



Development of a Mobile Interactive Musical Service

Diploma Thesis Presentation

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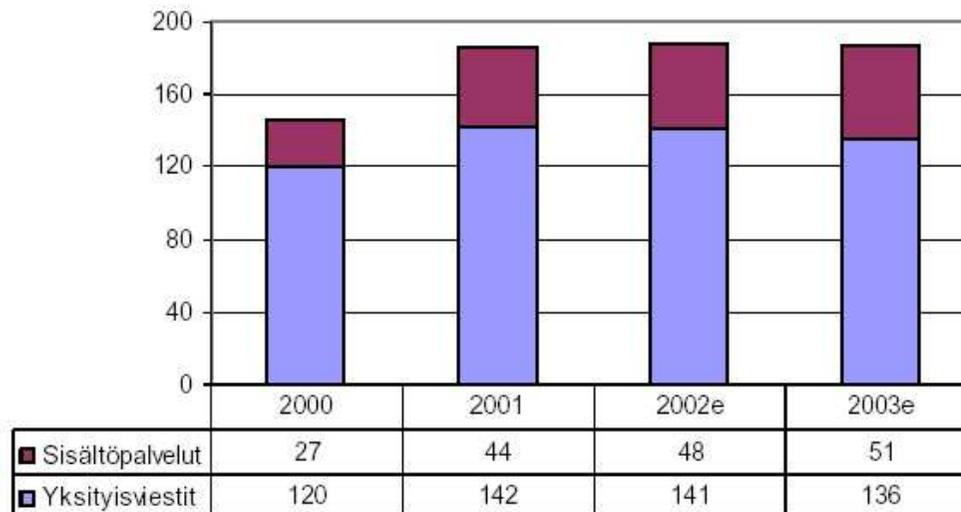
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Agenda

- Introduction
- Overview
- Algorithms
- System
- Demonstration
- Conclusions

Introduction

- Growth of SMS services has been rapid
- Ringing tones is the biggest single service category

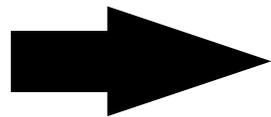


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Introduction, cont.

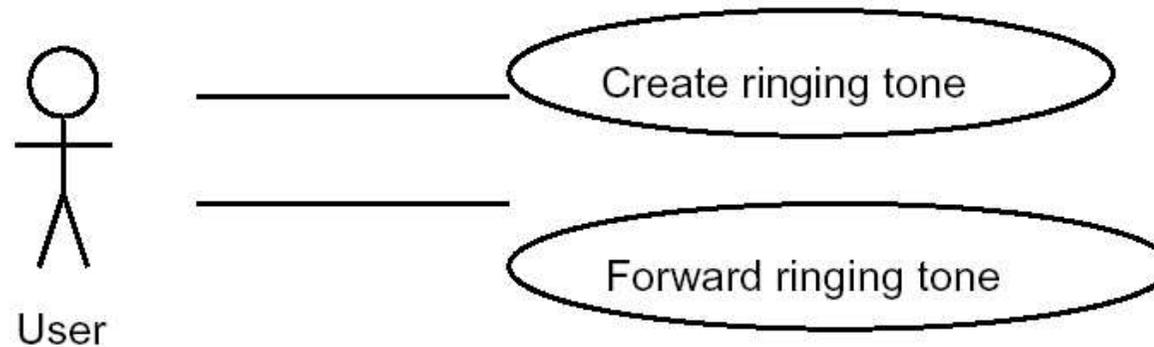
- Growth expected to slow down
- New service concepts needed



