

# Borboleta and SaguSaúde

Open Source Mobile Telehealth for Public Home Healthcare\*

Gustavo L. Duarte, Rafael Correia,  
Pedro Leal, Helves Domingues,  
Fabio Kon, Rubens Kon,  
João E. Ferreira

{gduarte, rafaeljpc, pedro.leal, hhdomingues, kon, jef}@ime.usp.br,  
rkon@usp.br

Department of Computer Science  
University of São Paulo

April 2010

\* Supported by FAPESP, Microsoft Research, and CNPq-Brazil

# Agenda

1. Brazilian Public Healthcare System
2. Home Healthcare
3. Borboleta Project
4. System Architecture
5. Future Work

# Brazilian Public Healthcare System

- Primary Healthcare is based on Healthcare Centers
- Each Healthcare Center is responsible for the primary healthcare in its geographical region
- Home healthcare services has proven to be very effective by focusing on preventive medicine

# Home Healthcare

- Family Health Program
  - Very comprehensive governmental program
  - Run by Healthcare Centers
  - 100 million users
- Enhanced variation: Primary Homecare
  - for people with locomotion difficulties
- Current state:
  - pencil and paper
  - data is lost, little knowledge is built

# Borboleta Project

## **Objectives:**

- Develop a mobile system for management of health information in the context of public Healthcare Centers
- Open Source
- Focused on home healthcare service
- Integrated to the Healthcare Center's Information System

# Borboleta Project

## **Benefits:**

- Automates data collection and processing
- Facilitates access to patient health information during home healthcare
- Guarantees that less data is lost due to handwritten records that are not processed
- Enables health and temporal/geographical information linkage

# System Architecture

## **Borboleta – the Mobile Module**

- JavaME-based EHR system for smartphones
- No network access at the patient's home
- Carries the records of patients to be visited
- Works disconnected from the central module
- Collected data is synchronized with central database in the Healthcare Center via WiFi

# System Architecture

## **Borboleta – the Mobile Module**

- Technologies used:
  - Java ME - LWIT toolkit
- Runs on: Windows Mobile, Symbian OS, and PalmOS
- 12 incremental versions released to the health professionals

# System Architecture

## Borboleta – the Mobile Module

Borboleta's Home Page



Patient List



Patient Screen



# System Architecture

## **SaguiSaúde – the Central Module**

- Web based EHR system
- Includes:
  - Users registry
  - Health appointments
  - System Administration
- Scheduling and history of health appointments
- Easily customizable

# System Architecture

## SaguiSaúde – the Central Module

- Technologies used: Ruby on Rails, AJAX, Web Services, PostgreSQL
- Runs on: Linux, Windows

**Encontros Agendados** [Buscar Agendamento](#) [Agendar um encontro](#)

Data: 29/10/2009

Paciente: Maria


2 pessoas encontradas

Data	Mat	Nome	Matricula	Nascimento	Mãe	Ações
03/10/2009	2	Maria de Jesus	1	1968-07-15	Sebatiana de Jesus	Editar Excluir
22/10/2009	4					Editar Excluir
28/11/2009	1	Maria de Lourdes	3	1978-07-19	Lourdes da Silva	Editar Excluir

3 Encontrado(s)


# System Architecture

## SaguiSaúde – the Central Module



MEDICINA  
USP


SaguiSaúde – Centro de Saúde Escola – Samuel Pessoa  
FMUSP-Butantã



**Cadastros** Exames Borboleta Administração

**Você tem acesso aos seguintes módulos:**

- [Cadastro](#)  
Contém todas as funcionalidades para o cadastro do paciente
- [Exame](#)  
Contém todas as funcionalidades para o agendamento e controle de exames laboratoriais.
- [Borboleta](#)  
Contém todas as funcionalidades para manipulação das tabelas auxiliares e encontros do borboleta.
- [Administração](#)  
Contém todas tabelas auxiliares do sistema.  
Gerenciamento de permissões e usuários do sistema.




Borboleta

0.1

Usuário atual: Admin [Sair do sistema](#)

Realização: **CCSL** CENTRO DE  
COMPETÊNCIA EM  
SOFTWARE LIVRE



IME - USP

# System Architecture

## Synchronization

- Composed of 3 phases:
  - Replication
  - Evolution
  - Reconciliation
- Records are replicated as disjoint sets between mobile devices to avoid conflicts
- Synchronization protocol based on REST

# System Architecture

## Synchronization

- Mobile and Central systems have different storage technologies and data models
- Data transformation process is done during synchronization (replication and reconciliation)
- Data mapping between models are XSLT files
  - Can be generated by graphical mapping tools

# Future Work

- Automatic identification and resolution of data conflicts
- Voice recognition for menu navigation
- Integration with multiple Healthcare Centers
- Data mining

# Acknowledgment

- FAPESP
- Microsoft Research
- CNPq-Brazil
- USP Qualipso FLOSS Competence Center

# Thank You!

## More information:

- [gduarte@ime.usp.br](mailto:gduarte@ime.usp.br)
- <http://ccsl.ime.usp.br/borboleta>