mmWave 雷達
姿勢辨識

組員：游駿哲、羅文佑

Outline

01

Background and Motivation

02

Devices Used

03

Goals and Objectives

04

Tools and Workflow

05

Challenges and Insights

Background and Motivation

Advantages of Using Radar for Action Recognition

a. Unaffected by lighting conditions.

b. Preserves user privacy, unlike cameras that capture direct images of people.

c. Capable of penetrating certain materials, such as curtains or clothing.

Application Scenarios

a. Elderly care environments.

b. Indoor human tracking.

c. Posture monitoring (e.g., sitting posture detection).

Devices Used

01

AWR1642 BOOST-ODS

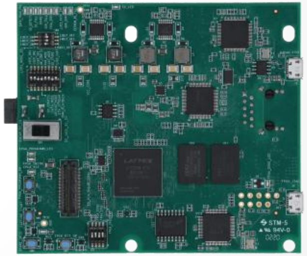
- Automotive mmWave radar system

AWR1642

02

DCA1000 (data capture)

- Captures raw ADC data (I/Q signals)
- Transfers data to PC via Ethernet



DCA1000

Goals and Objectives

Goal

- Use raw radar data to perform the full pipeline: from signal processing to model training.

Setup

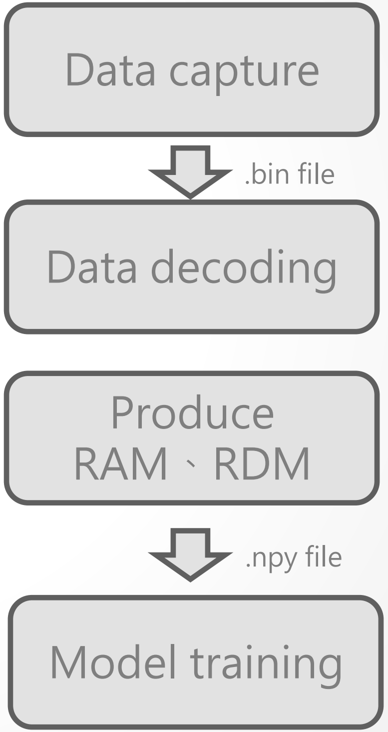
- 5 actions, 3 angles
  - **Actions**: standing, sitting, raising hands, hands on hips, using a smartphone.
  - **Angles**: –45°, 0°, +45°
- Single-person target
- Fixed environment

Tools and Workflow

01 mmWave Studio
→Raw data capture

02 MATLAB
→Data decoding and FFT processing

03 Python
→ CNN model training for classification



mmwave Studio

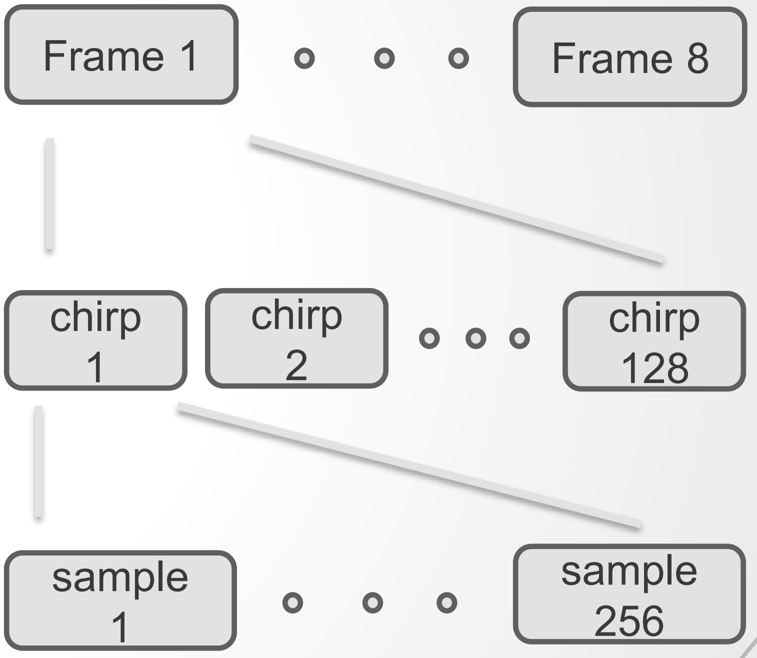
mmwave Studio

Radar Configuration and Data Capture

- Set radar parameters: chirp and frame configurations
- Use DCA1000 to capture raw data through hardware interface
- Save data as .bin files (binary I/Q format)

