

# Using Smart Phones for Context-Aware Prompting in Smart Environments

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January 14, 2011



# The Problem

Please turn off the burner.

Sugar is in the cupboard.

Its time to take medicine.

Sam is trying to get in touch with you. You look tired, why don't you take a nap.

**Automatic delivery of verbal or non-verbal interventions that would help a smart home inhabitant in successful completion of daily tasks.**

You just picked up the wrong vessel.

Its time to take medicine.

Sam is trying to get in touch with you.

Sugar is in the cupboard.

It would be a good idea to take a walk.

# Our Solution

Context-Aware  
Prompting

On the go prompt delivery  
on your Smart Phone

# Solution

Behavioral Context from  
Accelerometer Data on  
Phone

Movement-based Real-  
time Activity Recognition

# System Architecture

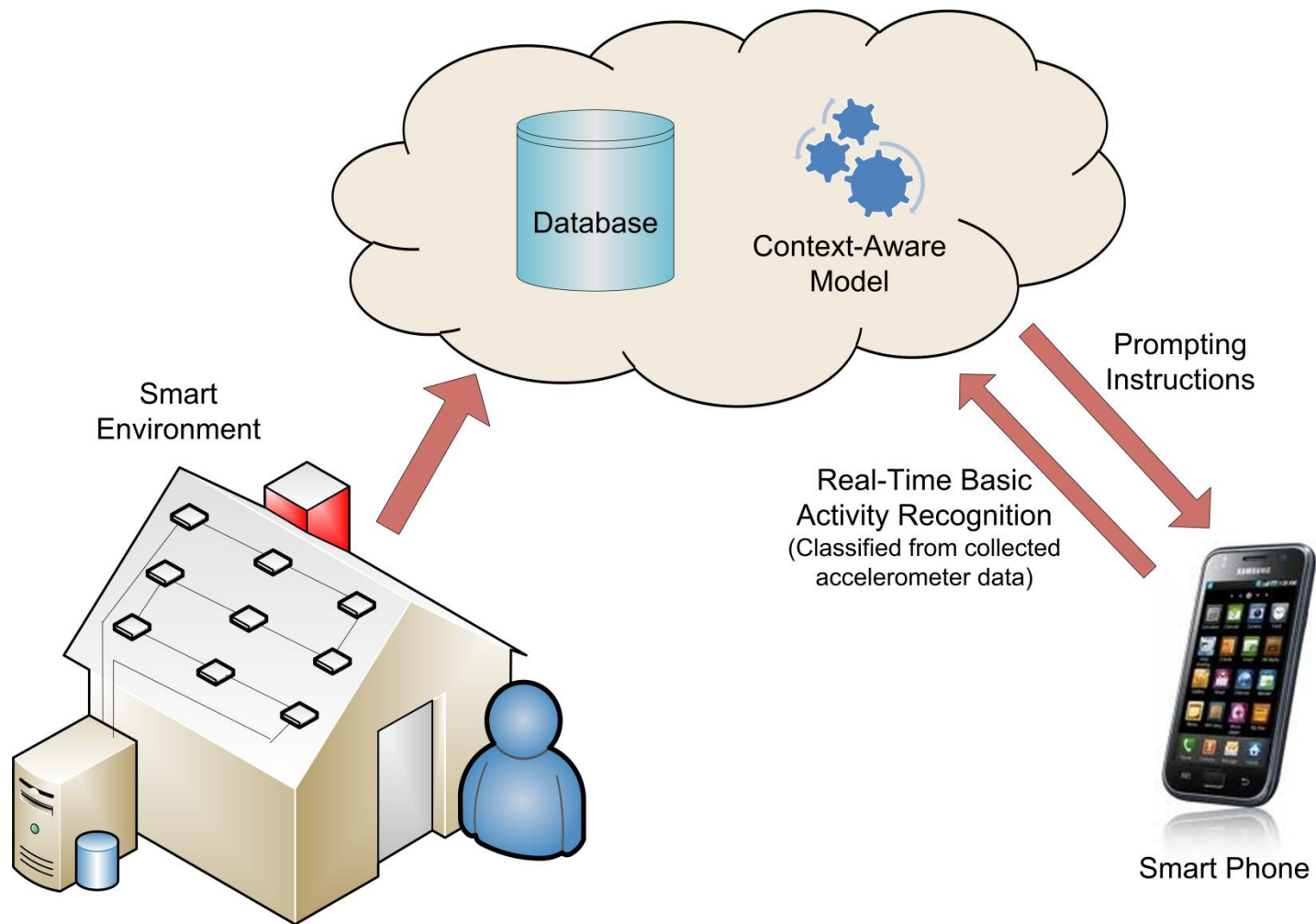


Figure 1: System Architecture

# Middleware Architecture

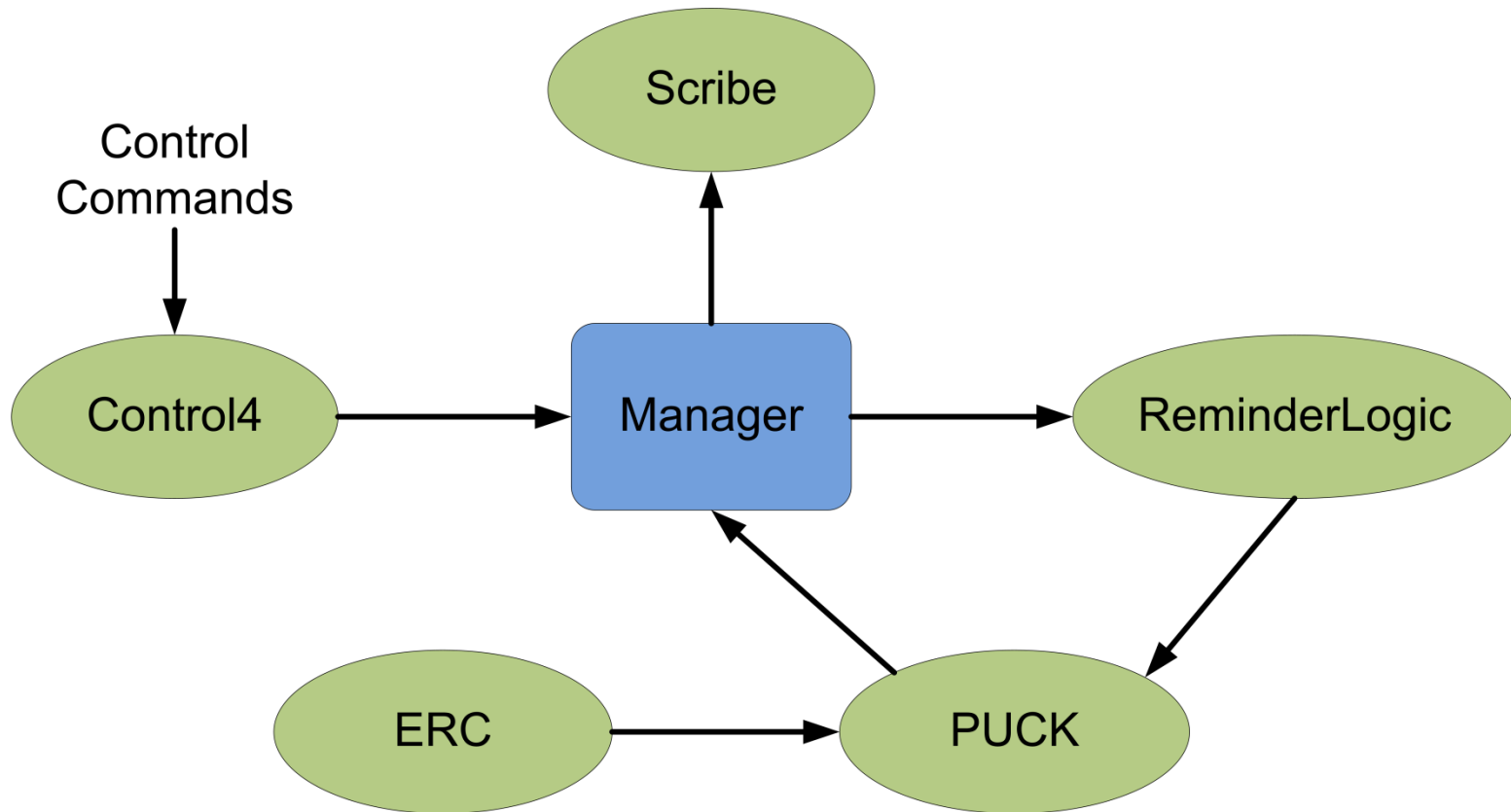
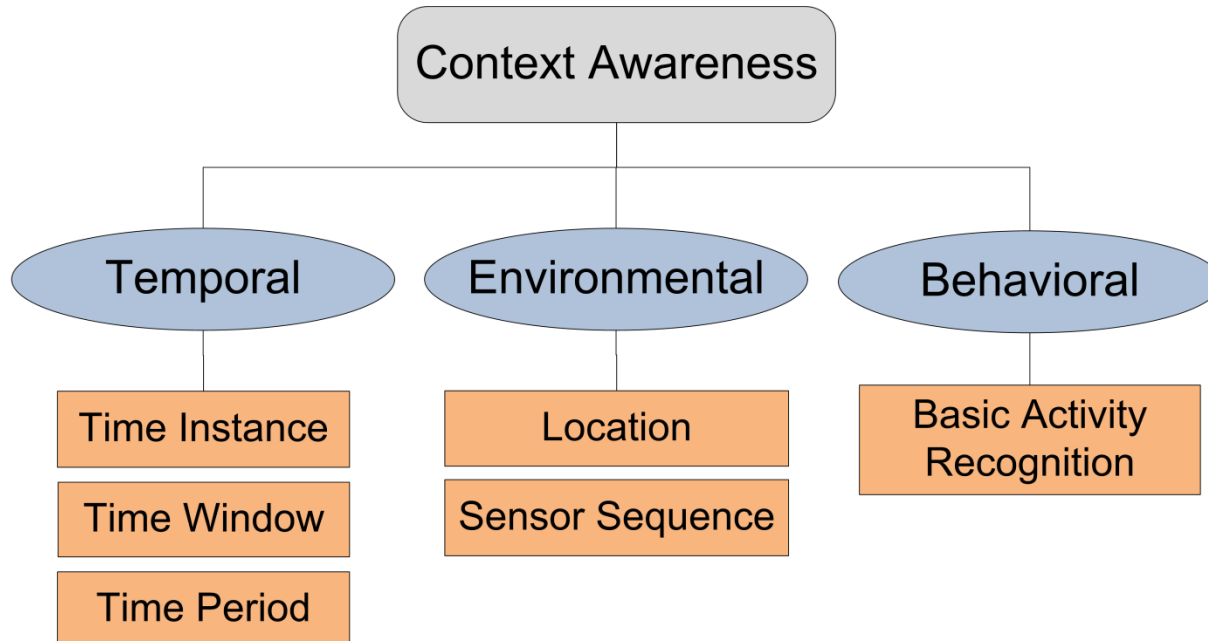


