Wireless ECG Monitoring w/ Remote Access

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Introduction

The design and testing of a wireless electrocardiogram (ECG) system is presented. The system incorporates various software packages to visually display the ECG waveform locally on a computer and remotely on a web page. The remote viewing capability also extends to using an Android phone application. The purpose of the system is to serve as a means for a doctor or physician to remotely check up on a patient away from a hospital setting. The patient benefits by being in a home environment while giving vital health information to medical personnel.

Problem

When a patient is in a hospital, they are surrounded with near constant care. If a problem arises, it can be detected and appropriate action can be taken in a timely manner. When a patient leaves the hospital or is not in a position to go to a hospital, the availability of health monitoring can drop dramatically. The patient's own knowledge of their condition is required to help them diagnose themselves and determine when they are not feeling well.

Due to limited monitoring methods while at home, problems that can occur might not be detected until the patient has been affected adversely. These problems create a need for intelligent monitoring of vital signs in the home environment. A system that could allow for a doctor to view data on a patient remotely can increase the prospect of detecting a serious health issue before it becomes a life threatening situation.

Scope of Work

The scope of the work includes designing the hardware and software components necessary to capture an ECG signal and allow for it to be remotely viewed. Components include

- Physical ECG device that is portable and non cumbersome to user

- Graphical user interface (GUI) for showing ECG on local machine and allowing for user to enter additional information

- Web page and Android phone application to allow for remote viewing of data

Implementation

Wireless ECG Device

The device measures ECG using three electrodes based on the Einthoven Triangle for detecting electrical activity of the heart. The electrode signals are passed through the following stages

- Amplification – Allows mV detection to be in V range

- Filtering – Reduces noise and power line interference

- Analog to Digital Conversion – Converts analog ECG signal to digital

- Transmission – Wireless transmission of ECG signal via Zigbee protocol

Device measures 3.8" x 2.4" x 1.0" with enclosure. Electrode leads are connected via headphone jack to enclosure.

