Lacewing 1.0

For ultra-rapid, molecular, multi-pathogen testing at the point of contact

Find out more information here

ProtonDx aim to provide rapid and accurate diagnostics, using cutting-edge technology, for everyone.

Why Lacewing?

Lacewing is a portable diagnostic tool used to quickly detect the presence of multiple pathogens in a single sample. This highly sensitive device is an affordable way to test to a PCR standard.

Lacewing has the potential to meet the needs of multiple groups, including: the travel industry, care homes, hospitals, pharmacies, labs, and humanitarian services [1].

1. Design for Manufacture: Suggesting changes to the current Lacewing prototype

Temperature-Sensing

- Not ideal to place a temperature sensor on the reader PCB
- Place thermistor on the cartridge for temperature reading

Wi-Fi and Bluetooth

- Improved connection from Bluetooth 2.0 to Bluetooth BLE with greater flexibility in data transmission
- More possibilities for the usability of the product

GPS and 3G

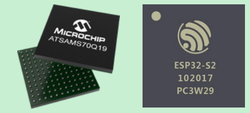
- Ideal for use in lower-income countries
- GPS to track regions where epidemics may be occurring

Microcontroller

- The STM32 is out of stock [2] due to global chip shortage so must choose a new, in stock, MCU
- Considerations for new MCU: stock, price, RAM, Flash memory and communication interfaces

2. Choosing and Testing Components - the global chip shortage and an increased need for new functionalities

Microcontroller



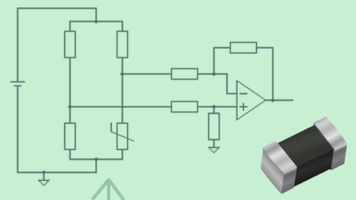
- **ESP32-S2** fulfilled all of the requirements and was easy to program
  - Tested: UART connection for WiFi, Bluetooth and 3G/GPS; SPI for connection with sample cartridge; I2C for connection to temperature sensor; ADC and DAC; PWM generation; duty cycle detection for PWM
- **ATSAMS70Q1** was hard to program due to technical roadblocks and lacking online support/documentation, but has been chosen for the final design as an extra MCU for robustness

Combined Wi-Fi and Bluetooth

- **ESP32-S3** Wi-Fi Development Kit was ordered
- Bluetooth 5.2 and Wi-Fi connection were tested and work

Temperature-Sensing circuit

- A thermistor was used in a wheatstone bridge circuit
- Resistors chosen for the largest rate of change of voltage around air temperature
- Tested with several thermistors to ensure reliability between thermistors



Bluetooth

- BMD-330-EVAL development kit was tested
- **Not chosen** due to difficulty with user interface

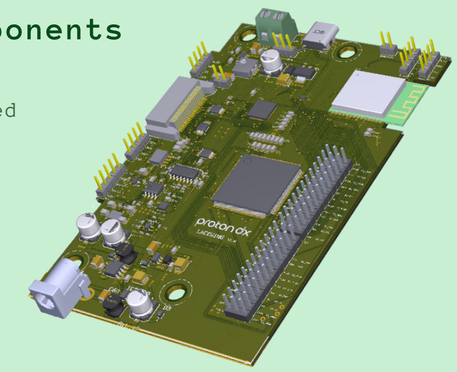
Wi-Fi

- CYW43439 Wi-Fi Development Kit was tested
- **Not chosen** as lacked of development resources

3. Designing a PCB - a new PCB to integrate all new components

Altium - software for designing PCBs

1. The PCB of the Lacewing 0.5 was inspected, and all replaced components were removed
2. The new circuit was designed to enable selection between two MCUs on board and to give access to pins that will help with development and debugging
3. The schematic and PCB floorplan was updated to include the new components
4. The tracks that connect each component were drawn, with care taken to make sure surrounding tracks will not affect each other
5. The ground and power layers of the PCB were drawn, to ensure good distribution of power and the reduction of cross talk and electromagnetic interference
6. The PCB was sent for manufacture



[1] https://protondx.com

[2] https://www.mouser.co.uk/c/?marcom=148435903