Project Presentation:

Rolling Reality: Leveraging Rolling Shutter Effects in Photography for

Privacy-Protected Human-Computer Interfaces

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### **Objective:**

Develop a mobile app to stabilize and smooth finger gestures captured by the rolling shutter cameras of phones in real-time. The app will reconstruct finger movements in 3D space using already developed LED-equipped gloves, refining gestures with image processing techniques for clearer interpretation and filtering out irrelevant data for enhanced privacy protection.

### Overview of the Project

#### Goals:

* Privacy-Protected Gesture Tracking: Filter non-relevant data from rolling shutter cameras to maintain privacy while focusing on active gesture movements.
* 3D Gesture Simulation: Reconstruct finger movements in real-time 3D space, compensating for rolling shutter distortions.
* Gesture Smoothing: Implement algorithms to ensure gestures or handwriting are refined for accuracy and clarity.

### Technical Approach & Deliverables:

This project aims to develop a mobile app capable of real-time gesture capture and processing, focusing on privacy protection and 3D gesture reconstruction. The following steps outline both the technical strategy and the key deliverables for the project:

1. Gesture Capture:
   * Use a smartphone camera equipped with rolling shutter technology to capture finger gestures.
   * Integrate LED-equipped gloves to track finger movements across consecutive frames.
2. 3D Gesture Reconstruction:
   * Reconstruct finger movements into a continuous 3D path, correcting for rolling shutter distortions.
   * Build smoothing algorithms using machine learning and image processing techniques to ensure accuracy and clarity of gestures.
3. Gesture Smoothing:
   * Implement machine learning models (using TensorFlow or PyTorch) and real-time image processing (via OpenCV) to refine and smooth gestures.
4. Privacy Protection:
   * Focus on gesture patterns while filtering irrelevant data, ensuring privacy protection by preventing non-pertinent information from being captured or processed.
5. Mobile App Development:
   * Develop an Android app for real-time gesture capture and 3D reconstruction.
   * Ensure seamless integration of real-time processing with the backend services using Firebase for data sync and user authentication.

### Technology Stack:

#### Project Management:

* GitHub – Version control and collaboration.
* Hive – Task management.
* Microsoft Teams – Team communication.

#### 3D Simulation:

* Unity3D / Unreal Engine – 3D visualization and simulation.
* Three.js – Web-based 3D rendering.
* OpenGL / Vulkan – Low-level 3D rendering.

#### Algorithm Development:

* Machine Learning:
  + TensorFlow / PyTorch – Gesture smoothing through neural networks.
* Image Processing:
  + OpenCV – Real-time gesture analysis and tracking.
  + Scikit-image – Advanced image processing.

#### Android App Development:

* Android Studio – IDE for app development.
* Kotlin / Java – Programming languages for Android.
* ARCore – Augmented reality support.
* Firebase – Backend services for data sync and user authentication.

### Development Timeline:

1. Project Planning:
   * Define project scope and objectives.
2. Research & Framework:
   * Study rolling shutter technology, LED glove integration, and 3D tracking.
3. Prototyping:
   * Develop UI/UX for the mobile app.
   * Integrate rolling shutter feed with LED gloves.
   * Create 3D simulation and gesture tracking systems.
4. Testing:
   * Test app functionality, gesture accuracy, and hardware integration.
5. Refinement:
   * Iterate and improve algorithms and UI/UX based on feedback.
6. Final Product & Deployment:
   * Finalize the app and prepare for launch.

### Challenges:

* Distortion Management: Handling rolling shutter distortions to accurately reconstruct gestures.
* Real-Time Processing: Balancing gesture tracking accuracy with system performance.
* Integration: Merging software and hardware components seamlessly.
* Privacy: Protecting sensitive data while ensuring effective gesture tracking.

### Looking for Individuals with Passion for:

* Project Management
* 3D Simulation
* Algorithm Development
* Android App Development

This project offers the opportunity to work on cutting-edge HCI technology with real-world applications in privacy, healthcare, and immersive experiences.