



DesignNews

MicroPython Embedded Applications

DAY 4 : MicroPython Limit Detection Simulator

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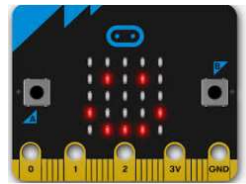
- Turn on your system sound to hear the streaming presentation.
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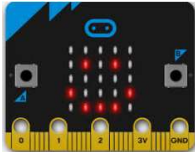


Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Kit:
Keystudio 37 in 1 Starter Kit with BBC micro:bit

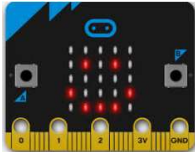




Agenda:

- What is a Simulator?
 - a) Purpose of a Simulator
 - b) Examples of a Simulator
- Introduction to the Limit Switch
- Limit Switch Applications
 - a) Sealed Limit Switch using a Machine Tool
 - b) End of Travel-On a Palletizer
 - c) Cat Whisker Switch – Material Handling
 - d) Used in Position in a Fill Operation
- Lab Activity: MicroPython Limit Detection Simulator

What is a Simulator?



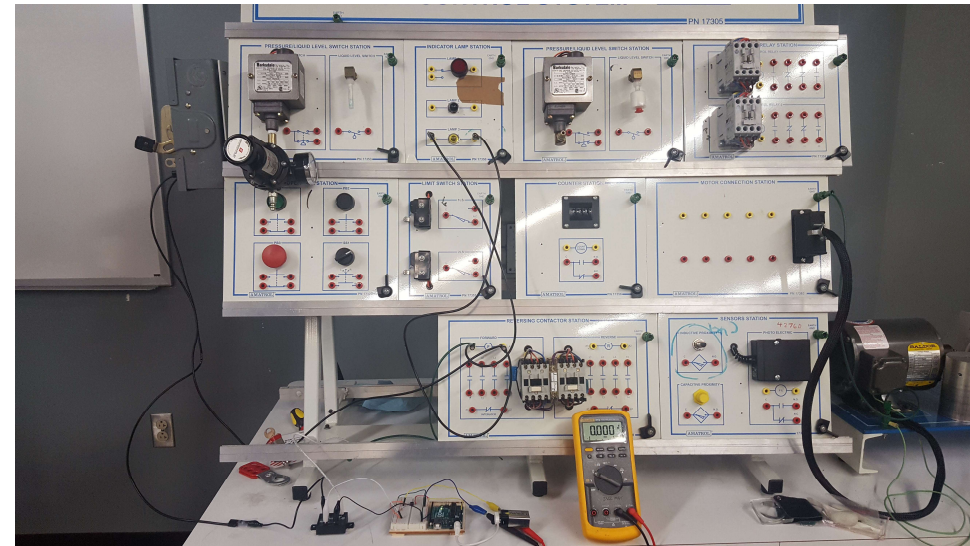
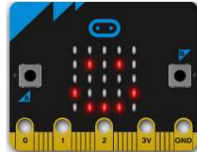
"A machine with a similar set of controls designed to provide a realistic imitation of the operation of vehicle, aircraft, or other complex system, used for training purposes." *Oxford Lexico Dictionary*

What is a Simulator?...

Purpose of a Simulator

The underlying purpose of a simulator

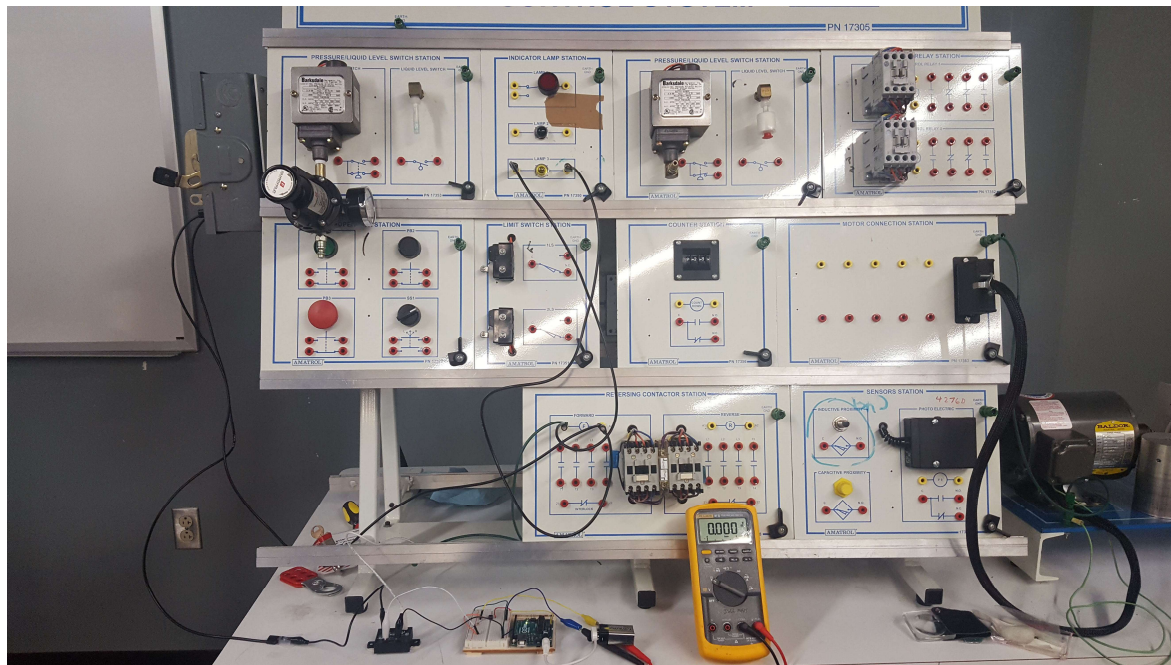
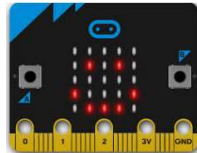
- To shed light on the underlying mechanism that control the behavior of a system.
- Can be used to forecast (predict) the future behavior of a system.
- To determine what can be done to influence the future behavior .



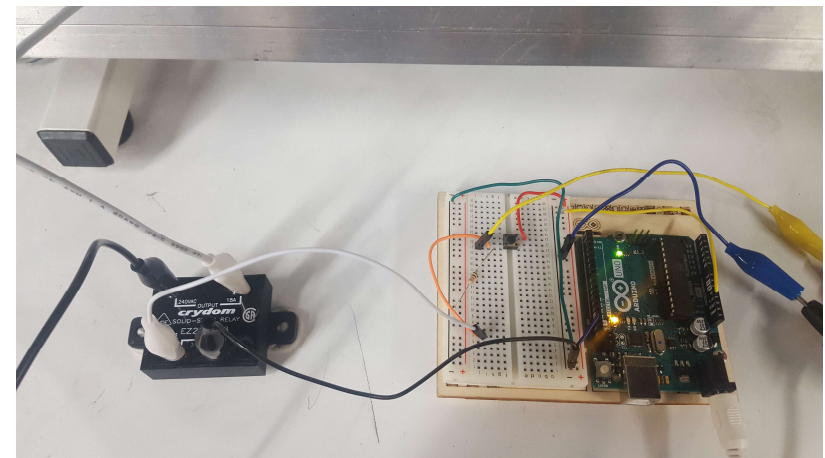
What is a Simulator?...

