Immersive pod for enhancing Virtual Reality experience

Submitted in partial fulfilment of the requirements

of the degree of Master of Design

by

P Sri Hari

Roll No. 176130008

Supervisor:

Prof. P Kumaresan

Industrial Design Centre

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

(2018)

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Chapter 1

Introduction

1.1 Background

Virtual reality is a computer-generated feel real environment. The sole purpose of Virtual Reality is to enable the user to manipulate and experience the digital or simulated environments as if it were the real world. The best Virtual Reality aims to achieve complete immersion. Virtual Reality uses various Immersive technologies to blur the line between the simulated world and physical world by provide complete immersion through stimulating various senses. Virtual reality seems to be identical to 3-D imagery, where you manipulate and experience the environment, rather than completely becoming part of the virtual world. The desire of the tech companies to foster innovations by pushing boundaries in digital media technology and develop new applications to harness this technology led to Virtual Reality. With the increased popularity of high-density displays and 3D graphic capabilities paved the path for new inventions in virtual reality. Virtual Reality environment is made up of life-sized digital images that appears according to the perspective of the user. The system running the virtual environment tracks the user's eye and head movements, so that it reacts and change the images on the display or initiates any relevant events. Various input devices like joysticks, track pads, pedals, knobs, switches, controllers, scanners, cameras, trackers, sensors are used to communicate the user inputs to the system running Virtual Reality. The effectiveness of the input device depends on the latency involved in transferring the control information to the processing unit and also the response rate of the output simulation. Experience to mimic the reality involves as minimum latency as possible.

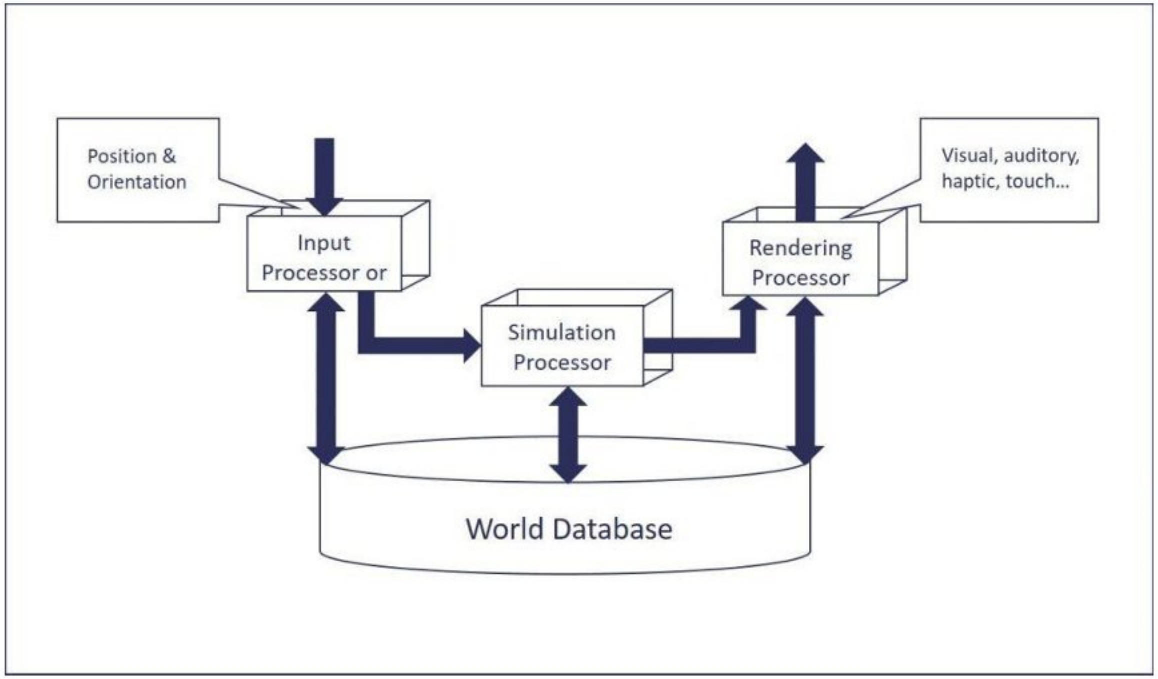


Figure 1.1 The Architecture of a Virtual Reality system*

(*Reference: https://www.fortech.ro/introduction-virtual-reality-world/)

1.2 Purpose

Humans perceive the world through perception systems and senses. We have five obvious senses: sight (Vision), touch (Somatosensation), taste (Gustation), smell (Olfaction) and hearing (Audition). But humans possess many other senses like temperature (Thermoception), balance (Equilibrioception), pain (Nociception), vibration (Mechanoreception), kinesthetic sense (Proprioception), and various internal stimuli. These additional sensory inputs and processing of sensory information by our brains ensures perception of information from the environment to our brains. The more the senses stimulated, the better the experience perceived. Everything we perceive about the reality is by way of our senses. Our experiential reality is a combination of perceived sensory information and sense-making mechanisms of that information by our brains. So, virtual reality is presenting our senses with a computer generated virtual environment that seems to mimic reality and can be explored.

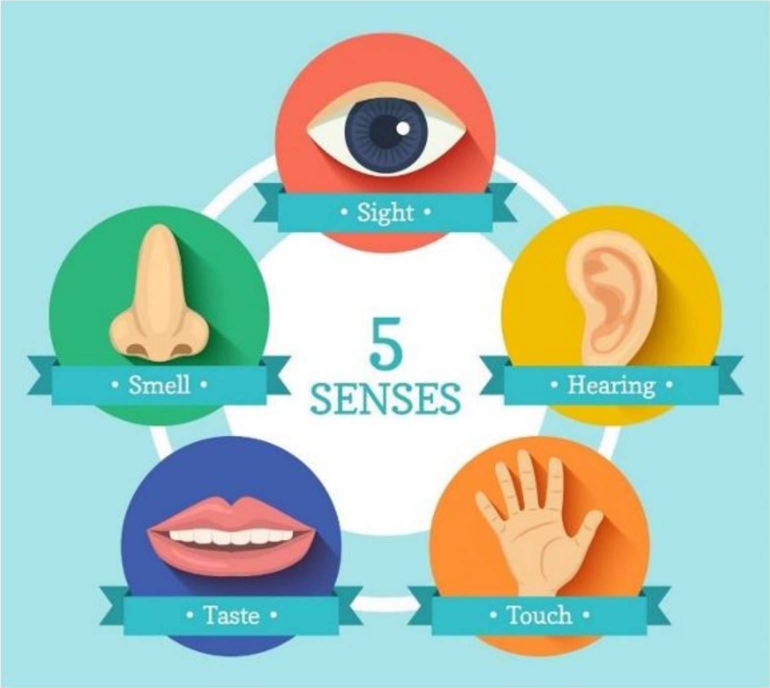


Figure 1.2 5 common senses perceived by humans*

(*Reference: https://younggrowingminds.com/pages/program2)

Most of the existing Virtual reality platforms rely only on the visual aspect (Sight) and do not stimulate other senses. The ideal experience can be generated by stimulating multiple senses that can be perceived by humans. The experience thus generated through stimulating multiple senses is rich in information of the real world and guarantees real life like experience.

1.3 Delimitations

The project is limited to developing a platform for integrating various immersive technologies like immersive projection, Ambisonics, and a motion platform. It doesn't involve in the development of the above mentioned technologies. The technologies are integrated in their existing forms without any alterations. The designing process involves exploration of various form factors to integrate these technologies and improve the immersive experience of Virtual Reality compared to the standard headset based virtual reality experiences existing in the market. The product is intended for the tech savvy high end customers, having ample of disposable income. Since pod is an interactive space, various Anthroprometric dimensions are taken into consideration. The dimensions are intended for Indian context and taken from "*Indian anthropometric dimensions for ergonomic design practice*", Chakrabarti, Debkumar. National institute of design, 1997. The pod is modular in nature and can be customized based on the applications like watching movies, game simulation, relaxing. Additional hardware is to be integrated with the pod in context with the application.

Chapter 2

Literature Survey

Virtual reality is an interactive computer generative experience taking place with in a simulated environment that incorporates feedbacks like auditory, visual and haptics. Paramount for sensation of immersion into virtual reality are high frame rate and low latency. Complete sensation of reality includes moving 3D images in color with 100 percent peripheral vision, binaural sound, scents and air breezes. Virtual reality aims to achieve total immersion. It means sensory experiences feel so real and mimics the real world or sometimes even excess bounds of physical reality by creating a world beyond physical laws.

2.1 Human sensation

Sense is a physiological capacity of an organisms that provides data for perception. The senses and their operations are studied in fields like cognitive science, neuroscience and philosophy of perception. The nervous system has a specific sensory system and sense organs dedicated to each sense. Some species (animals) are able to sense electric fields, magnetic fields, water pressure and currents. The five traditional human senses include sight (Vision), touch (Somatosensation), taste (Gustation), smell (Olfaction) and hearing (Audition). But humans possess many other senses like temperature (Thermoception), balance (Equilibrioception), pain (Nociception), vibration (Mechanoreception), kinesthetic sense (Proprioception), and various other internal stimuli that help them in perceiving the real world around them.

Figure 2.1 Five senses and their respective sensory organs*

(*Reference: https://en.wikipedia.org/wiki/Sense)

2.2 Types of immersion

The state of total immersion exists when enough senses are activated to create the perception of being present in non-physical world. Types of immersion are:

- *Mental immersion:* A deep mental state of engagement with suspension of disbelief that one is in a virtual environment.
- *Physical immersion*: Exhibiting physical engagement in a virtual environment and suspension of disbelief that one is in a virtual environment.

2.3 Virtual reality vs Non virtual reality:

Virtual reality seems to be identical to non-virtual reality content like 3D imagery, where the brain processes 2D imaginary to 3D content to experience the real environment, unlike 3D imaginary the information generated by virtual reality is directly consumed by brain without any additional processing.

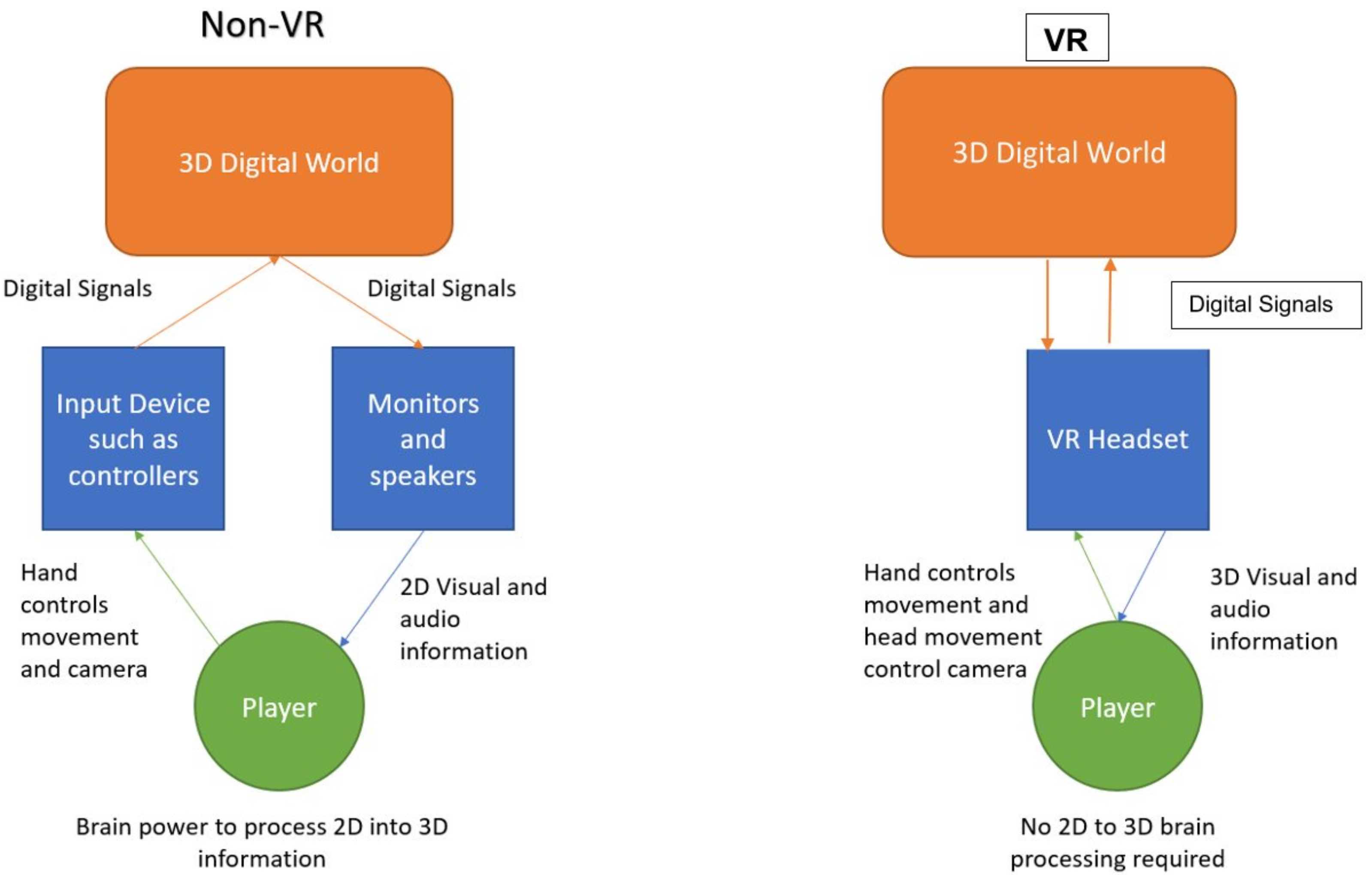


Figure 2.2 Difference between VR and Non VR content*

(*Reference: https://hackernoon.com/the-difference-between-ar-vr-mr-xr-and-how-to-tell-them-apart-45d76e7fd50)

