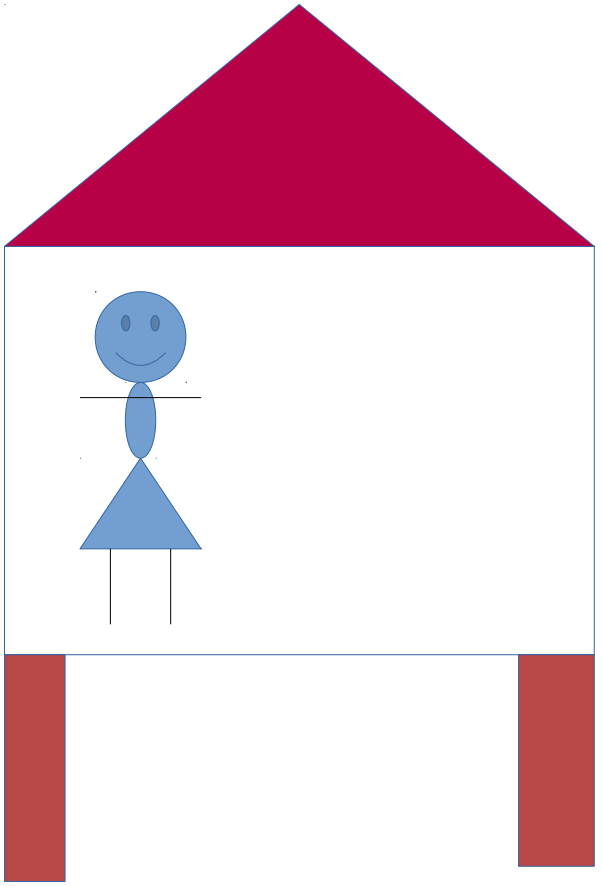
Monitoring Mum

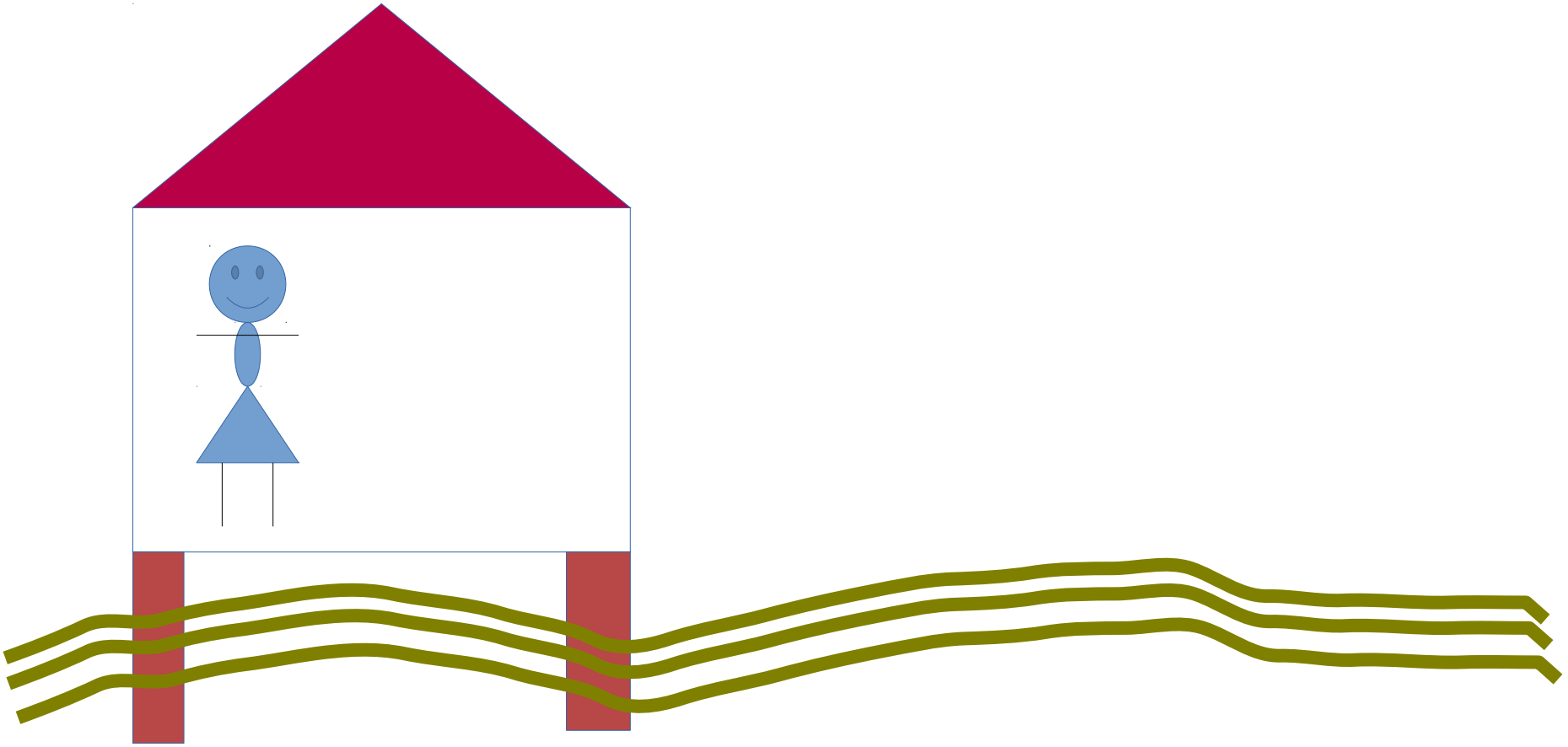
Open-source Telecare

Andrew Findlay
April 2017

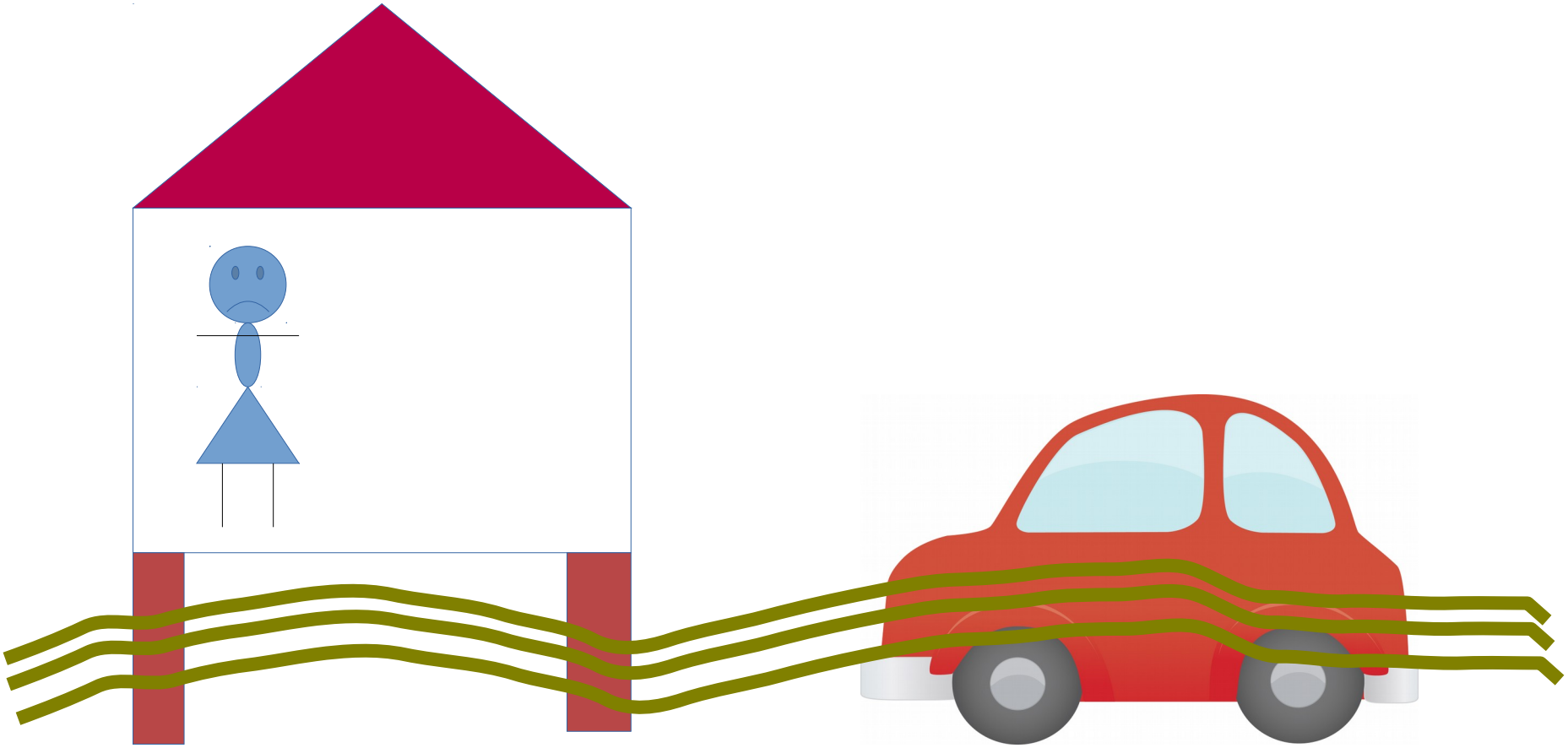
Once upon a time...