Purpose of a Simulator

Example: To shed light on the underlying mechanism that control the behavior of a system



Development of an Arduino AC Motor Controller Simulator



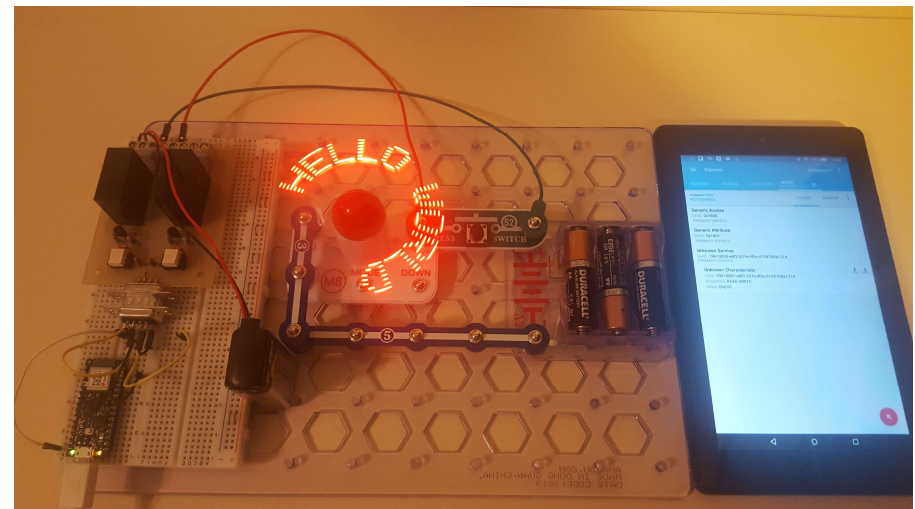
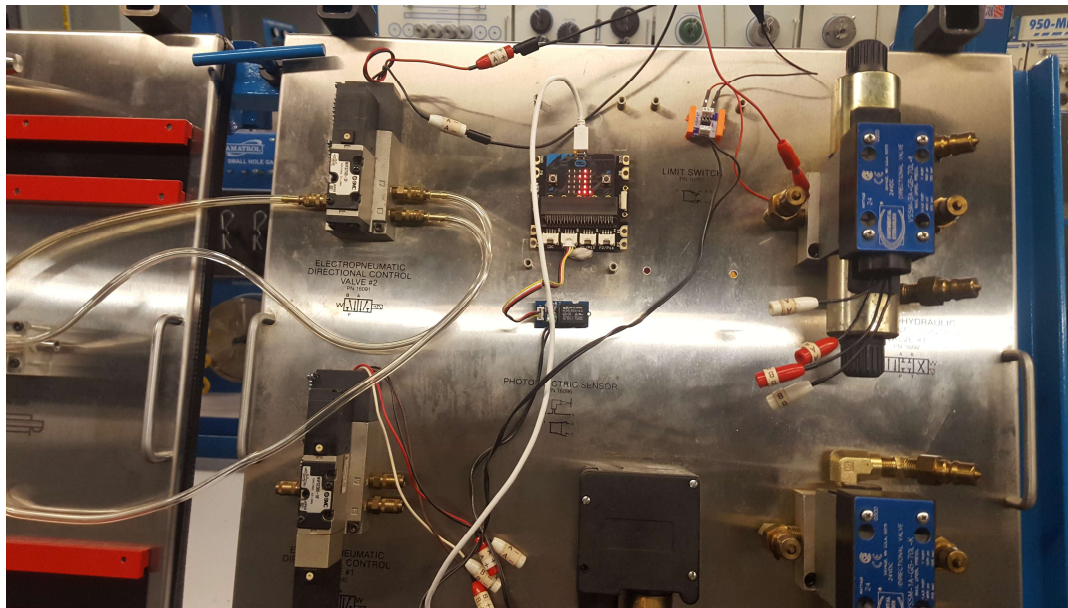
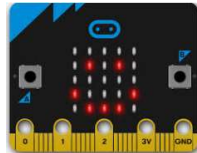
Question 1



What is the purpose of a simulator?

What is a Simulator? . . .

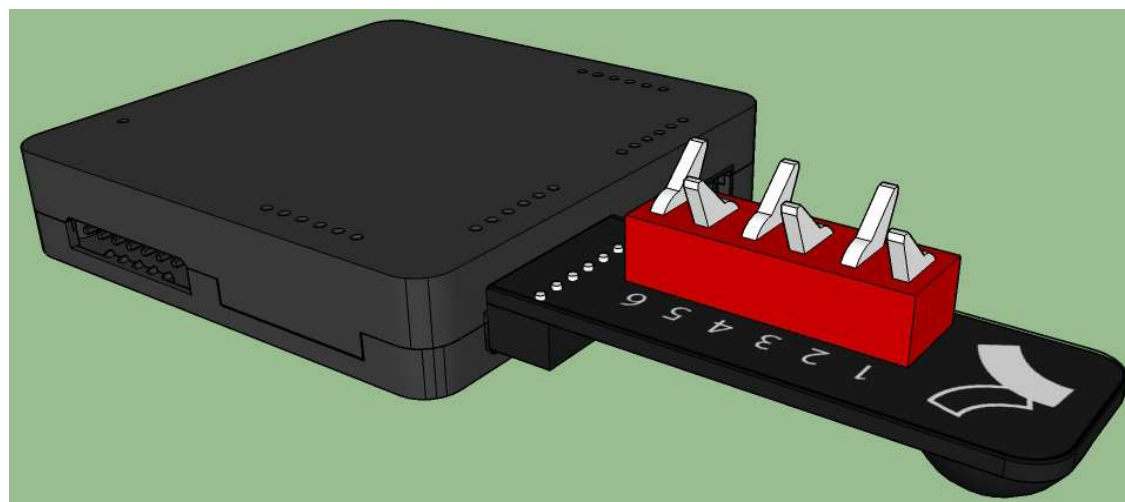
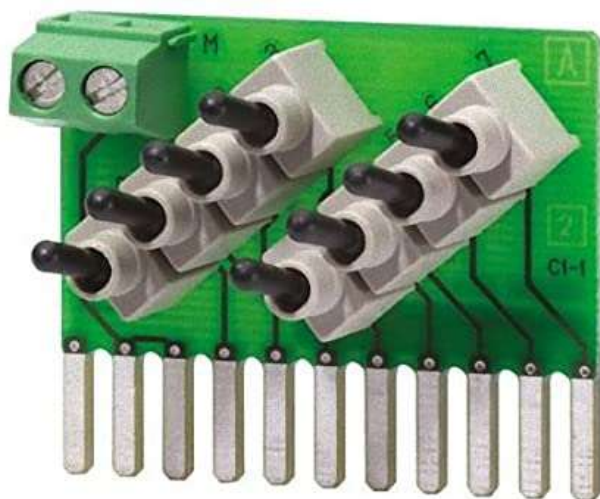
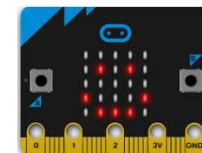
Examples of Simulators



Use for Training Purposes

What is a Simulator?...