2.4 Difference between Virtual reality, Augmented reality and Mixed reality

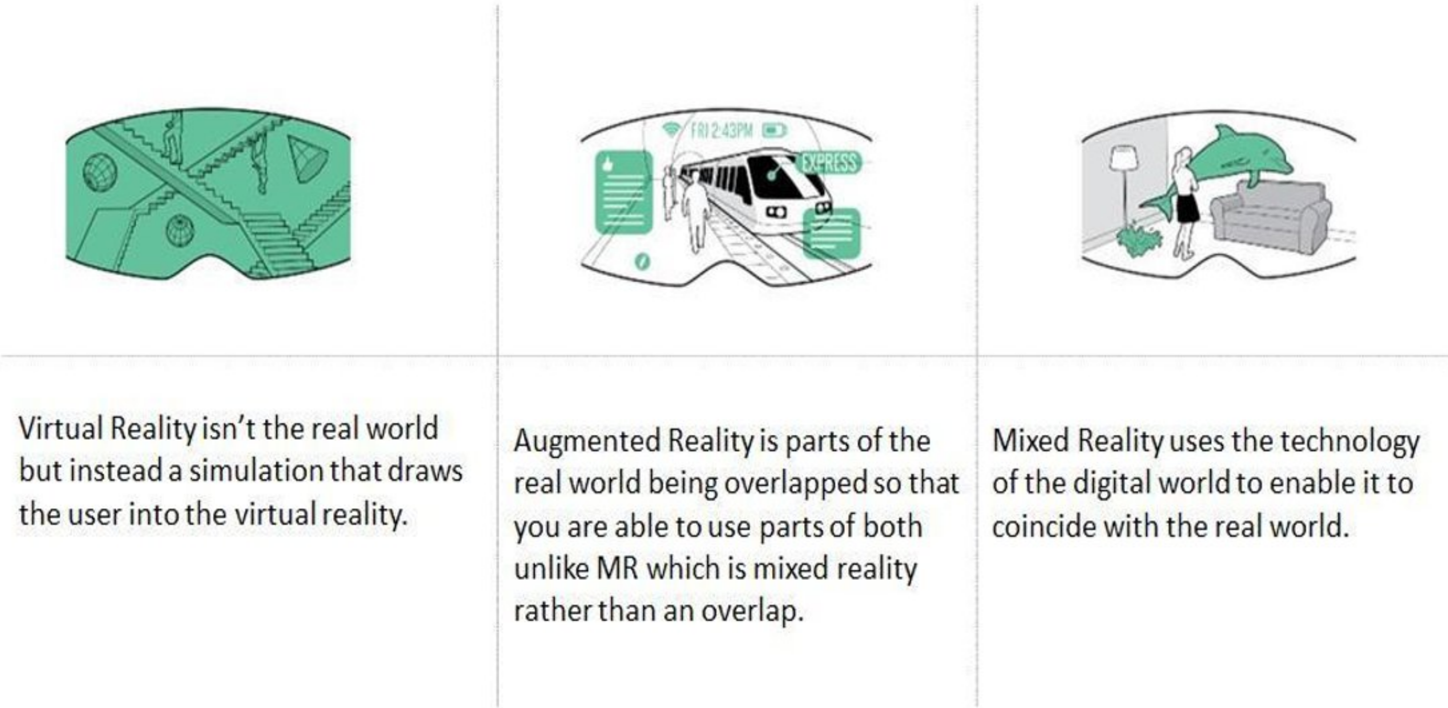


Figure 2.3 Difference between Virtual Reality, Augmented Reality and Mixed Reality*

(*Reference: https://filmora.wondershare.com/virtual-reality/difference-between-vr-ar-mr.htm)

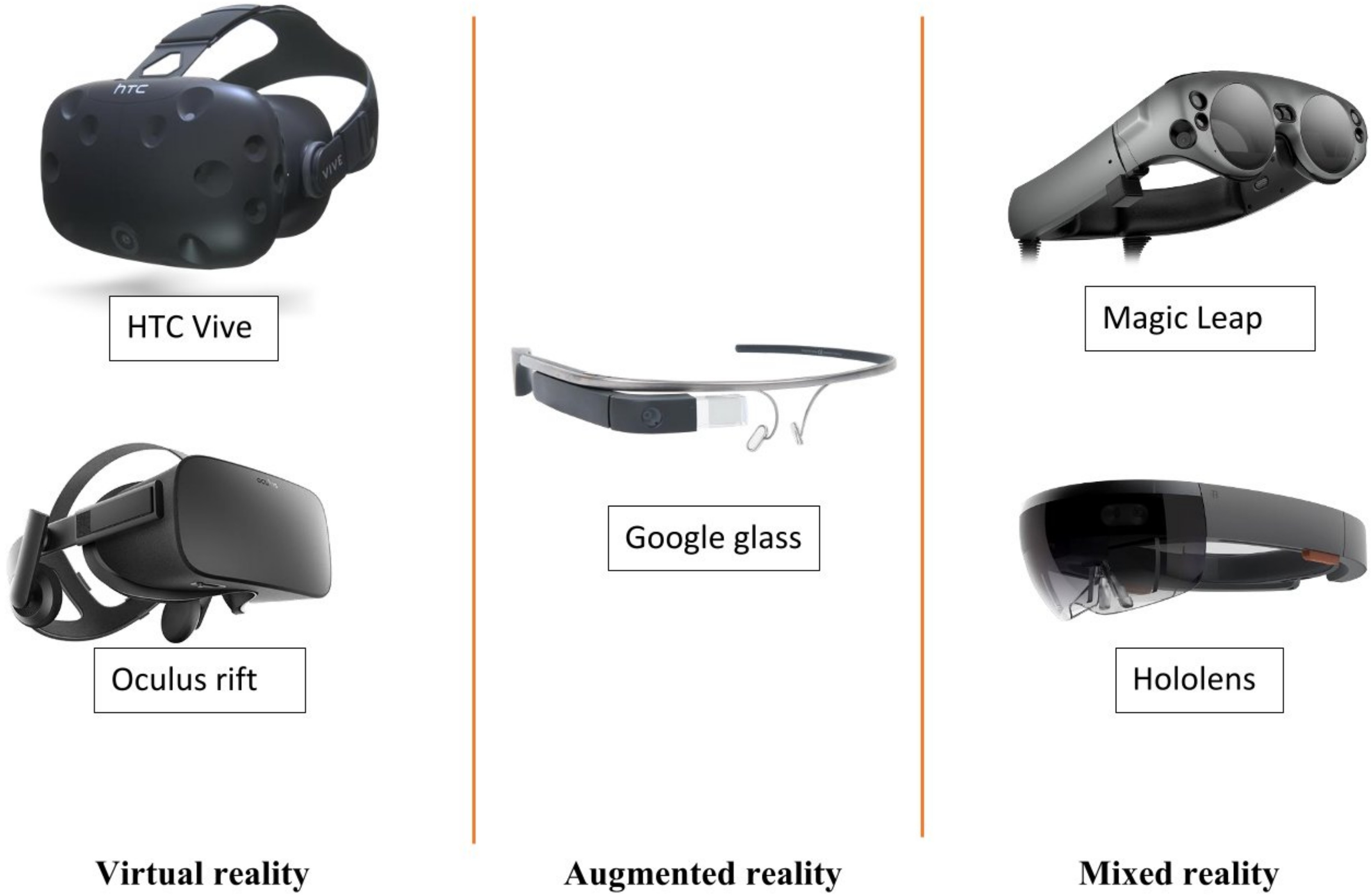


Figure 2.4 Various headsets for Virtual Reality, Augmented Reality and Mixed Reality

2.5 Hardware used in virtual reality

Multiple specialized types of hardware is used in the generation of virtual reality applications to mimic the perception of real environment which includes:

2.5.1 Image generators

Figure 2.5 Immersive projection on bubble wrap/ dome*

(*Reference: http://www.virtualdomes.com/products/immersavu-320/)

Immersive projection is a dome-based video projection environment. The projection dome is filled with real-time computer animations. Immersive projection environments have evolved from numerous influences like flight simulation, multi-projector environments and virtual reality. Initially dome projections used wide-angle lenses (35 and 70 mm). Later, dome projections utilized fisheye lens. Usually raster video projectors, either singly or grouped are used to cover the dome surface with animations and full-color images. The individual projector(s) are driven by different or same video sources, rendered in either real-time covering an entire domed projection surface. It yields an immersive experience by filling entire viewer's field of view.

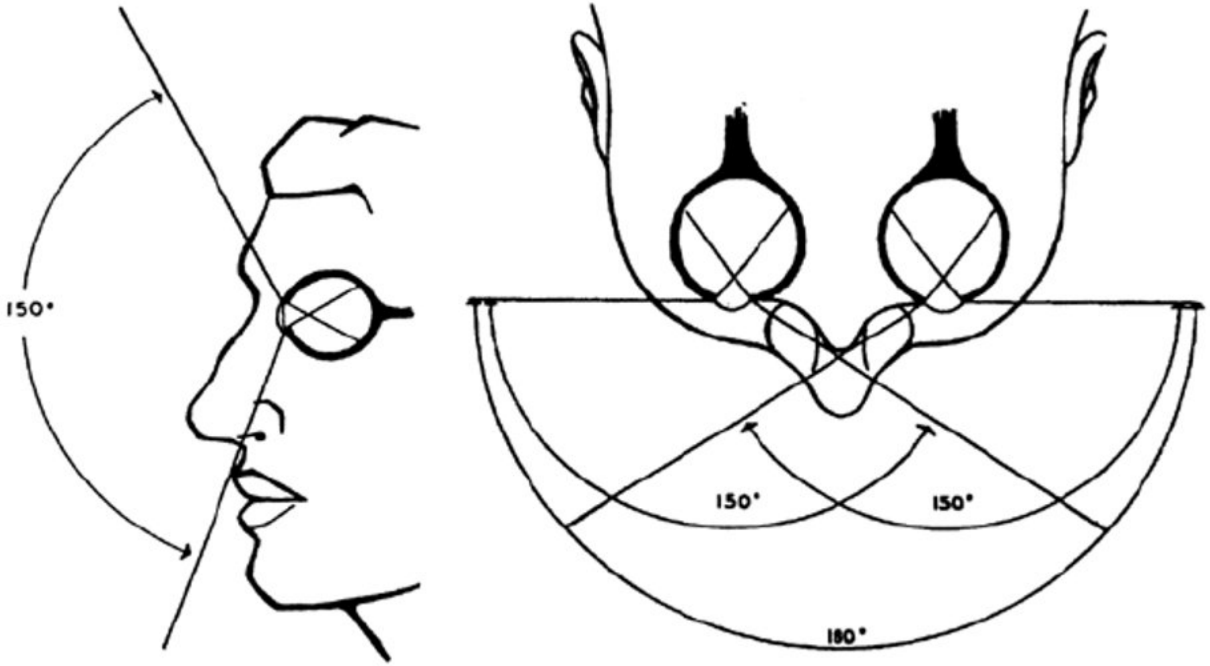


Figure 2.6 Human eye Field of view (180^0 Horizontal X 150^0 Vertical)*

(*Reference: https://www.researchgate.net/figure/11-Human-field-of-view-a-vertical-b-horizontal-from-Heil92_fig10_2617390)

Field of vision (FOV): Observable environment at any given movement. Wider the FOV, the realistic the experience.

2.5.2 Audio devices

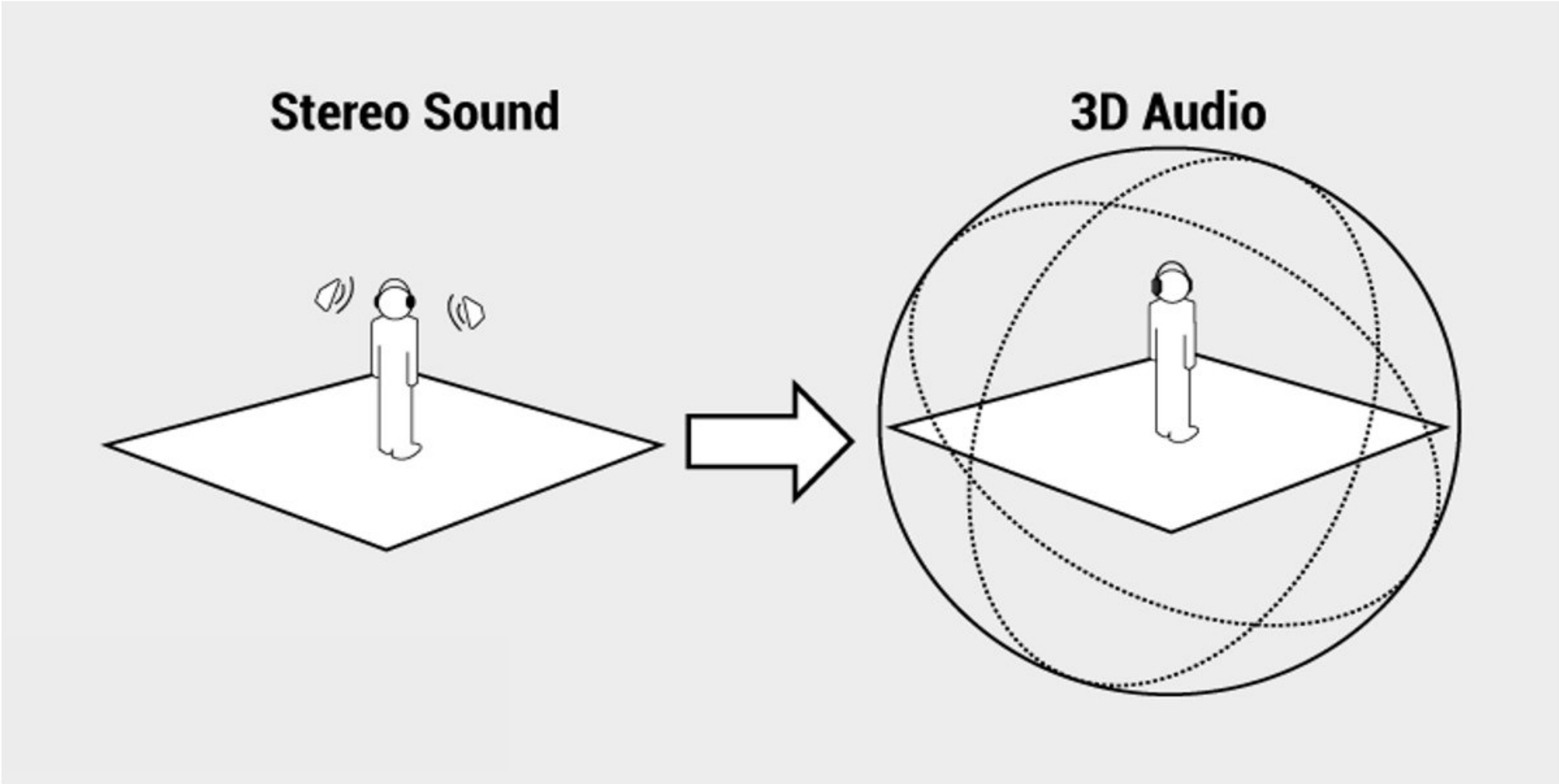


Figure 2.7 Difference between stereo and Ambisonics*

(*Reference: http://www.ccinnovations.ca/clearinghouse/1140/soundlab-creates-virtual-environments-of-sound-and-design/)

Ambisonics is a sound technology that manipulates the sound produced by speakers. It involves the virtual placement of sound sources at any place in the three-dimensional space. Ambisonics is spatial domain convolution of sound waves. It a process of transforming sound waves as natural sounds, which originate from a point in a 3-D space. It tricks the brain using the auditory nerves and ears, pretending to be originating from 3D space upon hearing, but in reality sound originating from just 2 speakers.

