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Resense: Transparent Record and Replay of Sensor Data in the Internet of Things

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Abstract

Conducting repeatable and scalable experiments on Internet of Things (IoT) test beds requires **(i)** manual fine tuning with extensive A/B testing and **(ii)** edge case / rare event testing that leads to extremely long test durations.

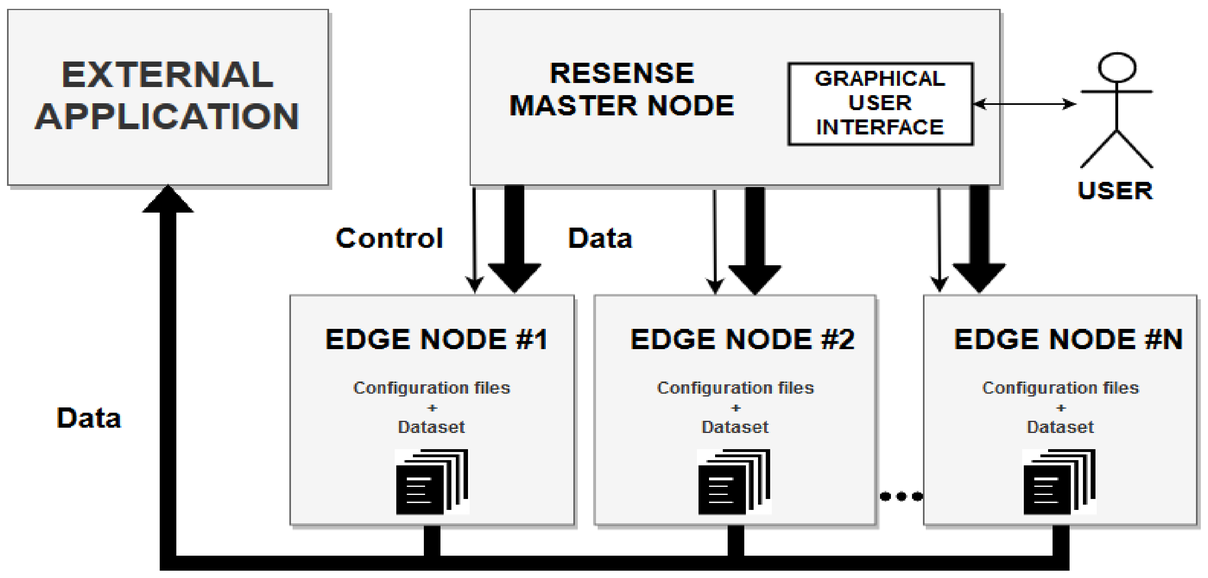
Being able to **replay** sensor data on real test beds **enables** researchers to run **repeatable experiments** without these problems.

In this paper we make the following contributions:

1. We show how to transparently emulate sensors in order to record and replay sensor data.
2. We provide an easy to use software for setting up and executing IoT experiments involving heterogeneous sensors.
3. We demonstrate recording and replaying real world sensor data in the context of sports analytics on a set of Raspberry Pis.

Our proposed **Resense** framework **allows** for replaying sensor data using **emulated sensors** and **provides** an easy-to-use software for setting up and executing **IoT experiments**.

