First Five: Design Document and Technical Details

Overview

The first moments of a baby's life are crucial, and mostly joyous moments, however what are you meant to do when things don't go as planned? This is the situation that many pediatric nurses are faced with on a daily basis. In the first five minutes after birth, it's critical that the right procedures are followed. Ensuring that these procedures are meticulously timed and correctly interpreted is of the utmost importance, and there is really no margin for error. Creating an app that could streamline this process could help ensure that things are done right, and hopefully help nurses save lives.

When a newborn is having issues with breathing, there is a well defined protocol to follow. This protocol is called the Neonatal Resuscitation Program, a procedure designed by the American Academy of Pediatrics. This program is essentially formed by a series of prompts that must be responded to every 30-90 seconds, depending on the stage the patient is at. For example, one prompt might be: "Is heart rate below 100bpm, or is gasping or apnea present?'. This question would offer two very simple responses: 'yes' or 'no'. If the user was to select 'yes', they would be taken to a screen with instructions with what to do for the next 30 seconds (in this case, 'clear airways'). At the end of the 30 seconds, they would be prompted again about the situation. There are many prompts like this that are important to get right, but it is of course very difficult to commit all these to memory, especially for new nurses.

The design and development of an application that can serve as a timer, as well as offer the relevant prompts could prove to be an invaluable tool for pediatric nurses. These days, it is extremely common for nurses to have some form of web enabled device with them at all times, so this solution would not require them to carry any additional items with them while on the job. Instead of nurses having to interpret the situation, simple prompts can be offered (e.g. 'is the there a good tone to their crying?' 'yes or no'), and their responses would progress them to the next stage accordingly. This means they would merely have to *recognise* and not rely on *recall* which significantly reduces cognitive load.

First Five is a responsive web app that can be used on all web enabled devices, as well as providing native options for users who might want to save it to their phone as an app. It utilises a HTML5, CSS3, JavaScript, PHP, and MySQL, as well as several libraries and frameworks which will be discussed below. The web app can be found at: www.thequickbrownfoxinc.com/firstfive

Back End Architecture

The backend architecture utilises a model-view-controller (MVC) format. Controller files were utilised to facilitate interaction between the front and back end, and acquire relevant content as needed. View files handle all presentation of the site and content.

Controller Files

lookup.php - This file takes the input from the form on 'patient.php' and queries the database with the patient ID entered in the form. It then redirects to 'results.php' to display this data.

store.php - This file is triggered when a user opts to save results, and it adds the results to the database. It also queries the database for the ID generated for these results, and then redirects to 'saved.php' to display this ID.

View Files

index.php - This is the primary page on the site and displays the primary timer as well as the prompts and buttons for users to respond to.

documentation.php - This page has the First Five video, a download link for this doc, and a full user's guide on the primary functions of the application.

patient.php - This page is found via the 'Results' tab on the nav bar, and is simply a form where users can enter a patient's ID to look up their outcome.

results.php - This page displays a requested patient's outcome.

saved.php - This is a confirmation page that tells the user if the last results have been saved, and gives them the patient ID of the data that was saved so they can look this up again later.

Database

First Five utilises a MySQL database, and uses PHP to interact with it. In the First Five database, there is one table called 'patient'. Its columns are as follows:

