Electrical Overview

Year: 2016 Semester: Fall Team: 7 Project: ANPR Parking System

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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** | 5 | x3 | 15 |  |
| **Interface Considerations** | 5 | x3 | 15 |  |
| **System Block Diagram** | 5 | x3 | 15 |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 4 | x2 | 8 |  |
| **Formatting and Citations** | 4 | x1 | 4 |  |
| **Figures and Graphs** | 5 | x2 | 10 |  |
| **Technical Writing Style** | 5 | x3 | 15 |  |
| **Total Score** | 97 | | |  |

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

General Comments:

*Good job! There is a clear improvement in writing and most of the discussions are clear. And the system block diagram is excellent!*

*Still, some formatting issues showed up in previous assignments are still there. And it will be better if there are less grammar mistakes.*

*By the way, for the Bill of Materials, the “package” field is the type of the electronic packaging needed for the corresponding component, so most of the devices should not have “stand alone” in that field. And “bulk” doesn’t mean anything to me for that field. Some good examples for that can be found at:*

[*https://engineering.purdue.edu/ece477/Course/Assignments/Example/BillOfMaterialsEx1.xlsx*](https://engineering.purdue.edu/ece477/Course/Assignments/Example/BillOfMaterialsEx1.xlsx)

1.0 Electrical Overview

There are four main parts in this project: A Raspberry Pi with a camera, a microcontroller, a motor and for each spot a wireless module. For the Raspberry Pi, it needs to capture and analyze images, and get the plate numbers for the car in each image. The microcontroller needs to control the motor, receive data from each spot and display information on several 16-segment displays. We choose to use several shift registers to drive the 16-segment displays. Furthermore, it needs to record the entrance/exit time of each car. The gate bar is controlled by the motor. The wireless module will send the spot number and occupancy status received from an infrared sensor to the microcontroller. Also, at each spot, there is one LED light indicator for drivers to see if the spot is empty or not.

2.0 Electrical Considerations

2.1 Operating Voltage

The microcontroller (PIC24FJ128GA010) for our design allows a voltage range of 2.0V to 3.6V. [1]. The radio transceiver module (MRF24J40MA) allows a voltage range of 2.4-3.6V (3.3V typical). The LED for each spot requires 2.5 V voltage [4]. The motor’s operating voltage is 12V.

Infrared emitters [7], phototransistors [8], shift registers and segments displays will operate on 5V.

2.2 Operating Frequency

The operating frequency for our design is not critical. The whole process does not require a high frequency. The data between raspberry pi and micro is really short as we only pass the plate number to the microcontroller.

For shifting segments displays, we need to shift 8 modules at a time, which means 8 \* 17 bits every time. To prevent user seeing the shifting, we need the shifting finish within 50 ms. That means a 50 \* 8 \* 17 = 6.8 kHz CLK frequency is needed.

2.3 Power supply

* The power to controllers will be supplied by a 5V 2A wall adapter. Most of the components require 3.3V to operate. A voltage regulator is used.
  + Microcontroller[1] = 200mA
  + LED[4] = 70 mA
* Raspberry Pi will use usb port as power supply (Micro USB socket 5V1, 2.5A) [5].
* 5V wall adapter is used for all 5V parts.
  + Infrared Emitters[7] = 100mA
  + Phototransistors[8] = 100nA in dark.
* The DC motor will be supplied by a 12V wall adapter with maximum current of 1.1A [6].
* 16 Segments Display [3] = 20 mA per segment

\*I cannot find the data sheet for 16 segments displays. I just chose a similar model.

3.0 Interface Considerations

3.1 Serial Interface

A serial interface will be used to send the signal to segments displays. The multiple 16-segment displays will be driven by several shift registers. The signal used to control these displays will be shifted out from one pin. The serial clk will be asserted from the microcontroller to the shift registers. For each period of the clock, one data bit will be shifted out from the microcontroller.

3.2 Raspberry Pi 3 Interface



SPI will be used to make communication between Raspberry Pi and microcontroller. Master will be set up for Raspberry Pi because Pi only has master mode. We need to let microcontroller perform as the master when the microcontroller detects there is a car in front of the gate bar, it will send the signal to Raspberry Pi which tells Raspberry Pi to take the image of the plate and perform the plate recognition algorithm. The maximum speed of this connection is 50 Mb/s, and the expected usage will be less than 1 Mb/s because the data size is only a few bytes.

4.0 Sources Cited:

[1] Microchip. (2012) “PIC24FJ128GA010 FAMILY” [Online]. Available: <http://ww1.microchip.com/downloads/en/DeviceDoc/39747F.pdf>

[2] Microchip. (2008) “MRF24J40MA Data Sheet” [Online]. Available: <http://ww1.microchip.com/downloads/en/DeviceDoc/70329b.pdf>

[3] Dongguan Houjie Keming Electronic Factory. “Specifications of Seven segment LED display” [Online]. Available:

<http://p.globalsources.com/IMAGES/PDT/SPEC/509/K1036016509.pdf>

[4] Mouser Electronics. (2016) “Lite-On LTL2V3EY3KS” [Online]. Available: <http://www.mouser.com/ProductDetail/Lite-On/LTL2V3EY3KS/?qs=sGAEpiMZZMtmwHDZQCdlqZICT%252bSaMZUBPCv17hk0k%252bHHF10yo6kNRg%3d%3d>

[5] Raspberry Pi. (2016) “Raspberry Pi 3 Model B” [Online]. Available: <https://www.inet.se/files/pdf/1974044_0.pdf>

[6] Robotshop. (2016) “Cytron 12V 17RPM 277oz-in Spur Gearmotor” [Online]. Available: <http://www.robotshop.com/en/cytron-12v-17rpm-277oz-in-spur-gearmotor.html>

[7]Mouser Electronics. (2016) “ OSRAM Opto Semiconductors SFH 4550” [Online]. Available: <http://www.mouser.com/ProductDetail/Osram-Opto-Semiconductor/SFH-4550/?qs=%2fha2pyFadugXm7hvHtHLeWIe4ZA%252bUPHGXT%252bI5HTSwUo%3d>

[8]Mouser Electronics. (2016) “Fairchild Semiconductor QSD124” [Online]. Available: <http://www.mouser.com/ProductDetail/Fairchild-Semiconductor/QSD124/?qs=sGAEpiMZZMs50KUSuyRkpqmW%252bYzaTd1qpijOcPsCWn8%3d>

Appendix 1: System Block Diagram

System Block Diagram.png