Lecturus: Collaborative Mobile Phone Lecture Recording

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Abstract. We present the Lecturus Mobile Phone based lecture recording system. Lecturus allows a group of students, connected via social networks, to collaboratively record, photograph and annotate a lecture in real time. A key motivation was to minimize attention to the recording process itself and maximize attention to the lecturer. This was achieved by A. breaking a complicated task of recording and annotating a lecture into simpler sub-tasks (recording audio, taking photos, adding textual annotations) and distributing those tasks among the participants. B. simplifying the tasks to minimize their cognitive load. C. Uploading and allowing participants to later view, manage, edit and share their recording via RESTful web services.

Keywords: Digital media · Cognitive load · Human computer interaction
Mobile computing · Web services

1 Introduction

For thousands of years students have been looking for ways to best remember a lecture that they attended. Initially they used poetry and song as a memory enhancement mechanism [1, 6]. Later, with the development of tools for writing and drawing (charcoal, ink, pens, papyrus, parchment, paper), they took notes and drew illustrations as ways of retaining access to information over time and space [1, 6]. These tools were the main methods of personally recording information for over 3000 years [6]. The late 19th century and the 20th century saw the development of new media capture and recording technologies (Still Image Photography, Audio Recording and Moving Image Cinematography). As these technologies matured, they became more capable (i.e. movies synchronized with sound, higher quality recordings) as well physically smaller and less expensive. This enabled the use of these tools in more personal settings, as well as in the lecture hall [7]. The last few decades have seen such devices falling in price to become available for most middle-class students if they wanted them. The second decade of the 21st century has continued this trend, with mobile phones taking over as the main media recording device for billions of people, replacing the stand-alone camera, the portable video camera and the tape recorder. The mobile phone has become the new universal recording device, enabling the creation of more than 3 billion photos and 400,000 of *hours* of video per *day* [2, 3].

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Lecturus is a project developed at the Shenkar College of Engineering, Design, Art that explores how to merge lecture recording with today's ubiquitous social networks, enabling a group of connected students to record a lecture in a distributed and cooperative fashion and then later view, manage, edit, search and share their peer co-created recordings via RESTful web services.

1.1 Issues with Lecture Recording with Mobile Phones

Has the ubiquity, capability and low cost enabled the smart phone to become a viable tool in recording lectures by students? In some cases it has, but because such recordings must be performed by a single user, not many users are willing to invest the time and effort of recording a lecture on their own. A typical scenario would see a student asking permission from the lecturer to record the lecture. If they opt to record just audio, then they could place the phone near the lecturer (on a table or on the lecture podium). If they wanted to record video, they would keep the phone with them and need to hold it up to keep the lecturer or the board and screen in the field of view being recorded. If they opted to take still images of the board or screen then they would launch the phone camera application and raise the phone to take a picture each time they wanted to capture a photo. Each of the cases described above have different attention demands (picking the phone up, launching the camera or audio recording application, taking a picture, etc.). Lastly, having captured the media from a lecture, they must edit it: organize the files, decide which photos to use and then manually connect between the photos and any text annotations they might have created. With time-based media such as audio or video, the process is much more demanding: the student must search though the captured media material in a linear fashion to connect between any point of interest (photos, annotations) and the time of their occurrence within the recording itself. All this makes the task too time consuming or difficult for most people in most cases.

2 The Lecturus Peer Lecture Recording System

The Lecturus project was designed to enable students to make use of the mobile phone as a peer lecture recording device, while minimizing the difficulties described above. We defined the following top level goals for the project:

1. Ensure that the process of recording a lecture does not get in the way and grab too much *attention* from the lecture itself.
2. Allow students to easily *capture* rich media recordings of lectures within an academic context.
3. *Store* the recordings and their associated materials online and enable users to view, edit and share their recordings.

2.1 Minimizing Attention Issues

Our first priority in designing the system was to ensure that the students who use the system suffer the least amount of multitasking attention deficits. We did not want that the use of the system will steal attention away from the lecturer and thus needed to find

a user flow that would minimize, as much as possible, the user interactions with the system during the lecture. Our solution focuses on two factors: a. *Spreading the task* across more than one student and b. *minimizing interface focus* during use.

Spreading the Task: If a task demands too much attention to be performed, then one possible solution is to divide the task between several different actors. As can be seen below, after a new recording is set up by one of the students (defined as the Owner), they then proceed to invite a set of friends to participate in the actual recording process. Most of the rest of the functions are available to all participants in parallel, thus *minimizing the amount of **actions** each participant needs to perform*. We divided the task into the following sub-tasks:

1. Setup:

a. Creating a new Recording: Connecting the recording to a specific course and a specific class and giving it a name. [Owner]
b. Setting the Text Tags to be used in the recording. [Owner]
c. Inviting friends to participate in the recording. [Owner]
d. Receiving a notification to participate in the recording. [Invitees]
e. Agreeing to participate in the recording. [Invitees]

2. Recording:

a. Recording a continuous audio track of the recording. [Owner]
b. Taking photos and saving their creation time-stamps to synchronize them with the audio recording. [All Participants]
c. Adding text annotations and saving their creation time-stamps to synchronize them with the audio recording. [All Participants]
d. Ending a Recording. [Owner]

3. Post Recording:

a. Listen to the recording while seeing each photo and text annotation at the correct time during playback. [All Participants]
b. Edit the location of photos and text annotations within a recording, including the option to delete them. [All Participants]
c. Change the privacy setting of each recording (Public or Private). [Owner]
d. Sharing a recording. [Owner]

Minimizing Interface Focus: Since we want the users of our system to keep their attention focused on the lecturer, we looked for a way to minimize the actions they would need to perform to take photos and add textual annotations. Since all other functions are not needed during the recording phase, they were removed from the interface during the recording. This left us with taking photos and adding annotations:

1. **Taking a Photo:** Since taking a photo forces the user to raise their phone to aim the lens to the target area in the visual field, we opted to use the physical motion of raising the phone from the table and moving it into a vertical orientation as the trigger that launches the camera. By doing this we minimize the attention needed to find and place the finger on the phone buttons needed to launch the camera or the

need to unlock the phone and then launch the camera. *By sensing that the phone has been moved into a photo taking "position" the system helps minimize attention demands*.

2. **Adding Text Annotations:** It was obvious to us that we did not want students to manually type text annotations on their phone because this will steal attention away from the lecturer and will thus be counter-productive [4]. Thus, we decided to offer a group of 4 pre-set annotations (that can be edited *before* the recording begins) that are presented as 4 buttons on the screen. During the recording students need only tap the buttons to add that annotation and save it's time-stamp. *Although this task demands attention, it is a small amount of attention for a lot of cognitive reward*. See Fig. 1d, e.

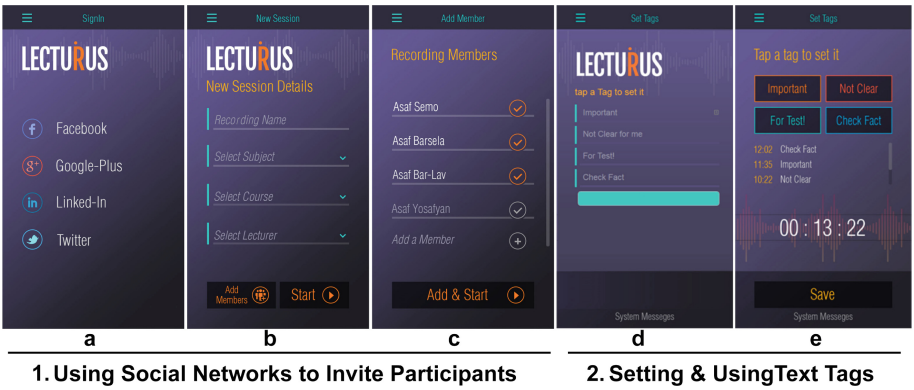

Fig. 1. 1: Social Network Screens: a. Select the Social Network. b. Enter Recording details then Add participants. c. Select participants from the selected social network. 2. Setting Text Tags Screens: d. The Edit Tag screen that is available *only before starting* a recording. e. Tag Button Screen: Note the four Large Text Tag buttons available during the recording

2.2 Adding Participants Using a Social Network

Since a recording using the lecturus system is handled by a group of peers, the recording owner must first invite his or her friends to participate in the recording. When a user joins the Lecturus system they are asked to log in using one of the existing Social networks (Facebook, Google Plus, LinkedIn, Twitter). The service then allows them to invite participants to a recording from their social network contacts. See Fig. 1a–c. Each invitee receives a notification to participate in the recording. If they accept, they are added to the active participant list. Once the owner starts the recording, all participants are notified and can add photos and annotations as they see fit.

2.3 Online Access to Recorded Content

To minimize data loss in case of a network disruption, all media is continuously uploaded in chunks during a recording. Once a Recording is finished, all its online materials are transcoded and made available for personal viewing, editing and Sharing. See Fig. 2.

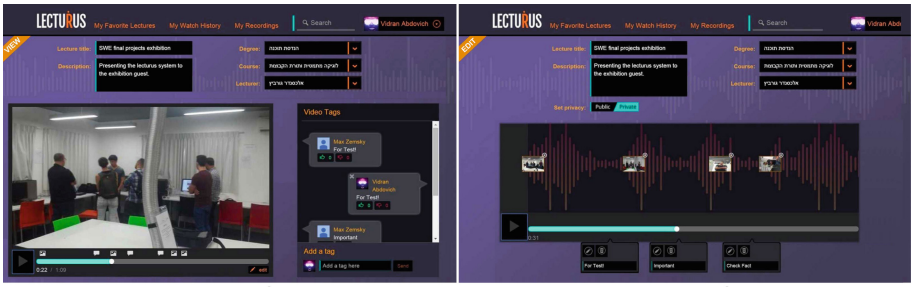

Fig. 2. A. View recording screen. Includes audio playback, synched photos, and synched text annotations. B. Edit recording screen. Move photos and annotations. Edit annotations.

2.4 System Overview

The Lecturus system was built using Web technologies. The Mobile Client was developed as a Hybrid Application using HTML/CSS/JS based web pages inside an Apache Cordova wrapper that enabled access to phone functionality via the Android Native Platform API for recording audio and sensing phone motion. A NodeJS server was developed to gather recording blocks, merge them into single files and transcode them to a web friendly format, save the media files (audio and images) on a Cloudinary service and the text annotations and media time-stamps into a MongoDB database service. This data is accessed via a Web Client that allows users (recording owners and participants) to view, edit, search and share the recordings on their large screen web browsers. See Fig. 3.

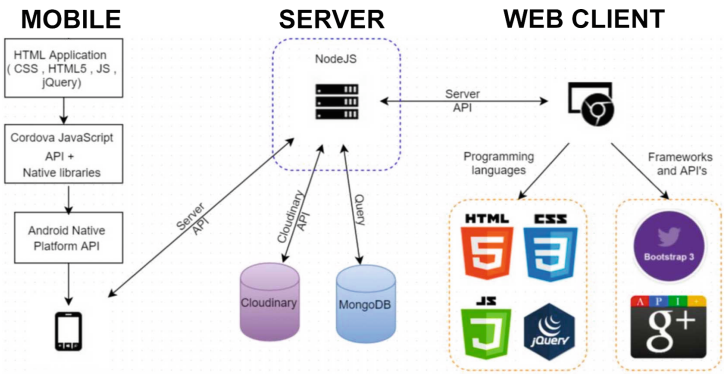

Fig. 3. Lecturus system structure and data flows

3 Results and Future Work

The Lecturus project was designed to enable students to merge the capabilities of the Smartphone with a peer based service to collaboratively record lecture recordings while minimizing attention deficits to participants. A prototype of the service was developed

and tested within the Software Engineering department at Shenkar. To facilitate the process, the service was linked to the institutional course database making it easy for users to add a new recording within the context of a course name, lecture date and lecture room.

Testing was done with a group of 7 students, over a period of two weeks, during which they were asked to use the system to record several lectures. Participants were randomly selected to be recording "owners" who had to set up a new recording, invite participants and then end the recording. All participants also tested the online web interface to view, edit and share recordings. Tests showed the utility and usability of the system, with multiple 90 min recordings successfully recorded, uploaded, transcoded, viewed, edited and shared. All in all, the participants had no problem in understanding the service, editing the text annotations, inviting recording participants and creating recordings. They did comment that it was not always clear to them if the recording was being successfully uploaded and saved during the recording process. We are planning to improve system feedback to make this clearer. The one major missing piece that most users requested was the option to record video. We are now planning to develop a video recording module for future testing.

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