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Executive Summary

We are working on creating a system to replace current AV Control systems. Our system will control 8 sets of lights, 2 projectors, 2 screens, 3 audio sources, 4 video sources and select two video inputs. The system will be controlled from a software based User Interface on a PC that communicates with a control box to control all the separate parts of the system. The system will be based on universal design principles to enable it to be used by anybody using the system.

The only deliverable for this project as of today is a report on a complete prototype design for a classroom AV system. The deliverables can change if we get funding for the project, but currently we have no budget. We will try to borrow any equipment we can find to create a demonstration for this project. As such, there will be no change in ownership of any equipment. If any equipment is purchased for this project, it will belong to whoever purchased it. The project will be completed before May 5, 2012.

Project Definition

Project Overview:
AV Presentation control systems are fairly common in classrooms. They allow a teacher to control the screens, projectors and sound from one spot without having to walk around the room flipping switches. The current systems that NAU uses in the engineering building have many problems. They are not very reliable, not very user friendly, expensive to acquire and very expensive to maintain.

The reliability problems of the current system are due to both design issues as well as users breaking them. The systems have many parts that are built into non-ventilated lecterns, causing heat buildup which destroys components. Many of the system components are accessible to users; which allows users to accidentally break stuff by changing settings or pulling wires. The systems use special connectors that aren't meant to be handled very often; because of this the cables tend to break fairly easily. When a cable does break the connectors aren't easy to acquire, which causes things to stay disabled for extended periods of time when they could have quickly and easily been replaced if they were normal cables. As with the cables, the other components take a long time to replace which causes some rooms to have reduced functionality for long periods of time.

The UI (User Interface) of the current system is not very user friendly. There are two control locations; the control for audio, video and screens is located on a lectern in the front corner of the classrooms and the lighting controls are located near the doors. The light switches aren't labeled, so people have to experiment with them to figure out what controls are available and which switches correspond to each set of lights. The audio, video and screen controller isn't very usable for most users. The system gives no feedback and is poorly labeled, so the users don't know if they are hitting the right button or if something is just broken. The system is not universally designed which makes the system hard to use for blind users because it lacks any auditory feedback and the system is out of reach for users in wheelchairs.

The cost of maintaining the systems is extremely high because of proprietary and integrated components. When any of the components break or stop working, the school has to call in the vendor to repair them because they aren't available to the school to purchase. Because of this, the vendor can charge outrageous prices for hardware, labor and travel time because it's the only source available. This not only costs the school more money, it also costs time and hurts the learning environment. When a part breaks it may take months for the school to be able to replace it. During that time the functionality it provided is no longer available. If the amplifier went out a teacher will not be able to play an important video to the class, and will most likely spend ten minutes of class trying to figure out how to get it to work. The cost in time can be very detrimental to the learning experience.

NAU needs a system that gets rid of the current problems and adds new functionality. The system needs to be more reliable, easier to maintain, cost less than the existing systems and use a universally designed software interface. We would like our project to create the best possible classroom environment for all users, use less power, give more control, have better components and be completely universally designed.

The system that we develop could have many applications and benefits. By creating a system that enables better control and automation of normal building components, it could be used in any home or building. The possible benefits include easier access, lower power consumption, better security and easier usage for handicapped people. The immediate benefits to the school would be a better learning environment because there would be less wasted time for teachers and less downtime of the classroom systems.

System Layout:
There are two system layout diagrams; Figure 1 is a non-technical explanation and Figure 2 is a more technical diagram. The diagram in Figure 1 shows a non-technical layout of a possible system. The interface is on the computer at the purple lectern, which controls the black control box that is not directly accessible to users. A control line goes from there to a control box that directly controls the two displays, the light controller, video controller and the audio controller. The turquoise audio control box takes care of audio selection, mixing and amplification; it then sends the audio to the speakers. The red video mixer takes up to four inputs and sends the video to a users' choice of projectors. The blue light controller controls up to eight sets of lights.

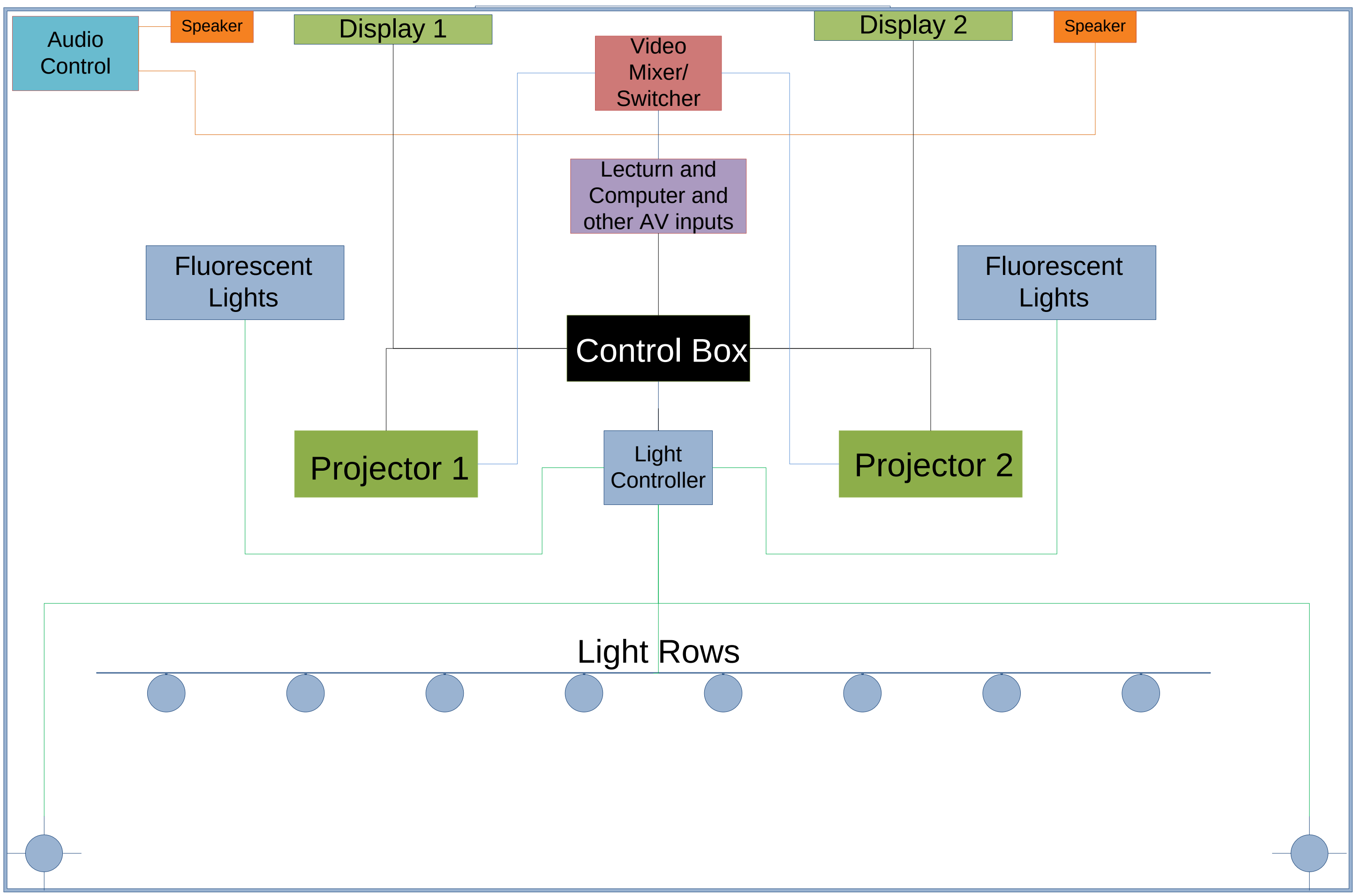

Figure 1: System Layout – Non-technical

The diagram in Figure 2 shows the basic layout of a possible system. The inputs are on the left, the control devices are in the center and the outputs are on the right. The system will be designed for four AV inputs that can be sent to two video outputs. The system will allow for any combination of input with outputs. The basic design will incorporate the ability to mix in two other audio inputs and will provide an audio output for the ability of recording or providing an output channel to assist people who are hard of hearing. The components will all be COTS (Commercial off the Shelf) to make them less expensive and easier to replace. There are currently three primary control areas we are investigating; video, audio and lighting. The control box will interact with the UI to control a video selector, audio mixer, amplifier, lights and screens. The outputs currently planned are two projectors, two screens, one set of stereo speakers, eight sets of lights and at least one audio line-out jack.

