

Figure captions:

- Figure 1. Typical information flow in a multimodal architecture
- Figure 2. Facilitated multimodal architecture
- Figure 3. The three-tiered bottom-up MTC architecture, comprised of multiple members, multiple teams, and a decision-making committee
- Figure 4. Functionality, architectural features, and general classification of different multimodal speech and gesture systems.
- Figure 5. Quickset system running on a wireless handheld PC, showing user-created entities on the map interface
- Figure 6. The OGI Quickset system's facilitated multi-agent architecture
- Figure 7. Architectural flow of signal and language processing in IBM's HCWP system
- Figure 8. Boeing 777 aircraft's main equipment center
- Figure 9. Boeings natural language understanding technology
- Figure 10. Boeings integrated speech and gesture system architecture
- Figure 11. The NCR Field Medic Associates (FMA) flexible hardware components (top); FMA inserted into medics vest while speaking during field use (bottom)
- Figure 12. The NCR Field Medic Coordinators (FMC) visual interface
- Figure 13. The BBN Portable Voice Assistant (PVA) interface illustrating a diagram from the repair manual, with the systems display and spoken language processing status confirmed at the top
- Figure 14. Data flow through the PVA applets three processing threads
- Figure 15: BBNs networked architecture for the PVA, with speech recognition processing split up such that only feature extraction takes place on the handheld

