Smart Saw

DESIGN DOCUMENT

SD32
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Executive Summary

Development Standards & Practices Used

Osha Health and Safety standards will be followed when testing and operating the saw

IEEE 1118.1-1999: Use of microcontroller to control and communicate with sensors within device

IEEE C95.1-2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

IEEE 2030.2.1-2019: IEEE Guide for Design, Operation, and Maintenance of Battery Energy Storage Systems, both Stationary and Mobile, and Applications Integrated with Electric Power Systems

IEEE 2700-2017: Standard for Sensor Performance Parameter Definitions

IEEE 7.8.1: To accept responsibility for health. Safety, and welfare of the public and to disclose factors that could possibly endanger the public

IEEE 7.8.2: To avoid conflict whenever possible

IEEE 7.8.3: To be honest and give realistic estimates about data

IEEE 7.8.4: To reject Bribery (Signed contract with Pachyderm Ind.)

IEEE 7.8.5: To improve the understanding on the technology along with its benefits and consequences

IEEE 7.8.6: To maintain competence and be qualified for the task at hand

IEEE 7.8.7: To seek, accept, and give criticism about technical work

IEEE 7.8.8: To treat fairly of all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, and gender expression

IEEE 7.8.9: To avoid hurting others along with their employments and reputation by false or malicious action

IEEE 7.8.10: To assist colleagues and co-workers in their work by following the IEEE code of ethics

Summary of Requirements

Functionality

- Wireless control
- Improve user experience
- Digitally read in orientation of the saw
- Digitally read in position of jaws, main chainsaw rotation bar, chainsaw motor
- Improve battery efficiency

Resources

- Motor encoders (Specific brand TBD)
- Arduino Uno
- Tilt sensors (Specific brand TBD)
- Transmitter and receiver module

Aesthetics

- Easy to understand design
    - Warning and danger indicators for components that can cause harm(jaws and chainsaw)
- Organized and covered wires/electronics

User Experiential

- Easy to understand and ergonomic controller
- Readily available safety features

Economic/market value

- Main chainsaw chassis made from plastic
    - Design will be 3d printed for the scope of this project
- Chainsaw is electric

Environmental

- Chainsaw is electric

UI

- Intuitive controls
- Easy to connect saw and controller

Applicable Courses from Iowa State University Curriculum

EE 333: Electronic Systems Design, CPRE 288: Embedded Systems I, EE 201: Electric Circuits, EE 230: Electric Circuits and Systems, EE 285: Problem Solving Methods and Tools for Electrical Engineering, EE 185: Introduction to Electrical Engineering and Problem-Solving I

New Skills/Knowledge acquired that was not taught in courses

Project documentation, project planning , building a BOM, material acquisition and research, and team communication.

Table of Contents

List of figures/tables/symbols/definitions (This should be the similar to the project plan)

BOM - (Bill of Materials)

IEEE - (Institute of Electrical and Electronics Engineers)

1 Team

1.1 Team Members

David Kruse

Mitchell Kistner

Austin Mackedanz

Jace Fedler

Lance Longhorn

Patrick Pham

Ethan Bauman

1.2 Required Skill Sets for Your Project

Software Programming, Electrical Circuit Design, CAD design, PCB Design and Controls.

1.3 Skill Sets covered by the Team

(for each skill, state which team member(s) cover it)

Software: Ethan Bauman, Austin Mackedanz, Jace Fedler

Circuit Design: Ethan Bauman, Mitchell Kistner, David Kruse, Jace Fedler

CAD Design: Lance Longhorn, Mitchell Kistner, Patrick Pham

PCB Design: Mitchell Kistner, Ethan Bauman, Austin Mackedanz, David Kruse

Controls: Ethan Bauman, Jace Fedler, Austin Mackedanz

1.4 Project Management Style Adopted by the team

Our project management style is an agile style that has weekly meetings with our client to discuss ideas. There is more continuous planning than front heavy planning.

1.5 Initial Project Management Roles

Mitchell Kistner : Project Manager and CAD Design

Ethan Bauman : Controls and Software

David Kruse : Circuits and PCB Design

Austin Mackedanz : Software and Circuit

Lance Longhorn: CAD Design and Circuit

Patrick Pham : CAD Design and Circuit

Jace Fedler : Controls and Software

2 Introduction

2.1 Problem Statement

-Our client currently has a prototype for a branch saw, a device that can clamp onto a branch and allows the user to saw off the branch from a safe distance. The problem that the client has brought to us is the saw currently is not as user friendly as he wants. He would like the saw to be upgraded so that the status of the clamp, saw, and the arm that moves the saw are all monitored. That data should be used to optimize the saw's performance, ie, safer cuts, more efficient use of battery. He would also like to greatly reduce the steps a user has to take in order to operate the saw safely and effectively.

