

Challenge #7: Infectious Swarm!

Your Task: Create a swarm with the Arduino-XBee or Photons. The swarm will react to an “infection” triggered by a button push.

Setup: configure each of your devices with 1 input switch and 3 output LEDs (Red, Green, Blue) as per the schematic below. The LEDs should be current-limited with 220 ohm resistors. A logical 1 on the DIO will energize the LED. The switch will be normally high (pulled up by 10K ohm resistors) and produce a digital zero when pressed. Be sure to debounce the switch in software.

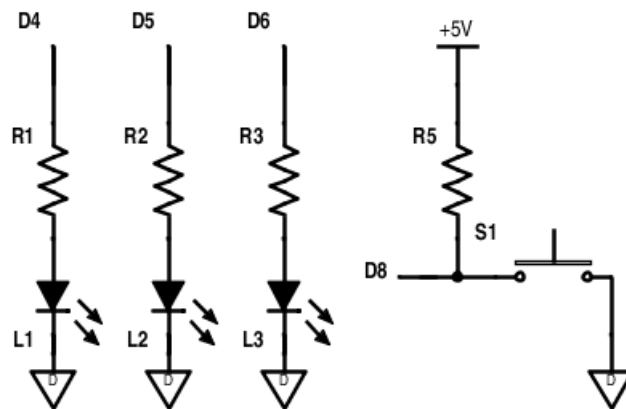


Figure 1: Schematic of LEDs and Input Switch

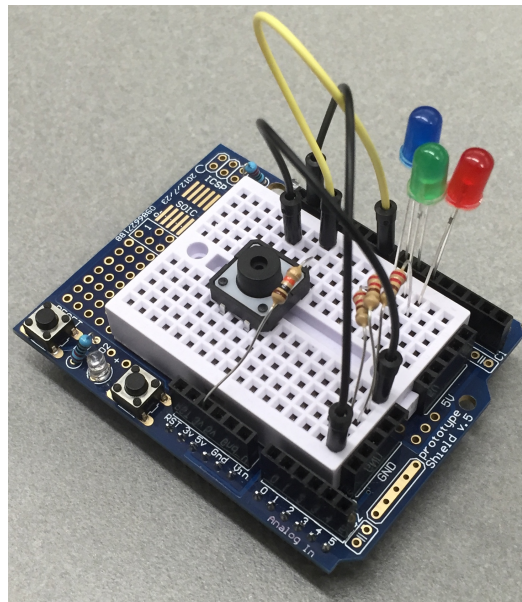


Figure 2: Circuit Rendered on Prototype Shield

Programming: your task will be to create a **single** program that operates on each device that realizes a larger system behavior. The details are below.

Basic elements – any device

- There are three LEDs. The Blue indicates a **leader**; the Green indicates **not infected**; and the Red indicates **infected**
- Pressing the button with either **start an infection** or **clear an infection** depending on being a **leader** or a **non-leader**
- One leader is elected on startup per connected network
- A new **leader is elected** if an existing leader disappears or is turned off
- While infected, each device will send out **infection messages** to other connected devices with a fixed period of 2 seconds
- A **clear infection message** has priority over **infection message**

Leader-specific

- The leader is immune to infections and cannot infect itself
- Pressing the button will cause a leader to send a **clear infection message** to other devices. This should happen only once per button press (not continuous).
- It is possible to have reinfections if not all devices are immediately reachable

Non-leader-specific

- Pressing the button causes a non-leader to infect itself
- Upon receiving a **clear infection message**, a non-leader will return to the **not infected** state and propagate the **clear infection message** to its neighbors
- Infections are persistent; repeat infections can occur if any of the non-leaders in the network are not cleared
- A non-leader is immune to infection for 3 seconds following a **clear infection message** to prevent immediate re-infection

This assignment requires the ability to partition the network and thus the XBees are the preferred wireless device. The Photons can be used if enabled to operate in the DCF mode (see https://en.wikipedia.org/wiki/Distributed_coordination_function) in which the devices communicate on a peer-to-peer mode without an access point providing the alternative (PCF).

Learning objectives: Swarming, multihop, distributed algorithms, leader election.