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

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Abstract
Current meeting information capturing paradigms such as pen and paper has been found to be tedious and distractive. This paper presents CollabMeet, 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 only moments deemed important by meeting participants are recorded with a single click of a button. 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

Mobile phone, meeting, social interaction and sense making, audio, computer-supported cooperative work

Introduction

Meeting as a collaboration method to create and share people's knowledge is gaining ever-greater importance in the modern day society, as more and more emphasis is put on information exchanged or decisions made in meetings. However, 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 current solution: note taking with pen/paper, is found to be unsatisfactory due to its effort intensiveness yet being error prone and incomplete [10].

Many solutions have been proposed, each with varying degree of success and drawbacks. Collaborative note taking, such as NotePal [2], does improve completeness and accuracy, but does not resolve the issues of it being effort intensive and its inability to capture other communication cues such as tone. Audio recording of the meeting in entirety [3,6], while requiring little effort during the meeting and shown to be very useful for reconstructing meeting content [3,6,10], 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 [1,8,9]. However, existing solutions require specialized hardware, or even special rooms, which naturally inhibit the widespread adoption of these technologies. So, despite previous effort, uptake is limited, and pen/paper continues to be the mainstream of meeting support tools.

In this paper, we present CollabMeet, a mobile phone based meeting information capture system that utilizes the built in touch screen and recording ability of today's smart phones. In addition, with the one screen, one click system, we introduce 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 our system with previous meeting information capture systems is as follows:

1. Audio recording are made by mobile phones, implying portability. In addition, recording from a microphone device close to speaker source ensures decent audio quality from built-in or relatively inexpensive microphones, and allows for remote meeting participants.
2. Non-distractive one click recording by meeting participants ensures that only audio of the important parts of the meeting is 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 also opens up new opportunities of generating meeting minutes and audio indexing 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),

Scenario

Meeting Room Capture

John runs into a meeting, two minutes late. After two consecutive meetings, he could not possibly remember what is this meeting suppose to be about. Calmly, he boots up CollabMeet 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. In addition, the system shows five other participants: four in the same room and one remotely located consultant on phone bridge.

As the meeting progresses, great ideas are starting to emerge from the brainstorm session. The flow is way too fast and interesting to allow time for writing. Fortunately, with one click of a button, John can be assured that all these interesting ideas are faithfully captured on the server. 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, the company's CFO happens to be on the road. Having a 10 minute opening, he listens in to some of the recordings made and nods in agreement with many of the proposed ideas.

Post Meeting Collaboration and Expansion

During the meeting, it was decided that John will be responsible for organizing the brainstormed ideas, and coordinating the execution of them. As he writes down the ideas from the audio snippets, he found some pleasant surprises. One of his colleagues has also helpfully recorded the consultant's detail step-by-step execution plan, which John somehow missed. "Lucky the instruction is captured word for word. 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." "Great. Rock n' roll time!"

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 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 2nd Generation (hereby on called iTouch for short) with Objective C. To ensure that users can seamlessly capture audio that has gone by, we have our 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. Experiment subjects are 15 volunteers recruited from the Carnegie Mellon Silicon Valley student body who were novices of the system.

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 CollabMeet 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 CollabMeet, each person will receive additionally a zip file of time stamped audio snippets they recorded during the meeting.

Experiment Results-Meeting Reconstruction Score

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

Discussion of a few assumptions are also in order. First of all, group note-taking practices affect reconstruction score greatly, such that members of the same group usually score similarly, while inter-team scores vary greatly. Therefore we find it only meaningful to compare how each team performed with and without the help of our CollabMeet system. In addition, we also find that the presentation of task 2 is inherently more ambiguous than task 1, noticeably affecting the percentage score of reconstruction. Finally, we believe that 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. All these factors were taken into account when we analyze the reconstruction score detailed in table 1.

Using linear regression, we have discovered an interesting relationship between the reconstruction score for task 1 and task 2. Specifically, define R as the number of recordings made by the group, and T_1, T_2 as task 1 reconstruction score and task 2 reconstruction score respectively, then

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

Table 1. Group score for meeting reconstruction

Key:
T_1: task 1 reconstruction score
T_2: task 2 reconstruction score
CM: Meeting with CollabMeet system

Question	Collab-Meet	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".

- $T_2 = T_1 - 7.58\% + (0.26R)\%$
  (for groups that used CollabMeet on task 2)
- $T_2 = T_1 - 7.58\% - (0.26R)\%$
  (for groups that used CollabMeet on task 1)

This means that in task 2, due to inherent ambiguity in the task, teams tend to score 7.58% lower. On the other hand, 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

We now look at the qualitative results of our CollabMeet system usability by comparing the survey response for it with the pen/paper + clock system. As shown in table 2, meeting participants find the CollabMeet 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 CollabMeet client in helping to identify other meeting participants.
2. Time management was not emphasized in our experiment meetings, as we were more interested in gauging the potential usefulness of our system for meeting information capture and retrieval, and so no time limit was set. Therefore, subjects found many of the time management related UI of little relevance. However, time management is of utmost importance in most real-world meetings.

It is also not surprising that experiment subjects found the CollabMeet client drawing more attention away from the meeting than a clock interface, because subjects have to click on another subject's name to record audio, versus doing nothing. While recording during a meeting does incur extra overhead, but this overhead should be compared with the overhead of capturing information with contemporary technology such as pen/paper, and/or the cost of not having the important information captured.

Discussion

In this paper, we have proposed a mobile phone based, social interaction centric meeting information capture system with a one screen, one click simple interface that allows users to both make audio recordings for important meeting moments and receive feedback about a meeting on the same screen. System usability wise, survey results show that there is still room for improvement on our prototype system to make it less distractive to meeting users. In terms of meeting information capture, in spite of our pilot study's limited scope, we can see a positive correlation between the number of audio commits and the reconstruction score. This is a promising start, and it will be interesting to try to build and improve on this positive correlation.

There are also a number of possible improvements that would make the system more helpful to users. First of all, on the meeting information retrieval end, we would like to implement a dedicated web-based audio retrieval and playback webpage, so that users will be able to browse and choose the desired audio file in the context of other meeting information. In addition, we would like to provide the functionality of tagging or commenting on specific audio snippets to facilitate even faster retrieval, similar to the social tagging mechanism proposed in [5]. For meeting information capture, we would like to incorporate the functionality of uploading photo and text contents to facilitate better capturing of

different types of information [4]. Finally, it would be interesting to explore the idea of semi-automatically generated meeting minutes that is based on "request to record" information collected by the system, utilizing the inherent social redundancy [7].

Building a widely adoptable and acceptable meeting information capture and retrieval system has turned out to be a challenging problem, as most current systems still have hardware and/or software hurdles to overcome [10]. However, by proposing a mobile phone centric solution, and bringing in the idea of social tagging and social redundancy into meeting information capture and retrieval, it would be one step in the right direction to tackle this hard yet invaluable problem.

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