UN Speech Interpreter

UNIS - Radix

ASE 61XX – Team 2

Information System Synthesis Specialists –
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UN Interpretation Services

The **Interpretation Service** at United Nations Headquarters **facilitates communication** at intergovernmental meetings by providing interpretation from and into the **six official languages** of the United Nations:


Arabic


Chinese


English


French


Russian

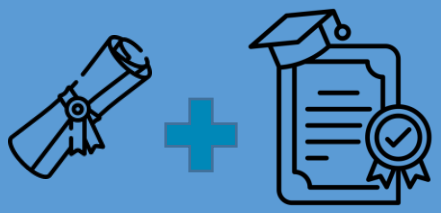

Spanish

Aim: To provide quality interpretation to the meeting bodies at any time and in any place where such services are required

Interpretation Service is composed of a staff interpreters

Interpretation Service Topics

- Peace
- Security
- Sustainable development
- Human Rights
- Environment



To become an interpreter, one needs to have a university degree (in Language) & passed the UN examinations for language positions

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Current State

Bi-Lateral Interpreting

U.N. General Assembly have representatives from all nations with many different languages. **The presenter cannot simultaneously accommodate all ambassadors thus interpreters are required.**

Private close door meetings between foreign delegates eg. Trump Putin meeting

100 - 110

words per minute is optimal speed for interpreting

Interpretation

Simultaneous

The interpreter **uses microphones and earpieces** with interpreters working from a sound-proof booth

Chuchotage – Whispered interpreting to a single person in close proximity to third parties

Maintains an optimal distance from the speaker (the **Ear-Voice Span**)

Interpreter will not parrot the behavior of the speaker

Consecutive

The interpreter **waits until the speaker pauses** and then interprets.

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Forms of Communication

Non Verbal Communication

Head movements

Posture

Facial Expressions

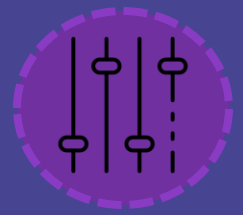
Eye movements

Gestures

Proxemics

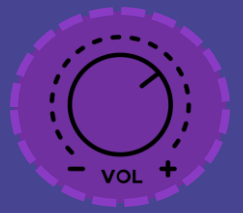
Verbal Communication

Spoken Language



Tone

Word Emphasis



Volume

Speed

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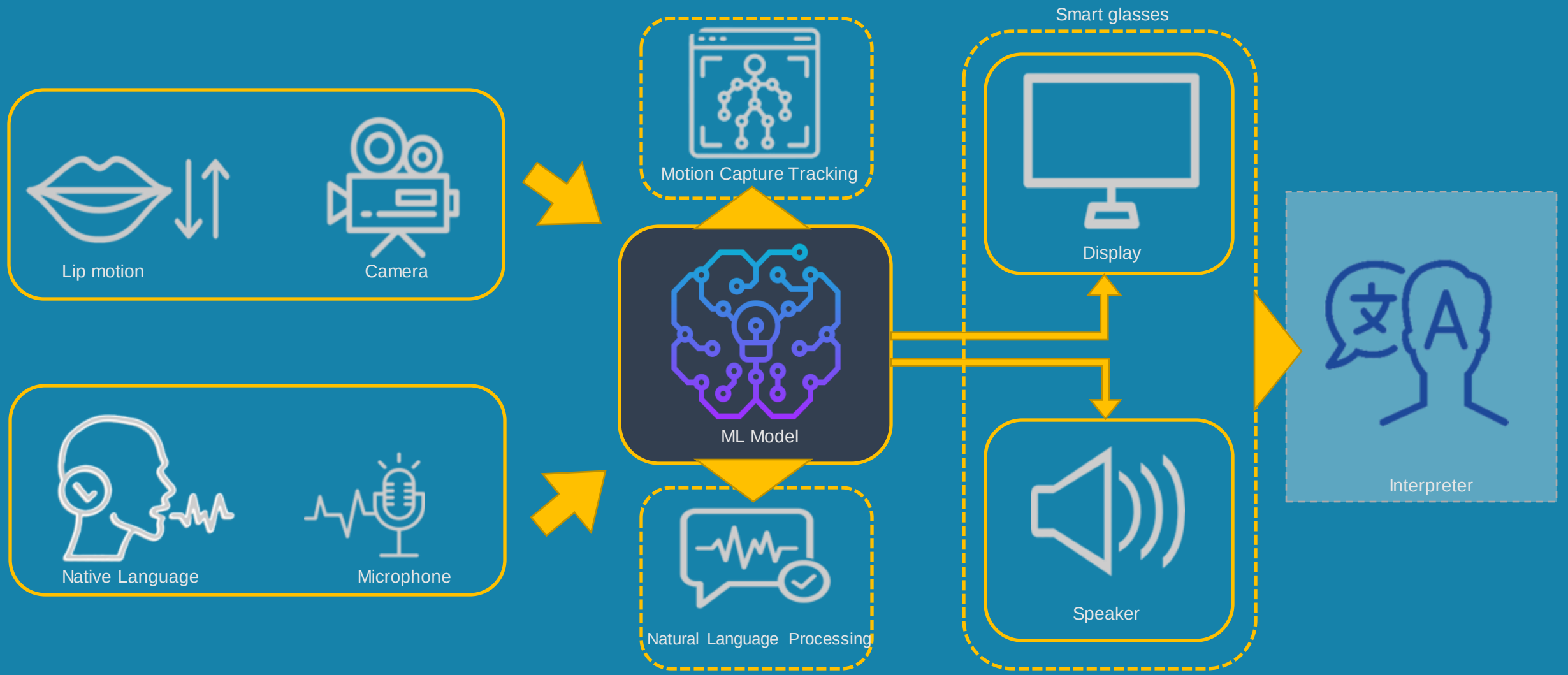
UNIS-Radix OV-1



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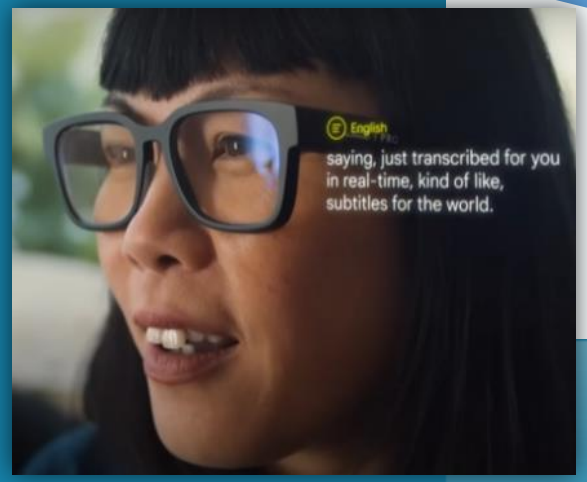
Radix System Smart Glasses Example



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Refined System Requirements

ID	Requirement	Verification Method
Sys-1.1	Interpretation: The system shall support the following languages listed in the table below. *(table omitted for conciseness)*	Test- Random sample 1,000 hours of audio from U.N. presentations to compare with certified interpreters.
Sys-1.2	Interpretation: The system shall have a interpretation accuracy of 97%.	Test- Random sample 1,000 hours of audio from U.N. presentations to compare with certified interpreters.
Sys-2.1	Audio: The system shall provide interpreted audio within 4 seconds of a sentence completion. (target 3 seconds)	Test- Random sample 1,000 hours of audio from U.N. presentations.
Sys-2.2	Audio: The system shall provide interpretation in the speaker's voice with 97% accuracy.	Test- Compare 20 speaker's generated voice with 1 hour of additionally sampled audio.
Sys-3.1	Video: The system shall provide a video overlay over the speaker's mouth to match interpretation audio.	Test- Random sample 1,000 hours of audio from U.N. presentations
Sys-4.1	Operations: The system shall support up to 1,000 listeners simultaneously.	Analysis- Impractical to test.
Sys-4.2	Operations: The system shall use wireless transmission.	Demonstration.

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Refined System Requirements

ID	Requirement	Verification Method
Sys-4.1	Operations: The system shall support up to 1,000 listeners simultaneously.	Analysis- Impractical to test.
Sys-4.2	Operations: The system shall use standard wired and or wireless transmission methods.	Demonstration.
Sys-5.1	Hardware: The headset shall have a profile meeting Engineering drawing XYZ. (*contents look similar to Vuzix Blade 2)*	Inspection
Sys-6.1	Data: The headset will transmit up to 10 Mbps.	Test
Sys-6.2	Data: Any stored data on the system will be encrypted.	Test
Sys-6.2	Data: Any stored data on the system will be GDPR compliant.	Inspection

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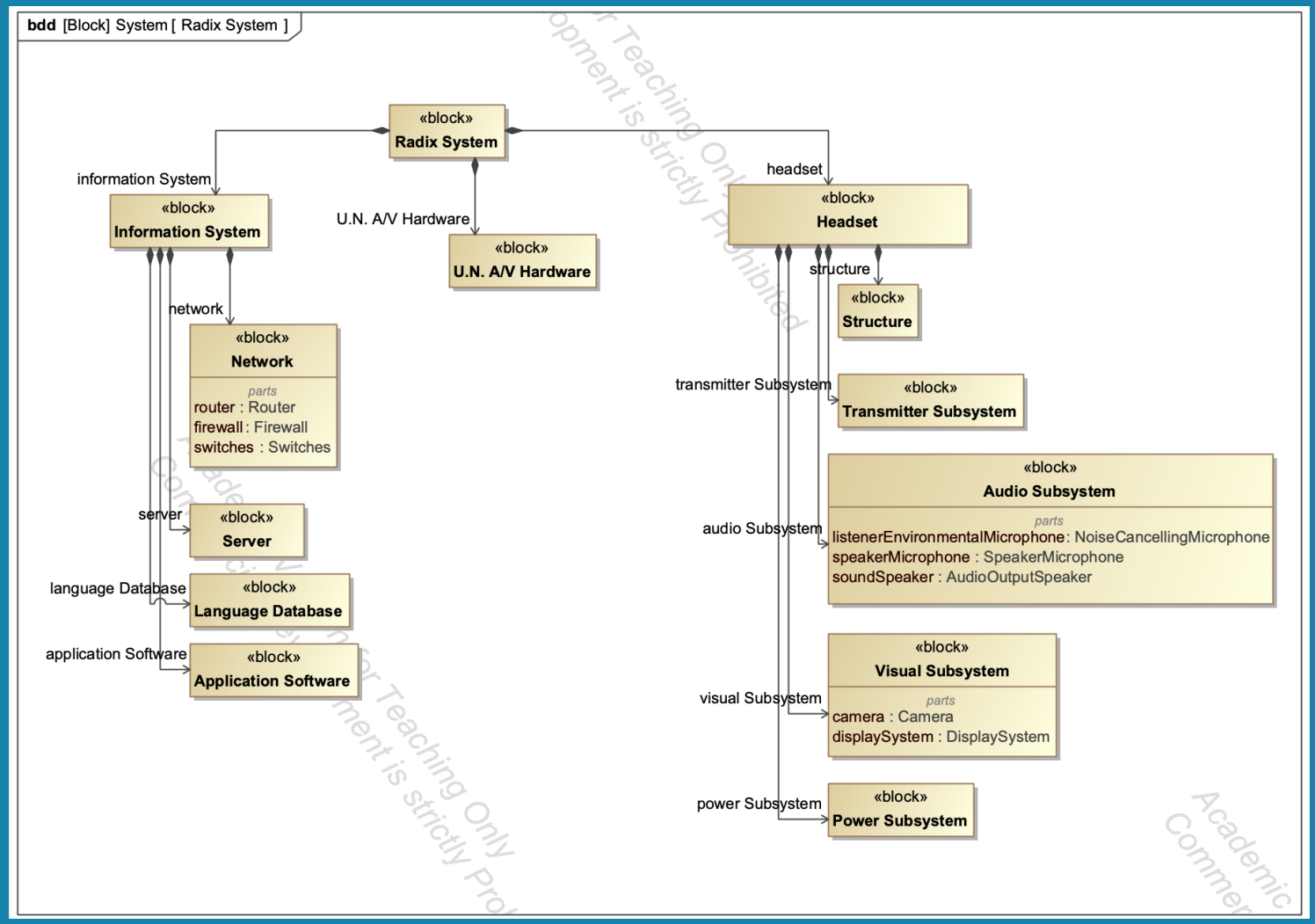
System Level Architecture

- System Level Architecture generated and iterated to capture the System.
- System involves the Radix Information System, existing U.N. A/V infrastructure, and the user Radix Headset.
- HSI involved in every aspect.



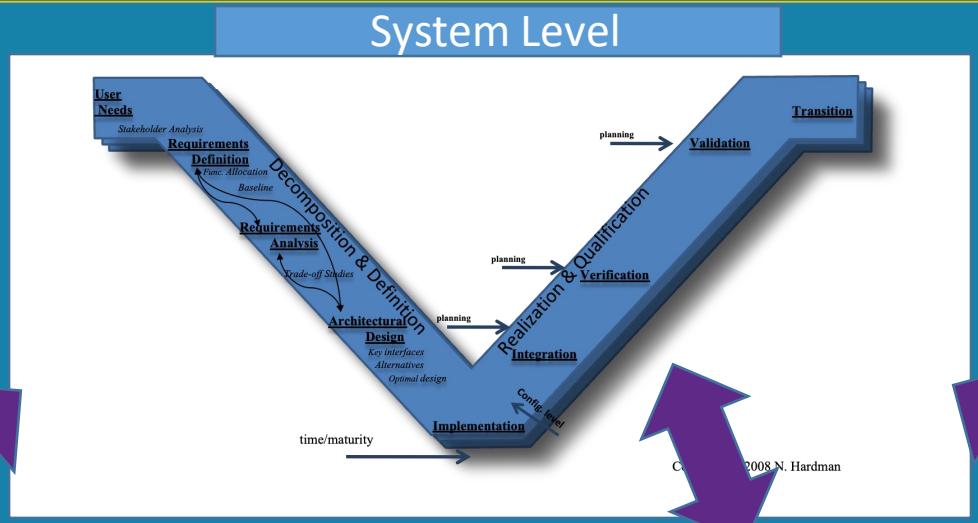
UNIS-Radix Work Breakdown Structure

- WBS created to manage personnel and resources.
- Broken into Design, Manufacturing, and Enablement teams.
- Systems Engineering is a team sport.

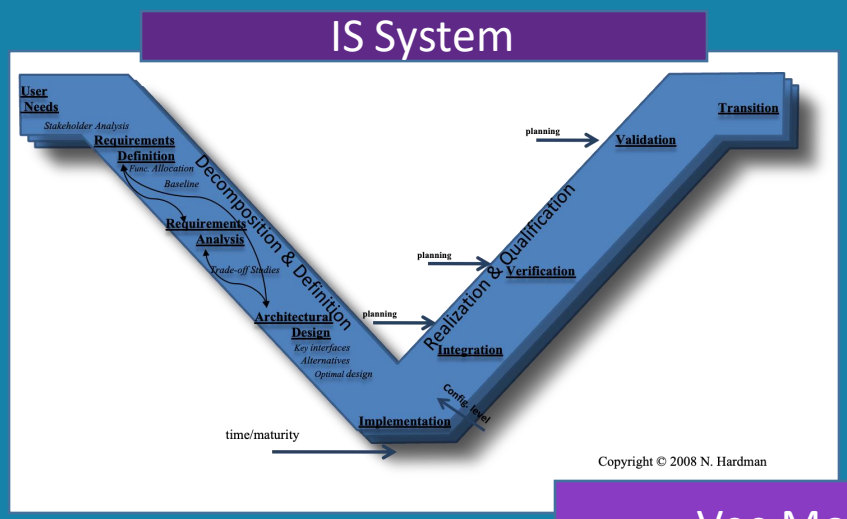
1. Design	2. Manufacturing	3. Enablement
1.1 System Engineering	2.1. Operations	3.1. Training
1.2. Information Systems	2.2. Facilities	3.2. Customer Development Liaison
1.3. Sensor System	2.3. Procurement	3.3. Project Management
1.4. HSI		3.4. Logistics
1.5. Display Technology		3.5. Risk
1.6. Power System		

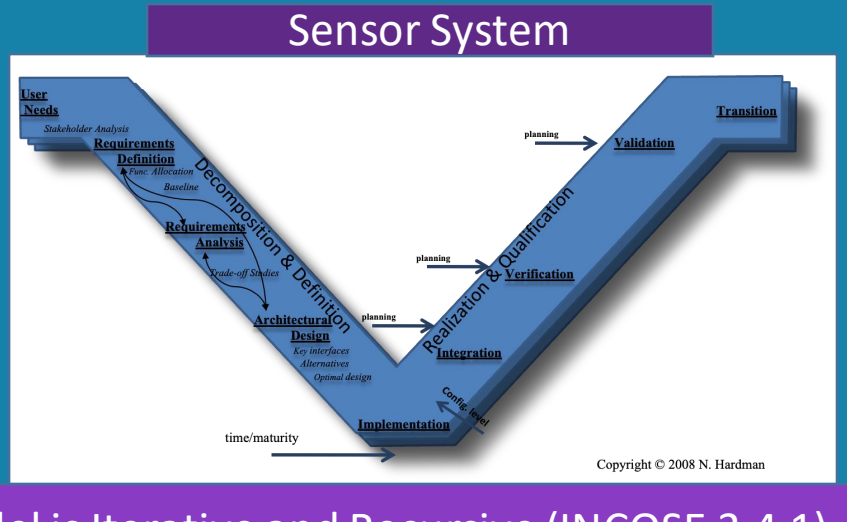
System Vee flows to Subsystem Vee's

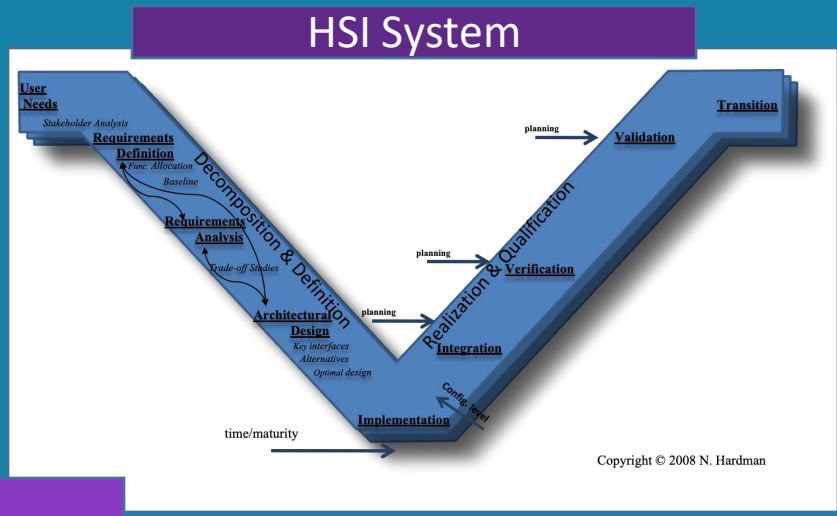
Level N



Level N+1







Vee Model is Iterative and Recursive (INCOSE 3.4.1)

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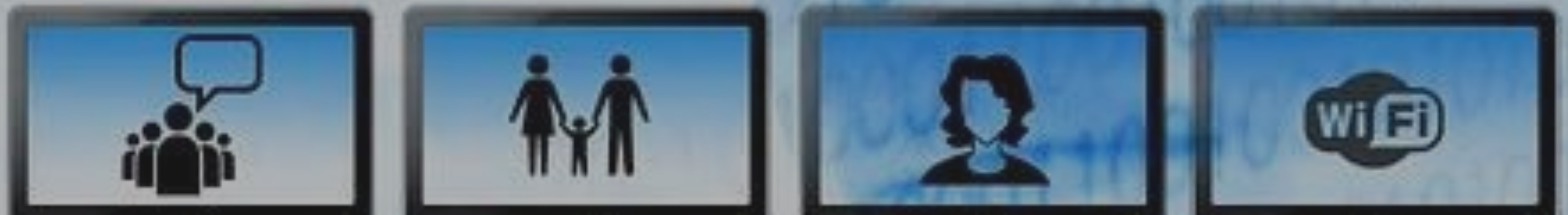
Information Systems Component



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Information Systems Requirements

Requirement ID	Requirement
IS2001	The speech interpretation system shall filter audio noise.
IS2002	The speech interpretation system shall filter motion noise.
IS2003	The system shall search the filtered words against the translate database.
IS2004	The system shall interpret filtered motion by searching the non-verbal language motion database.
IS2005	The system shall merge the processed audio and motion data.
IS2006	The system shall validate the merged data.
IS2007	The system shall have cloud storage capability.
IS2008	The system shall have the required network bandwidth.
IS2009	The system shall have local and cloud infrastructure.
IS2010	The system shall provide audio output.
IS2011	The system shall display video output with facial overlay.