Figure 2: Middleware Architecture

# Phone Infrastructure

- **Device:** Samsung Captivate™
- **Operating System:** Android 2.1
- **Networking:** WiFi makes local connection to XMPP server.
- **Accelerometer Type:** Tri-axial
- **Frequency of Data Collection:** 20Hz

# Context Model



# Example of Context Awareness

- Taking medication sometime in between 7:00 AM and 8:30 AM, right after breakfast:

## Tigger Pattern

```
startTime(7:00:00) ^  
dayOfWeek() ^  
triggerPattern (M013,sitting,walking-standing,M016-M017-M018)  
→ prompt(medication.wav)
```

## Kill Pattern

```
endTime(8:30:00) v  
endPattern(D007, I002 ABSENT) v  
repeats(10)  
→ stopPrompt()
```



# Movement-Based Activity Recognition

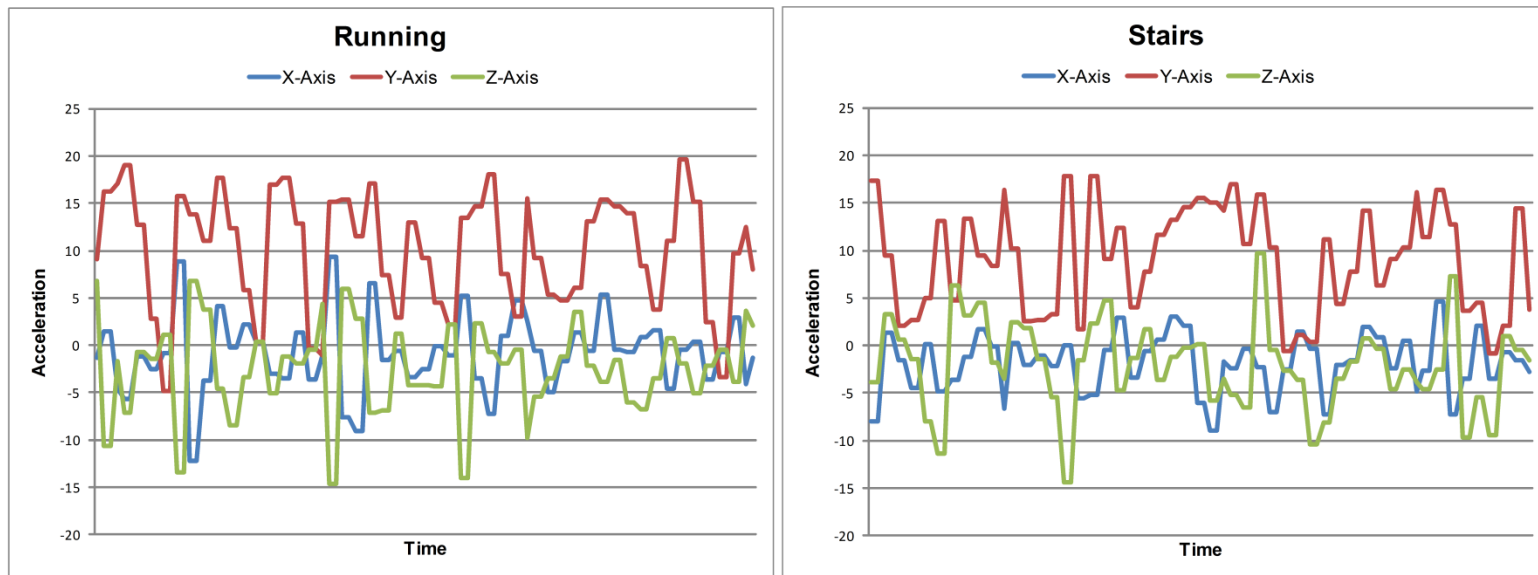


Figure 3: Accelerometer Data for X, Y and Z Axes for activities “running” and “climbing stairs”

# Features

Features	Description
Arithmetic Mean (X, Y and Z axes)	Arithmetic mean of the values of an axis in the time segment.
