A Context Aware Interruption Management System for Mobile Devices

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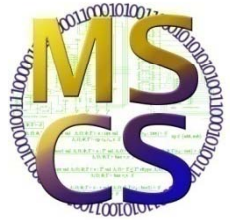


Outline

- Motivation
- Problem Description
- Contribution
- Characteristics
- Related Work
- System Architecture
- Case Study Application
- Evaluation
- Future Work

Motivation (Some Statistical Data)

- Phone Subscriptions Worldwide ~ 4.6 billion by the end of 2009
- There are 225,000 active iPhone Apps with over 5 billion downloads
- Undesirable interruptions constitute 28 percent of the knowledge worker's day. Which translates to a loss of 700 billion dollars per year in US alone

Motivation(cont'd)

- 18-21 year olds are losing advantage over 35-39 year olds in cognitive demanding situations solely because of electronic communication technology
- When interrupted, users take up to 30% longer to complete a task associated with up to twice the number of errors
- Yesterday's Speaker, Prof.Wolfson's talk interruption

Problem Description

- The massive growth of mobile devices comes with a cost: INTERRUPTION without any consideration of TIME and PLACE

- Hence, we need a mobile interruption management system that will decide in real-time if the user should be interrupted

Contributions

- Designed and developed a mobile **intelligent** interruption management architecture for mobile devices
- Implemented a case study application using the developed system architecture
- Evaluated the prototype application
- Gathered users' feedback regarding the usability of the case study application

Desirable Characteristics

- Mobility (C1)
- Customizable (C2)
- Adaptable (C3)
- Context Aware (C4)
- Automated (C5)
- Unavailability Aware (C6)