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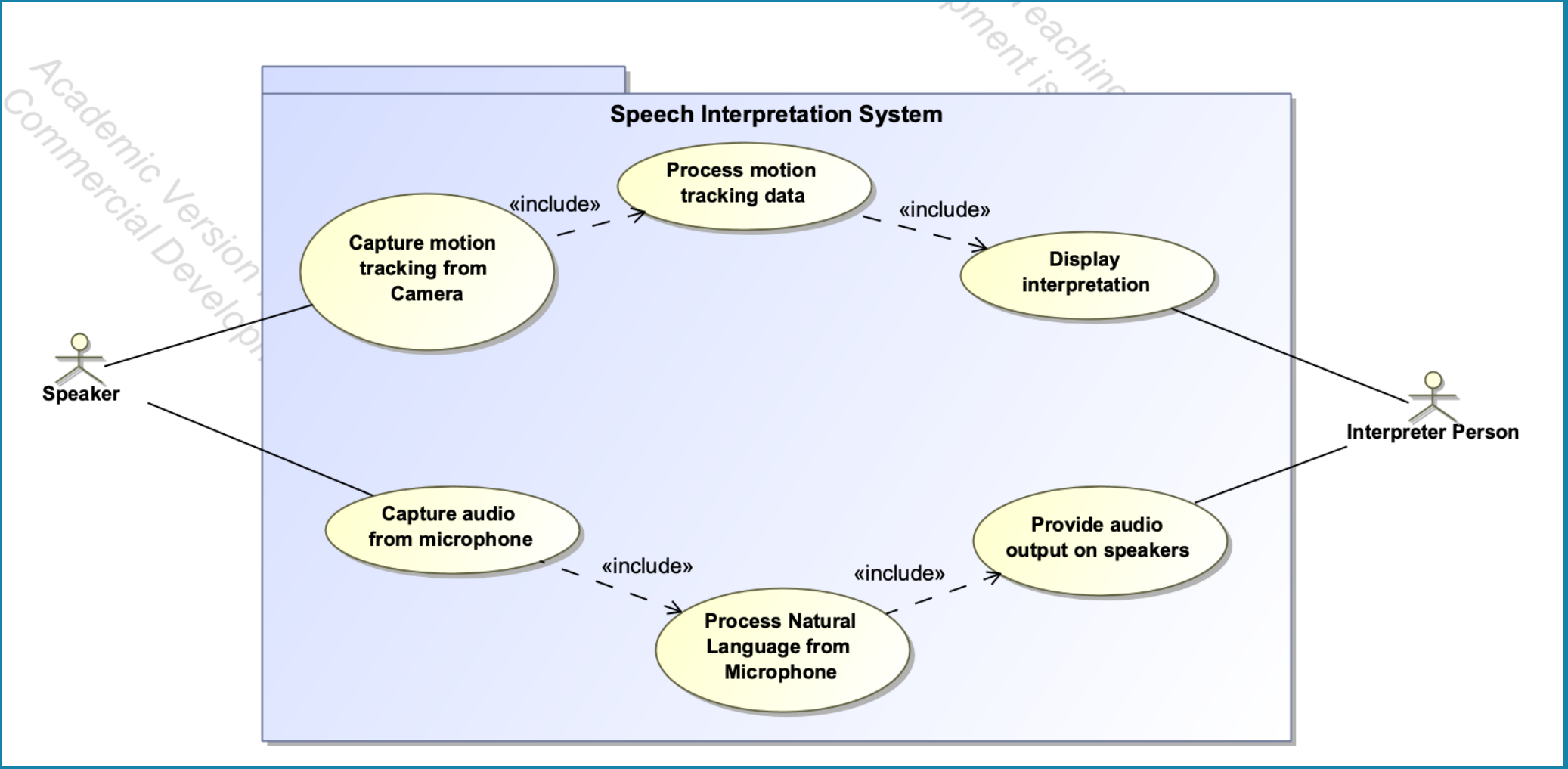
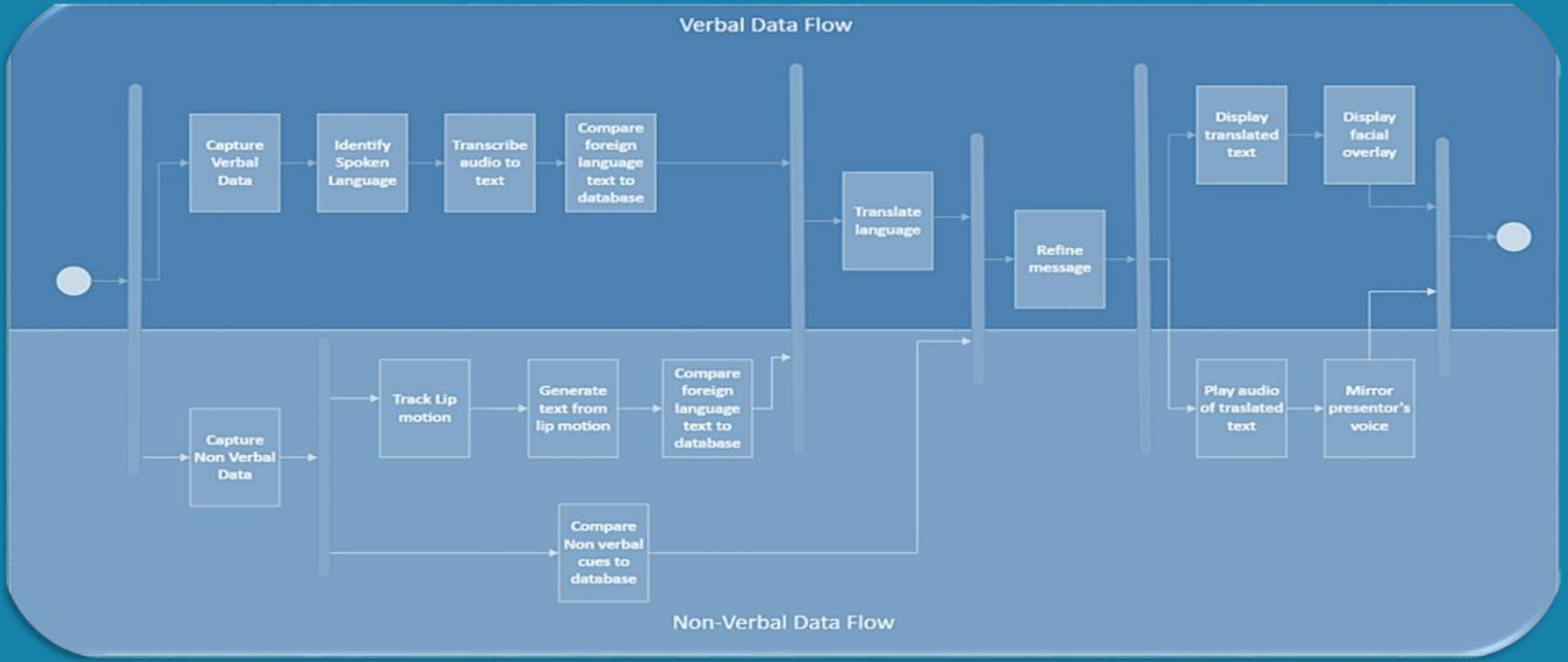
Use Case Diagram



Activity Diagram – Convert to SysML



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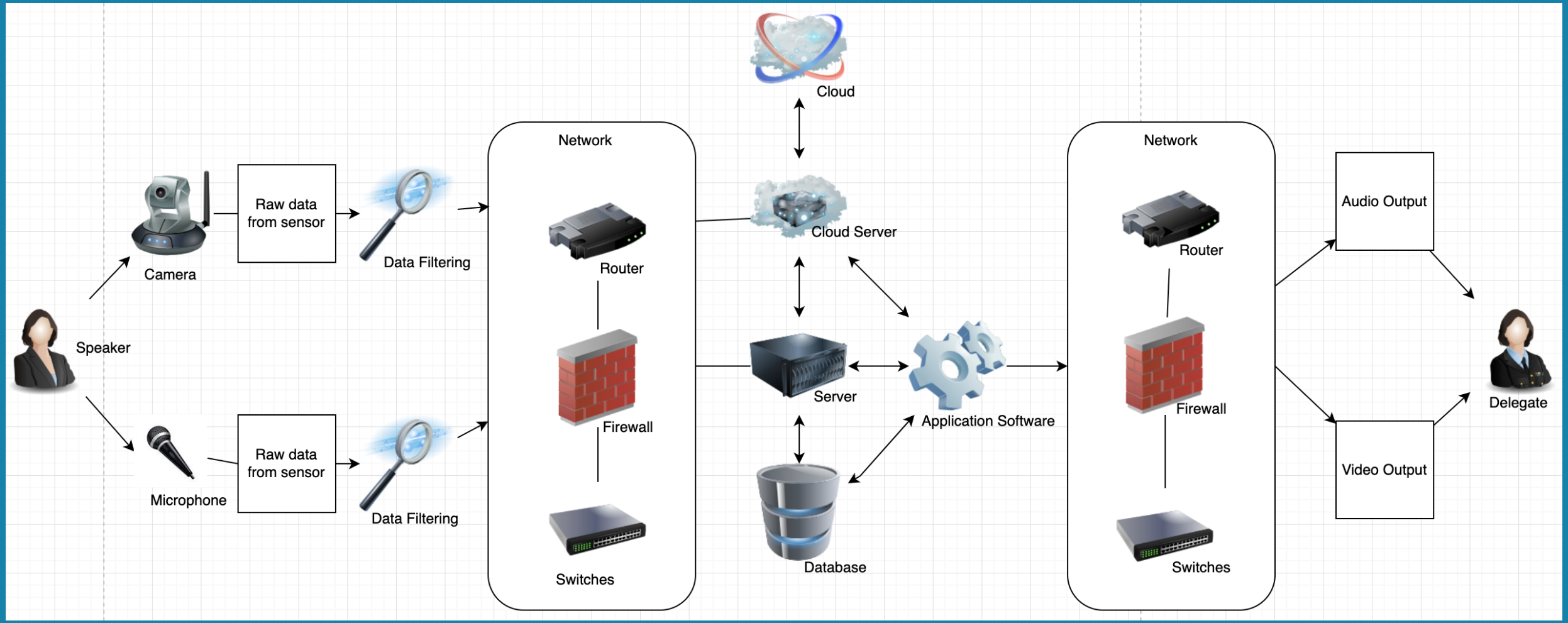
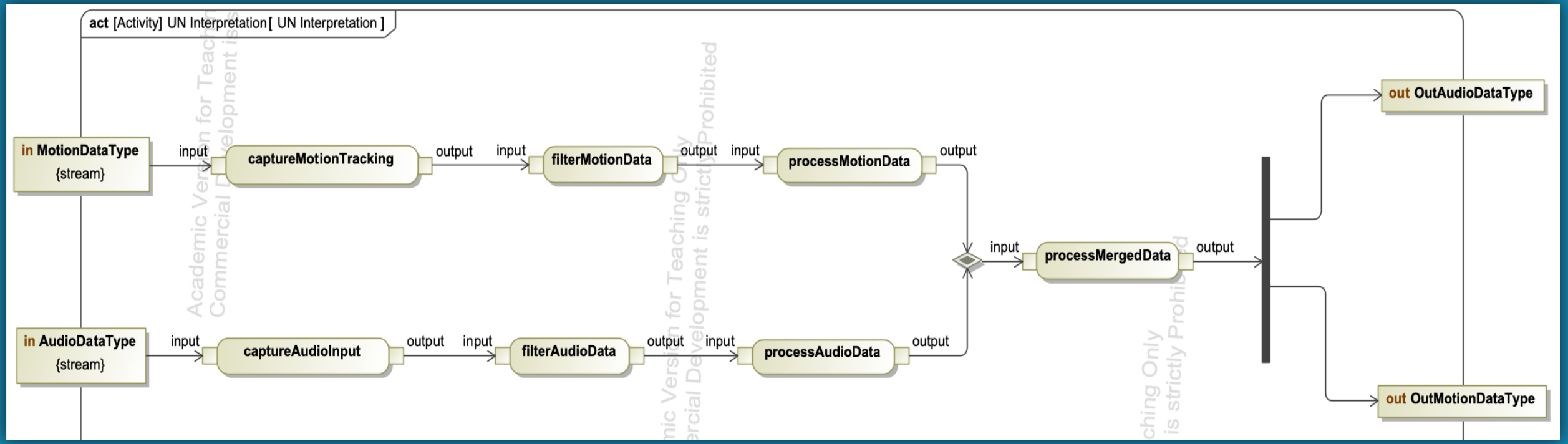
Network and Infrastructure Details



Data Flow Activity Diagram



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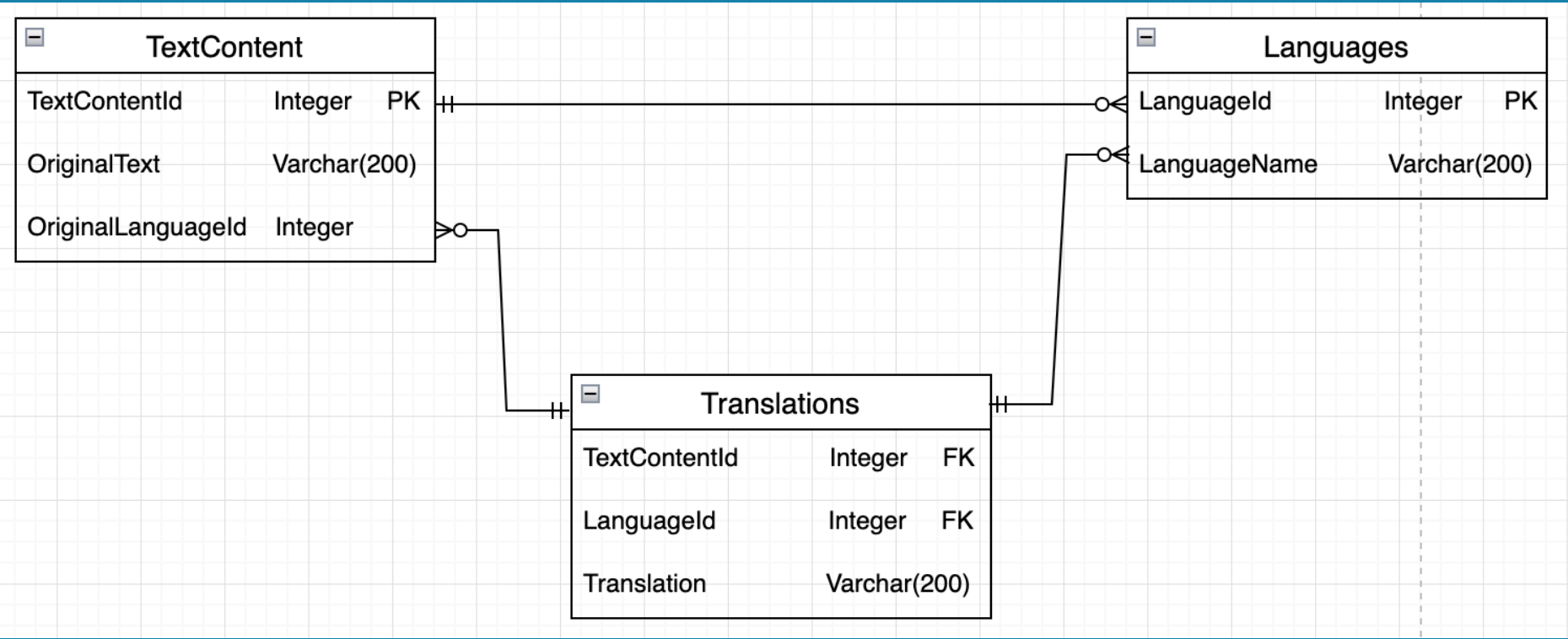
Verbal Database Schema Diagram

All texts have a translation in each supported language.



Schema must have:

- A master table of languages.
- A table of texts in the original language.
- A table of translated texts.

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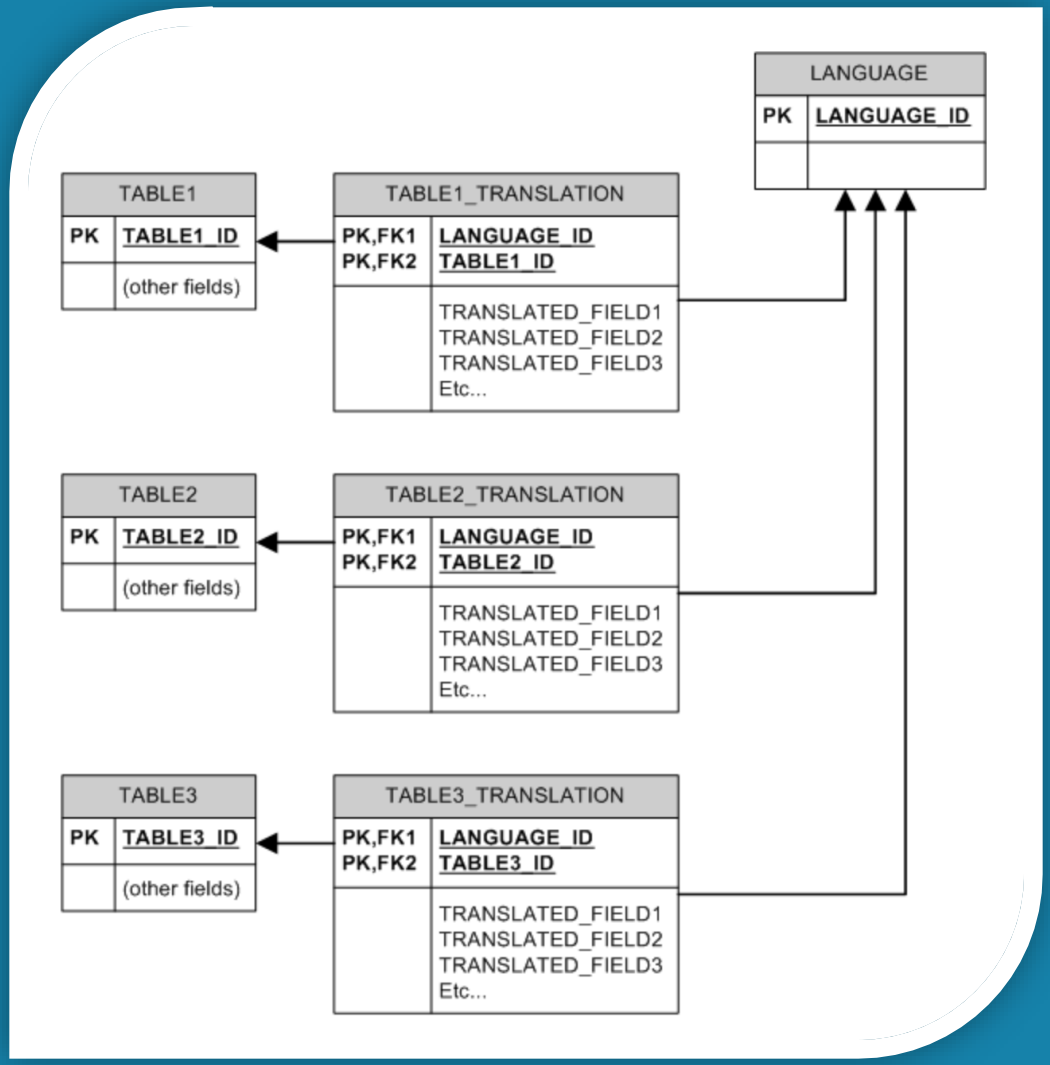
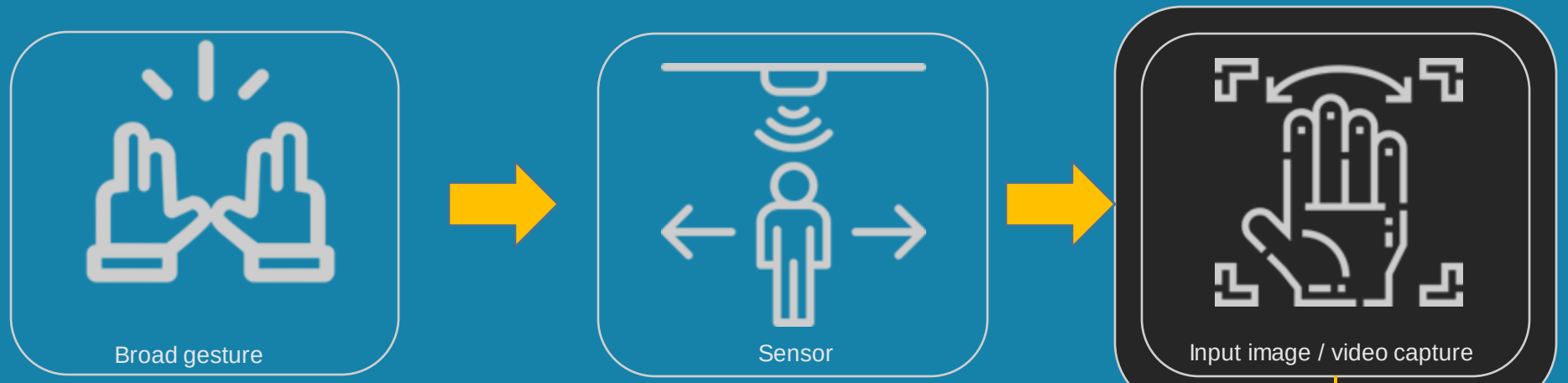
Database Schema Details

- Only a foreign key to the translations table is stored
- A separate table contains a row for each translation to a language.
- A 1:N relationship between translatable tables and translations
- One new translation table for each translatable table



Body Language Processing System



Gesture Class Label

Image Pre-Processing → Feature Extraction → Gesture Recognition Tracking System → Recognized Gesture

Pre-Processed Image

Extracted image / video features

Classification

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Mapping emotion Creating gesture DB

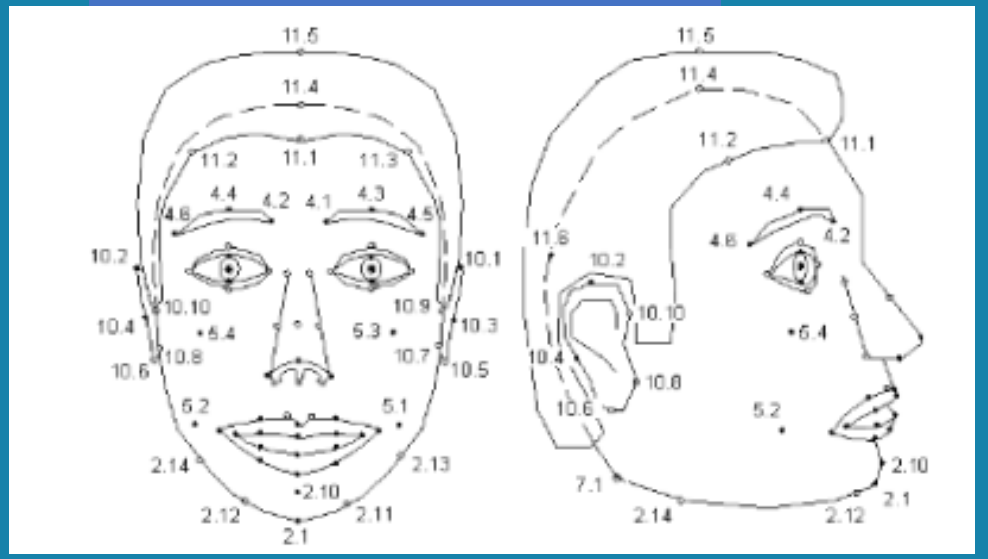
Characteristic points in the facial area can be automatically detected and tracked.

Metrics from these points will feed a fuzzy inference system whose output is a vector of parameters that depicts the systems' degree of belief with respect to the observed emotion.

Proposed emotion tracking template

Anger	squeeze_l_eyebrow (+) lower_t_midlip (-) raise_l_i_eyebrow (+) close_t_r_eyelid (-) close_b_r_eyelid (-)	squeeze_r_eyebrow (+) raise_b_midlip (+) raise_r_i_eyebrow (+) close_t_l_eyelid (-) close_b_l_eyelid (-)
Sadness	raise_l_i_eyebrow (+) close_t_l_eyelid (+) raise_l_m_eyebrow (-) raise_l_o_eyebrow (-) close_b_l_eyelid (+)	raise_r_i_eyebrow (+) close_t_r_eyelid (+) raise_r_m_eyebrow (-) raise_r_o_eyebrow (-) close_b_r_eyelid (+)

3D mapping of a persons face



Examples of emotions and their score

	Activ	Eval		Activ	Eval
Afraid	4.9	3.4	Angry	4.2	2.7
Bashful	2	2.7	Delighted	4.2	6.4
Disgusted	5	3.2	Eager	5	5.1
Guilty	4	1.1	Joyful	5.4	6.1
Patient	3.3	3.8	Sad	3.8	2.4
Surprised	6.5	5.2			

A Fuzzy System for Emotion Classification based on the MPEG

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NLP

Speech Capture

Input sentence → Breaks sentence into words → Syntactic analysis → Semantic analysis → Pragmatic analysis → Machine understands input → Human Readable output → Compare to database → Formulate Translation

Affect Analysis → Speech recognition → Speech Synthesis

(Generative Adversarial Network)

