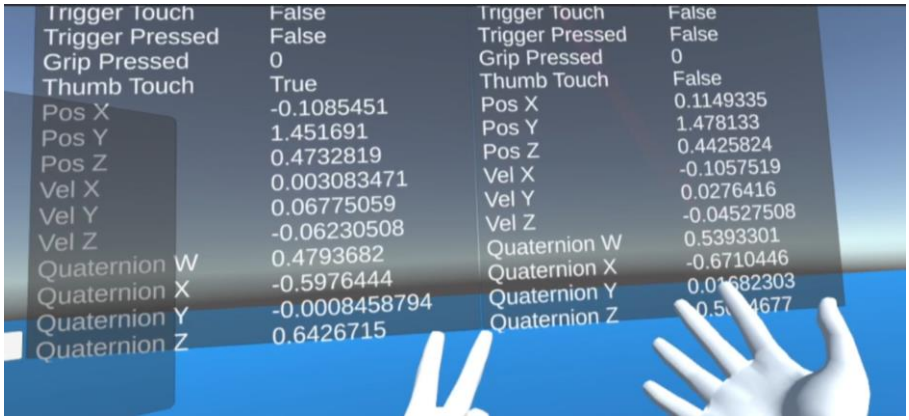
MOTION TRANSLATOR

Aplikasi ini dibangun dengan menggunakan Unity Editor, suatu aplikasi antarmuka pengguna yang terhubung dengan perangkat Virtual Reality Meta Quest 2, sebagai media perantara untuk merekam data gerakan isyarat tangan. Tampilan pada headset Meta Quest 2 ditunjukkan pada Gambar 1.

Gambar 1. Antarmuka Pengguna

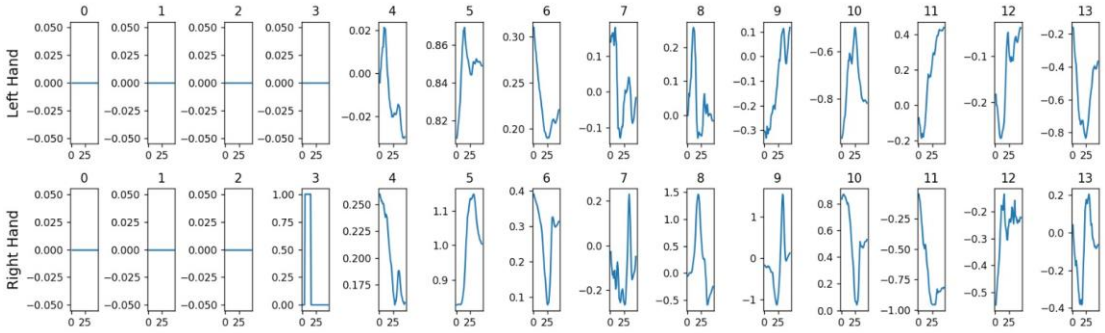
Sensor yang diterapkan teridiri dari 28 parameter masukan (tangan kiri dan kanan) yang berubah-ubah pada saat dilakukan gerakan isyarat tangan, seperti tampak pada Gambar 2.



