

Reaction Game LED Version

- * **What You Need:**
 - 1 x Crazy Circuits Bit Board
 - 1 x micro:bit
 - 4 x Crazy Circuits 10mm LEDs
 - 1 x Crazy Circuits Jumbo Pushbutton
 - 1 x Crazy Circuits Piezo Speaker
 - 1/8" Maker Tape
 - 1 x LEGO Baseplate
 - Misc LEGO Bricks

- * **How it Works:**

The LEDs will flash on and off in order (one at a time) and when the fourth LED is lit you should press the button. If you successfully press the button while the fourth LED is lit, you'll get a point, and the score will be shown on the LED matrix on the front of the micro:bit

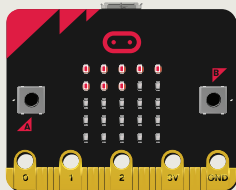
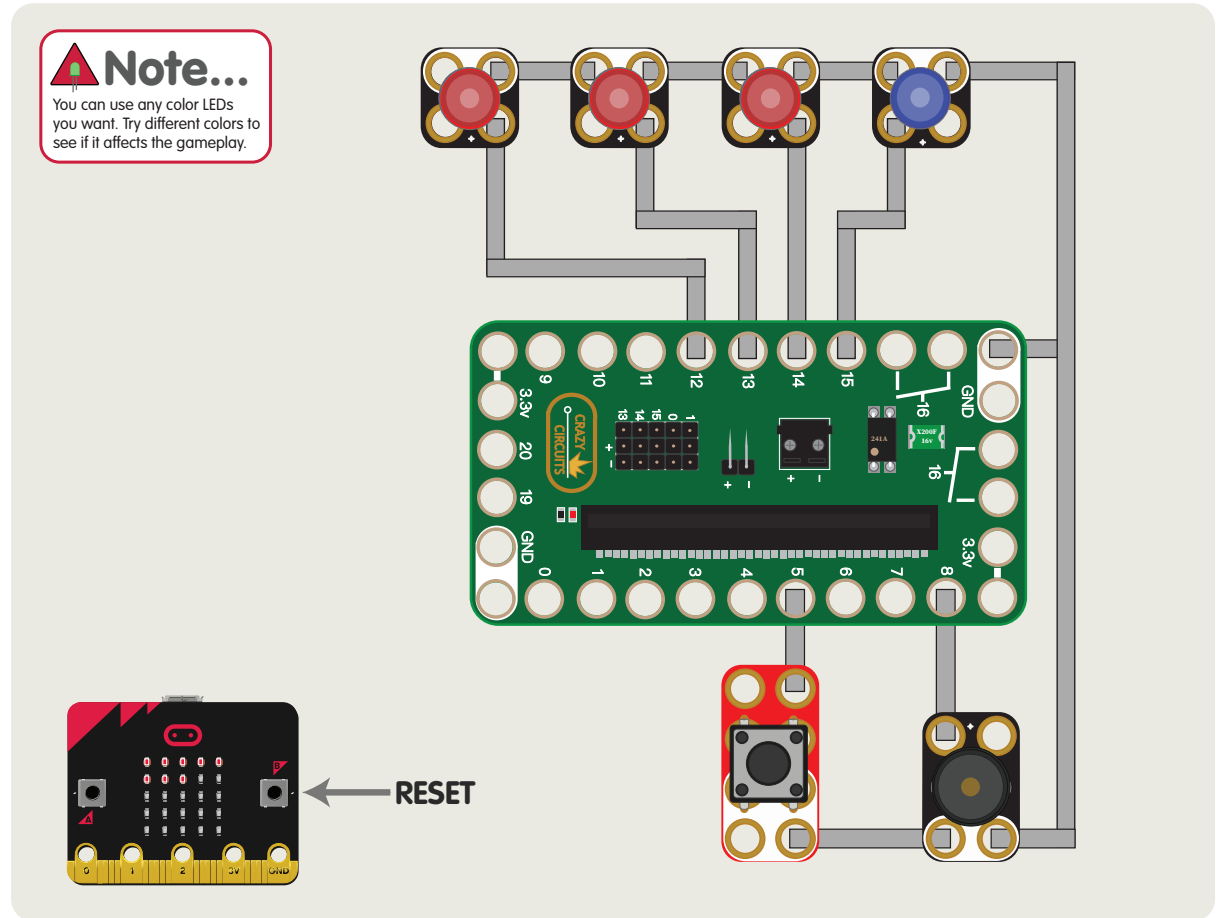
If you press the button when LED one, two, or three is lit you will lose a point. (The default code will not go below zero, since there isn't an easy way to display a negative score on the LED display.)

Each time you press the button at the correct time the speed will increase, making it more difficult to get the timing right for the next time.

The piezo speaker will play two different tones, one when you successfully press the button, and one when you press it at the wrong time. It will also play a song when you win by scoring the determined amount of points.

If you want to abandon a game and start over you can press the reset button. (Button B on the micro:bit)

Note...
You can use any color LEDs you want. Try different colors to see if it affects the gameplay.

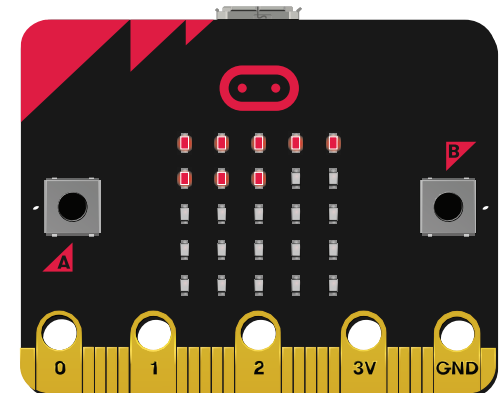


Scoreboard:

We're going to use the built-in LED matrix on the front of the micro:bit to display the score.

Each time you get a point it will light up another LED, and if you lose a point it will turn off an LED to indicate your score is lower.

With the code we provide you can then set your **winScore** to a maximum value of 25 if you want to use the entire matrix.



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* The Code:

We've broken our program into seven sections. We'll start by looking at the smaller sections then move on to the **forever** loop, which is the most complex.

Don't worry if you don't understand all of the code! You can always build the circuit, load the code, try it out, and then make changes to the code to see how it affects the gameplay.

The **on start** section always runs first in our program, and we used it to set things that only need to happen one time at the start.

For this program we start by enabling the built-in LED matrix, then calling the **resetGame** function (more on that later). We also set pin 5 to **up** so we can use it with the pushbutton connected to it, disable the built-in speaker, and then set pin 8 to work with our Piezo Speaker.

You'll notice our "event handler" for **button B** also contains the call to **resetGame**. This allows us to reset all our variables at any point while the game is running if we want to start over.

⚠ A note about "event handlers"

Typically if we want to check for something happening in our program we need to use a conditional statement in our **forever** section. We would add in the code blocks and the logic and test for a specific condition (like a button press.)

Event Handlers are special "functions" that run all the time, and continually check for a specific thing, like **button B** being pressed.

In this case we use the special event handler to trigger the game to reset the variables and start over.



```
function lightLED num num2 num3 num4
digital write pin P12 to num
digital write pin P13 to num2
digital write pin P14 to num3
digital write pin P15 to num4
```

Our **lightLED** function allows us to call the function with a set of **parameters**.

When we call our function we "pass in" four numbers. Our numbers need to be either a 0 or a 1, which corresponds to setting each pin to 0 or 1, which is **off** or **on**. This allows us to turn on (and off) all four LEDs with a single command.

If we have a block like so:



```
call lightLED 1 0 0 0
```

It will turn on the first LED and turn off the rest of them. If we pass **0, 1, 0, 0** it will turn on the second LED and turn off the rest of them, etc.

In our **resetGame** function we set the variables for the game.

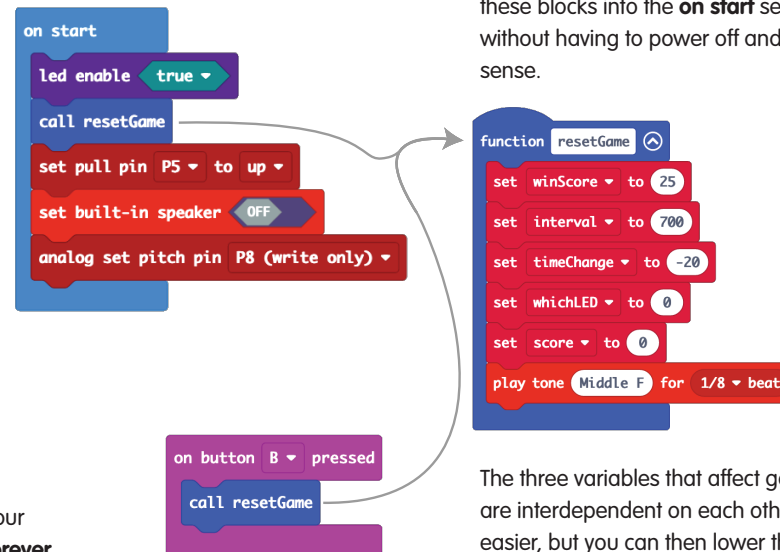
If we did not have a special reset button we could probably have put all of these blocks into the **on start** section, but since we want to reset the game without having to power off and back on the micro:bit this method makes sense.

Here's what each of our variables does:

winScore sets the score you need to reach to win the game.

interval sets the amount of time each LED remains lit for.

timeChange sets the amount of time we subtract from **interval** after each successful button press.



```
on start
led enable true
call resetGame
set pull pin P5 to up
set built-in speaker OFF
analog set pitch pin P8 (write only)

on button B pressed
call resetGame

function resetGame
set winScore to 25
set interval to 700
set timeChange to -20
set whichLED to 0
set score to 0
play tone Middle F for 1/8 beat
```

The three variables that affect gameplay; **winScore**, **interval**, and **timeChange**, are interdependent on each other. If you lower the winScore the game will be easier, but you can then lower the interval to make it more challenging again.