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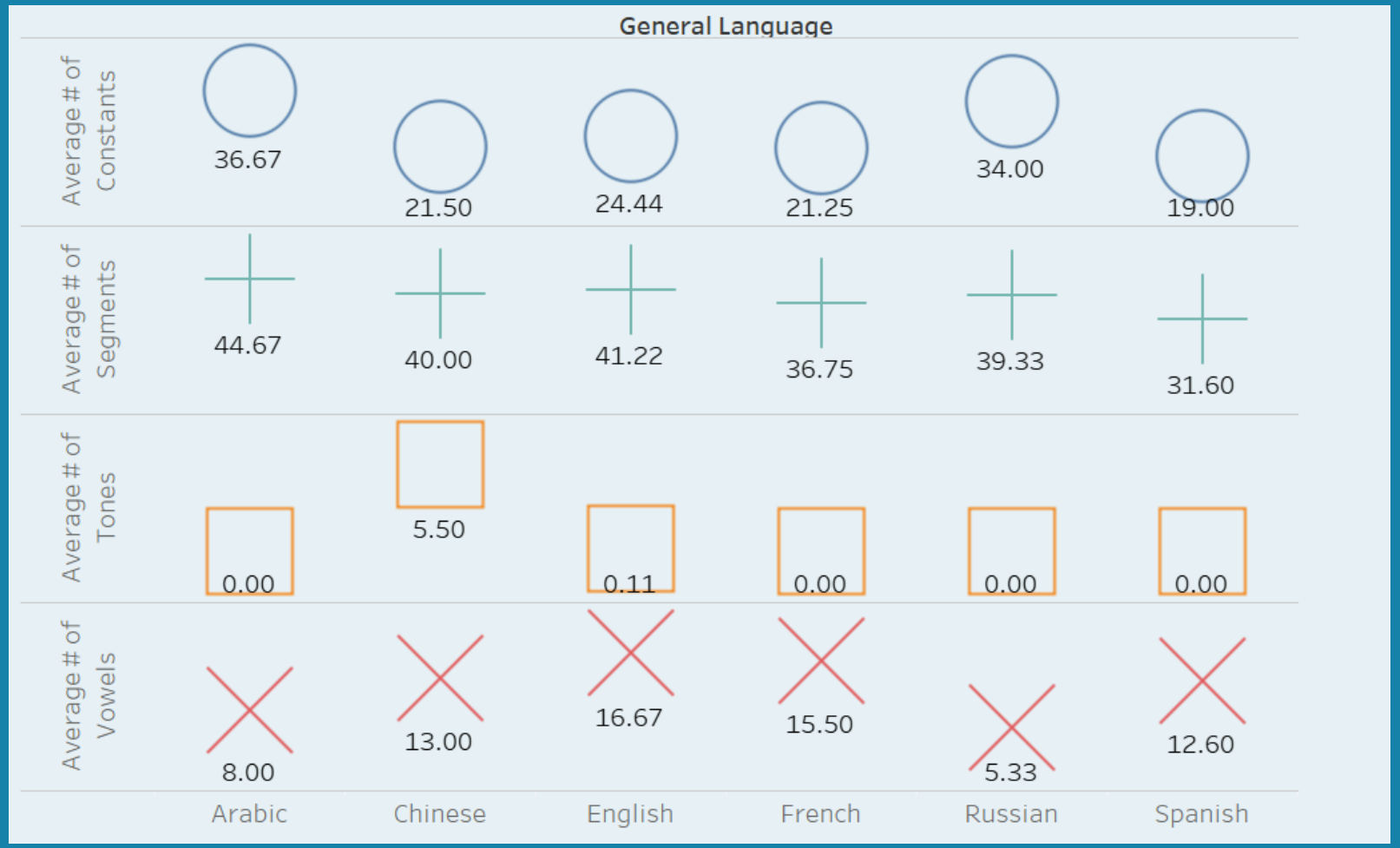
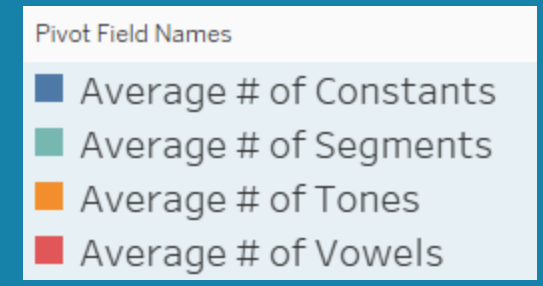
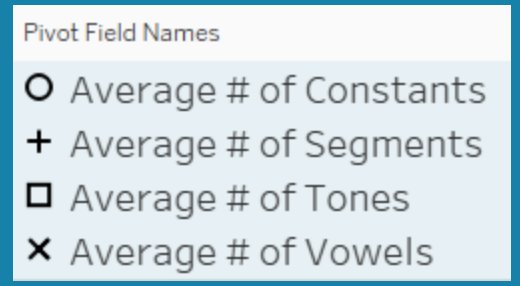
Phonetic Breakdown







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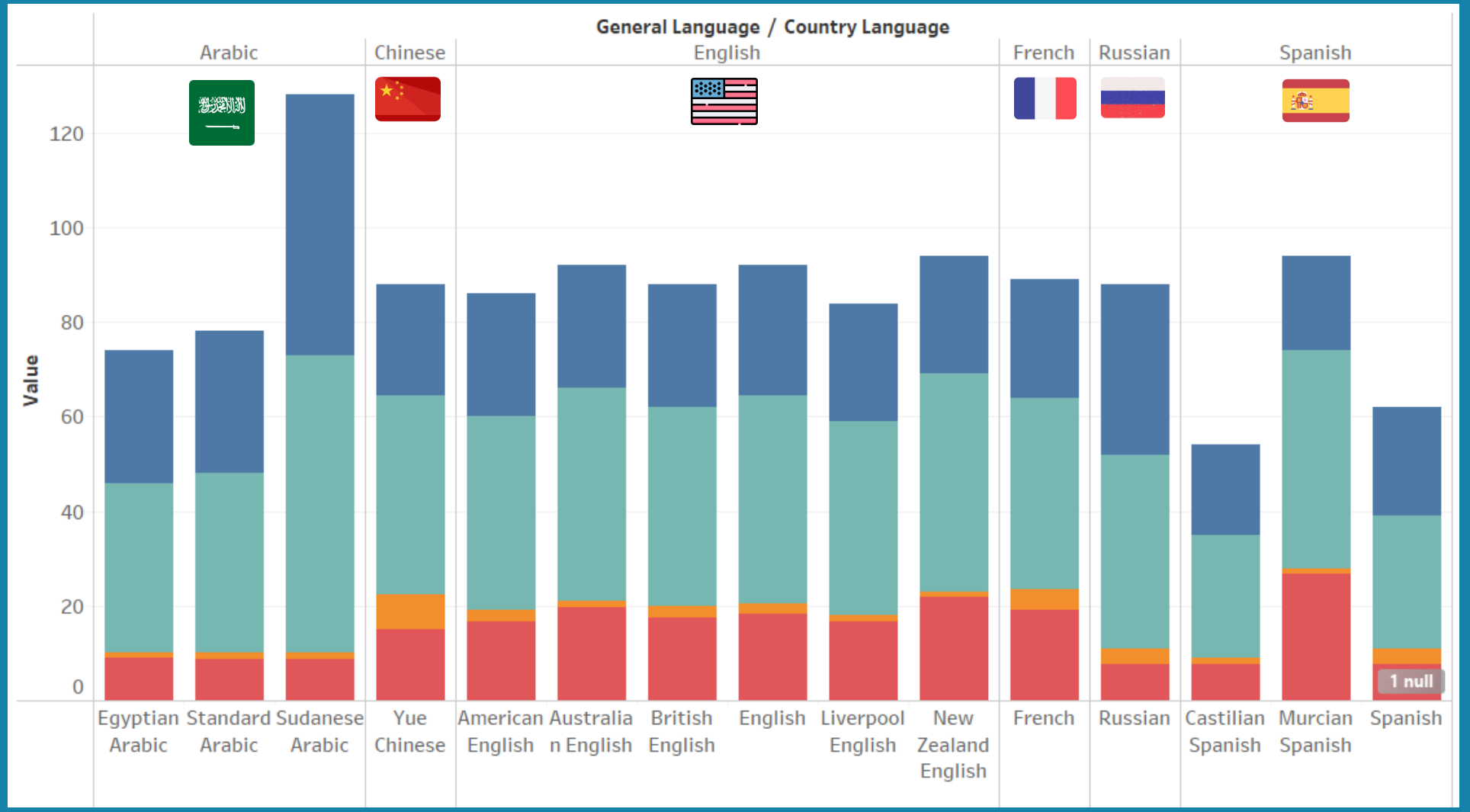
Phonetic Breakdown Cont.



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Algorithm Selection

Hidden Markov Model

+	-
Great Fit with Sequential Nature of Speech	- Not Flexible - Hard to Grasp all the phoneme varieties

Neural Network

+	-
- Flexible - Phoneme Pro	- Lots of Data - Bad fit with sequential nature of speech

A Basic Introduction to Speech Recognition (Hidden Markov Model & Neural Networks)

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Measuring Sentiment of Text

Whissell Dictionary of Affect

Contains over 3000 terms, each with a description and an example of how a particular **state of mind** or **emotion** is expressed in language

Measures:

- Pleasantness
- Activation
- Imagery (ease of forming a mental picture)

Whissell dictionary of Affect

Linguistic Inquiry and Word Count

Text analysis software program that uses dictionary-based methods to analyze texts. Used to assess the **emotional**, **cognitive**, and **structural elements** of texts

Measures:

- Analytical Thinking
- Clout / Confidence
- Authenticity (honesty vs hedging)
- Emotional Tone / affect

Linguistic Inquiry and Word Count

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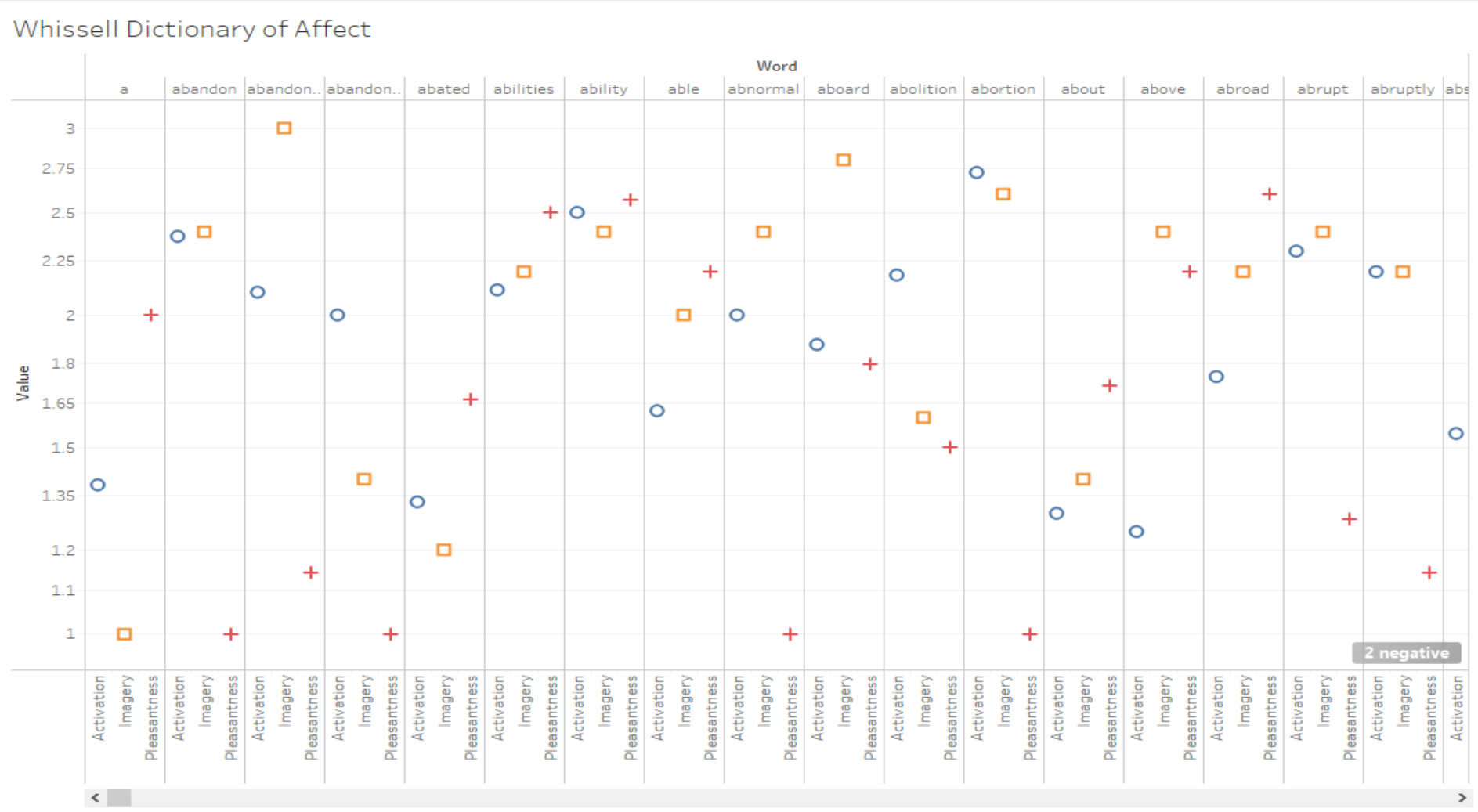
Visualization

Whissell's Dictionary of Affect



Measure Names

- Activation
- Imagery
- Pleasantness

Measure Names

- Activation
- Imagery
- Pleasantness

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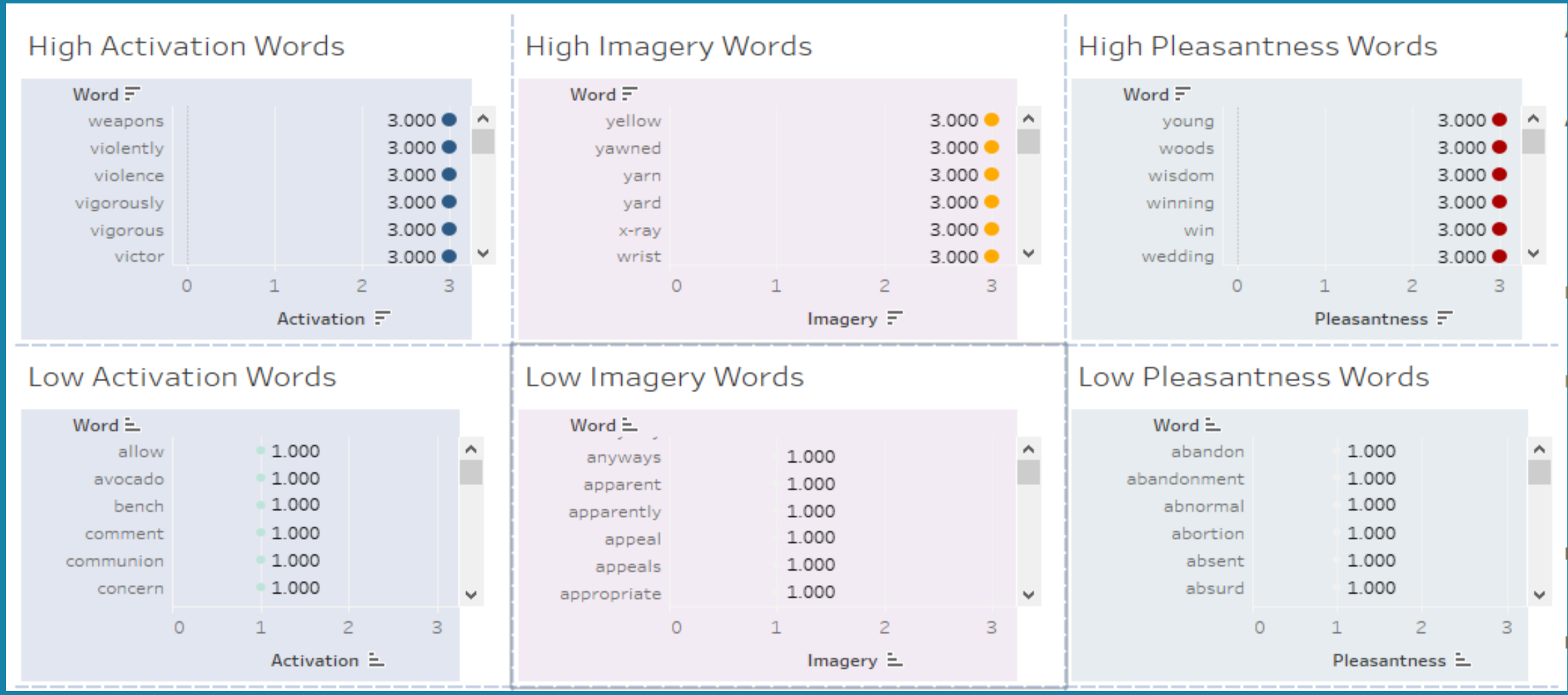
Sample of Whissell Dictionary



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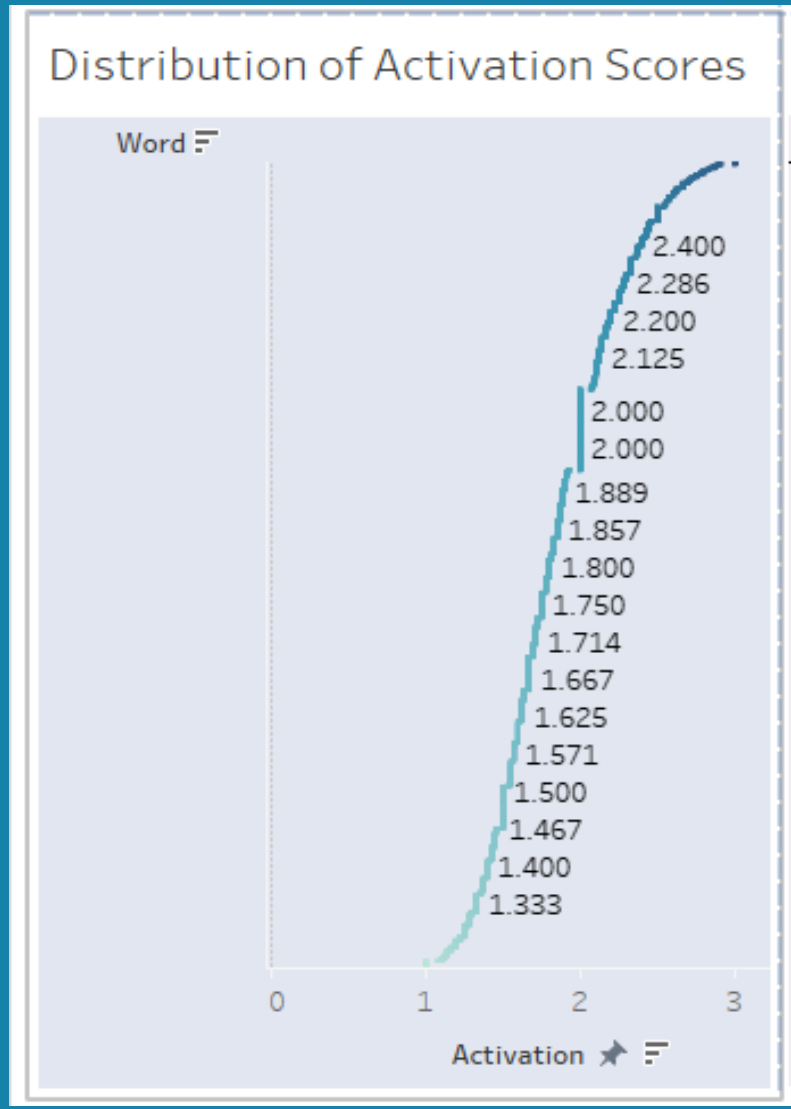
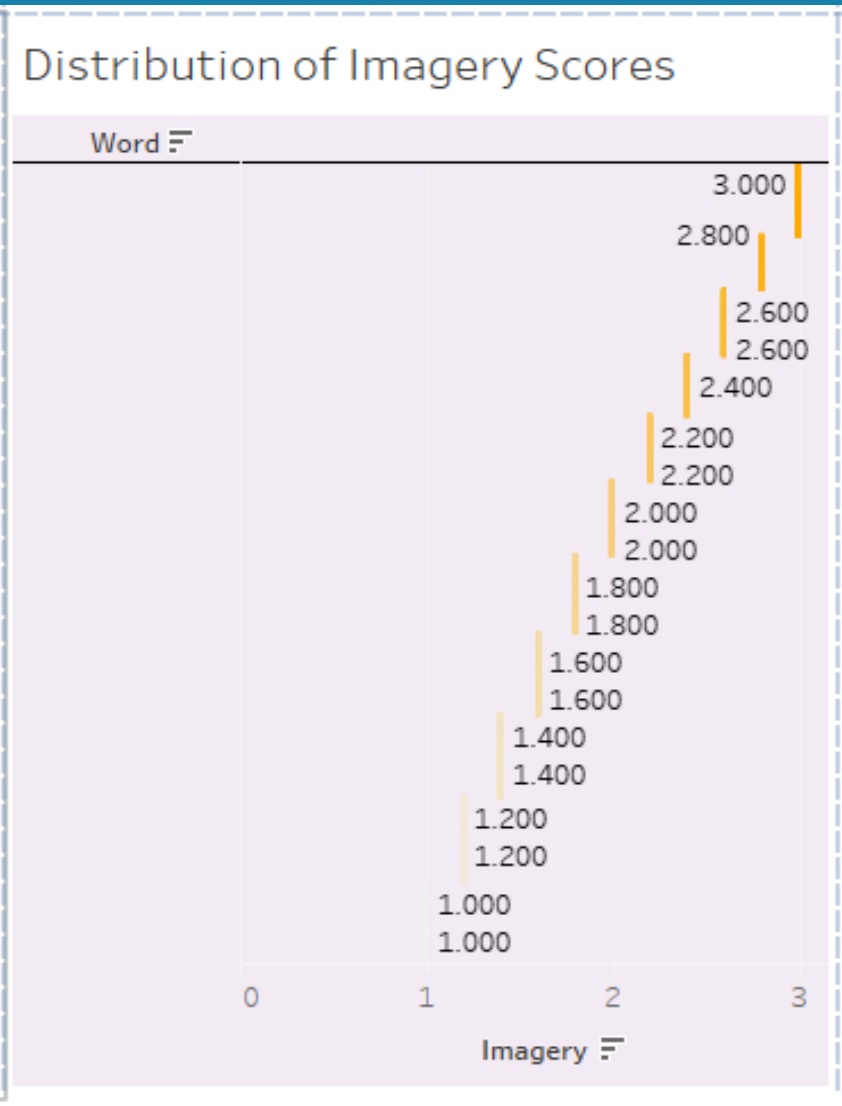
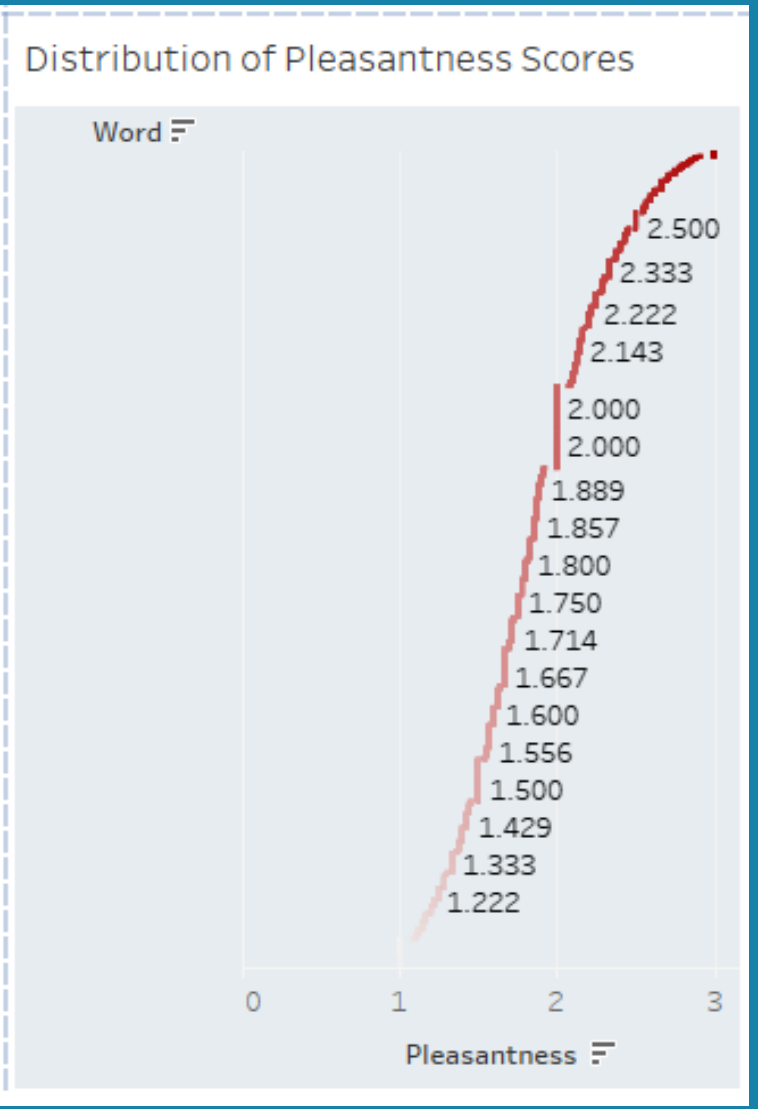
Evaluation of Whissell Dictionary







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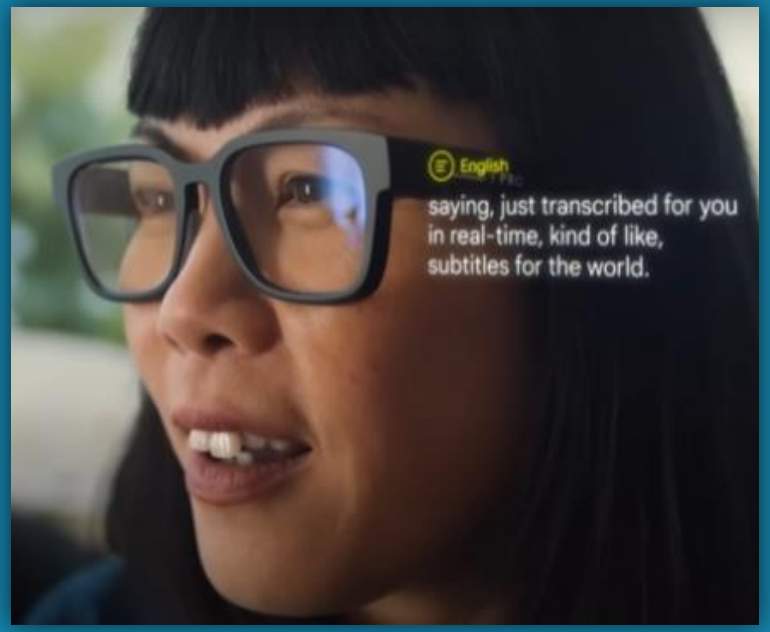
Output – Media Synthesis