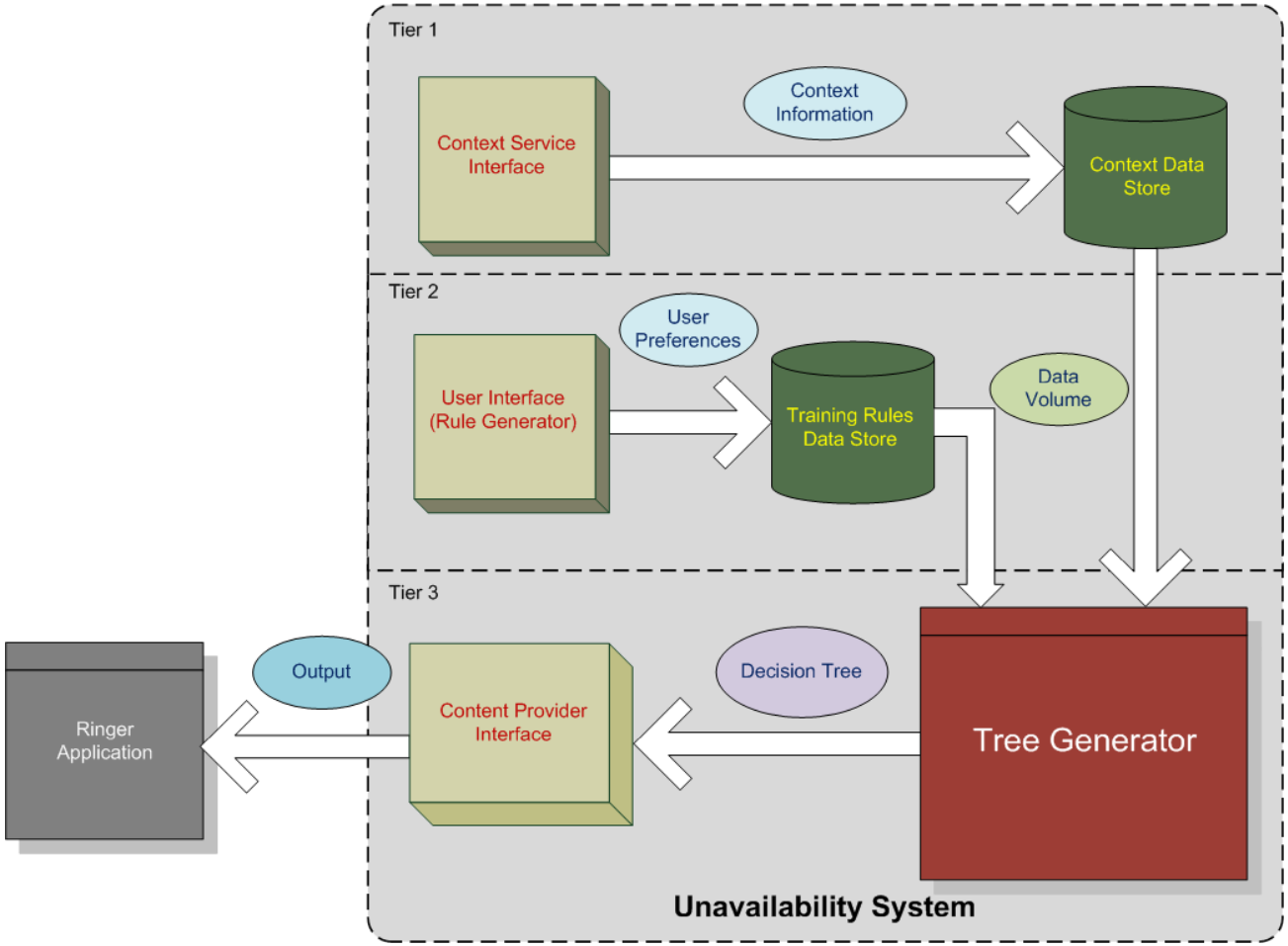
Related Work

- Dekel et al. [11] built an application that minimizes mobile phone interruptions by changing profile settings intelligently
- Savioja [32] addresses different kinds of alarms for different types of interruptions in control room environments
- Khalil & Connelli [25] use calendar information of the phone to minimize disruptions
- Godbole & Smari [15] proposed a methodology and design process for building interruption aware system
- Bailey (2008) uses non specific task cues such as desktop activity, pupil size, etc.

Related Work (Comparison of various systems)

Characteristics → / Research Works ↓	C1	C2	C3	C4	C5	C6
Toninelli et al. [36]	X	X	-	X	X	-
Godbole & Smari [15]	-	-	-	X	X	-
Picard et al. [31]	-	-	X	-	X	-
Bailey et al. [5]	-	-	X	X	X	-
Ho & Intille [20]	-	-	X	X	X	X
Mark et al. [27]	-	-	-	X	X	-
Dekel et al. [11]	X	X	-	X	X	-
Guzman et al. [17]	X	-	-	X	X	-
Khalil & Connelli [25]	X	X	-	-	X	X
Marti & Schmandt [28]	X	X	-	-	-	X
Our System	X	X	X	X	X	X

System Architecture



System Architecture (Contd...)

