Automated Medical Reporting

Seminar Medical Informatics

Guest lecture
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www.care2report.nl

Scientific vision of Care2Report program

Using *speech recognition technology* and *action recognition technology* to automate reporting.

We aim to **apply** this **general** vision in the healthcare domain due to the societal need in this domain: high administrative burden.

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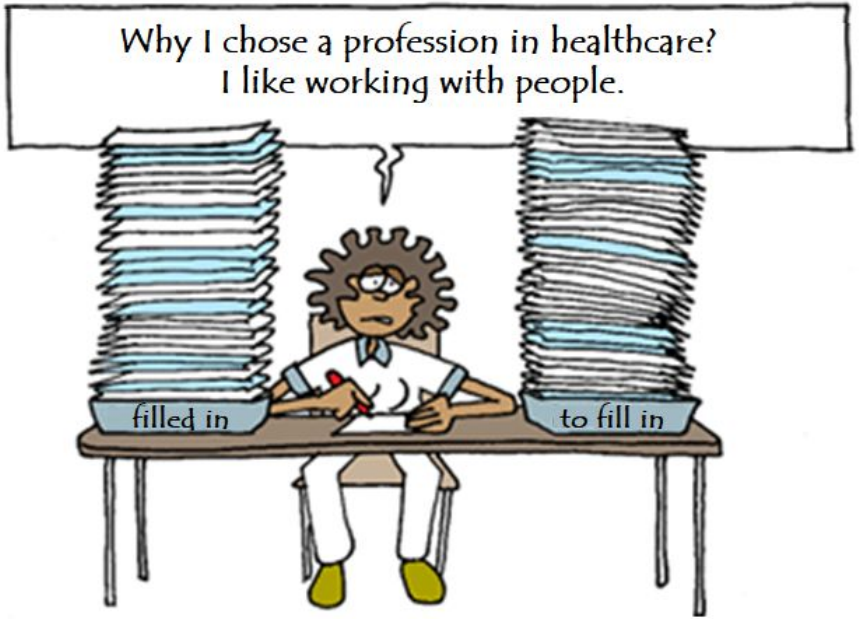
Collaborating partners

Care2Report is a large scale research program encompassing multiple research projects (PhDs, graduation projects, ...).

Collaboration with:

- Nivel, Netherlands institute for health services research.
- UMCU, trauma surgery department.
- VU Amsterdam, Computer Science department, Knowledge Representation and Reasoning group.

Societal context



Up to 3 hours administration a day for care providers

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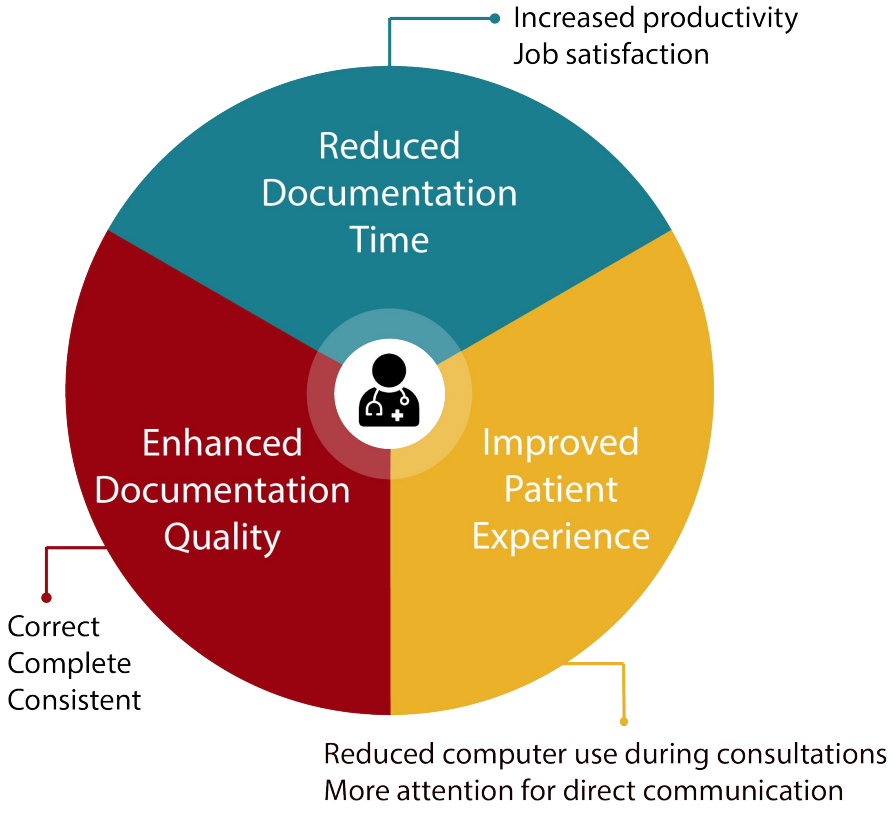
The issues of medical reporting

- Cumbersome
- Typing while with patient
- Too shallow



Explaining problems with data

- Being a physician is one of the five professions experiencing the **highest workload** in the Netherlands (CBS, 2017).