We can cope with this

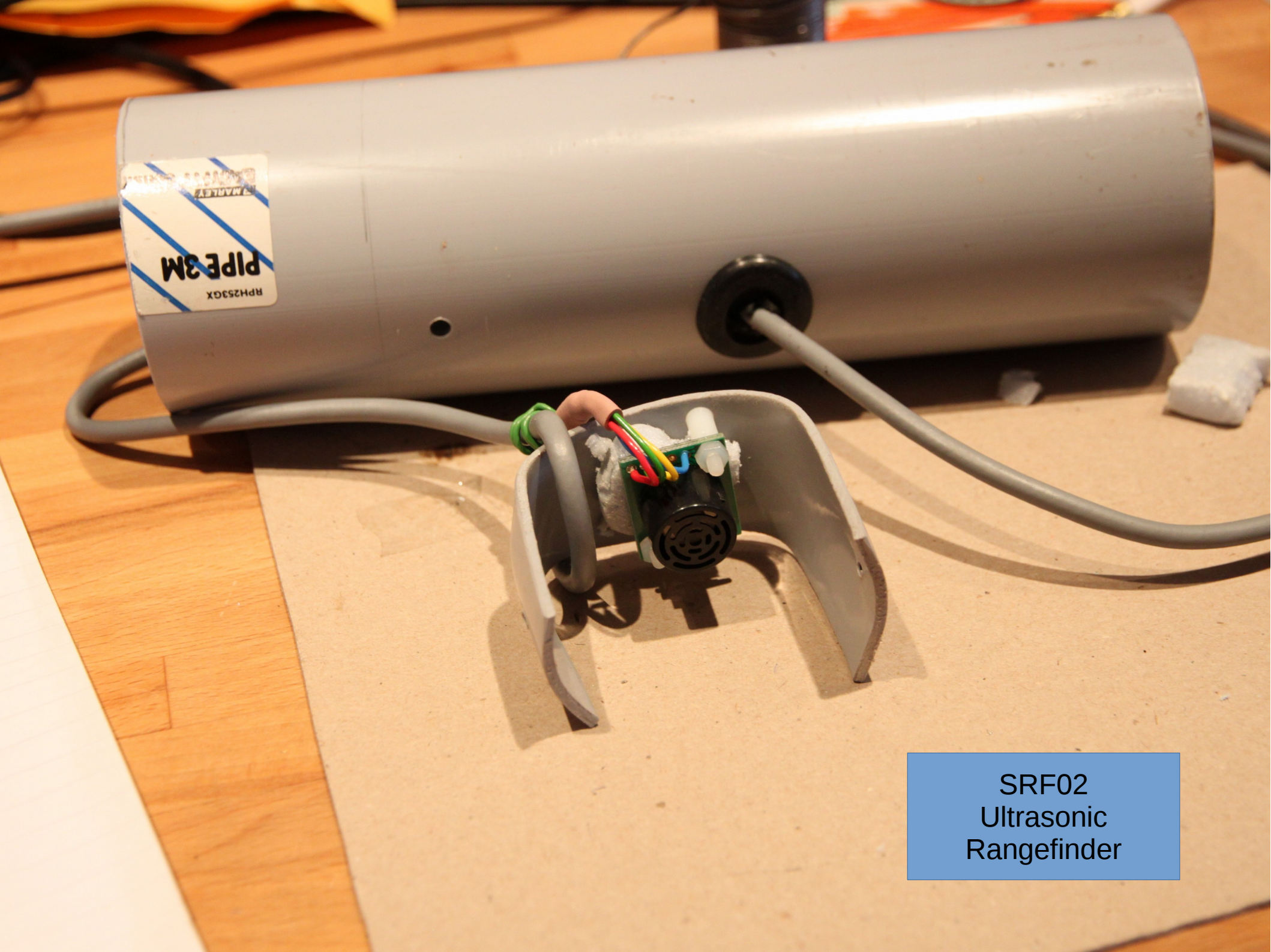


But not this

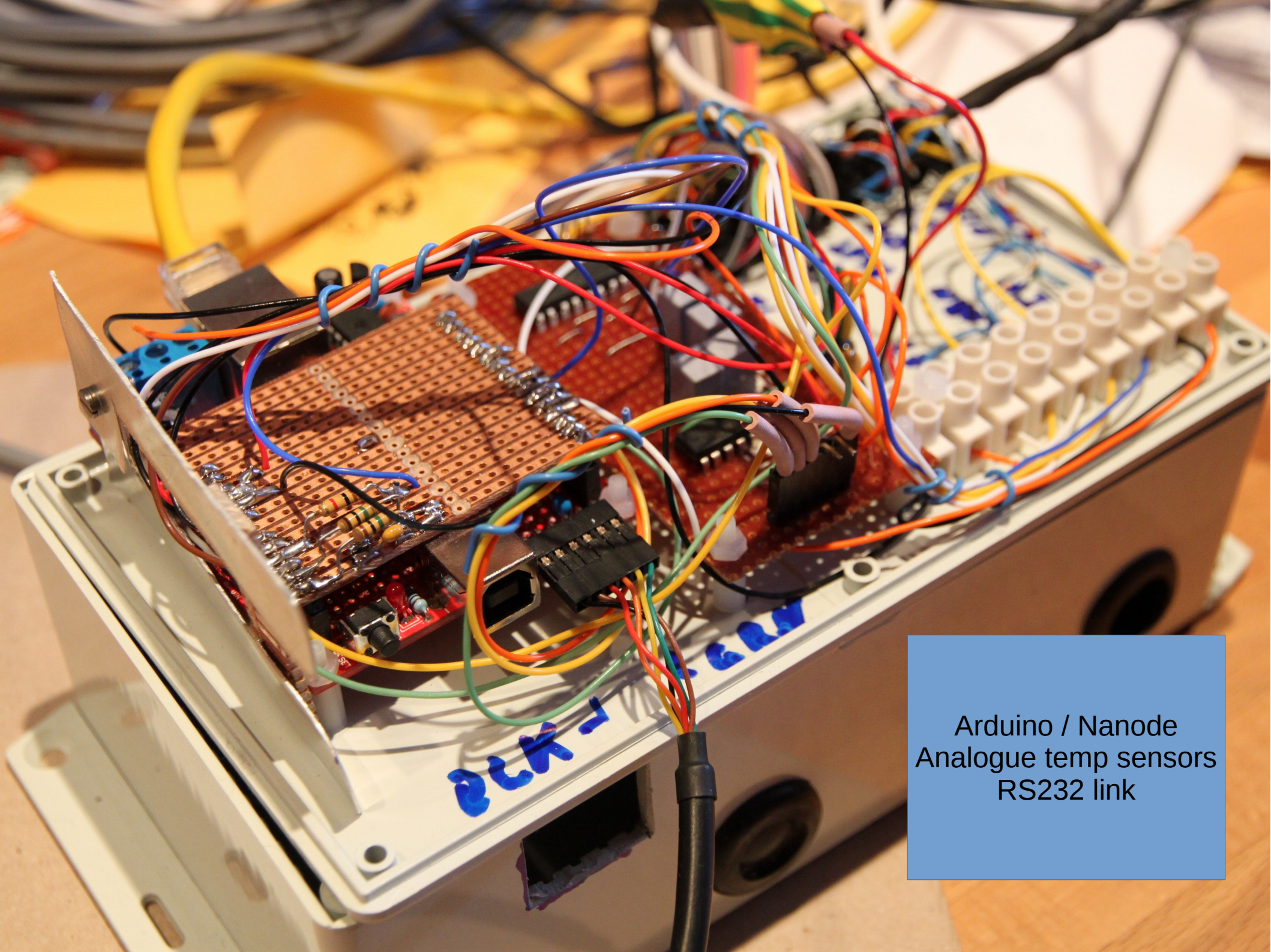


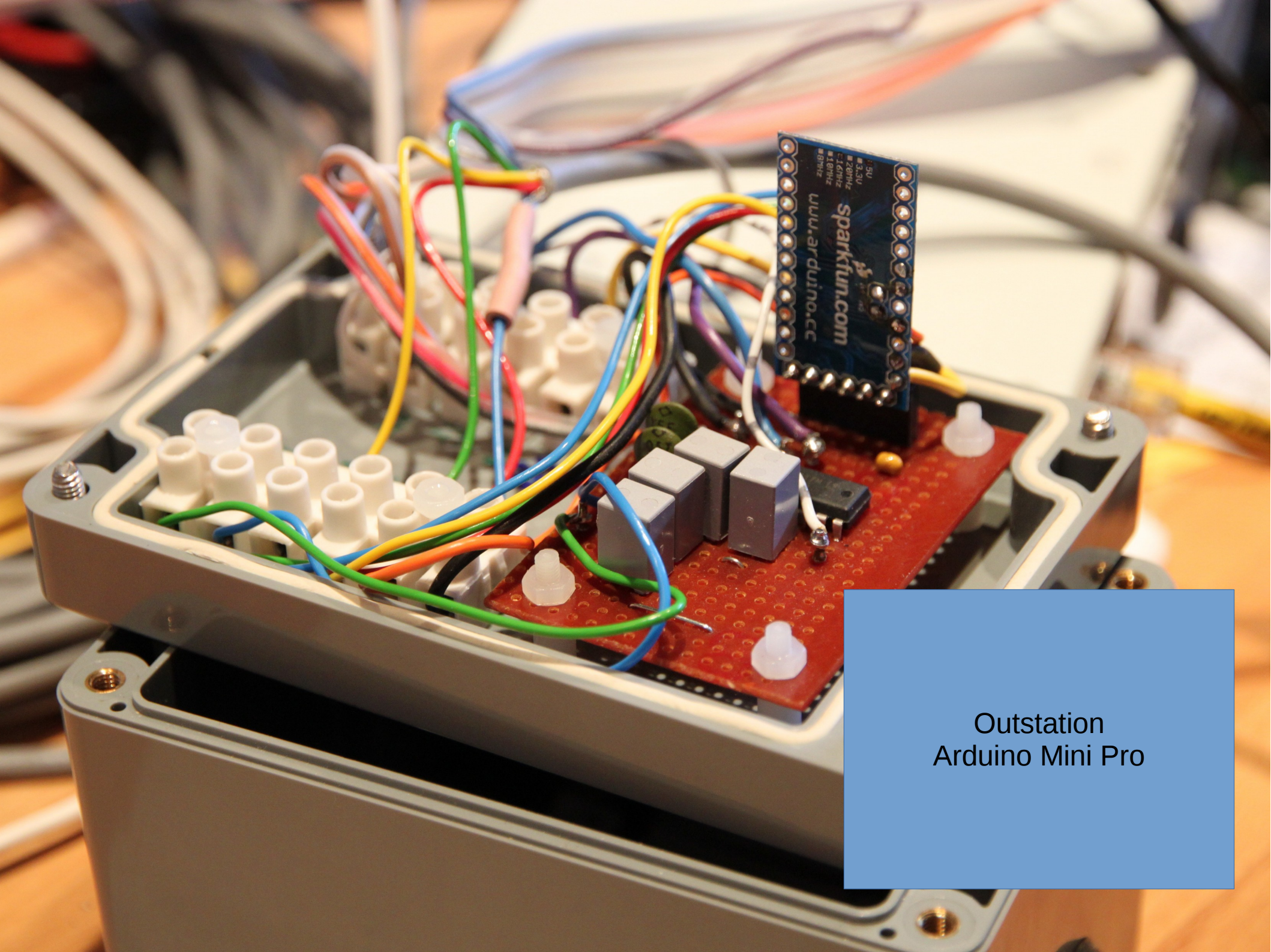
IoT to the rescue

- Monitor the river
- Monitor the mother
- Raise the alarm
- Keep the trend data



SRF02
Ultrasonic
