



Multimodal Medical Data Capture and Representation

Qian Hu

781-271-2959

qian@mitre.org

MSR

Problem



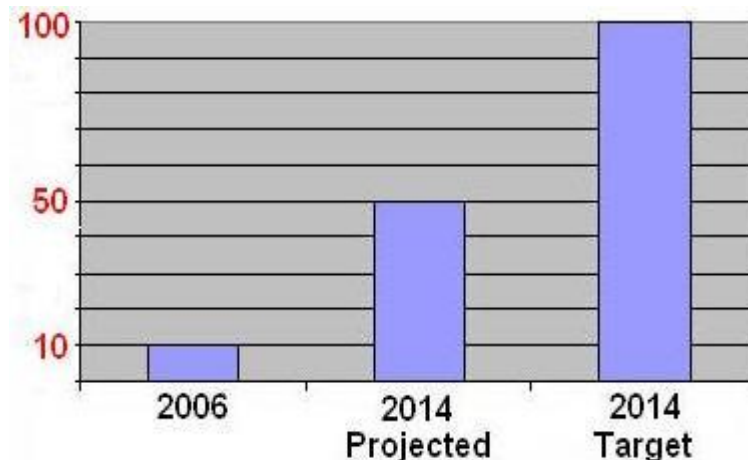
- **The difficulty of capturing structured clinical information from unstructured data poses an obstacle to widespread adoption of Electronic Medical Record (EMR) systems**
- **Automatic Speech Recognition (ASR) and Handwriting Recognition (HR) have been applied to EMR systems with limited success due to**
 - **Lack of required accuracy**
 - **Poor integration with EMR systems and hospitals' workflow**
 - **Problems converting doctors' natural speech or handwritten notes to a standard format**

Background

■ Everybody wants EMRs

- Hospitals are using/building their own EMR systems
- Standards committees (*HITSP, CCHIT) are busy creating standards
- The DoD and the VA already have the nation's largest EMR systems

■ At the current rate and using today's methods, the federal government will only reach 50% of its proclaimed EMR goal by year 2014



■ Added time, changes to workflow, and lack of interoperability using current systems hinder EMR creation by medical professionals

*HITSP—Healthcare Info. Tech. Standards Panel; CCHIT—Certification Commission for Healthcare Info. Tech.

Objective

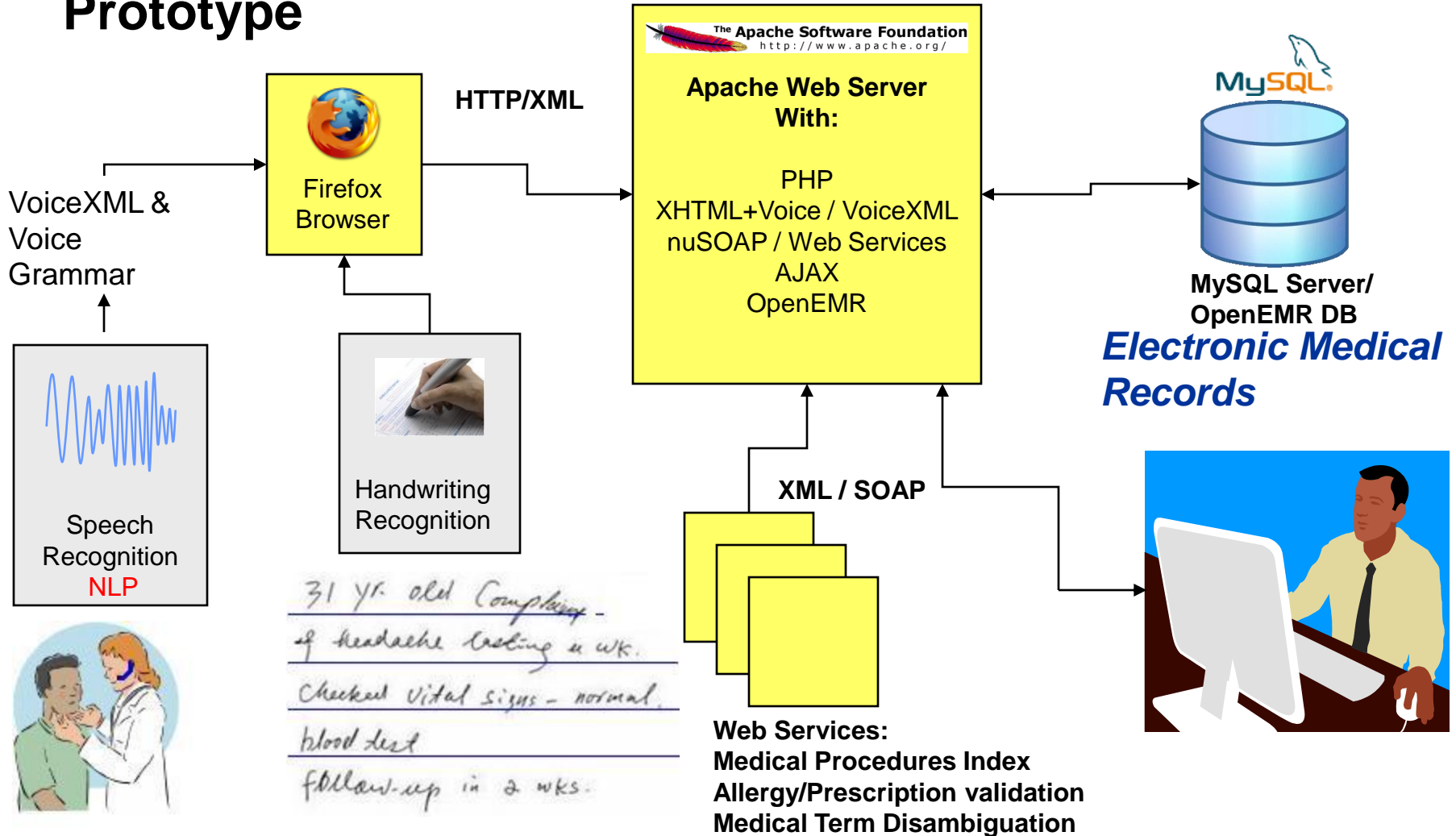
- Create a **multimodal** medical **data capture** method and **exploit** rich medical/linguistic resources and standards to **represent** the captured information for enterprise interoperability

