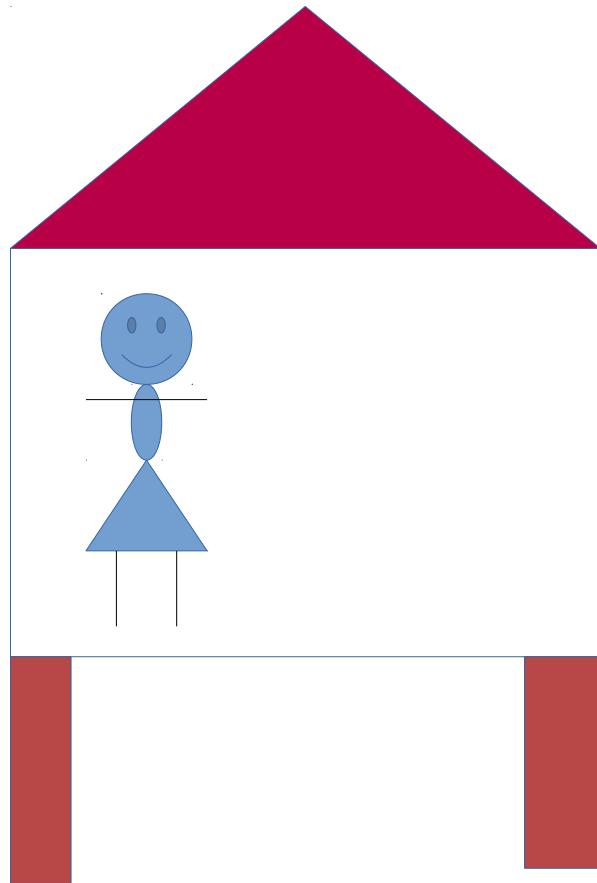


Monitoring Mum

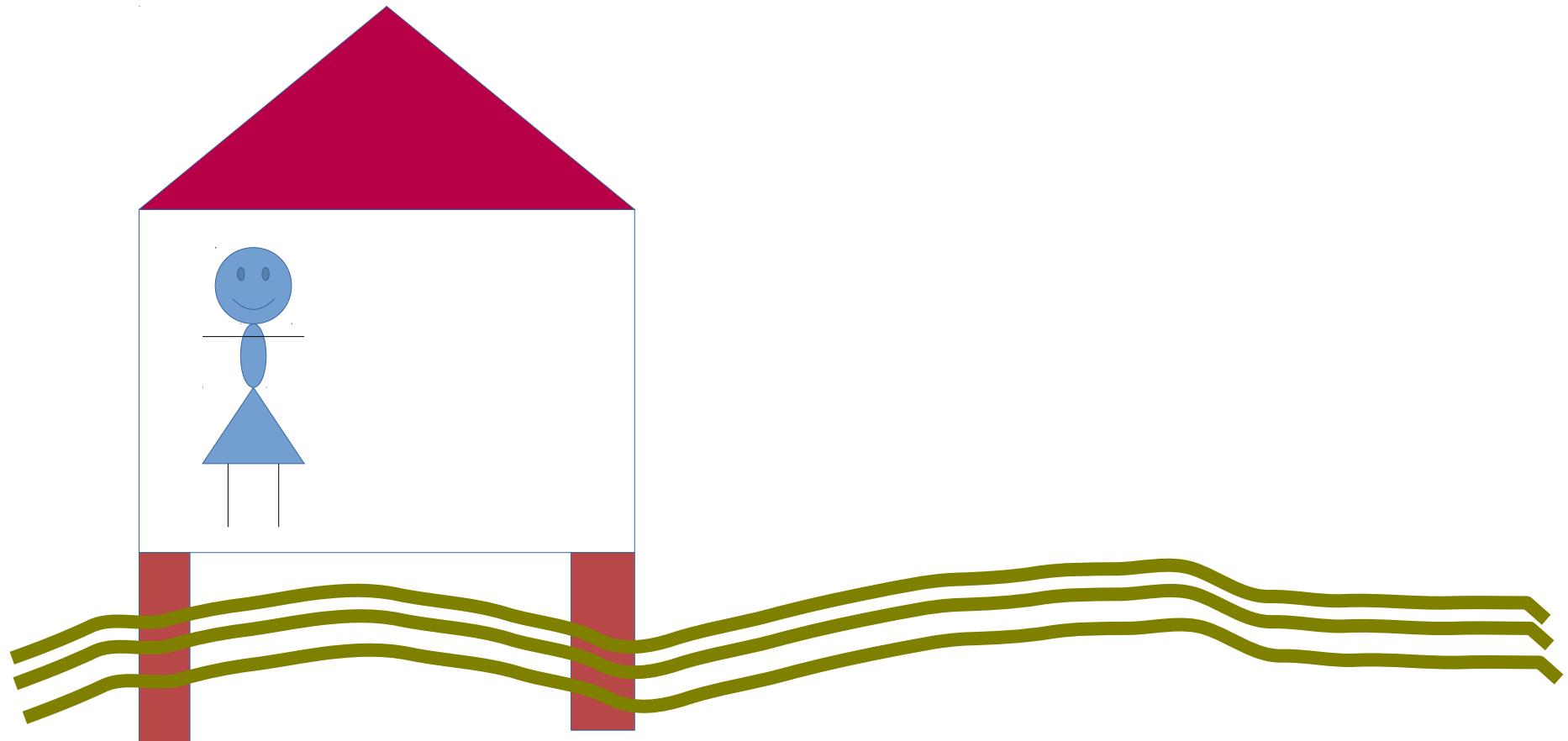
Open-source Telecare

Andrew Findlay
April 2017

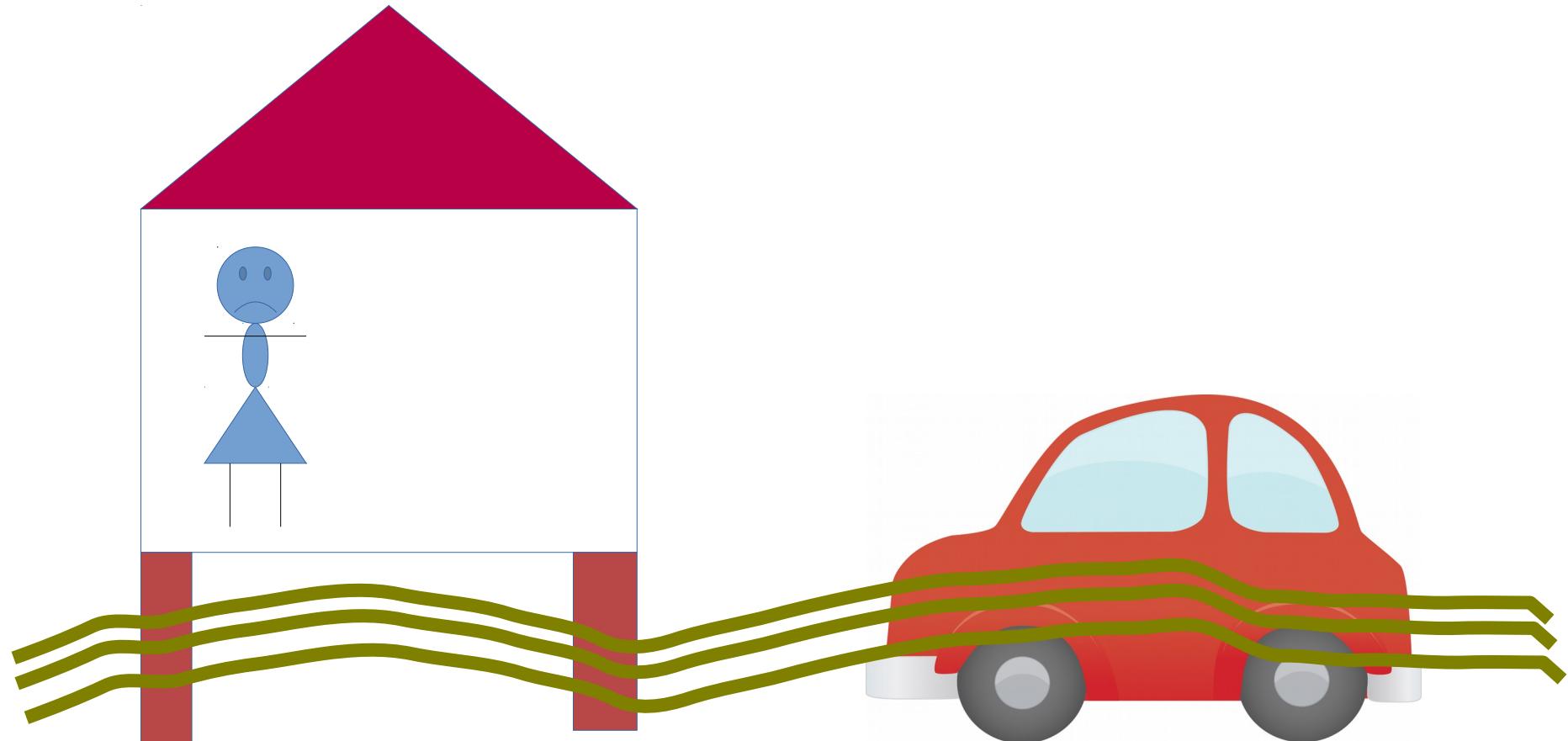
Once upon a time...



