

Real Time Sensor Readings on a Raspberry Pi

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Outline

- **Background**
- **Objectives**
- **Hardware**
- **Software**
- **Applications**
- **Conclusions**

Background

- **Raspberry Pi OS not real-time**
 - **Debian Linux derivative**
- **Microkernel or RTOS needed**
 - **Enables real-time programming**

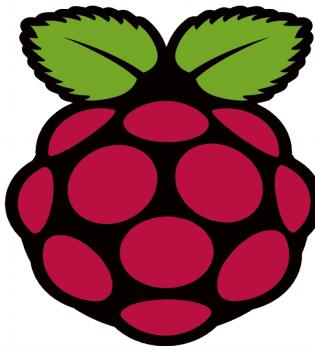


Image courtesy of the Raspberry Pi Foundation.

Objectives

- **Read sensors in real time on Pi**
- **Obtain sensor data within timing constraints**
 - **Encoder: 5ms**
 - **Humidity & temperature: 100ms**

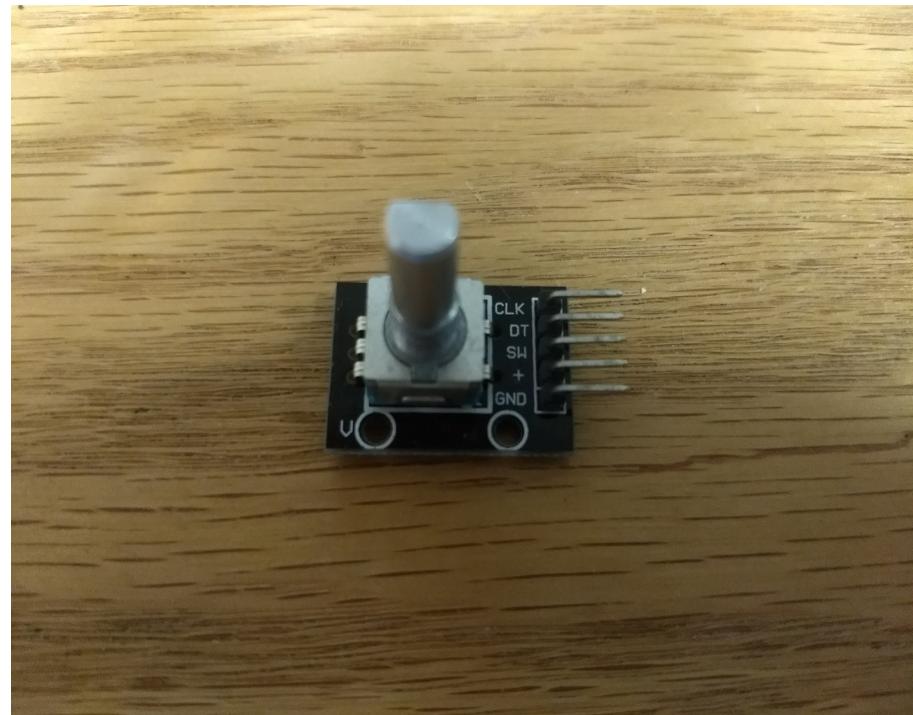
Hardware

- **Raspberry Pi**
- **Rotary Encoder**
- **DHT11 Sensor**



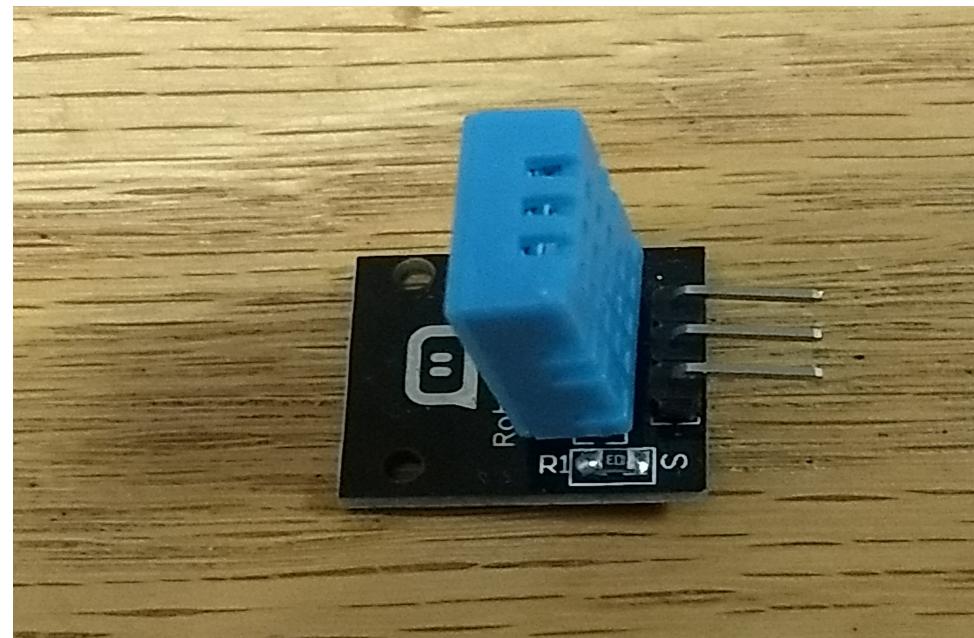
Hardware: Rotary Encoder

- **Twenty pulses per cycle**
- **Four pins used**
 - **5V Rail**
 - **Ground**
 - **Switch**
 - **Data**

