

Environment Monitor System

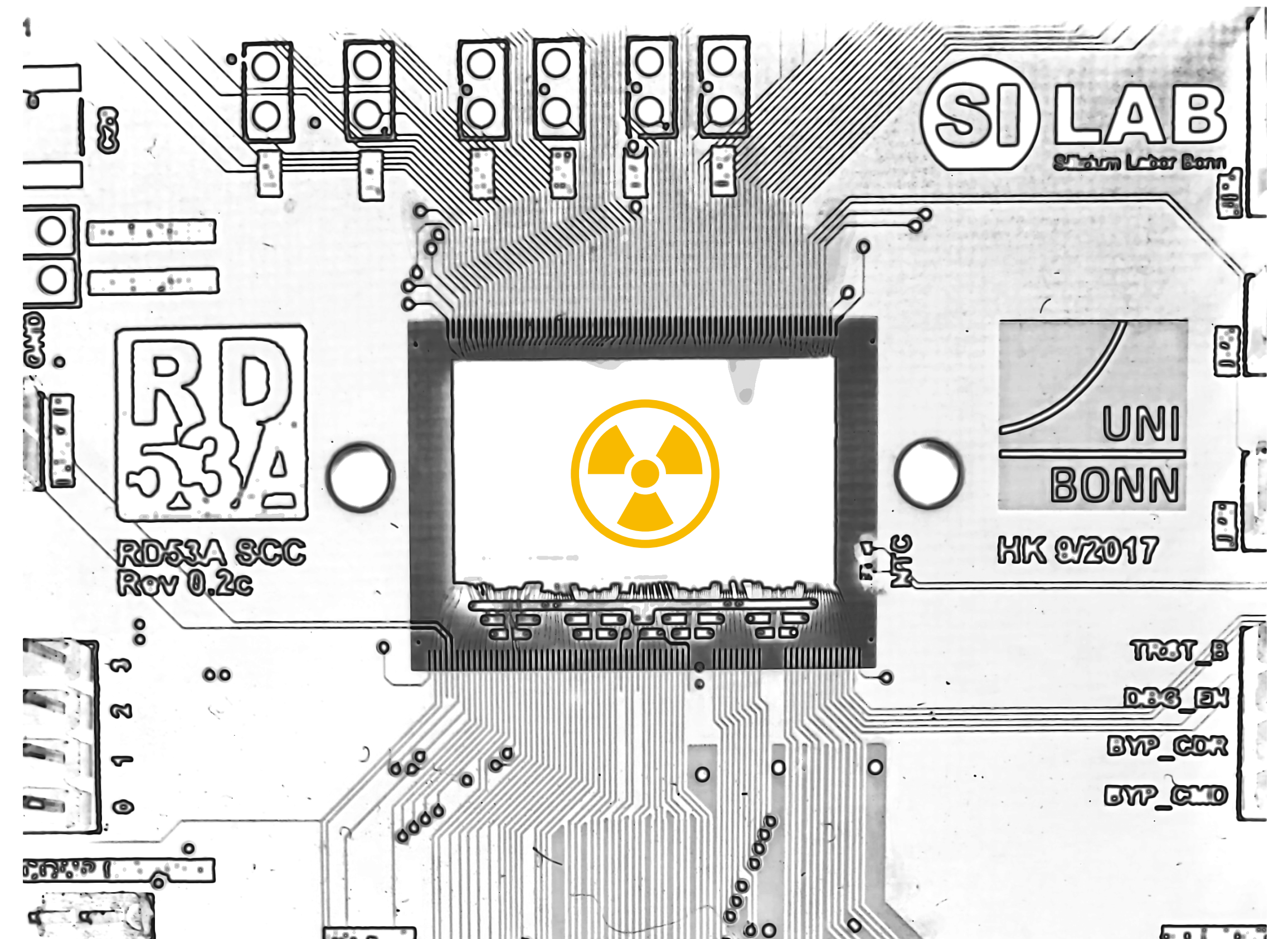
for the Long-term Exposure Experiment

May 25, 2018 Yuxuan Zhang

The long-term exposure experiment

The long term exposure experiment is designed to test the performance and stability of RD53A chip when exposed to radiation.

