ECE 411
11/8/17
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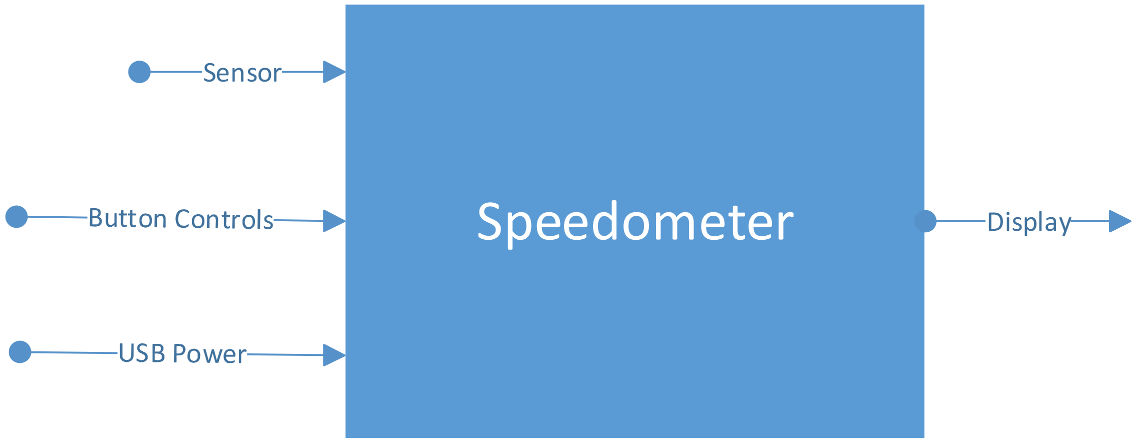
Detailed Design:

Speed Demon Speedometer

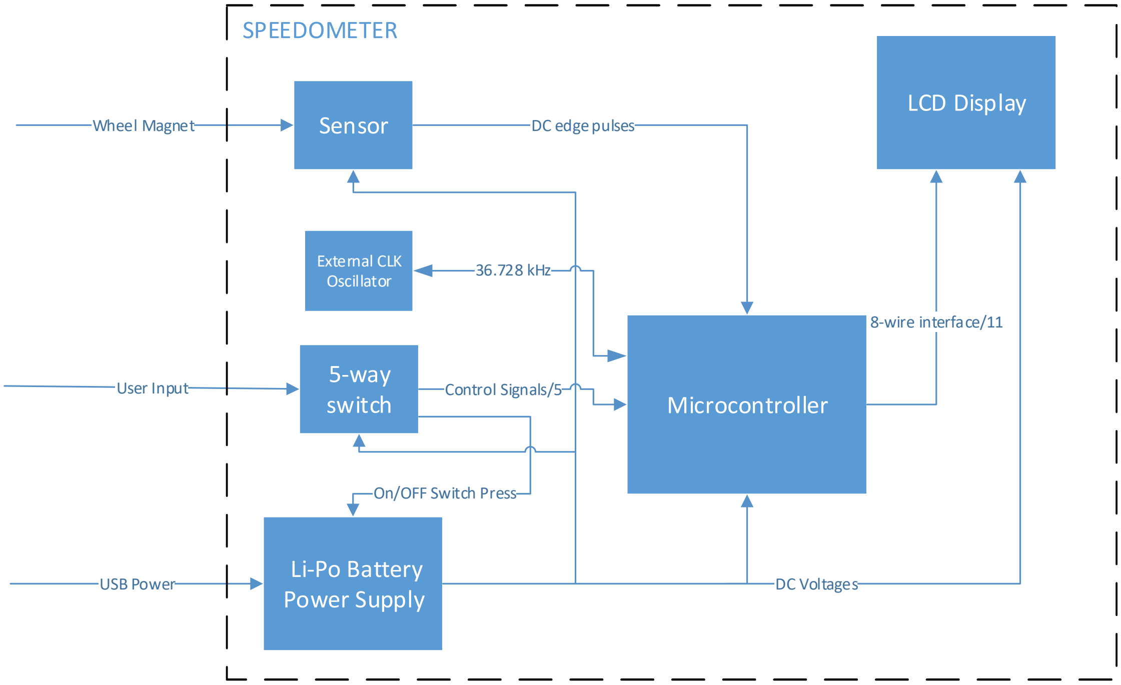
Level 0



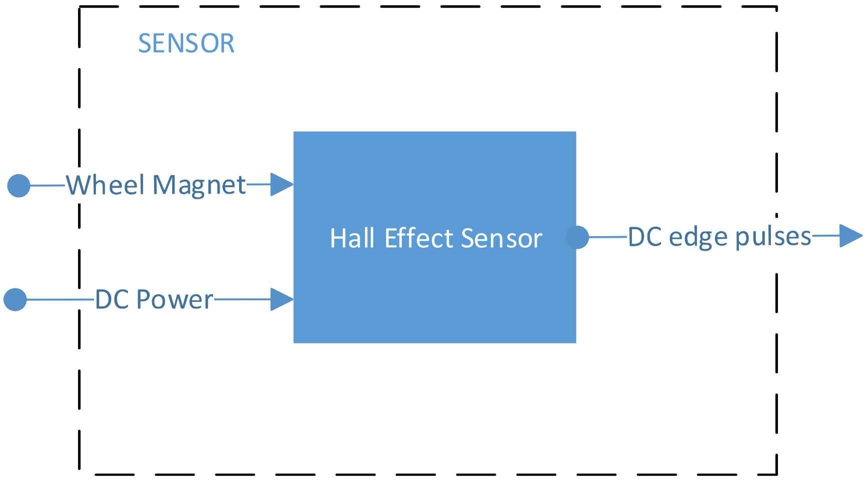
Level 0

Module	Speedometer
Inputs	- Sensor - Power supply: various DC power - 5- way tactile switch
Outputs	- LCD screen
Functionality	Receive signal from sensor,calculate/display speed

Level 1

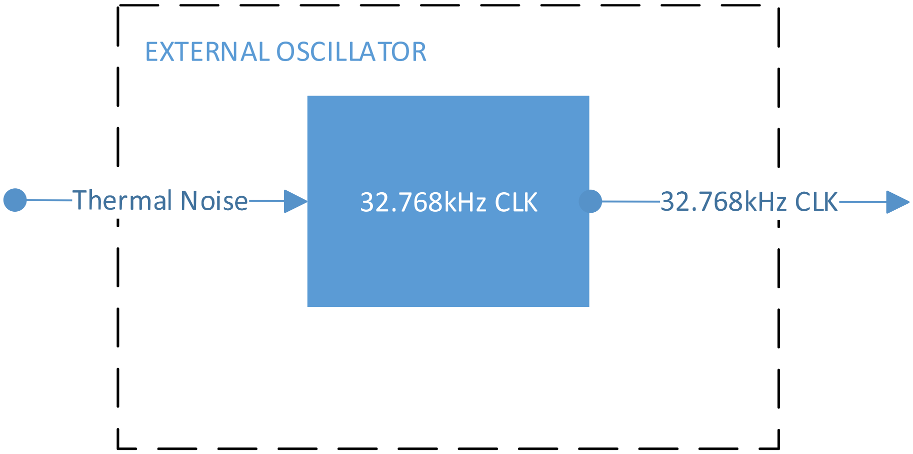

SPEEDOMETER
Wheel Magnet
Sensor
DC edge pulses
LCD Display
External CLK Oscillator
36.728 kHz
8-wire interface/11
User Input
5-way switch
Control Signals/5
Microcontroller
On/OFF Switch Press
USB Power
Li-Po Battery Power Supply
DC Voltages

Level 1



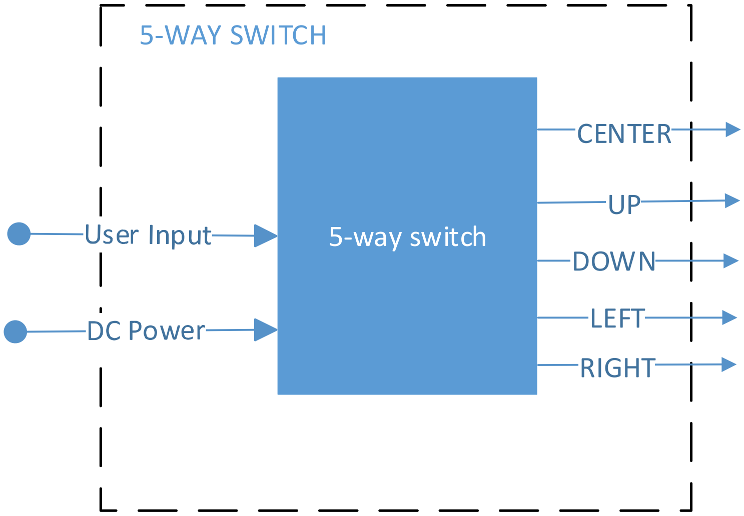
Module	Sensor Module
Inputs	- Proximity-induced magnetic field flux from wheel magnet - +~4VDC (direct from battery)
outputs	- Binary pulses
Functionality	Provide edge-detectable information about wheel location.