2.2 Intended Users and Uses

The intended users of the product are currently in the commercial and consumer market. The product is targeted towards tree trimming businesses and crisis response organizations. Because of its compact and affordable size, it also provides a cheaper alternative to expensive tree trimmers and dangerous home tree trimming methods.

1. Tree Trimming Business
    a. **Characteristics:** Relies on people needing trees trimmed, wants to provide quality and reliable work
    b. **Needs:** Equipment to trim trees, people to use tree trimming equipment safely and effectively
    c. **Uses and benefits:** Reduces the equipment load the business has to worry about, less safety risk, reliable work

2. Crisis Response Organization
    a. **Characteristics:** Need for as many saws for downed limbs and other limbs in the way.
    b. **Needs:** Safe way to cut apart trees for removal
    c. **Uses and benefits:** Easy to move product, anyone can operate the product
3. Tree Trimming Enthusiast
    a. **Characteristics:** wanting to cut down trees in order to avoid paying tree trimming business, possibly wants either firewood or regular wood for future carpenter work
    b. **Needs:** Safer tree cutting equipment as well as being user friendly to the enthusiast
    c. **Uses and benefits:** Cheaper than hiring a company to trim trees and safer than trimming trees with a standard saw.

2.3 Requirements & Constraints

Functional

- Wireless control
- Improve user experience
- Digitally read in orientation of the saw
- Digitally read in position of jaws, main chainsaw rotation bar, chainsaw motor
- Improve battery efficiency

Resource

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- Tilt sensors (Specific brand TBD)
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Economic/market

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    - Design will be 3d printed for the scope of this project
- Chainsaw is electric

Environmental

- Chainsaw is electric

UI

- Intuitive controls
- Easy to connect saw and controller

2.4 Engineering Standards

Osha Health and Safety standards will be followed when testing and operating the saw

- Safety glasses worn when saw has access to power
- Good cable management
- Etc.

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3 Project Plan

3.1 Project Management/Tracking Procedures

-We are using the agile project management style, as our project has many independent modules, which can be worked on independently of each other, with them all coming together at the end to form the final project.

-We are using Asana to track progress throughout the project. We are using Box for document sharing between us and the client. We are using Slack to communicate within the group and with the client as well.

3.2 Task Decomposition

Safety

-Create a physical killswitch on the Smart Saw that stops the saw and cut power

-Add killswitch functionality to the wireless controller

Wireless Communication

-Establish wireless communication between the Smart Saw and a controller

-Create a controlling apparatus that can read in status of the main motor bar, chainsaw, and jaw

-Enable the controller to control the jaw, main motor bar, and chainsaw

Main Motor bar status

-Read in current and position of the main motor bar

-Transmit status of the main motor bar to the controller

Chainsaw status

-Read in current and position of the chainsaw

-Transmit status of the main motor bar to the controller

Jaw Status

-Read in current and position of the chainsaw

-Transmit status of the main motor bar to the controller

Orientation

-Attach a gyroscope sensor to the main body of the Smart Saw

-Read in orientation of the Smart Saw and transmit to the controller

Automation

-Use data read from sensors to simplify the user interface

3.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

Safety

-**Milestone:** Physical and controller killswitch completely turn off power to Smart Saw

Wireless Communication

-**Milestone:** The status of the main motor bar, chainsaw, jaw, and the orientation of the Smart Saw is read into the controller and can be adjusted using the controller.

-Controller can read and transmit data from (distance)

-Controller receive and transmit data in (time)

Main Motor bar status

-**Milestone:** The current draw of the main motor bar and its velocity is received by the controller

-The main motor bar can be controlled wirelessly using the controller

Chainsaw Status

-**Milestone:** The speed of the chainsaw is read into the controller and can be adjusted using the controller

Jaw Status

-**Milestone:** The position of the jaw is read in and controlled by the controller. The status of the jaw should be read as a value between 0%-100%, 100% being fully enclosed.

Orientation

-**Milestone:** Gyroscope is firmly attached to the main body of the Smart Saw. Orientation in terms of pitch, yaw, and roll in degrees.

Automation

-**Milestone:** Controller allows the user to press a button to close the jaw of the Smart Saw, and another button to complete the procedure of cutting off the tree limb.

-The Smart Saw will use its orientation from the gyroscope sensor to decide the direction of its cut(clockwise or counterclockwise) relative to the branch it is mounted on.

-The Smart Saw will slow down the velocity of the main motor bar to ensure the power draw of the chainsaw and main motor bar is constant throughout the entire cutting procedure.

3.4 Project Timeline/Schedule

By End of October:

Have a top level diagram of the entire project completed, as well as a task list of what is needing to be programmed.

By End of November:

Have all of the required parts ordered, and have initial ground workings of code for each of the four individual modules.

By End of December:

Have safety features, main motor bar status, and chainsaw status fifty percent of the way implemented.

By End of January:

Have safety features completely implemented, have jaw status implemented.