id (autoincrement) - a unique identifier for a patient

depth - this indicates the final prompt (i.e. the outcome) of the NRP

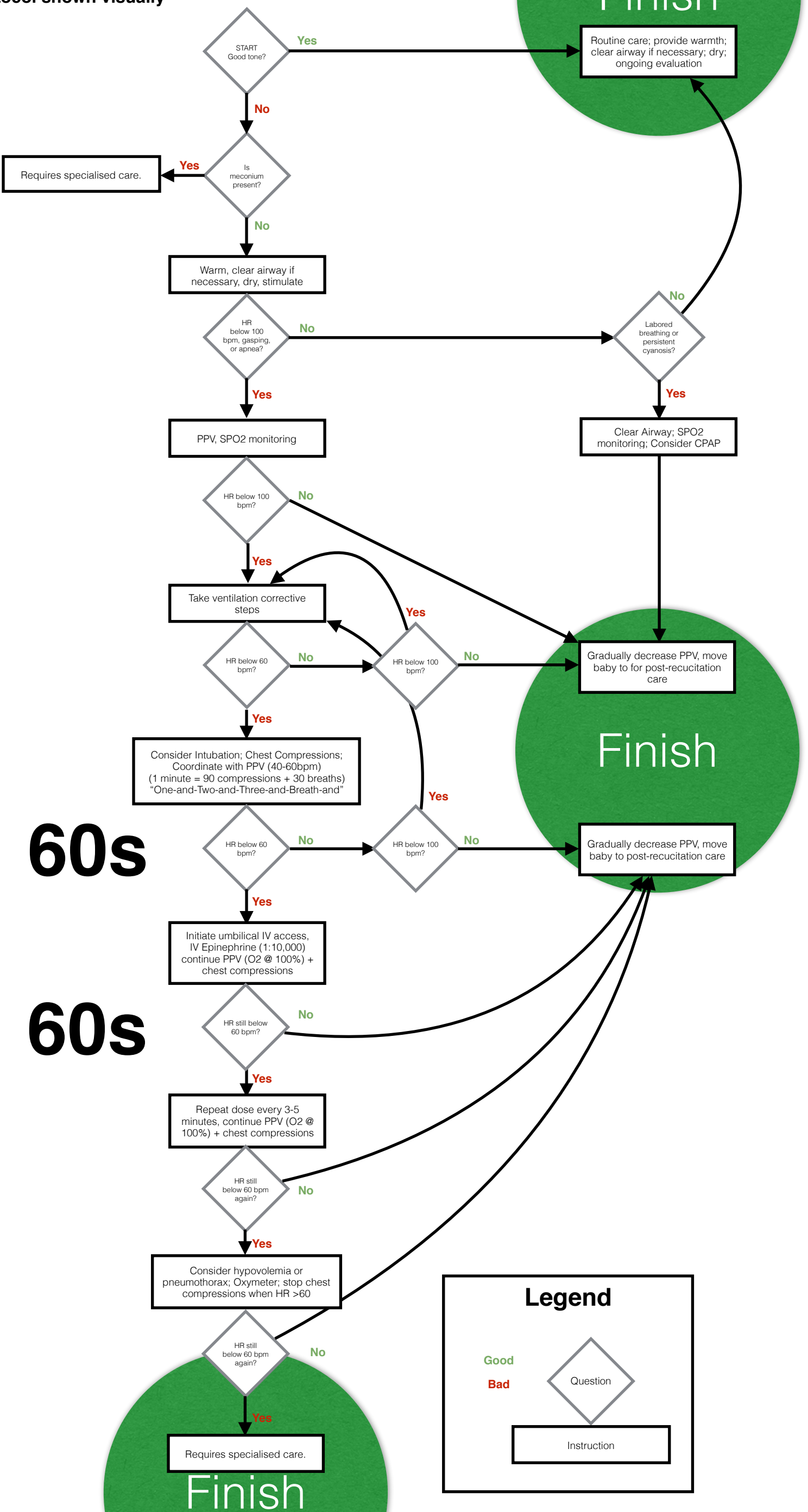
time (current timestamp) - this indicates the time at which the final outcome was

Front End Design

The site is roughly divided into three main sections: NRP prompts, Results, and the How-To Guide. The NRP prompts make up the primary use of the app, as it has the timer and prompts. As a user, it is simple to use, simply having to respond 'yes' or 'no' based on the current prompt. When a user selects their response, their 'depth' is updated (as per figure 2 below) and a new prompt is offered. When the reach the end of a sequence, they are offered the option to save their results, where they are then given a unique patient ID they can keep and search for later. On the Results page, users can enter the patient ID for the relevant patient, that they were given when they ran through the NRP prompts. Upon submitting this form, the database is queried for the results and time taken for that patient ID, and these results are shown to the user. Finally, the How-To Guide, which serves as the required documentation, is simply where users can learn about how to use the app, and also includes a disclaimer about the app's intention to be used by medical professionals.

All custom javascript is contained in the 'main.js' file. There are several small functions for doing things like pausing and resuming the timer, adjusting the placement of the html elements and content, etc.. But the primary function of this file is to track a user's progression through the steps in the protocol. The simplest way to explain these functions is visually, and so a flowchart of the protocol is shown below in Figure 1, and a translation of this into the javascript function can be seen in Figure 2.

