

**Product Design Specifications:  
MRI-Compatible Olfactometer  
Team Roles:**

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**Function:** The purpose of this design is to deliver timed amounts of olfaction stimulants to a test subject undergoing an fMRI scan.

**Client Requirements:**

- Must be user friendly
- Must have replaceable parts
- Must be automated
- Must have quick setup time
- Must be MRI compatible

**Design Requirements:**

- Constant temperature and humidity
- Have up to four odor canisters to 37.5° C.
- Control air pressure to 1 atm.
- Easily portable, must weigh less than 15 kg.
- Must fit within limited table space. Roughly 1 m x 1 m.
- Must have a computer interface.
- Must present odor for controllable amount of time in a mask or cannula
- Must have ability to control the flow rate
- Easy to set up
- USB connection
- Compatible with EPRIME
- Must be able to go to the no-odor condition in under one second
- Must not retain any residual odors
- Must be compatible with the “active sniffing” technique
- Must be able to determine when odor reaches subject

**1. Physical and Operational Characteristics**

**a. Performance Requirements:** The olfactometer must operate for a desired time sequence. For example, the odor could be sent for 30 s, and then clean air must be sent for 30 s. There will be four complete sets of an odor sent to the cannula and clean air sent to the cannula.

**b. Safety:** The air pressure must not be strong enough to cause discomfort or dizziness to the patient. Therefore, the pump should not exceed 21 kPa.

**c. Accuracy and Reliability:** A high degree of repeatability is required. Flow rate must be constant and controllable. The temperature of the liquid odors must be kept at 37.5° C, and the humidity must be kept under 20%.

**d. Life in Service:** Parts should be made replaceable, increasing the service life indefinitely. The cannula must be replaced after each test, and parts will be replaced primarily following accidents. The olfactometer will be used daily for at least 30 min at a time.

**e. Shelf Life:** The olfactometer should last in storage as long as the shelf life of the commercially available parts used (the valves, pump, flow meter, etc.). A ten-year life span would be desirable.

**f. Operating Environment:** The olfactometer will be used in an ordinary MRI environment. All of the components that are near the MRI scanner must be compatible so that they do not interfere with the magnet that operates with a magnetic field of 2 T and at a Larmor frequency of 42.57 MHz/T.

**g. Ergonomics:** The olfactometer should require as little human interaction as possible while still remaining reliable and user friendly. The users should be able to quickly control the desired flow rates and timing, and then proceed with the experiment.

**h. Size:** The olfactometer must be small enough to fit on a 1 m by 1 m tabletop. It must be easily transportable between buildings.

**i. Weight:** The liquid controller must be light enough to be carried up and down stairs and between buildings by an average person. Therefore the weight should be less than 15 kg.

**j. Materials:** Materials must not interfere with the magnet of the MRI scanner. The tubes that follow the odor canisters should be made out of Teflon so they do not retain any odors. The canisters should be made of polyethylene so they could be easily cleaned.

**k. Aesthetics, Appearance, and Finish:** The olfactometer should be designed with functionality in mind, and aesthetics are of secondary concern.

## **2. Product Characteristics**

**a. Quantity:** One unit will be needed.

### **b. Production Cost:**

Estimated budget: \$750.00 - \$1250.00

## ITEM COST

Quantity	Item	Price per Item	Total Price
1	Housing tray	\$10.00	\$10.00
<b>Cole-Parmer: <a href="http://www.coleparmer.com/">http://www.coleparmer.com/</a></b>			
1	6-way solenoid valves	\$498.00	\$498.00
1	Flow meter (direct read)	\$40.00	\$40.00
3	1/8" Teflon tubing	\$27.50	\$82.50
1 (10 per pack)	Tefzel cones	\$23.50	\$23.50
1 (10 per pack)	Polypropylene fittings	\$20.00	\$20.00
1 (10 per pack)	Tee fittings	\$9.25	\$9.25
1 (10 per pack)	Barbed fittings	\$21.25	\$21.25
1	HEPA-VENT capsule	\$55.00	\$55.00
<b>Fisher Scientific: <a href="http://www.fishersci.com/">http://www.fishersci.com/</a></b>			
1 (10 per pack)	Swinnex syringe filters	\$68.00	\$68.00
<b>Measurement Computing: <a href="http://www.measurementcomputing.com/">http://www.measurementcomputing.com/</a></b>			
1	Swiith and Sense 8	\$299.00	\$299.00
<b>Radio Shack: <a href="http://www.radioshack.com/">http://www.radioshack.com/</a></b>			
6	LED button switches	\$1.99	\$7.94
1	12VDC Adapter	\$21.99	\$21.99
1	Printed circuit board	\$3.49	\$3.49
1	Project enclosure	\$5.99	\$5.99
1 (30 per pack)	Nylon wire ties	\$4.49	\$4.49
1	Heat Shrink Tubing	\$3.99	\$3.99
<b>Discount Filter Store: <a href="http://www.discountfilterstore.com/">http://www.discountfilterstore.com/</a></b>			
1	OmniFilter R200	\$9.42	\$9.42
<b>Pet Guys: <a href="http://www.petguys.com/">http://www.petguys.com/</a></b>			
1	Elite 801 air pump	\$6.49	\$6.49
<b>JRS Medical: <a href="http://www.jrsmedical.com/">http://www.jrsmedical.com/</a></b>			
4	Nasal cannulas	\$0.84	\$3.37
<b>TOTAL:</b>			<b>\$1197.67</b>

### 3. Miscellaneous

**a. Standards and Specifications:** No standards or specifications are required.

**b. Customer:** The olfactometer will be used by faculty members in the department of radiology and neurology on the UW-Madison campus. The customer prefers E-Prime for easy integration into already existing programs. An air pressure system will drive odors into the cannula.

**c. Competition:** There are currently no devices on the market that meet all of the client's requirements.