Gesture Recognition Device – iGest

Jayavel Dhamodharan, Balamurali Murugesan, Anil Prabhakar
Dept. of Electrical Engineering, IIT-Madras, Chennai.
http://create.iitm.ac.in, http://www.enability.in

Objective

- To design a wearable communication device for people with speech disorders like cerebral palsy, dysarthria, cluttering etc...
- To provide a highly consistent device for people with severe motor impairments.
- To assist the physiotherapist in monitoring occupational therapy.
  - Monitoring the treatment gives better understanding about the motor skills of subject.
  - An offline monitoring and procedure correction will be helpful in deciding the effectiveness of the procedure underwent.

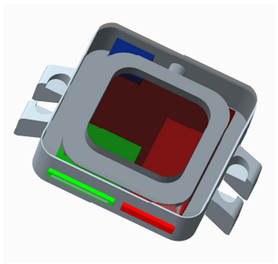
Gesture Recognition

- Tracking of physical movements of a human body.
- Tracking gestures with different algorithms enables multiple applications.
- It avoids direct contact over the system,

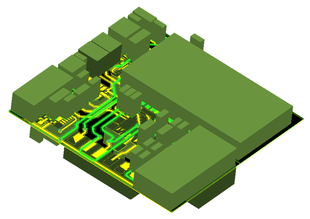
Methodology

- The device consists of inertial measurement unit which transmits the gesture data to a system.
- An android application that performs DCM algorithm to extract the yaw, pitch, roll information from the gesture data and synthesize predefined voice.
- A computer application that performs kalman filter algorithm to extract the three dimensional coordinates to track the hand position in space.

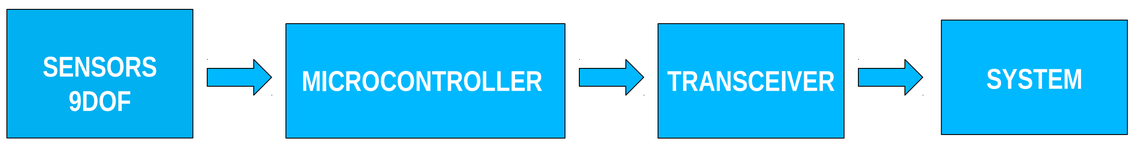
System development



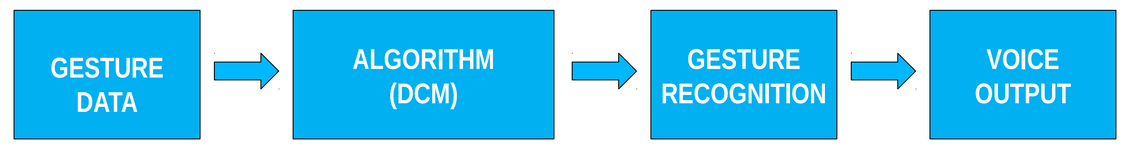
- Dimensions
  - Casing: 42 x 42 x 12 mm
  - PCB: 35 x 35 x 1.6 mm
- Bluetooth-V2.0
- microSD card
- Micro USB charger
- LiPo battery 3.7 V, 110 mAh

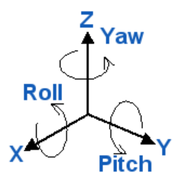


Hardware Design



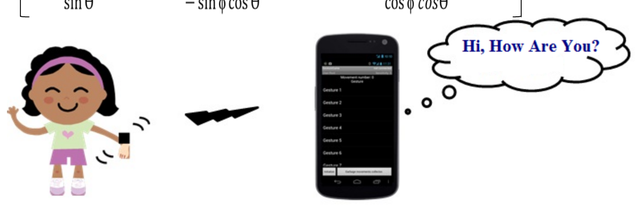
Voice synthesizer





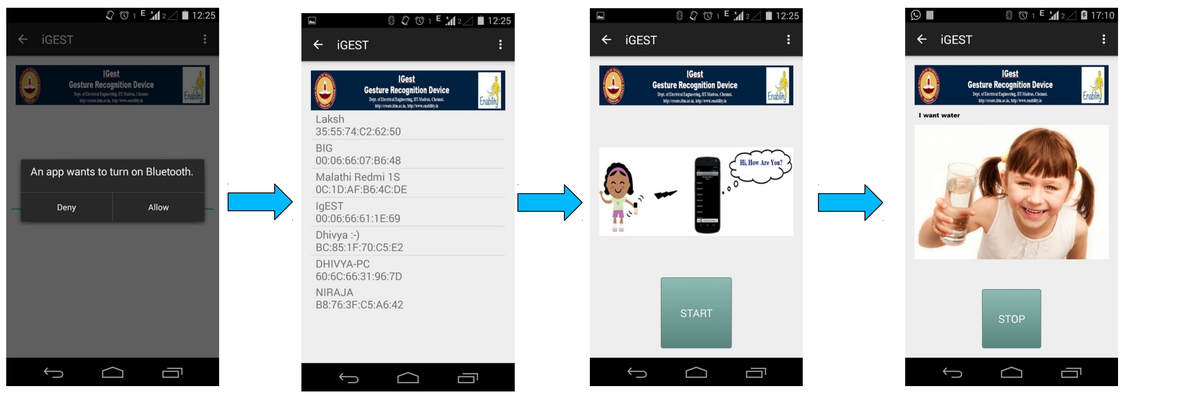
$$A = \begin{bmatrix} \cos\theta\cos\Psi & \cos\theta\sin\Psi + \sin\phi\sin\theta\cos\Psi & \sin\phi\sin\Psi - \cos\phi\sin\theta\cos\Psi \\ -\cos\theta\sin\Psi & \cos\theta\cos\Psi - \sin\phi\sin\theta\sin\Psi & \sin\phi\cos\Psi + \cos\phi\sin\theta\sin\Psi \\ \sin\theta & -\sin\phi\cos\theta & \cos\phi\cos\theta \end{bmatrix}$$