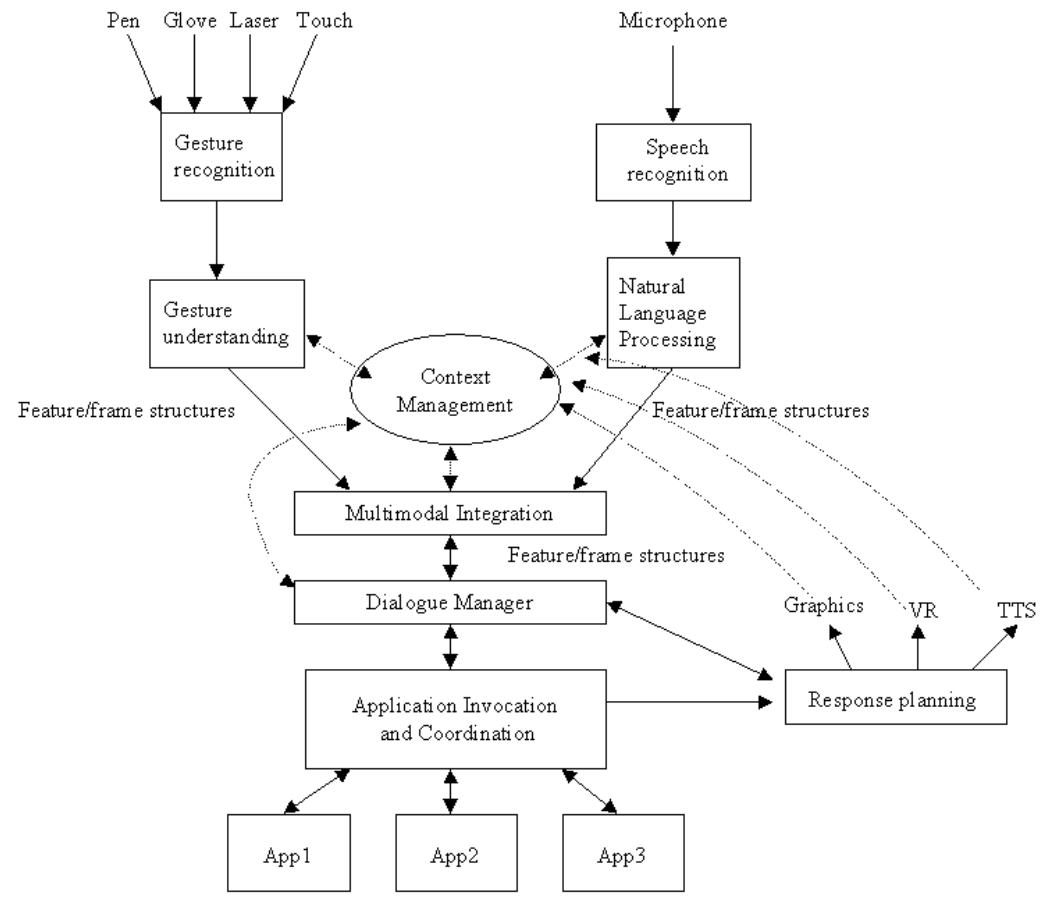


Figure 1

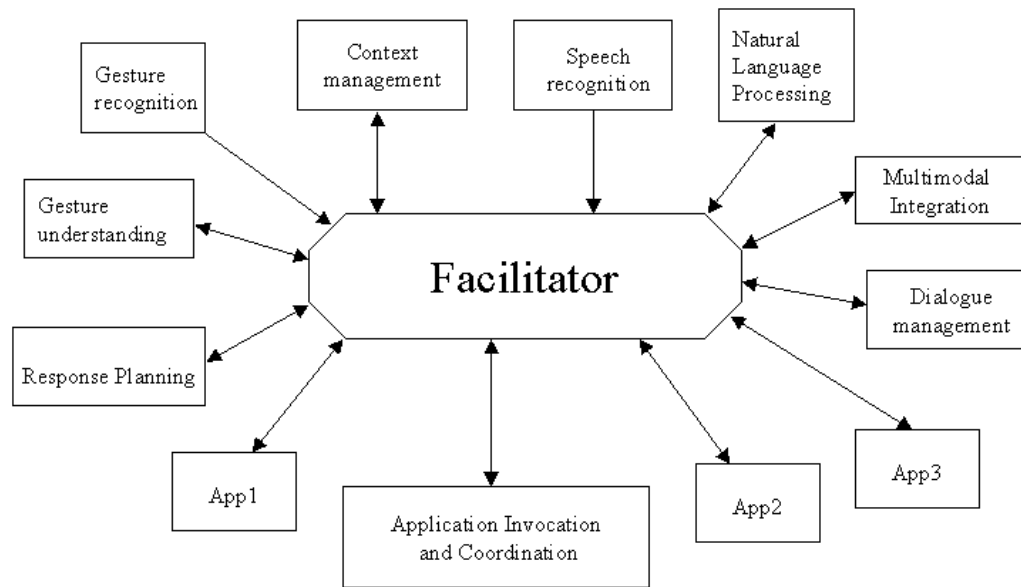


Figure 2

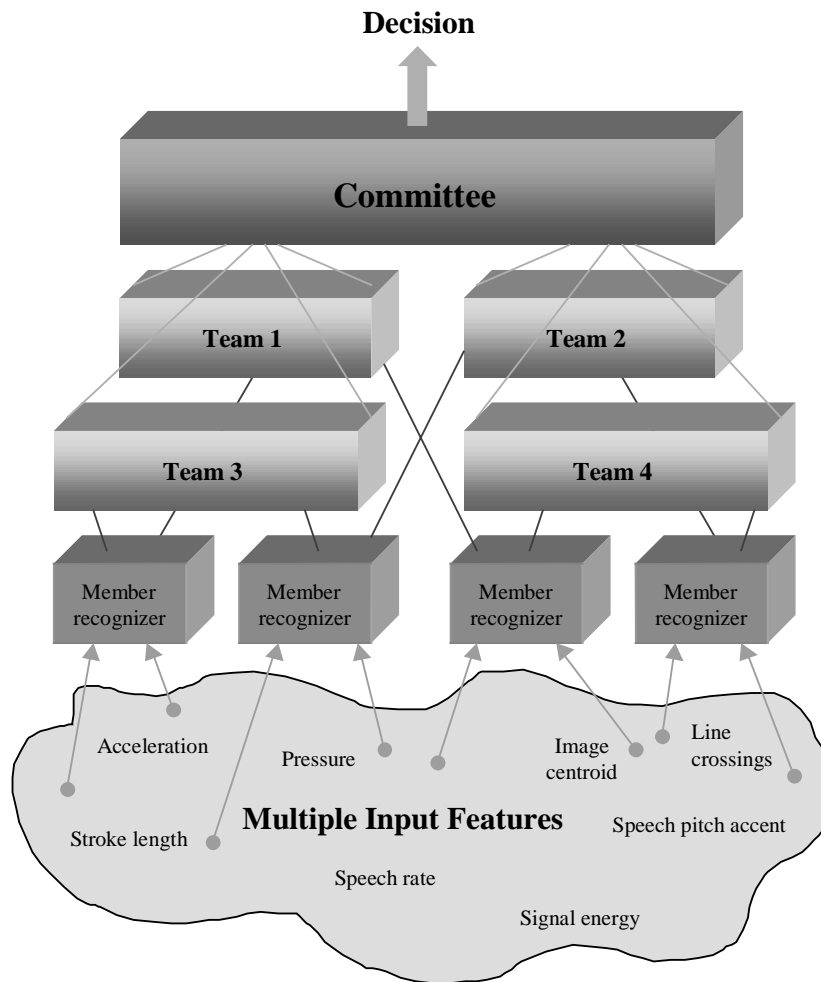


Figure 3

Multimodal System Characteristics:	QuickSet	Human-Centric Word Processor	VR Aircraft Maintenance Training	Field Medic Information	Portable Voice Assistant
Recognition of simultaneous or alternative individual modes	Simultaneous & individual modes	Simultaneous & individual modes	Simultaneous & individual modes	Alternative individual modes ¹	Simultaneous & individual modes
Type & size of gesture vocabulary	Pen input, Multiple gestures, Large vocabulary	Pen input, Deictic selection	3D manual input, Multiple gestures, Small vocabulary	Pen input, Deictic selection	Pen input Deictic selection ²
Size of speech vocabulary³ & type of linguistic processing	Moderate vocabulary, Grammar-based	Large vocabulary, Statistical language processing	Small vocabulary, Grammar-based	Moderate vocabulary, Grammar-based	Small vocabulary, Grammar-based
Type of signal fusion	Late semantic fusion, Unification, Hybrid symbolic/statistical MTC framework	Late semantic fusion, Frame-based	Late semantic fusion, Frame-based	No mode fusion	Late semantic fusion, Frame-based
Type of platform & applications	Wireless handheld, Varied map & VR applications ⁴	Desktop computer, Word processing	Virtual reality system, Aircraft maintenance training	Wireless handheld, Medical field emergencies	Wireless handheld, Catalogue ordering
Evaluation status	Proactive user-centered design & iterative system evaluations	Proactive user-centered design	Planned for future	Proactive user-centered design & iterative system evaluations	Planned for future

Figure 4

¹ The FMA component recognizes speech only, and the FMC component recognizes gestural selections or speech. The FMC also can transmit digital speech and ink data, and can read data from smart cards and physiological monitors.

² The PVA also performs handwriting recognition.

³ A small speech vocabulary is up to 200 words, moderate 300-1,000 words, and large in excess of 1,000 words. For pen-based gestures, deictic selection is an individual gesture, a small vocabulary is 2-20 gestures, moderate 20-100, and large in excess of 100 gestures.

⁴ QuickSet's map applications include military simulation, medical informatics, real estate selection, and so forth.