We can cope with this

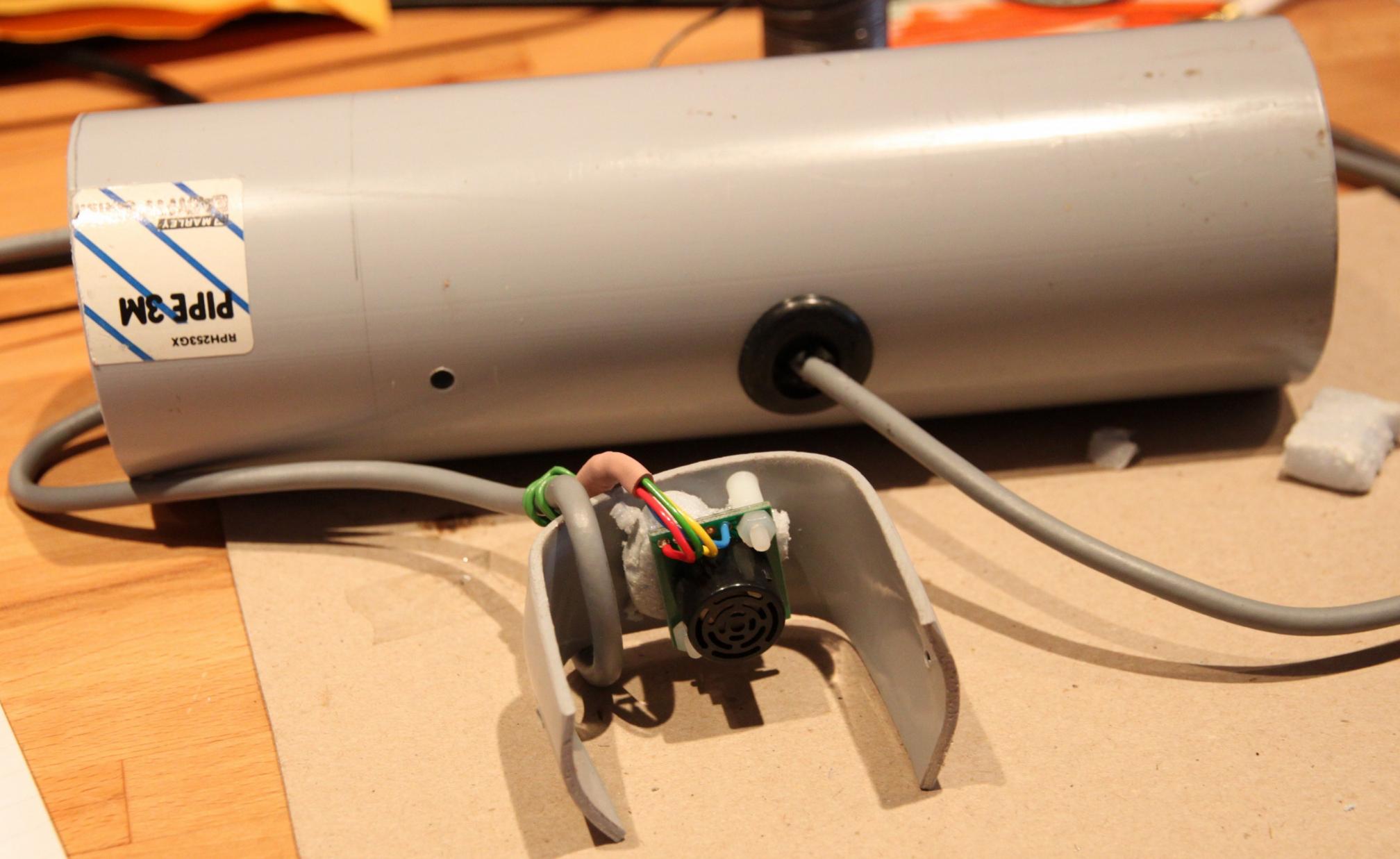


But not this

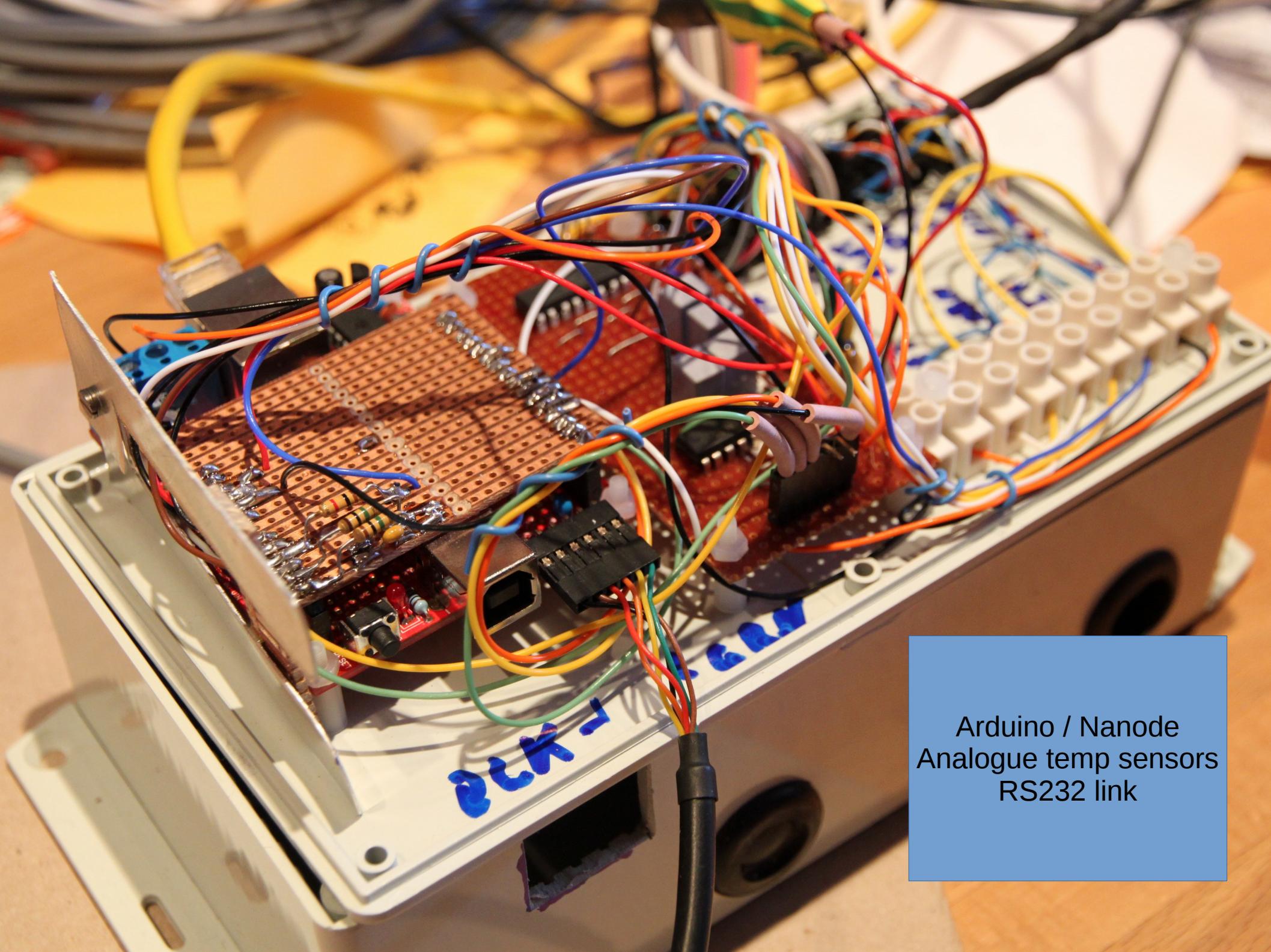


IoT to the rescue

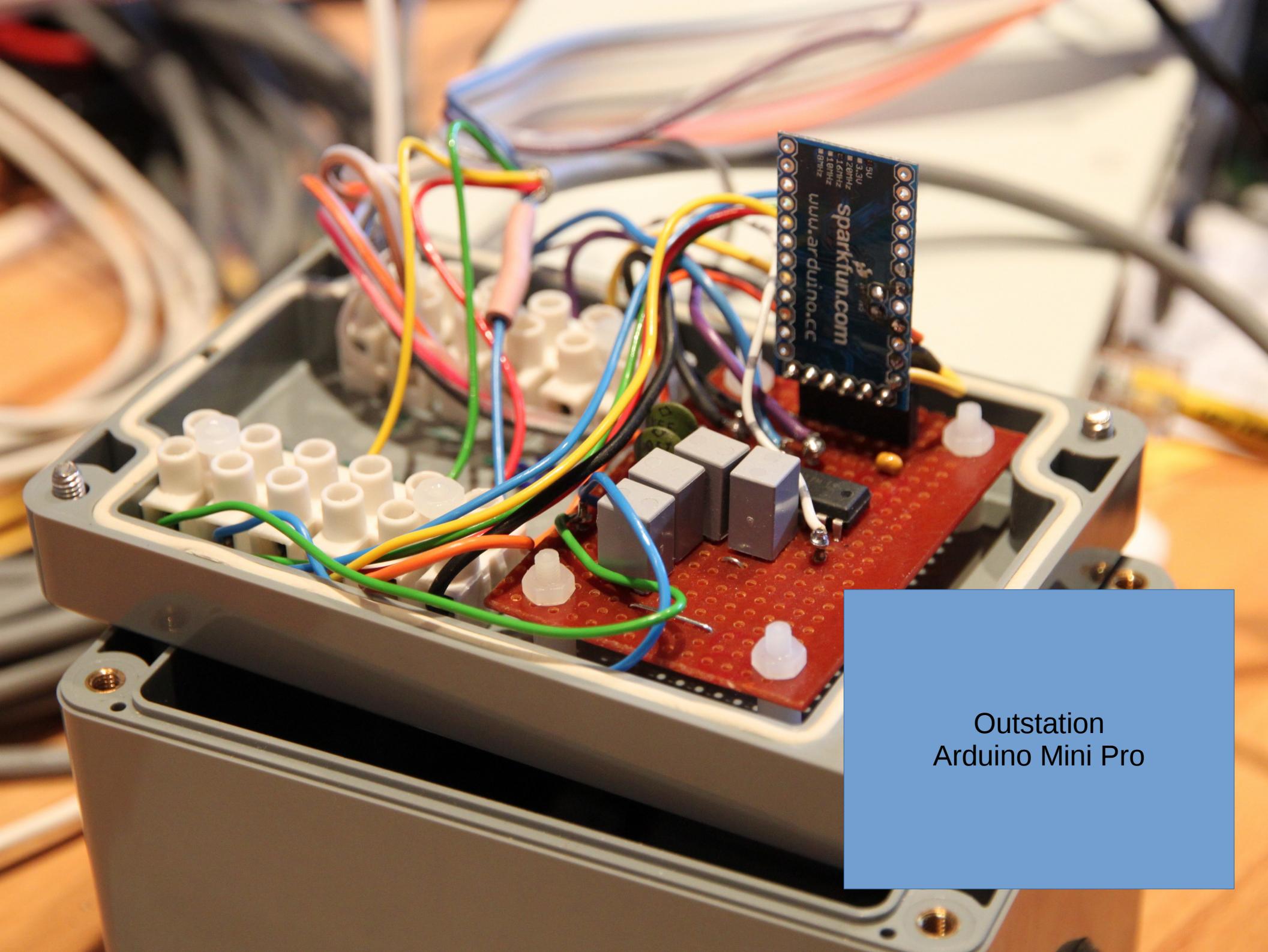
- Monitor the river
- Monitor the mother
- Raise the alarm
- Keep the trend data