Elmorex: Rring

- Call service – Sing – Receive ringing tone

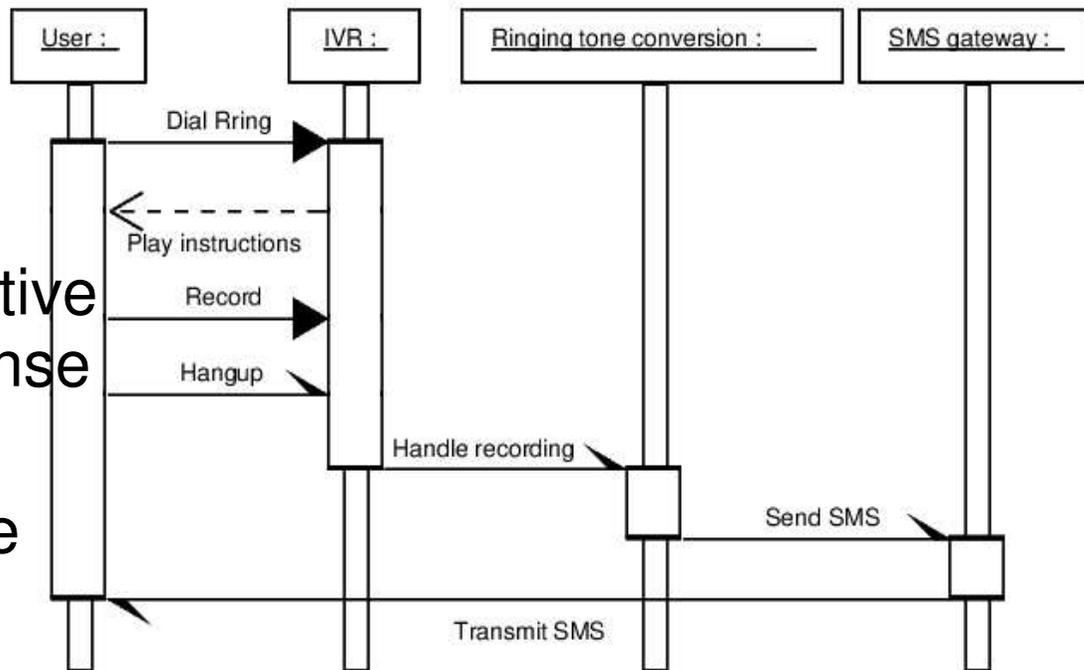
Overview



- Basic usage is simple
- Dial the service, sing, and receive the ringing tone
- Forwarding planned, but not implemented

Service Structure

- Modular: 3 independent components
 - IVR (interactive voice response platform)
 - Ringing tone conversion
 - SMS gateway



Boundary conditions

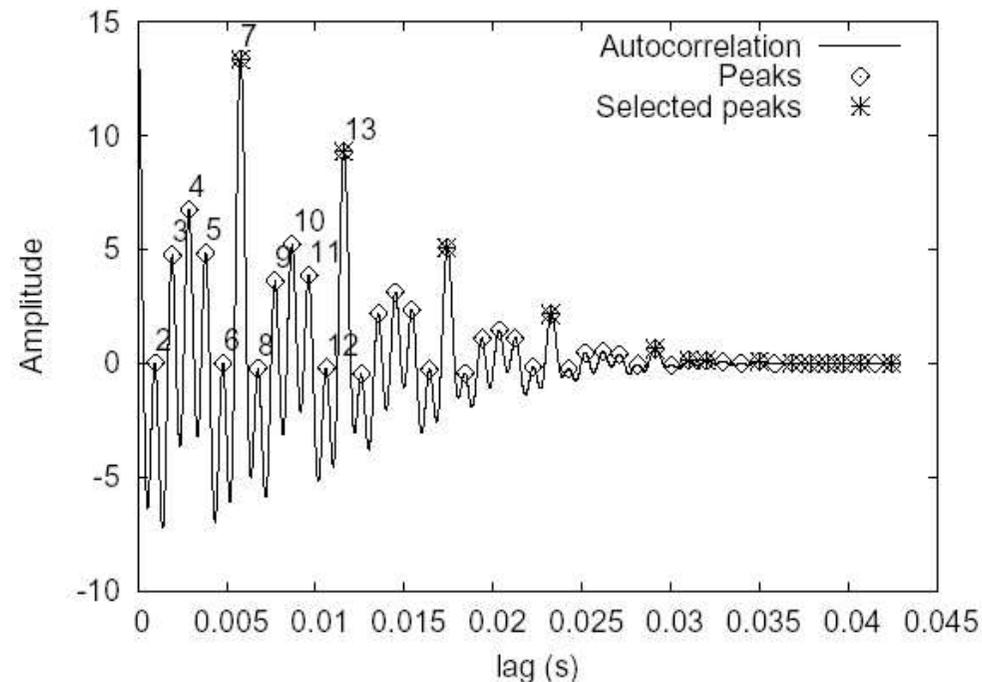
- Range of possible fundamental frequencies: 80 Hz – 2.8 kHz (from low male voice to high whistling)
- PSTN (public switched telephone network) frequency range: 300 Hz – 3.4 kHz
- PSTN Signal/Noise ratio: 38 dB
- GSM MOS (Mean Opinion Score): 3.5–4.0

Fundamental frequency detection

- Time-, frequency- or cepstrum-domain
- Fundamentals often not present in signal, so time-domain techniques are needed
- Fast Autocorrelation -based method chosen

