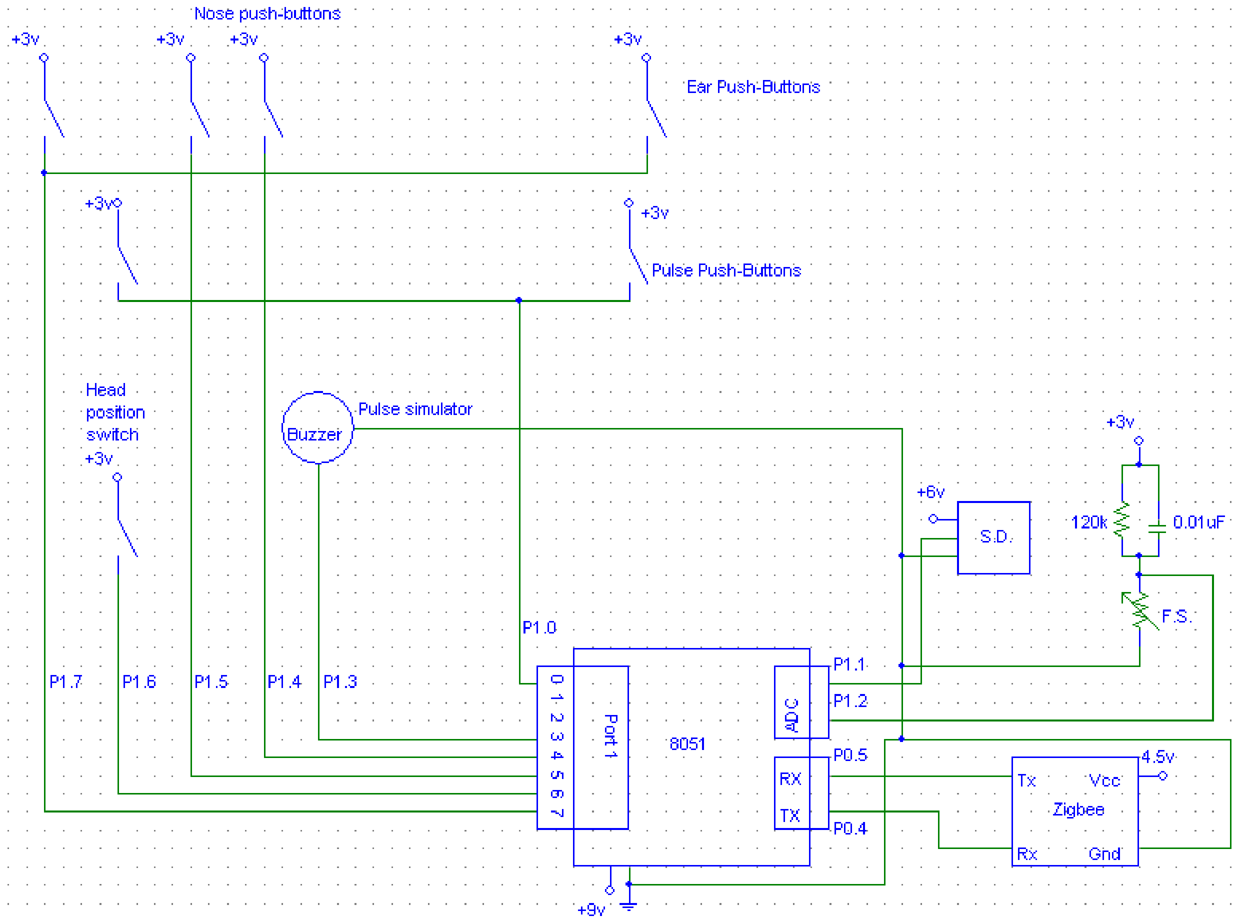


Figure 5

Appendix 3

Gantt chart

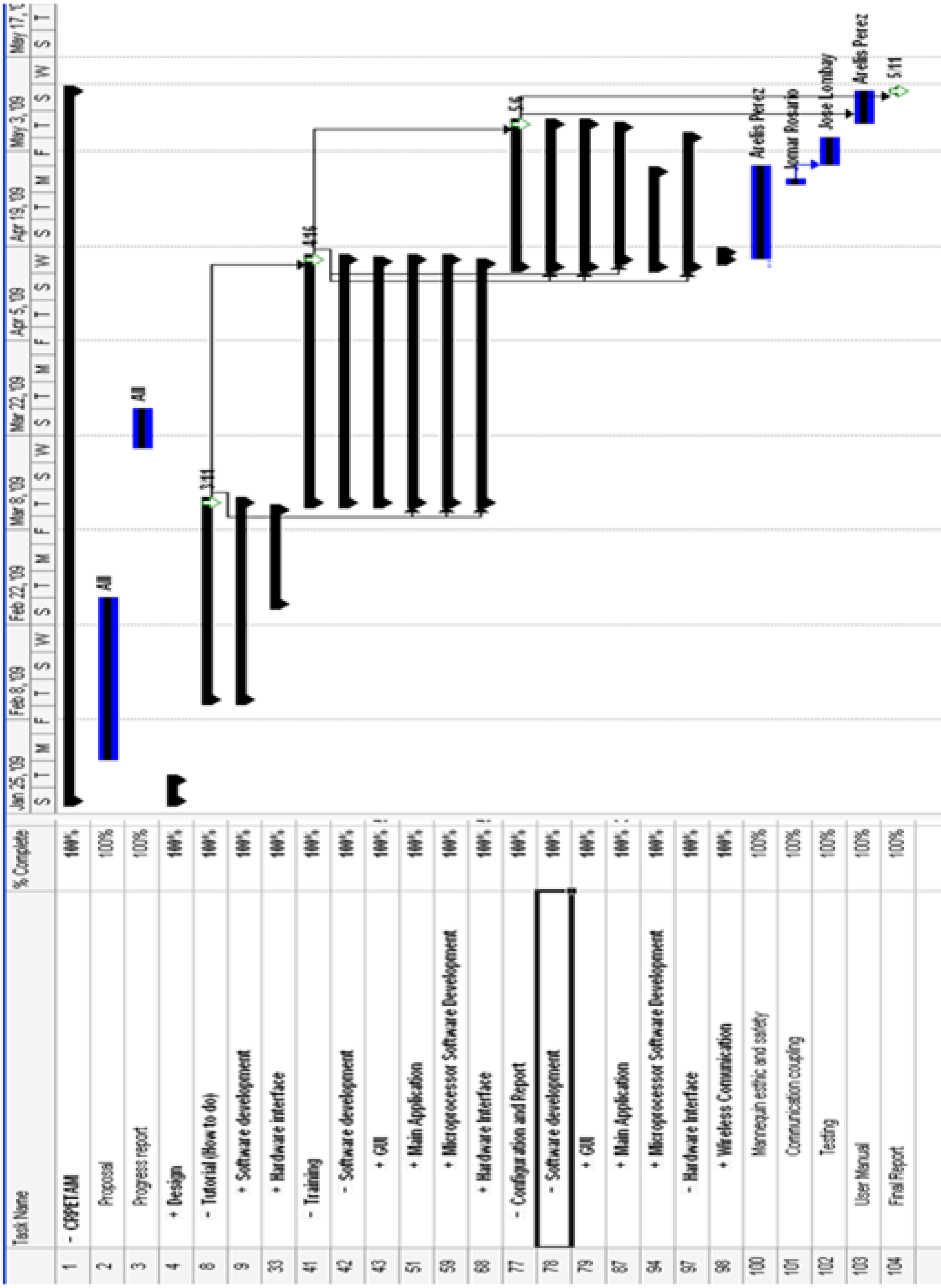


Figure 6

Appendix 4

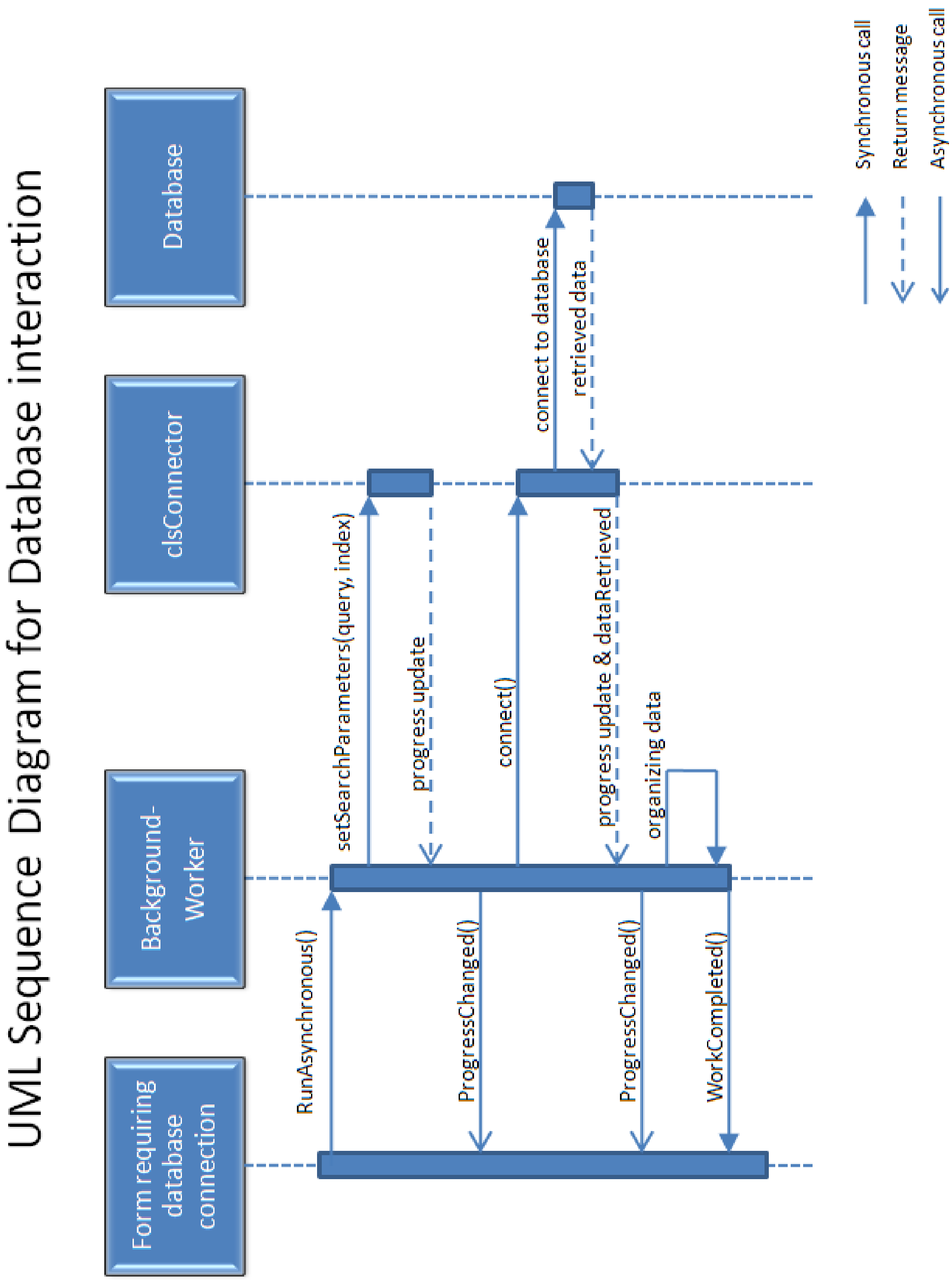

UML Sequence Diagram for Database interaction
Form requiring database connection
Background-Worker
clsConnector
Database
RunAsynchronous()
setSearchParameters(query, index)
progress update
ProgressChanged()
connect()
connect to database
retrieved data
progress update & dataRetrieved
ProgressChanged()
organizing data
WorkCompleted()
Synchronous call
Return message
Asynchronous call

