Seamless Health

Collaborative Systems

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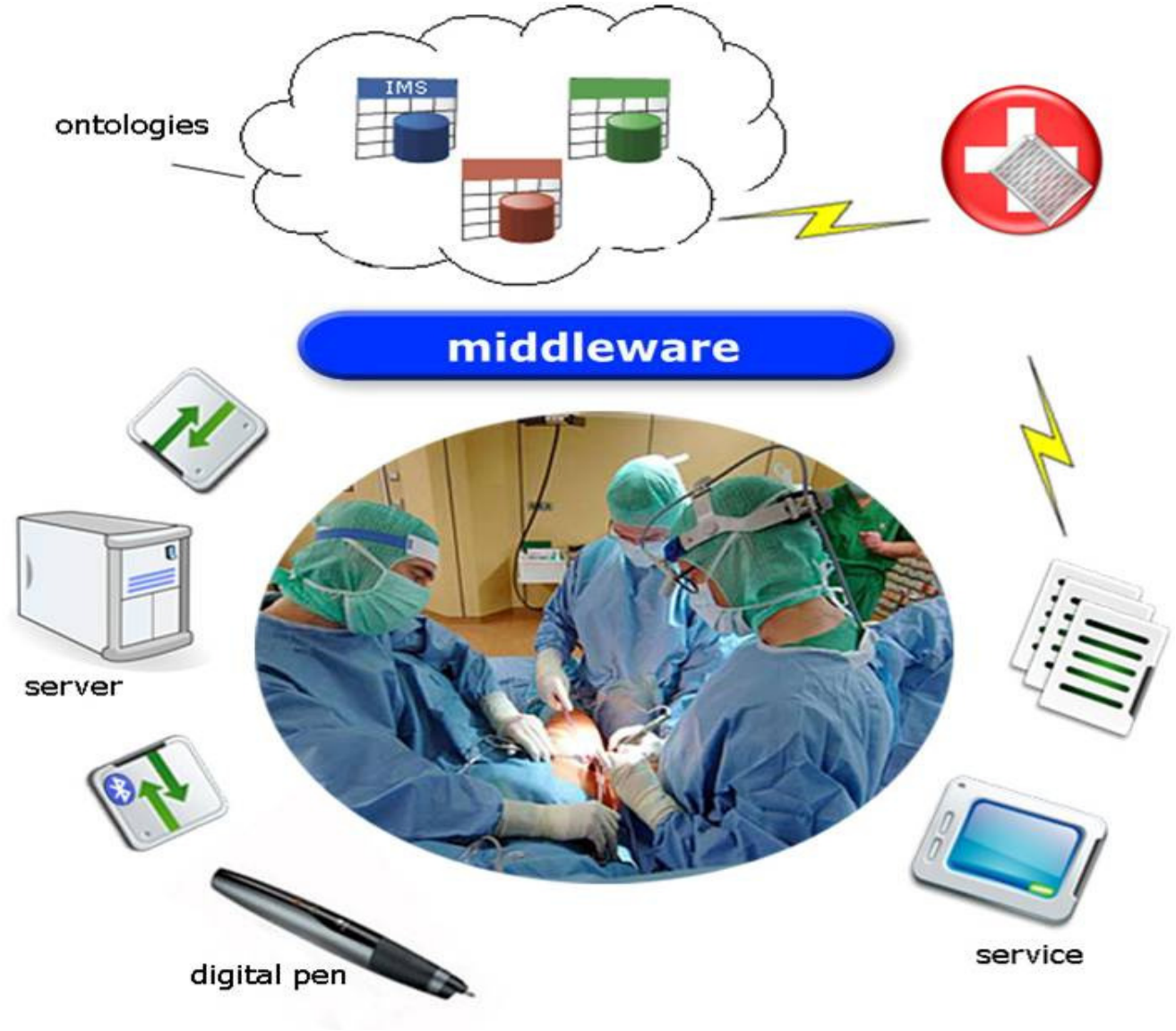
1. Introduction



- **Current state**
  - more than 5 million users of digital pen & pager daily
  - 400 million forms used each year
  - Growing adoption of pen-based solutions