Rangefinder

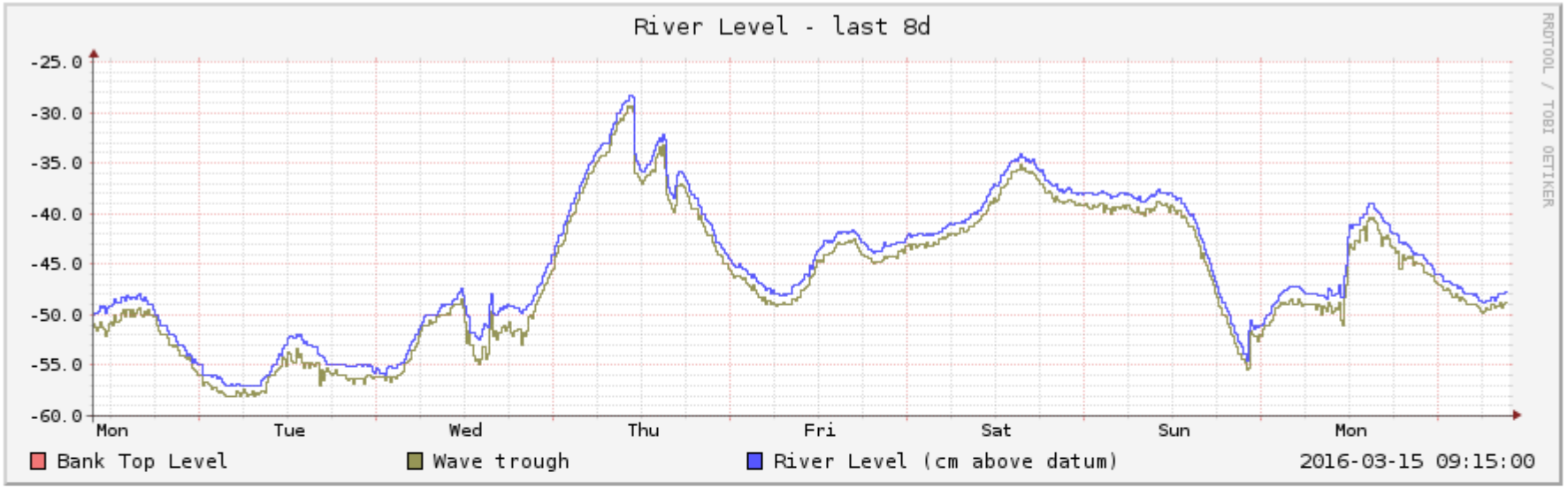

Arduino / Nanode
Analogue temp sensors
RS232 link

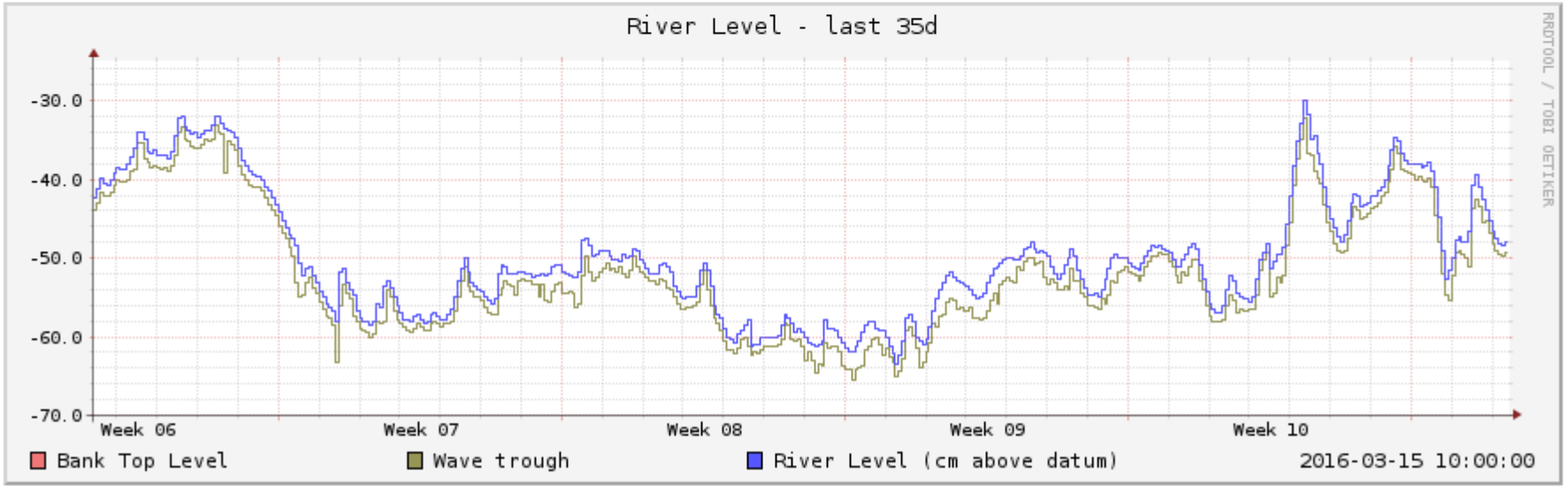

Outstation
Arduino Mini Pro

Other bits

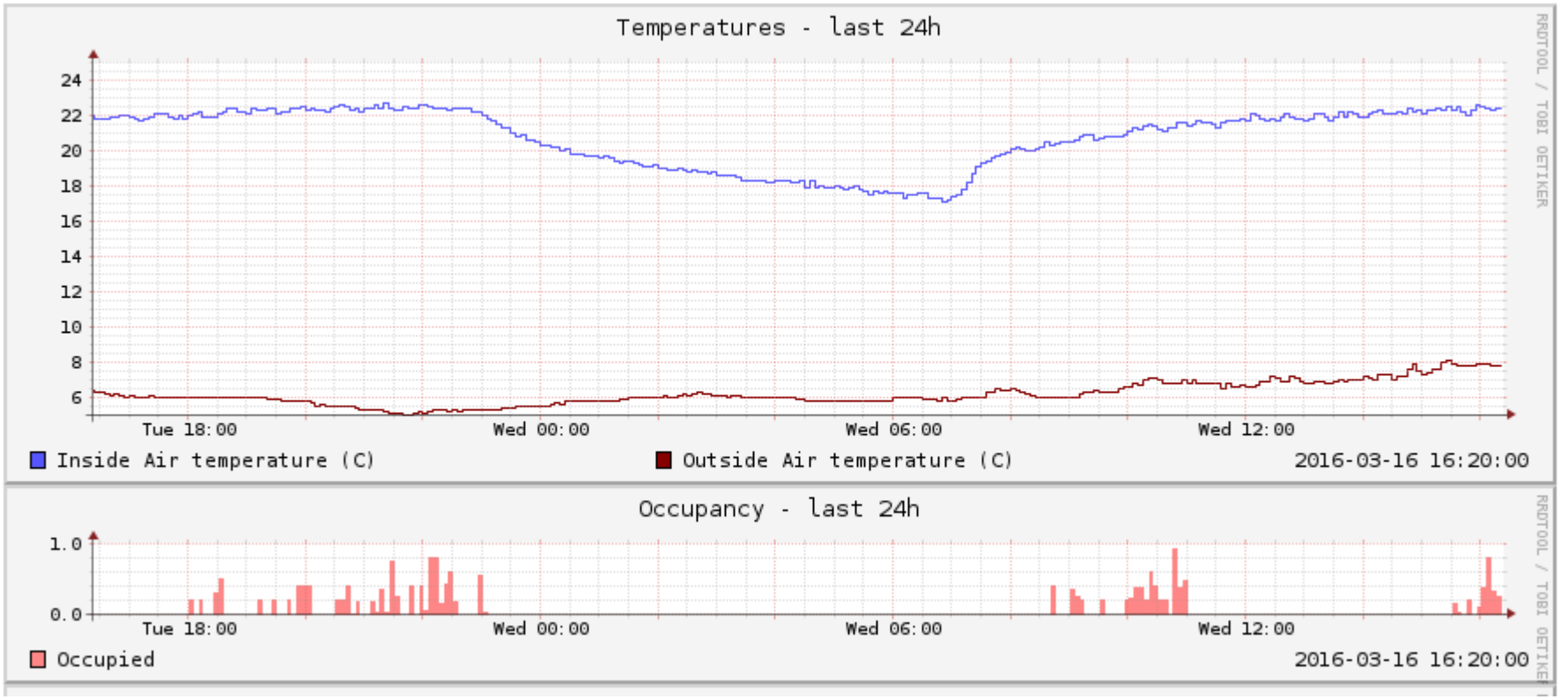
- Linux webserver
- Arduino IDE
- RRDTool
- Movement sensors

