

The background features a series of thin, light blue lines that flow and curve across the frame, creating a sense of motion and depth. The lines are more densely packed in some areas, forming a wave-like pattern that peaks towards the right side of the image.

# Summary of the Paper "Pervasive Augmented Reality- Technology and Ethics"

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# Introduction

- Pervasive augmented reality (AR) will most likely have a major impact on various aspects of our future life.
- Smartphones could be replaced by head-worn AR displays soon.
- Therefore, ethical concerns must be discussed beforehand.



Source: <https://www.allaboutvision.com/resources/eye-news-trends/augmented-reality-ar-glasses/>

# Chapters

1. Technical Aspects

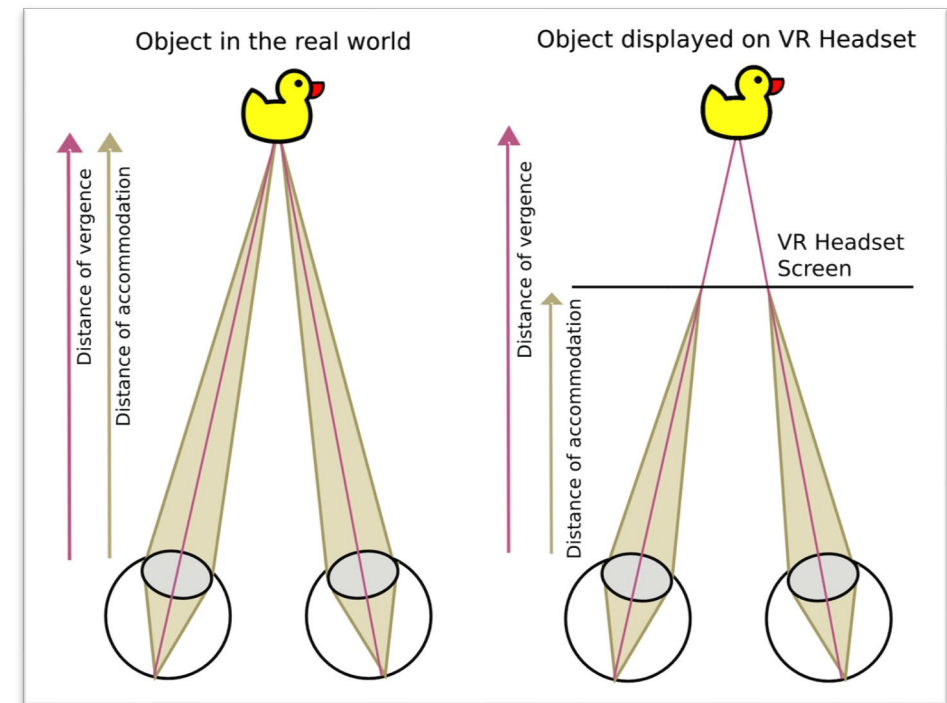
2. Ethical Concerns

3. Conclusion

# 1. Technical Aspects

# Display

- Integrated into regular glasses.
- Computer generated image projected into the view of the physical world.
- Problems of current implementations are
  - low fidelity of the image,
  - limited field of view (FOV),
  - issues with color and brightness,
  - poor latency,
  - accommodation-vergence conflicts.



Source: [https://en.wikipedia.org/wiki/Vergence-accommodation\\_conflict](https://en.wikipedia.org/wiki/Vergence-accommodation_conflict)

# Sensors

- Various sensors needed to display relevant, context adaptive information.
- Sensors are used to
  - track the position of the user,
  - sense the user state,
  - capture user input.
- Interpretation of the sensor data is needed.

# Communication

- Connection to the internet using WiFi or mobile data networks.
- 6G will be available soon, providing sufficient speed to transmit all relevant data.



# User Interface

- Content is primarily displayed on the screen.
- Auditive extension are also possible.
- Context dependency leads to a smooth integration of virtual content into the real world.



(a) without augmentation

(b) augmented with pervasive AR glasses



# Fully integrated Pervasive AR Systems

- Many technical aspects are already available.
- Rapid development in all important technical areas.
- Combining of all technical aspects into one device which can be worn in everyday use.



Source: <https://www.ray-ban.com/germany/electronics/RW4006ray-ban%20|%20meta%20wayfarer-schwarz/8056597769440>

## 2. Ethical Concerns

# Data and Privacy

- Google Glass (2013) sparked ethical concerns.
- AR mainly on mobiles (e.g., Pokemon Go) raises privacy issues.
- "Intelligent user interfaces" capture extensive user/environment data.
- Potentially invasive.
- **Privacy Measures:**
- Industrial guidelines (e.g., Meta's "Ray-ban Stories") focus on simple mechanisms for noncontinuous use.
- Pervasive AR lacks a straightforward opt-out mechanism due to continuous data collection.
- Conceptually possible to process data internally but challenging to enforce in practice.



