**Logging sub-system for sprinkler control program**

Logging sub-system is intended to be used as a part of the sprinklers\_pi running on Arduino/AVR, as well as for use in OpenSprinkler. Logs are stored on micro-SD card.

Logging sub-system supports two key types of logs – Event logs and Time Series logs. Event logs are used to capture any kid of events, first of all – watering runs. Key characteristic of events is unpredictable, irregular time and unknown number of events. Event logs are analogous to windows log events.

Time Series logs are streams of counters or similar data. For example, stream of data from temperature or humidity sensors. Key characteristic of the Time Series data is the repeated, regular nature of it. An example of the time series data is windows perf counters recording.

Logging sub-system stores data in CSV files in few different directories. Four files are used:

1. System events file (mm-yyyy.log). This file stores general-purpose system events – errors, warnings, and essential events. Content of the file depends on the level of logging enabled, but each record represents an event.
2. Watering events file (mm-yyyy.wat). This file stores watering information – each record represents zone run, and includes date-time stamp, zone and run time. This file is intended for generating usage graphs etc and can be easily imported to Excel for analysis.
3. Water flow sensors readings (mm-yyyy.wfl). This is time-series data. Multiple water flow sensors data can be stored in this file.
4. Temperature, humidity and other environmental sensors readings (mm-yyyy.env). This is time-series data. Multiple temperature sensors data can be stored in this file.

Water flow sensors and environmental sensors data is stored in different files to allow easy data analysis – you can just download required type of data into Excel and process it, with no need to filter out desired type of data. Also it helps to reduce file size by optimizing file format, especially in the view of the possible significant volume of data.

If/when other types of sensors will be added to the system additional log files may need to be created OR new sensor data can be stored in the existing files.

Files are stored in different directories to speed up access. On one hand it is preferable to keep files small to allow quick access to data, but also having lots of files in a single directory makes file open operation considerably slower (Arduino cannot cache directory and FAT). A compromise solution is to store files in few directories, keeping file size and number of files relatively small.

**System event data – file format (files in /logs directory)**

File name: mm-yyyy.log

1. Day of the month (one or two digits)
2. Time in "hh:mm:ss" format. Note: seconds part may be absent
3. Event source (e.g. "sys")
4. Event type (1/2/3 for error/warning/info)
5. The rest is event-specific, and could be treated as a string

One event per line, max line length - 255 characters. Encoding - ASCII.

**Watering events log (files in /watering.log directory)**

File name: mm-yyyy.wat

1. Day of the month (one or two digits)
2. Time in "hh:mm" format
3. Zone ID (one or two digits)
4. Run time in minutes
5. Schedule ID
6. Adjustment
7. Weather underground adjustment

One event per line. ASCII encoding.

Watering events data can be retrieved as CSV file (for Excel download etc), but it is also used to support built-in Sprinklers Logging feature. To support built-in Logging watering events data is exposed as JSON, with format specifically compatible with the native Sprinklers\_pi format to allow use of unmodified WEB UI.

**\*\*\*Sensors data\*\*\***

**Water flow meters data (files in /wflow.log directory)**

File name: mm-yyyy.wfl

1. Day of the month (one or two digits)
2. Time in "hh:mm" format
3. Water sensor ID (one or two digits)
4. Water flow reading (e.g. "2.5")
5. Duration in seconds

One event per line. ASCII encoding.

When multiple water flow sensors are installed additional sensors data can be represented by separate records, one record per sensor. Water flow readings are assumed to be in gallons. Time duration indicates the period of time this water flow reading is for. E.g. if water flow reading is 2.5, and time is 300, it means that during the last 5 minutes (300 seconds) sensor detected the flow of 2.5 gallons of water.

This information allows data consumers to calculate accurate flow rates while allowing variable logging rate speed - some of the sensors may be sending data every minute, other sensors may be sending data every 10 minutes etc. Also it allows data consumers to determine periods of activity and inactivity.

Water flow records are expected to be for periods when there is detectable water flow - absence of a record indicates absence of the water flow. When water flow is detected updates/records are expected every few minutes.

**Temperature sensors data (files in /tempr.log directory)**

File name: mm-yyyy.tem

1. Day of the month (one or two digits)
2. Time in "hh:mm" format
3. Temperature sensor ID (one or two digits)
4. Temperature (e.g. "70.5")

One event per line. ASCII encoding.

Sensor readings represent reading values at the time of the timestamp. E.g. if the reading is 70.5, it means that at the moment of time defined by the timestamp actual temperature was 70.5F. Temperature is assumed to be in Fahrenheit.

**Humidity sensors data (files in /humid.log directory)**

File name: mm-yyyy.hum

1. Day of the month (one or two digits)
2. Time in "hh:mm" format
3. Humidity sensor ID (one or two digits)
4. Humidity reading (e.g. "60")

One event per line. ASCII encoding.

Sensor readings represent reading values at the time of the timestamp. E.g. if the reading is 60, it means that at the moment of time defined by the timestamp actual humidity was 60%. Humidity is assumed to be in %.