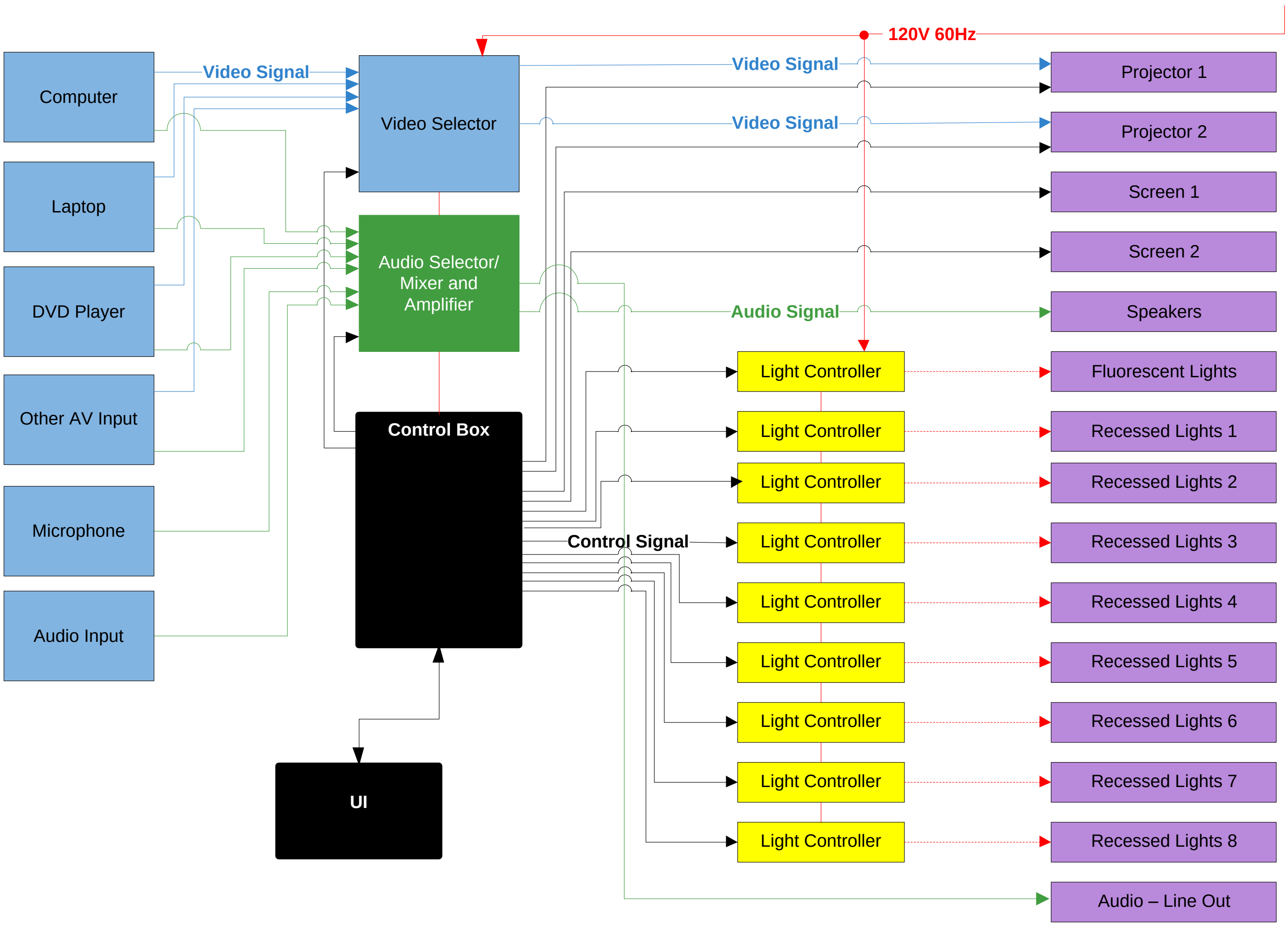

Figure 2: System Layout – Technical

Research Survey Results

There have been no changes to the research portion since the previous document.

Classroom Presentation Systems:
There are many different types of classroom management systems used at different universities. Texas Woman's University has a very nice looking touch panel based system that controls the audio and video and has an interactive troubleshooting and service request application built into it (Foulds, 2011). The University of Minnesota spent $7M creating a system that has automated diagnostics on nearly all systems to reduce downtime of bad components (James R. Gregory (University of Minnesota), 2004). The systems for many other universities are posted one educate.edu. There are even systems at NAU that have software based controls for the audio, video and lighting. The goal of our system isn't new; it's an evolution of older systems. The systems started off as push button types that we still have in our building and started including more and newer features. Unfortunately one system doesn't fit all; each system is customized to a particular niche market.

Universal Design:
Universal Design is a way of developing a product to make sure that any person can use it at any time. Universal design is usually broken up into seven principles (Molly Follette Story, James L. Mueller, & Ronald L. Mace, 1998):

- Equitable Use
- Flexibility in Use
- Simple and Intuitive Use
- Perceptible Information
- Tolerance for Error
- Low Physical Effort
- Size and Space for Approach and Use

By applying universal design principles; a product will not only work for more people, such as disabled users, but will also work better for normal users in unusual situations. For example; we design a computer interface that is usually navigated by looking at the screen and using a mouse. If we apply universal design principles to the interface when we design it and make the tab order logical and enable auditory feedback, then a user could lose both the mouse and screen and the interface would still be usable.

Video Selection and Transport:
Our school currently uses VGA switchers in the engineering building and the Wettaw auditorium. The analog system was standard 5+ years ago, but we have moved on to primarily digital video signals for nearly every market. A quick look at projectors (Newegg, 2011), computers, laptops (Amazon, 2011) and displays (Newegg, 2011); will make it clear that we have moved on to digital connections and primarily HDMI. Because most components are HDMI we should be moving to HDMI switchers for our video. HDMI switches are also less expensive now than their analog counterparts because they are being used by normal consumers, not just businesses. Another advantage to digital signals is that there is less distortion when they are transported long distances.

Interface:
Current interfaces are both software and hardware based. The hardware based interfaces have major drawbacks; they aren't user friendly to many users, they cost a lot to replace, and they can't be upgraded. Software based solutions can be better, but they usually suffer even worse problems than hardware based solutions. The systems tend to use too many screens, such as the systems in Engineering 101 and the Wettaw auditorium. They are also usually closed systems and can't be customized, which makes upgrading them cost even more than the hardware based solutions. The ideal interface will be customizable by the users, user friendly to everybody including

people in wheel chairs and blind users and the interface will be easy to update if the hardware in the room changes.

Control:
With the current systems implemented in the engineering building, the systems are proprietary and we don't know exactly how it's controlled. The current systems have what is referred to as a "black box," signals go in and signals come out projecting onto the screens. What is known about this "black box" is that it is an embedded computer (Moxa), or a comparable system, running software to accept a signal that has a certain action, whether that is to put the screen down or to turn on the projector. Since the systems are proprietary, debugging a problem in the system becomes much more difficult. If the problem lies within the "black box," debugging becomes impossible. Also, with the current systems, the "black box" is specific to each room; one couldn't just pull and move the box to another room. By generalizing the software on an embedded computer, one will be able to quickly configure the software to tell the embedded computer what is available in the room for use. This will allow for COTS embedded computers to be configured to be in use in any setup of the system.