2.5.3 Motion platforms

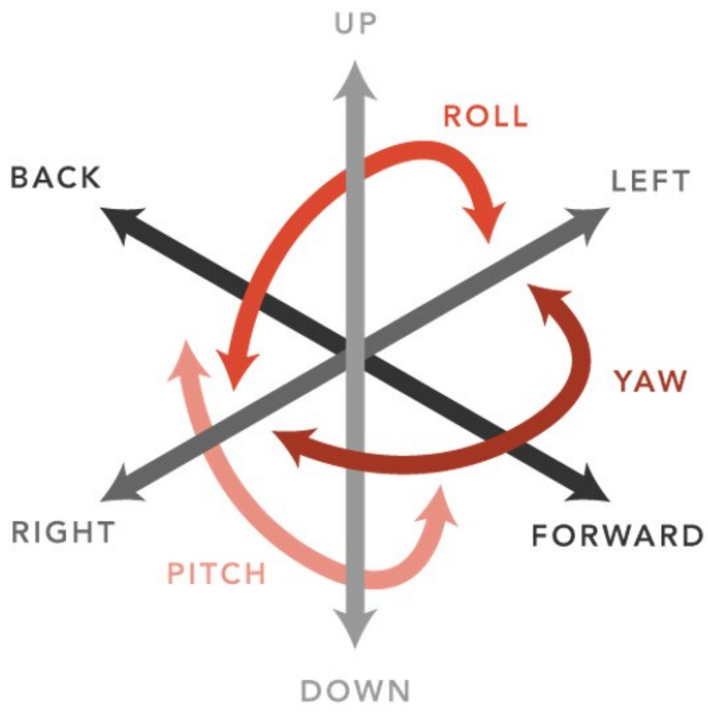


Figure 2.8 Motion of object in 3D space

In mechanics, degrees of freedom (DOF) is defined as modes in which a mechanical device can move. The number of DOF is the total number of independent displacements of motion. A machine even if operated in two or three dimensions can have more than three DOF. It is widely used to define motion capabilities of a machine or device. To define the motion of an object in the free space, at least 6 DOF is employed. Six degrees of freedom refers to movement of a rigid body in 3D space. The body is free to change position as up/down (heave), left/right (sway) , forward/backward (surge) translation in three mutually perpendicular axes, along with changes in orientation through rotation about three axes, often known as roll (longitudinal axis), pitch (transverse axis) and yaw (normal axis).

Figure 2.9 Flight simulator with 6 Degrees of freedom*

(*Reference: http://www.ckas.com.au/flight_simulators_27.html)

A motion platform is a mechanism that creates feeling of being in a real motion environment. The movement is synchronized with a display. Motion platforms provides movement in all of 6 DOF as experienced by an object in a free space. These are the three translational degrees of freedom (heave, surge and sway) and three rotational degrees of freedom (yaw, roll and pitch).Motion simulators can be classified based on the controlling mechanism of the simulator:

Active rider: Occupant is controlling the vehicle (Ex: Flight Simulator)

Passive rider: Vehicle is controlled by an external source and the driver is passive (Ex: Theme park rides)

Motion platforms are used to link a computer-based dynamic model of a particular system to physical motion gives the user the ability to feel how the machine responds to control inputs in the real world scenario. Driving simulation allow the use of specialized controllers having haptic technology giving real time tactile. A motion simulator provides the player with full-body tactile feedback. Motion gaming platforms can simulate turning, accelerations and decelerations. Motion platforms permit stimulative realistic gaming experience and allow greater physical correlation to sound and sight in game play.

The use of motion platforms is to simulate real-world events to provide the user a near-identical experience. In simulator acceleration cannot be sustained because of physical limits of the size of the motion platform. Hexapod motion platforms are used by many Full Flight Simulators in use today for training pilots in worldwide civil aviation.

2-Degrees of freedom motion platform:

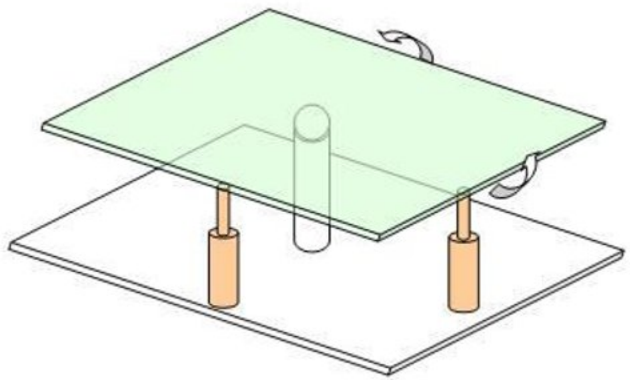


Figure 2.10 2-DoF motion platform*

(*Reference: http://www.simprojects.nl/motion_systems.htm)

It supports Roll angle movement and Pitch angle movement. The platform consists of a tilting platform with center support. The person on the platform sits relatively high with respect to the pivoting point and results in high center of gravity making the platform more difficult to drive. The platform simulates forward and sideward motion along with roll and pitch motion.

3-Degrees of freedom motion platform:

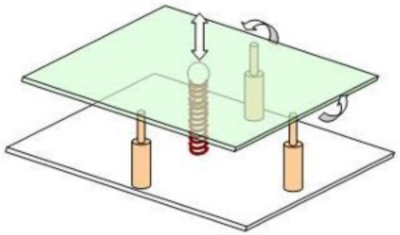


Figure 2.11 3-DoF motion platform*

(*Reference: http://www.simprojects.nl/motion_systems.htm)

It supports vertical movements, roll angle movements and pitch angle movements. It is a variation on the previous construction i.e. center support can move up and down. The spring bears most of the platform weight .Three linear actuators with relatively low driving power can be used to construct 3DoF platform.

4-Degrees of freedom motion platform:

Figure 2.12 4-DoF motion platform*

(*Reference: http://www.simprojects.nl/motion_systems.htm)

Simulators with 4 DOF have pitch, roll, yaw and heave. It simulates acceleration or deceleration by gravity forces as a result of forward or backward tilt of the seat (pitch). If the seat tilts backwards, gravity pushes you to the seat simulating acceleration. If seat tilts forwards, gravity pulls you from the seat and simulates deceleration.

6-Degrees of freedom motion platform:

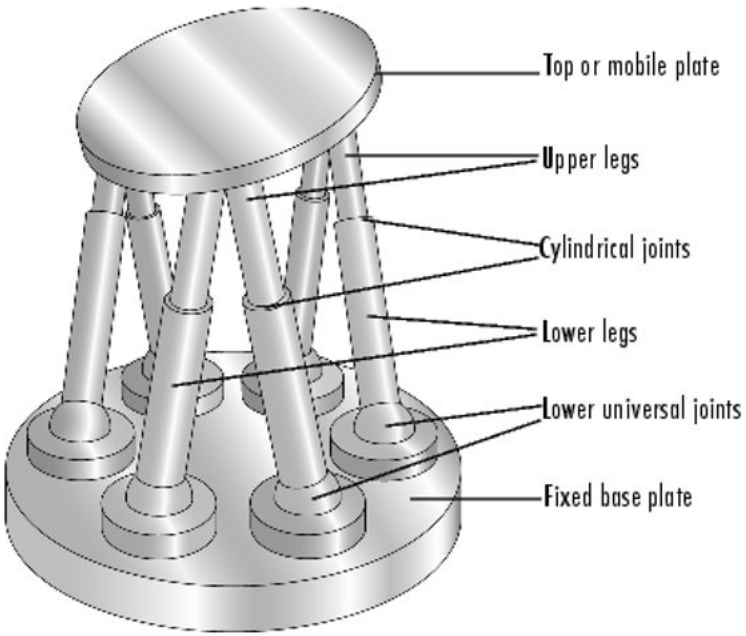


Figure 2.13 6-DoF Gough-Stewart platform*

(*Reference: https://www.mathworks.com/help/physmod/sm/mech/ug/about-the-stewart-platform.html)

Gough-Stewart platform is the widely used 6 DoF motion that has six prismatic actuators attached in pairs to three positions on the platform's baseplate, crossing over to three mounting points on a top plate. Devices mounted on the top plate are moved in 6 DoF like a freely-suspended body in a free space. It has three linear movements along each axis i.e. x, y, z (lateral, longitudinal and vertical) and the three rotational movement i.e. yaw, pitch and roll.

2.5.4 Motion sensors

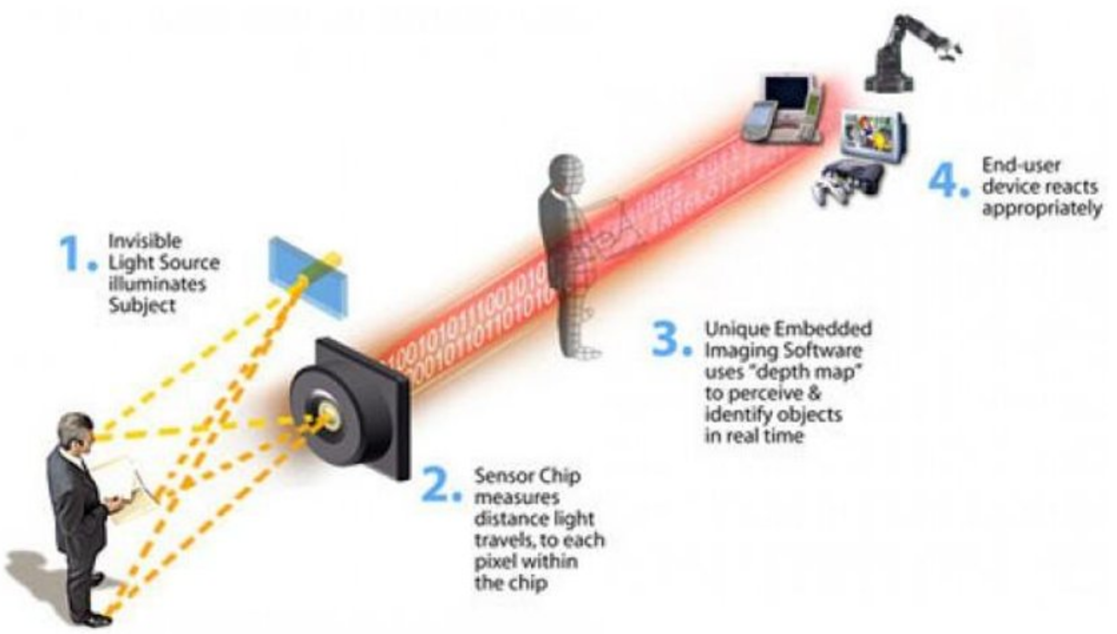


Figure 2.14 Motion sensing using a camera*

(*Reference: https://www.wired.com/images_blogs/gadgetlab/2010/11/Canesta-howitworks1.jpg)

Motion sensor/detector is a device to detect moving objects, often a component of a system that automatically performs motion detection. It may contains a microwave, optical, acoustic sensor. Disturbances in the optical, acoustic, microwave field are interpreted by the electronics based on respective technologies. Motion detectors have applications in domestic and commercial fields. Low-cost digital cameras with integrated software are used widely in motion detection. Infrared cameras can be used to detect motion in the dark, which is undetectable by a human eye. This motion inputs are further processed to generate control signals for exploring virtual reality content.

2.5.5 Graphic processors

Figure 2.15 Nvidia graphic processors*

(*Reference: https://www.nvidia.com/en-in/geforce/graphics-cards)

Creating a truly immersive VR experience demands precise simulation of intended environment that includes graphics, behavior and audio. Graphics processors take advantage of AI and advanced VR shading technologies to elevate VR simulations to a level of realism far beyond the traditional rendering. Graphics processors are the backbone for creating an immersive world in virtual reality. They drive enough pixels to deliver a sharp image which seems closer to reality. Dedicated graphics chips take up the task of rendering complex 3D worlds with high-resolution textures. It's a hectic task to feel truly immersed in a virtual world when you look at a blocky text, grainy screen and objects that look pixelated. To make virtual reality experience a breeze need to deploy powerful dedicated graphic processors. The graphic processors also need a fairly powerful PC to create realistic environments right in front of your eyes.

