Line Follower Kit Specifications

David van Warmerdam, Luka Nielsen,
Milan van de Zanden & Aditya Shekhar

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1 Main Board

In Figure 1 the full PCB layout of the main board is shown.

1.1 Battery

The battery used for the kit is the: EVE 18650 Li-ion Battery - 3100mAh - 10A - INR18650-33V [1]. This is the main source of power of the kit and is used for the Arduino, motors, and sensors.

1.2 Battery management circuit

Figure 2 shows the circuit for the battery charge controller and protection. In order to charge the battery a TP4056 [2] is used as a charge controller. The battery is procted by a DW01A [3]. A standard USB C connector is used that has the CC lines connected to tell the power supply to source the maximum available power at 5V.

1.3 Arduino Nano

For the controller of the kit an Arduino Nano is used. Figure 3 shows how the pins are connected.

1.4 Motors

The motors used for the kit are the JGA25-370 Geared Motor [4].

1.5 Motor drivers

To turn (i.e. drive) the motors, a simple MOSFET [5] driver circuit is used seen in Figure 4.

1.6 Boost circuit 1

A boost circuit is used to boost the 3V3 from the battery to 5V for the Arduino Nano. See Figure 5. This boost converter has a static gain and cannot be changed. The converter IC used for it is the TI TLV61046A [6].

