CHAPTER 1

Orphans: Node Structure

1.1 Node Hardware

Due to low cost and ease of use, the Arduino platform was selected as the host for the low-level I^2C interface for communication to the Melexis MLX90620 (*Melexis*). Initially, this presented some challenges, as the *Melexis* recommends a power and communication voltage of 2.6V, while the Arduino is only able to output 3.3V and 5V as power, and 5V as communication. Due to this, it was not possible to directly connect the Arduino to the *Melexis*, and similarly due to the two-way nature of the I^2C 2-wire communication protocol, it was also not possible to simply lower the Arduino voltage using simple electrical techniques, as such techniques would interfere with two-way communication.

A solution was found in the form of a I^2C level-shifter, the Adafruit "4-channel I2C-safe Bi-directional Logic Level Converter" [1], which provided a cheap method to bi-directionally communicate between the two devices at their own preferred voltages. The layout of the circuit necessary to link the Arduino and the *Melexis* using this converter can be seen in Figure 1.1 on the following page.

1.2 Node Software

To calculate the final temperature values that the Melexis MLX90620 (*Melexis*) offers, a complex initialisation and computational process must be followed, which is specified in the sensor's datasheet [3]. This process involves initialising the sensor with values attained from a separate on-board I^2C EEPROM, then retrieving a variety of normalisation and adjustment values, along with the raw sensor data, to compute the final temperature result.

The basic algorithm to perform this normalisation was based upon code by users "maxbot", "IIBaboomba", "nseidle" and others on the Arduino Forums [2]

