Project Notes:

Project Title:
Name:

Note Well: There are NO SHORT-cuts to reading journal articles and taking notes from them. Comprehension is paramount. You will most likely need to read it several times so set aside enough time in your schedule.

Contents:

Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

Knowledge Gap	Resolved By	Information is located	Date resolved

Literature Search Parameters:

These searches were performed between (Start Date of reading) and XX/XX/2019.
List of keywords and databases used during this project.

Database/search engine	Keywords	Summary of search

Article #1 Notes: Title

Article notes should be on separate sheets

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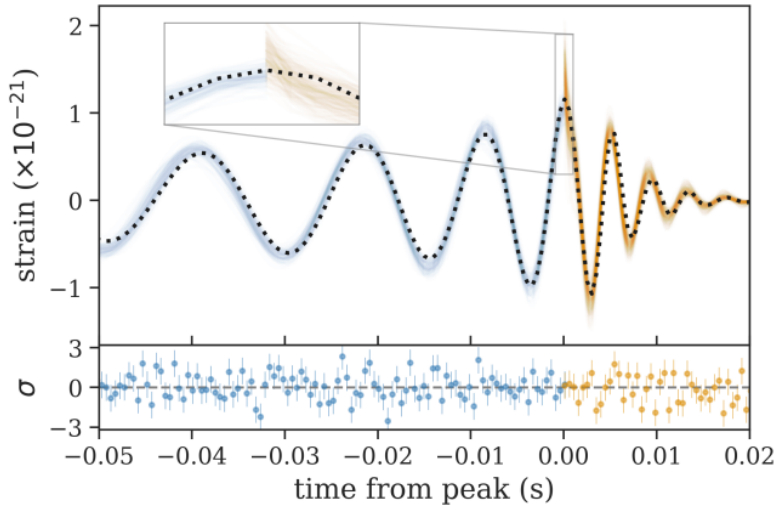
Source Title	
Source citation (APA Format)	
Original URL	
Source type	
Keywords	
Summary of key points (include methodology)	
Research Question/Problem/ Need	
Important Figures	
Notes	
Cited references to follow up on	
Follow up Questions	

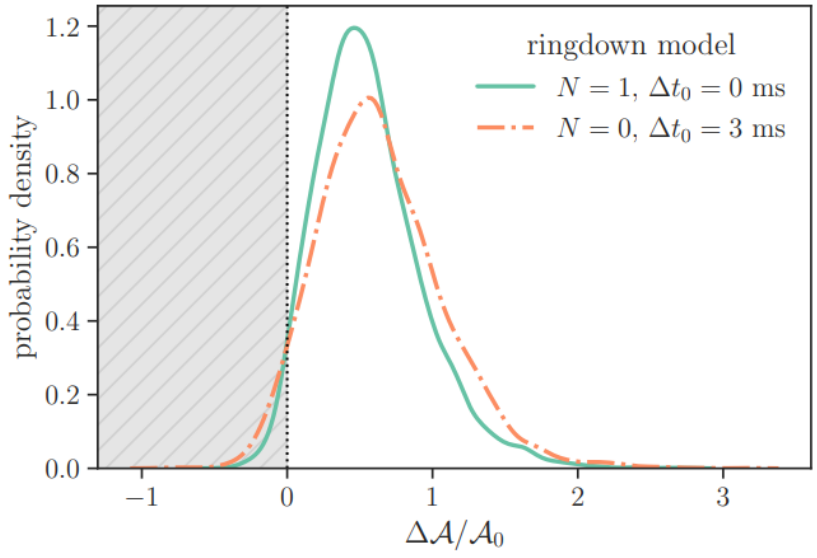
Article #2 Notes: Testing the Black-Hole Area Law with GW150914

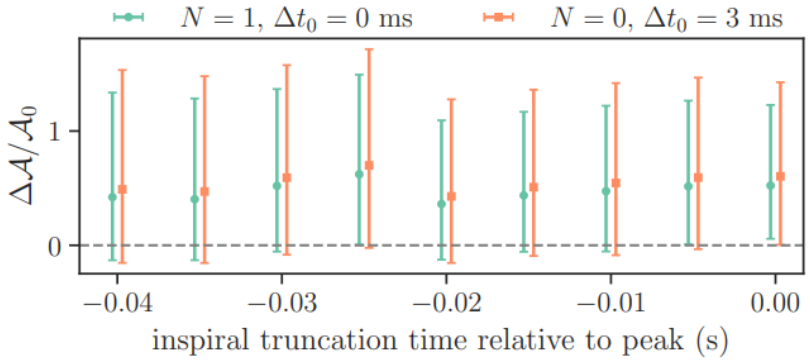
Article notes should be on separate sheets

Source Title	Testing the black-hole area law with GW150914
Source citation (APA Format)	Isi, M., Farr, W. M., Giesler, M., Scheel, M. A., & Teukolsky, S. A. (2021). Testing the Black-Hole Area Law with GW150914. *Physical Review Letters*, *127*(1). https://doi.org/10.1103/physrevlett.127.011103
Original URL	Testing the black-hole area law with GW150914 (arxiv.org)
Source type	Science Journal Article
Keywords	Astrophysics
Summary of key points (include methodology)	This article explains that the Hawking's area theorem is that black hole surface area is not able to decrease and only increases when more mass is added to it. To test this, a group of astrophysicists looked at ripples caused by merged black holes. What they found upholds the theory with a 95 percent confidence level.
Research Question/Problem/ Need	Is the black hole area theorem correct?

Important Figures	







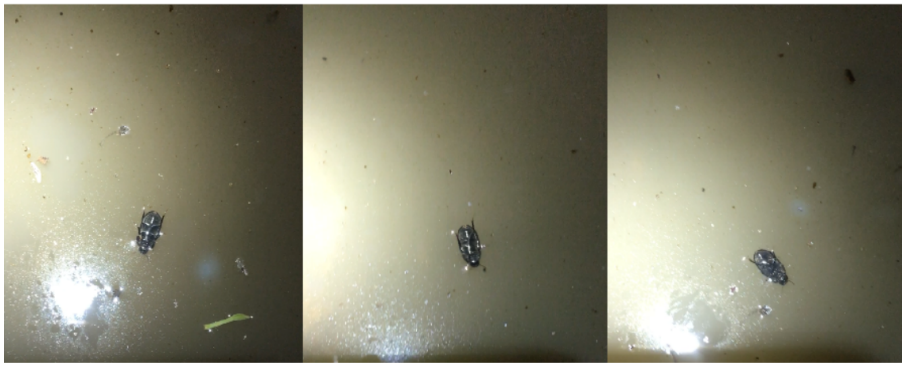
Notes	• Black Hole Theorem:
	  ○ Black holes cannot decrease in surface area over time
	  ○ Mirrors physics rule that entropy cannot increase over time
	• More mass will cause more spin, which could lower surface area, but the theory states that this will never happen and gained surface area will never be less the lost surface area
	• First time gravitational waves from two black holes colliding were found
	• 95% confidence in the theory from the date

Cited references to follow up on	M. Isi *et al*. Testing the black-hole area law with GW150914. *Physical Review Letters*. In press, 2021.
Follow up Questions	1. What could potentially cause a black hole to stray from this theory (such as radiation), other than adding more mass? 2. What has been the results and confidence level of findings for research on the same theory? 3. Is there any down property or theory in quantum mechanics that clashes with the black hole theory?

Article #3 Notes: Locomotion with a twist: Aquatic beetle walks upside down on the underside of the water's surface

Article notes should be on separate sheets

Source Title	Locomotion with a twist Aquatic beetle walks upside down on the underside of the water's surface
Source citation (APA Format)	Gould, J., & Valdez, J. W. (2021). Locomotion with a twist: Aquatic beetle walks upside down on the underside of the water's surface. *Ethology*, *127*(8), 669–673. https://doi.org/10.1111/eth.13203
Original URL	https://www.researchgate.net/publication/352798570_Locomotion_with_a_twist_Aquatic_beetle_walks_upside_down_on_the_underside_of_the_water's_surface
Source type	Science Journal Article
Keywords	Animals, Robotics
Summary of key points (include methodology)	Although it is not a new discovery, the article explains the phenomenon that some beetles can walk upside down in water. It is not known how the beetles described are able to do it, but research is currently going on regarding the subject. The article suggests surface tension, air bubbles, or the water's surface having a chemical on/in it as hypotheses for the phenomenon. It is mentioned that the fact that beetles can do this has been recorded, but not studied. The article also suggests that research around this could inspire the making of bio-inspired aquatic adhesives and motions that have biomimetic engineering and robotic applications
Research Question/Problem/ Need	How can this phenomenon be better recorded, studied, and applied?

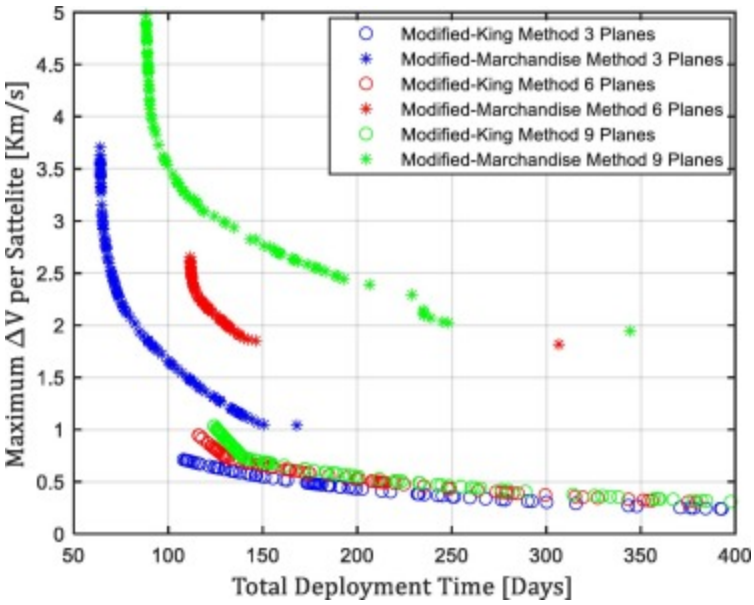
Important Figures	 https://www.researchgate.net/profile/Jose-Valdez-8/publication/352817385_Video_S1_Video_recording_of_a_beetle_likely_family_Hydrophilidae_walking_upside_down_along_the_underside_of_the_surface_of_the_water_of_an_ephemeral_pool/data/60db028992851ca944946caa/eth13203-sup-0001-videos1.mov?origin=publication_detail ^ Video of beetle
Notes	- Phenomenon not previously abundantly recorded - Beetles may or may not have water repellant feet - Seem to use an air bubble to keep themselves afloat - Beetles have been known to walk on top of the water but not underneath surface
Cited references to follow up on	Chen, Y., Doshi, N., Goldberg, B., Wang, H., Wood, R.J., 2018. Controllable water surface to underwater transition through electrowetting in a hybrid terrestrial-aquatic microrobot. Nature communications 9, 1-11 Ditsche, P., Summers, A.P., 2014. Aquatic versus terrestrial attachment: Water makes a difference. Beilstein Journal of Nanotechnology 5, 2424-2439. Feilich, K., 2012. Beetles use bubbles to stick underwater. The Journal of Experimental Biology 215, vi-vi
Follow up Questions	1. What is the physics behind the beetle walking upside down on the surface of water? 2. How could this concept be applied to robotics?

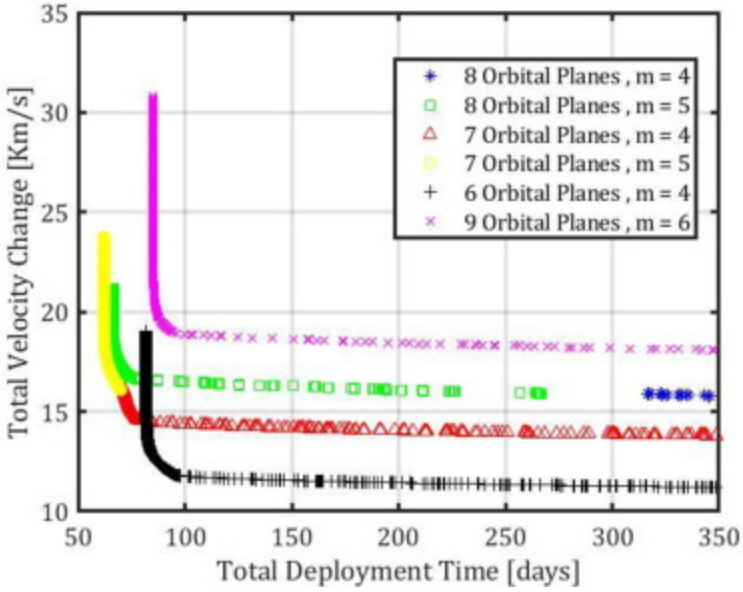
	3. What is the anatomy of the feet of the beetle and what parts of it are water repellant?

