Sensors for Hand Gesture Recognition

1. Vision-based
   - RGB camera
   - RGB-D camera (ToF based on IR)

2. Wearable
   - Gloves and sensors mounted to the hand
   - Electromyography (EMG) sensors
   - Suit

3. Non-Wearable
   - WiFi
   - UltraSonic
   - Radar
   - Theremin

1. Vision-based

- RGB camera
  - stereo:
    - StereoLabs ZED Camera (2 RGB cameras)
  - with structured light:
    - Kinect v1 (RGB camera, IR camera)
  - stereo with structured light:
    - Intel RealSense Stereo Depth Camera (RGB camera, 2 IR cameras)
    - two cameras Logitech C270, projector Hitachi CP-X308
      Generation of 3D models through structured light,
      Manteca F., 2018 [1]
      https://repositorio.unican.es/xmlui/handle/10902/15136
  - based on shadow attributes:
    Human Sensing Using Visible Light Communication.
    Tianxing Li, Chuankai An, Zhao Tian, Andrew T. Campbell, Xia Zhou, 2015 [2]
    https://doi.org/10.1145/2789168.2790110
  - with glove marker

- RGB-D camera (ToF based on IR)
  - Kinect v2 (RGB camera, IR camera, 3-axis accelerometer)
  - Azure Kinect (RGB camera, IR camera, IMU)
  - Leap Motion (2 IR cameras)
  - Intel RealSense LiDAR Camera L515 (LiDAR, RGB camera, IMU)

2. Wearable

- Gloves and sensors mounted to the hand

  - CyberGlove:
    - 18 or 22 flex sensors, camera marker

  - WaveGlove:
    - five inertial sensors

    WaveGlove: Transformer-based hand gesture recognition using multiple inertial sensors,
    Králik, M., Suppa. M., 2021 [3]
    https://arxiv.org/abs/2105.01753ArXiv

  - gloves with five flex-sensor and two pressure sensors:

    IoT Based Sign Language Interpretation System,
    Golda Jeyasheeli P and Annapoorani K Miss, 2019 [4]
    https://doi.org/10.1088/1742-6596/1362/1/012034

  - six magnetic active nodes:

    MagIK: A Hand-Tracking Magnetic Positioning System Based on a Kinematic Model of the Hand,
    F. Santoni, A. De Angelis, A. Moschitta and P. Carbone, 2021 [5]
    https://ieeexplore.ieee.org/document/9376979

  - yarn based stretchable sensor arrays (YSSA):

    Sign-to-speech translation using machine-learning-assisted stretchable sensor arrays,
    Zhou, Z., Chen, K., Li, X. et al. , 2020 [6]
    https://doi.org/10.1038/s41928-020-0428-6

  - EGaIn-Silicone Soft Sensors:

    Hand Gesture Recognition Using EGaIn-Silicone Soft Sensors,
    Shin S, Yoon HU, Yoo B., 2021 [7]
    https://doi.org/10.3390/s21093204

- Electromyography (EMG) sensors

  - intramuscular
  - surface (SEMG)

- Suit
    - Xsens MVN Link

      IMU (3-axis accelerometers, gyroscopes and magnetometers), barometer

      I See Your Gesture: A VR-Based Study of Bidirectional Communication between Pedestrians and Automated Vehicles,
      Michael R. Epke, 2021 [8]
      https://doi.org/10.1155/2021/5573560

3. Non-Wearable

- WiFi
    - WiGAN:

      WiGAN: A WiFi Based Gesture Recognition System with GANs,
      Jiang, D.; Li, M.; Xu, C., 2020 [9]
      https://doi.org/10.3390/s20174757

    - WiGeR:

      WiGeR: WiFi-Based Gesture Recognition System,
      Al-qaness, M.A.A.; Li, F., 2016 [10]
      https://doi.org/10.3390/ijgi5060092

- UltraSonic
    - Ultrasonic Sensor HC-SR04 (attached to Arduino)

      Performing Basic Tasks on Computer using Hand Gestures & Ultrasonic Sensors,
      Gopi Manoj Vuyyuru, Malvika Ramesh Shirke, 2021 [11]
      https://www.ijert.org/research/performing-basic-tasks-on-computer-using-hand-gestures-ultrasonic-sensors-IJERTV10IS050279.pdf

    - Murata Electronics MA40S4S, MA40S4R

      Hand Gesture Detection and Recognition Using Spectrogram and Image Processing Technique with a Single Pair of Ultrasonic Transducers,
      Feng, G.-H.; Lai, G.-R., 2021 [12]
      https://doi.org/10.3390/app11125407

- Radar
  - Pulsed:
    - ultra-wideband (UWB)

      UWB-gestures, a public dataset of dynamic hand gestures acquired using impulse radar sensors,
      Ahmed, S., Wang, D., Park, J. et al., 2021 [13]
      https://doi.org/10.1038/s41597-021-00876-0

  - Continuous
    - K-MC1 (CW radar)

      A Frame Detection Method for Real-Time Hand Gesture Recognition Systems Using CW-Radar,
      Yu, M.; Kim, N.; Jung, Y.; Lee, S., 2020 [14]
      https://doi.org/10.3390/s20082321

    - Google Soli (FMCW radar, DSSS radar)

    - DopNet
      - database for RADAR gesture recognition
      - data measured with FMCW and CW Radars (Ancortek)
      - http://dop-net.com/

- Theremin
  - Analyzing Theremin Sounds for Touch-Free Gesture Recognition,
    Svilen Dimitrov, 2010

  - Using a Theremin for Micro-Gesture Recognition in an Automotive Environment,
    Svilen Dimitrov, Christoph Endres, 2010

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In Proceedings of the 21st Annual International Conference on Mobile Computing and Networking (MobiCom '15). 2015. Association for Computing Machinery, New York, NY, USA, 331–344.
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IEEE Transactions on Instrumentation and Measurement, vol. 70, pp. 1-13, 2021, Art no. 9507313
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Journal of Advanced Transportation, vol. 2021, Article ID 5573560, 10 pages, 2021.
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