University of Michigan Lecture Archiving

and related activities of the ATLAS Collaboratory Project

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ATLAS Collaboratory Project

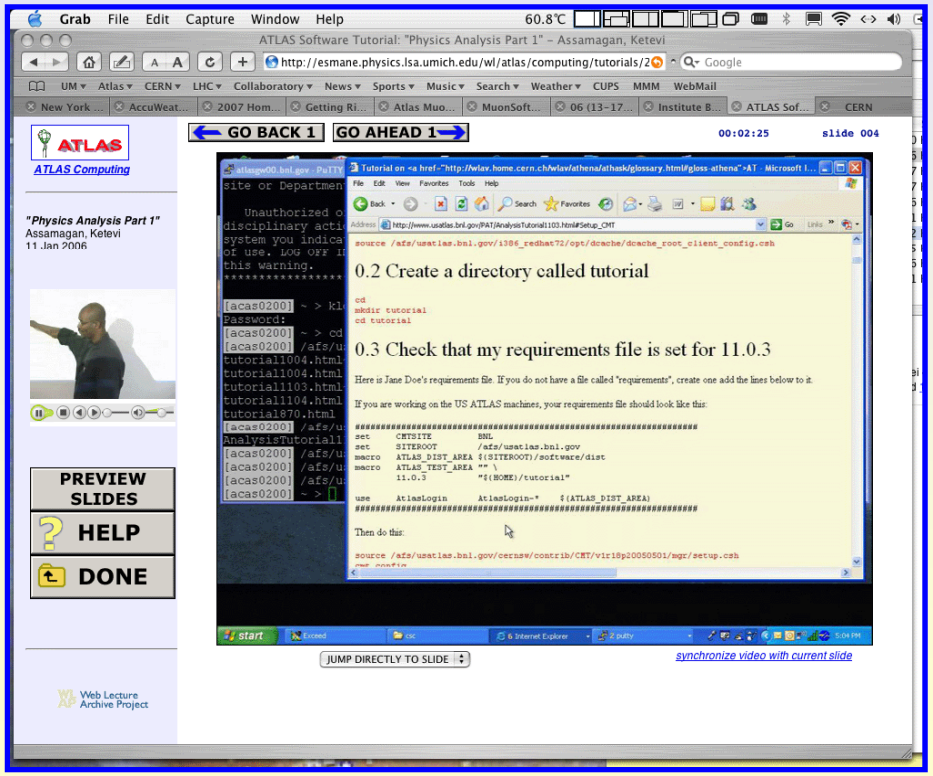
- Goal: to study and advance the technologies and practices required for the organization and execution of modern, large-scale collaborative research experiments
- Activities since 1999
  - archiving of ATLAS meetings and software tutorials
  - development of automated lecture archiving systems
  - development and promotion of Lecture Object
  - QoS bandwidth reservation testing
  - design and implementation of group-to-group video conferencing facilities at CERN and Michigan (usage data? what we've learned?)
  - recommendation of collaborative tools products

ATLAS Collaboratory Project

- shaping collaboration conference
- Collaborative Tools REU
- testing remote teaching facility for US faculty visiting CERN

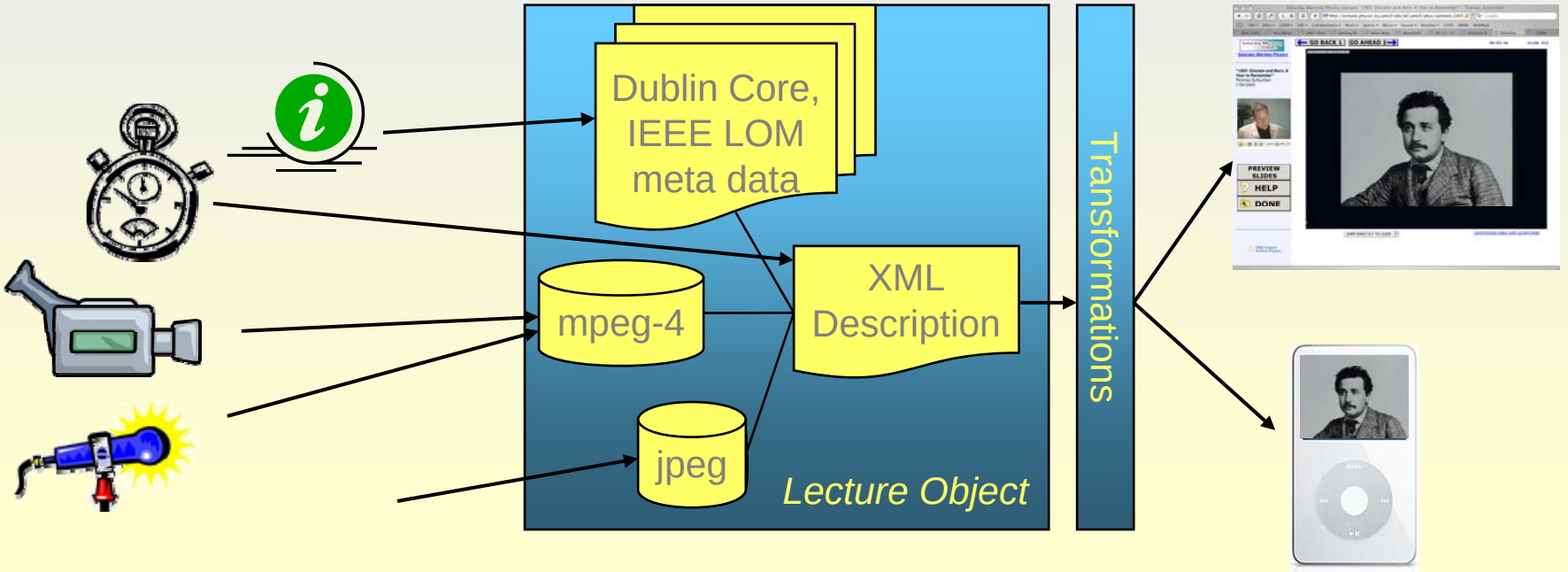
What is a Web Lecture?

