

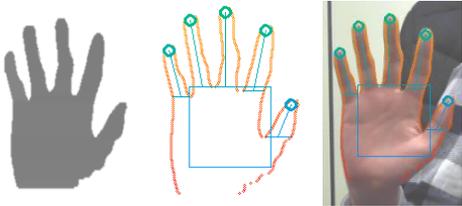
# Real-time hand gesture recognition

## Object based real-time hand detection

Object based hand detection algorithm detects hands using its geometric shape. This algorithm separates foreground object from background based on its depth. And it analyzes whether the shape of this foreground object is similar to that of a hand. This algorithm also provides real-time operation with low complexity calculation on an embedded board.

Specification (on Samsung Exynos 5422 @ 2.0GHz)

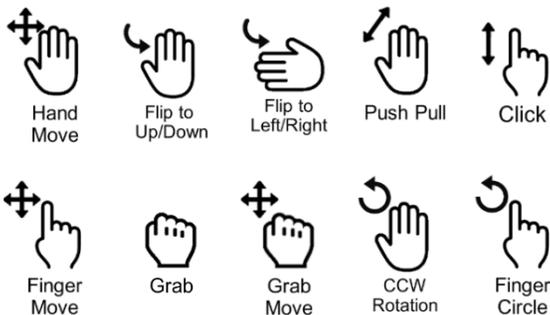
Initial hand detection accuracy	94.80 %
Hand tracking accuracy	95.70 %



## Experience advanced hand gesture interface

### Intuitive gestures for HMI interface

We implemented hand gesture recognition algorithm on an embedded board. The intuitive hand gestures below can be applied on many Human-machine Interaction(HMI) applications like smart TV, smart cars and VR/AR.



### Computer Architecture & Parallel Processing Lab Seoul National University

- Image processing with stereo & depth image
- Video compression algorithm optimization and H/W development
- Next-generation memory, deep-learning, car auto-pilot system

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### Display driver & Image processing Lab Sun Moon University

- Real-time hand detection and tracking algorithm
- Display driver circuit design
- Image enhancement for displays (LCD, OLED)
- Image compression for display

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### Digital System Design Lab Inha University

- Next generation virtual reality (VR) systems
- Algorithm and architecture for video coding
- Processing in memory (PIM) for video applications

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MORE INTERACTIVE

MORE IMMERSIVE

# Virtual Reality with Space Expansion

## Expand your world

Virtual Reality with Space Expansion (VR-SE) is the new concept, which overcomes the existing VR system that provides limited experience. The conventional VR system only allows rotational view changes, pitch, yaw, and roll. This 3DoF (Degree of Freedom) VR system cannot change a view point even though you try to move from side to side, up and down or backwards and forwards.

From now, time to move! see the different views! and feel real!

## How to Expand the world

### 360 degree ray space for videos

Our VR-SE is based on the concept of ray space. First, the ray spaces for four directions are constructed and the 360 degree ray space is then built by connecting four ray spaces. To do this, disparity map estimation, virtual view synthesis and image stitching techniques are used at every video frame for dense ray space. According to user's view position and direction, a bundle of pixels are selected from the 360 degree ray space.

### 360 camera systems & Test sets

We've used 24 Xiaomi Yi cameras to construct a 360-degree ray space. Each 6-camera-array of them captures each four directions. The videos from cameras are played in the ray space. You just pick any view and watch it!



## Experience whatever you want

VR is the technology for experience. With VR, you can enjoy the concert in your home and you can even experience universe, the North Pole, or seafloor, etc. With our VR-SE, however, you can float into the space and swim under the sea.

*"Have you ever imagined walking around the North Pole with a polar bear?"*

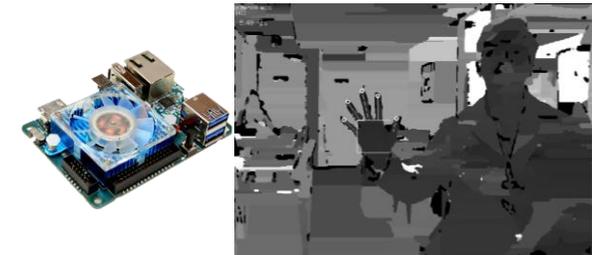
*"Everything you can imagine is real!"*  
- Pablo Picasso



## Real-time depth estimation with stereo matching

### Resembles the perception of human

Stereo matching makes depth map from two RGB images by mimicking binocular vision of a person. This real-time object based stereo matching algorithm calculates distance between the cameras and the object of interest with 94.72% accuracy.



### Embedded board real-time operation

We implemented real-time stereo matching and hand gesture recognition algorithms together on an embedded board. This implemented embedded system runs depth map extraction, hand detection and hand gesture recognition in real-time. This system can be applied on many applications like mobile and wearable devices.

Stereo matching		Hand gesture recognition	
Initial	Tracking	Initial	Tracking
8.08 fps	72.31 fps	72.49 fps	97.76 fps

(tested on Samsung Exynos 5422 @ 2.0GHz)

