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A THERMALLY ACTUATED MICROVALVE FOR SMART IRRIGATION IN PRECISION AGRICULTURE APPLICATIONS

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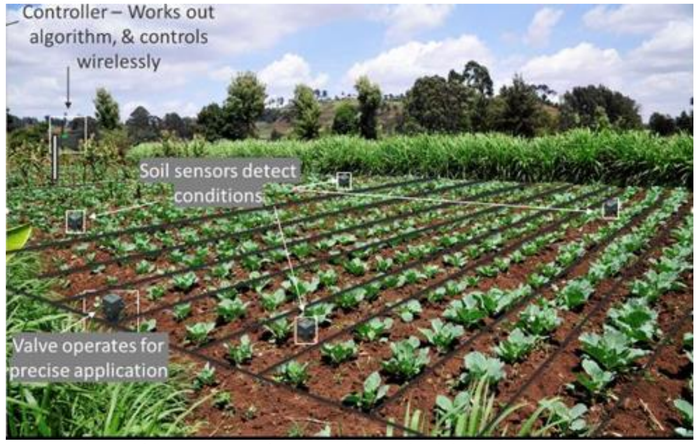
T3: TEXAS A&M TRIADS FOR TRANSFORMATION
A President's Excellence Fund Initiative

MOTIVATION FOR RESEARCH

Development of a simple and low cost smart irrigation system (precision agriculture) for meeting the individual water needs of plants in a field



➢*Microsoft: https://www.microsoft.com/mea/make-your-wish/wish-details?id=2669*

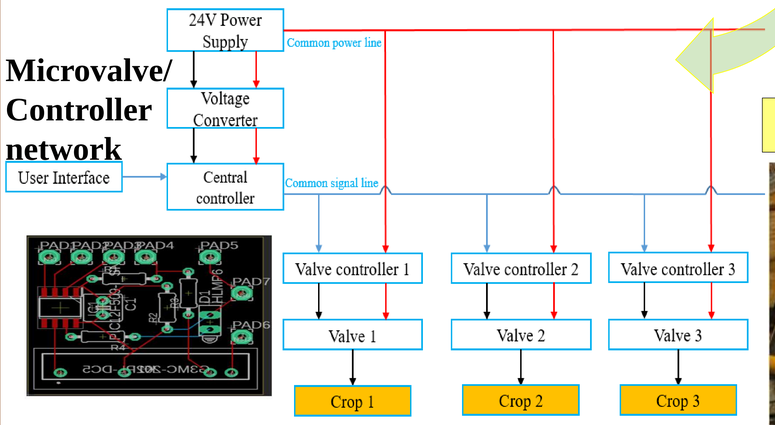
AIM/GOAL OF RESEARCH

Develop and test a microfluidic system that could be controlled to deliver the needed amount of water to individual plants.

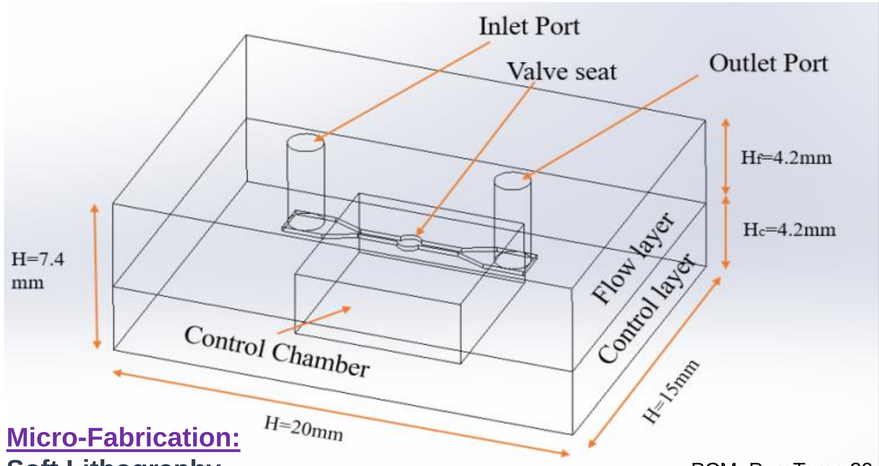
NEEDS:

(a) Safe & reliable;
(b) Low cost;
(c) Simple manufacturing;
(d) Low power;
(e) Tolerate pressure loads;
(f) Simple actuation;
(g) Easy control;
(h) Amenable for remote control;
(i) Long-term reliability (life-cycle duration of 3~5 years);
(j) Low maintenance (or no maintenance);
(k) Robust to weather (i.e., in open fields and orchards).