Figure 7

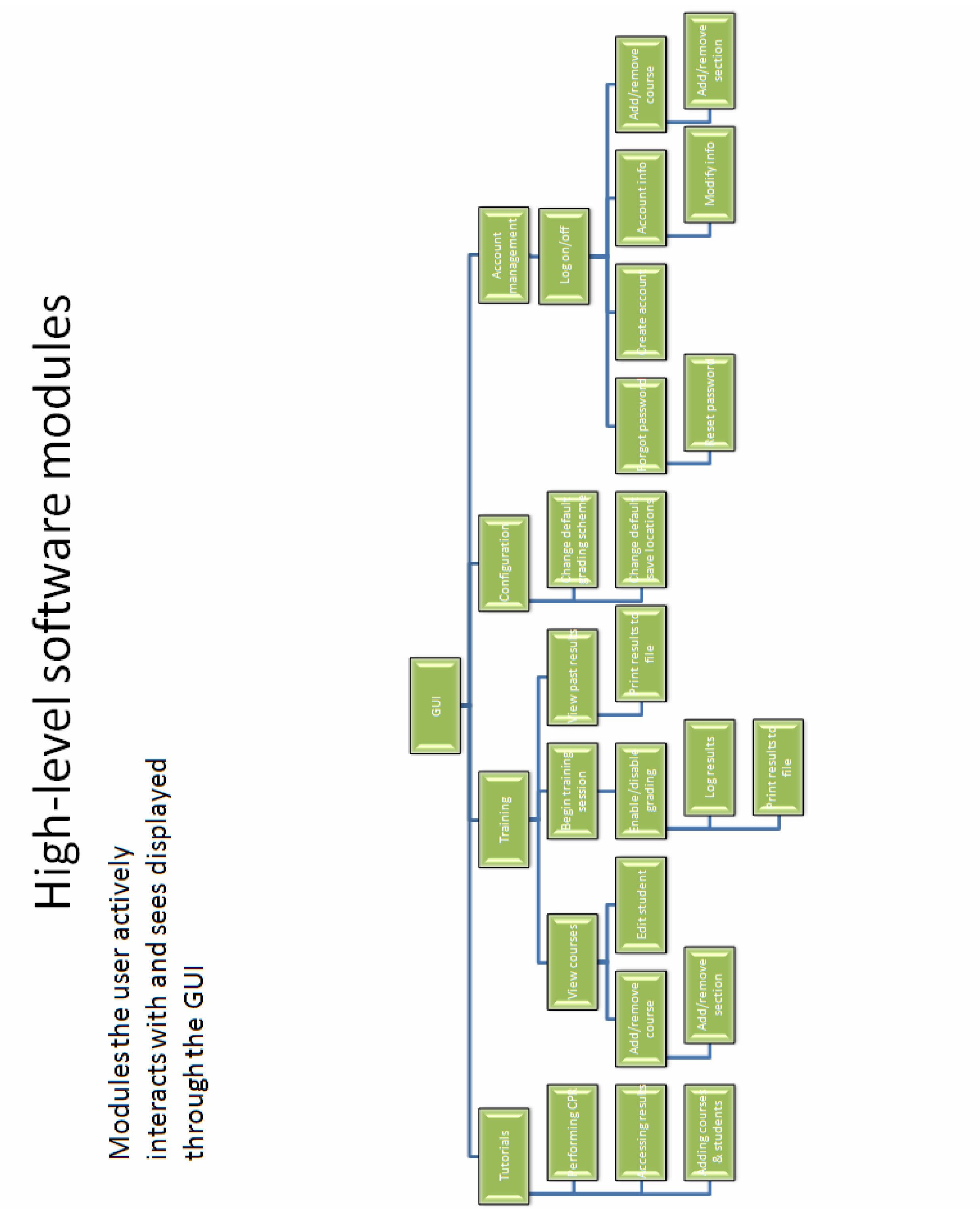

High-level software modules
Modules the user actively interacts with and sees displayed through the GUI
GUI
Tutorials
Training
Configuration
Account management
Log on/off
Account info
Modify info
Add/remove course
Add/remove section
View courses
Edit student
Begin training session
Log results
View past results
Print results to file
Enable/disable grading
Change default grading scheme
Change default save locations
Create account
Reset password
Forgot password
Performing CPR
Accessing results
Adding courses & students