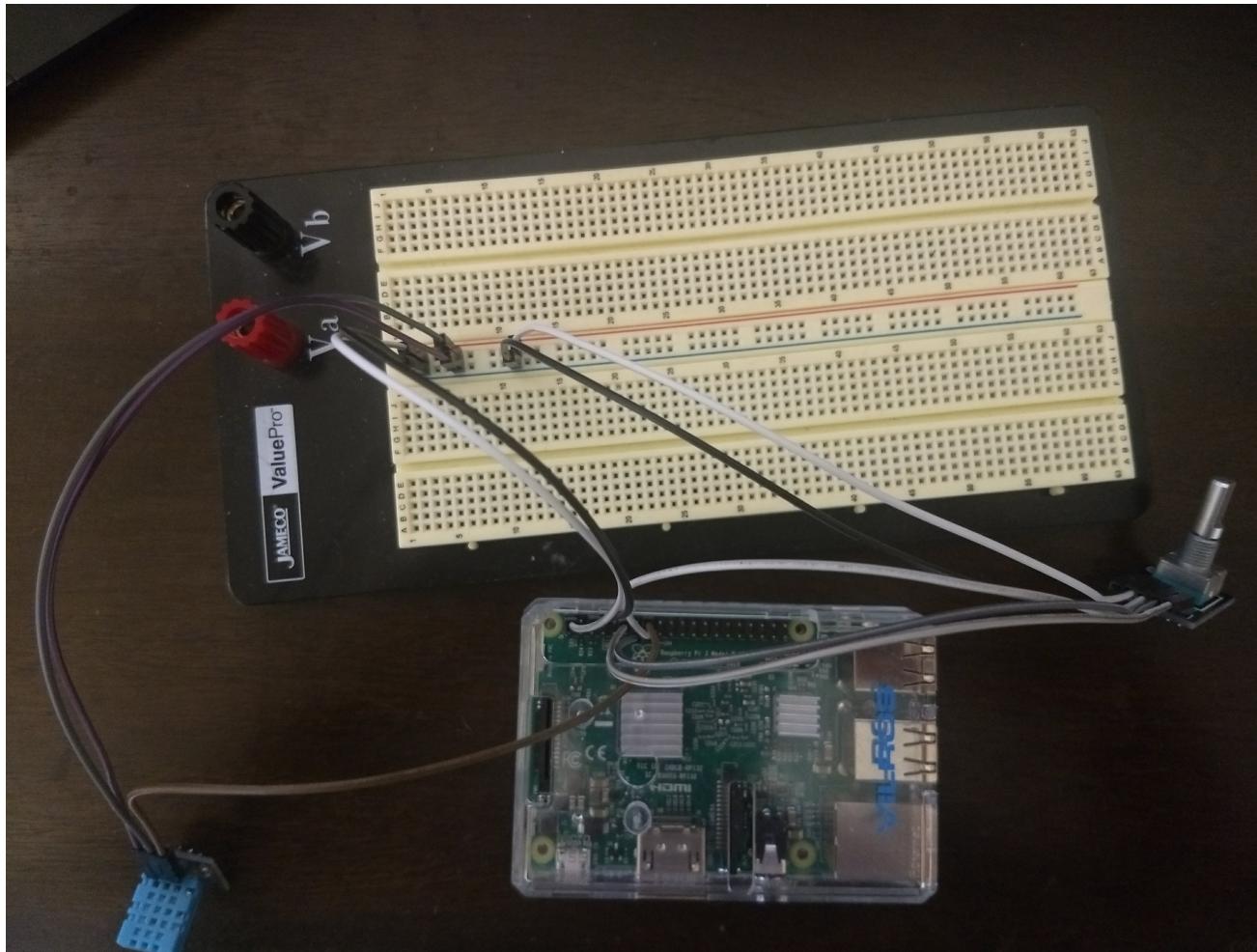


Hardware: DHT11 sensor

- **Records temperature and humidity**
- **Checksum to validate data**
- **Three pins used**
 - **5V rail**
 - **Ground**
 - **Data**