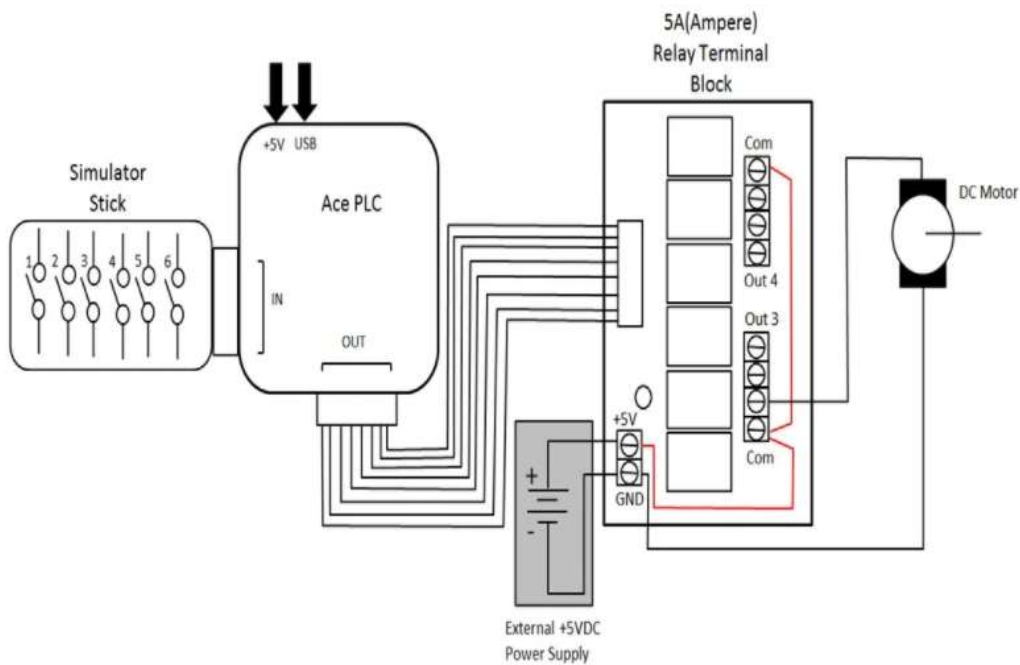
Examples of Simulators



Use for Training Purposes

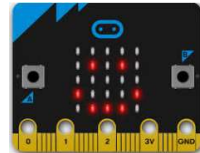
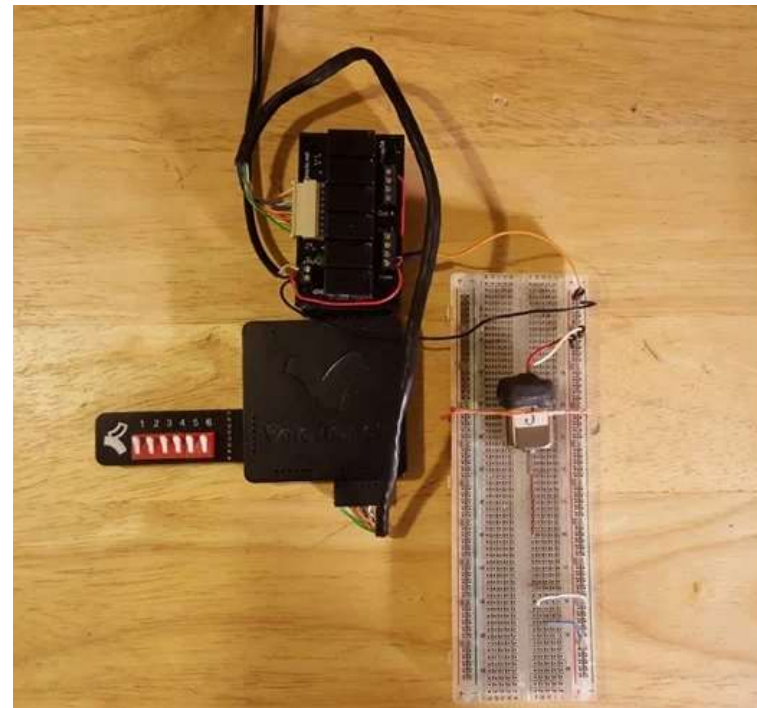
What is a Simulator?...

Examples of Simulators



Use for Training Purposes

Source: Wilcher, D. (2016, April 21). *Build a desktop automation trainer*. https://www.allaboutcircuits.com/projects/build-a_12-desktop-industrial-automation-trainer/



Question 2

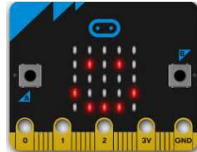


Reviewing slide 11, what electrical component is used to simulate input signals?

What is a Limit Switch? . . .

A mechanical input that requires:

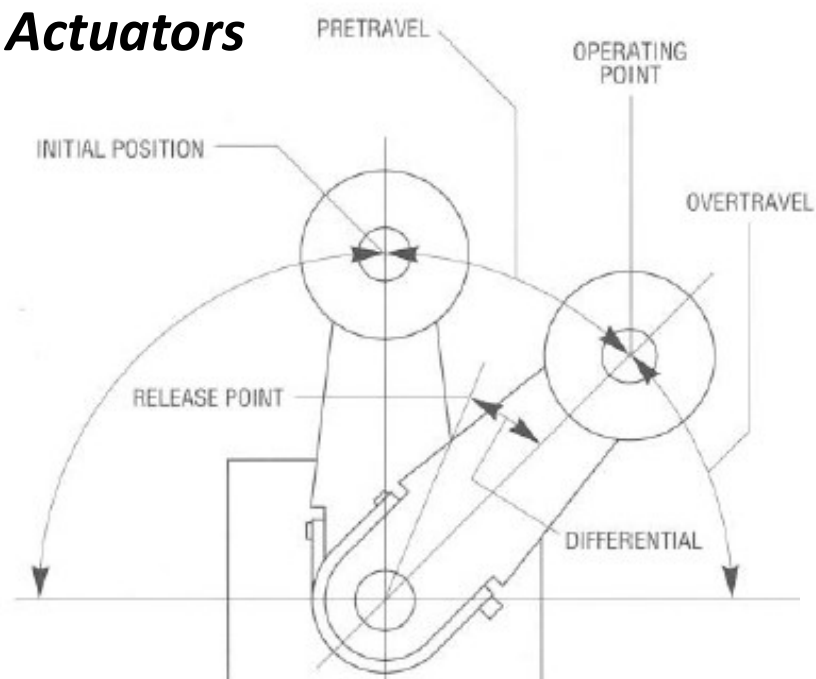
- physical contact obtained with the switch actuator
- the switch actuator making contact with the object
- physically opening and closing a set of contacts within the limit switch enclosure
- the contacts to stop and start the flow of current in the electrical circuit