Level 1



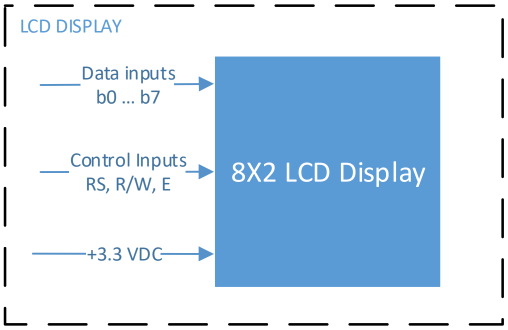
Module	External Crystal Oscillator
Inputs	- Thermal noise/OSC loop
outputs	- 32.768kHz Clock
Functionality	Provide a stable clock reference for the MCU

Level 1



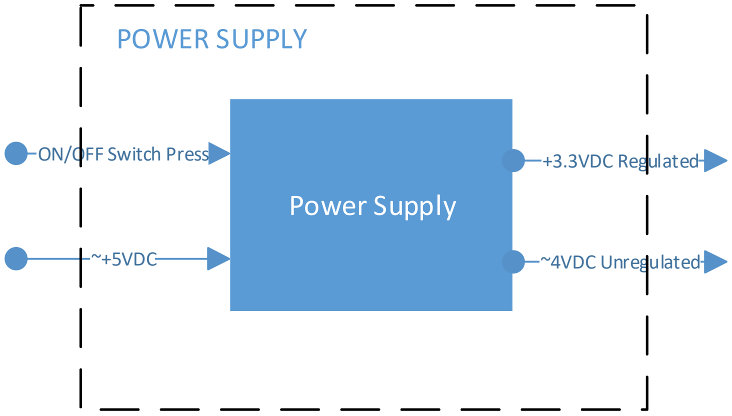
Module	5-Way Switch
Inputs	- User tactile input
outputs	Binary ‘button press’ data. NP = +3.3VDC, P = GND - CENTER - UP - DOWN - LEFT - RIGHT
Functionality	Provide user interfacing and device control capability

Level 1



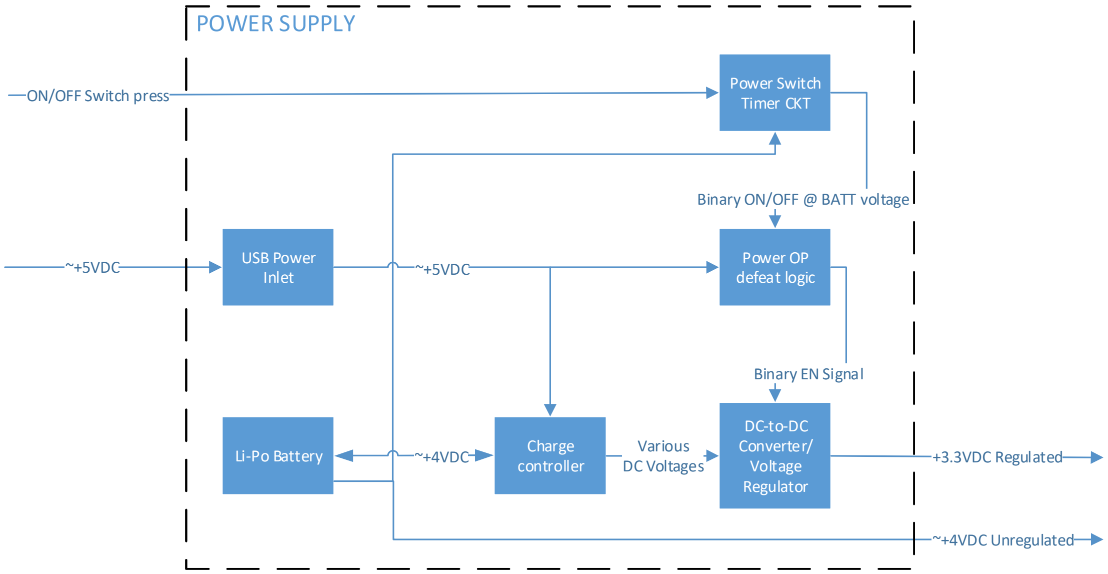
Module	8x2 LCD display
Inputs	- 8-Wire binary data bus from MCU + 3 ctrl inputs (tot. 11) - 3.3V DC Power supply
outputs	[Visual information]
Functionality	Visualize the speed by showing it on the screen

Level 1



Module	Power supply
Inputs	- ON/OFF switch (CENTER) - 5V from USB
Outputs	- +3.3VDC regulated power - Raw battery power (~+4VDC)
Functionality	Power supply for the device