- **Daily work in hospital**
  - admission

    id-card, health-fund-card
  - anamnesis (medical history)
  - vital signs

    temperature, blood pressure, pulse

- **Daily work in hospital**
  - testing (already done and outstanding)

    x-ray, CT, physical therapy, diagnostics
  - bill
  - letter for family doctor

    what have been done, would should be done

- **Geneva University Hospital**
  - HP's Forms Automation System
  - largest hospital in Switzerland
  - 10,000 employees; 400,000 patients a year
  - employees and patients accept this "natural technology" very quickly

- **Geneva University Hospital**
  - data can be processed much more quickly
  - efficiency increased
  - costs reduced

- **Chennai Kaliappa Hospital, India**
  - ELIXIR – a healthcare information system
  - 350 patients a day
  - a lot of paper work
  - preparing reports of test results consumed a lot of time

- **Chennai Kaliappa Hospital, India**
  - today:
    - posting test results directly to the computer
    - faster flow of information
    - no several copies of documents
    - shorter waiting time for patients

Anoto

- Swedish high tech company
- core business = digital pens and paper providing Anoto functionality
- transmission of handwritten text into the digital world
- comprehensive solution entailing paper, pen and server technologies
- recognizes the form and position, where you entered data

- **Digital pen**
  - the pen does not have any buttons or display
  - It looks and feels like an ordinary pen
  - You activate the pen simply by removing the cap and deactivate it by replacing the cap again

- **‘Digital’ paper**

Business View

- increasing efficiency
- ease of use
- cooperation with partners
- scalable (hospital,…)

Content View

- using adopted OWL
- ontologies

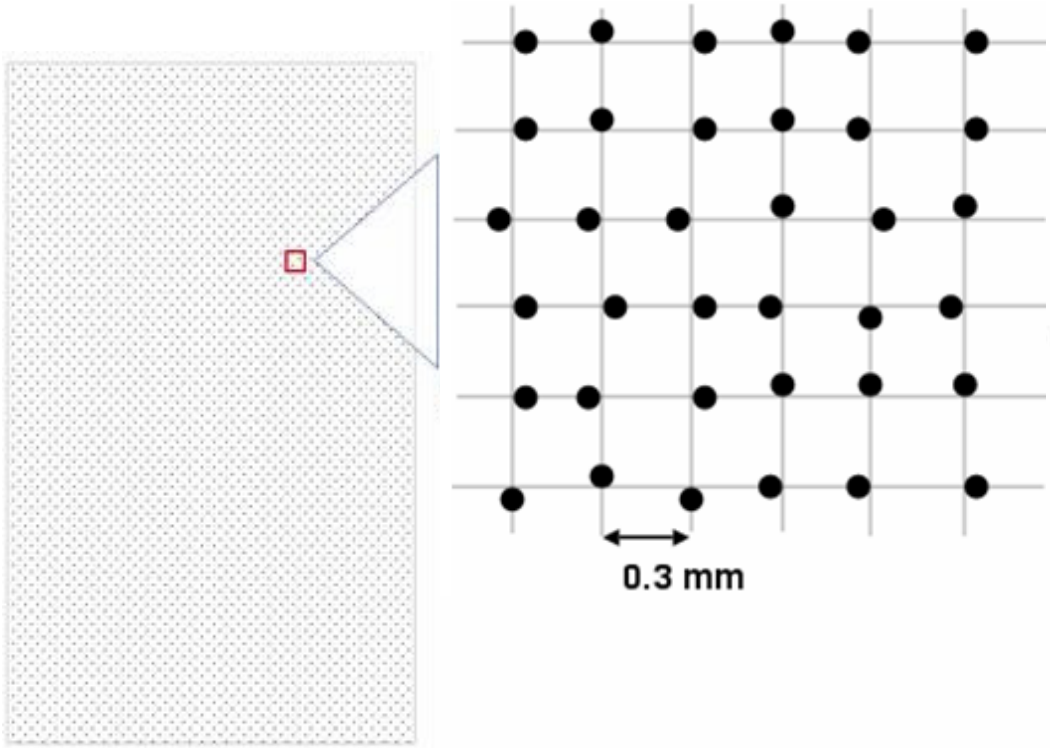
Management View

- using unified process
- using collaborative team support
- everyone min Level 2 (CMMI,...)
- using CM System

