Research : Power Delivery Validation

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Design Details

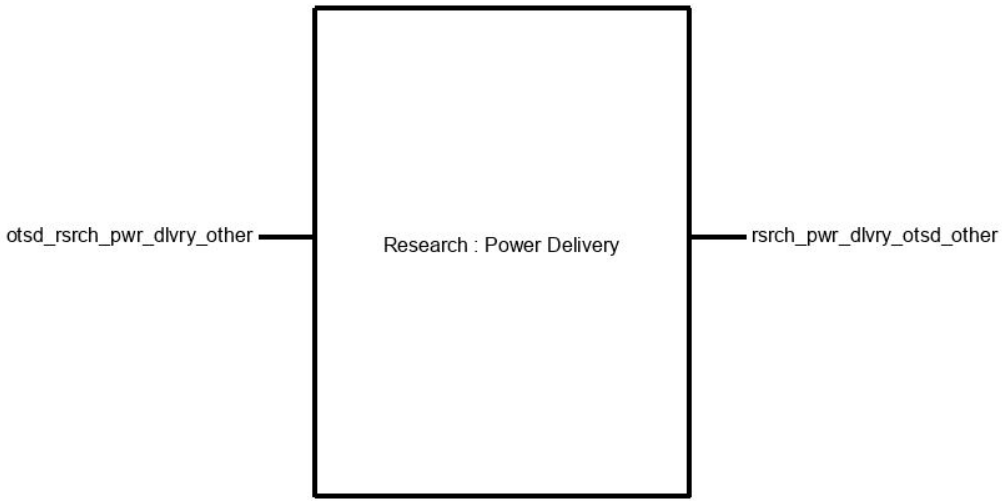

Figure 1: Black Box for Research Block

The Electric Weed Control project is heavily based on research. After researching previous existing systems, and learning about the effect of high voltage on plants, my knowledge in this area has increased. After applying a device generating high voltage (e.g 15kV) on the plant, current flows for the duration of the contact time. The plant tissue is damaged by current flow, and the resistance of the plant decreases as the cell structure starts to get damaged. The best way to apply electricity to eliminate weeds would be through two electrodes connected to a high voltage power supply. One electrode would be placed on the plants stem, the other would be placed in the ground next to the soil, that would allow the current to flow in the plant between the two electrodes, causing plant death. Electric weed control is a better way of eliminating problematic weeds as that does not damage the soil structure, and does not harm the crops. The soils moisture levels are also important as they require different levels of voltage. Dry soil usually has a higher resistance level and would require more voltage applied to the plant to do the damage required. That is why having a variable power supply is important in this project. Research was also made on power delivery, how to generate kilovolts using a variable power supply safely, and what components to use. Many options are available for boosting voltages into high levels. Stun-gun modules, line output transformers, and microwave oven transformers can all be modified and used to generate such high voltages while being able to change the output according to the input. Line output transformers / flyback transformers might be a better option because they generate tens of kilohertz, which is safer for the person operating it as high

frequency tends to pose less of a threat of electrocution, and would be smaller and lighter to carry around.

Design Validation Overview

The research that was done was important because it gave a better understanding of how to construct the device. Research has taught us what voltages were required to damage weeds, how to apply the device on the plant for the most damage, and how to generate tens of kilovolts safely using the correct equipment. The research done has also helped by looking at previous built systems, and learning what errors might arise, and how to prevent them. All of the information gathered helps us build a fully functional device that outputs the high voltages required to damage the plants using the correct design such as having an electrode connected to the probe to touch the plants, and placing the other electrode in the soil next to the plant.

Design Validation Interface Table

otsd_rsrch_pwr_dlvry_other

Other: "Electric Weed Control: Theory and Applications'	Article Name only - This article talks about how electric weed control is done, what methods are used, and the advantages of it against other methods such as chemical pesticides.
Other: "Using Electric Current as a Weed Control Method"	Article name only - This article talks about an experiment done, by applying different amounts of voltages on plants and observing how each voltage value would affect the plant.
Other: "How to use a transformer to step-up voltage"	Article name only - This article talks about how to create a transformer using coils with an air gap in between, with the turn ratio depending on how much you would like to increase the input voltage. It generates high voltages using an AC input voltage.
Other: "Electric Methods of Killing Plants"	Article name only - This article talks about two methods of killing plants with electricity. One being high voltage, short duration pulses and the other being an electrode connected to a high voltage source, placed on the plant for a duration of time to let the current flow through it.

rsrch_pwr_dlvry_otsd_other

Other: Applying high voltage to weeds and the ground will not affect the soil in any way in the future	According to an article called "Old Sparky: Could Electricity Be Farming's New Weed Killer?" many tests have been made. None of the tests have shown any negative signs on the soil, damaged the soil, damaged the crops or caused any safety issues on the device operator.
Other: Placing one electrode in the ground next to the plant, and the other electrode on or close to the plant's growth point, has the current flow through the plant between the electrodes	The best way to kill weeds using electricity would be by applying two electrodes that are connected to a high voltage power supply. One electrode would be placed on the plants growth point, and the other would be placed in the soil. That would allow the current to flow in the plants cells between the two electrodes. In other words, the current passes through the plant and is returned into the transformer through the electrode placed in the soil.
Other: Transformers can also be used as voltage boosters, they boost AC voltages and have a high frequency rate	Transformers are a good way of generating high voltage arcs. Using transformers is safer for the person operating the device because they generate very high frequency levels, which poses a less risk of electrocution. Transformers are also easier to carry around as they are smaller in size, because they require little components to generate high voltages. A modified flyback transformer would be a great way of generating high voltage and frequency for a similar project, and is cost-effective.
Other: When the current in the plant decreases, that means the cell structure has been damaged	When electricity is applied to the plant, the plant's tissue gets boiled because of the high heat generated from the electrical components. As the plant starts to die, the resistance starts to decrease because of the cell structure being damaged from the high heat.

Other: 15kV voltage applied for seconds is more than enough to damage weeds especially if they are in the growing stage	Applying 15kV to weeds for seconds would damage all the plants tissues, causing it to die. Plants in the growing stage usually require much less voltage to have the same affect. That is the main reason that a variable power supply is effective in this case, to save more energy on early stage plants.
Other: When the soil resistance increases, the power dissipated in the weed decreases. This can happen when the soil moisture levels decrease	Dry soil usually has a higher resistance. Therefore, when the soil is dryer, the power dissipated in the weed is less because of the resistance of the soil. That is another reason why a variable power supply is important. When the soil is wet, the resistance decreases causing the plants to take more damage from lower voltage levels.

References

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