Power Supply Level 2



Level 2

Master Module	**Power Supply**
Submodule	USB Power Inlet
Inputs	- USB connection (all pins except PWR/GND are NC)
outputs	- ~+5VDC
Functionality	Source of charging power for battery

Master Module	**Power Supply**
Submodule	Li-Po battery
Inputs	- Current from charge controller
outputs	- ~+4VDC
Functionality	Power source for device

Master Module	**Power Supply**
Submodule	Charge controller
Inputs	- USB power - Battery power
outputs	- Battery charging current - Battery power thru
Functionality	Routes power either from USB inlet to battery, or from battery to rest of device

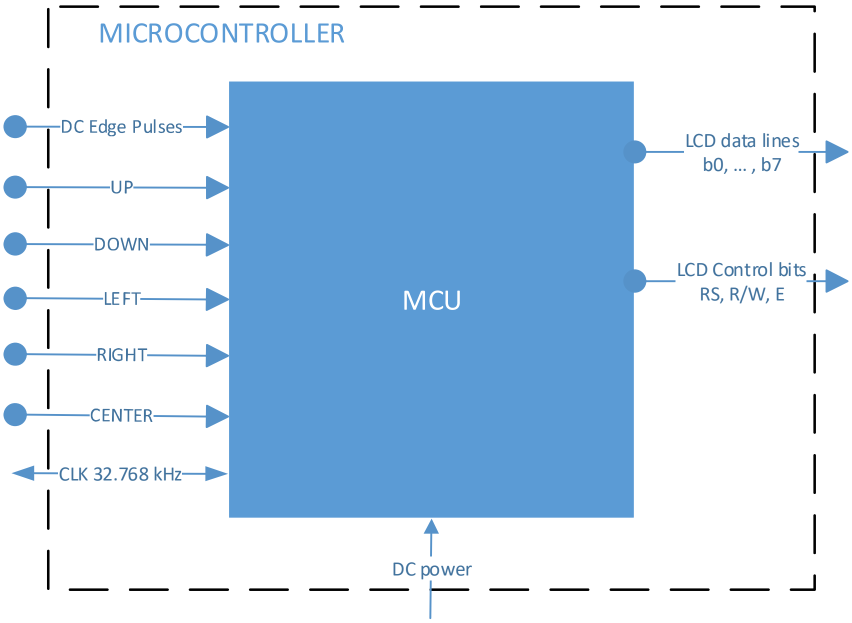
Master Module	**Power Supply**
Submodule	ON/OFF Switch Timer Circuit
Inputs	- Center switch push - Raw battery power
outputs	- Binary ON/OFF signal @ batt voltage

Functionality	User control for device power state. Outputs ‘on’ (batt voltage) with a momentary press of center button, outputs ‘off’ (GND) after long press of ~1s.

Master Module	**Power Supply**
Submodule	Power OP Defeat Logic
Inputs	- ON/OFF signal from timer switch circuit - USB power (+5VDC)
outputs	- Binary EN signal
Functionality	Controls device power state using EN input of DC-to-DC converter. Follows signal from ON/OFF Timer Circuit unless USB power plugged in. Disables power when USB present. Circuit is powered by ON/OFF signal from timer circuit.