SRF02
Ultrasonic
Rangefinder



Arduino / Nanode
Analogue temp sensors
RS232 link

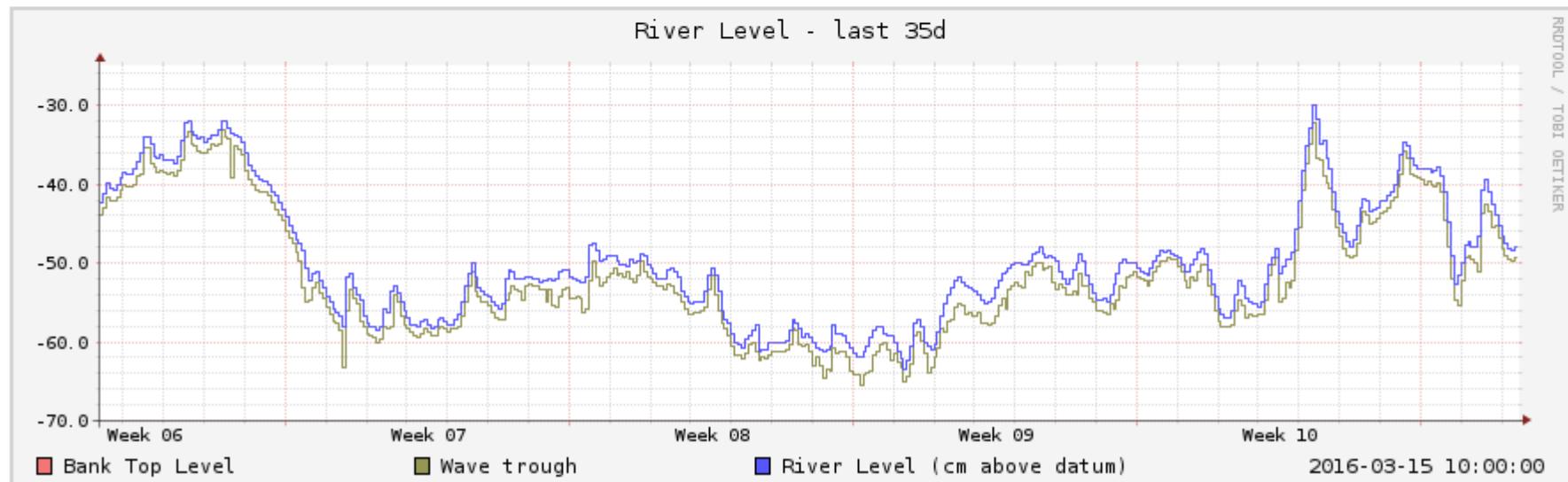
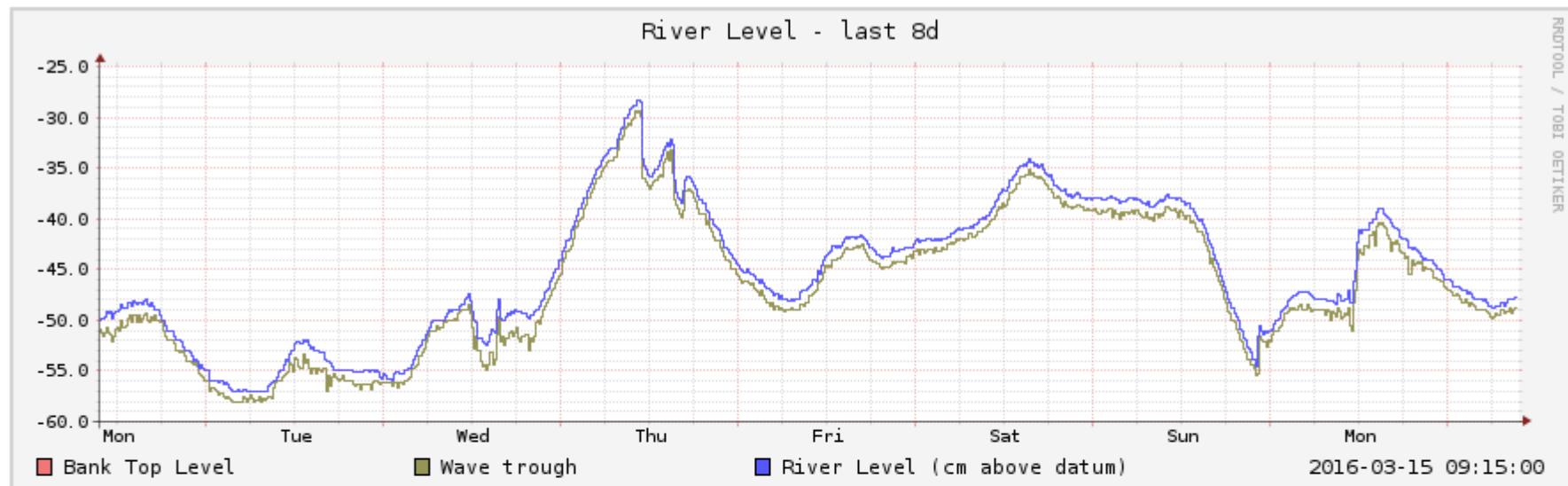


