Project Plan of

Ventilator Weaning Assistant System (VWAS)

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Introduction

A ventilator weaning assistant system (VWAS) is able to help the doctor in the ICU to check the conditions of the patients with both machine learning and rule-based protocols. It will remind the doctor about the condition change and suggest the possible starting of weaning process. The goal is to minimize the work of the doctor and VWAS is able to put all the necessary information together to benefit the doctor. Doctors won't be able to review all the results once they are available thus the current system lacks, while VWAS will be able to collect all the results once they are available and make some suggestions whenever the new results come. At the same time, VWAS will be able to provide some summarization of all the patients in the ICU, such as average length, available ventilator units, race/gender/age distribution.

Project organization

The responsibility of each team member is listed in Table 1.

Table 1 Responsibilities of Team Member

Team Member	Primary Role(s)	Responsibilities
Xu Shi	Project Management, Weaning Protocol Research	Coordinated team meetings, Weaning protocol research, Technical writing and editing, and QA
Xiaoyang Xia	Weaning Protocol Research, Database Developer	Weaning protocol research, Handling FHIR server, Technical writing and documentation
Xingdan Wang	Full Stack Developer, Architect	Lead the frontend design and development, JS programming, visualization, GitHub deployment
Kunming Zhu	Machine Learning	Lead the machine learning part: model selection, model training, and optimization

Chen Hu	Frontend Developer	Front end design, Data Preparation and Visualization, Update the Gantt charts and other records management
Manfred Chan	Data Generation and Optimization	Lead data generation, reformatting, and optimization for machine learning, Technical writing and editing, and QA

Management

The estimates of the time frame of the project is shown in Figure 1.

Name	Week 8 3/1/2021	Week 9 3/8/2021	Week 10 3/15/2021	Week 11 3/22/2021	Week 12 3/29/2021	Week 13 4/5/2021	Week 14 4/12/2021	Week 15 4/19/2021	Week 16 4/26/2021
Xu Shi	Proposal Preparation	Project Design/Implementation Plan		Weaning Criteria Research		Clinician View Design & Implementation		Final Documentation Preparation	Team Evaluation
Chen Hu	Proposal Preparation	Project Design/Implementation Plan		Weaning Criteria Research		Clinician View Design & Implementation		Test bug fix & Final Presentation	Team Evaluation
Xingdan Wang	Proposal Preparation	Project Design/Implementation Plan		Research on Synthea		Clinician View Design & Implementation		Integration Test & Final Presentation	Team Evaluation
Xiaoyang Xia	Proposal Preparation	Project Design/Implementation Plan		Research on Synthea		Population View Design & FHIR Server Connection		Data Upload	Team Evaluation
Kunming Zhu	Proposal Preparation	Project Design/Implementation Plan		Algorithm Selection		Population Health View Design & Implementation & Testing		Test bug fix & Final Presentation	Team Evaluation
Manfred Chan	Proposal Preparation	Project Design/Implementation Plan		Algorithm Selection		Artificial Patient Data Generation	Testing	Integration Test & Final Presentation	Team Evaluation

Figure 1 Estimated Time Frame of the Project

The schedule will be updated through the project and a final Gantt Chart will be produced at the end of the project and will be provided separately.

The predevelopment part of the project will be focusing on the weaning protocol and selection of program language and associate libraries. Possible candidates including Python, JavaScript, Flask library, Django library, Scikit-learn (sklearn) library and Numpy library.

The engineering part includes data generation, frontend, backend development and machine learning development. Synthea will be used to generate synthetic patient data. At the end of this phase, a demo application will be provided for testing.

The postdevelopment part will focus on testing and final presentation. An application deployment will be finalized in this phase.

Project control

In order to make sure a deployable application can be delivered by the deadline, a weekly internal meeting will be set up. Also, an external meeting with TA will be set up on a weekly basis. The project timeline will be updated weekly based on the real progress. Questions and technical hurdles need to be communicated through Microsoft Team so they can be addressed in a timely manner. If help is needed from the TA, questions need to be posted on Slack/email.

Maintenance and support

Since this is only a term project, no plan for the maintenance and support is provided.

Risks associated with software development planning

The major risks based on the scope of the project includes:

1. Synthea generated patient data may not have all the data needed for the weaning protocol, and even if it does, it may not be accurate enough. Synthea randomly generates data based on a range. This will decrease the accuracy of the machine learning model.
2. Training machine learning models requires having sufficient data, but there may not be enough to train one to the point where it outperforms a rules-based system. Since the data is generated by Synthea, output data quality is hard to control. It may not be able to generate balanced data to train the model.
3. Mechanical weaning process is a very complicated process and it really depends on the doctor's experience. With the available data, it may be extremely hard to predict every step of the weaning process.
4. Since the team members are from different parts of the US, efficient communication may be hard.

A risk reduction plan is also prepared to minimize the possible risk.

1. Try to provide weighted data by using Synthea and make it more close to the real ICU situation.

2. Try different models and find out the best accuracy one. Since the focus of this project is not the machine learning part. Efforts will be taken to improve the model to the best we can.
3. In order to make the VWAS deployed by the end of this semester, we will not cover all the steps of the weaning process instead we will focus on recommending when to start the weaning process.
4. Microsoft Team and Slack will be used to communicate between team members.

With these actions, the estimated risks will be reduced to a minimum level.