Figure 8

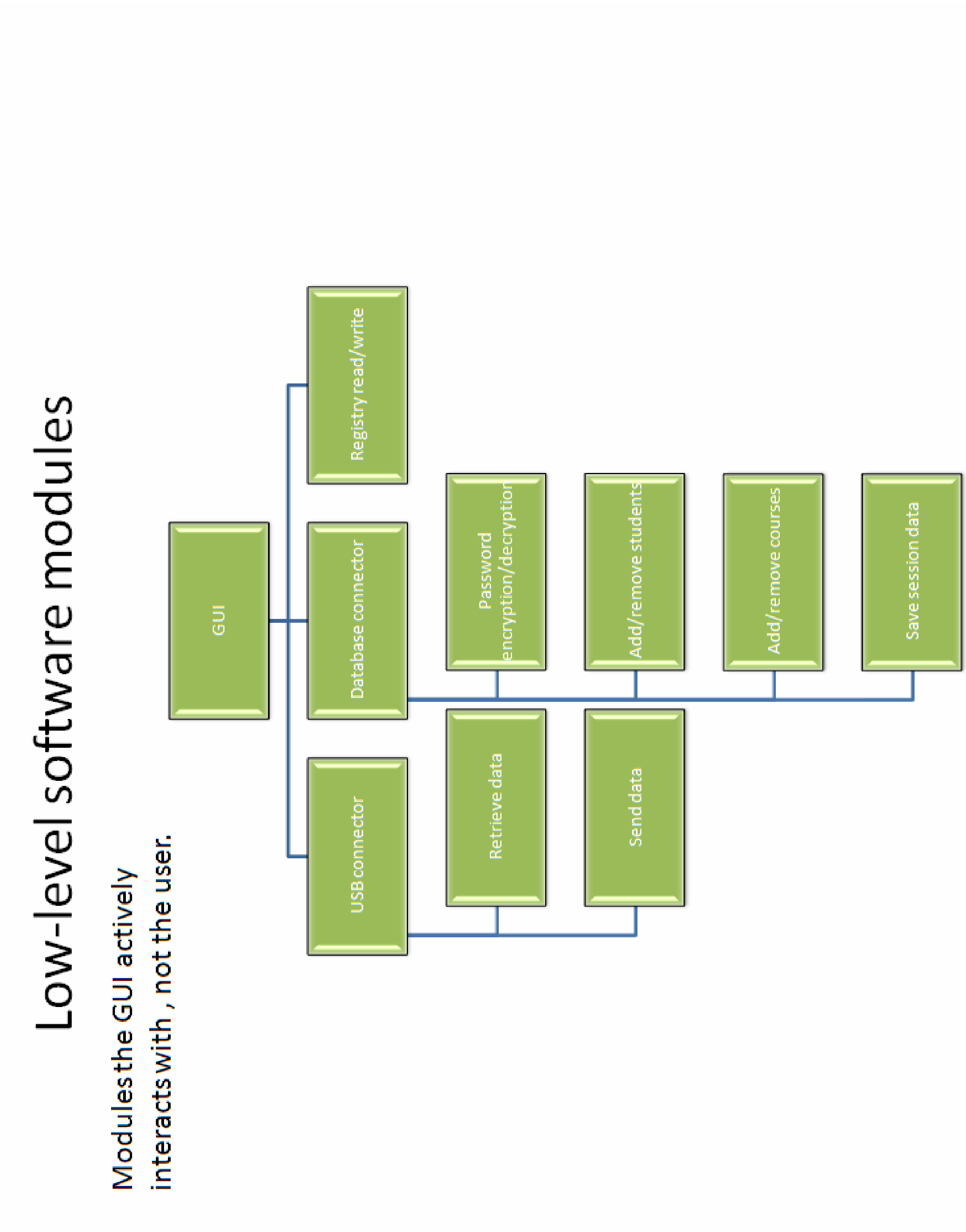

Low-level software modules
Modules the GUI actively interacts with , not the user.
GUI
Registry read/write
Database connector
USB connector
Password encryption/decryption
Add/remove students
Add/remove courses
Save session data
Retrieve data
Send data