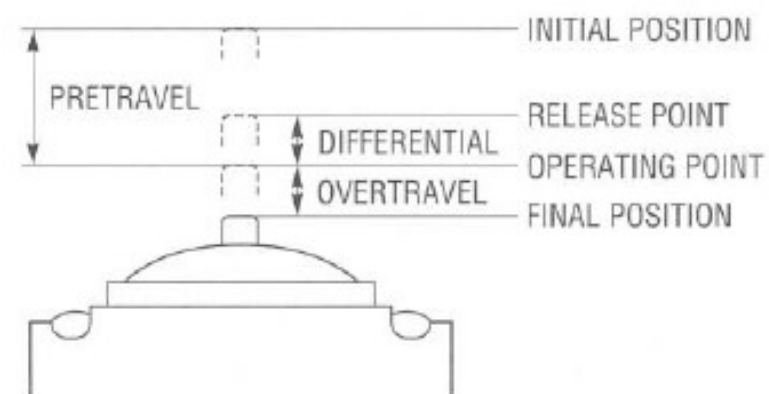
Source: Rockis, G. J., & Mazur, G. A. (2014). *Electrical motor controls for integrated systems (5th ed)*. American Technical Publishers.

What is a Limit Switch? . . .

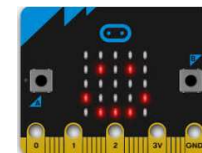
Types of Actuators



Lever Type Actuator

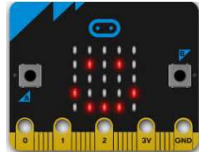


Plunger Type Actuator



Source: https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf

What is a Limit Switch? . . .



Limit Switch Terminology

- **Pretravel** — the distance or angle that the actuator must go through to trip the contacts
- **Operating Point** — position of the actuator at which the contacts snap to the operated position
- **Release Point** — the position of the actuator at which the contacts return to their original state
- **Differential** — distance (degrees) between contacts trip and contacts reset
- **Overtravel** — movement of the actuator beyond the contacts trip point
- **Initial Position** — position of actuator when no external force is applied to the actuator

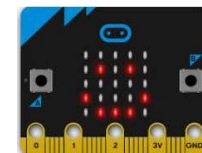
Source: https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf

Question 3



For a limit switch, a mechanical input that requires_____

What is a Limit Switch? . . .



Types of Limit Switch Styles



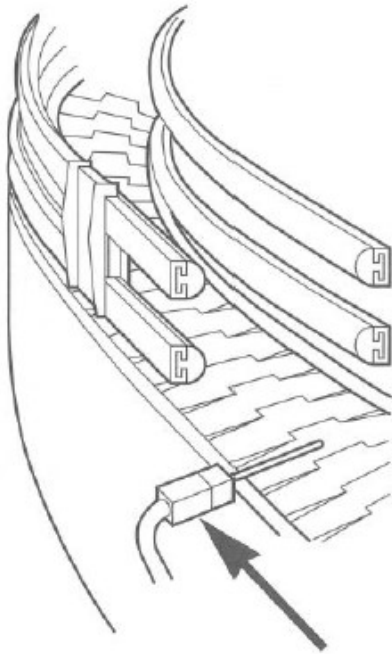
Plug in Limit Switch



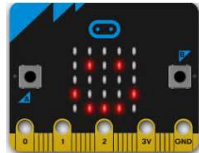
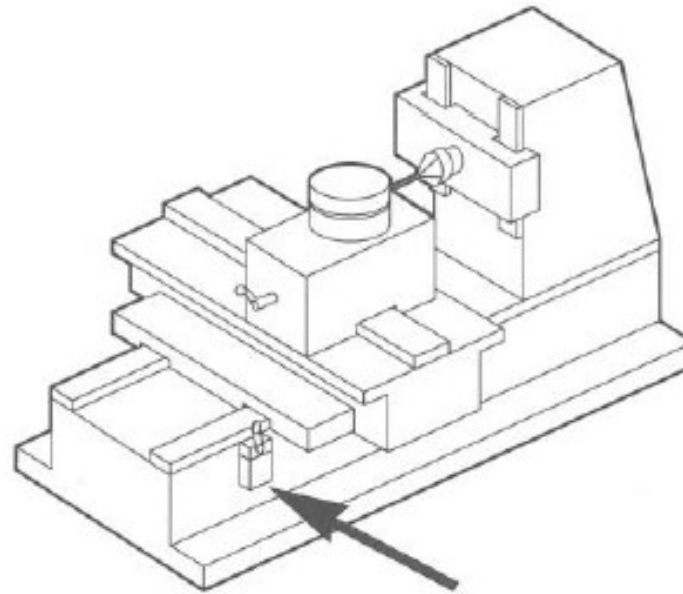
Source: https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf

Limit Switch Application

Cat Whisker Limit Switch Used in Material Handling



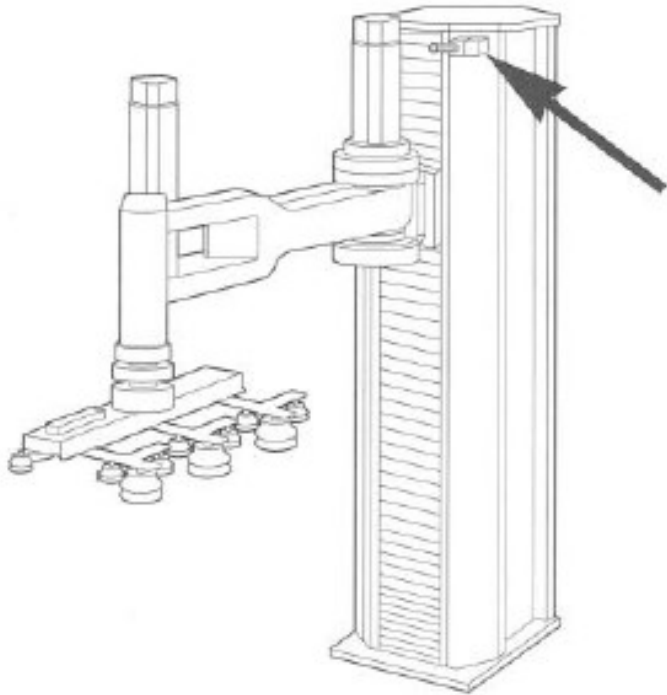
Sealed Limit Switch Used in Machine Tool