- Two thirds of care providers indicate that **administrative burden** is too high (Nivel, 2017).

- In long-term care in the Netherlands, administration tasks require over 100,000 full-time positions, costing over **5 billion euros per year** (Berenschot, 2016).

Explaining problems with data

- **94% completeness rate** of trauma resuscitation records in the electronic medical record (EMR; Bilyeu & Eastes, 2013).

- Research applied in general pediatrics indicated that the electronic records contained only **65% of all patient information** (Roukema, bleeker, Van Ginneken, Van der Lei & Moll, 2006).

- Introduction of so-called *scribes* were associated with **greater patient interaction** in primary care, i.e., 85% vs. 13% spending >75% of visit interacting with the patient (Mishra, Kiang & Grant, 2018).

Approach

1. **Transformation** of audio, video and sensor data from medical interactions into text using existing speech and action recognition technology.

2. **Formal interpretation** of situations, measurements and treatments based on multimodal input combined with semantic technology.

3. **Generation of medical reports** using categorizations and conventions in the specific medical domain.

4. **Completion** of the reports and **uploading** through a generic EMR-interface.

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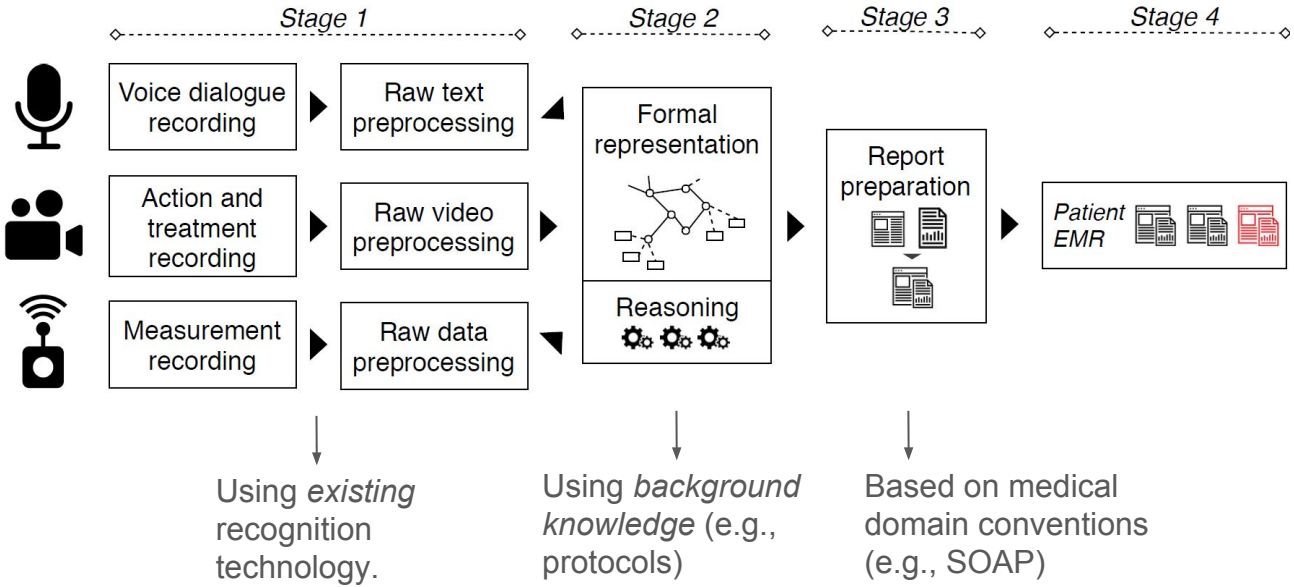
Process overview



Note: the care provider retains overall responsibility.
He/she can check, edit and upload the generated report.