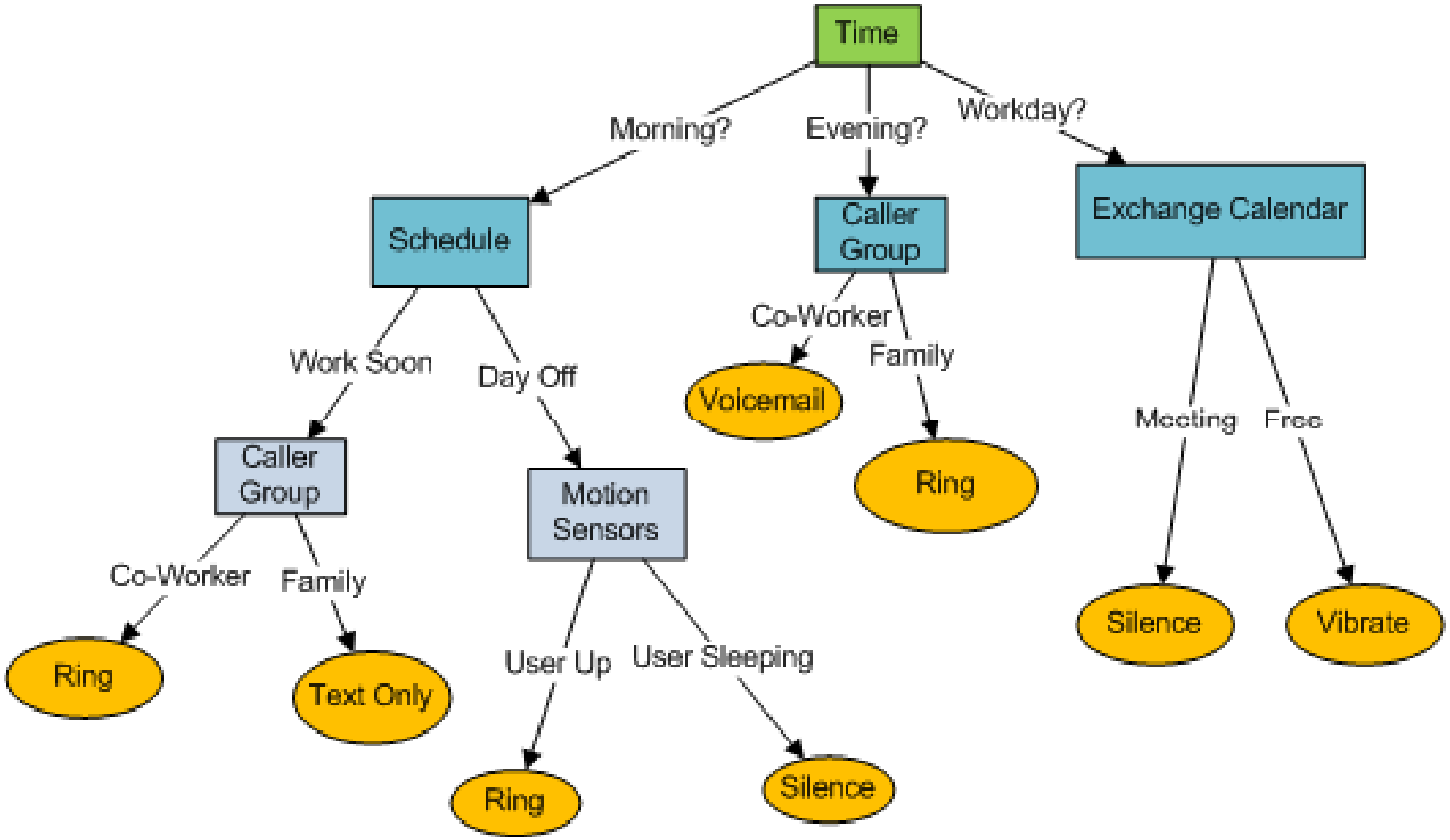
- **Tier 1 (Context Information).** This tier aggregates information from the internal sources and generates a Context object to be stored in the Context Data Store. This object is passed to the Tree Generator (Decision Tree tier) for processing

- **Tier 2 (User Preferences).** User specific choices and rules are stored in this tier

- **Tier 3 (Decision Tree).** The Tree Generator receives inputs of Context Data Point from Tier 1 and user preferences from Tier 2 and then generates a decision tree structure.

System Architecture (Contd...)

An example decision tree:



Case Study Application (Scenario)

- An organization wants to send all its sales employees performance metrics each hour
- Each sales person has an area specified as their work area and the company wants to send the metrics only during work hours.
- Whenever the sales person is in some scheduled event the company does not want to send the metrics

Case Study Application (Services Used)

Three contexts used: Location, User's Schedule, and Day of week along with Time of day.