Technology View

- layer architecture
- middleware
- Anoto functionallity, IMS, BlueTooth

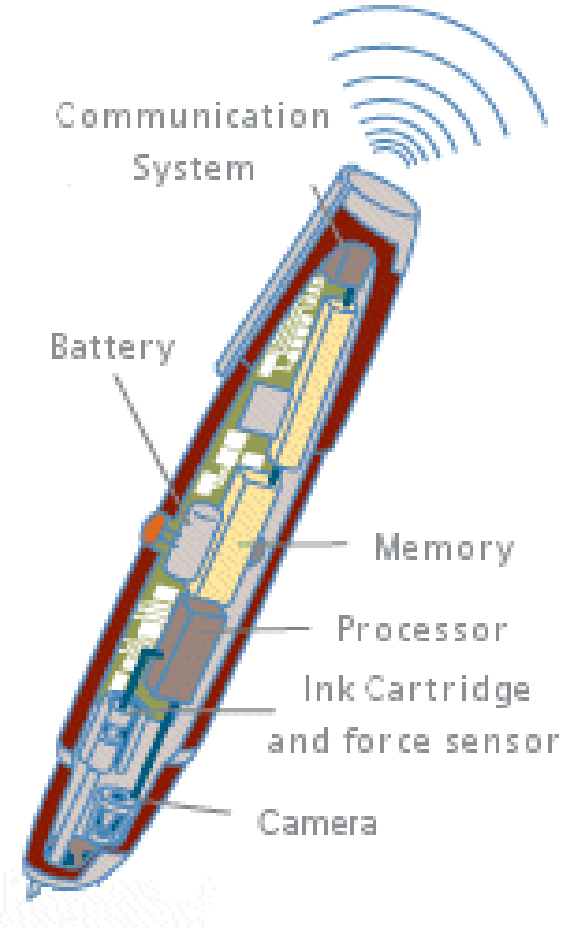
Digital Paper



Digital Paper

- proprietary pattern of dots
- pattern of 6x6 dots uniquely defines the position
- unique patterns for area of 4.6 million km²
- Forms designed on Computer
- Patented by Anoto

Digital Pen


Communication System
Battery
Memory
Processor
Ink Cartridge and force sensor
Camera

Digital Pen

- 100 Snapshots per second
- Memory: 400 pages (A4)
- Looks and feels like an ordinary pen

- **Display**
  - Portable display
  - Bluetooth receiver
  - Wi-Fi Transmitter / Receiver
  - Displays response by the server

IMS

- Hierarchical DBMS by IBM
- Very sophisticated technology
- Fast and high availability
- hierarchical structure
  perfectly fits the XML like files