Outstation
Arduino Mini Pro

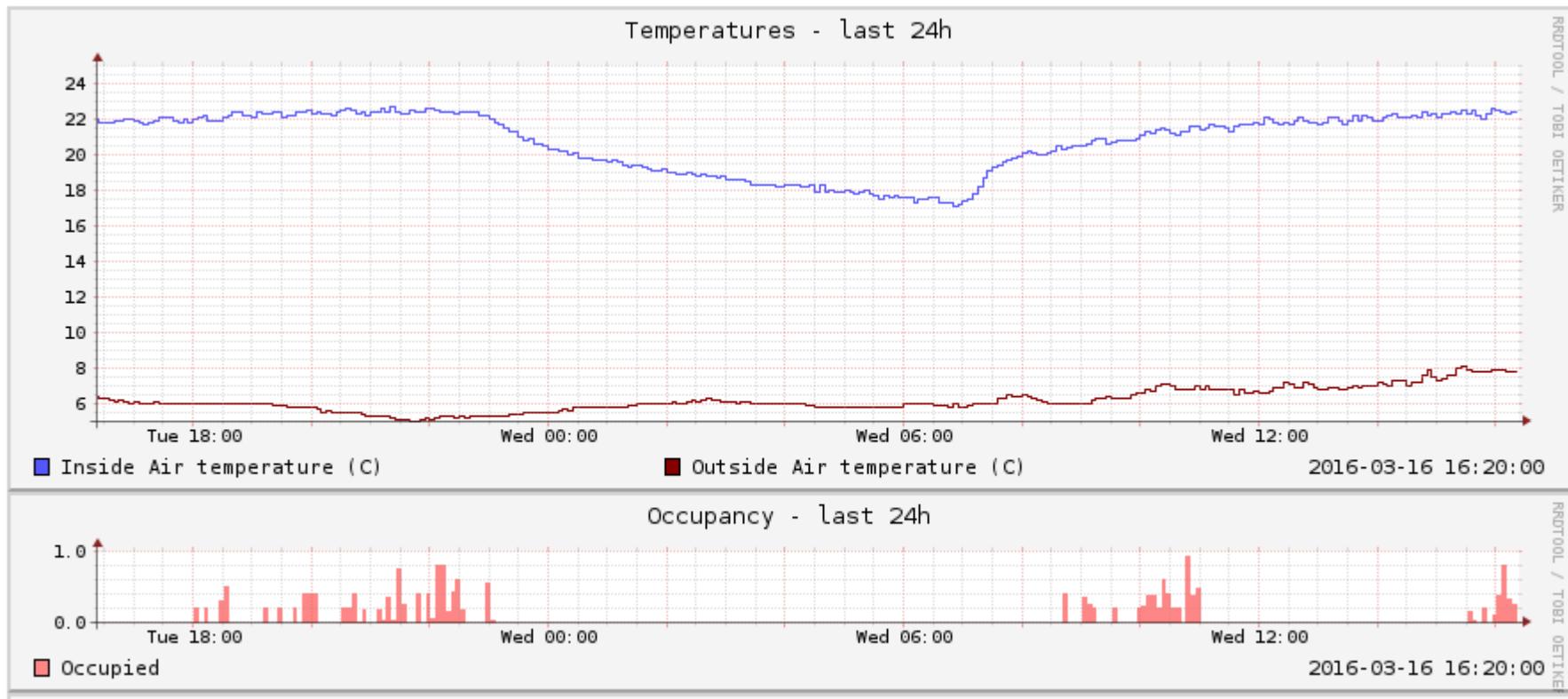
Other bits

- Linux webserver
- Arduino IDE
- RRDTool
- Movement sensors

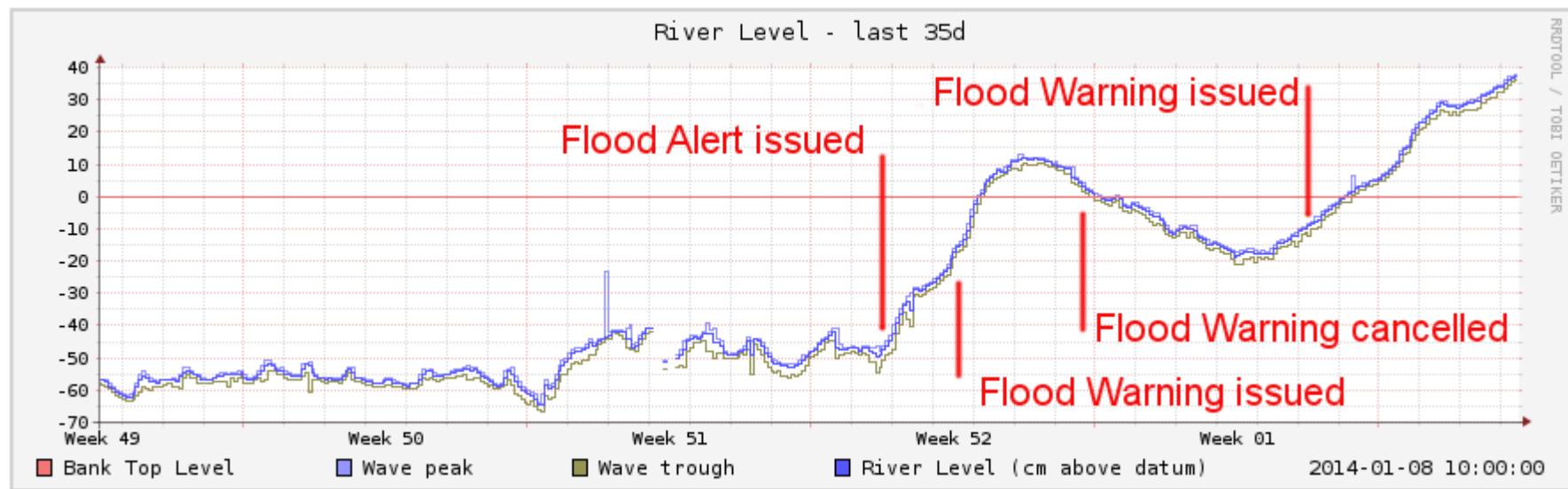
Web page for the river



Web page for Mum



December 2013





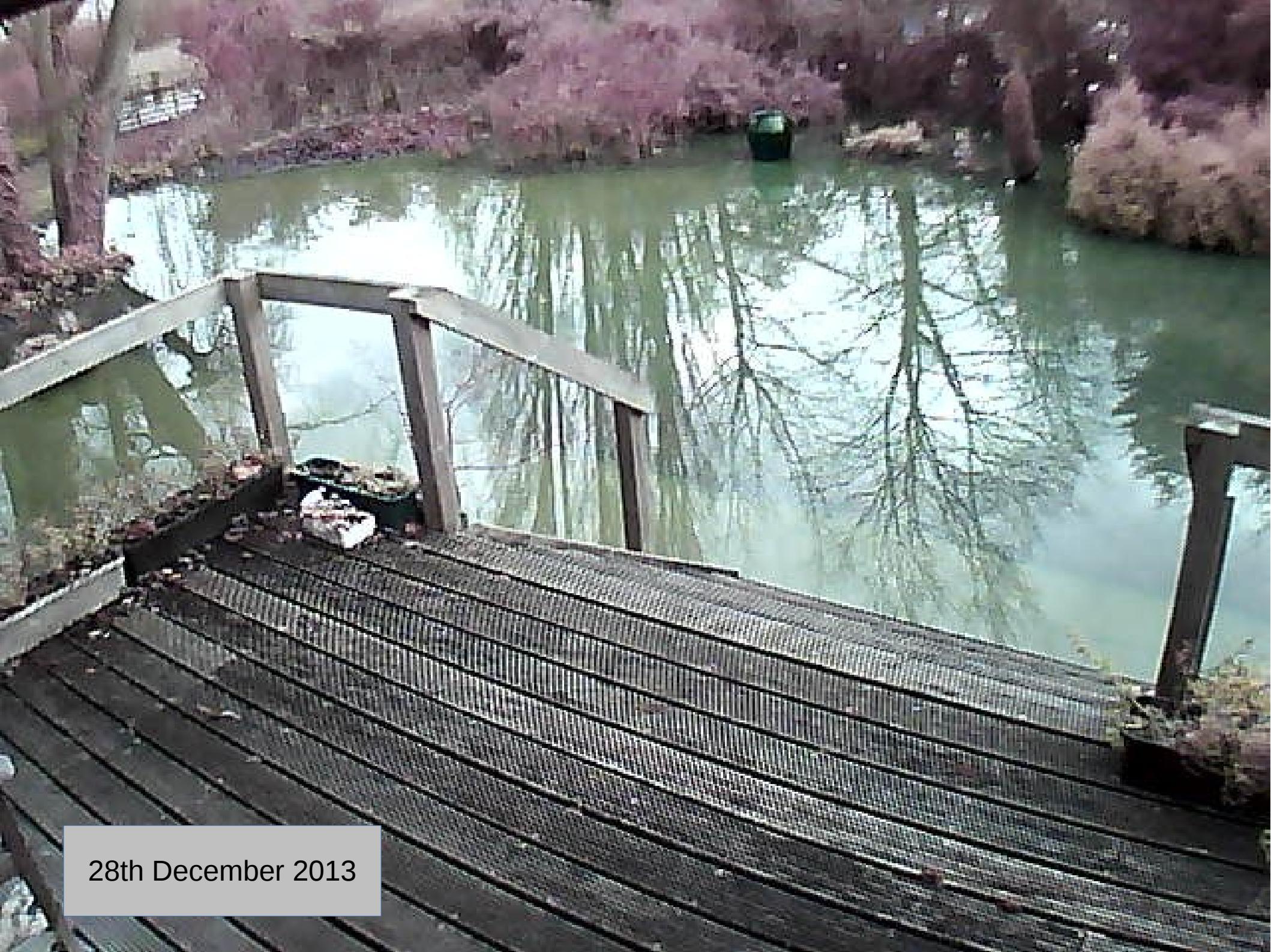
24th December 2013



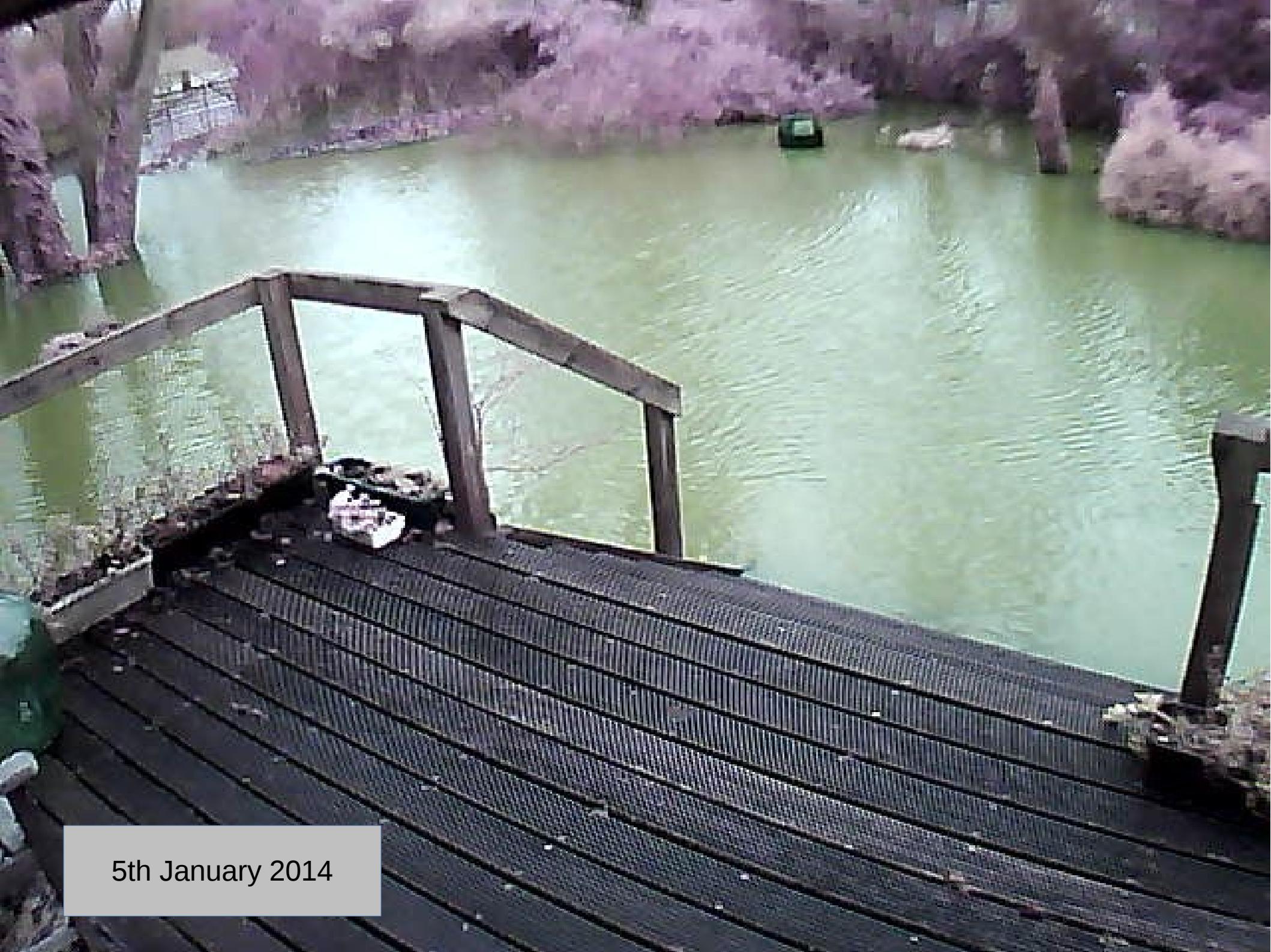