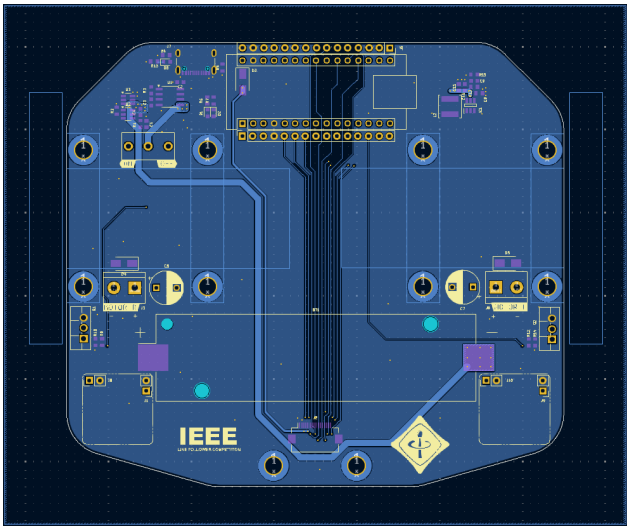

Figure 1: The Main Board PCB

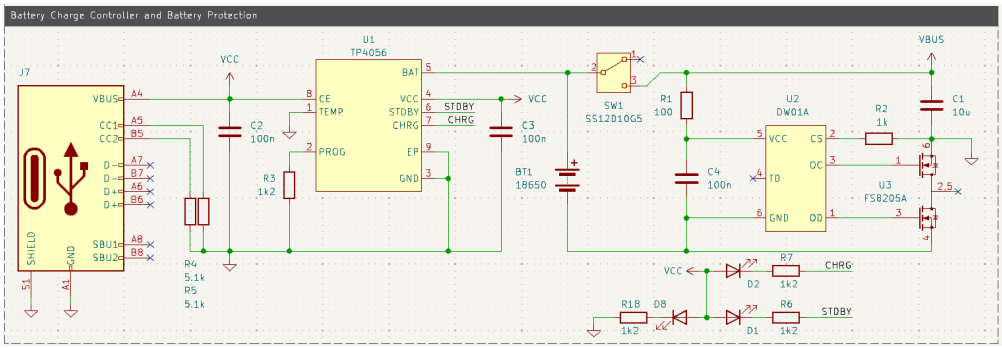

Figure 2: Battery Charge Controller and Battery Protection

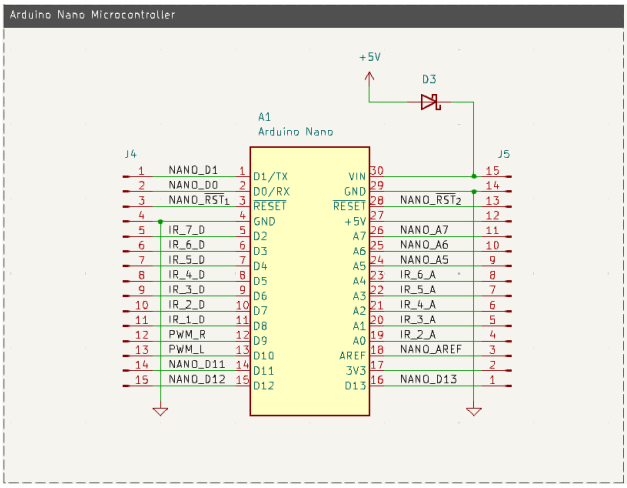

Figure 3: Arduino Nano Connections

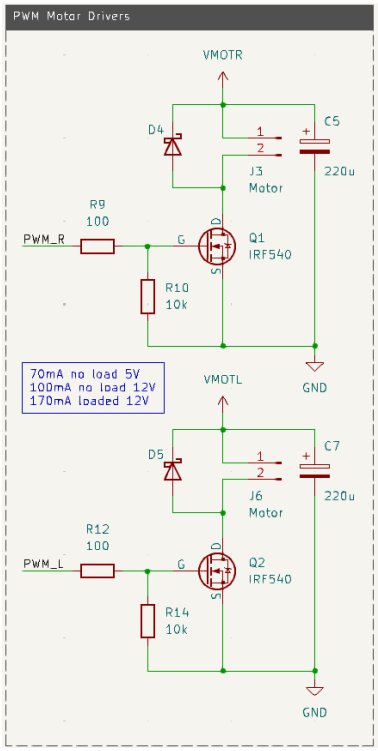

Figure 4: Motor Driver Circuit

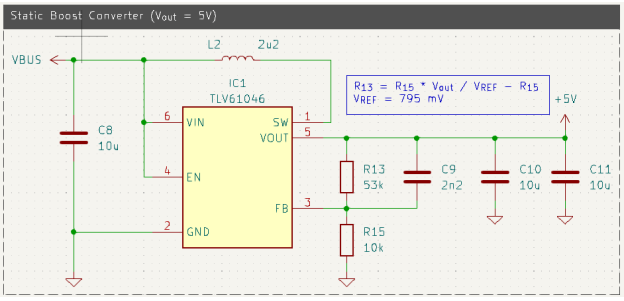

Figure 5: Static boost converter for Arduino Nano

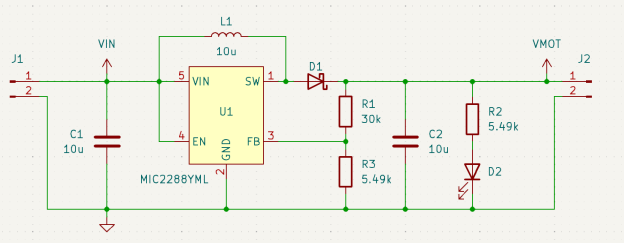

Figure 6: Boost converter (for motors) circuit

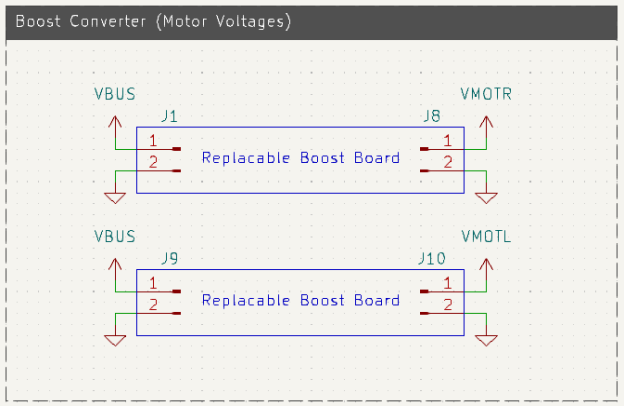

Figure 7: Boost converter (for motors) connection to main board

1.7 Boost circuit 2

Another boost circuit is used to create 8V for the motors. This is done with 2 separate boost converters, one for each motor, to ensure enough power can be delivered. These boost converters come on a separate PCB that is easily replaced on the main PCB. This is done so that they can easily be replaced when broken, which could, for example, happen when too much current is drawn. The boost converter circuit can be seen in Figure 6. For this boost circuit a Microchip MIC2288 [7] is used. The connection to the main board can be seen in Figure 7.

2 Sensor Board

The full sensor board PCB layout can be seen in Figure 8. The circuit per sensor, the sensor used is the CNY70 [8], can be seen in Figure 9. The sensor data are both obtained digitally and analogly. To obtain the digital value of the sensor, a comparator is used, the TI LM339 [9]. The reference value can be adjusted via a potentiometer to tune the range.