Activities

- Evaluating ASR and HR technologies to identify areas for enhancement and adaptation to medical applications
- Evaluating open-source EMR systems, including OpenEMR, used in a number of hospitals
- Interviewing doctors and visiting hospitals to understand the workflow and EMR requirements
- Establishing baseline performance using existing technology
- Building training corpora for ASR/HR
- Designing a multimodal research prototype
- Developed two key components of voice functionality to improve the interface control and ease of voice documentation
- Enhanced the default handwriting recognition lexicon with medical terminology, acronyms, and some medical symbols
- Collected handwriting samples of medical symbols and experimented with various pattern recognition algorithms for symbol recognition
- Developing NLP algorithms to automatically segment and add sections and section headings by identifying key phrases
- Researching and developing algorithms to understand natural medical dictation, extract key information, and populate the data value into EMR systems

Highlight

Architecture of MITRE Prototype



Demonstration

Summary History Encounter Transaction Documents Report Close
Sydney Jones (ID: 4, DOB: 2001-07-11, Age: 5, Home: 978-999-9999) Logged in as: Randall Fish Encounter Mon February

SOAP

Subjective 31
Objective
Assessment
Plan

the patient is 5 foot 10 inches tall ... weighs 155 pounds his temperature is 102 degrees ... heart beat 89 per minute ... 140 over 70 is blood pressure



NLP algorithms extract key data values

Multimodal OpenEMR Engine populates the values into required data fields

Vitals

Name	Unit	02/05/07	02/05/07	02/05/07
Height	in	70	48	76
Weight	lbs	155	31	300
BP Systolic	mm/hg	140	0	100
BP Diastolic	mm/hg	70	0	0
Pulse	per min	89	0.00	0.00
Respiration	per min		0.00	0.00
Temperature	F	102	0.00	0.00
Temp Location		Tympanic Membrane	Tympanic Membrane	Tympanic Membrane
Head Circumference	cm		0.00	0.00
BMI	%		9.49399463383838	36.6491437924956
Oxygen Saturation	%		0.00	0.00
Waist Circumference	in		0.00	0.00

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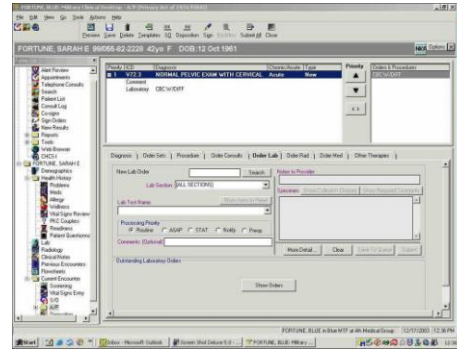
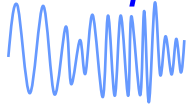
Impacts

- **Multimodal technology and methodologies for medical data capture and representation can revolutionize the creation of EMRs**
- **Going beyond verbatim conversion to encode conceptual underpinnings is critical for interoperability among healthcare and research institutes**
- **The voice command and control of software applications and handwriting recognition are much needed in eye-busy and hand-busy situations beyond medical domains**
- **Speech and handwriting data collected with well-designed collection paradigms and guidelines are important resources for research and for evaluating relevant technologies**

Future Plans



① Voice Command
"Prescription"



Isordil	<input checked="" type="checkbox"/>
Benadryl	<input type="checkbox"/>

⑥

Isordil

②

HWR
Digital Pen
Benadryl ?
Isordil ?

Prompt
for
Voice

③

Automatic
Speech
Recognition

④

Natural
Language
Processing

⑤

Mutual Disambiguation: HWR, Voice, NLP

Medical
Domain
Knowledge

Isordil:
chest pain
Benadryl:
allergies

Electronic
Medical
Record

No History of
Allergies
Chest Pain