Augmented Reality Video Feed

Possibility for text overlay

Cyber Security

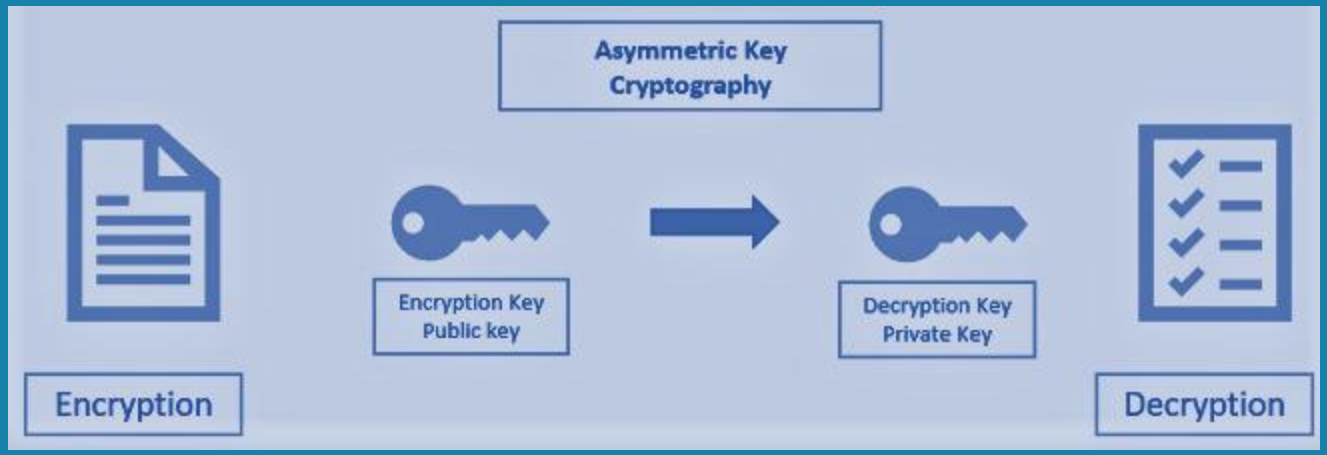
Firewalls	Intrusion Detection Systems
Encryption	Antivirus Software
User Access Controls	Network Segmentation

Cisco Firewall has a firewall and IPS built in

Further leverage native firewalls on cloud server products

GDPR Compliant

Asymmetric Cryptography based on SHA-3



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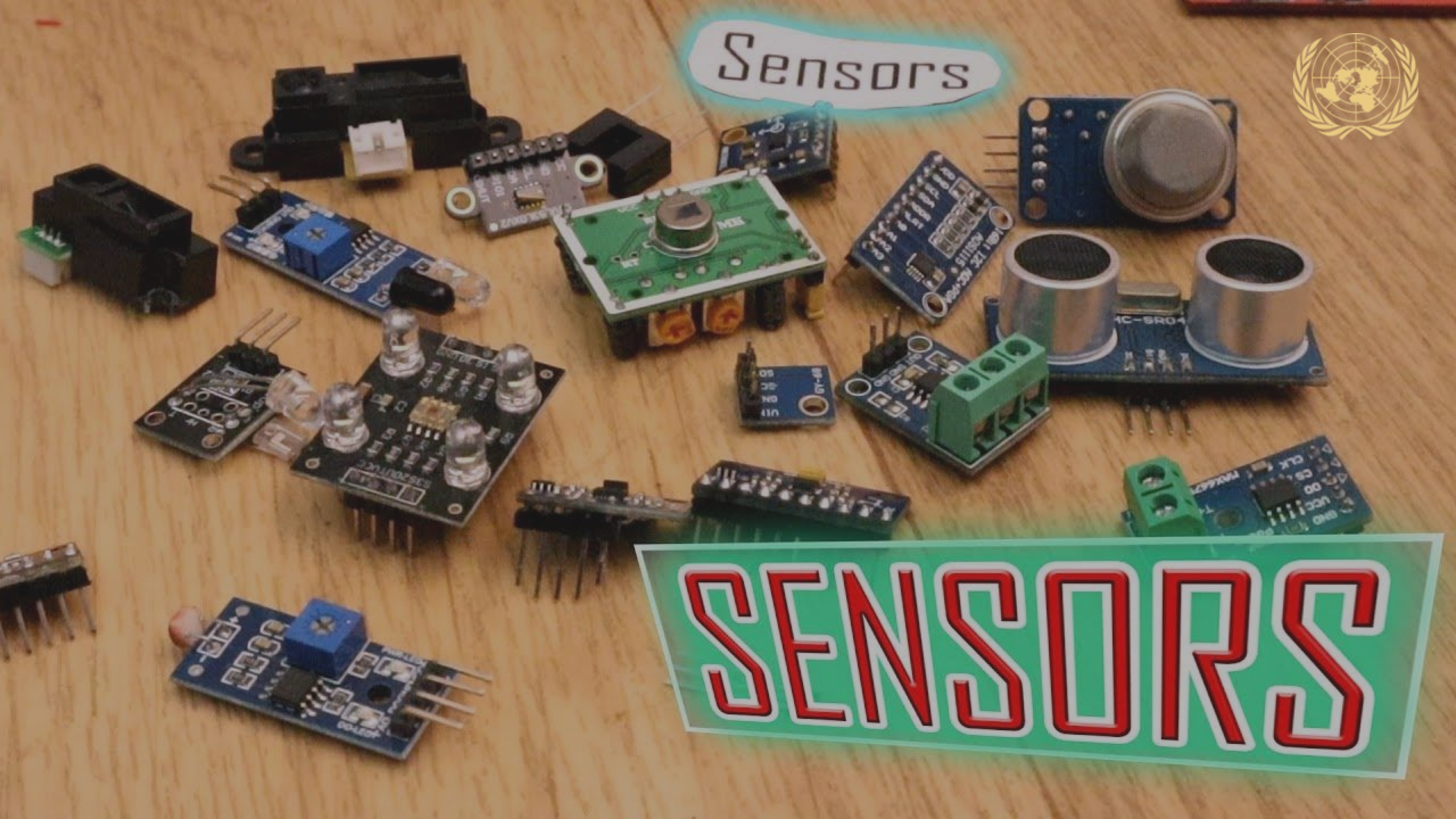
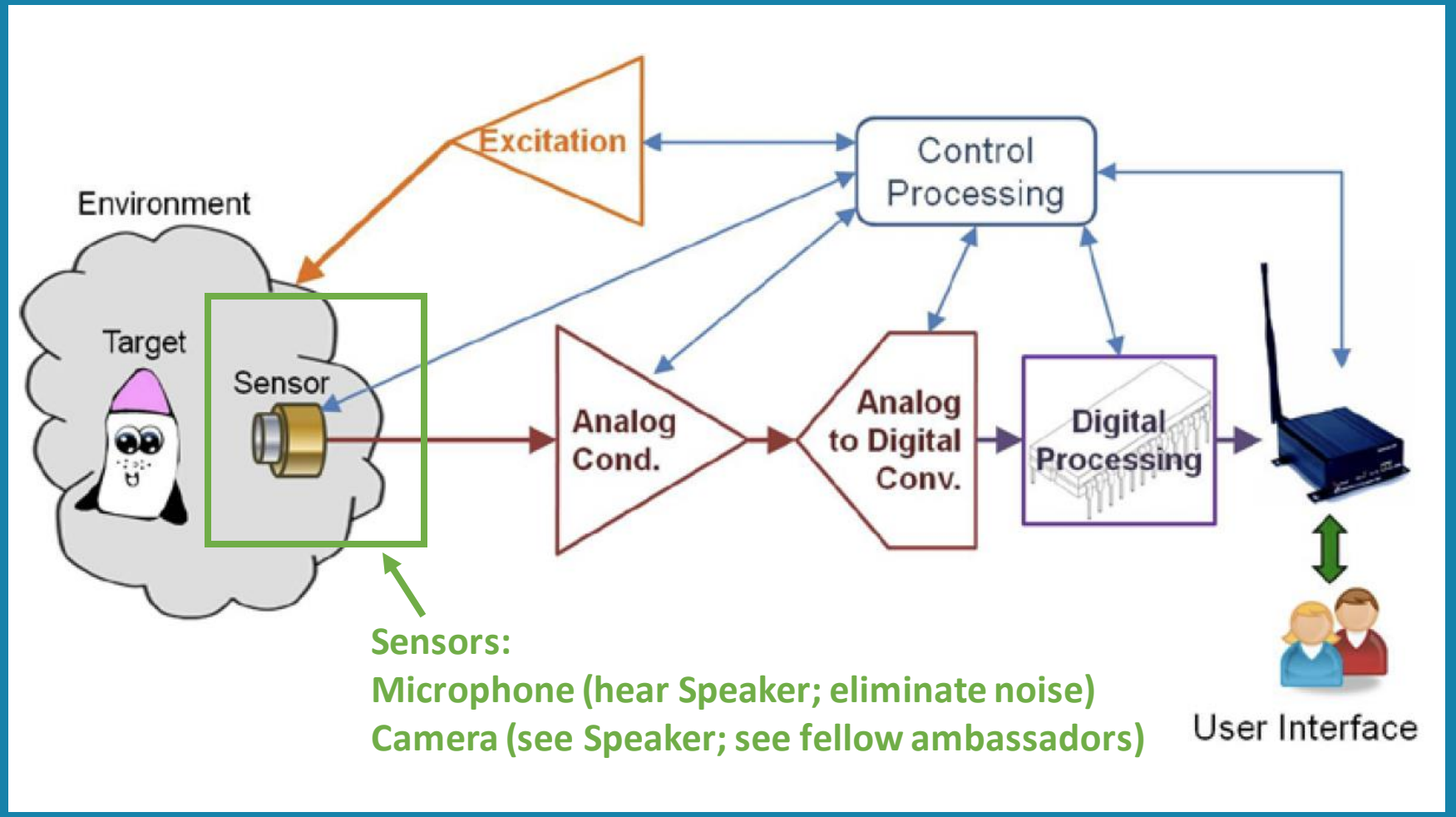
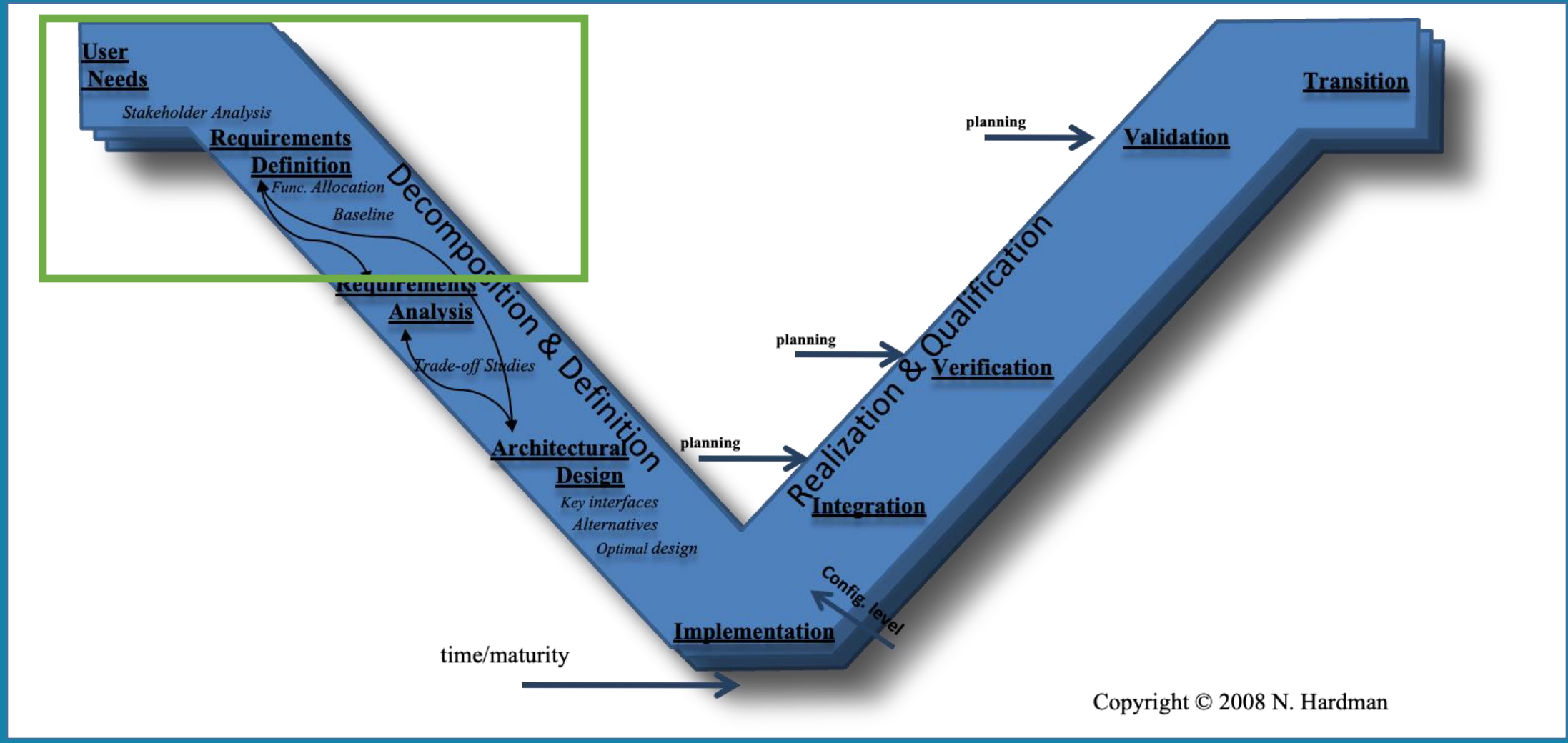

Sensors
SENSORS

Generic Sensor Model



Sensor System Needs



Sensor Needs Considerations

What is needed by the Customer (U.N.)?

Radix System needs to hear the speaker. (Speaker microphone)

→

Ambassadors need to see the Speaker. (Speaker Camera)

→

Ambassadors need to hear the speaker with minimal environmental disturbance (Listener noise cancelling microphone)

→

Ambassadors need to see each other. (Listener Camera)

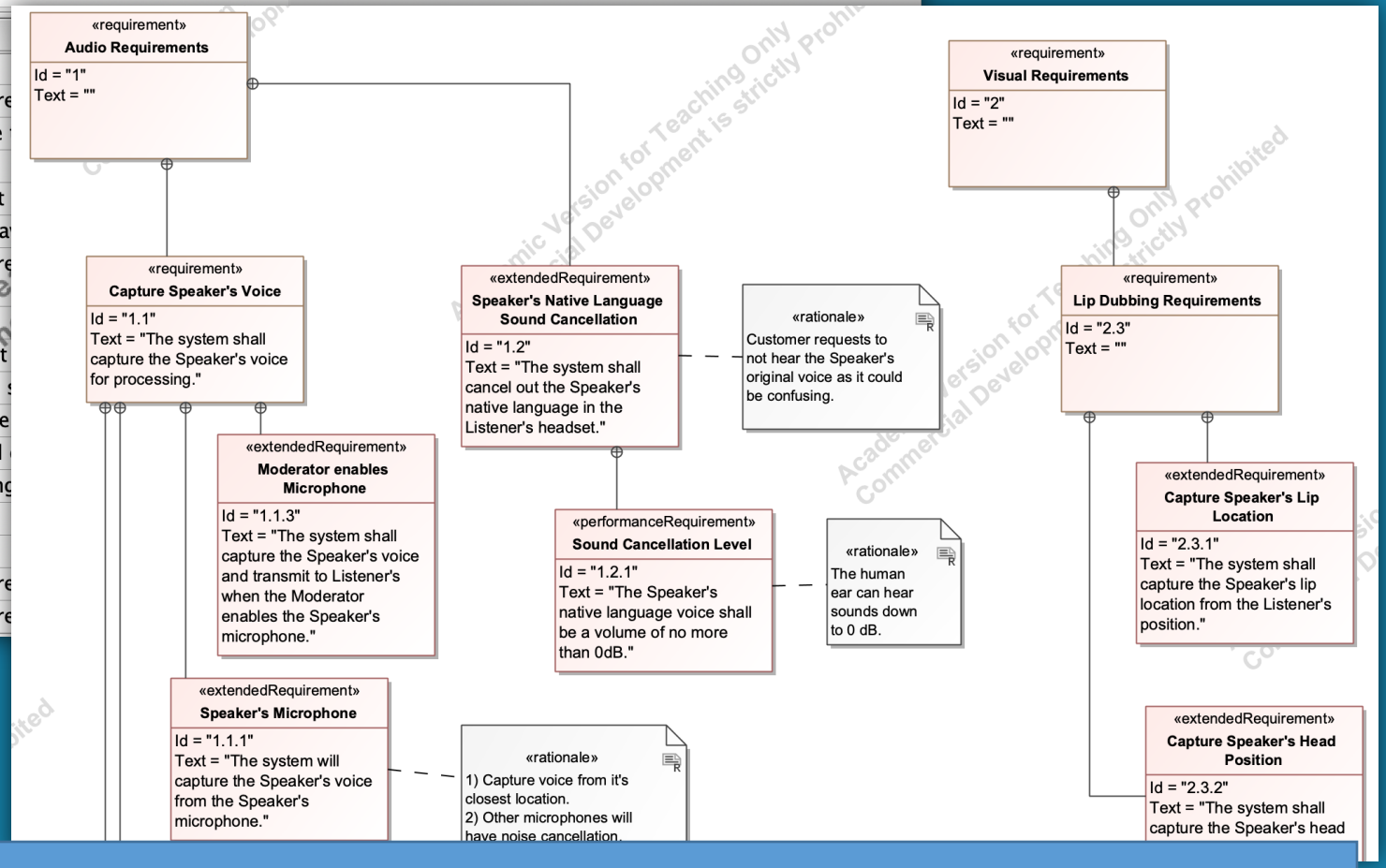
Implement modern 1) Microphone and 2) Camera sensors to support AR.

Sensor Requirements

Criteria

Scope (optional): System Requirements ... Filter:

#	Name	
1	R 1 Audio Requirements	
2	R 1.1 Capture Speaker's Voice	The system shall capture
3	E 1.1.1 Speaker's Microphone	The system will capture
4	P 1.1.2 Microphone Performance	
5	P 1.1.2.1 Microphone Frequency Range	The microphone shall at
6	P 1.1.2.2 Microphone Sampling Rate	The microphone shall ha
7	E 1.1.3 Moderator enables Microphone	The system shall capture microphone.
8	Ph 1.1.4 Microphone Physical Design	
9	Ph 1.1.4.1 Microphone Size	The microphone shall fit
10	Ph 1.1.4.2 Microphone Weight	The microphone weight
11	Ph 1.1.4.3 Microphone Color	The microphone shall be
12	E 1.2 Speaker's Native Language Sound Cancellation	The system shall cancel
13	P 1.2.1 Sound Cancellation Level	The Speaker's native lang
14	R 2 Visual Requirements	
15	R 2.3 Lip Dubbing Requirements	
16	E 2.3.1 Capture Speaker's Lip Location	The system shall capture
17	E 2.3.2 Capture Speaker's Head Position	The system shall capture



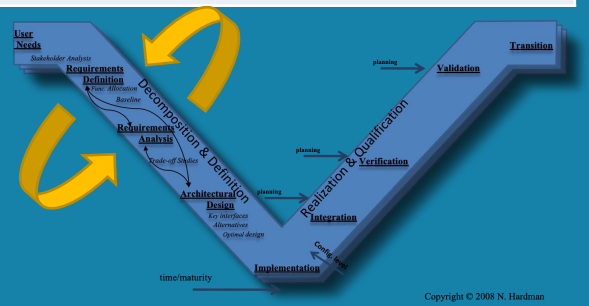
Requirements captured in System Model.

Sensor Requirements

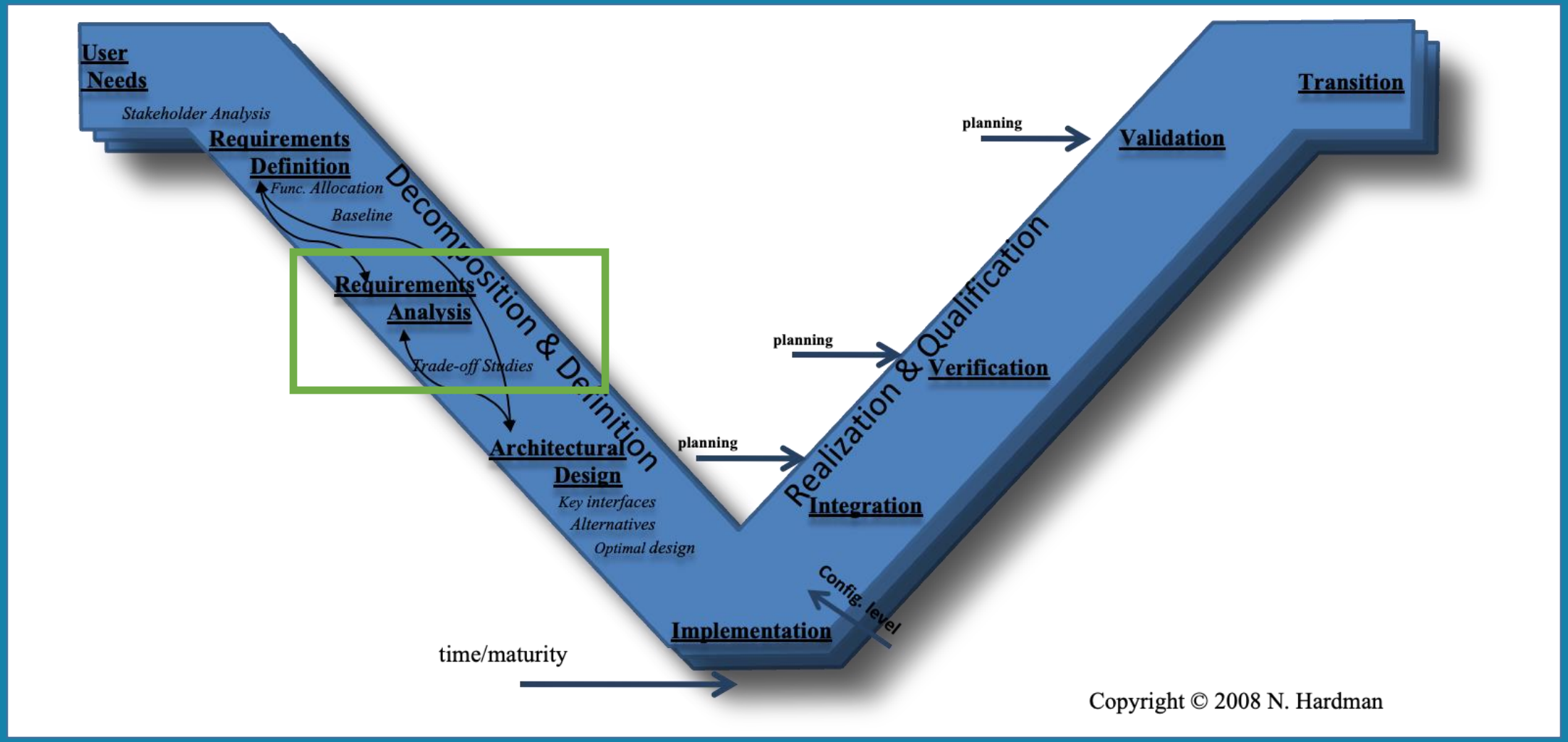
1 Audio Requirements	
1.1 Capture Speaker's Voice	The system shall capture the Speaker's voice for processing with 320kbps. (Rationale: Meet system audio data needs)
1.1.1 Speaker's Microphone	The system will capture the Speaker's voice from the Speaker's microphone.
1.1.2 Microphone Performance	
1.1.2.1 Microphone Frequency Range	The microphone shall at minimum capture frequencies between 80 and 400 Hz.
2 Visual Requirements	
2.3 Lip Dubbing Requirements	
2.3.1 Capture Speaker's Lip Location	The system shall capture the Speaker's lip location from the Listener's position with a minimum resolution of 1080p. (Rationale: Meet system video data needs)
2.3.2 Camera Sensor	The system shall use a 1/3" camera sensor. (Rationale: Meet system envelope)
3 Transmission Requirements	
3.1 Sensor Transmission Rate	The sensor system shall require a transmission rate of no more than 10Mbps. (Rationale: Meet system IS requirements)

*Underline indicates requirement refinements based on constraints.