By End of February:

Have radio communication with the saw from a controller established. Begin designing of controller housing.

By End of March:

Have all functionality completely implemented, and begin testing the product.

By End of April:

Begin refining functions, work out the issues that we may find during testing.

By End of May:

Finish documentation, as well as turning over finished product to the client.

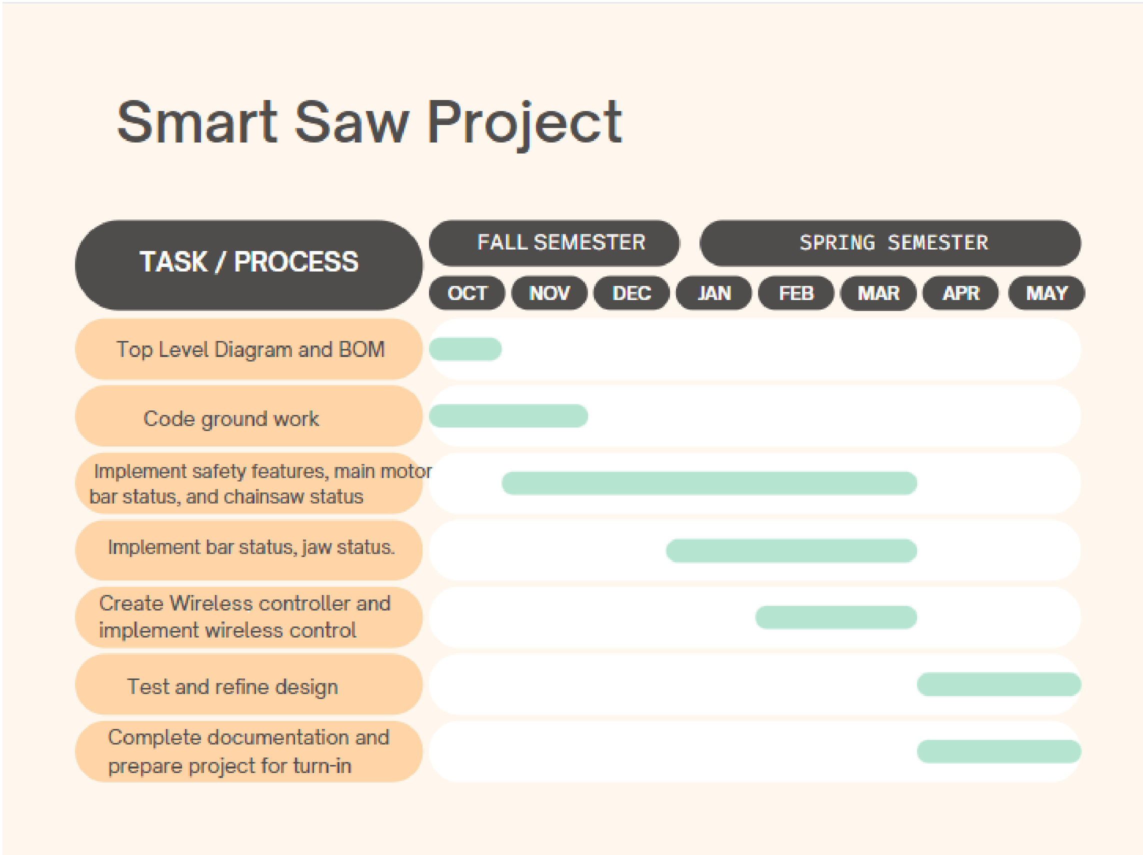

Figure 1: Proposed schedule of Workload

3.5 Risks And Risk Management/Mitigation

Safety - 0.6

-When creating a physical killswitch in line with the main power, there is risk of shock, as well as powering part of the saw that wasn't intended. To mitigate risk, we can remove the chain of the chainsaw, detach jaw, and fully remove power from the main motor bar in advance

Wireless Communication - 0.5

-There is the chance our controller sends faulty data, causing the Smart Saw to act unsafely. We will remove the chain of the chainsaw and work at least 6 feet away from the chainsaw when testing.

Main Motor Bar Status -0.6

-Faulty data can be sent to the saw, causing the main motor bar to spin faster than the Smart Saw can handle. The Smart Saw, if placed on a table, can also slam the chainsaw into the table if it does not have the clearance. The Smart Saw must be mounted so that the chainsaw can fully rotate.

Chainsaw Status - 0.8

-A chainsaw unintentionally spinning is always dangerous, we will have the chain of the chainsaw removed when doing any testing off of a tree and the main power disconnected

Jaw Status - 0.6

--The jaw can close unintentionally, and can also close quicker than intended. Working a safe distance from the saw and having an easily accessible kill switch will mitigate the risk.

Orientation - 0

-No risk is anticipated when reading in data from the gyroscope sensor.

