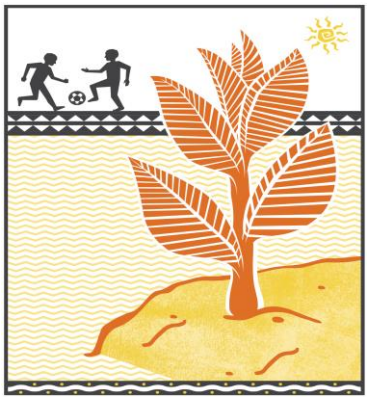
Smart Irrigation System

In this TI-Innovator™ project, you will design a smart irrigation system that could be used to monitor and meter water from a rain collection cistern that might be used to irrigate a small family garden in Zimbabwe. This model also applies to other related scenarios where "smarter water" usage makes sense. For example, water restrictions are often put in place during the hot summer months in areas of excessively hot and dry climates. A smart water irrigation system could alleviate some of these restrictions as well, if people are smarter about the way they water their yards.



You will have to utilize math skills, computer programming and engineering to design and build a smart watering system to solve a real world problem like the drought in Zimbabwe or, even the problem right in your backyard!

Background:

A drought in South Africa has caused a famine in Zimbabwe and local students are quitting school and soccer to stay home and help grow food for the family. What can be done differently in regards to the watering of crops to allow students to stay in school, instead of working the fields?

Your Challenge:

You are challenged to help solve this problem by designing and building a smart irrigation system to manage a limited amount of water collected in a cistern to irrigate a garden.

Activity Materials:

- TI-Nspire CX family or TI-84 CE Graphing Calculator
- TI-Innovator Hub
- 4 AA Batteries and Battery Holder
- Temperature & Humidity Sensor
- Moisture Sensor
- Light Sensor
- MOSFET
- Water Pump Motor DC 3V Mini Submersible Water Pump for Fountain Aquarium 120L/H Max Lift 3.6FT
- 2 male to male breadboard jumper cables
- 1/4" I.D. (Inner Dimension) x 3/8" O.D. Outer Dimension) tubing.
- Drinking straws
- Duct Tape
- 1 Gallon milk jug
- *Perlite or other medium/soil for plants to grow in
- *Fast germinating seeds like radish, lettuce or similar.

**Optional- If desired, the project can be continued over a longer period of time where the watering water system can be leveraged to grow an indoor garden.*

Project Tasks:

1. Write a program "Hello World" that displays a text message on the calculator using the Disp command.
   - Change task 1 to display a text message multiple times using a For loop.
2. Write a program to display colors on the TI-Innovator Hub.
   - Extension – use a for loop to allow for input from the user to determine color.
3. Write a program to Blink the RGB LED.
   - Extension – use a for loop to allow the RGB LED to blink multiple times.
4. Mini-Project: Using what you learned from the example program using the Brightness Sensor, write a program that will use the brightness of the sensor as input to trigger different sounds as output.
   - Extension - Create a function to determine the frequency of the sound that is triggered.

5. Mini-Project: Write a program that connects and reads an external light sensor.
    - Write a program that takes input from the external light sensor and uses if-then-else decision logic to control an output (sound or light) based on the sensor readings.
6. Mini-Project(s): Using what you learned from the previous example, write a program to connect and read the values of these additional sensors:
    - Connect an external digital temperature and humidity sensor
    - Connect a soil moisture sensor, to the previous program,
    - Use the sensor(s) to read various soil levels (either indoors or out)
7. MOSFET (Field Effect Transistor) and Water Pump Set Up check and sample code
    - Set up the MOSFET and Water Pump
    - Write the code to turn on the water pump for 3 seconds
8. Putting it All Together: Use the programming skills you have learned previously, to design and build a Smart Watering System using multiple sensors and a MOSFET and submersible water pump, and other materials provided.
    - Soil Moisture Sensor
    - Temperature and Humidity Sensor
    - Light Sensor
    - MOSFET
    - Submersible Water Pump
    - External Battery Source

Example TI-BASIC Code for TI-Nspire CX:

Code snippet to CONNECT the Sensors:

```
Send "CONNECT LIGHTLEVEL 1 TO IN 1”
Send "CONNECT DHT 1 TO IN 2”
Send "CONNECT MOISTURE  1 TO IN 3”
Send "RANGE LIGHTLEVEL 1 0 100”
Send "RANGE MOISTURE 1 0 100”
Send "CONNECT ANALOG.OUT 1 TO OUT 1”
```

Code snippet to Warm Up the Humidity Sensor:

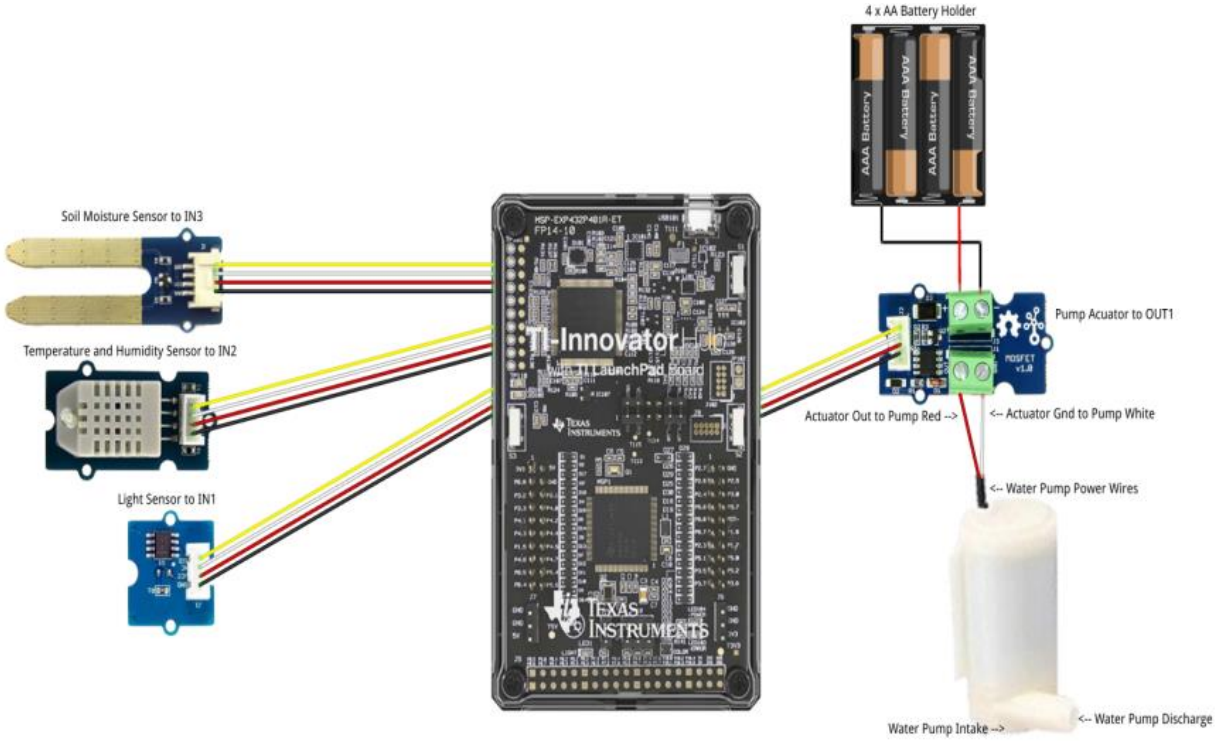
```
Disp "Warming Up Sensors!”
temperature:=−273
While temperature < −270
Send "READ DHT 1 TEMPERATURE”
Get temperature
Wait 1
EndWhile
DispAt 1,”Sensors ready”
```

Code snippet to READ the Sensors:

```
Send "READ LIGHTLEVEL 1”
Get light
Send "READ  MOISTURE 1”
Get moisture
Send "READ  DHT 1 TEMPERATURE”
Get temperature
Send "READ  DHT 1 HUMIDITY”
Get humidity
```

To break an infinite loop, press and hold the ON key until you receive a Quit option

Sensor and actuator Hub connections:



Possible Control Algorithim: