

Solutions

Chapter 10: Project: Embedded systems

Questions, pages 98–9

- 1 This Digital Dice system has only one input device, which is the button. However, the inputs to the system are data and electricity. This system has seven output devices, which are the seven LEDs. Outputs for this system are light and a very small amount of heat.

If you added a piezo buzzer to this system, then the system would also generate sound as an additional output.

2 Control structures:

The main Setup and Loop functions are both types of control structures. Within these structures we have a FOR loop within the Setup function to set the pin mode of each of the LED pins.

Within the Loop function we have an initial IF statement to check if the button has been pressed, and then we have six nested IF statements that check what the random number is to provide the dice pattern on the LEDs.

Finally, we have a FOR loop that sets the status of the LEDs to low.

Data Structures:

There are five global variables of type 'int' (integer) declared at the top of this code; one of which is an array (led_pins).

The local variable 'thisPin' is also a data structure (integer) and is used within each of the FOR loops.

- 3 There are seven conditional IF statement blocks in this code. The first checks to see if the button has been pressed via the 'buttonState' variable, and the other six IF statements produce the dice pattern on the LEDs depending on what random number is produced.

You could replace one of these IF statements with an ELSE statement by selection one of the dice patterns as a 'default' pattern. This would usually be done by choosing either the 'One' or 'Six' pattern as the default. If we chose to make 'Six' the default pattern, then the code within the loop functions would look like the code on the following page.

```

void loop() {
  buttonState = digitalRead(button1);
  if (buttonState == LOW){
    ran = random(1, 7);
    if (ran == 1){
      digitalWrite (led_pins[3], HIGH);
      delay (pause);
    }
    if (ran == 2){
      digitalWrite (led_pins[2], HIGH);
      digitalWrite (led_pins[4], HIGH);
      delay (pause);
    }
    if (ran == 3){
      digitalWrite (led_pins[2], HIGH);
      digitalWrite (led_pins[3], HIGH);
      digitalWrite (led_pins[4], HIGH);
      delay (pause);
    }
    if (ran == 4){
      digitalWrite (led_pins[0], HIGH);
      digitalWrite (led_pins[1], HIGH);
      digitalWrite (led_pins[5], HIGH);
      digitalWrite (led_pins[6], HIGH);
      delay (pause);
    }
    if (ran == 5){
      digitalWrite (led_pins[0], HIGH);
      digitalWrite (led_pins[1], HIGH);
      digitalWrite (led_pins[3], HIGH);
      digitalWrite (led_pins[5], HIGH);
      digitalWrite (led_pins[6], HIGH);
      delay (pause);
    }
  }
  else {
    digitalWrite (led_pins[0], HIGH);
    digitalWrite (led_pins[1], HIGH);
    digitalWrite (led_pins[2], HIGH);
    digitalWrite (led_pins[4], HIGH);
    digitalWrite (led_pins[5], HIGH);
    digitalWrite (led_pins[6], HIGH);
    delay (pause);
  }
}

for (int thisPin = 0; thisPin < 7; thisPin++) {
  digitalWrite(led_pins[thisPin], LOW);
}
}

```