ECG Device with Electrodes

LabVIEW GUI

The LabVIEW GUI displays the ECG waveform and contains an interface for user to enter additional information such as blood pressure, pulse oximetry and other basic medical information. All data and information is saved to a database so that it can be further accessed via web page and Android application.
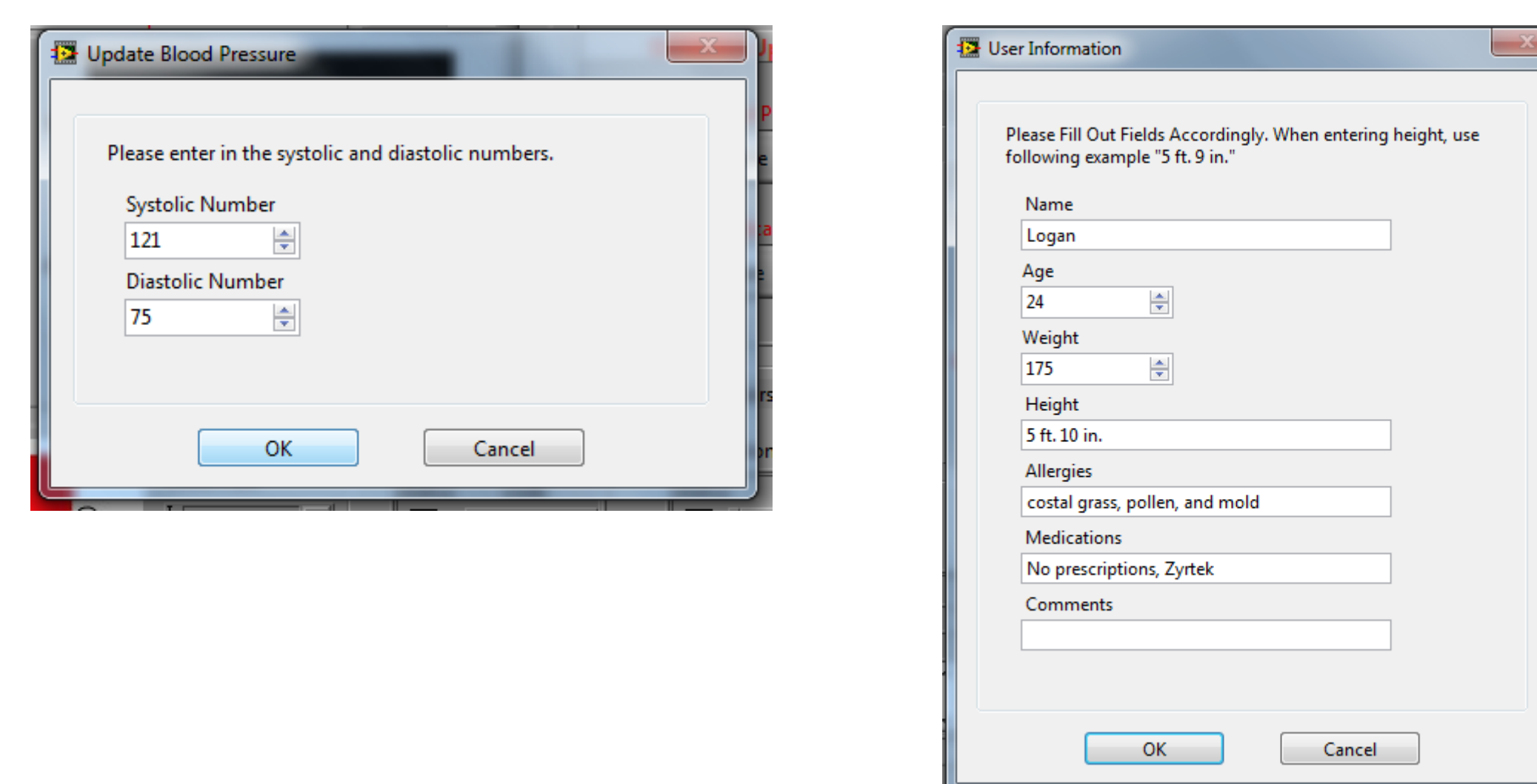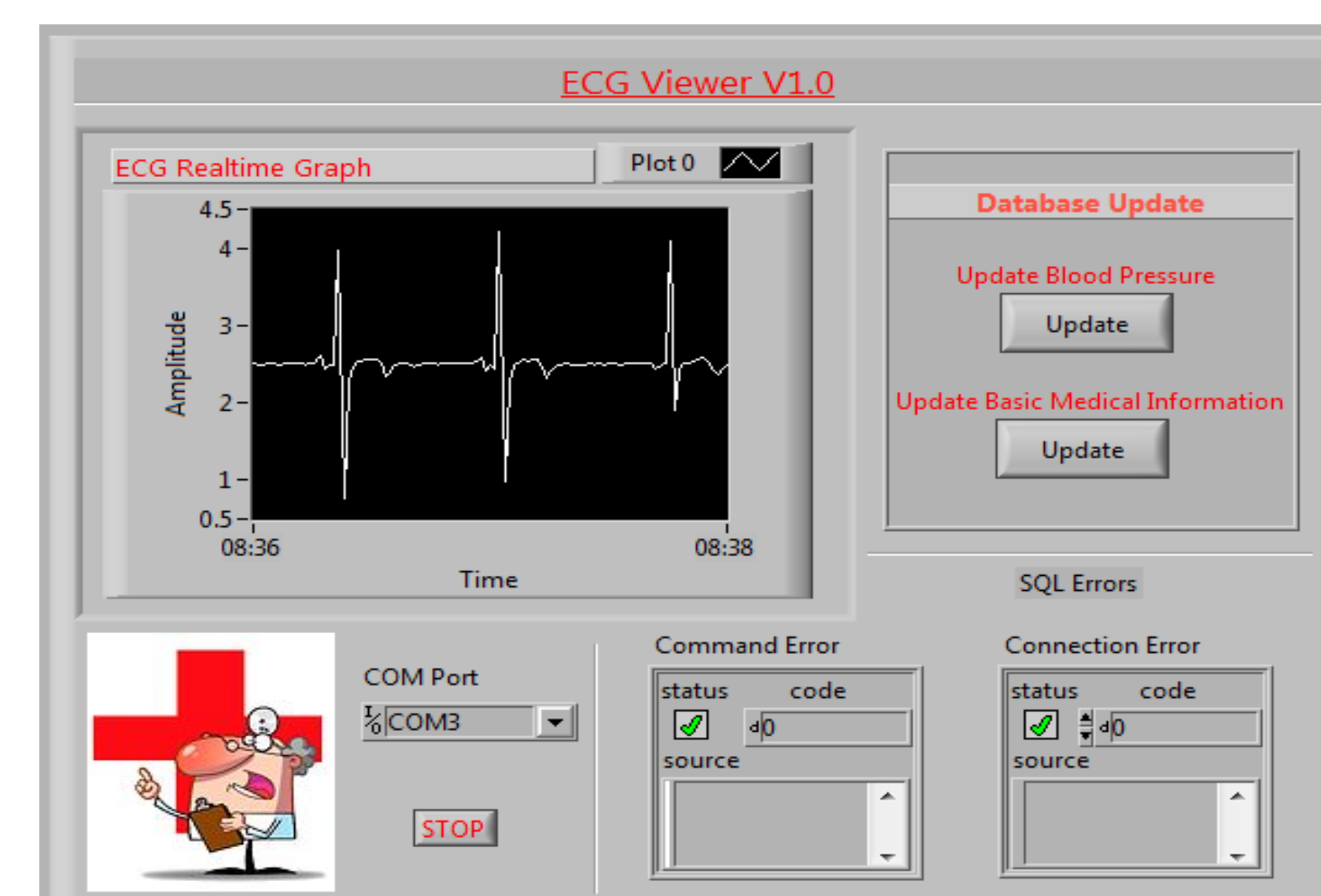

