Automated Drink Mixer

Group 40

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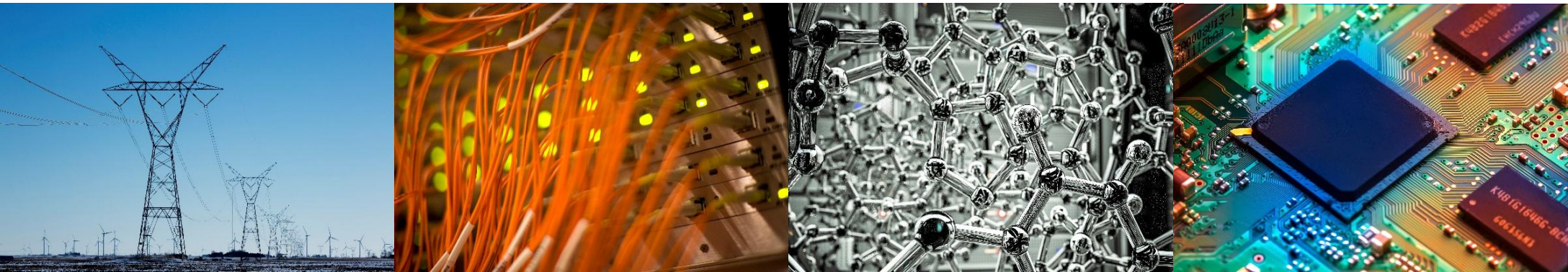
Introduction

- Automated drink making with minimal user interaction

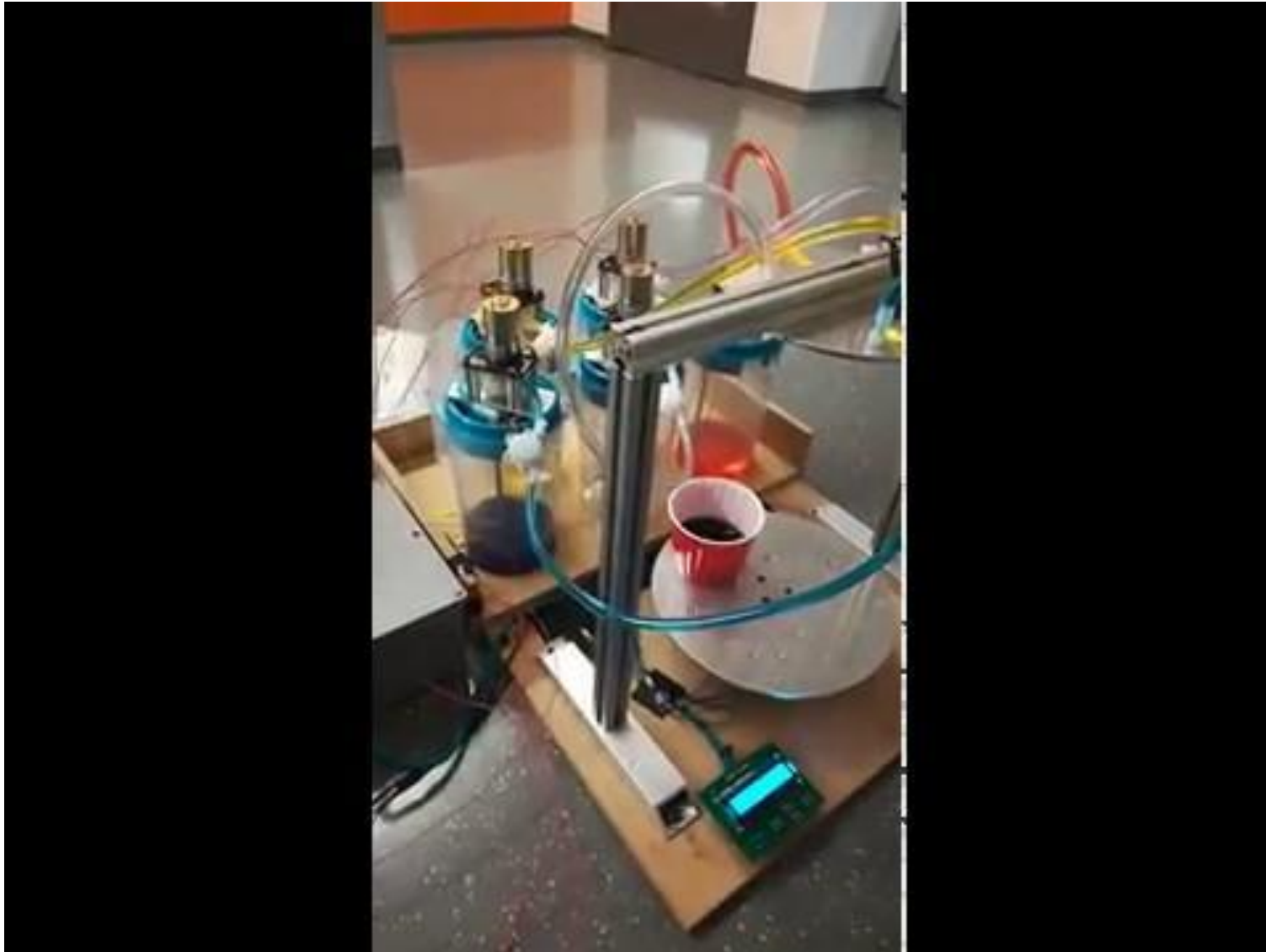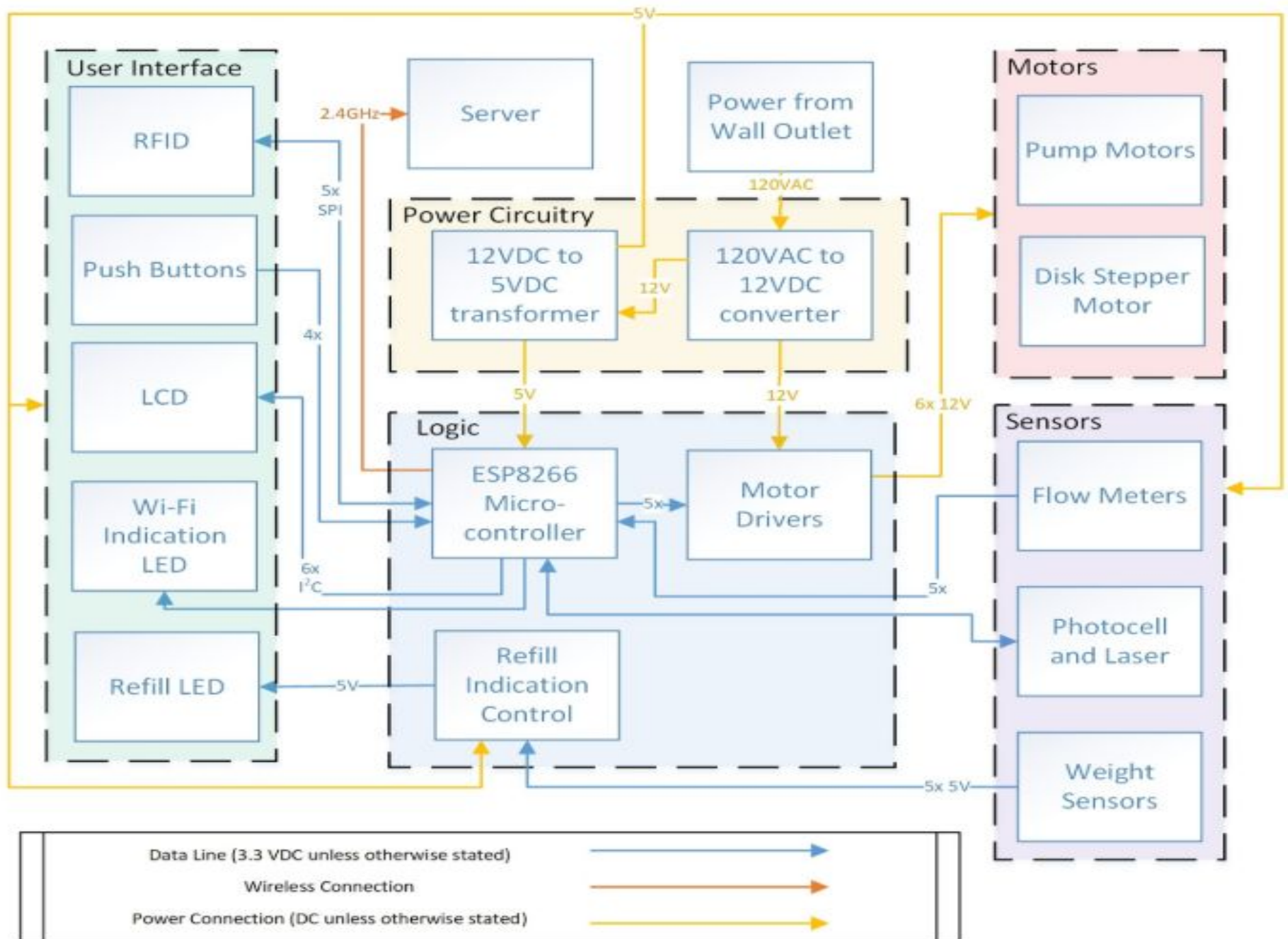- WiFi enabled system tracks transactions