Ontologies

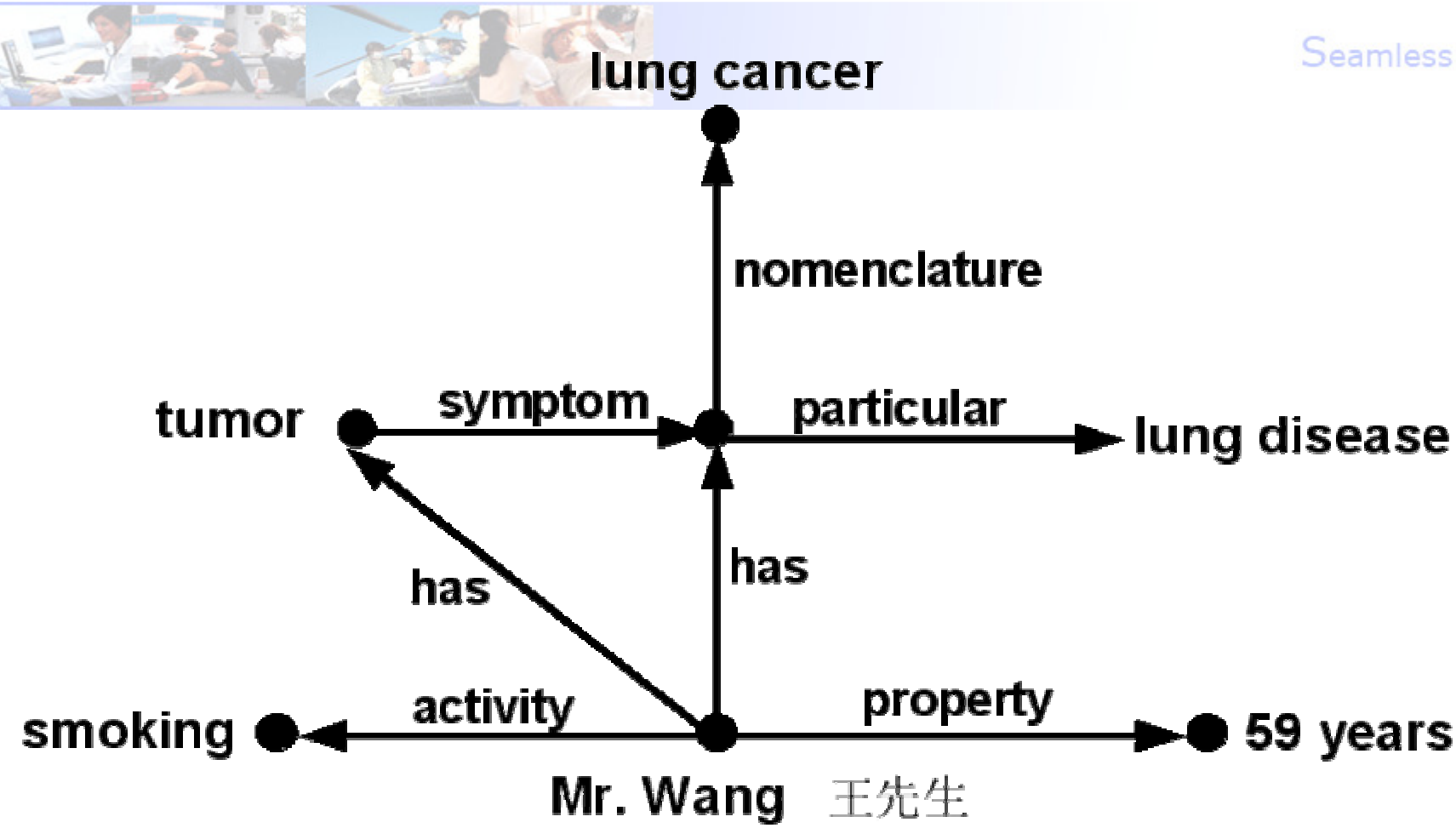
- Knowledgemodels
  (Knowledgepresentation or Knowledgenetworks)
- Networks of Informations and Relations
- Agents can understand Ontologies
- similarities to object oriented world

Ontologies

- concepts
  (similar to classes)
- instances
  (similar to objects)
- relations
  (e.g. object1 owns object2, object1 hits object2)

Ontologies

- inheritances
  (it's possible to inheritance concepts and relations)
- axioms
  (statements (knowledge) which is ever true in the Ontologie)



59 year old Mr. Wang has lung cancer which is a lung disease.

He has a tumor.