25th December 2013



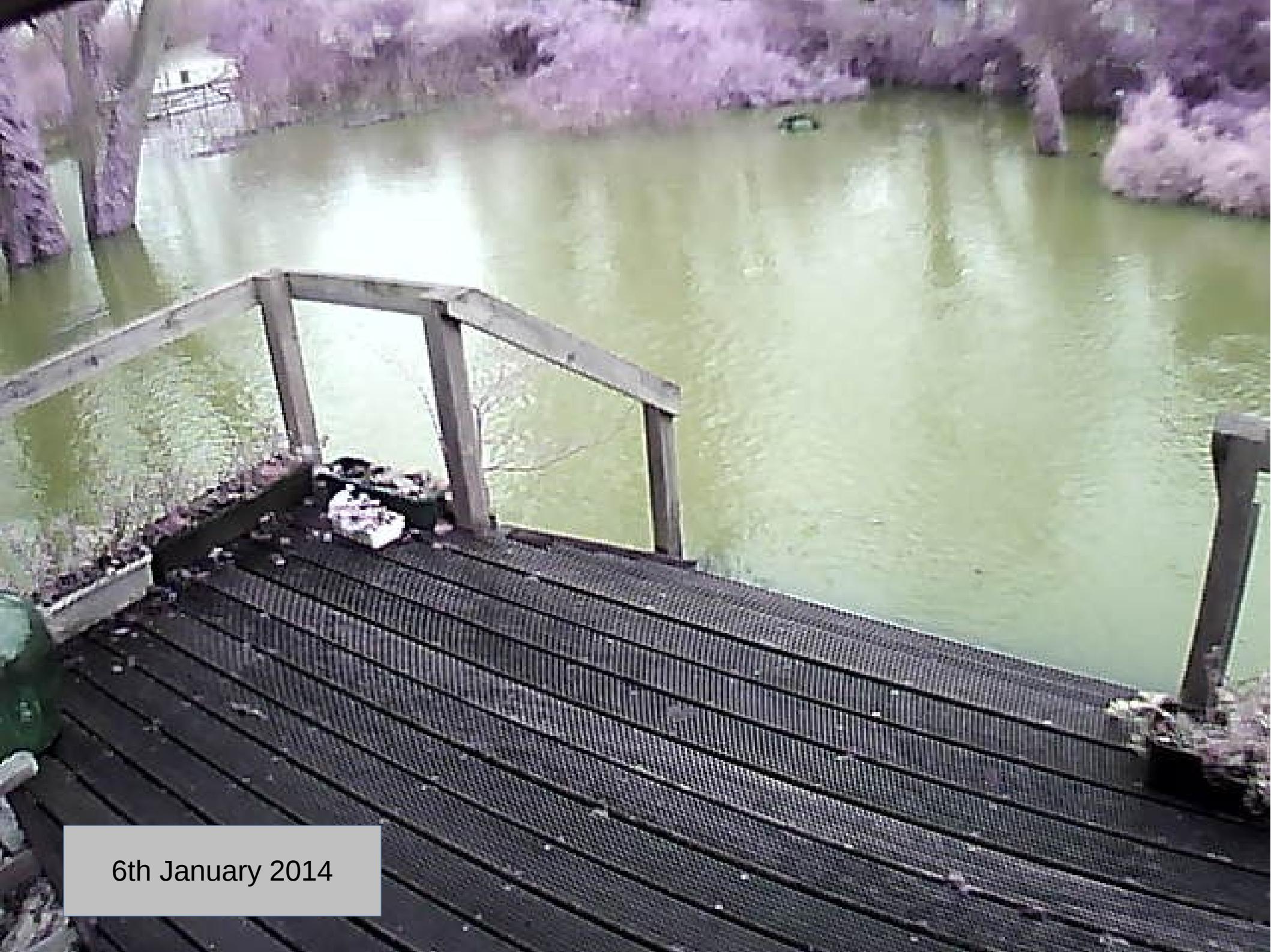
26th December 2013



28th December 2013



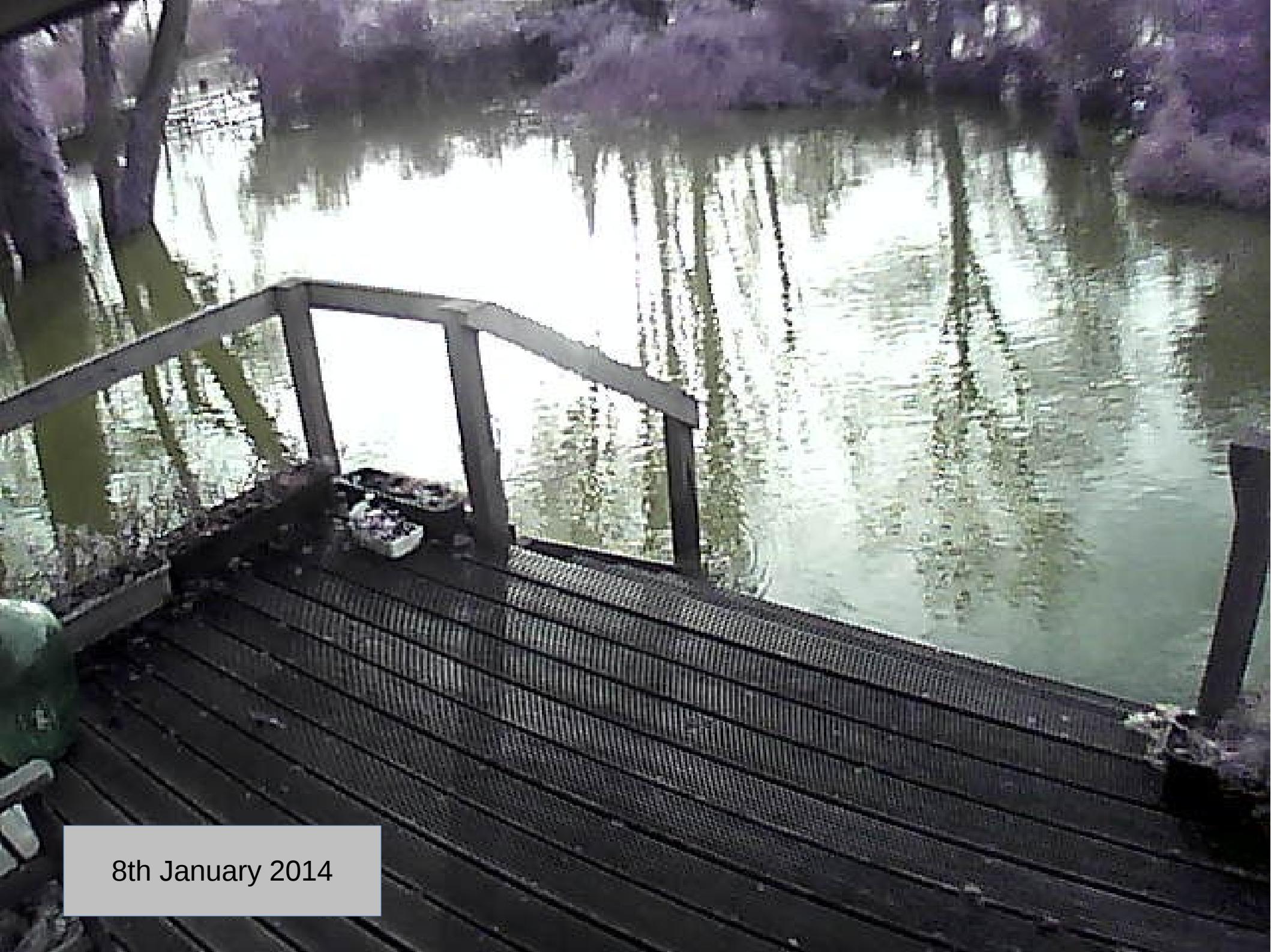
5th January 2014



6th January 2014

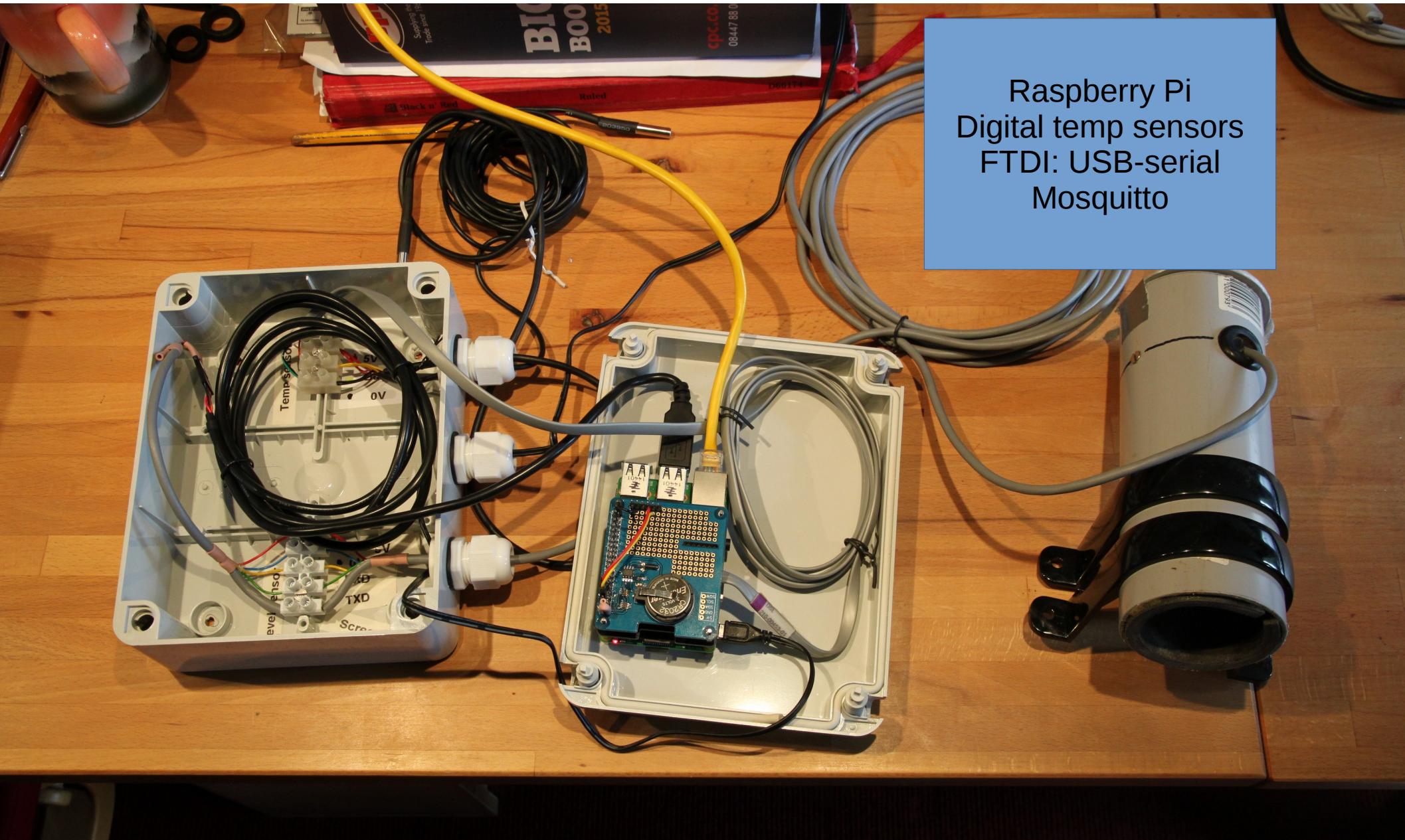


7th January 2014



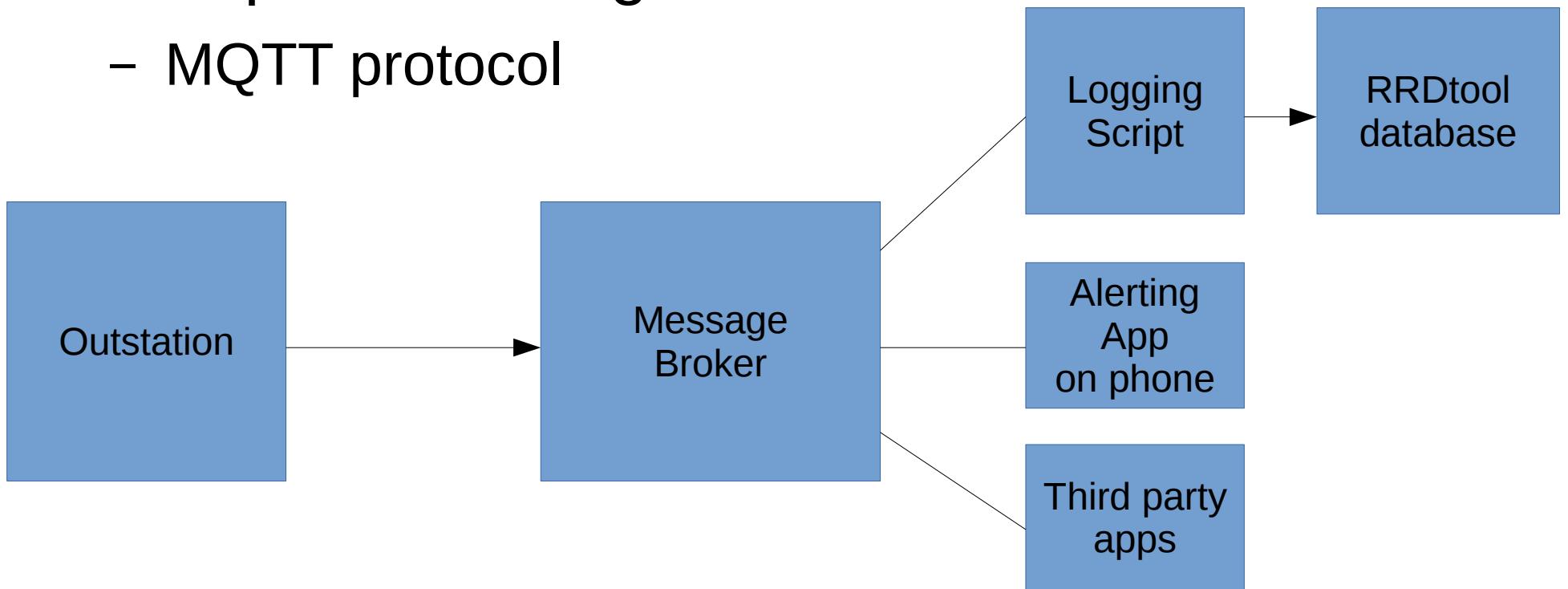
8th January 2014

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

