User Needs Intended Uses	Design Inputs (Technical Requirement)	Acceptance Criteria Ideal/Goal	 Limit	Design Outputs	Essential Design Outputs (Check if essential)	Design Verification (Outputs = Inputs)	Design Validation (User Needs Met)
Customer Requirements (e.g. Functional)							
Pipetting volume range	10-500 uL	1-1000 uL	10-500 uL	Test usability of various sized pipettes (1-20 uL to 200-100 uL sized pipettes) to determine usability of multiple sizes			
Accurate pipetting in terms of liquid volume delivery	2 uL increment accuracy (tolerance)	1 uL increment	2 uL increment	Record masses of varying increments of liquids to determine the volume pipetted. Test with low and high viscosity liquids.			
Must fit on a lab bench	800x800x550 mm	Less than 750x750x500 mm	Less than 850x850x600 mm	Measure LENGTH x WIDTH x HEIGHT			
User-friendly interface	Preset protocols for PCR and calibration			Determine effectiveness of protocalls by comparing to desired protocall output			Conduct survey for GUI satisfaction
Transportable by two individuals throughout a lab	Approximately 30 pounds. Not physcally awkward to carry. Transportable by 2 individuals.	Less than 25 pounds or transportable by a single person	Less than 40 pounds or transportable by two people	Weigh device. Determine how many individuals necessary to transport a short distance (between lab spaces)			
Programmable by intermediate in arduino code	Uses basic arduino code	Programmable by anyone in lab	Programmable by person with significant arduino code knowledge	Determine difficulty of code.			Have user write arduino code
Must fit multiple components	plates (common in lab), pipette tips, waste disposal	Compatible with all components in lab	Uses fewer than 3 external components	Determine whether all components stated could be used			
Must avoid contaminating samples with external proteins, nucleic acids, or degratory enzymes	Comparable RNA, DNA, protein concentrations to assays run by hand			Use a nanodrop or other protein/nucleic acid concentration detecting device and compare statistically the differente to manual pipetting			
Must save time/resources	Time spent accomplishing a task using the device is less than if not using the device (should take less than ~20 minutes per pcr plate)	Maximum time per plate: 10 minutes	Maximum time per plate: 30 minutes	Measure time elapsed during single pipetting task (1 plate)			
Does not require supervision	After running a programmed task on the device, the user does not need to supervise the device while it completes the task	No individuals needed to supervise machine after selecting protocol	Individual needed for supervision for first and last 5 minutes of process				
Must be at least as accurate as by hand in terms of positioning	Repeated positioning error is (percent deviation from human error)	Makes no errors based on protocol	Makes less errors than a person	Watch machine and quantify errors			
Manual for use	Documentation for protocls that lab novices can follow	Any individual can use manual to use basic protocols	Trained individual needed to use basic protocols	Determine level of training necessary for use of manual			
Product Performance Requirements (e.g.Mechanical)							
Must sustain repeated use (maintain accuracy) - calibration (self-calibration)	Lifespan of 10 years	Lifespan of 50 years	Lifespan of 7 years				
Method to verify accuracy	Calibration/accuracy verification mode that the user can run						
Powered by standard wall outlet	120V power supply						
Interfaces with Other Systems							
Potential to interface or include other lab equipment (centrifuge)							
Program must document actions, experiments	Count number of pipetted wells, document media/fluid used						
Compatible with current technology (pipettes, tips, etc.)	Existing tips and pipettes and plates used at sci tech						
Other							

Name	Signature	Date
Edmund Tamas Takata	Edmund Tamas Takata	10/11/2017
Nickolas Hartman	Nickolas Hartman	10/11/2017