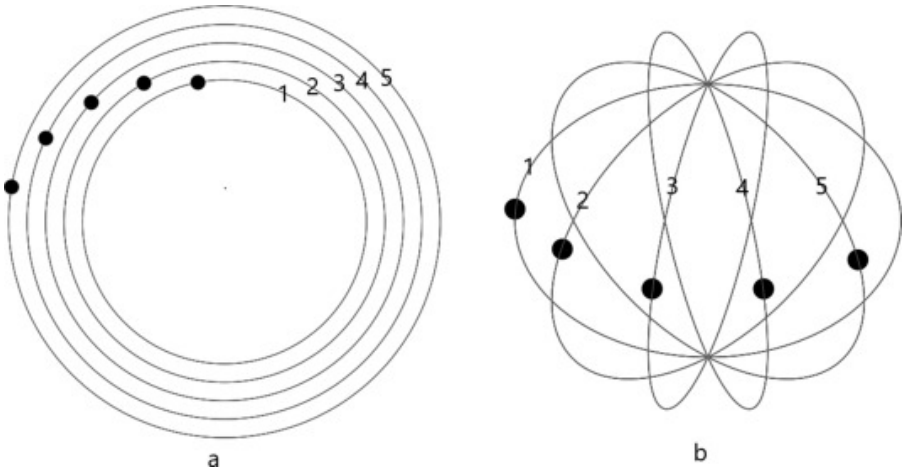
Article #4 Notes: Developing novel multi-plane satellite constellation deployment methods using the concept of nodal precision

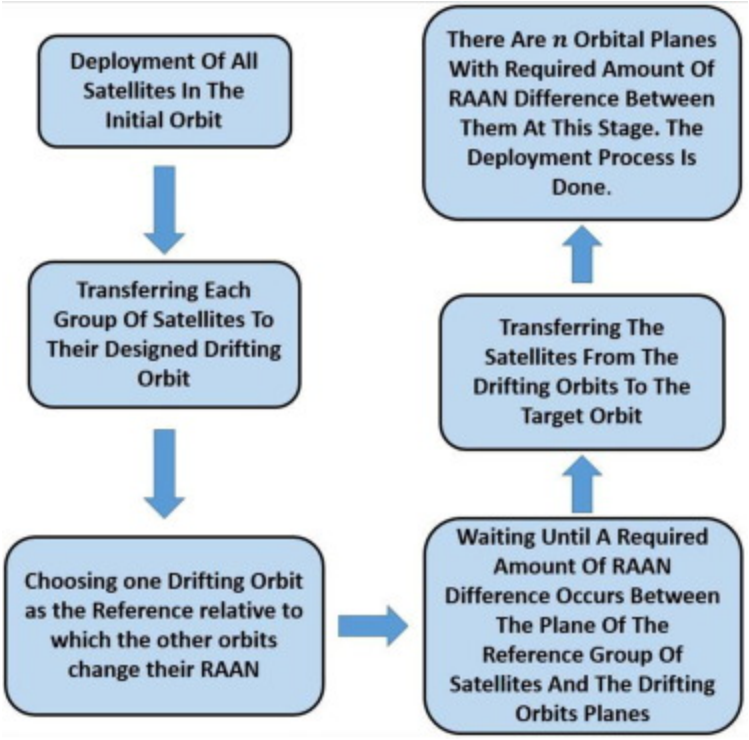
Source Title	Developing novel multi-plane satellite constellation deployment methods using the concept of nodal precision
Source citation (APA Format)	Mahdisoozani, H., Bakhtiari, M., & Daneshjoo, K. (2021). Developing novel multi-plane satellite constellation deployment methods using the concept of nodal precession. Advances in Space Research, 68(8), 3141–3158. https://doi.org/10.1016/j.asr.2021.06.010
Original URL	Developing novel multi-plane satellite constellation deployment methods using the concept of nodal precession - ScienceDirect (wpi.edu)
Source type	Journal article
Keywords	Satellites, Space
Summary of key points (include methodology)	This article talks about the current and proposed methods for constellation satellite deployment as well as energy efficiency and cost for these methods. It provides two main methods of doing so, the Marchandise and King method, which both include a single deployment/launch instead of multiple launches to put satellites into different planes. Both methods are mathematically modeled and compared. The overall consensus is that the Marchanside method would be the most cost and time effective and provides the easiest solution.
Research Question/Problem/ Need	How can satellite constellations be more cost and energy efficient in their deployment?

Important Figures



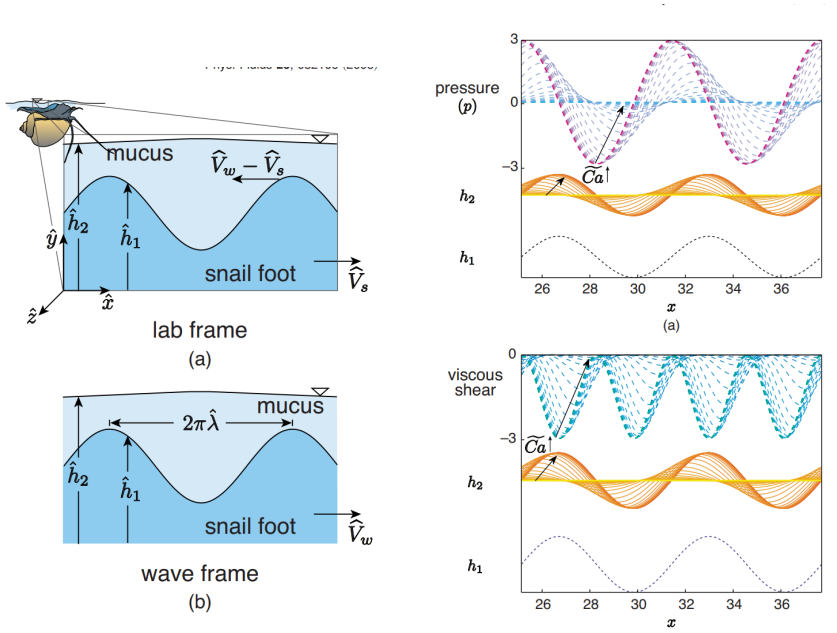


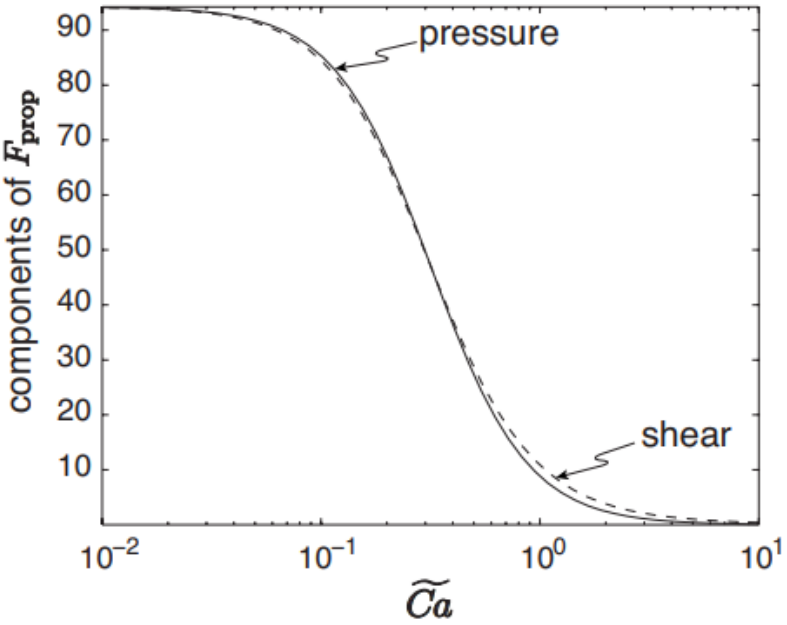


	
Notes	More velocity changes necessary and more complexity for more orbital planes necessary
Cited references to follow up on	S. Cornara, T.W. Beech, M. Belló-Mora, G. Janin Satellite constellation mission analysis and design Acta Astronaut., 48 (2001), pp. 681-691, 10.1016/S0094-5765(01)00016-9 G. Santilli, C. Vendittozzi, C. Cappelletti, S. Battistini, P. Gessini CubeSat constellations for disaster management in remote areas Acta Astronaut., 145 (2018), pp. 11-17, 10.1016/j.actaastro.2017.12.050
Follow up Questions	How can either of the models presented be reduced in complexity by separating satellites into groups with multiple launches

Article #5 Notes: Crawling beneath the free surface: water snail locomotion

Source Title	Crawling beneath the free surface: water snail locomotion
Source citation (APA Format)	Lee, S., Bush, J. W. M., Hosoi, A. E., & Lauga, E. (2008). Crawling beneath the free surface: Water snail locomotion. *Physics of Fluids*, *20*(8), 082106. https://doi.org/10.1063/1.2960720
Original URL	https://thales.mit.edu/bush/wp-content/uploads/2012/10/water-snails.pdf
Source type	Journal Article
Keywords	Sorbeoconcha physidae, underwater, locomotion
Summary of key points (include methodology)	Vocab: ● Ciliary - relating to cilium - a short microscopic hairlike vibrating structure found in large numbers on the surface of certain cells, either causing currents in the surrounding fluid, or, in some protozoans and other small organisms, providing propulsion. ● Pedal Mucus - functions in locomotion by coupling the movements of the foot to the substratum ● Prosobrancia - a group of mollusks which includes the limpets, abalones, and many terrestrial and aquatic snails. They all have a shell, and many have an operculum. ● Opisthobranchs- a marine mollusk of a group that includes the sea slugs and sea hares. They have a small or absent shell and are typically brightly colored with conspicuous external gills. ● Pulmonata - a group of mollusks which includes the land snails and slugs and many freshwater snails. They have a modified mantle cavity which acts as a lung for breathing air. Their goal was to explain, using physics and qualitative analysis, how some snails are able to walk on the underside of the surface of

	water. They looked at the mucus and how that connects to the snails's foot. How the wave looking pattern formed in the connection produces the propulsion In essence, the 'top' part of the mucus sticks to the surface while the snail creates flow in the more 'bottom' parts. This flow creates a propulsion for the snail stuck to the mucus. Used the velocity in mucus (based on waves, size, speed of snail) to find what the propulsion force and drag force would be respectively. Did not talk about fluid forces on the organism Basic goal was to demonstrate that the locomotion was possible with the mucus and small motions from the snail.
Research Question/Problem/ Need	How can aquatic snail locomotion on the underside of the water be explained?
Important Figures	



Notes

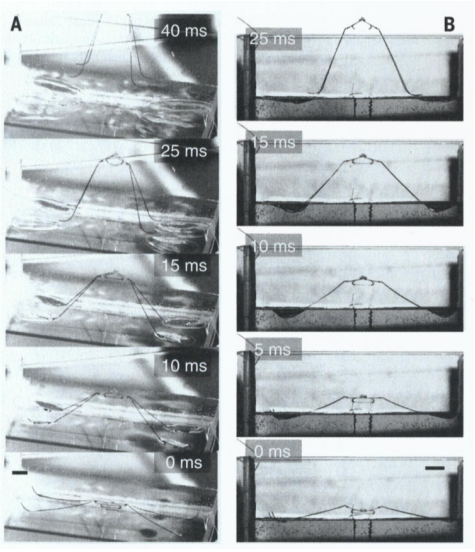
- Three modes of locomotion for gastropods:
  - Ciliary motion, Pedal waves, and Swimming
    - § Ciliary: beating of large arrays of cilia on the animal's foot
    - § Pedal: Waves of contraction that propagate in the direction of their motion "direct waves"
      - Focus on snail foot versus pedal mucus
      - Pedal mucus can act as an adhesive with small strain so it's able to create regions of flow by locally shearing it while the rest of the mucus

	stays on the solid o Energetically favorable -? how · Gastropod types: prosobranchia, opisthobranchia, gymnomorpha, and pulmonata · Aquatic Snails: Direct waves are employed for propulsion. The presence of a trail of snail mucus was also seen in initial observations · Snail is rendered neutrally buoyant by trapping air in its shell · SNAIL FOUND IN FRESH POND, MA · Since water snails can also walk on land, mucus is likely not all too dissimilar from that of land snails · Four distinct physical features of motion: o free surface with finite surface tension o layer of non-Newtonian mucus o deformations of the foot and the surface o flow inside the mucus · Their approach: given the shape of the foot they solve for the shape of the liquid-air interface and velocity field in the mucus layer and then calculate the resulting propulsive force and drag on the snail · Lots of math · The undulation of the snail foot causes stress that deform the mucus-foot interface and make flow in the mucus o The resulting stress pushes on the of the snail foot, leading to a propulsive force.
Cited references to follow up on	M. Denny, “The role of gastropod pedal mucus in locomotion,” Nature London 285, 160 1980. G. Deliagina and G. N. Orlovsky, “Control of locomotion in the freshwater snail planorbis corneus. I. Locomotory repertoire of the

	snail," J. Exp. Biol. 152, 389 1990.
Follow up Questions	How may this relate to the aquatic beetle? What is the mucus made of or composed of? How does the aquatic snail breath underwater? How does the snail 'get' on the underside of the surface of the water? (Flip itself, sink, etc?)

Article #6 Notes: Jumping on water: Surface tension-dominated jumping of water striders and robotic insects

Source Title	Jumping on water: Surface tension-dominated jumping of water striders and robotic insects
Source citation (APA Format)	Koh, J.-S. ., Yang, E., Jung, G.-P. ., Jung, S.-P. ., Son, J. H., Lee, S.-I. ., Jablonski, P. G., Wood, R. J., Kim, H.-Y. ., & Cho, K.-J. . (2015). Jumping on water: Surface tension-dominated jumping of water striders and robotic insects. *Science*, *349*(6247), 517–521. https://doi.org/10.1126/science.aab1637
Original URL	https://www-science-org.ezpv7-web-p-u01.wpi.edu/doi/full/10.1126/science.aab1637
Source type	Journal Article
Keywords	Biomimic, water walker, robot
Summary of key points (include methodology)	Vocabulary: • Integument - a tough outer protective layer, especially that of an animal or plant. • Superhydrohobic - repelling water to the degree that droplets do not flatten but roll off instead. • Meniscus - the curved upper surface of a liquid in a tube.