Requirement Definition and Requirement Analysis are iterative.



Sensor Requirement Analysis



Major Constraints

Radix System

- Data: System data rate and transmission Speed
- Power: Battery life
- Physical: Size and mass of System
- Time-to-Market: Ready by 2027; prefer by start of CY 2025.

Sensor Subsystem

- Data: Sensor data rate
- Power draw of sensors (allocated power)
- Physical: Size of individual sensors (allocated volume and mass)

Sensor Data Rate Trade Off

Sensor Data Rates:

- Audio: 96 to 1.4 Mbps
- Video: 1 Mbps to 68 Mbps

Transmission Mode:

- Bluetooth (v5): 2 Mbps
- Wifi: 10’s Mbps to Gbps

Format	Sampling	Bit Rate	Quality	Size
MP3	8000 - 16000 Hz	16 - 96 kbps	Very low	Very small
	16000 - 32000 Hz	96 - 196 kbps	Decent	Small
	44100 Hz	256 - 320 kbps	Good	Medium
	48000 Hz	320 kbps	Excellent	Large

*Lossless is considered 1.4Mbps

Type	Video Bitrate, Standard Frame Rate (24, 25, 30)	Video Bitrate, High Frame Rate (48, 50, 60)
2160p (4K)	35–45 Mbps	53–68 Mbps
1440p (2K)	16 Mbps	24 Mbps
1080p	8 Mbps	12 Mbps
720p	5 Mbps	7.5 Mbps
480p	2.5 Mbps	4 Mbps
360p	1 Mbps	1.5 Mbps

Bluetooth data rate greatly limits Video Quality.

Power Draw of Sensors

Function: Capture speaker to provide visual overlay.

CMOS Power roughly 0.4uW/pixel in region of interest.

Trade-Space:

- High resolution provides image processing information (lip tracking).
- Lower resolution decreases data rate transmission and reduces power.

Product Name	Resolution	Power (W- LVDS)	Power/pixel (uW/pixel)
MT9V024/D	752 x 480	160 mW 60 fps	.44
Python 480	808 x 608	226 mW 60fps 265 mW 120 fps	.35
Vita 1300	1280 x 1024	475 mW 150 fps	.36
Vita 25K	5120 x 5120	3.4 W 52 fps	.13

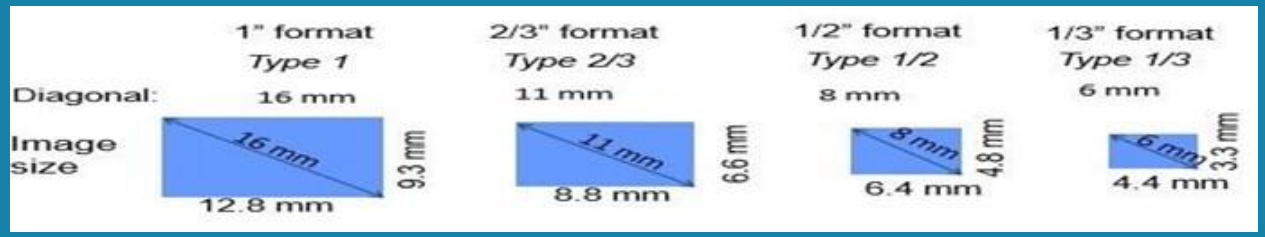
Physical Size Constraints

Minimize Camera size while maintaining performance.

Considerations: Resolution, High frame rate and global shutter, Sensitivity, Lens mount selection, Image circle diameter, Low light performance/

All sizes can meet video resolution needs, frame rate, sensitivity, have appropriate lens technology, and perform well with nominal room lighting.

All sensors have inefficiencies with crop factors compared to the 35mm.



Type	Diagonal (mm)	Width (mm)	Height (mm)	Area (mm²)	Crop factor
1/2"	8	6.4	4.8	30.7	5.41
1/2.3"	7.66	6.17	4.55	28.5	5.64
1/2.5"	7.18	5.76	4.29	24.7	6.02
1/3"	6	4.8	3.6	17.3	7.21
1/3.2"	5.68	4.54	3.42	15.5	7.61
1/4"	4.5	3.6	2.7	7.92	10.81
2/3"	11	8.8	6.6	58.1	3.93
35mm full-frame	**43.1–43.3**	**35.8–36**	**23.9–24**	**856–864**	**1**

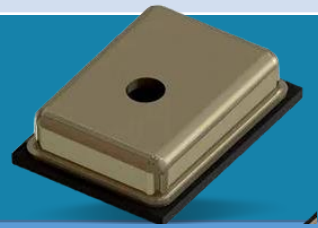
It is important to note that the crop factor is related to the ratio of the camera sensor's size to a 35 mm film frame.

$$\text{Crop Factor} = \text{Diagonal}_{35mm} / \text{Diagonal}_{sensor}$$

https://www.e-consystems.com/blog/camera/technology/what-is-cmos-sensor-size-in-embedded-cameras-how-to-pick-the-right-sensor-size/

Microphone Survey

Parameter	Condenser	Dynamic	MEMs
COTs Example	Neumann TLM 103	Shure SM58S	MP34DT06J
Cost	$1,200	$100	$2.26
Frequency Range	20Hz-20kHz	50Hz-15kHz	100Hz-10kHz
Power Input	48 V	48 V	1.8 V
Max SPL (saturation)	138 dB	94dB	122.5
Weight	1 lbs	0.66 lbs	.00005 lbs
Size	5.2" x 2.36"	6.3” x 2”	.04” x .12” x .16”
Signal-Noise	87 dB	-54.5 dBV	64 dB
Self Noise	7 dB	N/A	N/A



MEMS performance is good enough for this applicaiton.

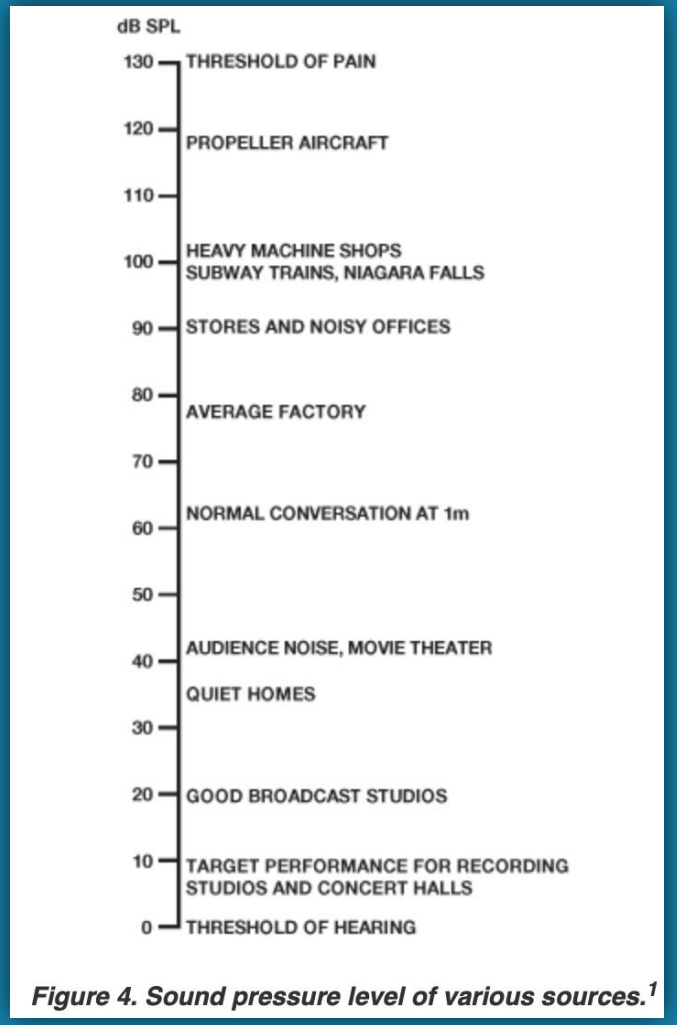
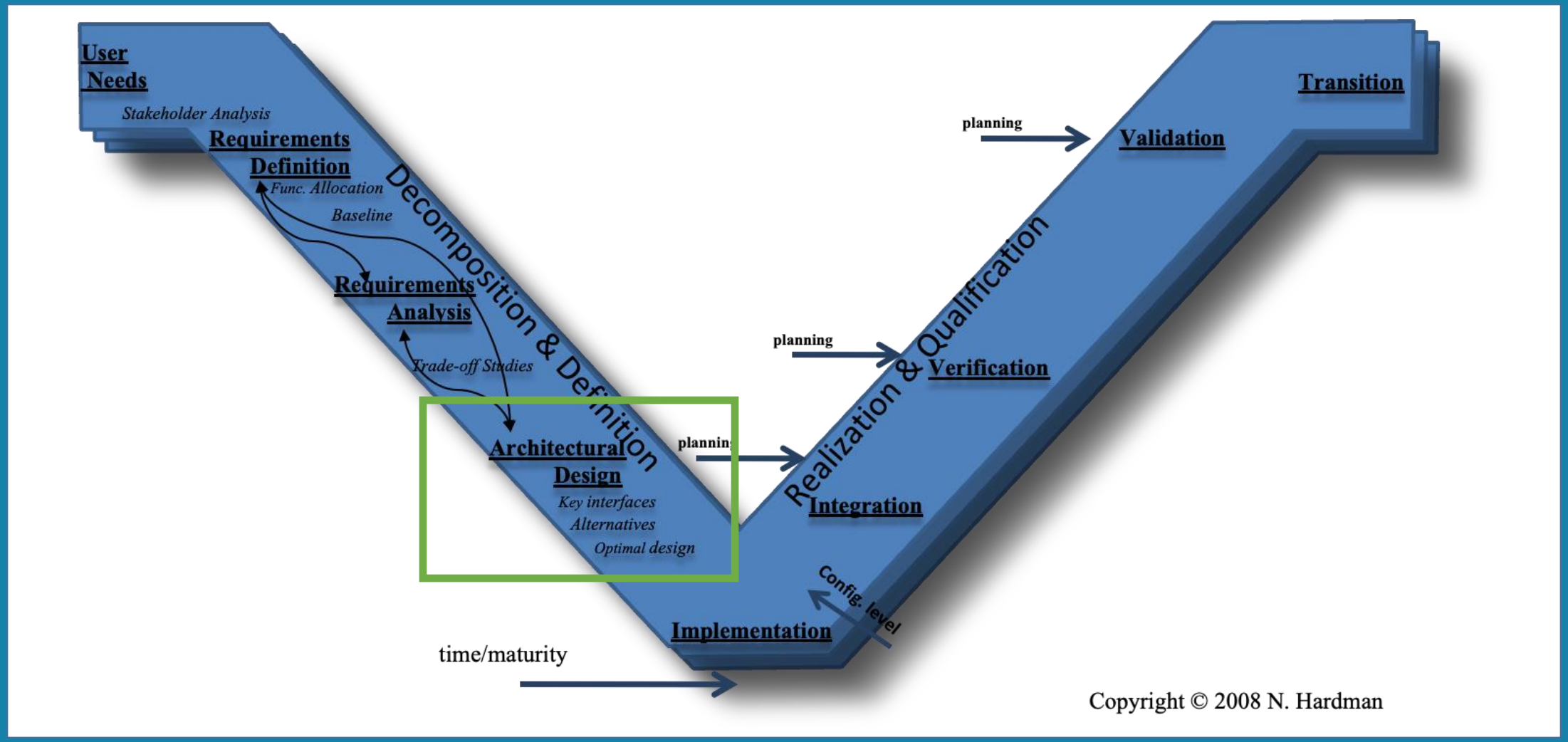
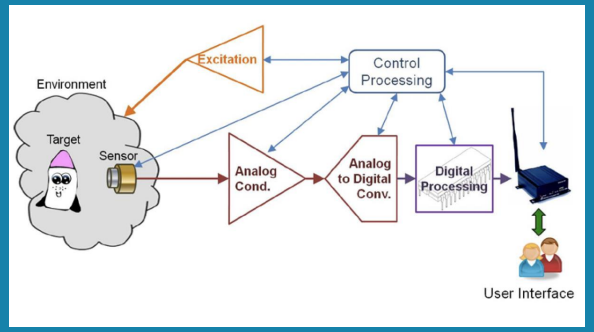


Figure 4. Sound pressure level of various sources.[1]

Sensor Architecture Design



Audio Subsystem Architecture



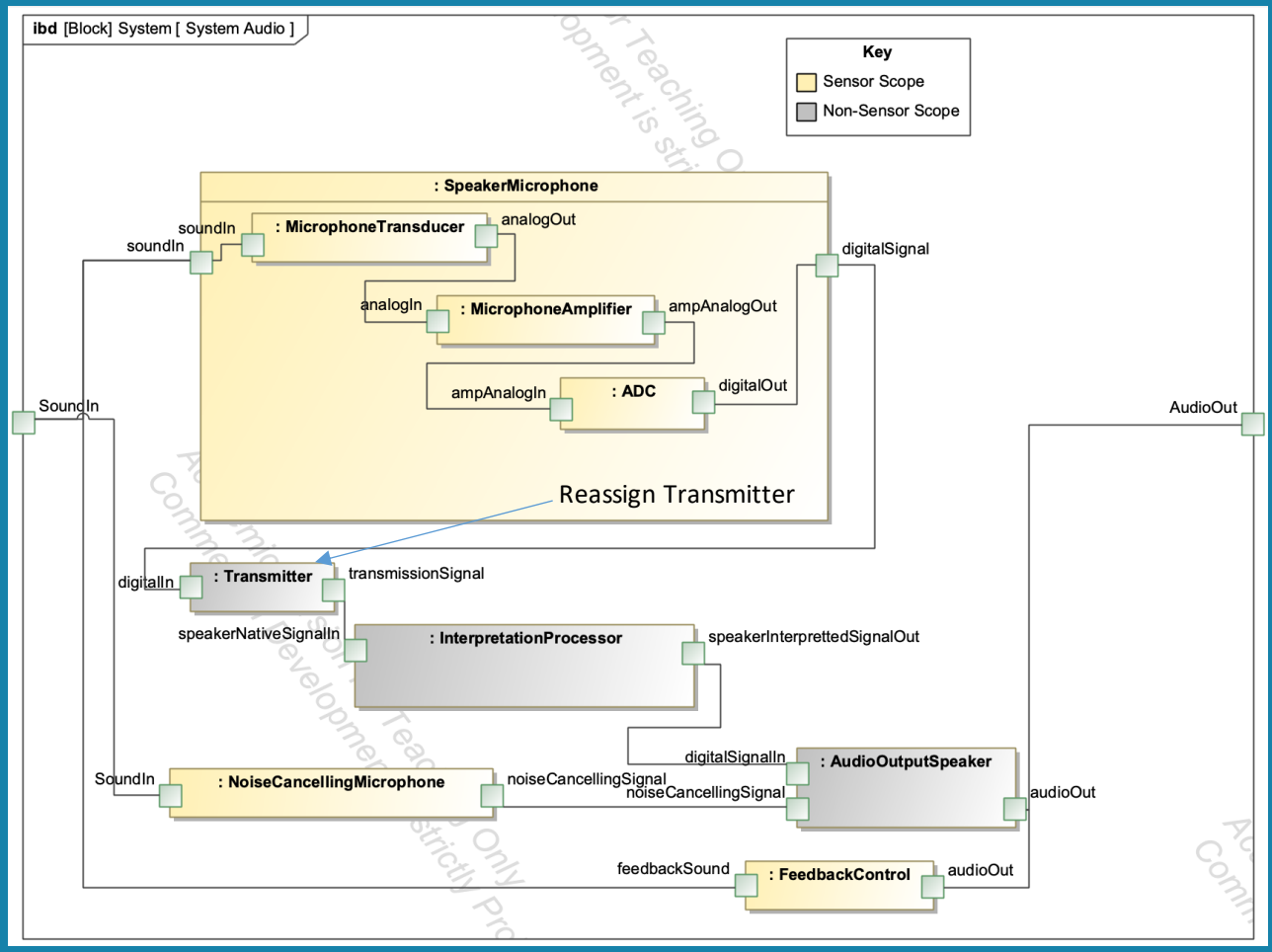
Purpose: Provide the delegate translated audio.

Function: 1) Receive audio of the speaker 2) provide noise cancelling function for the delegate/listener. 3) (Out of Sensor Scope) Provide translated audio to delegate.

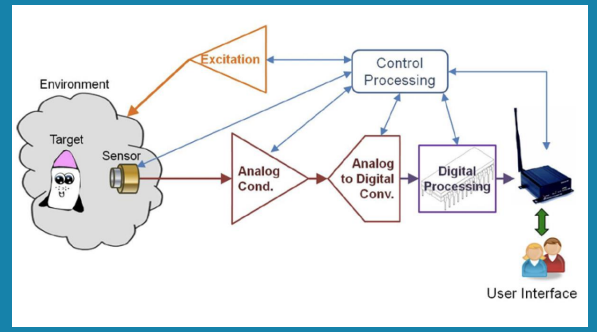
Form: 1) All-in-one package 2) Distinct speaker microphone and noise-cancelling ear piece.

Key Interfaces:

1. Microphone transmission to Processor
    1. Moved transmitted away from microphone ownership. Sensor only provides data and Transmitter sends data.
2. Processor transmission to Audio Speaker
3. Noise Cancelling Microphone to Audio Speaker



Visual Subsystem Architecture



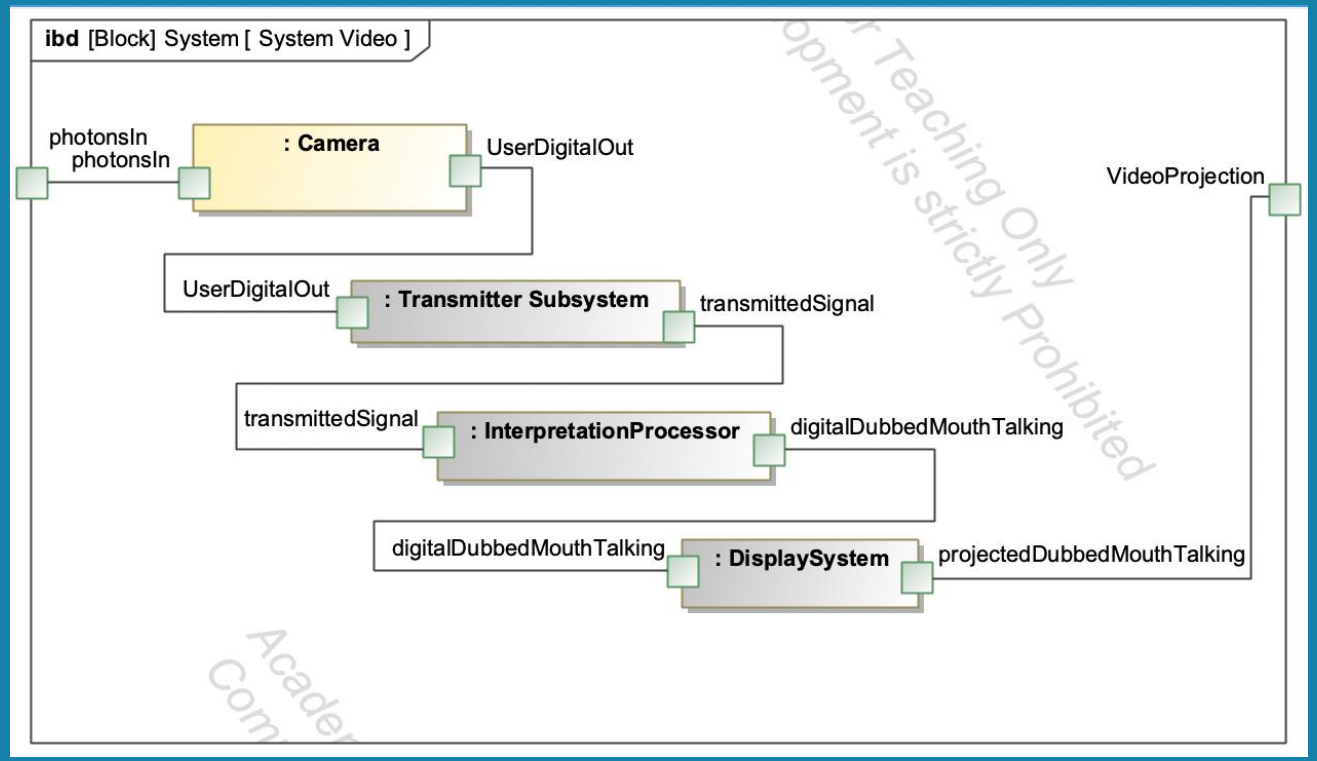
Purpose: Provide overlay of speakers mouth in the delegate's language.

Function: 1) Capture the listener's viewpoint. 2) Process the listener's viewpoint 3) Display the overlay.

Form: 1) All-in-one package 2) Discrete elements.

