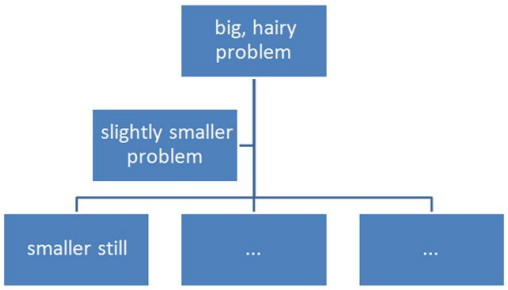
Homework 5 System Design:

Functional Decomposition

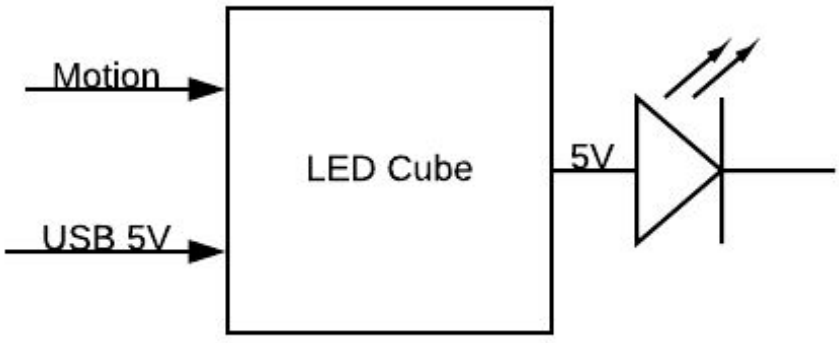
Team 1



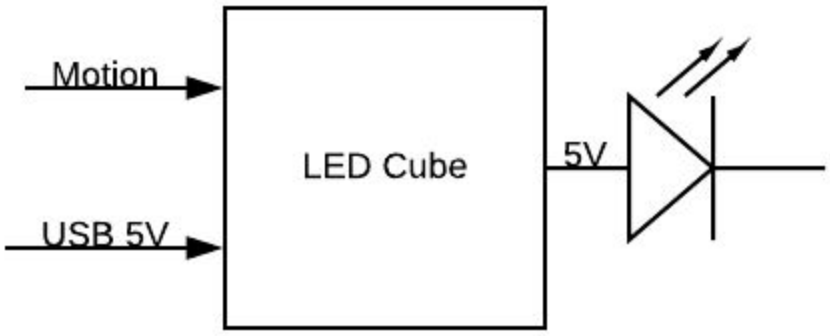
Authors:	Artem Kulakevich, Ignacio Mejia, Nikolay Nikolov, Lance Kaliliuli				Group #1
Github	https://github.com/nnikolov3/ECE411				
Version #:	1.0				
Date:	14-Nov-2019				

LED Cube

- Requirements:
    - LEDs must respond to changes in angular velocity in all 3 axis.
    - Must incorporate ON/OFF modes that can be controlled by motion
    - Must be powered by a rechargeable Li-ion battery
    - Battery must be safely charged by USB 5V, 1A+ supply
    - LEDs can be controlled to be on or off while the cube is charging.

