Electrical Overview

Year: \_\_\_2019\_\_\_ Semester: \_\_Fall\_\_\_\_\_\_ Team: \_\_8\_\_\_ Project:\_\_\_\_\_Condiment Express\_\_\_\_\_\_\_\_\_\_

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Assignment Evaluation:

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| --- | --- | --- | --- | --- |
| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Electrical Overview** | 5 | x3 | 15 |  |
| **Electrical Considerations** | 3 | x3 | 9 | Review required |
| **Interface Considerations** | 3 | x3 | 9 | Review required |
| **System Block Diagram** | 5 | x3 | 15 |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 4.5 | x2 | 9 |  |
| **Formatting and Citations** | 5 | x1 | 5 |  |
| **Figures and Graphs** | 5 | x2 | 10 |  |
| **Technical Writing Style** | 4.5 | x3 | 13.5 |  |
| **Total Score** | 85.5 | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

General Comments:

*Relevant overall comments about the paper will be included here*

Rework on the Electrical and Interface considerations.

1.0 Electrical Overview

Overall, the system is controlled by the Espressif System’s ESP32, a 32 bit SoC with 240 Mhz clock speed that also includes Bluetooth, wifi, and networking modules. The microcontroller software, besides its main functionality of controlling the sensor and communicating with its peripherals, also translates the input which is in (x,y) coordinate to PWM signal which is used to control the stepper motor.

The internal Bluetooth module is used to communicate with the computer via serial peripheral on the laptop. Instruction set such as “move to (x,y) position”, “perform such a task” will be sent line by line via Bluetooth.

The OLED module is used to display information such as the location of the “catcher”, a moving arm that catches the falling condiment. The OLED is manipulated via SPI and it can be operated at 3.3 V logic level. The software will perform the basic GUI rendering graphics and ASCII text.

Sensors such as temperature and humidity sensors are controlled via I2C protocol. Sensors such as weight sensor, which is used for weight measurement, is communicated via ADC.

The reset of the motors will be controlled via PWM signal through and external PWM integrated chip due to the minimum number clock channel on the ESP32.

All the other digital switches such as limit switch will be controlled directly via GPIO pins.

2.0 Electrical Considerations

The operating frequency used in our electric system is 240 MHz which is overkill for our application. However, due to the network hardware, onboard Bluetooth and WiFi, and sleeping features available in the ESP32, it is no doubt our choice for this task. As we have stated in our proposal, even though we are not going to implement any networking feature, the end goal is to design this device into an IoT.

The voltage usage of each component is clearly labeled in Appendix 1. I have also summarized all the essential information bellow.

The power source that directly connected to the PCB is a 110 V to 12 V DC switching power supply which we bought online. It can provide 12 V DC power continuously with a current of 10A

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Part Name** | **Quantity** | **Typ Operating Voltage** | **Typ Current Draw** | **Typ Power Consumption** | **Voltage Tolerance** | **Current Tolerance** | **Power Tolerance** |
| ESP32 | 1 | 3.3V |  |  |  |  |  |
| HTU21D Temp & Humidity Sensor [7] | 1 | 3V | 450uA | 1.35mW | 1.5-3.6V | 300-500uA | 2.7uW |
| Weight Sensor (HX711)  [1] | 3 | 3.3V | 100uA | 330uW | 2.6-5.5V | Absent from Data Sheet | Absent from Data Sheet |
| NEMA17 Stepper Motor | 5 | 12V | 1.6A | 19.2W | Absent from Data Sheet | Absent from Data Sheet | Absent from Data Sheet |
| Vibration Motor [3] | 1 | 3V | 60mA | 180mW | 2V-5V | 60-100mA | 180-500mW |
| Servo Motor  [4] | 12 | 5V | Absent from Data Sheet | Absent from Data Sheet | 4.8-7.2V | 500mA-900mA | Absent from Data Sheet |
| Servo-Motor Driver(PCA9685)  [5] | 1 | 3.3V | Absent from Data Sheet | Absent from Data Sheet | 2.3-5.5 | 100mA Max | Absent from Data Sheet |
| OLED  [6] | 1 | Absent from Data Sheet | Absent from Data Sheet | Absent from Data Sheet | 0-16V | Absent from Data Sheet | Absent from Data Sheet |

3.0 Interface Considerations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **From** | **To** | **Duplex?** | **Interface Type** | **\*\*Clock line Freq** | **Used for** |
| ESP32 | Encoder | No | System Timer Input | 120Hz | User uses this Encoder to select menu items on the oled. It act like a user interface. |
| ESP32 [6] | OLED | YES | SPI | 20MHz | Display user info on OLED. It provide visual feedback to the user |
| ESP32 [7] | HTU21D Temp & Humidity Sensor | YES | I2C | 0.4MHz | Control the Sensor. The I2C line provide instruction and data to the register on HTU21S |
| ESP32 [1] | Weight Sensor (HX711) | No | System Timer Input | 80Hz Max | Read Weight Sensor Data. The HX711 uses custom clock and data protocol. |
| ESP32 [5] | PCA9685 | Yes | I2C | 50MHz Max | Control Servo Motor |

\*\*The data rate, although is not the same as the clock freq, it is proportional to the data rate, some of the system , such as HX711 does not have a clear data rate written on the data sheet.

4.0 Sources Cited:

[1] 24-Bit Analog-to-Digital Converter (ADC) for Weigh Scales. (unknown). *AVIA Semiconductor*. Available at:

<https://cdn.sparkfun.com/datasheets/Sensors/ForceFlex/hx711_english.pdf> [Accessed 14 Spe 2019]

[2] Wires, B. (2019). *Big Sale Nema 17 Unipolar 1.8deg 26Ncm (37oz.in) 0.4A 12V 42x42x39mm 6 Wires*. [online] Omc-stepperonline.com. Available at: <https://www.omc-stepperonline.com/nema-17-stepper-motor/grande-vendita-nema-17-unipolare-1-8deg-26ncm-37oz-in-0-4a-12v-42x42x39mm-6-fili.html> [Accessed 14 Sep. 2019].