2.5.6 Control devices

Figure 2.16 VR controllers*

(*Reference: Reference: https://www.digitaltrends.com/?s=virtualreality+controls)

Precision and freedom in motion tracking allows user to interact with virtual worlds using hands and fingers. Few next-generation wearable technologies turns hands into intuitive controller for virtual reality. It utilizes small inertial sensors with ultra-low latency. It enables complete control of any visual display using unlimited hand gestures. Some controllers decipher brain activity to determine a person's intention and then convert them as control inputs in virtual reality. It uses dry electrodes to record brain activity via electroencephalography (EEG) and these signals are fed into a software that analyzes the signal and determines the action that should occur. Traditional controls like touch pads, analogue stick, paddles, buttons, hand gloves are not suitable for virtual reality hence developers should invent hybrid controllers for VR experience.

Chapter 3

Design of immersive pod for virtual reality

3.1 Design brief

3.1.1 Objective

The primary objective of the project is to design a completely new system to enhance the virtual reality experience compared to headset based virtual reality applications that focus solely on the visual aspect of virtual experience. The new system must stimulate multiple senses to enhance immersiveness of the virtual experience.

3.1.2 Target audience

The product is intended for tech savvy high end customers who embrace change. They are curious and willing to learn and have ample disposable income. Their primary focus is on the exclusivity factor. Quality is of utmost importance, still offering value.

3.1.3 Scope of the project

The project is limited to developing a platform for integrating various immersive. It doesn't involve in the development of any technology. The technologies are integrated in their existing forms without any alterations. The designing process involves exploration of various form factors to integrate these technologies and improve the immersive experience of Virtual Reality compared to the standard headset based virtual reality experiences existing in the market. Since pod is an interactive space, various Anthroprometric dimensions are taken into consideration. The dimensions are intended for Indian context and taken from "Indian anthropometric dimensions for ergonomic design practice", Chakrabarti, Debkumar. National institute of design, 1997. The pod is modular in nature and can be customized based on the applications like watching movies, game simulation, relaxing. Additional hardware is to be integrated with the pod in context with the application.

3.1.4 Overall style and look

Since the immersive pod is intended for luxury customers, there are no constraints either on the form language or materials used as long as they appeal to the target audience. As the product is primarily technology based, the form must exhibit cues related to futurism and technical excellence.

3.1.5 Budget and other constrains

Luxury is any expenditure that goes beyond the necessary. Since the project is a conceptual projection and intended for the luxury high end customers, there are no constrains either budget or materials used. The primary focus is on the exclusivity factor rather than affordability. The intended audience are willing to pay more if they are provided with customized, better, meaningful services and experiences while purchasing this luxury product.

3.2 User study

People aspire to luxury goods as they provide them the thrill associated with the sense of belonging to a selected few, still providing an opportunity to show off personal connoisseurship. These customers move quickly up the Luxury Pyramid towards niche and exclusive goods. They are willing to pay more if they are provided with customized, better, meaningful services and experiences while approaching and purchasing a luxury product.

Figure 3.1 High end luxury customers*

(*Reference: https://www.designscene.net/luxury customers)

The following are the insights based on study by various world class trend forecasting agencies like Trend Hunter, WGSN, PSFK, Digital trends, CNET.

- Reasons for people buying a luxury good is self-reward.
- Majority customers know exactly what they want before purchasing a luxury good.
- All Global luxury consumers are interested in content that provides them with practical and personal advice on new trends and seasonal must-have products.

- Customized services and special treatment are also expected as a part of purchase.
- The concept of modern luxury is to become much more digital but at the same time experiential.
- Luxury goods shoppers expect a streamlined experience that minimizes the number of decisions they have to make, since most of them are time-challenged people.
- Luxury consumers are more sophisticated, they remain cautious, needing reassurance about the quality and authenticity of their purchases.
- Luxury consumers spend more if they feel that the product is worth it.
- Primary focus should be on demonstrating the value of your product instead of competing on price.
- Problem with going for lower prices can backfire and may create consumers with the impression that your products are of lower quality.
- Quality is one big reason consumers choose luxury products, they appreciate exclusivity factor.
- Highest quality is always preferred to separate your brand from the rest of your competition.
- Don’t afraid to alienate consumers who don't fit the bill, because not everyone can afford or your audience anyway.
- Most customers see luxury as a way to set themselves apart
- Customers define luxury as the pinnacle of aesthetics and design
- Virtual reality expands from just video gamers to a mass market by connecting people regardless of physical location.
- Virtual Reality evolves into something you participate physically in VR world.
- Headsets today cater only to visual senses, and a little bit of audio. If rest of the senses are catered like temperature, acceleration, balance and smell the reality factor of VR becomes stronger.
- Most people don’t prefer a “normal” life. They prefer to explore the wonders of the world.
- Virtual reality is not just for gaming – it can make a real difference to our collective futures. It can have unmatched presence in the fields like watching movies, surgeries, space exploration, gaming, teaching.

3.3 Design Conceptualization

The following subsystems have been intended to be in the final design based on the intial evaluation of various subsystems that can be placed in the pod:

- *Immersive Projection*
- *Ambisonics*
- *Motion Platform*
- *Motion sensing*
- *Power unit*
- *Air conditioning*
- *Electronics bay*

Among all the above existing sub systems, the immersive projection unit has higher significance and the primary design focuses is on this sub unit. Since the immersive projection uses a domed display to cover the entire visual field and this unit has similarity with that of a Dragonfly's head. The eye of a dragonfly is considered as the world's most complicated eye structure. These eyes occupy about half the area of the head and provide the dragonfly with a very wide visual field that goes in line with our design requirement of immersive projection dome to cover the entire visual field of the user.

Figure 3.2 Design inspiration from dragonfly head *

(*Reference: https://www.designanduniverse.com/articles/dragonfly.php)