Automation - 0.7

--The automation process will involve multiple parts of the Smart Saw moving at the same time, each being dangerous on their own(chainsaw, motor rotating chainsaw, jaws). There will be a physical and remote killswitch on the Smart Saw chassis and controller respectively. When testing, we will operate the Smart Saw from a distance of 6 feet and also have the chain of the chainsaw removed when not operating on a branch.

3.6 Personnel Effort Requirements

Chainsaw, Jaw, and Bar rotation statuses	175
Safety	35
Radio Communication	175
Automation	140
Testing and Refinement	175
Total Hours:	700

3.7 Other Resource Requirements

-Other resources which may prove helpful to this project are going to be expertise regarding arduino coding, general software expertise, and radio communication expertise.

4 Design

4.1 Design Context

4.1.1 Broader Context

Area	Description	Answers
Public health, safety, and welfare	How does your project affect the general well-being of various stakeholder groups? These groups may be direct users or may be indirectly affected (e.g., solution is implemented in their communities)	One of the main objectives of the Smart Saw project is to increase the safety of chainsaw users. The product however does not protect bystanders from any falling branches
Global, cultural, and social	How well does your project reflect the values, practices, and aims of the cultural groups it affects? Groups may include but are not limited to specific communities, nations, professions, workplaces, and ethnic cultures.	The product will allow homeowners to have a sense of ownership over their land care by allowing them to trim trees by themselves while still being safe. Equipping crisis response teams with this product also gives them one more layer of security and versatility when facing a situation.
Environmental	What environmental impact might your project have? This can include indirect effects, such as deforestation or unsustainable practices related to materials manufacture or procurement.	The Smart saw is entirely electric with a rechargeable battery. Reducing any emissions. The saw also guarantees a straight cut, reducing the amount of waste if the lumber is going to be used.
Economic	What economic impact might your project have? This can include the financial viability of your product within your team or company, cost to consumers, or broader economic effects on communities, markets, nations, and other groups.	The Smart Saw is meant to be a cheaper alternative to a tree trimming company. The product being safer than trying to complete a job with a normal chainsaw, and cheaper than a tree trimming service makes it economically viable. The product can be marketed to both homeowners, and tree trimming companies, as well as crisis response organizations that help with clearing out debris.

4.1.2 Prior Work/Solutions

-While the market does not currently have a remote, smart chainsaw, we are able to compare to the prototype we are improving upon. Our main objective is to make the smart saw able to receive commands wirelessly. The main advantage of this would be how it is much safer to trim trees while being out of the tree and away from the saw compared to being directly under the tree branch to control the saw arm and clamp. A shortcoming with this decision is the need for multiple sensors in order to read and control power, saw position, and clamp postition.

-Our product also provides consumers with another choice between hiring a tree trimming service or using a safe, easy to use solution that our saw provides. An average tree-trimming service costs $70-$200 per hour. The smart saw would be priced under $1000. This would be a good option that would allow a consumer to avoid paying for such an expensive service and still keep themselves safe should they not have the experience to use a regular saw.

https://www.gotreequotes.com/how-much-does-an-arborist-cost/per-hour/#:~:text=With%20a%20professional%20arborist%2C%20your,the%20cost%20will%20be%20higher.

4.1.3 Technical Complexity

-Our design requires wireless communication, motor control, automation, and circuit theory. Wireless communication, motor control, and automation all require a proficient background in programming and knowledge of how sensors operate and which sensors make the most sense to use for this application. Circuit theory is necessary to understand how the electronics communicate with each other as well as how to power the components safely. Advanced math knowledge may also be necessary in order to optimize the battery the saw is running on so that we can get the maximum amount of cuts out of one charge.

4.2 Design Exploration

4.2.1 Design Decisions

Wireless communication method

-We had a few options on how we want to remotely communicate with the saw but we have landed on using radio frequency and creating a physical custom controller. We had considered using bluetooth and creating an app, but through discussion, we found we are more familiar with physical electronics rather than app development. If we had chosen an app, we would have spent more time than necessary learning how to create an app.

Sensors

-We have chosen to use a gyroscope, rotary encoder, and hall sensors in order to track the orientation of the saw in space, the position of the main bar rotation and power draw of the chainsaw. The gyroscope sensor will help decide what direction the chainsaw should cut. The rotary encoders will be used to precisely control the rotation of the chainsaw as well as take in hall sensor input to know when to slow down. These sensors are what will allow the chainsaw to optimize battery charge and prevent the saw from breaking itself.

Microcontroller

-Originally we were going to use an Arduino Uno, but to ensure we can accommodate for the motor controllers, wireless communication, and sensor input, we've decided to increase our available I/O pins by upgrading to an Arduino Mega. Choosing to move forward with the Uno may prevent us from being able to reach full functionality .

4.2.2 Ideation

-One of our ideas in the smart saw design is the integration of an Arduino and its bluetooth capabilities in order to allow users to connect to the saw with their mobile devices and allow for a friendly user interface.

