

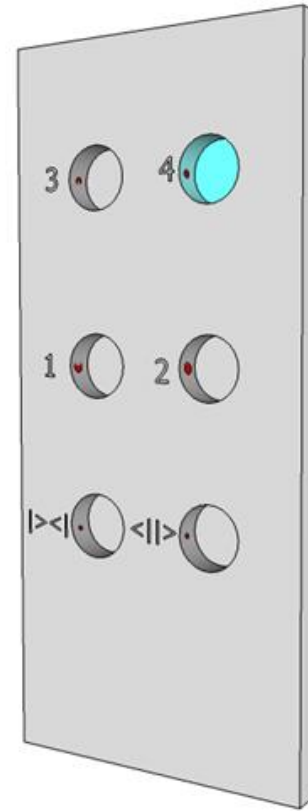
CleanLift

Touchless Elevator Panel

Please respect confidentiality

Overview

- Team Porcupine
- Motivation and Background
- General system overview
- System component breakdown
 - Sensing grid
 - Control System
 - Physical Panel
- Stages of development
 - Proof of concept
 - Initial prototype
 - Final prototype
- Challenges and user testing
- Business case
- Project budget and timeline
- Future directions



Team Porcupine



CEO - Ryan Goldan - 5th Year Biomedical Engineering

- Project planning
- Design & Assembly of final demo



CTO - Elizabeth Durward - 5th Year Systems Engineering

- Electronic systems
- Design/CAD and assembly of demos



CCO - Lauren Jackson - 5th Year Systems Engineering

- Software
- VR integration



CFO - Simon Huang - 5th Year Systems Engineering

- VR module programming
- LED design and selection

Motivation

- Spread of diseases in high risk environments
 - Hospitals
 - Cruise Ships
- More bacteria than hospital toilets seats [1]
 - Buttons hard to clean
 - Insufficient cleaning
- Cause of anxiety for germ conscious
- Industrial Settings
 - Dirty Hands or Gloves



Background

- Touchless technology is everywhere
 - faucets
 - toilets
 - hand dryers
 - paper towel dispensers
 - automatic doors
 - motion activated lights
- Various touchless sensors
 - Optical
 - Visible
 - Ultraviolet (UV)
 - Infrared (IR)
 - Ultrasonic
 - Capacitive