	• Capillary - any of the fine branching blood vessels that form a network between the arterioles and venules. • Ultralight - Extremely lightweight • Viscous Friction - arises when a solid object moves in the middle of a fluid, a gas or a liquid. • Rupture - a breach of harmonious relationship First, it talked about water walkers and how the motion of their legs work to create movement and then jumping. It also explains what other small robots have done. It then goes on to explain the mathematics in finding values such as the surface tension, how that relates to the mass, leg length in proportion to the body, etc. After that it talks about the driving force of the jump and then how their robot was going to achieve it. The next section has a detailed description and images of the jumping robot they created as well as tools used to create the robot and their general methods. It finally talks about what constraints the robot met and what the creation of the robot and application of the principles proves - water walker jumping motion can be robotically replicated.
Research Question/Problem/ Need	How can water-walkers' jumping motion be robotically recreated?
Important Figures	

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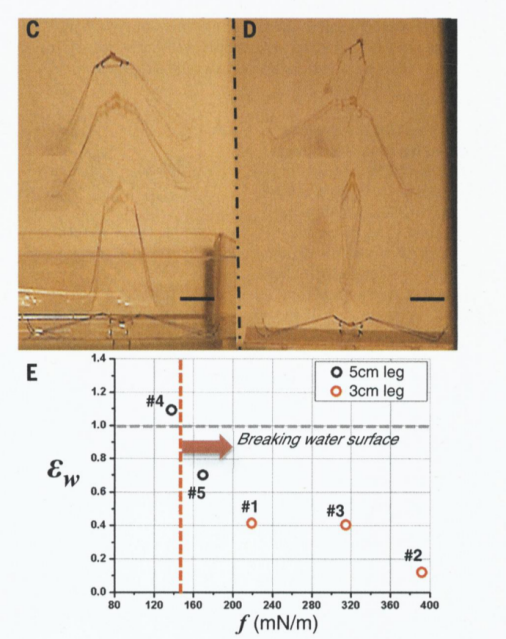
<td> 
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<td>Notes</td>
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Surface tension is the main cause considered in locomotion on the top of the surface of the water
Lots of small scale robots had been made before this but none of them looked at the jumping motion or capabilities
Jumping looks at vertical components while walking looks at horizontal so they are very different
Water striders can jump as high on water as they can on land
They only recorded water walkers from a local pond for their observation
Four legs push inwards/down on the water to create dimples and force up
Light body with long perimeter is best for the jumping
Insect rotates legs and doesn’t just push them down
Implies that the walkers are only able to use the propulsion force when there is dimples in the water
Maximize momentum transfer by keeping high force on each leg until the last moment
Biomechanical mechanism of described robot is inspired by the flea (look into flea robot…?)
Leg length and actuator stiffness affect driving force
Flexure hinge-based components were used to make the robot
Sheet nickel titration NMA actuator
Wire legs coated in superhydrophobic material
They had 5 prototype robots
Their robot jumped better in water than on land which is counterintuitive

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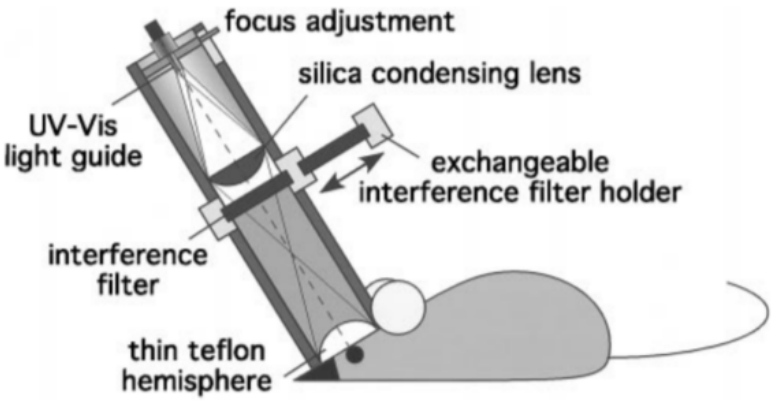
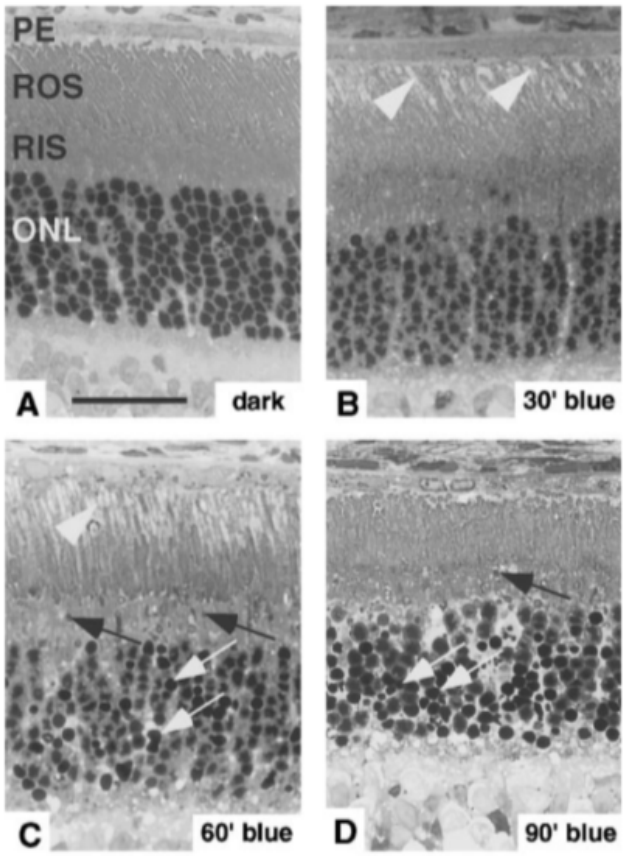
	○ Likely because of the horizontal motion/spin of legs? ● Their robot showed it was possible to recreate the motion
Cited references to follow up on	23. J.-S. Koh, S.-P. Jung, R. J. Wood, K.-J. Cho, A jumping robotic insect based on a torque reversal catapult mechanism. *2013 IEEE/RSJ International Conference of Intelligent Robots and Systems* (2013), pp. 3796–3801.
Follow up Questions	Could the same techniques for making the body and legs be used to recreate the aquatic beetle? Could this be combined with the described robots that can walk on the water to create a robot able to walk and jump? What about landing? Would I be able to find a lab willing to help me with my project? What was the timeframe of the making of the described robot?

Article #7 Notes: Rhodopsin-Mediated Blue-Light Damage to the Rat Retina: Effect of Photoreversal of Bleaching

Source Title	Rhodopsin-Mediated Blue-Light Damage to the Rat Retina: Effect of Photoreversal of Bleaching
Source citation (APA Format)	Grimm, Christian, et al. “Rhodopsin-Mediated Blue-Light Damage to the Rat Retina: Effect of Photoreversal of Bleaching .” *Investigative Ophthalmology & Visual Science February 2001*, vol. 42, no. 2, Feb. 2001, pp. 497–505.
Original URL	https://iovs.arvojournals.org/article.aspx?articleid=2122982&resultClick=1
Source type	Journal Article
Keywords	Blue light, damage, retina
Summary of key points (include methodology)	The researchers looked at how blue and green light affect damage on rat eyes and how different levels of rhodopsin affect this. The article started with a general statement of these goals and went on to describe multiple different methods and experiments done to achieve varying results. The research showed that light intensity, rhodopsin in the eyes, and blue light all contribute to the most retina damage.
Research Question/Problem/ Need	To test is rhodopsin and different levels of it’s bleaching affect the damage blue light does on rat retinae.
Important Figures	

	
Notes	· The amount of rhodopsin available for bleaching determines white light damage. · The retina has more capacity for intaking blue light · Blue light effects blue-light absorbing enzymes that can be damaged from too much blue light · The test subject for this study was anesthetized rats · Some of the rats were able to have different amounts of rhodopsin in their retinas through bleaching · This allowed the researchers to test how the blue light effected the rods with or without the rhodopsin · Results basically found that no rhodopsin caused no damage from exposure to blue light while the

existence of rhodopsin did cause damage

· Study also found that green light produced no effect.

· Exposure to high levels of white light cause cell death

· Not explained: Does this damage cause blindness, lack of vision? KG with lots of vocabulary and uncertainty about what/where everything is in the eye

· Also need extrapolation on how any of this related to the human eye

· Light exposure was done for anywhere from 30-120 minutes in the different tests

· When they took off a device to keep the energy levels of light consistent (in order to have very high light levels), they found a lot of hot spots and light damage.

· Blue light cause DNA binding activity

· If continuing this topic, I need to look more into human eye anatomy to have better background information as I struggled to understand a lot of the text.

Vocab:

1. Rhodopsin - a purplish-red light-sensitive pigment present in the retinas of humans and many other animal groups

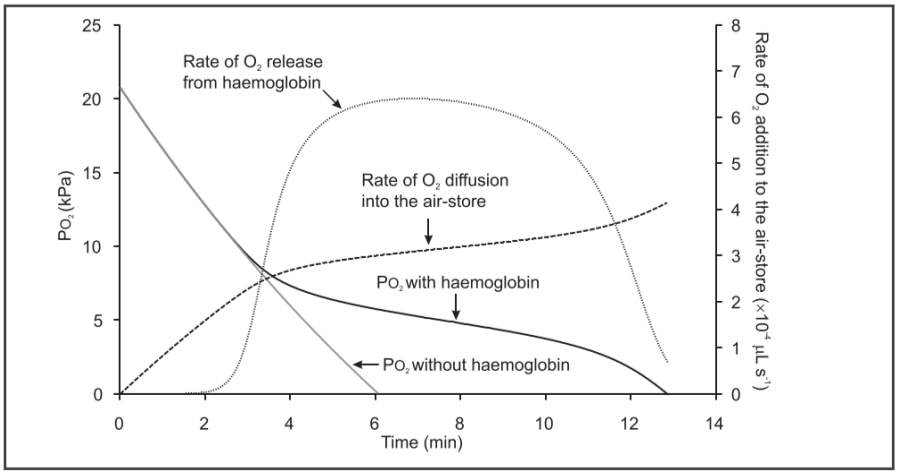
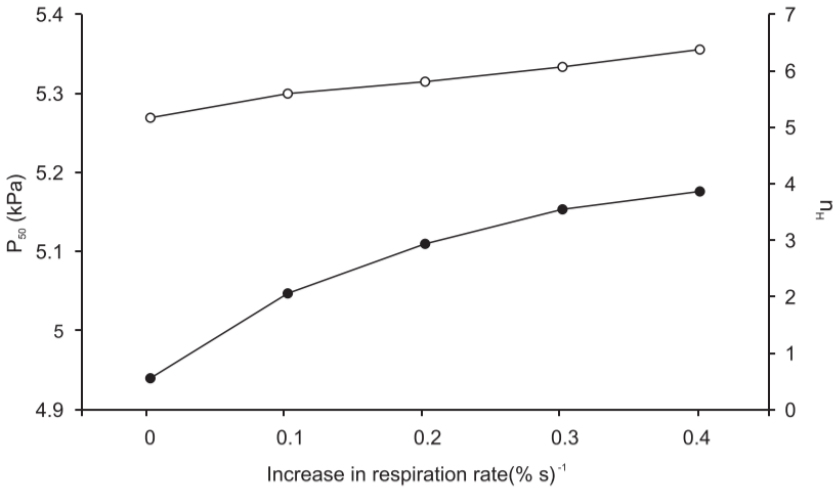
2. Epithelium - the thin tissue forming the outer layer of a body's surface and lining the alimentary canal and other hollow structures.

3. Photoreversal - An enzymatic repair system that uses short-wavelength visible (violet and blue) or long-wavelength ultraviolet light to reconstitute the deoxyribonucleic acid of cells that have been irradiated by ultraviolet light. Also known as photoreactivation.

	4. Apoptosis - the death of cells which occurs as a normal and controlled part of an organism's growth or development. Also called programmed cell death. 5. Polyunsaturated – (of an organic compound, especially a fat or oil molecule) containing several double or triple bonds between carbon atoms. Polyunsaturated fats, which are usually of plant origin, are regarded as healthier in the diet than saturated fats. 6. Epithelium – the thin tissue forming the outer layer of a body's surface and lining the alimentary canal and other hollow structures. 7. Deleterious – causing harm or damage. 8. Chromophores – an atom or group whose presence is responsible for the color of a compound. 9. Synthase – an enzyme that catalyzes the linking together of two molecules, especially without the direct involvement of ATP.
Cited references to follow up on	14. Hafezi F, Marti A, Munz K, Reme CE. Light-induced apoptosis: differential timing in the retina and pigment epithelium. *Exp Eye Res.* 1997;64:963-970. 21. Organisciak DT, Winkler BS. Retinal light damage: practical and theoretical considerations. *Prog Retinal Eye Res.* 1994;13:1-29.
Follow up Questions	● How does this relate to the human eye? ● Does this damage cause lack of vision or blurred vision in the rats? To what extent? ● Do other color lights have any effect on the damage?

Article #8 Notes: Oxygen Binding Properties of Backswimmer (Notonectidae, Anisops) Haemoglobin, Determined in Vivo

Source Title	Oxygen Binding Properties of Backswimmer (Notonectidae, Anisops) Haemoglobin, Determined in Vivo
Source citation (APA Format)	Matthews, Philip G. D., and Roger S. Seymour. “Oxygen Binding Properties of Backswimmer (Notonectidae, Anisops) Haemoglobin, Determined in Vivo.” *Journal of Insect Physiology*, vol. 57, no. 12, Dec. 2011, pp. 1698–706. *DOI.org (Crossref)*, https://doi.org/10.1016/j.jinsphys.2011.09.006.
Original URL	https://www-sciencedirect-com.ezpv7-web-p-u01.wpi.edu/science/article/pii/S002219101100271X?via%3Dihub
Source type	Journal Article
Keywords	Bubble, Aquatic Insect, Buoyancy
Summary of key points (include methodology)	The article begins with describing haemoglobin and its uses in other insects or similar cases. It then talks about how backstriders use the haemoglobin and describes how the usage differs. A graphical and mathematical analysis of the oxygen levels in the haemoglobin over time is done and the tests and methods done/used to get the data are described. It then goes on to discuss some of the flaws or potential flaws in the beetle’s system and concludes with a summary of other points.
Research Question/Problem/ Need	How can backstrider’s use of haemoglobin to keep neutral buoyancy and breath underwater be quantitatively explained?

