Automated Sample Agitation Transportation System:

Cheap, Accessible Blood Test Automation

Dorjee Tenzing, Connor Platt, Gregory Ziegler, Mishari Alsabih, Alex Besanceney | Sponsored by Gamze Onuker
ECE 129 | Stephen Petersen

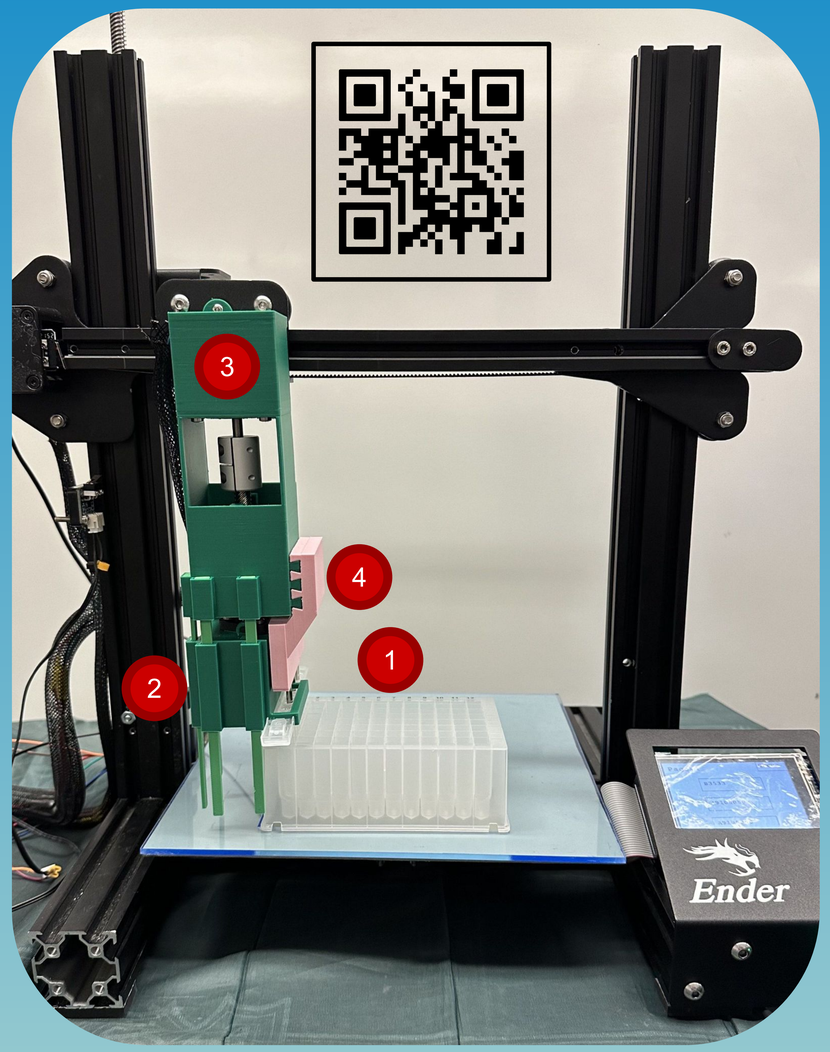
Objective

Currently, an entire blood testing procedure takes two hours of repetitive, hands-on work, preventing nurses from providing direct care to patients. While this process has already been automated, the existing market solutions are expensive (~$10k).

We have teamed up with PhD student Gamze Onuker to provide a cheaper, more customizable option which she will use in her innovative research to detect viral diseases earlier in their progression using magnetic bead-based purification.

What our sponsor needs from us?

Customizability is key in Gamze's research. We have provided her sub-millimetre precision with speeds up to 300mm/s. We have also increased the number of test tube columns (1) she can use from 6 to 12, while simultaneously decreasing the number of user interactions from multiple to just one!



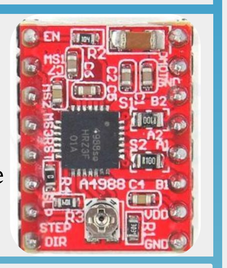
Agitation Body Design

We added an additional axis of movement to agitate samples during blood testing. This design includes:

- A secondary body (2) that moves independently from a primary body (3)
- A slider to insert magnetic rods into plastic combs (4)

A4988 Stepper Motor Driver

- Controls stepper motors with step and direction signals from the ESP32
- Each step turns the shaft 1.8°, but can be refined to 0.1125° with microstepping



Power

- Buck regulator and SMPS regulate power from wall outlet
- Powers ESP32 microcontroller, stepper drivers and daughterboard

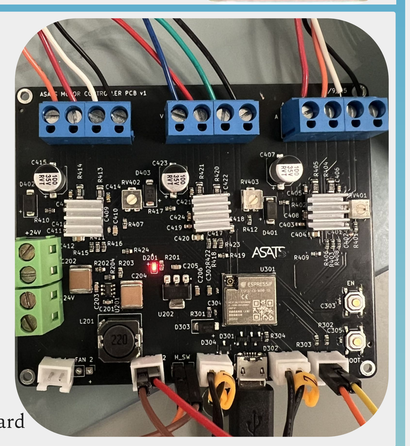
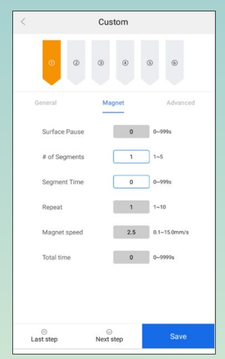


Figure: Power Supply and Motor Controller Motherboard

How does the device work?

Create a Protocol

User selects parameters for protocol



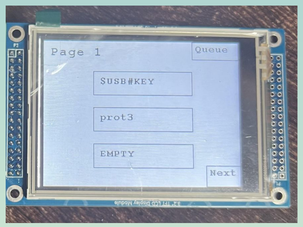
App

Scan Protocol onto Touchscreen

QR Scanner

Select a Protocol

Daughterboard sends selected protocol data to motherboard via UART



Touchscreen

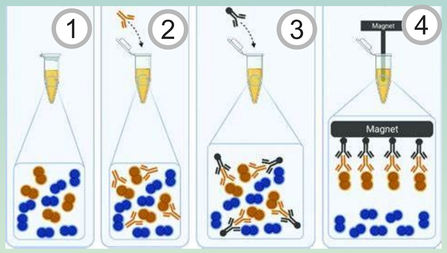
Begin Motor Operation

Scan me for demo!

Executing a Protocol with Two Key Movements

Repeat the magnetize and agitation movements until the sample is purified.

Magnetize: bind sample to testing liquids



Agitate: remove contaminants by rapidly moving combs up and down