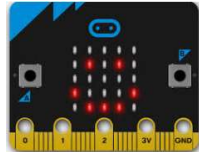
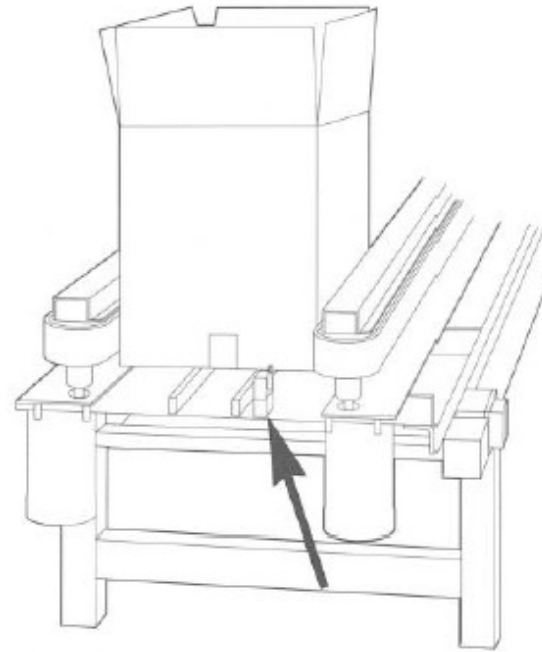
Source: https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf

Limit Switch Application. . .

Limit Switch Used to Indicate End of Travel On a Palletizer



Used in Positioning in a Fill Operation



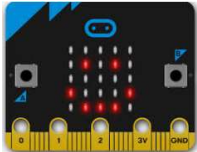
Source: https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf

Question 4

On slides 19 and 20, what limit switch applications are being presented?



MicroPython Limit Detection Simulator: Context

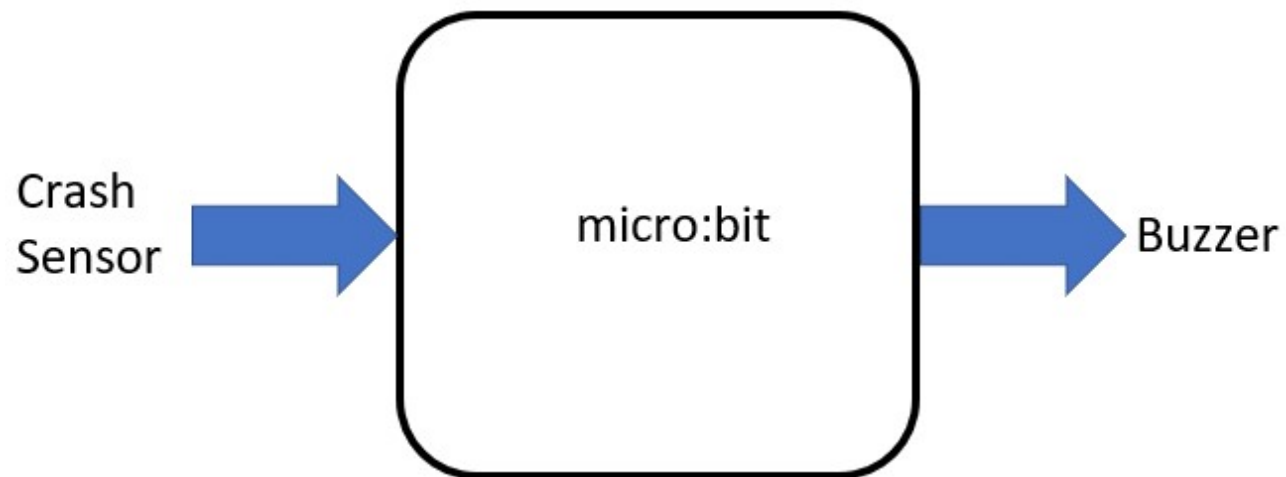
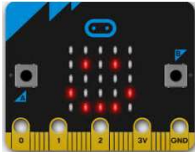


This 3D printer needs a detection system to alert the designer the print job is completed. The 3D job is completed by way of the print tray positioned at the bottom of the printer!

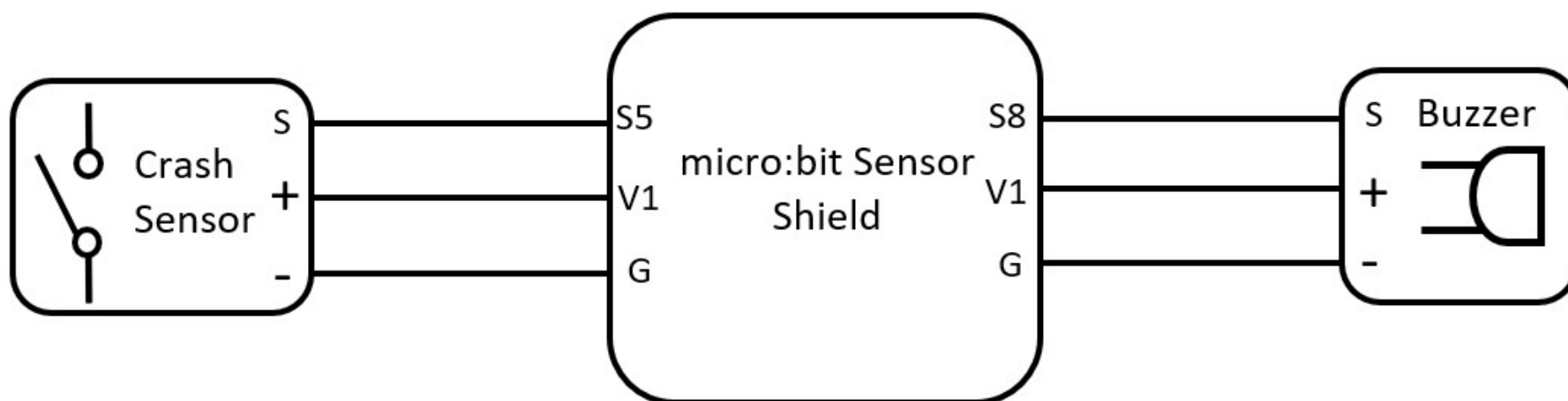
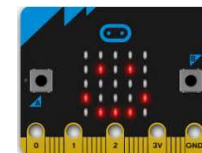


The print tray travels from the top to the bottom while extruding material for the 3D print job!