Lighting Control:
The user should be able to turn the lights on/off from the same screen that they turned the projector on/off from. Also, the user should be able the opportunity to adjust banks of lights on different locations of the class. For that reason we needed relays that would control the light from far distance. There are many kinds of relays on the market, we chose SSRs (Solid state relays) to accomplish this task. Based on our research, SSRs are the most efficient comparing to other relays in the market. For example, comparing to Electro-Mechanical Relays which is the second choice that would do the same job, SSRs are faster to response, their lifetime is longer, doesn't bounce the operation, does not make any noise when turning the switch on, their size is smaller, it works well with I/O cards, and it is doesn't get effected by storage it. However, SSRs has some disadvantages comparing to other relays, it makes low noise and heat which is cause of high resistance when it is closed; when it is open there should be a low resistance which cause leakage current (μA). Also, it requires isolated bias supply for gate charge circuit as found on clare.com, happmart.com, and Wikipedia.com. The range of the desired SSRs price starts from 20 to 50 US dollar as figured from different big sellers online such as Crydom and OPTO22.

Audio Selection, Mixing, and Amplification:
For this project our team is looking for ways to amplify sounds of different equipment like laptop, DVD player, and sound from microphone. The team is looking at different kinds of audio system like amplifier and mixer that will produce the sound as an output from different systems. What the team needs is an affordable audio selection for the system that works for longer years with minimal repairing if it needed. Our team is interested to have amplifiers and mixer controlled through some kind of signal like USB or RS-232 with minimal power (Extron Electronics).

All the devices will be controlled through black box and it will send out signal to each device what to do. When a user wants to use specific device like turning projector on and lower the screen. A USB or RS-232 signal will go into the black box and then the device will receive instructions through the software and will start working. By sending a signal the device will know which device a user will be using. There will be multiple devices will be used by the user and through the embedded system that receive all the signals will control the device to turn on or off (Markettek).

Projectors:
Projectors are one of the common devices used in business world as well as in school and universities. Projectors help people see things clearly and understand the idea which is hard to explain on the white or black board. Majority of the projectors uses RS-232 signals to project through different devices. The team is looking to minimize the wiring and control the project through imbedded software and through signals that uses less power and work for longer hours. There has been a lot of advancement made on projectors. The quality of the picture

has improved since the HDMI port was introduced in new televisions as well as in projectors and it can be found on desktops/laptops (Projector Central). The amplifier will be controlled through a signal, so as the projector. It will turn on and turn off the projector and will display the image on the screen. The team will be using a signal device that uses minimum amount of power and works fast.

Screens:
The current screens in the engineering building are motorized, the size is 96”X96”, they have a good view and quality, and the size view is good for the students. We are not looking to provide another idea of screens, but we might adjust the positioning as requested from couple professors. As far of reasserting we found that da-lite would be the best choice to buy the projection screens from, according to focusedtechnology.com and couple other specialist websites, the price is in the range of 19 hundred US dollar for such a screen as the one that we are currently using at the engineering rooms. Also, it is important to point on the controlling system of the projection screens. The projection screens need a low voltage control (LVC), LVC are relays that take the voltage from the Linux box and convert the signal to a very low voltage signal. LVCs are in the range of 300 to 380 depending on the number of projection screen in the room.

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Requirements and Specifications

Mechanical:

Presentation System:
The systems' mechanical specifications are very open. It needs to be small enough to not interfere with classroom activities, but can be sheltered in a large box such as a lectern or in the ceiling. The weight of the components will determine where they can be placed. The system should stay under 10 cubic feet and under 100 pounds. The organization of the system is constrained by the individual parts, and is currently unknown. Interconnects must be commercially available so they can be easily replaced. The package is completely open to us, we can store everything in a box or space it out around the room. Protecting the components is a constraint; they must be protected from the user and preferably out of sight.

Video Selection and Transport:
The only mechanical factors we are concerned with on the video switchers are the interconnects and protection. The interconnect needs to be commercially available to keep maintenance costs down. The switcher must be protected from users, which means it will be either locked up or hidden in the wall or ceiling.

Control:
The current system has the "black box" placed in the ceiling of the rooms. If we continue with the same layout of the current system, the size and weight of the embedded computer will need to be able to fit into one ceiling tile in size (less than 1.5 square feet) and be light enough to be supported by the ceiling structure (less than 5lbs). The organization of the device will not be an issue since cable management can be used to organize the route of cables into and out of the embedded computer.

Lighting Control:
Solid state relays are very small and light. Since the SSR are going to handle automated switching it should be away from users to increase their life time and to not hear their low noise.

Audio Mixing and Amplification:
The size of the system should be small and able to fit in lectern and less weight. The amplifier should be connected through signal from different inputs. The system will turn off automatically when detect the higher power coming from power supply. There should different inputs to connect with computer, DVD and projector to produce amplified sound.

Projectors:
The mechanical aspect of the projector is to find a small size projector with less weight. The projector installed and supported by the ceiling. The weight of the projector will be around 50lbs or less. The projector will include different input to connect with the black box. There will be less amount of cabling will be used instead the system will work through relay or RS 232 signal.

Screens:
Projector screens use a fiber with a special reflective coating to maximize the picture quality. The light can reflected back when using different color screen which can be harmful to human eye. In most places white screen are used because it absorbed and not reflect back which results in loss of image. Other things need to considered is the screen size, room size, room lighting, screen brightness and seating. If persons are very close to the screen the reflected light can harm their eyes and can feel dizzy at time

when looking at the screen for longer times. The size is depending on the room size.

Mechanical Specifications						
	NWC	Classroom Presentation System	NWC	Video Selector	NWC	Interface
Size Weight		N/A		N/A		N/A
Organization		N/A		N/A		N/A
Interconnect		Depends on the individual components		N/A		N/A
Packaging	N	Commercially Available	W	HDMI		N/A
Protection		N/A		N/A		N/A
Etc.		N/A		Shielded from users		N/A
		N/A		N/A		N/A
	NWC	Control Box	NWC	Lights Controller	NWC	Audio Mixer
Size Weight	W	Less than 1.5 square feet in size	W	Small	W	Small size/ Fit in lectern
Organization	W	Less than 5lbs	W	light	W	Less weight
Interconnect		N/A		N/A	N	Signal connection
Packaging		N/A		N/A	N	Different inputs
Protection		N/A		N/A	W	Included
Etc.		N/A	N	Isolated	W	Turned off when high power
				N/A		
	NWC	Audio Amplifier	NWC	Projector	NWC	Screen
Size Weight	W	Small size/ Fit in lectern	W	Small size/ Fit in lectern	N	Depending on the class size
Organization	W	Less weight	W	50lbs or less		N/A
Interconnect	N	Signal connection	N	Signal connection		N/A
Packaging	N	Different inputs	N	Different inputs		N/A
Protection	W	Included	W	Included		N/A
Etc.	W	Turned off when high power	W	Security hardware included		N/A

Electrical:

Presentation System:
The system doesn't have much in the way of electrical constraints. Our system must use 120V AC power, but we can create dc power for different parts of the system. We would like the system to use less power than existing systems. The values and ranges will be constrained by the individual components; they just need to work together. Interfacing and aging are both heavy constraints of the system; all the components must work together and last longer than the current components.

Video Selection and Transport:
The switcher must use a power source that can be easily provided. The accuracy, values and ranges must be within the limits of the input and output video devices. We will need to put a surge protector in front of it to keep it from dying too early.

Control:
The embedded computer should be able to be run off a typical 120V AC wall outlet and be able to be up and running with minimal effort to power the device. The device should be able to provide a minimum of eight (8) RS-232 serial ports and at least four (4) digital I/O, with a minimum voltage of 5V. Interfacing with the device should be able to be done through an IP address (Ethernet) or at the minimum, a serial communication port.

Lighting Control:
The electricity that is available in engineering building is 120V and 240V. For that reason we are focusing on the relays those support these ranges. Also, the current of system that we are looking to support suspected to support 9-25A.