Important Figures	 *P.G.D. Matthews, R.S. Seymour / Journal of Insect Physiology 57 (2011) 1698–1706* 
Notes	· Backswimmers are a beetle from Australia that is able to create a bubble on the ventral surface of their body and use their haemoglobin to control the oxygen level in order to keep floating since they also have to breath from the bubble · Haemoglobin is a respiratory pigment that is found commonly in vertebrate · Haemoglobin used the maximize oxygen storage and serve as an oxygen reserve · Haemoglobin also help with *buoyancy regulation*

	· Studies that look at haemoglobin usually do it in lab conditions and not natural conditions which effect their behavior · The backswimmer is able to produce temporary near-neutral buoyancy · Method was to use biotonometry(?) to determine oxygen levels in haemoglobin · Description of location of bubble: o "…carry a bubble of air within two lateral grooves on the ventral surface of their abdomen. This ;air-store' is help over the abdominal spiracles and, when the bug is submerged, is covered completely by a fringe of long hydrophobic hairs…" § Covered in hydrophobic hairs -> find equivalent material/way to make to be used in biomimicry · Plastic? Hydrophobic materials, etc? · Without haemoglobin, the beetle is not able to keep neutral buoyancy · Next part includes lots of graphical figures and described the relationships and models for the graphs based on time points such as haemoglobin starting to release O2 Vocab: 1. Haemoglobin – a red protein responsible for transporting oxygen in the blood of vertebrates. Its molecule comprises four subunits, each containing an iron atom bound to a heme group. 2. Haemolymph – a fluid equivalent to blood in most invertebrates, occupying the hemocoel. 3. Hypoxic – adj form of hypoxia: deficiency in amount of oxygen reaching the tissue 4. Spiracles – An external respiratory opening, especially each of a number of pores on the body of an insect, or each of a pair of

	vestigial gill slits behind the eye of a cartilaginous fish. 5. Monomeric – adjective form of: a polymer comprising of one monomer unit 6. Tetreameric – adjective form of: a polymer comprising four monomer units. 7. Hemipteran - An insect of the order Hemiptera, such as an aphid, cicada, or leafhopper. 8. Sigmoid - A sigmoid function is a mathematical function having a characteristic "S"-shaped curve or sigmoid curve
Cited references to follow up on	Matthews, P.G.D., Seymour, R.S., 2006. Diving insects boost their buoyancy bubbles. Nature 441, 171. Miller, P.L., 1966. The function of haemoglobin in relation to the maintenance of neutral buoyancy in *Anisops pellucens* (Notonectidae, Hemiptera). Journal of Experimental Biology 44, 529–543.
Follow up Questions	Could a similar method to the usage of hydrophobic hairs be adapted to a biomimicry design? What would the haemoglobin act like outside of lab conditions? How do the bubbles used by this beetle relate to that used by the hydrophillae?

Article #9 Notes: Technological Trends in Improved Mobility of the Visually Impaired

Source Title	Technological Trends in Improved Mobility of the Visually Impaired
Source citation (APA Format)	Paiva, Sara, editor. *Technological Trends in Improved Mobility of the Visually Impaired*. Springer, 2020.
Original URL	https://link-springer-com.ezpv7-web-p-u01.wpi.edu/content/pdf/10.1007%2F978-3-030-16450-8.pdf
Source type	Book Chapter
Keywords	Visually impaired, assistive technology, haptic
Summary of key points (include methodology)	The chapter of the book basically describes different devices that could be used in ground level object or condition identification for VIPs. It's organized loosely based on device range, sensor type, or primary function/goal.
Research Question/Problem/ Need	How can the mobility of VIPs be improved with assistive devices?
Important Figures	None
Notes	· 1.3 billion people have vision impairment · 36 million people are totally blind · This number could become triple due to population grown and aging · Primary obstacles in creating assistive technology for this are ground plane conditions and obstacles · Most stuff has focused on front-on obstancle detection · Ground plane hazards list: o Staircases

	o Potholes o Pits o Ramps o Ditches o Loose surfaces . · My device would be considered an ETA for Ground Plane Hazards Detection (and potentially obstacle detection) · Most technologies use one or a combination of infrared sensing, ultrasonic sensing, and laser telemeters. · Ultrasonic and infrared were easier because lasers typically included the need for darkness or low light conditions · Beginners prefer haptic/vibration feedback when using technology but more experienced users prefer audio feedback as it is more precise Note: I have only made note of technologies or ideas I'd be interested in looking into and general unique aspect that gives the reason why. Random notes about potential criteria or important points are scattered in between · Mobifree came, sunglasses, and echo – Uses a WPAN to connect devices which may be useful concept to look into if I also want to include multiple parts · Users noted that cane is heavy and this was disliked · Prattico hybrid electronic system – Low-pass filter used to smooth output signals · ioCane – Location of ultrasonic sensor on a cane

	to detect things at head level · LaserNavigator – Used loudspeaker instead of vibration actuator · Miller Andriod Application – Brings up point that phone battery would have to be taken into account if any mobile app/technology was used/created · Smart Cane System – Included facial recognition software but was limited by the number of vibration sequences it can give as feedback · McCarthy Augmented Depth visual representation – emphasize ground obstacles and floor-wall boundaries by artificially increasing contrast between obstacles and ground surface using ground plane extraction algorithm · Parikh stick concept – pothole detection with accelerometer? · Users generally give feedback about weight, bulkiness, or awkwardness · Nakashima Proposal*** o Identify road surface condition utilizing ultrasonic sensors o Surface condition detected by reflection intensity o Able to theoretically be used to detect puddle, asphalt, soil, and lawn o Not actually applied to any devices for the visually impaired yet · Lots of the methods discussed (around 30) were bulky, heavy, or only focused on one function so they wouldn't actually be feasible to VIPs 1. VIP – Visually impaired person 2. ETA – Electronic travel aid; visual substitution for perception of the environment

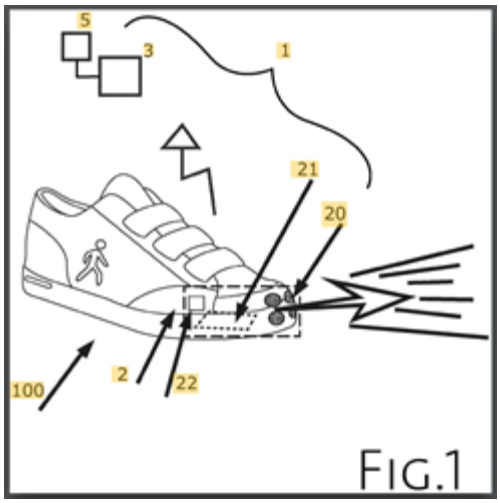
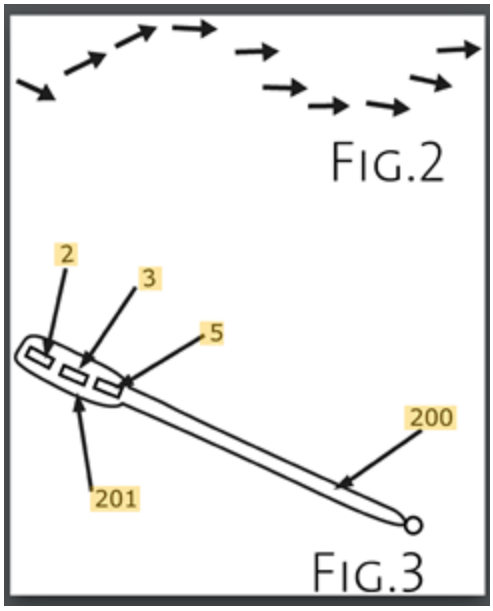
	3. EOA – Electronic orientation aid – provide orientation for VIP 4. PLD – Position locator devices – Devices with GPS or navigation service 5. Low-pass Filter - A low-pass filter is a filter that passes signals with a frequency lower than a selected cutoff frequency and attenuates signals with frequencies higher than the cutoff frequency.
Cited references to follow up on	Nakashima, S., Aramaki, S., Kitazono, Y., Mu, S., Tanaka, K., & Serikawa, S. (2016). Road surface condition distinction method using reflection intensities obtained by ultrasonic sensor. In *2016 International Symposium on Computer, Consumer and Control (IS3C)*. Washington, DC: IEEE. McCarthy, C., Walker, J., Lieby, P., Scott, A., & Barnes, N. (2014). Mobility and low contrast trip hazard avoidance using augmented depth. *Journal of Neural Engineering, 12*(1), 016003. Miller A. (2014). *Walking assistant - A mobile aid for the visually-impaired*. California Polytechnic State University, San Luis Obispo.
Follow up Questions	● Can I adapt any of the methods described for my own project? ● What are the costs and kinds of ultrasonic sensors each device used? ● How long was the timeframe for designing some of these devices described?

Patent #1 Notes: Orientation aid for the blind and visually impaired comprising a device for detecting surroundings

Patent #1 Notes: Orientation aid for the blind and visually impaired comprising a device for detecting surroundings

Article notes should be on separate sheets

Source Title	Orientation aid for the blind and visually impaired comprising a device for detecting surroundings
Source citation (APA Format)	Raffer, Pajestka, M. R. K. P. (2014). *Orientation aid for the blind and visually impaired comprising a device for detecting surroundings* (EP2956920B1). European Patent Office. https://patents.google.com/patent/EP2956920B1/en?q=~patent%2fCN103750985A
Original URL	https://patents.google.com/patent/EP2956920B1/en?q=~patent%2fCN103750985A
Source type	Patent
Keywords	Haptic, Visually Impaired, Sensor
Summary of key points (include methodology)	The patent had random times when it would turn into German and then back into English so the methodology was very messed up. It was clearly a translation and not a lot of the information was clear. What I understood was that there was some sort of audio feedback to the user based on their

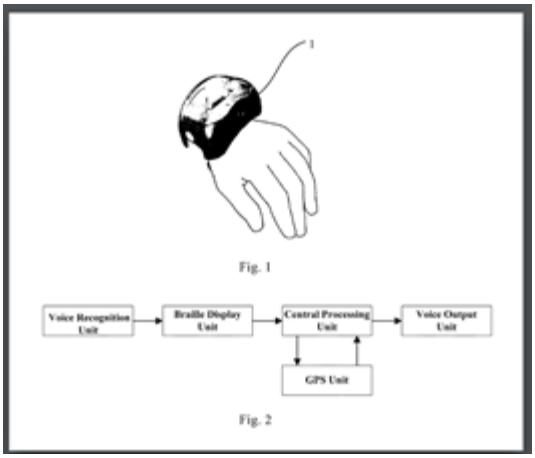
	orientation. The orientation was found using sensors on the shoe and the rod.
Research Question/Problem/ Need	How can orientating be made easier for visually impaired persons?
Important Figures	 FIG.1  FIG.2 FIG.3

Notes	· Linking of distance and position sensors · Used foot angle/direction in order to help with orientation detection · They also used electric current pulses as bahptic feedback · A sensor unit is integrated into the shoe · ^^Acceleration or distance sensor? · Also described that an optical sensor could be used and where it would be placed but not what it does. None of the other sections mention optical sensors.
Cited references to follow up on	US20090122648A1 2007-11-12 2009-05-14 Trustees Of Boston University Acoustic mobility aid for the visually impaired DE10334009A1 2003-07-25 2005-02-10 Diehl Munitionssysteme Gmbh & Co. Kg Blind and partially sighted persons orientation aid is integrated in blind persons stick and uses modulated transmission and array detector to measure distance to objects
Follow up Questions	What sensors did they use specifically? Is there any sort of research that goes with this patent? Why are no non-patent citations cited?

Patent #2 Notes: Wearable blind guiding apparatus

Article notes should be on separate sheets

Source Title	Wearable blind guiding apparatus
Source citation (APA Format)	Zhang, J. Z. & BOE Technology Group Co Ltd. (2015). *Wearable blind guiding apparatus* (US9990860B2). U.S. Patent and Trademark Office. https://patents.google.com/patent/US9990860B2/en?q=~patent%2fCN103750985A&country=US
Original URL	https://patents.google.com/patent/US9990860B2/en?q=~patent%2fCN103750985A&country=US
Source type	Patent
Keywords	Visually Impaired, navigation, sensor
Summary of key points (include methodology)	The device itself is essentially a digital gps for the blind. It utilizes voice detection and braille display to give information and get feedback/requests.
Research Question/Problem/ Need	How can navigation be made easier for the blind

Important Figures	 

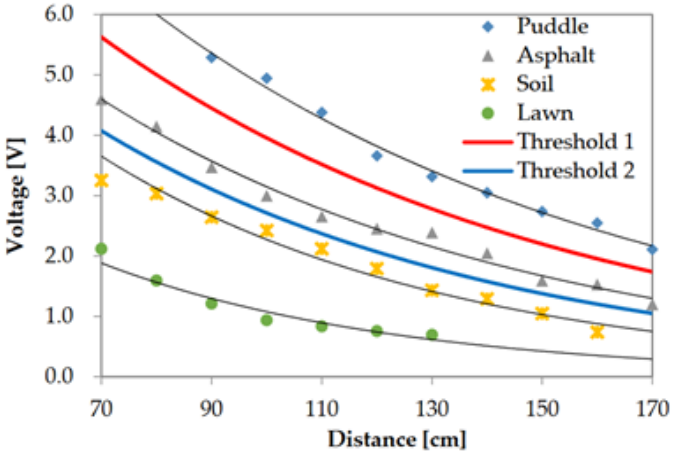
Notes	· GPS Unit is stored, not internet · All pieces fit into one little box-looking thing? · Braille display unit for written information ** · ^^Look into how this works · Can be placed into many different forms (jewlery, bracelet, headband etc) · Also able to optain ground condition? – Where are the sensors? · Uses tri-axial accelerometer (look into) · Braille display used for confirmation · Apparently includes 2 other sensors that are not mentioned in beginning or diagram. · Makes for 2 wearable assemblies as part of the device
Cited references to follow up on	US20140184384A1 * 2012-12-27 2014-07-03 Research Foundation Of The City University Of New York Wearable navigation assistance for the vision-impaired US20120062357A1 * 2010-08-27 2012-03-15 Echo-Sense Inc. Remote guidance system
Follow up Questions	What kinds of sensors did they use? Why weren't the added sensors included in the beginning summary? Any fallow-up research or notes.