Web page for the river

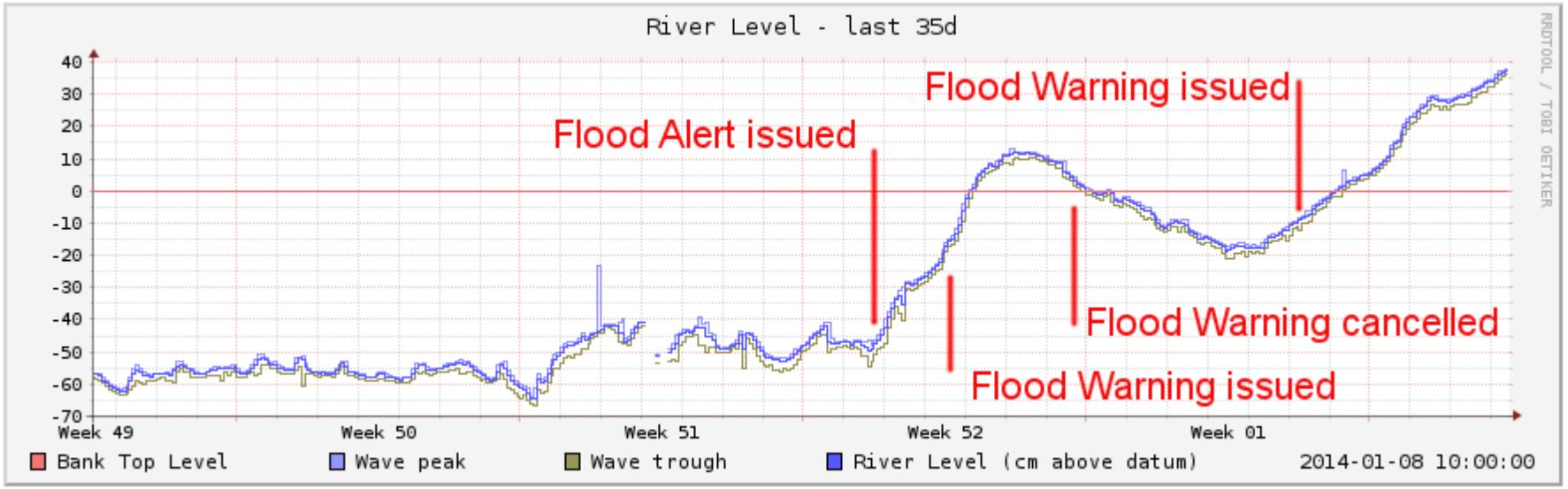




Web page for Mum

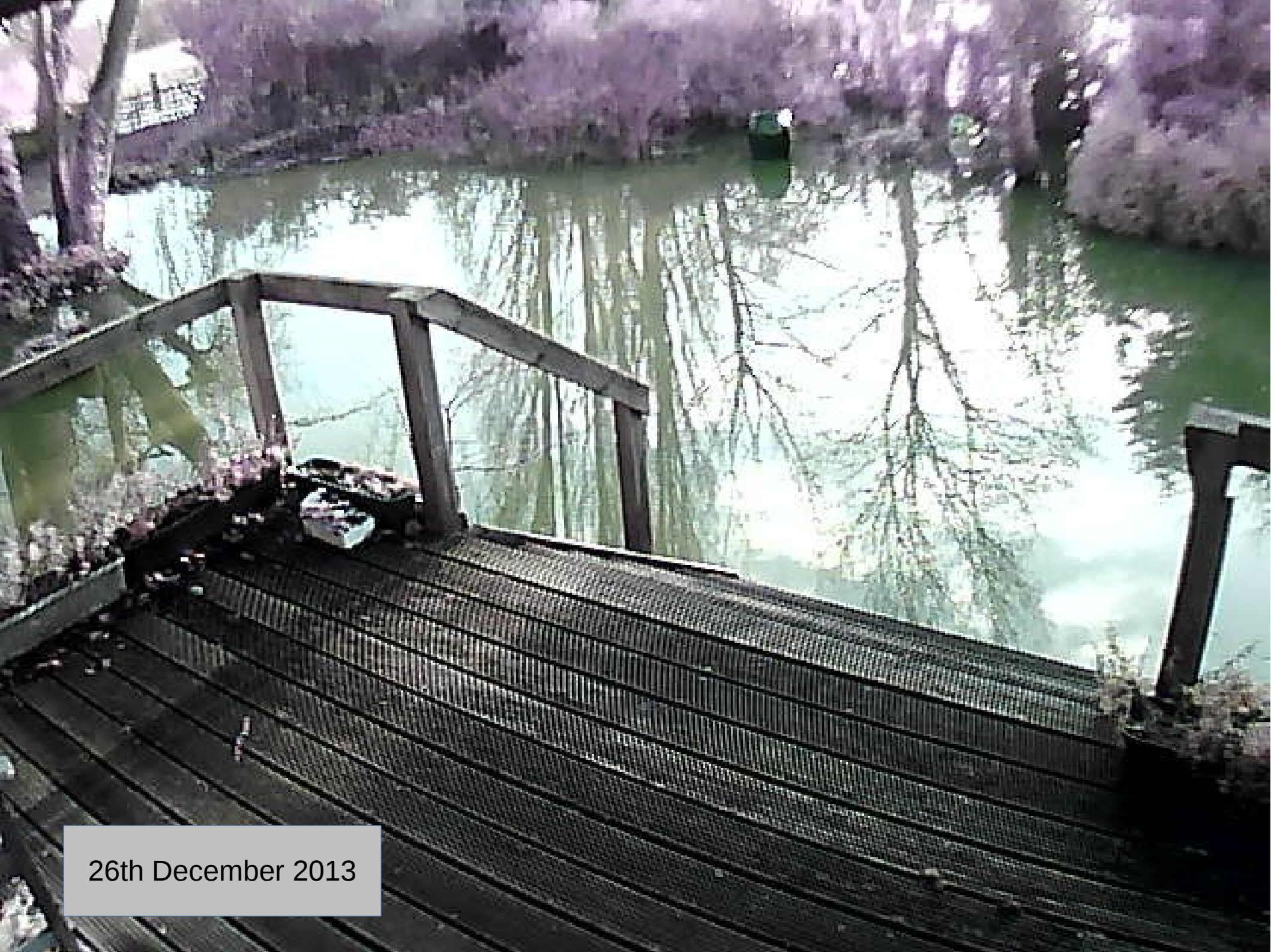


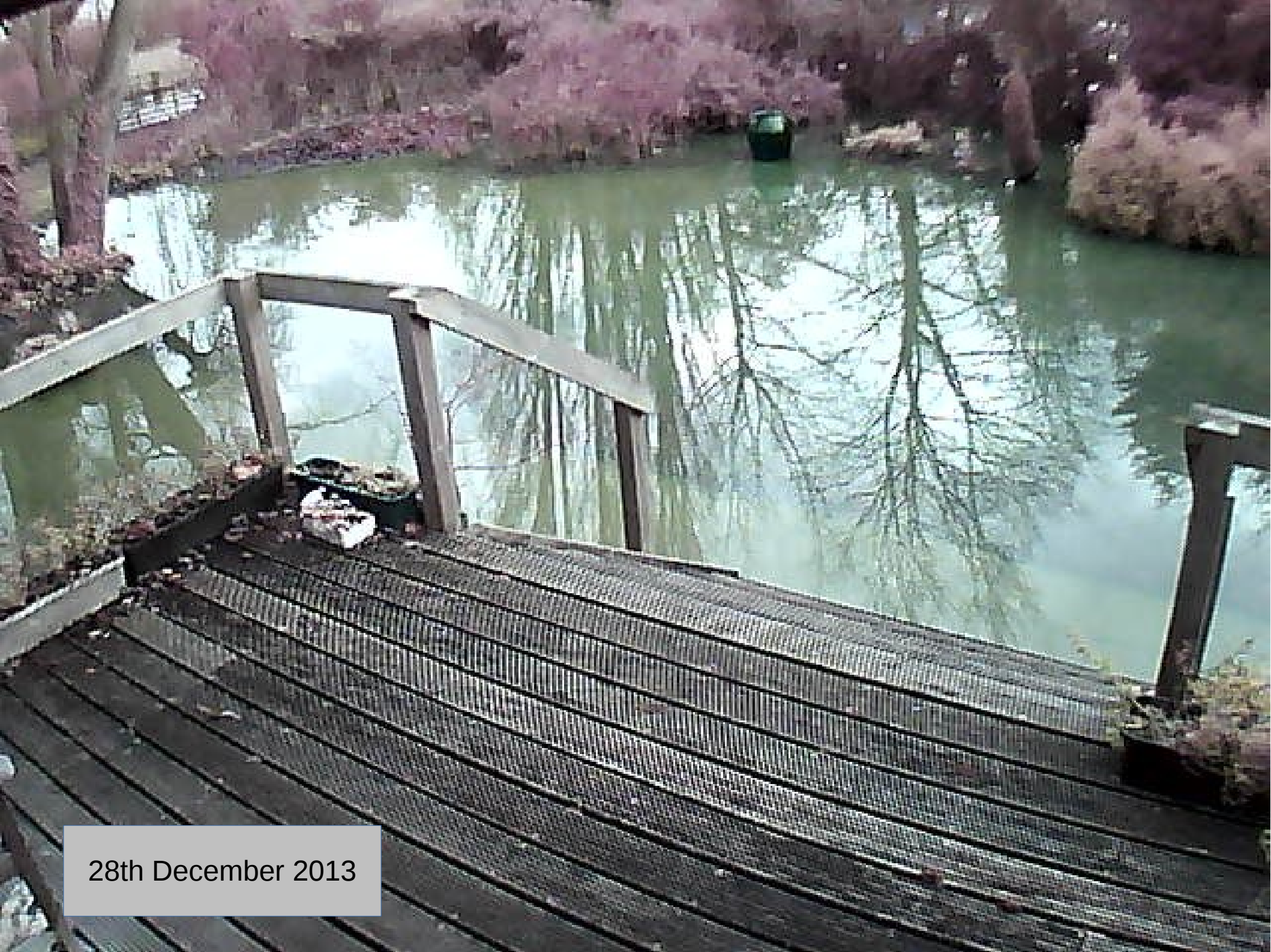
December 2013




24th December 2013


25th December 2013


26th December 2013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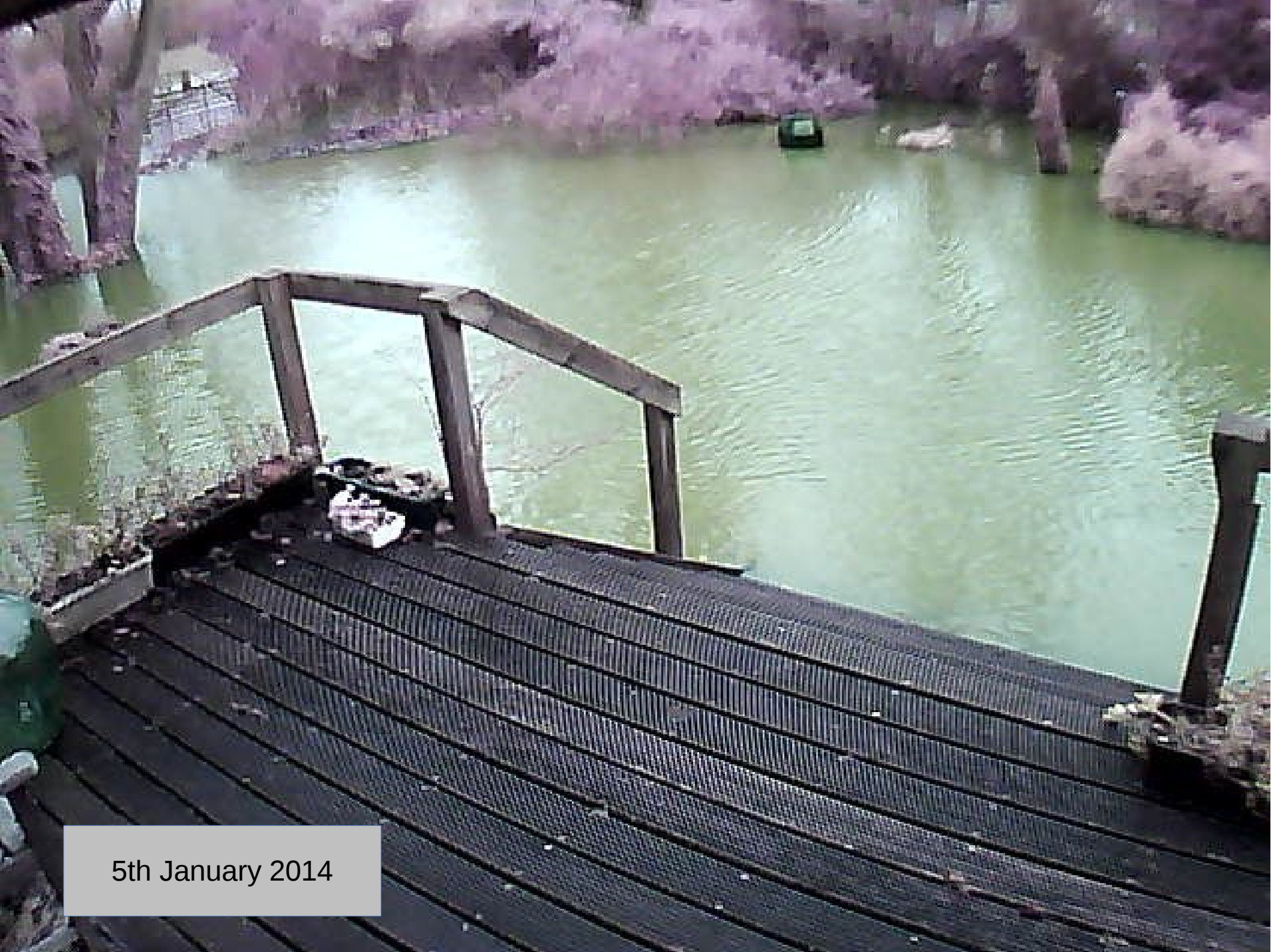
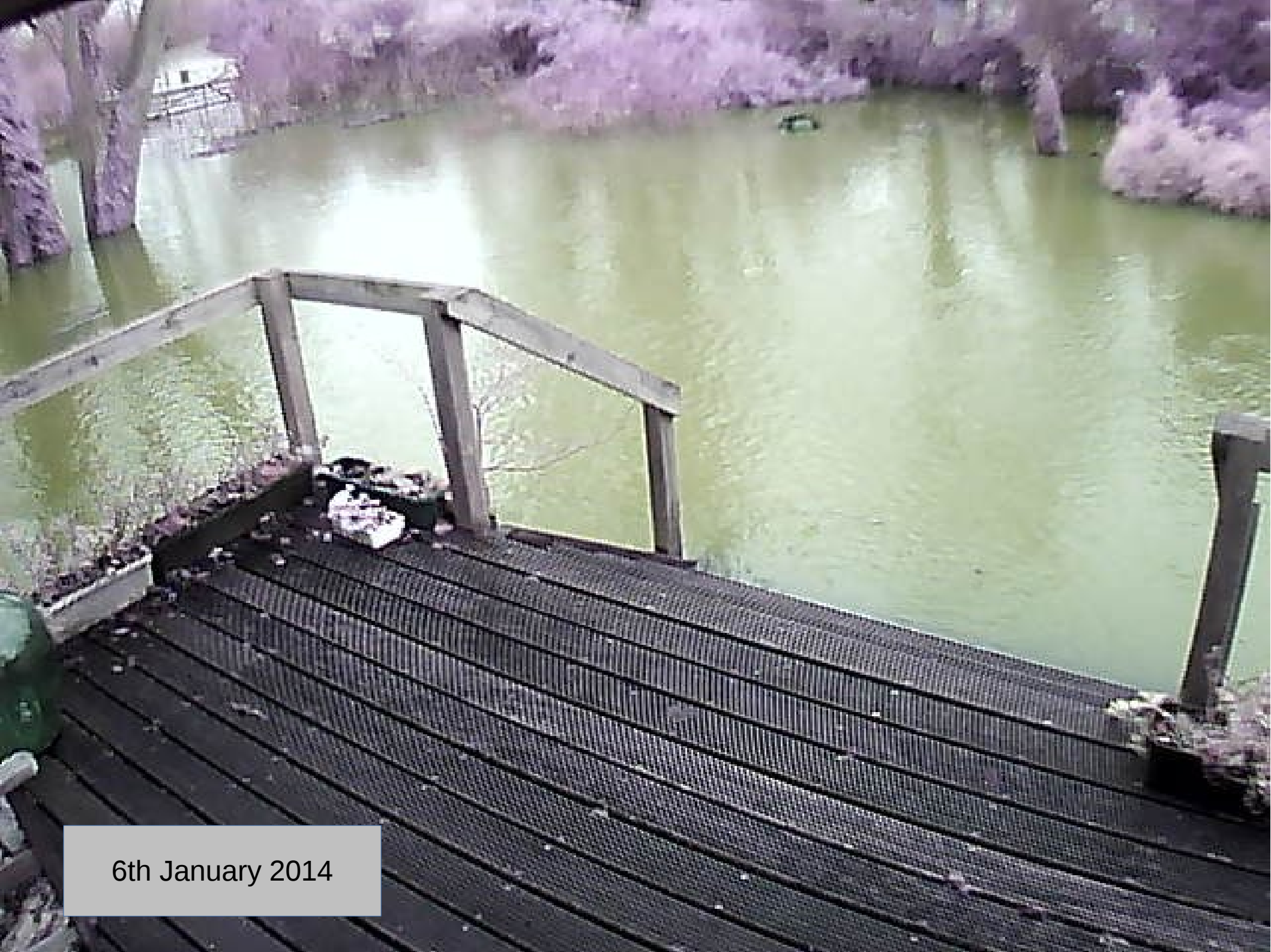