Lua Script Automation

- Lua scripts are used to automate radar parameter setup and trigger data capture



Structure of data

matlab

matlab

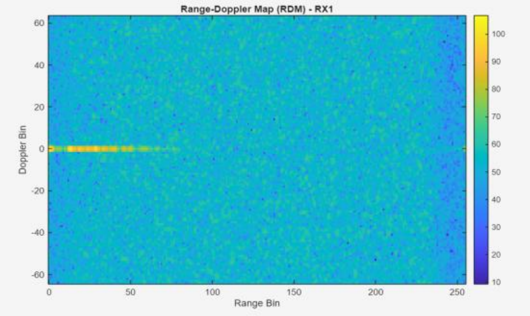
a. **Raw Data Reconstruction**
   - Parse .bin file into a 4D array: [Samples, Rx, Chirps, Frames].

b. **1D FFT (Range FFT)**
   - Perform FFT across ADC samples for each Rx and chirp.
   - Converts time-domain signal into range information.
   - Output: Range Profile (1D).

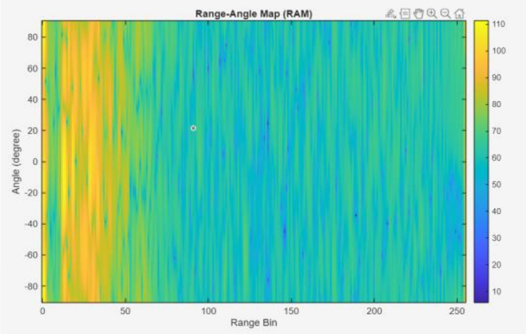
c. **2D FFT (Doppler FFT)**
   - Perform FFT across chirps (Doppler dimension)
   - Output: Range-Doppler Map (RDM).

d. **3D FFT (Angle FFT)**
   - Perform FFT across Rx channels (antenna array)
   - Output: Range-Angle Map (RAM).

e. **Data Storage**
   - Save processed results as .npy files for later use.



RDM



RAM

Python

Python

Input Data

- Use .npy files of Range-Angle Maps (RAM) and Range-Doppler Maps (RDM)
- Explore a dual-input architecture

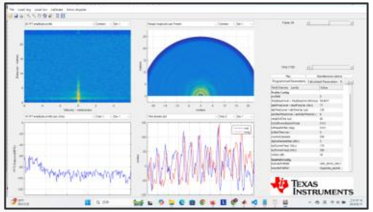
Model Architecture

- Built with TensorFlow using a Convolutional Neural Network (CNN)
- Structure:
  Conv → MaxPooling → Dense → Softmax

Classification Targets

- Action only
- or Action + Angle

Python



預測動作：hand_on_hips (index: 3)
預測角度：minus45 (index: 1)