LabVIEW GUI Components

Webpage

The web page serves as one method of remote monitoring. Using various scripts with PHP and JavaScript, values obtained from LabVIEW can be retrieved from the database and displayed onto an HTML page. The ECG graph is real-time and updates as values are saved to the database from LabVIEW. Additionally, the systolic and diastolic blood pressure numbers can be graphed and compared to a color coded references.
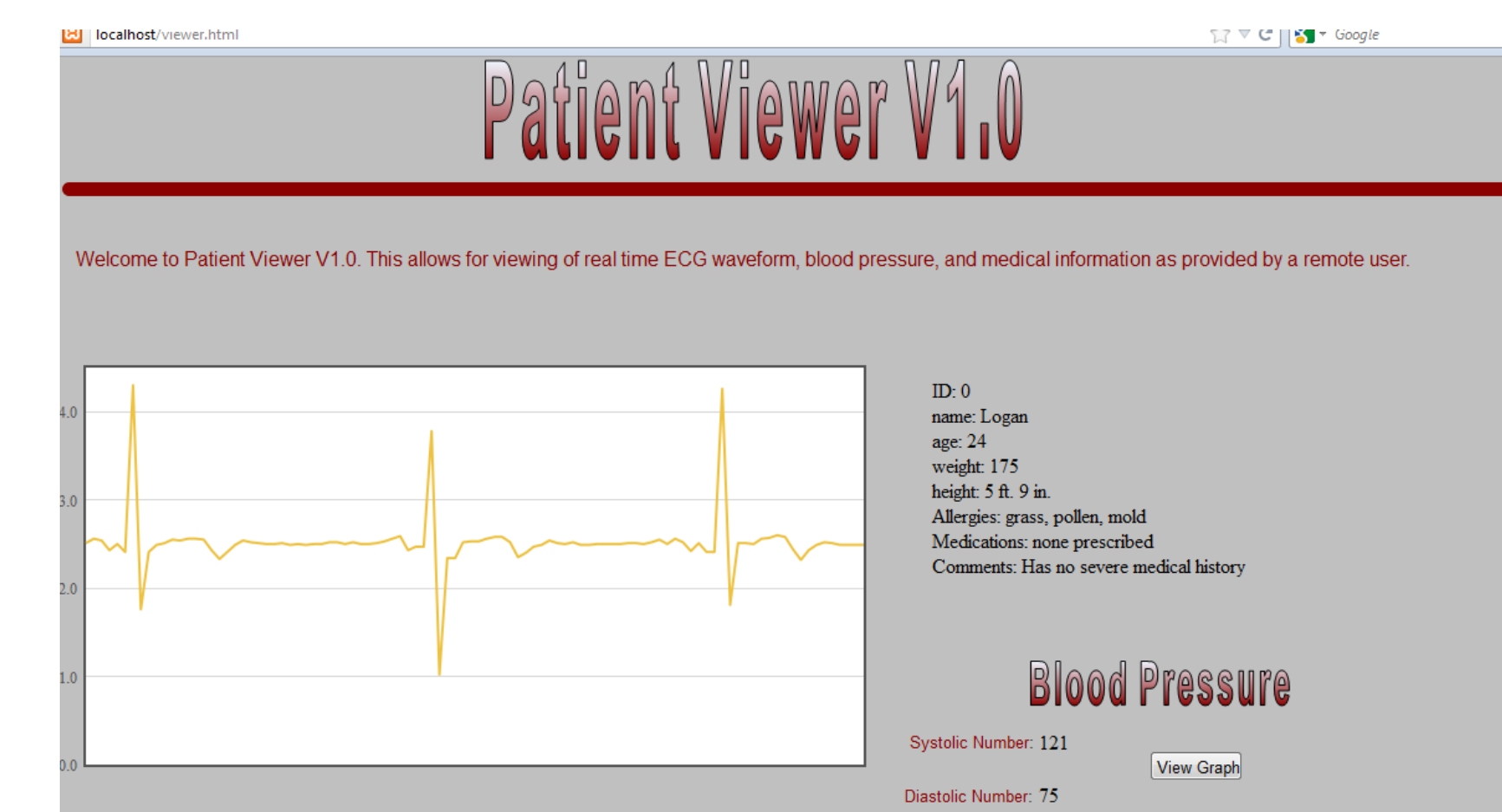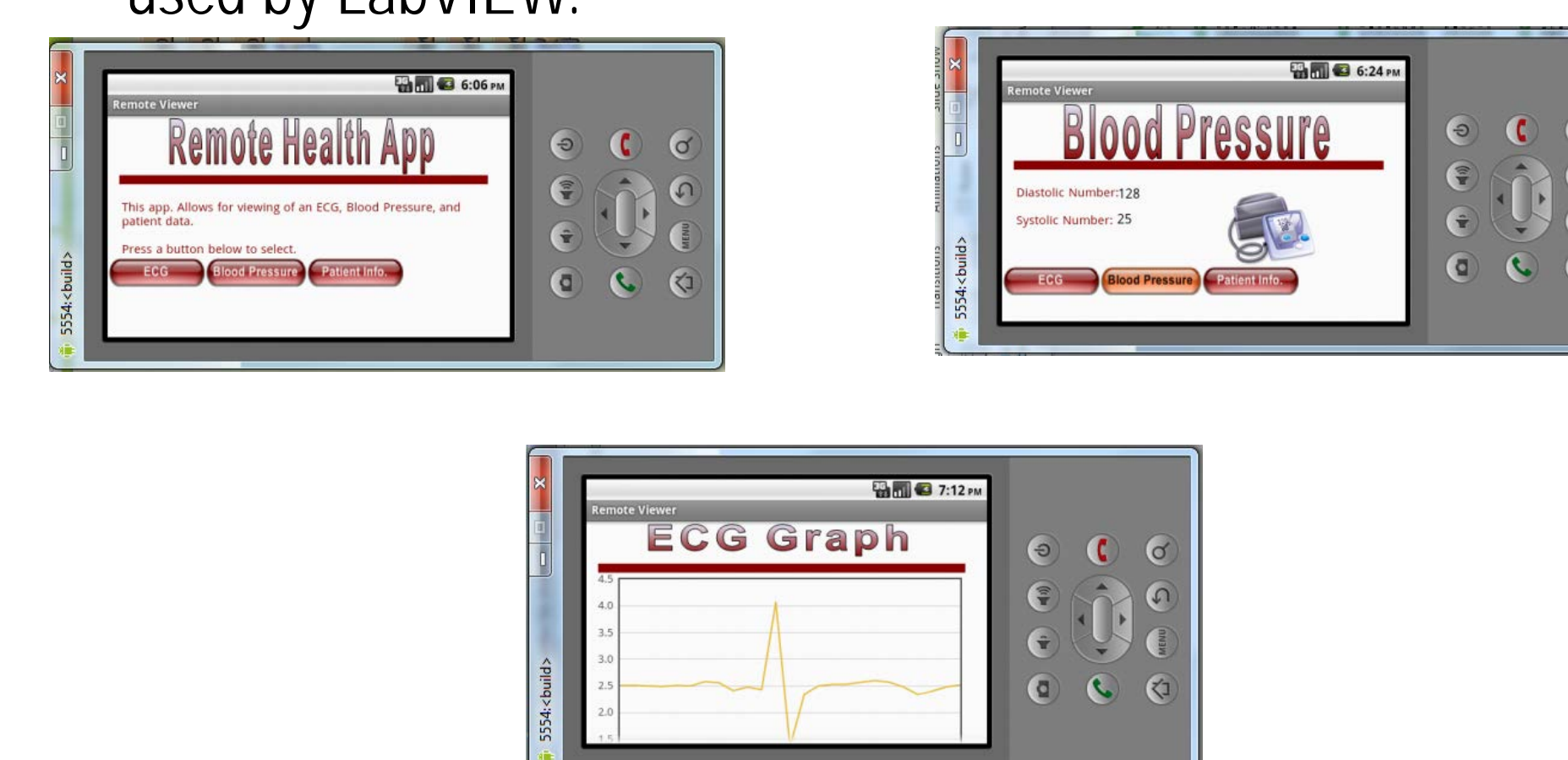

