MR-COMPATIBLE OLFACTOMETER

Team Members:
Ryan Kimmel
Joe Decker
Steve Welch
Kaitlin Brendel

Client: Dr. Vivek Prabhakaran
Advisor: Professor John G. Webster

Overview

- Problem Statement
- Background Information
- Project Design Specifications
- Design 1
- Design 2
- Design 3
- Design Matrix
- Electronics
- Final Design
- Future Work

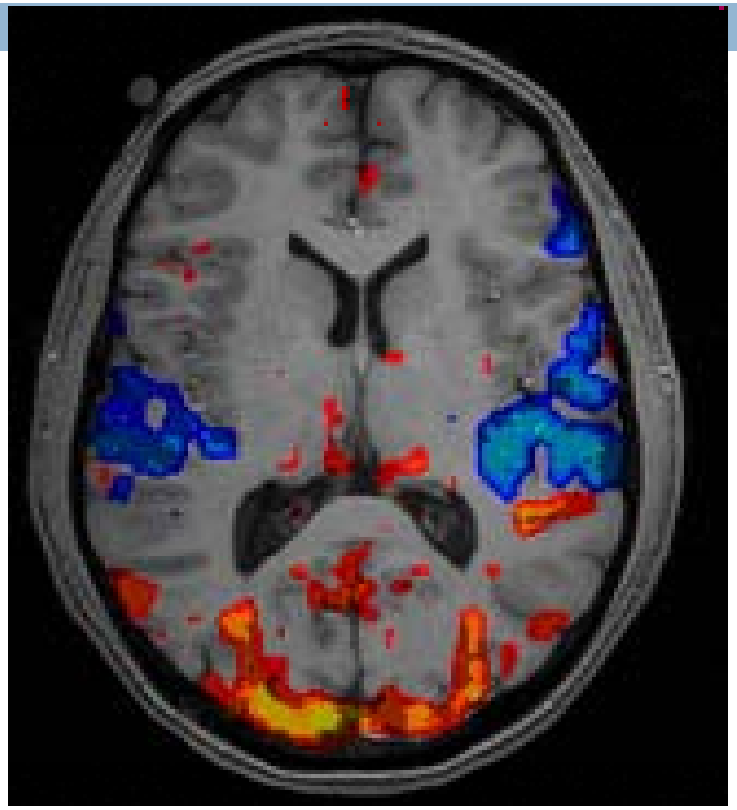
Problem Statement

- Olfactory System to deliver timed odors
- For use during an fMRI experiment
- Must be MR compatible
- Provides accuracy for experiment
  - "Smell sticks"

www.teslasociety.com

fMRI Background

- Functional Magnetic Resonance Imaging
  - Blood Oxygen Level Dependent (BOLD)
  - Measures haemodynamic response of brain



This image is an activation map of a simple experiment where the subject was repeatedly shown an image for 30 s and a dark screen for 30 s.

