

# American Sign Language (ASL)

Slate8 (“Sign Language to English”)

Top Level Design Solution

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# Focused Objectives of ASL

- Background
- Problem Definition
- Current Status of Art
- Solution Approaches
- Top Solution Design

# Before there was American Sign Language!

## Background

- Communication was little or none
- Discriminated against
- Left out or forgotten
- Lack of confidence
- Being a burden or obligation to someone



# National Association of the Deaf (NAD)

## Background

- Gave the hearing impaired a voice
- Gave a sense of belonging
- Restored or gave confidence
- Gave a degree of independence
- Communication only with other hearing impaired or through interpreter.



# Idea Thinkers (Designers and Inventors)

## **Current Status of Art**

- How can I make communication between the hearing and hearing impaired better?
- I'll use audio or video?
- I'll use audio and video in a stand alone device?
- I will make it portable and convenient
- I will make it user friendly

# Design Constraints

Cost for tracking software is little to no cost. Open source software may be available or gain rights for design.

Cost for sequencing software is little to no cost. Open source software may be available or gain rights for design.

No cost for hardware (Phone), hardware (camera, speaker, microphone).

Need specially design motions sensor for watch.

Need specially design watch case for sensors.

Little to no cost for Java app creation for ASL app.

# Standards and Regulations

ADA Compliant – Adheres to ADA section 508, and WCAG 2.0 – Handicap Accessible

Large screen display and color compliant

Multimedia capabilities

Easy to navigate

Design using Accessibility Frameworks, text – to – speech, haptic (touch), and gesture technologies

Safe for all ages

Legal – does not interfere with other apps and hardware.

## Design 1 Sign Language App Pros and Cons

<b>Pros</b>	<b>Cons</b>
Target is in direct line of sight	Other images in background
Both hands and body within view	Must be constantly held on target
Real time conversion of ASL to text and audio	Some hand signals have to be learned by sequencing software
Larger onboard memory for multiple language conversions	
Low or no cost for software, no cost for extra hardware design	
Convenient and portable	
Sequencing/tracking software to learn new signals	
Larger database of ASL symbols and video tutorials	
Larger display screen and speaker	
3 dimensional software available as open source or with acquired rights	



## Design 2 Watch with ASL App Pros and Cons

Pros	Cons
Wearable	Cannot capture both hands unless close together
Do not have to maintain constant focus	Requires additional hardware - sensors
Range limited to hand or two if close together	Limited space for software
Convert ASL text and audio	Costly due to sensors and specially design watch
Memory storage for ASL database and sequencing software	Sequencing/tracking software limited to one hand two if close together
	Limited room for ASL video tutorials
	Small display screen and speakers

## Design Decision Matrix

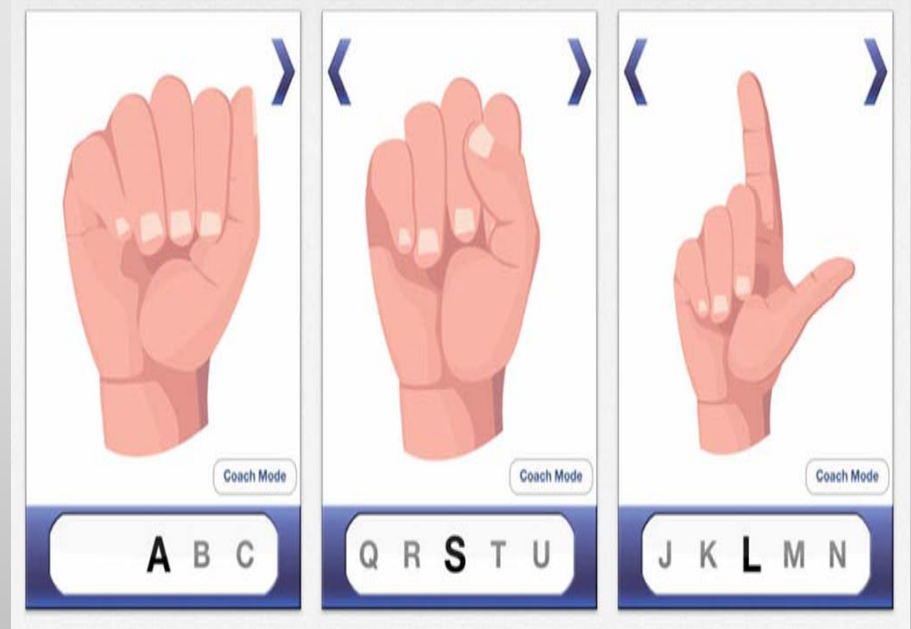
	Weight	Design 1	Score	Avg Score	Design 2	Score	Avg Score
<b>Real Time Functionality</b>	5	Hand/Face Recognition	5	25	Hand/s Recognition	3	15
<b>Real Time Symbol Recognition</b>	5	Sign Language Conversions Text/Audio	5	25	Sign Language Conversions Text/Audio	3	15
<b>Visual/Audio</b>	4	Large Display	4	16	Large Display	2	8
<b>Sequence Software Adaptability</b>	4	Database Symbol Storage	4	16	Database Symbol Storage	2	8
<b>Large Storage</b>	3	ASL Tutorials	3	12	ASL Tutorials	1	3
<b>Accessibility</b>	5	Ease Of Use	5	25	Ease Of Use	2	10
<b>Total</b>				<b>119</b>			<b>59</b>