Source: <https://www.nanalyze.com/app/uploads/2020/02/ARVR-data-visualization-Teaser.jpg>

# Illusion and Belief

## **AR Illusion and Belief.**

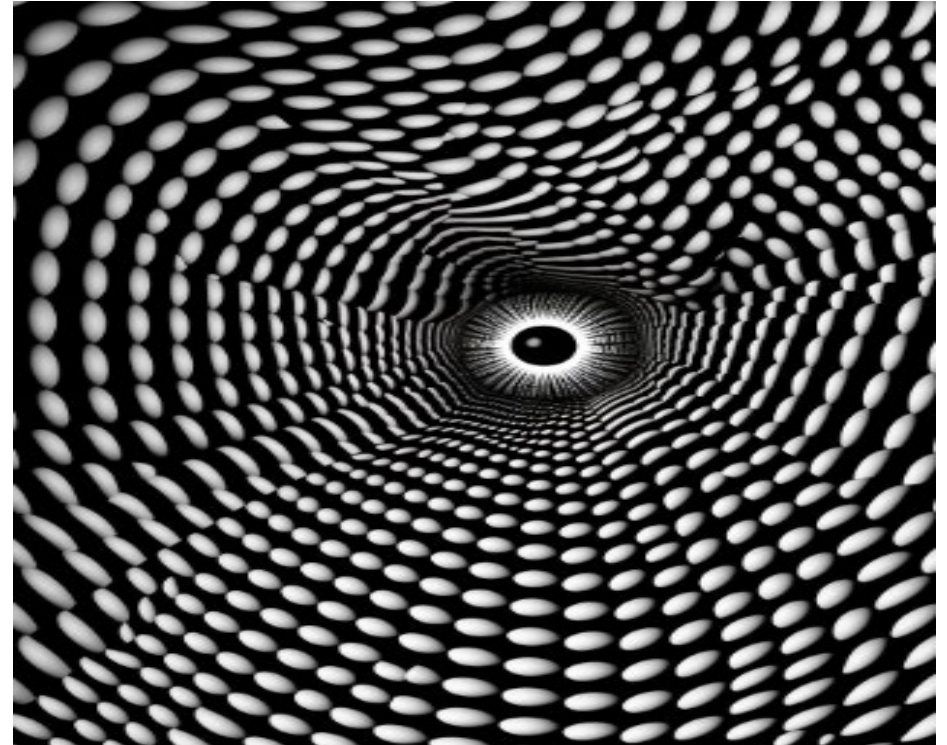
## **Pervasive AR's Unique Challenges.**

## **Deceptive Potentials and Concerns.**

## **Problems occur in Pervasive AR:**

- 1) Reintroducing Disbelief
- 2) User Control

## **Advocating for Transparency.**



Source: <https://www.promptermag.com/p/prompter-mag-optical-illusions>

# Health and Safety

- **AR Health & Safety Concerns:**
  - 1) Traditional AR
  - 2) Common Mobile AR
- **Pervasive AR Health & Safety Areas:**
  - 1) Perceptual Distraction and Blind Spots
  - 2) Ergonomics
  - 3) Long-term Effects
- **Modulation of User View**



Source: [https://miro.medium.com/v2/resize:fit:1400/1\\*yZ4zjLPoC\\_XQdytQdE7kZg.jpeg](https://miro.medium.com/v2/resize:fit:1400/1*yZ4zjLPoC_XQdytQdE7kZg.jpeg)

# Rights and Access

- **AR Rights and Access Challenges:**
  - Pokemon Go Controversy
- **Pervasive AR's Impact on Rights and Access:**
  - 1) Changes to Notions of Ownership
  - 2) Legal Rights in Virtual Space
- **Issues with Ownership Rights:**
  - 1) Inappropriate Augmentation
  - 2) Adapting Laws
- **Creation of Digital Twins**

# Conclusion

- Pervasive AR needs an "ethics-by-design" approach.
- Existing ethical discussion are insufficient.
- To solve the ethical problems, a collaborative effort across various scientific disciplines is needed.

Can you find examples where  
(pervasive) AR is already  
present?

Do you use (pervasive) AR  
devices in your everyday life  
already?

Reference: H. Regenbrecht, S. Zwanenburg and T. Langlotz, "Pervasive Augmented Reality—Technology and Ethics," in *IEEE Pervasive Computing*, vol. 21, no. 3, pp. 84-91, 1 July-Sept. 2022, doi: 10.1109/MPRV.2022.3152993.