Analogue design considerations

A total of three circuits design were proposed for this project. Their features and functionalities were then evaluated when deciding on the final circuit design which is discussed further in the Analogue Design Decisions section.

The first circuit (this circuit does not have a schematic...yet??) consists of three fundamental circuits which are the sensing circuitry, filtering circuitry and the gain circuitry. The DC offset from the signal is removed by the coupling capacitor in the high pass filter in the filtering circuitry. The high frequency signal is then amplified in the gain stage. The DC offset applied within the gain stage ensures that the output voltage is within the PSoC voltage range.

The second circuit proposed for the project (the one nitish drew in class during the first week of semester) consists of two fundamental circuits which are the sensing and filtering circuitries. The AC coupling removes the DC offset from the signal coming from the sensing stage which therefore increases the resolution of the signal measurement (???). Why the transistor tho???

The third circuit consists of four fundamental circuits which are the sensing, filtering, buffering and the gain circuitries. Low frequencies are filtered out by the high pass filter, ensuring no amplified unwanted signals in the later gain stage. The buffering stage then isolates the output from the first circuitry from the input of the second circuitry. The DC offset applied then shifts the amplified signal to ensure that they are within the PSoC operational voltage.

Analogue design decisions

For the final circuit design, the third circuit proposed for the project were chosen as it encapsulates the features that enables the project to meet its specifications and goals.

Firstly, its filtering properties allows the limiting of light with frequencies lower than the light projector used (120Hz), especially the ambient light at 50Hz. Without these filtering properties, the low frequency signals will be amplified in the amplification stage of the circuit. This will cause inaccurate analogue values when the output signal from the circuit is being fed into the ADC of the PSoC, resulting in the difficulty to differentiate between a wall and a path on the projected map.

Secondly, the values of the resistor and capacitors in the circuit were especially suitable as the corner frequency would remove as much noise as possible without attenuating the frequency from the projected light.

The buffering circuitry in the proposed circuit provides isolation from the filter stage that has a high output impedence to the amplification stage which has low input impedence level. This ensure maximum energy transfer between two fundamental circuits while preventing the signal transferred to interfere with the desired operation of the whole circuit.

Software motor control

The two motors attached to the robot works independently. Each motor has its own PWM component connected. Due to the robot's hardware configurations, motor 1 naturally rotates at a faster rate as compared to motor 2. Therefore, the software plays a big role to ensure the uniformity and synchronisation of the two motors.

In order to regulate the speed of the motors, testing were carried out at different battery voltages. Through trial and error, it is found that within the robot's operational voltage range, the PWM value for motor 1 and motor 2 constantly differs by 2. This linear relationship is then applied in every single speed correction algorithm made in the program.

Motor speed measurements and PWM values calibrations were also carried out by always placing the moving robot on the ground as it ensures robot is travelling at its natural speed which is when normal reaction due to its weight and frictional force is taken into account.