Ethical Analysis

Solar Powered Charging Station

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Abstract – In this paper, the Solar Powered Charging Station is introduced and a list of concerns regarding the ethics of the project is brought forward and addressed. The first concern of which regards the use of solar panels from an ecological standpoint and confronts the byproducts that result from their construction. The next concern addressed the IEEE standards for the use of batteries and grounding. The final concern was regarding the prevention of intentionally or unintentionally committing plagiarism when developing code or writing a paper and provides the preventive measure of license awareness to keep that from happening.

Keywords: ***Solar, Battery, Ethics, Standards, IEEE***

I. INTRODUCTION

There are many different standards and ethical issues that need to be addressed when building a project. Standards need to be followed in order to insure safe operation and maintenance of the solar charging system. There are three main components of the system: The PhotoVoltaic or 'P.V.' panel, the battery, and the microcontroller system. Each portion of this system will need to be grounded, to insure the safety of the user. Safety is paramount when designing the system.

For the project, there also exists a software/web development portion where a website with statistical information for the project will be stored. The website will have user accounts that will need to be protected. Any encryption that we use will need to follow U.S. exportation laws.

Standards and Ethical rules to follow for this project can be found at the Institute of Electrical and Electronics Engineers, better known as I.E.E.E. This association created a set of ethical rules known as the I.E.E.E. Code of Ethics that every engineer should keep in mind when designing new technology. As far as standards, the I.E.E.E. group created The National Electrical Safety Code. This N.E.S.C. is widely adopted by most of the U.S. with a few states as exceptions. The standards for different states/countries should be researched in order to avoid legal problems. The stricter standard should always be used when in question of which to follow. Also, when finding a standard, make sure to use the most recent version of the standard.

II. BACKGROUND

The Senior Project to be made is a solar powered charge dock for the various small battery powered transportation around campus. Students are turning to cheaper alternatives to cars and buses to get to class. Cars require gas, insurance, parking permit and possibly a car payment. The busses around campus stop only at certain points along predetermined time stops. The clean alternative to these is riding traditional bikes/ human powered propulsion. Students, however, are starting to prefer the ease and speed of battery powered scooters and bikes.

III. SOLAR POWER

a. Issues

Just like any other "green" energy source solar energy is not purely green. To produce these photovoltaic panels it takes energy and resources to produce. When turning silicon into a purer form (polysilicon) a by product called silicon tetrachloride is made. Silicon tetrachloride is a toxic substance,but can be recycled to claim the silicon which can be used to create more solar panels. An issue with recycling the product is that it is very expensive to have the equipment to recycle the silicon tetrachloride and it is to casually dump it. In 2011 China has set standards requiring companies to recycle at least 98.5% of their silicon tetrachloride waste. This has increased how "green" the production is,but it is hard to prove how well this rule is enforced.

Hydrochloric acid is another concern in the production of solar panels. Hydrofluoric acid is used to clean the wafers by removing damage from sawing and helping fix the texture of the surface so that the panel can more easily

collect sunlight. When an unprotected person comes in contact with this substance because it is very corrosive, it can cause damage such as destroying tissue. So, handling hydrofluoric acid requires professional handling, and needs to be disposed of properly after being used. One accident in China stated that 10 times the permitted level was found in a river near by farmers would clean their animals. This killed hundreds of fish and many of the farm animals.

Another issue would be the payback time required to offset the environmental cost of the production of the solar panels. With newer panels some may only take 6 months to a year to pay off their environmental cost. Although this is relative to the location where these devices are installed. In the beginning of the production of PV panels they could be seen being developed in more major countries to be used in the same countries to produce power. Now, the majority of PV panels are produced in countries like China where their carbon emissions are already at a high number and the PV panels they are producing are being sent to other countries to produce power there instead. This makes it so that their carbon footprint will continue to increase while they cannot offset the cost.

IV. BATTERIES and GROUNDING

Issues

The project will use several lead-acid batteries. Batteries require care and maintenance. Broken and misused batteries can leak. This battery acid can burn and cause fires and pollute the environment. A battery that is misused can cause damage to the system. An example of battery misuse could be simply installing the battery backwards. Having reversed the terminals can cause overcurrent, damage, and possibly fires.

For any electrical system grounding is necessary. A system that is ungrounded poses a danger to users and the equipment. Every part of the system needs to be grounded to insure safety. Anything that is metal, conductive, or a powersource. This protects from unwanted short circuits and possible even lightning strikes.