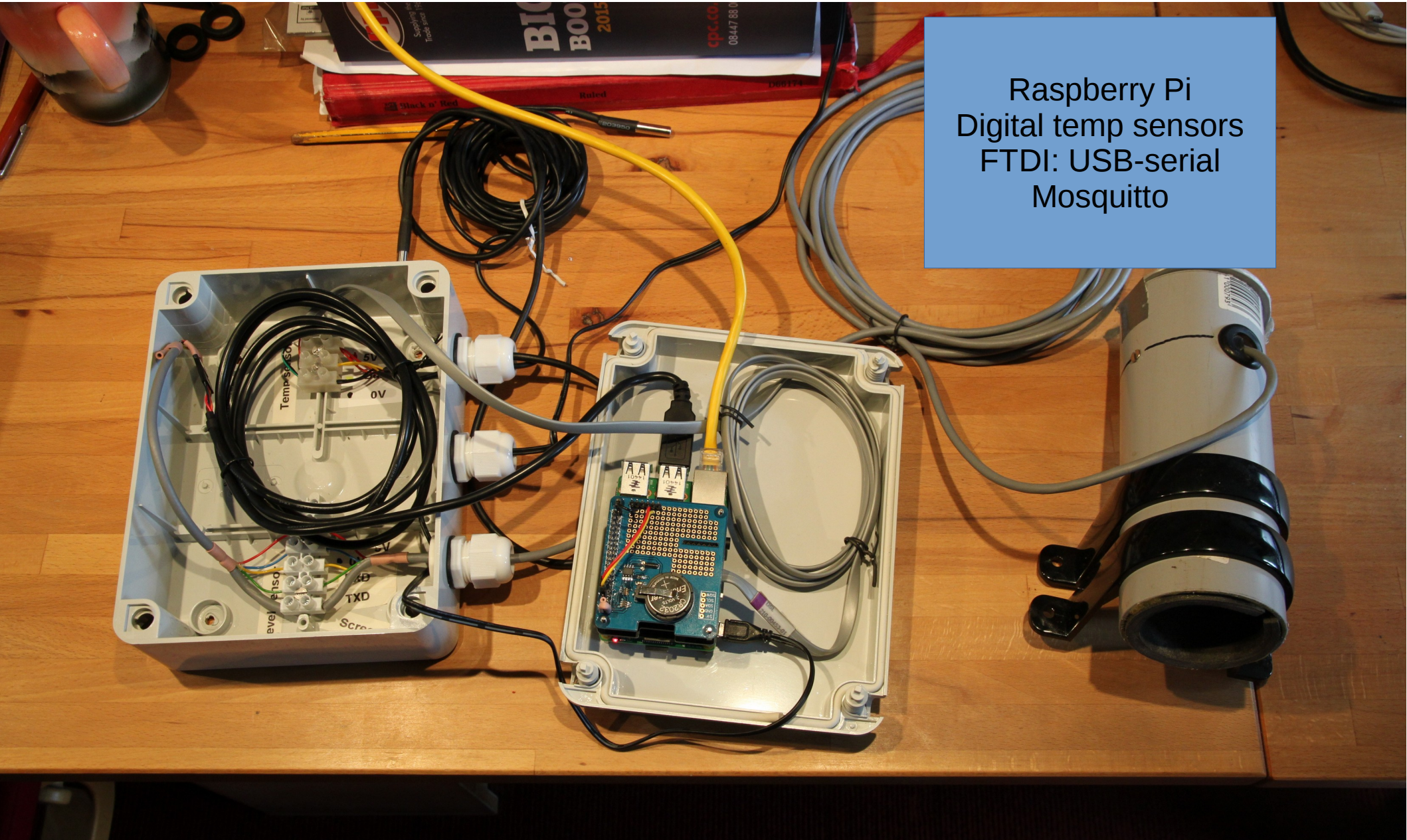
5th January 2014


6th January 2014


7th January 2014

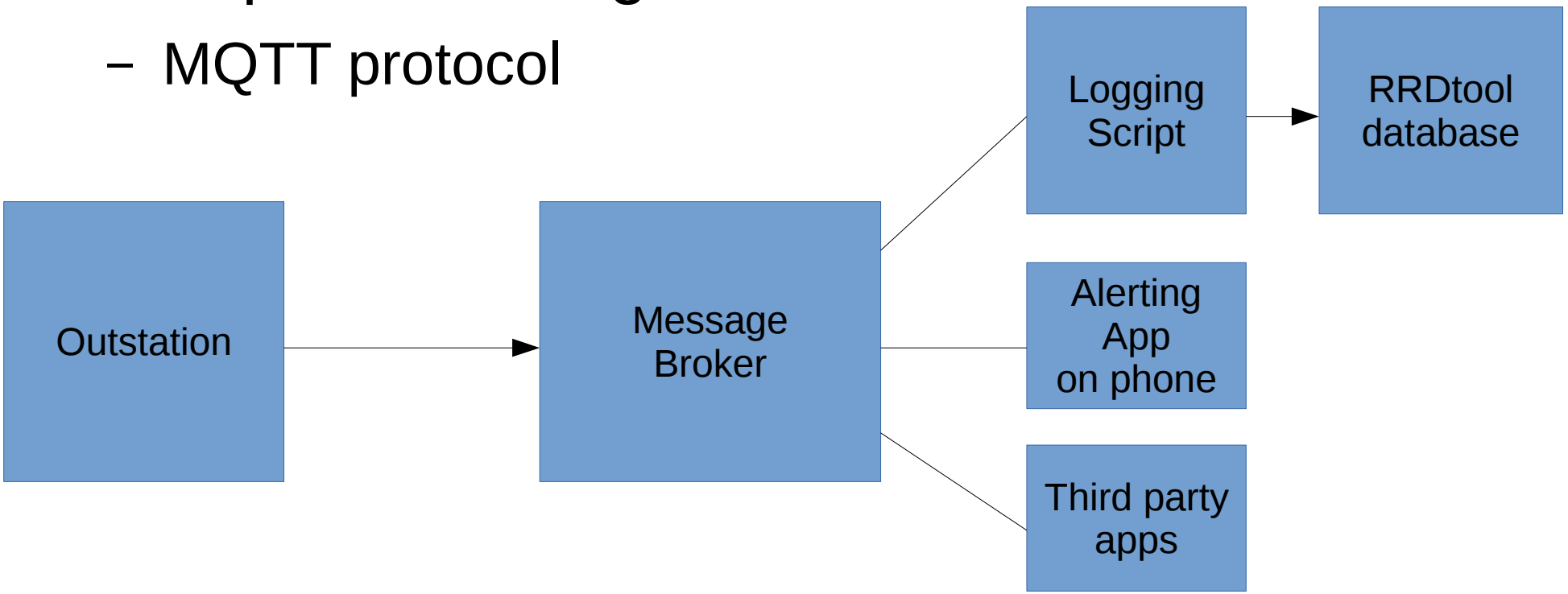
8th January 2014

Datalogger Version 2



Publishing live data

- Message Queues
  - Publish/Subscribe model
  - Allows multiple consumers to use the data
- Mosquitto message broker
  - MQTT protocol



MQTT: Topic and Data

Topic	Data
sensor/thames1/temp/air	11.5
sensor/thames1/temp/river	11.75
sensor/thames1/level/river	{ "count" : 10, "max" : -55, "time" : 1493046748, "mean" : -55, "min" : -56 }
sensor/loddon1/temp/air	12.5

We have data

- dl1.findlays.net
- River data is public – Oct 2012 onwards
- House data protected by ACLs
- Achievements
  - Detected several heating failures
  - Helped to get mother out before some floods
  - Provided data series for heat-pump project planning at Henley Management College

Mother is getting older

- More forgetful
  - Sometimes forgets to eat
  - Family worry more about falls
  - Family worry more about cooking accidents
  - Family worry more about unscrupulous visitors and phone-calls
  - Refuses to carry phone or panic button
- Mother is not worried at all!
  - *We* need reassurance that she remains safe...
  - Resist pressure to move her to 'a home'

Fix the phone

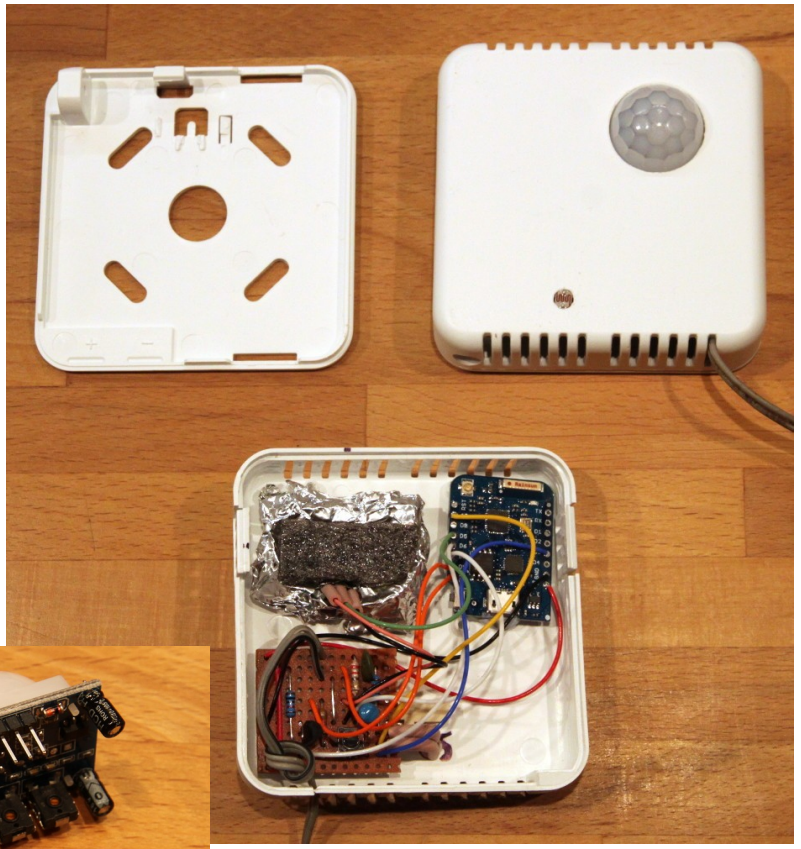
- Commercial product: TrueCall Care
  - Fit between master socket and house phones
  - Transparent to calls from registered numbers
  - Can intercept or block calls by rule
  - Optional Web-based management service
  - Downloads numbers and rules each night using dial-up modem

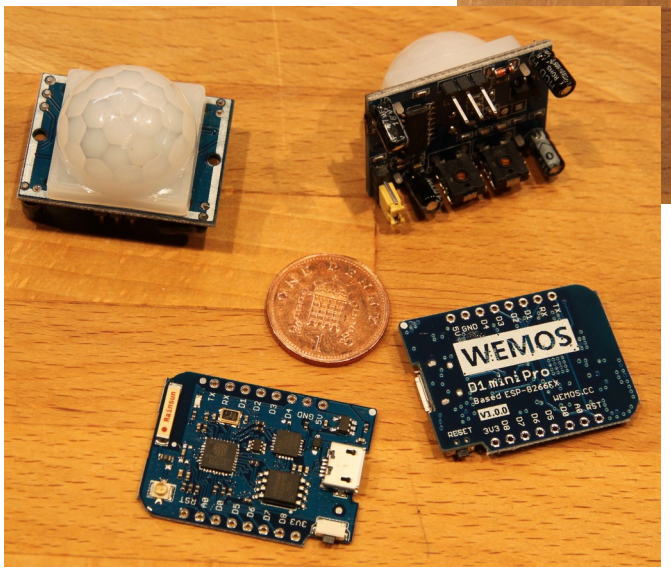
Improve in-home monitoring

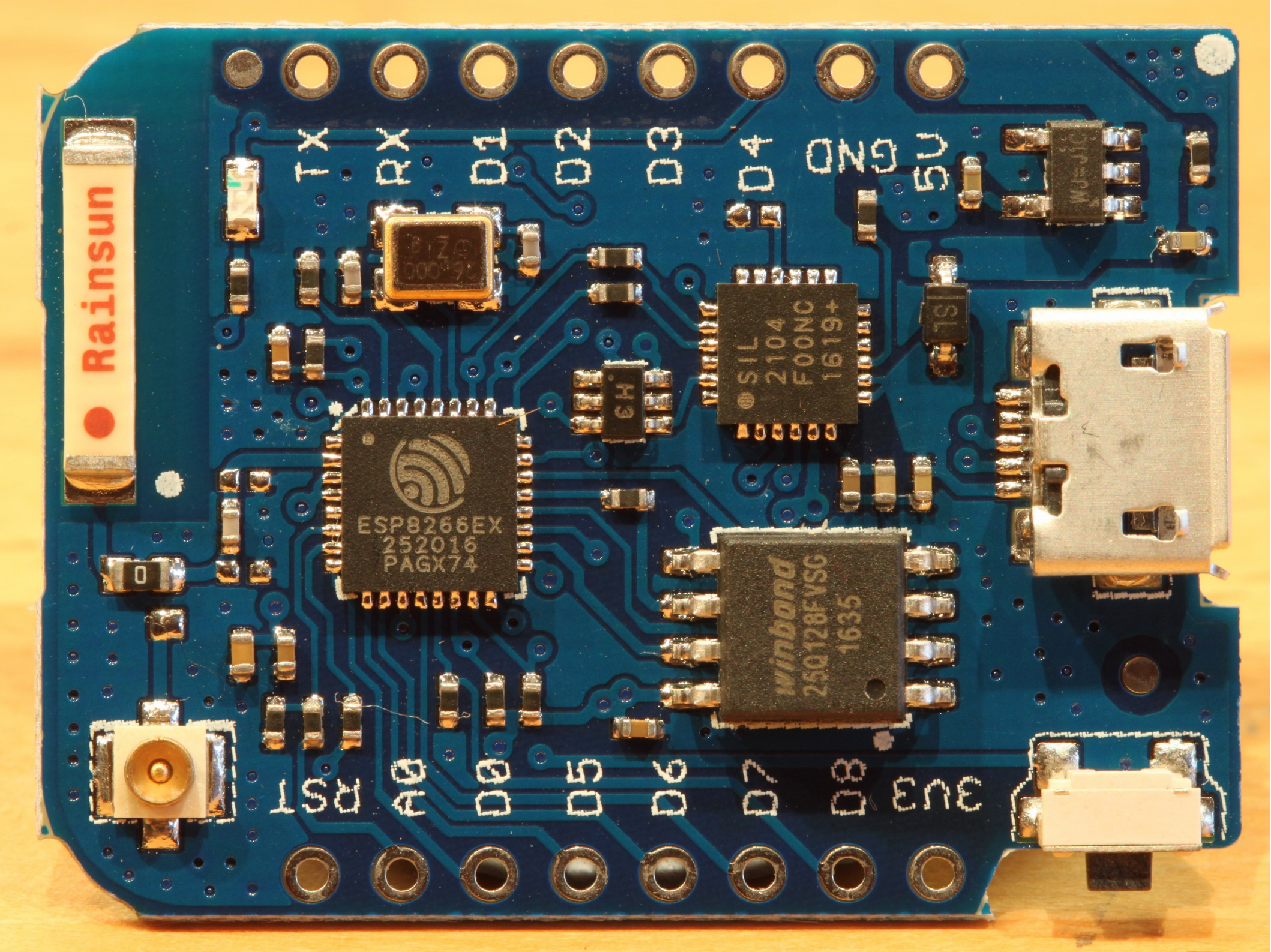
- Cameras too intrusive, and cannot give alerts
- Cannot ask mother to carry any devices
- Lots of people need this, so:
  - Open Source / Open Hardware project
  - Design as a product
  - Design for easy installation (wire free)
  - Consider security and privacy from the start
  - Alerting is complex: can we harness AI?
  - Most homes will need a lot of sensors