Figure 9

ERD

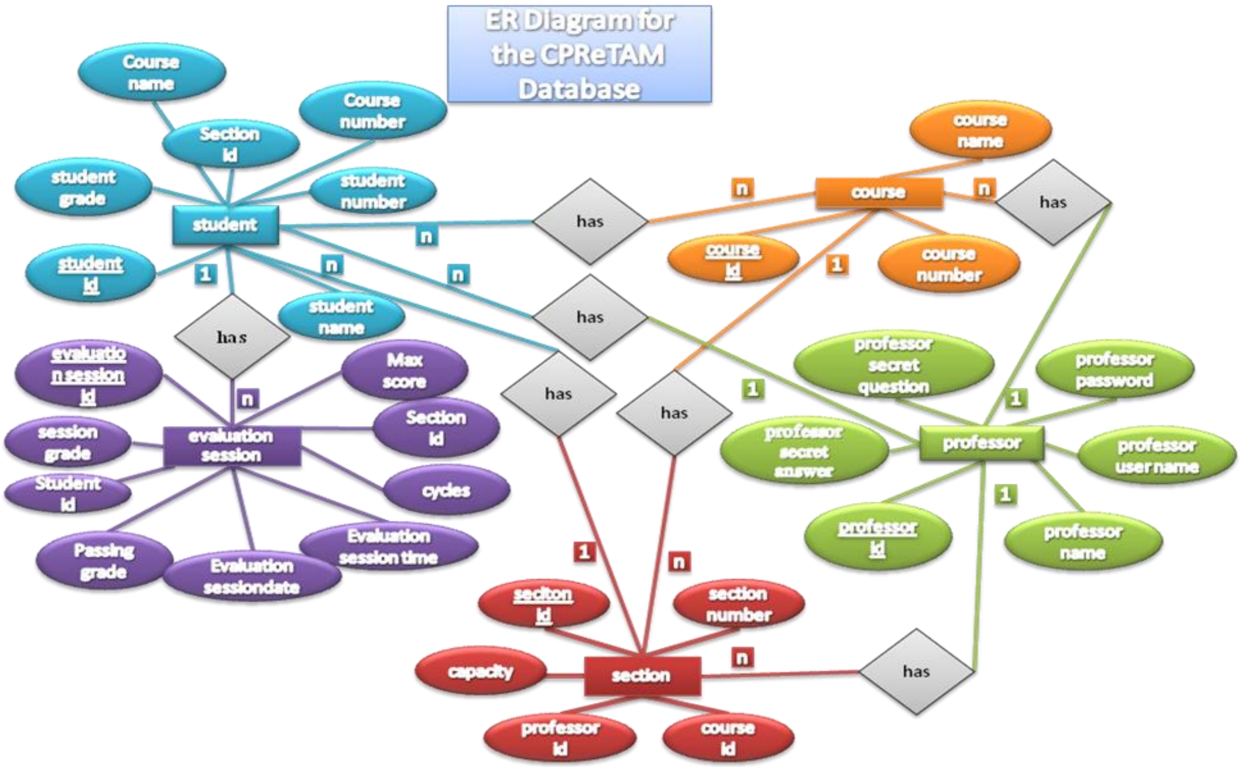


Figure 10

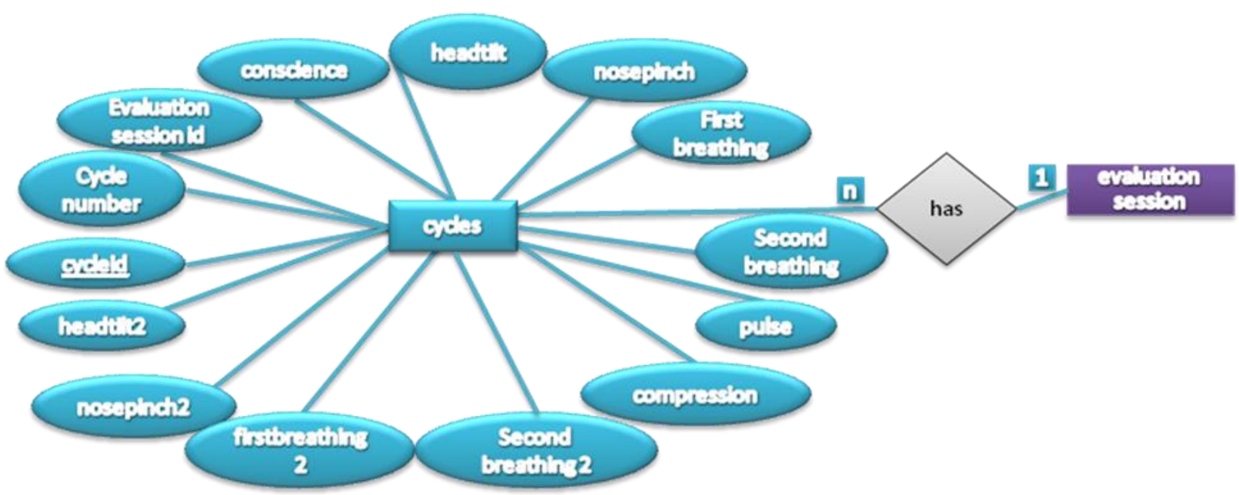


Figure 11

Appendix 5

Mannequin

Figure 12

Original artwork used for logo

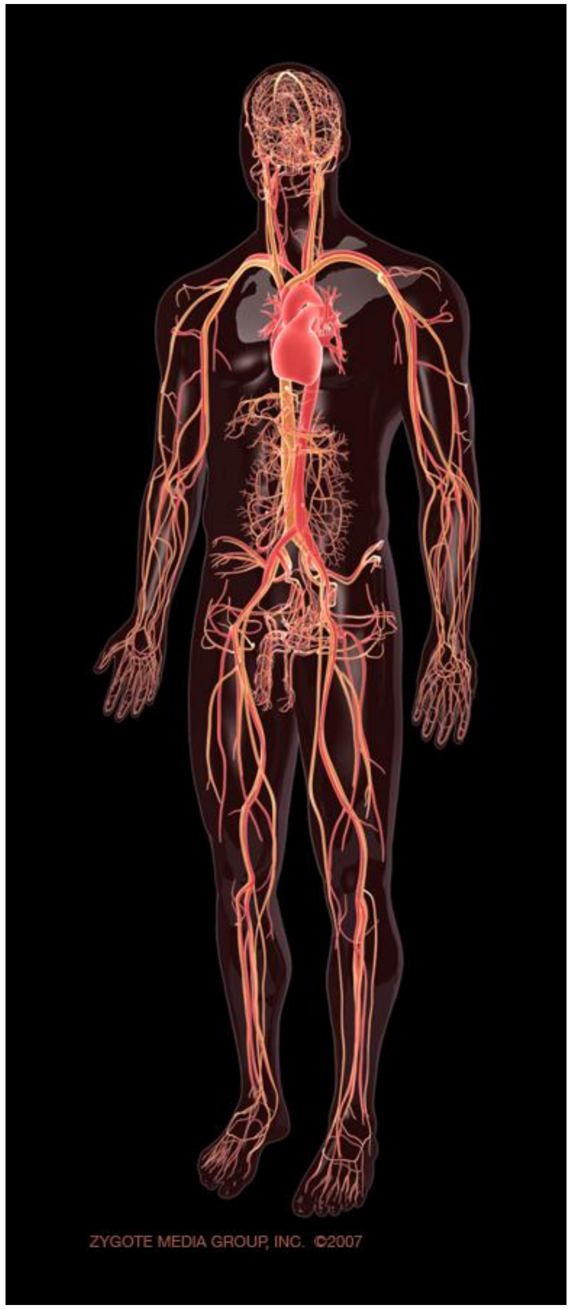


Figure 13

Appendix 6

Test Cases

Please refer to the CPReTAM_Test_Cases document.