Article #10 Notes: Application of Ultrasonic Sensors in Road Surface Condition Distinction Methods

Article notes should be on separate sheets

Source Title	Application of Ultrasonic Sensors in Road Surface Condition Distinction Methods
Source citation (APA Format)	Nakashima, S., Aramaki, S., Kitazono, Y., Mu, S., Tanaka, K., & Serikawa, S. (2016). Application of Ultrasonic Sensors in Road Surface Condition Distinction Methods. *Sensors*, *16*(10), 1678. https://doi.org/10.3390/s16101678
Original URL	https://doi.org/10.3390/s16101678
Source type	Journal article
Keywords	*Directly sourced from another reading's citations
Summary of key points (include methodology)	The first section is an overview of past articles and research on the topic. The article then talks about the distinction method and why it didn't work with the puddle. They had images of the electrical components and sensors that they used and tested their results experimentally.
Research Question/Problem/ Need	How can ground condition detection methods be improved by being able to account for phase changes?

Important Figures	



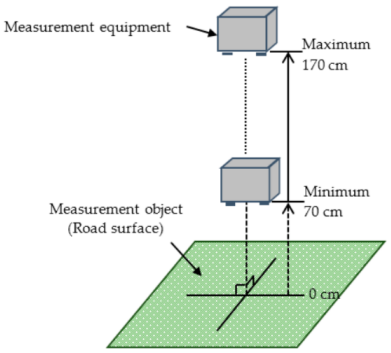
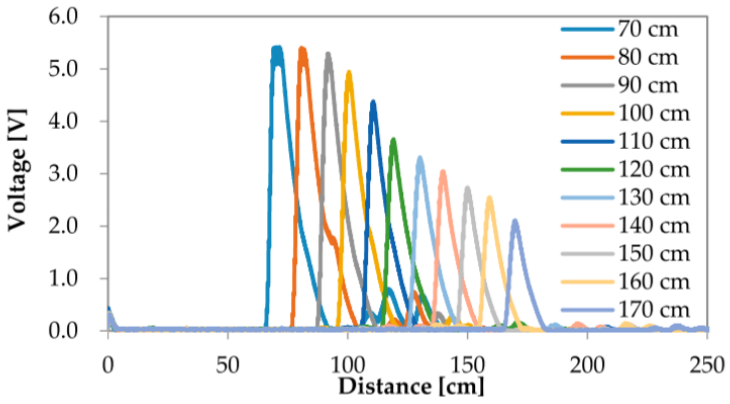


Figure 4. Experimental environment.



Notes	· Visually impaired people have a lot of methods for obstacle detection but not ground surface detection. · Previous studies use ultrasonic sensors as well · Studies have looked at material distinction* [7,8 references?] · This study is an extension of a previous study that did the same kind of detection but was not able to compensate for puddles. · Ultrasonic wave reflects disorder if the surface being detected is rough. · Detecting distance also has to be taken into account as it also changes the frequency · Study used aerial ultrasonic sensor · Range finders also use ultrasonic waves · Study uses independent unit structure · For the experiment the only variable that they changed was the surface type that they were detecting. The range, distance, and time interval of measurement were all the same. · Puddle actually had largest threshold.
Cited references to follow up on	Iwasaki, D.; Haruyama, K.; Mu, S.; Lu, H.; Tanaka, K.; Kitazono, Y.; Wakasa, Y.; Serikawa, S.; Nakashima, S. Ground material distinction method using reflection intensities obtained by ultrasonic sensor. In Proceedings of the 2012 IEEE/SICE International Symposium on System Integration (SII), Fukuoka, Japan, 16–18 December 2012; pp. 117–120.

Follow up Questions	How could this same technique be used when detecting surfaces at an angle with a ultrasonic sensor? How can this be functionally applied to a device for the visually impaired? How accurate is this method with different kinds of surfaces, or similar surfaces?

Article #11 Notes: An Integrated Ultrasonic Sensor Based Smart Cane For Assisting the Visually Impaired

Article notes should be on separate sheets

Source Title	AN INTEGRATED ULTRASONIC SENSOR BASED SMART CANE FOR ASSISTING THE VISUALLY IMPAIRED
Source citation (APA Format)	Mahajan, R. (2017). AN INTEGRATED ULTRASONIC SENSOR BASED SMART CANE FOR ASSISTING THE VISUALLY IMPAIRED. *International Journal of Advanced Research in Computer Science*, *8*(9), 731–734. https://doi.org/10.26483/ijarcs.v8i9.4919
Original URL	http://ijarcs.info/index.php/Ijarcs/article/view/4919/4405
Source type	Journal Article
Keywords	Ultrasonic sensors, visually impaired, haptic feedback

Summary of key points (include methodology)	This article was one of the many I found that included a description of the how the group formed a white cane that included ultrasonic sensors and haptic feedback. It is a common theme among research about this kind of technology for utilization of haptic sensors to help the visually impaired. They described some of the advantages and downsides of using ultrasonic sensors, the diagram of the electrical components. They described some literature on the subject as well as the proposed features of the device.
Research Question/Problem/ Need	How can ultrasonic sensors be implemented into a white cane in order to give the visually impaired more independence and allow them to better detect obstacles?

Important Figures	

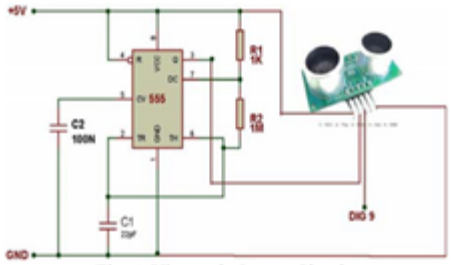


Fig. 4. Ultrasonic Sensor Circuit

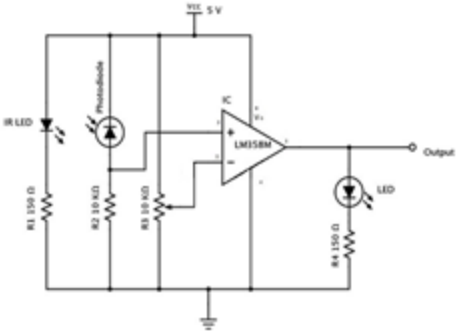


Fig. 6. IR Sensor Circuit

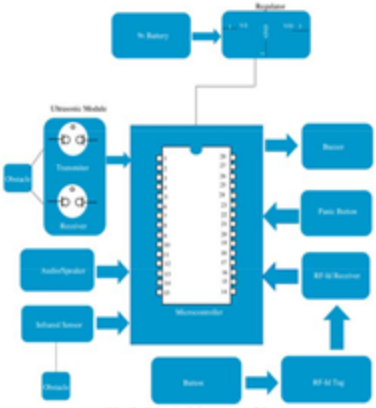


Fig 7. Block Diagram of System

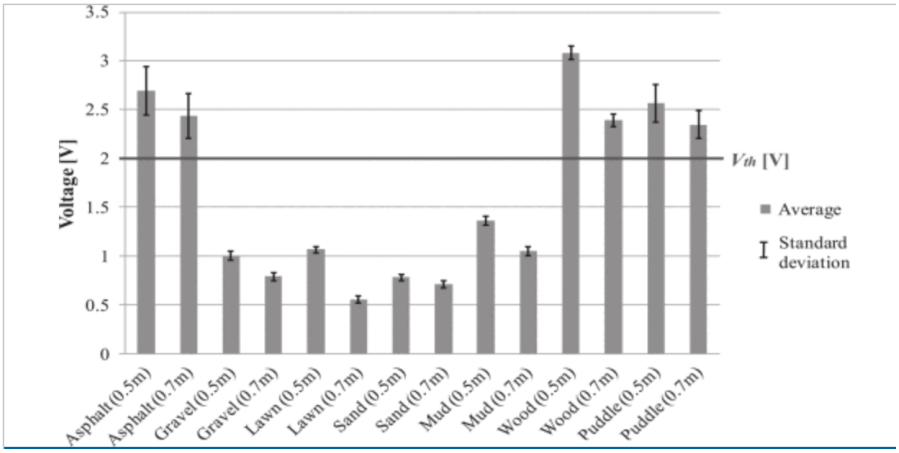
Notes	· Includes GPS feature to allow alert system for contacts of the blind person in emergency or panic situation · RF sensors implemented to locate the device if misplaced** · Discusses different time of flight vs direct measurement modes for ultrasonic sensors · One involves waves bouncing off an object the other involves there being a receiver at the other end that translates the waves · Frequency of wave shifts when bounces off of a moving object · Disadvantages of ultrasonic sensors: · Does not work with soft surfaces that will absorb the waves · False responses possible with loud noises · Inaudible detectors have a minimum sensing distance · Atmospheric changes (temperature, humidity) will have minor effects on the response of the sensor.
Cited references to follow up on	http://sensorwiki.org/doku.php/sensors/ultrasound Sudhanthiradevi.M, Suganya Devi.M,Roshini.R ,Sathya.T, "Arduino Based Walking Stick For Visually Impaired", IJARTET 2016 Shashank Chaurasia, K.V.N. Kavitha, "An Electronic Walking

	Stick For Blinds, International Conference on data Communication and Embedded Systems ICICES, pp. 1-5, 2014.
Follow up Questions	What are some features that other cane systems have that this one may not? How could a ground condition detection feature be added to this cane?

Article #12 Notes: International Symposium on System Integration

Article notes should be on separate sheets

Source Title	International Symposium on System Integration
Source citation (APA Format)	Iwasaki, D., Haruyama, K., Mu, S., Lu, H., Tanaka, K., Kitazono, Y., Wakasa, Y., Serikawa, S., & Nakashima, S. (2012). Ground material distinction method using reflection intensities obtained by ultrasonic sensor. *2012 IEEE/SICE International Symposium on System Integration (SII)*, 117–120. https://doi.org/10.1109/SII.2012.6427385
Original URL	https://ieeexplore.ieee.org/document/6427385
Source type	Journal Article
Keywords	Ultrasonic sensor, ground material distinction, reflection
Summary of key points (include methodology)	This article introduces their ultrasonic sensor distinction methods. They then went on to describe past work on the subject and their proposed method based on those past experiments. They then did experiments with different ground types and used graphs to analyze their results. The article describes the major flaw in their process, which is the method's inability to detect the condition of a puddle.
Research Question/Problem/ Need	How can ground condition detection methods be improved by being able to account for phase changes?

Important Figures	  (a) Asphalt (b) Gravel  (c) Lawn (d) Sand  (e) Mud (f) Wood  (g) Puddle
Notes	• Previous studies only look at seeing existence of an object or distance from sensor • This one uses different reflection intensities to figure out surface type • Past research has flaw because range scale for distinguishing subject is very narrow/small • **Ultrasonic sensor used not stated although company that created the sensor is states • Materials : asphalt, gravel, lawn, sand, mud, wood and puddle • 50 cm and 70 cm distances

	● Kept temperature a constant ** ? ● Also used sensor parallel to surface
Cited references to follow up on	**1.**Yusuke Moritake and Hiromi Hikawa, "Hardware Material Recognition System Using Combinatorial Logic Circuit and Ultrasonic Sensor," The Journal of the Institute of Electronics, The Transactions of the Institute of Electronics, Information and Communication Engineers A, J85-A(5), 610-614, 2002-05-01. **3.**Takeshi Takegami, "Fundamental study of surrounding situation sensing for visually handicapped person using ultrasonic ranging sensors," Bulletin of Saitama Gakuen University, Faculty of Humanities, 10, 297-307, 2010-12.
Follow up Questions	How could this same technique be used when detecting surfaces at an angle with a ultrasonic sensor? How can this be functionally applied to a device for the visually impaired? How accurate is this method with different kinds of surfaces, or similar surfaces?