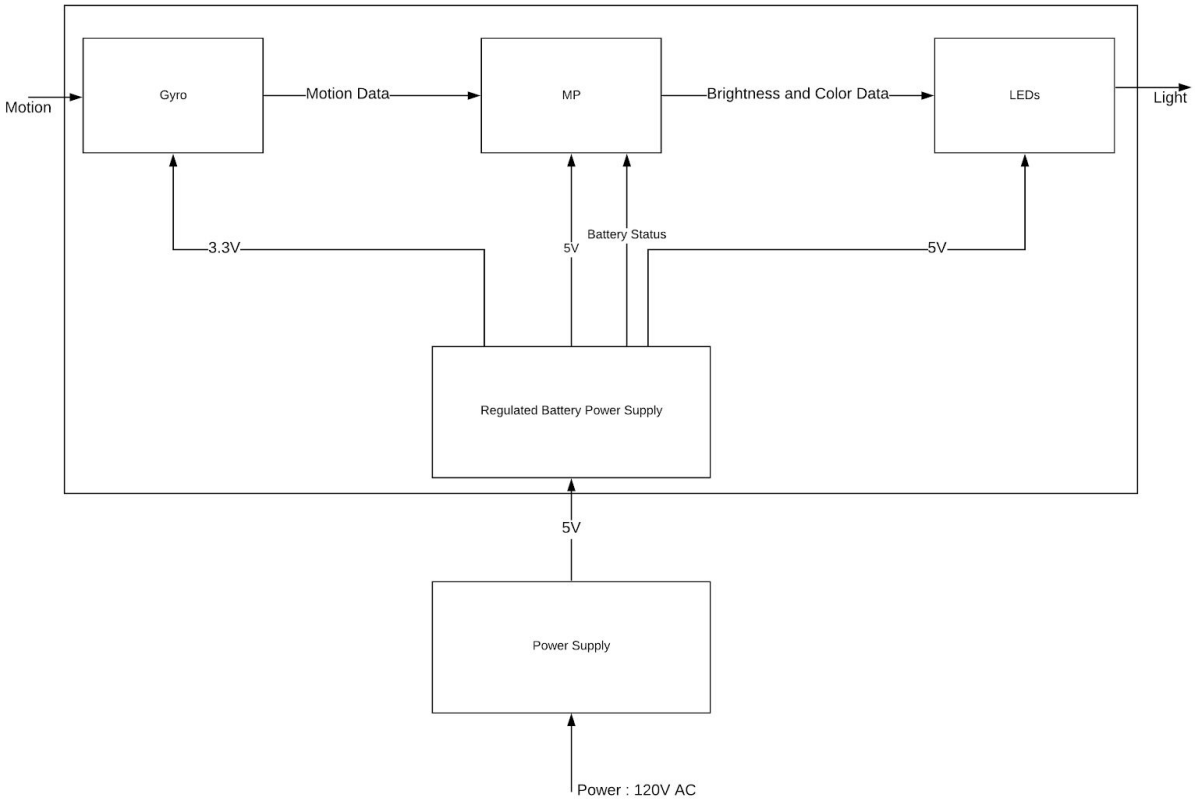


LED Cube Level 0:

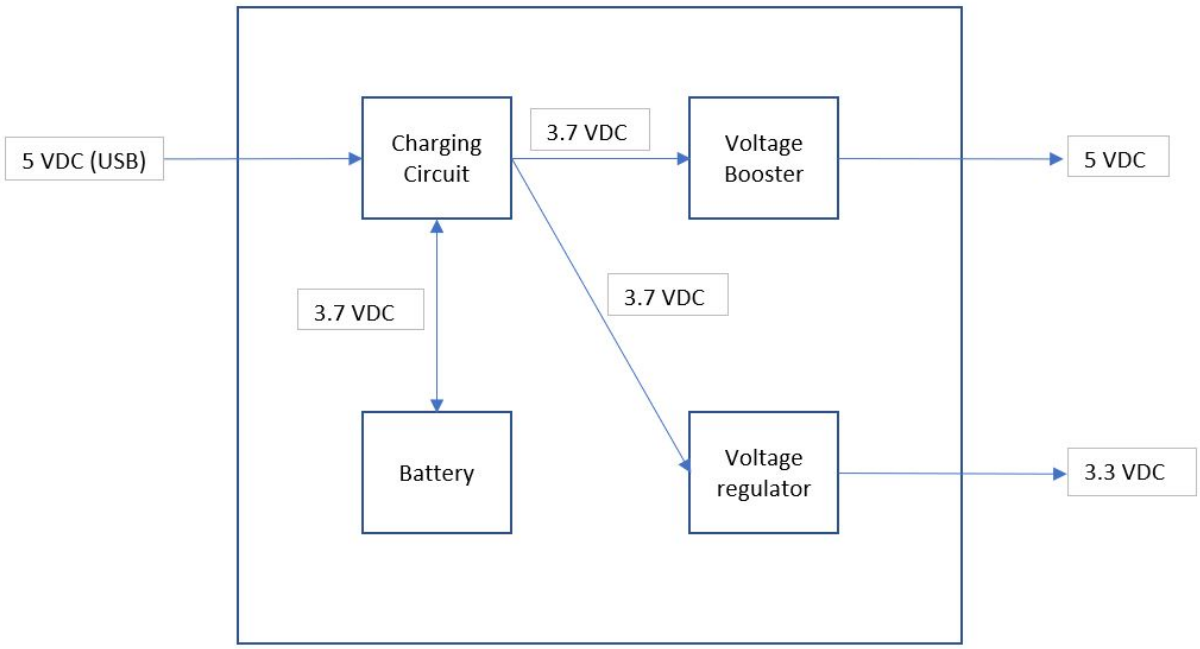


Module	LED Cube
Inputs	Voltage: 5 VDC User Motion Control:variable
Outputs	Optic: LED with 5V peak
Functionality	LEDs change their brightness and color in response to the motion of the Cube in (x, y, z) dimensional space.