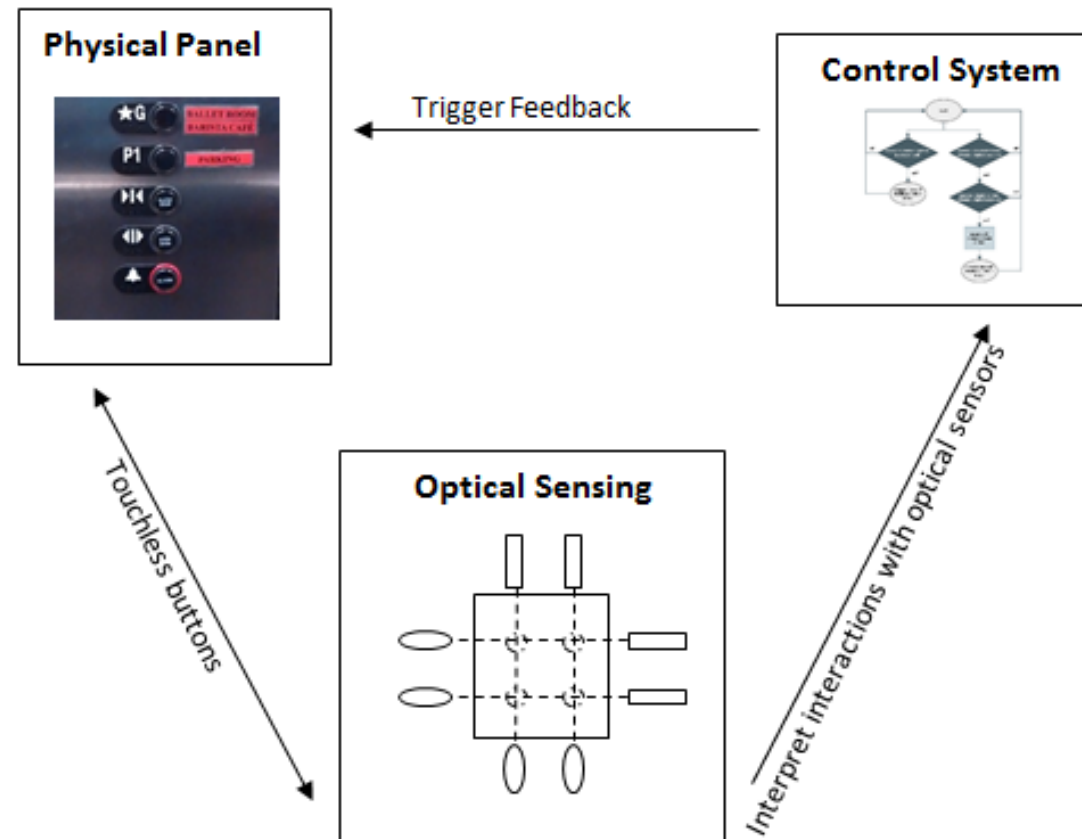


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General System Overview

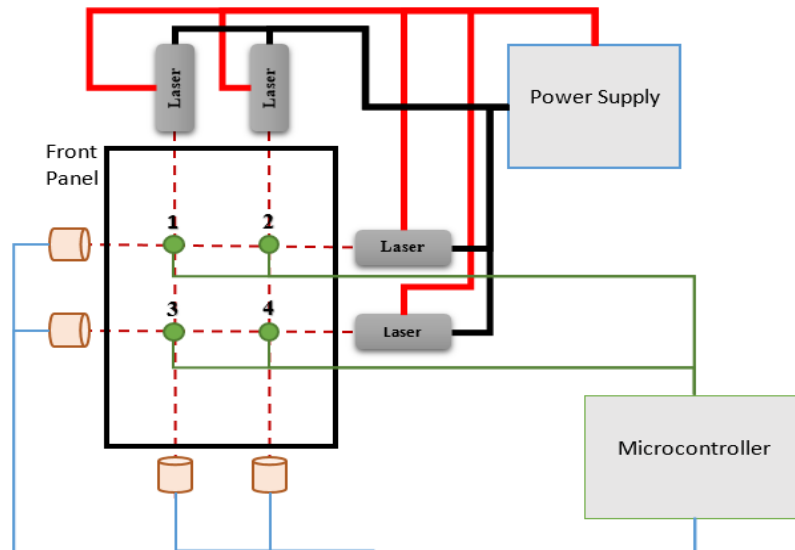
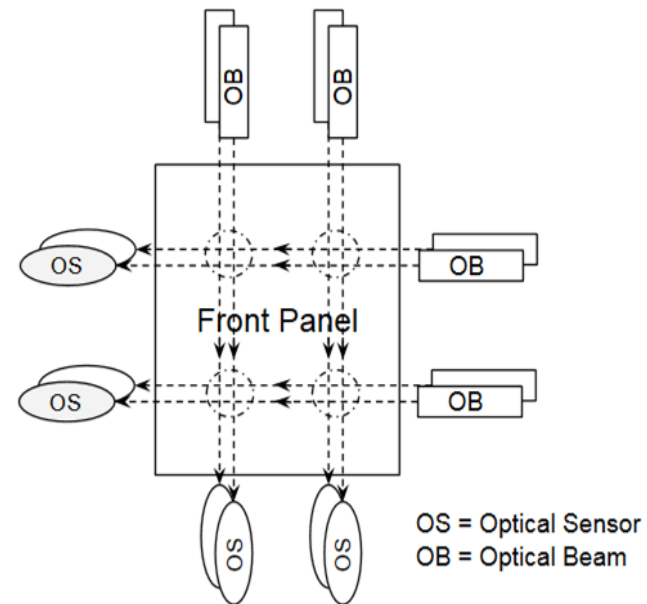
- Laser Grid
- Control System
- Physical Panel



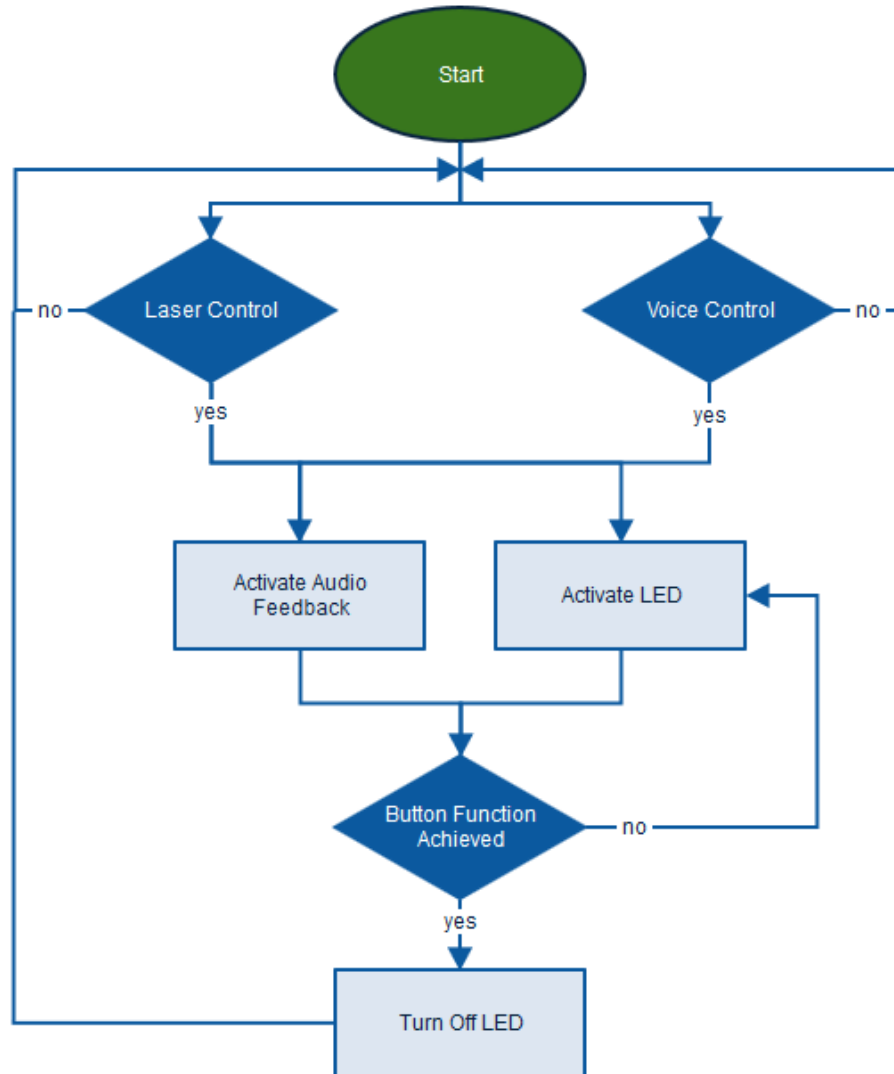
Laser Grid

- Optical vs. capacitive
- Array of optical beams
- Optical Sensor
 - Photoresistor
- Optical beam
 - Laser

 = Photocell
  = LED



Control System



- Implemented using
 - Arduino Uno
- Voice Recognition
 - EasyVR 3.0 shield

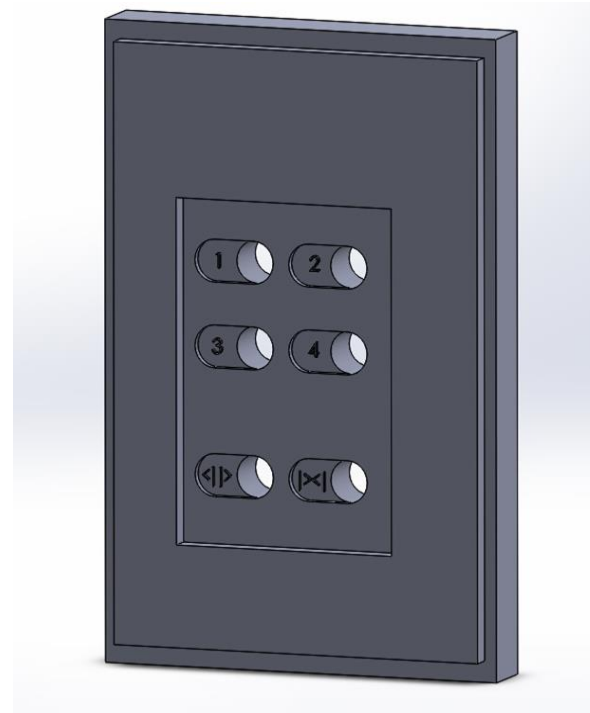
Error detection

- Error Cases
 - Button triggered > 15 seconds
 - Button triggered > 30 seconds
 - Greater than 1 button triggered simultaneously