-Another option was adding a PCB for long term use and organization.

-some of our options in wireless Controllers are the RC car controller or creating our own controller using a game controller as a base

4.2.3 Decision-Making and Trade-Off

Criteria	Weight	Bluetooth App	RF Controller
		Score|Total	Score|Total
User Interface	.3	5|1.5	4|1.2
Cost	.1	5|.5	4|.4
Effectiveness	.3	3|.9	5|1.5
Ease of Implementation	.3	2|.6	3|.9
Total	1	3.5	4

4.3 Proposed Design

4.3.1 Overview

-For our project's wireless addition, we plan on making a radio controller to communicate with the saw. The controller would have a trigger system similar to other yard working tools where releasing the trigger will immediately stop the saw. The saw's onboard computer would make use of the sensors we add to the saw. These sensors would look at the position of the saw, speed of the saw, and the power draw of the saw in order to make the most efficient cut.

4.3.2 Detailed Design and Visual(s)

Hardware:

-For our controller, we would use an arduino to operate a transceiver to send and receive data to the arduino on the saw. The controller would have an indicator for power and connectivity to the saw. For its functions, it would have a switch to set connection to a specific saw and two three position rocker switches to control the clamp and the saw blade. There is also a safety switch which must be on in order to operate the saw. The saw's arduino would be in charge of receiving and interpreting data from the sensors on the saw. The gyroscope would generate data based on the saw's position and the hall sensor within the saw's motor would know the saw's speed. There is also a visual indication showing that there is connection between the saw and controller and a kill switch on the saw for safety concerns.

Software:

-For our project the software will control the functionality of the devices in the say and operate for the connection between the saw and remote. In the saw when a function is called from the remote it will check to make sure proper power is on and that the saw is currently in a safe operating state. If it passes both instances the function will move on to executing the command while constantly checking for the previous requirements to be met. With the Remote the code will constantly check if a button is being pressed to send data to the saw. For turning on the saw, the remote will constantly send a run command to the saw and as soon as connection is lost or the run button is let go the remote will stop sending the run command and the saw will shut the blade off as soon as it stops receiving that signal.

