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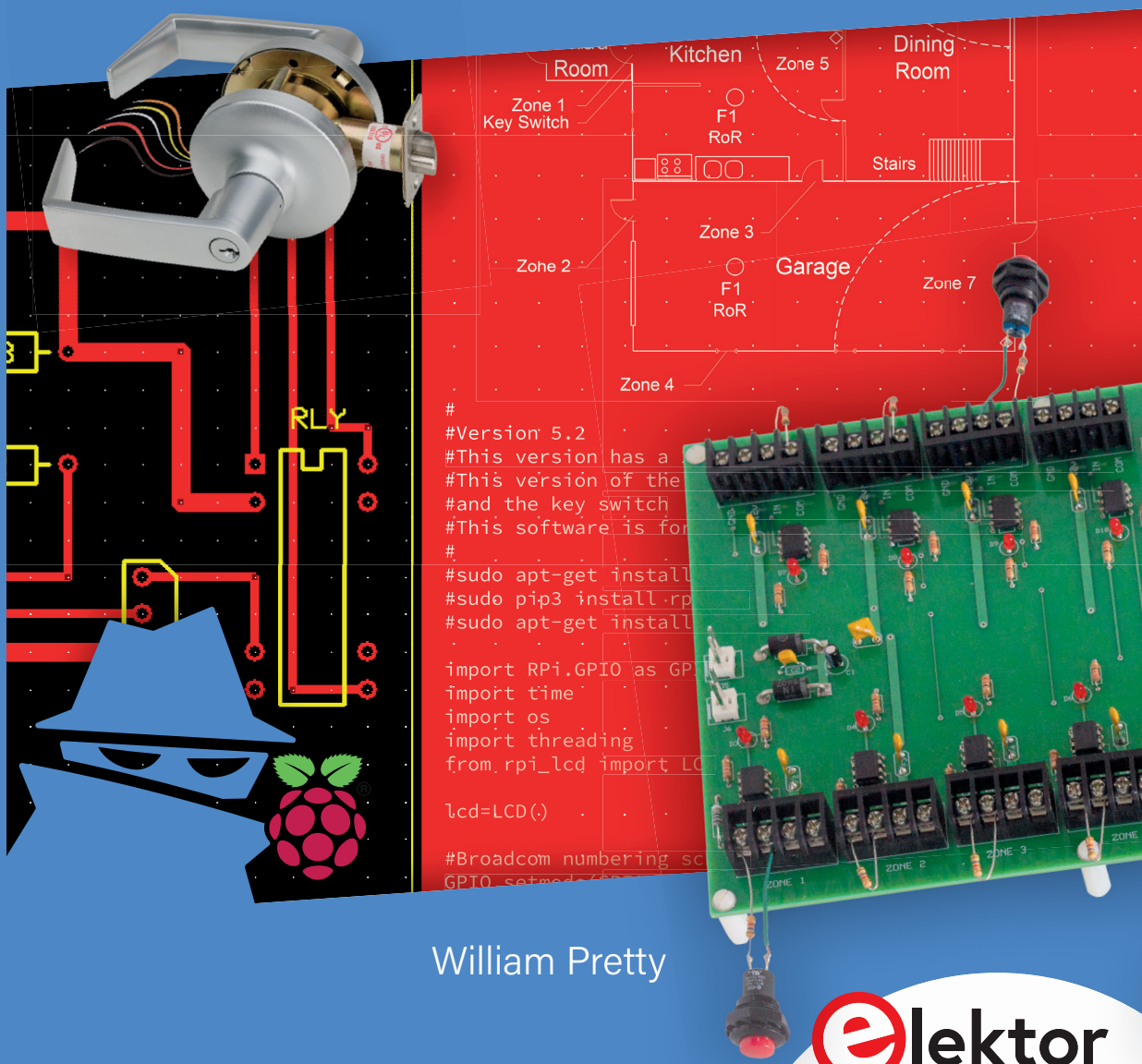
Building an High-Tech Alarm System with Raspberry Pi



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Chapter 1 • Introduction to Alarm Systems

In this chapter we will discuss the basic components of any alarm system. All alarm systems have two basic functions. First, they monitor their environment looking for a change such as a door or window opening or someone moving about in the room. The second function of the system is to alert the human to this change. Our alarm system uses a scanning type software to detect intruders. We will use the 'standard' guard dog as an analogy. In a scanned type of system, the guard dog paces back and forth at the fence looking out for either an intruder or someone that it recognizes. In our design, if you have an alarm key, you can disarm the system and enter. In an interrupt driven system, the dog is asleep until it hears an intruder (or you). It then wakes up and deals with the situation. I have chosen the scanning method because in my opinion the software is easier to write and explain. It can scan all eight zones in about one second.

You don't have to be an electrical engineer to install an alarm system, just a good carpenter, painter, and plasterer! I'm not by the way so I'll leave hiding wires up to you.

Also, because our alarm system runs on 12 volts, you don't have to be a licensed electrician to install it. If you can plug in a wall adapter, you can build and test this alarm system.