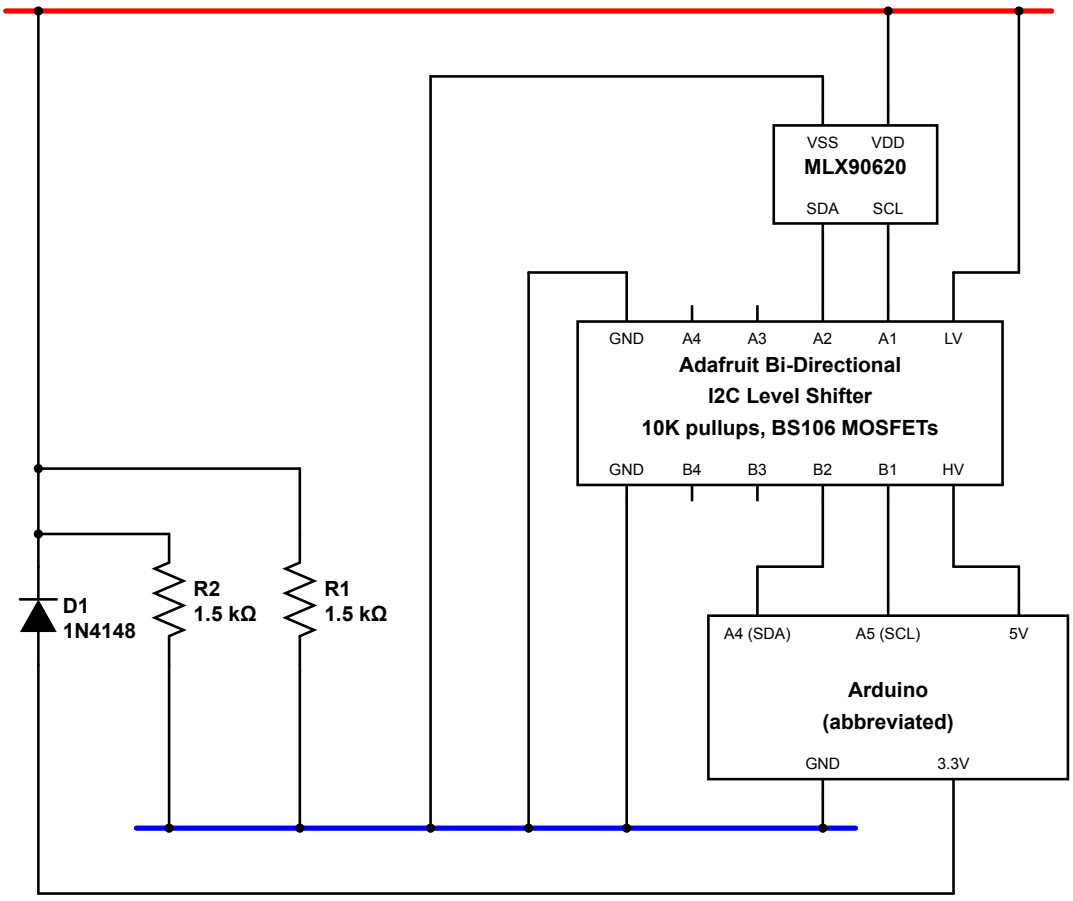


Figure 1.1: MLX90620 and Arduino integration circuit

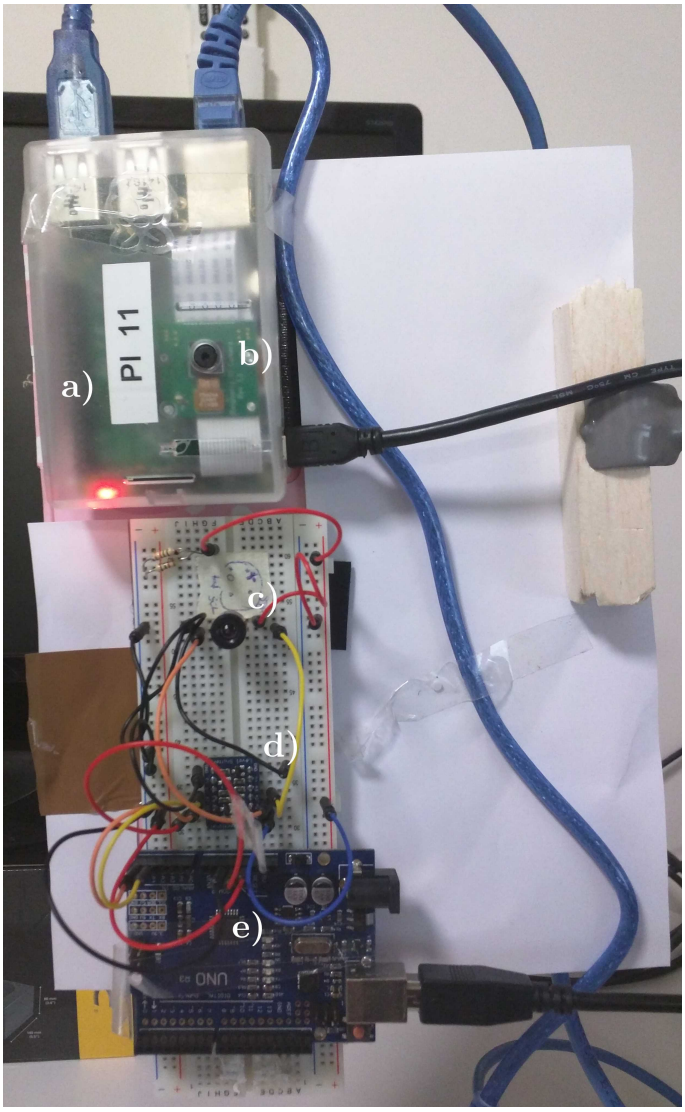
```
INIT 0
INFO START
DRIVER MLX90620
BUILD Feb  1 2015 00:00:00
IRHZ 1
INFO STOP
ACTIVE 33
```

Figure 1.2: Initialisation sequence

```
START 34
MOVEMENT 0
1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
STOP 97
```

Figure 1.3: Thermal data packet

and was modified to operate with the newer Arduino I^2C libraries released since the authors' posts. In pursuit of the project's aims to create a more approachable thermal sensor, the code was also restructured and rewritten with more comments and named constants so that the code is more readily understood and easier to modify for other purposes.