Physical Panel

- Intuitive user experience and aesthetics
- Similar layout to current panels
- Visual and audio feedback
- Safety
 - Isolate lasers
 - Implement all elevator standards

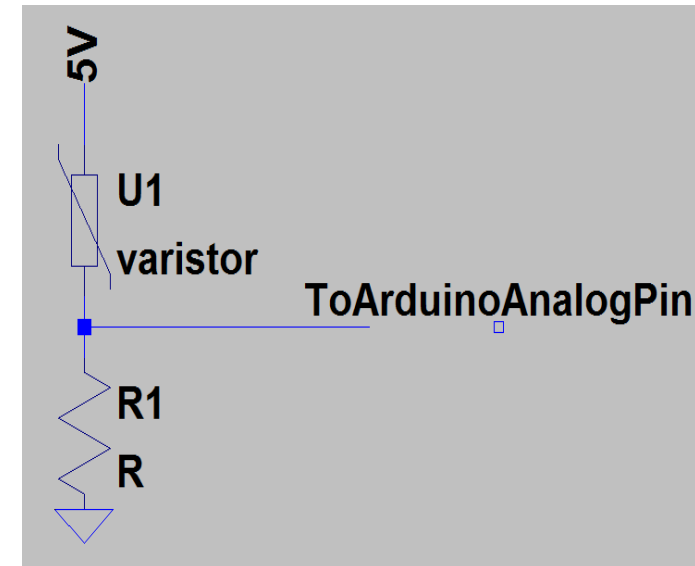


Overview

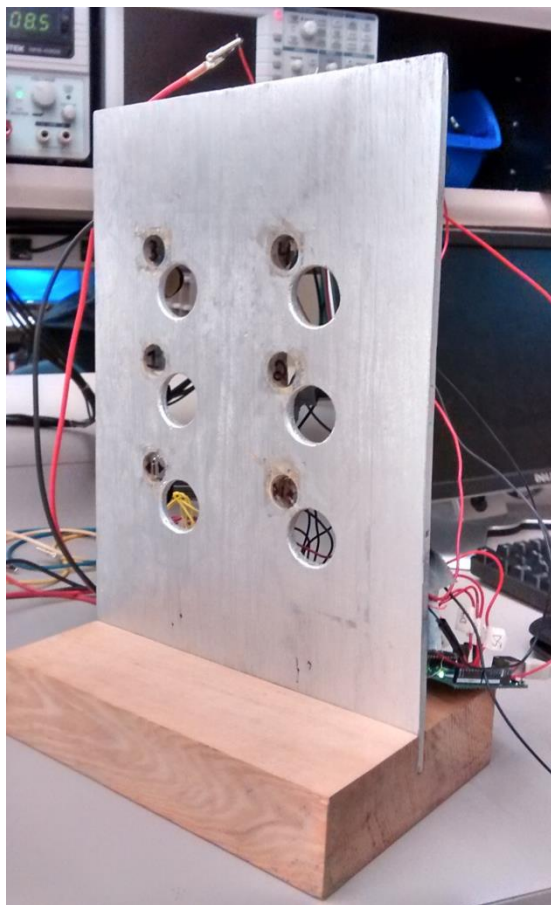
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Proof of Concept - 1 button