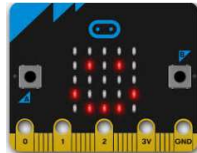
MicroPython Limit Detection Simulator High Level Abstraction Block Diagram



MicroPython Limit Detection Simulator: Electrical Wiring Diagram



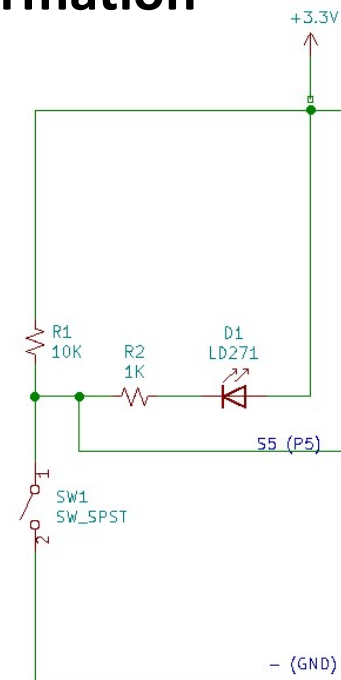
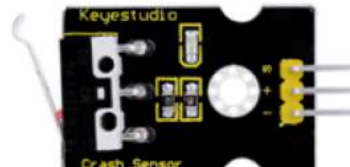
MicroPython Limit Detection Simulator: Crash Sensor Information



Crash Sensor Pinout

Pin definition

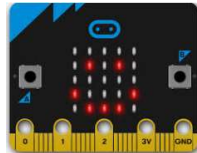
- Positive pin (+): 3V-12V power supply
- Negative pin (-): ground
- Signal pin (S): High-Low level output



**Circuit Schematic
Diagram**

Source: [https://wiki.keyestudio.com/KS0361\(KS0365\)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit](https://wiki.keyestudio.com/KS0361(KS0365)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit)

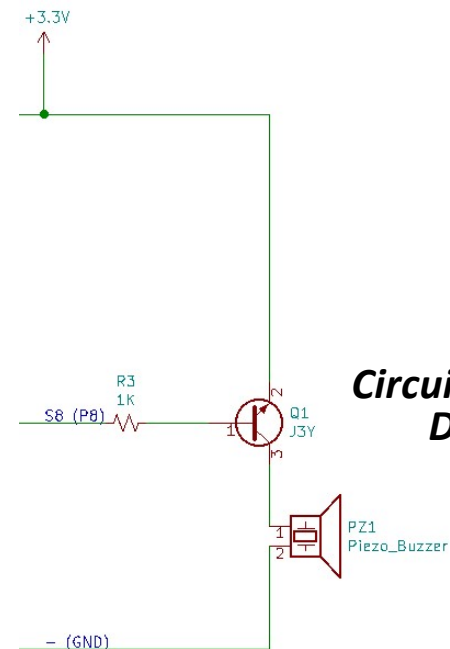
MicroPython Limit Detection Simulator: Buzzer Information



Buzzer Pinout

Specifications

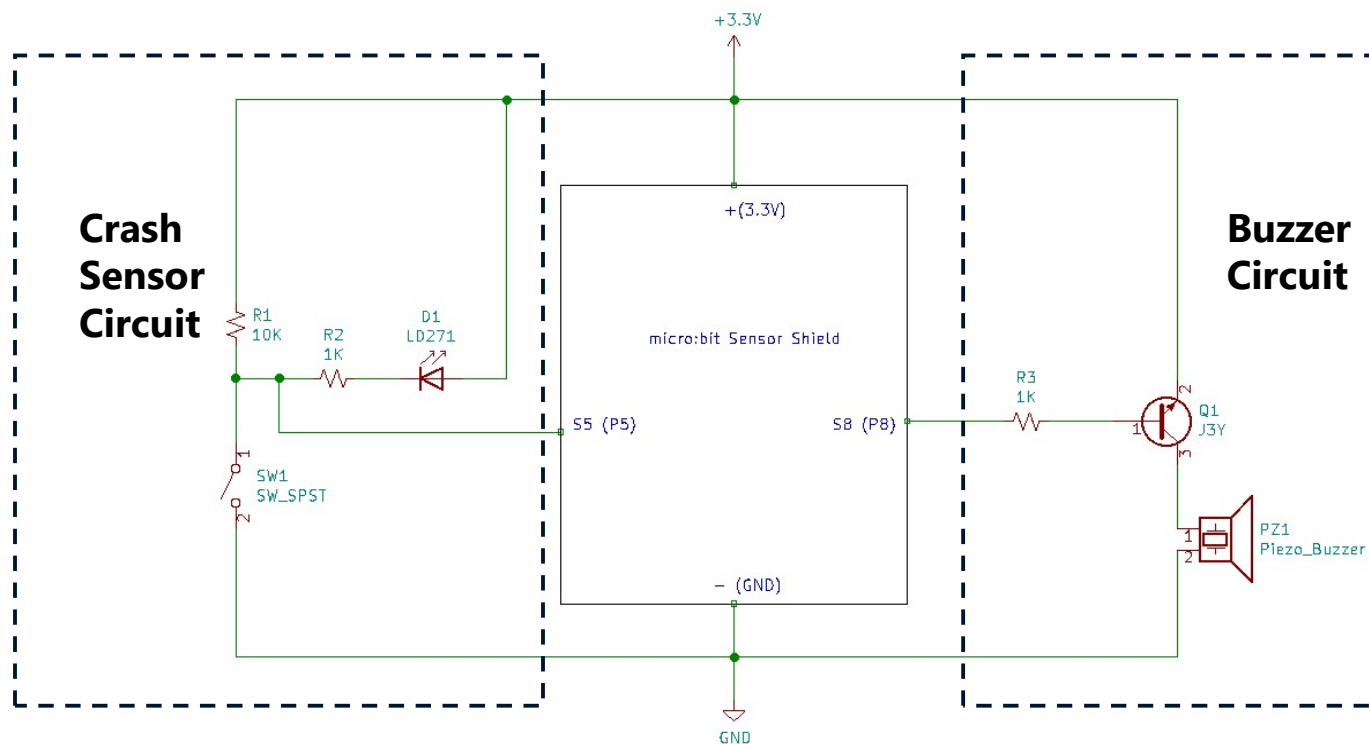
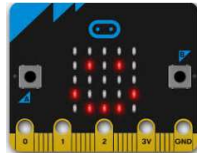
- Working voltage: 3.3-5v
- Interface type: digital
- Size: 30*20mm



