Mounted Display 2011 & Poster for same paper

A Design of Low Cost Head-Mounted Display Using Android Smartphone 2014

COMP 30025J

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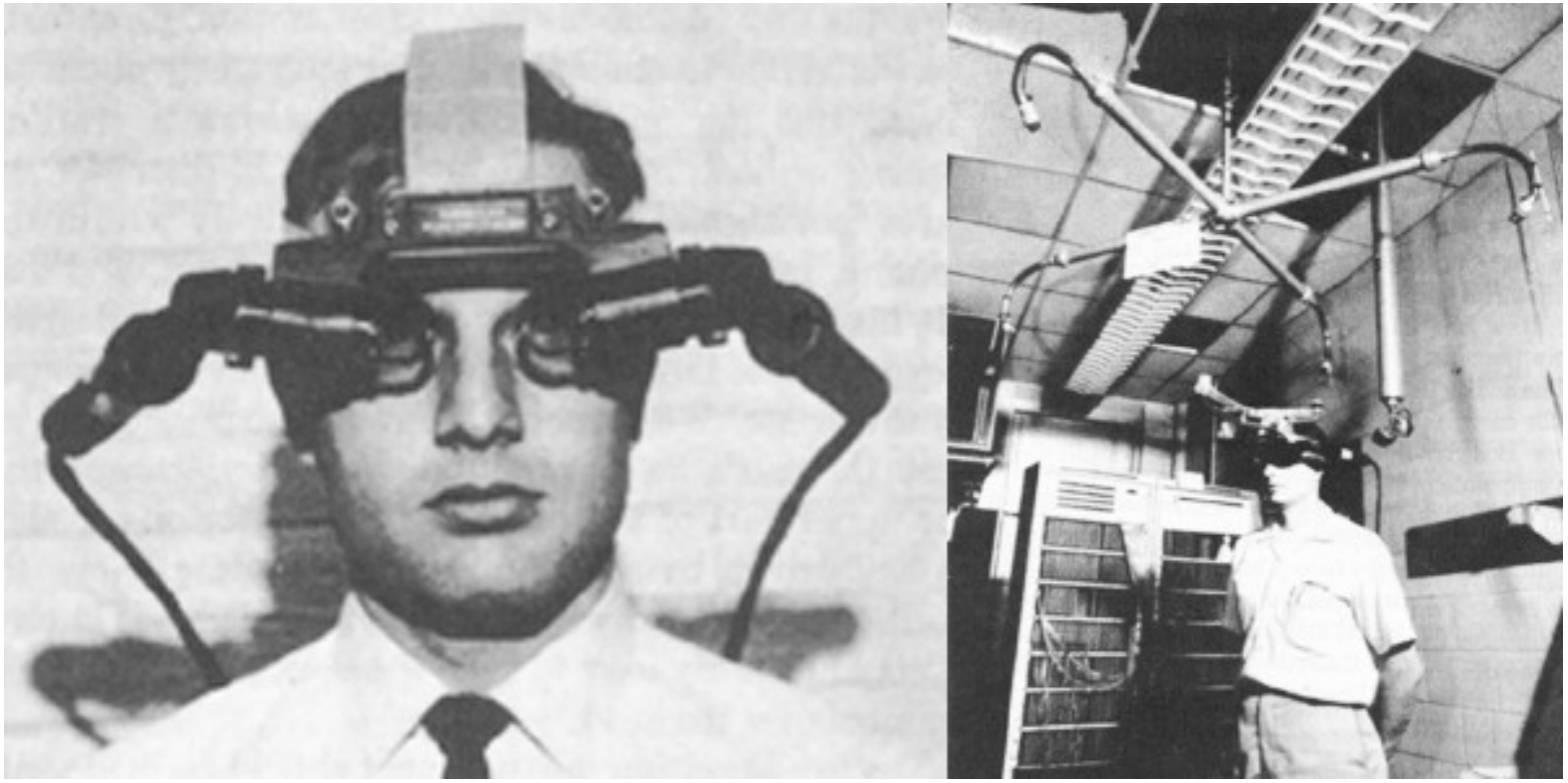
Before we read the papers

- Lets get a bit of background on the previous technology developed in this area.
- HMD research has been going on since Ivan Sutherlands (Sword of Damocles)
- The technology hit a road block though , and even expensive HMD only had 50 to 60 degree field of views