# ASL Designed Devices

## Current State of Art

- Teaches Symbol Identification
- Video record with playback interpretation
- Early detection and warnings

## American Sign Language App

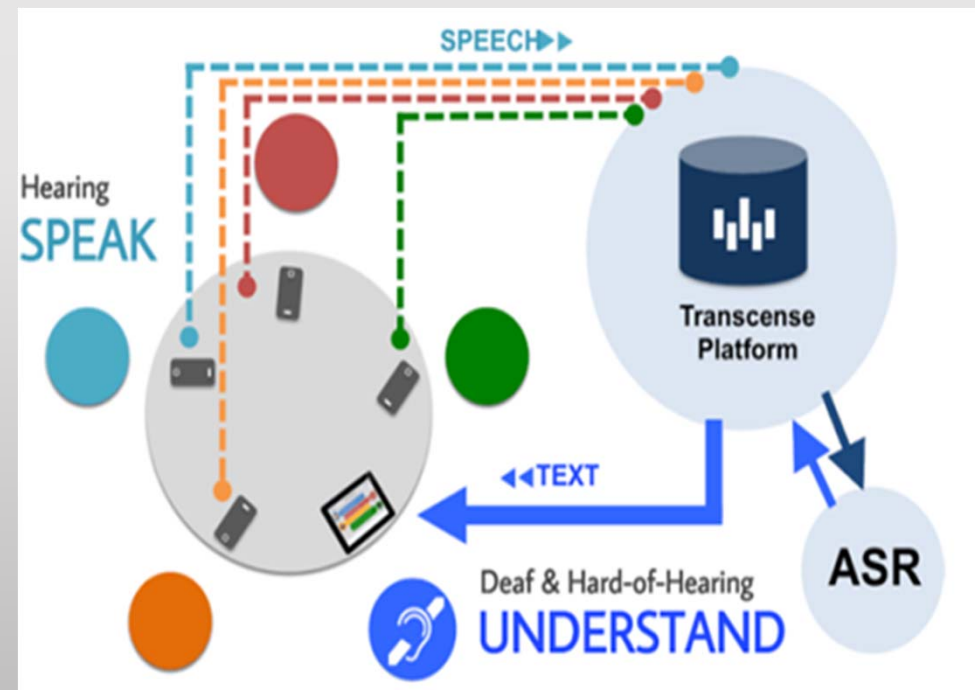


# ASL Designed Devices

## Current State of Art

- Individual recording devices
- Base station
- Automatic Speech Recognition
- Group Meetings