Room-node

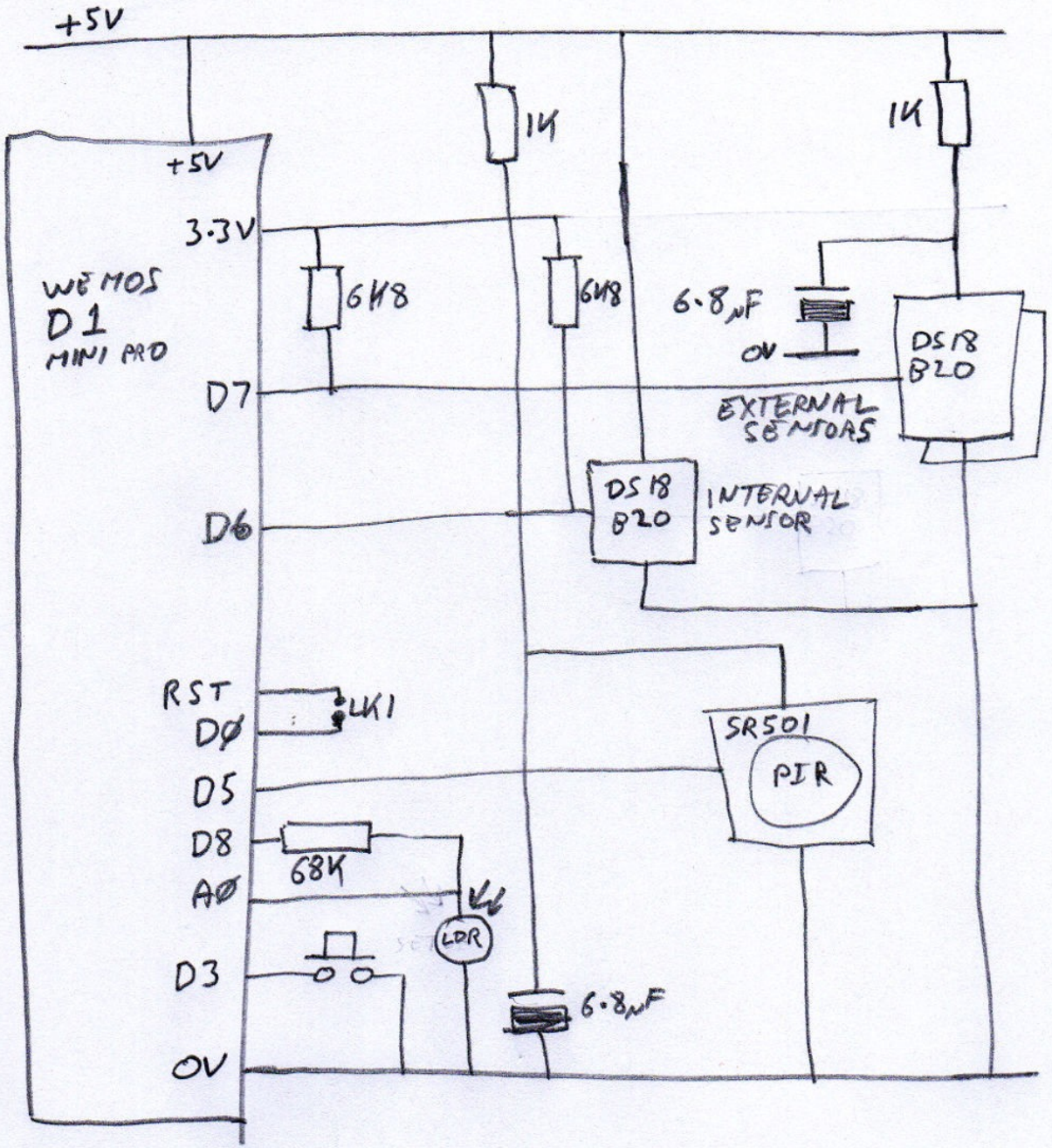
- Temperature
- Movement
- Light level
- Prototype using WiFi
- ESP8266 chip
- WeMOS D1
- Needs mains...
- ZigBee?






Rainsun
TX RX D1 D2 D3 D4 GND 5V
ESP8266EX
252016
PAGX74
SIL
2104
F00NC
1619+
winbond
25Q128FVSG
1635
RST A0 D0 D5 D6 D7 D8 3V3

MONITORING MUM ROOMNODE (WIFI)



Homie

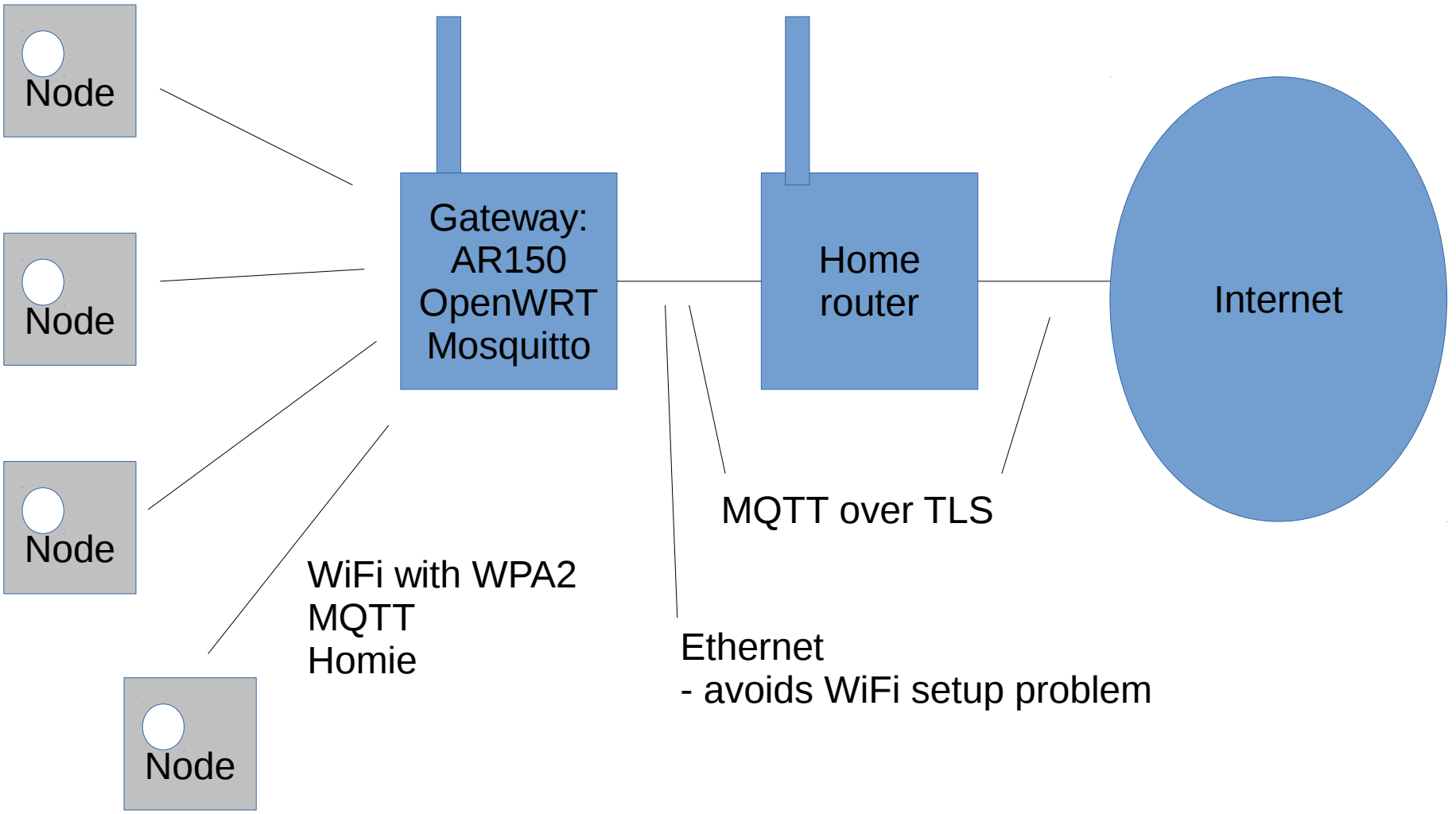
- IoT framework using MQTT
- Unconfigured node runs a WiFi access point
- Send messages on event or on timer
- Auto sends housekeeping data
  - Software version
  - Signal level
  - Uptime
- Accepts command messages
- Supports over-the-air software update

```
void loopHandler() {
  unsigned long now = millis();

  // Start temperature conversion
  if (!thermoConverting && (now - lastTemperatureSent >=
                                          temperatureInterval)) {
      // We need to request a conversion
      internalSensors.requestTemperatures();
      thermoConverting = true;
      // DS18B20 does 12-bit conversion in 750ms so give it 1000ms
      thermoReadyAt = now + 1000UL;
   }

  // Read temperature
  if (thermoConverting && (now > thermoReadyAt)) {
    thermoConverting = false;
    // Read the temperature
    float internalTemperature = internalSensors.getTempCByIndex(0);
    // Send the temperature
    temperatureNode.setProperty("internal").send(
                                      String(internalTemperature) );
    // Record the time
    lastTemperatureSent = now;
  }
}
```