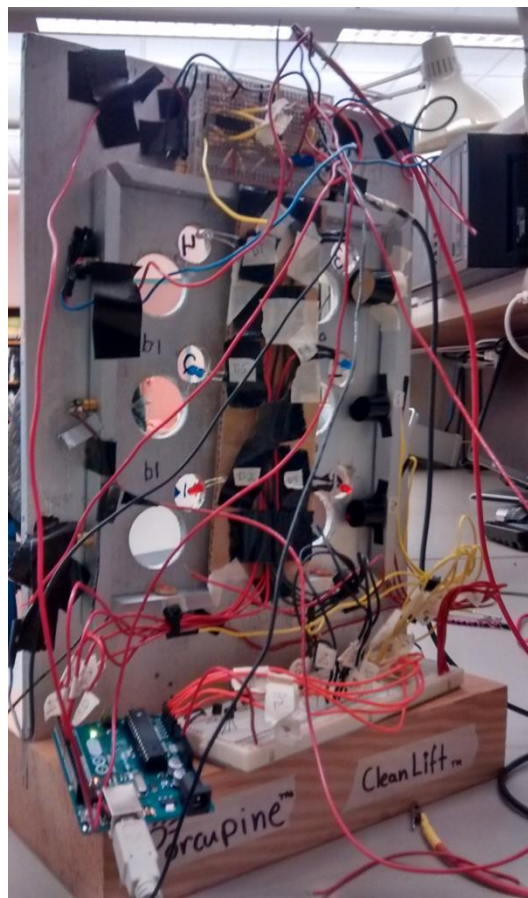
- One Laser Proof of Concept



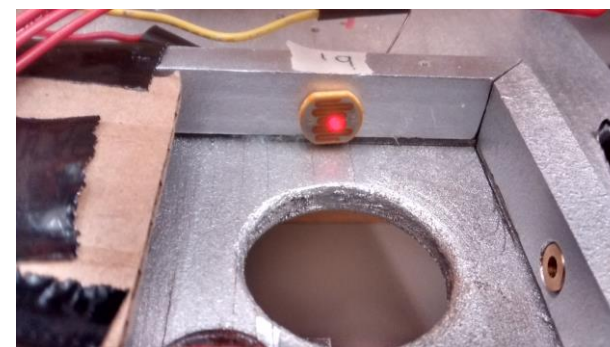
Initial Prototype



Front Panel

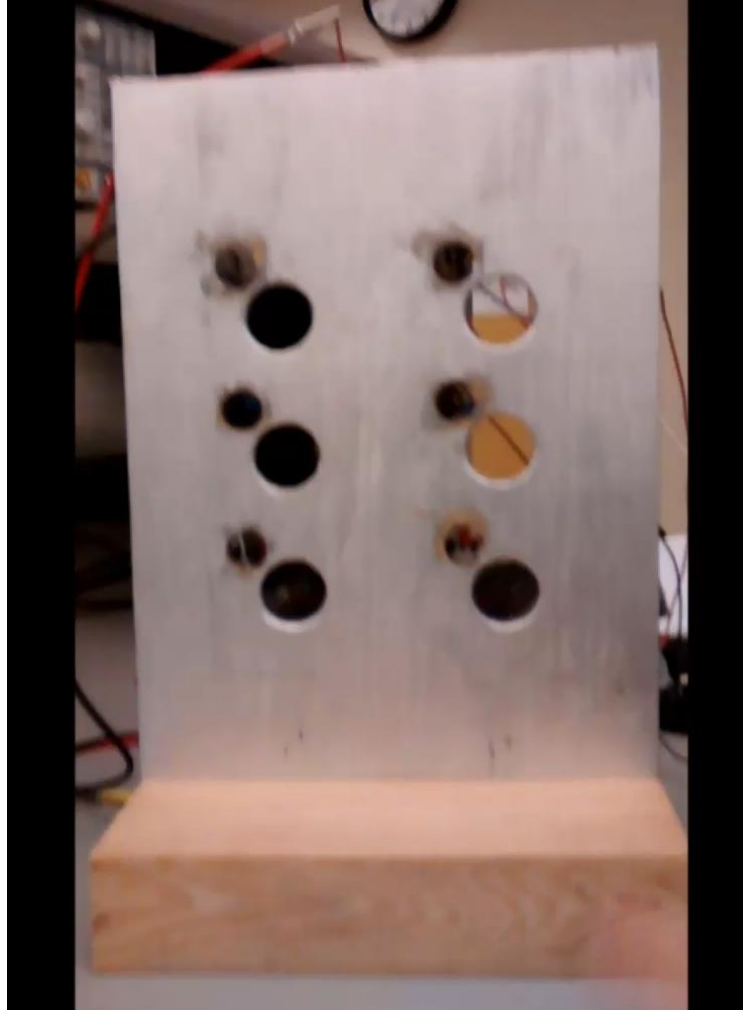


Back Panel



Lasers & Photocells

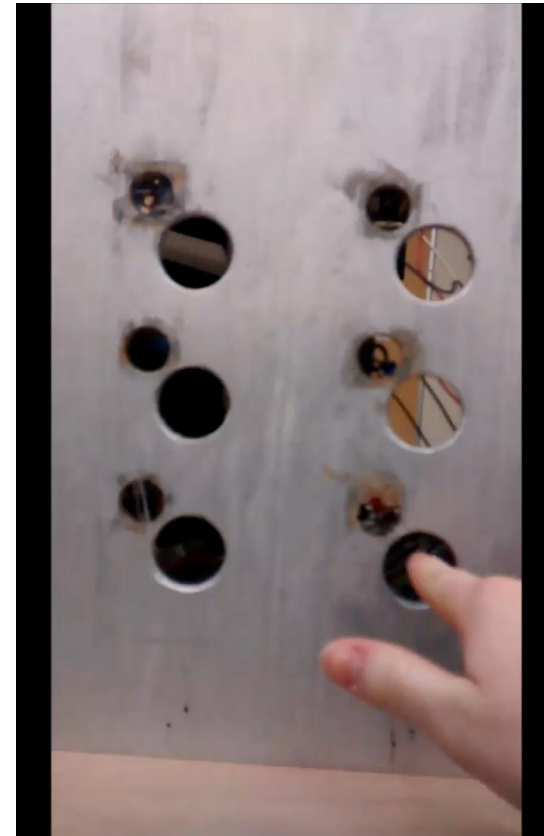
Initial prototype video



Challenges & User Testing

- Hard to align lasers and photocells
 - Moved to individual alignment for next prototype
- Ambient light was a challenge
- Possible to insert finger and miss grid point
 - Need for redundancy
- User Testing
 - LED hole confusing
 - Want tactile feedback
 - Larger recesses

Bad laser alignment



Demo Prototype

Successfully implemented:

- Sensing grid with redundancy
- LED/Audio Feedback
- Control system
- Voice recognition module
- Panel and enclosure



