Ethical and Environmental Analysis

Year: 2016 Semester: Fall Team: 7 Project: ANPR Parking System

Creation Date: Nov.11, 2016 Last Modified: Dec.11, 2016

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Assignment Evaluation:

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| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Environmental Impact** | 4.5 | x6 | 27 |  |
| **Ethical Challenges** | 4.5 | x6 | 27 |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 4 | x2 | 8 |  |
| **Formatting and Citations** | 4.5 | x1 | 4.5 |  |
| **Figures and Graphs** | 5 | x2 | 10 |  |
| **Technical Writing Style** | 4 | x3 | 12 |  |
| **Total Score** | 88.5 | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

Comments:

*Most of the requirements for this assignment have been met. However, this document can be more focused on the product itself (and what can be done to improve the product). For the Environmental Impact analysis, more specific means / processes for the team to reduce the negative impacts are still possible.*

*What’s more, there is a huge space for this document to improve in terms of writing. Many arguments shown are very hand-wavy. And there are grammar errors throughout the whole document, which can cause a lot of confusion.*

*Still, the whole document is reasonably well-written. One can get all the points from the author with some effort.*

1. Environmental Impact Analysis

Our project – ANPR consists of a microcontroller, a Raspberry Pi, two camera models, two motors, two groups of eight sixteen-segment display, seven pairs of infrared sensors and a bunch of LEDs. Inside the product we have a PCB with many components soldered on it and the batteries. Most of the components inside the ANPR system are readily available for consumer to purchase and are widely used in other electronic devices. Despite this fact, some materials used in the production of the ANPR system could have a negative impact on the environment during manufacturing and when the device is nearing the end of its lifecycle except Raspberry Pi and microcontroller, which could be recycled. There are environmental concerns in all three stages of its life cycle: manufacture, normal use and disposal.

Among all the components, the first thing needed to be concerned is the PCB. “A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. Components – capacitors, resistors or active devices – are generally soldered on the PCB. Advanced PCBs may contain components embedded in the substrate.” [1] During the manufacturing of PCB, countless of chemicals are used and wasted and many of those chemicals are considered toxic. Some of these toxic chemicals may be released into the atmosphere or pollute water which are both hazardous to environment. For example, when soldering the PCB, the solder used to make electrical connections contains lead, which is considered a toxic material. The fumes from the solder are considered a health hazard. One way to prevent it is to do soldering operation in a closed environment. After that the fumes must be given appropriate extraction and cleaning before being released to the atmosphere. [2]

The particular semiconductors used for LED manufacture are gallium arsenide (GaAs), gallium phosphide (GaP), or gallium arsenide phosphide (GaAsP), which are classified as toxic materials in a research, which indicates that these semiconductor materials can be toxic in animals. [3] Although, it doesn’t have a clear evidence proving that it is detrimental to human, I still regard it as a concern. To decrease the probability of this hazardous effects, the process of production has to be maintained in a closed environment.

The battery jack’s manufacture, which is made out of polypropylene, has an environmental impact. Since it is almost all plastic, as we all know, plastic is made of petroleum, which is a limited resource in the world, and it is difficult to be recycled or dissolved. Therefore, we tried our best to limit the amount of batteries using in our project. For example, we used a transformer to provide both 9V and 5V in a certain circuit.

During normal use, since our project will be fully packed up and all components has been settled, it won’t have much detrimental impact on the environment. One thing it may affect the environment is the battery change. I have already claimed the method we use to reduce this impact.

LED is another part that will have environmental impact. “LED lights are up to 80% more efficient than traditional lighting such as fluorescent and incandescent lights. 95% of the energy in LEDs is converted into light and only 5% is wasted as heat. This is compared to fluorescent lights which convert 95% of energy to heat and only 5% into light! LED lights also draw much less power than traditional lighting; a typical 84-watt fluorescent can be replaced by a 36 watt LED to give the same level of light. Less energy use reduces the demand from power plants and decreases greenhouse gas emissions.” [4]

At the end of the life cycle of this project, it is important to figure out an appropriate way to dispose and recycle the parts we used before: PCBs, LEDs, batteries and so on.

The PCB manufacturing process is very complicated, involving many special chemicals and valuable materials. These materials discharge into the environment in the forms of wastewater, spent solution and solid waste. There are several steps [5] to recycle the PCB:

1. recovery of copper metal from edge trim of printed circuit boards.
2. recovery of tin metal from tin/lead solder dross in the hot air leveling process.
3. recovery of copper oxide from wastewater treatment sludge.
4. recovery of copper from basic etching solution.
5. recovery of copper hydroxide from copper sulfate solution in the plated through holes process.
6. recovery of copper from the rack stripping process.
7. recovery of copper from spent tin/lead stripping solution in the solder stripping process.