Key Interfaces:

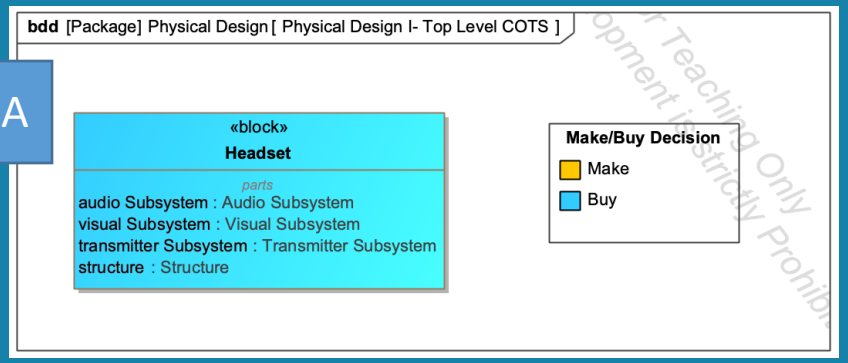
1. Camera transmission to Processor
2. Processor transmission to Display System (out of scope for Sensors Subsystem)



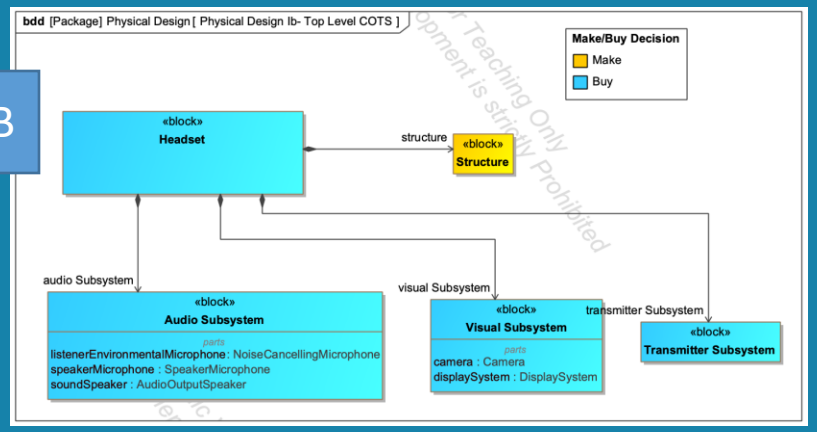
Design Options

- Top-Level Buy- COTS AR Glasses (e.g. Vuzix Blade2, HoloLens)
  - Either IA) COTS As-Is or IB) COTS modular structure to add/remove pieces
- Lower-Level Buy- Custom design (i.e. more interesting for ASE6111)

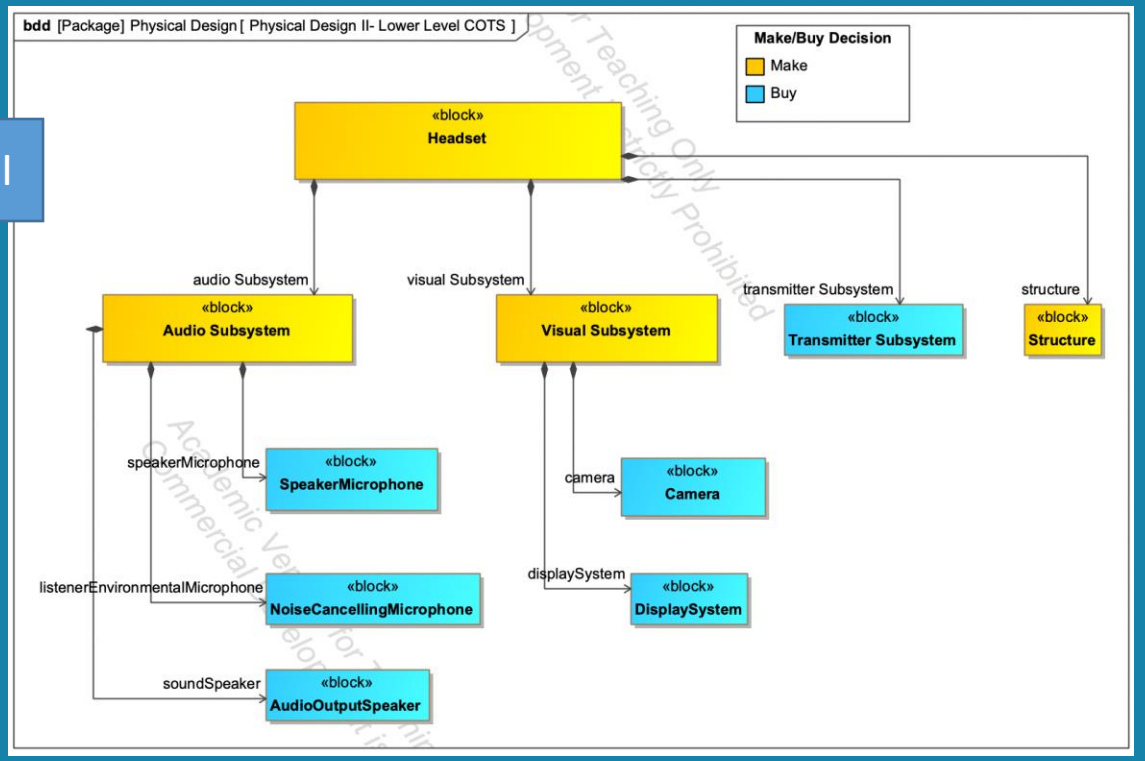
IA



IB



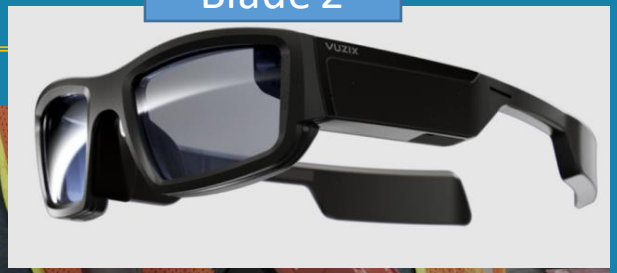
II



Alternative: IA Top Level Buy

HoloLens

Blade 2



Description: Buy a readily available AR product.

Pros:

1. Availability- many options
2. TRL Level 8/9

Cons:

1. Not specifically designed for application; missing and extra features
2. Cannot meet requirement all requirements: 1) Vuzix not compatible with glasess wearers 2) HoloLens is not a low profile.
3. Users unlikely to wear AR glasses long-term.

https://vuzix-website.s3.amazonaws.com/files/Content/Vuzix+Blade+2/Vuzix-Blade2-Smart-Glasses-Product-Sheet.pdf

Alternative: IB Top Level Buy- Modular

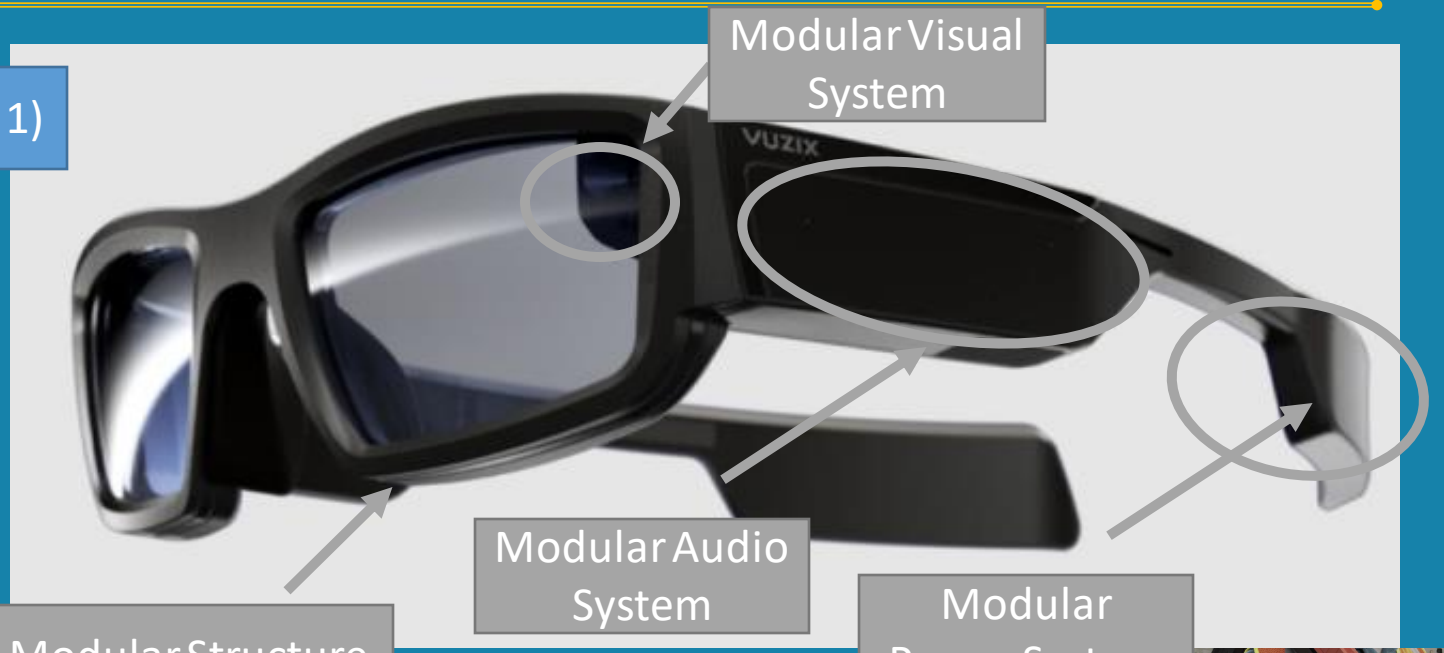
Description: Buy a readily available AR system but work with vendor to repackage structure with modular units.

Provide modular options for:

1) as-is system
2) clip onto user's glasses (lenses need waveguide coating)
3) ear-piece only option.

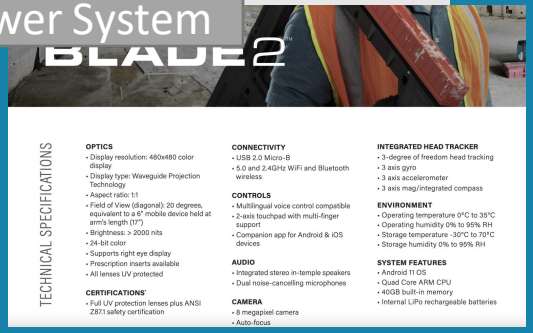
Pros/cons: same as IA but users more enthusiastic about using product.

1)



2)

3)



https://vuzix-website.s3.amazonaws.com/files/Content/Vuzix+Blade+2/Vuzix-Blade2-Smart-Glasses-Product-Sheet.pdf

Alternative II: Lower-Level Buy

Description: Modular custom design. Split the structural components (frame, lenses) from the functional components (display, speaker).

Pros:

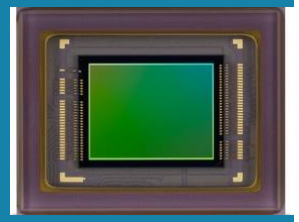
1. Meet all System Requirements
2. Configurable Structures (As-Is, user glasses*, ear-piece only)
3. In-ear audio rather than bone conduction

Cons:

1. Starting at a Lower TRL.
2. Slower time to market (need Development time plus stand up production)

*glasses must have AR coating.

Camera



Model name	Sample shipment date (planned)	
IMX675 1/3-type (6.53 mm diagonal) approx. 5.21 effective megapixel*2 CMOS image sensor	August 2022	USD 10**

SONY

100K Pixel PC camera lens

- The lens is applied to 1/5"CMOS, for use in PC camera. This 100K pixel digital camera lens is suitable for 1/5"CMOS sensor. It contains
- 3 elements (2pcs aspheric plastic lens + 1pc IR-coating filter) F.no is 2.0. this lens is increasingly popular as the PC camera market continue to grow.

LARGAN 大立光電股份有限公司 LARGAN PRECISION CO.,LTD.

Microphone

EK-23133-000

knowles

Mouser #:	721-EK-23133-000
Mfr. #:	EK-23133-000
Mfr.:	Knowles
Customer #:	Customer #
Description:	Microphones 5.56 X 3.98 X 2.21MM -53 SENS, 12SL PORT

AMF-N97C51-NA

AATC

Mouser #:	253-AMFN97C51NA
Mfr. #:	AMF-N97C51-NA
Mfr.:	AATC
Customer #:	Customer #
Description:	Microphones NOISE CANC 9.7x5mm

*Vendors leveraged from reported iPhone technology

Initial Alternative Down-select

Parameter	1A: Top Level Buy		1B: Modular	II: Lower Level
Design Name	Blade 2 (Glasses AR)	MS HoloLens (Face-shield AR)	Blade 2 Mod	Custom Radix Headset
TRL	8	8	7	4
Unit Cost	$1,200	$5,000	$1,299	$800
Development Cost	$0	$0	$400K	$1.5M
Development Time *	None	None.	1.5 years	3 years
Requirement Exceptions	Users with prescription glasses.	Minimal profile.	None.	None.
Sensor Exceptions	None.	None.	None.	None.
User Preference over existing system	**15%**	**5%**	**85%**	**85%**

*U.N. requests system ready by 2027; prefers prior to 2025.

U.N. Committee Down-selected to develop a new system: 1B or II to improve regular use to an acceptable level.

Final Sensors Down-Select

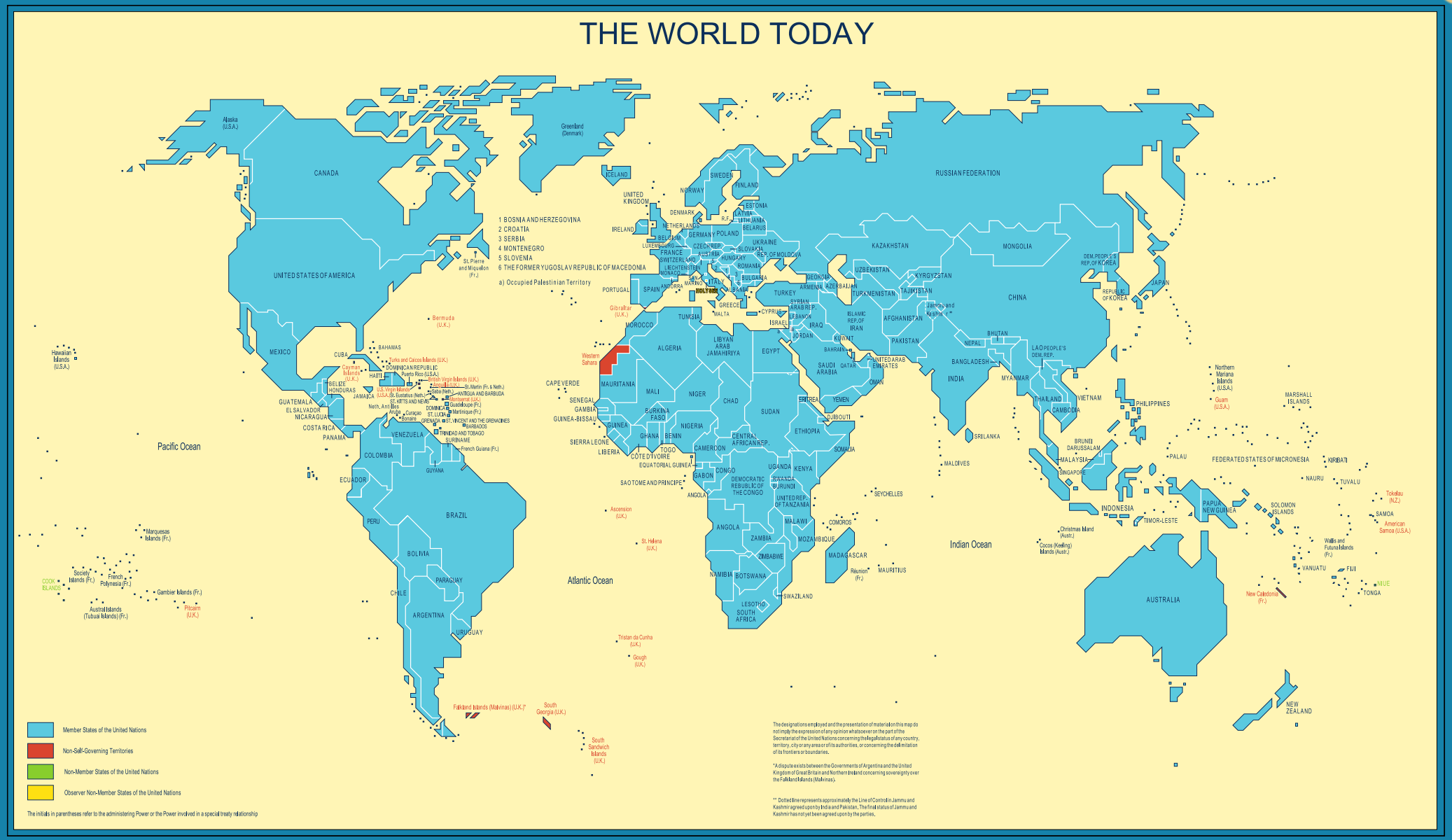
- Option II: Specifications set after running Optimization of Battery Life, Resolution, Data rate across domains (Sensors, Displays, Power, IS).
- Prefer Developing new system. (Pughe shown in []) Pughe score +1.
- Blade 2 preferred for risk averse posture and faster integration time.
- Custom headset provides a future proof solution directly suitable to UN use-cases without gold-plating, developed with international collaboration.
- * Could reduce risk with a 1A prototyping/trial run followed by Option II roll-out

Parameter	1B: COTS Modular	II: Lower Level
Design Name	Blade 2 Modification	Custom Headset
TRL (NASA standard)	7 - prototype	4 – breadboard [-]
Risk Level	Medium- Develop lens for prescription wearers	Medium* [-] Development
Unit Cost	$1,299 Unit + $300 Lenses	$800 unit [+] + $300 Lenses
Development Cost	$400K	$2.5M [-]
Development Time	1.5 years	3 years [-]
Camera Resolution	480p	1080p [+]
Audio Data Rate	Not stated	320kbps [o]
Audio	Bone Conduction	In-ear [+]
Battery Life	1 hr stand alone 10 hr collar supply	1.5 hr [+]
Development Team	USA	UN Committee [+]

Human Systems Integration Component

JT

United Nations Delegations of the World



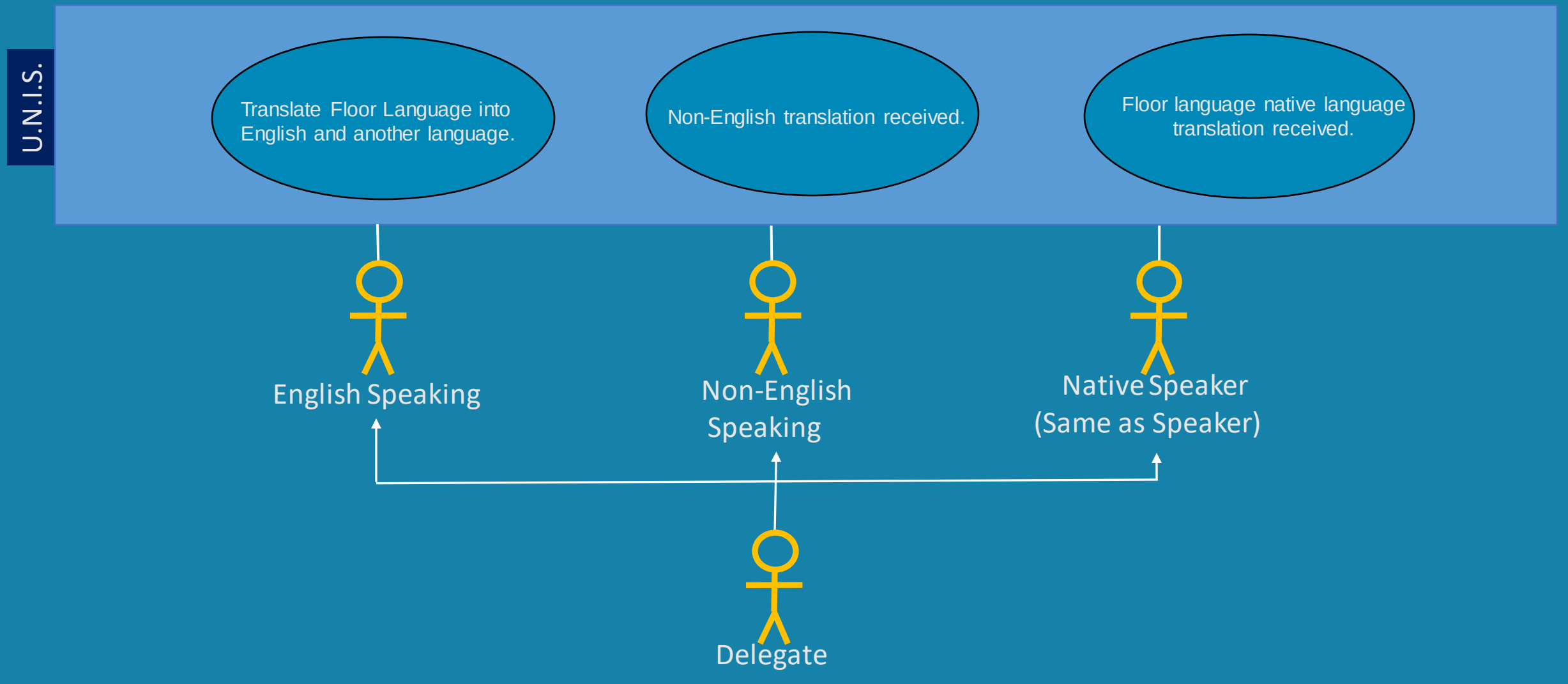
H.S.I Analysis: Mission Task Matrix for U.N.I.S. - Radix

Mission Elements	Scenario Number														
Mission Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Interpret floor language into English for single United Nations non-English speaking delegate.	x			x	x	x	x						x	x	x
Interpret floor language into English and one other language for multiple United Nations non-English/non-other language speaking delegates.		x		x	x	x	x						x	x	x
Interpret floor language into English and multiple other languages for multiple United Nations non-English/multiple other language speaking delegates.			x	x	x	x	x						x	x	x
Environmental Factors															
Lightning within 5 miles of United Nations shuts down interpretation system.	x	x	x					x	x	x	x	x			
Temperature within United Nations delegate auditorium overheats interpretation system.	x	x	x					x	x	x	x	x			
H.F.E., Manpower, Personnel, Training (H.S.I.)															
Interpretor does not know how to operate the interpretation system.	x	x	x					x	x	x	x	x			
Delegates do not use the system receivers correctly.	x	x	x								x				
Tasks															
Receive audio from floor language speaker.	x	x	x	x	x	x									x
Identify native language from received audio.	x	x	x	x	x	x									x
Translate identified audio into English or other non-English language.	x	x	x	x	x	x							x		x
Transmit translated floor language to United Nation delegates receivers.	x	x	x	x	x	x	x							x	x
Gather biometric feedback via system sensors to confirm proper language translation.	x	x	x	x	x	x									x
System Failure or Malfunctions															
United Nations Interpretation System language translation software application mistranslates the floor language.	x	x	x							x					
UNIS delegate receivers do not work properly.	x	x	x								x				
UNIS cabling disconnects.								x	x	x	x	x			

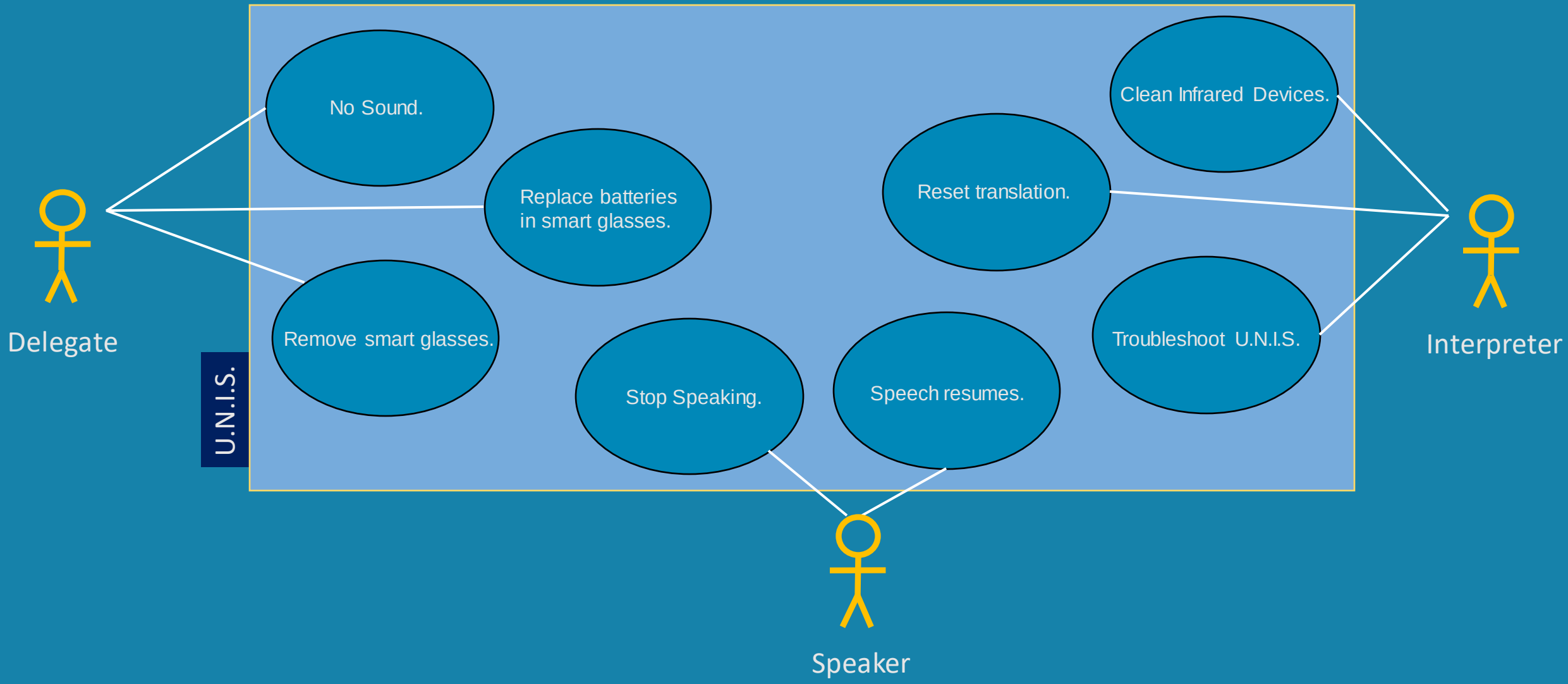
Scenarios for U.N.I.S. - Radix

1. Single Language Translation
2. Dual Language Translation
3. Multiple Language Translation
4. Lightning Strike
5. System Overheats
6. Improper System Operation
7. Individual Help
8. Receive Audio
9. Identify Native Language
10. Translate Audio
11. Transmit Language
12. Evaluate Images
13. Software Problems
14. Smart Glasses Inoperative
15. Cabling Disconnects