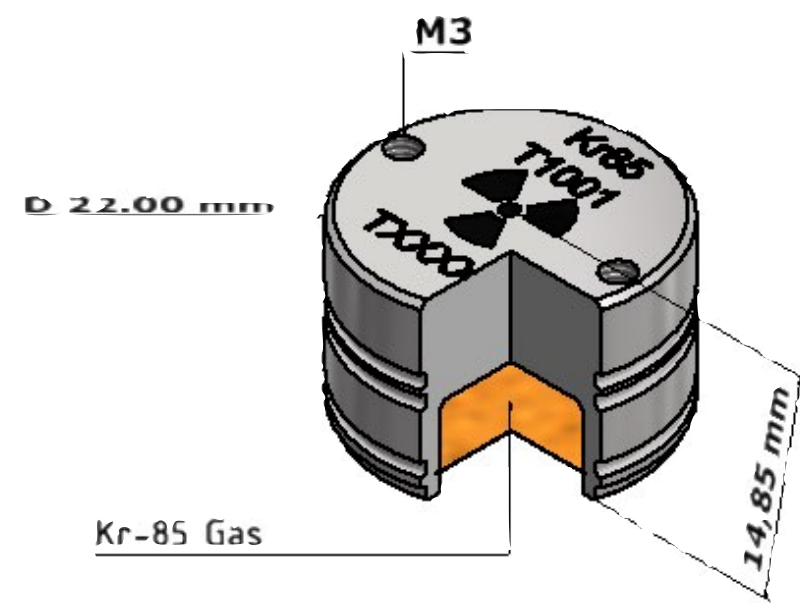
- Last for 2 years.
- Chip Exposed to Radiation Source.
- 2 Independent Sample RD53A Chips.
- 3 Kr-85 Radiation Sources (One for backup).
- Controlled Environment in Freezer.
- Continuous Readout from the Chip.



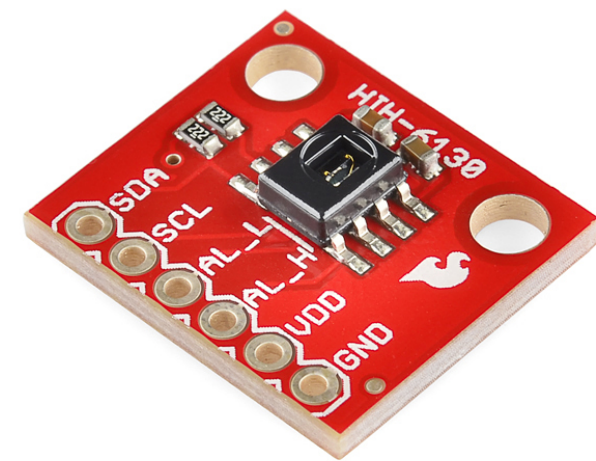
Why we need a monitor system

- **WATCH**
Keep monitoring the environment inside the refrigerator, 7×24.
- **ALERT**
Send an alert when something goes wrong.
- **REACT**
Take automatic actions to protect the chip when necessary.
- **MONITOR**
Give access to the readout data, anywhere around the world.