## American Sign Language System

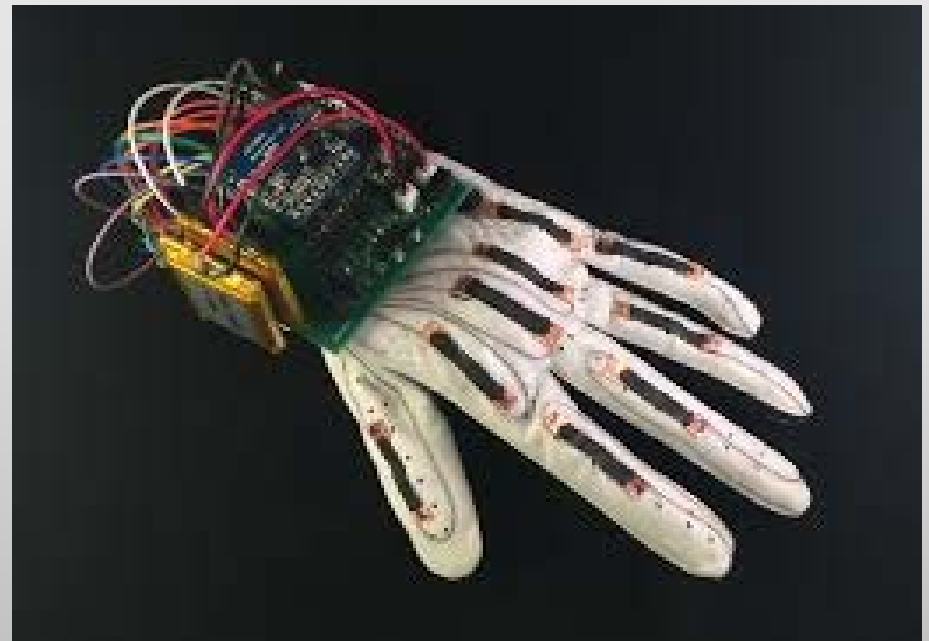


# ASL Designed Devices

## Current State of Art

- Wirelessly translates the American Sign Language alphabet into text
- Controls a virtual hand to mimic sign language gestures