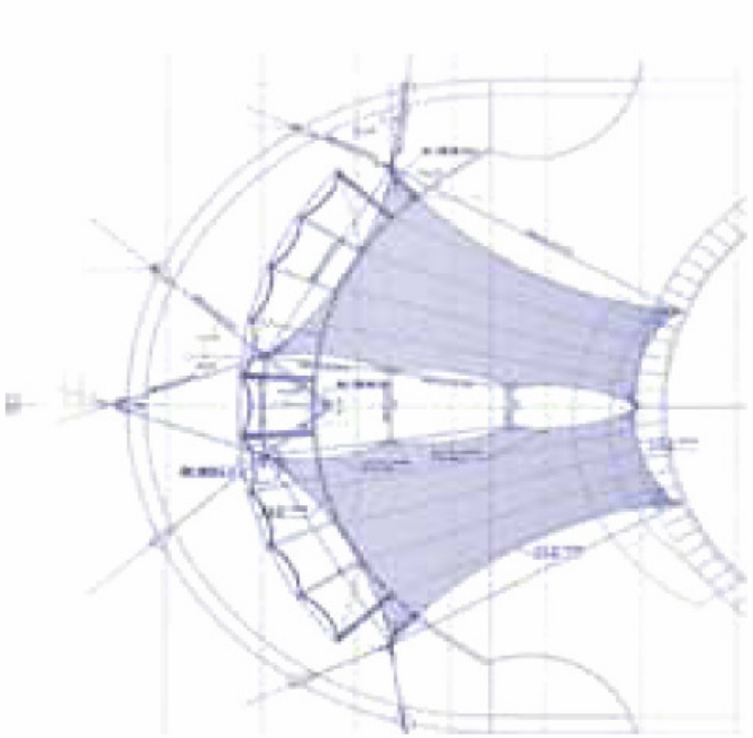
He is smoking.

Ontologies - OWL

- Web Ontology Language
- a language to create Ontologies
- code looks similar to XML
- predicate logic is also supported
- www.w3c.org
- we will need to adopted and extend OWL

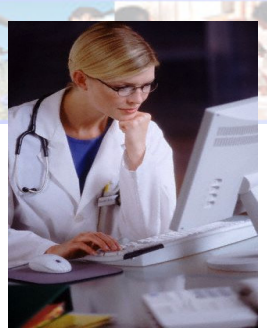
Properties of the Architecture

- suitable for a good security concept
- Adaptable
- Extensible
- Distributed



Layer Architecture

4	service layer
3	ontology layer
2	information conversion layer
1	information extraction layer