LED Cube Level 1:

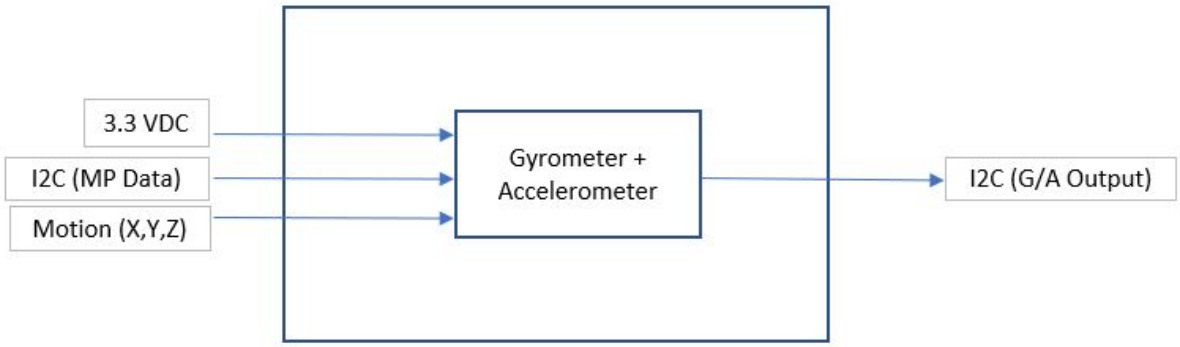


Regulated Battery Power Supply Level 1:



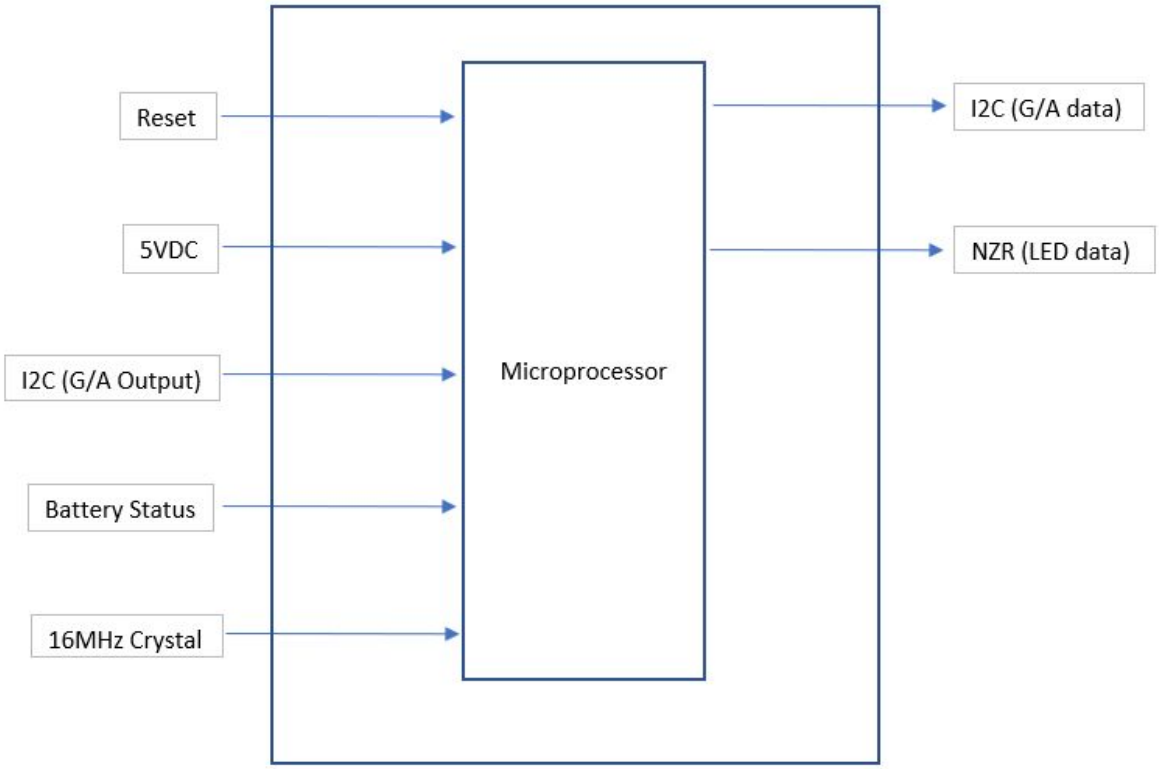
Module	Regulated Battery Power Supply
Inputs	Voltage: 5 VDC from power supply
Outputs	Voltage: 5 VDC Voltage: 3.3 VDC
Functionality	Accepts 5VDC input to safely charge 6000mAh 3.7V battery. Provides discharge protection to battery, and supplies 5v output through voltage booster, and 3.3V output through regulator.