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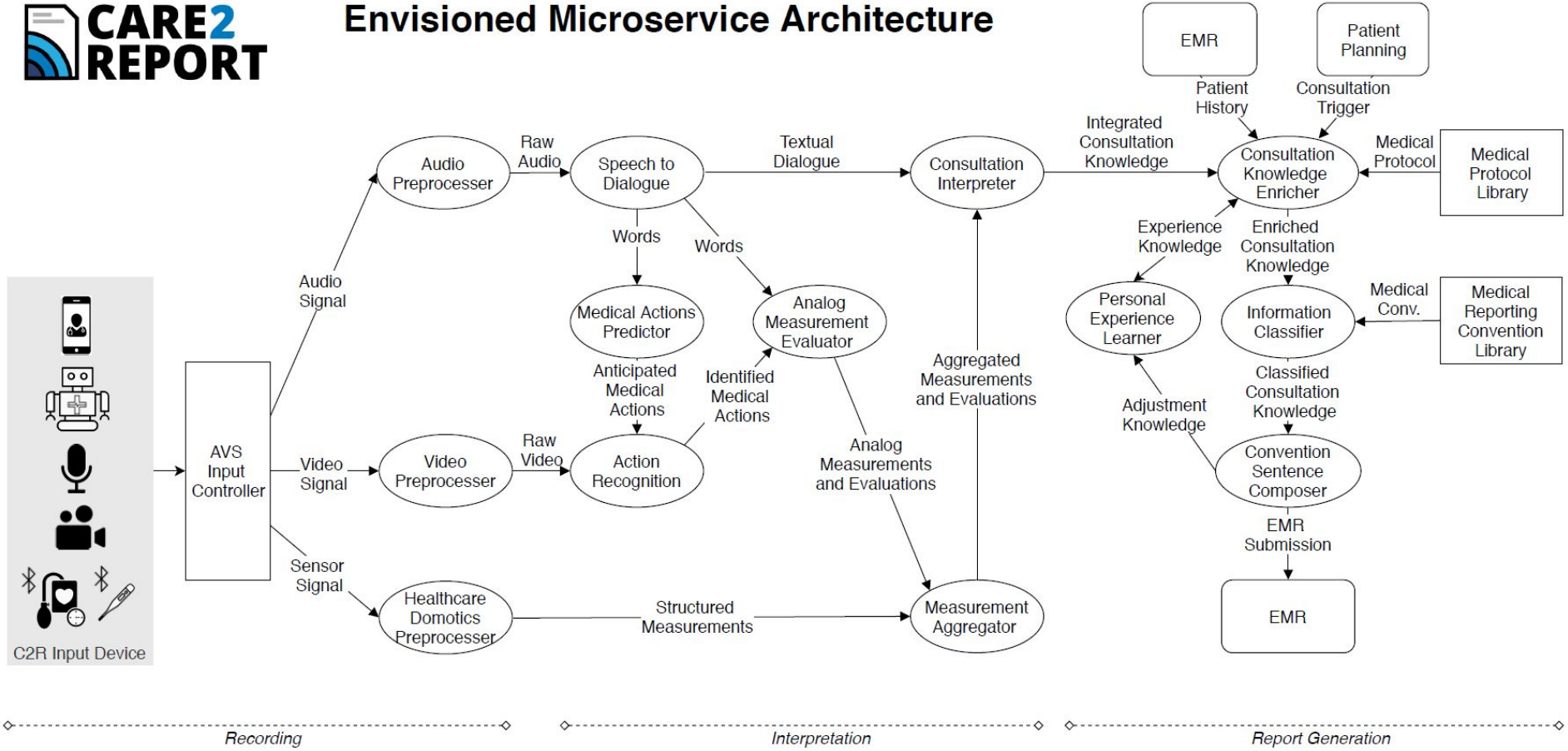
Envisioned Microservice Architecture