- Low-bandwidth media-rich presentation viewable with:
  - any web browser
  - RealPlayer plug-in
- Media streams:
  - lecturer's audio
  - lecturer's video
  - high-res slide images
  - high-res chalkboard images
- Features
  - slide index
  - ability to "jump around"
  - platform independence
  - low bandwidth
  - ability to evaluate usage



What is a Lecture Object?

- Originally proposed by Giosue Vitaglione at Pontignano 2000 conference
- A standardized data object containing metadata, timing, high-res media
- Designed for
  - Longevity
  - Sharing among multiple institutions
  - Flexibility in viewing formats



Timeline: Lecture Archiving

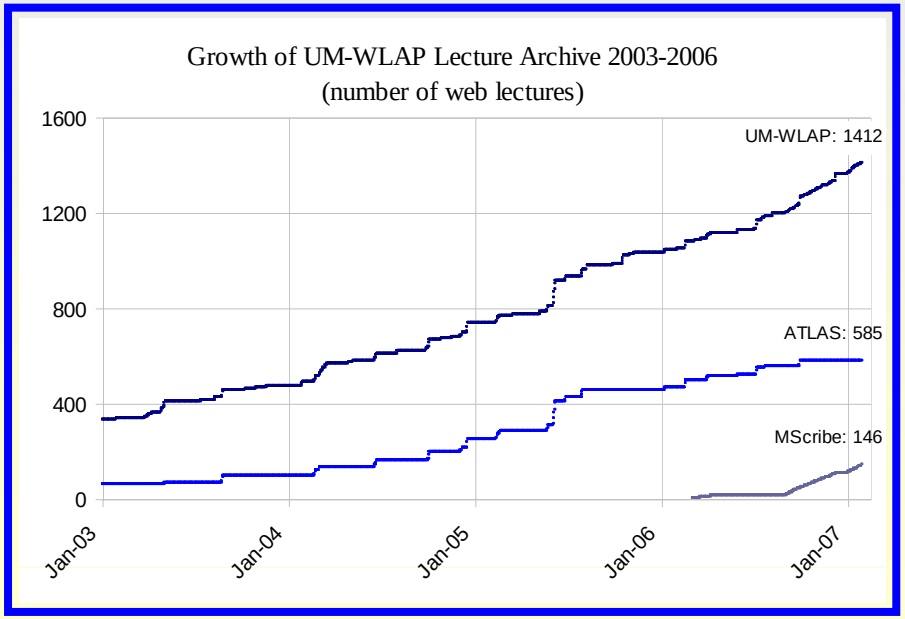
- 1997: initial development of web lecture recording/viewing software
- 1999 – Present: Web Lecture Archive Project funded by ATLAS and U-M to record events:
  - Software Tutorials
  - Physics Workshops
  - Large group meetings
- 2003: $250,000 grant from NSF (partnering with APS) to develop more automated recording, archiving and tracking system
- 2005: Patent filed for infrared tracking camera system
- 2006–07: MScribe Pilot Project
  - recorded 8 entire U-M courses using automated carts
- 1999 – Present: ongoing development:
  - Lecture Object specification
  - Web Lecture viewer software
  - media formatting and processing software
- 2007: Our archive now has 1600+ lectures

Contents of Lecture Archive

- The ATLAS experiment
  - software tutorials
  - physics workshops
  - large meetings
- Special CERN events and workshops
- Special University of Michigan events
- U-M Saturday Morning Physics (since 2001)
- American Physical Society (APS) meetings
- Int'l Conference on Systems Biology 2005 at Harvard
- MScribe classroom recordings (2006-07)
  - American Culture, History of Art, Physics, Statistics, Psychology, Bioinformatics, School of Information