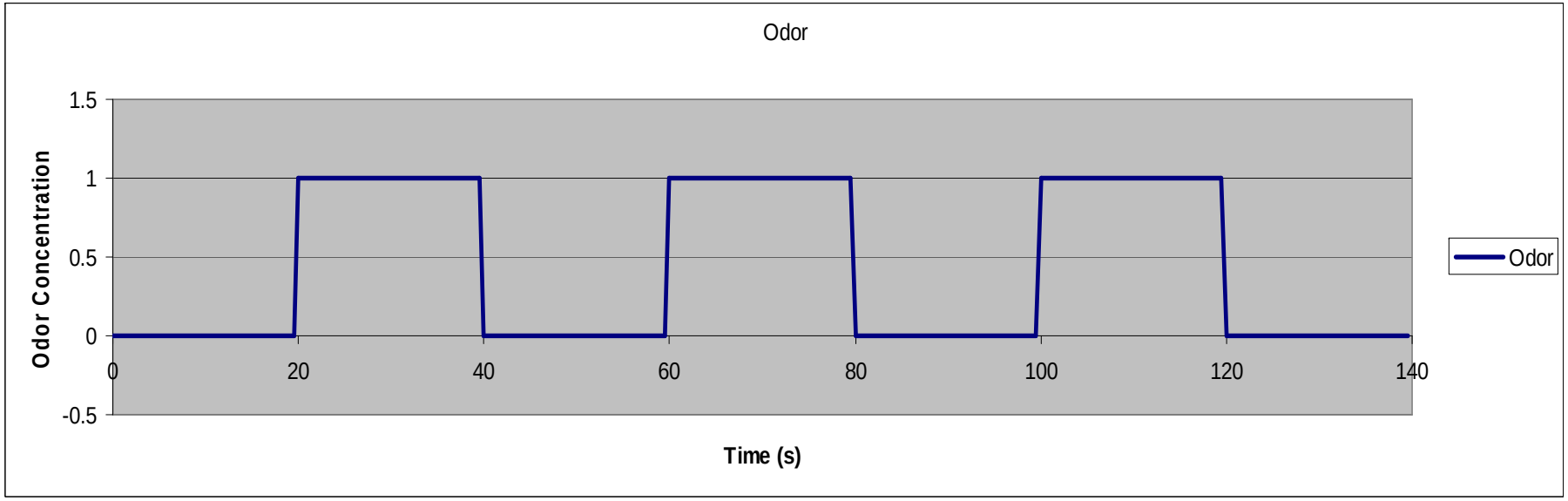
http://www.fmrib.ox.ac.uk/education/fmri/introduction-to-fmri/what-does-fmri-measure

Importance of Olfactory Research

- Alzheimer Research
  - Early diagnosis may include a loss of sense of smell
- Obesity Research
  - Sense of smell very closely related to taste
- Perfume Industry Research
- Cancer Treatment Research
  - Some odors relax patients

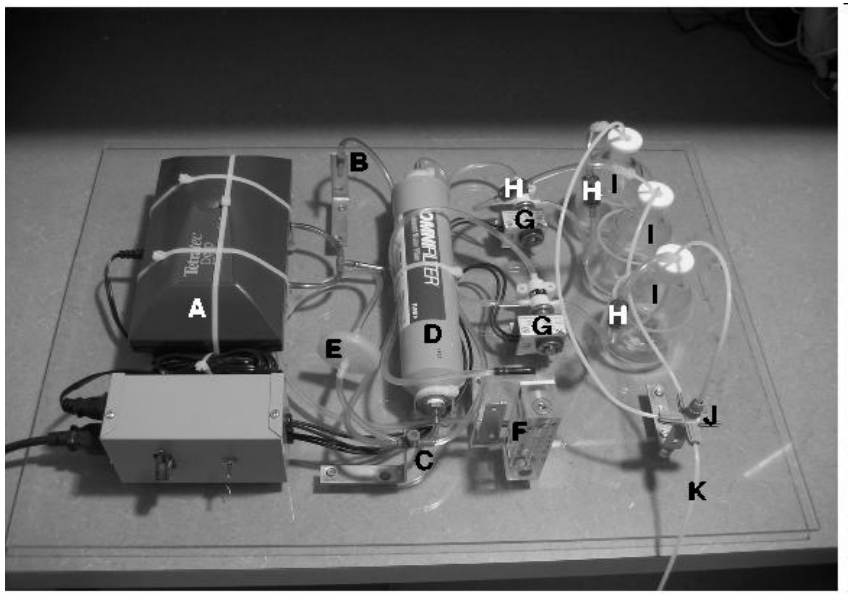
fMRI Olfactory Experiment

- Odor presented at periodic increments
- Monitor brain response to different odors
- Odor examples include: Vanilla, Ammonia, etc.



Past Olfactometers

- Many have been created for research at different universities and hospitals
- None commercially available



An olfactometer used at Harvard and McLean Hospital.