After going through these steps, environmental pollution to atmosphere, water, soil and human will be reduced to its minimum.

Most people understand that batteries needed to be recycled. If batteries are not recycled, these metals such as zinc and lead can pollute the environment. Depending on how batteries are discarded, the metals can be released into the air or remain behind in the ash created by incineration. Batteries that are disposed of in landfills can leach into the soil, contaminating groundwater supplies. [6] Therefore, recycling batteries is a must-to-do process after life cycle ends up or battery change.

The main issue with LED disposal is the mercury used for the picture illumination, which may cause ground water contamination if disposed incorrectly. Mercury is a highly potent neurotoxin that impacts the function and development of the central nervous system in both people and wildlife. Exposure to mercury is particularly dangerous for children since mercury is most harmful in the early stages of development. [7]

1. Ethical Challenges

Product safety is an ethical obligation insofar as companies have a duty to provide consumers with whatever it is they pay for and products are assumed to be safe for ordinary use. Nonetheless, “statistics indicate that the faith consumers must place in manufacturers is often misplaced. Every year millions of Americans require medical treatment from product-related accidents”. For example, drugs often have harmful side effects (including death) and many children’s toys contain harmful chemicals such as lead. As for our project, we are pretty confident in our project, ANPR is almost risk-free, however, we still need make deliberate consideration. Even it is a 0.1% risk to occur, it is our best interest to ensure that consumers will be noticed about the danger as much as possible, and then they can deal with potential hazard situation.

As the project is a system consists of electronic components, the first thing we need take consideration is the power supply. If there is an accident with power supply, the whole system won’t work. However, even if the power supply stops working, the whole system won’t become a danger to user. It is inconvenient for user to go in or go out of the garage, because the automatic recognition system stopped. While we don’t have any protection for our prototype now, we will implement a fuse to help protect the circuit and a backup power supply as revision to the real product in order to protect users and enhance the utility for users.

Moreover, the next issue is regarding the motor part of the system. Since the lifting bar is usually heavy, it may have little chance falling down. One way I came up to deal with this question is to reduce the weight of the lifting bar while keeping the strength of the bar, in case that the lifting bar falls down in an accident. Also, a warning sign should be placed on the lifting bar, which is like adding a fuse to a circuit for protection, adding an insurance to the project. However, I have to admit that this kind of accident is unlikely to happen.

The last issue I concerned is the system’s stability of the software part. Since this is a modernized all electrical controlled parking lot, it is the base that the software must work correctly all the time. If any part of the program has a bug, then the whole system will break. For example, if the sensor used to detect if the car is entering the parking lot halted, then there is no other way to lift up the bar to let vehicles come in. Also, if database damped, then the automatic charge system can not work anymore. We will try our best to make sure the software will go through sufficient test before deployment.

3.0 Sources Cited

[1] “Printed circuit board,” *Wikipedia*. [Online]. Available: https://en.wikipedia.org/wiki/printed\_circuit\_board. [Accessed: 10-Nov-2016].

[2] “Printed Circuit Board,” *How printed circuit board is made*. [Online]. Available: http://www.madehow.com/volume-2/printed-circuit-board.html. [Accessed: 10-Nov-2016].

[3] “Toxicity of indium arsenide, gallium arsenide, and aluminium gallium arsenide.,” *National Center for Biotechnology Information*. [Online]. Available: https://www.ncbi.nlm.nih.gov/pubmed/15276420/. [Accessed: 10-Nov-2016].

**[4]** S., “The Advantages of LED Lights for the Environment,” *The Advantages of LED Lights for the Environment*. [Online]. Available: http://www.sepco-solarlighting.com/blog/bid/145611/the-advantages-of-led-lights-for-the-environment. [Accessed: 10-Nov-2016].

[5] “Printed Circuit Board Recycling Methods - epa.gov.” [Online]. Available: https://www.epa.gov/sites/production/files/2014-05/documents/handout-10-circuitboards.pdf. [Accessed: 10-Nov-2016].

**[6]** “BU-705: How to Recycle Batteries,” *How to Recycle Batteries*. [Online]. Available: http://batteryuniversity.com/learn/article/recycling\_batteries. [Accessed: 10-Nov-2016].

**[7]** “Mercury Poisoning and Pollution < Moms Clean Air Force,” *Moms Clean Air Force*, 2016. [Online]. Available: http://www.momscleanairforce.org/how-mercury-poisoning-works/. [Accessed: 10-Nov-2016].