Section 1: Background

User guides and do it yourself step by step instructions are an extremely valuable resource to those interested in repairing things without going to a business. Currently, sites such as *Chiltondiy* provide a method for hobbyists to access manuals, documentation, and step by step guides, but only provide one size fits all guidance.

1.1 Existing Problems

While guides are available to purchase online or in person, those unfamiliar with home repair often struggle to follow them. Guides commonly provide diagrams of needed steps to achieve the repair, but cannot account for variations, and often only show the component of interest without any surrounding parts. This results in situations where, while an individual may have purchased a guide and located the section on the part of interest, they struggle to translate this into making repairs. Likewise, many parts require a series of steps to remove or replace, often presented in a condensed list in guides. Some steps may be easily missed by inexperienced hobbyists, as guides provide no feedback if a step is followed correctly or missed.

1.2 Current Technology

In recent years, image processing and augmented reality functionality, software, and libraries have advanced significantly. It is now possible to easily transform images using libraries such as *Scikit-Image*, and phone software and hardware allows applications to make changes to incoming video. Combined, these developments allow for easier and more specialized augmented reality.

Scott Fairbanks, an instructor at Oregon State University, has recognized these issues and developments, and proposes an application geared towards solving them.

Section 2: Vision

With an app that can function as a better replacement for repair manuals, many users can attempt technical tasks with confidence. This app will not only help individuals fix their problems, however, it will also inspire a belief in oneself in trying new difficult jobs. Through the app, users will be instructed step by step on how to complete their task at hand. Instead of possibly outdated images, users will better understand the steps necessary through their own phone's camera by highlighting objects on screen. Thorough instruction will ensure everyone from a mechanic to a highschool student can attempt tasks such as replacing their car's air filter.

2.1 Central Hypotheses

Growth Hypothesis: Many users already pay for technical instruction manuals on websites for the convenience of having instruction manuals online. Utilizing an app that provides user specific instructions instead of the archaic images provided on many manuals will draw users in as they will find the task at hand easier.

Value Hypothesis: Using the user's camera to allow for specific instructions rids the user of any uncertainty created by a normal instructions general image. Ridding the instructions of any confusion that can be caused by approximate images allows for an easier task, and instills confidence in the user by instructing them every step of the way.

2.2 High-Level Requirements

Functional Requirements: Once opened, the app comes to an instruction selection screen that lists all manuals available to the user. The user then can select the desired instruction set such as "Change Air Filter Honda Civic 2016 - 2020", which takes the user to a screen displaying their camera view. The app then displays the first step of the process, which is to open the hood of the Honda Civic in this case. Once the user taps the next instruction button the app then looks for what it recognizes as a Honda Civic air filter, then once found in camera view highlights the next step on screen, which is to unscrew the screws. If the app cannot recognize the desired object, it will ask the user to replace the camera to allow object recognition. This highlighting is done through Augmented Reality technology, allowing the user to see highlighted screws from most angles in 3d space. Once the user unscrews the screws and presses next step the air filter top is highlighted as taking it off is the next step. This process of highlighting each part is continued until the user has reassembled the air filter completing the process.

Non-Functional: The main technology this app uses is python's scikit library to identify objects. After an object has been identified utilizing the phone's camera (iOS only) the object will be colored in a specific color. The entire app will be designed utilizing xCode to design Swift code to allow for iOS development. Furthermore, the application should have no or little lag time between video recording and video augmentation, to ensure that augmented reality added to videos is useful to users.