Audio Mixing and Amplification:
The team is looking for a system that uses less power and more reliable. The system should be able to use for longer hours and highly accurate. The ranges of the system will be provided in the instructions manual. The amplifier will be controlled through relay and different signals from the control box. The system will have longer life and will be less expensive.

Projectors:
The projector will be running on a 120V AC wall outlet. The power will cut down depending upon the power needed to run the projector for longer hours. The output that will produce from the projector will be highly accurate and the security hardware will be included for the protection.

Screens:
The projection screen should support 120V or 240V. Also, we should know the control signal to connect the screen to our embedded system and we are working on this part and contacting manufactures to get the catalogs of their products.

Electrical Specifications						
	NWC	Classroom Presentation System	NWC	Video Selector	NWC	Interface
Power		Want - Low	W	120V AC		N/A
Accuracy	N	High	N	Highly accurate		N/A
Values, ranges		N/A		N/A		N/A
Interfacing	N	Commercialy Available	W	3 pronged wall connector		N/A
Aging		N/A	N	long life		N/A
Etc.		N/A		N/A		N/A
	NWC	Control Box	NWC	Lights Controller	NWC	Audio Mixer
Power	W	120V AC wall outlet	N	120-240 AC	W	12 Watt or less
Accuracy		N/A	N	high	W	Higher accuracy
Values, ranges		5V digital I/O		N/A	N	(+-)20 Hz
Interfacing	W	Serial, Ethernet	N	I/O	N	Internal relay
Aging		N/A	N	long life	W	Longer life
Etc.		N /A		N/A		
	NWC	Audio Amplifier	NWC	Projector	NWC	Screen
Power	W	15 Watt	W	120 V	N	120 or 240 V
Accuracy	W	Higher accuracy	W	Higher accuracy	N	highly accurate
Values, ranges	N	(+-)20 Hz		Depend upon input		N/A
Interfacing	N	Internal replay	N	Internal relay	N	right signal
Aging	W	Longer life	W	Longer life	N	Long life
Etc.						

Environmental:

Presentation System:
The system as a whole must be able to sustain the temperatures, humidity and shock within the building. The components must operate at temperatures between - and + with humidity ranging from 0 to 60%. The shock and vibration numbers will be dependent upon the size and placement of the individual components.

Video Selection and Transport:
The switcher must be able to withstand normal building temperatures, humidity and vibration. If it is placed in a lectern it must be able to withstand people kicking the box and bouncing when being moved.

Control:
Since most of the embedded computers are used in industrial applications, temperature, humidity and vibration are not an issue. The embedded computer will be stored inside where such conditions are kept relatively constant, temperature ranging from 30 degrees F and 110 degrees F. To prevent shock to the system, a surge protector will be needed when the system is put into place.

Lighting Control:
Since SSR are going to handle the electricity, it is important to be away from a humid weather. What we know about temperature and humidity is, it is essential to the proper operation of SSR but we need to provide more information about the temperature of the place that is going to be stored in. Flagstaff has a very dry weather and humidity should not be an issue.

Audio Mixing and Amplification:
The system will work in extreme temperatures and will produce less heat. The humidity will not have much impact on the device and it will be vibration protected. Without shock protection the system might burn and dysfunction.

Projectors:
The lumen of the projector produces heat and if it runs for longer period of time the temperature can rise. There won't be any problem with the temperature, humidity, and vibration it will be manufactured in such way that there won't be any issue. The projector will be able to run in extreme temperatures and will have a safety device to control the temperature.

Screens:
The projection screen should be in a dry place to increase its life time. The reason why, for some products has mechanical parts which are involved of rolling the screen down are made of iron which are highly affected of humid weather. Also, the projector should be in a room with not high temperature.

Environmental Specifications			
	NWC Classroom Presentation System	NWC Video Selector	NWC Interface
Temperature	N Room Temp. +- 40 degrees	N Room Temp +- 40 degrees	N/A
Humidity	N/A	N/A	N/A
Vibration, shock	N/A	N/A	N/A
Etc.	N/A	N/A	N/A
	NWC Control Box	NWC Lights Controller	NWC Audio Mixer
Temperature	Room Temp +- 40 degrees	N Room Temp 77F	N Work in extreme/normal condition
Humidity	N/A	N/A	W Less humid
Vibration, shock	W Surge protector	N Avoided	N Vibration protected
Etc.	N/A	N/A	
	NWC Audio Amplifier	NWC Projector	NWC Screen
Temperature	N Work in extreme/normal condition	N Work in extreme/normal condition	N Room Temperature 77F
Humidity	W Less humid	W Less humid	N Dry
Vibration, shock	N Vibration protected	N Vibration protected	N/A
Etc.			

Documentation:

Presentation System:
Our system will need to be heavily documented. We will need to have manuals for all the components and the interface. We will need to provide a schematic for the installers and maintainers. We will need to provide operators manuals and user's guides for users and administrators. Our code must be well documented, maintainable and run on Windows. We will need to create procedures for troubleshooting as well replacing parts.

Video Selection and Transport:
Good documentation needs to be provided to us for any switcher we use. We will need the signaling specifications as well as the manuals to enable us to interface it with our system. Pre-existing code to get the switcher working would be a major desire to keep our development time down. The switcher must work with normal signaling standards, either RS-232, USB or digital I/O.

Control:
Documentation for the device that is selected will need to include an operator's manual, a maintenance manual, and a user's guide. As a want, the device should include some example code on how to interface with the different ports of the device and should be either Windows or Linux based. Code that will be written for the device should be able to accommodate upgradability for new devices that will interact with it.

Lighting Control:
Documentation of SSRs will need to include datasheets that specify each of the Voltage input, Voltage load and outputs, as well as instructions on the sizes and weather.

Audio Mixing and Amplification:
All the required documents like operator's manual, maintenance manual, user's guide and other documents about the system will be provided. The amplifier should be able to work on different platforms like Windows/Linux or through relays and signals. Amplifier coding will be provided to show details about different inputs.

Projectors:
All the required documents like operator’s manual, maintenance manual, user’s guide and other documents about the system will be provided. The amplifier should be able to work on different platforms like Windows/Linux or through relays and signals. Amplifier coding will be provided to show details about different inputs.

Screens:
All the required documents will be available with the screen how and where to install. The guide will be given where to install the screen and it should be in line with the projector. It is necessary to align the screen with the projector otherwise the picture will be out from the screen.

Documentation Specifications						
	NWC	Classroom Presentation System	NWC	Video Selector	NWC	Interface
Operator's Manual	N	Need to provide	N	Must be provided	N	Need to provide
Maintenance Manual	N	Need to provide	N	Must be provided	N	Need to provide
User's Guide	N	Need to provide	N	Must be provided	N	Need to provide
Coding	W	Well documented, easily upgradable	N	Need documentation	W	Well documented, easily upgradable
Platform	N	Windows	N	Any signalling standard	N	Windows
Etc.	W	Tooltips on the UI			W	Tooltips on the UI
	NWC	Control Box	NWC	Lights Controller	NWC	Audio Mixer
Operator's Manual	N	Need to provide	N	Must be provided	N	Included
Maintenance Manual	N	Need to provide	N	Must be provided	N	Need to provide
User's Guide	N	Need to provide	N	Must be provided	N	Included
Coding	W	Well documented, easily upgradable		N/A	W	Documented
Platform	N	Windows or Linux		N/A	N	Connection with controller
Etc.		N/A		N/A		
	NWC	Audio Amplifier	NWC	Projector	NWC	Screen
Operator's Manual	N	Included	N	Included	N	Should be provided
Maintenance Manual	N	Need to provide	N	Need to provide	N	Should be provided
User's Guide	N	Included	N	Included	N	Should be provided
Coding	W	Documented	W	Documented	N	should be provided
Platform	N	Connection with controller	N	Windows/Linux	N	Should be provided
Etc.						

Testing:

Presentation System:
We will need to do extensive testing of every part of the system to insure everything works together and as expected.

