**Outline**

The home sensor system monitor and records data from a variety of sensors in a residential setting.

**Physical Hardware**

The system is composed of a number of sensors wired to and powered by a central ATMega 2560 microcontroller (sensor hub). The microcontroller is connected via 3 TTL serial lines to a host server (server). 

The sensor hub supplies 5 volts to all sensors. The server and sensor hub are on a battery backup power supply which can power the systems for 2-4 hours in the event of a power failure.

**Data format**

Data is transmitted from the sensor hub to the server via TTL serial data. Each serial interface provides a connection for different services.

* Serial 0 - Interface to program the sensor hub with new firmware
* Serial 1 - System interface - all data sent to the server on this interface is logged. All data is sent via JSON.
* Serial 2 - User interface - this interface allows data to be sent / received manually over a console. Usually used for debugging. Data is sent as plain text.

Data on serial 1 is sent via json strings. Incoming JSON strings are checked for validity and logged to a file. Each file grows to a maximum of 4 MB before a new file is created.

There are three message types possible.

| name | notes | typical occurrence |
| --- | --- | --- |
| print\_reading | environment (temp, RH, etc.) Includes a summary of trigger\_data. | once per minute. This time is referred to as **'sample period'** |
| trigger\_data | motion sensors and door open/closed | when a sensor changes states (0->1,1->0) |
| system\_start | indicates sensor hub has started | When the sensor hub is started or restarted (the server will sometimes force restart the hub if it does not receive data after a few minutes) |

**print\_reading fields**

This document only covers the print\_reading data msg type.

**Format:**

**adc\_{n}\_{type}**

* adc fields are direct reads of adc (analog to digital converter) pins. Sampled once a second
* {n} is the pin number

| 64 | water pressure (main line) |
| --- | --- |
| 65 | feb24 2022 became north sump line pressure. (previously was legacy co2 reading - not used) |
| 66 | feb24 2022 became south sump line pressure. (previously was legacy co2 reading - not used) |
| 67 | liquid moisture basement floor east |
| 68 | liquid moisture basement floor west |
| 69 | liquid moisture basement sump pump lid (will detect sump overflow condition) |

* {type} is the type of reading

| avg | average (mean) in of that sample period |
| --- | --- |
| max | max value for that sample period |
| min | min value for that sample period |

**baro1**

Barometric pressure measured outside. Measured in millibars. Note: missing decimal. Reading 100339 as 1003.39 millibars.

**co2**

co2 equivalent floor 1. Measured in ppm.

**compdt**

Date /time firmware for sensor hub last compiled.

**elec\_{n}\_{type}**

* elec fields are readings of electrical power usage at the circuit breaker. Readings are unitless but are relative to one another. Current is read via a split core transformer. Readings are taken 1 time a second but avg,max,sum are over the sample period (1 minute).
* {n} is the sensor number:

| 0 | Hot water heater |
| --- | --- |
| 1 | Upstairs |
| 2 | Main line phase 1 |
| 3 | Main line phase 2 until 2022-01-16, then cabinet circuit power |
| 4 | Electric range / oven (240 volt) |
| 5 | Washer / dryer (240 volt) |
| 6 | Furnace blower motor |
| 7 | [not used] |

* {type} is the type of reading:

| avg | average (mean) in of that sample period |
| --- | --- |
| max | max value for that sample period |
| sum | additive sum of all readings during the sample period |
| val | last instantaneous reading |

**flow2**

Flow of north output of sump pumps 1 and 2

**flow3**

Flow of south sump pump output for sump pump 3

**k**

Placeholder - always has value v

**millis**

The number of milliseconds the sensor hub has been running since last reboot.

**pitime**

Time and date msg was received by server.

**read\_duration**

Time in milliseconds the sensor hub took to read temperature and RH sensors.

**rh\_{n}**

Relative humidity in %. The location of these sensors:

| 1 | Center of basement |
| --- | --- |
| 2 | Basement wall |
| 3 | Outside |
| 4 | Floor 1 |
| 5 | Garage |

**temp\_{n}\_{ok}**

* Temperature readings in degrees fahrenheit.
* Keys with 'ok' are boolean values to indicate whether the sensor reading had any errors. 0 = errors, 1 = no errors.
* {n} is the sensor number:

| 1 | Basement center |
| --- | --- |
| 2 | Floor 2 |
| 3 | Floor 1 (on the floor) |
| 4 | Garage |
| 5 | Attic crawl space |
| 6 | Furnace output air duct |
| 7 | Basement exterior wall |
| 8 | Outside air temperature |
| 9 | Floor 1 (ceiling) until 12-2019 then moved to first floor closet |

**trpin\_{n}\_{type}**

trpin data is from trigger pins. These are boolean values (1 = True, 0 = False) based on motion sensor and door open/close events. Since immediate action may be required for trigger data they are sent as soon as pin state changes. trigger\_data data is sent immediately when the trigger event is received and stored as msg type = trigger\_data. These fields serve to summarize the trigger data for the sample period. Trigger data is sampled at 10 hertz. (10 times a second)

Pin number information:

| 38 | motion back yard |
| --- | --- |
| 40 | motion front yard right |
| 43 | motion floor 2 - PIR sensor |
| 44 | motion front yard left |
| 45 | Garage door left - feb 2022 update to optical sensor, previously magnetic reed switch which had many outages / issues |
| 47 | motion floor 1 - PIR sensor |
| 49 | Garage door right - feb 2022 update to optical sensor - previously magnetic reed switch which had many outages/issues |

| samples | number of samples in sample period |
| --- | --- |
| sampleson | number of samples where pin state is 1 |
| state | state on last read |

**tvoc**

Total volatile organic compounds in air. Downstairs. Same location as co2 sensor.

**unixtime**

**type**

Identifies msg as print\_reading, trigger data or system\_start. Always present in all msg types.

**uctime**

millis field duplicate.

**unixtime**

unixtime msg received by server.