Who Said What When? Capturing the Important Moments of a Meeting

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Abstract
Meeting information capturing paradigms such as pen and paper has been found to be tedious and distractive. This paper presents Meeting Essence II, a mobile phone based, one screen meeting information capture system to address these issues. We also introduce a new social interaction centric recording paradigm, where events in the meeting are identified by meeting participants and are recorded, classified by time and person with a single screen touch. Results from our pilot experiment shows that our system positively contributes to the quality of meeting reconstruction, while being minimally distractive to the meeting participants.

Keywords
Computer supported cooperative work, handheld devices and mobile computing, office and workplace, user interface design

ACM Classification Keywords
H5.3. Group and Organization Interfaces: Computer-supported cooperative work.

General Terms
Design, Human Factors.

Introduction

Meeting as a collaboration method to create and share people's knowledge has always been important. Sadly attribution and outcomes of meetings are often forgotten. Without suitable capture and retrieval mechanisms, these important information are prone to being interpreted incorrectly or differently by different people, in addition to fading in memory over time. Yet the dominant solution: note taking with pen/paper, is found to be unsatisfactory due to its effort intensiveness yet being error prone and incomplete [9].

Many solutions have been proposed, each with varying degree of success and drawbacks. Collaborative note taking, such as NotePal [2], have even added difficulty to taking and finding notes. Some value has been ascribed to annotating PowerPoint to improve completeness and accuracy, but does not resolve the issues of it being effort intensive and its inability to capturing or classifying communications for follow-up. Audio recording of the meeting in entirety [4,6], while requiring little effort during the meeting and could be very useful for reconstructing meeting content [4,6,9], is hampered by the difficulty of retrieving important points from long recordings of meetings. Another class of proposed system relies on multiple combinations of text, audio, video, and meeting minutes to aid information recall [1,7,8]. Such high-tech solutions come with equipment overhead and use overhead. Requiring specialized hardware, or even special rooms, has inhibited the widespread adoption of these technologies. Even where people have access to previous exotic solutions, good records of meetings have not commonly been useful [3]. So, despite previous effort, uptake is limited, and pen/paper continues to be the mainstream of meeting support tools.

In this paper, we present Meeting Essence II, a mobile phone based meeting information capture system that utilizes features of a ubiquitous mobile phone to effortlessly record important moments of a meeting for follow-up. Selections on the screen make meeting records and augment the unified meeting visualization. This introduces a new social interaction centric recording paradigm where only moments deemed important by meeting participants are recorded, and users get to choose when and who to record by clicking on the name of the person that they want to record on a mobile phone screen.

The main difference of this system with previous meeting information capture systems is as follows:

1. A single touch on the name of the person who said something interesting would record the person starting 10 seconds before the selection was made. The system records and displays who found it interesting and when in the meeting did it happen.
2. Non-distractive one selection recording by meeting participants ensures that only audio of the important parts of the meeting are actually stored for later retrieval.
3. The social interactive nature of how recordings are made (each meeting participant getting to choose when and who to record) gives instant feedback on participants' contribution to the meeting, and the audio indexing becomes an automatically generated minutes for the meeting via the collected social interaction information.

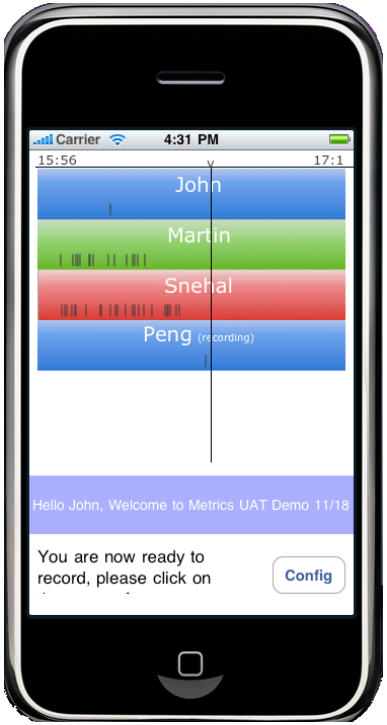

Fig 1. Client interface on the iTouch. Note the following features:

•Time management: scheduled meeting start time and end time, current time, and vertical line to denote progression of meeting time.

•Participant information: Color-coded blocks each representing a meeting participant. Each block displays the status of the person (such as recording), number of times recorded (tick marks), and doubly serves as a button to request having that person recorded.

4. The system makes high quality recordings from microphones that are close to the participant using personal ubiquitous phones instead of expensive special purpose rooms or hardware.

Scenario

Meeting Room Capture

John comes to a meeting that was setup with people he doesn't remember. He opens Meeting Essence II on his iPhone and enters the conference code. A quick scan of the displayed meeting information reminded him that it is a 3pm~4pm, 60 minute brainstorming session on the company's budget situation. Lucky for him the meeting interface includes the names of the five other participants: four in the same room and one remotely located consultant, Martin, on phone.

As the meeting progresses, great ideas are starting to emerge from the brainstorm session. The flow of ideas is way too fast and interesting to allow time for writing. Fortunately, when anyone selects a name, who identified that name and what is being spoken are stored in the server's record of the brainstorm session and noted on everyone's screens. Even the remotely located consultant's audio can be assured of good quality, as audio recording is made from the mobile phone sitting beside him. While all this is going on at the headquarters, Sally the CFO happens to be on the road. Having a 10-minute opening, she logs on and can see all the important ideas that the participants identified as a synopsis. Up to speed now she calls and logs into the interface. John notices her button appear on his iPhone and asks if Sally wants to say something.

Post Meeting Collaboration and Expansion

During the meeting, it was decided that John would be responsible for organizing the brainstormed ideas, and coordinating the execution of them. As he adds his comments for the audio snippets, he is grateful that Peng thought to record Martin's detail step-by-step execution plan. "Sure helped to answer many of my lingering questions," John thought, "and even better, I could play this exact instruction to my team, and put everyone on the same page."

System Implementation

The system consists of two parts: the mobile phone front end and the server back end. The back end consists of two servers. First is a Ruby on Rails (RoR) server, which handles and displays all meeting related contextual information, such as meeting name and length, and meeting participants. In addition, it keeps track of two signals, "request for recording" (when a meeting participant thinks someone has said something important and would like it recorded), and "request for refresh" (when meeting status has changed and all devices are advised to refresh the meeting report page). The second server is an Apache server running PHP, which allows for efficient handling of audio file uploads and downloads. Currently, the only way to playback the audio files is to download them via the Apache server.

The meeting report page, which is managed by RoR, is the focal point of the application, serving both as the meeting status display and where requests for recordings are made. All the meeting context information mentioned in the previous paragraph is displayed on the meeting report page. As it is a webpage, all meeting participants and observers can

	T_1	T_2	# of Audio
Group 1	66% (ME)	52%	38
Group 2	89%	86% (ME)	17
Group 3	87% (ME)	77%	17
Group 4	53%	48% (ME)	7
Group 5	59% (ME)	39%	24

Table 1. Group score for meeting reconstruction

Key:
T_1: task 1 reconstruction score
T_2: task 2 reconstruction score
ME: Meeting with Meeting Essence II system

browse the page, either with a mobile phone or a browser, and see the latest status of the meeting. In addition, clicking on the name of a meeting participant on the page would order that meeting participant's device to record and commit this part of the audio.

The front end is implemented on an Apple iPod Touch (iTouch) with Objective C. To ensure that users can seamlessly capture audio that has gone by, we have the iTouch recording constantly in the background. Once a user decides that a certain piece of audio is important and decides to commit (via the request for record), it will capture the previous 10 seconds, record for 10 more seconds, and upload the 20 seconds of audio onto the server, as it is the audio strip deemed important by the meeting participant.

Experiment

We have conducted a pilot study to understand the usability and performance of our system. 15 experiment volunteers were recruited from the Carnegie Mellon Silicon Valley student body to experience the system and its use in a hidden profile task meeting.

For each of these meetings, the subjects were given a Hidden Profile task, also known as a Stasser task. This consists of three sets of readings given to three different people, with each reading containing different criteria. The set union of all the criteria on the readings will allow the group to find an unambiguous best choice from a group of given candidates. In addition, the subjects were explicitly told that they would be asked about choice and criteria for choices in a reconstruction phase. No limit was set on the length of discussion for both of these meetings.

Groups were randomized to start with iTouch or without and alternated for the second meeting. Each group started with a meeting to choose a manager for mining operations. Each group's second meeting concerned choosing a post-wedding reception site.

Experiment Design

The experiment is divided into two phases: the meeting phase, and the meeting reconstruction phase conducted a week after the meeting phase. During the meeting phase, the subjects are divided into groups of three, and were asked to conduct two meeting tasks. In one of the meetings, they have only pen/paper and a clock displayed on their iTouch, while in the other, the subjects will have access to pen/paper and the Meeting Essence II system to do note taking.

Meanwhile, the meeting reconstruction phase is an individual task, where each participant was given the pen/paper notes they have taken during the experiment. For the meetings that had Meeting Essence II, each person additionally received a zipped file of time stamped audio snippets recorded during the meeting.

Experiment Results-Meeting Reconstruction Score

We evaluate the effectiveness of meeting information capture system by calculating the average score of all members in an experiment group for a given meeting reconstruction task (0 to 100%). In the reconstruction task, they were asked to recall the decisions they made in the meeting, and how they arrived at that decision.

Factors taken into account when analyzing the reconstruction scores for table 1:

Question	Meeting Essence II	Clock
Do you think the interface help in the meeting?	2.87	2.4
Do you think the interface draws attention away from a meeting?	3	1.93

Table 2. Survey response for system usability. A 5 point Likert Scale was used, where 5 stands for "very much".

1. Group note-taking practices varied greatly between groups. Therefore, only within-group comparison of with and without our Meeting Essence II was done.
2. The presentation of task 2 is inherently more difficult than task 1, noticeably affecting the percentage score of reconstruction.
3. Each group's level of uptake of our system, which can be roughly gauged by the number of audio commits, may have an effect on the reconstruction score.

Using linear regression, we discovered that: for R, the number of recordings made in a meeting, and M for Mining and W for Wedding % correct on reconstruction

- $W = M - 7.58\% + (0.26R)\%$
  (for groups that used Meeting Essence II on task 2)
- $W = M - 7.58\% - (0.26R)\%$
  (for groups that used Meeting Essence II on task 1)

The number of audio recordings correlate positively with the reconstruction score of the task which the system was used, contributing over 1% for every 4 audio snippets committed.

Experiment Results–Survey of System Usability
Qualitative results of Meeting Essence II system usability compare survey response for the iTouch condition with the pen/paper + clock condition. Table 2 shows that meeting participants find the Meeting Essence II system only marginally more helpful during their meeting. We have attributed it to the fact that

1. The experimental meetings had a relatively small number of collocated participants, therefore would not need the Meeting Essence II client in helping to identify other meeting participants.

2. Time management was not emphasized. Therefore, subjects found many of the time management related UI of little relevance. In actual use, we expect time management features to be valued.

In this first experience of selecting a subject's name to record audio, versus doing nothing, subjects found the Meeting Essence II client drawing more attention away from the meeting than a clock interface. While recording during a meeting does incur a little overhead, this is less overhead than other known approaches for annotating a meeting. We expect this overhead to diminish with time.

Discussion

In this paper, we have demonstrated a novel mobile phone based, social interaction centric meeting information capture system. The system only requires a touch to make audio recordings for important meeting moments, and receives feedback about a meeting on the same screen. Surprisingly even one touch was noted as a distraction (press- to-talk microphones also annoy meeting goers.) In spite of pilot study's limited scope, it shows a positive correlation between the numbers of audio commits and the ability to reconstruct what happened in a meeting.

Several alternative user interfaces were explored. This version allowed casual demonstrations to explain how the system keeps users aware of time left in a meeting, relative input from both people that record an idea and people whose ideas are recorded. Being shown once this final version allowed all presented to understand what to do and how to do it. It eliminated learning and remembering button actions. We are proud of

integrating the dimensions of time and contribution as a user interface/visualization in this application.

We are quite sure that the simplicity of use and added information about meetings will allow experienced users to gain the value of improved reconstruction shown in our pilot study while enjoying new benefits of being able to know more about their meeting. The interface facilitates knowing about time spent and left, about dominance and contribution of people, it focuses people on contributing instead of doing other things with their phone, and it reminds people of who is in the meeting. The interface can in fact become a communication tool within the meeting allowing people to notice and be noticed by others.

Finally people like the fact that the system automatically keeps a record of when and who participated and what they did. We expect that this interface will facilitate simpler setup of better documented meetings allowing new kinds of light weight meetings which might change the way we construct and follow-up on consensus.

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