

# TV-CV19 Telemedicine App and Universal Ventilator Controller

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## 1. Project Charter

COVID19 is an ongoing, global pandemic, stretching healthcare resources and systems to their limits. TV-CV19 is an ongoing effort aimed at addressing the shortage of healthcare providers and ventilators, both of which are necessary for effective treatment. The TV-CV19 project is a web application that provides healthcare workers and volunteers with a simple-to-use interface to track and manage their patient populations, and a universal ventilator controller that interfaces with the plethora of makeshift ventilators being designed by teams around the globe.

### 1.1. Project Overview

This project is separated into two components, which are to be integrated into a single, final product. The first component consists of an open source telemedicine application that enables healthcare workers and volunteers to provide care they otherwise could not provide by themselves. The app provides healthcare providers instant access to patients, with a video feed and real-time patient data that can be used by the supervising provider to assess a patient's condition. The second component of this project is the integration of makeshift ventilator controls into the application.

### 1.2. Project Approach

Our goals will be achieved by two development paths, which will ultimately coalesce into a single final product.

#### First Approach:

- Address the lack of healthcare workers by providing a usable interface for caretakers and volunteers to manage their patients.
- Enlist community help as we can set up live streams of the patients as well as their current monitor levels.

- The app will allow clinicians and nurses to oversee their volunteers and will allow for quick escalation of concerns to be addressed.

Second Approach:

- Provide a control interface for the myriad makeshift ventilators currently being designed and implemented in hospitals around the world.
- Physicians and respiratory therapists are accustomed to a particular set of control parameters on the ventilators they use.
- Important that the incoming wave of makeshift ventilators feature many of the standard control parameters found on FDA-cleared machines.

### **1.3. Project Major Deliverables**

- a minimum viable product (MVP) version of the TV-CV19 app.
- allow the app for the interfacing of clinicians, nurses, and volunteers to monitor patients and communicate
- integrate universal ventilator controls(tentative)

*For a description of deliverables and milestones, see Section 4.*

### **1.4. Constraints, Risk, and Feasibility**

There are many aspects of this project which present constraint and risk. The primary constraint to this project, and all other projects in the time of COVID19, is social distancing and the requirement to work from home. This constraint prevents us from getting immediate help as you would in a collaborative workplace environment.

The risks of this project revolve around the unknowns at this point, such as if the technology will be feasible, or will the customer accept our solution. The technology might not be feasible as there are many pieces of the project and we are unsure if everything will work properly together.

This project will be greatly feasible as it is relatively simple to build and code, however putting it together will be a challenge. The constraints and risk must be considered in the design process as they can make or break the project.

## **2. Group Management**

### **2.1. Roles**

This project extends beyond the CSE145/237d Embedded Systems course. There is a larger team composed of UCSD students and volunteers who are invested in development of this project. Jeremy and Bryant will be helping the established team where necessary, and will work as a flat organizational structure between one-another.

- Project Lead - Michael Barrow
- Web Design Lead - Jennifer Lueng
- Web Development Lead - Chris Crutchfield
- Web Development Lead - Stephen Barrow
- Integration Lead - Mustafa Gobulukoglu
- Many more on the team

### **2.2. Decision Making**

Project decisions will be decided by consensus between Bryant and Jeremy.

### **2.3. Communication**

The primary channels of communication will be UCSD email, Scalable CV19 Solutions Slack Channel, and direct iMessage.

### **2.4. Scheduling**

For scheduling, the milestone breakdown will be used to schedule todos for the given week. It is wise to use an agile development plan for this project, therefore the team members will plan out the implementation details of their week around when they are starting that part. Weekly meetings will be held with the team and therefore making it easier to keep everyone accountable.

### **2.5. Responsibilities**

Both team members share responsibility for all milestones. Specific tasks will be assigned on an ongoing basis, as needed.

## 3. Project Development

### 3.1. Development Roles

Bryant: Software

Jeremy: Hardware

### 3.2. Hardware and Software

For Hardware, a Raspberry Pi will be used for the makeshift ventilator control (we already have one)

For Software, the app will be written in Angular(Frontend) and C#(Backend). The Raspberry Pi will be interfaced through the webserver.

### 3.3. Testing

Regression testing is already built in the code for the app, if there are significant issues, the project can roll back to the previous git commit. This regression testing is done automatically. For hardware, there will be a functionality test for each addition we make to the project.

### 3.4. Documentation

The documentation for the test will be done in github as the code is being written. At the end, there will be documentation for each API route as well as how each page works and what it requires.

## 4. Project Milestones

### 4.1. Milestone 1 - Complete First Angular Page View

Deadline: April 30, 2020

Expected Effort: 15 Hours

- Get familiar with the existing code base
- Learn Angular
- Build the front view of the screen, put all the checklist items on page
- Incorporate functionality of the checklist onto the page
- Push code back to code base and check for issues
- Integrate to the backend with correct routing

## 4.2. Milestone 2 - Complete Two Additional Angular Page Views

Deadline: May 12, 2020

Expected Effort: 20 Hours

Based on the knowledge from Milestone 1, construct more of the pages.

*\*Views to be completed will be directed by web-dev lead at the appropriate time.*

- Build the doctor/nurses menu
- Build the front end view of that page views
- Integrate functionality to their page views
- Integrate to the backend with correct routing

## 4.3. Milestone 3 [Update May 5, 2020] - Integrate gtest Framework with Arduino Extension ARTe

Deadline: May 12, 2020

Expected Effort: 20 Hours

Because the TVCV19 project will be controlling patient-facing medical devices (ventilators) the FDA requires the code base be constructed using strict unit testing and regression testing methods. The Ventilator API library is being written in C++, and is intended to be run on an Arduino Due. The code will be compiled using the standard Arduino compiler with the Arduino Real-Time Extension (ARTe). gtest is a well-established framework for C++ unit testing and regression testing, but does not easily integrate into the Arduino IDE and a separate testing compilation toolchain must be established.

## 4.4. Milestone 4 - Integrate Angular/Webapp code with Native code

Deadline: May 21, 2020

Expected Effort: 20 Hours

- Porting web app/Angular code into native code such as Cordova or its derivative Ionic
- Make the routes align from the native app as they do in the webapp
- This will allow the app to be browser independent

#### 4.5. Milestone 5 - Integrate Raspberry Pi Based Makeshift Ventilator into Existing App Framework

Deadline: June 1, 2020

Expected Effort: 20 hours

- Integrate the native app with the makeshift ventilator
- Add the calls from the native app's controls to call the webserver
- Allow the C# web server to interface with the hardware