Standards

IEEE has a selection of standards used in the design of a PV system. This is the IEEE Guide for Selection, Charging, Test and Evaluation of Lead-Acid Batteries Used in Stand-Alone PV Systems. This includes a great list of standards that deal with selection of the right battery for the system that is needed. It also includes standards from other organizations and documents. Some examples are the National Fire Protection Agency or N.F.P.A. or the National Electric Code or N.E.C. The N.E.C. is of particular note for this project, since this is the code that is used in Georgia, G.S.U's home state.

As far as grounding, IEEE recommends following NFPA70-NEC690.41-64 code for residential solar system bonding and grounding methods for lightning protection. Since solar panels are positioned on the top of structures, they are the most susceptible to lightning strikes. Grounding for this reason, is very important.

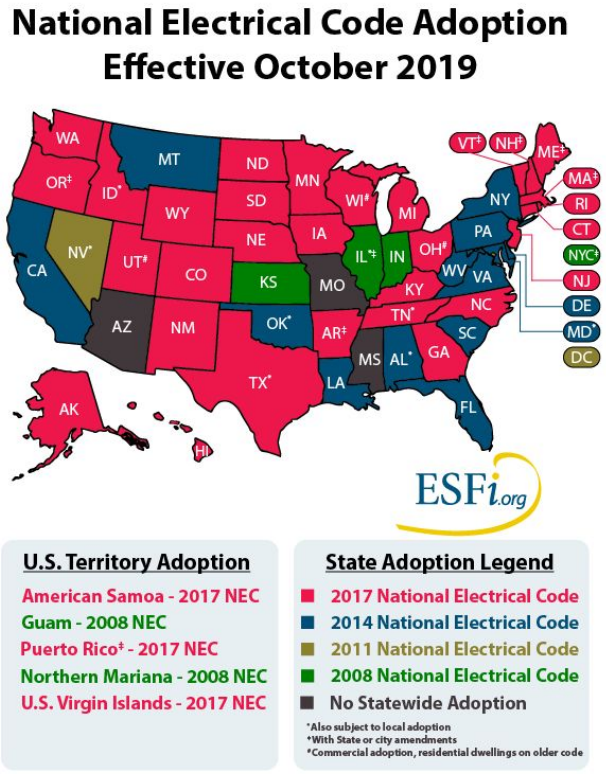

Fig. 1: Here is an example of the different editions of N.E.C. codes that are used throughout the United States. [8]

V. Code Development and Plagiarism

a. Issues

This project contains several portions which will require significant amounts of programming in order to function. One portion involves an RFID scanner and servo motor being controlled by an Arduino Uno microcontroller. Another portion will control the movement of the solar panels as they attempt to remain perpendicular to the sun in order to obtain maximum efficiency. Also, this team has a website, which always requires research to implement functionality, and there is always optimism in using a Raspberry Pi to communicate between the charging station and a server for the gathering of statistics. All of these areas are windows for the act of plagiarism.

b. Standards

The IEEE Publication Services and Products Board Operations Manual, Section 8.2.4, reacts to plagiarism with punishment that is anywhere between demanding a formal apology for improperly credited work to lifetime prohibition of publication in all IEEE-copyrighted publications for blatantly copying another's work and passing it off as their own [3]. Whether it's intentional plagiarism, intentional being copying other material and not citing deliberately, or unintentional, copying of others' work without properly citing or simply forgetting to cite in a proper manner [4], it can ruin a person or project and the future thereof.

c. Actions Taken To Avoid

An action that will be taken to avoid any of this happening is being aware of where any code or research is being obtained from. A good method of making sure that something is available for use is checking the licensing of that resource. Especially when finding code, it is common for code developers on platforms, such as Github, to provide the type of licensing that they are publishing their code with. A safe licensing to seek out is the Unlicense, one of the most permissive licenses, which releases software into the public domain [5], giving much freedom to the end user to do whatever he/she wants with it. On top of this, it can be considered respectful and honorary of IEEE standards to credit the developer in some way to show their contribution.

VI. CONCLUSION

The list of concerns brought forward include the ecological effects of the byproducts of solar panel production, the IEEE standards of grounding and battery usage in the circuits, and the preventive measures to avoid committing plagiarism when developing code, or any part of the project for that matter. These concerns are seen as an opportunity to make the project better, more efficient, legal, and overall safer so that it can become an overall better product.

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