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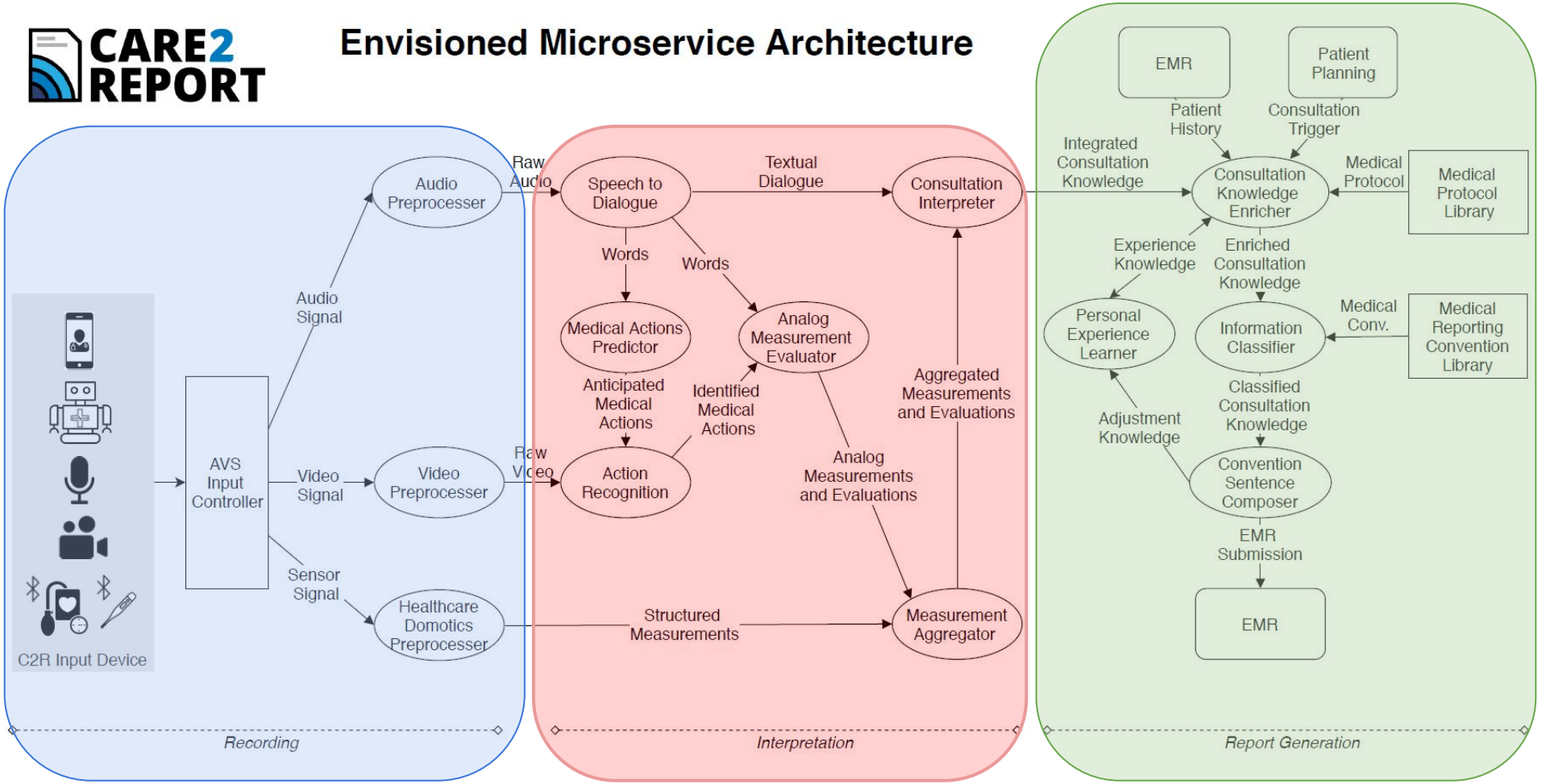
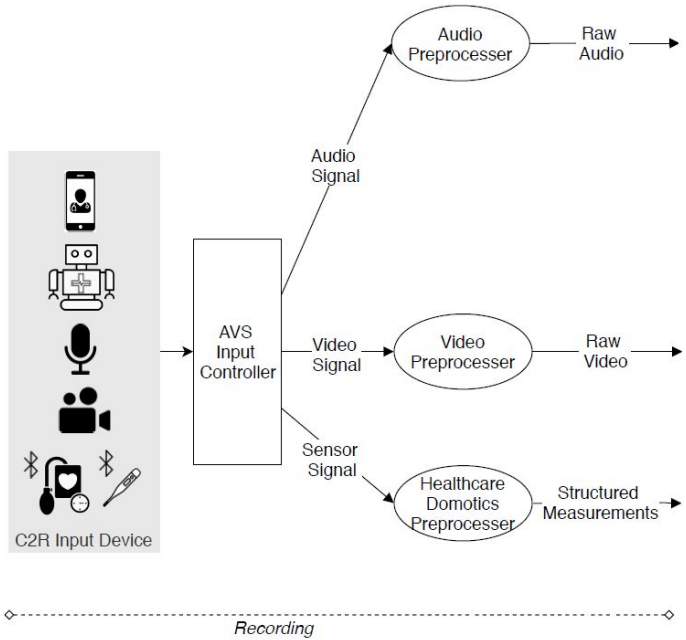
Envisioned Microservice Architecture