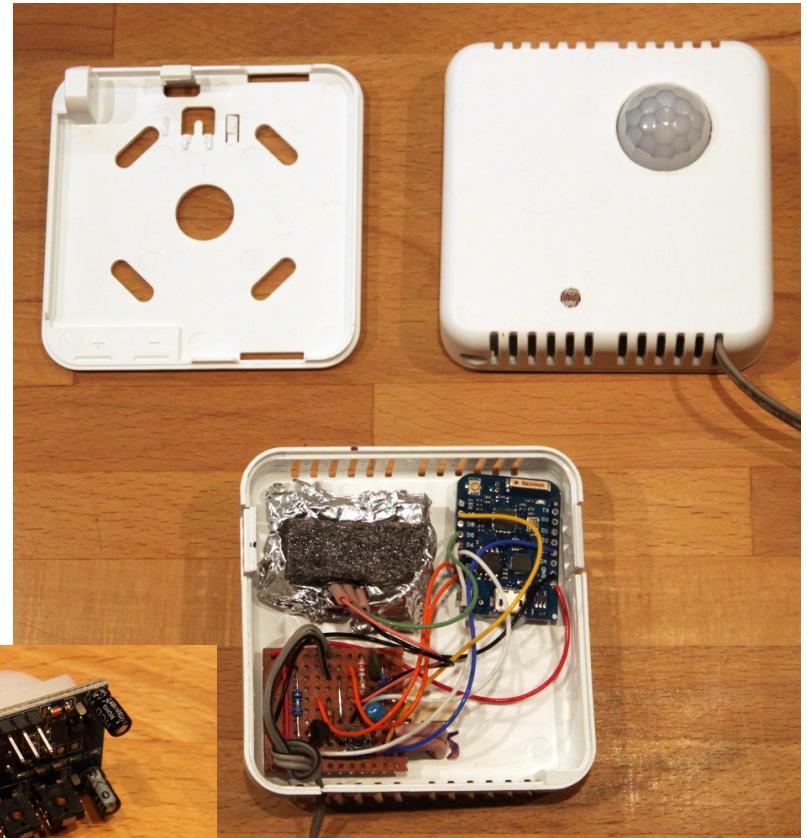


Improve in-home monitoring

- 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

ESP8266EX
252016
PAGX74

SIL 2104
FOONC
1619+

Winbond
25Q128FVSG
1635

TX

RX

D1

D2

D3

D4

D5

D6

D7

D8

D9

GND

5V

rst

Ag

D0

D5

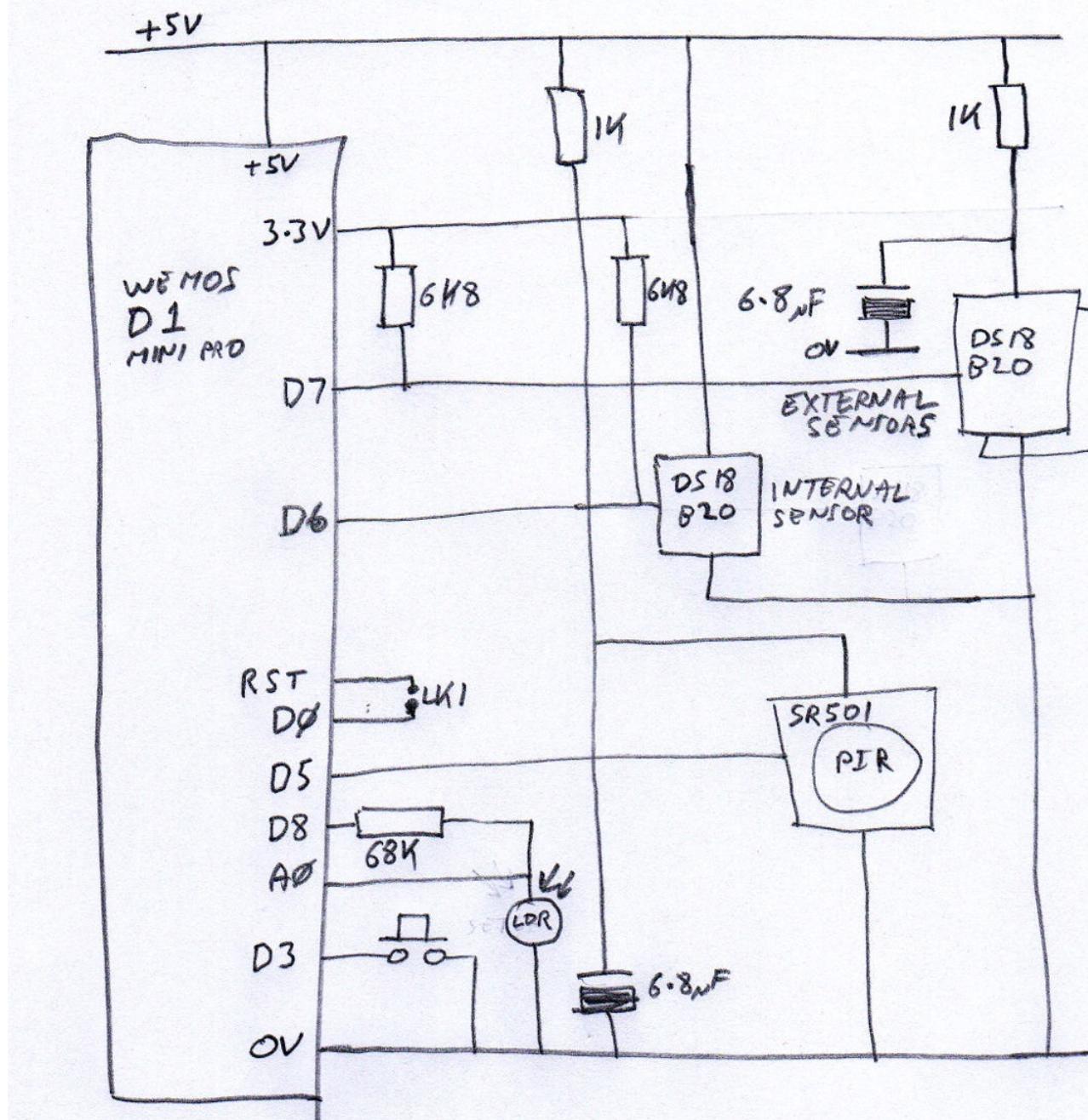
D6

D7

D8

EAE

MONITORING MUM ROOMNODE (WIFI)



