

# Decreasing Interruption Levels of Incoming Phone calls Using Calendar Events and Ambient Noise

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## ABSTRACT

Communication technology systems today do not adequately use situational context clues available with available sensor technology. We describe a contextual input, mobile phone application running on the Android OS which aims to reduce the number and amount of interruptions by evaluating both events inputted from Google Calendar as well as ambient noise as detected by the phone. We had users try out the application over a two-day period, during which they were asked to fill out surveys on provided Motorola Droid phones after every incoming call. After comparing the results from those users using and not using our application, results indicated that there were minor decreased interruption levels with our system, but nothing significant.

**ACM Classification:** H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces. H1.2 [Models and Principles]: User/Machine Systems; I2.6 [Artificial Intelligence]: Learning.

**General terms:** Design, Human Factors

**Keywords:** mobile phone ringers, context-based systems, human interruptibility, wireless applications, RingSense

## INTRODUCTION

In person, it usually is not very difficult to tell whether someone is interruptible or not. However, when using mobile communication, it is much more difficult to assess interruptibility. One way to improve the quality of systems and decrease system interruptions is to take advantage of device sensors to assess the user's setting.

With the proliferation of information technology systems such as online calendars and increasingly accurate sensors, mobile systems should harness these in order to improve performance. Our hypothesis is that it is possible to use calendar events, a set of heuristics, and ambient noise sensors to decrease interruption levels of incoming phone calls.

## RELATED WORK

Much research has been done to test this idea of interruptibility across instant messaging and desktop computing using contextual clues in order to decrease when systems interrupt users.

Studies have been run on implicit human computer interac-

tion in which situational context can find the most suitable times for interruptions and reduce the needs of interruptions [4]. In the area of text and instant messaging, the detrimental effects of instant messaging on task completion have been explored [2]. Furthermore, a set of sensors and heuristics which could determine with 78% accuracy in an office / lab setting was developed by Fogarty, *et al* [3], as well as research which rated the effectiveness of self-reported interruption levels [1].

## SYSTEM DESCRIPTION

Our system, RingSense, was implemented as an Android application, running on Droid phones that we distributed. RingSense uses two inputs to gauge the participant's interruptibility: the user's Google Calendar and ambient noise.

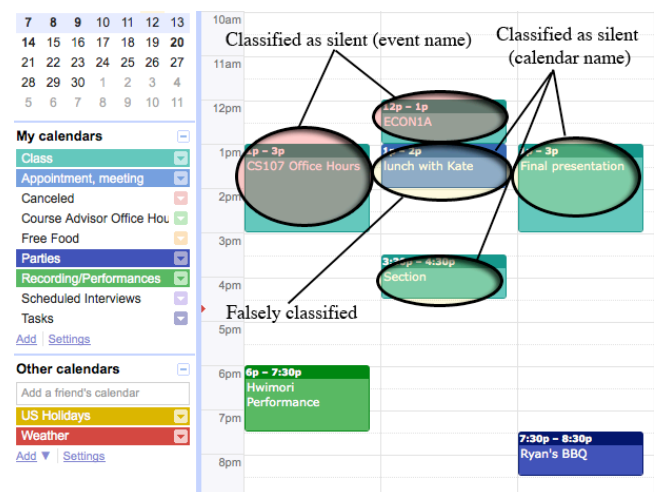


Figure 1. System's Classification Heuristics

Events on the participant's calendar are classified as 'silent' if they satisfy certain heuristics. If any calendar or event name contains the words 'meeting,' 'class,' 'interview,' or 'appointment' or the plural representation of these words, RingSense automatically turns the phone to silent. Additionally, if the first characters of any calendar or event are defined by the regular expression 'X\*Y\*X' where X is any capital letter, and Y is any number we assume the event is a class and automatically turn the phone to silent.

The silencing of the phone is executed in an opt-out manner; the phone notifies the user that it is silencing itself, and the user can turn ring or vibrate back on if they desire to do so. In Figure 1, 'Lunch with Kate' may be falsely classified because the user put it under the calendar name 'Appointments, meetings.' In this circumstance, the user may want to opt-out.

Additionally, if the user receives a call during an event where RingSense had turned their phone to silent, RingSense notifies them when the event is complete, and reverts the ring back to its previous setting before the meeting. If they do not receive a call during a silent event, their phone just reverts back to its previous setting without any notification.