3.4 Conceptual sketches

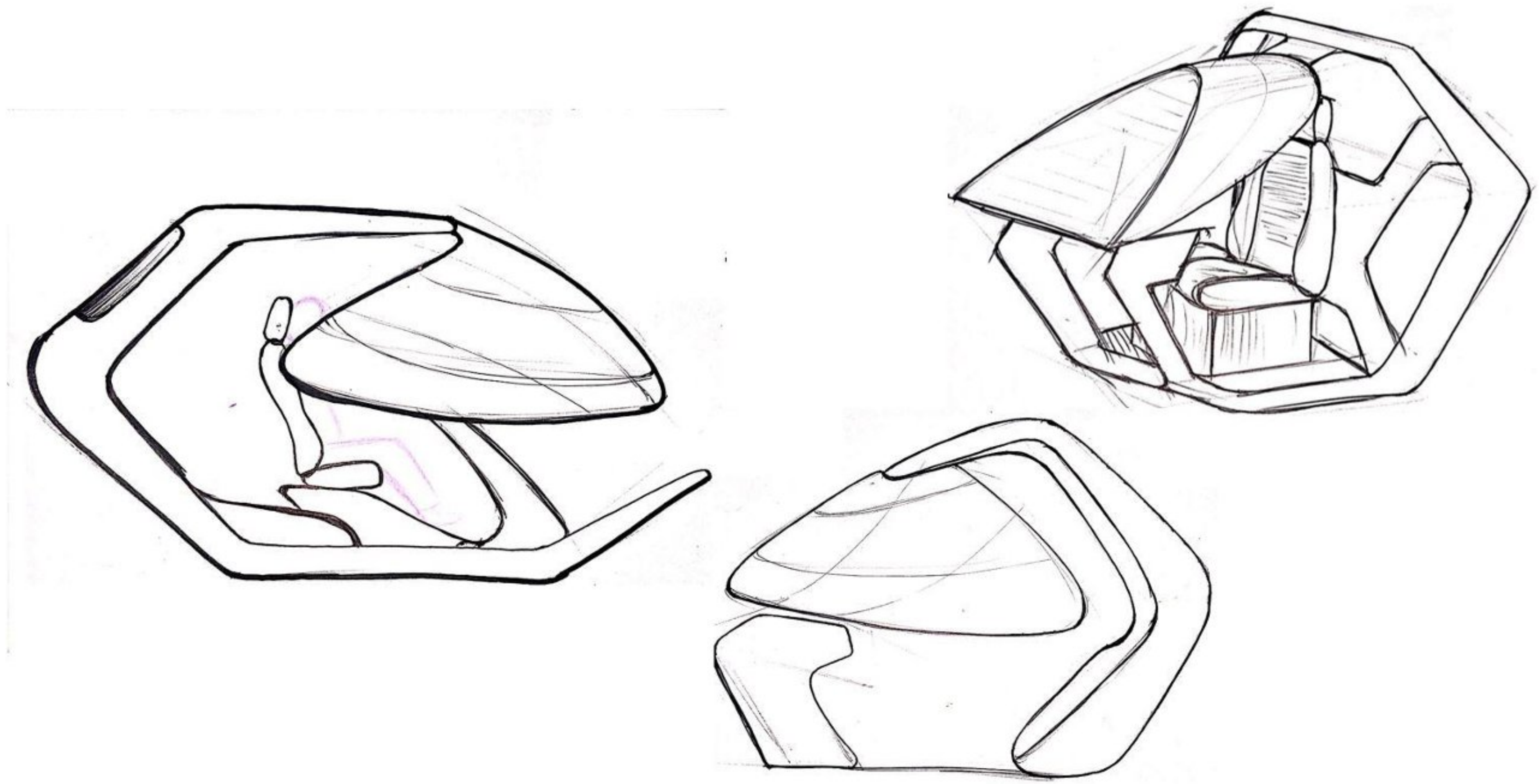


Figure 3.3 Forms based on open cabins

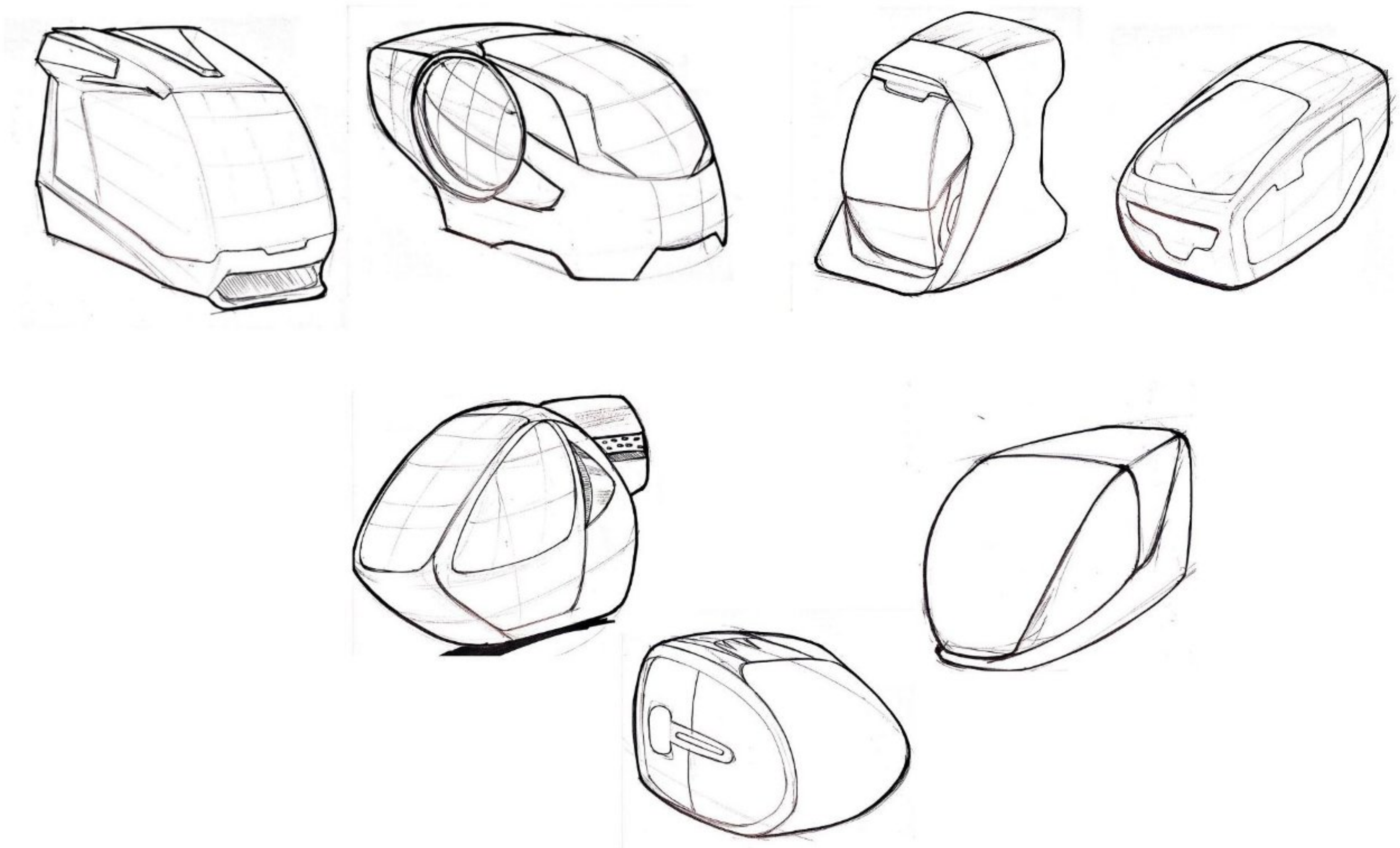


Figure 3.4 Forms based on closed cabins

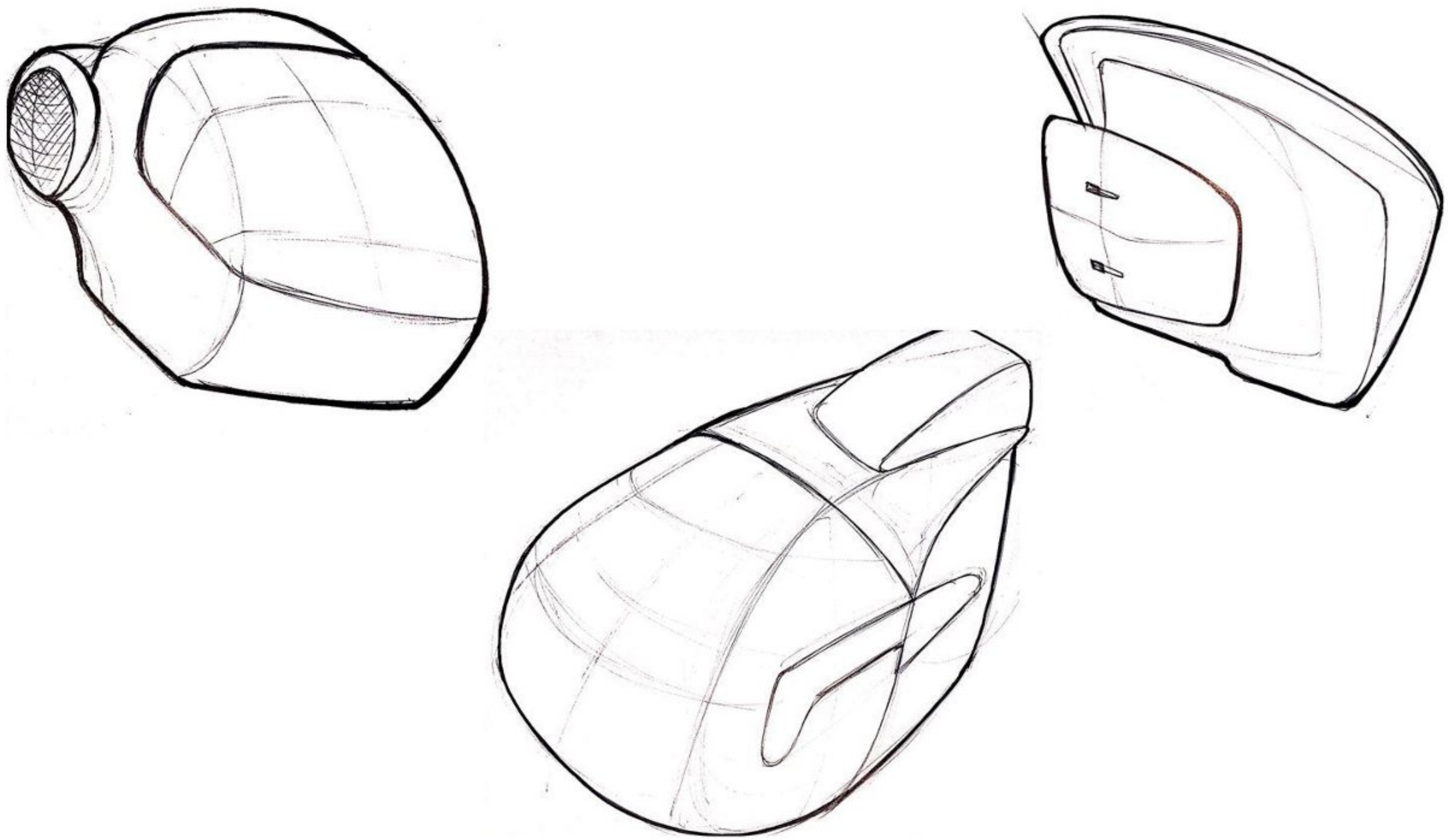


Figure 3.5 Forms inspired from dragon fly

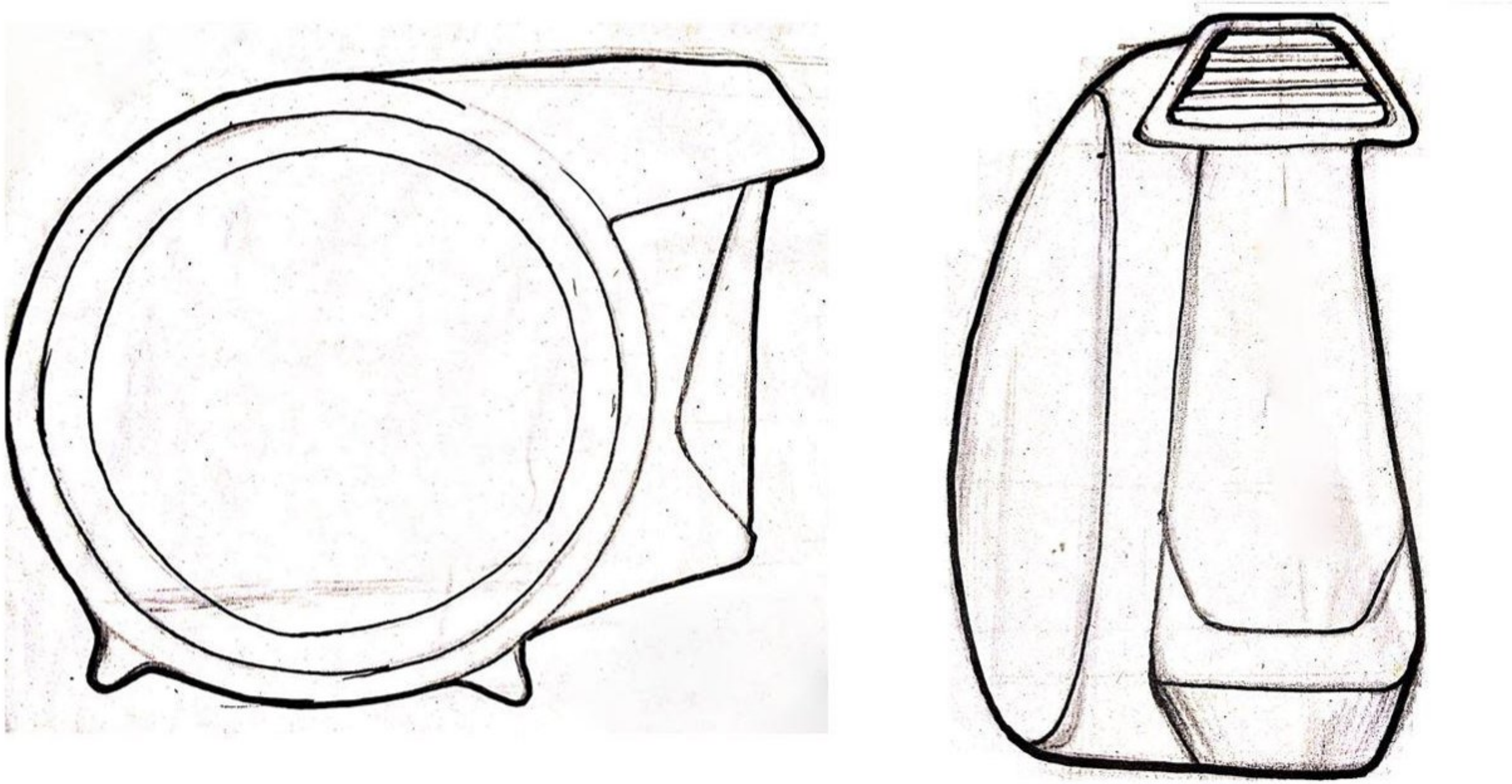


Figure 3.6 Form based on design requirements and inspired from dragon fly

3.4.1 Concept 1

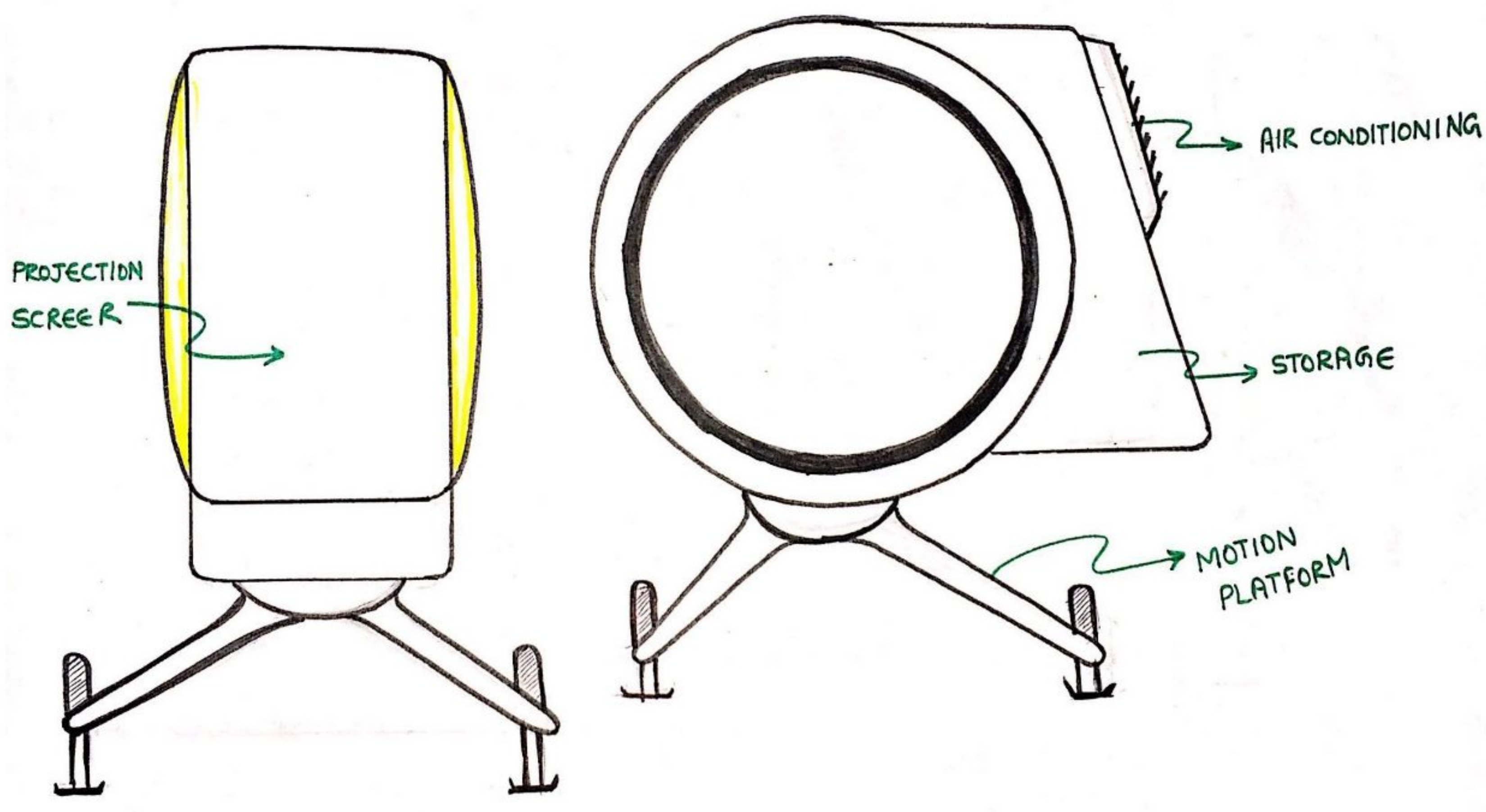


Figure 3.7 Concept 1 inspired from dragon fly with 4 DoF motion platform

3.4.2 Concept 2

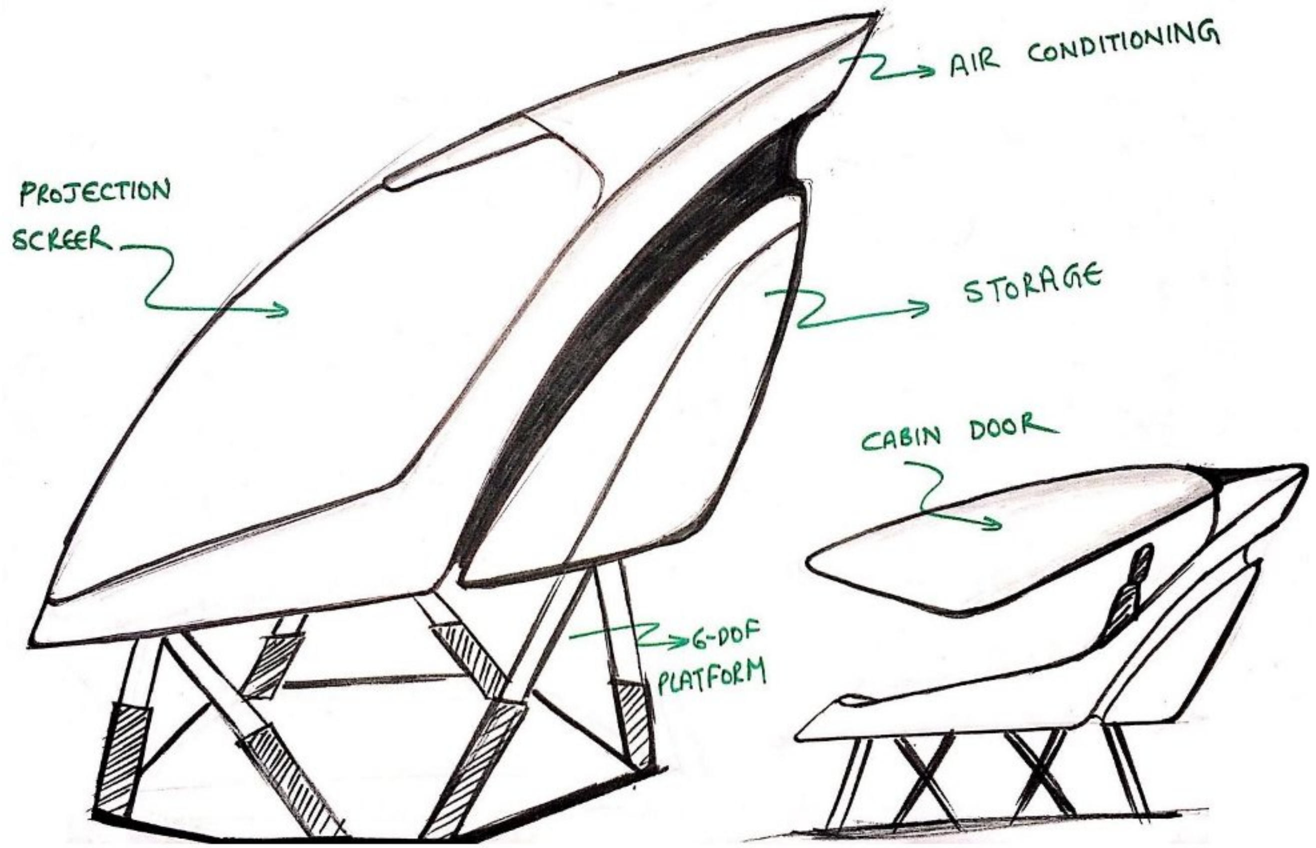


Figure 3.8 Concept 2 inspired from fighter aircraft bubble canopy with 6-DoF motion platform