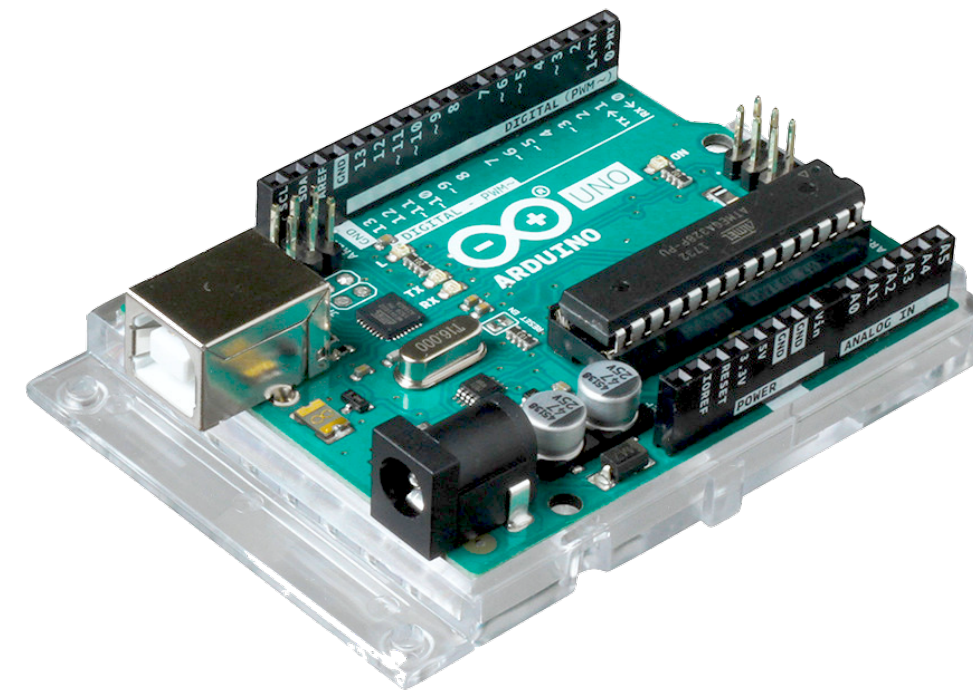
What we need to launch the experiment



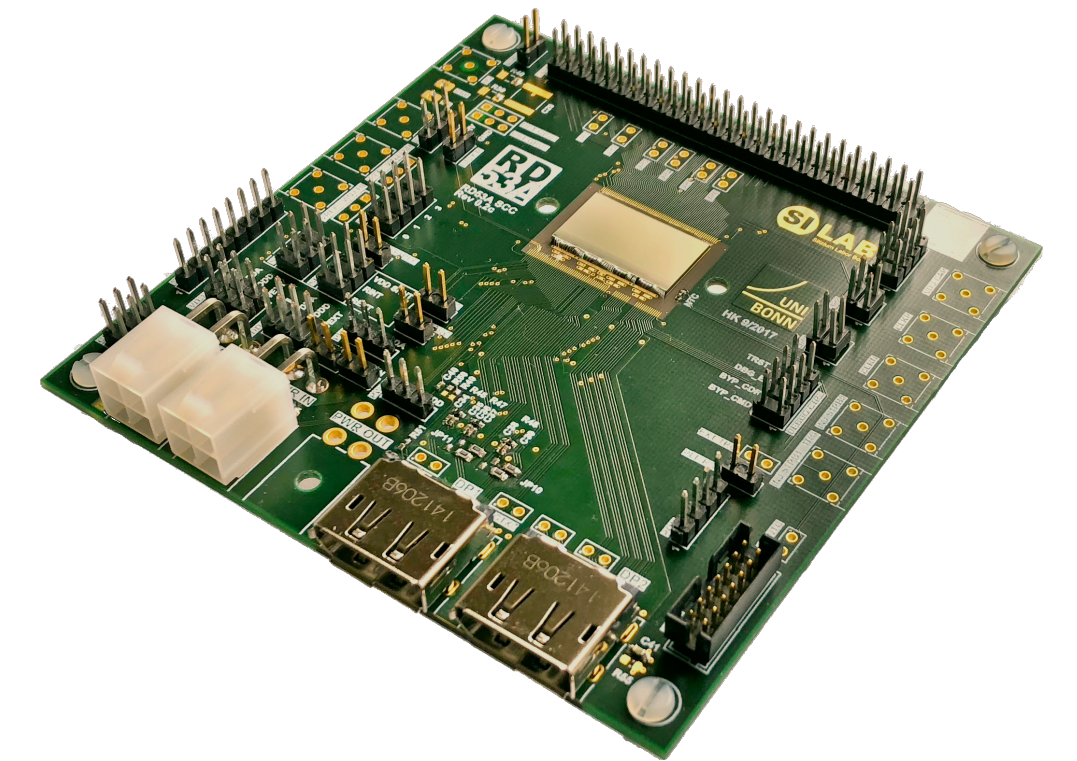
Kr-85
Radiation Source



HIH-6130
The environment sensor



Arduino UNO
Programmed for Sensor Readout

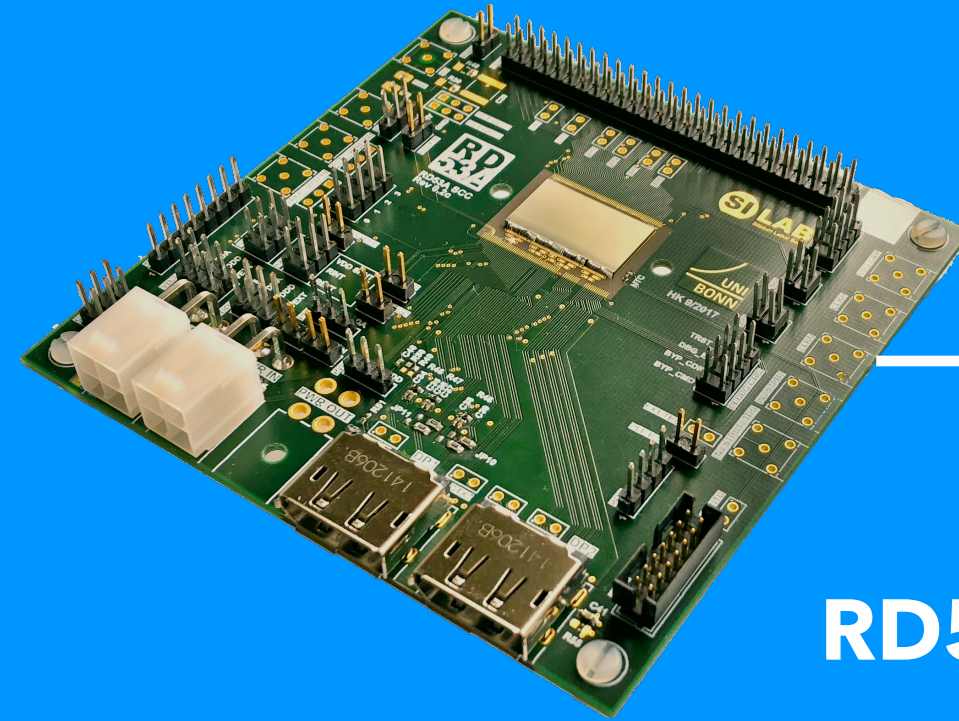


RD53A
To be radiated

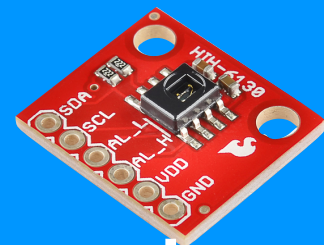
Inside Freezer



Radiation Source
Attached to each chip



RD53A X2



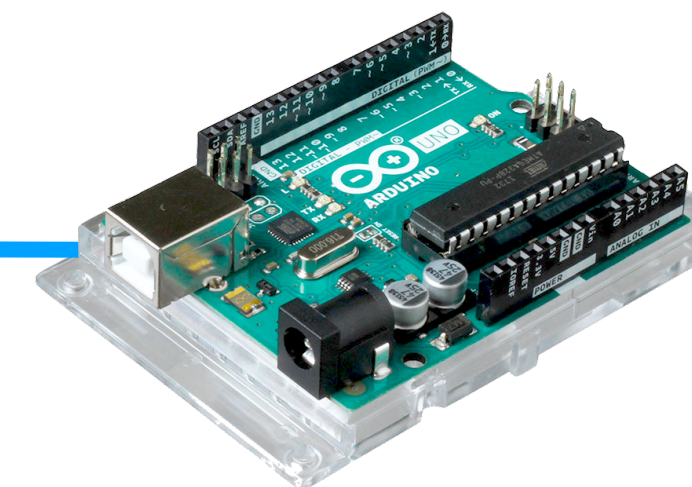
HIH-6130



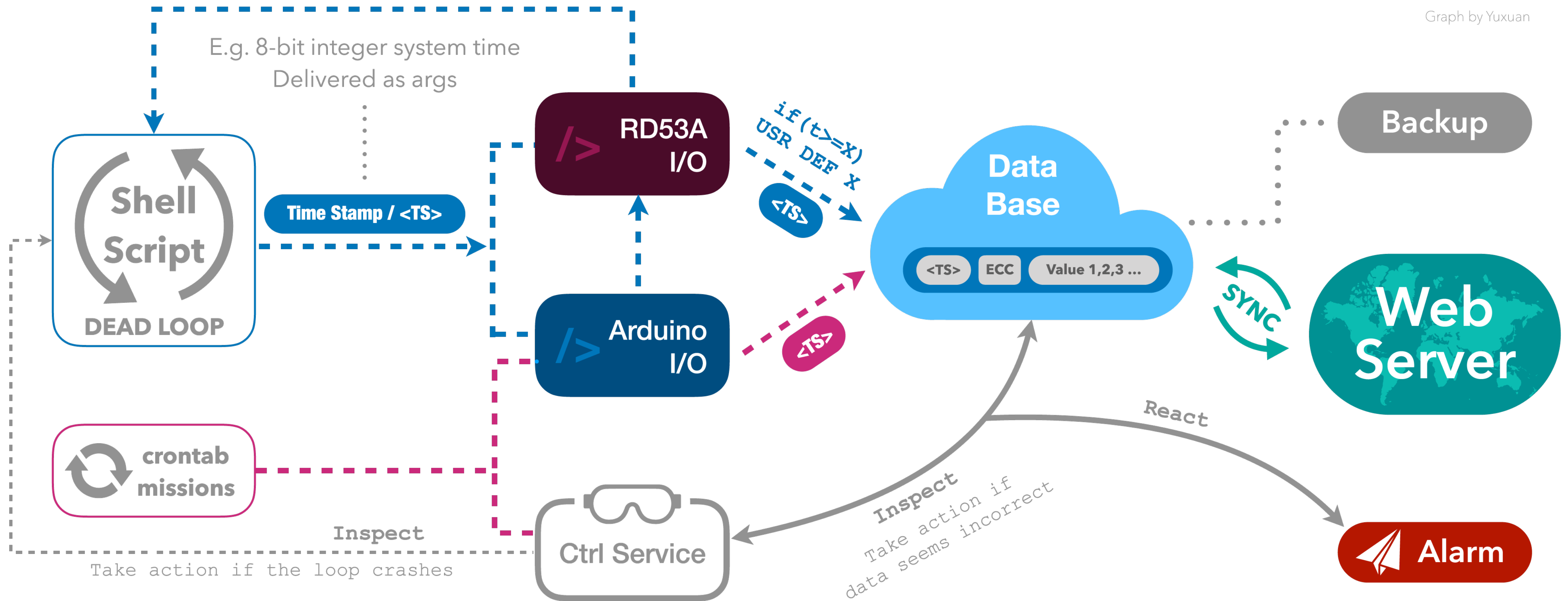
I/O Bus



(LOCAL Database)



USB Serial



Logic Graph of the monitor system

Inside the Database

Log

| Key | Type | Description |
|--------|--------|---------------|
| ID | int | auto-add, PRI |
| SRC | int | mag-source |
| TYPE | int | message-type |
| ERR_ID | int | error-ID |
| CONT | string | detailed-info |
| TS | int | uni-timestamp |
| DT | Time | auto-update |

This table contains information about system updates, regular inspections, and also have log of errors and exceptions.

ENV Data

| Key | Type | Description |
|-------|-------|----------------|
| TS | int | timestamp, PRI |
| ECC | int | err-correct |
| Env_T | float | temperature |
| Env_H | float | humidity |
| DT | Time | auto-update |

This is the data table recording the environment temperature and humidity from Arduino, HIH-6130 sensor. We can easily get a graph of history environment condition using this table. And we can also predict the future humidity and temperature by studying its trend.

RD53A Readout *

| Key | Type | Description |
|---------|--------|-----------------------|
| TS | int | timestamp, PRI |
| ECC | int | err-correct |
| ana_V | float | analog-volt... |
| dig_V | float | digital-vol... |
| Env_T | float | temperature |
| Env_H | float | humidity |
| RD_path | string | readout-file -path |
| DT | Time | auto-update |

There are two tables of this kind, corresponding to two chips being tested.

* These two tables are not yet been created, because the RD53A portal is not ready.