Demo Prototype

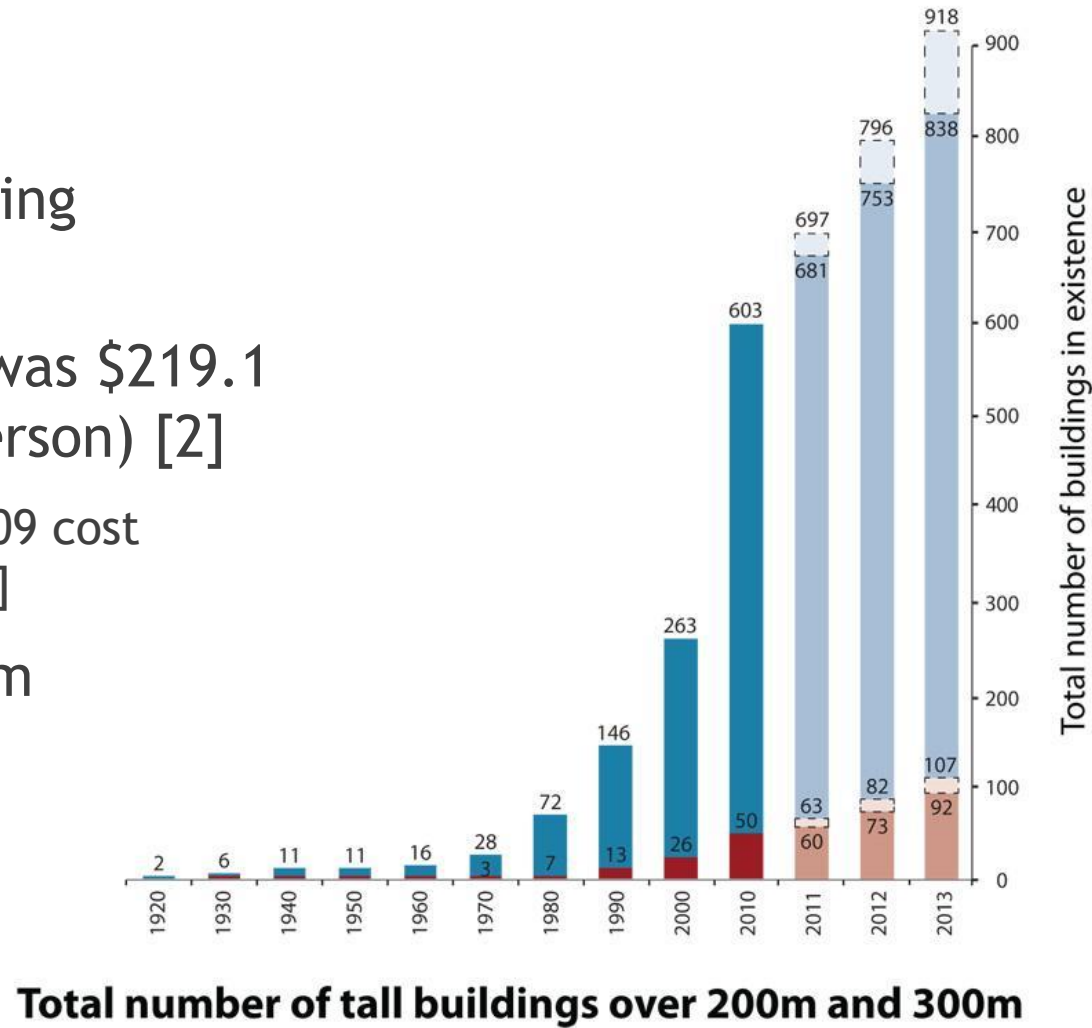


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Market

- Elevator demand is exponentially increasing
- Canadian health care expenditure in 2015 was \$219.1 billion (\$6,105 per person) [2]
 - Flu vaccinations in 2009 cost Canada \$1.5 billion [3]
- Positive response from acquaintances in the healthcare industry



Business Case

- Large markets
 - Primary → Hospitals
 - Secondary → Residential
- Competition
 - Hyundai Elevator Co. (Korea) - Touchless foot button. Only for calling the elevator. [4]
 - Patent application in China - grooves with ultraviolet emitters and sensors [5]
 - Similar design by Yanko Design - mock up of a UV sensor panel [6]
- Comparable unit cost to traditional panels
- Financing
 - Licence technology to an elevator manufacturer
 - Royalties for every elevator sold with our panel



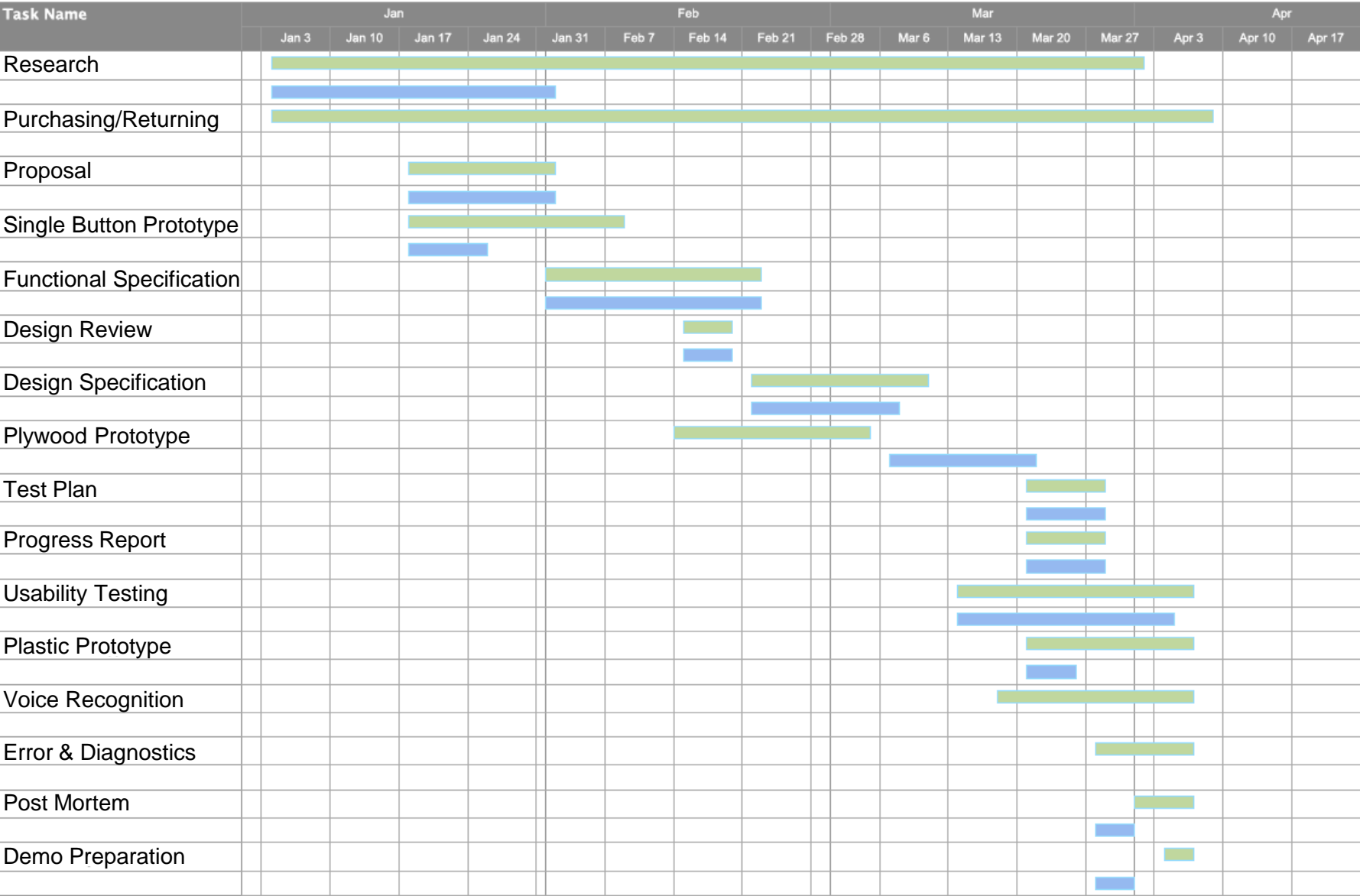
Project Budget

Section	Estimated Cost	Total Spent
Physical panel	\$150.28	\$143.66
Sensing Grid	\$196.63	\$134.03
Control System	\$102.95	\$84.91
Subtotal	\$449.86	\$362.60
Shipping	\$30.00	\$12.11
Contingency	\$89.97	-
Total	\$569.83	\$374.71