Objective

- Systematically reduce clutter at busy bars
- Track user purchases with RFID cards
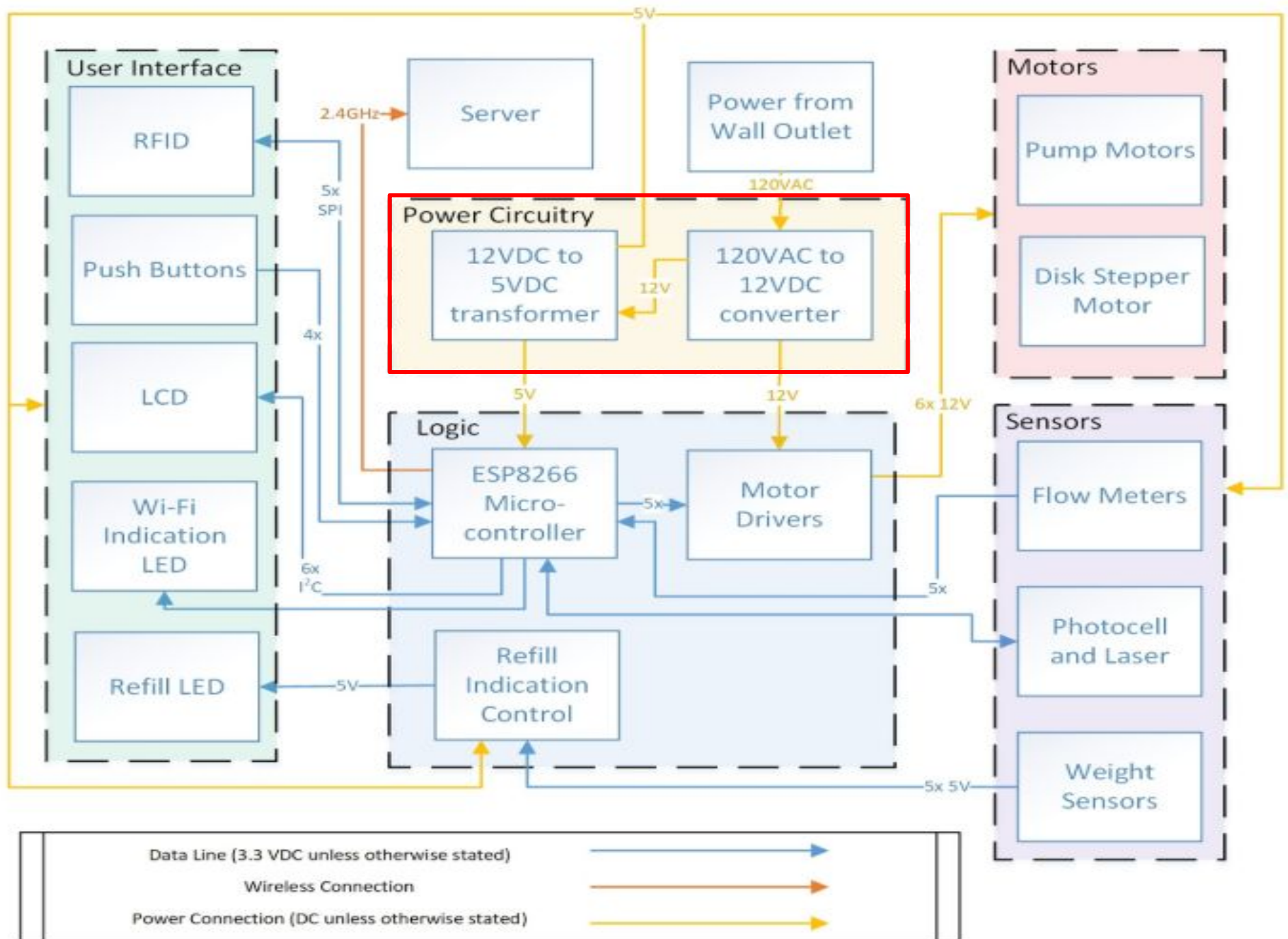- Reduces human error in mixing drinks

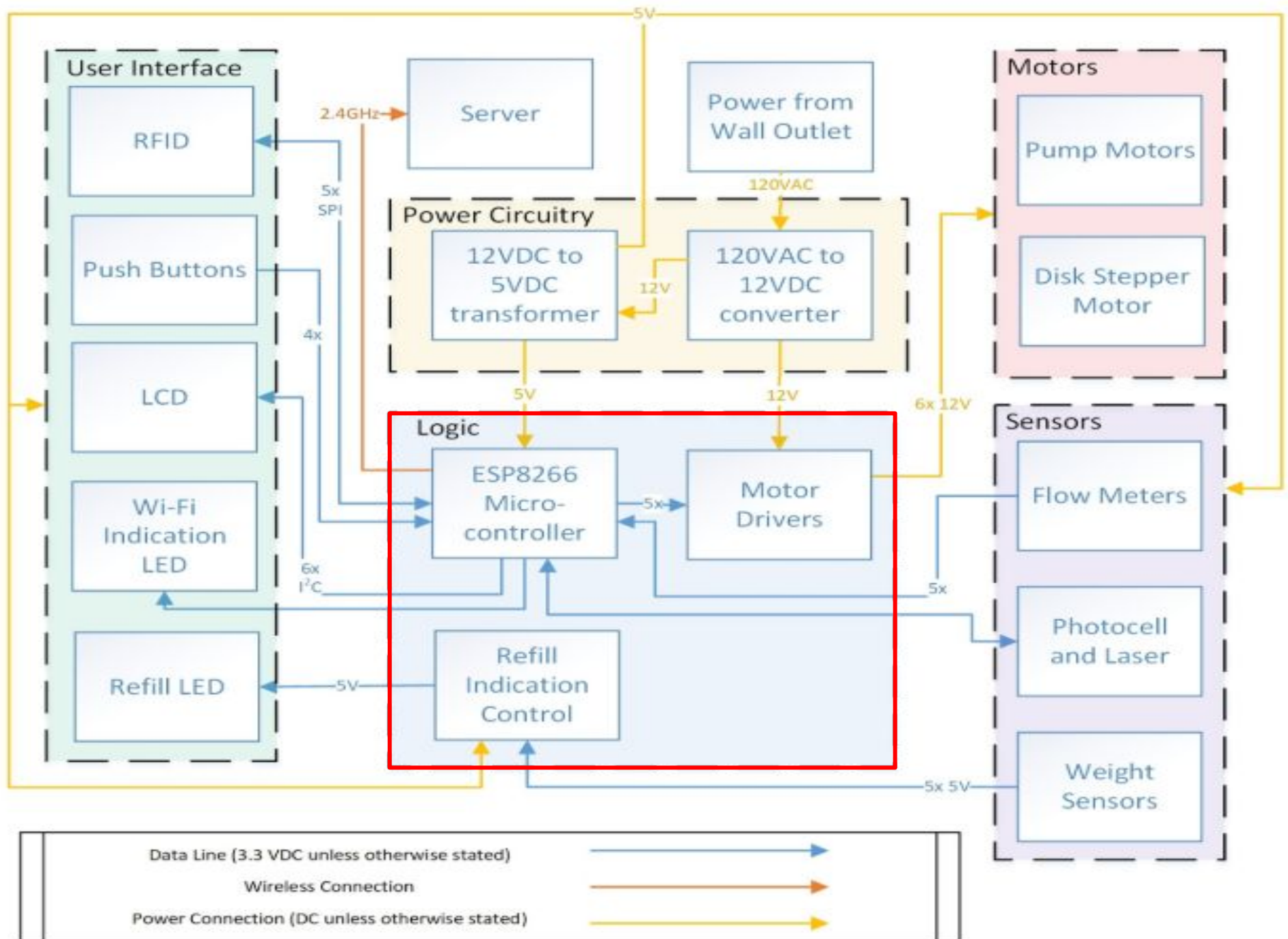Pour Bros
Champaign, IL

DID IT WORK?