SQL

Log Table

| Field | Type | Null | Key | Default |
|--------------|-----------|------|-----|-------------------|
| TS | double | NO | PRI | NULL |
| ECC | int(11) | YES | | 0 |
| Env_Temp | double | YES | | 0 |
| Env_Humidity | double | YES | | 0 |
| Last_Update | timestamp | NO | | CURRENT_TIMESTAMP |

```
>>
```

```
MySQL -u
```

```
>>
```

```
DESC ARDUINO_IO;
```


SQL

Environment Data Table

| TS | ECC | Env_Temp | Env_Humidity | Last_Update |
|---------------|-----|----------|--------------|---------------------|
| 1526943121482 | 0 | 22.8871 | 51.0387 | 2018-05-21 15:52:03 |
| 1526943181225 | 0 | 22.8569 | 51.0142 | 2018-05-21 15:53:03 |
| 1526943241974 | 0 | 22.8267 | 51.002 | 2018-05-21 15:54:04 |
| 1526943301700 | 0 | 22.8367 | 51.1119 | 2018-05-21 15:55:04 |
| 1526943361434 | 0 | 22.8367 | 51.0142 | 2018-05-21 15:56:03 |
| 1526943421147 | 0 | 22.8367 | 51.0142 | 2018-05-21 15:57:03 |
| 1526943481882 | 0 | 22.8166 | 51.002 | 2018-05-21 15:58:04 |
| 1526943541639 | 0 | 22.8166 | 51.002 | 2018-05-21 15:59:04 |
| 1526943601400 | 0 | 22.8166 | 50.9776 | 2018-05-21 16:00:03 |
| 1526943661150 | 0 | 22.8367 | 51.2094 | 2018-05-21 16:01:03 |
| 1526943721902 | 0 | 22.8267 | 51.124 | 2018-05-21 16:02:04 |
| 1526943781625 | 0 | 22.8166 | 51.0752 | 2018-05-21 16:03:04 |
| 1526943841366 | 0 | 22.8267 | 51.0265 | 2018-05-21 16:04:03 |
| 1526943901104 | 0 | 22.8166 | 50.8679 | 2018-05-21 16:05:03 |
| 1526943961851 | 0 | 22.8166 | 50.8434 | 2018-05-21 16:06:04 |
| 1526944021595 | 0 | 22.8267 | 51.0265 | 2018-05-21 16:07:04 |
| 1526944081345 | 0 | 22.8367 | 51.0387 | 2018-05-21 16:08:03 |
| 1526944141088 | 0 | 22.8166 | 50.7947 | 2018-05-21 16:09:03 |

>>

MySQL -u

>>

```
SELECT *  
FROM ARDUINO_IO  
WHERE ...;
```

SQL

Log Table

| Field | Type | Null | Key | Default |
|------------|--------------|------|-----|-------------------|
| ID | int(11) | NO | PRI | NULL |
| MSG_Source | varchar(20) | NO | | Unknown |
| MSG_Type | varchar(20) | NO | | Unknown |
| Priority | int(11) | NO | | 0 |
| ERR_ID | int(11) | NO | | 0 |
| MSG_Index | varchar(200) | YES | | NULL |
| Stamp | int(11) | NO | | 0 |
| Date_Time | timestamp | NO | | CURRENT_TIMESTAMP |

*This table will soon be updated. See [Github-Repo](#) for details.

```
>>
```

```
MySQL -u
```

```
>>
```

```
DESC Log;
```