Gambar 2. Parameter Isyarat Tangan

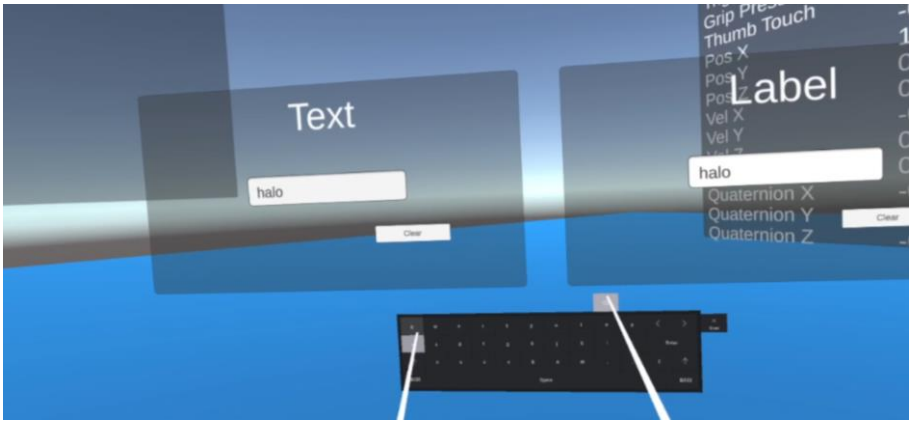
Hasil perekaman data yang berupa grafik seperti contoh pada Gambar 3. Setiap data terdiri dari 14 parameter dari tangan kiri dan 14 parameter lagi dari tangan kanan dengan parameter *Trigger Touch, Trigger Pressed, Grip Pressed, Thumb Touch, Position* (X, Y, Z), *Velocity* (X, Y, Z), *Quaternion* (W, X, Y, Z).

Dalam kode program ditambahkan formula sehingga dapat dipastikan bahwa data yang terkumpul bersifat relatif terhadap headset. Pemadanan ini bertujuan untuk mencegah gerakan tangan memengaruhi rotasi tubuh, dengan jelas mencerminkan arah wajah pengguna tanpa menyebabkan interferensi. Proses ini melibatkan modifikasi lokasi titik pusat dan rotasi global berdasarkan orientasi *headset*.



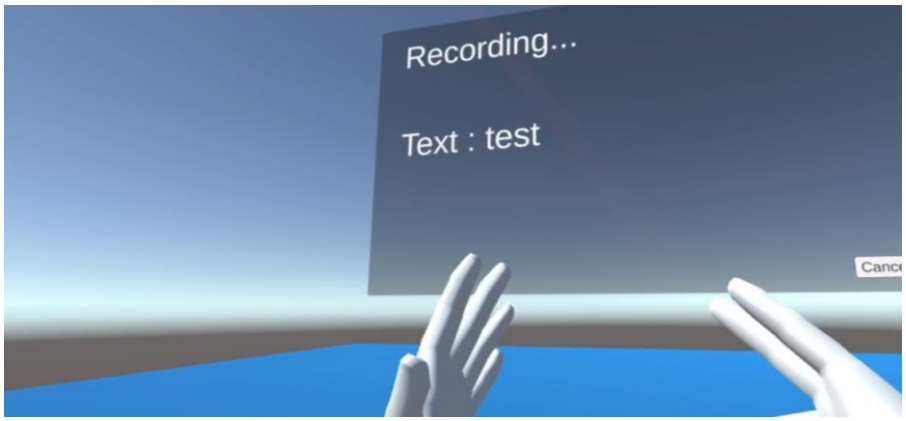
Gambar 3. Contoh Hasil Perekaman Data

Aplikasi dilengkapi fasilitas isian teks dan memberikan label pada data yang akan direkam, disajikan pada Gambar 4.



Gambar 4. Isian Teks untuk Label Data

Pada Gambar 5 tampak proses perekaman data dengan melakukan gerakan isyarat tertentu sesuai dengan keperluan.