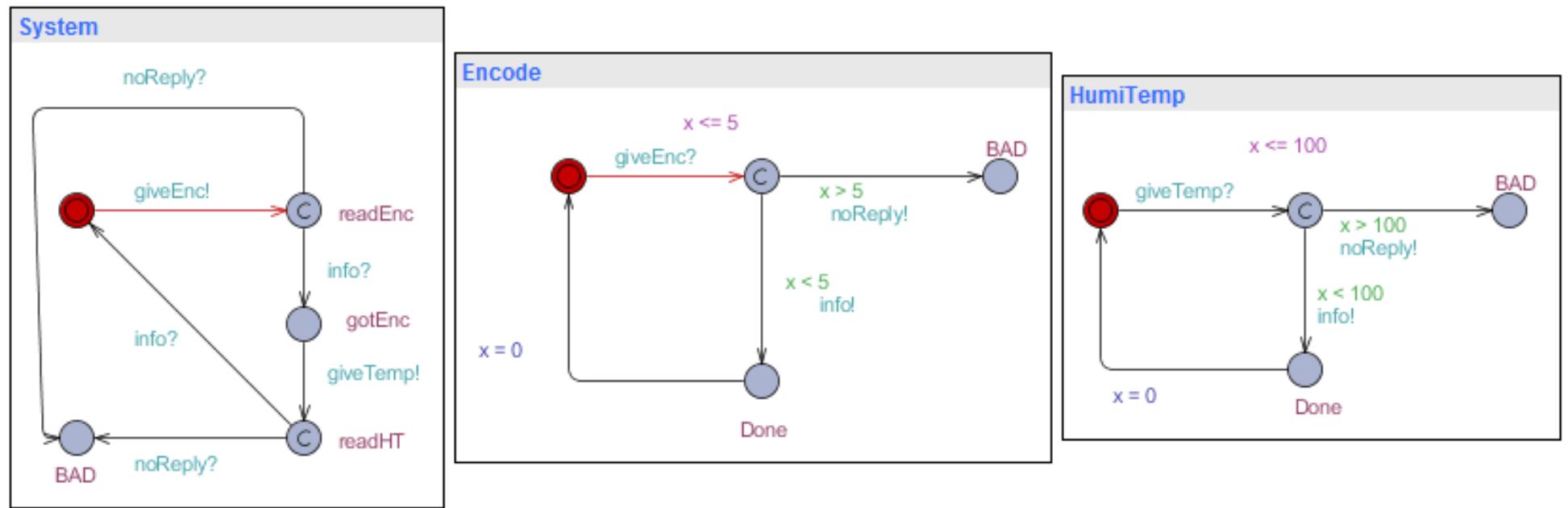
Hardware



Software

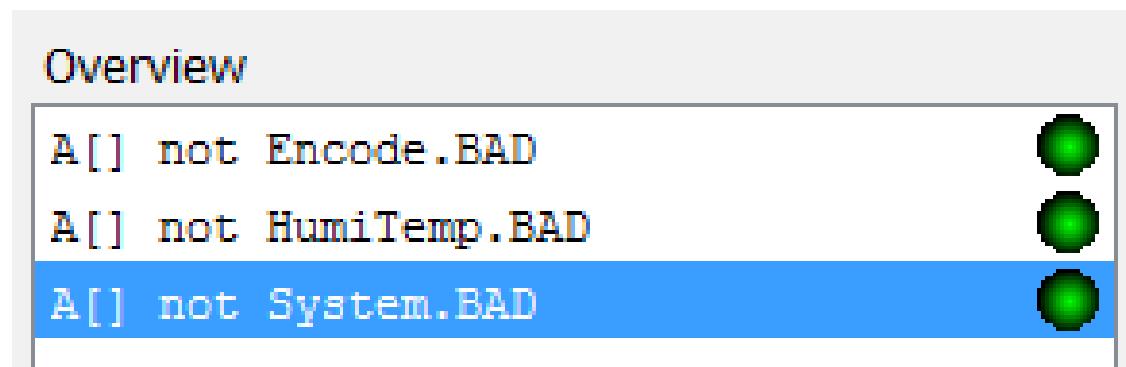
- **UPPAAL Model**
- **Xenomai Functions**

UPPAAL Model



UPPAAL Verification

- Neither the system nor either sensor enter a bad state



Xenomai Functions

- **Initialization**
 - `rt_task_create()`
 - `rt_task_start()`
- **Scheduling**
 - `rt_task_set_periodic()`
 - `rt_task_wait_period()`
- **Deletion**
 - `rt_task_suspend()`
 - `rt_task_delete()`

Applications

- **Extensibility**
- **Greenhouse Atmospheric Control**
- **Hospital Air Quality Monitor**
- **Hiking/Climbing Safety Monitor**

Questions