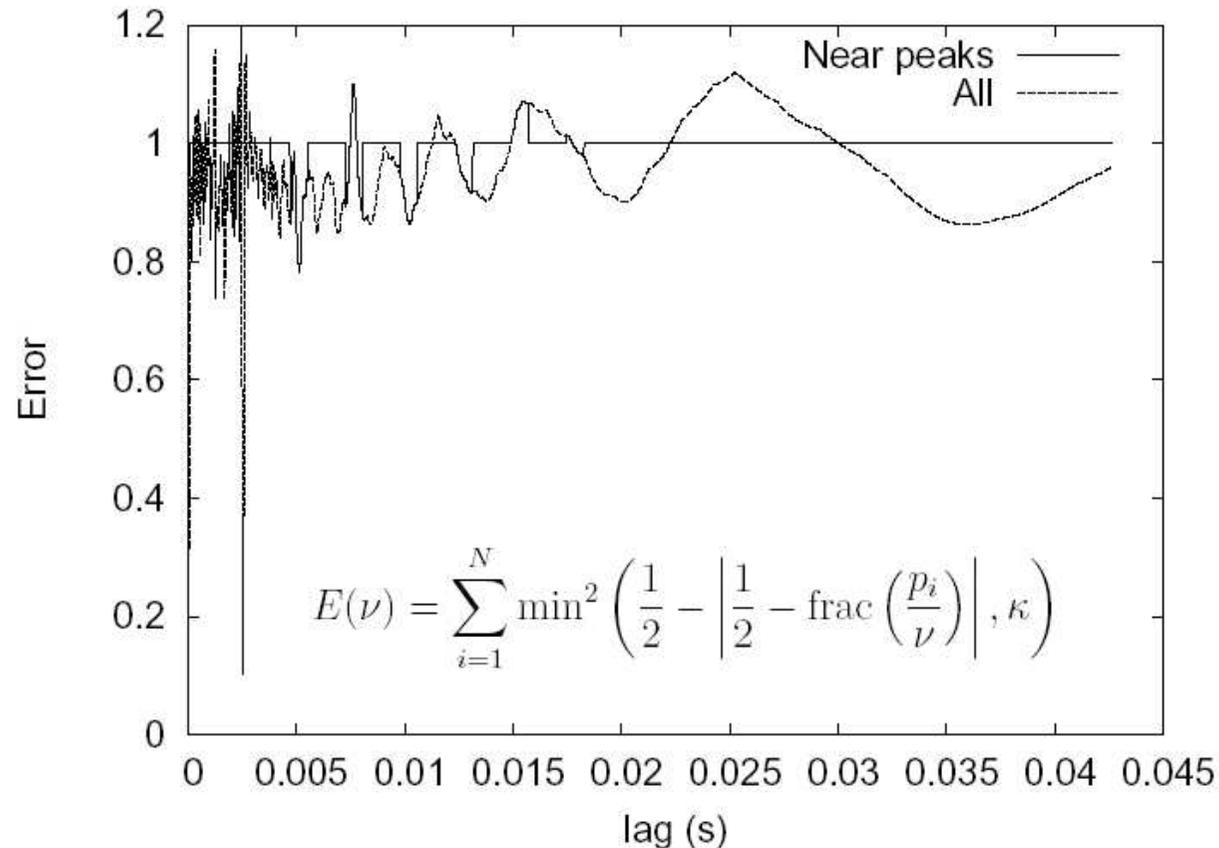
Fundamental frequency detection, cont.

- Biggest peaks are picked from autocorrelation vectors



Fundamental frequency detection, cont.