- Used Google Calendar as the scheduler
- GPS service
- System clock as the third service

Case Study Implementation (Platform)

Development Platform: **Android**
Cell Phone Used: HTC G1 from TMobile

Reasons to choose Android:

- Linux to the core and entirely open sourced
- Can run background processes using minimal CPU and battery resources
- Only platform that allows full control of the ringer application

Case Study Application (Screenshots)

Location Finder

lat: 43.038577 long: -87.9292736

1313 W Wisconsin Ave Milwaukee WI 53233

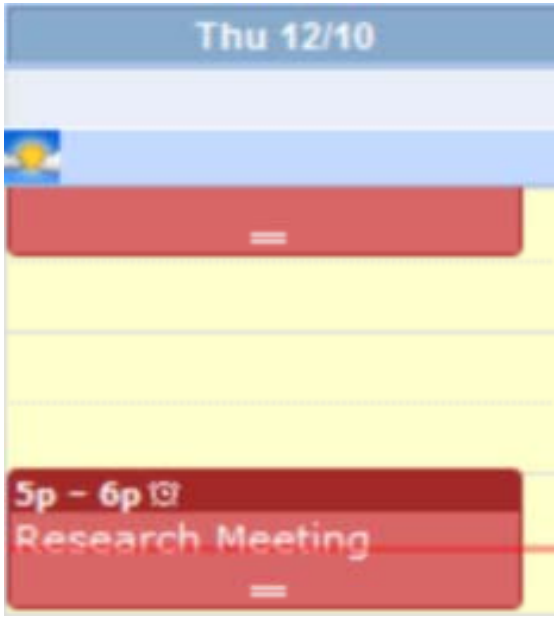
distance: 0 meter

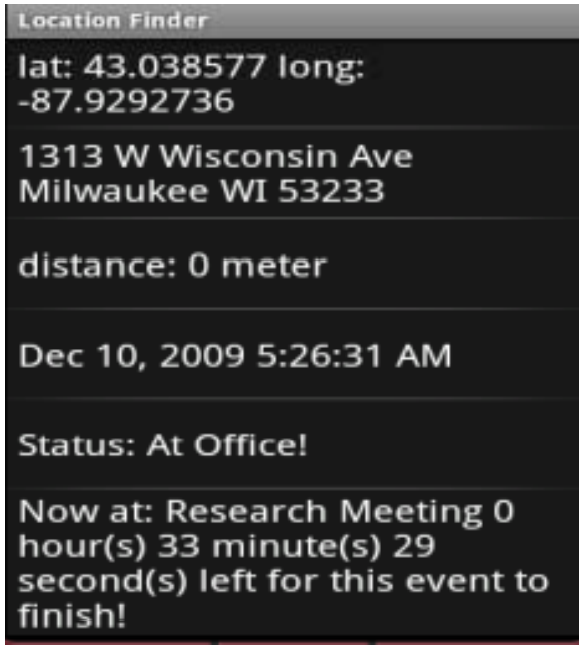
Dec 10, 2009 5:26:31 AM

Status: At Office!

Production: 500 Sales: 300 Rank: 3

Case Study Application (Screenshots Contd...)