Gambar 5. Proses Perekaman Data

Berikut ini adalah kode utama program.

```
using System;
using System.Collections;
using System.Net.Http;
using System.Collections.Generic;
using UnityEngine;
```

```
using UnityEngine.XR;
using TMPro;
using Newtonsoft.Json;
using UnityEngine.UI;
using Newtonsoft.Json.Linq;

namespace MotionTranslator {

    [RequireComponent(typeof(VRInput))]
    public class RecordingStatus : MonoBehaviour
    {

        public TMP_InputField textField;
        public TMP_InputField labelField;
        public TextMeshProUGUI content;
        public TextMeshProUGUI countClassText;
        public TextMeshProUGUI recordingText;
        public TextMeshProUGUI statusText;
        public TextMeshProUGUI dataCountText;
        public Button cancelButton;
        public Button sendToNetworkButton;
        public Button popLastElementButton;

        private List<List<float>> _tempLeftControllerRecordData;
        private List<List<float>> _tempRightControllerRecordData;
        private VRInput _controller;
        private bool _recording;
        private bool _prevButtonState;
        private bool _cancelling;

        private List<object> _dataToSendThroughNetwork;

        private String _previousClassValue = "";
        private String _currentClassValue = "";
        private int _countClassValue = 0;



        // Start is called before the first frame update
        void Start()
        {
            _recording = false;
            _cancelling = false;
            _prevButtonState = false;
            _tempLeftControllerRecordData = new List<List<float>>();
            _tempRightControllerRecordData = new List<List<float>>();

            _dataToSendThroughNetwork = new List<object>();

            _controller = GetComponent<VRInput>();
```

```
            if (cancelButton == null)
            {
                cancelButton = GetComponent<Button>();
            }

            initializeListener();
        }

        // Update is called once per frame
        void Update()
        {
            if(_controller._rightController.isValid){
                CheckRecordingButton();
            }

            if(_recording){
                ShowRecordingMessage();
                RecordControllerData();
                ShowCancelButton();
            }else{
                if((_tempLeftControllerRecordData.Count > 0 &&
_tempRightControllerRecordData.Count > 0) && !_cancelling){
                    addRecordControllerDataToList();
                    _tempLeftControllerRecordData.Clear();
                    _tempRightControllerRecordData.Clear();
                    ShowClassCount();
                }

                if(_dataToSendThroughNetwork.Count > 0)
                {
                    ShowSendToNetworkButtonAndCountMessage();
                }
                else
                {
                    HideSendToNetworkButtonAndCountMessage();
                }
                ShowNotRecordingMessage();
                HideCancelButton();
            }
        }

        void initializeListener()
        {
            cancelButton.onClick.AddListener(HandleCancleButtonClick);
            sendToNetworkButton.onClick.AddListener(HandleSendThroughNetwork);
            popLastElementButton.onClick.AddListener(HandlePopLastElement);
        }

        void HandleCancleButtonClick()
        {
```

```
            _cancelling = true;
            _recording = false;
            _tempLeftControllerRecordData.Clear();
            _tempRightControllerRecordData.Clear();
            statusText.text = "Record Cancelled.";
            _cancelling = false;
        }

        void HandlePopLastElement()
        {
            if (_dataToSendThroughNetwork.Count > 0)
            {

_dataToSendThroughNetwork.RemoveAt(_dataToSendThroughNetwork.Count - 1);
// Remove the last element
            }
        }

        void ShowCancelButton()
        {
            cancelButton.gameObject.SetActive(true);
        }

        void HideCancelButton()
        {
            cancelButton.gameObject.SetActive(false);
        }

        void ShowSendToNetworkButtonAndCountMessage()
        {
            sendToNetworkButton.gameObject.SetActive(true);
            dataCountText.text = "Data Count : " +
_dataToSendThroughNetwork.Count.ToString();
        }

        void HideSendToNetworkButtonAndCountMessage()
        {
            sendToNetworkButton.gameObject.SetActive(false);
            dataCountText.text = "";
        }

        void CheckRecordingButton()
        {
            bool currentButtonState = _controller.rightController.getSecondaryButton();
            if (currentButtonState && !_prevButtonState){
                // Flip switch
                _recording = !_recording;
            }

            _prevButtonState = currentButtonState;
```

```
    }

    void ShowRecordingMessage()
    {
        recordingText.text = "Recording...";
        content.text = "Text : " + textField.text;