[3] Motor Viberator. (2011). *Product specification* [Online]. Available at: <https://cdn-shop.adafruit.com/product-files/1201/P1012_datasheet.pdf> [Accessed 14 Sep 2019].

[4] MG996R. (unknown) *High Torque Metal Gear Dual Ball Bearing Servo*. Available at:

<https://www.electronicoscaldas.com/datasheet/MG996R_Tower-Pro.pdf> [Accessed 14 Sep 2019].

[5] PCA9685. (2015). *16-channel, 12-bit PWM Fm+ I2C-bus LED controller*. Available at:

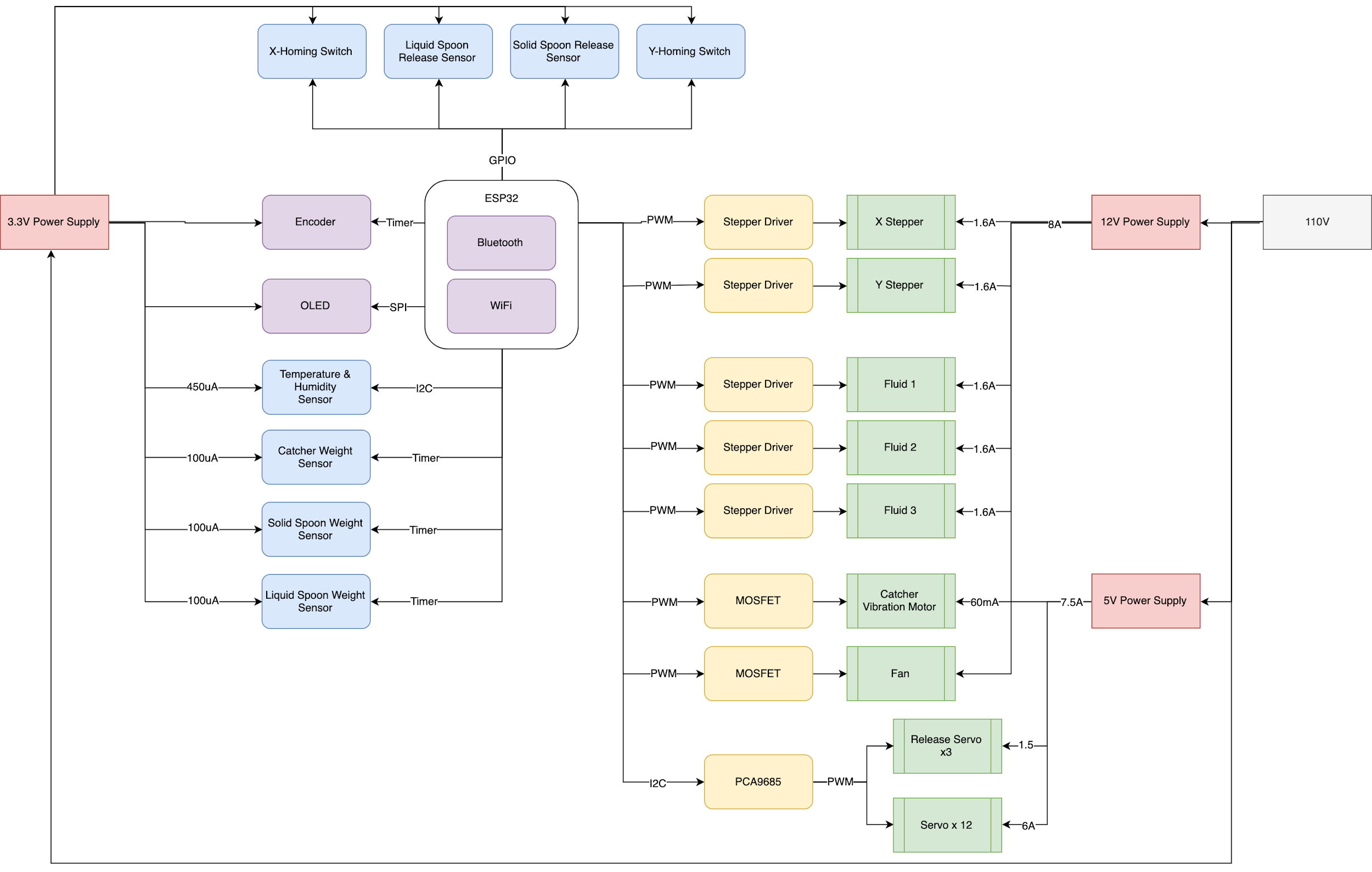
<https://cdn-shop.adafruit.com/datasheets/PCA9685.pdf> [Accessed 14 Sep 2019].

[6] SSD1305. (2008). *Advance Information 132 x 64 Dot Matrix OLED/PLED Segment/Common Driver with Controller*. Available at: <https://cdn-shop.adafruit.com/product-files/2719/2719+DATA.pdf> [Accessed 14 Sep 2019].

[7] HTU21D(F) Sensor. (2013). *Digital Relative Humidity sensor with Temperature output.* Measurement Specialties. Available at:

<https://cdn-shop.adafruit.com/datasheets/1899_HTU21D.pdf> [Accessed 14 Sep 2019].

Appendix 1: System Block Diagram

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\*\* Note that the 12 Volt power supply is not part of the PCB, it is a commercially available 110 V AC to 12 Volt DC switching power supply.