SYSTEMS ENGINEERING ELEMENTS FOR SENIOR PROJECT REPORTS

1. Conceptual System Design

1.1 Statement of the Problem Definition and Need Identification

Our project involves designing and developing an advanced LED banner display for the ECE Center for Intelligent Systems located in the Armstrong building. Currently, there is no such device concentrated around this faculty- and student-led research laboratory. Many students, faculty, and visitors, especially those outside the bounds of the engineering department, are unaware of its existence, so it would be valuable to design a method of information sharing that raises awareness about the center's everyday activities. The banner would be on display on the hallway directly outside the lab. As a result, it would be beneficial to also display general information and helpful reminders to engineering students, such as events from the engineering updates emails. However, for those nonstudents who are only visiting the building, this advanced banner display can simply be a showcase of the engineering capabilities of the faculty and students. Overall, this project would increase the quality of the Armstrong facilities and provide a number of simple benefits to its members.

1.2 Documentation of the System Feasibility Analysis

Display	Pixel LED Matrix Display
	LED Display Sign High Resolution
	LCD Display Monitor
Display Cover Material (for deployment)	Metal, Wood
Board	PSoC 5LP Development Kit

Table 1. Technology options

	Raspberry Pi
Power Supply	<u>12V 5A Power Supply</u>

Feasibility of the Display

Currently, there are three display options for the banner. The pixel LED matrix display is an option similar to what was suggested by Dr. Pearlstein, and is the most affordable option out of the three. However, there are certain features that are not available, such as a built-in power supply, that the LED display sign with high resolution has. The LED display sign is the second pricier option that has programming software and a much larger size. The LCD display monitor will be the priciest option with the most features, but it may not be what we are looking for in terms of the project requirements.

Feasibility of the Embedded Board

There are currently only two options for embedded development boards that are being considered. The PSoC 5LP board is a piece of hardware that we can acquire through the engineering department of TCNJ, which wouldn't have to be included in the budget, meaning we can spend more on other hardware. Our team members also have experience using it, so it would be the most viable option. A raspberry pi is the other easily accessible option which we would have to acquire and learn ourselves in order to use. It may be a great backup option where we can learn and utilize a new technology.

Feasibility of the Display Cover

It would be ideal for project deployment to design and construct a display cover that would be able to hold and hide all hardware components against the wall. There should be enough space for the banner to connect to an outlet. Some type of metal, light but durable, would be the ideal material for this cover. Wood is another option, but this material may pose a fire risk in case of malfunctions.

Feasibility of the Power Supply

A 12V 5A power supply which connects to an outlet should be enough to power the board we end up choosing to develop on. The power supply must have a cord with at least three feet of length in order to deploy the banner in a sufficient manner against the wall, at eye level at least.

1.3 Documentation of the System Operational Requirements

1.3.1 Mission definition

The mission of the Intelligent Systems Banner Display is to showcase announcements and other important information to the faculty, students, and visitors of Armstrong Hall on the TCNJ campus. These announcements will be targeted towards the electrical and computer engineering students on campus. This banner display will make it easier for students to keep up to date with engineering activities, seminars, and deadlines.

1.3.2 Performance and physical parameters

Some of the physical parameters for the banner display include the height, width, and weight of the display. A screen around 8in by 18in is being considered for the width and height. The weight of the banner display will be about 5 to 15 pounds. The performance of the system's software will have a high speed as the system should be able to display and receive information within a small time window. Additionally, the software that receives and displays data should have 100% accuracy to guarantee the messages are informing visitors of the correct information.

1.3.3 Operational deployment and distribution

The Intelligent Systems Banner Display has no distribution requirements as it is only one, unique system for Armstrong Hall. For deployment, the banner display will need to be attached to the wall outside

the Robotics Research Lab at a high position to prevent accidentally blocking. The display may need to be near an outlet to power on if a wired power source is a required hardware.

1.3.4 Operational life cycle

The intended time the banner display will be operational in Armstrong is between 8 and 12 years. This is considering the burn out time of an LED bulb. Furthermore, technology is always progressing towards more powerful software and smaller hardware. If our banner display's features become outdated, the system could be replaced before our anticipated end date.

1.3.5 Utilization requirements

The Intelligent Systems Banner Display will be operational 24 hours and 7 days a week since the building is open most of the day. In addition, the banner display will need to be updated constantly with new information and maintain the current time and date.

1.3.6 Effectiveness factors

The display of the system will need to be bright enough that it can be easily read at a distance. The system's weight will need to be light enough, so it can be properly hung on a wall. The software should be reliable to limit the amount of times the user needs to check if the display is updated.

1.3.7 Environment

The proposed banner display will only be operational indoors since it will be located in Armstrong Hall. Therefore, environmental factors such as the humidity, weather, and storms will not affect the banner. However, the temperature of the room will need to be cool to prevent the LED display from overheating. If the banner would need to be relocated to another building, outdoor factors should be considered for the system to prevent any environmental damage.

1.4 Documentation of the Technical Performance Measures of the system using a Modified House

of Quality Family



1.5 Documentation of the Functional Analysis and Allocation for the system via Functional Flow

Block Diagrams (FFBDs)



1.6 MatLab System Composer Functional Block Diagram for the system, and simulation of the







Third Level - Command Line: Enter



Third Level - Config Options: Configure



2. Preliminary System Design

2.1 Documentation of the Functional Packaging into Major Elements