Video Selection and Transport:
We will need to test the switcher with the existing equipment as well as any equipment we wish to hook up to it to make sure they work together. The procedures aren’t important, but we need to verify that it works the way the documentation tells us it should.

Interface:
We will need to go through extensive testing of the interface to make sure it is usable by many different users and that it doesn’t contain bugs. We will also have to test it out with the controller to make sure they are able to properly communicate.

Control:
When testing the device to make sure that it is running completely, we will first need to make sure that we can interface with the device. After establishing an interface connection, we will test the inputs and outputs of the device. Test code will allow us to retrieve information about the inputs and outputs to determine if they are able to be used. If the I/O is usable, the next test is to make sure the software that will be developed is able to be configured with not too much effort. The tests ensure that the device will be able to be used in the presentation system.

Lighting Control:
When testing SSRs to make sure that it is running well, we will first need to make sure that we can interface with the system. Also, we will test the inputs and outputs of the device.

Audio Mixing and Amplification:
To test the equipment is to run the system and follow the procedure. Included items with the system and which wire to connect where. Very intense testing will be done to check the system capability and will run to its maximum limits.

Projectors:
To test the projector is to run to its maximum capacity and understand what needed to done when the system fails. The testing will be done considering the power, life of the system, and the I/O slots. There will be different inputs on the projectors that will connect through computers, and other devices.

Screens:
To test the screen one need to check is it installing at the right place or does it need additional space to install. Once it is installed check the motor to see if the screen is moving up and down or no. Connect with the projector and see if the screen has adjusted with the screen or the picture is out of balance. Connect the laptop with the projector and check the display and resolution. What output does it showing on the screen VGA or HDMI?

Testing Specifications			
	NWC Classroom Presentation System	NWC Video Selector	NWC Interface
Procedures Equipment Etc.	N Extensive testing . N Test with the system	N Must work with controller N Must work with equipment	N Extensive testing . N Test with the system
	NWC Control Box	NWC Lights Controller	NWC Audio Mixer
Procedures Equipment Etc.	N Extensive testing N Must communicate with other devices N/A	N Must work with the embedded system N Must work with the equipments N/A	N Intense testing N Complete System
	NWC Audio Amplifier	NWC Projector	NWC Screen
Procedures Equipment Etc.	N Intense testing N Complete System	N Intense testing N Complete System	N Need to be tested N must be tested with the embedded system

General:

Presentation System:
The system needs to be more reliable than the current solutions used at NAU. Self-calibrating is something we would like to include in the system. We have no vendor preferences; we want to build the system so that components from any vendor can be utilized to replace aging parts. Our system needs to be designed so that anybody can use it.

Video Selection and Transport:
The switcher must be as reliable as or more reliable than the ones NAU is currently using. It must be able to auto- detect signals and their characteristics. We have no vendor preference or client preferences.

Control:
In general, the embedded computer needs to be one of the most reliable components of the system; the embedded computer is what makes controlling the room possible. Calibrating the device may take some time. This will guarantee that the components that will be connected to the computer will work properly when controlled. Currently, there are no preferred vendors and price should be kept under $500.

Lighting Control:
In general, the SSRs should be able to be purchased through a vendor with little effort and arrive in a reasonable timeframe. The device should be covered under normal warranty with an option to extend the warranty to meet NAU purchasing standards. Pricing will depend on the model of SSRs purchased but should not exceed more than $50.

Audio Mixing and Amplification:
In general amplifier have input signals which a voltage or a current. It is used in audio application like a loudspeaker that is used to make human voice louder or play recorded music. It is designed to amplify the device they are intending to drive. The team will be looking for the system which is more reliable than the current system is installed in the engineering building. Instruction will be provided to setup the system with the preferences of vendor and client.

Projectors:
General purpose of the projector is to see a display on a bigger screen. What different kinds of videos, presentations, lectures, business use and others. Projected display can help students to understand the material better and help to a person who is presenting. Affordable price and long life hours for the lamp can offer good performance and flexibility.

Screens:
General purpose of the screen is to see the projected picture from a projector. The screen should be white so that it can absorb the reflected picture and not reflect the light. The size of the screen depends upon the size of the room and number of people will there to see the display.

General Specifications			
	NWC Classroom Presentation System	NWC Video Selector	NWC Interface
Reliability	N More reliable than existing systems	N As reliable as existing switcher	N More reliable than existing systems
Self Calibrating	W Easy setup and automatic diagnostics		W Easy setup and automatic diagnostics
Vendor Preferences	No		No
Client Preferences	N Engineering Teachers		N Engineering Teachers
Etc.			
	NWC Control Box	NWC Lights Controller	NWC Audio Mixer
Reliability	N Needs to be very reliable, central control point	N very reliable	N More reliable
Self Calibrating	Will take some calibrating for different components	W easy to setup	W Easy to setup
Vendor Preferences	None	No	W Reliable
Client Preferences	None	N Engineering Teachers	N Professors
Etc.	N/A	N/a	
	NWC Audio Amplifier	NWC Projector	NWC Screen
Reliability	N More reliable	N More reliable	N Should be Reliable
Self Calibrating	W Easy to setup	W Easy to setup	W Easy to setup
Vendor Preferences	W Reliable	W Reliable	
Client Preferences	N Professors	N Professors	N Engineering Teachers
Etc.			

Design

User Interface:
The UI will be software based and universally designed to allow anybody to use it. Multiple interfaces will be used to make it more user-friendly by enabling users to customize their view and create custom presets for the room. Users will be able to see all the information or use only presets to control everything at one time, the prototype interfaces are shown in Figures 3 through 5. The interfaces will provide all the information a user needs on one screen and the amount of information they see can be customized. They will be able to see everything at once, Figures 3 and 4, or be able to view just their presets, Figure 5. The program will also be designed to allow blind users full use of their preferred text to speech software. By creating a logical tab and menu system they will be able to effectively navigate and change options without having to see the screen or use a mouse.

We looked at different ways and systems for creating a software-interface on, and decided to create the UI with VB.Net for windows computers. The engineering building has windows PCs in every classroom, so it is a free solution to implement. Also, using pre-existing code will enable us to do a lot more with the system than we could if we started from scratch with another language.