a) Raspberry Pi

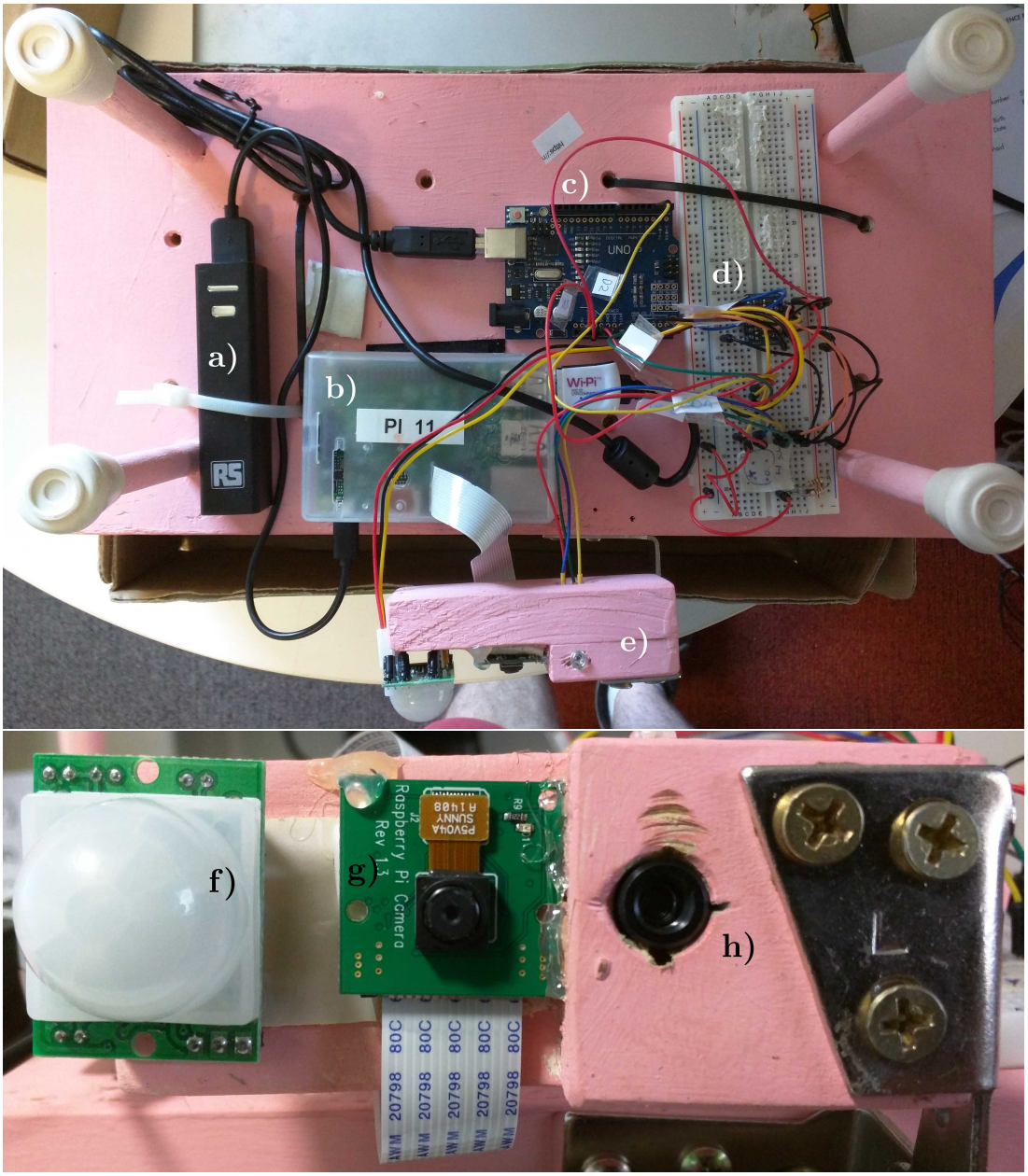
b) Camera

c) *Melexis*

d) Level-shifting circuitry

e) Arduino

Figure 1.4: Prototype A



a) Battery pack

b) Raspberry Pi

c) Arduino

d) Level-shifting circuitry

e) Movable sensor mount

f) PIR

g) Camera

h) *Melexis*

Figure 1.5: Prototype B

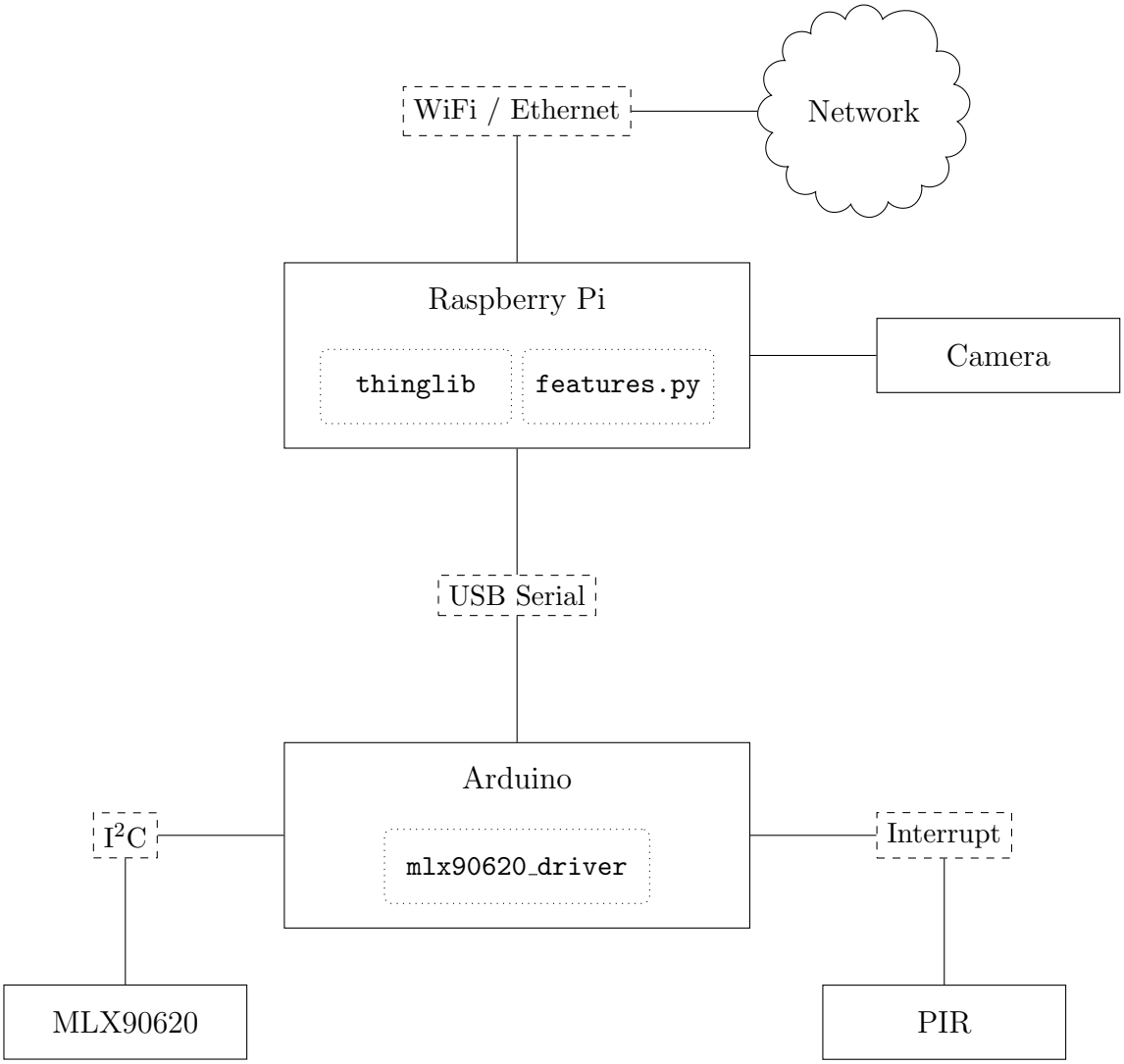


Figure 1.6: Prototype B system architecture

Bibliography

[1] Adafruit. 4-channel I2C-safe bi-directional logic level converter - BSS138 (product ID 757). http://www.adafruit.com/product/757. Accessed: 2015-01-07.

[2] Arduino Forums. Arduino and MLX90620 16X4 pixel IR thermal array. http://forum.arduino.cc/index.php/topic,126244.0.html, 2012. Accessed: 2015-01-07.

[3] Melexis. Datasheet IR thermometer 16X4 sensor array MLX90620. http://www.melexis.com/Asset/Datasheet-IR-thermometer-16X4-sensor-array-MLX90620-DownloadLink-6099.aspx, 2012. Accessed: 2015-01-07.