ATLAS Recordings

- list of recordings this year
- graph of how many recordings



MScribe

- MScribe is the next step toward large-scale automation of web lecture recording
- Its new developments and technology are being used simultaneously to benefit ATLAS
- Goals of MScribe Pilot Project (2006-07):
  - Completely automate the recording of classroom lectures
  - Develop a robust tracking system to eliminate human camera operator
  - Study how students use recordings and the ramifications of the technology

MScribe – Technical Achievements

- 4 automated, self-contained, portable carts built
- 8 courses, 200 hours of video recorded
- recordings accomplished by unskilled student helpers
- RealPlayer Web Lectures and video iPod lectures were provided for students online
- venues ranged from small classrooms to large auditoria
- chalkboard writing and tablet PC annotations were captured
- automatic processing software developed and improved

not sure if i'll use these pics yet...

MScribe – Pedagogical Studies

- Questionnaire results:
  - 58% of all students used MScribe
  - students spent more time in class taking notes
  - students spent more time reviewing lecture content / notes
  - students spent more time studying for exams
  - class attendance was not noticeably affected
- Focus group findings:
  - MScribe technology allows students to pay closer attention to the ideas in a lecture.
  - Some use the live lecture to outline important points and to “absorb” the information, and detail the notes by listening again later.
  - Student use patterns differ.
- Server log analysis:
  - students fast forwarded through web lectures, but did not jump around much
  - students made heavy use of web lectures right before exams

MScribe benefit to ATLAS

- MScribe recording system now installed on a laptop
  - Drastically more portable than cart, laptop can be taken all over the world (auto-tracking not yet included)
  - Allows us to post ATLAS talks faster
- Laptop system used to record these ATLAS meetings:
  - Physics Analysis Tools Workshop (April 2007, Norway)
  - CTEQ Workshop (May 2007, Gull Lake, Michigan)
  - ATLAS Week (July 2007, Glasgow)
  - UM-CERN REU Student Talks (August 2007, CERN)
  - First ATLAS Physics Workshop of the Americas (August 2007, SLAC)
- Have recorded 5 events and 120 talks with the laptop-based system

Lecture Object Development

- MScribe technical advisory committee is working on refining the standard
- We are collaborating with CERN in this development. Gregory Favre (CERN IT) is working to make SMAC support it.
- Next versions of the Lecture Object will:
  - support arbitrary numbers of streams
  - support access control, authorization, copyright
  - remain simple, minimal and easy to use
  - be targeted to **lectures**, not generalized “learning objects”

Users of Lecture Object

- Using a simple, open, well-defined global archival standard will:
  - encourage multiple institutions to share their archives
  - enable shoe-string operations as well as well-funded groups to easily produce compatible content
- Archives using UM-WLAP technology and Lecture Object maintained by:
  - University of Michigan WLAP / MScribe
  - CERN
  - American Physical Society (APS)
  - Fermilab

Advanced Indexing and Search using BlueStream

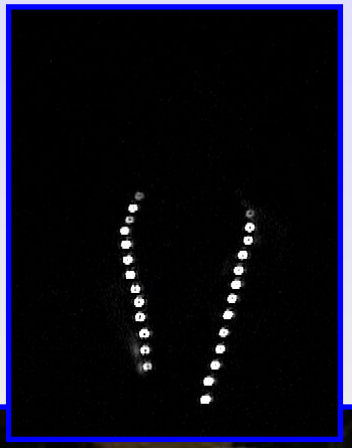
- BlueStream is an online environment at the University of Michigan with powerful tools for working with digital video, audio, images, and documents.
- The ATLAS Collaboratory Project, through WLAP and MScribe, has made hundreds of hours of video available online
- Clearly, powerful search and indexing is needed.
- BlueStream has tools that ingest video, images and metadata and
  - transcode it to multiple formats
  - convert speech to text to index the video stream
  - perform OCR on the slide images
  - provide search functions that take the user directly to a point in the video
- We have begun working with this tool to provide advanced search capability for some classroom lectures

Survey of Tracking Technologies

Human camera operator	Intelligent tracking that generates pleasing video	Very expensive, gets tired after several hours	
Ultrasonic Developed by AT&T labs	Probably accurate enough for tracking a lecturer	Requires extensive permanent installation	
Radio Frequency (RF) BlueSoft	Almost reasonably priced (6,000 USD)	Slow and insufficient accuracy, especially indoors	
Ultra Wide Band (UWB) UbiSense	Almost reasonably priced (10,000 USD), more accurate than RF	Requires extensive set-up and calibration	
Position Sensitive Detectors (PSD)	Extremely accurate	Not sensitive enough at long range	
IR quad detector	Inexpensive, accurate	Will always require a pan-tilt platform	
“passive” IR Used in Boeing factories	Inexpensive (4000 USD), simple and very accurate	Very easily distracted by any reflective objects in the room	
“active” IR Using IR LED necklace	Inexpensive (4000 USD), simple and very accurate	Confused by incandescent lights and bright sunlight	

