Introduction to Sensors and Actuator

Final report assignment

General requirements

In this assignment you are to design a system that will implement a system in the following way:

1. Identify and quantify the sensors needed to implement the required functions
2. Identify and quantify the actuators needed to implement the responses needed
3. Identify the processor(s) required and the interfacing requirements and methods
4. In each case (sensors, actuators, processors) identify possible alternatives

Notes:

To identify a device means to describe its function (i.e. a pressure sensor, an electromagnetic solenoid, etc.) To quantify it means to define its properties (such as range, span, sensitivity, etc.). In most cases this would mean specification of a part number and inclusion of its data sheet as part of the design.

In your design you should be as specific as you can. However, it is understood that one cannot get to the level of individual components in a circuit. Rather, you should stick to detailed block diagrams. The block diagrams must identify all important blocks in the system and must specify the requirements (inputs, outputs, function) of each block.

If your design proposes to use a sensor that does not exist (either because a sensor/actuator does not physically exist or because the span or sensitivity or some other property cannot currently be achieved in a commercial sensor) simply indicate the type of sensors and its properties. For example, suppose you want to sense water quality and you need a chemical sensor that would detect the level of potassium in the water. If a sensor of this type does not exist, specify it by giving required properties: Example: sensitivity – 100 ppm or 0.1 ml/l, span – 12 ml, range – 0.01 and 12 ml, type: contact, immersible sensor, temperature range: -30^{a}C to 100^{a}C, etc.

The actuators in the system should be viewed as generic – a light display is an actuator as is an electric motor or an air piston. In some cases, display is all that is needed or can be incorporated (for example, monitoring of a gas tank, displaying the fuel level). In other cases, an actuator may take action (such as a variable speed fan used to keep the temperature of a radiator within required limits).

The processors and their function must be specified as fully as possible. This should include the functions needed (amplification, A/D, etc.), inputs and outputs, signal levels, requirements of various functions (for example: sensitivity and amplification in amplifiers, power, current and voltage in an actuator when appropriate, sensitivity and resolution of an A/D, etc.). It is understood that in some cases you will not have sufficient information to fully specify some properties. For example, in cooling a radiator, one needs to know the power needed and that would depend on data you would not have such as what is the source of heat, how much power the radiator is supposed to dissipate, air temperature, etc. In such cases, specify as much of the properties of the fan as you possibly can. For example, if the radiator is in a car, the fan should operate at 12V, must use a dc motor and must be relatively small and flat to fit in the car. Also, it is obvious that it must be relatively high power to be able to dissipate considerable heat.

Similarly, if you are measuring temperature between 0 and 100 ªC with a thermocouple and interfacing it to a microprocessor, the input (say 0 to 500 mV) must be amplified so that the span of the thermocouple matches the input (0-5V for example) and must be digitized. What are the interfacing requirements at the processor? The A/D has a resolution of, say 10 bit. What is then the accuracy of the whole system? What is the smallest temperature change that can be sensed?

I hope the general comments above help.

You can and should use the internet to see what is available in terms of sensors, actuators and processors and, indeed, what similar designs exist. There are many excellent sources of circuits and designs and many sources of sensors and actuators on the web. A good search will give you much useful information that can help you with the design. Any material you use, from any source, should be properly referenced. However, the design should be yours, in the sense that if you were to actually produce it, nobody could claim that you copied their design and possibly sue you.

Your report should include the design, all considerations and alternative designs and all relevant material, including data sheets, references. The whole report can be sent by e-mail or as a paper copy.

Deadline: Last day of classes (August 9, 2006). If you require additional time, please let me know by August 9 since I have to submit a grade by Tuesday, August 15, 2006. If you require an extension I will submit a grade of "Incomplete", which will then change to the actual grade upon submission and grading of your report. I recommend that you complete the report in time. If however you choose the extension option, for whatever reason, please remember that a grade of incomplete reverts to an F if a grade change is not submitter by the end of the following Semester.

You are being assigned a specific topic on which to work (below). If you are not happy with the assigned subject, or if you would like to address a different topic, you can do so by defining your own. If you choose to do so, you must discuss that with me. Please send me the title of the topic with a short description of what you plan to do. Unless the topic has been assigned to somebody else or it is too trivial, I will approve it. I ask that you come up with the subject (if you choose to do so) within at most two weeks.