Article #13 Notes: Outdoor Difficulties Experience by a Group of Visually Impaired Iranian People

Article notes should be on separate sheets

Source Title	Outdoor Difficulties Experience by a Group of Visually Impaired Iranian People
Source citation (APA Format)	Riazi, Abbas, et al. “Outdoor Difficulties Experienced by a Group of Visually Impaired Iranian People.” *Journal of Current Ophthalmology*, vol. 28, no. 2, June 2016, pp. 85–90, www.ncbi.nlm.nih.gov/pmc/articles/PMC4909643/, 10.1016/j.joco.2016.04.002.
Original URL	https://www.sciencedirect.com/science/article/pii/S24522325153 0055X?via%3Dihub
Source type	Journal Article / Survey
Keywords	Survey, Mobility, Visually Impaired, assistive device

Summary of key points (include methodology)	· Includes information about visually impaired and what devices are available to help with navigation · Methods of the survey. Where, when, who was surveyed · Reviewed causes of vision impairment and living situation. (retina pigmentosa and optic atrophy were the two most common) · The results talked about the following: · Gps problems · Potential Accident Risks · Difficulty using TGSI · Inappropriate canes and downsides of using guide dogs · Main Concerns and suggestions · They then went on to discuss similarities, patterns, solutions, and general discussion on the data KG: · Information from VIPs from other regions · Accessibility of devices for these people · Common injuries VIPs could sustain from accidents
Research Question/Problem/ Need	What issues do visually impaired Iranian individuals face when outdoors

Important Figures	

Notes	· One of the main focusses was sidewalk safety · Many of the Iranians preferred to walk on the street because of the many hazards on the sidewalk · Uncomfortable asking for help b/c of social stigma and people not believing them · Night time walking/traveling is easier because they can better identify car lights · Participants indicated that visually healthy people were not aware that TGSI are for visually impaired and not for them · Holes/grates on sidewalks provide major hazard as they are hard to detect · Random unexpected obstacles like boxes on sidewalks from street vendors Is also hard to avoid · Random head level obstacles are typically the most dangerous · Participants liked the idea of warning/detection mechanism on canes to help alert them · Found that some canes got stuck in holes or were unsturdy · VIPs had difficulty hailing taxis because they cannot recognize if it is coming towards them or another person · Headphones for audio gps restrict hearing of outside world which is important
Cited references to follow up on	1.Marin-Lamellet C, Aymond P. Combining verbal information and a tactileguidance surface: the most efficient way to guide people with visualimpairment in transport stations?Br J Vis Impairment. January 1, 2008;26:63e81

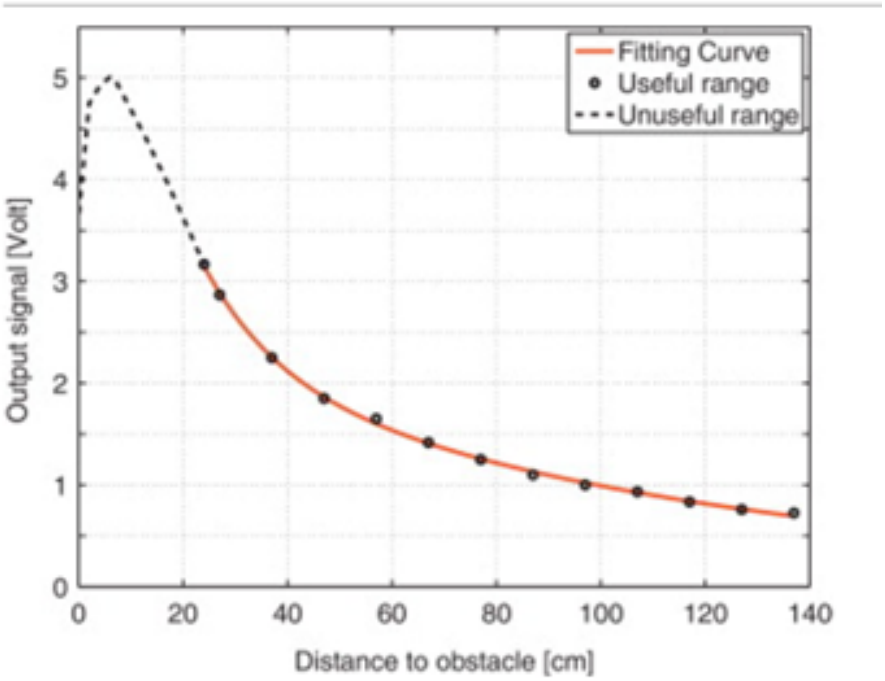
Follow up Questions	How accessible are assistive technologies to these people? How can the suggestions/problems expressed be fixed with assistive technologies? Are there any studies on the general population of the area and how aware they are of impaired individuals?

Article #14 Notes: A new hybrid infrared-ultrasonic electronic travel aids for blind people

Article notes should be on separate sheets

Source Title	A new hybrid infrared-ultrasonic electronic travel aids for blind people
Source citation (APA Format)	Prattico, Flavio, et al. “A New Hybrid Infrared-Ultrasonic Electronic Travel Aids for Blind People.” *Sensors and Actuators A: Physical*, vol. 201, Oct. 2013, pp. 363–370, 10.1016/j.sna.2013.06.028.
Original URL	https://www.sciencedirect.com/science/article/pii/S0924424713003166#bib0075
Source type	Journal article
Keywords	Visually Impaired, ultrasonic sensors, travel aid, analogical output

Summary of key points (include methodology)	· They first introduce past technologies and flaws with common ETA types (camera, plain ultrasonic or plain infrared, etc) · Propose their idea for combination of ultrasonic and infrared · Show prototype of device and explain wear/usability · Describes motors and sensors used · Showed analogical output data and line of best fit · Discussed noise and three different methods to reduce it · Conclusion KG: · Information on analogical output and how I can obtain that data/output · Specifics about infrared sensors and how they may differ from ultrasonic and not be able to do similar ground detection · Different kinds of noise reduction methods for data
Research Question/Problem/ Need	How can infrared and ultrasonic devices be combined in order to make an improves ETA for the visually impaired

Important Figures	
Notes	· Combined infrared and ultrasonic · Infrared more accurate but connot detect glass/mirrors · They were able to detect stairs and the infrared was able to detect conditions at an angle ******** · INFRARED SENSORS CAN BE USED AT ANGLES · Combined ultrasonic and infrared!!!! · Noise reduction methods: · Look into these · LOW PASS FILTER

Cited references to follow up on	S.K. Bahadira, V. Koncara, F. Kalaoglu **Wearable obstacle detection system fully integrated to textile structures for visually impaired people** Sensors and Actuators A: Physical, 179 (2012), pp. 297-311 M. Lee, S. Lee *** **Design and analysis of an infrared range sensor system for floor-state estimation** Journal of Mechanical Science and Technology, 25 (2011), pp. 1043-1050 R. Farcy, R. Damaschini **Hand-held triangulation laser profilometer with audio output for blind people** Journal of optics, 29 (1998), pp. 250-252
Follow up Questions	· Can infrared sensors be used similarly to ultrasonic sensors to detect ground surface condition? · What other designs could the researchers have considered (non-belt)? · How could this device be effectively tested?

Article #15 Notes: Performance comparison of Infrared and Ultrasonic sensors for obstacles of different materials in vehicle/ robot navigation applications

Source Title	Performance comparison of Infrared and Ultrasonic sensors for obstacles of different materials in vehicle/ robot navigation applications
Source citation (APA Format)	Adarsh, S., Kaleemuddin, S. M., Bose, D., & Ramachandran, K. I. (2016). Performance comparison of Infrared and Ultrasonic sensors for obstacles of different materials in vehicle/ robot navigation applications. *IOP Conference Series: Materials Science and Engineering*, *149*, 012141. https://doi.org/10.1088/1757-899x/149/1/012141
Original URL	https://media.proquest.com/media/hms/PFT/1/dw4OK?hl=&cit%3Aauth=Adarsh%2C+S%3BS+Mohamed+Kaleemuddin%3BBose%2C+Dinesh%3BRamachandran%2C+K+I&cit%3Atitle=Performance+comparison+of+Infrared+and+Ultrasonic+sensors+for+...&cit%3Apub=IOP+Conference+Series.+Materials+Science+and+Engineering&cit%3Avol=149&cit%3Aiss=1&cit%3Apg=&cit%3Adate=Oct+2016&ic=true&cit%3Aprod=ProQuest&_a=ChgyMDIxMTIxODAyNTE0NjEzMDoyMTEzODMSBTgyOTEzGgpPTkVfU0VBUkNIIg42OC4xMTguMjM4LjEzMCoHNDk5ODY3MDIKMjU2NDcxMjg1ODoNRG9jdW1lbnRJbWFnZUIBMFIGT25saW5lWgJGVGIDUEZUagoyMDE2LzEwLzAxcgoyMDE2LzEwLzMxegCCAURQLTEwMDc4NTEtMjkxMjAtQ1VTVE9NRVItMTAwMDAyNjAvMTAwMDAyNjUvMTAwMDAyNTAvMTAwMDAzNTUtNjU3MjkwOJIBBk9ubGluZcoBTk1vemlsbGEvNS4wIChXaW5kb3dzIE5UIDEwLjA7IFdpbjY0OyB4NjQ7IHJ2Ojk1LjApIEdlY2tvLzIwMTAwMTAxIEZpcmVmb3gvOTUuMNIBElNjaG9sYXJseSBKb3VybmFsc5oCB1ByZVBhaWSqAi5PUzpFTVMtRG9jVmlld1BkZlVybFNlcnZpY2UtZ2V0TWVkaWFVcmxGb3JJdGVtygIPQXJ0aWNsZXxGZWF0dXJl0gIBWeICAU7qAgVwcmltb%2FICAPoCAVmCAwNXZWKKAxxDSUQ6MjAyMTEyMTg

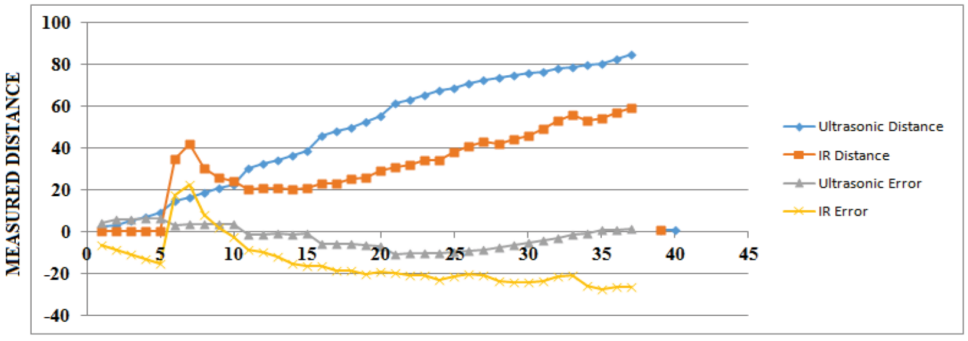
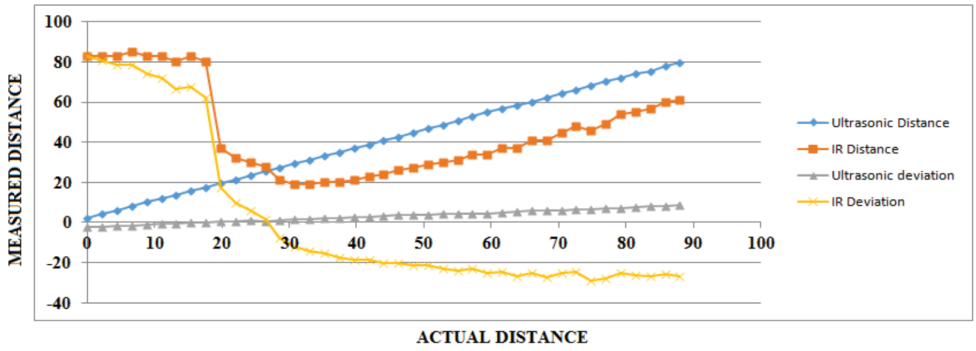
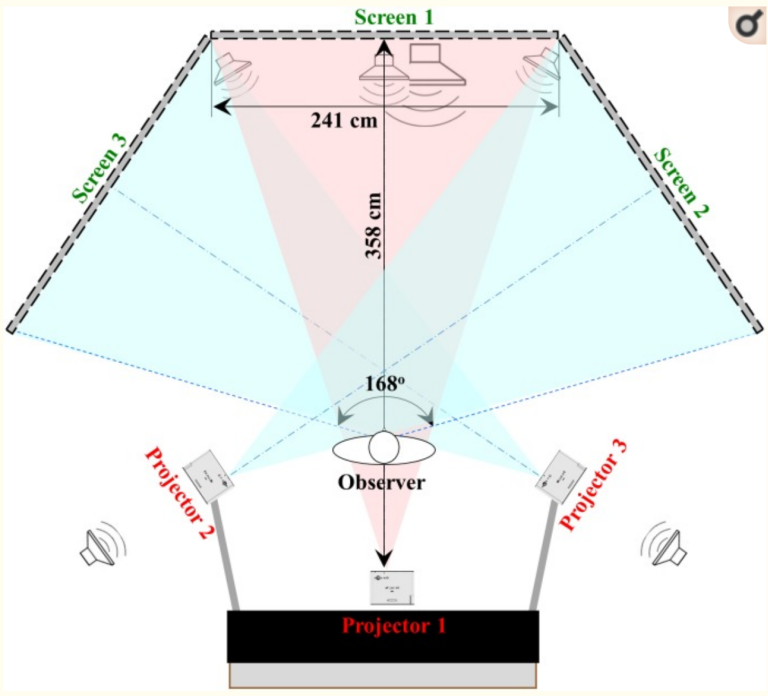
	wMjUxNDYxMzE6MjYwMDQ0&_s=Ei6cydwbz6lThczD8lQMU89edhc%3Ditle
Source type	Journal article
Keywords	Infrared, obstacle
Summary of key points (include methodology)	• Similar sensors, but focus was to find which was better for certain *types* of obstacles • They described the ultrasonic and infrared sensors they used in detail • Went through specs of robot • Went through how the robot will be used to compare • Cardboard, Paper, Sponge, Wood, Plastic, Rubber and Tile
Research Question/Problem/ Need	For what situations should you use an infrared versus an ultrasonic distance sensor in robotic application
Important Figures	 **Figure 4.** Plot (Measured Vs Actual distance)  **Figure 7.** Plot (Measured Vs Actual distance)

	Table 2. Statistical analysis of sensor data for different obstacle materials | Material | Ultrasonic Sensor | | Infrared Sensor | | (r) (US-IR) | | | *Std. Dev* | *r* | *Std. Dev* | *r* | | | Cardboard | 9.3 | 0.9879 | 10.6 | 0.91089 | 0.88424 | | Paper Sheet | 37 | 0.2611 | 20.2 | 0.97866 | 0.20663 | | Sponge | 5.8 | 0.9868 | 21.6 | 0.78774 | 0.72976 | | Wood | 10 | 0.9999 | 36.5 | -0.3291 | -0.3285 | | Plastic | 4.3 | 0.9995 | 25.1 | 0.78681 | 0.78767 | | Rubber | 4.6 | 0.9988 | 58.3 | 0.90998 | 0.9216 | | Tile | 11 | 0.9952 | 23.8 | 0.73032 | 0.73085 |
Notes	• Obstacle detection for robots • Shows for different materials • Infrared sensors used • Mentioned how colors effect readings • Also used ultrasonic sensors • IR have higher resolution and quicker response times • Used sensors at multiple angles on the robot • Shorter range obstacle detection 10-80cm • IR typically best overall, although the ultrasonic sensors had less deviation • Further studies looked into how neural networks can be used to improve readings *Fuzzy network?
Cited references to follow up on	RP GP2Y0A02YK Infra-Red sensor Datasheet G. Benet, F. Blanes, J.E. Simo, P. Perez, 2002, Journal of Robotics and Autonomous Systems , vol. 10, Pp. 255-266.
Follow up Questions	Which of these sensors would be best for my application? Would the same results apply for the frequency aspect of the sensors? What extrapolations can be made based on categories and 'types' of material?

