Autonomous Probing Station for the Measurement of Single DNA and RNA Sequences

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Objective

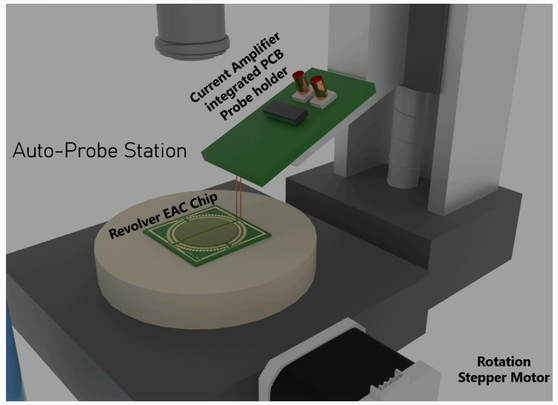
The goal of the project is to develop an autonomous system capable of measuring single molecule DNA and RNA sequences for electronics and sensing applications.

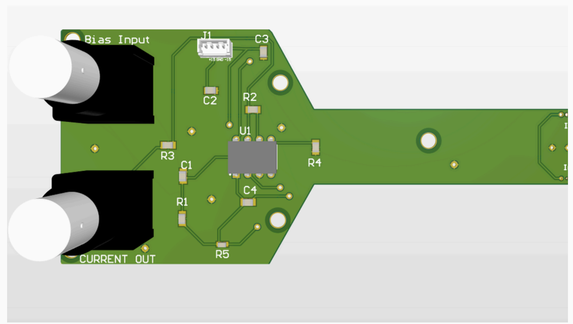
Abstract

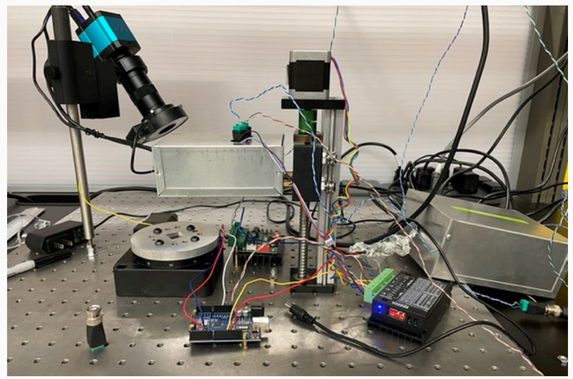
Single-molecule break junction devices are used to determine the electrical conductance of single molecules by repeatedly bringing two metal electrodes into contact, applying an electrical bias, and measuring current as the electrodes are pulled apart. Changes in the electrical characteristics of RNA sequences can be used to identify toxic sequences and strains. This process is done manually, which can be tedious and time consuming. Automating the process can minimize the time it takes to collect accurate and consistent data.

Methodology

- A current amplifier was used to increase the small current signals to a more measurable range without changing the voltage input.
- National Instrument Data acquisition was used in order to measure the current and voltage from the PCB while also being programmable.
- Arduino microcontroller was used in order to communicate between the portable computer and staging area.
- Stepper motors and drivers were used to rotate the microchip and also change the elevation of the PCB.

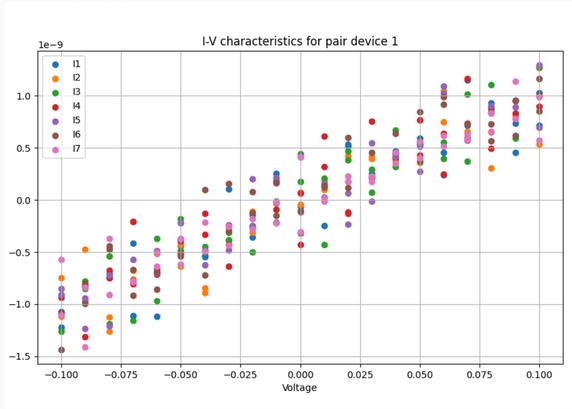


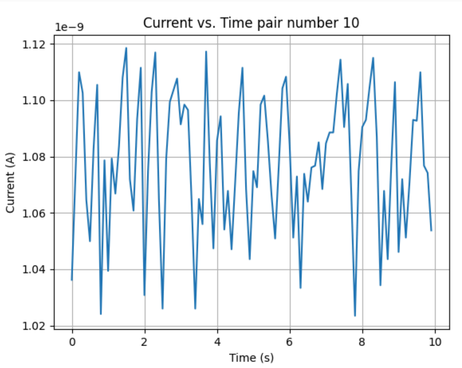




Results

- By implementing the autonomous probing station, the time spent on gathering data was significantly shortened to 5.5 seconds per pair of junctions.
- Gathered data displayed an error margin of 1.5%.
- Through iterative testing, the I-V and I-t characteristics remained consistent.
- The programmed user interface allows for parameters to be easily mutable.





Future work

- Improvements will be made to enhance the portability and practicality of the system.
- Implement autonomous calibration for the positioning of the micro-chip will be done in order to minimize error and increase consistency.
- Continue working on a circuit that can be used to perform simultaneous measurements after the probing station has identified working junctions.

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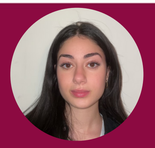

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References

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