- Funding - ESSSEF \$399
- Cost per button: \$22.98 (3x2 panel)

Project schedule

Actual timeline
Proposed timeline



Future Directions

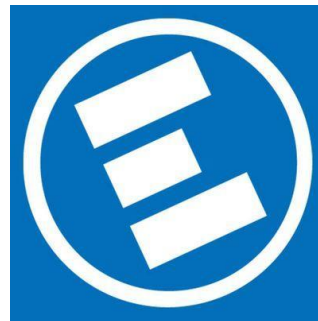
- Tactile Feedback
 - e.g. Air puffs
 - Electroshock (suggested by Dr. Rawicz)
- Braille
- Experiment with other sensors
 - Infrared (IR) and/or near-IR
 - Capacitive
- Power save mode
 - Use PIR motion sensor
 - Turn off sensing grid >20 mins inactivity

Conclusion

- Accomplished most of what we proposed
 - Multiple iterations
 - Final demo both functional and aesthetically appealing
- Lessons learned
 - Project documentation
 - Planning, budgeting, and time management
 - Technical
- Solved a real problem

Acknowledgements

- Ian Durward tools, material and advice building the initial prototype, and for making the final box to specs provide
- Michael Sjoerdsma for suggesting an optical grid
- Gary Houghton for advice on wire management
- Gary Shum for 3D printing assistance and advice
- Chakaveh Ahmadizadeh - laser cutting assistance
- Funding sources - ESSSEF, Wighton Fund



References

- [1] C.E. Kandel, A.E. Simor and D.A. Redelmeier, "Elevator buttons as unrecognized sources of bacterial colonization in hospitals." *Open Med*, vol. 8, no.3, pp.e81-e86, 2014.
- [2] Canadian Institute for Health Information, "Spending," 2015. [Online]. Available: <https://www.cihi.ca/en/spending-and-health-workforce/spending>. [Accessed 4 April 2016].
- [3] The Globe and Mail, "Cost of vaccinating a nation hits \$1.5-billion and climbing," 12 Nov 2009. [Online]. Available: <http://www.theglobeandmail.com/life/health-and-fitness/health/conditions/cost-of-vaccinating-the-nation-hits-15-billion-and-climbing/article1318824/>. [Accessed 4 April 2016].
- [4] Hyundai Elevator Co. Ltd, "New Yzer," 1 May 2014. [Online]. Available: http://www.hyundaielevator.co.kr/eng/about/PR/news/1189331_1881.jsp. [Accessed 5 April 2016].
- [5] 李良杰, "Contact-free elevator button". China Patent CN 201310313137, 9 Oct 2013.
- [6] C. Burns, "3,500 Bacteria Per Square Inch," Yanko Design, 17 April 2009. [Online]. Available: <http://www.yankodesign.com/2009/04/17/3500-bacteria-per-square-inch/>. [Accessed 6 April 2016].



*P*orcupine Solutions

“Don’t touch it!”

Questions ?

CleanLift

Touchless Elevator Panel

Technical Specifications

CAD Designs - Recess & Panel

- Recesses drawn in Solidworks and 3D printed
- Panel cut using Laser cutter based on CorelDraw schematic

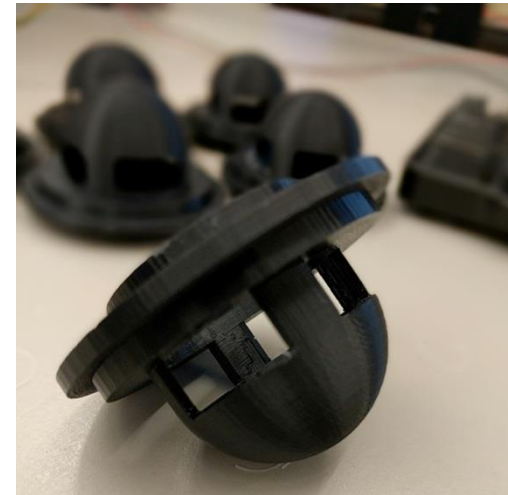
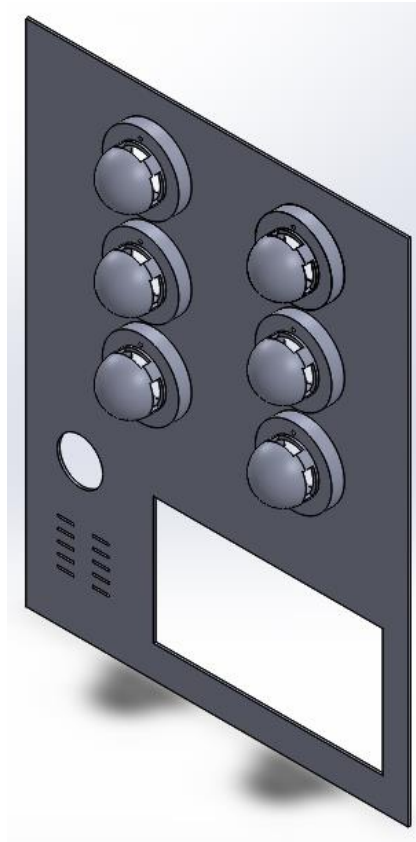


Diagram - Toggles and Lasers

- Lasers brightness controlled by R13 trimpot
- Lasers can be turned off using W1
- VR mode selected using toggle switch W2
- Error LED illuminated based on Arduino output