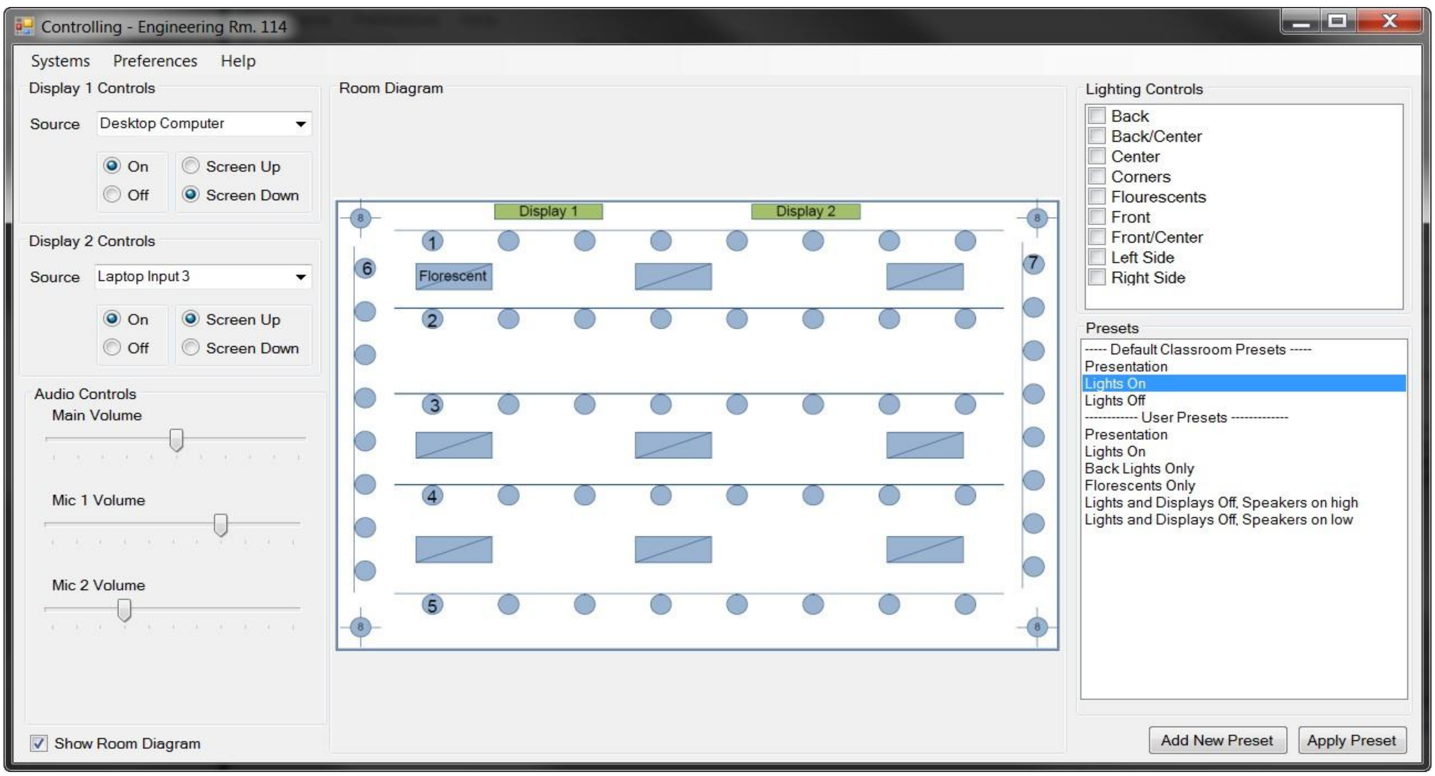


Figure 3: Prototype UI with room diagram

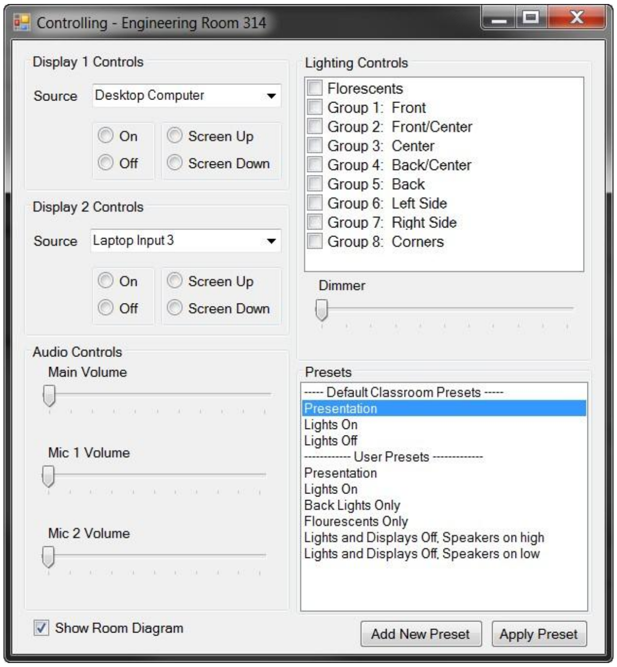


Figure 4: Prototype UI without room diagram

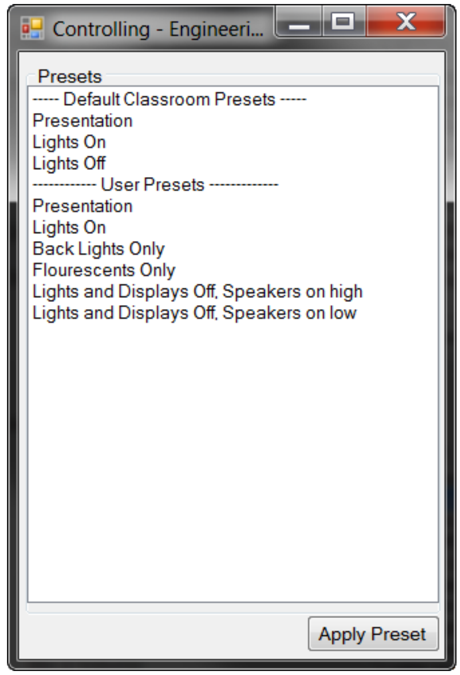


Figure 5: Prototype UI with only Presets

Video Switcher:
Decision: We have decided to recommend the Monoprice 4x2 Matrix HDMI switch. While we were able to find better equipment, the price was the deciding factor between the 2 port and 4 port types. The Monoprice switch can be obtained for 1/10 the cost of other switches. The Monoprice switch also has its signaling protocols published, so we wouldn't have to try to get them from the manufacturer. Table 1, shown below, is our decision matrix for switches. We narrowed it down to three possibilities, then selected between them based on the scores we assigned to each category.

Product	Manufacturer	Price	Reliability	Functionality	Documentation	Score
4x2 Matrix HDMI Switch	Monoprive	5	4	4	4	**17**
4x2 Matrix HDMI Switch	Bytecc	5	4	2	2	**13**
4x4 Matrix HDMI Switch	StarTech	1	4	5	3	**13**

Table 1: Decision matrix for the video switcher

Controller:
Decision: For the controller, the group has decided to go with a two part system. The first part will be an embedded computer; the second will be a USB-to-serial converter. The design was chosen because of the cost of purchasing an embedded computer with eight (8) serial ports. Each of the components of the controller, the embedded computer and the converter, will have four (4) serial ports. This allows for eight (8) serial ports to be used without the high price. Below are Tables 2 and 3 for possible controllers and converters.

Controller	Type	Serial Ports	Digital Output	USB	ower Consumpti	Reliability	Price	Score
Moxa IA260-CE	Embedded Computer	3	5	2	4	5	1	**20**
Advantech UNO-1019	Embedded Computer	3	2	1	3	3	3	**15**
Network Technologies	Embedded Computer	3	3	3	4	3	3	**19**
RS-232 Serial Device Se	Embedded Computer	3	2	2	3	3	3	**16**
Startech PEX8S952	PCI Card	5	1	1	2	3	4	**16**
Startech PEX4S553	PCI Card	3	1	1	2	3	5	**15**

Table 2: Decision matrix for the controller

Converter	Type	Serial Ports	Driver Support	Power	Reliability	Price	Score
Moxa UPort 1650-8	USB-to-Serial	3	5	3	5	2	**18**
Digi Edgeport/4	USB-to-Serial	3	5	5	4	2	**19**
SIIG JU-HS4011-S2	USB-to-Serial	3	3	5	3	4	**18**

Table 3: Decision matrix for the converter

Recommended Parts: Based on the Tables 2 and 3, the recommended controller is a Moxa IA260-CE and the recommended converter is a Digi Edgeport/4. The reason for these two parts is based on a combination of the score and that the group has access to similar devices, a Moxa IA240 and an Edgeport/4, courtesy of Dr. Paul Flikkema. With these two devices available, the group will be able to get started with writing code and testing the devices together.

The Moxa IA260-CE was selected because of the capability of eight (8) digital outputs which allows us for the capability any digital signal, including lights. Since the Moxa selected has a USB 2.0 port on it, this allows for us to connect converter to the device, expanding the number of serial ports from four (4) to eight (8). The device features a stable Linux 2.6.23 operating system and allows for remote access to the device. The device also features a MTBF (mean time between failures) of 143,328 hours, or 16 years. The Digi Edgeport/4 was selected because of the reliability and the power the device needs. The device is powered via USB with no need for an external power supply.

Lighting:
As shown in Table 4, we picked OPTO22 and Crydom because they are the best US companies who specialize in making high quality solid state relays. Also dealing with a company that is inside the US makes shipping better than international companies. From Table 4, it shows that we picked 240D10. The reason for choosing the OPTO22 240D10 is because it is cheaper and gives the user the option to run them on 120V or 240V.

