

# MICROCONTROLLER BASED AUTOMATION AND ACTUATION OF CONTROLLED CHEMICAL REACTIONS

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# VISION

- MANY CHEMICAL REACTIONS NEED HUMAN PRESENCE TO CONTROL COMPLEX CHEMICAL REACTIONS THAT REQUIRE PRECISION AND MONITORING.
- BY USING A MICROCONTROLLER, WE CAN CONTROL THE REACTION PARAMETERS AND GET PRECISE STOICHIOMETRIC MEASUREMENTS, ELIMINATING HUMAN ERRORS.
- IT CAN ALSO ALLOW FOR FURTHER AUTOMATION OF SIMPLER STEPS WITHIN A CHAIN OF PROCESSES, FOR ANY LABORATORY EXPERIMENTATION INVOLVING TIME SENSITIVE OR DETECTABLE RESULTS.
- AS A BASELINE, WE WANT TO DEMONSTRATE THIS ON A BASIC REACTION LIKE TITRATION.

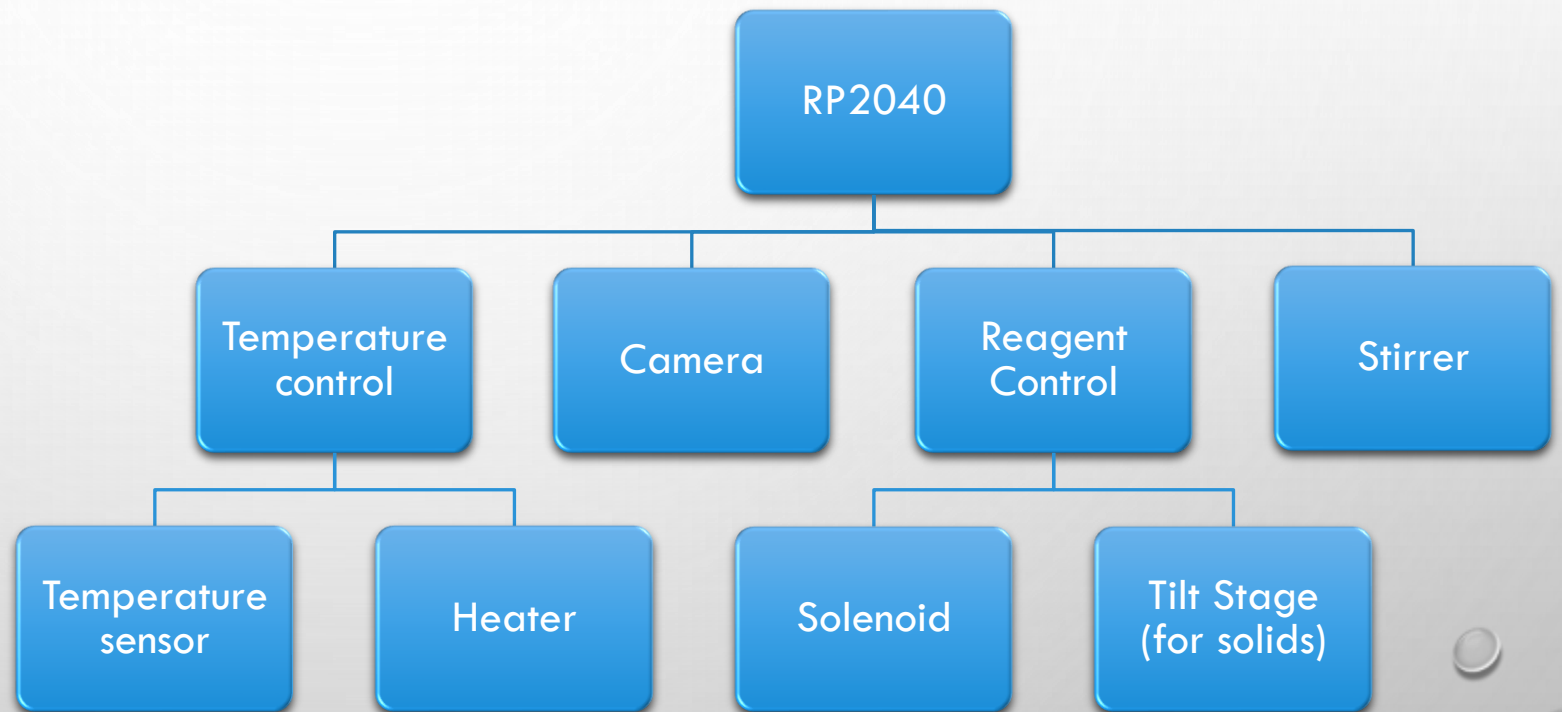


# SENSORS AND COMPONENTS WE EXPECT TO INCORPORATE

- TEMPERATURE: WE CAN USE A COIL OR A HOT PLATE POWERED USING SIGNALS FROM THE RP2040 BOOSTED USING A BUCK-BOOST CONVERTER. THE TEMPERATURE WILL ALSO NEED TO BE SENSED USING A THERMOCOUPLE.
- COLOR: WE CAN USE THE CAMERA ONBOARD THE RP2040 PICO4ML BOARD. THIS WILL ALSO ALLOW US TO MAINTAIN A RECORD OF REACTION COMPLETION.
- STIRRER: CAN POSSIBLY BE IMPLEMENTED WITH A MAGNETIC STIRRER CONTROLLED USING A VOLTAGE FROM GPIO OR AT A BASIC LEVEL USING AN APPENDAGE AND A SERVO MOTOR.
- VALVE TO CONTROL INPUT: IN ORDER TO CONTROL THE AMOUNT OF REAGENTS BEING USED, WE USE SOMETHING SIMILAR TO A SOLENOID.