Figure 5

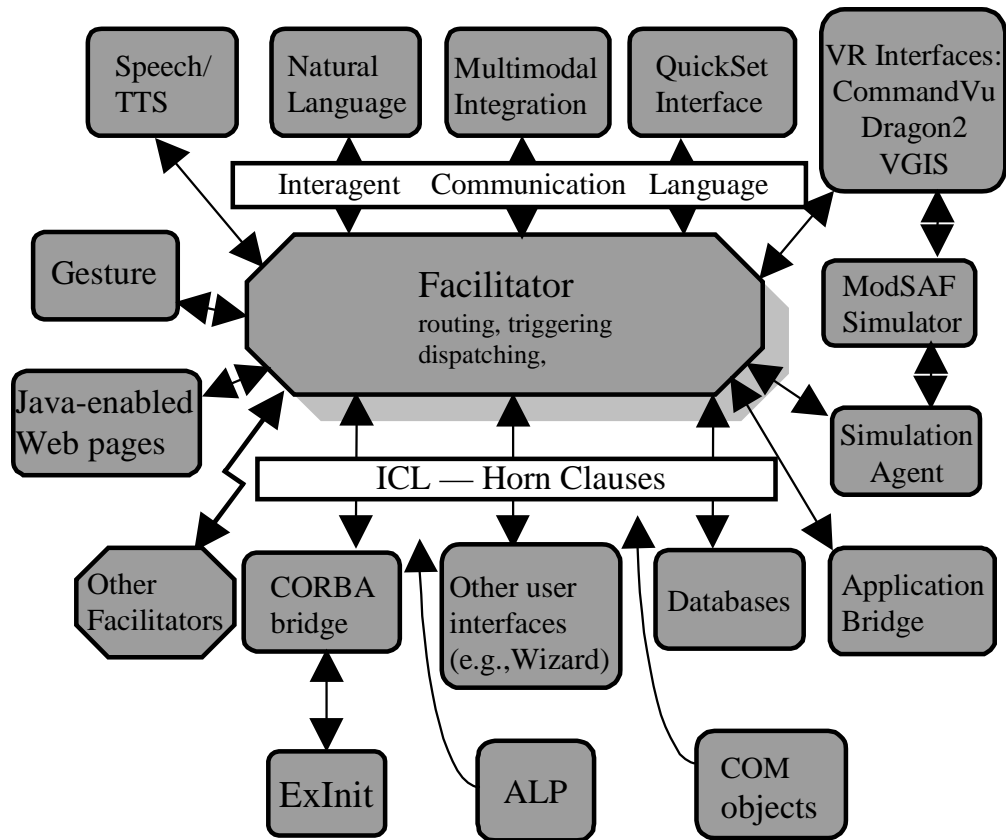


Figure 6

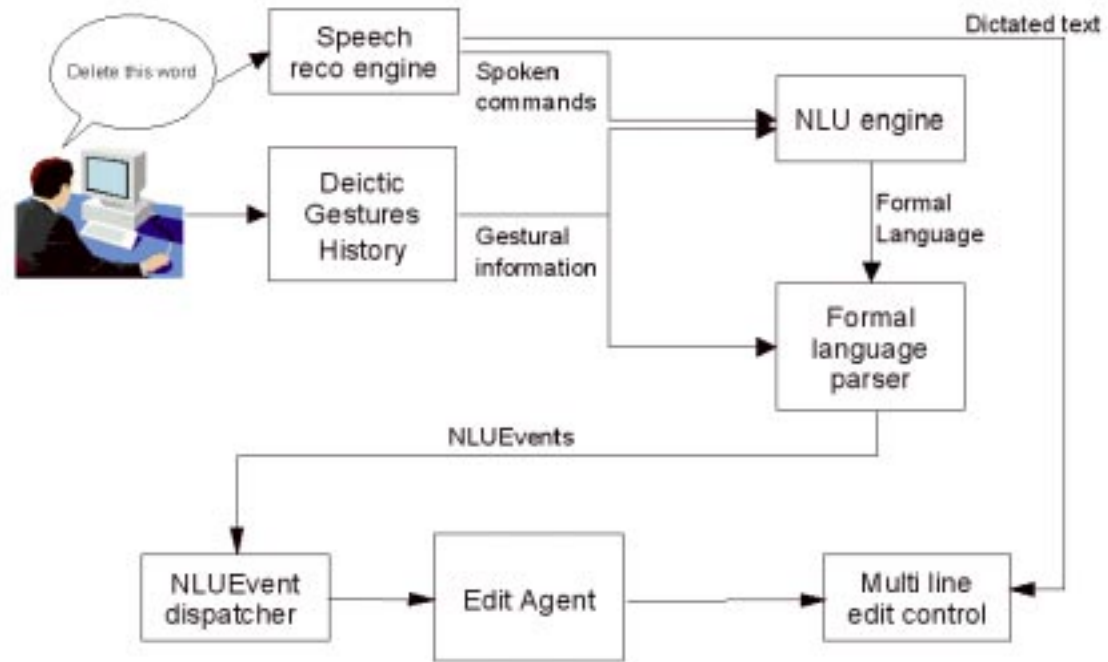


