Seam Carving Through Time

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Team D9
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The Goal

- **Project Statement**: Altering video playback speed without losing content
- Use Cases:
  - Watching all FIFA World Cup games without pulling all-nighters
  - Watching a youtube video at double speed without rewatching the important parts
  - Looking back at security camera footage but with double speed
  - Automatic processing of live video recordings

A Rough Prototype

Original

Double speed

Drawbacks of the current method

- Slow
- Jittery
- Low resolution
- Some key actions were cut

Solution

- Perform expensive operations in hardware
- Use a more sophisticated algorithm
- Parallelize

Seam Carving in 2-D

An algorithm for **content-aware** image resizing.

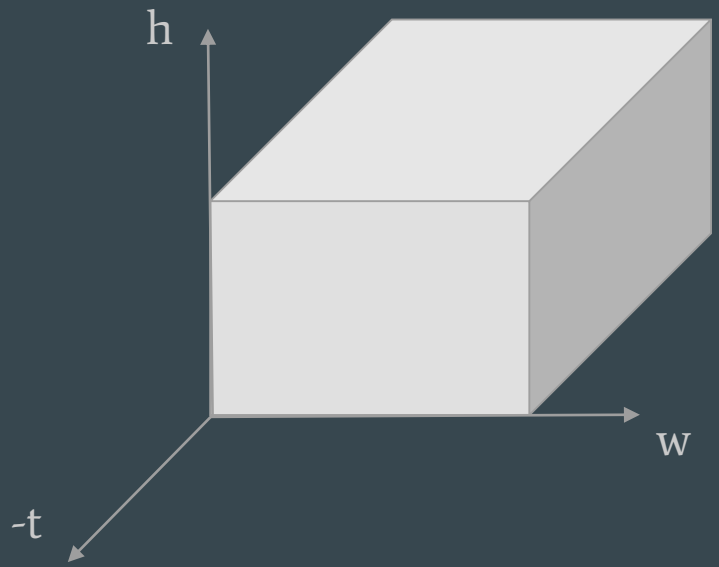
Scaled

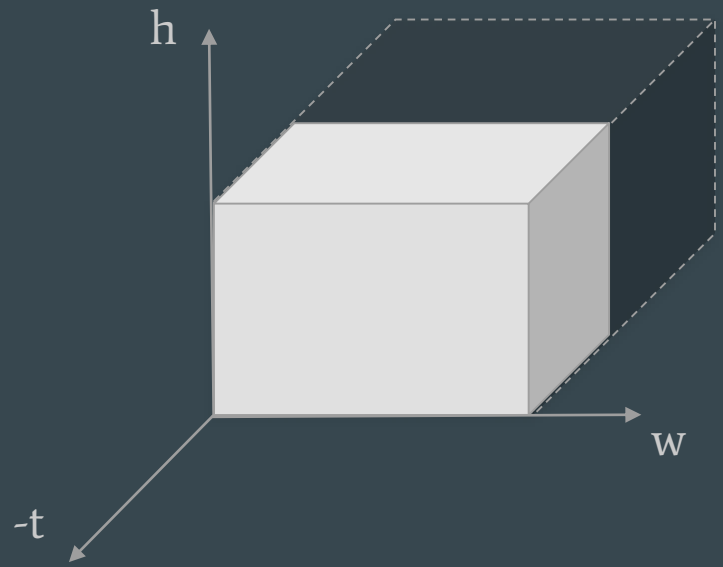
Cropped

Seam carved

Our Project -- Seam Carving in 3-D

Expanding seam carving to the 3rd video dimension -- extension and compression in time.



