VR System: Trackers

가상현실 시스템: TRACKERS

VR 3-2

TRACKING TECHNOLOGIES & PRODUCTS

트래킹 기술 & 제품

목 차

- Some Basic Concepts for VR
- Tracking Technologies & Products

Body Tracking

- Definition:
  - Body tracking makes the control of the environment natural, intuitive, and with "invisible" interfaces
  - We have had limited success in tracking various parts of the body such as head, hand, and eye
  - Two Major Tracking

Head Tracking: Allows for drawing the Virtual Environment(VE) from the point of view of the user

Hand Tracking (Position of the Hand): Generally done in conjunction with gesture recognition (i.e.: grab, point, etc.)

Body Tracking: Techniques for Tracking 트래킹 기술

위치, 각도

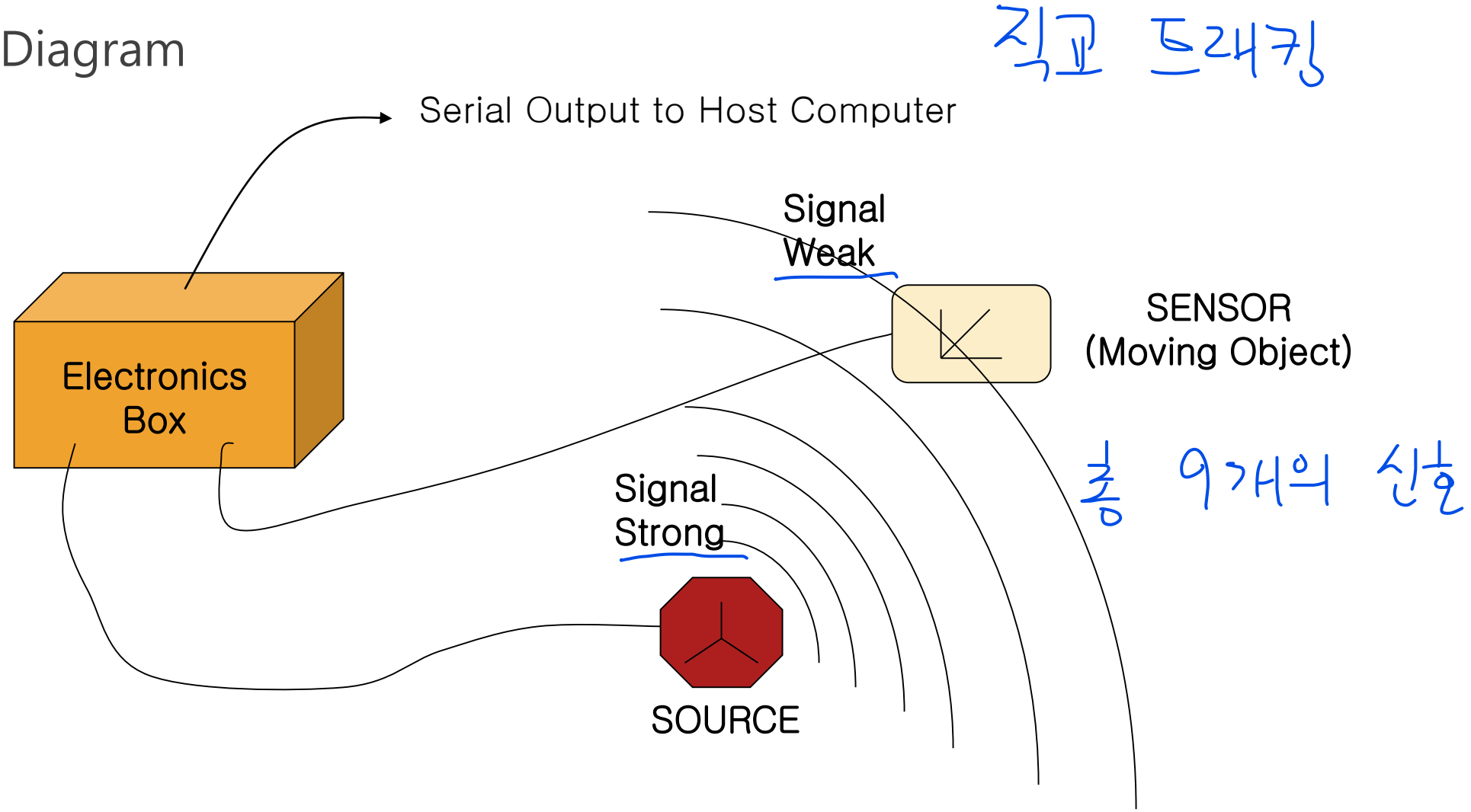
- Position & Orientation Tracking: Detect the position and orientation of a sensor in 3D space relative to a fixed source
  - There are 3 main technologies:
    - Orthogonal Electromagnetic Fields 직교하는 전자기장
    - Ultrasonic Signals 초음파
    - Video Signal 비디오