Figure 7

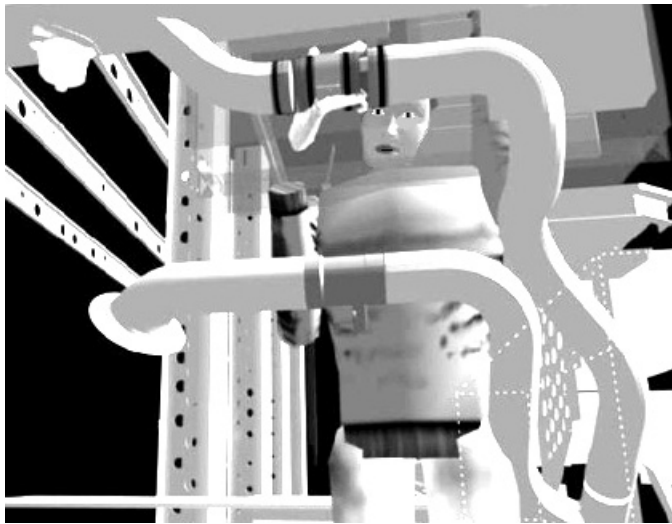
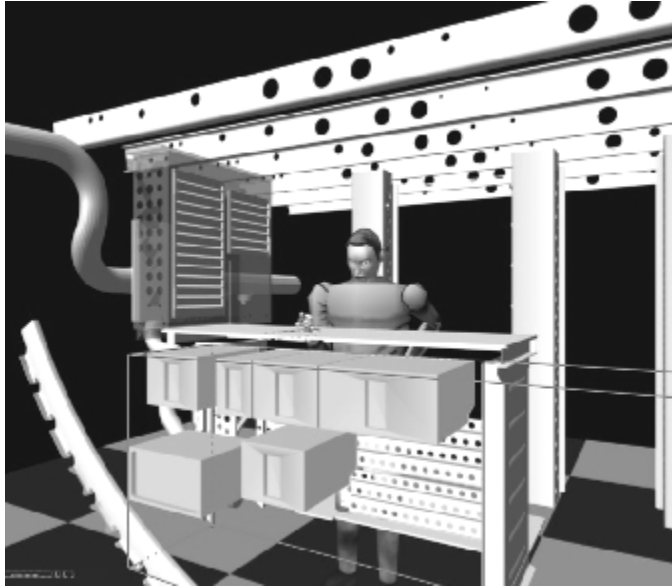


