2020 ENEL 387 Project Deadlines and Deliverables

Jan 27 – Deliverables document posted

Feb 7 – Project proposal (1 page PDF) due via URCourses

Mar 6 – Functional Specification (PDF) due via URCourses

Mar 2/3/4 –Project Checkpoint during lab periods

Apr 6/7/8 – Project Demo during lab periods, Final Report due at demo.

Project Scope and Requirements:

Working in groups of two*, students are expected to create an electronic system based on the STM32F100 microcontroller/ STM32VLDiscovery Board/ ENEL 384 Board. Additional circuitry can be accommodated on a breadboard, solder-type protoboard, or any other appropriate platform.

The system will control a mobile robot which will be capable of navigating a course, identifying and interacting with various targets along the route. An example of a suitable course can be found by visiting the site for the Trinity College Home Fire Fighting Robot Competition. Our course will use elements similar to the courses used in that competition. Details on the actual navigation course will be posted in a separate document.

The maximum dimensions of the robot will not exceed 31 cm in any direction. The robot may be wheeled or tracked (no walking robots). The robot may be constructed from commercially available kits, technical building kits (vex/LEGO), or be a custom design or modification to a chassis.

The generic requirements for the system are that it:

- **must accept dynamic inputs from the outside world**
- **must provide controlled outputs to the outside world**
- **must incorporate at least two sensors in addition to those provided on the ENEL 384 board.**
- **must include both digital and analog sensors**
- **must incorporate at least two output devices in addition to those provided on the ENEL 384 board.**
- **must have at least two different output interface systems (PWM, SPI, UART, GPIO to external drivers)**
- **must have at least one output device with a current requirement greater than the STM32F100 rated output current**

Inputs to the system may range from switches, push buttons, keypads, and other contact based devices, to force/pressure/strain sensors, temperature/humidity/moisture sensors, light sensors, distance sensors, GPS receivers, etc.

Outputs from the system may include LED's, an LCD display, motor drivers, relay drivers, audible devices, etc.

As we go through the lab course, you will see a number of different microcontroller interface systems which can be used to connect devices to your STM32. We will **NOT be looking at the following: USB, Ethernet, CANbus, I2C. AVOID THEM IN YOUR DESIGN!** The interfaces we will look at are: Digital I/O, Analog Input, PWM, Serial Peripheral Interface (SPI), Universal Synchronous Asynchronous Receiver Transmitter (USART). These basic interfaces will be more than sufficient for the purposes of the ENEL387 project.

Project Proposal:

Each group will submit, via URCourses, a one page PDF which explains their project idea. They must describe how the robot will interact with solid walls or obstacles, black navigation lines on white horizontal and /or vertical surfaces, light sources, and infrared sources along the route. The proposal will outline the inputs they will sense, and the outputs the system will produce. A simple block diagram would be useful in this document. The Lab Instructor will review the proposals and provide feedback. Any proposals that appear too simple or too complex will have suggested modifications attached.

Functional Specification:

The Functional Specification will be a multi-page document, written in the form of a simple user manual for the robot being developed. The most important part of the Functional Specification is that it describes, in detail, the various functions and tasks that the project will perform. It will include a block diagram, a sketch of the physical system, a list of all user controls and indicators, a list of all other inputs and outputs as well as a short description of the overall operation of the device.

The Functional Specification is your road map for the project. The final project will be partially evaluated against the list of tasks and functions that you lay out in this document.

Project Checkpoint:

The Project Checkpoint is a show and tell session. Each student will be expected to have all their required components available, have datasheets available for each component, and be able to show, via a schematic (drawn with an appropriate CAD tool), how the components will interface to the STM32F100.

Project Demo:

The student will provide the Lab Instructor, and other interested parties, with a demonstration of the operation of their robot. The robot will be expected to navigate the course provided. All navigation runs will be timed, and the time will be used as part of the evaluation. The project will also be tested against the Functional Specification provided earlier in the course. Marks will be based on the robot's navigation abilities, its interaction with obstacles along the course, its ability to perform all tasks outlined in the Functional Specification, supporting documentation, and physical construction.

Final Report:

The Final Report will expand the information provided in the Functional Specification. It will include a full electrical schematic for the robot , datasheets for all components used, a complete listing of the program used in the project, and a detailed procedure of the testing carried out during the development of the project.