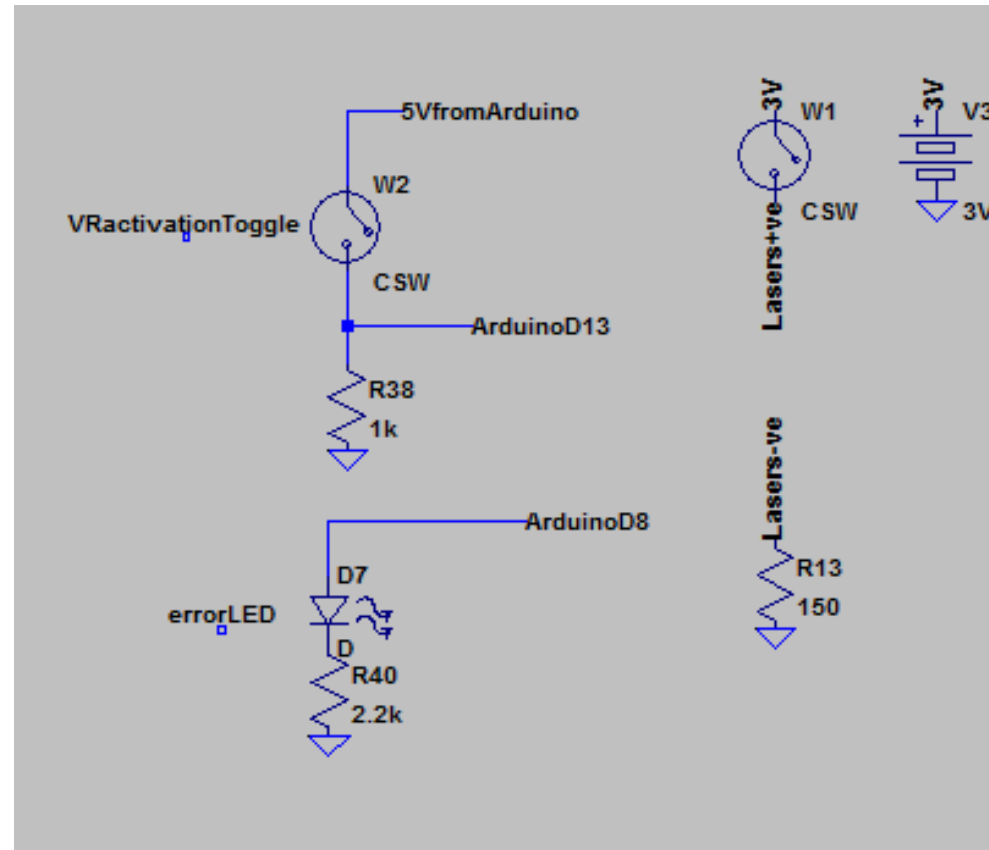


Diagram - Photoresistors

- 6 to Arduino analog input
- 4 digitized using comparators with hysteresis

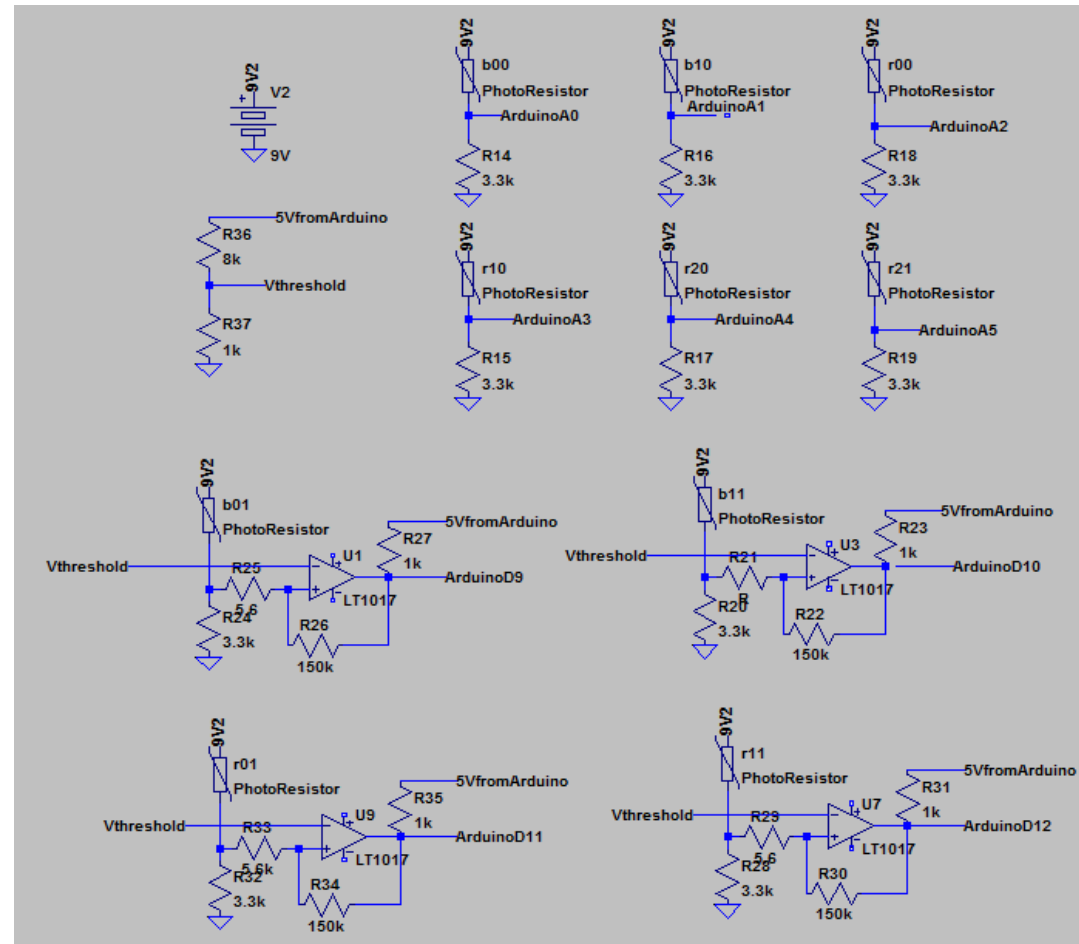
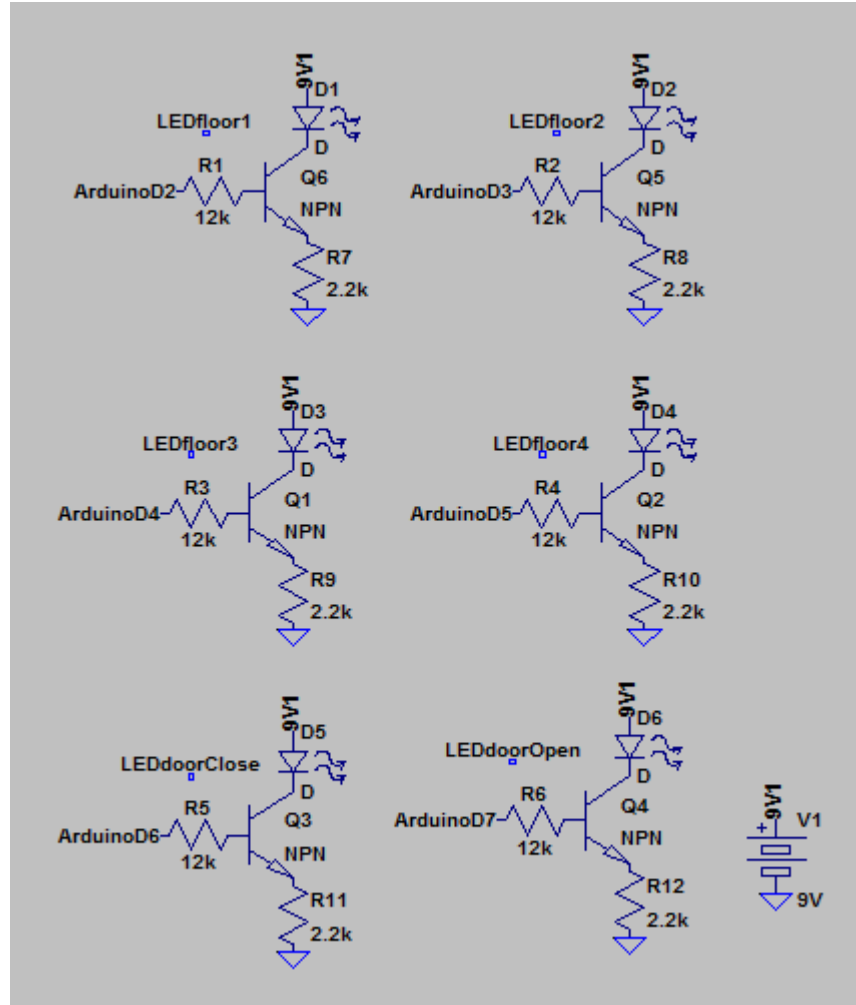