Gyro/Accelerometer Level 1:



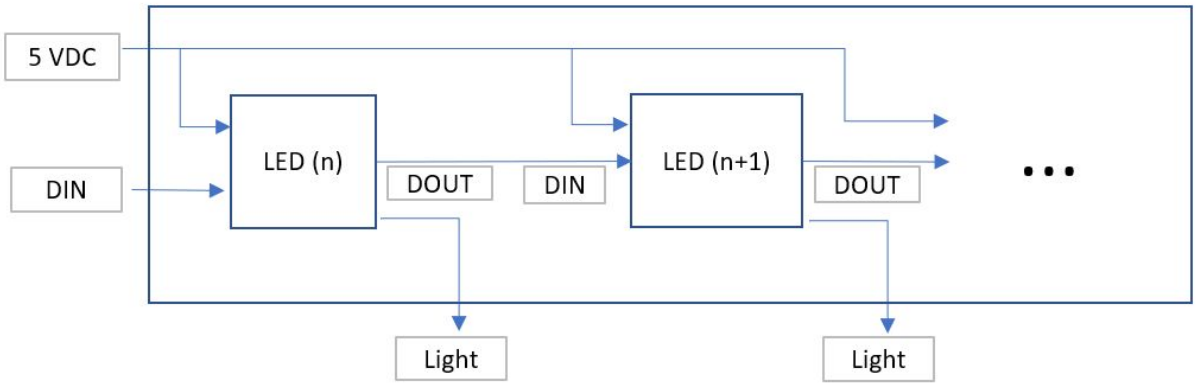
Module	Gyro/Accelerometer
Inputs	Voltage: 3.3 VDC from regulated battery power supply Coms: I2C (SCL, SDA) User Motion Control:variable
Outputs	Coms: I2C (SCL, SDA)
Functionality	6-axis motion tracking device (3-axis gyro, 3-axis accelerometer). Uses a digital motion processor (DMP) with its dedicated I2C bus, to accept motional inputs and process data for output.

Microprocessor Level 1



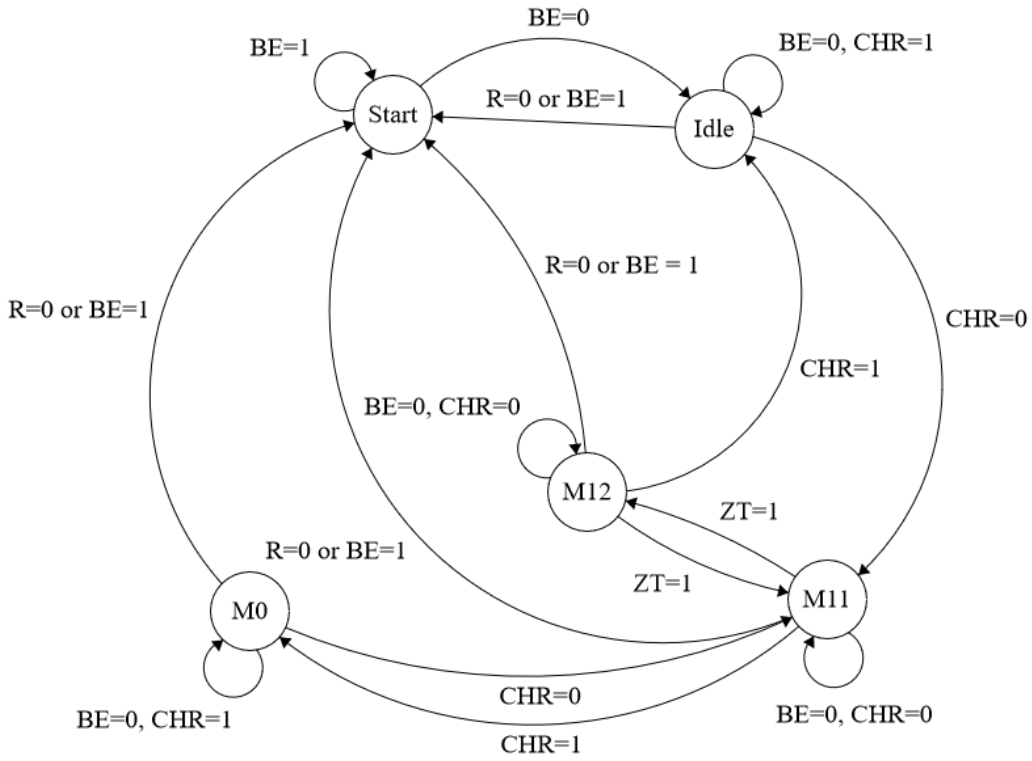
Module	Microprocessor
Inputs	Voltage: 5 VDC from Voltage Booster Coms: I2C from gyro/accelerometer Reset: Restarts microprocessor Clock: 16Mhz Crystal Interrupt pin: Battery charger status
Outputs	Coms: NZR to LEDs (1 pin) Coms: I2C to Gyroscope (SCL, SDA)
Functionality	Communicates with gyroscope/accelerometer chip to enable and constantly collect data. Converts position data to light intensity and color data for LEDs. Determines cube functionality based on battery charging status and physical motion.