User Interface
- RFID
- Push Buttons
- LCD
- Wi-Fi Indication LED
- Refill LED

Server

Power from Wall Outlet

Motors
- Pump Motors
- Disk Stepper Motor

Power Circuitry
- 12VDC to 5VDC transformer
- 120VAC to 12VDC converter

Logic
- ESP8266 Micro-controller
- Motor Drivers
- Refill Indication Control

Sensors
- Flow Meters
- Photocell and Laser
- Weight Sensors

2.4GHz
5x SPI
4x
6x I²C
5V
12V
120VAC
12V
5V
12V
6x 12V
5x
5x
5x 5V
-5V
-5V

Data Line (3.3 VDC unless otherwise stated)
Wireless Connection
Power Connection (DC unless otherwise stated)

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Power Circuitry

- ## 120VAC to 24VDC converter
  - Used for pumps
  - ~24.3V
- ## 24VDC to 12VDC transformer
  - Used for stepper motor

- ## 24VDC to 5VDC transformer
  - 5.024
 - Used for small electronics

Main Printed Circuit Board

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User Interface
- RFID
- Push Buttons
- LCD
- Wi-Fi Indication LED
- Refill LED

Power Circuitry
- 12VDC to 5VDC transformer
- 120VAC to 12VDC converter

Logic
- ESP8266 Micro-controller
- Motor Drivers
- Refill Indication Control

Motors
- Pump Motors
- Disk Stepper Motor

Sensors
- Flow Meters
- Photocell and Laser
- Weight Sensors

Server

Power from Wall Outlet

2.4GHz

5x SPI

4x

6x I²C

5V

12V

120VAC

5V

12V

6x 12V

5x

5x

5x 5V

-5V

Legend:
- Data Line (3.3 VDC unless otherwise stated)
- Wireless Connection
- Power Connection (DC unless otherwise stated)

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Logic Unit

- NodeMCU microcontroller
- Refill Indication Control
- Component Drivers

Main Printed
Circuit Board

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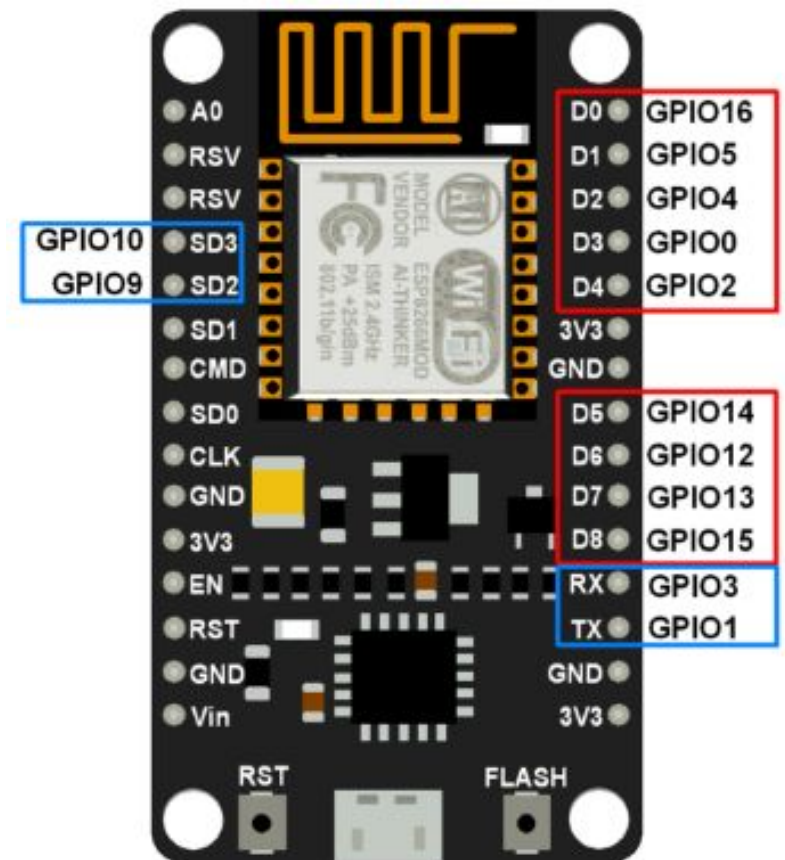
NodeMCU Microcontroller

- ## Powered by 5V
  - internally converted to 3.3V to send signals

- ## CPU to run software
  - sends control signals to subunits

- ## IOT capabilities
  - connects to a server to keep tabs
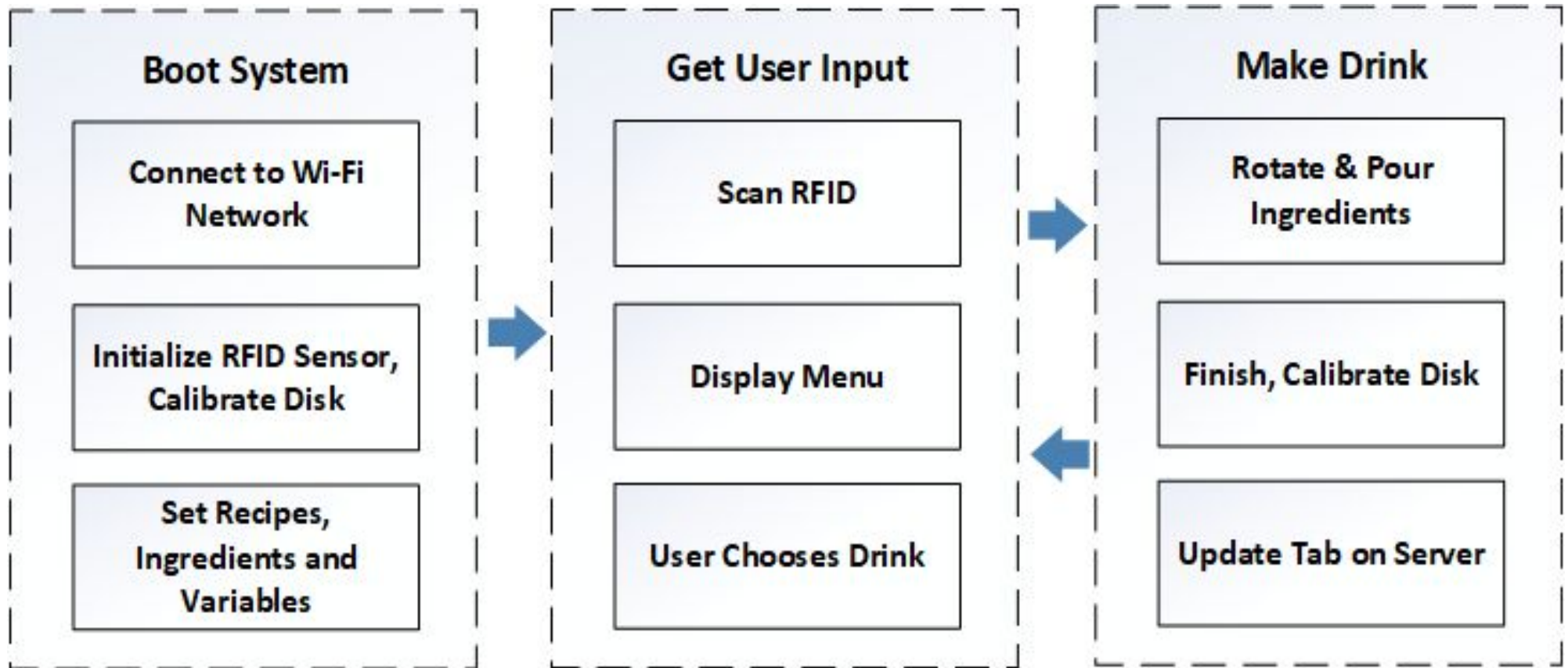
NodeMCU Microcontroller

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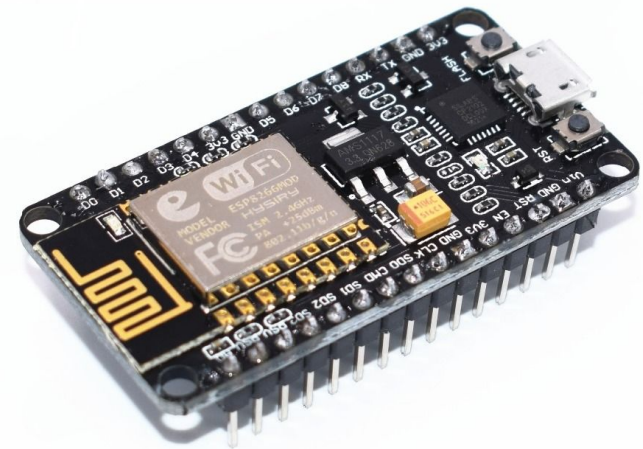
NodeMCU Communication

- ## Problem: Not enough pins
  - Left side used for flashing
  - Bottom right used for RFID
  - Top right used for I2C

