# Risk Assessment
# Safety Plan

## I. Project information:

| Development of a Tree Climbing Snake Robot | 1/20/17 |
|---|---|
| Name of Project | Date of submission |

| Team Member | Phone Number | e-mail |
|---|---|---|
| Jorge Campa | 954-980-0397 | Jac12@my.fsu.edu |
| Michelle Maggiore | 813-735-6199 | mdm13e@my.fsu.edu |
| Esteban Szalay | 850-567-7776 | es11v@my.fsu.edu |
| Justin Morales | 786-693-0806 | Jrm13h@my.fsu.edu |

| Faculty mentor | Phone Number | e-mail |
|---|---|---|
| Jonathan Clark | | jeclark@fsu.edu |

## II. Project description:

The removal of tall trees is a dangerous and expensive job. In order to remove these trees, workers must climb up and slowly top the tree in small segments. Team 10's task is to increase the safety of this task by substituting the worker with a robotic snake. The robotic snake will be able to climb a tree in a helical path and top the tree. However, Team 10 will only be focusing on the climbing aspect of the snake robot. The goal is to create a snake robot that can ascend and descend a tree while carrying a payload. This payload will represent the weight of the cutting tool that will be implemented in future iterations of the project.

## II. Describe steps from project initiation to completion:

The first step is for the user to place the snake robot around the tree. The user will then activate the motors remotely. (During testing this will be done by hand). The motors will create tension in the cables, will cause the snake robot to curl and wrap around the tree. Once the snake robot has enough force to clamp on the tree, the user will drive the snake robot up until it reaches the desired height. Next the user will drive the snake robot back down the tree, to uncurl it and finally remove the snake from the tree.

## III. Given that many accidents result from an unexpected reaction or event, go back through the steps of the project and imagine what could go wrong to make what seems to be a safe and well-regulated process turn into one that could result in an accident. (See examples)

Several injuries can occur when handling the snake robot. When transporting the robot to the tree the user might cut themselves due to the sharpness of the spiked wheels. When the snake is curling around the tree, anything in between the robot and tree will be crushed. While the robot is climbing up there could be a motor, wire, communication or electrical component failure which may cause the robot to fall off the tree. Also during climbing, debris may fall from either the tree or the robot. Some of the electrical components failures that may occur include: battery leaks, short circuits, electrical fires and loss of power.

## IV. Perform online research to identify any accidents that have occurred using your materials, equipment or process. State how you could avoid having this hazardous situation arise in your project.

Some of the most common causes for electric motor failures are incorrect power supply, overheating, weather damage and vibrations. In order to prevent motor failures the correct power will be determined and the good housing will be created. The most common failures with the cable is breaking from over tension and getting tangled. The ultimate tensile strength of the wire will be kept in mind when selecting the correct cable. The cables will have sufficient guiding in order to prevent entanglement. The main causes of battery failure are over/under voltage and too high/low temperature. Again the battery will be tested first to ensure the correct amount of power is supplied, in case of current overload software and circuits will be designed to prevent shortage. Proper electrical component casing will be designed to prevent overheating and failure.

## V. For each identified hazard or "what if" situation noted above, describe one or more measures that will be taken to mitigate the hazard. (See examples of engineering controls, administrative controls, special work practices and PPE).

The use of personal protective equipment (PPE) can be used to minimize possible injuries. The PPE that must be used when operating the snake robot includes gloves, safety glasses, and hard hats. The gloves and the safety glasses will help prevent injuries to the hands and eyes when handling the robot. The hard hat will help prevent head injuries that may occur when the robot is climbing. Steel toe boots are recommended but not required. Another measure to help prevent injuries is to design a stand fixture. This fixture will be mounted to the tree and allow the user to place the robot on top of it. Which will allow the user to safely step away and operate the robot, especially when the robot is curling around the tree. In order to prevent electrical failures, good electrical housing must be designed to protect the electrical components.

## VI. Rewrite the project steps to include all safety measures taken for each step or combination of steps. Be specific (don't just state "be careful").

First mount the fixture for the robot on the tree. Then, with the correct PPE place the robot on the fixture. Step a safe distance away from the robot and initiate the clamping via the remote control. Carefully ensure that the robot is securely clamped to the tree. Next step away from the tree and drive the robot up the tree until it reaches the desired height. Then drive the robot back down while watching out for any falling debris. Once the robot has returned to its initial position, uncurl it using the remote and carefully remove it from the tree.

## VII. Thinking about the accidents that have occurred or that you have identified as a risk, describe emergency response procedures to use.

Seek immediate medical attention if injury is serious. Always have more than one operator present.

## VIII. List emergency response contact information:

- Call 911 for injuries, fires or other emergency situations
- Call your department representative to report a facility concern

| Name | Phone Number | Faculty or other COE emergency contact | Phone Number |
|---|---|---|---|
| Michelle Maggiore | 813-735-6199 | | |
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## IX. Safety review signatures

- Faculty Review update (required for project changes and as specified by faculty mentor)
- Updated safety reviews should occur for the following reasons:
  1. Faculty requires second review by this date:
  2. Faculty requires discussion and possibly a new safety review BEFORE proceeding with step(s)
  3. An accident or unexpected event has occurred (these must be reported to the faculty, who will decide if a new safety review should be performed.
  4. Changes have been made to the project.

| Team Member | Date | Faculty mentor | Date |
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**Report all accidents and near misses to faculty mentor.**