Alarm System Sensors - Door / Window Contact

The simplest and one of the most common sensors is the door / window contact. This sensor consists of a magnet which is installed on the moving part of the door or window. This magnet holds a switch closed. The switch portion of the sensor is attached to the door or window frame. Figure 2 shows what is inside a typical sensor of this type.

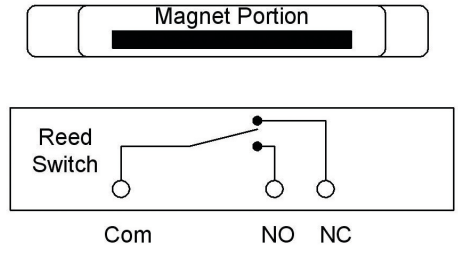

Figure 1-1. Door / Window Contact Schematic

Figure 1-2. Door / Window Contact

Motion Detectors

The next most common sensor is the PIR or Passive Infra-Red detector. This sensor measures the ambient temperature of the room and waits for a change in the ambient. Often called a 'blip'.

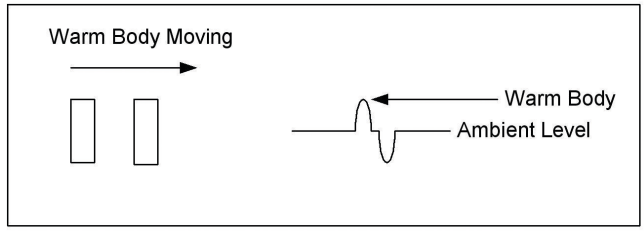

Figure 1-3. How PIR Sensor works

Simple PIR sensors tend to be fooled by large pets (like your guard dog). For that reason, they have a "pet" setting which ignores any object less than 30 pounds, which is moving close to the floor. More modern (expensive) sensors also have a mmWave sensor built in which tends to reduce false alarms and makes the sensor harder to fool. The dual sensor is about three times the price of a simple PIR detector and communicates with the panel with the same contact switch arrangement.

Figure 1-4. PIR Motion Sensor

Glass Break Sensor

Another type of sensor is the glass break sensor. This type of sensor is commonly used by shop owners to help detect vandalism. This sensor uses a microphone to 'listen' for the sound of breaking glass.

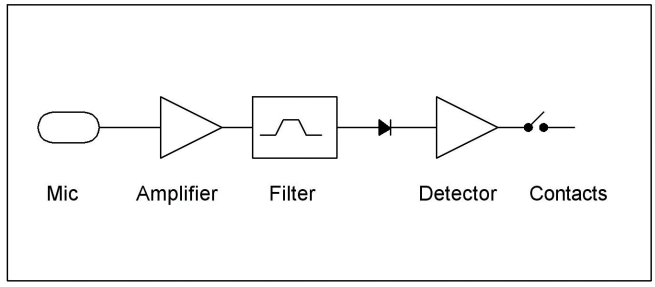

Figure 1-5. How Glass Break Sensor works

The system consists of a sensitive microphone, an amplifier, and a filter (usually digital signal processing). The output of this filter is connected to a detector circuit which activates the alarm system contacts when the sound of breaking glass is 'heard' by the microphone.

Figure 1-6. Typical Glass Break Sensor

Fire Alarm Sensors - Heat Detectors

There are two basic types of heat detectors, mechanical and electronic. The electronic type of detector uses a thermistor as the sense element. A thermistor is type of resistor that changes its value based on the ambient temperature. In practice two thermistors are used. One resistor is exposed to the ambient air and the other is partially sealed from the surrounding air. A fast rise in the air temperature, for example from an open flame, is sensed by the resistor which is exposed to the surrounding air. The resistor changes its value, and an alarm is triggered. A slow rise in temperature, from a smoldering fire, is sensed by both resistors and again an alarm is triggered.

There are two types of mechanical heat detector, bimetallic and pneumatic.

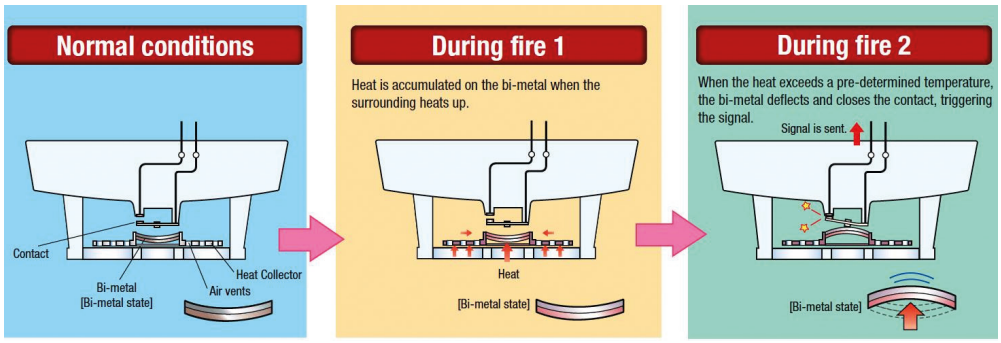

Figure 1-7. Bimetallic Heat detector © Hochiki

A bimetallic heat detector contains a metallic strip consisting of two different metals bonded together. When heat reaches the strip, it bends until the contacts are closed and an alarm condition is signaled.