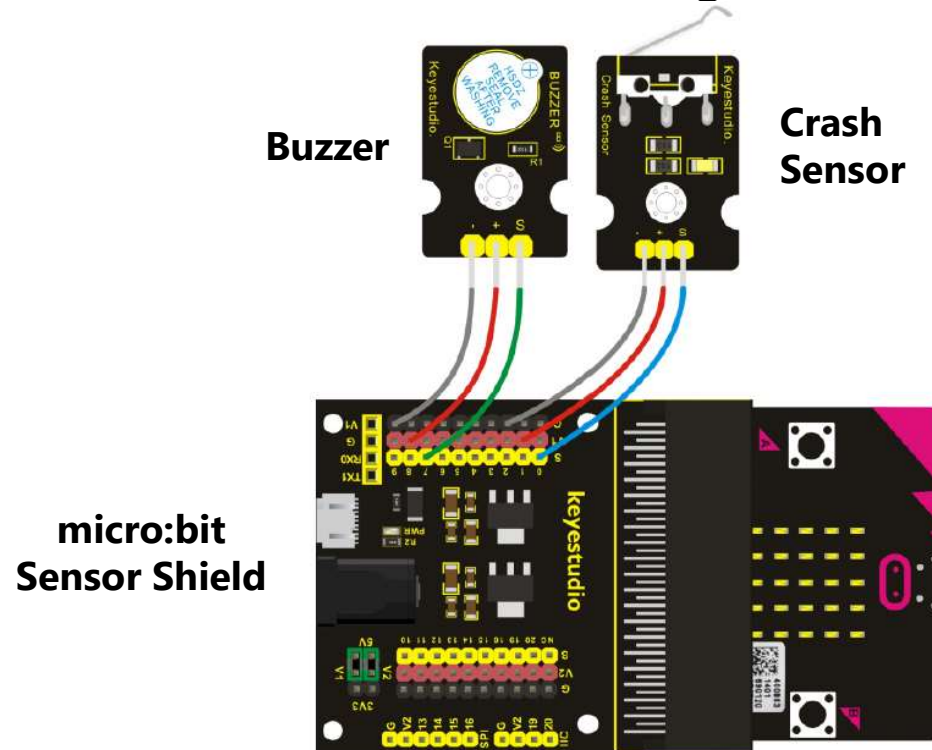
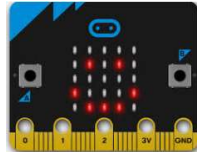
**Circuit Schematic
Diagram**

Source: [https://wiki.keyestudio.com/KS0361\(KS0365\)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit](https://wiki.keyestudio.com/KS0361(KS0365)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit)

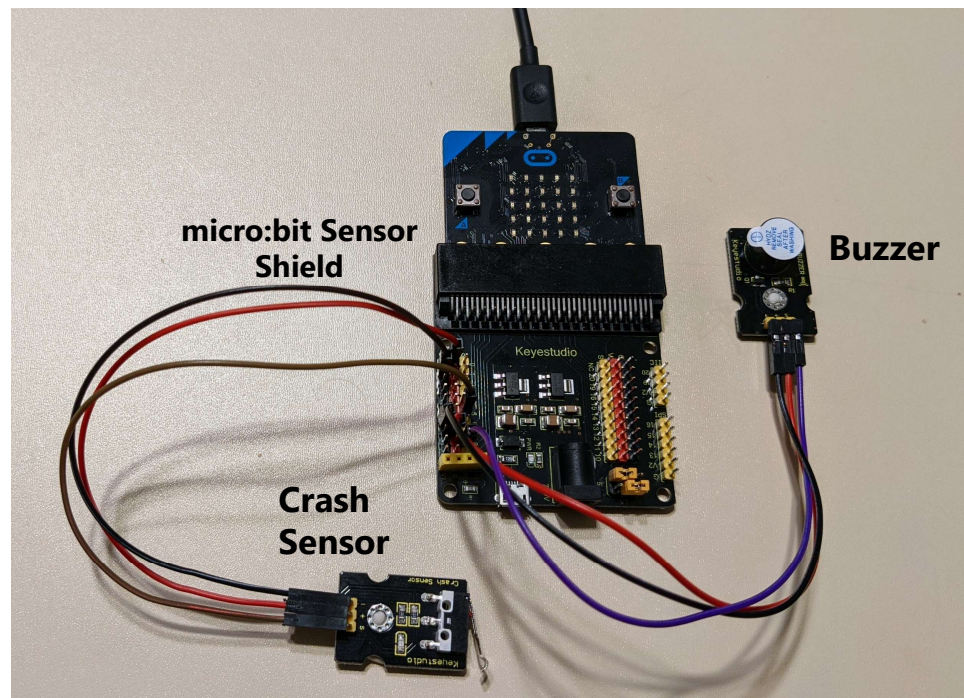
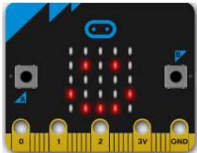
MicroPython Limit Detection Simulator: Circuit Schematic Diagram



MicroPython Limit Detection Simulator: Pictorial Diagram

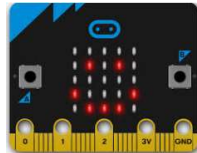


MicroPython Limit Detection Simulator: Final Build



Source: [https://wiki.keyestudio.com/KS0361\(KS0365\)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit#Project_18:_To_The_Top](https://wiki.keyestudio.com/KS0361(KS0365)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit#Project_18:_To_The_Top)

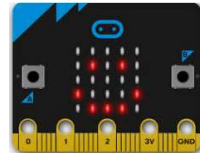
MicroPython Limit Detection Simulator: EduBlocks to MicroPython Prototype Code (Version1)



```
1 from microbit import *
2 while True:
3     if pin5.read_digital():
4         display.show(Image.CLOCK1)
5         pin8.write_digital(0)
6     else:
7         display.show(Image.SAD)
8         pin8.write_digital(1)
```

Source: <https://microbit-micropython.readthedocs.io/en/v1.0.1/tutorials/images.html>

MicroPython Limit Detection Simulator: EduBlocks to MicroPython Prototype Code (Version1) Machine Code



```

1  :020000040000FA
2  :0400000A9901CODEBA
3  :100000000400020218E01005D8E01005F8E010006
4  :1000100000000000000000000000000000000000E0
5  :1000200000000000000000000000000000000000E0
6  :1000300000000000000000000000000000000000E0
7  :10004000678E01005D3D000065950100678E01002F
8  :10005000678E01000000000000218F0100678E010003
9  :1000600069E8000D59A0100D9930100678E01006C
10 :10007000678E0100678E0100678E0100678E0100A8
11 :10008000678E0100678E0100678E0100678E010098
12 :10009000678E01000D8A0100D98A0100A5E90000E0
13 :1000A000B5E90000678E01000000000000000000BC
14 :1000B0000000000000000000000000000000000040
15 :1000C00010B5064C2378002B07D1054B002B02D02E
16 :1000D000044800E000BF0123237010BD2001002070
17 :1000E00000000000098870300044B10B5002B03D0DC
18 :1000F0000349044800E000BF10BDC0460000000F6
19 :100100002401002098870300164B002B00D1144BCC
20 :100110009D46402292029A1A924600218B460F4633
21 :100120001348144A121A28F050FE0F4B002B00D02F
22 :1001300098470B4B002B00D0984700200021040068
23 :100140000D000D48002802D00C4800E000BF20F050
24 :10015000E3FB2000290028F08EFB20F029FBC0469D
25 :100160000000080004000200000000000000000027
26 :1001700018010020E02F0020000000000000000017
27 :1001800010B54A68014926F045FE10BDC43B030086
28 :1001900010B50400080021F08CF90300002C03D0F6
29 :1001A000012C06D0002003E00348002B00DC0348AC
30 :1001B00010BD40002043FBE7CCE70200C4E702008B
31 :1001C00043684B6083688B60C3680800CB60014B59
32 :1001D0000B607047A890020030B5040087B00D0096
33 :1001E0000020042A25D1200021F063F9AB0722D199
  
```

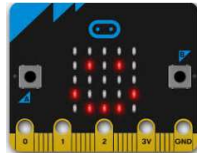
Source: <https://microbit-micropython.readthedocs.io/en/v1.0.1/tutorials/images.html>

Question 5



On slide 30, which MicroPython instruction turns on the limit detection simulator's buzzer?