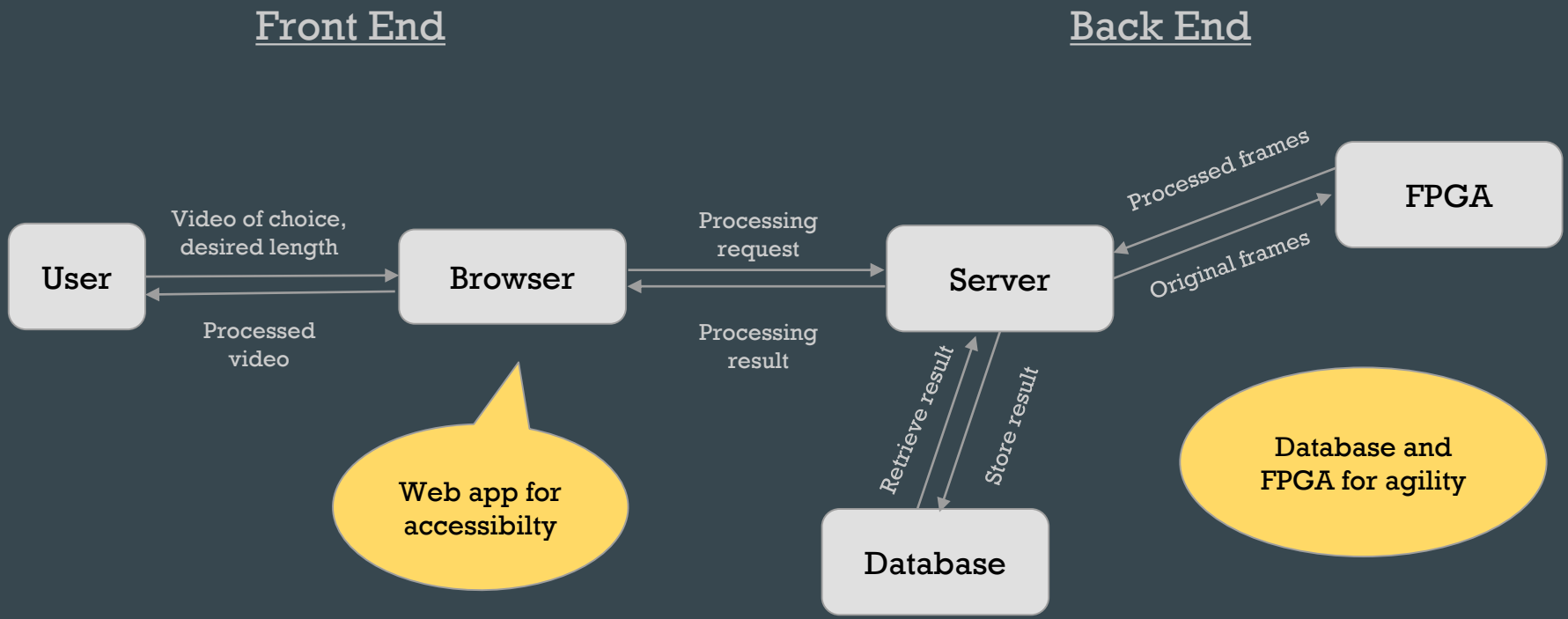


Requirements

- Functional
  - Smoothly shorten a video to ⅔ its original length
  - Process a video in the time it takes to play it
  - Process a 360p video
  - Stretch goal: Process streaming video with low latency
  - Stretch goal: Connect camera to FPGA to process live video

- Quality Attributes
  - Web platform for maximum compatibility
  - Seamless, accessible user interface
  - Rapid video processing to enable a smooth user experience

Solution Architecture Design



Testing

- Web Interface
  - Automated browser testing (Selenium webdriver)
  - JavaScript functional unit testing (Jest)
- Seam Carving
  - Small set of standard test cases for consistent measurements:
    - Unit tests: Hand-crafted, small frames
    - Easy: Well-defined slow and fast sections
    - Average: Typical gameplay
    - Edge cases: Camera angle changes, moving background

Metrics

- Processing time
- Resolution
- “Smoothness” of resulting video
  - Qualitative: Human rating
  - Quantitative: Energy function
- Interface compatibility with different media platforms

Division of labor

- Maxwell
  - Hardware implementation of seam carving
  - Hardware infrastructure
- John
  - Software implementation of seam carving
  - Software-web interface
- Riki
  - Web application development
  - Software-hardware protocol
  - Help with hardware design

Milestones and Timeline

Week 4	C++ seam carving
Week 6	C++ video carving, communication with FPGA
Week 8	Prototype web interface, FPGA seam carving
Week 10	Refinements to video carving algorithm, web-FPGA integration
Week 12	Video carving on FPGA, finalize web interface
Week 14	Stretch goals or slack