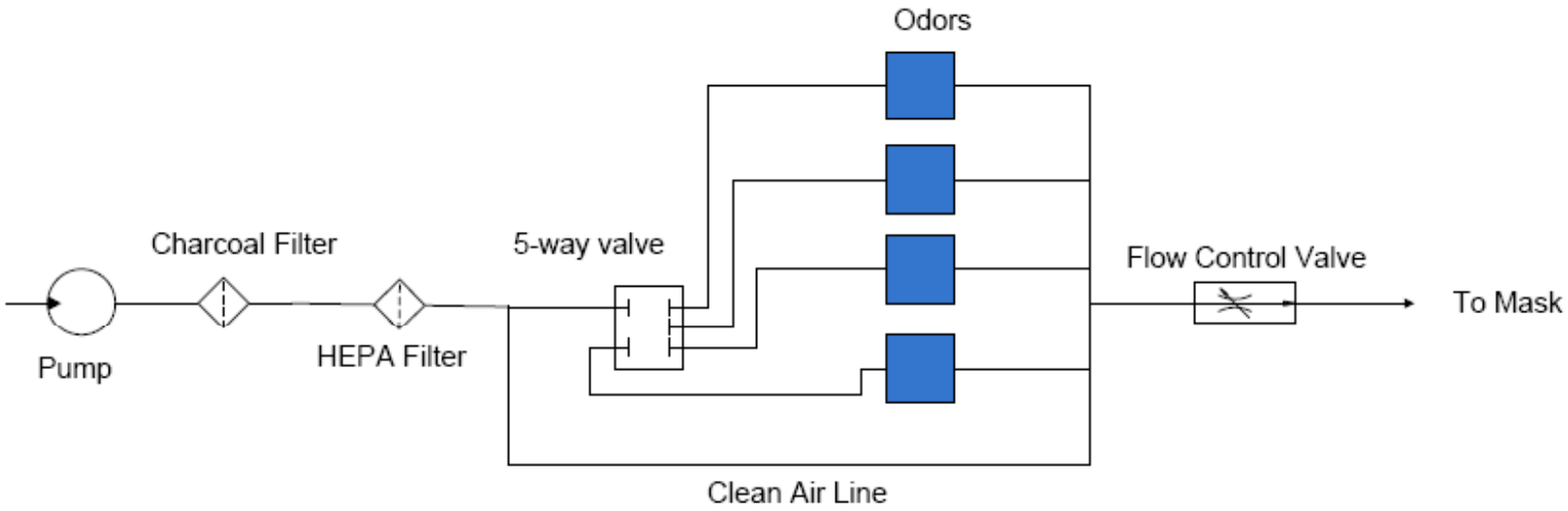
http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1602106

Design Specifications

- Must be MRI compatible (no metal)
- Must have temperature control
- Must have 4 odor inputs
  - Liquid form in glass canisters
- Must have computer control for odor release
- Must be compatible with the client's experiments