Root Mean Square (X, Y and Z axes)	$x_{rms} = \sqrt{\frac{x_1^2 + x_2^2 + \dots + x_n^2}{n}}$ where, $n$ is the time segment size (same for $y_{rms}$ and $z_{rms}$ )
Difference Between Max and Min Values	Difference between the maximum and the minimum values in the time segment on a particular axis.

# Experiments

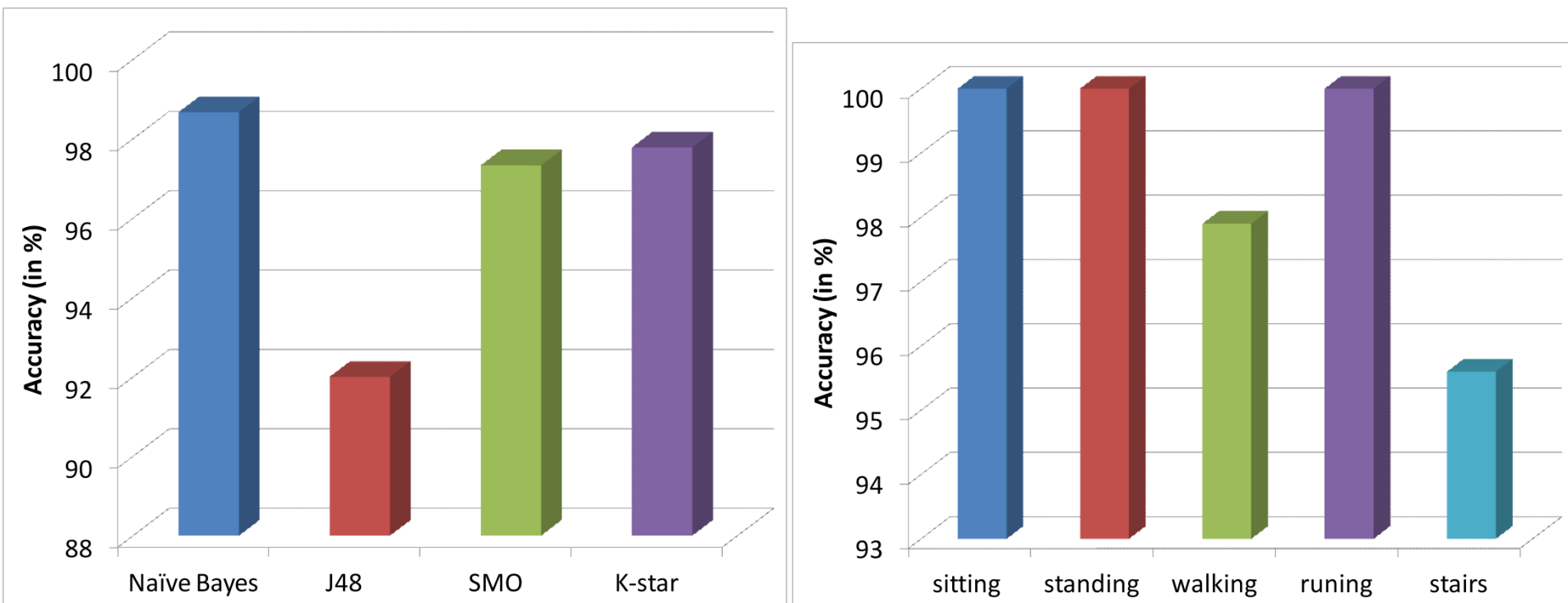


Figure 3: (left) Accuracies of Different Classifiers, (right) Accuracies for Different Activities with Naïve Bayes Classifier



Final implementation. Real-time activity recognition accuracy > 85%

# Future Work

- Phone software to include user's ability to reply to prompts.
- Asking users multiple choice questions to understand the state of the world better.
- User study to include large, unbiased sample size of clinical population (e.g. older adults with cognitive impairment).

# Contact Us

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