- Correct peak is selected by minimizing an error function

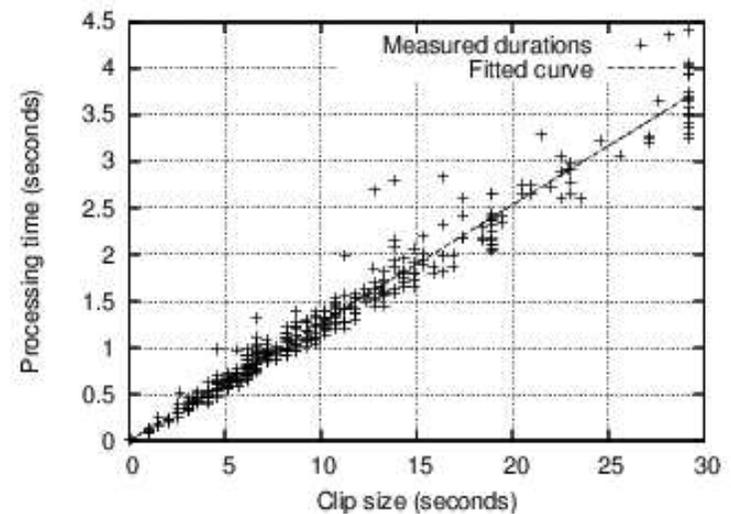
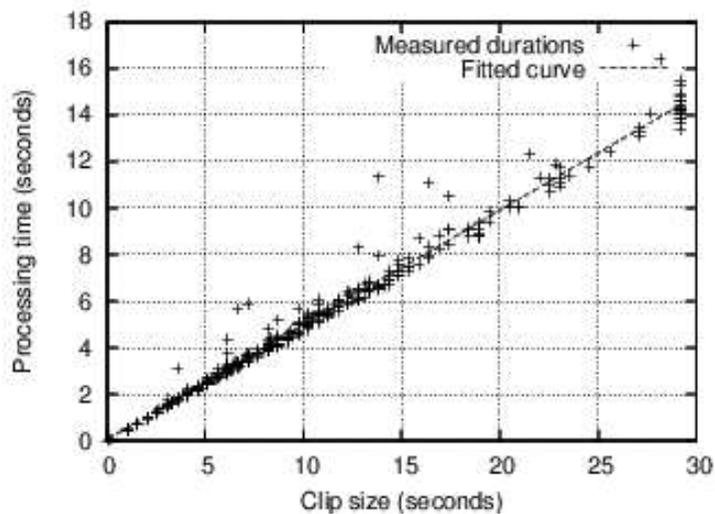


Event creation

- The voicedness of each frame is detected
- Events are formed from single pitch values in several passes:
 - Adjacent frames with pitch values close to each other are combined to form events
 - Short beginnings and endings of voiced events are combined to the longer adjacent event
 - Events with a short pause separating them are concatenated together