Article #16 Notes: Individuals with severely impaired vision can learn useful orientation and mobility skills in virtual streets and can use them to improve real street safety

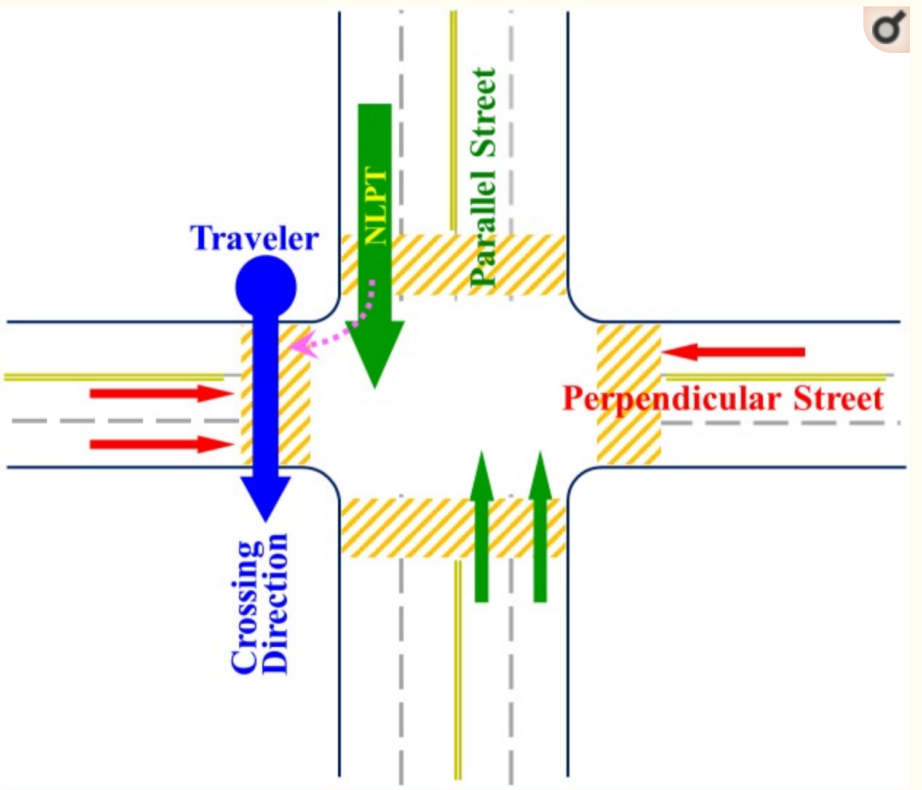
Source Title	Individuals with severely impaired vision can learn useful orientation and mobility skills in virtual streets and can use them to improve real street safety
Source citation (APA Format)	Bowman, E. L., & Liu, L. (2017). Individuals with severely impaired vision can learn useful orientation and mobility skills in virtual streets and can use them to improve real street safety. *PubMed*, *12*(4), e0176534. https://doi.org/10.1371/journal.pone.0176534
Original URL	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5405961/
Source type	Journal Article
Keywords	Vision impairment, safety
Summary of key points (include methodology)	The article starts with an introduction to the visually impaired and an explanation of issues they may face. The article also introduces virtual reality and how it was doing to be used. The article then discussed the methodology of how the learning and usefulness of the skills going to be measured through safety ratings of when participants thought it would be safe to crossroads compared to before and after the lessons. The methods were tested on real roads and in a VR simulation. Finally, they showed the results and how the lessons improved the safety ratings.
Research Question/Problem / Need	Can low vision individuals learn useful skills in virtual streets and apply them to improve real street safety.
Important Figures	

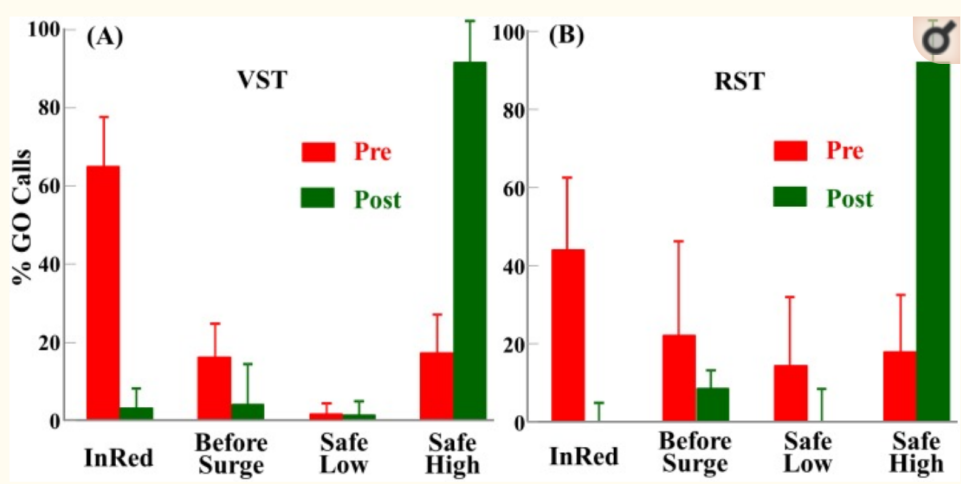


Open in a separate window

Fig 2

The visual and auditory display components of the VR simulation used in the research.





Notes

- No significant difference between groups that crossed real versus virtual crosswalks
- VR was an effective tool in this situation and the paper discussed how there could be further applications in the training.
- Safety score was directly related to the time of the start and end of the “safe to cross time” and when the participant said go to cross.
- Maximum training time was 30 minutes

	• Made sure that the person learning skills was comfortable by being able to hold their cane and have all their normal aids with then even though it was a VR experience. • Research was only done with visually impaired individuals who had a consistent problem identifying pedestrian symbols.
Cited references to follow up on	22. Lahav O. Improving orientation and mobility skills through virtual environment for people who are blind: past research and future potential. Proceedings of the 9th International Conference of Disability, Virtual Reality & Associated Technologies; Laval, France, 2012. p. 393–8. 28. Willis JR, Vitale SE, Agrawal Y, Ramulu PY. Visual impairment, uncorrected refractive error, and objectively measured balance in the United States. JAMA ophthalmology. 2013;131(8):1049–56. 10.1001/jamaophthalmol.2013.316 [PubMed] [CrossRef] [Google Scholar]
Follow up Questions	How does the observer format relate to other sensors? Can similar training be used for testing device software? How can this methodology be spread

Article #17 Notes: Devices for visually impaired people: High technological devices with low user acceptance and no adaptability for children

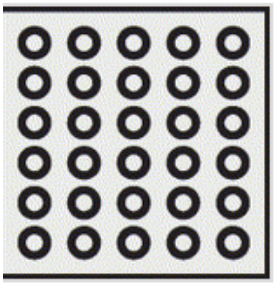
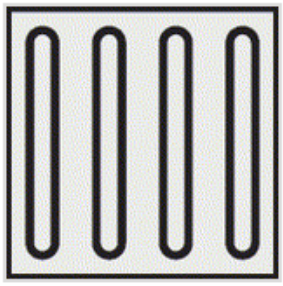
Source Title	Devices for visually impaired people: High technological devices with low user acceptance and no adaptability for children
Source citation (APA Format)	Gui, K., Ye, L., Ge, J., Cheikh, F. A., & Huang, L. (2019). Road surface condition detection utilizing resonance frequency and optical technologies. *Sensors and Actuators A: Physical*, *297*, 111540. https://doi.org/10.1016/j.sna.2019.111540
Original URL	https://www-sciencedirect-com.ezpv7-web-p-u01.wpi.edu/science/article/pii/S0149763415302864

Source type	Journal Article / Literature review
Keywords	Surface condition detection
Summary of key points (include methodology)	Includes a lot of background, specifically on visual impairment, children with visual impairments, past research on the subject, assistive devices, and how they have been used by both the adult and children visually impaired populations. The article talks about acceptance ratings and how past research relates to these ratings. Lastly, the article talks about how the information presented can be analyzed to help further devices.
Research Question/Problem/ Need	Why are the majority of technological devices available for visually impaired users meant for adults and not for children? Despite high technological advancements in recent years, why is there still no full user acceptance of existing sensory substitution devices?
Important Figures	(no figures, large tables included but too big for notes)
Notes	● Spatial cognition recognized as key for assisting persons with visual impairments ● Children with visual impairments or those born with them typically have more issues than those who develop it later in life ● LOTS OF ARTICLES IF NEEDED ABOUT STUDIES** ● Also lots of information about devices and devices from the past ● Article is very general and talks about all kinds of assistive devices for VIPs, and does not focus on one specific type (nav aids, screen readers, etc) ● Problem in field: not clinically validated. Lots of research done but not validated ● Multisensory integration may actually be worse for devices than only including one kind of feedback ● Too much attention needed to use a lot of the devices. ● Many devices also require a long period of training for use
Cited references to follow up on	Capelle, C., Trullemans, C., Arno, P., Veraart, C., 1998. A real-time experimental prototype for enhancement of vision rehabilitation using auditory substitution. Biomed. Eng. IEEE Trans. 45, 1279–1293 Kajimoto, H., Inami, M., Kawakami, N., Tachi, S., 2003. SmartTouch-augmentation of skin sensation with electrocutaneous display, haptic interfaces for virtual environment and teleoperator systems, 2003. HAPTICS 2003. Proceedings 11th Symposium on IEEE, 40–46.

	Rempel, J. (2012). Glasses That Alert Travelers to Objects Through Vibration? An Evaluation of iGlasses by RNIB and AmbuTech., AFB AccessWorld Magazine Technology News for dation for the Blind.
Follow up Questions	How can current devices be adapted for children's use? How can I use this information to help improve my device design/criteria? How can clinical testing be made more available for new assistive devices?

Article #18 Notes: Installation Errors and Corrections in Tactile Ground Surface Indicators in Europe, America, Oceania and Asia

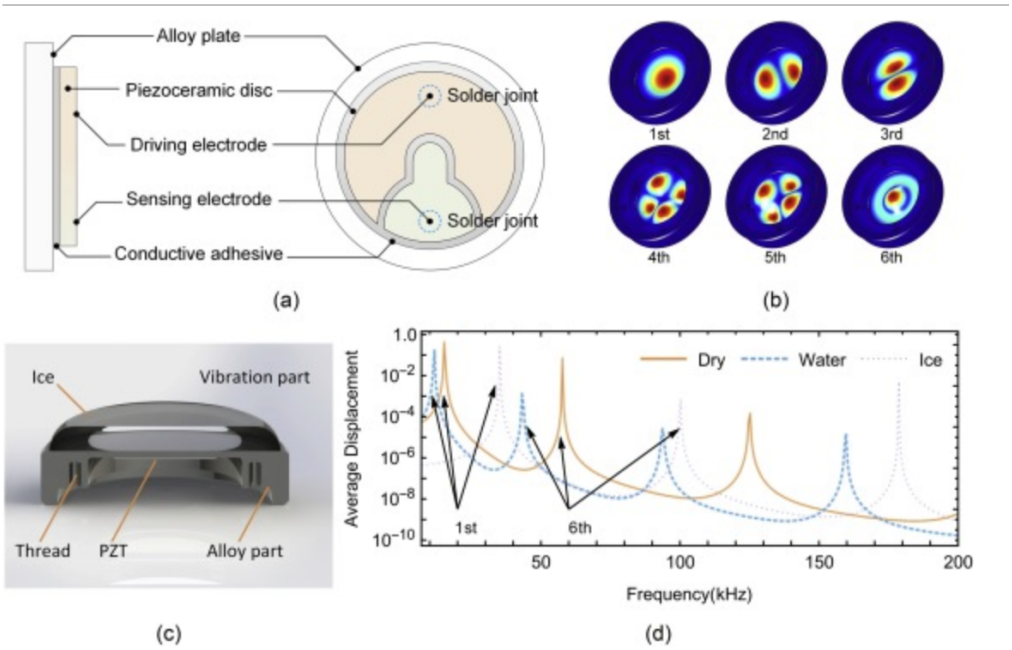
Source Title	Installation Errors and Corrections in Tactile Ground Surface Indicators in Europe, America, Oceania and Asia
Source citation (APA Format)	Mizuno, T., Nishidate, A., Tokuda, K., & Arai, K. (2008). Installation Errors and Corrections In Tactile Ground Surface Indicators in Europe, America, Oceania and Asia. *IATSS Research*, *32*(2), 68–80. https://doi.org/10.1016/s0386-1112(14)60210-7
Original URL	https://www.sciencedirect.com/science/article/pii/S0386111214602107
Source type	Journal Article
Keywords	Tactile Ground Surface Indicators
Summary of key points (include methodology)	A survey was conducted in multiple regions across the globe in urban areas where TGSI were installed. Similar mistakes were consistently made and this article talks about the common mistakes. It starts with an introduction of TGSI. They used methods described in another book/article to rate/identify misintallations of TGSI. The article didn't discuss methodology too deeply but did describe findings. The study described TGSI found in different countries and analyzed common flaws such an improper warning blocks or no inclusion of rails that should be paired with TGSI.