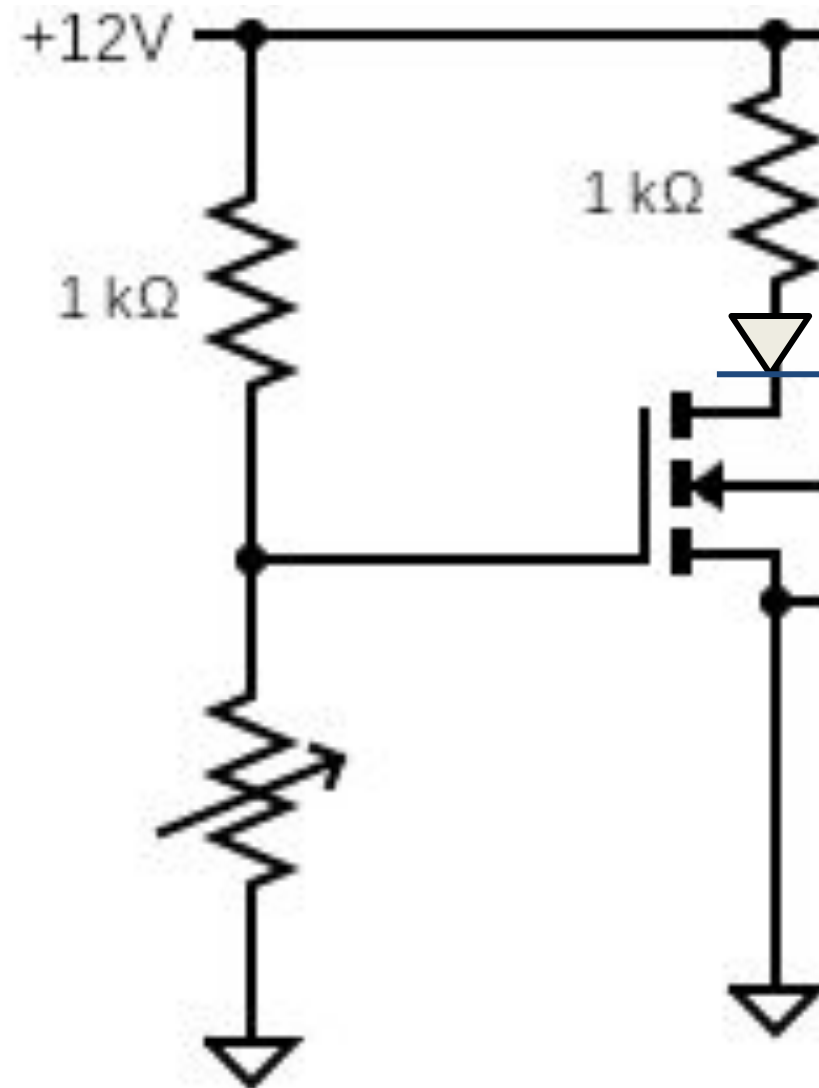- ## Solution: MCP23017 chip
  - 2-to-16 expansion chipset
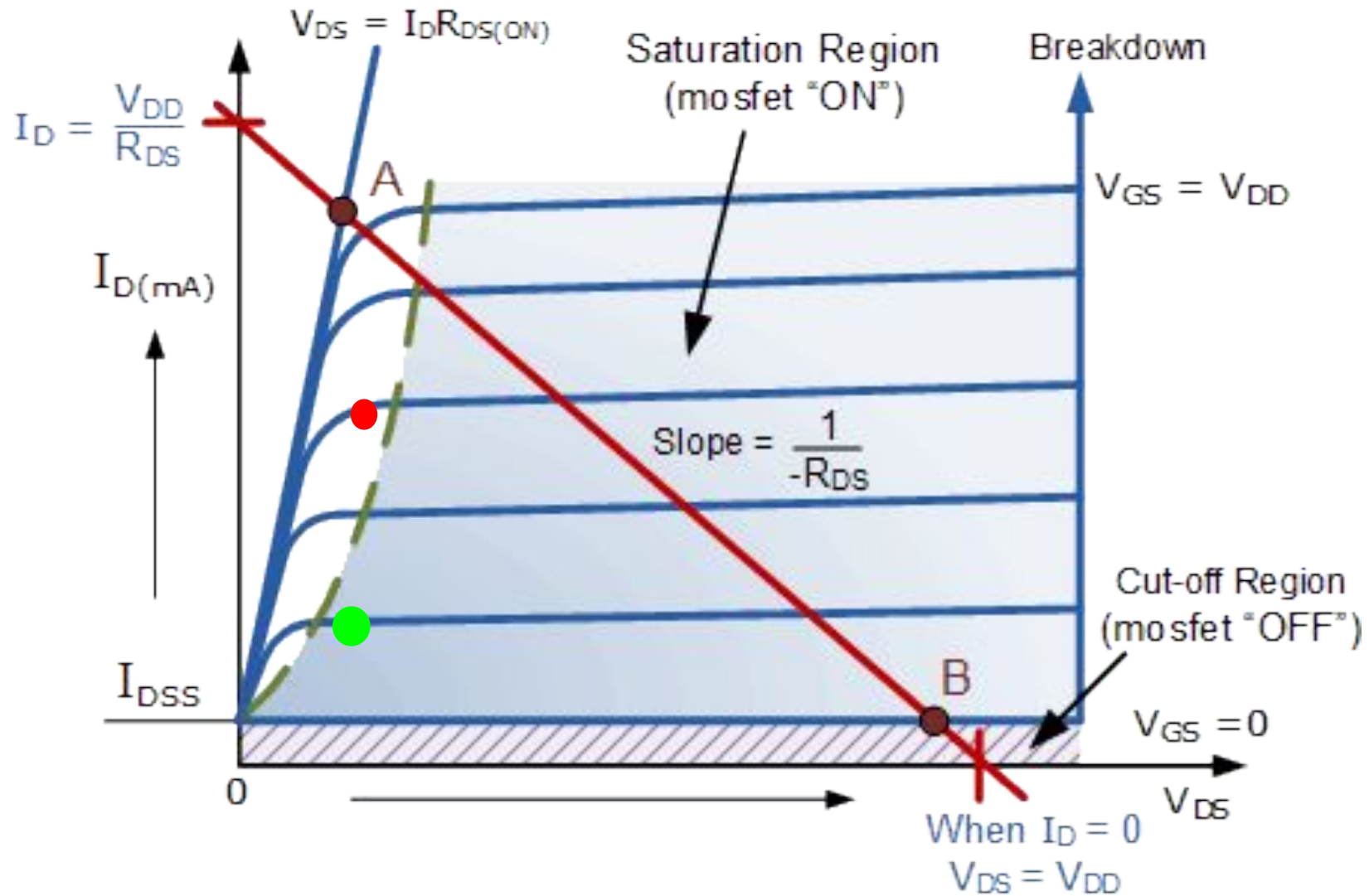

NodeMCU Microcontroller
Pinout Diagram

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Software Flow

Boot System

- Connect to Wi-Fi Network
- Initialize RFID Sensor, Calibrate Disk
- Set Recipes, Ingredients and Variables

Get User Input

- Scan RFID
- Display Menu
- User Chooses Drink

Make Drink

- Rotate & Pour Ingredients
- Finish, Calibrate Disk
- Update Tab on Server

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Recall: Refill Indication Control