굽은각도

- Angle Measurement: Detect the angle of bend of various parts of a structure. This structure may a mechanical arm or human body parts such as fingers

Body Tracking: Electromagnetic Tracking

- Simple Diagram



직교 트래킹

총 9개의 신호

Body Tracking: Electromagnetic Tracking

- Principle
  - A transmitter (source) sends signal which are detected by a sensor (receiver) in such a way that relative position and orientation of the sensor can be determined
  - Three orthogonal source coils (transmitters) emit a radio frequency electromagnetic signal in sequence
  - Three sensor coils simultaneously measure the signal coming from each of the three source coils
  - These nine measurements provide position and orientation information

Body Tracking: Electromagnetic Tracking

- Most common technologies in tracking
  - Used by many vendors 가장의 방법은 많이 쓰이고 있다
  - Performance varies a great deal and correlates with the price
  - Common products, however, are inaccurate in both position and orientation tracking
  - Tracking time: 40-60 ms

Body Tracking: Electromagnetic Tracking

♦ Advantages and Disadvantages

장 • Advantages

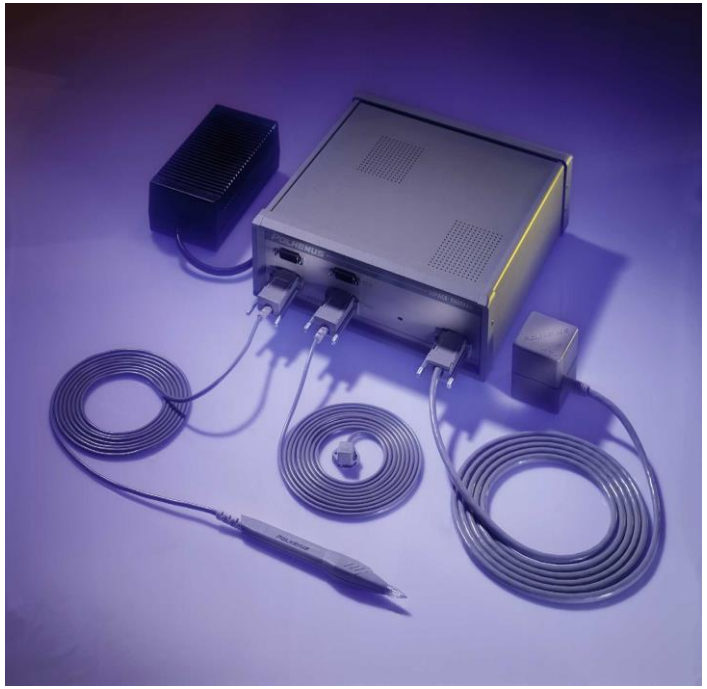
- Comparatively unencumbered tracking 비교적 성가시지 않은 트래킹
- Do not need a clear line of sight from the source to the sensor 방해에 강함
- Mature tracking which has been used in many other applications previously 성숙한 트래킹이라서 잘 쓰임

단 • Disadvantages

- Short usable ranges 짧은 거리
- Highly sensitive to electromagnetic radiation and metal in the environment 금속에 영향받음
- Relatively large errors in tracking 비교적 에러율 큼

Body Tracking: Electromagnetic Tracking

- Products for Electromagnetic Tracking
  - Liberty, FastTrack, and IsoTrack Systems by Polhemus



이미지 출처: polhemus.com

Body Tracking: Electromagnetic Tracking

- Example of Products: FastTrack System by Polhemus
  - Position Coverage: Provide the specified performance when the receivers are within 30 inches of the transmitter. Operation over a range upto 10 feet is possible with slightly reduced performance
  - Latency: 4ms
  - Update rate: 120 updates/s