Web Page Front Page
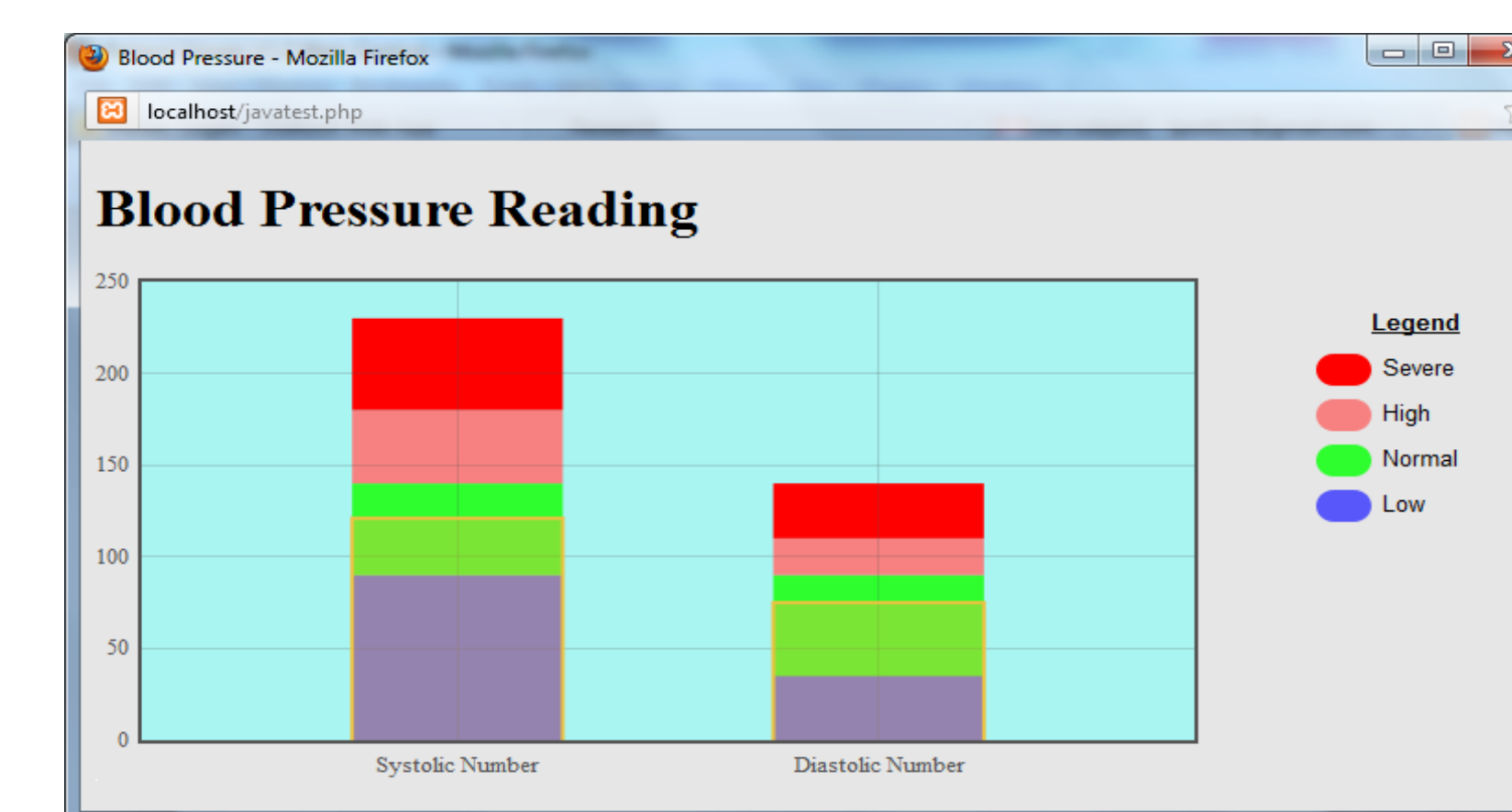

Blood Pressure Graph

Android Phone Application

The Android phone application allows for a more mobile way of remote monitoring. This allows for a quick viewing of data prior to initiating action. The Android application accesses specially designed mobile app. web pages connected to the database used by LabVIEW.