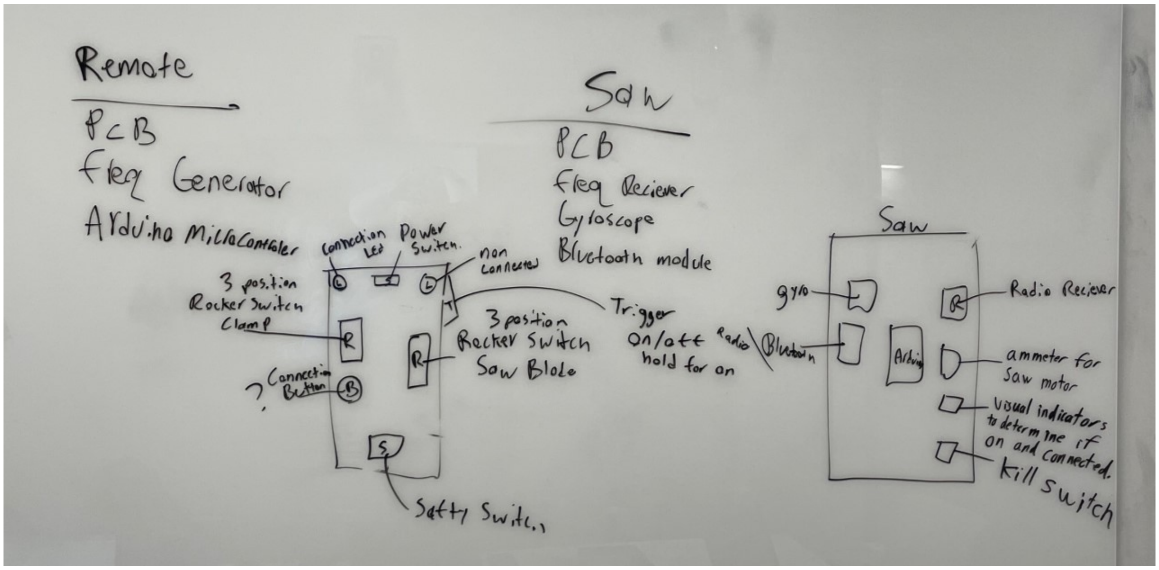

Figure 2: Initial drawing of remote and saw connections/switches

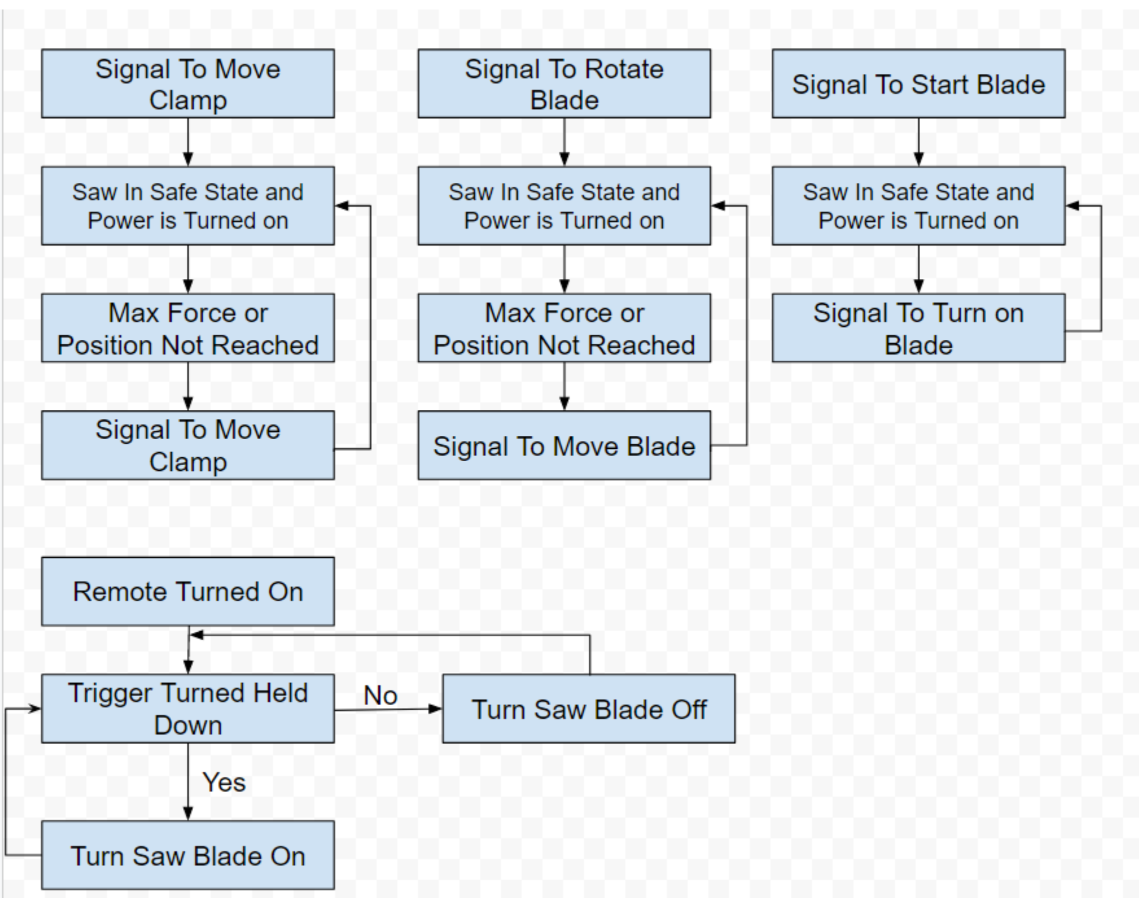

Figure 3: Programming Flowchart

4.3.3 Functionality

-The user would first make sure that the connection between the controller and the smart saw is secure and that they are communicating with each other. Then you would attach the smart saw to the branch, get away to a safe area from the branch, and use the controller to cut the tree branch. Then the smart saw would be detached and lowered down safely.

4.3.4 Areas of Concern and Development

-Some of our safety features include two triggers where one trigger has to be held down in order to turn on the saw blade. That'll fall in line with similar safety features on other saws and utilities. The prototype that's given to us is already designed to hold in place while it's operating so we won't have to worry about designing any mechanical safety features.

-Our primary concern is establishing effective communication between the saw and controller and addressing the possibility that the connection is broken.

-We plan on having the saw automatically shut down if connection is broken for an extended period of time (2-3 sec).

4.4 Technology Considerations

-We are choosing to use radio frequency to communicate between the smart saw and the controller that we are using. The strengths of radio frequency is that it has a higher range and is more secure, while disadvantages are that it is more inconsistent. It could be more consistent if it was higher power. A possible alternative is bluetooth.

4.5 Design Analysis

-We currently do not have the hardware available to us in order to prototype yet.

5 Testing

5.1 Unit Testing

-The main units that we are testing in our project are the main motor arm, main chainsaw, clamp, and wireless communication.

-Main motor arm: We are looking to control the position of the chainsaw. For testing the motor arm individually, its position will be read in and controlled through an arduino connected to a computer. We are wanting to control the arm in terms of degrees of rotation

-Main Chainsaw: The main chainsaw will also be read in and controlled through an arduino connected to a computer when being tested individually. We are wanting to determine the power draw of the chainsaw in terms of amps by using an on board ammeter.

-Clamp: The clamp's position will be tested individually by being controlled and read in through an arduino connected to a computer. The main point of data we are looking to control and read is how closed the clamp is on a scale of 0 - 100%. Where 0% is when the clamp is as open as it can be, and 100% is as closed as it can be.