Translation Pool: Dual Language Translation Use Case

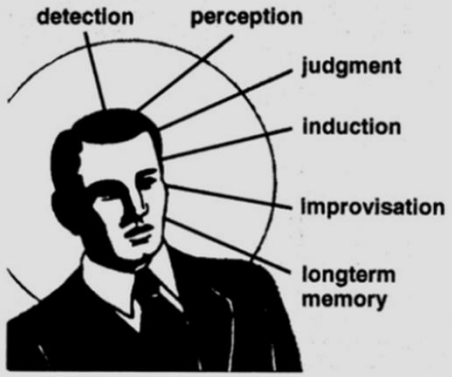


Troubleshooting: Smart Glasses Inoperative Use Case



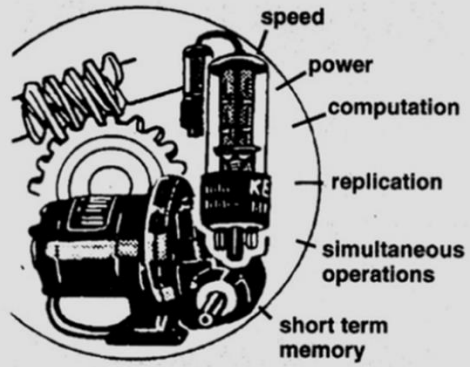
Paul Fitts “Human VS Machines” List

HUMANS SURPASS MACHINES IN THE:



- Ability to detect small amounts of visual or acoustic energy
- Ability to perceive patterns of light or sound
- Ability to improvise and use flexible procedures
- Ability to store very large amounts of information for long periods and to recall relevant facts at the appropriate time
- Ability to reason inductively
- Ability to exercise judgment

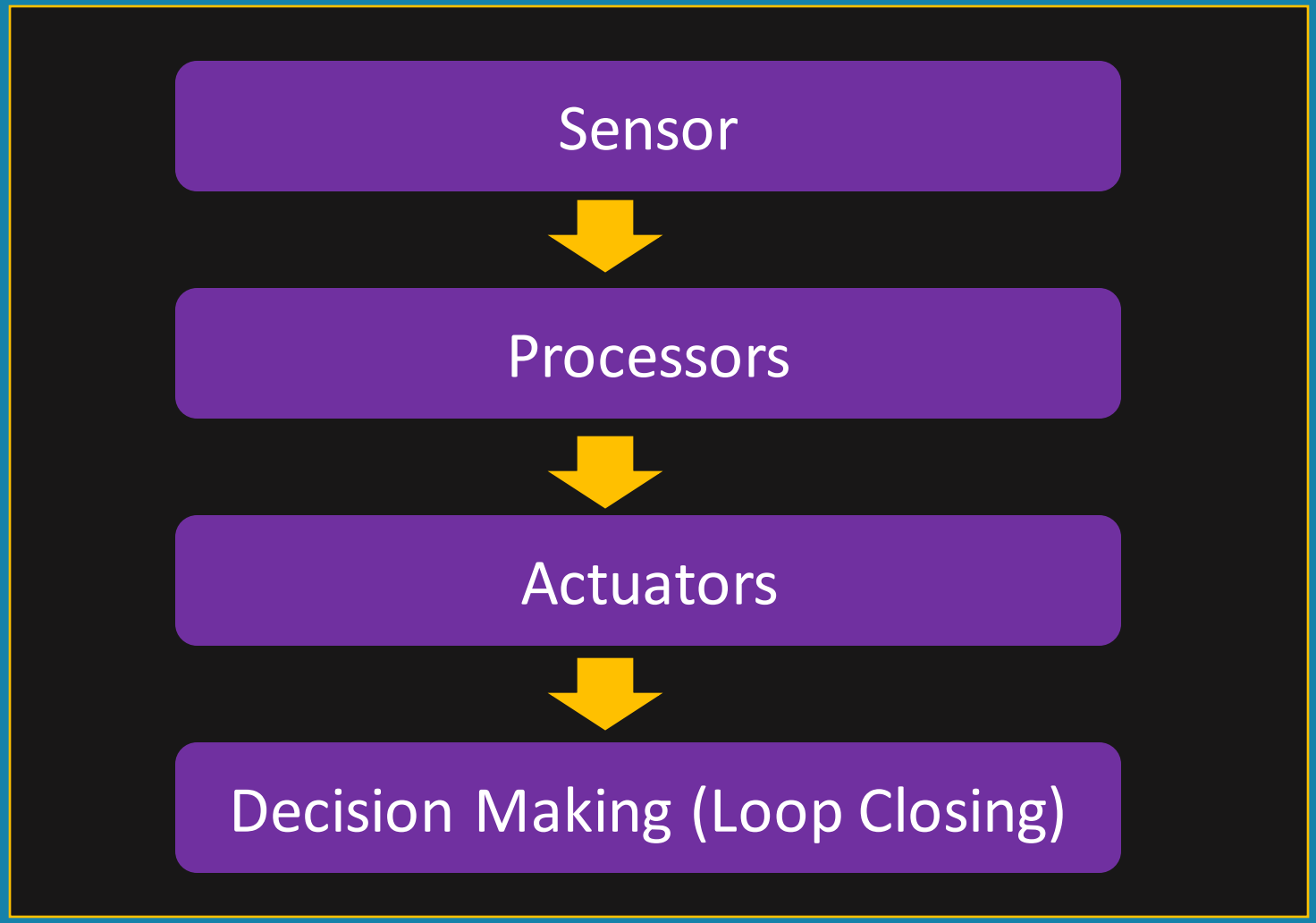
MACHINES SURPASS HUMANS IN THE:



- Ability to respond quickly to control signals, and to apply great force smoothly and precisely
- Ability to perform repetitive, routine tasks
- Ability to store information briefly and then to erase it completely
- Ability to reason deductively, including computational ability
- Ability to handle highly complex operations, i.e., to do many different things at once.

MW

Information Processing Loop



Operator Role Theory

Functional Breakout

1.0. Mission Planning
2.0. System Setup and Initialization
3.0. System Health and Monitoring
4.0. Communication
5.0. Sensors
6.0. Language Translation Software
7.0. Cultural Feedback

Process

- Assigned operator roles to functional breakout
- Analyzed which functions would be better served by humans, machine, or a combination.
- Added Performance Requirements
- Mapped the Functional Breakout, Performance to an added Configuration
- Updated the Operator Role

Operator Role Theory: Initial Findings for Steps 1 - 3

Functional Breakout	Operator Roles			
	Direct Performer (Human Alone)	**Manual Controller** (Human Supplemented by Machine)	**Supervisory Controller** (Machine Supplemented by Human)	**Executive Controller** (Machine Alone)
1.0. Mission Planning				
1.1. Collect Interpretation Services Request from United Nations Delegates				x
1.2. Determine Floor Language			x	
1.3. Determine Non-English Languages from expected United Nations Delegates			x	
1.4. Determine United Nations session date, duration and delegate planned training.			x	
1.5 Determine how many U.N.I.S. receivers needed for the session.				x
2.0. System Setup and Initialization				
2.1. Power on U.N.I.S.	x			
2.2. Enter number of supported delegates and native language		x		
2.3. Enter Floor Language		x		
2.4. Enter expected non-English languages		x		
2.5. Enter U.N. session date, duration, and planned timing for each delegate		x		
2.6. Enter number of delegate receivers and check seating chart dashboard		x		
2.7. Press initialize to start the interpretation session	x			
3.0. System Health and Monitoring				
3.1. Confirm U.N.I.S. normal state			x	
3.2. Troubleshoot any fault indications		x		
3.3. Monitor sensor normal state and conduct troubleshooting			x	
3.4. Monitor audio receipt			x	
3.5. Monitor audio translation process			x	
3.6. Monitor communications links to Floor Speaker and Delegates		x		
4.0. Communication				
4.1. Confirm communication subsystem normal state			x	
4.2. Troubleshoot any fault indications		x		
4.3. Confirm audio flow from Floor Speaker to Interpreter workstation			x	
4.4. Confirm translated audio flow from Interpreter workstation to Delegates receivers (e.g. Smart Glasses).			x	
5.0. Sensors				
5.1. Confirm sensor subsystem normal state			x	
5.2. Troubleshoot any fault indications		x		
5.3. Confirm microphone between Floor Speaker and Interpreter workstation operating normally			x	
5.4. Confirm IR connection between Interpreter workstation and Delegates receivers (e.g. Smart Glasses) w/in line of sight and operating normally			x	
5.5. Confirm biometric facial and speech recognition devices operating normally			x	
6.0. Language Translation Software (LTS)				
6.1. Confirm LTS normal state			x	
6.2. Troubleshoot any fault indications		x		
6.3. Check proper translated messages and audio exchanges with Delegate receivers (e.g. Smart Glasses)		x		
7.0. Cultural Feedback				
7.1. Ensure cultural aspects identified for planned translated languages		x		
7.2. Confirm U.N.I.S. gathering biometric information properly			x	
7.3. Update language translation based on cultural feedback information	x			

Operator Role Theory: Functional to Performance Requirements for U.N.I.S. - Radix

Functional Breakout (F)	Performance Requirements (P)
1.0. Mission Planning	**1.0. Mission Planning**
1.1. Collect Interpretation Services Request from United Nations Delegates	1.1. U.N.I.S. mission planning module allows delegates to fill out online request form including delegate state, name, and language preference while auto populating request database in 2 seconds.
1.2. Determine Floor Language	1.2. U.N.I.S. mission planning module determines and displays planned floor language from scheduled speakers list in 2 seconds.
1.3. Determine Non-English Languages from expected United Nations Delegates	1.3. U.N.I.S. mission planning module searches current delegate request database and determines all non-English speaking delegates scheduled to attend planned United Nations session in 2 seconds.
1.4. Determine United Nations session date, duration and delegate planned attendance.	1.4. U.N.I.S. mission planning module offers a yearly, monthly, weekly and daily calendar and session duration selection of delegate planned attendance in 2 seconds upon request.
1.5 Determine how many U.N.I.S. receivers (e.g., smart glasses) needed for the session.	1.5. U.N.I.S. mission planning module calculates the number of smart glasses required for the planned United Nations session from the delegate request database in 2 seconds.
2.0. System Setup and Initialization	**2.0. System Setup and Initialization**
2.1. Power on U.N.I.S.	2.1. U.N.I.S. setup/initialize module gives simple on/off button to power on or off U.N.I.S. in 10 seconds.
2.2. Enter number of supported delegates and native language	2.2. U.N.I.S. setup/initialize module populates and displays the number of supported delegates; lists the native languages on a dashboard and allows dropdown changes from the mission planning module in 2 seconds.
2.3. Enter Floor Language	2.3. U.N.I.S. setup/initialize module populates and displays the floor language on a dashboard and allows dropdown changes from the mission planning module in 2 seconds.
2.4. Enter expected non-English languages	2.4. U.N.I.S. setup/initialize module populates and displays on a dashboard the expected non-English languages and allows dropdown changes from the mission planning module in 2 seconds.
2.5. Enter U.N. session date, duration, and planned timing for each delegate	2.5. U.N.I.S. setup/initialize module populates and displays on a dashboard the calendar date, session duration and planned timing for each delegate from the mission planning module in 2 seconds.
2.6. Enter number of delegate receivers and check seating chart dashboard	2.6. U.N.I.S. setup/initialize module populates and displays on a dashboard the number of delegate receivers (e.g., smart glasses); displays the seating chart; and allows changes via deselect or select with mouse click or highlights from the mission planning module in 2 seconds.
2.7. Press initialize to start the interpretation session	2.7. U.N.I.S. setup/initialize module gives a simple soft initialize button and starts the interpretation session in 2 seconds when selected by mouse click.
3.0. System Health and Monitoring	**3.0. System Health and Monitoring**
3.1. Confirm U.N.I.S. normal state	3.1. U.N.I.S. health/monitor module determines and displays on a dashboard a simple green color-code lamp indicating normal system state when reaching and maintaining values within the normal range of system parameters in 2 seconds.
3.2. Troubleshoot any fault indications	3.2. U.N.I.S. health/monitor module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system state when reaching and maintaining values outside, approaching outside or within the normal range of system parameters in 2 seconds.
3.3. Monitor sensor normal state and conduct troubleshooting	3.3. U.N.I.S. health/monitor module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for camera, microphone, and smart glasses when reaching and maintaining values outside, approaching outside or within the normal range of each sensor system parameters in 2 seconds.
3.4. Monitor audio receipt	3.4. U.N.I.S. health/monitor module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for audio signal when reaching and maintaining values outside, approaching outside or within the normal range of the audio system parameters in 2 seconds.
3.5. Monitor audio translation process	3.5. U.N.I.S. health/monitor module determines and displays on a dashboard a simple text stream; message count; and error count of translated audio signal from the floor speaker in 2 seconds.
3.6. Monitor communications links to Floor Speaker and Delegates	3.6. U.N.I.S. health/monitor module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for infrared and audio communication links when reaching and maintaining values outside, approaching outside or within the normal range of each communication system parameters in 2 seconds.

Operator Role Theory: Functional to Performance Requirements for U.N.I.S. – Radix Cont.

Functional Breakout (F)	Performance Requirements (P)
4.0. Communication	**4.0. Communication**
4.1. Confirm communication subsystem normal state	4.1. U.N.I.S. communication sub-system module determines and displays on a dashboard a simple green color-code lamp indicating normal system state when reaching and maintaining values within the normal range of communication sub-system parameters in 2 seconds.
4.2. Troubleshoot any fault indications	4.2. U.N.I.S. communication sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system state when reaching and maintaining values outside, approaching outside or within the normal range of communications sub-system parameters in 2 seconds.
4.3. Confirm audio flow from Floor Speaker to Interpreter w orkstation	4.3. U.N.I.S. communication sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for audio signal between Floor Speaker and Interpreter workstation when reaching and maintaining values outside, approaching outside or within the normal range of the audio system parameters in 2 seconds.
4.4. Confirm translated audio flow from Interpreter w orkstation to Delegates receivers (e.g. Smart Glasses).	4.4. U.N.I.S. communication sub-system module determines and displays on a dashboard a simple text stream; message count; and error count of translated audio signal between Interpreter workstation and Delegates receivers (e.g., smart glasses) in 2 seconds.
5.0. Sensors	**5.0. Sensors**
5.1. Confirm sensor subsystem normal state	5.1. U.N.I.S. sensors sub-system module determines and displays on a dashboard a simple green color-code lamp indicating normal system state when reaching and maintaining values within the normal range of sensor sub-system parameters in 2 seconds.
5.2. Troubleshoot any fault indications	5.2. U.N.I.S. sensors sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system state when reaching and maintaining values outside, approaching outside or within the normal range of sensor sub-system parameters in 2 seconds.
5.3. Confirm microphone betw een Floor Speaker and Interpreter w orkstation operating normally	5.3. U.N.I.S. sensors sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for microphone between Floor Speaker and Interpreter workstation when reaching and maintaining values outside, approaching outside or within the normal range of the sensor sub-system parameters in 2 seconds.
5.4. Confirm IR connection betw een Interpreter w orkstation and Delegates receivers (e.g. Smart Glasses) w/in line of sight and operating normally	5.4. U.N.I.S. sensors sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for infrared signal between Interpreter workstation and Delegates receivers (e.g., smart glasses) when reaching and maintaining values outside, approaching outside or within the normal range and line of sight of the sensor sub-system parameters in 2 seconds.
5.5. Confirm biometric facial and speech recognition devices operating normally	5.5. U.N.I.S. sensors sub-system module determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for biometric facial and speech recognition images between Interpretation workstation and Delegates receivers (e.g., smart glasses) when reaching and maintaining values outside, approaching outside or within the normal range of the sensor sub-system parameters in 2 seconds.
6.0. Language Translation Software (LTS)	**6.0. Language Translation Software (LTS)**
6.1. Confirm LTS normal state	6.1. U.N.I.S. language translation software (LTS) sub-system determines and displays on a dashboard a simple green color-code lamp indicating normal system state when reaching and maintaining values within the normal range of Language Translation Software system parameters in 2 seconds.
6.2. Troubleshoot any fault indications	6.2. U.N.I.S. LTS sub-system determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system state when reaching and maintaining values outside, approaching outside or within the normal range of LTS system parameters in 2 seconds.
6.3. Check proper translated messages and audio exchanges with Delegate receivers (e.g. Smart Glasses)	6.3. U.N.I.S. LTS sub-system determines and displays on a dashboard a simple audio and text stream; message count; and error count of translated audio signal between Interpreter workstation and Delegates receivers (e.g., smart glasses) in 2 seconds.
7.0. Cultural Feedback	**7.0. Cultural Feedback**
7.1. Ensure cultural aspects identified for planned translated languages	7.0. U.N.I.S. cultural feedback sub-system identifies and displays cultural aspects via images on a dashboard for planned translated images in 2 seconds.
7.2. Confirm U.N.I.S. gathering biometric information properly	7.2. U.N.I.S. cultural feedback sub-system determines and displays on a dashboard a simple red (inoperative); yellow (degraded); or green (normal operation) color-code lamp indicating inoperative, degraded or normal system states for gathered biometric facial and speech recognition images between Interpretation workstation and Delegates receivers (e.g., smart glasses) when reaching and maintaining values outside, approaching outside or within the normal range of the cultural feedback sub-system parameters in 2 seconds.
7.3. Update language translation based on cultural feedback information	7.3. U.N.I.S. cultural feedback sub-system displays cultural feedback; recommends updates to original translated language; and allows selection of accept or reject the change on a dashboard in 2 seconds.

Selected Operator Roles

Functional Breakout	Operator Roles			
	Direct Performer (Maintainer)	Manual Controller (Interpreter)	Supervisory Controller (Interpreter)	Executive Controller
1.0. Mission Planning			3	2
2.0. System Setup and Initialization	2	5		
3.0. System Health and Monitoring		2	4	
4.0. Communication		1	3	
5.0. Sensors		1	4	
6.0. Language Translation Software (LTS)		2	1	
7.0. Cultural Feedback	1	1	1	

Table 1
Possible Configurations of Human and Machine Components for each Operator Role

Operator Role	Input	Processing	Response Selection	Output
Direct Performer	H or Hm	H	H	H or Hm
Manual Controller	H or Hm or M	H or Hm or M	H	H or Hm or M
Supervisory Controller	M or Mh	M or Mh	Mh	M or Mh
Executive Controller	M	M	M	M

Note: H = Performed by human
Hm = Performed by human supplemented by machine
M = Performed by machine
Mh = Performed by machine supplemented by human.

Operator Role Theory: Final Analysis for U.N.I.S. - Radix

Functional Breakout	Performance Requirements	Configuration	Operator Roles			
	P1.1. to P7.3.	1 - 7 with I, P, R or O	Direct Performer	Manual Controller	Supervisory Controller	Executive Controller
1.0. Mission Planning						
1.1. Collect Interpretation Services Request from United Nations Delegates	P1.1.	I5		x		
1.2. Determine Floor Language	P1.2.	2O				x
1.3. Determine Non-English Languages from expected United Nations Delegates	P1.3.	2P				x
1.4. Determine United Nations session date, duration and delegate planned training.	P1.4.	2O				x
1.5 Determine how many U.N.I.S. receivers needed for the session.	P1.5.	2O				x
2.0. System Setup and Initialization						
2.1. Power on U.N.I.S.	P2.1.	2I				x
2.2. Enter number of supported delegates and native language	P2.2.	2O				x
2.3. Enter Floor Language	P2.3.	2O				x
2.4. Enter expected non-English languages	P2.4.	2O				x
2.5. Enter U.N. session date, duration, and planned timing for each delegate	P2.5.	2O				x
2.6. Enter number of delegate receivers and check seating chart dashboard	P2.6.	7P			x	
2.7. Press initialize to start the interpretation session	P2.7.	5I			x	
3.0. System Health and Monitoring						
3.1. Confirm U.N.I.S. normal state	P3.1.	2O				x
3.2. Troubleshoot any fault indications	P3.2.	2O				x
3.3. Monitor sensor normal state and conduct troubleshooting	P3.3.	2O				x
3.4. Monitor audio receipt	P3.4.	2O				x
3.5. Monitor audio translation process	P3.5.	2O				x
3.6. Monitor communications links to Floor Speaker and Delegates	P3.6.	2O				x
4.0. Communication						
4.1. Confirm communication subsystem normal state	P4.1.	2O				x
4.2. Troubleshoot any fault indications	P4.2.	2O				x
4.3. Confirm audio flow from Floor Speaker to Interpreter workstation	P4.3.	2O				x
4.4. Confirm translated audio flow from Interpreter workstation to Delegates receivers (e.g. Smart Glasses).	P4.4.	2O				x
5.0. Sensors						
5.1. Confirm sensor subsystem normal state	P5.1.	2O				x
5.2. Troublehoot any fault indications	P5.2.	2O				x
5.3. Confirm microphone between Floor Speaker and Interpreter workstation operating normally	P5.3.	2O				x
5.4. Confirm IR connection between Interpreter workstation and Delegates receivers w/in line of sight and operating normally	P5.4.	2O				x
5.5. Confirm biometric facial and speech recognition devices operating normally	P5.5.	2O				x
6.0. Language Translation Software (LTS)						
6.1. Confirm LTS normal state	P6.1.	2O				x
6.2. Troubleshoot any fault indications	P6.2.	2O				x
6.3. Check proper translated messages and audio exchanges with Delegate receivers (e.g. Smart Glasses)	P6.3.	2O				x
7.0. Cultural Feedback						
7.1. Ensure cultural aspects identified for planned translated languages	P7.1.	2O				x
7.2. Confirm U.N.I.S. gathering biometric information properly	P7.2.	2O				x
7.3. Update language translation based on cultural feedback information	P7.3.	6O		x		

H.S.I. Task Descriptions

Item	Task	Description
1	Receive audio from presenter.	Presenter speaks into microphone. Audio travels along microphone cable into UNIS information system.
2	Identify native language from received audio.	UNSI information system samples received audio. UNIS looks up sample in language database. UNIS finds matching native language.
3	Translate identified audio into English.	UNIS information system converts audio into matched native language. UNIS information system runs translation sub-routine for English against matched native language. UNIS saves English translation.
4	Transmit translated language to United Nations delegates.	UNIS sends English translation audio to United Nations delegates via smart glasses.
5	Gather biometric feedback images via sensors.	UNIS sensors (cameras and smart glasses) picks up biometric movements of body gesters from United Nations delegates. UNIS compares delegates reactions to English translation. UNIS information system posts biometric feedback images of delegates. Interpreter analyzes each image for cultural differences in original English translation.
6	Accept or reject recommended final translation.	UNIS information system displays its recommended English translation based on observed biometric feedback of delegates. UNIS information system requests the interpreter accept or reject the recommended English translation.
7	Speak final translated language to United Nations delegates.	Interpreter speaks the final translated English to the delegates.