Refill Indication
General Schematic

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Refill Indication Control

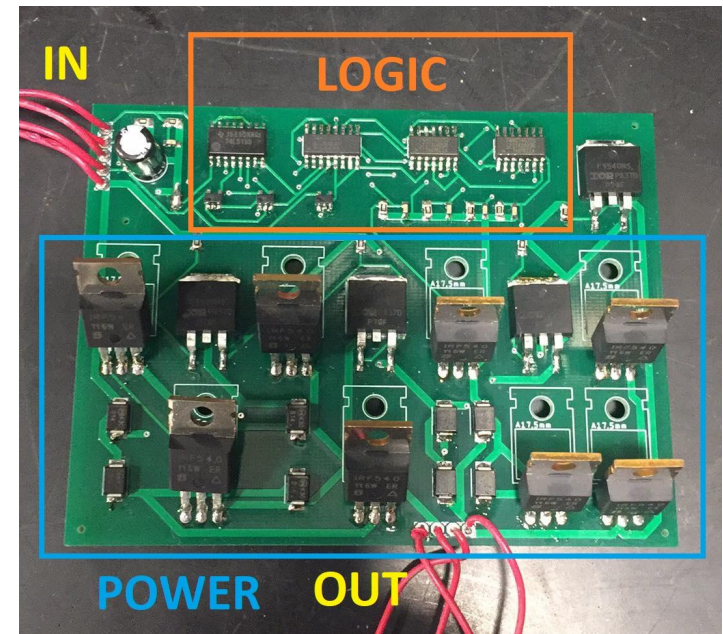

MOSFET Typical Characteristics Graph

Component Drivers

- ## Pump Driver
  - Stepped 3.3V to 24V

- ## Laser Driver
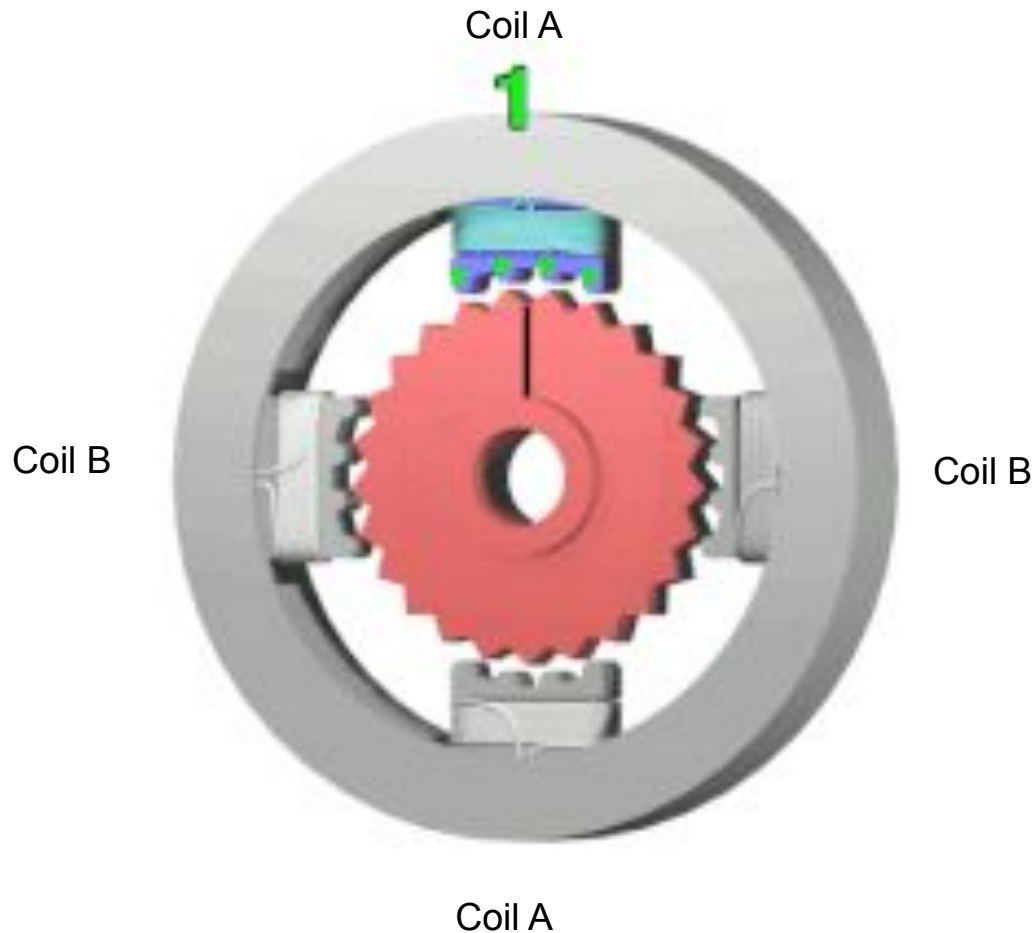 - Stepped 3.3V to 5V

Main Printed Circuit Board

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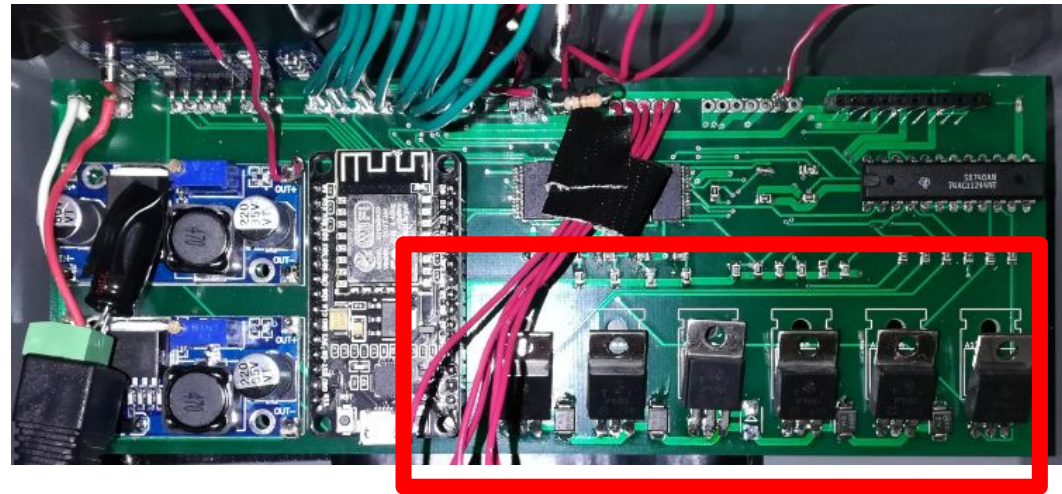
Stepper Motor Driver

- Controller for bipolar stepping sequence

- Problems:
  - Complexity
  - Shoot-through
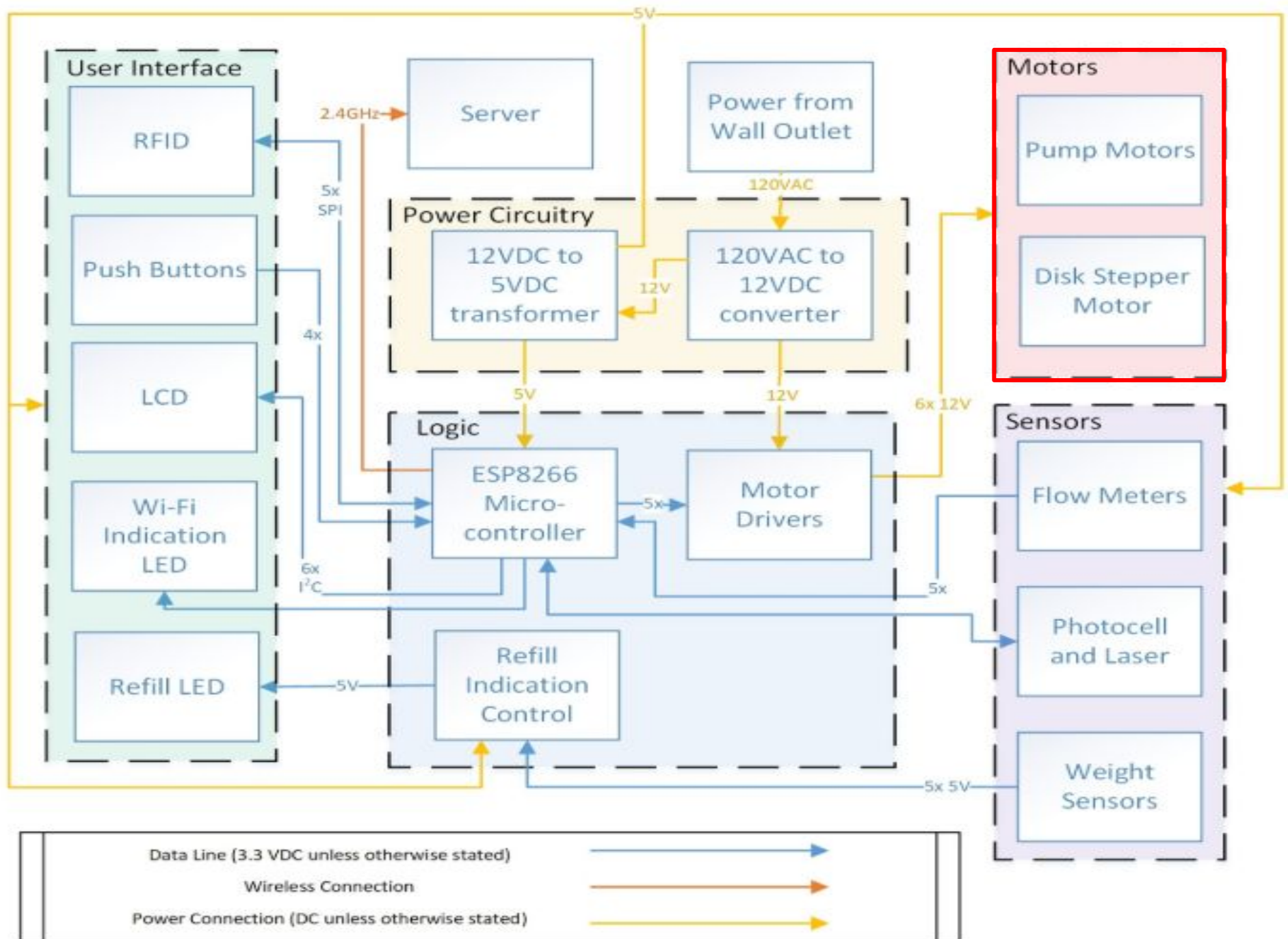 - Circuit Protection

Custom Stepper Driver PCB

- Precision half-stepping positions

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Stepper Motor Driver

Coil A

Coil B

Coil B

Coil A

Stepper Motor - Stepping Sequence Animation

Coil	A		B	
Terminal	1	3	2	4
1	1			1
2	1			
3	1		1	
4			1	
5		1	1	
6		1		
7		1		1
8				1

Stepper Motor - Half Step Coil Sequence

Peristaltic Pumps

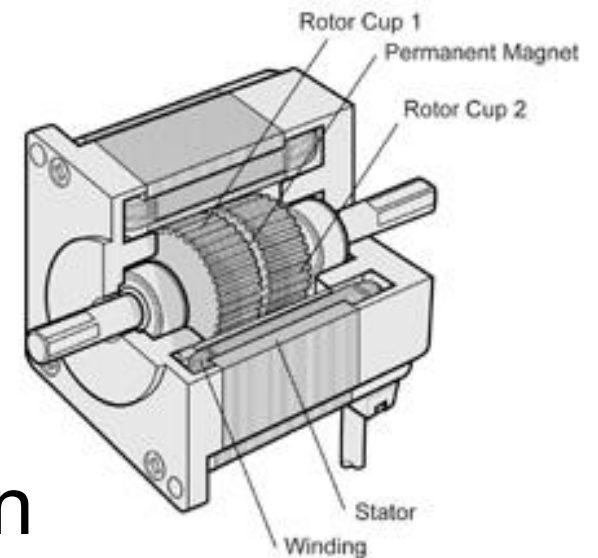| Time (s)	Volume Dispensed (mL)	Ticks Measured
5.00	90	2474
11.10	200	5014
16.66	300	7635
22.22	400	10140
27.77	500	12666