Homie

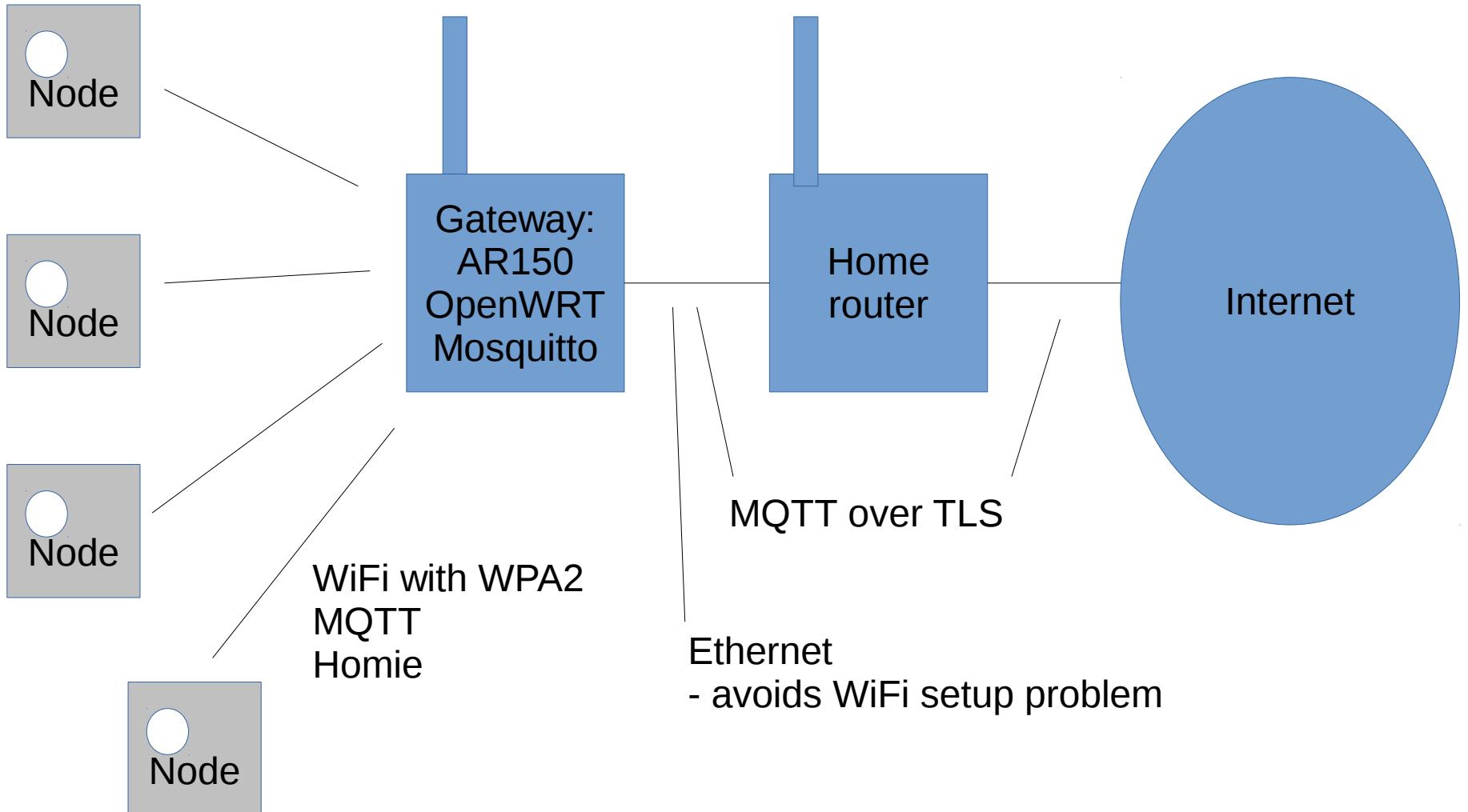
- IoT framework using MQTT
- Unconfigured node runs a WiFi access point
- Send messages on event or on timer
- Auto sends housekeeping data
 - Software version
 - Signal level
 - Uptime
- Accepts command messages
- Supports over-the-air software update

```
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

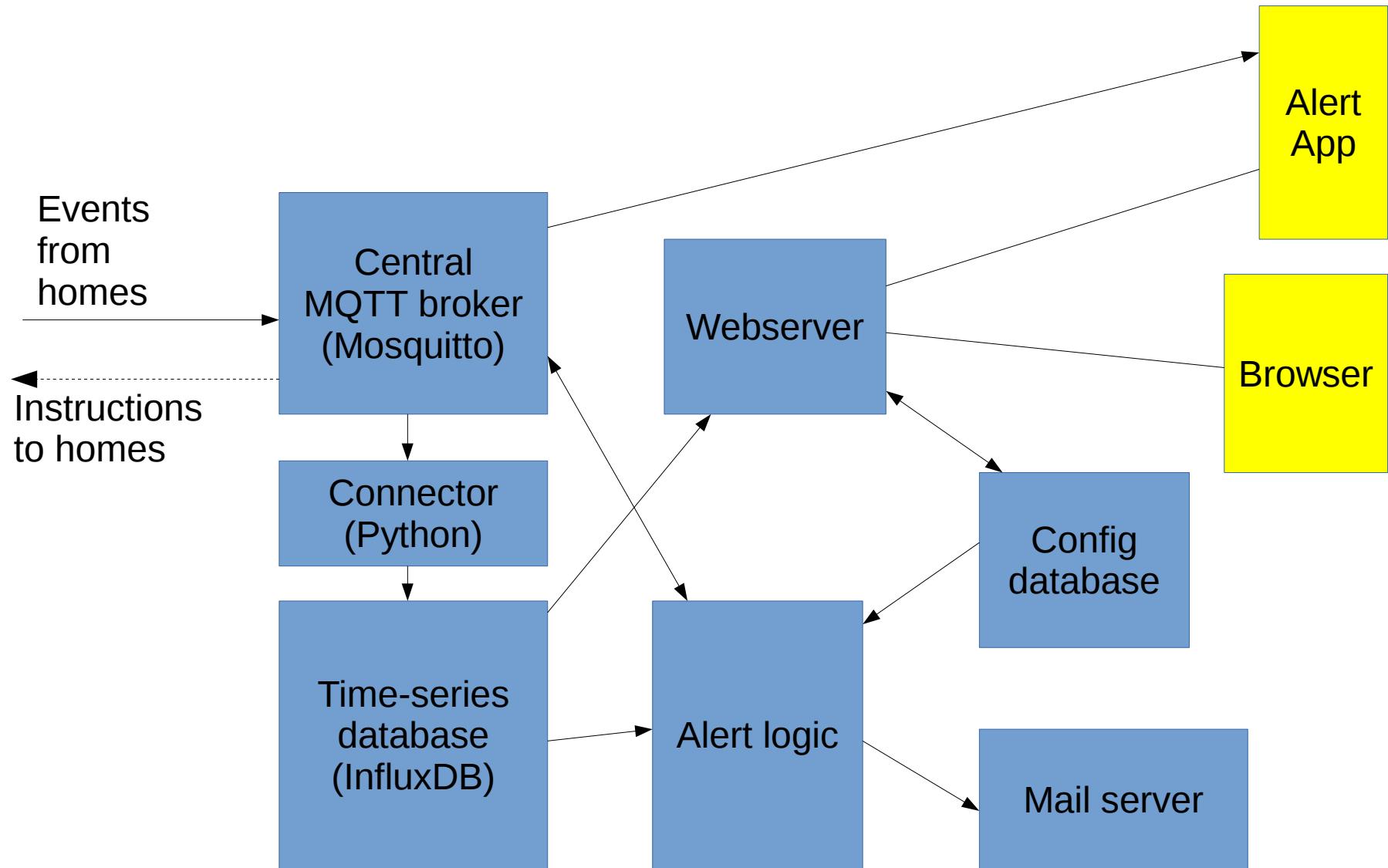


Messages from Room-nodes

- 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	87317735484734f90d14f2f208e8d1a0

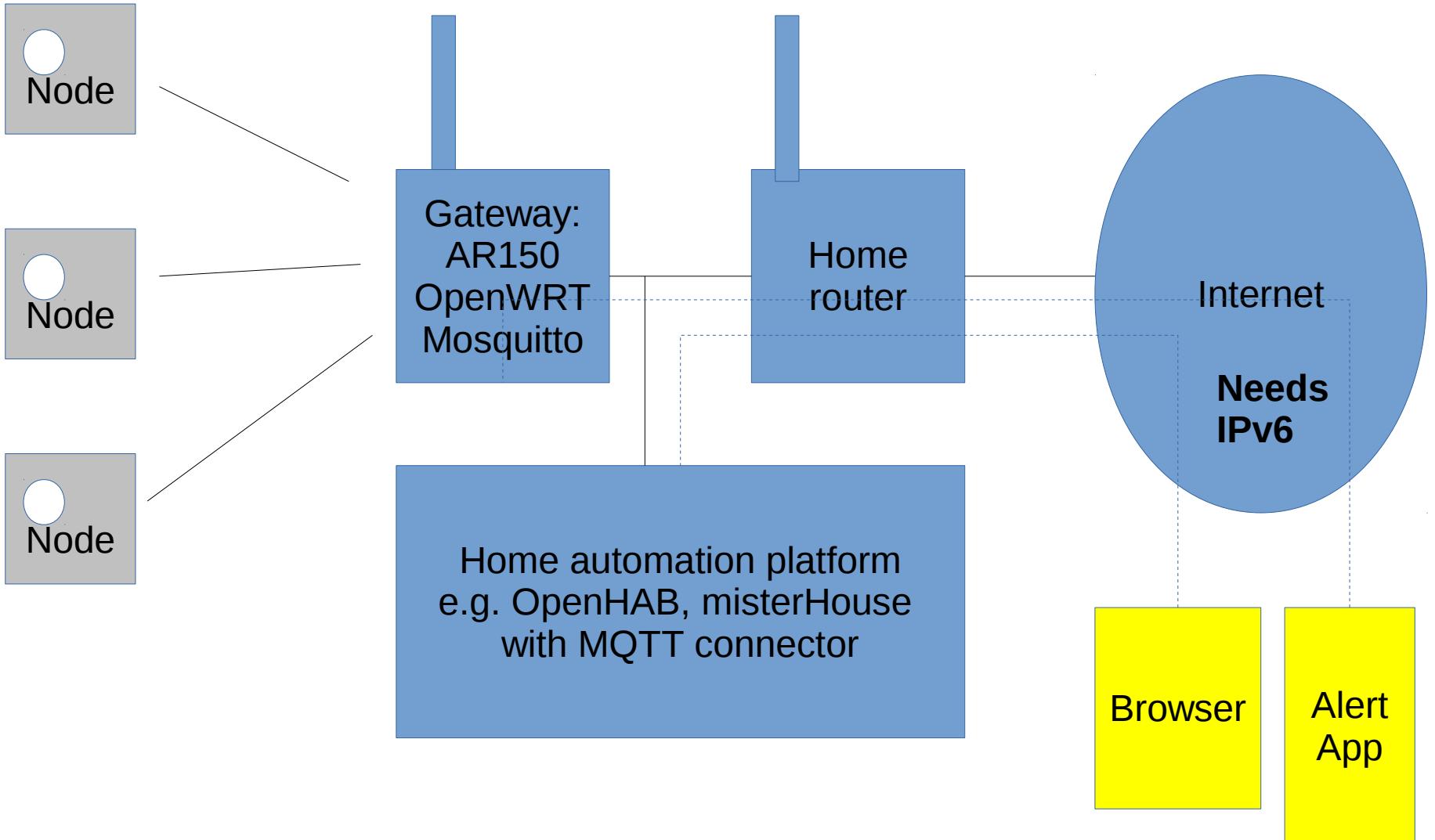
Shared server segment



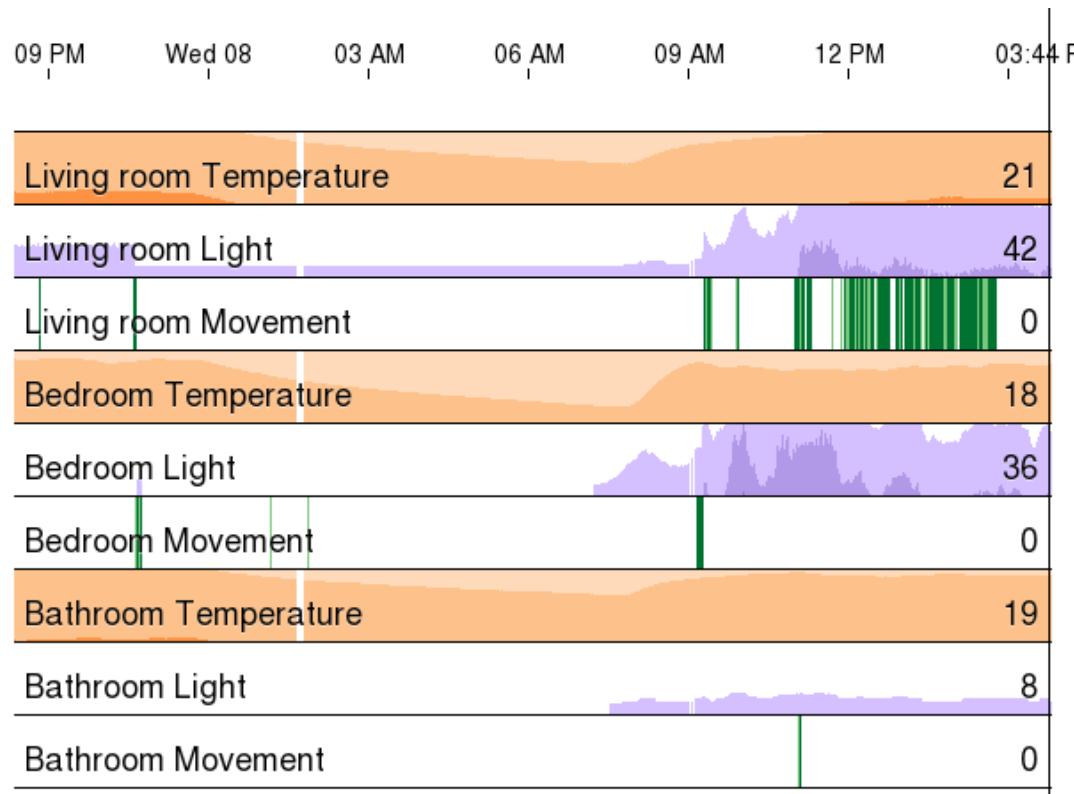
Buy it in a shop?

- 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



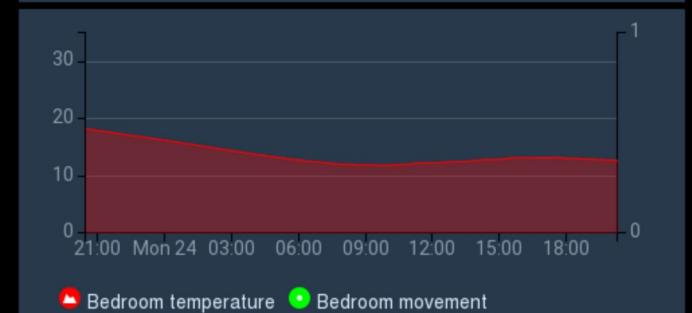