3.5 Concept evaluation

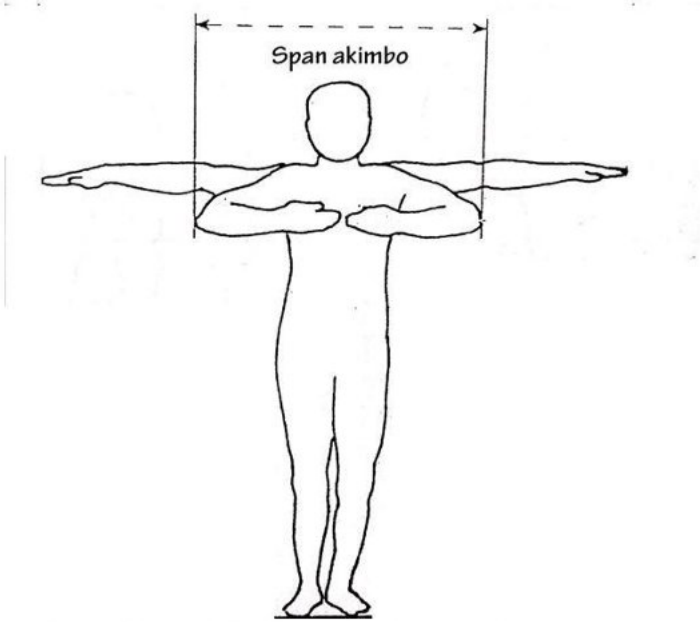
Table 3.1 Concept evaluation between concept 1 and concept 2

Sl. no	Evaluation Criteria	Concept 1 (Rated out of 5)	Concept 2 (Rated out of 5)
1.	Usability	4	3
2.	Immersiveness	3	4
3.	Modularity	5	2
4.	Cost	4	3
5.	Operatability	4	3
6.	Novelty	3	4
7.	Manufacturability	3	2
	Total	26	21

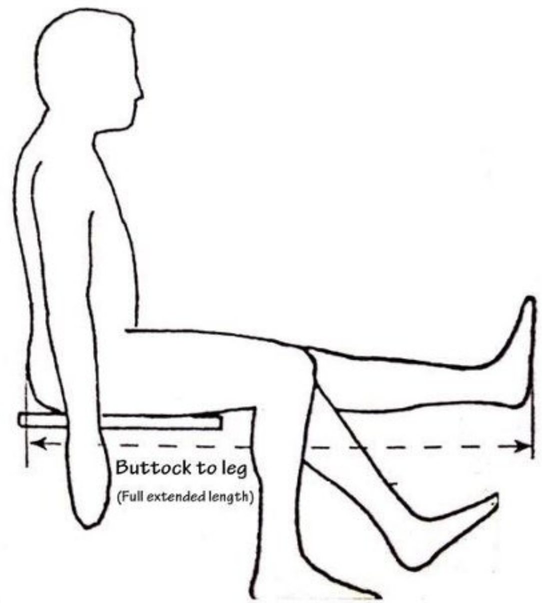
Both the concepts are rated on various criteria like ease of use, Immersive experience generated, Modularity, Total product cost, Operation complexity, Design novelty, Manufacturing complexities on a scale of five. Concept 1emerges as a clear winner with a significant difference, however efforts are put to implement best features of the concept 2 in concept 1 to make it a better product.

3.6 Anthropometrics considered in designing the cabin space

The immersive pod is primarily an interactive space, hence consideration of anthroprometrics is of utmost importance. The pod is intended for Indian customers and their anthroprometric dimensions are taken into consideration while designing the cabin space. (The dimension based on appropriate percentiles are taken from Chakrabarti, Debkumar. Indian Anthropometric Dimensions for Ergonomic Design Practice. Ahmedabad: National Institute of Design, 1997)



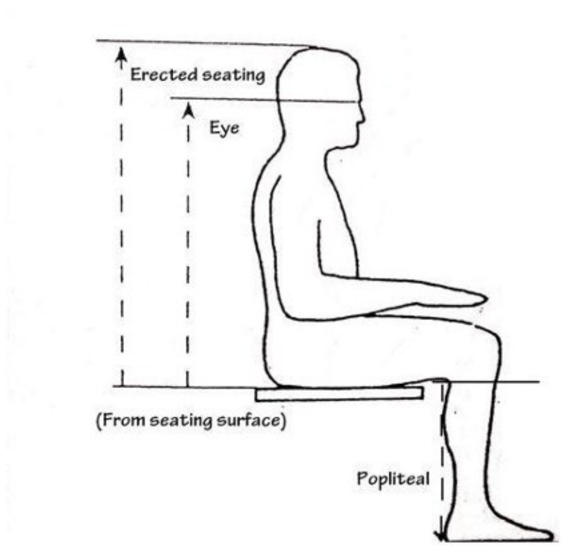
Span akimbo(Horizontal clearance)
95 th percentile male = 959 mm



Buttock to leg (Vertical clearance)
95 th percentile male = 1209 mm

Figure 3.9 Anthroprometric considerations for leg and hand clearance*

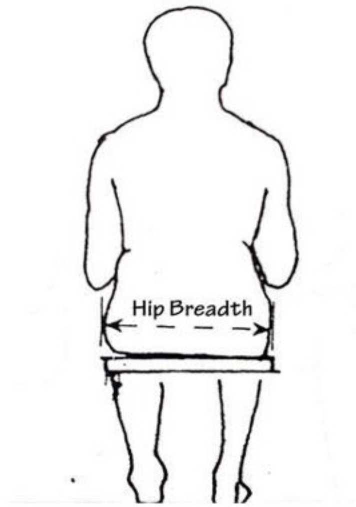
(*Reference: Chakrabarti, Debkumar. Indian Anthropometric Dimensions for Ergonomic Design Practice. Ahmedabad: National Institute of Design, 1997)



Erected seating(from seating surface)
95 th percentile male = 905 mm

Eye(from seating surface)
75 th percentile combined = 751mm

Popliteal(for variable seating height)
5 th percentile female = 365 mm to
95 th percentile male = 471 mm



Hip breadth(for seat width)
95 th percentile female = 429 mm

Figure 3.10 Anthroprometric considerations for seating*

(*Reference: Chakrabarti, Debkumar. Indian Anthropometric Dimensions for Ergonomic Design Practice. Ahmedabad: National Institute of Design, 1997)

3.7 Testing rig

To have a sense of space, a rig is constructed based on the above anthroprometric dimension and various clearances like head, legs, hands, shoulders are tested with users of varied heights.