Diagram - LEDs

- 6 LEDs powered using 9V
- Switched on and off using Arduino outputs
- Brightness controller by emitter resistors



Laser Safety

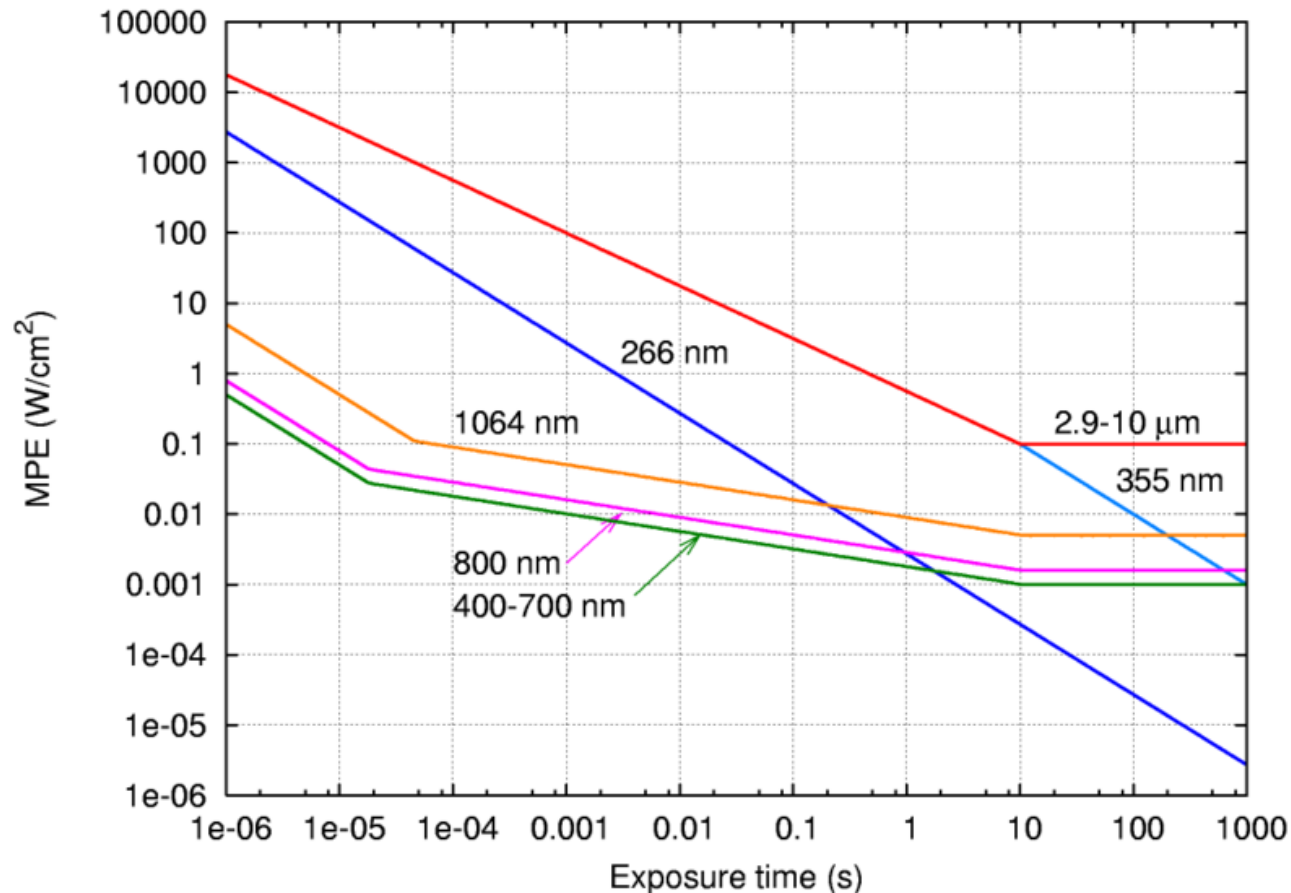


Figure: Maximum Permissible Exposure vs. Exposure time based on IEC 60825
MPE guidelines [7]