# Purdue ECE Senior Design Semester Report

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| **Course Number and Title** | ECE 477 *Digital Systems Senior Design Project* |
| **Semester / Year** | Spring 2006 |
| **Advisors** | Profs. Meyer, Johnson, and Nyenhuis |
| **Team Number** | 4 |
| **Project Title** | Digital Real-time Intelligent Networked Kegerator |

| **Senior Design Students – Team Composition** | | | |
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| **Name** | **Major** | **Area(s) of Expertise Utilized in Project** | **Expected Graduation Date** |
| Matthew Kocsis | CmpE | Software, hardware interfacing | May 13, 2006 |
| Ian Snyder | CmpE | Software, Hardware | May 13. 2006 |
| Justin Thacker | CmpE | Software | May 13, 2006 |
| Dustin Poe | EE | Hardware, Power Circuits | May 13, 2006 |

**Project Description:** Provide a brief (two or more page) technical description of the design project, as outlined below:

(a) Summary of the project, including customer, purpose, specifications, and a summary of the approach.

The Digital Real-Time Intelligent Networked Kegerator is a modular addition to an existing beverage dispensing device. The DRINK system provides the owner with complete beverage control, allowing owners to monitor user's consumption, set consumption limits, or completely restrict access. The DRINK system also addresses safety, legal, usability, and economic concerns of draft beverage distribution. Alcohol consumption monitoring will provide a tool to allow a person to know exactly how much they have consumed, learn estimated legal limits, and reduce unauthorized or unlawful drinking. System control and monitoring will allow users to track inventory, decrease beverage waste, and predict future resource needs. The System uses an embedded microprocessor, the Rabbit 3000, to monitor flowmeters and user inputs to control the system.

(b) Description of how the project built upon the knowledge and skills acquired in earlier ECE coursework.

This project built upon much prior coursework for each of the members. Simple circuit skills from EE 201, EE 207 and EE208 were used. Digital systems knowledge from EE 270 and EE 362 were also used extensively. Coding techniques and practices were also used from classes such as EE 264, EE 368, EE 495D and EE437. Analog systems courses, such as EE 255, were also helpful when designing some of our amplification circuits.

(c) Description of what new technical knowledge and skills, if any, were acquired in doing the project.

Our team learned what was involved in a full scale idea to product design timeline. We learned about necessary components, their selection and their interaction. Debugging and problem solving skills were also developed to work with external systems and hardware that we did not have complete knowledge in. We also learned part of the professional technical side of a design project, including safety, legal, and marketing aspects of a technical design.

(d) Description of how the engineering design process was incorporated into the project. Reference must be made to the following fundamental steps of the design process: establishment of objectives and criteria, analysis, synthesis, construction, testing, and evaluation.

During the design of this project, our team went through the entire engineering design process at many different levels. For each aspect of the project, for example the enclosure construction or the power supply design, we started by reviewing what the purpose of the specific component (or overall design) was. Once that was clear, we found products and assessed which of them would do a better job. Much of these assessments are included in our detailed design documentation. Once we received the necessary components, we put them together and made sure that they functioned as expected. Then we developed rigorous tests to make sure that the functionality of the component was consistent over time. After finishing a functional component, we then assessed if the component actually fit the need it was designed for. If at any stage during this process parts did not work or the result was not what was required, we stepped back in the design process and started moving forward with another solution.

(e) Summary of how realistic design constraints were incorporated into the project (consideration of most of the following is required: economic, environmental, ethical, health & safety, social, political, sustainability, and manufacturability constraints).

Since this project was designed to actually be used by one of the team members, there were many realistic design constraints. The inclusion of alcohol in the design also stemmed some major legal and safety considerations. First, our design had to be completely functional and built, which set manufacturability and sustainability constraints. Ethical, health and safety constraints were also set because when used improperly, our product could be involved in loss of human life or severe legal ramifications. We designed our project in ways that prevent unauthorized access to alcoholic beverages, and we built in several methods for verifying user identity beyond simple tags. The addition of biometric identification further strengthened the security of the design.

(f) Description of the multidisciplinary nature of the project.

This project not only used electrical and computer engineering techniques, but it also required knowledge of fluid mechanics, marketing, metalwork, and psychology. Given the nature of monitoring and controlling liquid, knowledge of how fluids work and are controlled was crucial to the first steps of the design. Incorrect metering or control devices could render the device inaccurate or unusable. In order to build the entire system, we had to develop skills in metalwork and industrial design. We learned about properties of metals, how to cut, bend, and mill them, and how to protect the surface after construction. Psychology was also very important to this project. In order for it to be usable, thought was given to the way users would approach and attempt to use the system. Care was taken so that important controls were obvious and easy to use. Marketing was also considered during the initial design of the project when we picked features we wanted to implement. We researched other projects and designed our system to have features that would be most beneficial to the end users.

(g) Description of project deliverables.

Our project is completely built into a large chest freezer. Mounted on top of the freezer is a hinged metal enclosure housing most of the designed components and all wiring. On the front, a bill validator, an LCD, a biometric reader, and a knob is mounted in addition to 4 draft faucets. Opening the hinged cover on the back reveals all of the PCBs, the wiring, and the beverage tubing. Opening the chest freezer provides access to the kegs, tubing, and flowmeter / solenoid units.