Voltage Load	Serial #	Current Load	Price	Size	Brand
24-140	D1210	10	$30.55	1.8"x1.87"x0.78"	Crydom
	120D10	10	$28.00	1.7"x0.98"x0.675"	OPTO22
	D1225	25	$35.00	1.8"x1.87"x0.78"	Crydom
	120D25	25	$29.00	1.7"x0.98"x0.675"	OPTO22
120-240	D2410	10	$36.00	1.8"x1.87"x0.78"	Crydom
	240D10	10	$28.00	1.7"x0.98"x0.675"	OPTO22
	D2425	25	$38.40	1.8"x1.87"x0.78"	Crydom
	240D25	25	$32.00	1.7"x0.98"x0.675"	OPTO22

Table 4: Decision matrix for the solid state relays

Screens:
The Draper Company is the choice for motorized screens; they are providing almost the same quality of product and with lower prices. We are currently using The Draper Series E at the engineering building, and they are very reliable and good quality.

Brand	Model	Cost	Size	Control
Da-Lite	Motorized Scenic Roller	$1,588.00	96"x96"	MC1, LVC
Draper	Series E	$900.00	96"x96"	MC1, LVC
Da-Lite	Tensioned Contour Electrol	$1,853.00	96"x96"	MC1, LVC

Table 5: Decision matrix for the projection screens

Screen Controllers:
There are several different ways that projection screens are controlled. One is the low voltage control (LVC), which is currently being used in the engineering building. The other is a motor control board (MC1) which allows for multiple types of communication as seen in Table 6. Since the communication of choice for this project is RS-232, the MC1 is a viable type of screen controller.

Choice	Brand	Type	Cost	Control Type
1	Da-Lite	LVC-IV	$350.00	IR and RF
2	Draper	MC1	$420.00	IR, RF, Ethernet, RS-232
3	Draper	LVC	$345.00	IR and RF

Table 6: Decision matrix for screen controller

Projectors and Audio Mixing/Amplification:

As shown in Tables 7-9, the selected devices were graded based on cost, performance and durability. The selected devices include the BenQ MS500 projector, the Audio Enhancement Innovator amplifier, and the Intelix Audisey Athena mixer.

Brand	Model	Cost	Performance	Durability	Score
BenQ	W710ST	3	3	4	**10**
Acer	X1230PS	3	2	2	**7**
BenQ	MS500	5	3	4	**12**

Table 7: Decision matrix for the projector

These devices have reasonable cost and their performances are very good in comparison to others and are more durable. Though the cost of amplifiers and mixers are high priced, they currently offer the communication type that we are looking for. The team is looking for devices that will work best for the project and will be able to use for long period of time and that consume less power.

Brand	Model	Cost	Performance	Durability	Score
AMC	XG-16	3	2	4	**9**
Stereo Mixer Amplifier	CT-Amp-32W-232	4	3	3	**10**
Audio Enhancement	Innovator	4	5	5	**14**

Table 8: Decision matrix for the audio amplifier

Brand	Model	Cost	Performance	Durability	Score
Stereo Mixer Amplifier	CT-Amp-32W-232	4	3	3	**10**
Intelix	Audisey Athena	4	5	4	**13**

Table 9: Decision matrix for the audio mixer

Constraints

Cost:
The cost of the project is one constraint that will need to be looked into. Currently there are no sponsors to help with the costs at this time. We are currently relying on the CEFNS IT department and/or the EE department for help in purchasing products for the project. The group is able to access both a Moxa and an Edgeport/4 to begin testing and developing code for the project.

Safety:
The second constraint we looked into is Safety. Our system could potentially cause a major safety hazard if designed poorly. For instance, if a fire breaks out in the building and an error occurs that causes the lights to turn off could potentially cause deaths. For that reason we have to allow it to make smart decisions to keep people safe.

Environmental:
The project our team is working on will have different kind of constraints. One of the constraints the team will encounter will be environmental constraints. Our team is looking for a system that uses less power and work efficient. One of the main constraints the team have will be the heat that produced by the devices. The system will work in extreme temperatures and will produce less heat. The humidity will not have much impact on the device and it will be vibration protected. Without shock protection the system might burn and dysfunction. There were devices like projectors, amplifier, mixer, lights, relay, and screen that will produce heat and can change the temperature of the room. Most of the devices will shut off if there is too much power coming in. all the devices will be controlled through control box that will turn the devices on or off. The devices will be turn on if it is needed otherwise it will stay off to save the power consumption.

Manufacturability:
Because our project will be gathering selected parts from different brands, we are looking to selected parts from high quality brands that match our requirements and then programming them to the embedded system. And, the presentation system must be manufactured to fit on an imaginary universal presentation room with different room dimensions. The system will be manufactured using Linux box that will operate everything through a linked platform from a connected computer. The presentation system is going to be accessible through platform program. This platform program should run on Microsoft, Linux and Apple Mac operating systems. The design shall only incorporate components that can be purchased through two of our main suppliers which are going to be for the Linux box and RS-232. The rest of the parts can be purchased from different companies and that must not harm the system.

Budget

Estimated Costs: The bill of materials for this project can be found in Table 3. Services that may be required at a later date include a dedicated server to house code for the project as well as run code that is specific to the project. The NAU EE department will be providing the computers to write and test code for the project, if the team members are unable to provide their own computers. Travel will not be an issue since all code writing and testing will be conducted in the engineering building. Cables, connectors, and any other supplies that may be needed for testing of the equipment may be borrowed from team members, if cables are available, or from the CEFNS IT department. As for supplies, if there are any small items that are needed, the group may purchase such items and keep copies of all receipts. Other than the occasional purchase, products and supplies will be purchased when needed. If products are unable to be purchased, the group will seek to borrow any necessary products or equipment to make progress with the project.

Item	Brand	Model	Quantity	Price
Video Switcher	Monoprice	4x2 Matrix HDMI Switch	1	$ 56.25
Projector	BenQ	MS500	2	$ 329.99
Amplifier	Audio Enhancement	Innovator	1	$ 2,232.99
Mixer	Intelix	Audisey Athena (8-channel)	1	$ 3,440.00
Solid State Relay	OPTO22	240D10	8	$ 28.00
Projection Screen	Draper	E Series (96"x96")	2	$ 900.00
Low Voltage Control	Draper	MC1	1	$ 420.00
Light	ULAmerica	SDS23P	16	$ 12.95
USB-to-Serial Converter	Digi	Edgeport/4	1	$ 303.00
Embedded Computer	Moxa	IA260	1	$ 899.00
			Total	$ 10,242.42