Peristaltic Pump - Flow Test Results
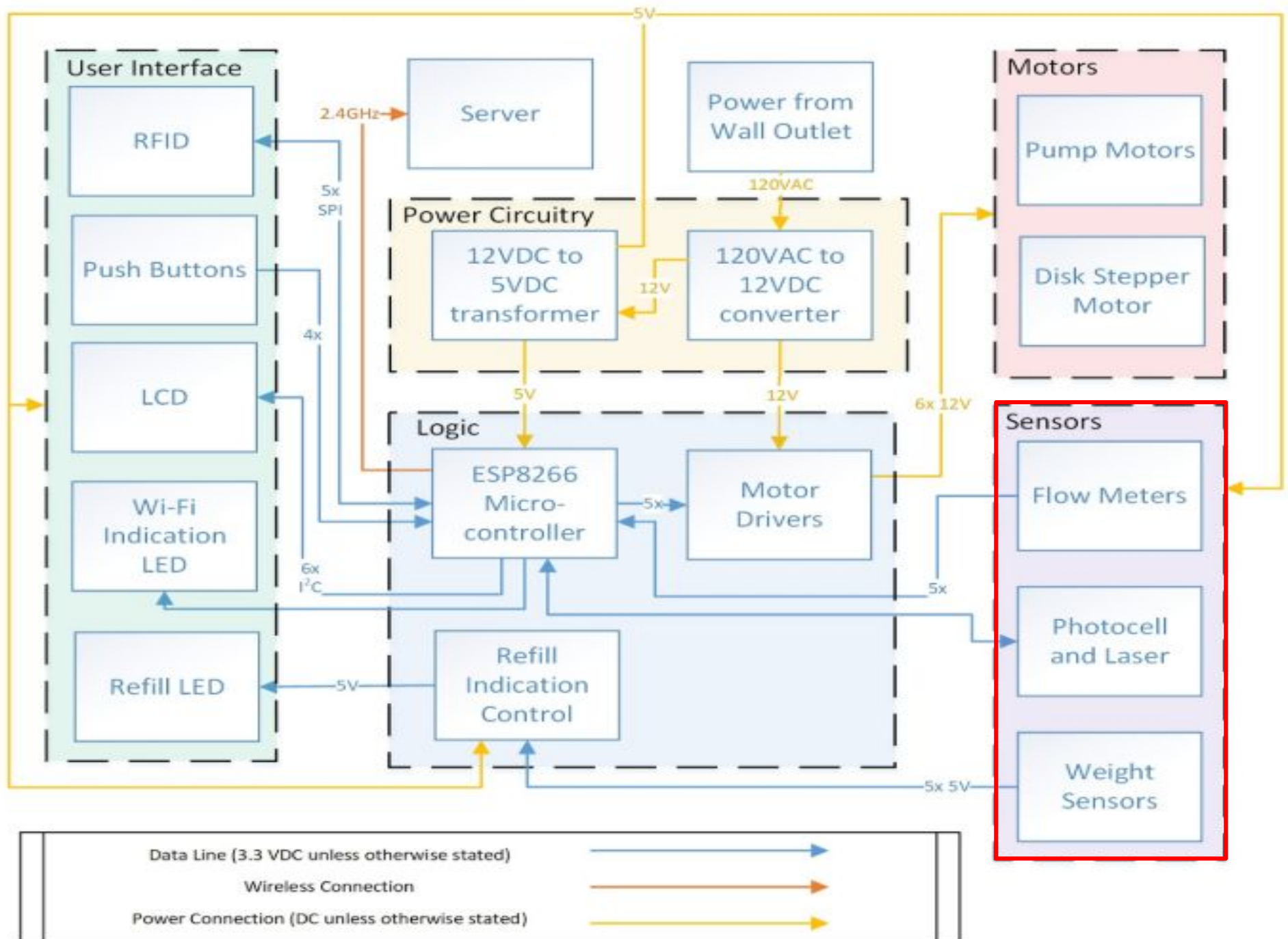
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Stepper Motor

- Spins bottom disk to preset positions

- 400 steps per revolution: 0.9° per step

- Laser & photocell for calibration
  - More detail in the sensor section
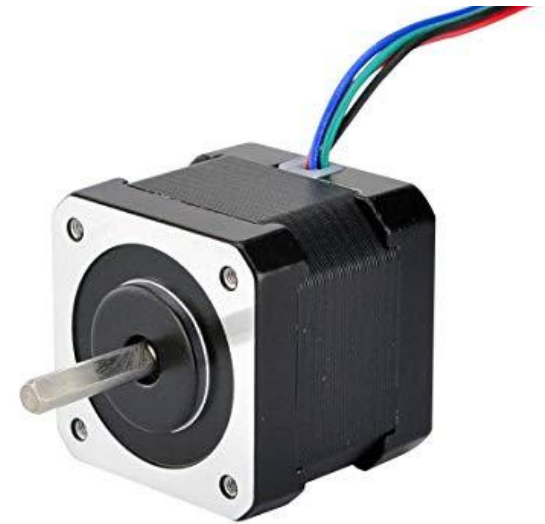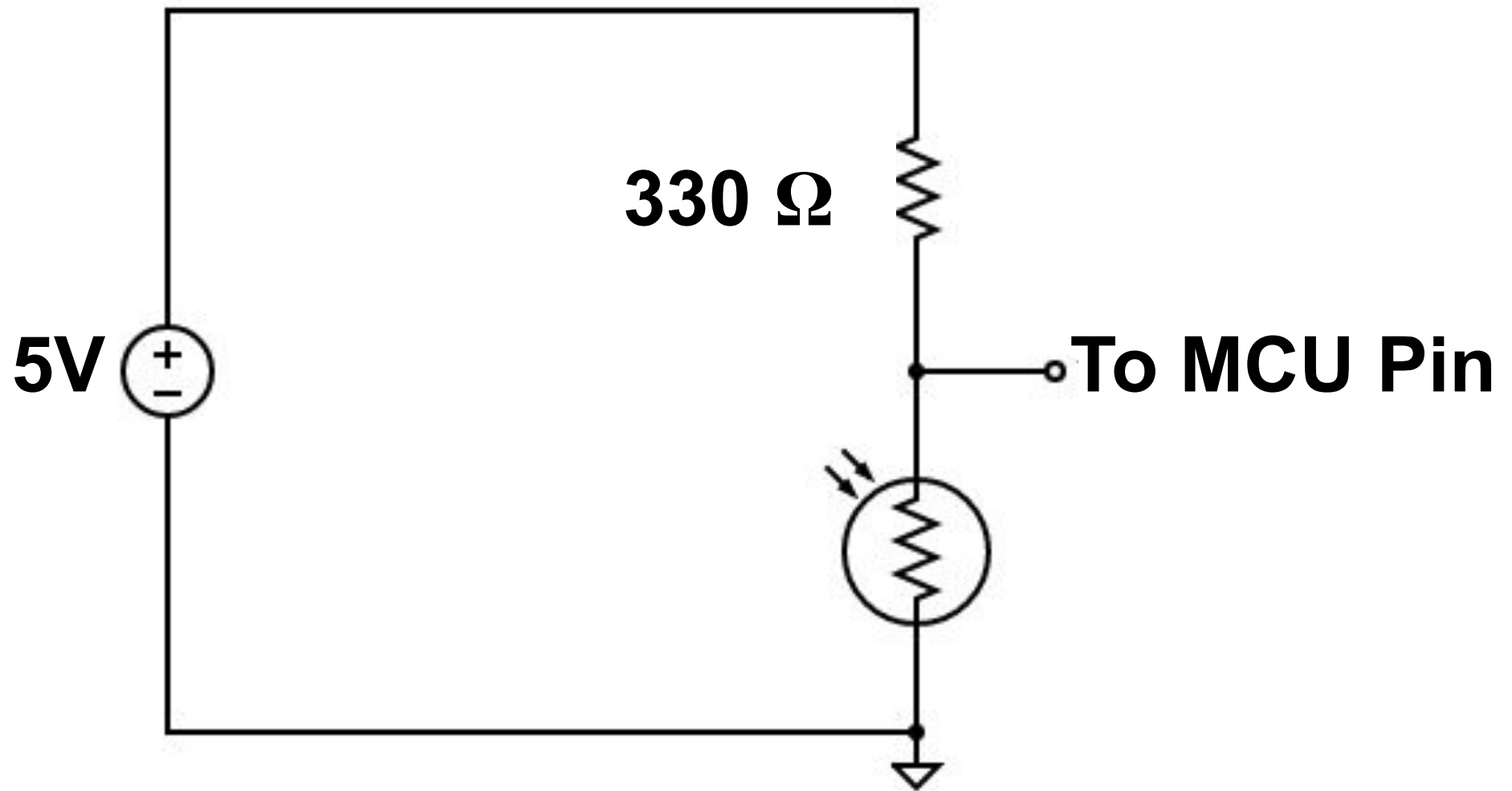