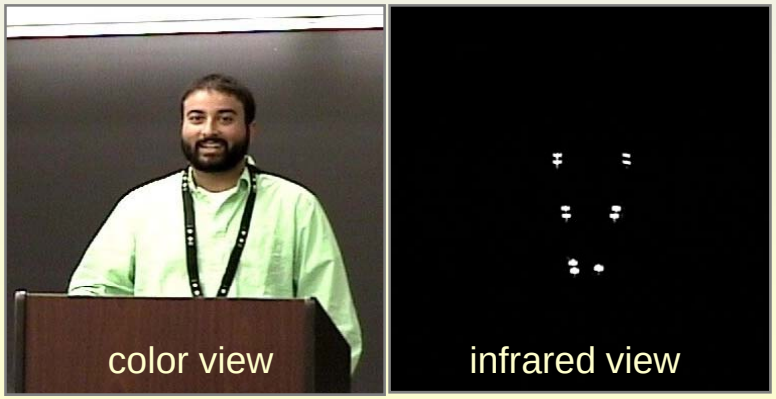
Active IR tracking system used for MScribe 2006-2007

- "Active" Infrared used 2006-07
  - necklace chain of bright IR LED's
  - CCD camera follows it
  - PTZ commands sent to video camera
- This system satisfies our criteria
  - Portable: sits on a cart
  - Robust: simple design makes it very robust
  - Affordable: currently under 4 000 USD
  - No expert intervention: start it and it works
  - Little setup: almost no calibration required
  - Accurate to within centimeters
- Improvements needed
  - confounded by incandescents, sunlight
  - can only be used in certain rooms



Active IR Tracking System – Recent Improvements

- Made improvements to IR tracking system
  - optimized filter arrangement
  - found extremely bright wide-angle IR LEDs
  - fully exploited camera settings
  - can now be used in all rooms on campus



new necklace with super-bright IR LEDs

Tracking Camera Current Research

- Necklace Design
  - testing fiber-optic options
  - parallel chain of wide-angle IR LEDs (120°, 8mW/sr)
  - super-bright wide-angle Malaysian LEDs (120°, 45mW/sr) with special high-current circuitry to drive them from battery pack
- Flashing LED necklace under development
  - will further improve signal-to-noise ratio
- Testing Tracking Algorithms
  - Modularizing current code
  - Generating database of position data
  - Trying to mimic human camera operator
- Ultrasonic Phase-Difference array
  - currently developing this completely different tracking technology in parallel with improvements to IR system
  - see next page…

Ultrasound Tracking System

- Necklace and receiver system, using ultrasound instead of IR:
  - necklace sends 40 kHz pulses instead of always-on LEDs
  - an array of 4 ultrasonic receivers on a 10cm² circuit board receive pulse at slightly different times. The phase difference is used to calculate angle
- Expected advantages
  - no competing noise in that medium
  - lower power consumption, longer battery life
  - can send synchronized RF pulse from necklace to calculate distance (3D position will enable better tracking/zooming)
  - can hopefully eliminate need for pan-tilt platform

PICTURE OF ULTRASOUND SYSTEM GOES HERE

U-M Campus-Wide Recording Service

- Already developed expertise and hardware/software tools over 8 years
- Have trained staff in place
- Requesting start-up funds from University to start a campus-wide recording service
- Because everything is digital and mostly automated, costs/pricing are low
- could become a model for CERN lecture recording service

The Future

- Totally automated room installations
  - record lectures at times specified in online agenda
- ultra-portable recording carts
  - entire system including tracking can be checked on airplane
- desktop recording software
- many display formats available
- multiple-person (and audience) tracking
- integration with other lecture recording systems:
  - SMAC
  - Apple's new lecture recording system (name?)
  - EVO

People

- Homer A. Neal – PI, Director
- Steven Goldfarb – Advisor, Research Scientist
- Jeremy Herr – Project Manager
- Tushar Bhatnagar – Engineering Student (IR tracking)
- Robert Vogt – Electrical Engineer (ultrasound tracking)
- Mitch McLachlan – Media Specialist (recording processes)
- Curtis Hiller – Web development, programmer intern
- Alumni
  - Jim Irrer - engineer
  - Cang Ye - engineer
  - Giosue Vitaglione – software developer
  - Eric Myers – software developer

Links

- To view ATLAS talks:

www.wlap.org/atlas

- Web Lecture portal:
  - http://www.wlap.org
- ATLAS Collaboratory Project
  - http://vesuvio.physics.lsa.umich.edu/acp