

### **Self Driving Labs for Chemistry**

- Self-driving labs built with general purpose robots and with common hardware can democratize chemical laboratory automation
- Specialized hardware for lab automation is expensive and lacks flexibility
- Precise liquid handling is an essential task in chemistry labs

#### **Problems with Automated Liquid Transfer**

Accuracy is limited when pouring liquids with a robotic arm [1]

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- Existing pipette automation requires expensive specialized hardware
- Specialized solutions for operating commercial pipettes with robotic grippers limit manipulation abilites [2]



**Initial Position** 

Aspiration

Links



**CHEMRXIV PAPER** https://doi.org/10.26434/chemrxiv-2023-nvxkg

## **GITHUB - DEMO VIDEO - SOURCE FILES**

https://github.com/ac-rad/digital-pipette

[1] N. Yoshikawa, A. Z. Li, K. Darvish, Y. Zhao, H. Xu, A. Kuramshin, A. Aspuru-Guzik, A. Garg, and F. Shkurti, "Chemistry Lab Automation via Constrained Task and Motion Planning," arXiv preprint arXiv:2212.09672, 2023. [2] J. Zhang, W. Wan, N. Tanaka, M. Fujita, and K. Harada, "Integrating a Manual Pipette into a Collaborative Robot Manipulator for Flexible Liquid Dispensing," arXiv preprint arXiv:2207.01214, 2022.

# DIGITAL PIPETTE

## **Open hardware for liquid transfer in self-driving laboratories**

< \$200

3D models and code are

entirely open-source!

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Dispensing

Performace is comparable to commercial micropipettes! (%)

rro

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-2.0

-4.0

-6.0

-8.0



8.0 6.0 -----4.0 2.0 0.0



#### **Pipette Design and Calibration**

Three piece, **3D printed** design

syringe

serial communication with the robot workstation

#### Length of Arduino pulse signal controls the length of extension,

which was calibrated to desired volumes by weighing the dispensed liquid

Proposed pipette costs less than 200 USD in total; comparable to typical micropipettes used in chemistry labs

1280

10.10

() 10.05

= 10.00

9.95

9.90

#### **Experiments & Validation**

[3] Opentrons, OT-2 Pipettes by Opentrons, 2023, https://opentrons.com/products/pipettes/ [4] I. O. for Standardization, Piston-operated volumetric apparatus - Part 2: Pipettes, International Organization for Standardization, ISO 8655



#### A linear actuator operates a standard 10 mL

# The linear actuator is controlled by an Arduino via USB