Microvalve/ Controller network

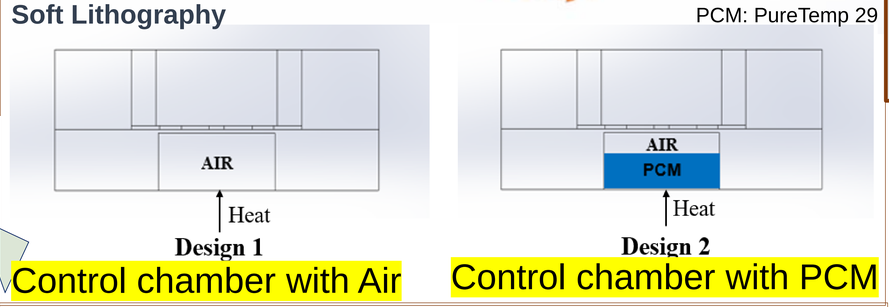


MICROVALVE DESIGN



Micro-Fabrication:
Soft Lithography

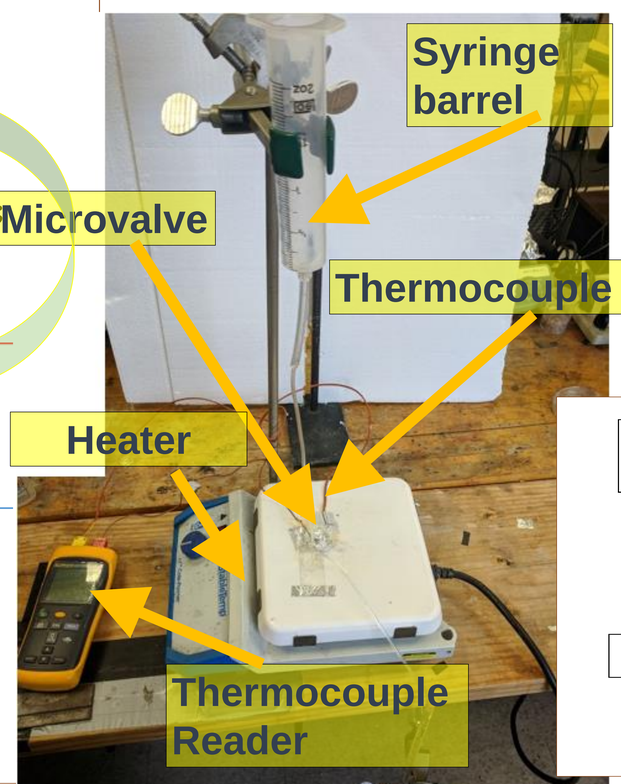
PCM: PureTemp 29

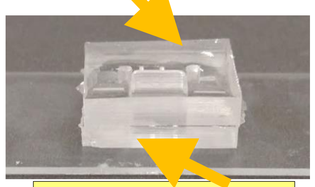


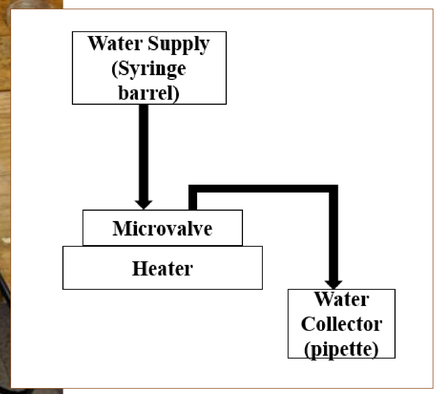
Control chamber with Air

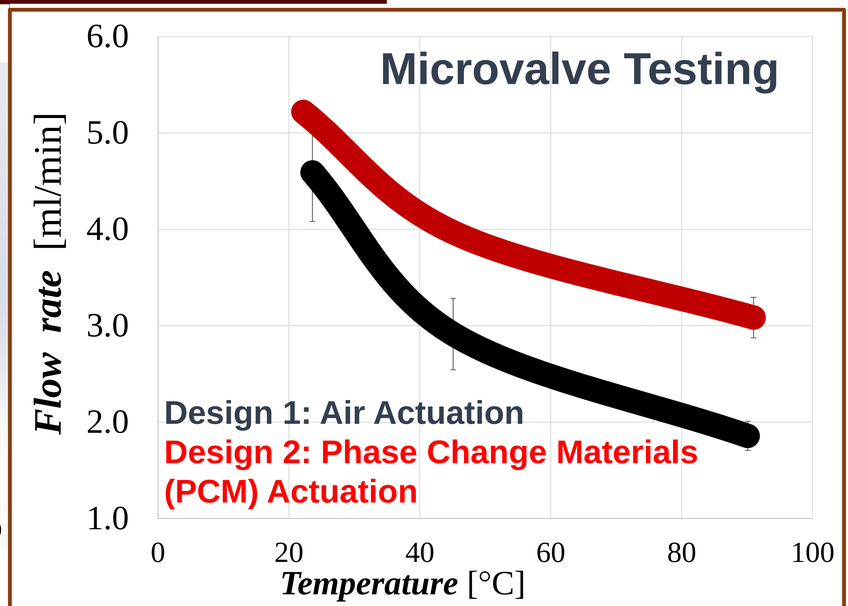
Control chamber with PCM

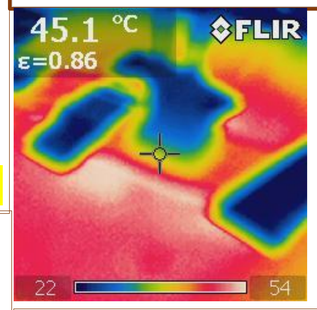
EXPERIMENTAL SETUP











Infra Red (IR) Image of Heated Micro-Valve

Micro-Valve Assembly

CONCLUSION

- **Simple and low cost manufacturing**
- **Design 1: 60% lower flow rate.**
- **Design 2: 40% lower flow rate**

FUTURE DIRECTION

- Computer modeling
- Experimental Validation
- System assembly & Testing

PUBLICATION: Bamido, A.*, Thyagrajan, A.*, Shettigar, N.†, and Banerjee, D., "A Thermally Actuated Microvalve for Irrigation in Precision Agriculture Applications", *Paper No. SHTC2020-8933, Proceedings of the ASME 2020 Summer* ***Heat Transfer Conference*** *(SHTC 2020* July 12-15, 2020, Rosen Shingle Creek, Orlando, FL.

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