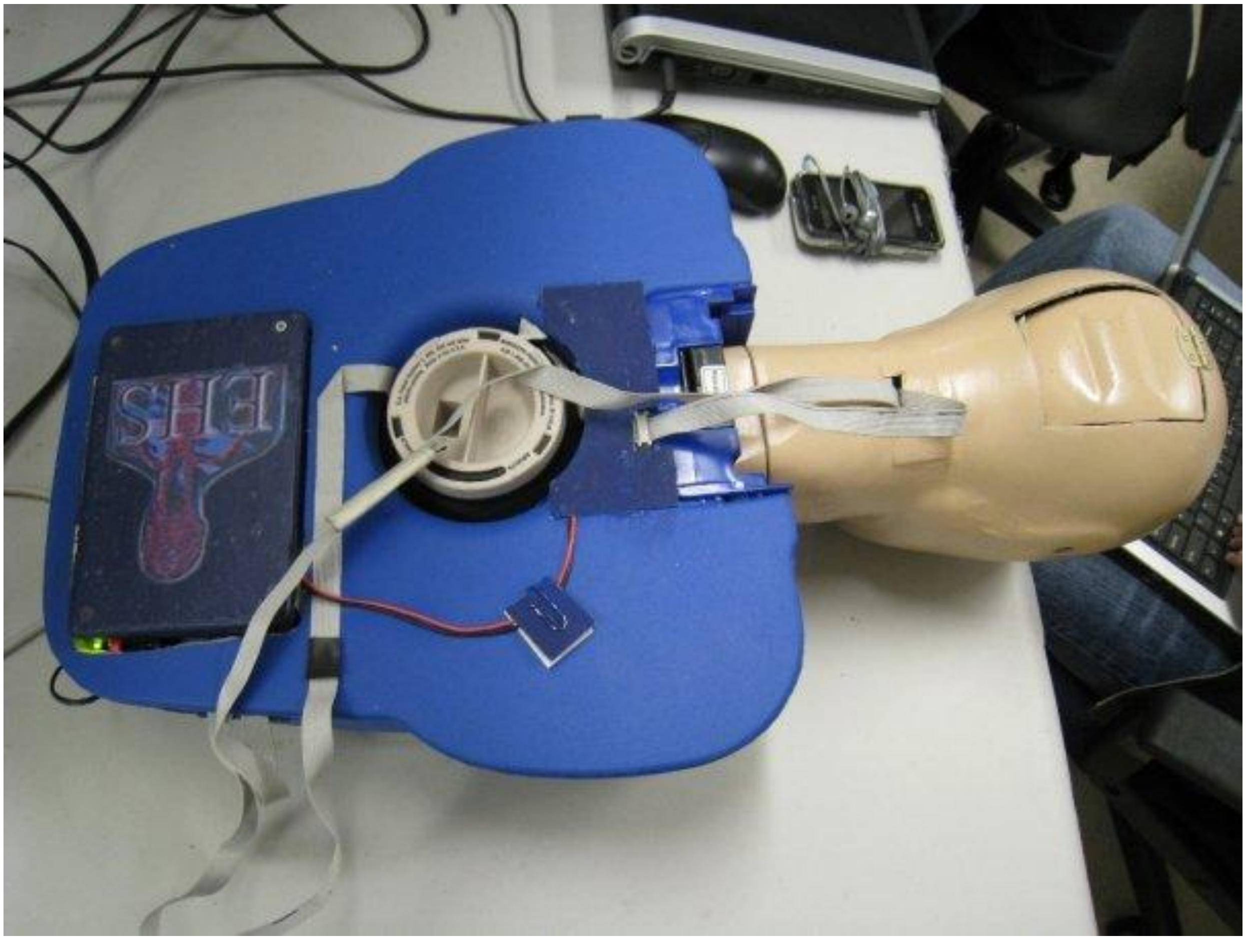
Appendix 7

User Manual

Please refer to the CPR eTAM User Manual document.