이미지 출처: polhemus.com

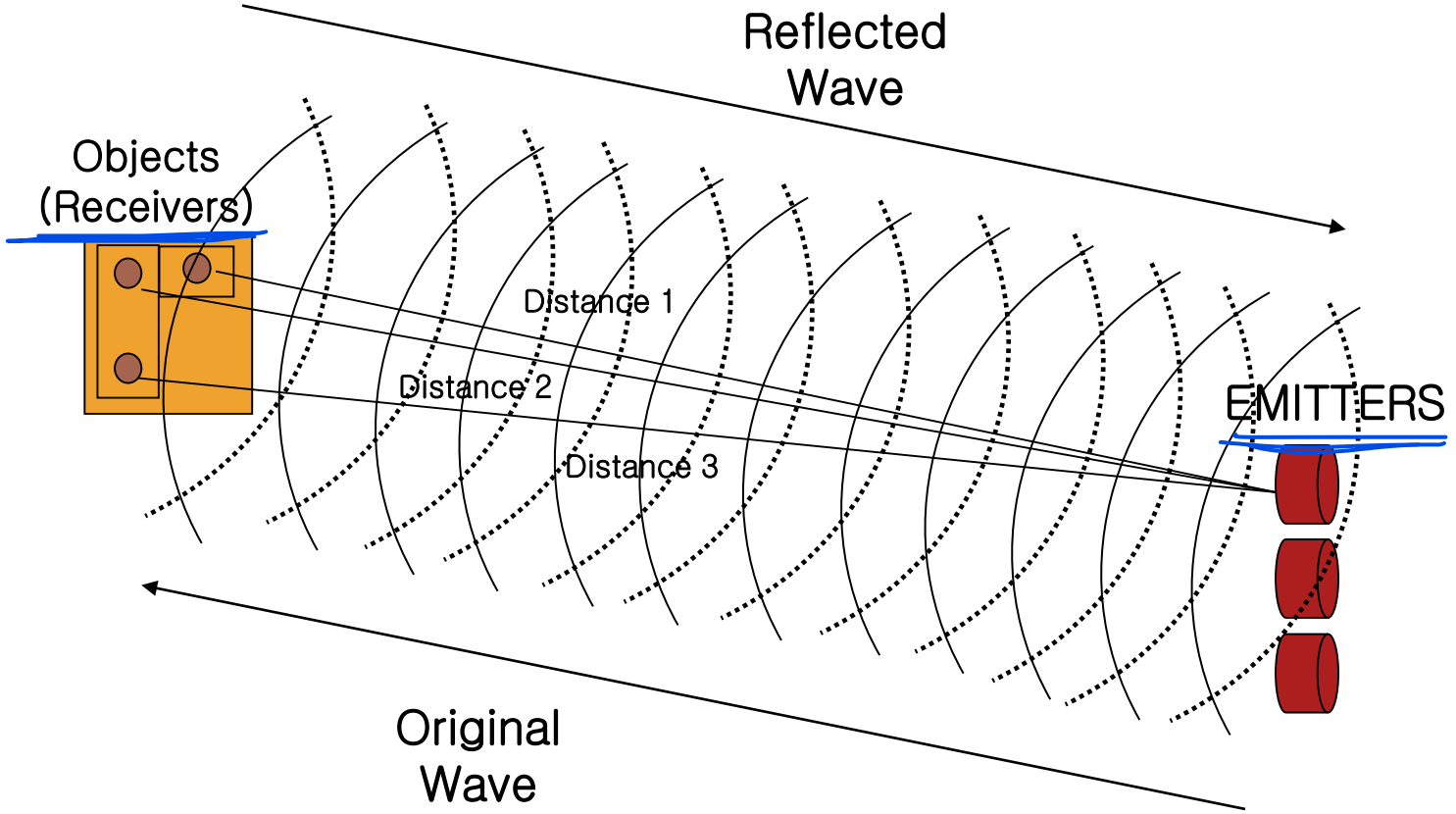
Body Tracking: Ultrasonic Tracking

초음파 트래킹

- Principle
  - This techniques is based on measuring the time of flight of sound signal
    초음파가 날아가는 시간을 측정
  - For position tracking, one emitter that emits an ultrasonic sound and three receivers that pick up the sound are used
    1개의 초음파 발산기와, 3개의 리시버
  - The time between emission and reception by each receiver gives emitter-receiver distance
    발산기와 리시버의 거리를 준다
  - 3 Receivers & 1 Emitter → Position is determined
    위치
    3 Receivers & 2 Emitters → Position and Rotation are determined
    위치, 방향
    3 Receivers & 3 Emitters → Full Position and Orientation are determined
    3 x 3 이 최고
    위치, 각도