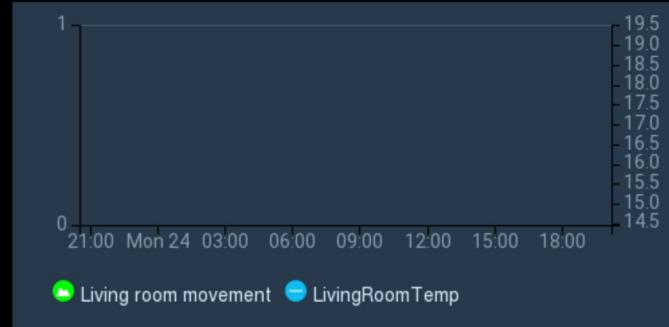
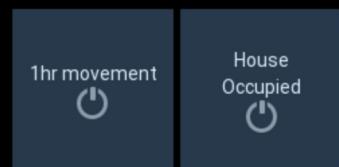
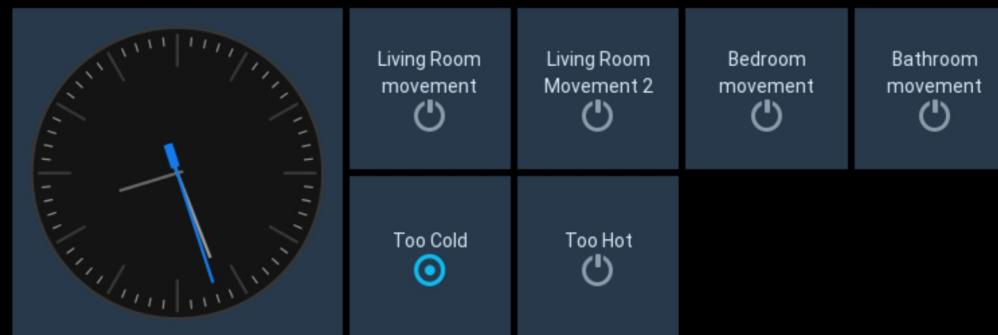
Display: horizon graphs



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

Display: OpenHab

≡ Granny 90



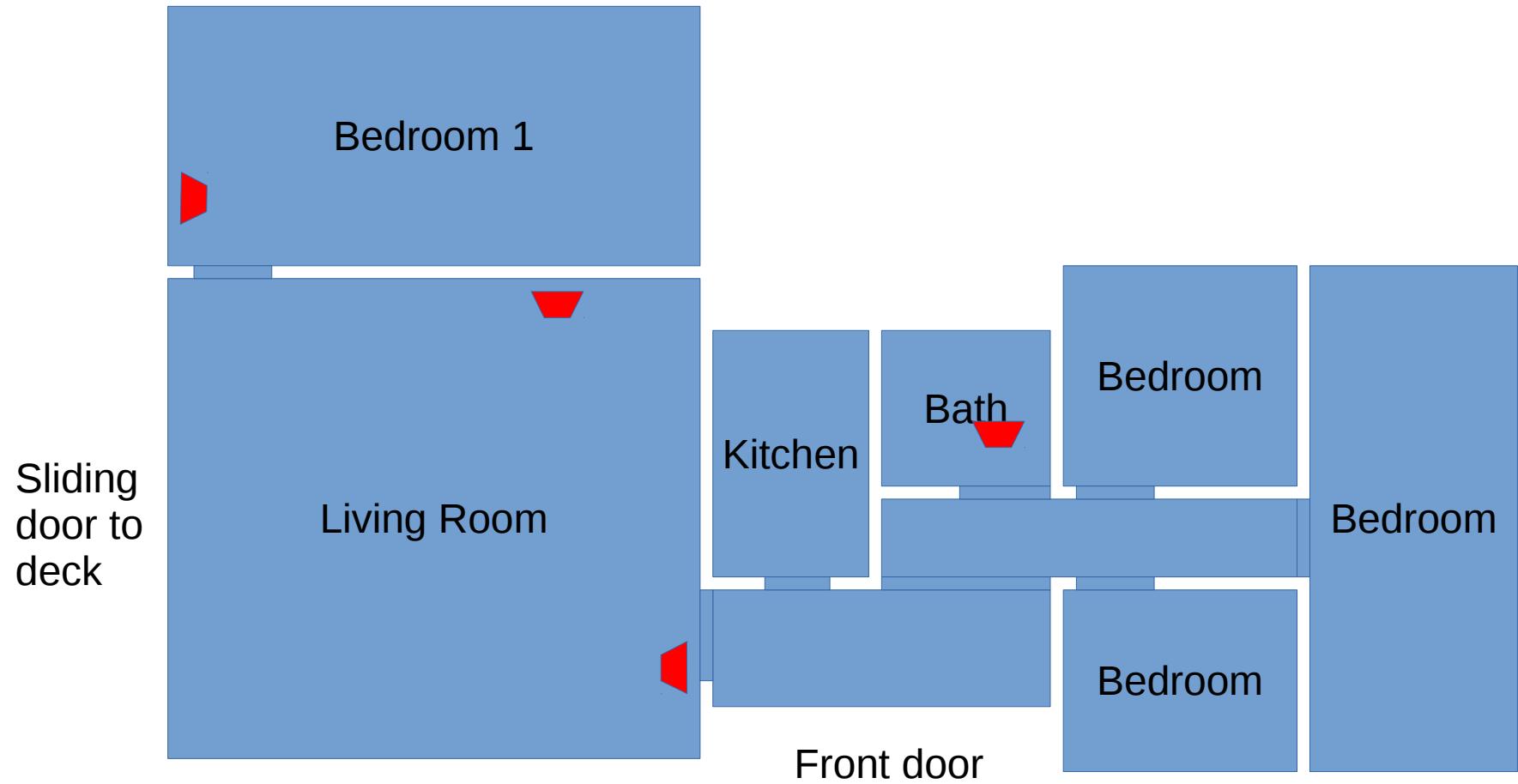
What can we learn?



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

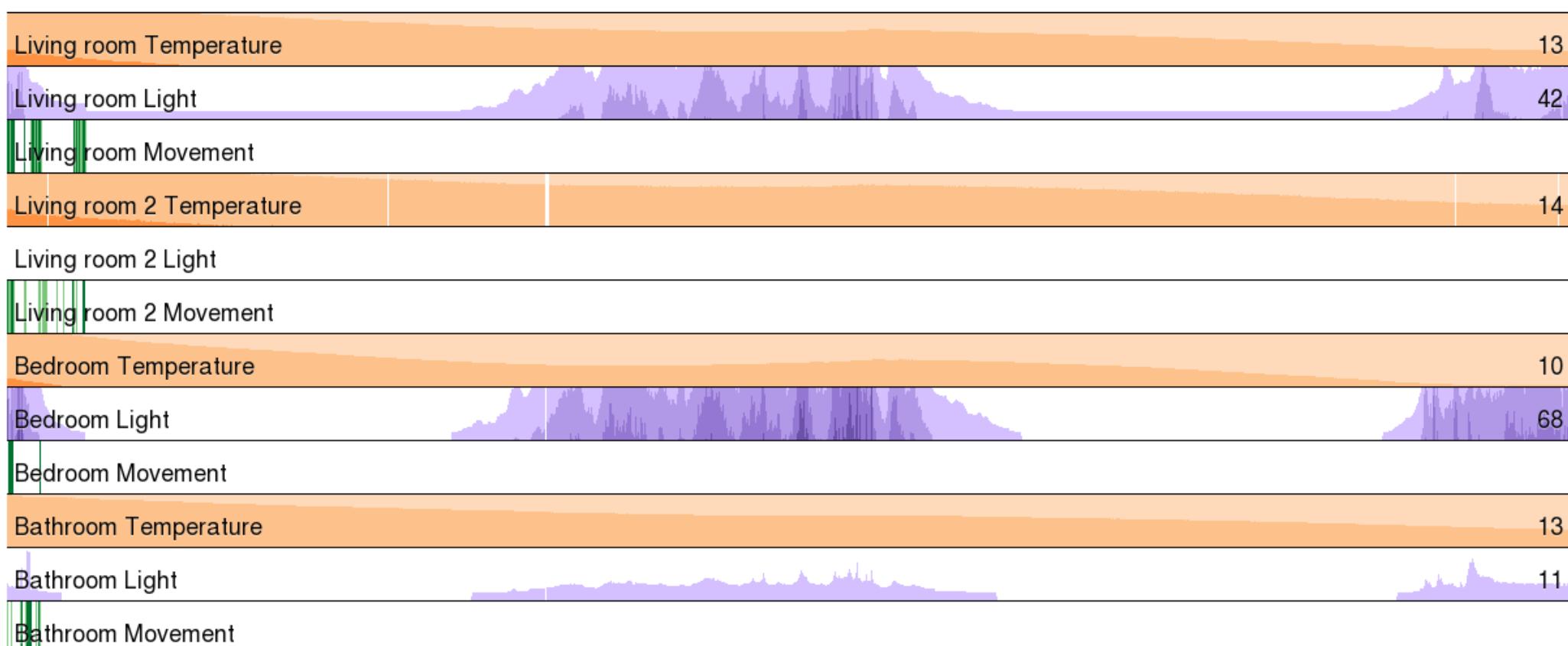
Sensor placement and rules



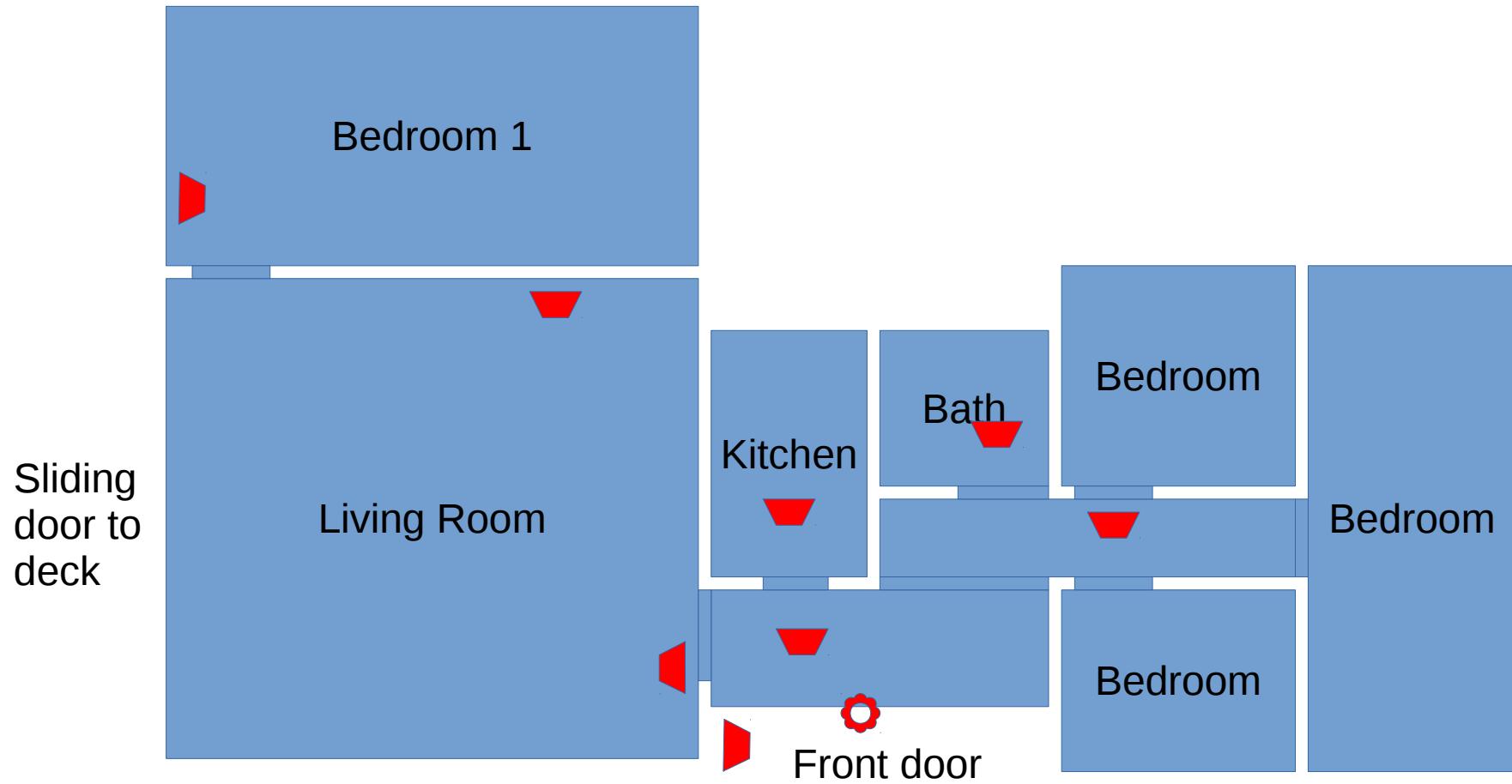
Combined Movement/Light/Temperature sensor

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



More sensors



- ▶ Combined Movement/Light/Temperature sensor
- ◉ Lock sensor

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

Andrew Findlay

andrew.findlay@skills-1st.co.uk

27th April 2017