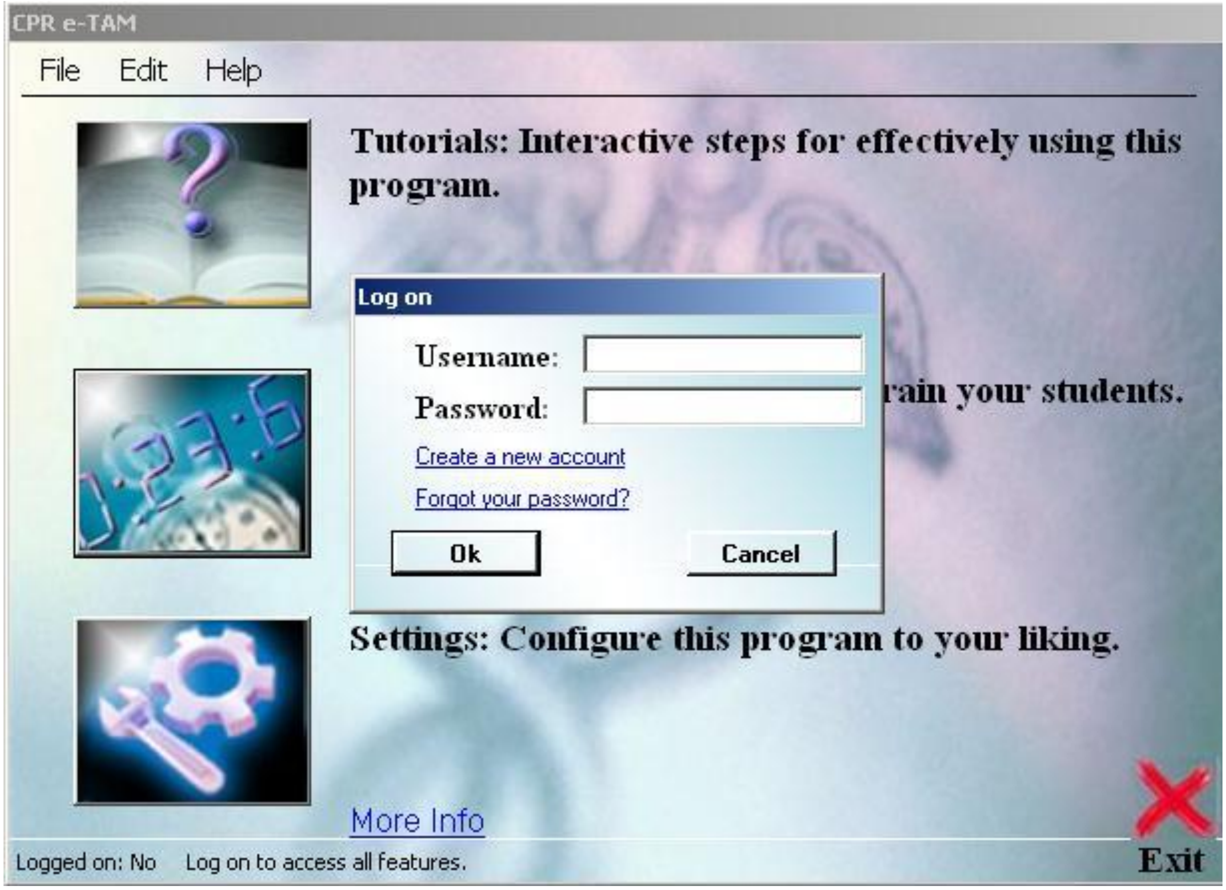
Appendix 8

Mannequin’s rear



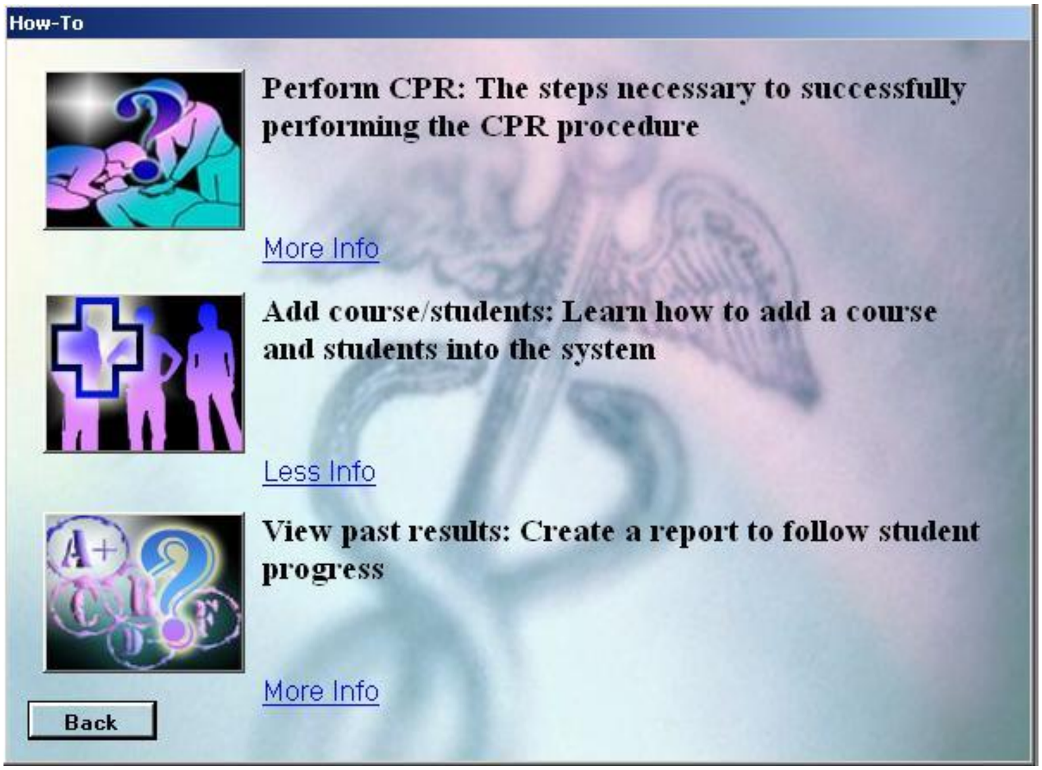
Appendix 9

GUI: Log on


CPR e-TAM
File
Edit
Help
Tutorials: Interactive steps for effectively using this program.
Log on
Username:
Password:
Create a new account
Forgot your password?
Ok
Cancel
rain your students.
Settings: Configure this program to your liking.
More Info
Logged on: No
Log on to access all features.
Exit