LEDs Level 1:



Module	LEDs (12 total)
Inputs	Voltage: 5 VDC, from regulated battery power supply Coms: DIN (NZR Communication mode)
Outputs	Optic: LED with 5V Internal Coms: DOUT (NZR)
Functionality	Has integrated oscillator and constant current control to ensure pixel point light color height consistency. One data line is required for communication with all LED in series.

Finite State Machine: Level 1



Outputs:

Start: LO = 0, MD = 0

IDLE: LO = 0, MD = 0

M11: LO = 1, MD = 1

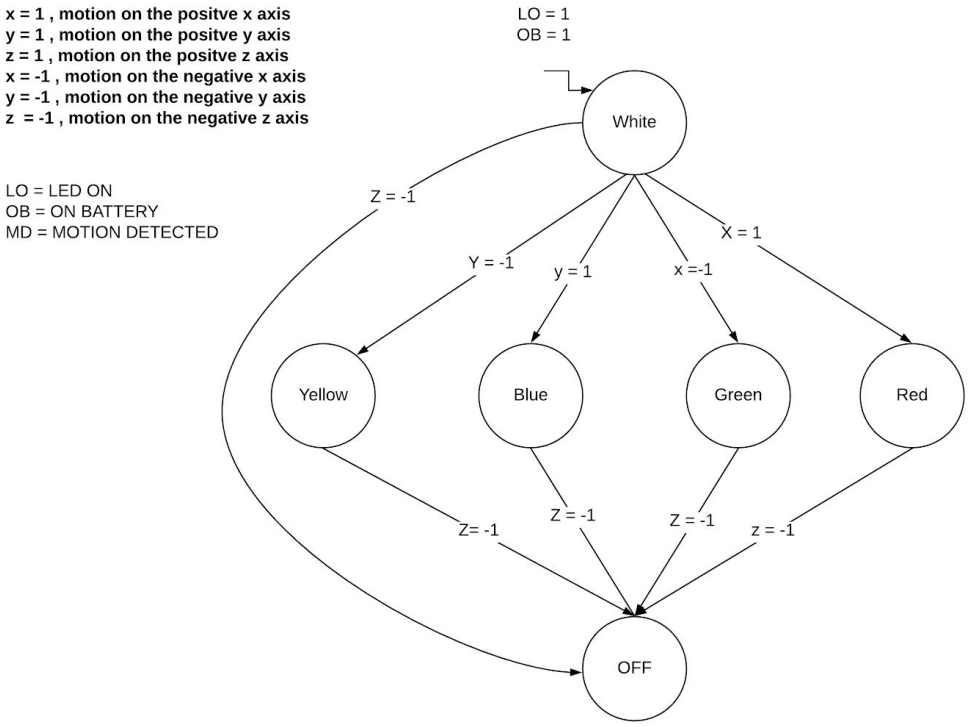
M12: LO = 0, MD = 1

M0: LO = 1, MD = 1

Module	Main Finite State Machine
Inputs	BE: Battery Empty (Battery dies at any time) CHR: Charging Reset: Reset from reset short on PCB ZT: G/A input, means cube has been flipped upside down. (only matters in M11 and M12)
Outputs	MD: Detect Motion is enabled. LO: LEDs are enabled.
Functionality	Main FSM to control the cube. Accounts for a dead battery/off state, that goes into an idle state when the battery has enough juice to power the MP. Then control

	motion and battery status interaction once on.

Finite State Machine: Level 2



Module	Mode 11
Inputs	OB: On battery LO: LEDs ON MD: Motion Detected Motion on the X Y Z axis
Outputs	LED: Red LED: Green LED: Blue LED: Yellow OFF: No output
Functionality	See diagram