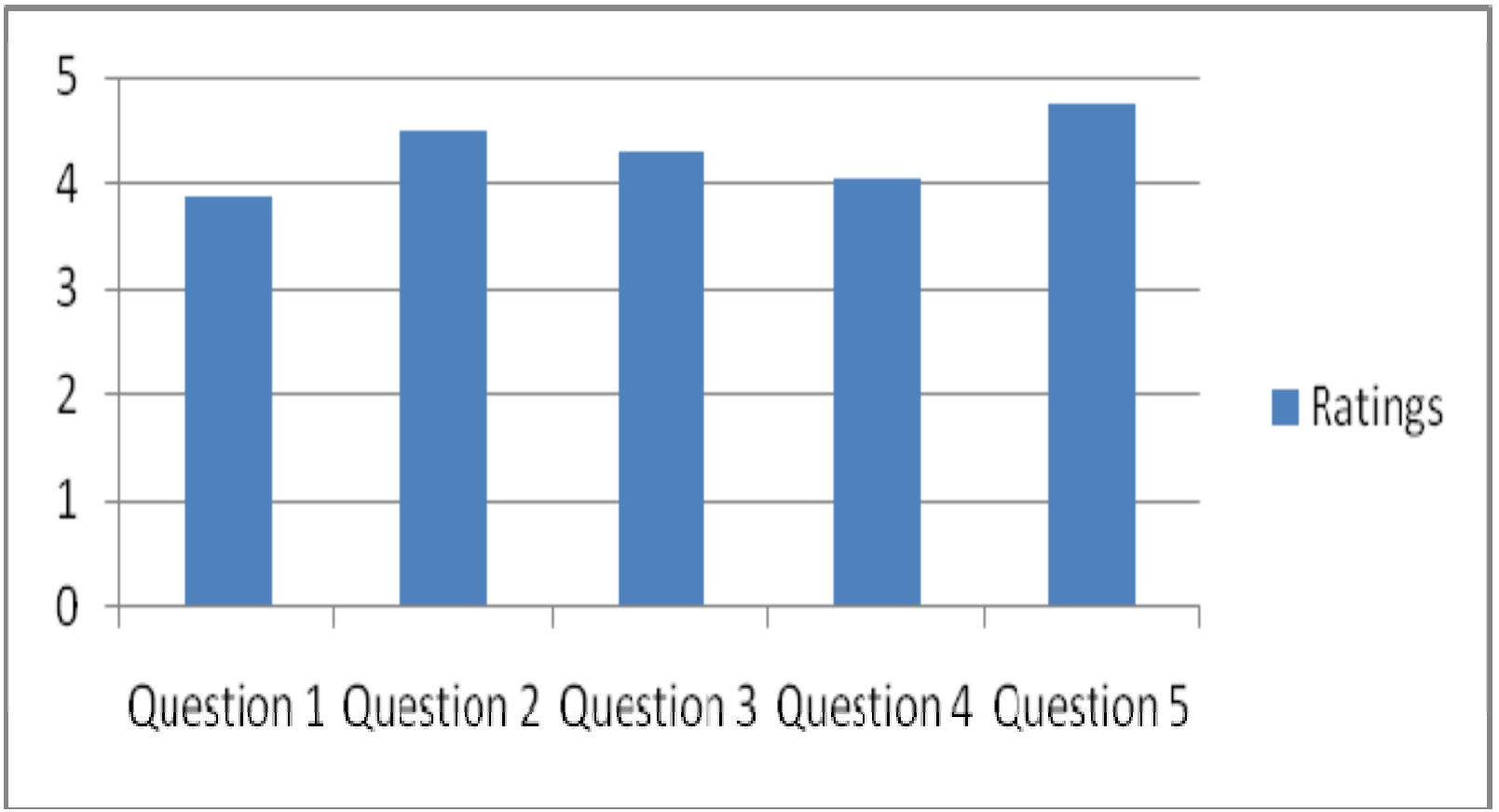
Evaluation

- Installed on a cell phone with dimensions only 117.7 mm × 55.7 mm ×17.1 mm
- Data volume received is calculated below 50 kilobytes at any given environmental change
- Has built in GPS for instance, one of the only data sources that can be assumed to exist for all deployments and use cases
- Decision tree traversal is a linear process. So the CPU power usage is very low along with the battery concerns
- The user interface component is a constant time computation; again less CPU and memory usage
- Utilizes the varying modes of unavailability; vision, hearing and touch and responds by ringing, vibrating or going silent

Usability Study

- Survey of 30 people (17 ugrads, 8 grads, 2 faculty, 2 industry, and 1 other)
- Q1: Overall, how would you rate the services? (*1 = Very Poor, 5 = Excellent*)
- Q2: What is the effectiveness of this application? (*1 = Not Effective at all, 5 = Very Useful*)
- Q3: How easy is it to give the input? (*1 = Very Hard, 5 = Very Easy*)
- Q4: Will you pay to use this application? (*1 = Definitely Not, 5 = Definitely Yes*)
- Q5: Would you recommend this application to a friend? (*1 = Surely Not, 5 = Surely Yes*)

Usability Study (cont'd)



Conclusions and Future Work

- The caller can be notified of the receiver's current state if s/he is not picking up
- Receiver can inform the caller when to try again
- Plan to formalize the model for unavailability which takes into account context-aware services such as location based services
- Will explore possible applications of our system in different application domains from cell phones to instant messaging, email clients, and social networking
- Currently working toward developing a formal model for Cost of Interruption (COI)

Thank You

Questions?