Module 21

Activity: Sensor Integration

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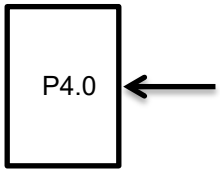
Question 1

Write C code that uses interrupts to count the number of high to low transitions on a P4.0 input. Set the priority to 3

uint32_t Count; // number of falling edges of P4.0
void Count_Init(void);
// initialize P4.0, arm, clear Count

void PORT4_IRQHandler(void){



Question 2

Write a C function that implements this digital filter. The 16-bit signed input to the function is the new data and the output from the function is the filter output (16-bit signed)

y(n) = x(n) +2*x(n-1)-2*x(n-2)-x(n-3)

where

x(n) is the current sample, `in`
x(n-1) is the previous sample
x(n-2) is the sample 2 times ago
x(n-2) is the sample 3 times ago
y(n) is the current filter output

The prototype is

```
int16_t Filter(int16_t in);
```

To analyze this filter you could break it into two parts

y1(n) = x(n) -x(n-3)
y2(n) = 2*(x(n-1)-x(n-2))

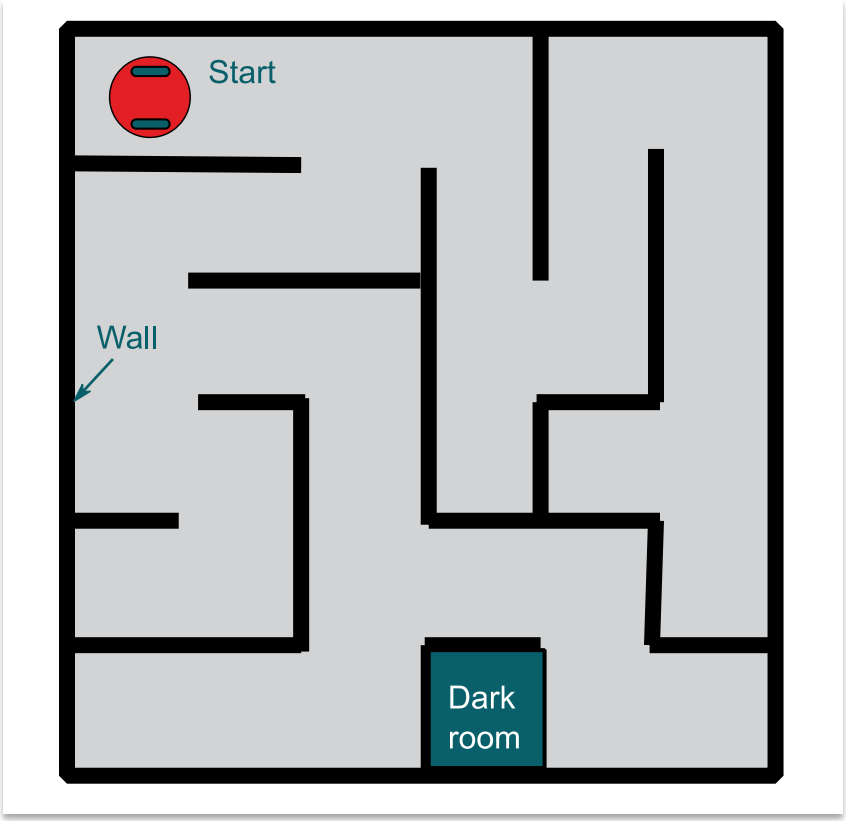
What type of filters are y1 and y2? Therefore, what type of filter is y?

Question 3

Interface a sensor to the robot.
Part a) Find a sensor at
https://www.pololu.com/category/7/sensors
Part b) Study which MSP432 pins are used by your robot, and find used pins needed to interface the sensor. Write low-level software to communicate with the sensor. Use a scope or logic analyzer to evaluate the low-level communication.
Part c) Write mid-level software that facilitates usage of the sensor. Include digital filtering and calibration as needed.
Part d) Write high-level software that deploys the sensor in an appropriate task.

Question 4

Build a maze. Use “2 by 4” wood walls if you have the OPT3101 sensor. Make a dark room by placing a roof over one place of the maze. The goal is to traverse the maze and find the dark room. Use the OPT3001 to detect the end of the maze. You can easily change the start and finish location to vary the competition.



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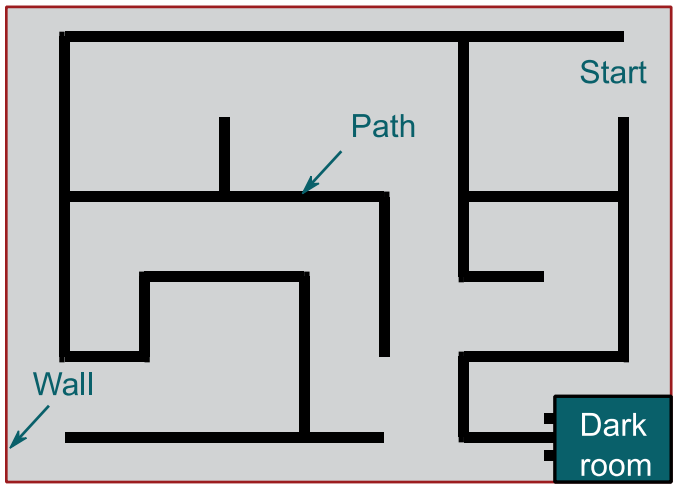
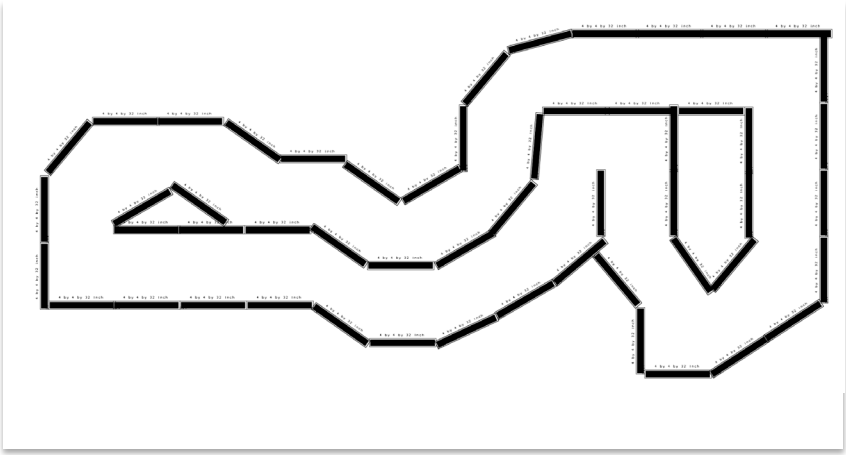
Question 5

Build a maze. Use “2 by 4” wood for the outer walls. Use optically absorbing black tape if you have IR line sensor. Make a dark room by placing a roof over one place of the maze. The goal is to traverse the maze and find the dark room. Use the OPT3001 to detect the end of the maze.





Question 6

Build a race track. Use “4 by 4” wood walls and use the OPT3101 sensor to detect the walls. The goal is to traverse the track as fast as possible. You can easily change the track by moving the wood walls. The wood is heavy enough not to require fastening together. If you use “2 by 4” wood, then you may wish to attach the pieces to each other. The following track is modelled after the Austin Gran Prix in Austin Texas.

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