-Wireless communication: Wireless communication will be tested on the basis of functionality and speed. The wireless communication has to be able to transmit and receive data between the controller and the Smart Saw from and to the sensors (main motor arm position, chainsaw current draw, and clamp position). We will also test how fast the Smart Saw responds to a controller input in terms of seconds.

5.2 Interface Testing

-The two interfaces that we have are the Smart Saw and the controller for the Smart Saw. The two interfaces need to be tested for connectivity by wireless means. More tests would be making sure the specific buttons on the controller work in conjunction with the Smart Saw. This would include making sure that the blade motor, bar turner, and clamp motor buttons/switches all work. Any tools that we would need are possibly a weighted through bag to attach the Smart Saw onto a branch.

5.3 Integration Testing

-For integration, we would first wire the sensors to the smart saw and one by one confirm their functionality. For example, when integrating the gyroscope, we would have our arduino output values from the gyroscope and alter the position of the saw blade to make sure we are getting the correct reading. One of the sensors, the ammeter, is within the motor provided in the prototype. Here we would again be reviewing the power draw based on different cuts. After confirming the sensors are working and accurate, we then need to test our controller to see if we can control the clamp and saw bar. We would also test our kill switches and other safety precautions.

5.4 System Testing

-For our systems level testing strategy, we will create a replicable testing jig that will allow us to consistently repeat the same cut. We can not use random logs to test the Smart saw initially because logs can vary in many shapes and sizes and can also contain knots which can throw off our data for repeated tests. We will need to build a mount that the saw can securely clamp onto, and then a large wooden dowel that the saw can cut. In order to test this, the main motor bar, main chainsaw, clamp, and wireless communication will all need to be functioning, and communicating with each other.

5.5 Regression Testing

-In our design we are trying to plan out space that would allow for extra modules that would be able to be added. We are making sure that the future additions such as code upgrades would not break the current system by planning ahead with how the device is coded.

5.6 Acceptance Testing

-A big part of our acceptance testing is ensuring our safety features work very responsively. So we want the on board killswitch cuts power to the saw immediately and that the wireless kill switch cuts power to the saw quickly. We will also want to test the Smart Saw on a variety of branches, rather than an ideal scenario like in our system testing. This will help us catch any edge cases that cause the saw to not work optimally or at all. Our client is working closely with our team so when we reach the testing phase of this project we will be working very inline with what he anticipates will be edge cases in our testing.

5.7 Security Testing (if applicable)

N/A

5.8 Results

-Our metrics for testing are: current draw of the main chainsaw in amps, responsiveness of the wireless communication in seconds, position of the main motor bar and clamp in degrees. Being able to dynamically read in those values will be proof wireless communication is established. Our systems level testing will prove that the design can work, and then our acceptance level testing will prove that the design can work for a large variety of cases.

6 Implementation

-We are planning on making the controller and programming the controller for the Smart Saw. We are also planning on programming bluetooth devices and data sensors that we will be installing on the Smart Saw. Our last part would be to combine the controller, sensors on the Smart Saw and other safety features together to finish our project.

7 Professional Responsibility

7.1 Areas of Responsibility

-One of the codes of ethics described in ACM version is to uphold and respect the code while holding each violator responsible to them. It addresses the seven professional responsibilities by combining them into a list that each member within the ACM or a professional should uphold to in order to uphold the expectation that is expected of them.

7.2 Project Specific Professional Responsibility Areas

-Work Competence will be a high responsibility to uphold due to the many moving elements that this project will demand. Most of our group have had experiences in CAD design, Arduinos, and electrical appliances so most of the roles needed for the project can be fulfilled to its best ability. Next on the important scale will be social responsibility, where we'll have to create a design that'll be relatively easy to mass produce and be durable enough to do its purpose: cut trees. Financial responsibility is already being handled via the BOM. Health and Safety is also being considered when testing the project as programming when to start and stop the saw was a part of our client's concern. Communication between our client and us still remains a high priority for us as we keep asking which components do they like and dislike. Finally our lowest priority in responsibility areas are sustainability and property ownership. Right now we're concerned about getting the project to work, and we believe that those two areas mentioned before wouldn't fit right in our workload.

8 Closing Material

8.1 Discussion

-The main results of our project will be a better product than the one that we started with. We will have started with a manually controlled Smart Saw that uses pre existing rc controllers to a wirelessly controlled Smart Saw with custom controllers. The requirement was making a wireless controller for the Smart Saw so that it can be used from a safe distance from the tree branch being cut down. We can achieve this by the end of next semester and have planned on how it will get done.

