Pin Status
An Arduino Debugging Library for High School E-textile Courses
Michael Schneider
University of Colorado, Boulder

Problem
The Arduino IDE, while designed for beginners, lacks debugging tools that could help new programmers to find and fix their program bugs.

Proposed Solution
- Arduino (C++) Library
- Works with original Arduino IDE (no modifications)
- Provides debugging info via Serial Monitor
- Tracks variables & allows for updates at runtime
- E-textile specific, uses the onboard neopixel leds to help students visualize the power moving through the system.

Student Experiences
- Students initially assumed the source of a bug, was the hardware (poor component or bad connection).
  - During observations, most bugs were found to be issues with programming logic.
- Students often read the code to try to find bugs and did not utilize print statements.
  - Debugging modifications were heavily facilitated by course assistants.

Student Feedback
- The serial output was found to be helpful, but the neopixel notifications were difficult to map to their corresponding pins
- Students found it difficult to handle "pauses" when testing system components. They would press a button once (instead of holding) and be confused as to why the debugger didn't read the value.

Example Student Code w/ Pin Status
```c
byte val = analogRead(A10);
ddebugger.add(&val, BYTE, "val");
ddebugger.breakpoint("After analogRead");
if(val > 20 && val < 50){
  debugger.breakpoint("Inside if");
  digitalWrite(3, HIGH);
}
else {
  debugger.breakpoint("Inside else");
  digitalWrite(2, LOW);//Incorrect Pin
}
```

Example Serial Output:
```
Breakpoint - After analogRead
1. Hardware Pins
2. Variables
What component would you like to view and/or update?
Selection (Q to quit): 2
Variable Watch
[index] variable_name (type): value
******************************************************************************
[0] val (byte): 37
******************************************************************************
Enter the index of the variable to be updated. Selection (Q to quit):
```

Acknowledgements
Craft Tech Lab @ CU Boulder, crafttech.org
Debugging by Design Collaborators, U. Pennsylvania

This work was supported by a grant from the National Science Foundation (Award #1742081). The opinions expressed are those of the authors and do not necessarily reflect those of the NSF.