Using ambient noise we also try to gauge when the user might be more amenable to interruptions. Every 5 seconds, we gather noise data by storing the max amplitude every second for five seconds. We then average these five amplitudes to compare to a threshold value. If the average exceeds the threshold, we turn the phone to its max volume, and set it to vibrate. Once the average drops below the threshold, we revert the phone's settings back to the user's preferences. This threshold is set to be slightly below the maximum amplitude that the phone's microphone is capable of picking up.

## MEASURES

The survey after every incoming call asked the user to rate how interrupted they were (on a scale of 1--not interrupted at all to 5--very interrupted) and, if they felt interrupted, what they would they have preferred the ringer to be (louder, quieter, or no change).

The application printed out the calendar events and also tracked ambient sound, in order to determine the calls received during events or during loud noises.

Afterwards, the participants were asked to fill out a post-questionnaire qualitative evaluation about their general phone habits, calendar habits, and general responses about the system.

## PARTICIPANTS

After initial testing of our system on 12 users, a total of 19 Stanford students (68% male, aged 17-25) who all used Google Calendar were recruited to participate in the experiment. We had 10 in the experimental condition and 9 participants in the control condition. Of those in the experimental, 45% used Google Calendar for more than basic reasons.

## PROCEDURE

Each trial took place over a 46-hour period, starting the

night of the first day and ending the night of the third day. We used a between subjects design, with two groups: control and experimental which received different versions of our application. On the night of the first day, participants were given a written briefing about the study, and they were asked to set-up call forwarding from their native mobile phone numbers. Finally, they were given a test call to show them how to fill out a survey on their phone. Then they were asked to log-in to the phones with their Google Accounts so their calendars were synchronized with their phone. In order to have a base-line level of incoming phone calls, we set up a system on CallFire to "poke" our users with phone calls at sometime during the late morning, early afternoon, and early evening to try and catch the users in an event.

Participants were randomized into which group they were put in--but both groups had the application running: the control group's RingSense logged the data but did not actively change the ring style, but the experimental group's did change.

## RESULTS

We received 133 survey responses. 40 of these responses were from the experimental group, 93 were control. The difference in survey responses is due in part to the random difference in the number of calls users received. Additionally, if multiple calls were missed in the control group because their phone was automatically turned to silent, they would only fill out one survey for all of these calls.

To compare the difference in interruptibility between the two groups, we performed a t-test on the mean interruptibility rating (ranging 1-5) of the two groups. The experimental group had an average interruptibility of 2.36 and the control had a mean of 2.65. Testing against the alternative hypothesis that the experimental mean is less than the control, the data produces a t-statistic of -1.77 and a p-value of .1047. Thus, our results were not significant enough to confidently say that RingSense decreased interruptibility.

## SYSTEM EVALUATION

The insignificance of our system's effect on interruptibility can be accounted for in part by the lack of valuable data in our results. The situation where a user was in an event classified as silent *and* they received a call occurred relatively rarely. After our initial tests, we attempted to increase the amount of valuable data by setting up the automated calling system to ping the participants at various times in the day, but unfortunately this still didn't produce enough useful data. To really assess significance, we need to perform our tests on hundreds of users over the span of months, because the context in which the control and experimental groups differ seldom occurs.

While it was difficult to gather significant quantitative data, we received some valuable qualitative responses. A trend

in these critiques stressed a desire for call importance or priority to be integrated into the system. One user said, "There were times when I felt really interrupted by a phone call that turned out to be one I wouldn't want to miss. So importance of a phone call isn't really addressed by the system as far as I can tell." A priority system could be implemented, but it would require either extensive priority tagging of user contacts, or screening interactions with the caller.

### **FUTURE WORK**

Apart from testing significance on a larger user base, RingSense could also potentially be applied towards phone power management. Instead of turning the phone to silent, we could set it to airplane mode for the duration of an event. Additionally, with the concession of some phone power, GPS and accelerometer inputs could potentially be integrated into our system to try to further gauge the user's setting and interruptibility level.

### **CONCLUSIONS**

Although our results were not significant, the application could still be useful for those who use Google Calendar extensively. The numeral feedback we received did not strongly correlate with the qualitative feedback we received from the surveys, suggesting that the system was a good idea and that users would use this *if* they could somehow keep track of "important" phone calls. Another iteration of this study with more participants over a longer time-span

would yield stronger results.

### **ACKNOWLEDGMENTS**

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