Recording



- Monitoring of input devices
  - Input and modality control
  - Quality check
- Off-the-shelf speech recognition (e.g., Google Speech).
- Off-the-shelf object and action recognition
- Bluetooth channels for healthcare domotics
  - Channel and signal identification
  - Fault recovery

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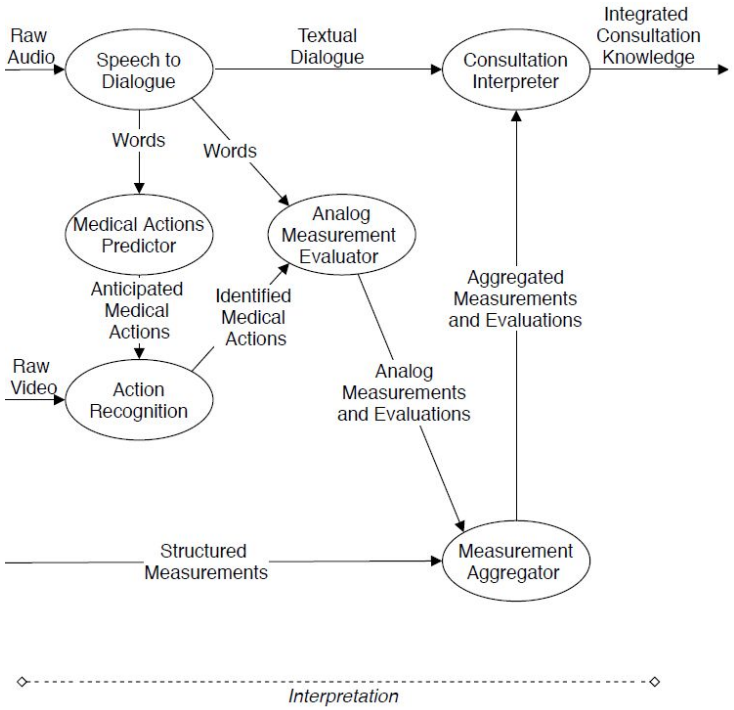

Interpretation

- Recognition enhanced by multimodality (also: Medical Consultation Timeline).
- Dialogue enables anticipation for actions and measurements
- Combine information from all sources.
- Formal representation / interpretation (triplestore, StarDog).