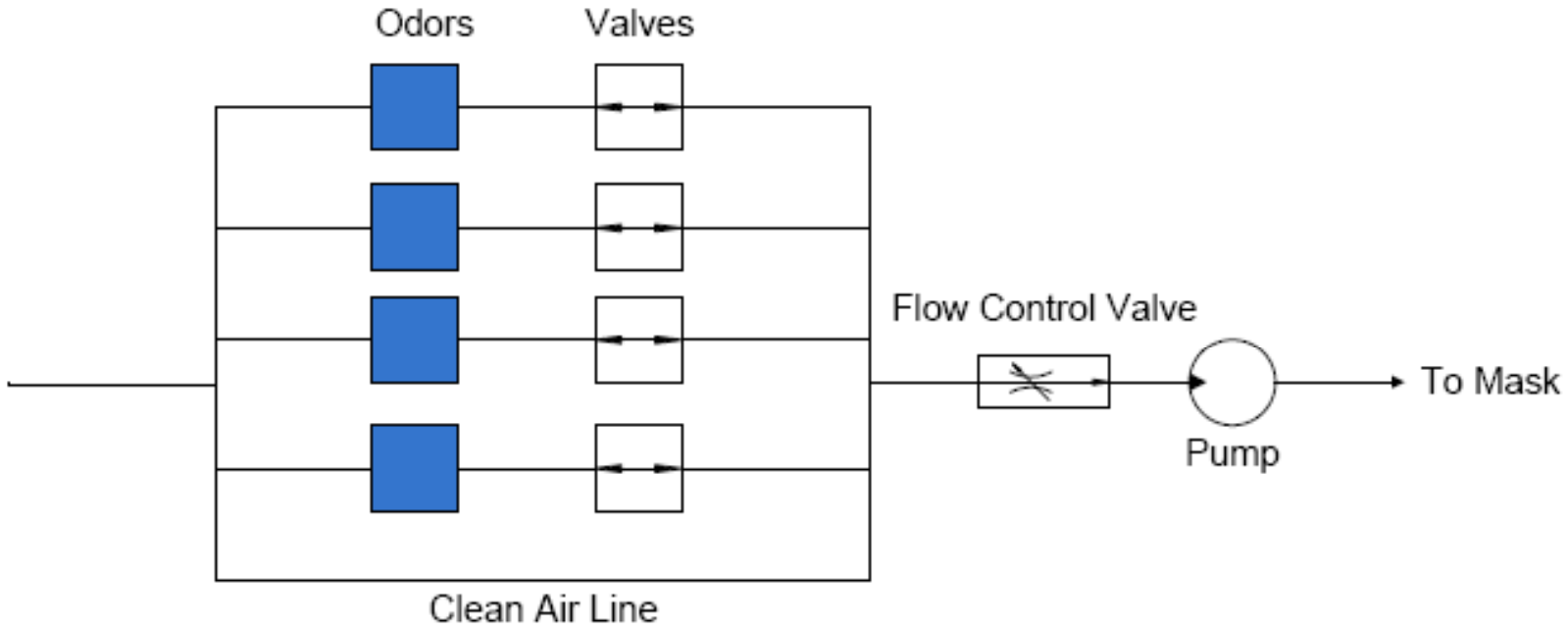
Option #1: Five-Way Positive Pressure

- One valve controls airflow to all odors
- Clean air line separate from the valve
- Rate of air flow controlled after odor is picked up