## American Sign Language Glove

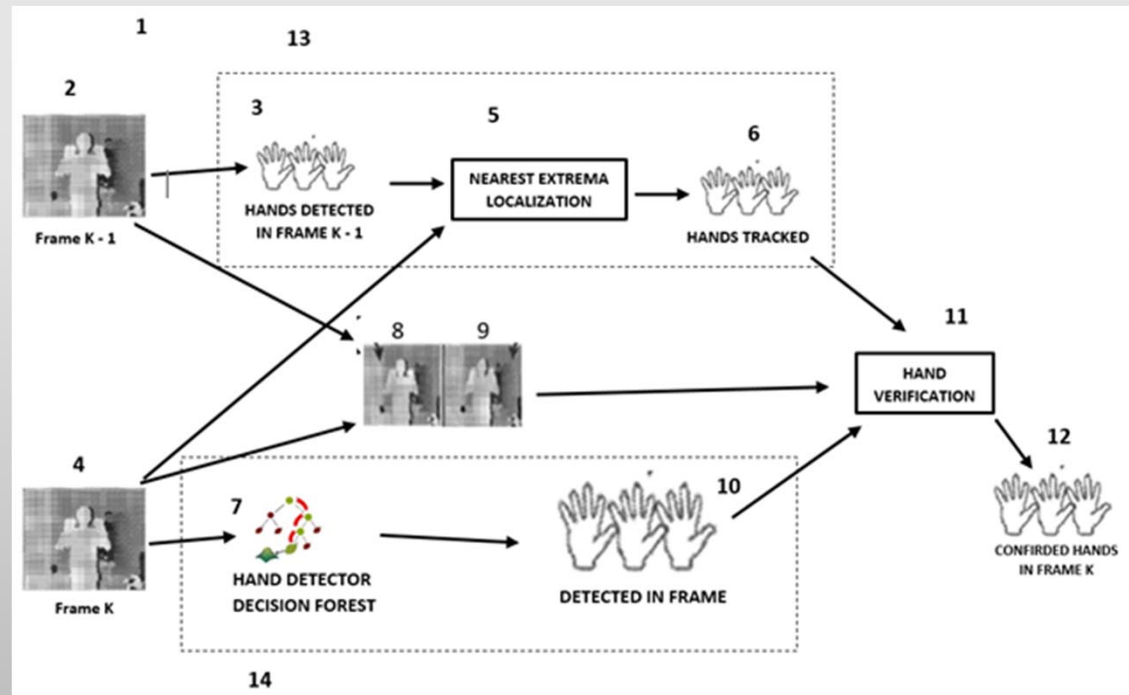


# Top Solution Design Solution Approach

## Three Dimensional Hand Tracking Using Depth Sequences

### Process

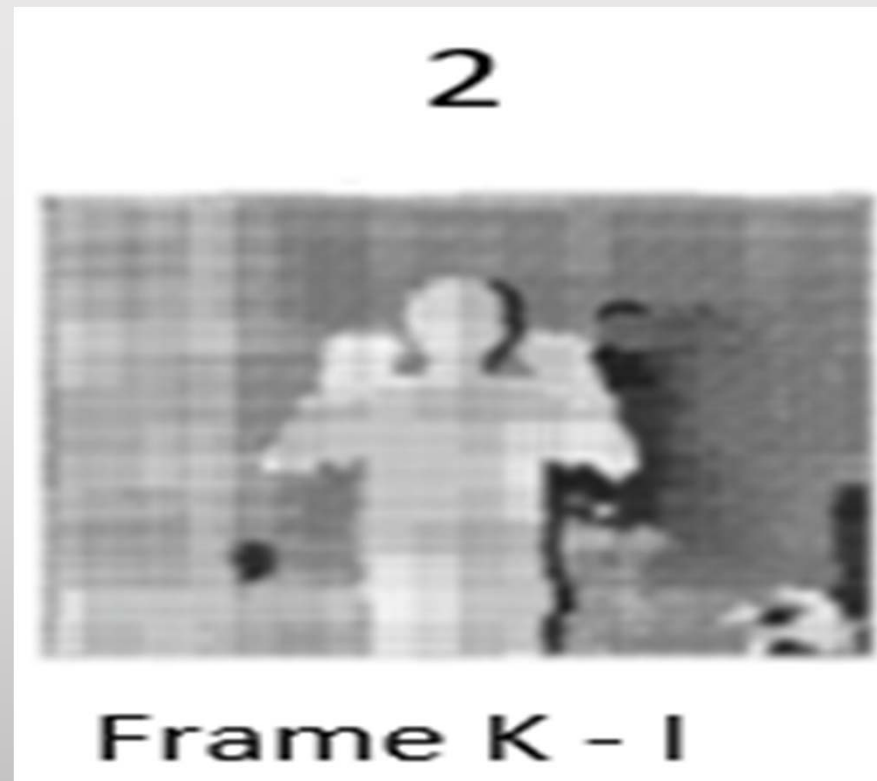
- FIG. 1 illustrates shows a model process for performing three dimensional hand tracking using depth sequences.



# Top Solution Design Solution Approach

## Step One

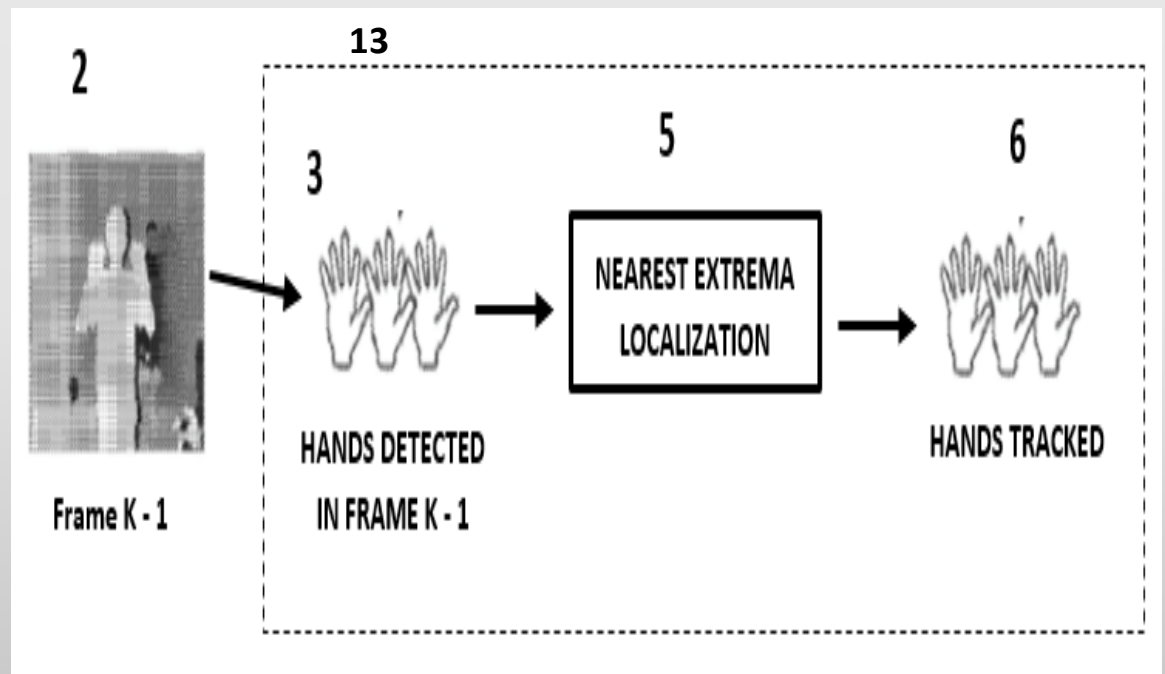
- First, the depth image for a previous frame (Frame  $K - 1$ ) is analyzed at Step 2.