# BLOCK DIAGRAM





# TENTATIVE PROJECT PLAN AND MINIMUM VIABLE GOALS

WHILE THERE MAY BE A LOT OF COMPLICATIONS IN SETTING UP A HOMOGENEOUS SYSTEM THAT WORKS WITH MANY DIFFERENT TYPES OF CHEMICAL REACTIONS, AS A START WE WANT TO TEST AGAINST A BASIC REACTION LIKE TITRATION.

WE EXPECT TO SET UP THE SYSTEM IN A SERIES OF STEPS:

1. WE SET UP THE REAGENT CONTROL WITH THE STIRRING OPERATION. IN SPECIFIC WE LOOK FOR PRECISION IN AMOUNT OF REAGENT DISPENSED.
2. WE INTEGRATE THE CAMERA IN AND TEST IT WITH A DYE BEFORE STEPPING IT UP WITH THE ACTUAL TITRATION PROCESS.
3. ADDING EXTRA-FUNCTIONALITIES LIKE TEMPERATURE CONTROL.





# RISK MANAGEMENT

## POSSIBLE PROBLEMS WE MAY FACE :

1. PRECISE VOLUME CONTROL OF REAGENTS MAY BE BETTER OR WORSE USING WEIGHT SENSING VERSUS LEVEL SENSING.
2. TEMPERATURE SENSOR AND HEATING ELEMENT CAN HAVE OVERHEATING OR CORROSION RELATED PROBLEMS IN ACIDIC/BASIC MEDIUM.
3. AMBIENT LIGHT MAY HAVE EFFECTS ON THE EFFECTIVENESS OF THE COLOUR SENSING ASPECT AND RELATED CONTROL

## TENTATIVE SOLUTIONS :

1. USING LONG CYLINDRICAL LEVEL PIPE TO CAUSE LARGE DISPLACEMENTS OF A MENISCUS FOR SMALL VOLUME CHANGES / USING A DROP COUNTER CALIBRATED VIA RP2040 CAMERA.
2. PASSIVATING THERMOCOUPLE WITH PROTECTIVE COATING/PLASTIC COVERING.
3. USING AN INDEPENDENT DIFFUSED WHITE LIGHT SCREEN/SOURCE IF REQUIRED AS BACKLIGHT FOR BEAKER.