Body Tracking: Ultrasonic Tracking

- Simple Diagram



Body Tracking: Ultrasonic Tracking

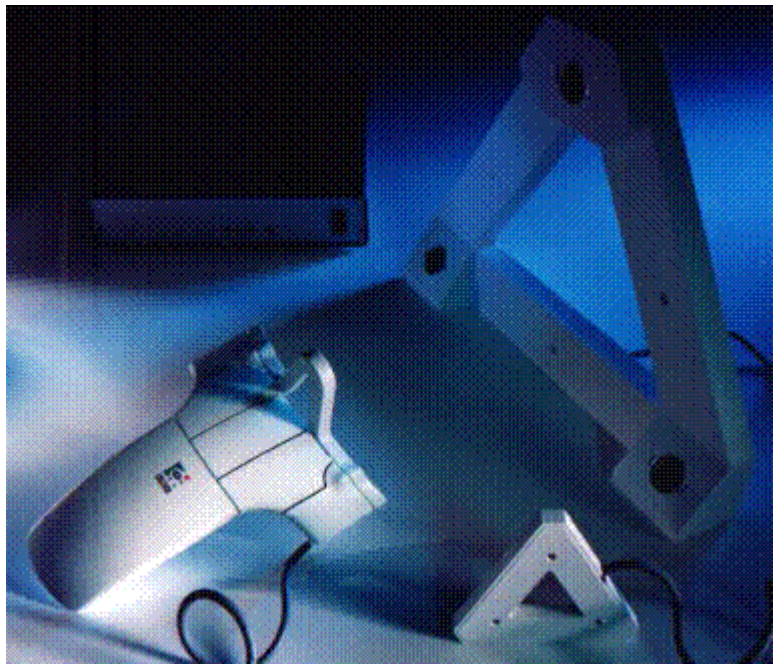
- Characteristics
  - Ultrasonic tracking is inherently noisy 초음파를 사용해서 noisy (기계 관점)
  - Thus, Heavy filtering is required 그래서 필터링 잘해야 함
  - The range is relatively short 상대적으로 비교적 짧다
  - Ultrasonic tracking is susceptible to echo in the environment 에코에 영향을 받을 수 있음

Body Tracking: Ultrasonic Tracking

- Advantages and Disadvantages
  - Advantages
    - Can be used as unencumbered tracking 덜 성가신 트래킹
    - Inexpensive hardware 싼 하드웨어
    - Relatively large range 조금 긴 사거리
  - Disadvantages
    - Need clear line of sight 방해에 약함
    - Software maybe costly 비싼 소프트웨어
    - Without LEDs, it maybe inaccurate LED 없으면 정확도 떨어짐