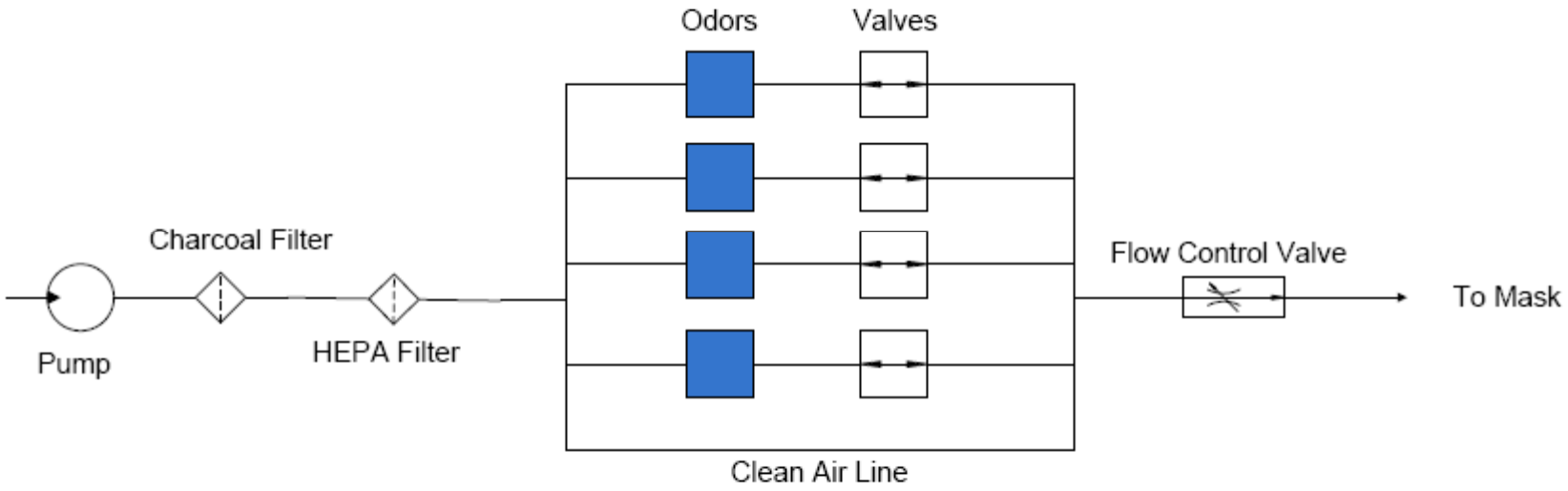
Option #2: Two-Way Negative Pressure

- Odors positioned behind pump to create vacuum
- Two way solenoid valves control air flow
- Air flow controlled before pump



Option #3: Two-Way Positive Pressure

- Four two-way solenoid valves
- Air pump forcing air through the system
- Rate of flow controlled just before the mask

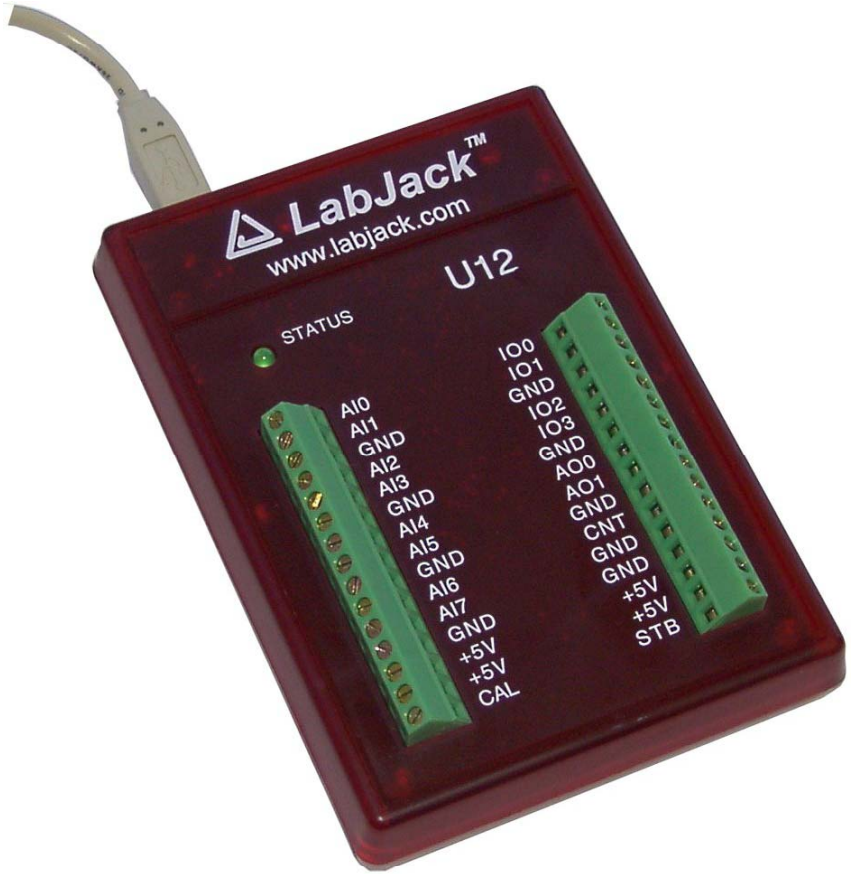


Design Matrix

		AIR FLOW DESIGNS		
Design Consideration	Weight	**2-way negative**	**2-way positive**	**5-way positive**
Safety	15	**13**	**13**	**13**
Cost	10	**5**	**7**	**9**
Ease of Operation	15	**14**	**14**	**14**
Accuracy for experiment	20	**13**	**18**	**16**
Aesthetics	5	**3**	**4**	**3**
Durability	15	**10**	**12**	**8**
Precision	20	**18**	**18**	**18**
TOTAL	**100**	**76**	**86**	**81**