Figure 1: The Neonatal Resuscitation Protocol shown visually



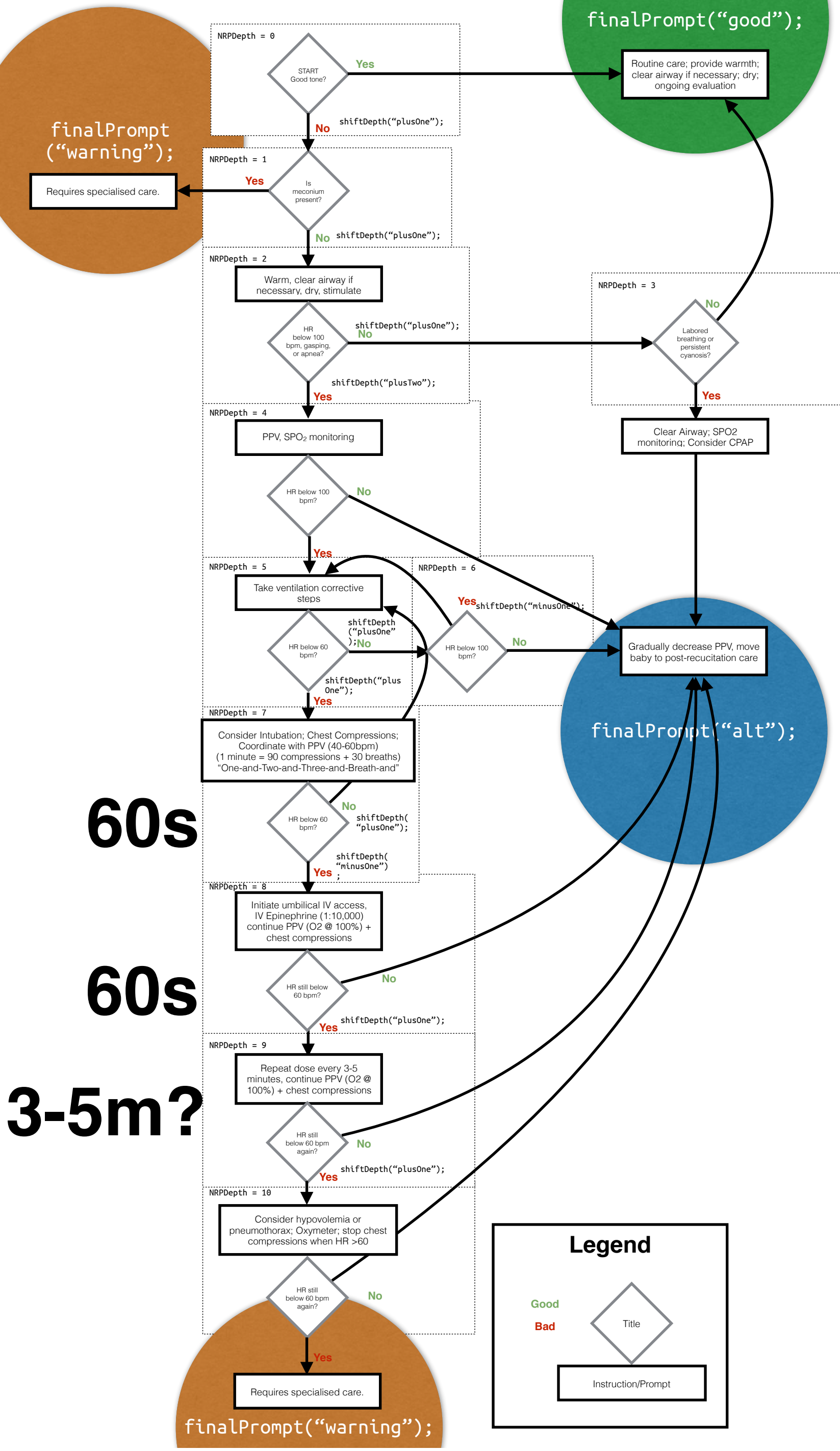


Figure 2: The NRP translated into function. Shows all core functionality of main.js

User Testing

The design of the site was intentionally kept very simple, utilising a colour palette of blues and greys, and then green and red to highlight important information. The site offers no other information other than what is needed, to minimise any chance of distraction. Some very simple user testing was conducted mid way through the project, in the form of semi-structured interviews with pediatric nursing students. The findings of this were simply to make the number on the timer bigger, and to be careful with the colour of the 'yes' and 'no' buttons. The issue there was that previously, the 'yes' button was always green and the 'no' button was always red. Now the difference is that green always indicates a positive health outcome and red always indicates a negative health outcome.

Libraries & Frameworks Used

Bootstrap is a front-end user interface framework developed to improve consistency and reduce the burden of maintenance required for small- to medium-sized web applications. The framework features a responsive design and graceful degradation, which makes it device-agnostic and accessible on a wide array of software and operating system platforms, so content and functionality can be optimally viewed and used regardless of the end-user's system. Although many such frameworks do exist to help solve these problems, Bootstrap is arguably the most well-supported one, as evidenced by the fact that it is the single most contributed and favorited repository on the well-known decentralised version control system, GitHub. NASA is one of many reputable organisations whose websites use the framework for these very reasons.

Bootstrap also provides support for font-icons, such as Glyphicons and Font-Awesome, which have several usability benefits over traditional image icons. These benefits include enhanced browser compatibility, scalability, and simplicity, helping to communicate complex ideas to audience in way that does not depend heavily on the user's familiarity with any particular language or culture.

One of the problems with popular frameworks is that once many people start to use them, many websites and applications start to all look the same. A theming framework known as Bootswatch which provides simple, modular styling components, was designed to help with this problem.

One further advantage to web applications with solid responsive design is gradually rising to prominence

as users expect websites to be more like apps on their smartphones. Modern, dynamic app-like websites that adapt to and learn from the user are becoming more popular, and developers must respond to these evolving expectations as the technology moves along to support them.

Adobe's free PhoneGap software is a recent innovation that bridges the gap between native app and website application by producing mobile device-native code. Developers no longer need to spend time and effort rewriting applications into multiple incompatible languages, but can instead focus on creating a single, well-designed responsive web application. First Five has been turned into an Android App using this service, and is available on the Google Play Store.