Human-Centered Requirements

Item	Human-Centered Requirements	Information Systems, Sensor, and/or Use Case Mapping
1	Brightness intensity coding shall be considered only to differentiat between an item of information and adjacent information.	Information System and Use Case #1: Single Language Translation
2	No more than two levels of brightness shall be used and each level shall be separated from the nearest other level by not less than a 2:1 ratio.	Information System and Use Case #1: Single Language Translation
3	Text characters that must be read shall not flash.	Information System and Use Case #1: Single Language Translation
4	Character width shall be approximately 0.9 of the height.	Information System and Use Case #1: Single Language Translation
5	When missing data are detected, the system shall prompt the user.	Information System and Use Case #1: Single Language Translation
6	The dialog of factual error messages shall be strictly factual and informative for the user, with neither humor nor admonishment used in structuring the messages.	Information System and Use Case #1: Single Language Translation
7	The viewing distance from the eye reference point of the seated user to displays located close to their associated controls shall not exceed 70 centimeters (28 inches).	Sensor and Use Case #1: Single Language Translation
8	Information presented on HUDs (smart glasses) shall be limited to critical data, which th user is required to monitor while simultaneously performing the primary visual work.	Sensor and Use Case #12: Evaluate Images
9	Regardless of the optical display technology, the head motion, or eye-box size shall not be less than 11.5 centimeters (4.5 inches) wide, 6.5 centimeters (2.5 inches) high, and 15 centimeters (6.0 inches) deep.	Sensor and Use Case #12: Evaluate Images
10	A signal-to-noise ratio of at least 10 decibels shall be provided in at least one octave band between 200 and 5000 Hertz at the operating position of the intended receiver. Signal-to-noise ratios can be greater as long as the levels do not exceed 115 decibels at the ear of the listener.	Sensor and Use Case #10: Transmit Audio

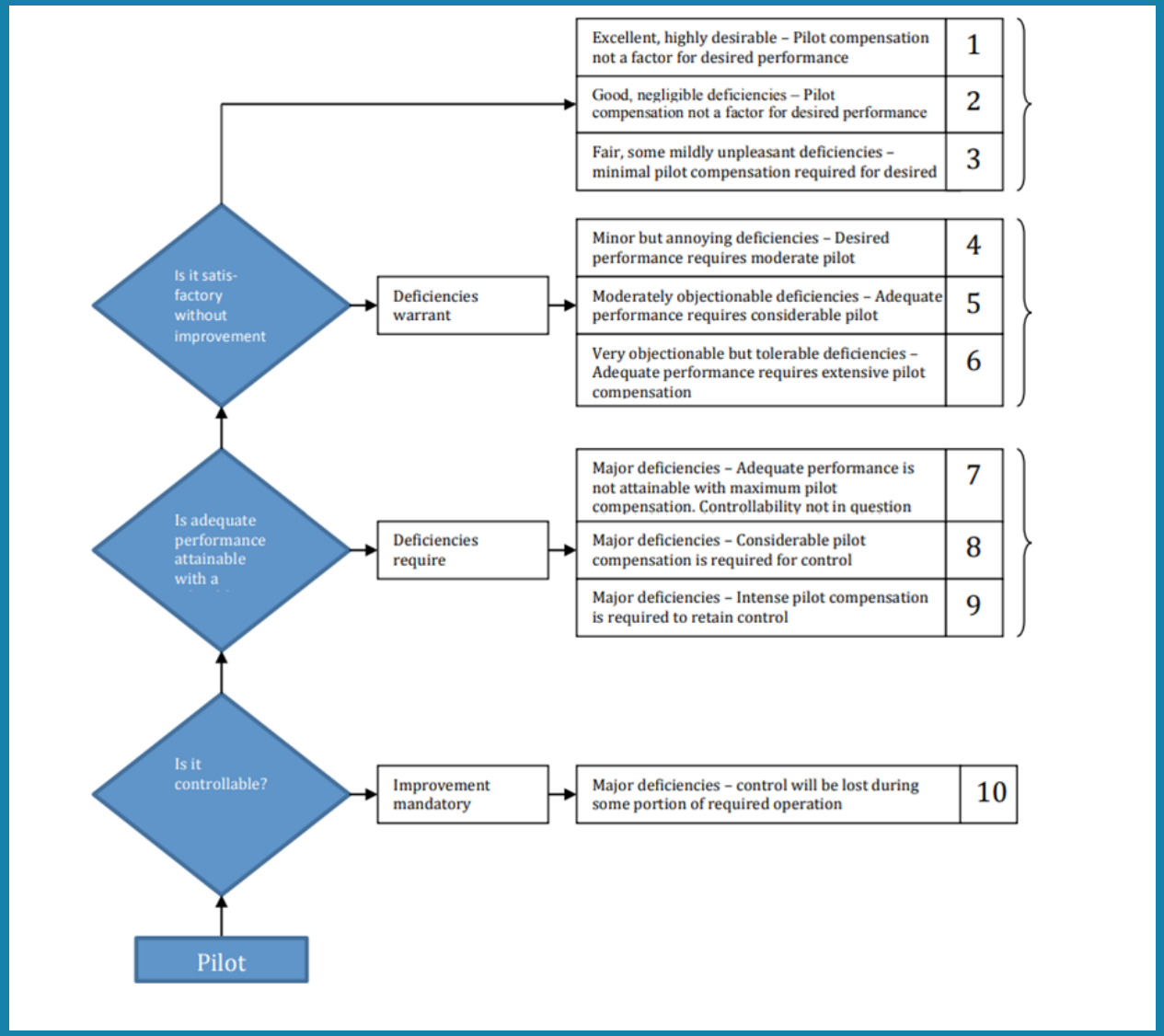
Tradeoffs

- Complex hologram reality sensors and displays
- Information System narrowed to just Commercial-Off-the-Shelf applications for translation software
- Simplified to just cameras, microphone, and VR/AR smart glasses
- Human Systems Integration: Human Factors Engineering, Personnel and Training
  - Human Performance and Reliability of the Interpreters was a critical factor in re-scoping
  - Interpreters language knowledge, skill, attributes, cognitive and physical abilities were analyzed
  - Training the interpreters and delegates to properly operate U.N.I.S. was very important design consideration from a H.S.I. perspective.

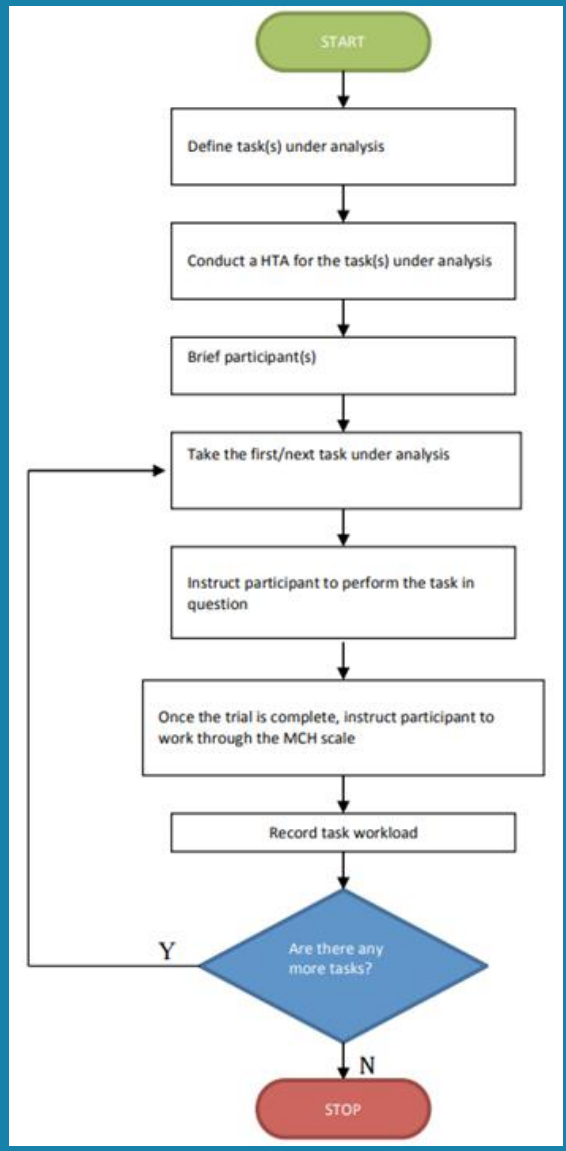
H.S.I. Workload Assessments

- Magnitude Estimation
- Bedford Workload Scales
- Modified Cooper Harper Scales (MCH)

Workload Assessments: Modified Cooper-Harper (MCH) Scale



MCH Process



MCH Flowchart

H.S.I. Test Plan for U.N.I.S.

Item	Test Objective	Description	Method
1	Evaluate UNIS receives audio from presenter's microphone.	Connect audio recorder to microphone and another one to UNIS. Ask presenter to speak for a minute. Play back both recordings. Compare them for exact match. Confirm with presenter the correct speech is on the UNIS recorder.	Demonstration
2	Evaulate UNIS translates audio into English.	Copy UNIS audio file into Audio-Video Analysis Tool. Run analysis software. Playback English audio file. Confirm with interpreter the results are accurate.	Demonstration
3	Evaluate UNIS gathers biometric feedback images from delegates.	Connect audio video recorder to smart glasses worn by delegate. Copy UNIS sensor images into Audio-Video Analysis Tool. Run analysis software. Playback images within UNIS. Compare with smart glasses recording.	Demonstration

- **H.S.I. Demonstration**. HSD is a formal requirement for a large program.
  - HSD uses a development team to demonstrate verification of key H.S.I. requirements.
  - HSD shows that a crew of the specified size and skill set perform all of the missions addressed in the MTA.
  - HSDs require a properly trained crew complement, using the real hardware and software, usually in a simulation environment with high fidelity and/or real-world setting.
  - Scenarios used for HSDs selected from the MTA and used in SEs featured as operational scenarios in the integration demonstration.
  - Two Phases:
    - Phase I: UN observers' demonstration on how U.N.I.S. meets the requirements. Request for additional scenarios.
    - Phase 2: Demonstrate additional tasks

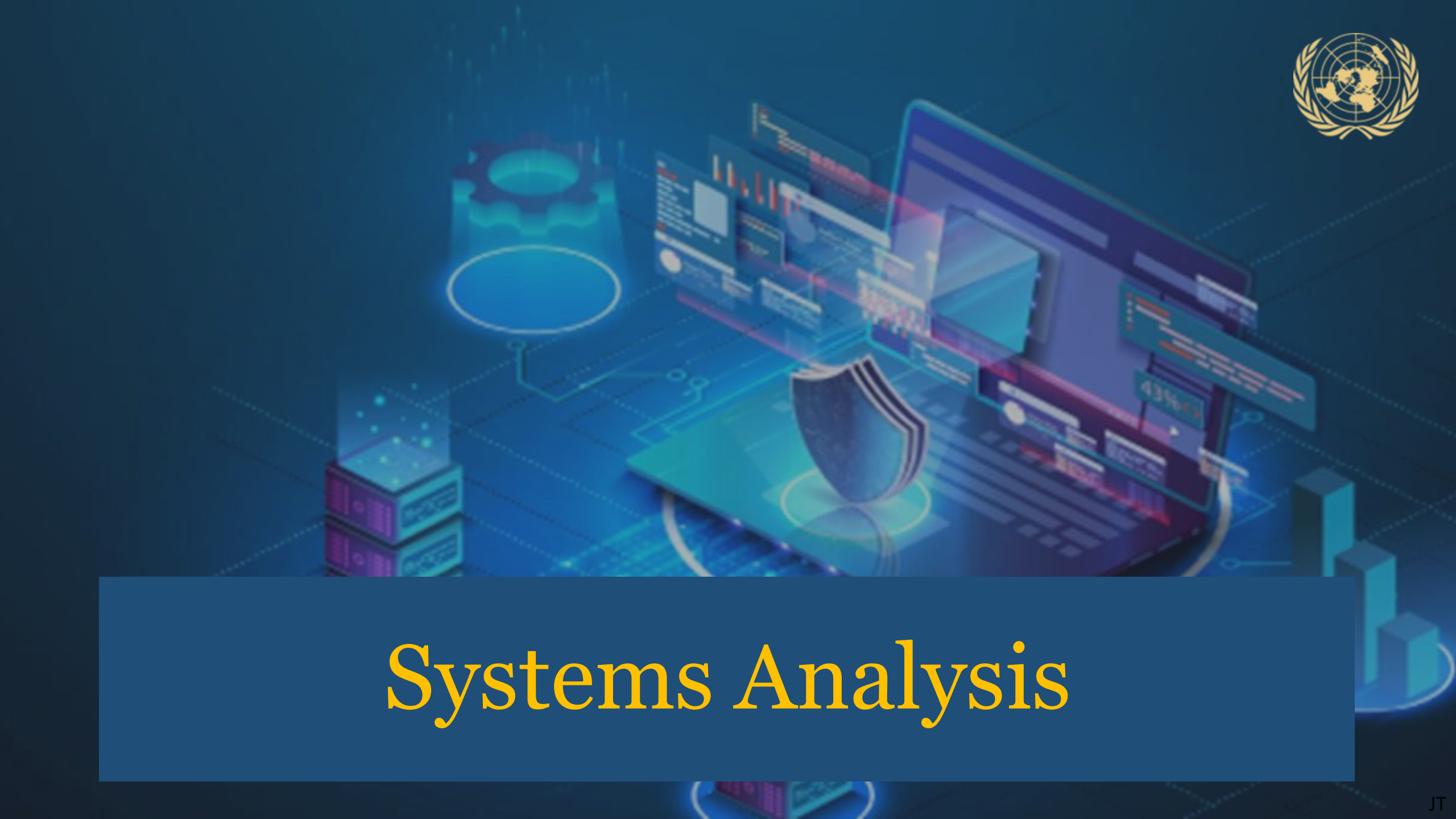
Test Objectives for U.N.I.S.

#1: Audio Analysis for U.N.I.S.

- Interactive Process Analysis by Bales (1951)
- Tools: Audio Recorders, GoldWave & Microsoft Access

2 & 3: H.S.I. Audio-Video Analysis

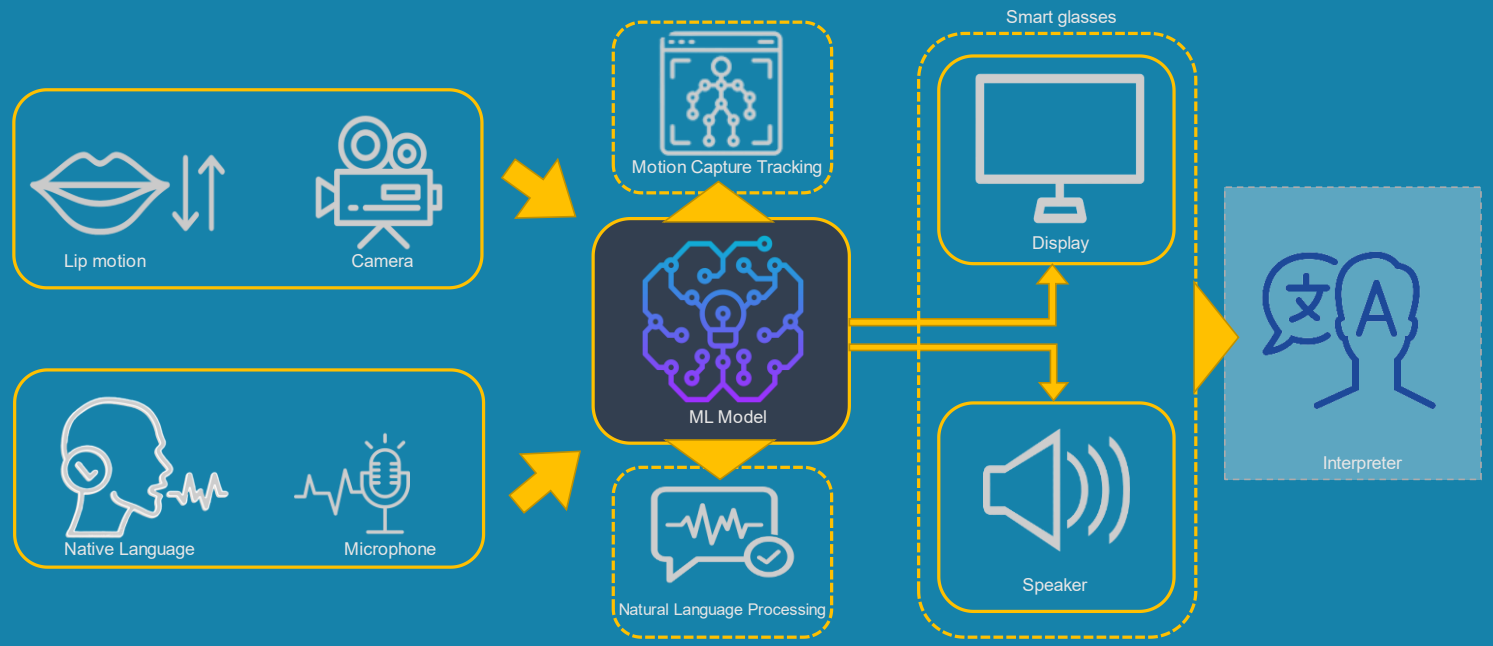
Method	Purpose	Advantages	Disadvantages
Open approach	The open approach allows for discoveries where no initial patterns have been identified, limiting any preconceived barriers by the designer.	• Chances of identifying criticalities are higher. • As the researcher listens or views the recording with an open mind, the possibility of introducing bias or overlooking details is lower.	Different participants or user groups may approach the scenario being recorded differently, which can add complexity when consolidating findings.
Closed approach	The second approach is in direct contrast to open approach. Here, the researcher analyzes the footage for a specific event, or with respect to a specific hypothesis that matter to the participants and/or to the research project.	As the problem statement or the question to which the researcher is seeking answers is already defined, it is a quicker approach to open.	• Chances of introducing researcher bias. • Chances of missed specific details because the researcher is looking for answers to existing questions.
Focused	In the focused approach, specific interactions are selected and examined for analysis. The focus is on a specific subject or content.	• Quicker than the open approach. • The researcher can devote attention to specific portions of the footage.	Other areas of the audio or video that may be relevant to the subject under consideration may go unheard or unseen.



Systems Analysis

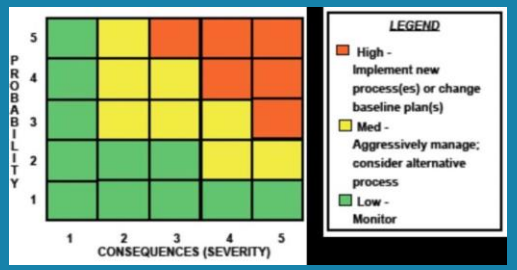
JT

Systems Analysis



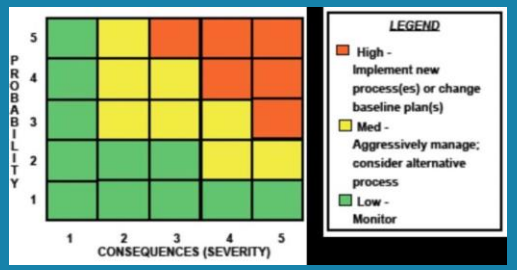
- The UNIS Radix System has integrated I.S., Sensors, and H.S.I. to serve the United Nations.

System Risk Roll-up



ID	Risk Statement	Probability	Impact	Risk Score
Sys-1	U.N. selects other COTS readily available products (Google Translator)	1- U.N. does not want to associate with Google, wants international development effort.	5- Program cancelled.	**Low**
Sys-2	Headset and Processor Integration Testing takes longer than planned 8 months.	2- Developing new technology.	4- Delayed roll-out and impacts contract awards.	**Medium**
Sys-3	COTS part availability due to supply chain constraints	3 – Parts can be purchased for designed system lifecycle with spares	4 – Alternative parts may delay roll-out	**Medium**
Display-1	The development of the lens waveguide technology does not meet customer schedule.	3- Prescription lens waveguide technology in development.	3- Limited video use to non-prescription glasses; no impact to audio feature.	**Medium**

System Risk Roll-up cont.



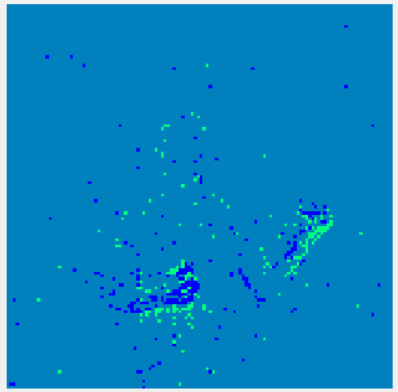
ID	Risk Statement	Probability	Impact	Risk Score
IS-1	Translation audio processing takers longer than 4 seconds.	2- Developing new technology.	4- Delayed function impacts contract awards.	**Medium**
IS-2	Translation is not 97% accurate.	2- Developing new technology.	4-Function impacts contract awards.	**Medium**
Sens-1	The vendor back—out of the agreed work to build a modular headset.	1- Vendor excited about work.	4- Impacts development by 4 months.	**Low**
Sens-2	The integration of the new sensor design cannot meet customer schedule need.	2- HR has hired personnel familiar with development.	5- Contract is cancelled for alternative design.	**Medium**

System Design Decisions

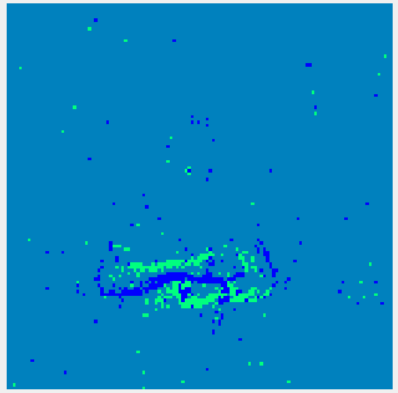
Contexts	Feature/Parameter	Selection	Rationale
Sensor, HSI	Modularity	Breakdown into 3 pieces	Structure to have audio only, video with generic glasses, video with prescription glasses
Sensor, IS, HSI,	Audio Data Rate	320kbps	Minimal data rate for interpretation voice dubbing and while maximizing native language sound quality.
Sensor, IS HSI	Camera Requirements	1080p	Minimal for acceptable mouth overlay and reduces total data transmission size.
Sensor, IS	Video Compression	AV1 Codec	45% lower data rate at same quality compared to H.264/AVC, royalty-free, reduces wireless transmission requirements
IS	Relational Database	Oracle	1. Reduces operational cost 2. Uses a single database for all data types 3. Richest feature-set of any RDBMS
IS	Cloud	AWS Cloud	Scalable, reliable, and secure global computing infrastructure
HIS, Sensor	Display	AR Glasses	More comfortable than VR goggles, allows for human interactions
HIS, IS	Latency	<3 seconds	Increase immersion, improve on current human process
HIS	Interpreter UI	Touchscreen	Large, easy to read buttons with intuitive, fast response

Thank You

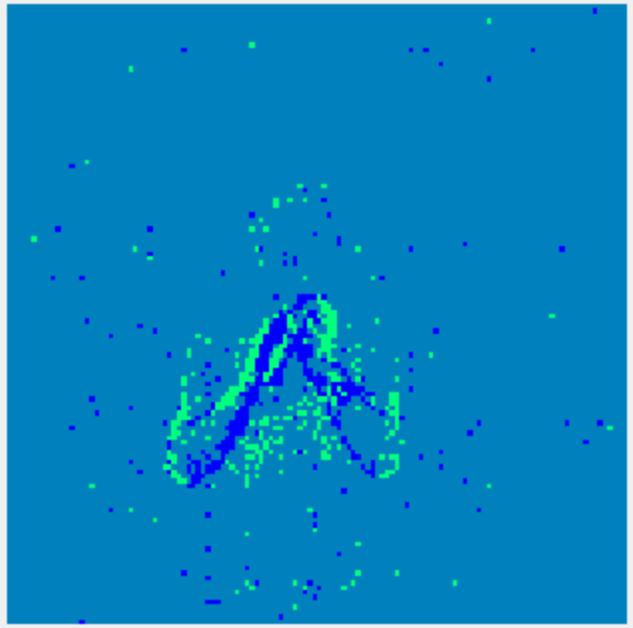
air guitar



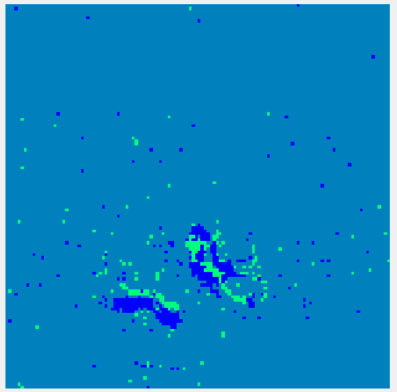
arm roll



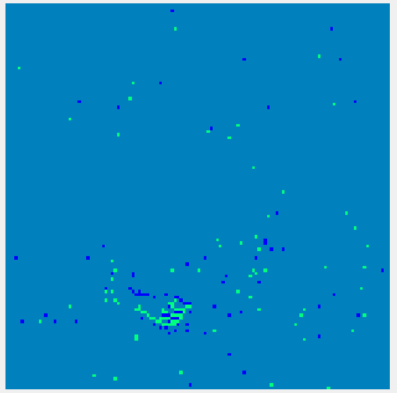
hand clap



air drums



other gesture



Questions

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