8.2 Conclusion

-So far in our project, we have spent time finalizing our design in conjunction with our client. We also got the parts which we needed ordered so that come next semester we are able to start implementing our designs to effortlessly begin the hands on work for our project. Our goals continuing this project are to integrate a wireless system into the saw so that we can communicate with it using a controller from a distance. We also plan on integrating an additional gyroscope as well as tapping into the encoders which are already inside our servo motors, so that we have access to information so we can control the saw more precisely from a remote. The constraint which we ran into during this set of the project was forgetting a part during our initial order, which delayed us one week on the project. We can be more thorough in our planning next semester to make sure we do not forget to order a part, although that should not be an issue as we have the required parts for our project already.

8.3 References

N/A

8.4 Appendices

Any additional information that would be helpful to the evaluation of your design document.

If you have any large graphs, tables, or similar data that does not directly pertain to the problem but helps support it, include it here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc,. PCB testing issues etc., Software bugs etc.

8.4.1 Team Contract

Team Name ___EE Gang_________________________________

Team Members:

1) ____Mitchell Kistner________________ 2) ________Ethan Bauman___________

3) ____Austin Mackedanz_____________ 4) ______David Kruse________________

5) ___Patrick Pham__________________ 6) _____Lance Longhorn______________

7) ____Jace Fedler__________________ 8) ________________________________

Team Procedures

1. Day, time, and location (face-to-face or virtual) for regular team meetings: Tuesday from 2:10 to 4:00

2. Preferred method of communication updates, reminders, issues, and scheduling (e.g., e-mail, phone, app, face-to-face): Face-to-face, Asana, Phone based.

3. Decision-making policy (e.g., consensus, majority vote): Majority Vote

4. Procedures for record keeping (i.e., who will keep meeting minutes, how will minutes be shared/archived): David Kruse

Participation Expectations

1. Expected individual attendance, punctuality, and participation at all team meetings: Show up to every meeting and if can't show, notice 1 hour in advance.

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines: If assigned a task it is on you to get it done without constantly needing to be reminded or pushing it to someone else without reason.

3. Expected level of communication with other team members: Don't be afraid to communicate when needing help or giving assistance or updates.

4. Expected level of commitment to team decisions and tasks:Communicate any decisions or tasks.

Leadership

1. Leadership roles for each team member (e.g., team organization, client interaction, individual component design, testing, etc.):

Mitchell Kistner : Project Manager and CAD Design

Ethan Bauman : Controls and Software

David Kruse : Circuits and PCB Design

Austin Mackedanz : Software and Circuit

Lance Longhorn: CAD Design and Circuit

Patrick Pham : CAD Design and Circuit

Jace Fedler : Controls and Software

2. Strategies for supporting and guiding the work of all team members:

Putting team tasks and subtasks on asana task board.

3. Strategies for recognizing the contributions of all team members:

Uses the Asana Task Board where team members are assigned tasks which can be seen by everyone.

Collaboration and Inclusion

1. Describe the skills, expertise, and unique perspectives each team member brings to the team.

Mitchell Kistner: Project management experience and a wrench turner

Ethan Bauman: Controls experience and experience with task management software.

David Kruse: Soldering skills in PCB testing and Quality Control experience

Austin Mackedanz: Electrical and programming experience

Jace Fedler : Electrical, controls, and programming experience, project and time management, specialization in computer engineering. Magic.

Lance Longhorn: Circuitry, Programming, and 3D modeling skills. Basic app development knowledge.

Patrick Pham: Linux, some programming experience, Small circuit knowledge.

2. Strategies for encouraging and supporting contributions and ideas from all team members:

Asana workspace are areas for collaboration on all the team tasks.

3. Procedures for identifying and resolving collaboration or inclusion issues (e.g., how will a team member inform the team that the team environment is obstructing their opportunity or ability to contribute?)

Have a meeting to talk through the options.

Goal-Setting, Planning, and Execution

1. Team goals for this semester: Get part of the project done and have a gameplan set to finish the project second semester.

2. Strategies for planning and assigning individual and team work: Team decision on who does what and project manager records and assigns tasks through asana.

3. Strategies for keeping on task:

Weekly meetings going over the tasks and current progress towards completion.

Consequences for Not Adhering to Team Contract

1. How will you handle infractions of any of the obligations of this team contract?

They will buy large Culver's cheese curds.

2. What will your team do if the infractions continue?

More cheese curds and discussion with the advisor if problems continue.

****

a) *I participated in formulating the standards, roles, and procedures as stated in this contract.*

b) *I understand that I am obligated to abide by these terms and conditions.*

c) *I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.*

1) ___Jace Fedler________________________
DATE__9/13/22__________

2) ____Austin Mackedanz________________

DATE __9/19/22__________

3) ____Ethan Bauman_____________________

DATE ___9/19/22_________

4) _____Lance Longhorn___________________

DATE ___09/19/22________

5) ______Patrick Pham_____________________

DATE ___9/19/22__________

6) ___________David Kruse________________

DATE ___9/19/22__________

7) ____________Mitchell Kistner_______________

DATE___9/19/22____