The sensorboard is connected to the mainboard using a FFC (Flat Flexible Cable). This cable will send both the digital (compared) output and the analog signal from the sensor to the Arduino.

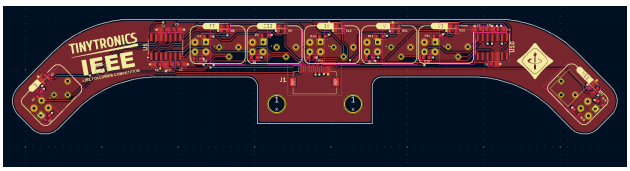

Figure 8: Sensor board PCB

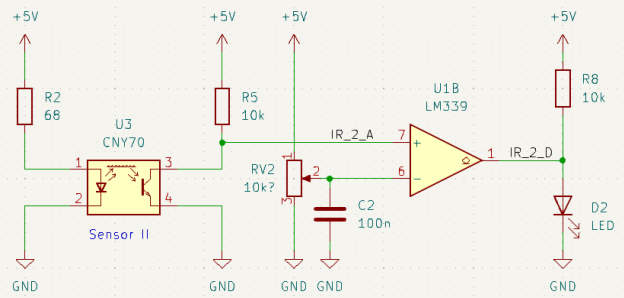

Figure 9: Active infrared sensor circuit (example from sensor 2

References

[1] Tiny Tronics. EVE 18650 Li-ion Battery. https://www.tinytronics.nl/en/power/batteries/18650/eve-18650-li-ion-battery-3100mah-10a-inr18650-33v. [Accessed 11-12-2024].

[2] TP4056 datasheet. https://dlnmh9ip6v2uc.cloudfront.net/datasheets/Prototyping/TP4056.pdf. [Accessed 11-12-2024].

[3] hmsemi.com. Dw01a. https://hmsemi.com/downfile/dw01a.pdf. [Accessed 11-12-2024].

[4] Seeed Technology Co. Motor. https://www.digikey.nl/en/products/detail/seeed-technology-co-ltd/114090046/10385097. [Accessed 29-12-2024].

[5] Fairchild. IRF540N. https://media.digikey.com/pdf/Data%20Sheets/Fairchild%20PDFs/IRF540N.pdf. [Accessed 11-12-2024].

[6] ti.com. https://www.ti.com/lit/ds/symlink/tlv61046a.pdf?ts=1735397595334&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FTLV61046A%252Fpart-details%252FTLV61046ADBVR. [Accessed 29-12-2024].

[7] microchip. Mic2288. https://ww1.microchip.com/downloads/en/DeviceDoc/MIC2288-Data-Sheet-DS20006034C.pdf. [Accessed 29-12-2024].

[8] vishay.com. https://www.vishay.com/docs/83751/cny70.pdf. [Accessed 30-12-2024].

[9] ti.com. https://www.ti.com/lit/ds/symlink/lm339b.pdf?ts=1735511386983&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FLM339B. [Accessed 30-12-2024].