# Top Solution Design Solution Approach

## Step Two

- The depth image data for the previous frame may simultaneously be passed to tracking process (13).



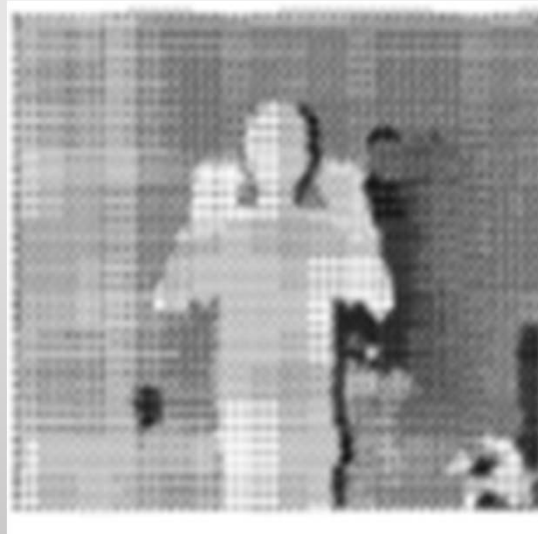


# Top Solution Design Solution Approach

## Step Three

- Depth image data is also passed to the motion detection process (8) and background modeling process (9) (for further verification).

8



MOTION DETECTION

9

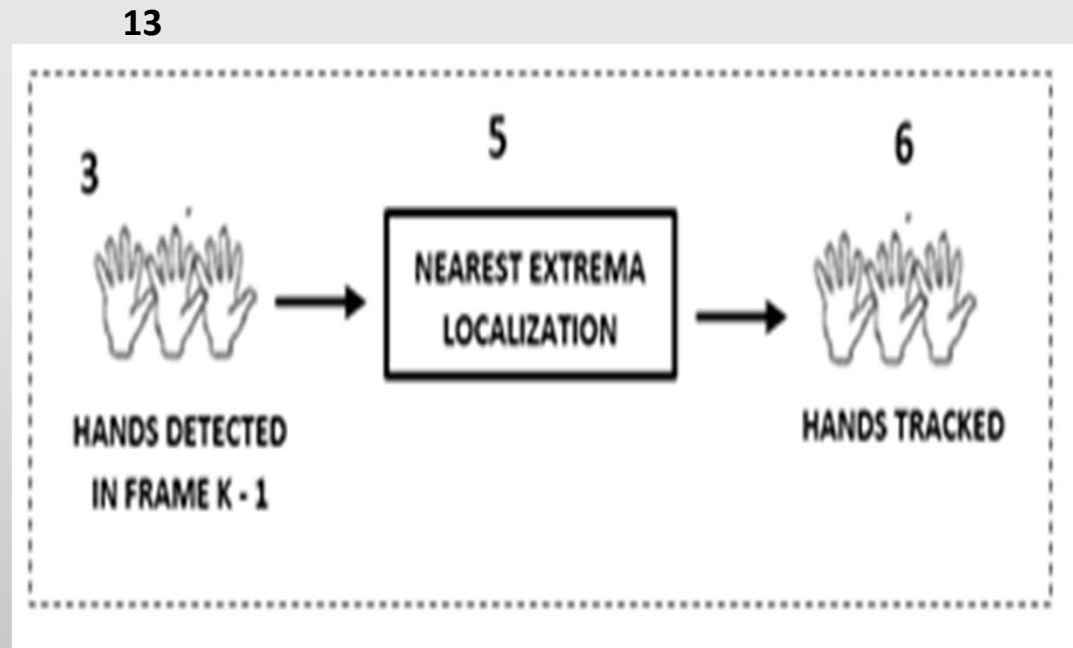


BACKGROUND MODELING

# Top Solution Design Solution Approach

## Step Four

- Within tracking process (13), the set of hands detected in the Frame K-1 are obtained (3).