	accuracy	loss
僅分類動作	≈ 0.8	≈ 0.3

Issue

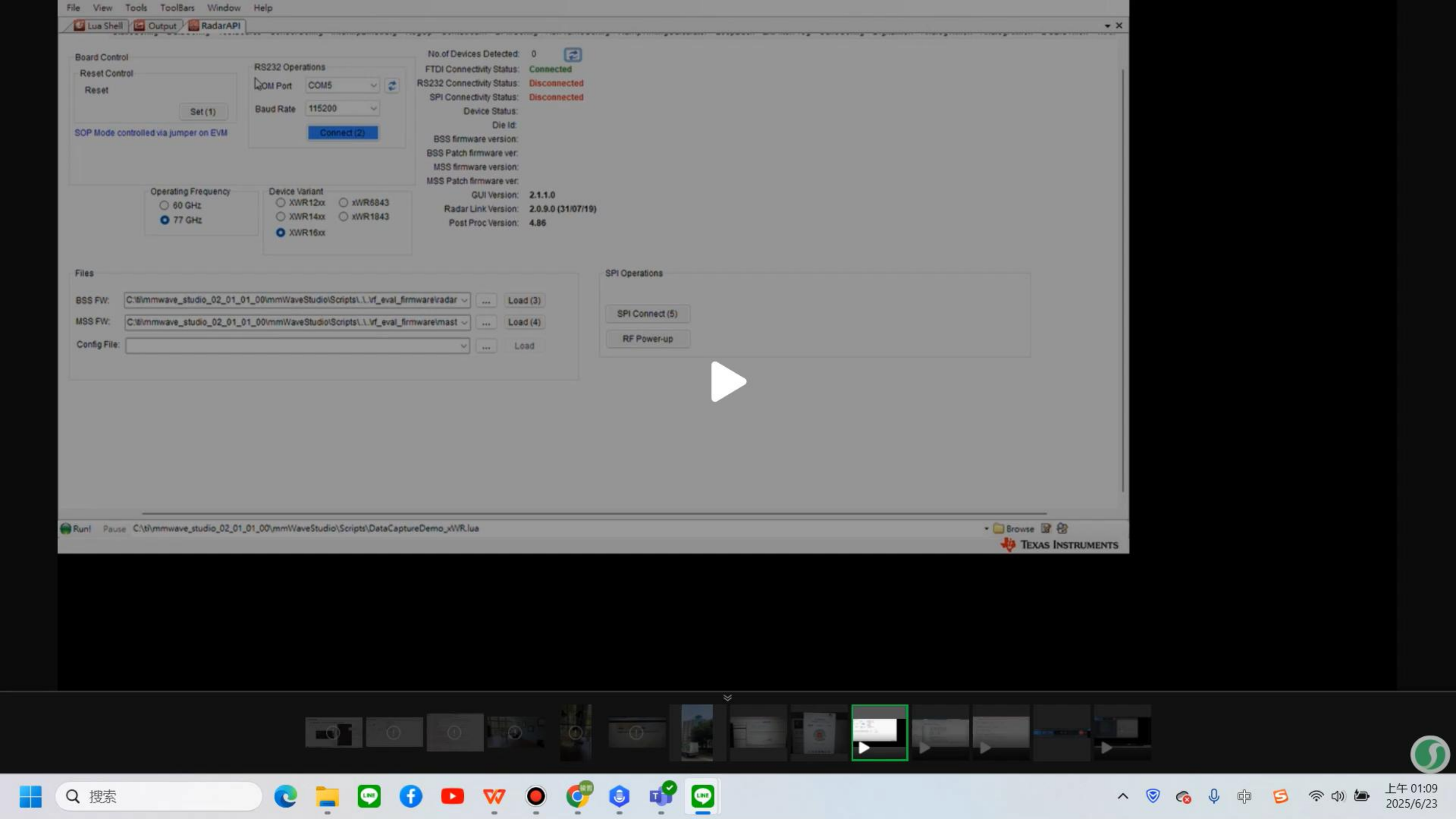
- The model struggles to recognize both action and angle simultaneously.

Possible Reasons

- Insufficient data volume.
- Too many classification categories.
- Data quality may be suboptimal.

Potential Improvements

- Increase dataset size.
- Adjust angle categorization strategy.
- Apply additional preprocessing (e.g., contrast enhancement).


File View Tools ToolBars Window Help
Lua Shell
Output
RadarAPI
Board Control
Reset Control
Reset
Set (1)
SOP Mode controlled via jumper on EVM
RS232 Operations
COM Port
COM5
Baud Rate
115200
Connect (2)
No.of Devices Detected: 0
FTDI Connectivity Status: Connected
RS232 Connectivity Status: Disconnected
SPI Connectivity Status: Disconnected
Device Status:
Die Id:
BSS firmware version:
BSS Patch firmware ver:
MSS firmware version:
MSS Patch firmware ver:
GUI Version: 2.1.1.0
Radar Link Version: 2.0.9.0 (31/07/19)
Post Proc Version: 4.86
Operating Frequency
60 GHz
77 GHz
Device Variant
XWR12xx
xWR6843
XWR14xx
xWR1843
XWR16xx
Files
BSS FW:
C:\ti\mmwave_studio_02_01_01_00\mmWaveStudio\Scripts\..\..\rf_eval_firmware\radar
Load (3)
MSS FW:
C:\ti\mmwave_studio_02_01_01_00\mmWaveStudio\Scripts\..\..\rf_eval_firmware\mast
Load (4)
Config File:
Load
SPI Operations
SPI Connect (5)
RF Power-up
Run!
Pause
C:\ti\mmwave_studio_02_01_01_00\mmWaveStudio\Scripts\DataCaptureDemo_xWR.lua
Browse
Texas Instruments
搜索
上午 01:09
2025/6/23

Challenges and Insights

Challenges

- Collecting radar data.
- Operating and configuring mmWave radar hardware.
- Processing raw ADC data into meaningful features.
- Understanding and implementing the machine learning pipeline.

Insights

- Gained experience with the end-to-end workflow from raw radar data to model training.
- Developed understanding of the characteristics and applications of mmWave radar data.

Thank you