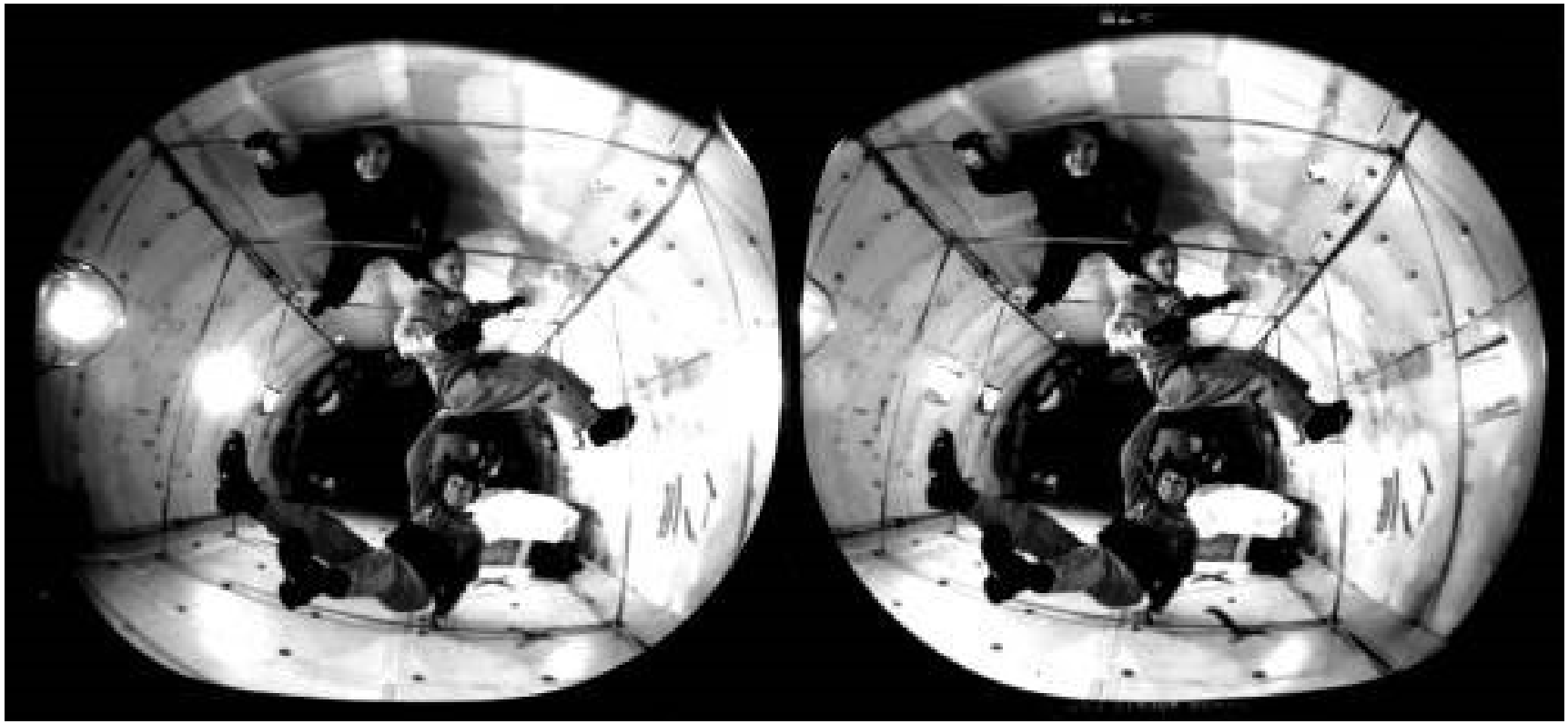
Ivan’s first HMD



Right time and right place

Eric Howlett , LEEP VIEWER)

1985



Low resolution & no GPU

A Design for a Smartphone-Based Head Mounted Display

- This paper was written in 2011, when the oculus had not even been kickstartered
- It shows that once certain technology come to maturity and remove bottle necks for other technologies then multiple people will realise the next step
- Its rare that only one people discovers something, Newton and Leibniz famously both discovered Calculus (Newton claims he just did not tell anyone)

Abstract

- The paper discusses the design of a inexpensive HMD
- Uses two IPhone's to achieve this

1 Introduction & 2 Related Work

- Ivan Sutherlands work on HMD's introduced and he is quoted "No available general-purpose computer would be fast enough to become intimately involved in the perspective computations required for dynamic perspective display"
- This has changed with the dedicated GPU create to help create Video games but now the technology can be used to create rich VR environment in sufficient speed that a user can experience them in real time.
- Scaling in HMD has not achieved the same cost efficiency of GPU though so at this time(2011) , VR in terms of HMD was not common.
- References that the LEEP optics are from previous NASA research