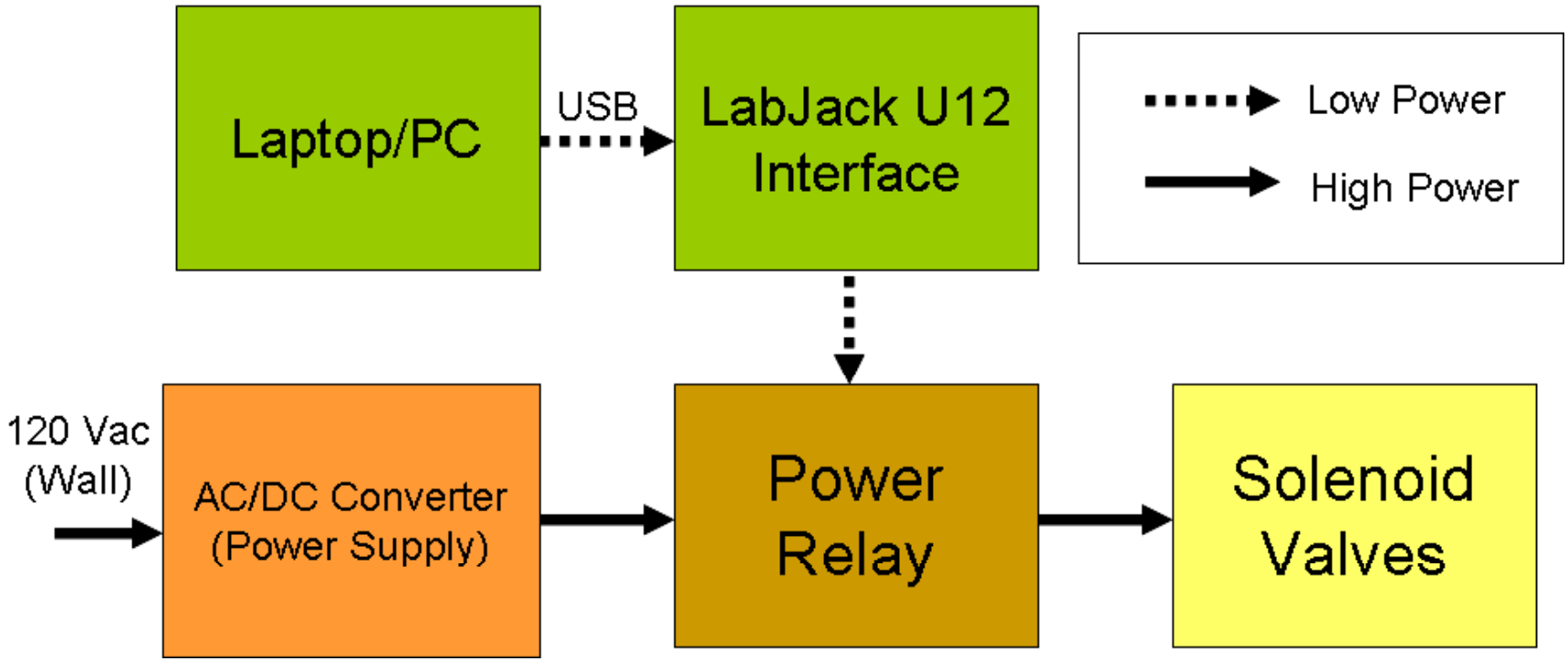
Electronics

- User supplies input to control valve array
- Requires components:
  - PC + Program
  - Bus Interface (right)
  - Power Source
  - Power Relay