Section 3: Prioritized Project Constraints

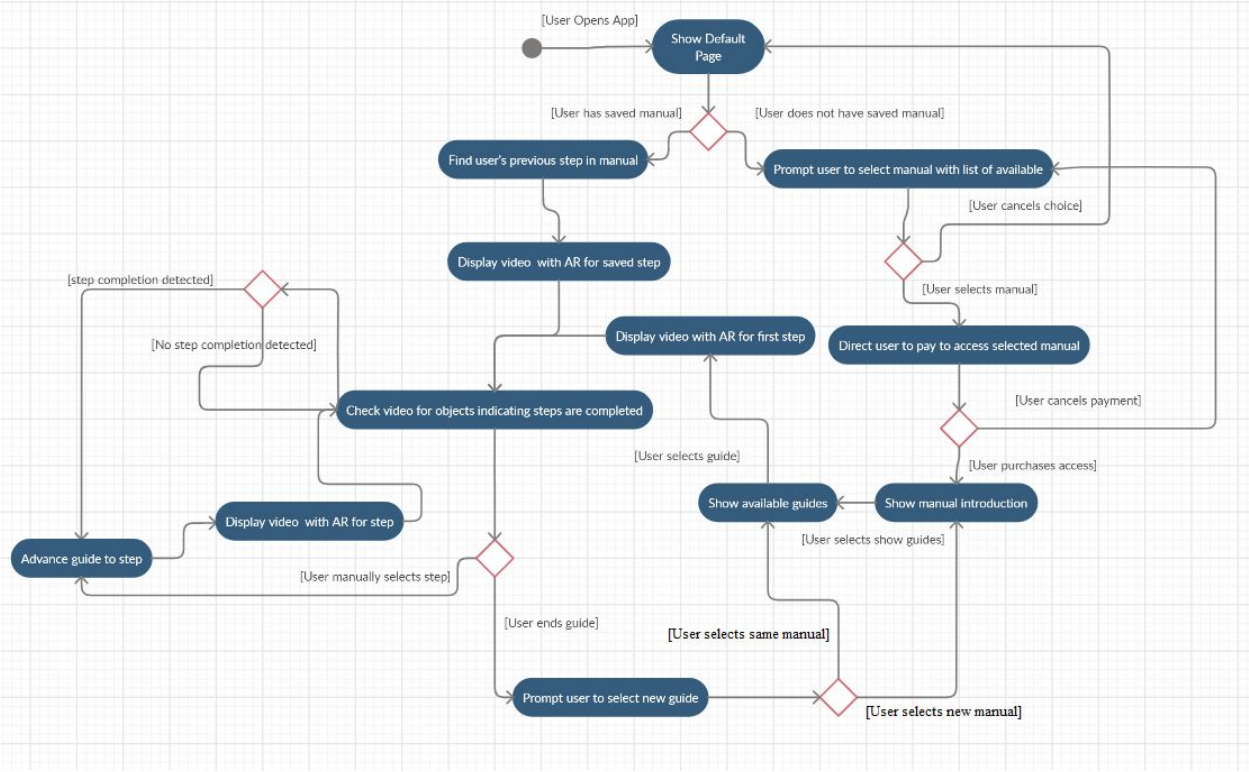
TIME: The largest time constraint the project is under is simply the timeline of the academic process. All members of the group are taking other classes, and the class itself only lasts three terms which sets a hard deadline on the project. This class environment also provides a great outline of time management. The Senior Software Engineering Project is a 3 credit course, and as most courses describe a student can expect to spend 3-4 hours a week studying per credit, thus a reasonable amount of time for a group member to average a week is around 12 hours. This time constraint plays a role into the central systems of the app, however, it seems that this time limit will affect the amount of different tasks that are natively in the app.

RESOURCES: Luckily, each group member has most of the technology to build this app. With iOS being the platform the app is designed for, every group member needs an Apple computer in order to run Xcode. The members that do not have access to an Apple computer have been granted access through Mac server space. An iOS phone is also necessary to test the app, however, all members personally own one, negating the need.

SCOPE: As previously stated, the scope of the project is well defined, with the main goal being an AR app that can provide an alternative to a repair manual. Once the base system has been developed, tasks will be needed to individually documented and input into the app, which is very time consuming. The scope as discussed with the project partner is to at least have 2 different full processes that can be done with no other instructions than what the app provides through its AR interface.

Section 4: Scope

4.1 Process Flows:



4.2 User Stories:

1. As a mechanic, I need a simple user interface so that I can follow the guide as I complete the job.
2. As a novice I need well worded instructions so that I can complete tasks I previously thought were too hard for me.
3. As a user I need the AR coloring to be clear enough to see each part I am supposed to manipulate so I can quickly complete the project.
4. As a skeptical user, I need the object I am working on to be recognized so I can work on the project from most angles I want.

5. As a user, I need an application so that I can access the AR guides.
6. As a user, I need to see markings on video of parts so that I can know what the next step is and avoid confusion.
7. As a user, I need a way to specify which guide to use so I can fix my problem.
8. As a user, I need the app to save my progress on a guide, so I'm not confused.
9. As a developer, I need a way to specify locations of interest on objects in videos so that I can create augmented reality guides for customers.
10. As a developer, I need a way to use python code in the application, so that I can utilize python libraries for image processing.
11. As a project partner, I need a functioning prototype of the application so that I can gauge the feasibility of continuing it.

Section 5: Iteration Plan and Estimate

Sprint 1

This sprint focuses on creating a basic app and basic image augmentation. This will provide later sprints with something to work off, and ensure testing is possible.

Estimated backlog items:

Create an application to house the AR guides

Sprint 2

This sprint focuses on implemented necessary features to the app created in sprint one. Access to camera video, augmented reality APIs, and allowing python to be used by the app are aspects of this sprint.

Estimated backlog items:

Allow application to augment video input from phones

Ensure augmented reality libraries can be used in the application

Sprint 3

This sprint focuses on refining the image processing capabilities of the application. Proof of concept object and part location are the main aspects of this sprint.

Estimated backlog items:

Identify objects and parts in images and augment the images

Sprint 4

This sprint focuses on translating image processing to video processing. Proof of concept video augmentation based on previous image modification is the main aspect of this sprint.

Estimated backlog items:

Identify objects and parts in video and augment the video

Sprint 5

This sprint will focus on creating systems to allow different object and part detection to be used with each step in a guide. Creating easily expanded functionality allowing for steps is the main aspect of this sprint.

Estimated backlog items:

Create a method to allow developers to specify steps in guides

Sprint 6

This sprint will focus on creating systems to allow different object and part detection to be used to change steps in a guide. Creating easily expanded functionality for automatically changing steps based on video content is the main aspect of this sprint.

Estimated backlog items:

Create a method to allow developers to specify object configurations to change steps in guides