MicroPython Limit Detection Simulator: Exploring the Limit Detection Hex (.hex) file



31.2 Register Overview

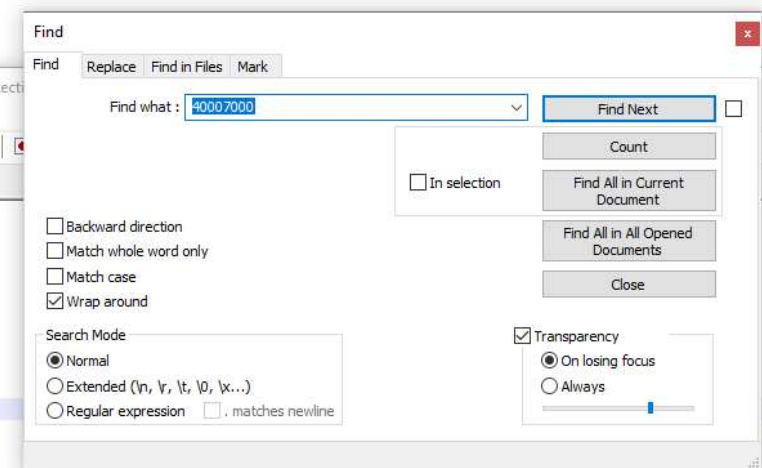
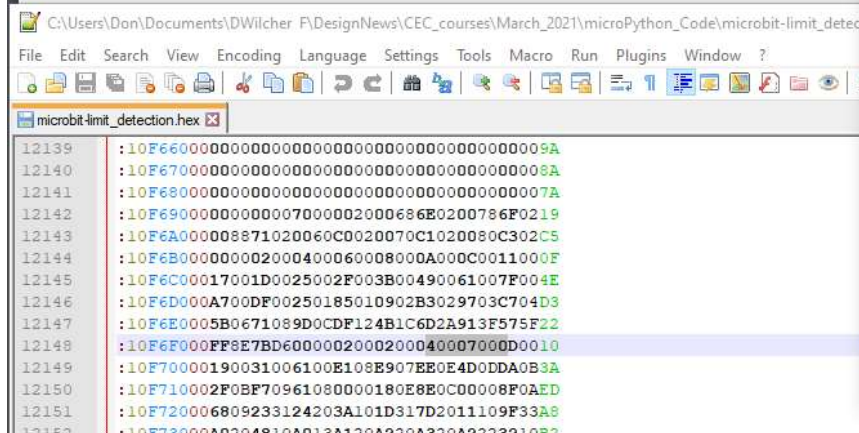
Table 314: Instances

| Base address | Peripheral | Instance | Description |
|--------------|------------|----------|-----------------------------|
| 0x40007000 | ADC | ADC | Analog to Digital Converter |

Table 315: Register Overview

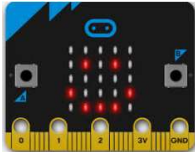
nRF51 series Reference Manual

Notepad++



Source: https://infocenter.nordicsemi.com/pdf/nRF51_RM_v3.0.pdf

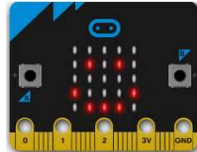
MicroPython Limit Detection Simulator: MicroPython Prototype Code (Version2)



```
1 from microbit import *
2 input = pin5.read_digital()
3
4 while True:
5     if pin5.read_digital():
6         display.show(Image.ARROW_S)
7         pin8.write_digital(0)
8         sleep(5)
9     else:
10        display.show(Image.HAPPY)
11        pin8.write_digital(1)
12        sleep(5)
```

Source: <https://microbit-micropython.readthedocs.io/en/v1.0.1/tutorials/images.html>

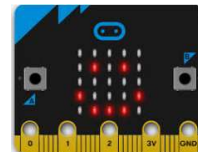
MicroPython Limit Detection Simulator: MicroPython Prototype Code (Version3)



```
1 from microbit import *
2 #input = pin5.read_digital()
3
4 while True:
5     if pin5.read_digital():
6         display.show(Image.CLOCK12)
7         sleep(1000)
8         display.show(Image.CLOCK3)
9         sleep(1000)
10        display.show(Image.CLOCK6)
11        sleep(1000)
12        display.show(Image.CLOCK9)
13        sleep(1000)
14        display.show(Image.CLOCK12)
15        pin8.write_digital(0)
16    else:
17        pin8.write_digital(1)
18        sleep(5)
```

Source: <https://microbit-micropython.readthedocs.io/en/v1.0.1/tutorials/images.html>

MicroPython Limit Detection Simulator: Further Insights



***Download
Metaverse for
Android or iOS
smartphone or
tablet to see an
Augmented
Reality Class
Session 4
Further Insights
discussion.***

***Scan this QR with
Metaverse App***



Question 6



In reviewing slide 35, while pressing and holding the Crash Sensor, the MicroPython code will simulate what type of movement on the micro:bits LED matrix?

Thank you for attending

Please consider the resources below:

- BBC micro:bit MicroPython Documentation Release 1.0.1
<https://microbit-micropython.readthedocs.io/en/v1.0.1/tutorials/images.html>
- nRF51 series Reference Manual
https://infocenter.nordicsemi.com/pdf/nRF51_RM_v3.0.pdf
- KeyeStudio 37-in-1 Starter Sensor Kit To The Top Project Guide
[https://wiki.keyestudio.com/KS0361\(KS0365\)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit#Project_18:_To_The_Top](https://wiki.keyestudio.com/KS0361(KS0365)_keyestudio_37_in_1_Starter_Kit_for_BBC_micro:bit#Project_18:_To_The_Top)
- Piezo Transducer Driver Circuits
<https://www.edn.com/increase-piezoelectric-transducer-acoustic-output-with-a-simple-circuit/>
- Eaton: Limit Switch Applications
https://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/pct_1549250.pdf
- Rockis, G. J., & Mazur, G. A. (2014). *Electrical motor controls for integrated systems (5th ed)*. American Technical Publishers.
- micro:bit Pinout I/O functions
<https://microbit-micropython.readthedocs.io/en/v1.0.1/pin.html>
- Wilcher, D. (2016, April 21). *Build a desktop automation trainer*. <https://www.allaboutcircuits.com/projects/build-a-desktop-industrial-automation-trainer/>



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