Layer 4

Services

Layer 3

Agents

IMS Databases

Layer 2

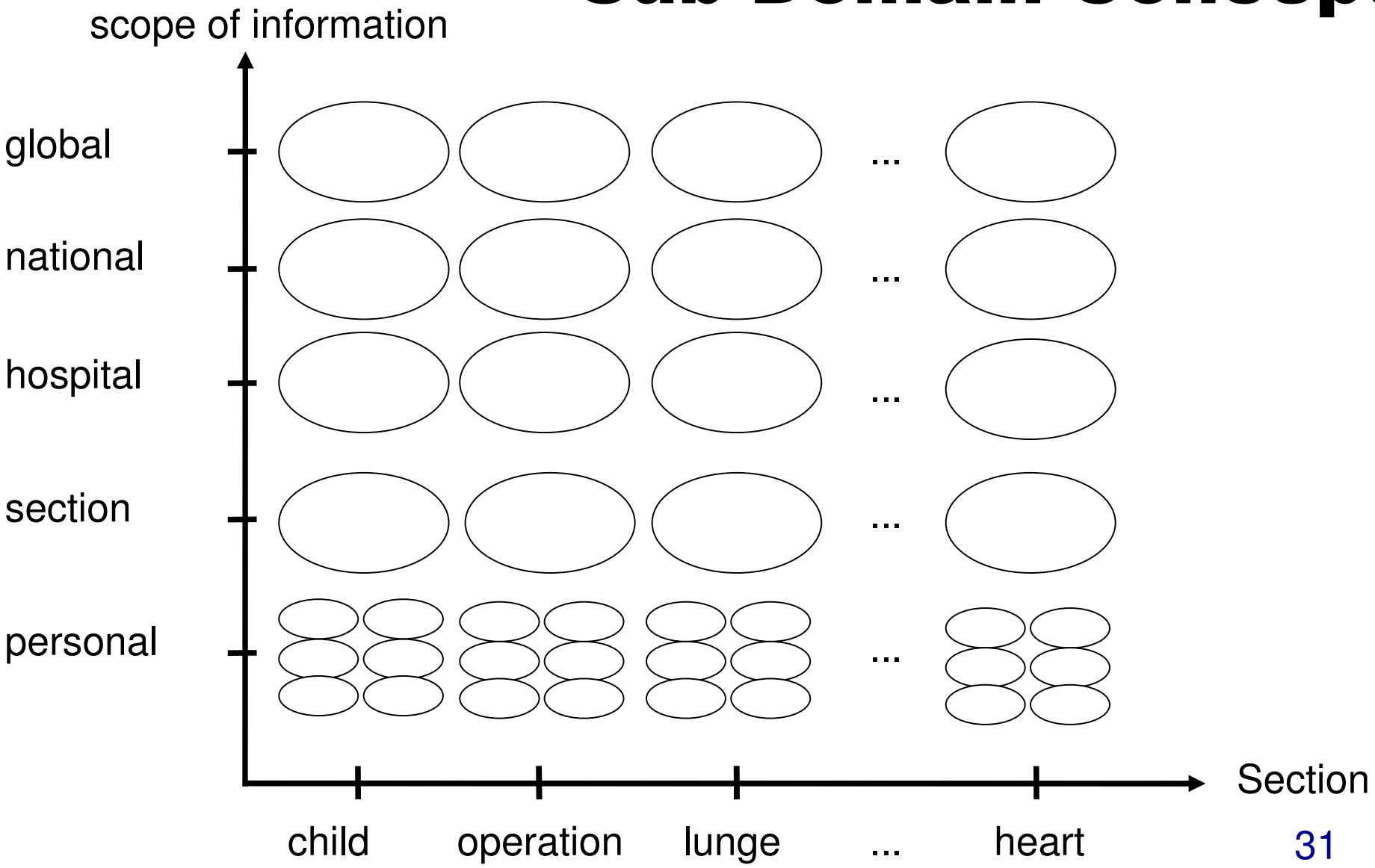
Information to Ontology

Layer 1

Information Extraction

- **layer architecture**
  - reduces complexity
  - you can edit, enlarge and replace layers
  - increases extensibility
  - layer architecture as practical approved concept

Sub Domain Concept

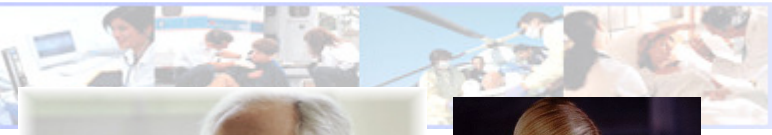


Sub Domain Concept

- reduces complexity
- improves security
- solution against information overflow
- shared knowledge
  - making the hospitals more effective and efficient
- global knowledge can be shared worldwide
  - making medicine and pharmacy industry better

Security considerations

- each patient has his one personal ontology
- patient identification
  - only possible in the personal ontology
  - no identification in ontologies of higher scopes
- access rights for users and agents



Services

Hospital's central IMS Database Server

MIDDLEWARE

MIDDLEWARE

Anoto Service Server

Agents

IMS Database Server heart section

MIDDLEWARE

STRENGTHS

- scalable
- reusable
- will increase efficiency and effectiveness
- many stakeholders
- accurate security concept
- collaborative team work will be supported

WEAKNESSES

- high development costs
- depending on investors

OPPORTUNITIES

- worldwide use of the system
- knowledge of medicine will be shared
- worldwide knowledge base of medicine
- new sensors can be included easily

THREATS

- new technologies can scare people
- stakeholders have different goals
- you need trust

Advantages over current systems

- New input devices can be introduced to the system
- Ontologies
- Intelligent agents
- Scalable, Extensible and Adaptable
- Created knowledge
- Includes Collaborative Team Support

Business Strategy

- like Musashi said turn small things into big things
- start of in a hospital
- then install your system in most hospitals of a country
- now sell your system worldwide
- connect the created knowledge

Possible realisation

- start of or buy a company in China
  - Agents, Services, adapted OWL and Middleware
- Cooperation with IBM
  - responsible for IMS Databases
- Cooperation with Anoto
  - responsible for the Anoto functionality
- Cooperation with Siemens
  - responsible for patient data measurement devices

Price vs. Effort

- Of course the price will be high
- But the effort will be much higher

Summary

- technologies
  - Anoto, Ontologies, IMS, Wi-Fi
- architecture
  - middleware, agents, subdomains, services
- assessment
  - huge potentials

Example Video

Questions and Discussion