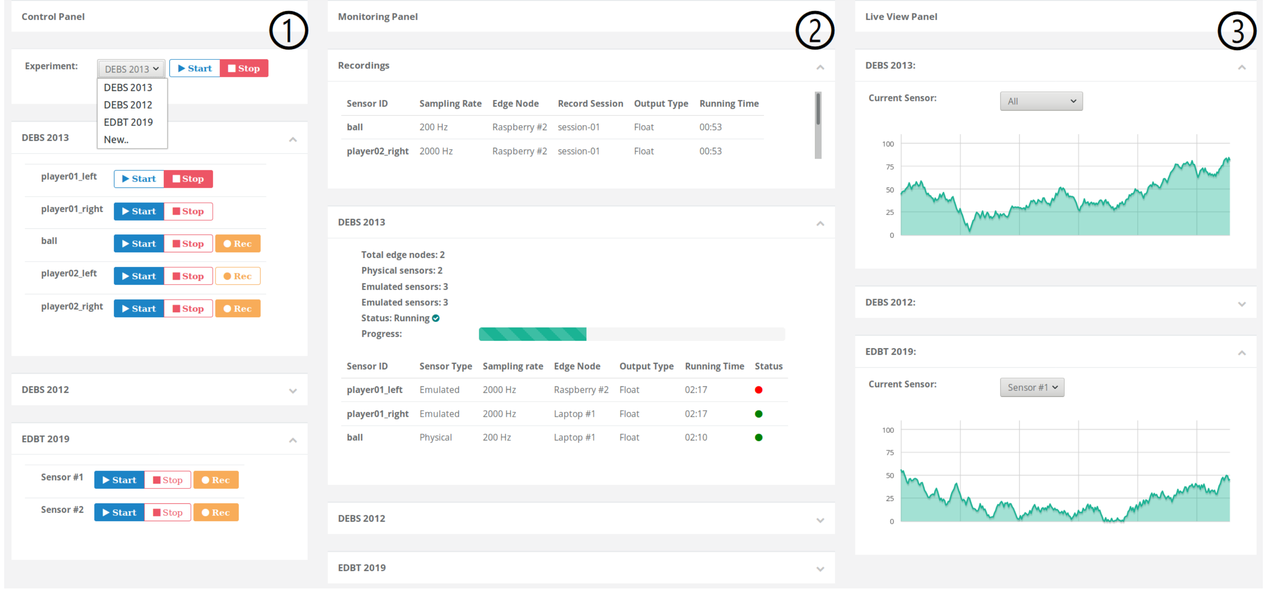
Resense Architecture



- Master/Slave approach to administrating nodes
- Users can control Resense through a Graphical User Interface
- Deployment of sensor data and configuration to edge nodes
- Replay and record data on demand

For external applications, it is transparent whether they read from physical or emulated sensors.

Experiment Dashboard



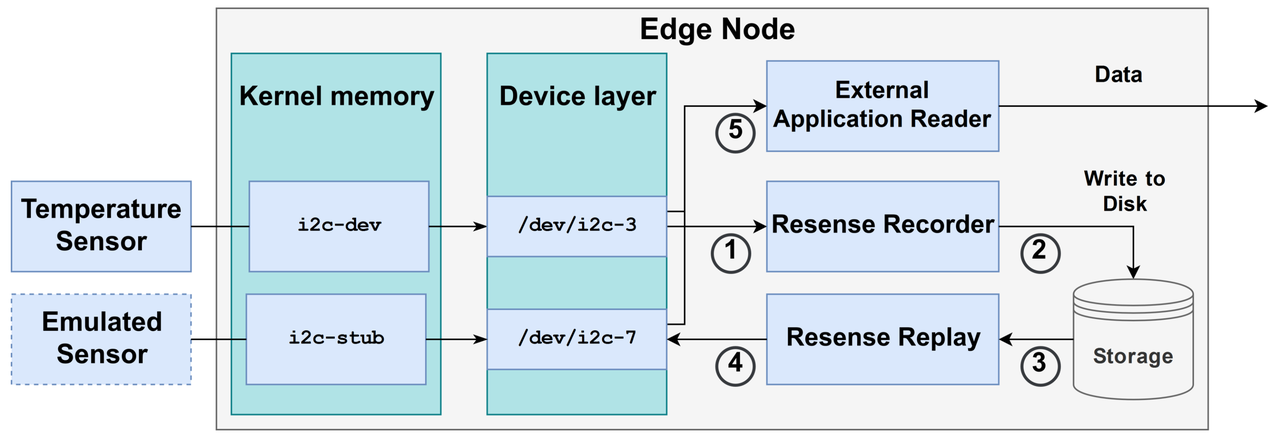
Resense's UI is split into **three main panels**:

① **Control panel**, shows list of experiments and sensors involved in the current configuration.

② **Monitoring panel,** displays statuses of current recordings and experiments that are running.

③ **Live view panel,** shows time series data for sensor readings for currently running experiments.

Edge Node Internals



① **Resense Recorder** reads values from a physical sensor.

② The **value is stored** for later use in replays by the system.

③ **Resense Replay** reads the values stored by the **Recorder**.

④ **Resense Replay** writes the values to emulated sensors that are allocated in **kernel memory**.

⑤ **External applications** can still read from both, physical and emulated sensors, since they **access them the same way**.

Open Source Repository

Resense open source repository:
https://github.com/TU-Berlin-DIMA/resense

Experiment Configuration

```
"experiment": "edbt-2019",
"nodes": [
{
  "edgeId": "edge-2",
  "host": "192.168.1.2",
  "user": "pi",
  "password": "raspberry",
  "sensors": [
    {"sensorId":"ball","type":["Integer"],"address":3},
    {"sensorId":"referee_left","type":["REAL"],"address":4}
  ]
},{...}]
```

An **example configuration** that portrays part of a sensor testbed setup that **replays data from a football match**.

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