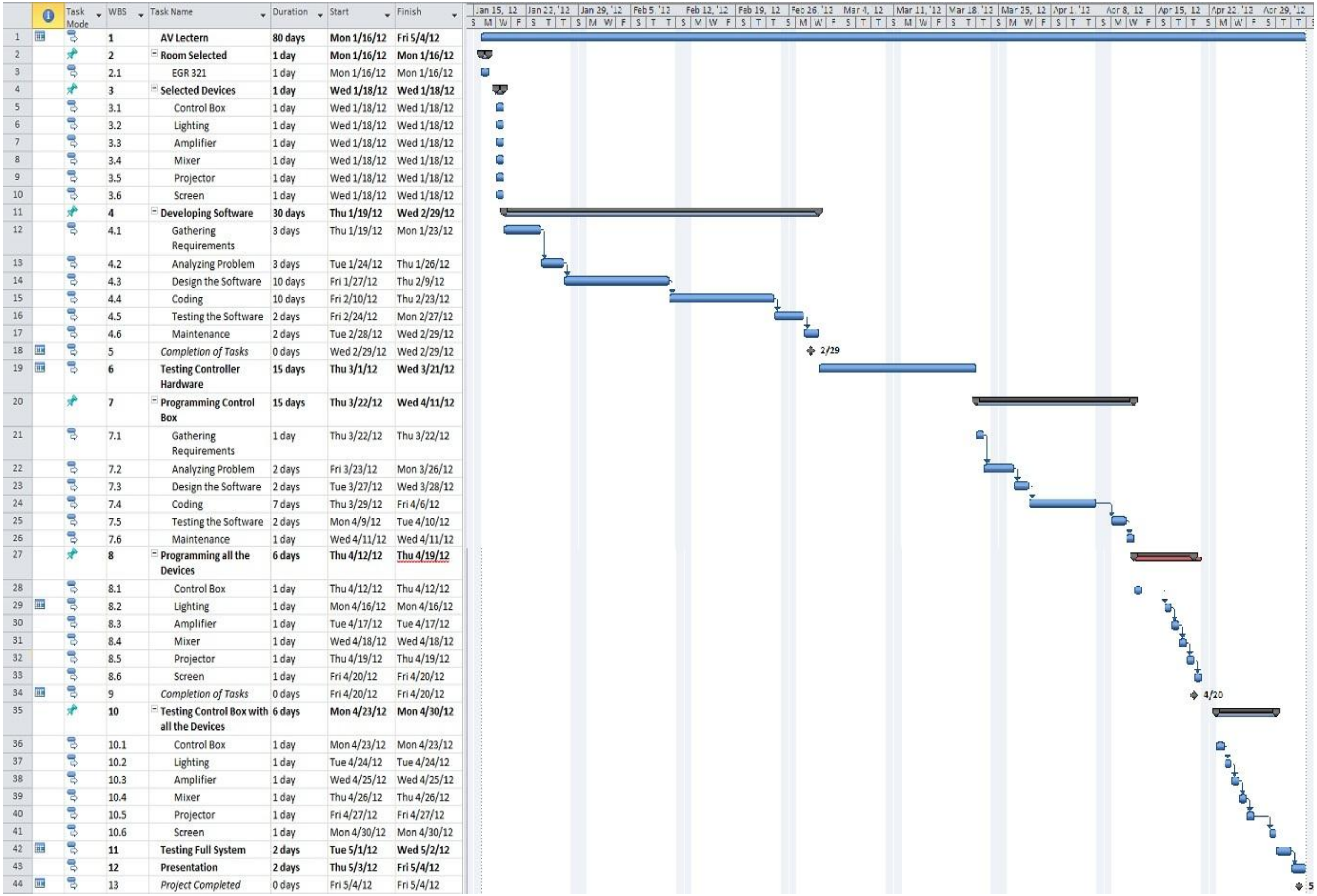
Table 10: Bill of Materials

Payment Arrangements: With prior authorization, payments to the team for any purchases made should be reimbursed at the end of the semester for the amount given by the copies of receipts. Reimbursements, if no sponsor is available, should be paid by either the CEFNS IT department and/or by the EE department.

Schedule/Deliverables

The project was distributed evenly to all the members in the team. The team will be testing the system at the Northern Arizona University Engineering building in room 321. First of all the research part was given to each member to find out what will work best. James working on the control box, Ibraheem was researching about lights, relays and screens. Umair was working on amplifiers, mixers and projectors while David was researching about everything and was providing some extra information about the project. The AV lectern project started in August 2011 and will be finished by May 2012. What the team will be working on next semester, the information is provided on the Gantt chart. The Gantt chart will be attached below.

First of all, the devices will be selected for the project, and then the team will move on to the developing software phase. The major part of the developing phase will be handled by David and James and later on Umair and Ibraheem will provide their inputs. The next phase of the project is to test the controller hardware. Once that is accomplished the next part will be to program the control box and then program the rest of the devices. Once the programming part will be complete the team will be testing the control box with all the devices attached. Finally, the full system test will be done and the team will give a presentation on the project.



	Task Mode	WBS	Task Name	Duration	Start	Finish
1		1	**AV Lectern**	**80 days**	**Mon 1/16/12**	**Fri 5/4/12**
2		2	**Room Selected**	**1 day**	**Mon 1/16/12**	**Mon 1/16/12**
3		2.1	EGR 321	1 day	Mon 1/16/12	Mon 1/16/12
4		3	**Selected Devices**	**1 day**	**Wed 1/18/12**	**Wed 1/18/12**
5		3.1	Control Box	1 day	Wed 1/18/12	Wed 1/18/12
6		3.2	Lighting	1 day	Wed 1/18/12	Wed 1/18/12
7		3.3	Amplifier	1 day	Wed 1/18/12	Wed 1/18/12
8		3.4	Mixer	1 day	Wed 1/18/12	Wed 1/18/12
9		3.5	Projector	1 day	Wed 1/18/12	Wed 1/18/12
10		3.6	Screen	1 day	Wed 1/18/12	Wed 1/18/12
11		4	**Developing Software**	**30 days**	**Thu 1/19/12**	**Wed 2/29/12**
12		4.1	Gathering Requirements	3 days	Thu 1/19/12	Mon 1/23/12
13		4.2	Analyzing Problem	3 days	Tue 1/24/12	Thu 1/26/12
14		4.3	Design the Software	10 days	Fri 1/27/12	Thu 2/9/12
15		4.4	Coding	10 days	Fri 2/10/12	Thu 2/23/12
16		4.5	Testing the Software	2 days	Fri 2/24/12	Mon 2/27/12
17		4.6	Maintenance	2 days	Tue 2/28/12	Wed 2/29/12
18		5	*Completion of Tasks*	0 days	Wed 2/29/12	Wed 2/29/12
19		6	**Testing Controller Hardware**	**15 days**	**Thu 3/1/12**	**Wed 3/21/12**
20		7	**Programming Control Box**	**15 days**	**Thu 3/22/12**	**Wed 4/11/12**
21		7.1	Gathering Requirements	1 day	Thu 3/22/12	Thu 3/22/12
22		7.2	Analyzing Problem	2 days	Fri 3/23/12	Mon 3/26/12
23		7.3	Design the Software	2 days	Tue 3/27/12	Wed 3/28/12
24		7.4	Coding	7 days	Thu 3/29/12	Fri 4/6/12
25		7.5	Testing the Software	2 days	Mon 4/9/12	Tue 4/10/12
26		7.6	Maintenance	1 day	Wed 4/11/12	Wed 4/11/12
27		8	**Programming all the Devices**	**6 days**	**Thu 4/12/12**	**Thu 4/19/12**
28		8.1	Control Box	1 day	Thu 4/12/12	Thu 4/12/12
29		8.2	Lighting	1 day	Mon 4/16/12	Mon 4/16/12
30		8.3	Amplifier	1 day	Tue 4/17/12	Tue 4/17/12
31		8.4	Mixer	1 day	Wed 4/18/12	Wed 4/18/12
32		8.5	Projector	1 day	Thu 4/19/12	Thu 4/19/12
33		8.6	Screen	1 day	Fri 4/20/12	Fri 4/20/12
34		9	*Completion of Tasks*	0 days	Fri 4/20/12	Fri 4/20/12
35		10	**Testing Control Box with all the Devices**	**6 days**	**Mon 4/23/12**	**Mon 4/30/12**
36		10.1	Control Box	1 day	Mon 4/23/12	Mon 4/23/12
37		10.2	Lighting	1 day	Tue 4/24/12	Tue 4/24/12
38		10.3	Amplifier	1 day	Wed 4/25/12	Wed 4/25/12
39		10.4	Mixer	1 day	Thu 4/26/12	Thu 4/26/12
40		10.5	Projector	1 day	Fri 4/27/12	Fri 4/27/12
41		10.6	Screen	1 day	Mon 4/30/12	Mon 4/30/12
42		11	**Testing Full System**	**2 days**	**Tue 5/1/12**	**Wed 5/2/12**
43		12	**Presentation**	**2 days**	**Thu 5/3/12**	**Fri 5/4/12**
44		13	*Project Completed*	0 days	Fri 5/4/12	Fri 5/4/12

Figure 6: Tasks and Gantt chart

PowerPoint Presentation