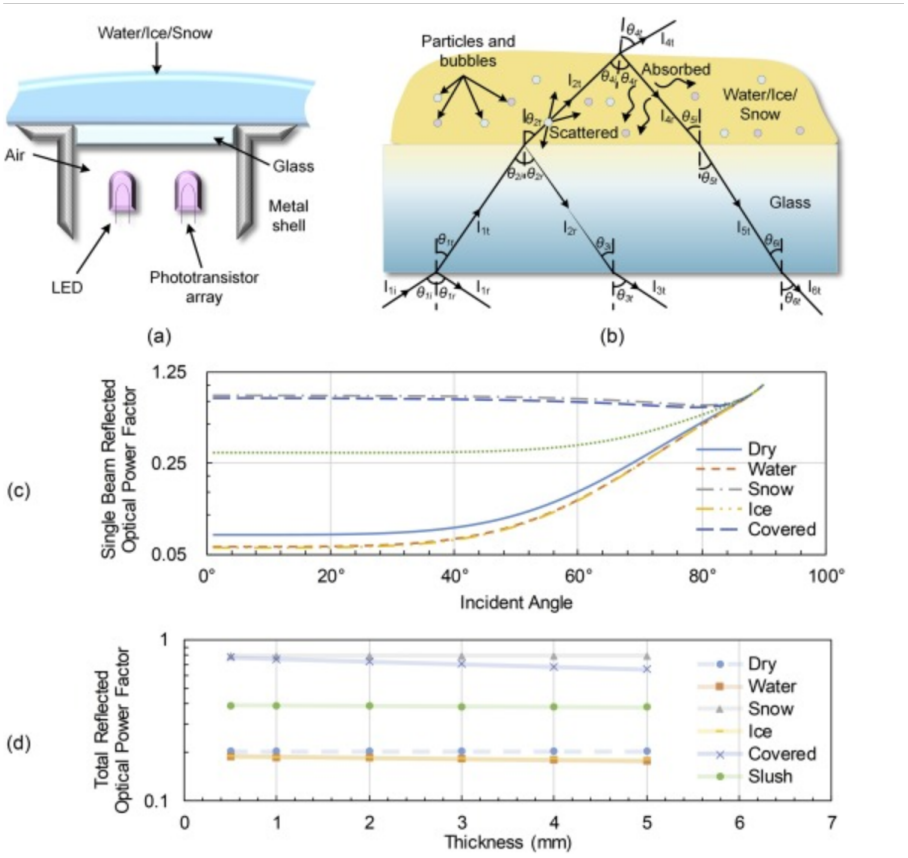
Research Question/Problem / Need	How can problems in TGSI installment be avoided?
Important Figures	     
Notes	• Countries: London, UK; Paris, France; Frankfurt, Germany; Brussels, Belgium; Amsterdam, Netherlands; California, USA; Tijuana, Mexico; Sydney, Australia; Auckland, New Zealand; Seoul, Busan and Daegu, Korea; Beijing, Shanghai, Dalian and Guangzhou, China; Taipei and Taichung, Taiwan; Hong Kong; Singapore; Kuala Lumpur, Malaysia; Jakarta, Indonesia; and Bangkok, Thailand • Some TGSI are directional, some are not. • Directional should be used at crosswalks or railroads • Some TGSI are commonly too big, which impedes the use of a cane, the mobility of wheelchair users, or elderly pedestrians • Some places were just using raised metal bars which are possible to go unnoticed by visually imapired pedestrians • All the countries seemed to have different styles of TGSI and no common usage was discussed or specifically identified • Some TGSI are interrupted by obstacles or manholes which causes consistency problems
Cited references to follow up on	Tokuda K. **Mobility Support Systems for the Visually Impaired** "IATSS Review", 23 (1) (1997), pp. 44-51

	(in Japanese) View Record in ScopusGoogle Scholar 4 Tokuda K., Mizuno T., Nishidate A., Arai K. **Standardization and Classification, Substandard Installation and Improving the Tactile Ground Surface Indicator (TGSI)** "IATSS Review", 33 (1) (2008), pp. 98-107 (in Japanese)
Follow up Questions	How can TGSI be specifically identified by my project? Are there easier ways to include technologies similar to TGSI in more widespread places? Why is this issue not addressed in some areas?

Article #19 Notes: Road surface condition detection utilizing resonance frequency and optical technologies

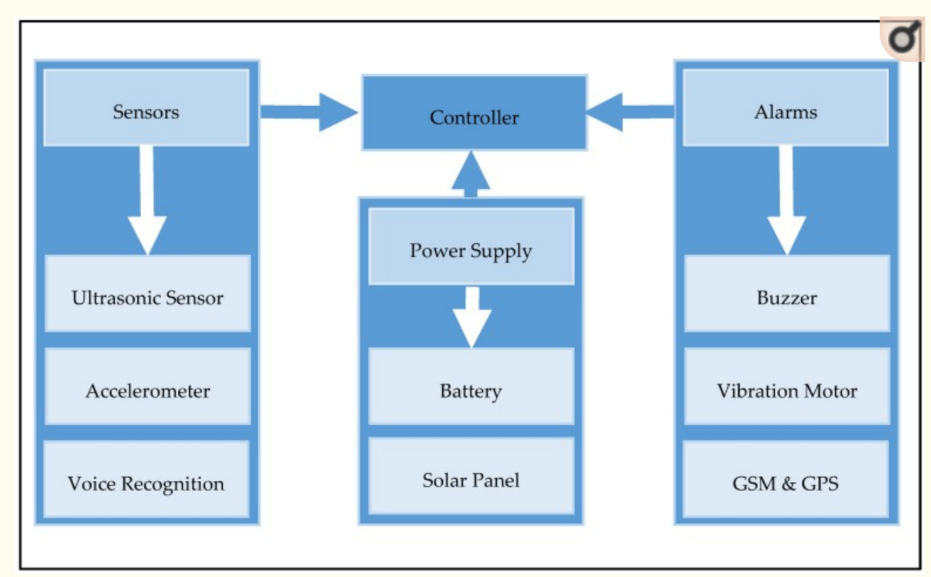
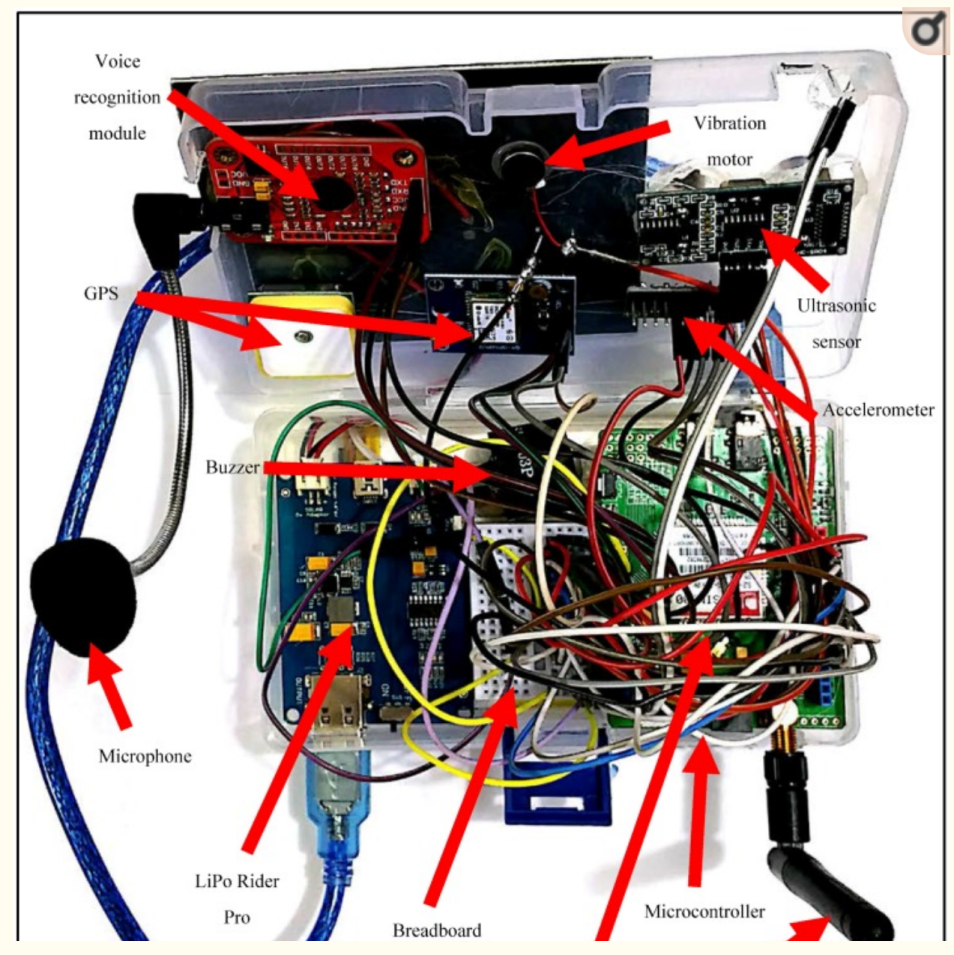
Source Title	Road surface condition detection utilizing resonance frequency and optical technologies
Source citation (APA Format)	Gui, K., Ye, L., Ge, J.,Cheikh, F. A., & Huang, L. (2019). Road surface condition detection utilizing resonance frequency and optical technologies. *Sensors and Actuators A: Physical*, *297*, 111540. https://doi.org/10.1016/j.sna.2019.111540
Original URL	https://www-sciencedirect-com.ezpv7-web-p-u01.wpi.edu/science/article/pii/S0924424719300998

Source type	Journal Article
Keywords	Road surfaces detection
Summary of key points (include methodology)	This article looks at detection road conditions with a stationary machine with non-contact devices. The article introduces the need and what past research has done, flaws in current devices, and how they plan to detect ice specifications. Their methods included the use of a piezoelectric sensor and optical sensors and they described how both of these were used in tandem to detect 6 different conditions and ice. They then discussed the experimental process of testing the device created.
Research Question/Problem / Need	How can road surface condition be detected using multiple methods combined?
Important Figures	

	
Notes	
Cited references to follow up on	A. Troiano, E. Pasero, L. Mesin **New system for detecting road ice formation** IEEE Trans. Instrum. Meas., 60 (3) (2011), pp. 1091-1101, 10.1109/TIM.2010.2064910 **Classification of road conditions: from camera images and weather data** IEEE Int'l Conf. on Computational Intelligence for Measurement Systems & Applications (2011), 10.1109/CIMSA.2011.6059917 Google Scholar
Follow up Questions	Can I use similar sensors for my condition detection? How could this be adapted to be used on-the-move (on a car)? Was this research ever expanded on or applied in the real world?

Article #20 Notes: Wearable Smart System for Visually Impaired People

Source Title	Wearable Smart System for Visually Impaired People
Source citation (APA Format)	Ramadhan, A. (2018). Wearable Smart System for Visually Impaired People. *Sensors*, *18*(3), 843. https://doi.org/10.3390/s18030843
Original URL	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5877379/
Source type	Journal Article
Keywords	Visually Impaired System
Summary of key points (include methodology)	The device developed focuses on street navigation and help in seeking assistance. The article starts with an introduction to the issue and multiple related works that they seem to plan to combine into one device. The system is proposed and described, including each of the components and what their individual purpose will be. The overall response was positive after testing, although not much was described about the testing process other than that.
Research Question/Problem / Need	How can a wearable smart system help visually impaired persons (VIPs) walk by themselves through the streets, navigate in public places, and seek assistance?

Important Figures	 
Notes	• Wrist located system that could also be adapted to white cane

	○ Most participants specifically chose to use the wrist location so they always had the device on them ● Used text alert system and good maps for location and GPS services ● The system was supported by a solar panel, although it was never described how useful/functional this was or if there were any downsides of including it. ● Lots of different types of feedback discussed. Sound, vibration, and GSM ● Since not a lot of information was given on testing it is unclear whether the large amount of feedback pieces/information was good or bad for the users. ● System described to be lightweight but a lot of components were included and no specific measurement was given. ● Overall it seemed to include a bunch of technologies but didn't give adequate description of how well everything worked together and what the testing participants' opinion of it was.
Cited references to follow up on	1. Jothi R., Kayalvizhi M., Sagadevan K. Smart walking stick for visually challenged people. Asian J. Appl. Sci. Technol. 2017;1:274–276. [Google Scholar] 2. 4. Sangami A., Kavithra M., Rubina K., Sivaprakasam S. Obstacle detection and location finding for blind people. Int. J. Innov. Res. Comput. Commun. Eng. 2015;3:119–123. [Google Scholar] 3. 13. Rao B., Deepa K., Prasanth H., Vivek S., Kumar S.N., Rajendhiran A., Saravana J. Indoor navigation system for visually impaired person using gps. Int. J. Adv. Eng. Technol. 2012;3:40–43. [Google Scholar]
Follow up Questions	Is this practical for everyday use? How could the device be adapted to be more compact? What are some other applications of the technologies used?