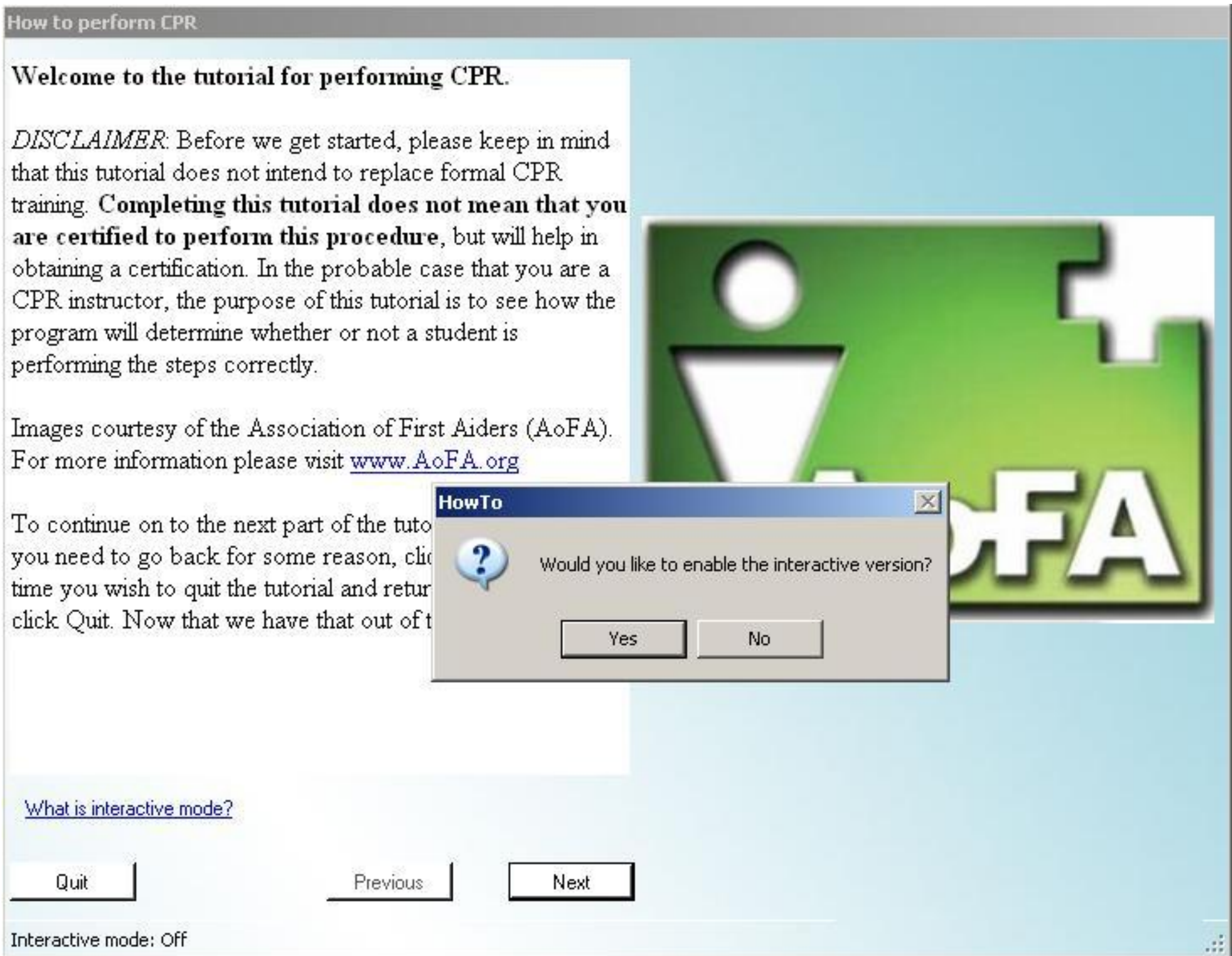
Appendix 10

GUI: Tutorial



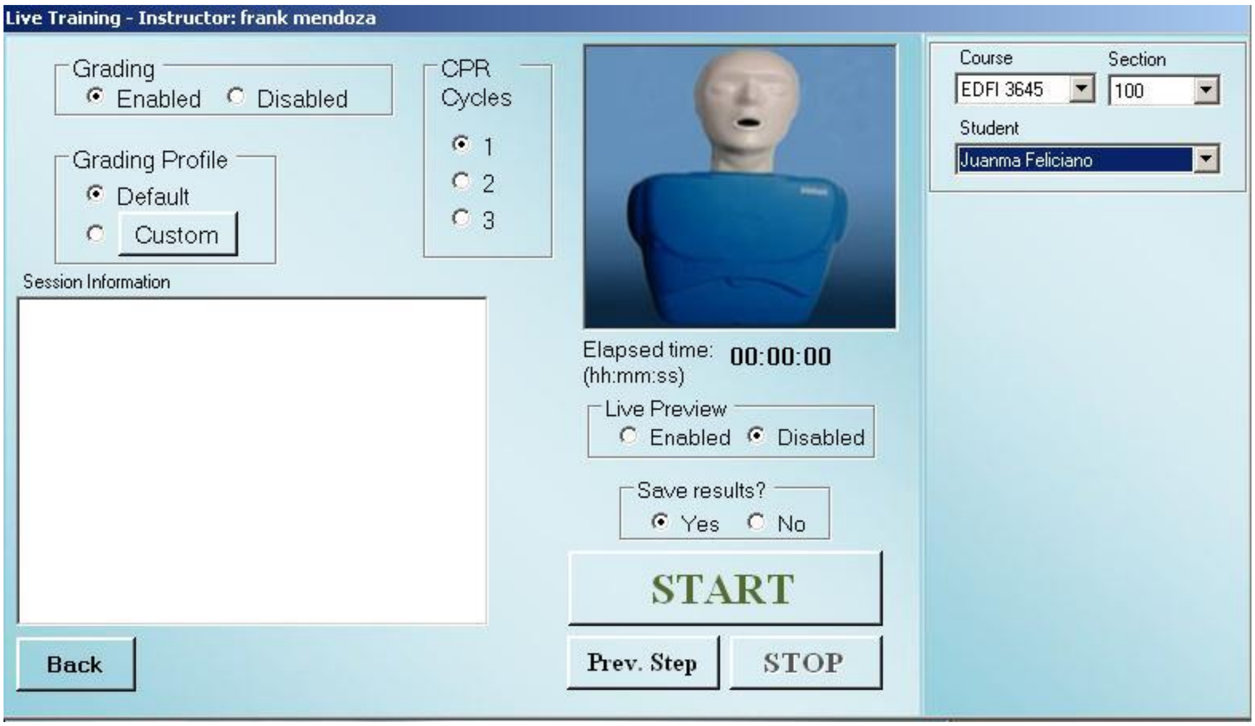
Appendix 11

GUI: How to



Appendix 12

GUI: Training



Appendix 13

GUI: Report

Evaluation report for

EDFI 3645 - 070

Below is the evaluation summary for the specified section. To view a detailed report of a particular student, click his or her name.

Student name	Student number	Session grades					
		Avg	1	2	3	4	5
Juanma Feliciano	802-03-1061	N/A	N/A	N/A	N/A	N/A	N/A
Magic Johnson	555-55-5555	N/A	N/A	N/A	N/A	N/A	N/A
Frank Sinatra	569-22-3265	N/A	N/A	N/A	N/A	N/A	N/A
Jerry Seinfeld	456-03-4568	79	100	96	100	20	N/A
George Costanza	456-40-5879	N/A	N/A	N/A	N/A	N/A	N/A
Elaine Benes	123-45-6789	N/A	N/A	N/A	N/A	N/A	N/A
Cosmo Kramer	987-65-4321	N/A	N/A	N/A	N/A	N/A	N/A
Click on a student's name to jump to his or her detailed report.							

Juanma Feliciano Back to top

No procedures performed yet!