Android Application Emulator Screens

Setup

The device connects to the user with 3 electrodes connecting in the vicinities of the left arm, right arm, and left leg. The device is placed inside a holder to be attached to a belt or pocket. This allows the user to not be encumbered by the device.
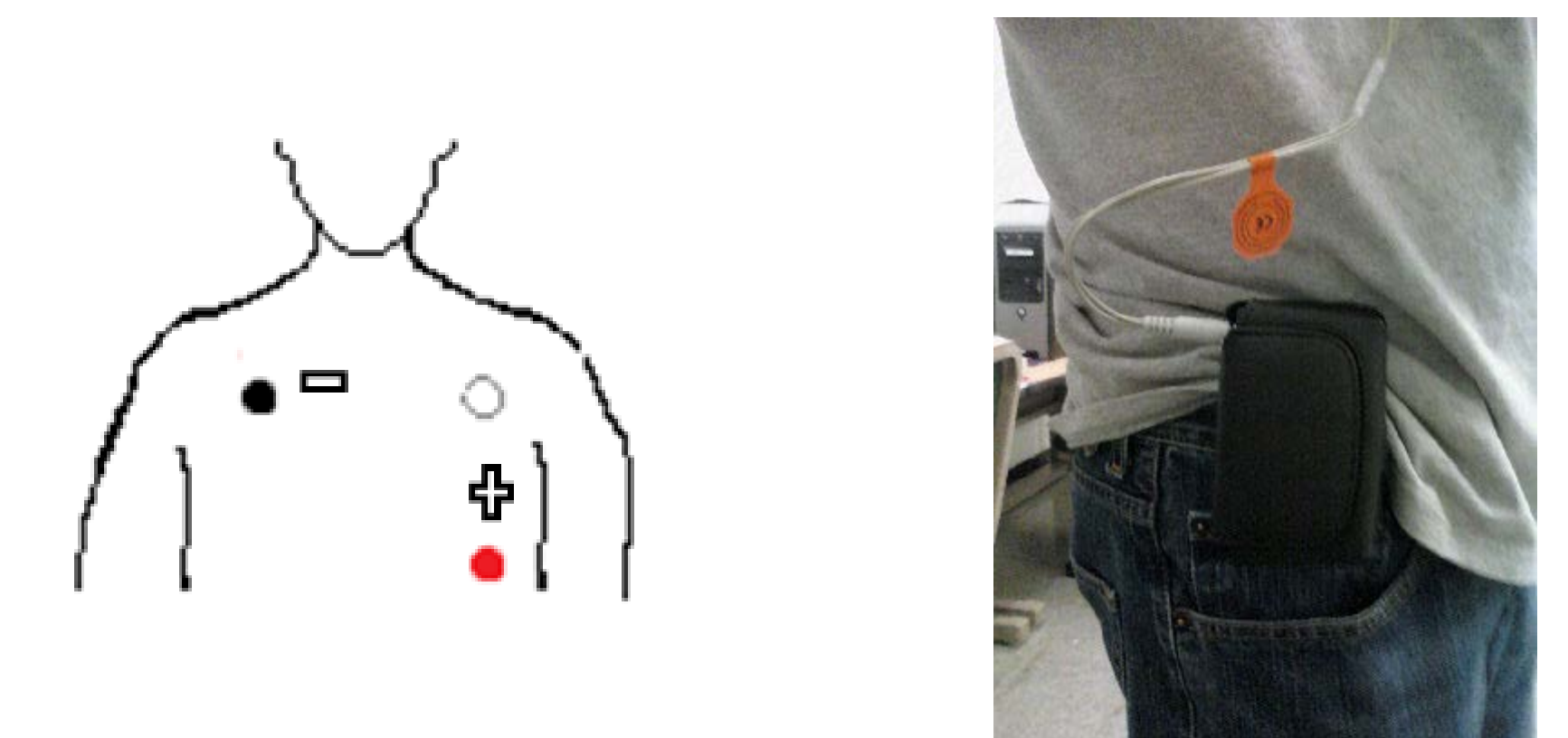
Electrode Setup and Device Placement

Summary

A wireless ECG device was prototyped and remote capabilities were demonstrated through a webpage and Android application. The device was made to operate with 3 leads in a small enclosure which is easily portable. The LabVIEW GUI displays the waveform and allows for further inputs. Through the use of a database, HTML pages were created allowing for web access. This prototype system demonstrates one of the potentials of wireless technology in a health monitoring application.

Future Expansion

ECG was demonstrated in the presented work, but future plans to include more wirelessly monitored vitals are being worked on This includes wireless monitoring of blood pressure, pulse oximetry, body temperature, etc. The end result is to achieve a level of diagnostics that is comparable to physically being at a medical office, while located in a home environment.