

Box 'o' Sensors

STEM Project Instructions

Goals

Gather sensor data over time. Analyse the resulting data and identify anomalies.

Hypothesise the reason for anomaly.

Learn how Rolls-Royce uses sensor data over time to detect faults in engines.

Teacher Instructions

Introduction

The project centers around a Raspberry Pi 3 computer.

Attached to the computer is a SenseHAT.

The SenseHAT features a range of sensors that can be accessed by the Raspberry Pi:

- Temperature
- Humidity
- Pressure
- Accelerometer
- Gyroscope
- Magnetometer (Compass)

This selection of sensors is similar to those used inside Rolls-Royce engines.

The Raspberry Pi has some software on it which regularly stores data from each one of these sensors into Comma Separated Value (csv) files which can later be read into Excel.

An extension of the activity may be to get the children to write the software for the Raspberry Pi.

You can use this experiment in a couple of ways.

You can either place the Raspberry Pi in a place over a couple of days and gather a reasonable amount of 'natural' information as the school operates day-to-day. Or you can operate the experiment on a much shorter time frame. For example, putting the Raspberry Pi next to a kettle, boiling the kettle, and analysing the data showing the humidity, temperature and vibrations changing.

Required Items

To run the activity, you'll need:

- A laptop
- Some way to read an SD card – either by a USB reader, or built into the laptop
- A place to put the Raspberry Pi close to a power socket and away from curious hands.
- Microsoft Excel, or Libre Office Calc

Set Up Instructions

Setting up the project is simple.

- Ensure the SD Card is in the Raspberry Pi
- Ensure the SenseHAT is securely attached to the Raspberry Pi
- Plug the power cable into the Raspberry Pi
 - Check that the lights on the SenseHAT come on in a rainbow pattern
- As prompted on the display. Use the joystick to select the time interval for gathering data. You can select either long, or short durations depending on if you're leaving the Pi in a place for a while, or running the experiment for a few mins, or an hour.
- Ensure that a light on the SenseHAT flashes green continuously.
- Leave the Raspberry Pi for a reasonable period of time in a single place
- Once a time has passed, 'click' the joystick and wait until the SenseHAT shows a red light.
- Once the Pi states you may shut it down. Push the joystick down to turn it off.
- Unplug the Raspberry Pi
- Remove the SD Card
- Put the SD Card into a laptop
- Copy the {environment, gyroscope, accelerate}[Today's Date].csv files to a place where the children can access it
- Open the CSV files in Excel or LibreOffice Calc, or similar, and utilise the data to generate line graphs showing time vs data

Script for introduction to children

We'll be using a Raspberry Pi computer to collect data from various sensors over time.

Once time has passed, we'll be collecting that data into Excel and making some graphs from it.

Hopefully, we'll be able to see how the environment changes over time, and be able to guess at what causes those changes. For example, does the temperature go up from 8:30am to 3:30pm? Why do you think that is?

What we're doing is very similar to what Rolls-Royce does with their jet engines.

They monitor the data over time and watch to see when things change from normal.

For example, when the temperature goes up above the normal state, we know that something isn't right, and we can fix it.