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| **Overview:** | | **Goals:** |
| In this project, students build and program an introductory example of a feedback and control loop. This engineering principle is central to many industrial systems and consumer products. There are feedback and control principles in many Texas Instruments TI-Innovator™ Hub projects. During the project, students will engage with fundamental concepts in programming, such as variables, loops, conditional statements and Boolean operators.  The project includes a series of challenges that build the conceptual knowledge and skills needed for the final open-ended challenge. | | Students will:   * Create and edit a Python program on the calculator. * Connect the Hub with a sensor to the calculator. * Write programs that include many commonly used Hub and calculator commands. * Build a simple feedback and control system. |
| **Note:** For programming commands for this project, refer to the “Python Syntax Quick Reference” document | | |
| **Setup Project:** | **Supplies:** | |
| Students may work in groups of two or three.  Digmoodring | * Calculator * Unit to Unit Cable * Hub * Temperature sensor * Grove Cable * Chenille (“Fuzzy”) Wire   Note: Students will need to push the wire through the holes on the temperature sensor board to create a ring. The sensing element is on the flat side of the sensor board. Expect (and encourage!) trial and error as students attempt to determine the most effective ring design. | |

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| **Student Activity:** | **Teacher Notes:** |
| **Challenge 6:**  Choose five mood messages from the list and write a program to display them, each on a different line, of the TI-Nspire CXII display. | * Mood messages to choose from   **Table  Description automatically generated**   * **Example Program:**   **Graphical user interface, text, application, chat or text message  Description automatically generated** |
| **Challenge 7:**  Combine your favorite mood color with your favorite mood message.  Write a program that displays both. | * **Example Program:**   Graphical user interface, text, application, email  Description automatically generated   * **Question:**   Table  Description automatically generated |
| **Challenge 8:**  Connect the temperature sensor to IN1 and write a program that creates a temperature object named my\_temp.  Measure the my\_temp object and store value in the variable named temp.  Display an appropriate prompt with the measurement value and units. | * Connect temperature sensor to port IN1   **Diagram  Description automatically generated**   * **Example Program:**   **Graphical user interface, text, application, email  Description automatically generated** |
| **Activity 10:**  Use the previous program to explore the temperatures around you.  -What is the temperature of the room?  -What is the temperature of your skin?  -How low of a reading can you measure?  -What is the temperature of an ice cube?  \* do not submerge sensor in liquid | * **Question:**   **Table  Description automatically generated** |
| **Challenge 9:**  Write a program using a for loop that will read and display ten temperature measurements.  Use sleep(2) to pause for two seconds in each cycle. | * **Example Program:**   Graphical user interface, text, application, email  Description automatically generated   * **Question:**   **Graphical user interface, text, application, email  Description automatically generated** |
| **Challenge 10:**  Use a while loop to continuously monitor temperature.  Include an if conditional statement using appropriate temperatures to display the following text and LED color:  - "cool" - blue  - "just right" - green  - "hot" - red | * **Example Program:** |
| **Final Challenge 11:** Use the skills from all of the previous challenges to design and code your mood ring. Your program should display mood messages and colors over a range of finger temperatures.  Helpful tips:  -As a starting point, modify a copy of the previous program. Switch to that program editor page, and select [ctrl]+B, then [menu]->Actions->Create Copy.  - Include at least five if case intervals that change the mood color and message based on finger temperatures.  - Temperature intervals of about two degrees will help your ring respond to typical temperature measurements. | * **Example Program:** |