Bipolar Stepper Motor Housing

Bipolar Stepper Motor Cutaway

Sensors

- Photocell and Laser Calibration

- Flow Meters

- Weight Sensor

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Photocell and Laser Calibration

330 Ω

5V

To MCU Pin

Photocell General Schematic

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Flow Meters

Flowmeter

- Hall Effect Sensor

- Generates a tick(wave) with each volumetric step
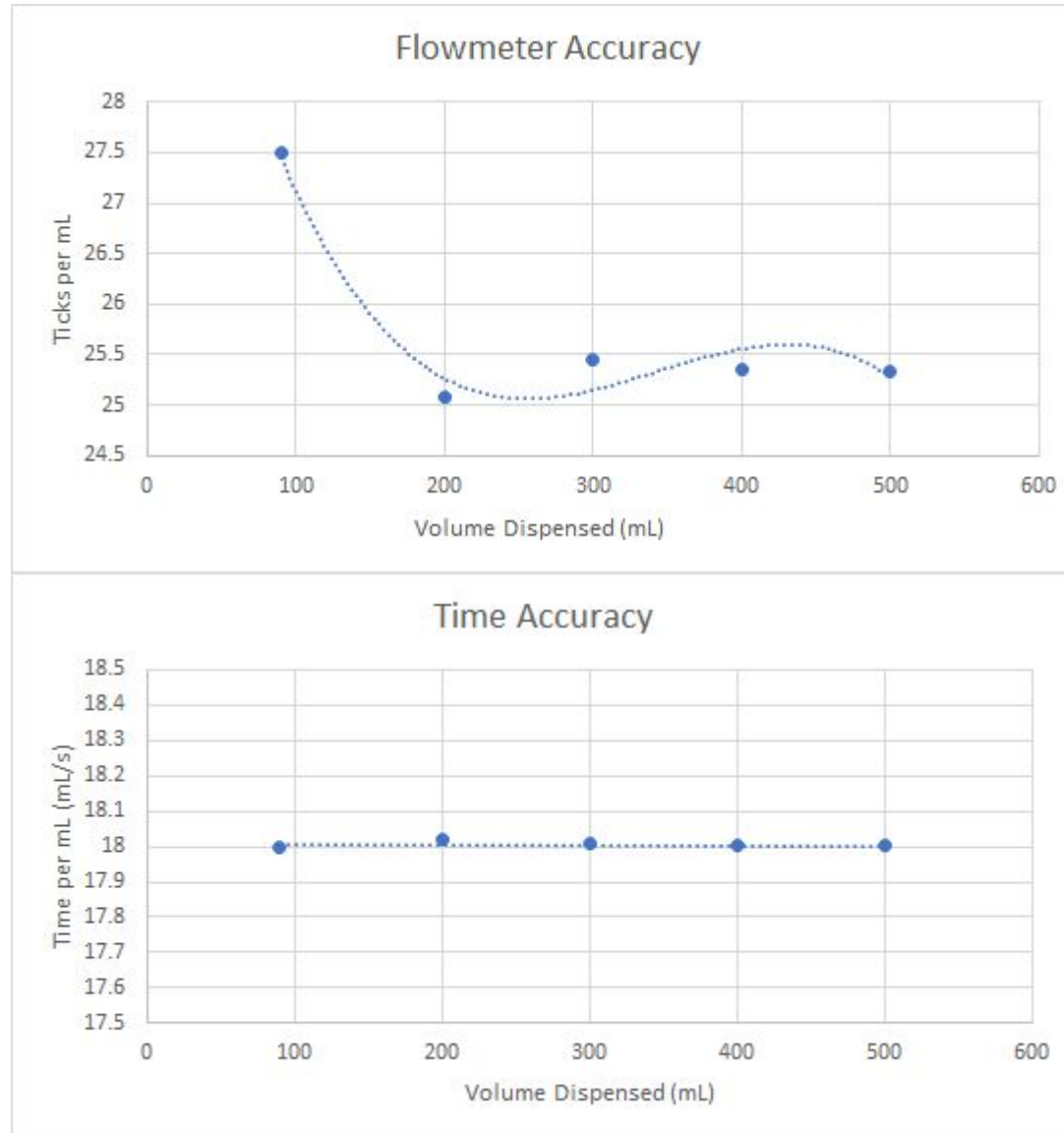
- Ticks used to calculate volume

Flowmeter Anatomy

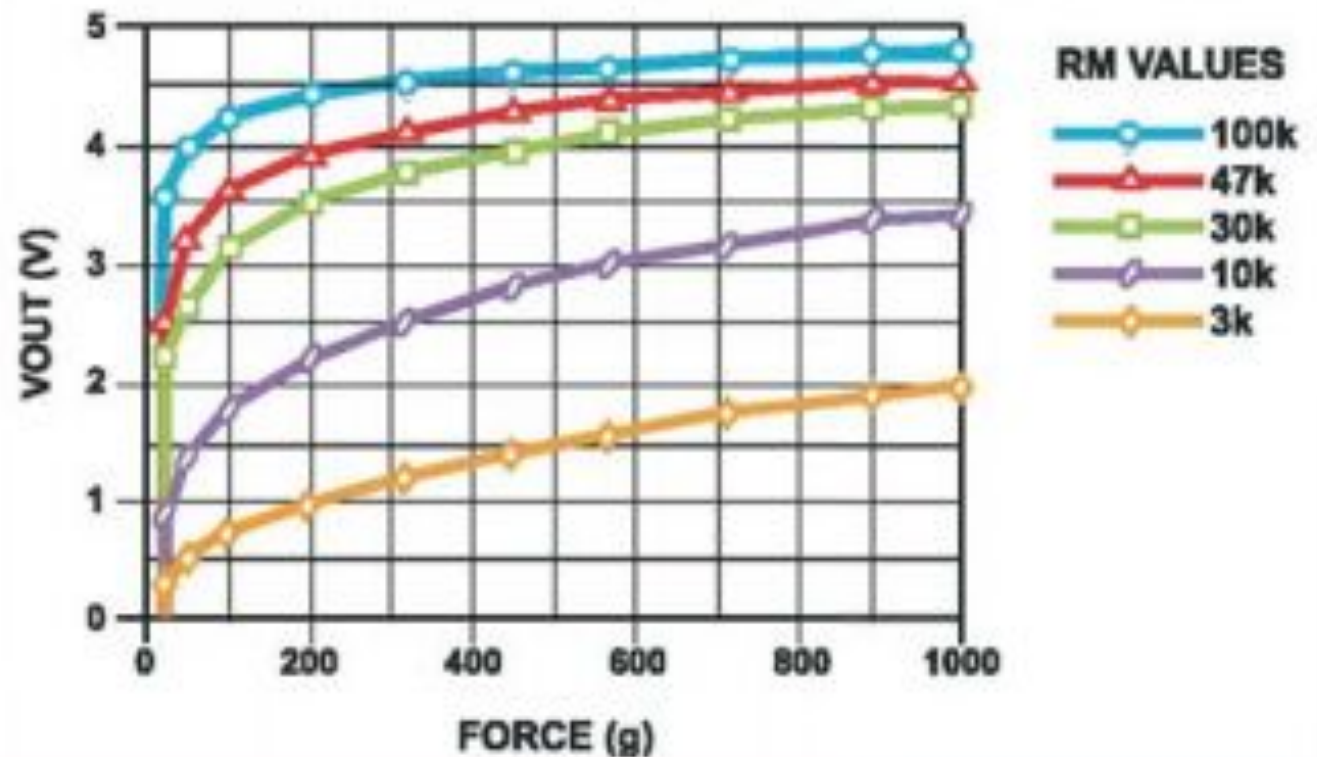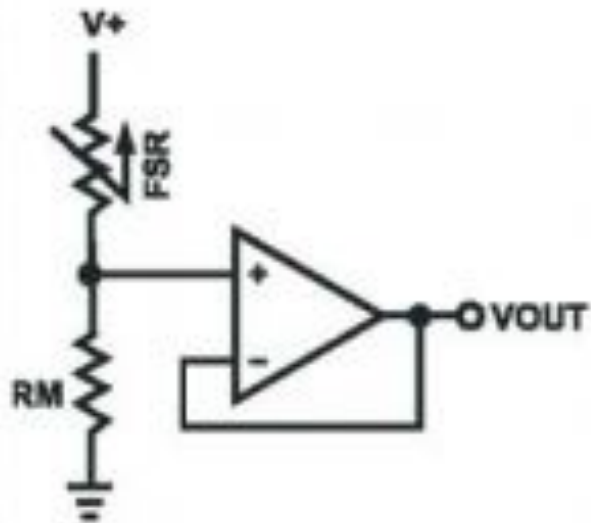ECE ILLINOIS