    }

    void ShowNotRecordingMessage()
    {
        recordingText.text = "Not Recording...";
        content.text = "Text : ";
    }

    void ShowClassCount()
    {
        _currentClassValue = labelField.text;
        if (_currentClassValue != _previousClassValue)
        {
            _previousClassValue = _currentClassValue;
            _countClassValue = 1;
        }
        else
        {
            _countClassValue++;
        }

        countClassText.text = _currentClassValue + " : " +
_countClassValue.ToString();
    }

    void RecordControllerData()
    {
        Controller vrHeadset = _controller.HMD;

        // Get the headset's position and rotation
        Vector3 headsetPosition = vrHeadset.getPosition();
        Quaternion headsetRotation = vrHeadset.getRotation();
        Vector3 headsetVelocity = vrHeadset.getVelocity();

        // Get the positions, velocities, and rotations of the left and right controllers
        Vector3 leftPosition = _controller.leftController.getPosition();
        Vector3 leftVelocity = _controller.leftController.getVelocity();
        Quaternion leftQuaternion = _controller.leftController.getRotation();

        Vector3 rightPosition = _controller.rightController.getPosition();
        Vector3 rightVelocity = _controller.rightController.getVelocity();
        Quaternion rightQuaternion = _controller.rightController.getRotation();

        // Transform controller data relative to headset
```

```
        Vector3 transformedLeftPosition = headsetRotation * (leftPosition - headsetPosition);
        Vector3 transformedRightPosition = headsetRotation * (rightPosition - headsetPosition);

        Quaternion transformedLeftRotation = Quaternion.Inverse(headsetRotation) * leftQuaternion;
        Quaternion transformedRightRotation = Quaternion.Inverse(headsetRotation) * rightQuaternion;

        Vector3 transformedLeftVelocity = leftVelocity - headsetVelocity;
        Vector3 transformedRightVelocity = rightVelocity - headsetVelocity;

        _tempLeftControllerRecordData.Add(new List<float> {
            _controller.leftController.getTriggerTouch() ? 1.0f : 0.0f,
            _controller.leftController.getTriggerButton() ? 1.0f : 0.0f,
            _controller.leftController.getGrip(),
            _controller.leftController.getThumbTouch() ? 1.0f : 0.0f,
            transformedLeftPosition.x,
            transformedLeftPosition.y,
            transformedLeftPosition.z,
            transformedLeftVelocity.x,
            transformedLeftVelocity.y,
            transformedLeftVelocity.z,
            transformedLeftRotation.w,
            transformedLeftRotation.x,
            transformedLeftRotation.y,
            transformedLeftRotation.z
        });

        _tempRightControllerRecordData.Add(new List<float> {
            _controller.rightController.getTriggerTouch() ? 1.0f : 0.0f,
            _controller.rightController.getTriggerButton() ? 1.0f : 0.0f,
            _controller.rightController.getGrip(),
            _controller.rightController.getThumbTouch() ? 1.0f : 0.0f,
            transformedRightPosition.x,
            transformedRightPosition.y,
            transformedRightPosition.z,
            transformedRightVelocity.x,
            transformedRightVelocity.y,
            transformedRightVelocity.z,
            transformedRightRotation.w,
            transformedRightRotation.x,
            transformedRightRotation.y,
            transformedRightRotation.z
        });
    }

    void addRecordControllerDataToList()
    {
```

```
        List < List<float> > _leftControllerRecordData = new
List<List<float>>(_tempLeftControllerRecordData);
        List < List<float> > _rightControllerRecordData = new
List<List<float>>(_tempRightControllerRecordData);
        var jsonObject = new
        {
            table = "data_basic_asl",
            classValue = labelField.text,
            text = textField.text,
            data = new
            {
                _leftControllerRecordData,
                _rightControllerRecordData
            }
        };

        _dataToSendThroughNetwork.Add(jsonObject);
    }

    void HandleSendThroughNetwork()
    {
        statusText.text = "Sending Record Data Through Network...";

        var jsonSender = new JsonSender();

        string url = "http://127.0.0.1:5000/api/store";

        try{
            HttpResponseMessage response = jsonSender.SendJson(url,
_dataToSendThroughNetwork);

            if(response == null){
                statusText.text = "Failed to send JSON data";
                return;
            }

            if(response.IsSuccessStatusCode){
                statusText.text = "Record has been sent successfully!";
                _dataToSendThroughNetwork.Clear();
            }else{
                statusText.text = "Failed to send JSON data";
            }
        }catch(Exception ex){
            statusText.text = $"Error sending JSON data : {ex.Message}";
        }
    }
  }
}
```