Homework 12: Ethical and Environmental Impact Analysis

Due: Friday, April 14, at NOON

Team Code Name: ____D.R.I.N.K______________________________ **Group No.** ___4__

Team Member Completing This Homework: ________Justin Thacker___________________

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NOTE: This is the last in a series of four "professional component" homework assignments, each of which is to be completed by one team member. The completed homework will count for 10% of the team member's individual grade. It should be a minimum of five printed pages.

Evaluation:

Component/Criterion	**Score**	**Multiplier**	**Points**
Introduction and Summary	0 1 2 3 4 5 6 7 8 9 10	X 1	
Ethical Impact Analysis	0 1 2 3 4 5 6 7 8 9 10	X 3	
Environmental Impact Analysis	0 1 2 3 4 5 6 7 8 9 10	X 3	
List of References	0 1 2 3 4 5 6 7 8 9 10	X 2	
Technical Writing Style	0 1 2 3 4 5 6 7 8 9 10	X 1	
		TOTAL	

Comments:

1.0 Introduction

The purpose of our project is to build an add on module for a kegerator that is capable of monitoring beverage consumption on an individual basis, regulating and sensing the temperature of the kegerator, displaying user and system statistics on an LCD screen, and allowing user manipulation of the system via an embedded web server. D.R.I.N.K (Digital Real-time Intelligent Networked Kegerator) uses RFID tags and a reader to track users, flow meters to monitor beverage flow from the keg, solenoids to regulate the flow of the beverage from the keg, and temperature probes to monitor the temperature of the kegerator. Also an actuator is used to regulate power going to the kegerator to control the temperature. D.R.I.N.K is controlled by the Rabbit 3000 microprocessor which is integrated into the RCM3315 module.

When developing a device like D.R.I.N.K. considerations of ethical and environmental impact must be examined before it can be sold to consumers. Details such as safety and reliability must not be overlooked during the design process. If not enough attention is given to these areas then a potentially unethical product could be placed on the market causing harm to its users. By providing adequate information about the product such as proper operating conditions, the device will be safe and reliable. Also the device must be engineered so that it does not harm the environment. Since D.R.I.N.K. contains several PCBs, which contain lead and mercury, the device must be properly disposed of once its lifespan is complete. By instructing the user of proper ways to dispose of our product, by means of recycling, the device is made safe for the environment.

2.0 Ethical Impact Analysis

When designing our product we had many safety concerns. We did not want any one harmed as direct result of using our product. Since our product involves the use of alcohol we had many concerns with safe drinking, primarily drinking and driving. The use of our product should not promote binge drinking of any kind so a great deal of attention was given to this part of the project. We also have to consider the accuracy of our BAC calculation. If this value is off by a great deal we could potentially place many people in harms way. A temperature probe failure could mean the destruction of a kegerator if the system does not handle this problem appropriately. Finally, increasing the lifespan of our product was a major goal. A longer lasting product helps ensure safe functionality throughout its lifespan.

2.1 Safety Concerns

Since our product involves the consumption of alcohol, our number one safety concern is to those driving on the street. The legal BAC limit for operating a vehicle in Indiana is .08% so our device must keep drinkers who are driving below the legal limit. Our device is capable of tracking the BAC of each user during a drinking period. The BAC of each user is updated every 15 minutes to provide an accurate measure. If a user is approaching the legal limit, the device will restrict access to the kegerator for that user by closing the solenoids. The solenoids will remain closed for that user until their BAC decreases to a safe and legal level.

Since we are not directly checking the BAC of each user with a breathalyzer, the device may not perform an accurate reading of a users BAC. We will be using weight, sex, time, and volume to calculate the BAC. Since some people may breakdown alcohol slower than others our calculation may be slightly off. Also if a flow meter is malfunctioning and is showing less volume than there really is, the calculation will be off. In order to compensate for this uncertainty, we will leave the ability to program tolerances into the device so that a BAC of less than the legal limit can be set to restrict users from accessing the kegerator. Another option could be to add a breathalyzer to the device that will take a much accurate reading although this will not be implemented in the current version of our device.