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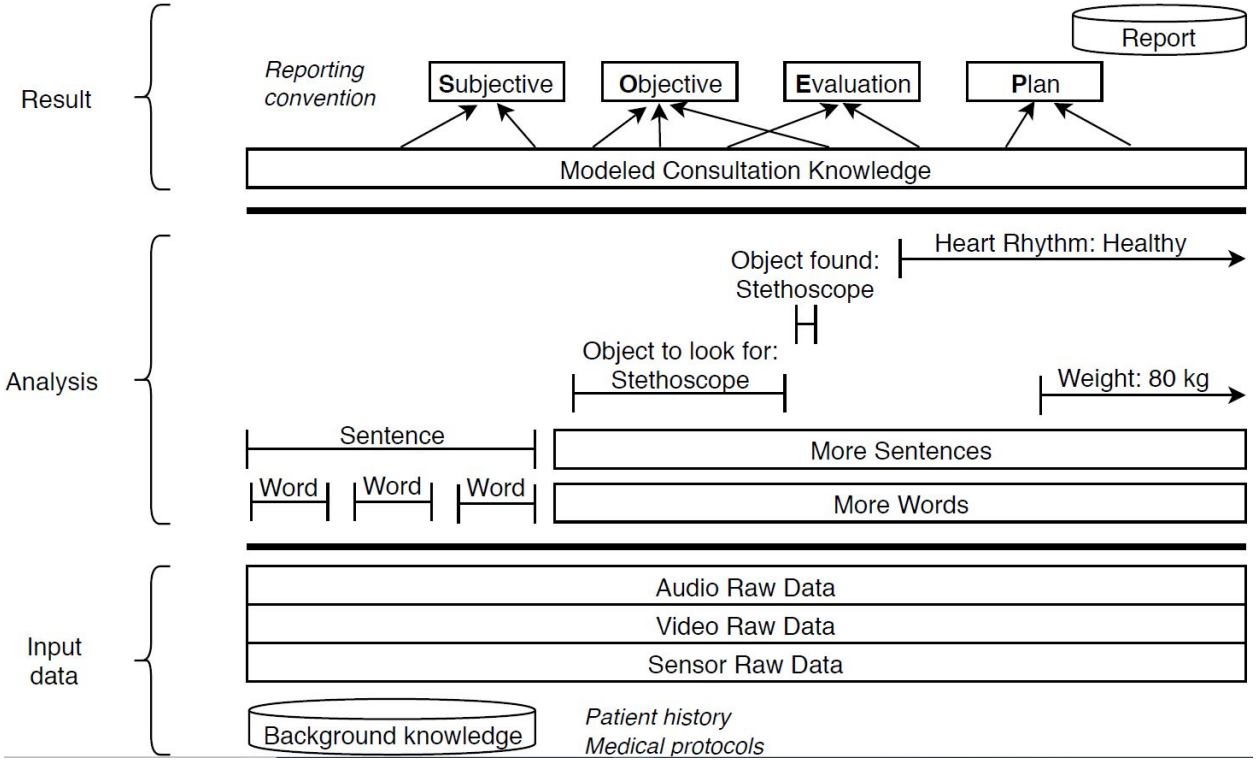
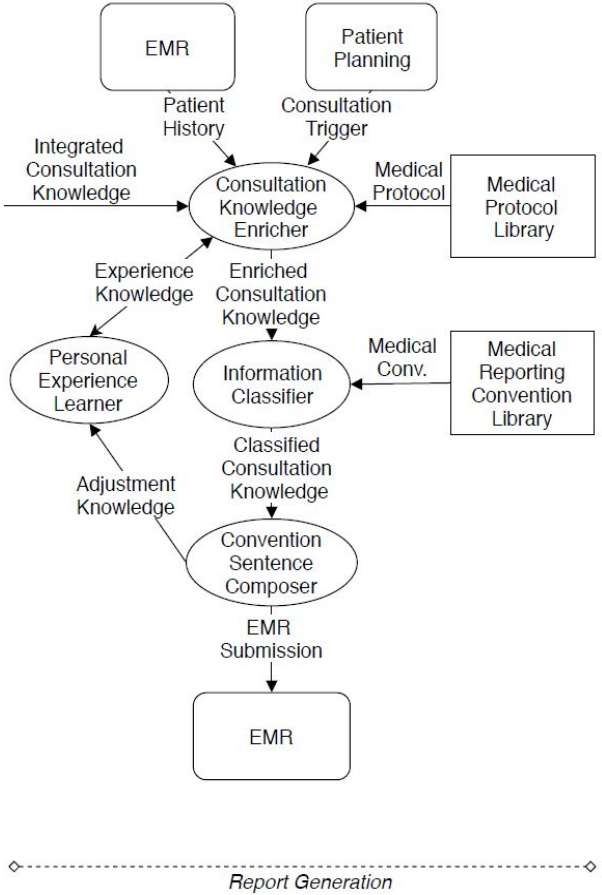
Medical consultation timeline





Report generation

- Using *background knowledge* to resolve ambiguity.
  - Consultation trigger, patient history, protocols
  - Existing medical knowledge graphs
- Select relevant information for the report based on reporting conventions.
- Use *sentence plans* to generate report.
- Learning component.