Body Tracking: Ultrasonic Tracking

- Products for Ultrasonic Tracking
  - Head Tracker by Logitec



Logitech Ultrasonic Trackers

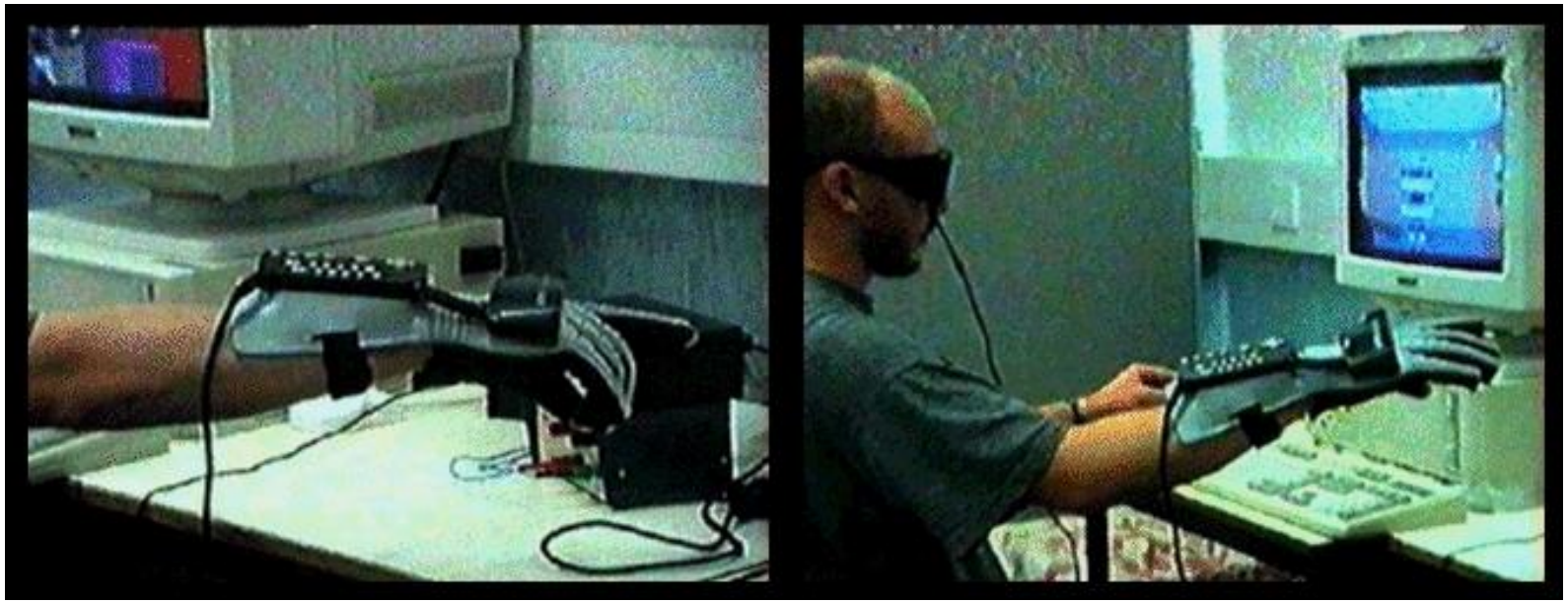
Logitech Ultrasonic 3D Mouse

이미지 출처: www.vrdepot.com/vrteclg.htm

이미지 출처: www.wikidata.org/wiki/Q30177091

Body Tracking: Ultrasonic Tracking

- Products for Ultrasonic Tracking
  - Mattel Power Glove



이미지 출처: www.angelfire.com/ok2/stepinto/PowerGlovePage.html

Body Tracking: Ultrasonic Tracking

- Products for Ultrasonic Tracking
  - Lyrobotix, Mobile VR headsets Using a combination of ultrasonic and Lighthouse-like tracking

이미지 출처: www.roadtovr.com/lyrobotix-merges-ultrasonic-and-lighthouse-like-tech-for-portable-positional-vr-tracking/

Body Tracking: Tracking by Video Signal

비디오 트래킹

- Principle
  - This is based on image processing on video frames to determine the position of various body parts 관절을 찍어서 처리
  - This technique has been successfully applied to multi-dimensional environments 여러사람도 가능
  - To simplify recognition, Light Emitting Diodes (LED) may mounted on the body parts and monitored by multiple cameras (for 3D positions)
  - Infrared LEDs may be used for fast processing

