Feasibility Model Design

F2019 – Edit this document into a deliverable.

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| Lab Section: | 2 | Group: | 5 |

# System-Level Design

Our ECE 298 projects start with a conceptual architecture, like the block diagram in **Error! Reference source not found.**a). Specific example in **Error! Reference source not found.**b). **Replace this figure with a high-level block diagram of your system.**



## Project Design Requirements

In PD 21 you learned about engineering requirements. they fall into three major categories, as follows:

1. **Functional requirements** are quantities that specify the performance of a design. They are related to the functions of the design, identified as answers to the question, "What does it do?" For example, a functional requirement for a coffee maker may specify the time required to brew a pot of coffee, a DC power supply may specify its maximum voltage, and a vehicle alarm system may specify how much noise it makes when it is set off
2. **Non-functional requirements** specify characteristics of the design that are not performance based. Theses are typically features or qualities that are desirable to the client. For example, ease of use, ease of manufacturing, and use of recycled materials.
3. **Constraint requirements** place limits on the design space, and often reflect budget or other project limitations. For example, cost, weight, and noise.

The basic form of most of these requirements is the same: a short description, followed by a relationship (equals, less than, or greater than) and a value.

**State three to five major Functional Requirements that your project must meet to successfully solve your problem statement.**

The four major functional requirements that our project must meet are:

1. The light sensor must communicate with the MCU if it is daytime or nighttime to enable the use of the ventilation or irrigation motors. If the light sensor has a resistance around 1000 kilo-ohms it should indicate to the MCU that it is for daytime. If the light sensor has a resistance around 10000 kilo-ohms it should indicate nighttime.
2. The temperature sensor must communicate with the MCU if the temperature is within a certain range (20 –30 degrees Celsius) to determine if the ventilation motors should be turned on.
3. The soil moisture sensor must communicate with the MCU if it senses a low-level scale to determine if the irrigation motors should be turned on. For instance, the irrigation motor will turn on if the soil moisture content is less than 10%.
4. The user must be able to set the threshold conditions required for the activation of the motors. For example, the threshold conditions could be set as 20-30 Celsius for the temperature sensor or a percentage of 10% or less for the soil moisture sensor.

## Project Sensors and User Inputs

* List the types of sensors and user inputs you may require (light, sound, temperature, magnetic field).

The types of sensors we will require are light, soil moisture and temperature sensors. For user inputs, we will need the user to enable and disable each motor driver as well as set the threshold conditions for the activation of the motors. We will also use the push buttons to allow the user to select between the zones.

* For each sensor and user input, list how you will connect it to the MCU, including additional interface components, if needed.
  + To connect the soil moisture and temperature sensor to the MCU we will connect them to a MUX. The MUX will then pick the analog signals required from the zones.
  + To connect the light sensor to the MCU we will connect it to GPIO pin; the light sensor will be used to tell the dc motor to turn on and off.
  + We will use the push buttons directly connected to the launchpad for zone selection.
  + A digital signal voltage level converted will also be used to step down the signal of the soil sensor which requires 5 V.
  + A computer interface (UART over USB) will be used to communicate with the MCU.

Note: We might change the use of the MUX based on the circuit.

## Project Actuators and Indicators

* List the types of actuators and indicators you may require (e.g. light, sound, mechanical motion)

The types of actuators and indicators we require are green/blue LEDs, dc brushed motor driver, and dc brushed motor.

* For each actuator and indicator, list how you will connect it to the MCU, including additional interface components, if needed.
  + The LEDs will be connected to resistors which are then connected to GPIO pin. The resistors will be used for voltage control.
  + The DC motors will be connected to the analog output of the DC brushed driver which is connected to the MCU. The DC brush driver will have an input of 5V in VM and VCC. We are inputting 3.3V by using GPIO High, in the Standby port and PWM port of the DC brushed driver. Then we will send the digital signal to AINs or BINs on DC brushed driver.
  + A digital signal voltage level converter will also be used to achieve the required 5V for the DC motor.

## Project MCU Peripherals

* List the resources inside the MCU that could be used to implement your project (e.g. ADC, timers, interrupts, GPIO functions).

The resources inside the MCU that could be used to implement our project are:

1. GPIO functions to connect the sensors, actuators and indicators to the proper pins for communication with the MSP430FR4133.
2. ADC for converting the analog signals of the light, sound and temperature sensors.
3. Timers to create delays.

Note: We might require more resources as we proceed further with the lab.

* List parameters that the software running on the MCU might require.

Parameters that the software on the MCU might require are ADC values, GPIO pin values, push button status, LCD display and timer.

## Project Testing Methodology

* For each sensor, user input, actuator, indicator, and MCU peripheral listed above, state how you will verify that each one is functioning as expected (a table may be helpful)

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| --- | --- |
| **Component** | **How to Verify Functionality** |
| Ambient Light Sensor | At a certain value, the ambient light sensor should turn on an LED to indicate that it is dark. To check, we will move our hand around the light sensor to see if the LED turns on. |
| Temperature Sensor | The sensor should display values on the LCD; as the temperature increases the values should as well. To check the increase in the value we will cover the sensor with our hand (temperature will rise due to body temperature). |
| Green/Blue LED | The LEDs should be able to turn on and off. |
| DC Brush Motor | The DC brush motor should turn on and be able to change its direction of rotation. |

* State how you will validate that each Project Design Requirement has been met

To validate if the light sensor enables the use of the ventilation or irrigation motors, we will cover the light sensor to indicate nighttime and we will connect it directly to the motors to see if it turns on. To validate if the temperature sensor turns on the ventilation motors, we will emulate

a high temperature. To validate if the soil moisture sensor turns on the irrigation motors, we will place the soil moisture sensor in an area of low moisture or use wet hands to check the percentage of moisture around the sensor. To validate if the user can set the threshold condition, the user will set the threshold condition for one of the motors. We will then fulfill this condition and see if the motor turns on.

# Feasibility Model Diagram and Software Flowchart (High-Level)

A simplified example is shown in **Error! Reference source not found.** and **Error! Reference source not found.**. **Replace these figures with high-level block diagrams of your system.**



 

## The LCD on the launchpad is also a digital output.

## Initial Bill of Materials

* List what modules and components (including quantities) are needed from the ECE 298 Parts spreadsheet for your Feasibility Model Design

|  |  |
| --- | --- |
| **Modules/Components** | **Quantities** |
| Soil Moisture Sensor | 1 (was not available for feasibility due to shortage) |
| Temperature Sensor - Analog | 1 |
| Ambient Light Sensor (LDR) | 1 |
| GREEN LED – Clear (5mm) | 1 |
| BLUE LED – Clear (5mm) | 1 |
| DC Brushed Motor Driver | 1 |
| DC Brushed Motor | 1 |