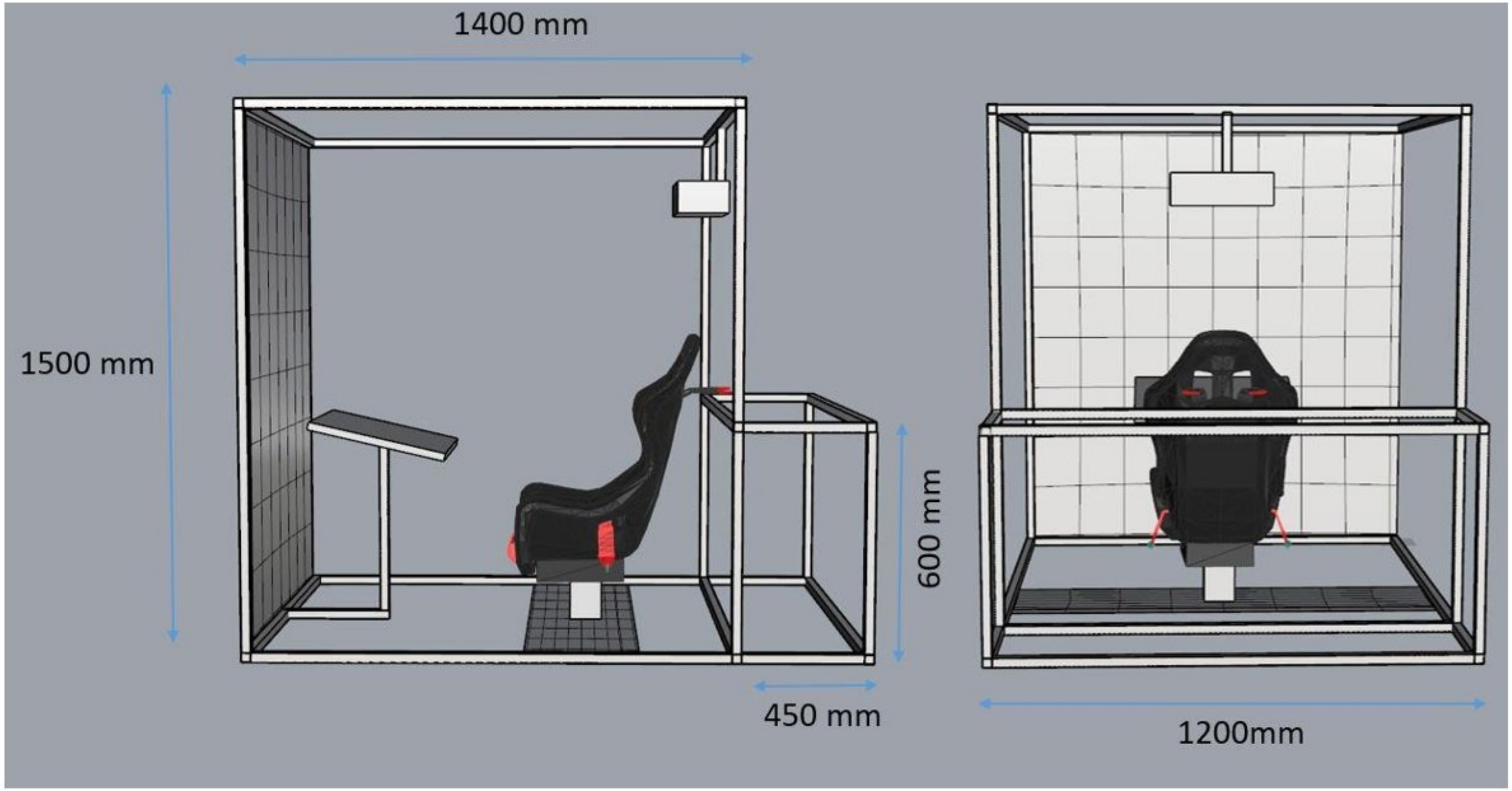


Figure 3.11 Dimensions of the rig

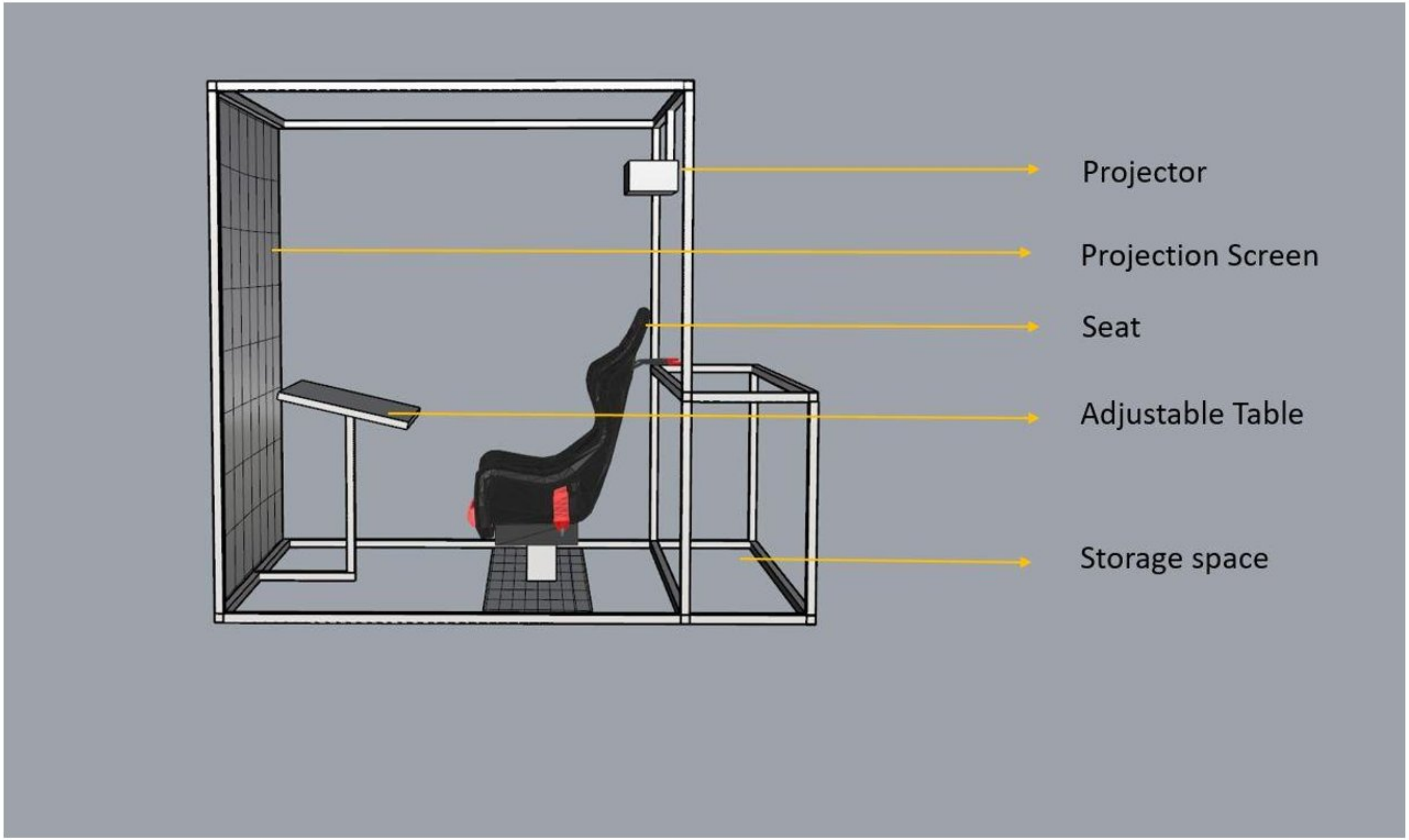


Figure 3.12 Components of the rig

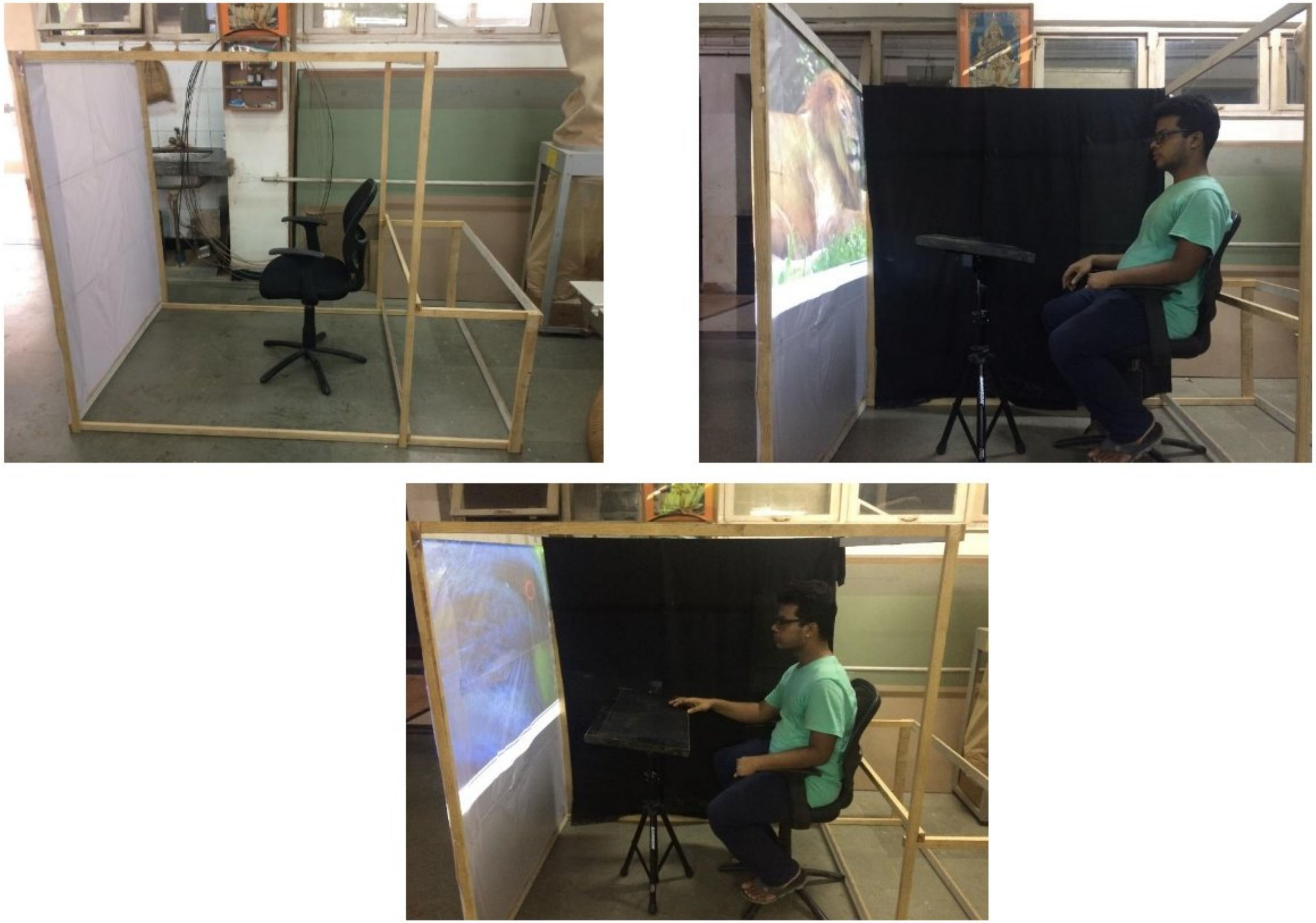


Figure 3.13 User interacting with the rig

User 1: Height 1660 mm

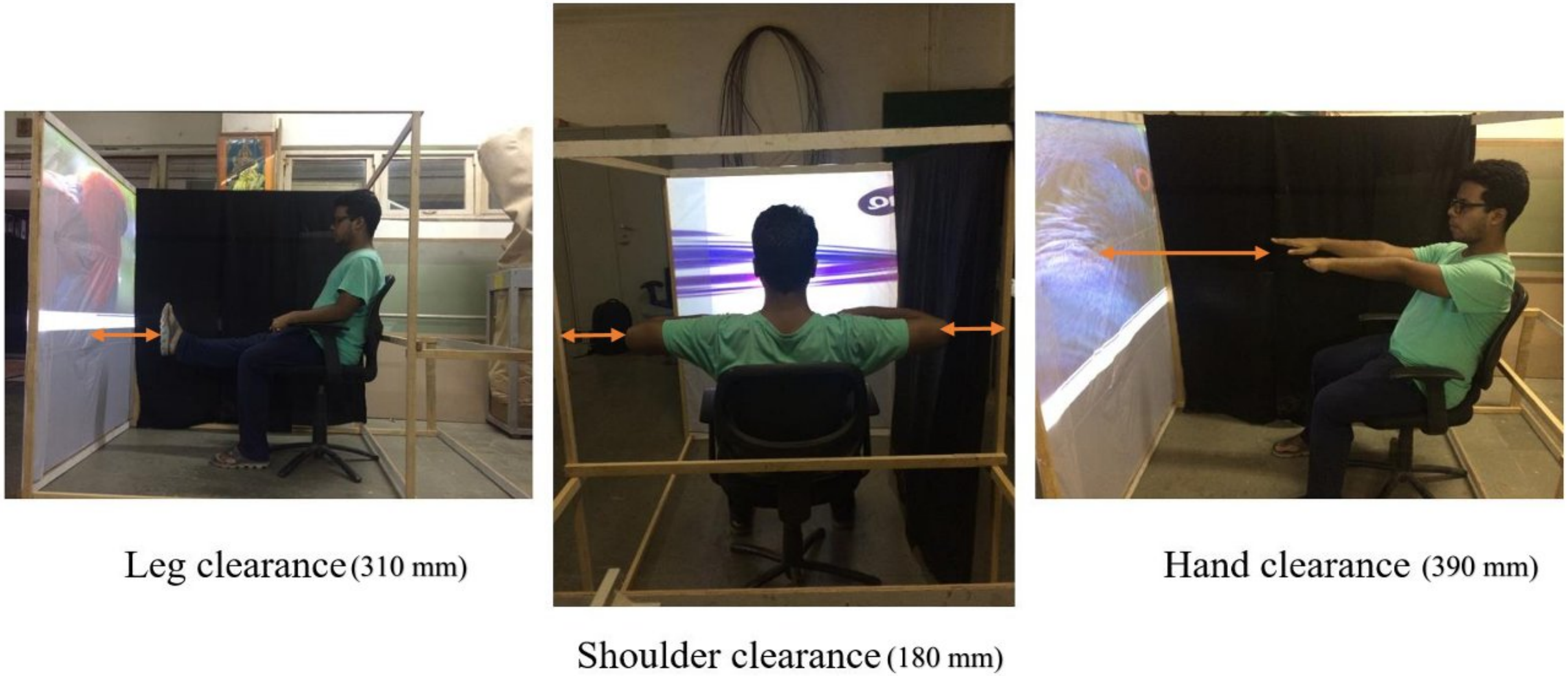
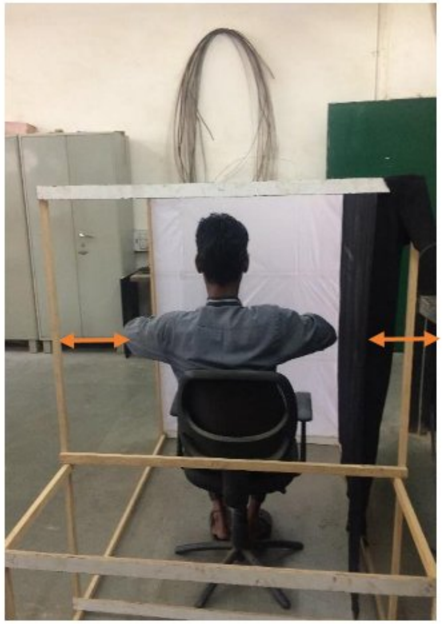


Figure 3.14 User 1 space clearances within the rig

User 2: Height 1842 mm

Leg clearance (180 mm)



Shoulder clearance (160 mm)

Hand clearance (460 mm)