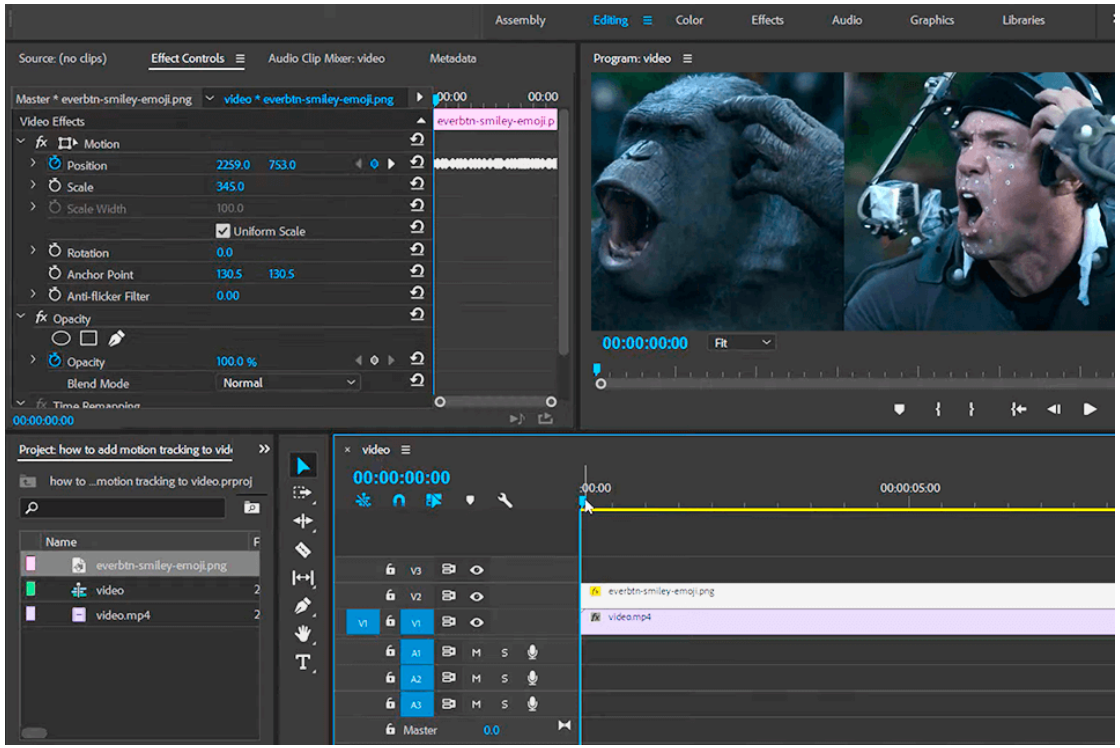
LED를 사용하여 여러 카메라로 측적,
적외선을 사용하면 더 빠름

Body Tracking: Tracking by Video Signal

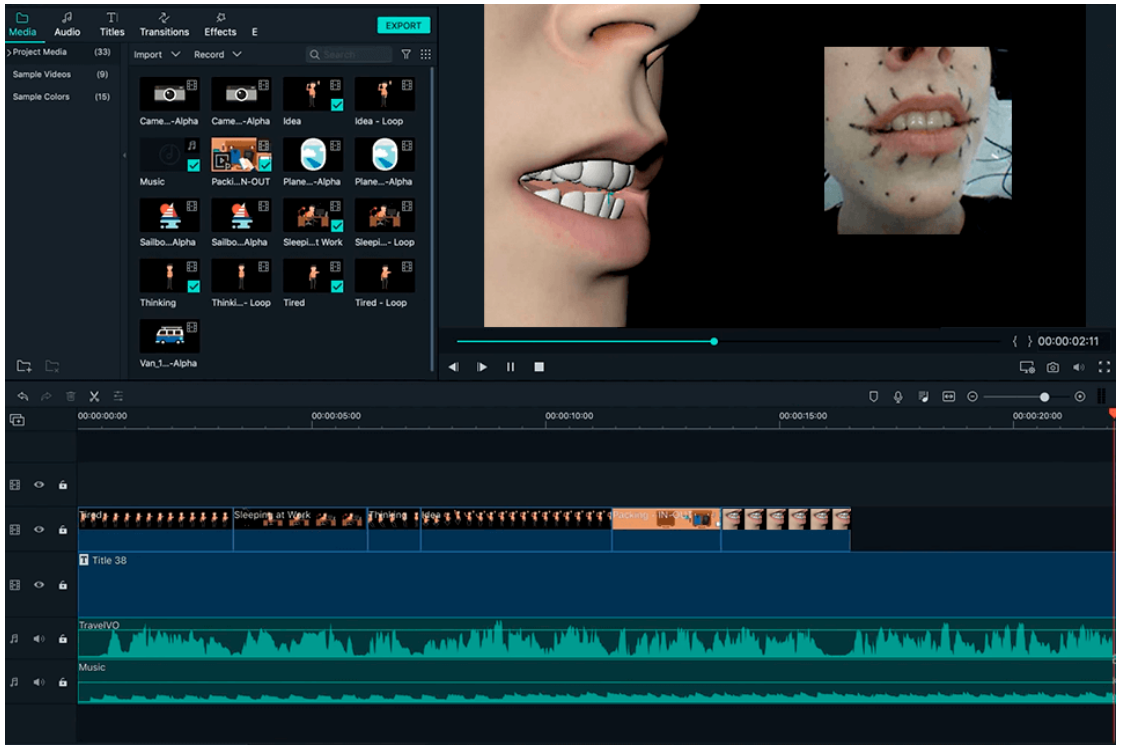
이미지 출처: 한성대학교 상상파크

이미지 출처: https://forum.thefreedictionary.com/poststt84379p7_Animated-GIF-Association.aspx