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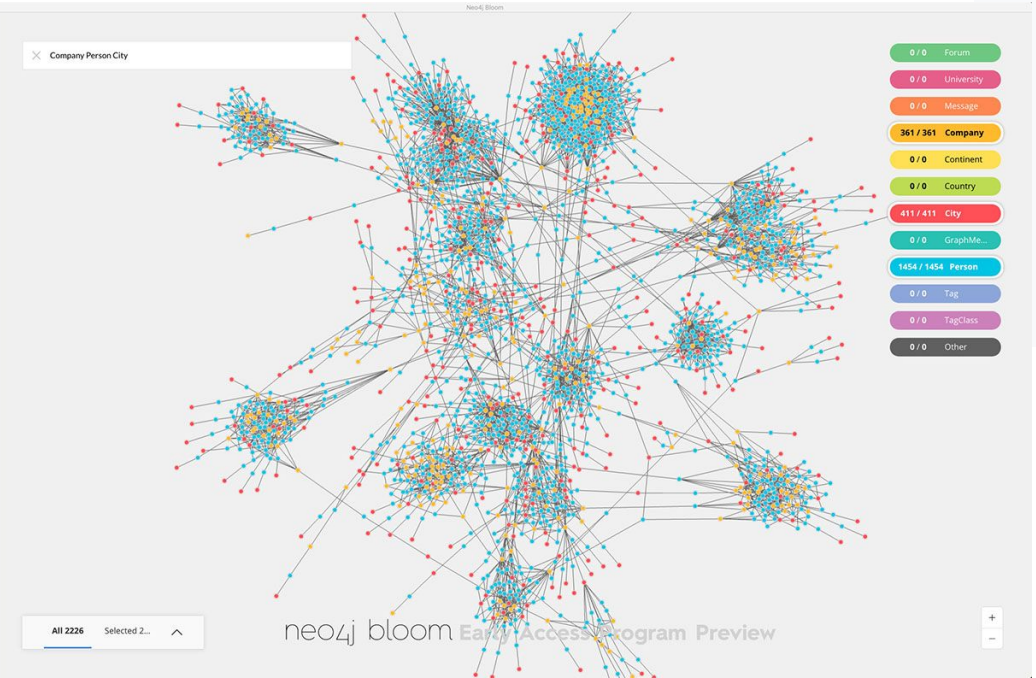
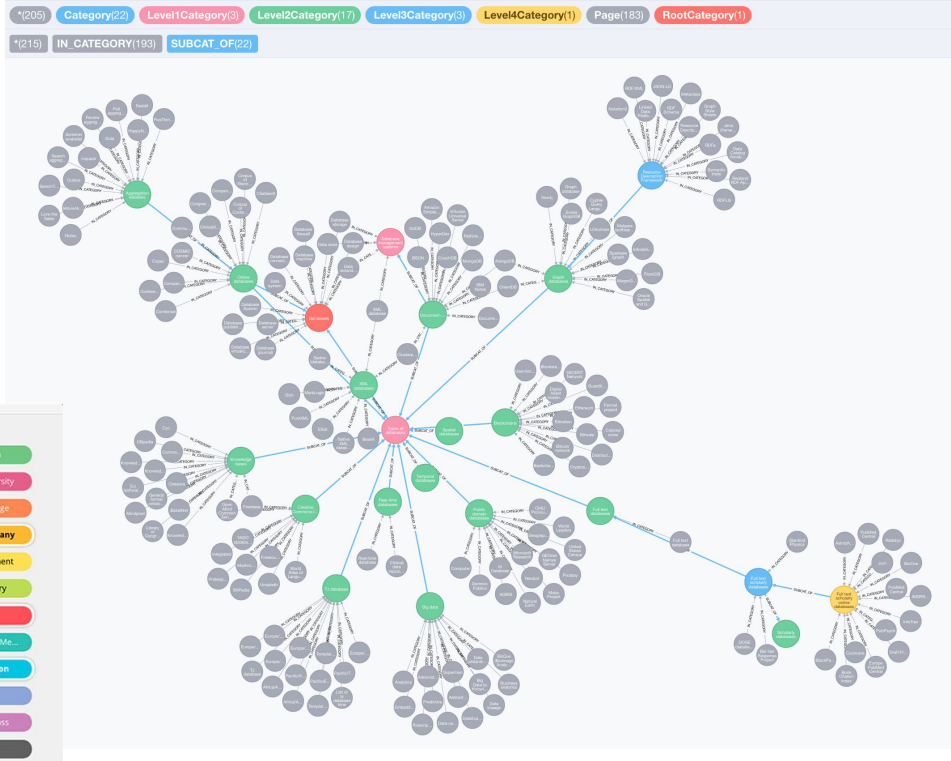
Knowledge graph