Figure 8

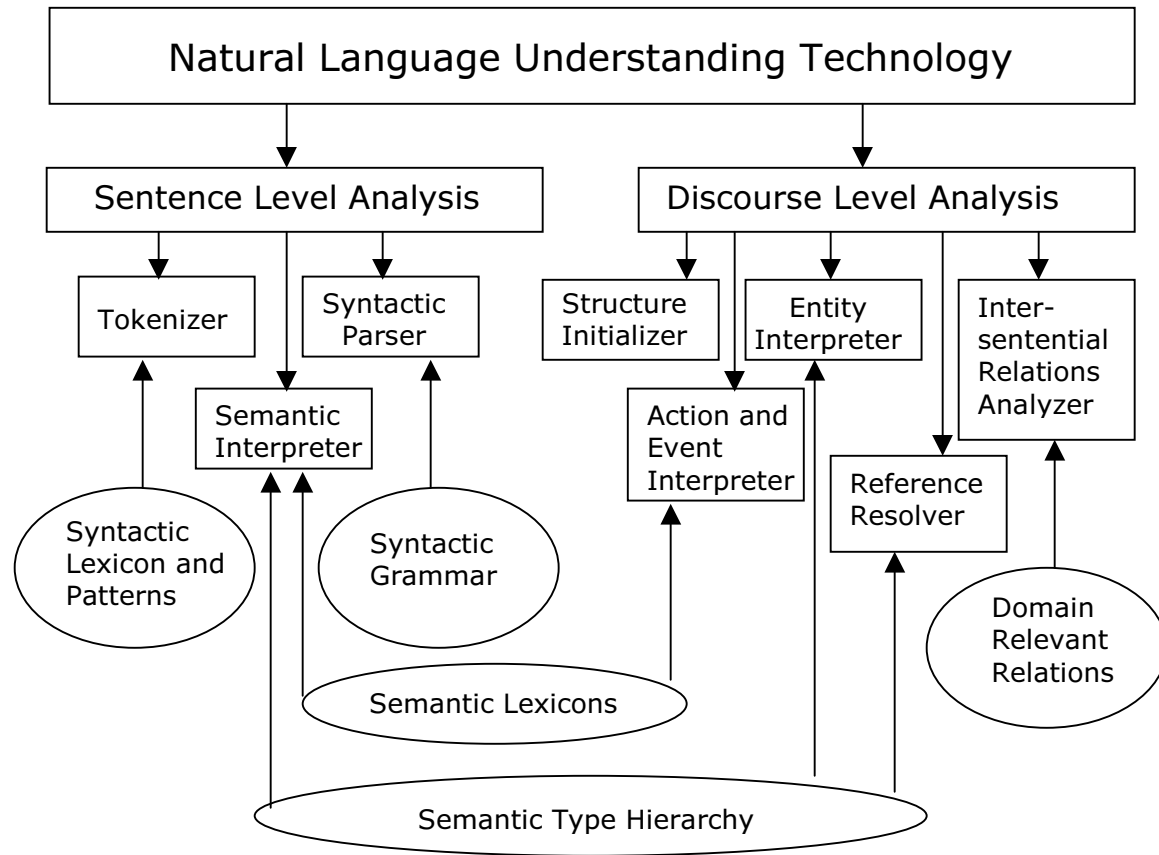


Figure 9

Speech-Gesture Integration Architecture

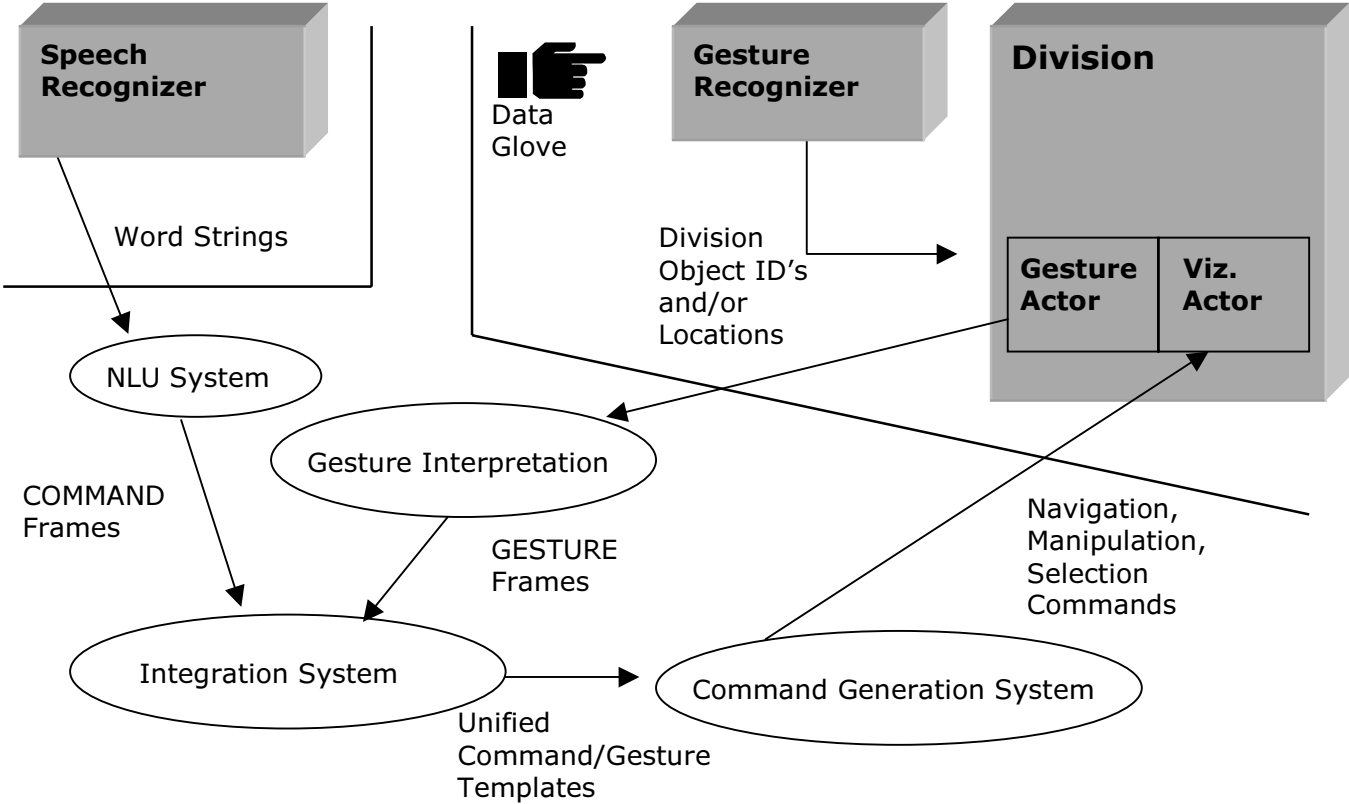


Figure 10



Figure 11

Field Medic Coordinator, Version: 97.11.20

Name: Meyers, Woody | Patient ID: P99ASK3439 | Service No.:

Patient Mgmt | Patients | Incident Site | Simple Record | Detailed Record | Patient Profile | Patient Log | Query

Injury Mechanism

Primary Assessment

Signs/Symptoms

Secondary Assessment

Glasgow Coma Scale

Diagnosis

Treatment

Triage/Evacuation

Head Assessment

Chest Movement

Skin Assessment

Secondary Circulation

Pupil Assessment

Motor Function

DW Open Wound

CW Closed Wound

Co Contusion

OB/GYN

Cardiac

Pn Pain

Fx Fracture

Entrance/Exit Wounds

Other

Blood Pressure: 122 / 85

Heart Rate: 82

Oxygen Sat.: 97

Resp. Rate: 15

Temperature: 98.6

Blood Glucose

Vital Sign Trends | Monitor Control

Male | Front | Female | Back

Show | Hide

This is the name of the currently active patient. | Elapsed Time: 00:49

Figure 12



Figure 13

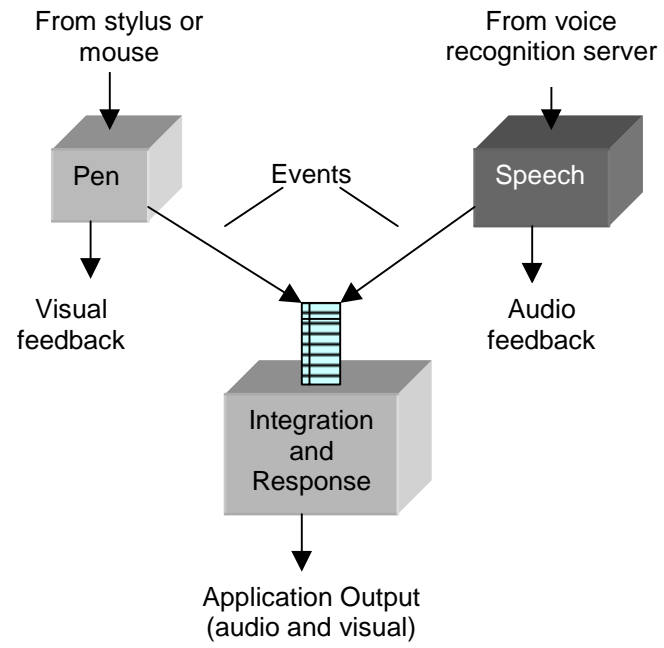


Figure 14

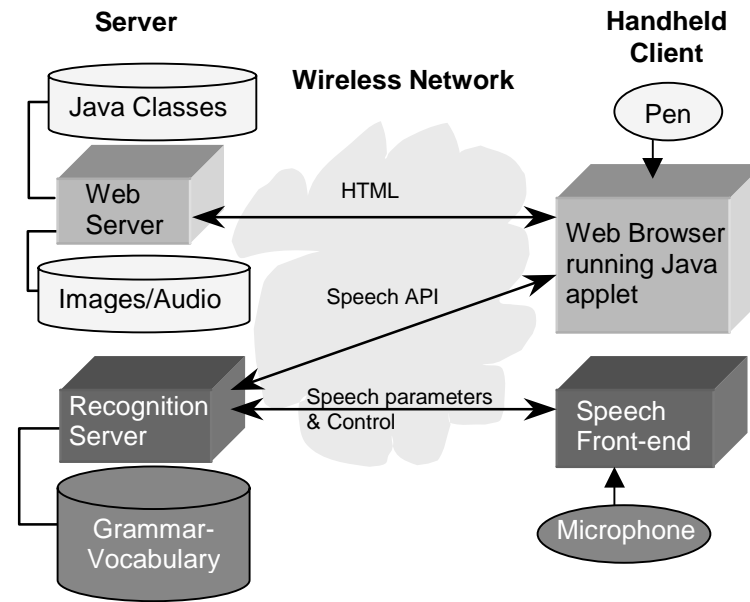


Figure 15