***DIGITAL LOGIC DESIGN PROJECT***

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The Concentration Companion

**Problem Statement:**

Grove City College, everyone knows how hard the academics are. In order to do well at this rigorous institution, you must work hard and study to keep your grades up. Finding a place to study at this college can be stressful, but with the Concentration Companion that problematic situation is no more. The Concentration Companion will help the individual locate an open spot to study or do homework. Many people waste their time looking around for an open spot and end up irate and miserable, which may result in the completion of zero work by the end of the day. The Concentration Companion will also be useful specific to the case of signing in and out of classrooms in the Hall of Arts and Letters. There are many great benefits to the addition of the Concentration Companion to Grove City’s campus. Most importantly it will help students become even more efficient while providing peace of mind that they have a spot to complete their assignments.

**Purpose:**

The main purpose of the Concentration Companion is to make it easier for students at Grove City College to find a place to study or do their work. This project idea has other benefits to it as well. For example, many students forget to turn off the lights and projectors when they leave. The Concentration Companion would solve this, optimizing power consumption as well as lowering maintenance costs, and expanding the life of projector/light bulbs. Finally, the Concentration Companion eliminates the need for signing in and out of classrooms during evening hours in HAL. The sign in system is inaccurate and flawed in that many students don’t sign in or out. The Concentration Companion automatically determines whether or not a classroom is in use. Clearly, there are many positive attributes to the Concentration Companion that will better the academic lives and careers of the students at Grove City College.

**Design Goals:**

1. Our first goal is to be able collect data from individual classrooms and store it in a central location.
2. The second goal is to develop a robust communication protocol using flags in our bit streams, a master clock cycle for the whole system, and room IDs and Hi-Z states for inactive rooms.
3. The third goal is to be able to turn off projectors and lights when the room is not in use.
4. The fourth goal is cost efficiency. This is achieved by polling the data onto a bus minimizing the amount of materials needed for the system.

**Roles:**

Theo Strangebye:

-Project Manager, VHDL coding for Campus Controller and Classroom Controller and design goals.

Daniel Colflesh:

-Campus Controller circuit schematic, documentation, meeting minutes and design goals.

Nathaniel Shaffer:

-Classroom Controller circuit schematic, documentation and design goals.

Armand Ignelzi:

-Building Controller circuit schematic and VHDL code, documentation and design goals.

**Documentation:**

**Classroom Controller:**

Each classroom has one Classroom Controller that has 7 inputs and 3 outputs.

Inputs:

* LightsOn
* ProjectorOn
* ClassroomInUse
* RoomID\_Rx0
* RoomID\_Rx1
* Clock\_in

-LightsOn and ProjectorOn are each connected to sensors that output a value of ‘1’ if the lights or projector is on.

-ClassroomInUse is connected to a thermal sensor that outputs a value of ‘1’ if it detects an object with a temperature of at least 90 degrees Fahrenheit.

-RoomID\_Rx0 and RoomID\_Rx1 are inputs for the 2-bit Room ID number. The campus controller will output the Room ID number of the classroom it wants to communicate with and the classroom controller with that Room ID number will come online.

-Clock\_in is the input of the master clock signal.

Outputs:

* Lights\_Enable
* Projector\_Enable
* Tx\_1

-Lights\_Enable enables the lights to be turned on from within the classroom, otherwise it disables the lights, turning them off.

-Projector\_Enable enables the projector to be turned on from within the classroom, otherwise is disables the projector, turning it off.

- Tx\_1 is the serial communication output. Classroom data is communicated to Campus Controller through this output.

**Campus Controller:**

The Campus Controller has 2 inputs and 3 outputs.

Inputs:

* Rx\_1
* Clock\_in

-Rx\_1 is the serial communication input. The Campus Controller receives this data from the Classroom Controller.

-Clock\_in is the input of the master clock signal. In this case the master clock signal is generated by an Arduino.

Outputs:

* RoomID\_Tx0
* RoomID\_Tx1
* Clock\_out

-RoomID\_Tx0 and RoomID\_Tx1 are the outputs for the 2-bit wide Room ID number. The Campus Controller outputs the Room ID number of the classroom with which it wishes to communicate.

-Clock\_out is the output for the master clock signal to the rest of the system.

The system itself contains 4 Classroom Controllers and 1 Campus Controller.

**Evaluation:**

The final implementation of the system achieved all of the design goals that we originally decided. The system solved the main problem of not knowing which classrooms were available to study in, with the added benefit of limiting unnecessary power consumption and extending the life of projector and ceiling light bulbs. Ultimately the system saves Grove City’s students time and effort while simultaneously saving money. While the final implementation of our system is limited in scope, it can be scaled up to accommodate as many rooms necessary. The implementation presented in class is a basic proof of concept.

There were several design stages that we went through. Initially we started with a design that had 3 controllers: classroom, building and campus. We also had 64 classrooms per building and 4 buildings. Due to limited availability of hardware, we decided to make system have 4 classrooms, 2 buildings and 1 campus controller. After the three-controller system failed, and because of time restraints, the decision was made to simplify the system by removing the Building Controller completely and modify the Classroom and Campus controllers to communicate with one another.

Overall the process of designing and implementing our system was challenging but went fairly smoothly. We started with an initial solution to the problem but were forced to simplify and modify the solution to a more realistic design. We all learned a lot about digital logic and the process of engineering.