If you adjust the timeChange to a much higher number, or set the interval to a much lower value it might make the game unplayable, or just more challenging! We've set what we think is a good balance as a starting point, but adjusting them and seeing what happens is part of the fun of game development!

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* Displaying the Score:

If you built the version of the Reaction Game that uses a 7 Segment Display you may remember that the code to show the score was just a single block of code. This time we need to do a bit more work to display the score.

We have two functions, **showScore** which deals with looping through all the LEDs and turning them on one at a time, and **clearScreen** which looks through all the LEDs and turns them off one at a time.

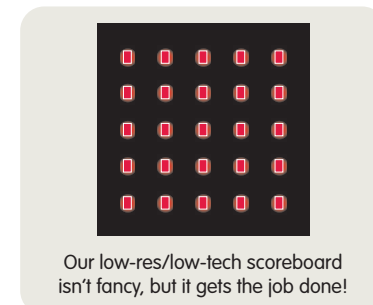
You might also notice that the first thing our **showScore** function does is call the **clearScreen** function. This is so we can always wipe the screen completely before displaying the score. Since the score could go down if you lose a point we had to make sure we didn't always just count up but also had the ability to count down.

If you want to make your own scorekeeping functions you can look at using the **show number** command in MakeCode or the **show leds** command.

We chose this method as a fun programming challenge! And since we created it as functions separate from our code we can easily use it in other programs that need a score keeping system.

```
function showScore
  call clearScreen
  set tempScore to score - 1
  set scoreX to 0
  set scoreY to 0
  set index to 0
  while index <= tempScore
  do
    plot x scoreX y scoreY
    change scoreX by 1
    if scoreX = 5 then
      set scoreX to 0
      change scoreY by 1
    change index by 1
```

```
function clearScreen
  set scoreX to 0
  set scoreY to 0
  set index to 0
  while index <= 25
  do
    unplot x scoreX y scoreY
    change scoreX by 1
    if scoreX = 5 then
      set scoreX to 0
      change scoreY by 1
    change index by 1
```



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⚠ The **forever** section of our code has a lot going on, so we've broken it into four sections to explain it.

If you checked out our guide titled **Blink Without Pause** we showed that while it's common to cause an LED to blink on and off using the pause command if you want **non-blocking code** (that is, code that never "pauses" while running) you can implement a timer that checks if a certain number of milliseconds has passed and then turn on (or off) your LED.

We use that method in the first part of the forever section to change which LED is lit each time our **interval** is passed.

We also check if our **whichLED** variable has increased past 4 and set it back to 0 if it has.

In our next section of code we check which LED is specified and then use our **lightLED** function to turn on one of the four LEDs.

Our **lightLED** function call passes four values to the function which means that with a single block of code we can control all four LEDs. This is much more efficient than using four blocks of code to individually control all four LEDs within each if/else statement.

```
forever
  set currentMillis to millis (ms)
  if currentMillis - previousMillis > interval then
    if myState = 0 then
      set myState to 1
    else
      set myState to 0
    set previousMillis to currentMillis
  if myState = 1 then
    change whichLED by 1
    if whichLED > 4 then
      set whichLED to 0
  if whichLED = 1 then
    call lightLED 1 0 0 0
    set myState to 0
  else if whichLED = 2 then
    call lightLED 0 1 0 0
    set myState to 0
  else if whichLED = 3 then
    call lightLED 0 0 1 0
    set myState to 0
  else if whichLED = 4 then
    call lightLED 0 0 0 1
    set myState to 0
  else
    call lightLED 0 0 0 0
```

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This section checks to see if the fourth LED is active, and also checks if the button is being pressed. If those conditions are met we increase the **score** by one. decrease the **interval** by the amount of time set for the **timeChange**, we play a tone, and we pause for half a second.

But what if the fourth LED is not active, and the button is pressed? Then we subtract one from the score, play a different tone, and again pause for half a second.

```
if whichLED = 4 and digital read pin P5 = 0 then
  change score by 1
  change interval by timeChange
  play tone High B for 1/8 beat
  pause (ms) 500
else if whichLED = 4 and digital read pin P5 = 0 then
  change score by -1
  play tone Low C for 1/8 beat
  pause (ms) 500
else
```

Lastly, we have a check if the score is less than one and if it is, we set it to zero. If we remove this check then our score could keep decreasing to negative numbers, which might make the gameplay even more challenging! Feel free to remove this section or adjust it in some other way.

The **call showScore** block handles calling the function to display the score on the LED matrix.

And finally, we check to see if our score is equal to the winScore, and if it is, you won the game! We then turn on all the LEDs, play a victory song, wait for two and a half seconds, then reset the game so we can try again.

```
if score < 1 then
  set score to 0
call showScore
if score = winScore then
  call lightLED 1 1 1 1
  start melody power up repeating once
  pause (ms) 2500
  call resetGame
```