VDR3

Team 510

# Mechanical Engineering Department, The FAMU-FSU College of Engineering

# EML4551: Senior Design 1

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The current design consists of three distinct components: a telescoping pole, external supports at the base of the telescoping pole, and a robotic arm attachment at the end of the telescoping pole that will perform fuse switching. The final design for each of these components is still under deliberation. Integrating all 3 components while meeting targets and metrics has been met with significant challenges.

The selected design is currently in the planning phase. Calculations are being done to ensure that targets and metrics are being met, as well as to identify problem areas of the design. The group is split up into two sub-groups, with one working on the telescoping base and the other working on the robotic arm. The base is going to extend to a height of 35 ft using pulleys powered by a single motor and use a tripod-like structure that provides stability and adapts to the uneven terrain. The robotic arm will be separated into two parts: the robotic gripper attachment and the arm and base of the robotic arm. The gripper must hold a weight of around 5 pounds to carry a fuse from the top of the pole to the ground. The gripper uses a servo motor that will have enough torque to switch the fuse. The body of the robotic arm uses three stepper motors to achieve three degrees of freedom. The primary advantage of stepper motors is that they allow for precise motion control without requiring feedback. The motors and the gripper will be powered by multiple battery packs and are controlled using motor drivers and microcontrollers.

The group opted to build the arm instead of buying a prebuilt arm because it allows us to have a long arm at a lower price. This robotic arm must be able to support a fuse from the top of the pole to the bottom of the pole. Regarding the telescoping pole, the group will use a system of layered tubes that extends to a height of 35 feet utilizing a series of pulleys. This pulley system will be powered by a single motor. The group will also have to power the device using a powerful battery and a microcontroller. The group will need to wire the motors and connect the robotic arm to the device. The group is also going to have to create code so that the robot performs the fuse-switching motions when prompted by user input.

One of the problem areas the group identified is the torque of robotic arm. To provide the torque necessary to perform fuse switching 4 to 6 ft away from the fuse, heavy motors and motor drivers and large gearboxes must be used. This weight and size may cause stability issues for the telescoping base of the device. Another one of the problem areas the group identified is the robotics arm’s ability to support the weight of the fuse. Originally, the group planned on the device being able to hold a weight of 14 pounds; however, after conducting more research, the group plans on having the arm support a weight of around 5 pounds. 14 pounds was the total weight of the fuse, with the fuse holder, and other components that the operator will not need to remove. 5 pounds being the weight that the device could support a wide variety of different fuses. Another problem area the group noticed is the weight of the overall device. The target weight for the device is less than 50 pounds as this is the maximum weight that is required for the lineman job. This target is exceedingly difficult to achieve because the robotic arm is currently 50 lbs. This alone exceeds our original target, and to support an arm extended 40 ft in the air from the ground, the material of the telescoping pole must be sufficiently stiff to accomplish this without substantial deflection. The materials that have these properties are steel and aluminum, but this makes the total weight of the device hundreds of pounds. To mitigate this, research is being done into composite materials such as fiberglass reinforced polymers that are less heavy but more stiff than other plastics.