In-home segment

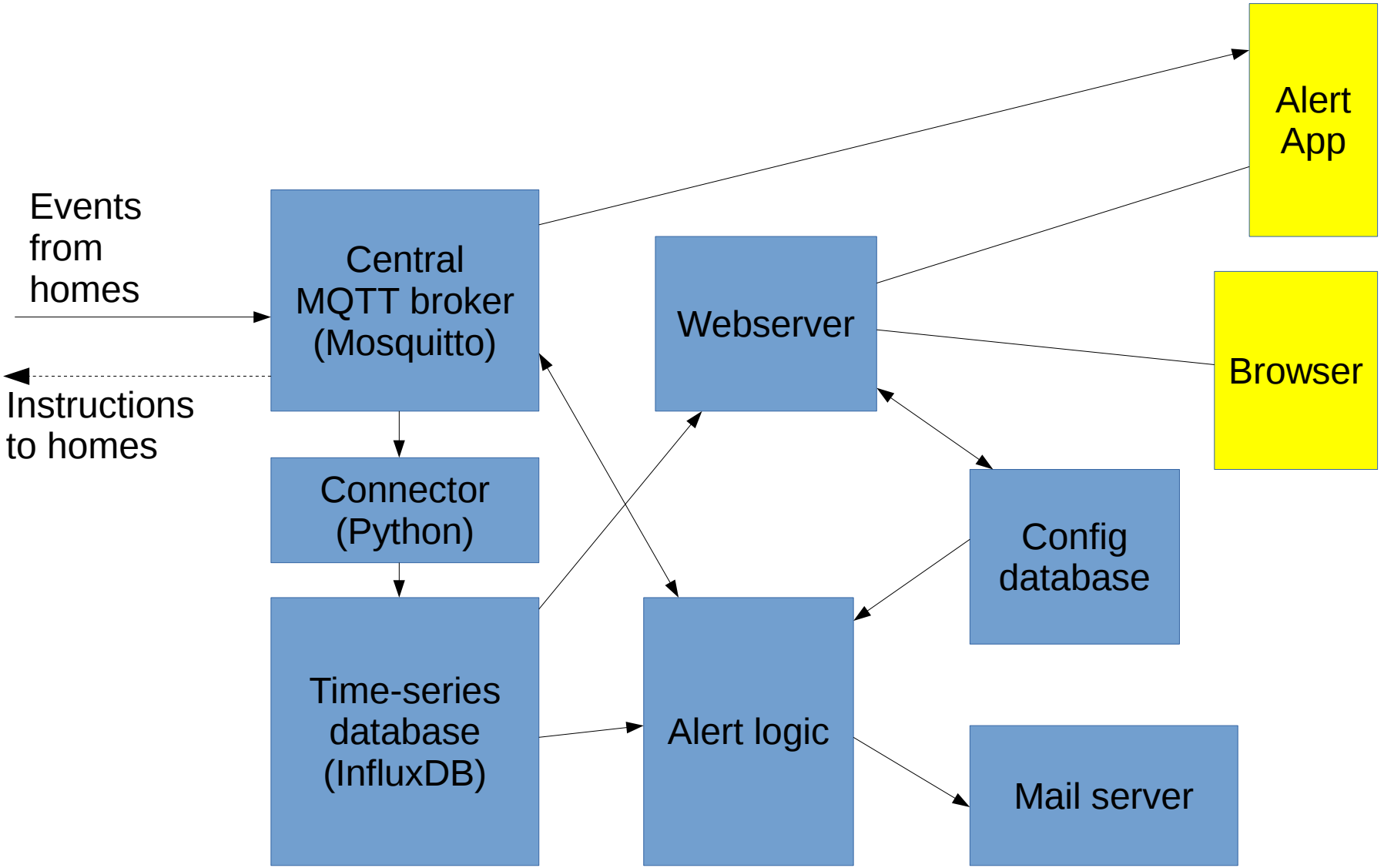


Messages from Room-nodes

- Topic names: mm/<location>/<node-ID>/<item>

mm/granny90/2c19e0ef/$stats/signal	16
mm/granny90/2c19e0ef/$stats/uptime	176409
mm/granny90/2c19e0ef/movement/recent	false
mm/granny90/2c19e0ef/temperature/internal	17.12
mm/granny90/1925b6ef/light/level	19
mm/granny90/2c198eef/$fw/checksum	8731773548473 4f90d14f2f208e8d1a0

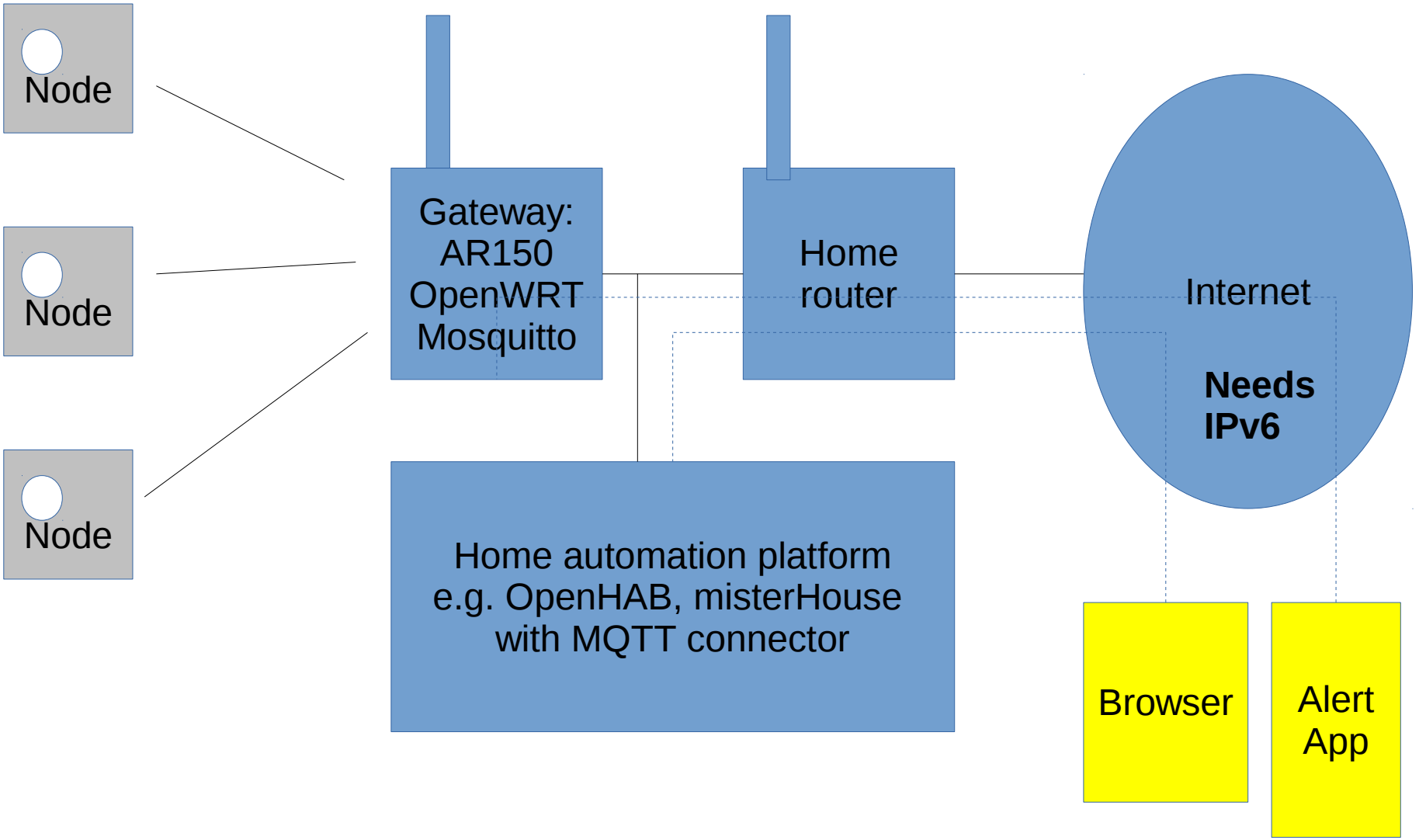
Shared server segment



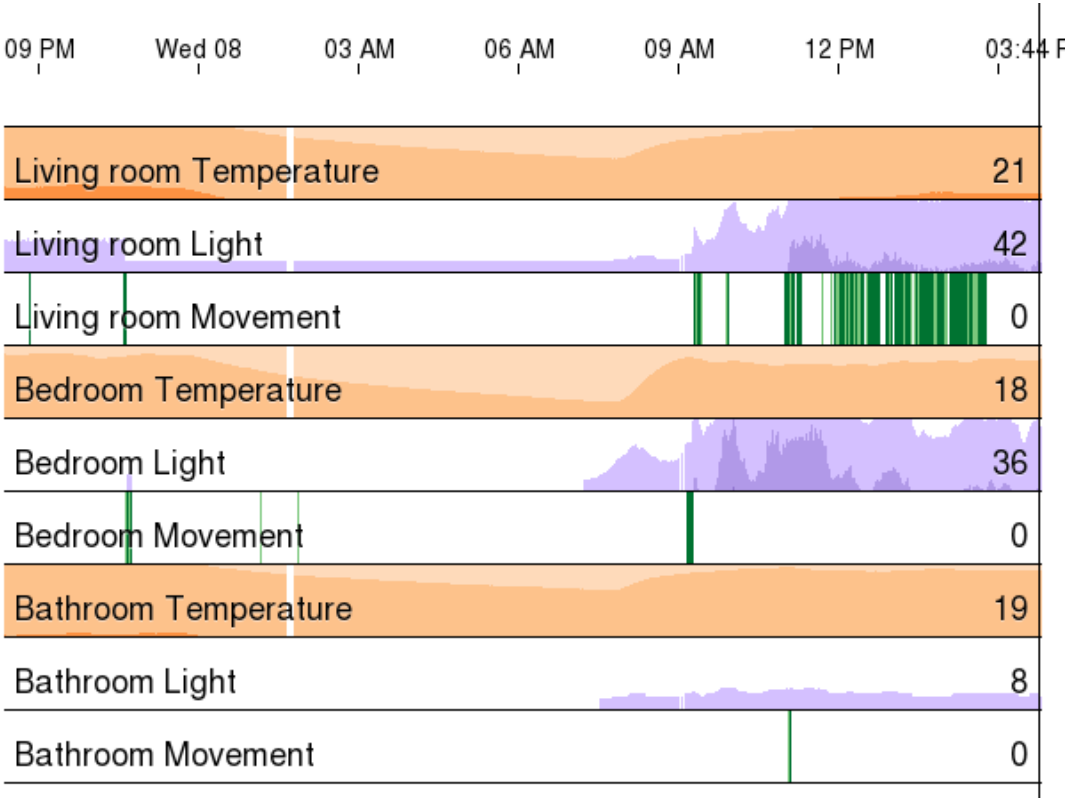
Buy it in a shop?

- Box containing gateway and a few sensors
  - Radios and security already configured
  - All open-source so can be re-flashed if desired
- Subscribe to a monitoring service (or build one)
  - Establish connection and trust with gateway
- Securely introduce more sensors if needed
- Securely exclude suspect nodes

Completely in-home variant



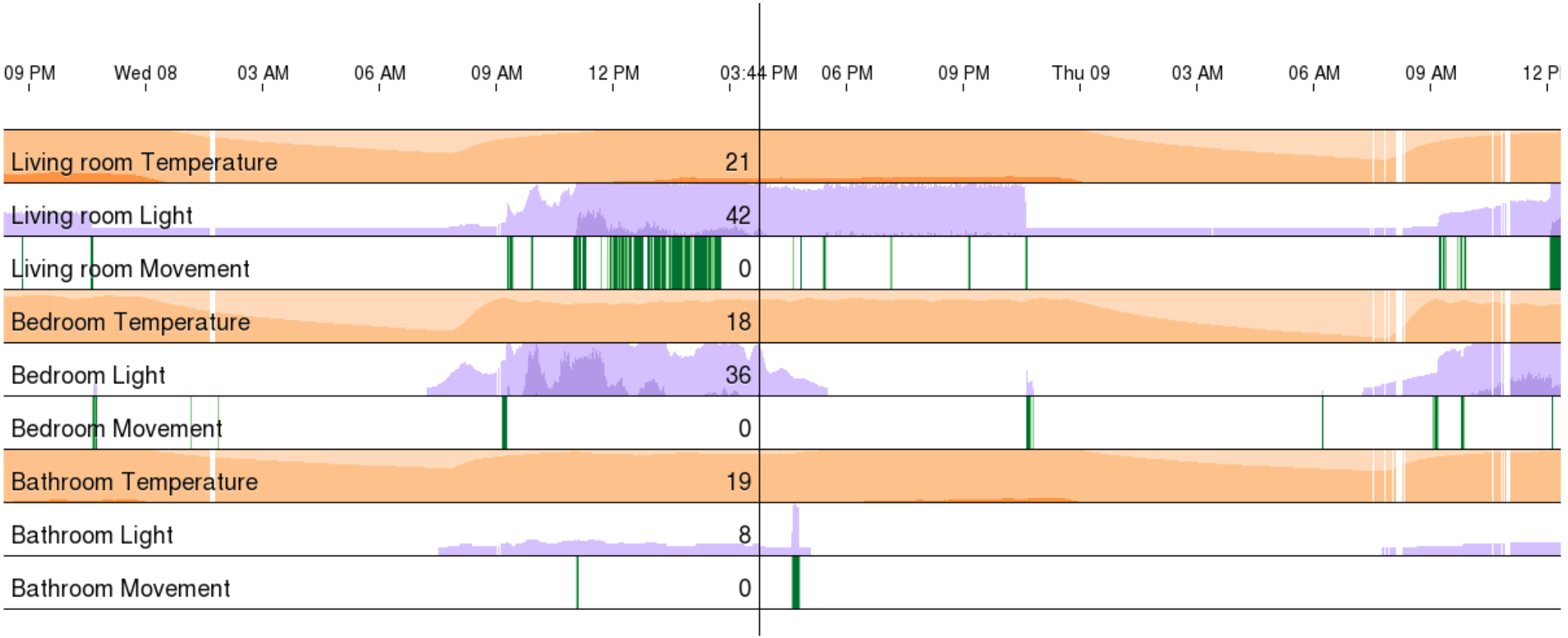
Display: horizon graphs



- Compress Y axis by using colour to indicate wraparound
- Scan cursor with mouse to read values