Body Tracking: Tracking by Video Signal



Software: Adobe Premiere Pro



Software: Filmora

이미지 출처: fixthephoto.com/best-motion-tracking-software.html

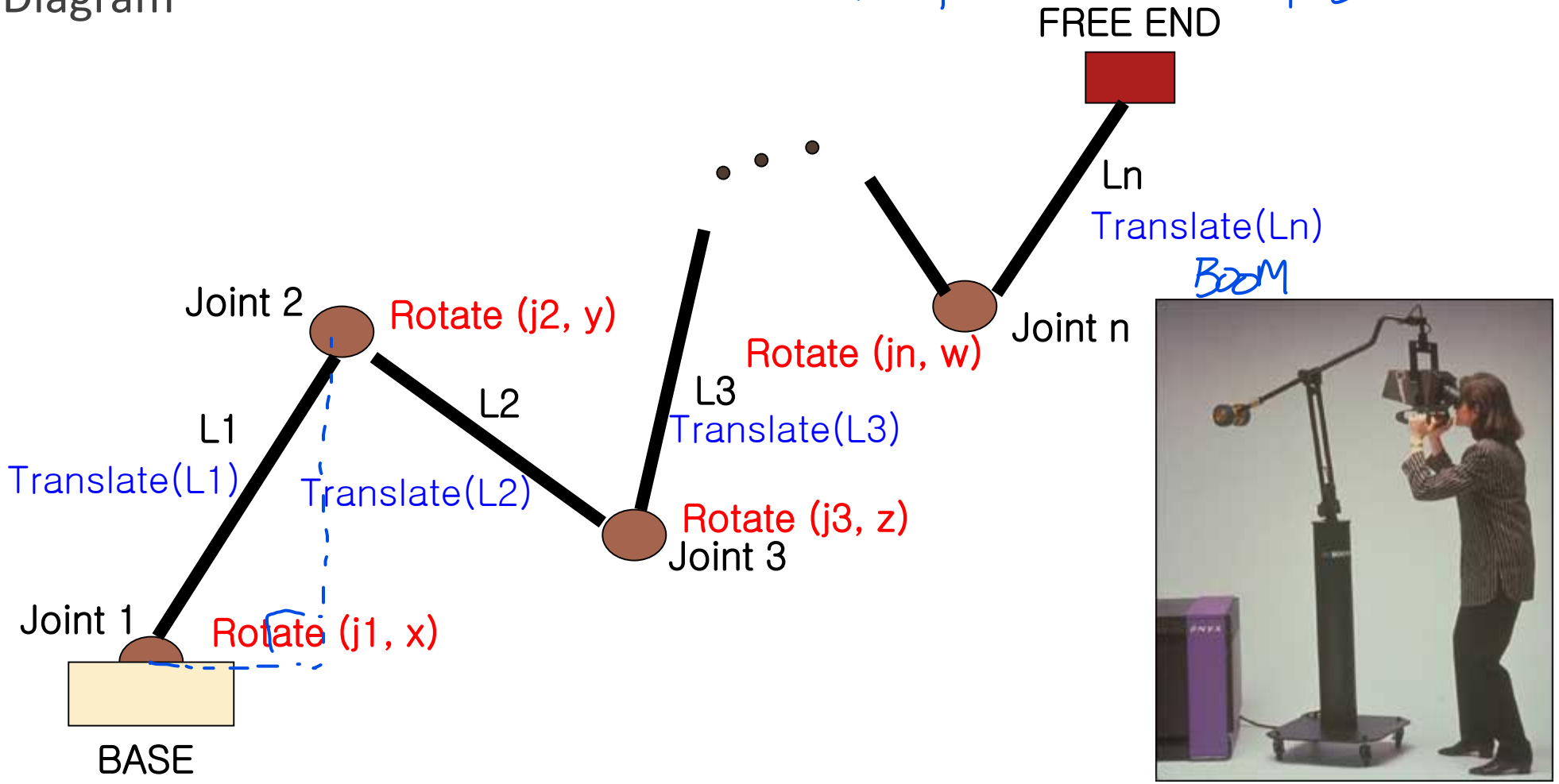
Body Tracking: Tracking by Video Signal

- Advantages and Disadvantages
  - Advantages
    - Can be used as unencumbered tracking 덜 성가신 트래킹
    - Inexpensive hardware 싼 하드웨어
    - Relatively large range 조금 긴 사거리
  - Disadvantages
    - Need clear line of sight 방해에 약함
    - Software maybe costly 비싼 소프트웨어
    - Without LEDs, it maybe inaccurate LED 없으면 정확도 떨어짐

Body Tracking: Tracking by Mechanical Linkage

- Simple Diagram

기계 연결 트래킹



이미지 출처https://www.evl.uic.edu/aej/428/week03.html

Body Tracking: Tracking by Mechanical Linkage

- Principle
  - We use a jointed structure that is fixed at one end (called BASE) for tracking
  - Within limits, the FREE END can move almost freely and arbitrarily
  - Sensors at joints detect the angle of the joint
  - By knowing the lengths of arms, a simple concatenation of translates and rotates can determine the position and the orientation of the FREE END relative to the base