Figure 3.15 User 2 space clearances within the rig

3.8 Final design

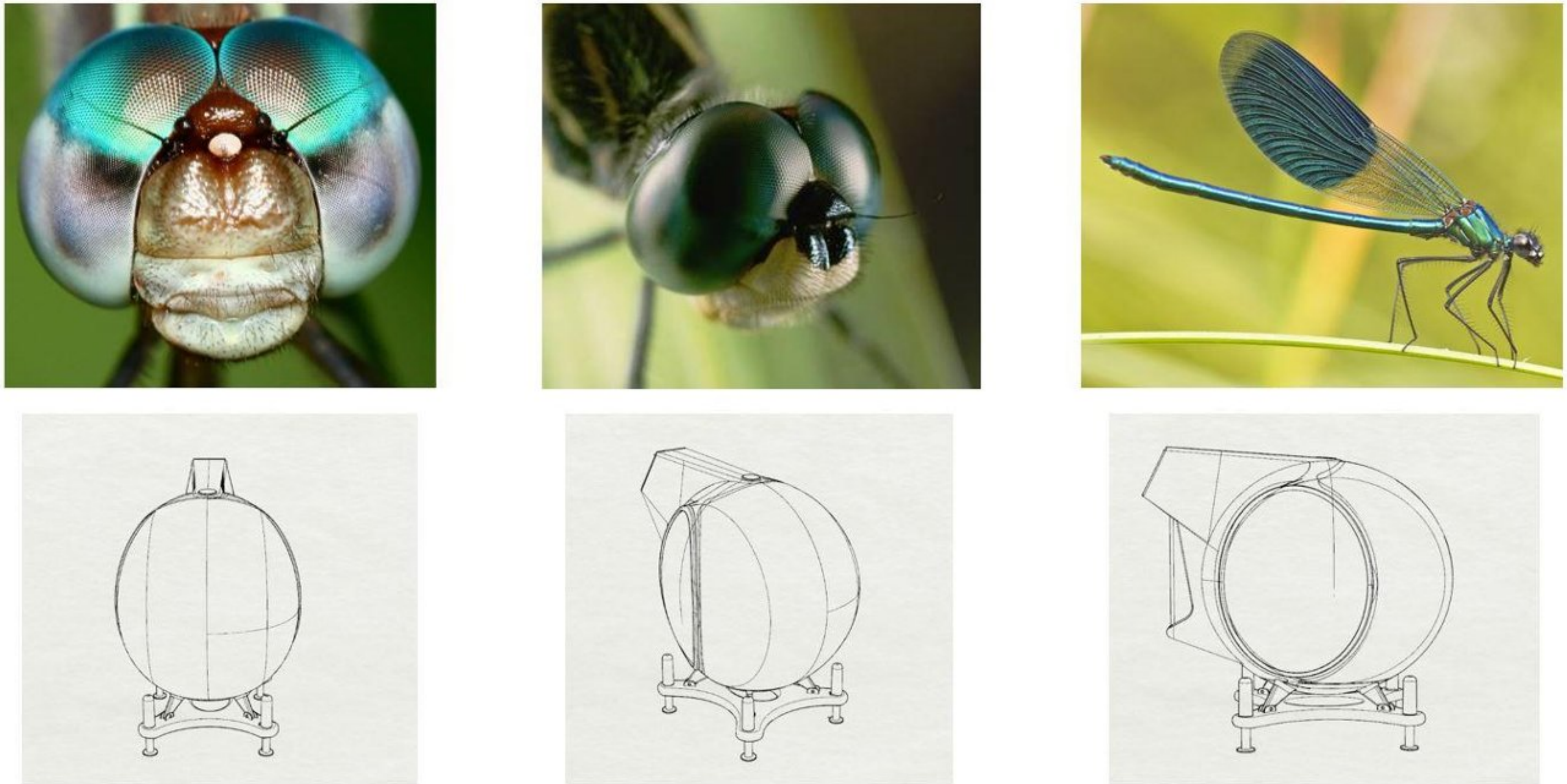


Figure 3.16 Design similarities with dragon fly

Figure 3.17 1:10 scaled model of immersive pod

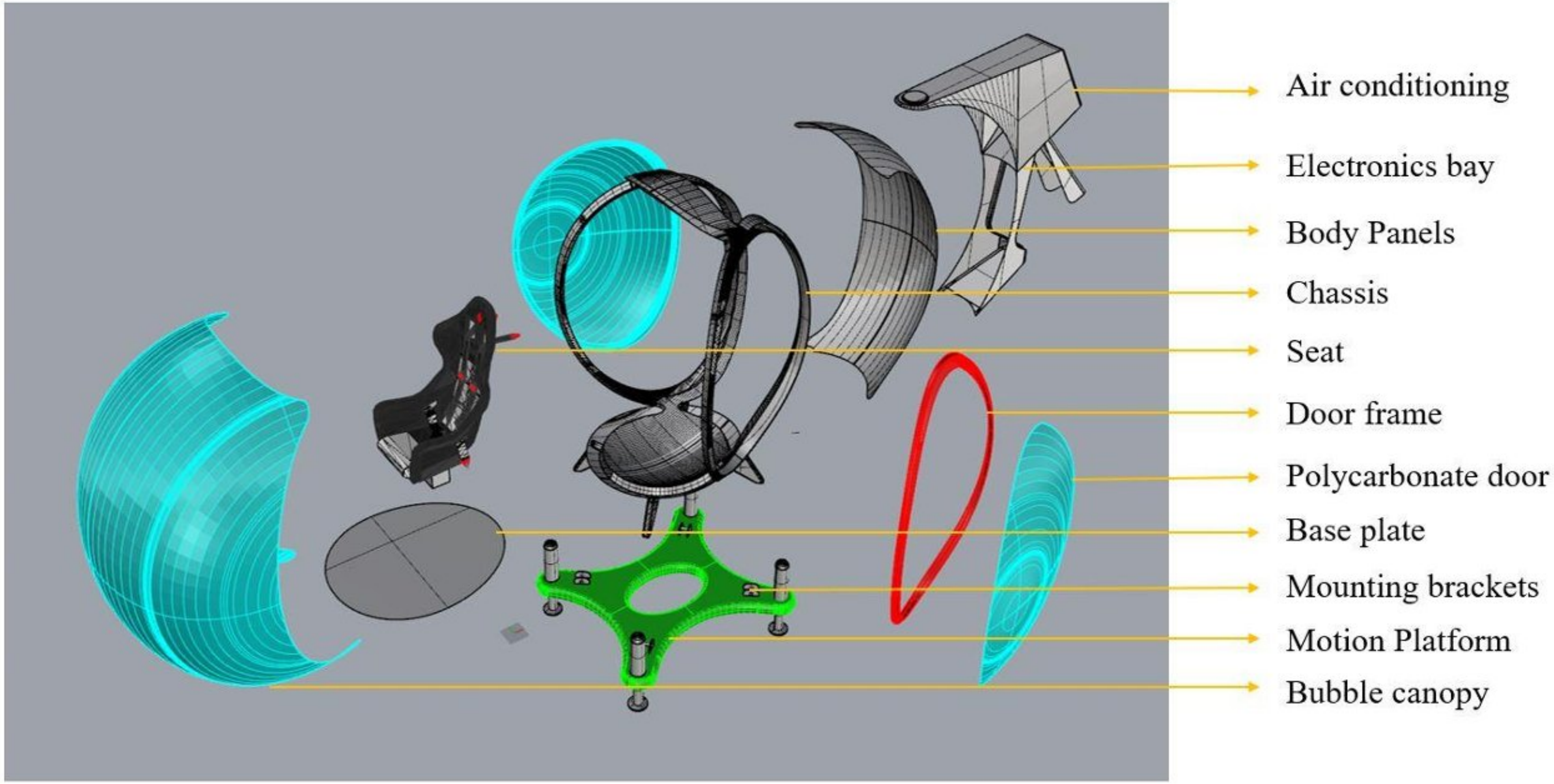


Figure 3.18 Exploded view of immersive pod

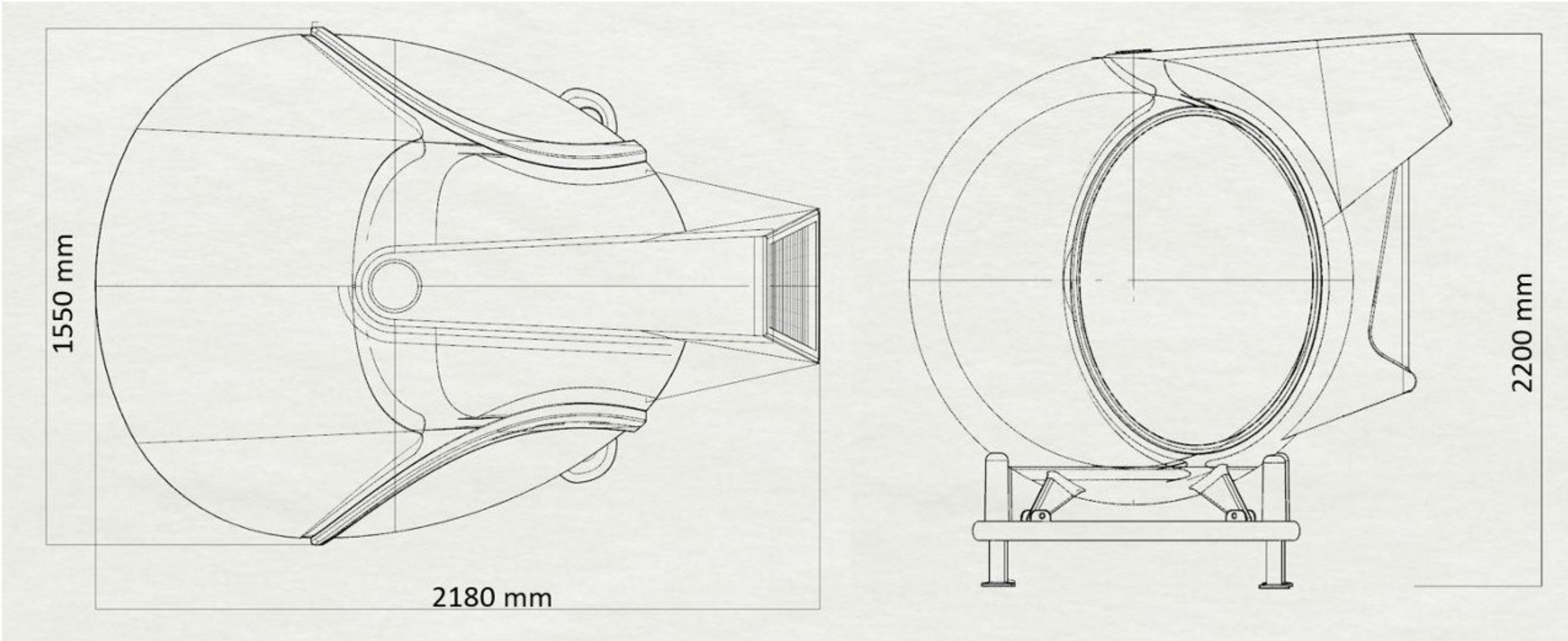


Figure 3.19 Dimensions of immersive pod

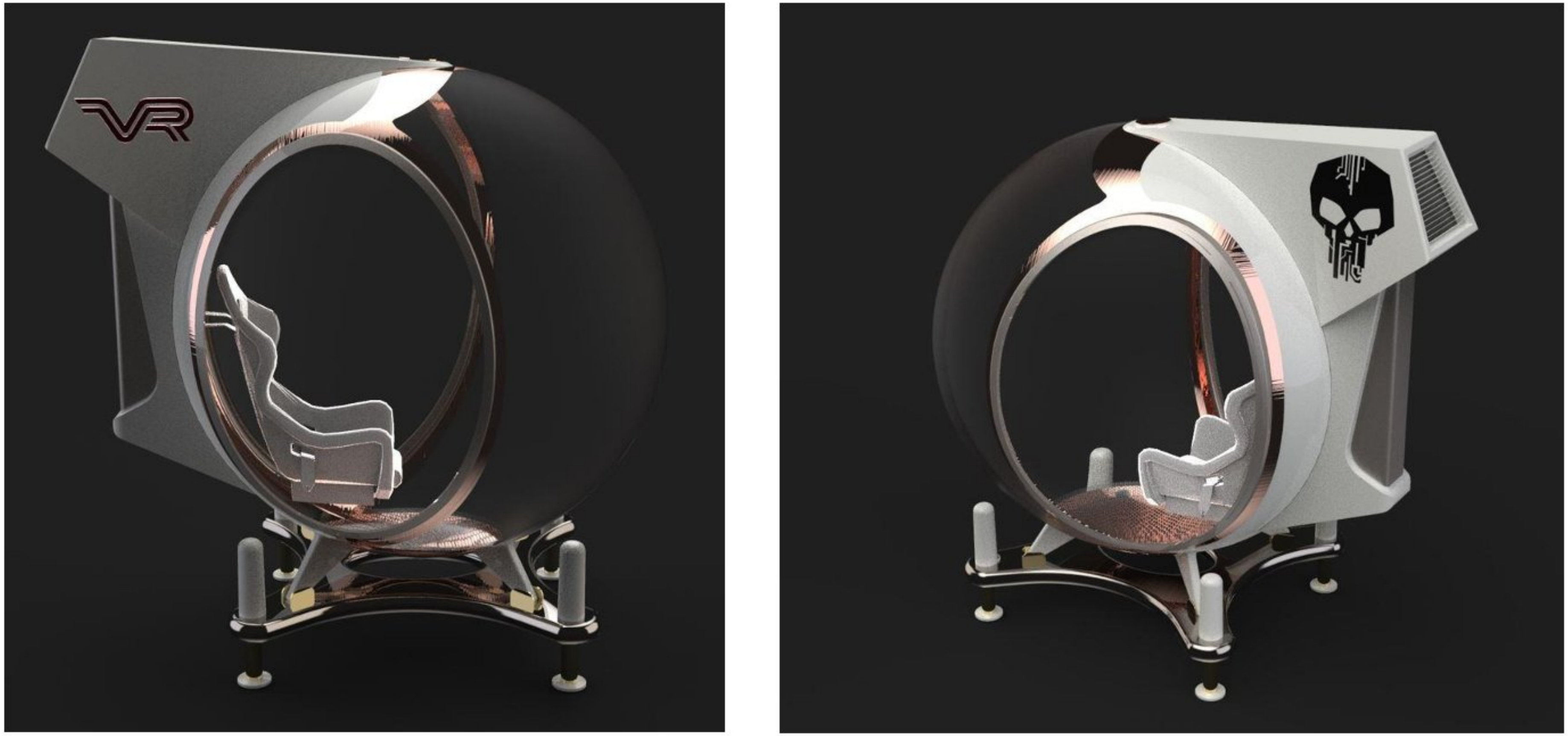


Figure 3.20 Renderings I of immersive pod

Figure 3.21 Renderings II of immersive pod

3.9 Materials

Table 3.2 Materials involved in manufacturing of the immersive pod

Sl.No	Name of the part	Material	Properties
1.	Linear actuators	Titanium	Strength, Temparature and corrosion resistant
2.	Frame	Aluminum	Light weight, High strength to weight ratio
3.	Bubble Canopy	Macrofol	Chemical and impact resistant, light, 200 x Strength of glass
4.	Seat Fabric	Tencel	Sweat wicking, textured, softer, cooler, breathable, biodegradable
5.	Foam	Sensus (Visco elastic Foam)	Interactive PU foam
8.	Body Panels	ARP(Aramid reinforced polymer)	Light weight, Strength

Chapter 4

Discussion and conclusion

The sole purpose of Virtual Reality is to enable the user to manipulate and experience the digital or simulated environments as if it were the real world. The best Virtual Reality aims to achieve complete immersion. Various input devices are used to communicate the user inputs to the system running Virtual Reality. The effectiveness of the input device depends on the latency involved in transferring the control information to the processing unit and also the response rate of the output simulation. Experience to mimic the reality involves as minimum latency as possible. Humans perceive the world through perception systems and senses. The sensory inputs and processing of sensory information by our brains ensures perception of information from the environment to our brains. The more the senses stimulated, the better the experience perceived. Everything we perceive about the reality is by way of our senses. Our experiential reality is a combination of perceived sensory information and sense-making mechanisms of that information by our brains. So, virtual reality is presenting our senses with a computer generated virtual environment that seems to mimic reality. Most of the existing Virtual reality platforms rely only on the visual aspect (Sight) and do not stimulate other senses. The ideal experience can be generated by stimulating multiple senses that can be perceived by humans. The experience thus generated through stimulating multiple senses is rich in information of the real world and guarantees real life like experience. Complete sensation of reality includes moving 3D images in color with 100 percent peripheral vision, binaural sound, scents and air breezes. Virtual reality aims to achieve total immersion. It means sensory experiences feel so real and mimics the real world or sometimes even excess bounds of physical reality by creating a world beyond physical laws.

The price of VR technology too high to be normalized within the mass market. Success of the VR technology is only realized if there is enough traction in the market. Virtual reality hardware is bulky, expensive and power-hungry. Virtual reality in some cases causes viewer disorientation, headache and nausea. The world of virtual reality technology is a fun and exciting place to experience. However, the current implementation and creation costs involved doesn't make it feasible for the majority population. Still, most organizations are investing for the developments and looking forward to see how this technology can contribute to Learning and Development in the future.

References

1. https://en.wikipedia.org/wiki/Virtual_reality

2. https://en.wikipedia.org/wiki/Sense

3. http://www.l-isa-immersive.com/immersive-experiences/#spatialized-creative-sound-design

4. https://www.digitalartsonline.co.uk/features/hacking-maker/360-video-projection-how-its-created-why-its-worth-your-time/

5. Chakrabarti, Debkumar. Indian Anthropometric Dimensions for Ergonomic Design Practice. Ahmedabad: National Institute of Design, 1997

6. https://en.wikipedia.org/wiki/Stewart_platform

7. https://www.realitytechnologies.com/virtual-reality/

8. https://www.thetechedvocate.org/what-is-the-future-of-virtual-reality/

9. https://virtualrealitypop.com/new-hardware-innovations-for-top-vr-devices

10. https://en.wikipedia.org/wiki/Flight_simulator

11. https://en.wikipedia.org/wiki/Parallel_manipulator

12. https://www.microsoft.com/en-us/hololens

13. https://www.magicleap.com/

Acknowledgement

Firstly, I would like to express my thanks and gratitude to my project guide Prof. P Kumaresan, without whom this project would not have been possible. I would also like to thank POC lab for helping me out with my project by providing necessary equipment.

Lastly, I would also like to thank studio staff for helping me out with prototypes and my family and friends for being my support during project time.

P Sri Hari