Display: OpenHab

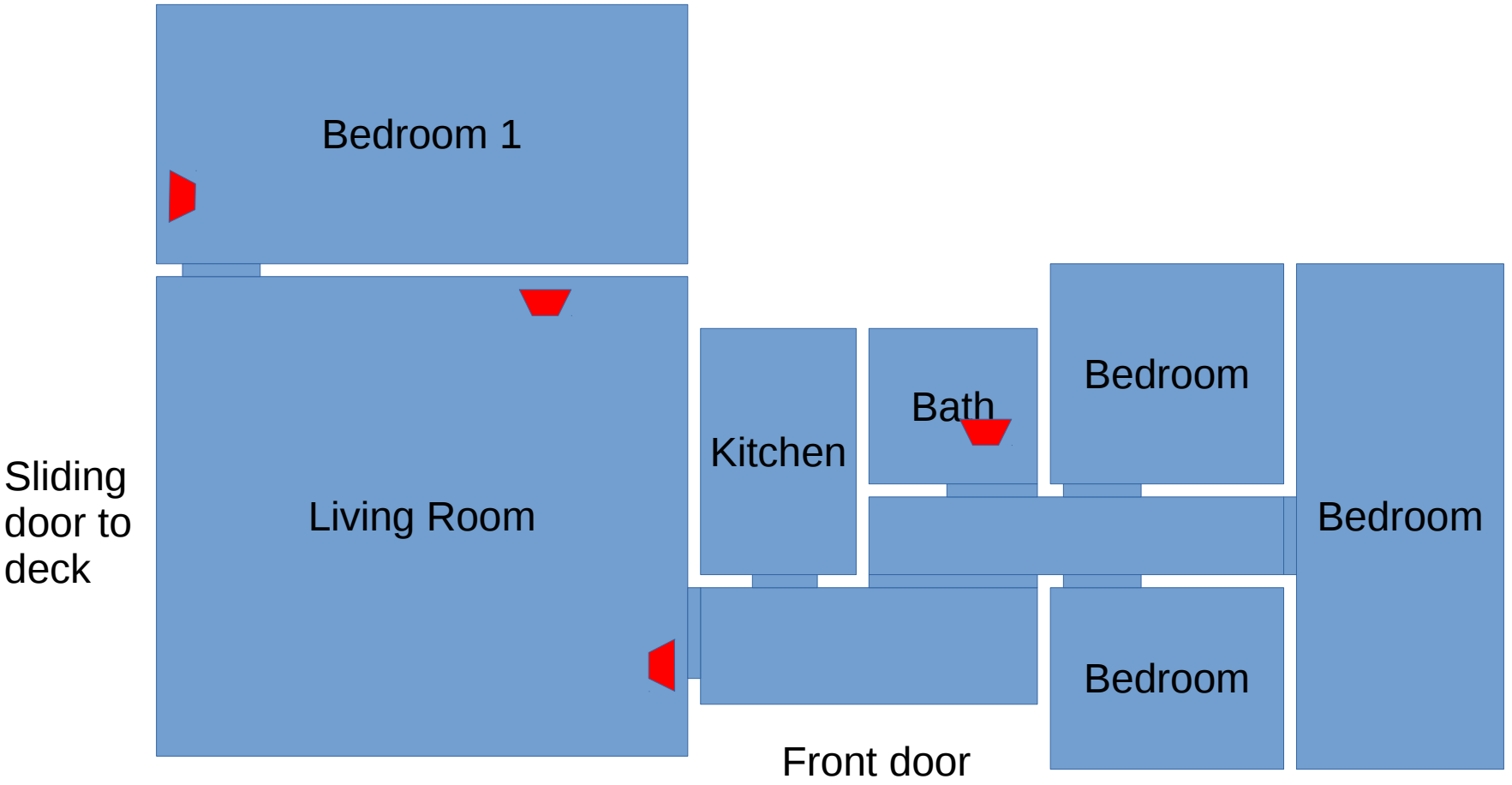
What can we learn?



Alerting Rules

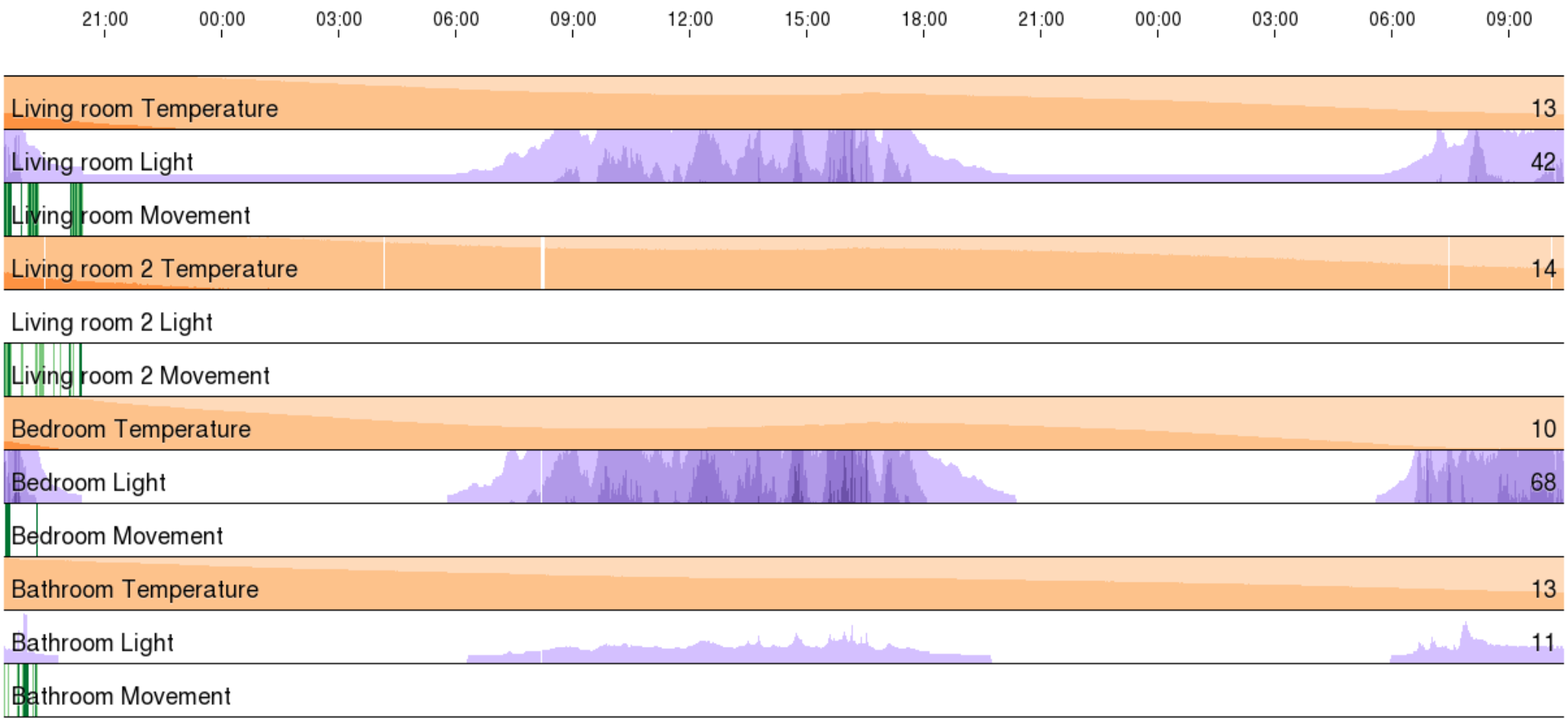
- House too cold or too hot
- Stuck in one room
- Did not go to bed overnight
- Did not get up in the morning
- Has not visited kitchen in <x> hours
- Has not visited bathroom in <x> hours
- Went outside and has not come back
- Has not taken medicines on time

Sensor placement and rules

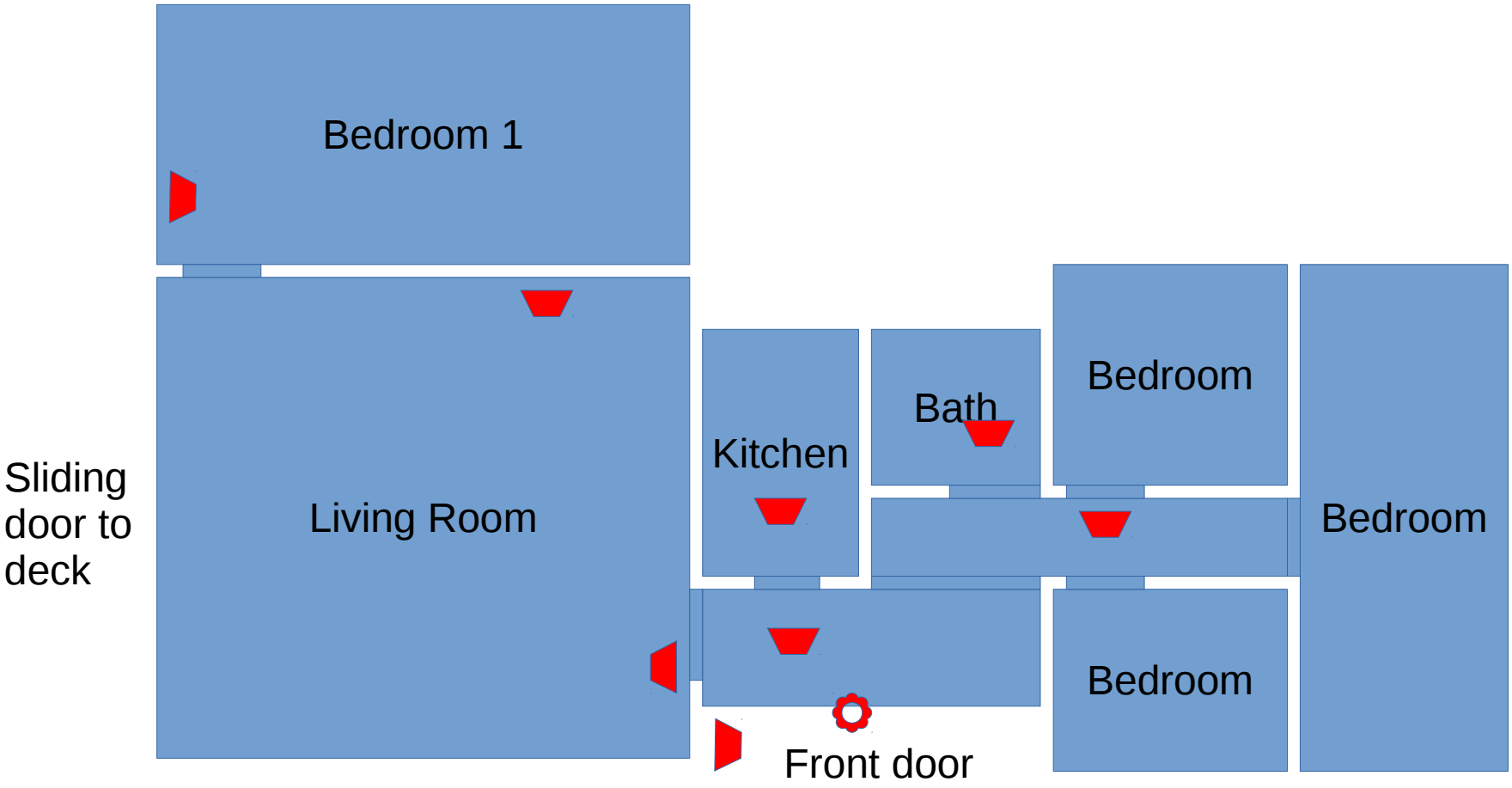


Combined Movement/Light/Temperature sensor

Where is Mum?


21:00
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
Living room Temperature
13
Living room Light
42
Living room Movement
Living room 2 Temperature
14
Living room 2 Light
Living room 2 Movement
Bedroom Temperature
10
Bedroom Light
68
Bedroom Movement
Bathroom Temperature
13
Bathroom Light
11
Bathroom Movement

More sensors



Behaviour changes

- Older people may not keep regular hours
- They become dependent on others
  - Stop going shopping
  - Stop gardening
- They lose motivation for basic routine
  - Cooking
  - Cleaning
  - Bathing
- Each change will need adapted rules

A challenging problem

- Writing good alert rules is hard
  - How can we make it possible for carers to adapt rules to requirements?
- Are we doing this for the client or for the carer?
  - Maybe a few robust rules and a good display system would work better
  - Carers must accept that it could take hours to generate an alert
- Issues of privacy and consent

Monitoring Mum

Now on GitHub:
https://github.com/afindlay/monmum

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27th April 2017