Discover Engineering!
Workshop on rapid prototyping of a
"High-tech" Security System

The code to run the security system circuit is available at:

Program Code:

```c
/*
hightech_security: Code for an Arduino-based, "high-tech" security system.
The code runs on an Arduino Uno connected to an ultrasonic range sensor, LEDs and a buzzer.
Passing through the security "beam" (ultrasonic range sensor) triggers an alarm!
*/

#define LEDGREENPIN 3
#define LEDREDPIN 4
#define BUZZERPIN 11
#define TRIGGERPIN 10
#define ECHOPIN 9

int alarm_activated = 0; // has the alarm been triggered yet?
int door_width; // the normal distance that the guarding "beam" covers

// Function used to measure distance using ultrasonic range sensor
int measure_distance_ultrasonic() {

  // Send an output pulse to the sonar sensor (1ms wide)
  digitalWrite(TRIGGERPIN, HIGH);
  delay(1); // wait 1ms
  digitalWrite(TRIGGERPIN, LOW);

  // Measure the time taken to receive the pulse back
  // Will be "0" or "-1" if no pulse is received
  int duration = pulseIn(ECHOPIN, HIGH);

  // Formula for the distance is half the duration, then divide by 2.910
  // to get distance in mm
  int distance = (duration/2) / 2.91;
  return distance;

}

// Function to activate the alarm!
void sound_alarm() {
  digitalWrite(BUZZERPIN, HIGH);
  digitalWrite(LEDREDPIN, HIGH);
  delay(500);
  digitalWrite(BUZZERPIN, LOW);
  digitalWrite(LEDREDPIN, LOW);
  delay(500);
  digitalWrite(BUZZERPIN, HIGH);
  digitalWrite(LEDREDPIN, HIGH);
  delay(500);
  digitalWrite(BUZZERPIN, LOW);
  digitalWrite(LEDREDPIN, LOW);
  delay(500);
  digitalWrite(BUZZERPIN, HIGH);
  digitalWrite(LEDREDPIN, HIGH);
  delay(500);
  digitalWrite(BUZZERPIN, LOW);
}
```

```
// This function is called once at the start of the program
void setup() {
  Serial.begin(115200);

  pinMode(LEDGREENPIN, OUTPUT); // Green LED can be switched on/off from this pin
  pinMode(LEDREDPIN, OUTPUT); // Red LED can be switched on/off from this pin
  pinMode(BUZZERPIN, OUTPUT); // Active Buzzer can be switched on/off from this pin
  digitalWrite(BUZZERPIN, LOW); // Turn it off to begin with!

  pinMode(TRIGGERPIN, OUTPUT); // Sonar pulses will be sent out of the Arduino
  pinMode(ECHOPIN, INPUT); // Echo pulses will be received into the Arduino

  delay(50);
  door_width = measure_distance_ultrasonic(); // measure initial doorway width

  Serial.print("door width (mm):\n");
  Serial.print(door_width);
  Serial.print("\n");

  pinMode(13, OUTPUT); // switch off on-board LED for now
  digitalWrite(13, LOW);
}

// This function is called repeatedly by the program
void loop() {

  if (alarm_activated == 0) { // not actived yet
    digitalWrite(LEDGREENPIN, HIGH); // green light on
    digitalWrite(LEDREDPIN, LOW); // red light off

    int distance = measure_distance_ultrasonic(); // measure current doorway

    if (distance < 0.8*door_width) { // something is passing the door! (0.8 to avoid false alarms)
      digitalWrite(LEDGREENPIN, LOW);
      sound_alarm(); // Sound the alarm!
      alarm_activated = 1; // we only want to sound the alarm once, switch off future checks
    }
  }
  delay(50);
}
```

Coding Instructions:

- **Setting up the Arduino IDE:**
  - Go to the web address above and click on the link to the code file called "security_system.ino"
    - This contains the code for the device: we will compile this code and upload it to your Arduino using the Arduino software on your laptop/computer and the USB cable
  - Open up the software/program "Arduino" on your laptop/computer (sometimes called the "Arduino IDE"):
    - If you don't have this installed already, you can download it for free from https://www.arduino.cc/en/software
    - Connect your Arduino to a USB port on your laptop/computer
    - The software should automatically detect your Arduino and which USB it is connected to, but if it doesn't, you can click on the drop-down menu towards the top left of the screen to select "Arduino Uno"

- **Compiling and running the code:**
  - Go to the menu "File" then "New" to start a new Arduino sketch
  - Delete the contents of the new file then copy and paste the code into this file
  - Click on the "Verify/Compile" button (the big tick inside a small circle, located up the top left of the Arduino IDE window) to compile the code.
    - If there are any code errors, and error message in orange writing will appear at the bottom of the program window
  - The click on the "Upload" button (the right-facing arrow in a circle at the top left of the Arduino IDE) to upload your code to your Arduino and run your program

- **Running your device:**
  - Once the code uploads, your device will begin running
  - The device takes a measurement of the distance in front of the ultrasonic range sensor as a "calibration" of the size of the doorway it will guard.
  - If the sensor detects something in the way, the alarm will sound!
  - To reset the alarm system, press the small red button on top of the Arduino: this will re-start the program, take a new calibration measurement and look for any further intrusions!