3 Apparatus

- 2 X iPhone 4's used for the display
- LEEP optics to provide at least a 90 degree field of view
- Fisheye distortion creates higher pixel density in the central region of the display and reduced density in the periphery, matching the resolution variance of the eye and retina

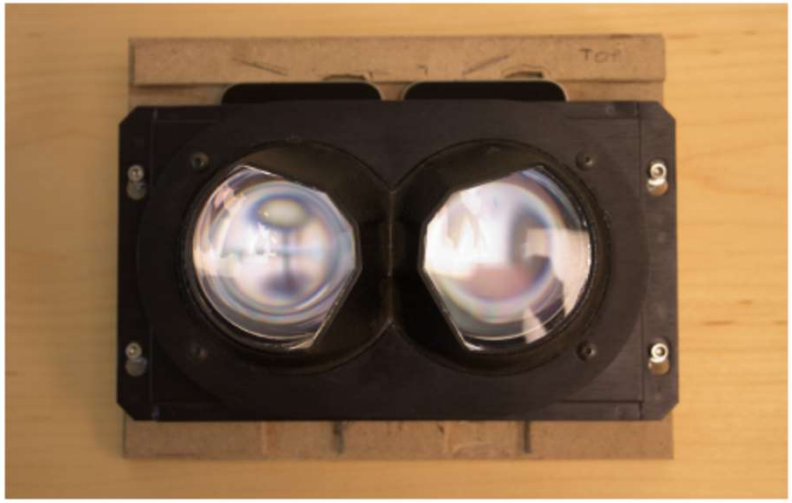
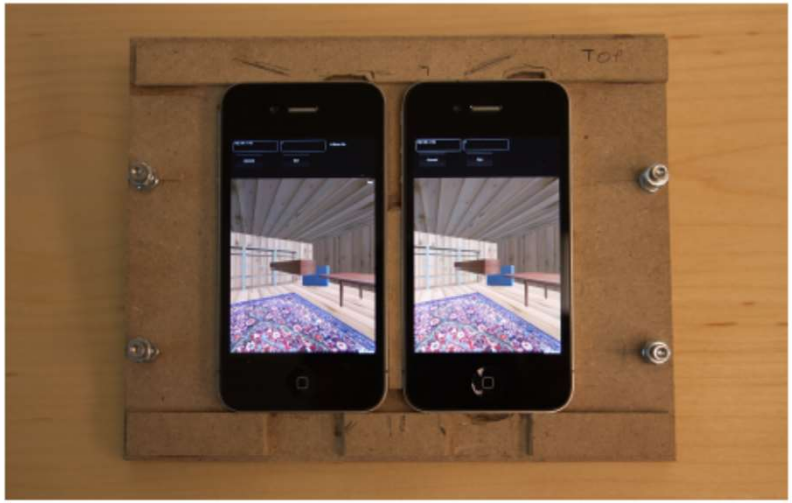


Figure 1: Experimental head mounted display with lenses in place.



4 Discussion

- Lag from using Phyton
- Sync issue in general from using two separate phones.
- Possible by sending a sync signal between phones, very common approach , HTC VIVE Lighthouses for example send a signal to sync each other.
- With a cheap HMD, many pick up and use applications become inexpensive to create.

5 Future work & 6 Conclusions

- Exploring different phones to see if they can move to a single display
- This proved right as the Oculus DK 2 is just a Samsung galaxy note 3 screen.
- Plastic LEEP OPTIC's are now more common place.
- Depth tracking using a Glyph , has not become common due to lag issues.
- In conclusions , they demonstrated how a smartphone display could prove to be an immersive VR HMD.

Poster

- This is an example of a poster for this paper.
- As you can see the author just highlight important parts of the work
- The poster is broken in to sections , just like a paper.
- Normally things like related work are ignored , and only 1 or 2 references are placed on a poster.
- Also not the amount of logo's, funding from multiple sources is quite normally, and like anything everyone gets credited for their help on the project.

A Design of Low Cost Head-Mounted Display Using Android Smartphone

- Demonstrates how the now common plastic HMD add on for mobile phones work
- Even as this paper was published ten's of manufacturers where making similar devices but it's a good paper to understand how such HMD's work

Abstract

- Low Cost Head-Mounted Display (LCHMD)
- Based on android
- Stereoscopic 3D player rather than being used to see in to VR worlds.
- Head-Mounted Displays are costly, proposed model is efficient terms of cost and time required to build HMD from scratch

I Introduction

- Introduced concept of a HMD
- Monocular approach such as google Glass only displays in one eye
- Binocular HMD displays such as the Oculus into two eyes
- Binocular HMD can be very expensive so this paper introduces an inexpensive design
- The design presented could work on nearly 80% of available smartphones in theory that are based on android . The device would have to be of course sized appropriately for each device.