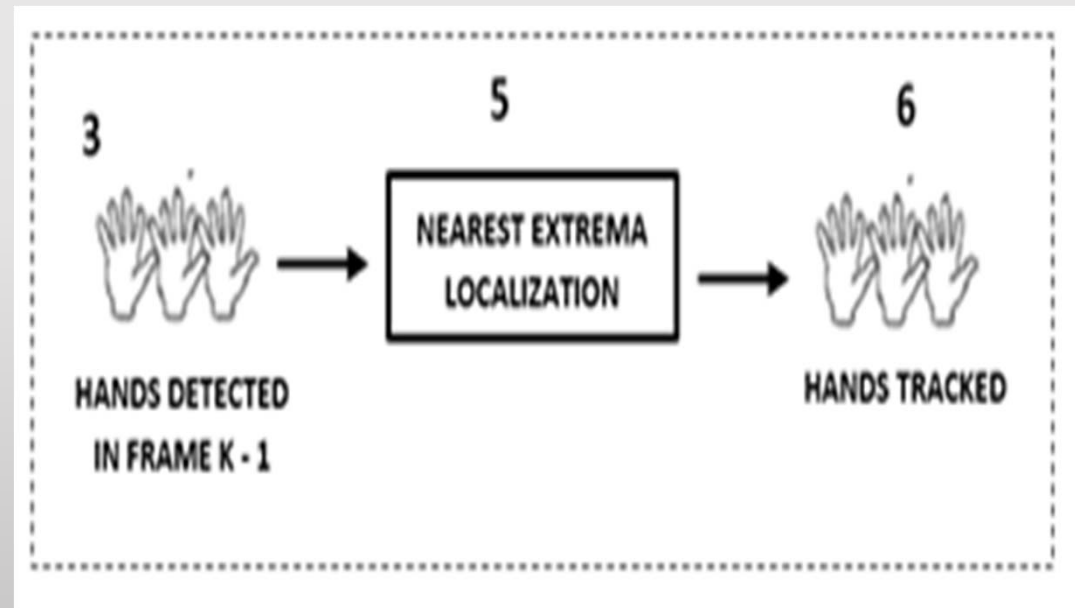


# Top Solution Design Solution Approach

## Step Five

- Next, the hands from Frame K-1 and Frame K (i.e., the “current frame”) may be subjected to a nearest extrema localization constraint (5).

13

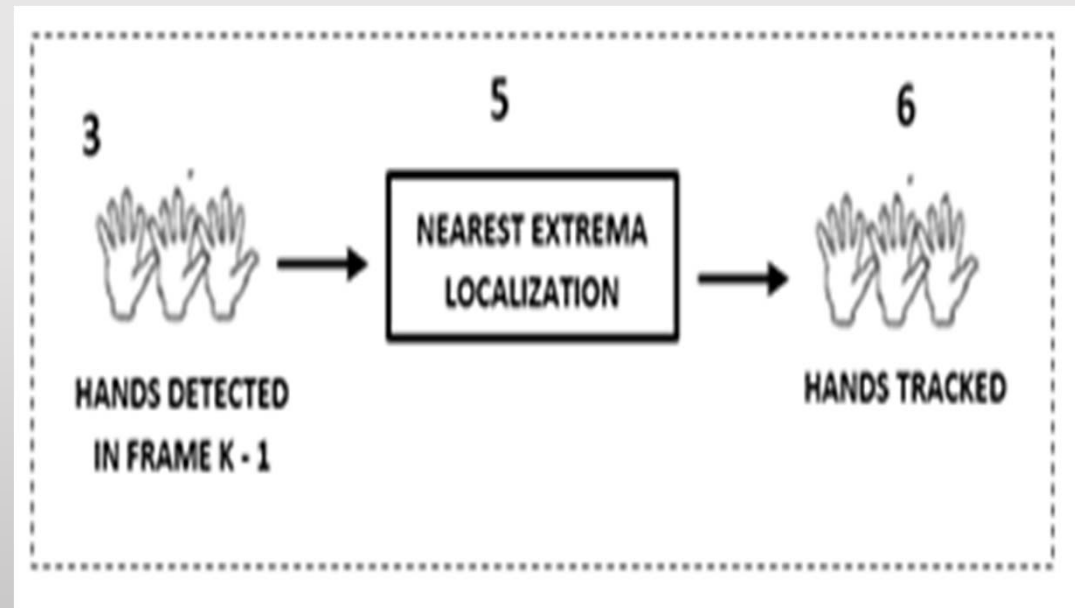


# Top Solution Design Solution Approach

## Step Six

- The hands that pass the nearest extrema localization constraint at step (5) are the confirmed set of hands that will be tracked (6) from Frame K-1.