Neo4j Graph Platform

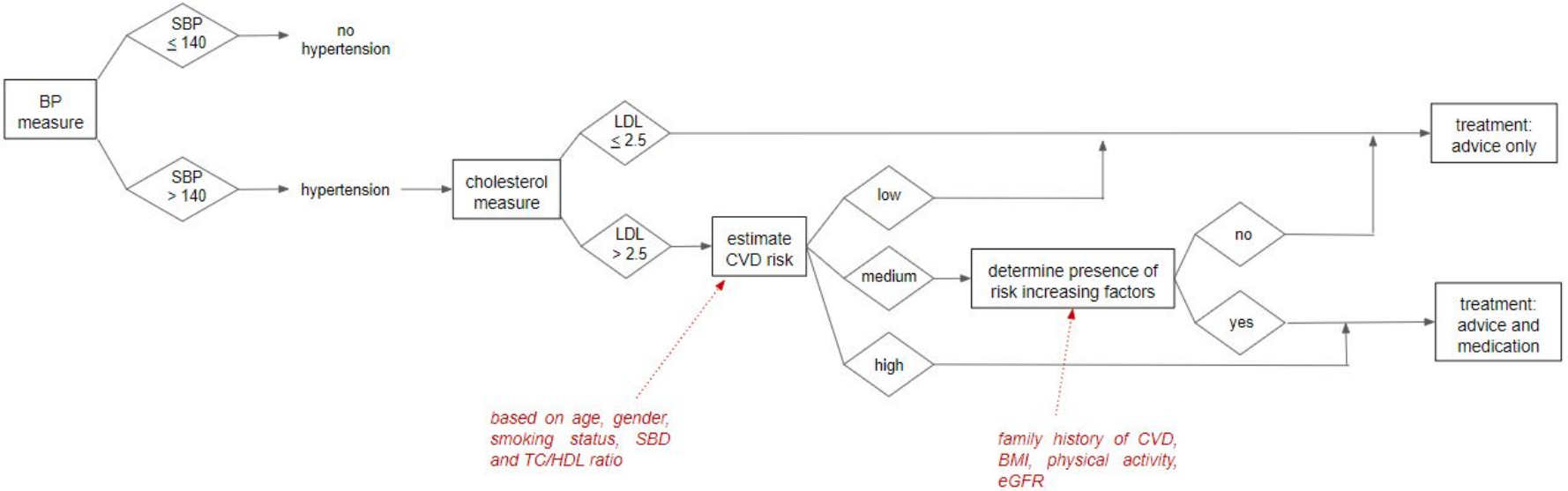




J. Barrasa, 2017

Protocol example - a very simple one . . .

- Examination for hypertension
- Measured twice in previous sessions, SBP 170 and 160
- Third measurement required for diagnosis



Abbreviations - BP: blood pressure, SBP: systolic blood pressure, LDL: low-density lipoprotein, CVD: cardiovascular disease

The current prototype

Demo video

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Paper submitted for publication

Automated Medical Reporting: From Multimodal Inputs to Medical Reports

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Abstract. We present our ideas and innovations concerning automated medical reporting to reduce administrative load in healthcare. Automated reporting is enabled through the integration of speech and action recognition technology with knowledge-based summarization of the interaction between care provider and patient. The aim is to automatically prepare a report of the medical consultation for the electronic medical record. For this purpose, an integrated hardware and software platform is under development that combines a non-intrusive device with microphone, camera and sensor technology with state-of-the-art speech and video analysis and semantic interpretation. We discuss our vision along with the architecture and functionality of the first prototype.

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Under development: second prototype *Speech2EMR-II*

Extending the functionality of the first prototype:

1. Full modality support (audio, video and sensor)
2. Semantic interpretation; formal knowledge representation (triplestores, StarDog)
3. Input medical protocols
4. Interface for reporting conventions and text plans
5. Corpus building infrastructure (Yoda, testing environment)

STARDOG

Graduation projects

- Many possibilities for master thesis projects
- View ongoing projects at www.care2report.nl
- List of possible projects at https://uu.konjoin.nl/project/88
- .. or you can come up with your own ideas!

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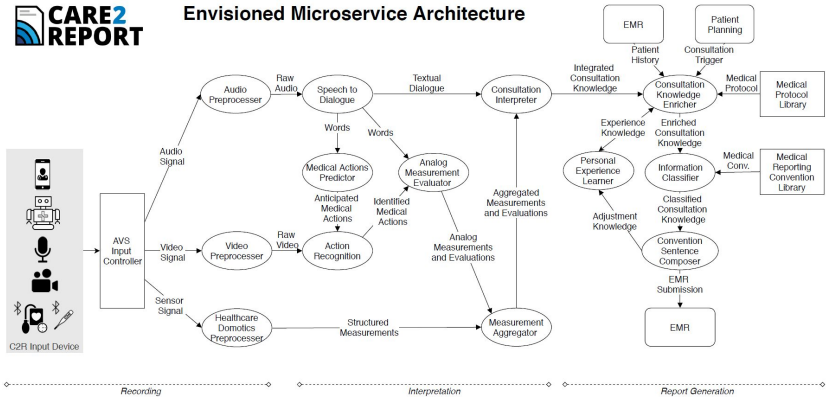
Primary options for graduation

- Representation of session dialogues into knowledge graphs with filtering
- Enriching session graph with patient knowledge graph (patient history)
- Matching dialogue and graph with medical protocols: primary and secondary protocol
- Report sentence composition based on knowledge graph and conventions
- Balancing the microservice architecture with medical variability: disease/protocol, domain, care provider, language/country



Discussion and questions

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