II Literature Survey

- Makes it clear that they are fully aware of current HMD's
- Epson's BT-200 / Oculus are mentioned and costs
- Justifies why they think work is still needed in the area.
- Also points out design flaws such as no integrated earphones in the Oculus DK 1 , this was solved for the final release.

III Design of Low Cost

- Components
  - HMD body
  - Spectacle Wireframe
  - Lenses
  - Ear Plugs
- All encased in a mobile case
- Eventually design looks very similar to Google Cardboards final version

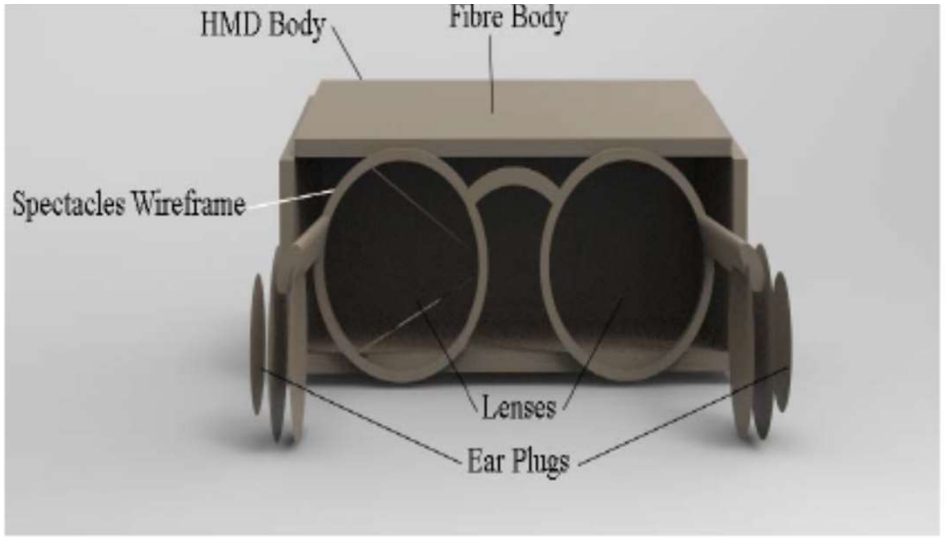


Fig 1: Basic block diagram of Low Cost Head Mounted Display.