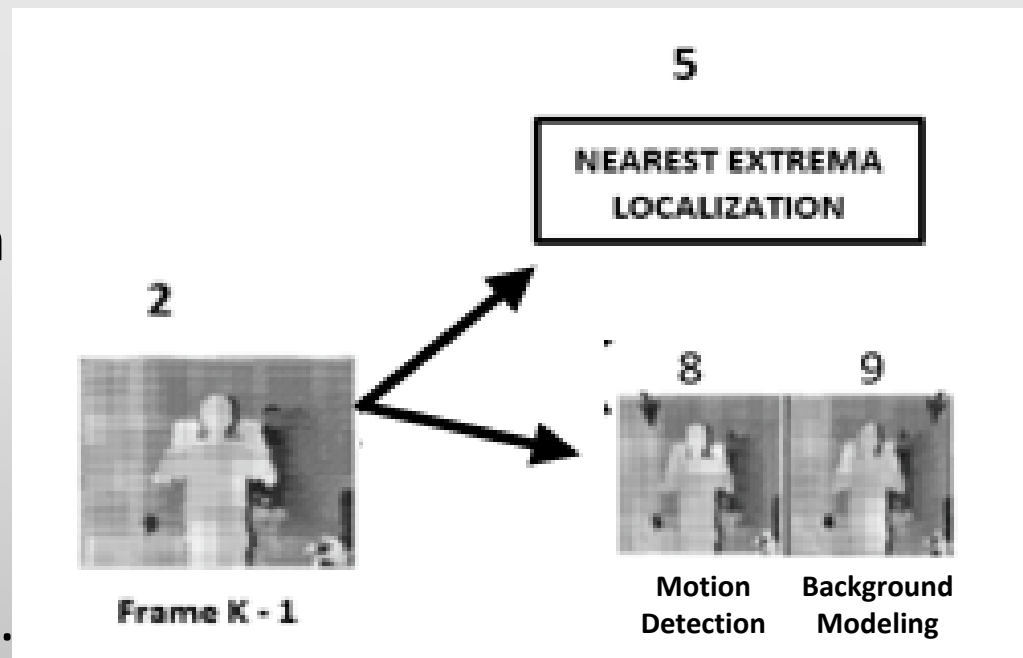
13



# Top Solution Design Solution Approach

## Step Seven

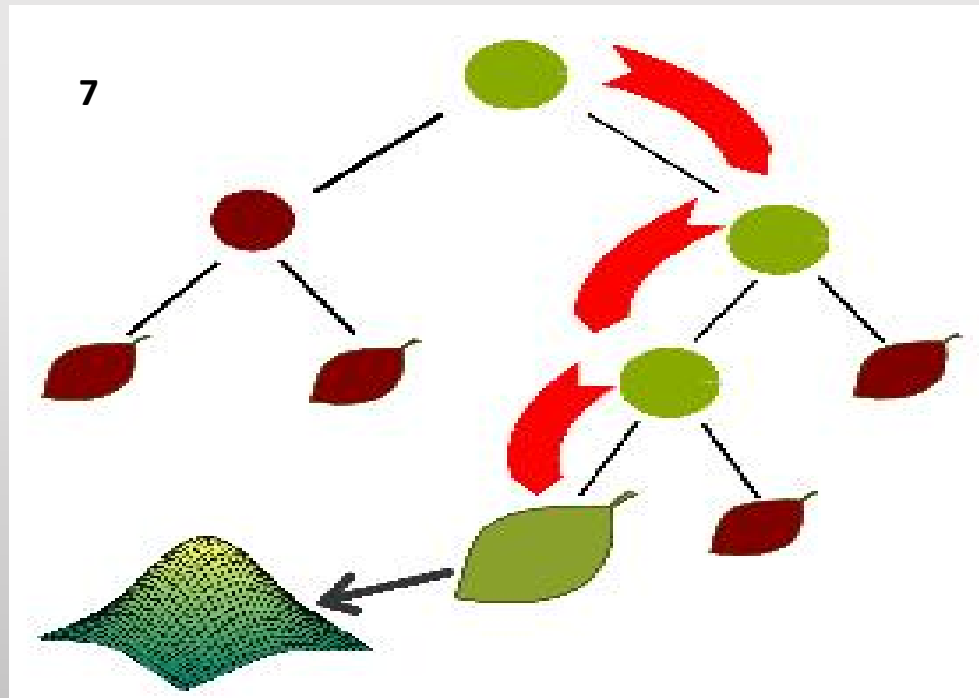
- Like the previous frame (Frame K-1), the information from the current frame (Frame K) may be passed to motion detection process (8) and background modeling process (9).