Flow Meters - Data

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Weight Sensor

Weight Sensor Characterization

Recall: Refill Indication Control
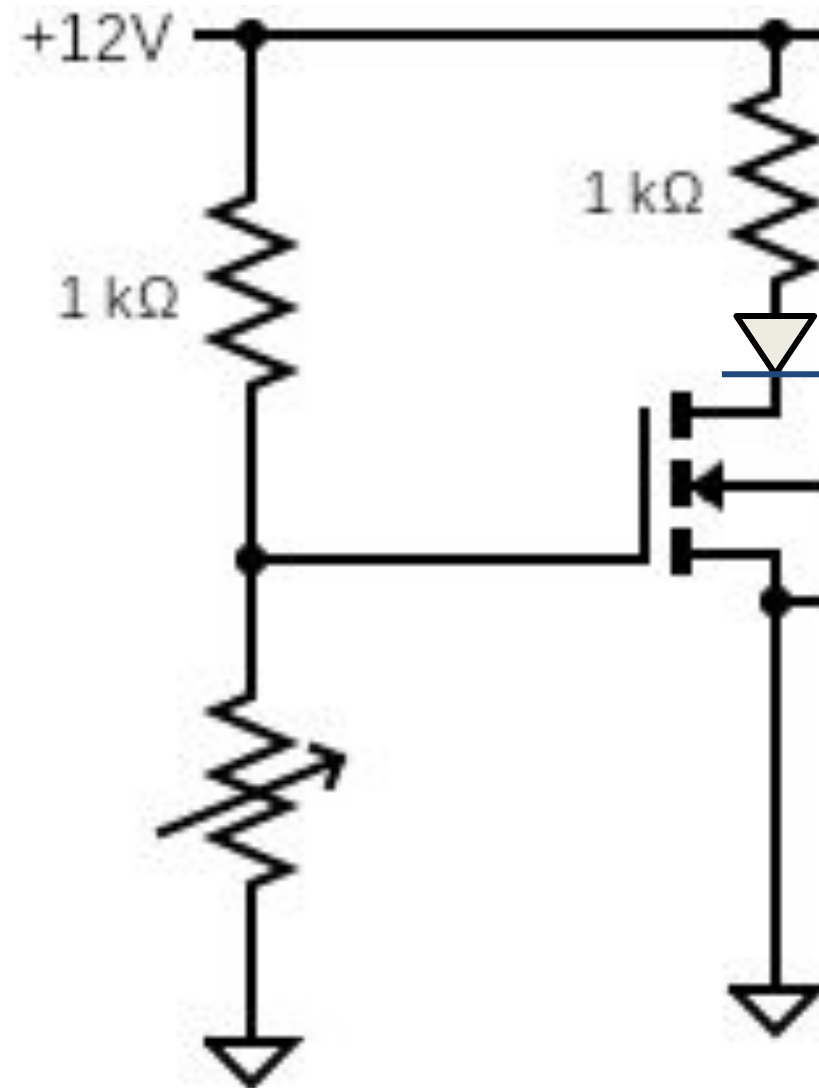
Weight Sensor
General Schematic

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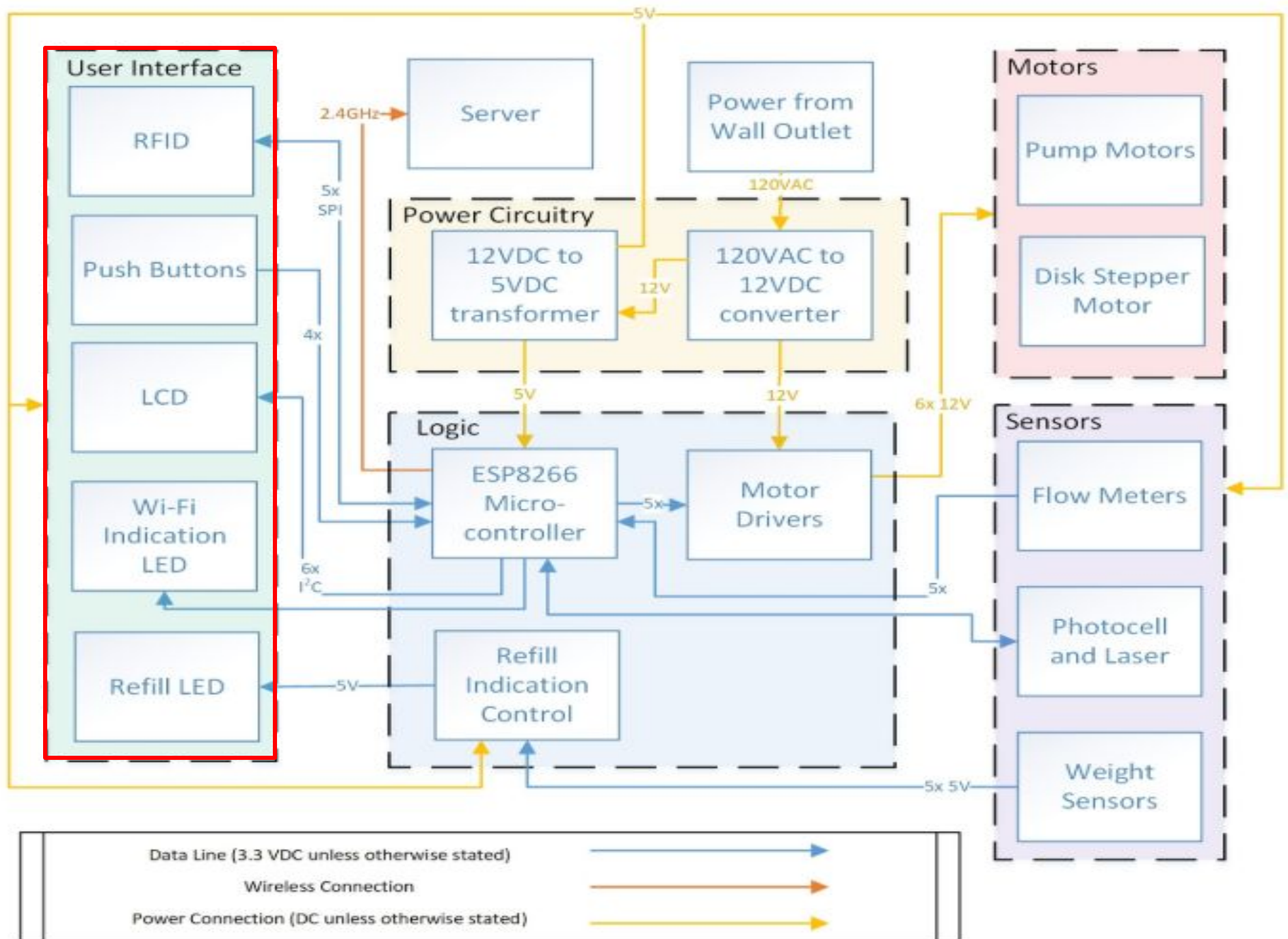
User Interface

- User-friendly, minimal interface
  - 4 buttons & LCD

- WiFi Indicator

- RFID Scanner
  - eliminates the need to type

Buttons & LCD

- User-friendly, minimal interface
  – Left, Right, Select, Back

- LCD connected via I2C

User Interface Printed Circuit Board

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WiFi & Server

- LED to show connectivity
- Uses SMTP to send email
- Python script collects email & keeps tab

```
import numpy, smtplib, time, imaplib, email

# define constant variables
Email = "handsfreemixer445@gmail.com"
Password =
Server = "imap.gmail.com"
button_delay = 0.2

# Function to read and delete the latest email
def read_latest_email():
    …
    return email_subject, email_message
```

Transaction Python Scraping Script

Emails as received by the psuedo-server

tab = { "Dave" : [Lemonade, Iced Water, ...],

"Eric" : [Fresh OJ, milk, ...],

"Matt" : [Iced Water] }

Server-side Transaction Log

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RFID

- ## MFRC522 Sensor

- ## Reads 13.56MHz Tags
  - simulates iCards

- ## Scan time
  ## < 5ms

MFRC522 RFID Sensor

```
This code scans the MIFARE Classsic NUID.
Using the following key: FF FF FF FF FF FF

**Card Detected:**
Time(ms) Spent: 4
PICC type: MIFARE 1KB
The NUID tag is:
In hex:  D9 4D F5 5D
In dec:  217 77 245 93

**Card Detected:**
Time(ms) Spent: 3
PICC type: MIFARE 1KB
The NUID tag is:
In hex:  8B 65 B9 15
In dec:  139 101 185 21

**Card Detected:**
Time(ms) Spent: 4
PICC type: MIFARE 1KB
The NUID tag is:
In hex:  E9 39 F5 5D
In dec:  233 57 245 93
```

RFID Time Testing Results

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Conclusion

- Overall system integrated successfully
- Problematic Components:
  - LCD
  - Stepper Driver
  - Flow Meters
- Future work:
  - expand and streamline software
  - use iCard compatible RFID sensor
  - optimize the physical form factor

Questions?

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