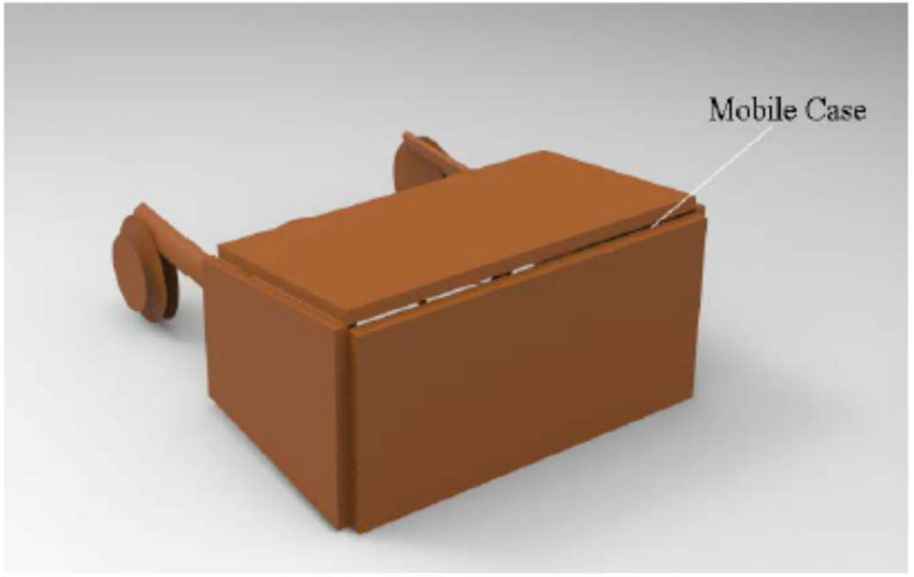


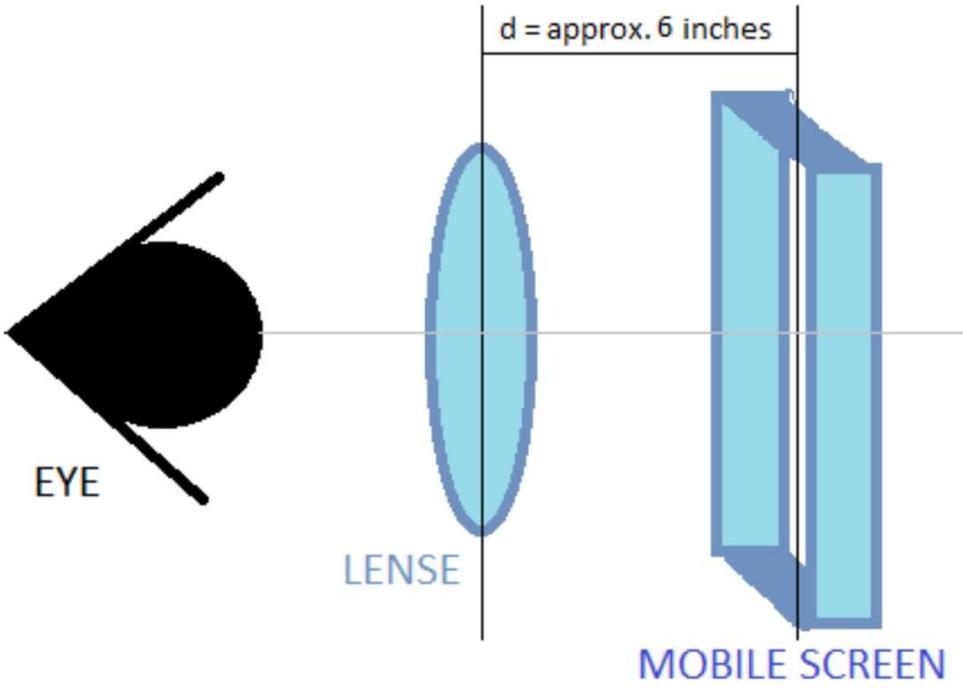
Fig 2: Left-Front view of LCHMD

IV. ANDROID APPLICATION

- Example is a video playing app
- To achieve a stereo display , the screen is divided into two equal parts namely A and A’.
- As both sides are running on the same devices, there is no synchronization issues.

ANDROID APPLICATION : Lens in more detail

- HMD depends on the distance between mobile screen and lens
- Power of Lens (in Diopter) = 1/ Focal Length (in Meters)
- They UNITY to create their application
- Application could stream from a desktop so act as another display instead of being run solely from the smartphone.



V. CONCLUSION &FUTURE SCOPE

- Points out that if the camera is turned on , the Glasses become see through Video AR displays
- Future explorations using large mobile screens could enhance the effect.
- Motion tracking is still an issue. (new Microsoft HMD / Hololen using time of flight sensors to solve this)
- Improved lens can be used

Next Week

- Next weeks paper will highlight interaction and how you can evaluate a system
- **Human Pacman: a mobile, wide-area entertainment system based on physical, social, and ubiquitous computing** by Adrian David Cheok , Kok Hwee Goh , Wei Liu , Farzam Farbiz , Siew Wan Fong , Sze Lee Teo, Yu Li and Xubo Yang

Possible Questions for the exam

- From now on each week , I start writing down possible questions for the exam.
- At least one or more of these will be in the final exam.
- Remember you have 120 minutes for the exam and will be answering 3 questions. So 40 minutes per question
- I would suggest making your argument to answering using 3 different arguments but you can get full marks answering in any way so long as you back up you point.

VR Questions

- "Why did inexpensive Virtual Reality headsets take so long to arrive and what factors are important in a Virtual Reality Headset?"
  - Use our Krevelen and Poelman paper to point out technology did not exist for long time.
  - Use Krevelen and Poelman to point out the enabling technologies needed
  - Use Olson et al and Surale and Shinde to show what was needed to final get inexpensive VR headsets
- "How can a VR HMD be integrated with different devices to create a rich VR experience and how can it be evaluated ?"
  - Reference Krevelen/Poelman for enabling technologies & Hightower/Borriello for how sensors can be integrated & Cheok et all for evaluating a system

AR questions

- " How do you a define Augmented Reality and using this definition how is a Augmented Reality headset work ?"
- Refence Milgram, Krevelen and Poelman and Hightower/Borriello
  - Use Milgram for definition
  - Use Krevelen and Poelman for the example enabling technologies
  - Give examples of how the sensors can work using Hightower/Borriello