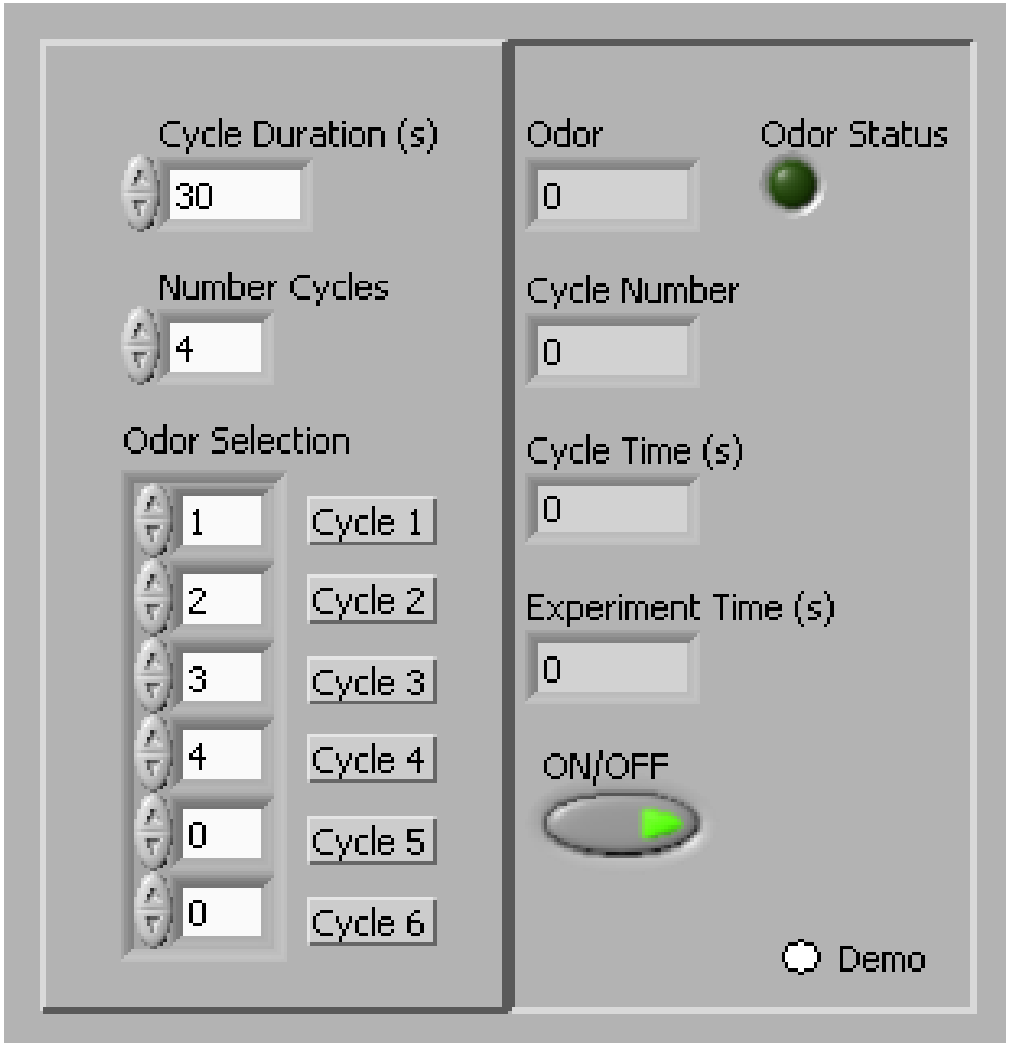
www.labjack.com

Electronics Layout



Program

- LabVIEW
- User Controls:
  - Odor Selection
  - Cycle Duration
  - Number of cycles
- Interface: LabJack U12 (USB)
  - Supplies low power signals to relay



Final Design Components

- **Pump:** Elite 801 Air Pump by Hagen, $7.99
  - 3.0 PSI, 2.5 W
- **Air Mask:** Anesthesia
  - $3.99 for 1
- **Odor Canister:** 250mL
  - $131.42 for 6
- **Filters**
  - OmniFilter R200, Charcoal
    - $13.50
  - Tiara Medical HEPA
    - $6.95

www.hagen.com

Future Work

- Select tubing/valve sizes
- Order parts
- Construct prototype
- Testing

References

- www.teslasociety.com
- www.fmrib.ox.ac.uk
- Lowen, S.B. and S.E. Lukas. 2006. A low-cost, MR-compatible olfactometer. Behav Res Methods 2006 38(2): 307-313.
- www.labjack.com
- www.hagen.com

Questions?