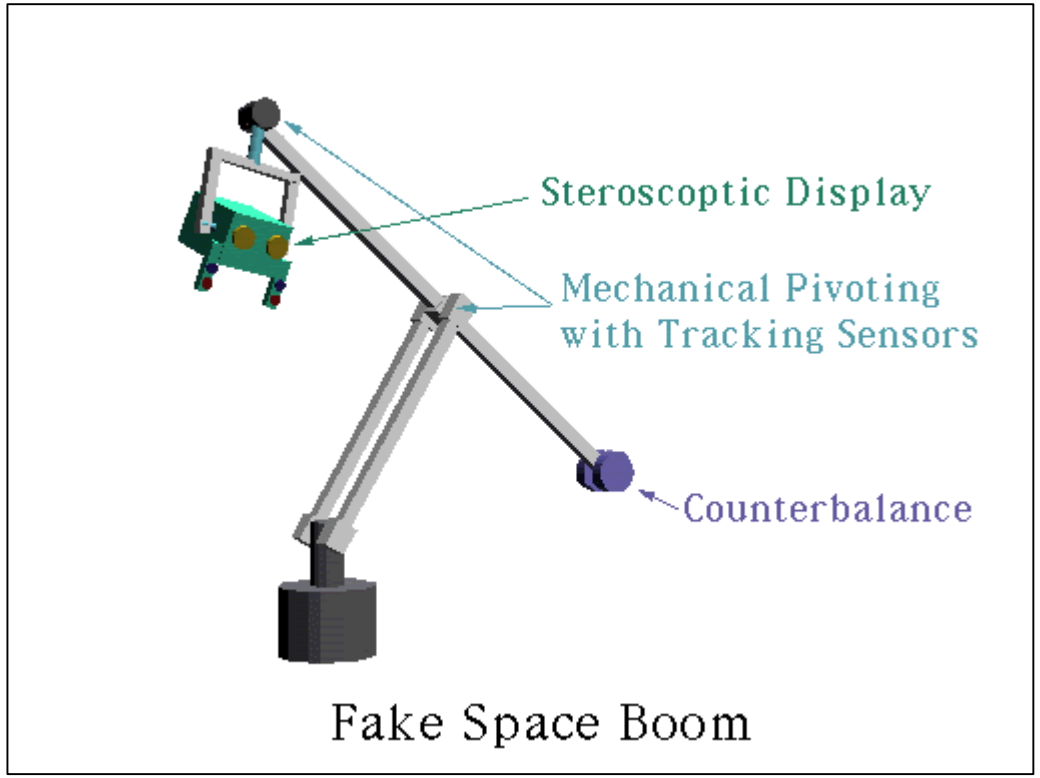
BASE 로부터 고정되어 있는 한 자유롭게 움직임

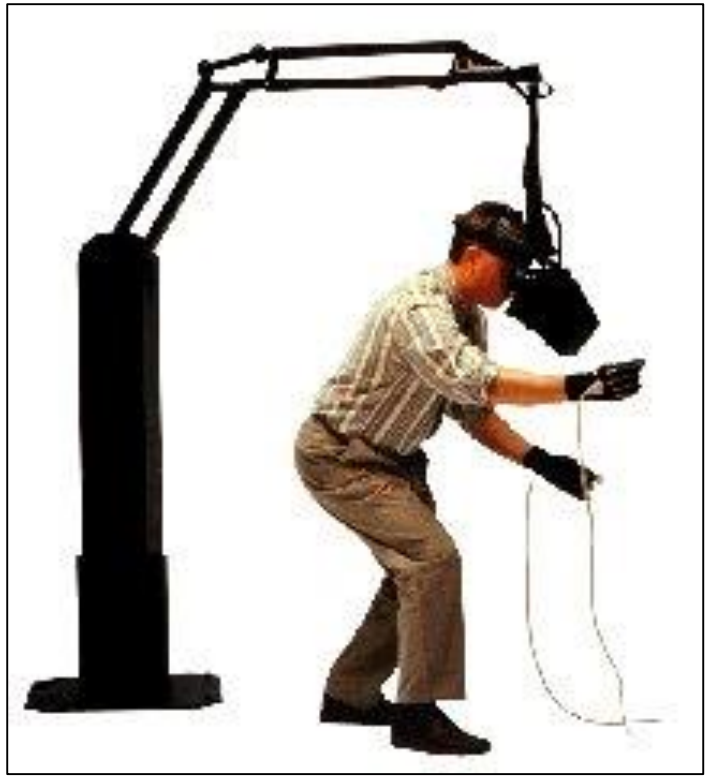
관절의 센서로 각도 감지

팔의 길이와 각도를 알면, BASE 의 상대적 위치를 알 수 있다

Body Tracking: Tracking by Mechanical Linkage

- Products for Mechanical Linkage Tracking
  - BOOM of Fake Space Labs





이미지 출처: www.hitl.washington.edu/projects/knowledge_base/virtual-worlds/EVE/I.A.1.Displays.html

이미지 출처: http://www.stereo3d.com/more.htm

Body Tracking: Tracking by Mechanical Linkage

- Advantages and Disadvantages
  - Advantages
    - High Speed 빠름
    - High Accuracy (The most accurate and most responsive of all existing products)
    - Eliminate the weight problem (Comfort) 정확함, 무게문제 해결함
    - Mature technology 성숙한 기술임
  - Disadvantages
    - Encumbered movements 성가심
    - Has obvious limits 명백한 한계 있음 (움직임 제한)
    - High costs (At least in the case of Fake Space) 비쌈

Questions?