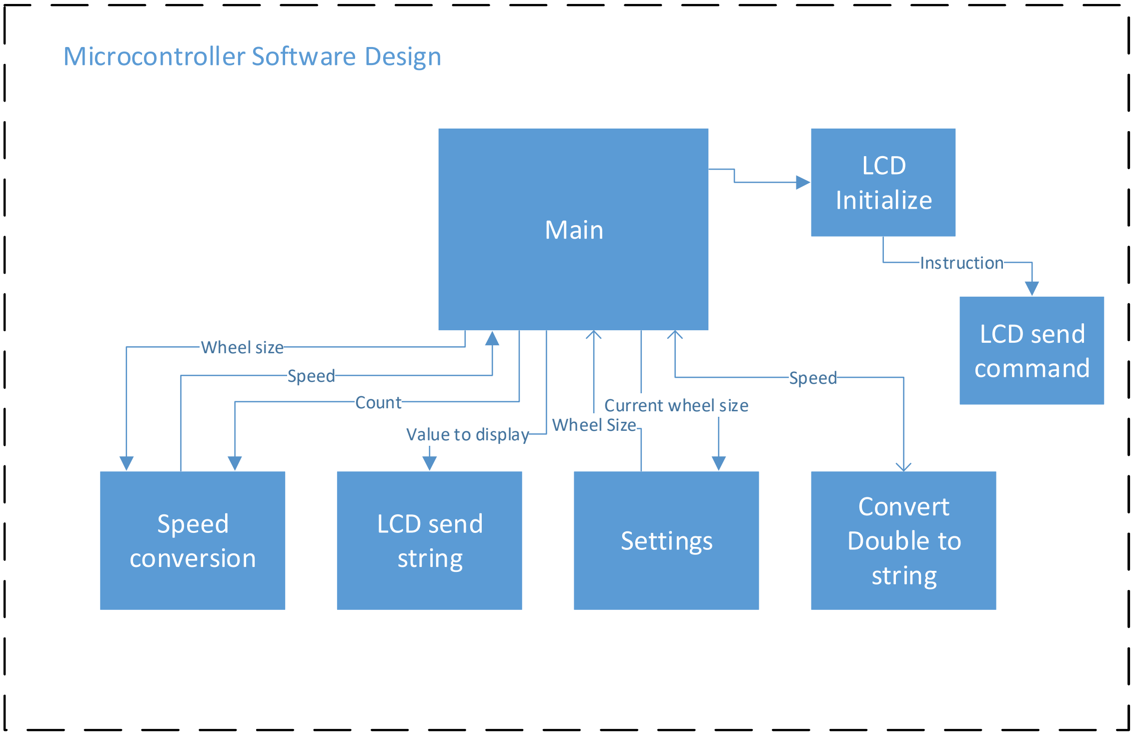
Master Module	**Power Supply**
Submodule	DC-to-DC Converter
Inputs	- Binary EN signal from Power OP Defeat Logic - DC power from charge controller
outputs	- +3.3V regulated power
Functionality	Switching power regulation circuit. Input power can be either battery or USB power, but EN should be off if USB power applied, so functional input should always be battery voltage.

Level 1



Module	Microcontroller
Inputs	- 1 bit Sensor inputs - 3.3V DC power supply - CENTER: Power on and select - LEFT: Left operation - RIGHT: Right operation - UP: Up operation - DOWN: Down operation
Outputs	- Data to LCD
Functionality	- Receive signal from input, calculate the speed, output to LCD

Level 2



Software:

Module Name	main()
Module Type	Coordination Module
Input Arguments	- none
Output Arguments	- Return 1 when operations are done.
Description	Main function begins by initializing the LCD with LCD_initialize() function call. speed_conversion() shall convert the input argument count to speed. Upon receiving the returned speed, double_to_str() is called to convert the value to a string. LCD_display() shall output the string argument to the LCD. The user_settings() function will also be called to allow the user to change the device's settings. The user interaction will involve a button switch to switch between the operating modes.
Modules	speed_conversion, LCD_display, user_settings(), double_to_str(),

Invoked	LCD_initialize.

Module Name	LCD_Initialize()
Module Type	Coordination Module
Input Arguments	- none
Output Arguments	- Returns 1
Description	Function will make a series of call to LCD_sendCommand() to set up the screen and cursor of the LCD.
Modules Invoked	LCD_sendCommand().

Module Name	speed_conversion()
Module Type	Transform module.
Input Arguments	- count: integer to store period between each sensor pulse. - wheel_size
Output Arguments	- speed: double to store calculated speed.
Description	The parameter ‘count’ and ‘wheel_size’ is passed in and the appropriate operations are performed to convert the count to speed. ‘speed’ is then returned to main.
Modules Invoked	none

Module Name	double_to_str
Module Type	Transform module.
Input Arguments	- speed: double which represents value of speed.
Output Arguments	- speed_str: string representation of value of speed.
Description	This function will be invoked by main to convert the parameter ‘speed’ to a string.
Modules Invoked	none

Module Name	LCD_sendString()
Module Type	Input Module
Input Arguments	• stringVal: String to be sent to LCD
Output Arguments	• Returns 1
Description	Function will select the LCD that will be written to, set LCD to character mode, enable the LCD, and set the parameter ‘stringVal’ to be displayed to the LCD. All signals will be sent to the GPIO output pins.
Modules Invoked	none

Module Name	LCD_sendCommand()
Module Type	Input Module
Input Arguments	• stringVal: String to be sent to LCD
Output Arguments	• Returns 1
Description	Function will select the LCD that will be written to, set LCD to command mode, enable the LCD, and write ‘stringVal’ out to the LCD.
Modules Invoked	none

Module Name	user_settings()
Module Type	Transform Module
Input Arguments	• Float current_wheel_size
Output Arguments	• Returns floating integer wheel_size.
Description	Function will call LCD_sendString() to display options to the user. User interaction will involve button presses to overwrite the current value of the wheel size. Function will then concatenate result and return ‘wheel_size’ main.

Modules Invoked	none