ϕ = arctan2(A31, A32)
Ψ = -arctan2(A13,A23)
Θ = arccos(A33)

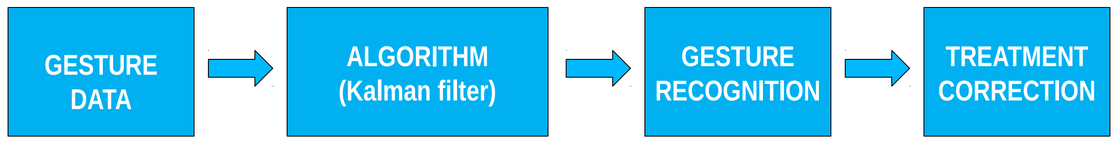


- **Reference**:
  - S. Qiao, A. Prabhakar, N. Chandrachoodan, N. Jacob, H. Vathsagam, " An inertial sensor-based system to develop motor capacity in children with cerebral palsy" International Conference of the IEEE EMBC, Japan, July 2013

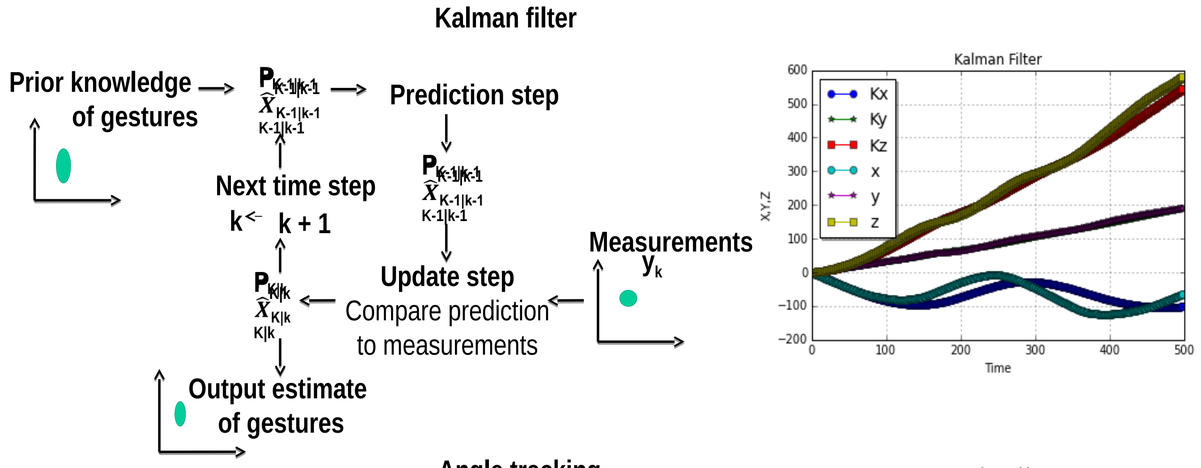
Android application



Occupational therapy monitor



Kalman filter

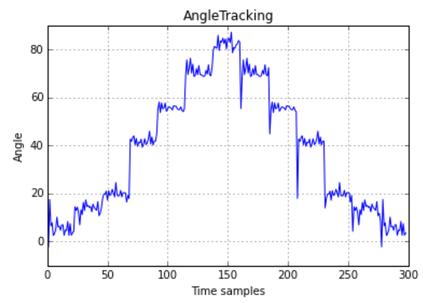


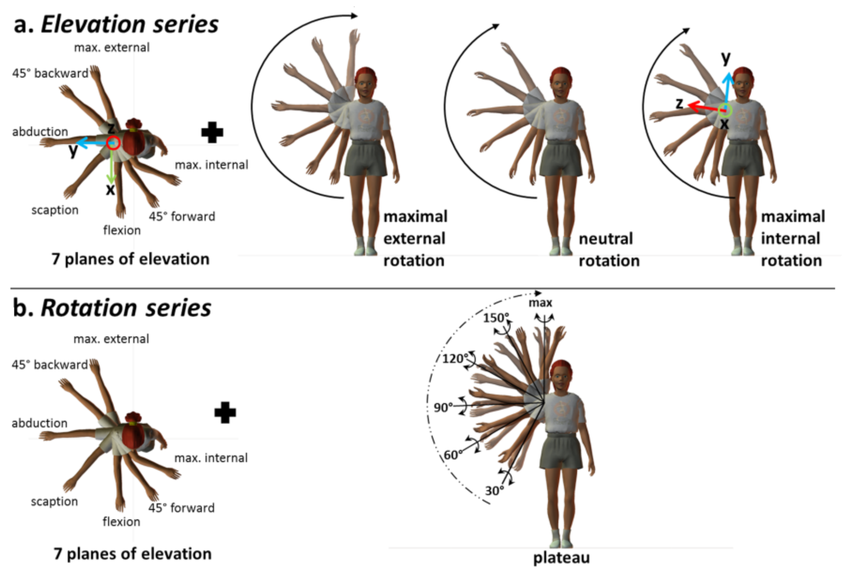
Angle tracking

$$X = \sin^{-1}\left(\frac{Gesture\ data}{Initial\ X\ mean}\right)$$

$$Z = \cos^{-1}\left(\frac{Gesture\ data}{Initial\ Z\ mean}\right)$$

$$\Theta = (X + Z) / 2$$





Summary & Conclusion

- A wearable AAC device is developed to convert the characteristic gestures to predefined voice output from a mobile phone.
- A wearable device is developed to monitor and record occupational therapy.
- The device provides a practical, user friendly, affordable and flexible solution, which is essential for people with special needs.

Acknowledgement

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