# Top Solution Design Solution Approach

## Step Eight

- Finally, each frame, as it becomes the “current frame,” is subjected to the hand detection process 14, which involve the hand detector decision forest (7)

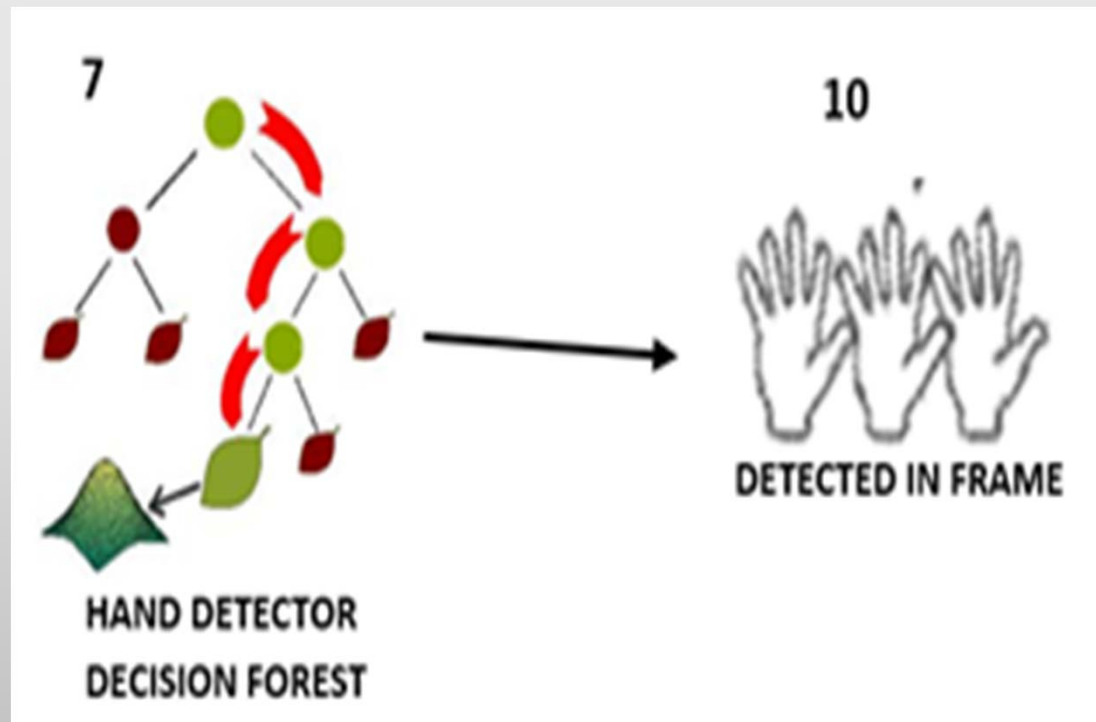


HAND DETECTOR  
DECISION FOREST

# Top Solution Design Solution Approach

## Step Nine

- Hands detected in the decision forest (7) result in a set of candidate hands (10) detected in the “current frame,” Frame K.



# Top Solution Design Solution Approach

## Step Ten

- This output of the current frame hand detection process (14) is then passed to hand verification stage (11).



**HAND  
VERIFICATION**



# Top Solution Design Solution Approach

## Step Eleven

- Finally, the hand candidates that pass the hand verification step (11) are output as confirmed hands in the current frame, Frame K, (12).



CONFIRMED HANDS  
IN FRAME K

# Conclusions

- There was a need for the hearing impaired to communicate.
- The ASL was created by the National Association of Deaf allowing the hearing impaired to communicate.
- Electronic and software device were created to improve the communication between the hearing impaired and others.
- Two conceptual designs, Real – Time ASL app, and Real – Time ASL Watch were chosen out of the many.
- Conceptual design 1, Real – Time ASL app, was chosen as the top level design due to its real – time, multiple symbol recognition, large display, software adaptability, and accessibility features.

# Acknowledgment

- Mohamed Chouikha, Ph.D.
- Department of Electrical Engineering and Computer Science, Howard University