Semi-Optional Homework Project Assignment

Select at least one or propose one not listed

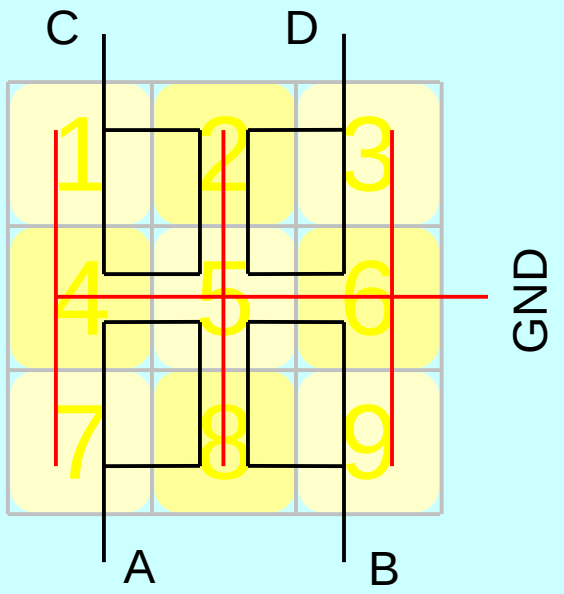
- After the school, starting from the moment you have your PicoBoards, you are encouraged to propose ***at least one solution*** for two problems mentioned below:
  - The ***first mandatory homework*** was already assigned at the end of ***Lab-10a***. The same is repeated here for completeness (next page).
  - The ***second one*** is supposed to be ***either*** one of those proposed here in this document ***or*** something else you should propose (and receive a confirmation from us) in case you cannot find an interesting one here.
  - Each page of this document contains a single homework proposal
- Your solutions should be e-mailed to us ***within two weeks*** after the school.
- You are welcome to ***discuss*** the hints/stimuli given with the homework projects in your final report as much ***detail*** as you think ***necessary***.
- The marks ***(*)***, ***(**)***, and ***(***)*** represent a subjective judgment for the afford/benefit required to solve a given problem. One can interpret this as the level of happiness promised ***;)***

4x4 Numerical Touch-Pad Design (**)

Using resistance reading ports A, B, C, and D

- Use the resistance reading ports as 4-bits ***binary inputs*** and ***map*** them onto a 4x4 touch sensitive numeric pad array.
- Use "*short circuit*" or "*some resistance*" condition as ***logic high*** and "open circuit" condition as ***logic low***. A possible ***mapping*** is given for a similar 3x3 pad:

  I. A, B, C, D wires are arranged as seen in the figure. The mapping table is also provided. (Please refer to the Lab-10a instruction sheet for more detail.)



Num	Wire
1	C
2	CD
3	D
4	A C
5	ABCD
6	B D
7	A
8	AB
9	B

Assignment:

- Design a ***4x4*** numeric pad similar to the one presented in Lab-10a.
- Design a possible ***wiring geometry*** which can fulfill the requirement and write down the ***mapping*** information
- Implement the ***decoder*** accordingly in Scratch (or with the python library)
- Consider ***merging*** a FSM and the numeric touch pad you designed to implement a ***vending machine***

Data Extractor (*)

from a plot printed on a paper

- Utilizing whatever you can find at home/office, design and implement a simple piece of hardware/tool which can be used to manually ***extract data points*** from a ***two dimensional plot*** printed on a paper. The apparatus you will design will be connected to PicoBoard so that the data can be read-out either by Scratch or by the python library. Program the needed software to interpret the data read-out from, say, the resistance reading ports.

- ***Hint #0:*** What is the shape of the calibration curves of the ports ? How can you use those curves for the purpose ? How can you read (x,y) coordinates of any kind ? What is the requirement to keep the aspect ratio of the plotted data ?

- ***Hint #1:*** To paint your portrait on a canvas, would you hire a painter who is known to see things 10 times narrower than they actually are ?

  - (if yes) What would you expect to see on the canvas after the painter finishes the job ?

Utilizing The Light Sensor (***)

An idea (#1)

- Design an ***angle measurement device***. Think of a suitable mechanical arrangement and calibrate the light sensor accordingly. Associate the angle with the data read-out from the sensor (calibration curve).

- Using the experience form the previous bullet, design a "solar" ***alarm clock*** and measure the sensitivity or ***time resolution*** of your solar clock.

- ***Hint #0:*** Use either Scratch or the python library. In case you use Scratch, all the sensors (apart from the button) return numbers between 0 and 100, however in case of python library, this dynamic range can also be between 0 and 1023. Consider this difference while designing.

- ***Hint #1:*** How can your solar clock work during the night ? Propose at least one method. If you set the alarm to, say 4 am, how can you make sure that it will not make an error larger than a certain amount ?

Utilizing The Light Sensor (**)

An idea (#2)

- The producers of the so called "***green***" light bulbs claim that their products provide "***the same***" amount of light as a "***non-green***" bulb but ***consumes*** less.
- Using the light sensor, compare a 100 Watts non-green bulb with its counterpart 14 Watts green bulb; confirm or falsify their claim.
- ***Hints:*** Do you need to calibrate the light source ? Why and/or how ?
  - (if yes) Does the calibration need to be linear ? Why ?
    - (if yes) How can you ensure that your calibration is linear ? Why ?

Car Counter (*)

On an auto road

- Design an application to read data from the PicoBoard such that ***counting car passages***, which are rare, on a road is possible.
- Utilize ***any*** read-out port(s) of the board as ***necessary***
- ***Hints:*** How can you be sure that the counter will only increment when an actual car passes ? How do you generate complementary data to cross check ?