Since there will be liquid around our device, careful planning was necessary when packaging our device. All electrical components had to be placed within the packaging or away from the draft tower. No exposed wires could be allowed anywhere in the design to eliminate the risk of shorting out components in the event that a beverage is spilled. The packaging will be made out of aluminum which can protect the internal elements from water damage. Also, the corners of the edges will be rounded to reduce the severity of an injury that can occur if someone falls into the device. External components such as the flow meters and solenoids come packaged in a water protective casing since they come in direct contact with liquid. Connections to these devices will be thoroughly covered to prevent any liquid from coming into contact with exposed wires, especially on the solenoids.

2.2 Device Failure

A third concern that we have is for the temperature probes. A faulty temperature probe that takes high readings could cause the compressor in the kegerator to never be shut off potentially destroying the kegerator’s compressor. If such an event does occur, code has been implemented to track the amount of time the compressor has been running. If the running time is not consistent with normal operation, the compressor is shut down and an error message is displayed on the LCD telling the user that a faulty temperature probe may be causing problems. If the air temperature is unusually high, this could also cause the compressor to run longer than normal and trigger this warning so documentation must be included explaining that this error could occur without a faulty temperature probe.

2.3 Lifespan

To avoid as many faulty components as possible, a great deal of time was taken to make the lifespan of the device as long as possible. By using the lowest possible power levels to safely operate all of the device components, we increase the longevity of not only individual components, but for the device itself. This aspect of the design is essential in producing a safe and reliable product.

3.0 Environmental Impact Analysis

There are many environmental hazards associated with our design that we must be aware of. There are environmental concerns associated with each phase of the products life, from manufacturing, to normal operation, and finally to disposal. The main environmental hazard will have to do with all of the printed circuit boards in our device.

3.1 Manufacturing

There are many environmental consequences that arise as a result of manufacturing printed circuit boards. Our device will be using a number of these which are found in the RFID module, bill acceptor, LCD, biometric scanner, microcontroller, and main board. The main hazardous byproducts resulting from the manufacturing of PCBs are industrial wastewater and treatment residues, spent process baths, acids used for cleaning equipment, copper sulfate crystals, and re-flow oil[1]. All of these byproducts contribute to potentially harmful effects to the environment.

3.2 3.2 Normal Operation

During normal operation our device creates no more environmental concern than any other environmentally friendly wall plug in electronic device. Since our device uses wall power which comes from a power plant, the only environmentally hazardous byproducts would be from the power plant itself. This is of little concern to the environmental impact of our product.

3.3 Product Disposal

The disposal of the product will produce the most environmental side effects. In order to reduce its impact we will provide documentation on proper disposal of the product. The electronic components that propose a threat are those that contain PCBs. We will recommend that these parts be taken to a facility where PCBs can be taken apart and reused. Silver, lead, copper, and gold can all be recovered from used PCBs[2]. The bulk of our packaging will be made of aluminum. This aluminum box can be taken to a recycling facility for disposal.

4.0 Summary

Considering the ethical and environmental impact of a consumer product is a crucial step of its development. Unethical engineering of a product can result in disaster. People can be injured and lawsuits can arise if proper precautions are not taken when designing a product. During the course of designing our project we took many precautions to ensure that our product would not result in disaster for some one using it. Environmental considerations were also taken regarding the materials used for the device. PCBs are essential to every electronic device so their use could not be avoided however it is recommended to our customers that they dispose of the PCBs at a proper facility. Also the choice to use aluminum because it can easily be recycled reflects the care we took in choosing environmentally safe materials.

List of References

[1] "Fact Sheet: Printed Circuit Board Manufacturers"[Online Document], Available HTTP: http://es.epa.gov/techinfo/facts/vdwm/va-fs6.htm

[2] "Printed Circuit Board Recycling"[Online Document], Available HTTP: http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/2_II_8.html

[3] "Hw12: Reliability and Safety Analysis" Andrew Parcel[Online Document], Available HTTP: http://shay.ecn.purdue.edu/~dsml/ece477/Samples/HW12_Samples.pdf

IMPORTANT:

Spend a significant amount of time on this

– see articles provided on the course web site. Use standard IEEE format for references, and CITE ALL REFERENCES listed in the body of your report. Any URLs cited should be "hot" links.