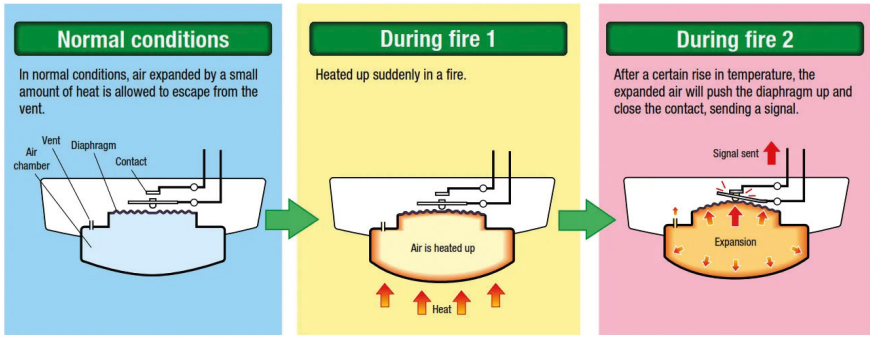

Figure 1-8. Pneumatic Heat sensor © Hochiki

Another type of heat detector is the fixed temperature heat detector. As the name suggests, the sensor is set to trigger at a specific temperature. The trigger temperature is usually marked on the outside of the device. The device shown below is a combination of ROR and fixed temperature device.

ROR heat detectors may not respond to smoldering fires. For that reason, a fixed element is also included in the device, in order to detect this type of fire. The small metal disk in the center of the unit is part of fixed element. In the bottom view, you can see a tube in the center of the device. This tube is filled with a wax like substance which is designed to melt at a preset temperature. In this case 136F or 67C. The small, pointed tube to the right of the large tube is the vent for the rate of rise detector.

Figure 1-9. Fixed Temperature / ROR Alarm

Figure 1-10. Bottom View

Heat detectors are useful in areas such a garages, kitchens, or workshops. Where a certain amount of smoke or fumes is 'normal' but would trigger a smoke alarm. This is due to dust or smoke particles in the air.

Fire Alarm Sensors - Smoke Alarms

There are three types of smoke alarms. These are photoelectric, ionization and a combination of both. The ionization type smoke detector uses a small radioactive source, usually americium-241. The detector consists of two positive and negative charged electrodes inside an ionization chamber.

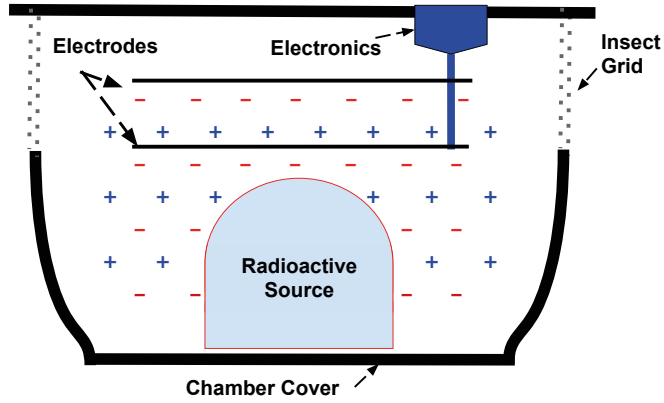

Figure 1-11. Ionization Smoke Detector

The radioactive alpha particles cause a small current to flow between the two electrodes. This current is sensed by the electronics of the detector. If smoke particles enter the chamber thru the bug screen, then the current flow is interrupted.

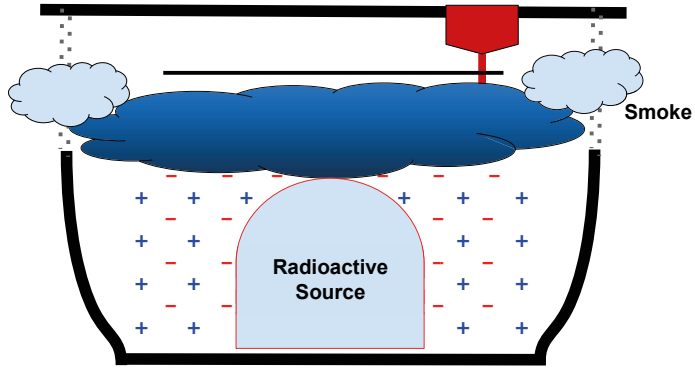

Figure 1-12. Smoke enters the detector

Once enough smoke has entered the chamber, the current change is detected, and an alarm condition is sent to the alarm panel. This type of detector is called a four-wire detector, because two wires are used to power the electronics and two are used for the alarm contacts.

The other type of smoke detector is the photoelectric based detector. There are two types of photoelectric smoke detector. The first type we will be discussing is the scattering type detector.

There is no direct path between the light source and the light receiver. This is due to a series of baffles inside the detection chamber.