Current Status

Left Sensor

3.41V ANALOG VOLTAGE

3.29V DIGITAL VOLTAGE

Right Sensor

3.18V ANALOG VOLTAGE

3.20V DIGITAL VOLTAGE

Environment Status

-22°C Environment Temperature

57% Environment Humidity

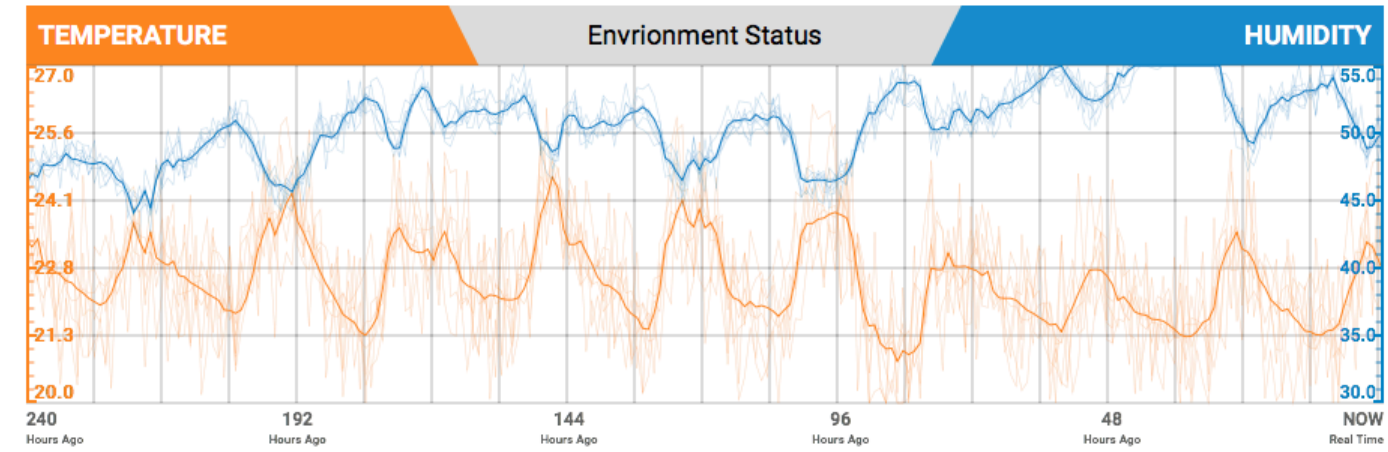
Radiation Source

L R

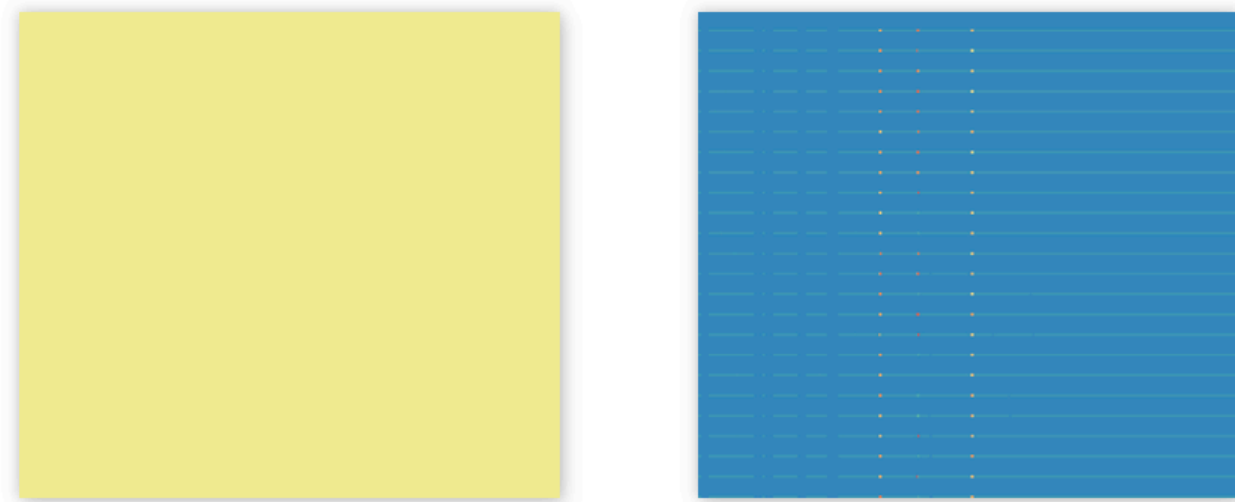
Radiation Source Position

12... AVERAGE

23... AVERAGE



Occupancy Map



System Log

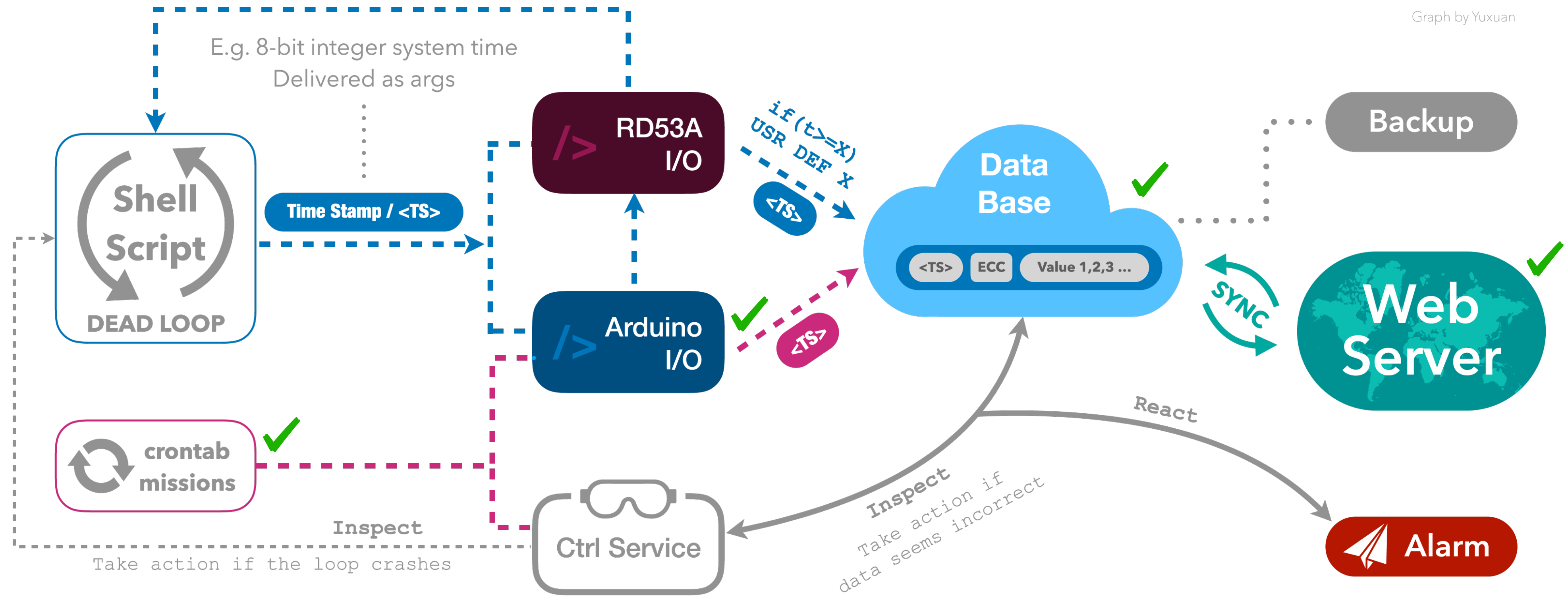
| ID | SOURCE | TYPE | CONTENT | DATE |
|-----|---------------|--------|--|---------------------|
| 244 | Arduino_Board | ERROR | <Serial_Connection_Error> Serial_Port_Not_Responding /dev/ttyACM1 (Abort) | 2018-05-18 16:43:02 |
| 243 | Arduino_Board | ERROR | <Serial_Connection_Error> Serial_Port_Not_Responding /dev/ttyACM1 (Abort) | 2018-05-18 16:42:01 |
| 242 | VERSION | Note | V4.18 Upgrade Note: V4.18 Log table filter is plugged into the webpage | 2018-05-16 15:17:01 |
| 241 | VERSION | UPDATE | From V4.17 To V4.18 | 2018-05-16 15:17:01 |
| 240 | VERSION | Note | V4.17 Upgrade Note: V4.17 This version is made compatible with Github versioning | 2018-05-15 10:57:01 |
| 239 | VERSION | UPDATE | From V4.16 To V4.17 | 2018-05-15 10:57:01 |
| 216 | Arduino_Board | ERROR | <Arduino_Board_Error> INVALID_Serial_INPUT 11517 476207600 11100 | 2018-04-25 20:50:04 |

Front End Development and Webpage Demo

[CLICK ME ^_^](#)

Summary

Graph by Yuxuan



Completed:

- Shell Script `launch.sh config.sh`
- Arduino Portal `Arduino_IO.py` (**AIO**)
- Data Base `MySQL (OR MariaDB)`
- Web Server `WebPageGenerator.py` (**WPG**)
Additional Javascript

Next step:

- I/O Portal `Cpp`, triggered @intv
- Control Service `Python`, always alive
- Backup Enabled thru lab system