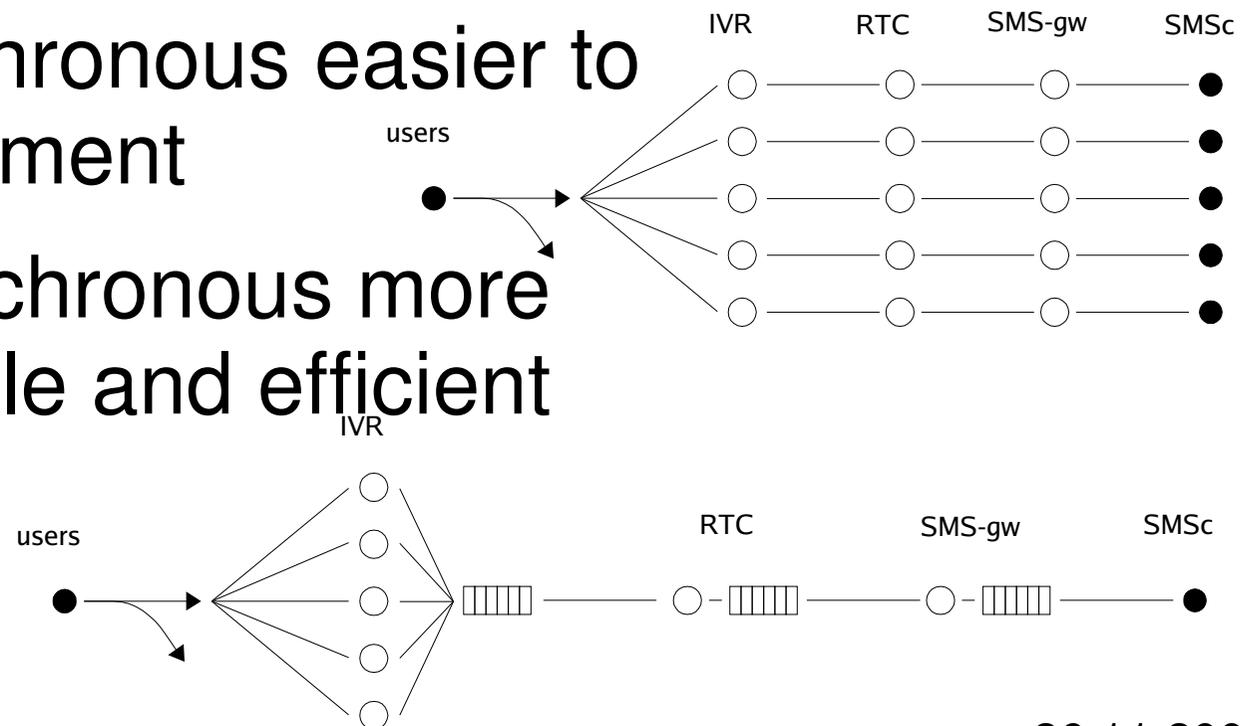
Computational efficiency

- Intel Celeron 375 MHz: 2 x real-time
- AMD Athlon 1400 MHz: 8 x real-time



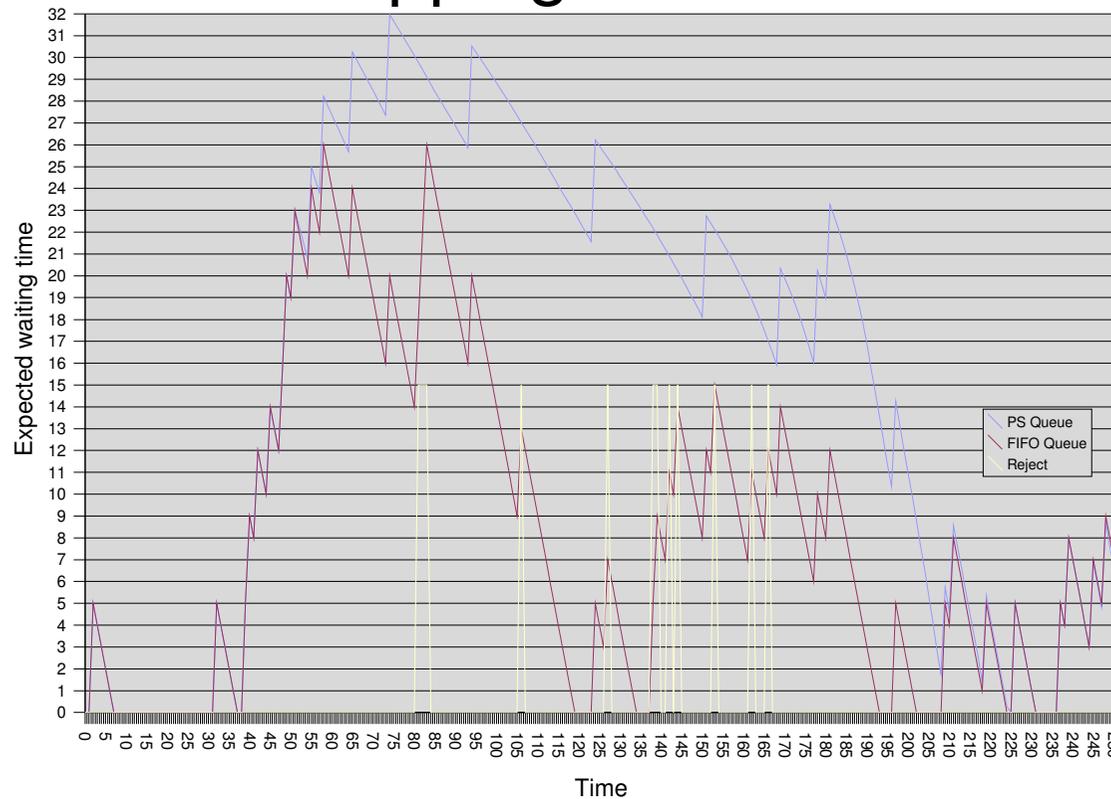
RTC architecture

- Synchronous (parallel) or asynchronous (serial)
- Synchronous easier to implement
- Asynchronous more reliable and efficient



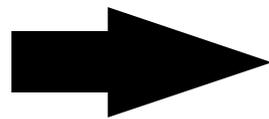
Load testing

- Synchronous configurations may induce swapping



Load testing, cont.

- Test setup confirmed simulated behaviour
 - Celeron backend collapsed when traffic intensity reached 2.6 Erl (a call every 10 seconds)
 - Athlon backend survived traffic intensity of 12.8 Erl (a call every 2 seconds)



PS can be used under moderate loads and modern hardware.

Demonstration

- Sample 1: Singing 356
- Sample 2: Bad singing 300
- Sample 3: Whistling 196
- Sample 4: Humming 218
- Sample 5: Recorded piece 195
- Sample 6: Another ringing tone 92

Conclusions

- A functional service was created
- Simple improvements would increase service reliability
- User quality expectations often set too high