In-Home Daily-Life Captioning Using Radio Signals

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* denotes equal contribution

How can I make sure grandma is fine?

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08:30am: *Grandma wakes up and leaves bedroom*

10:30am: *Grandma takes medicine and eats breakfast*

02:00pm: *Grandma is watching TV*

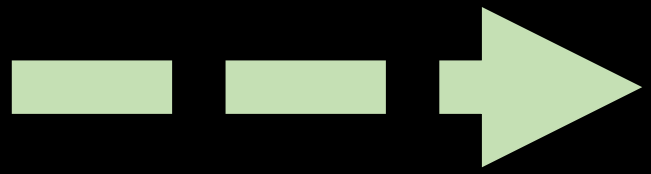
Camera is not acceptable

Camera

How to do Daily Life Captioning?

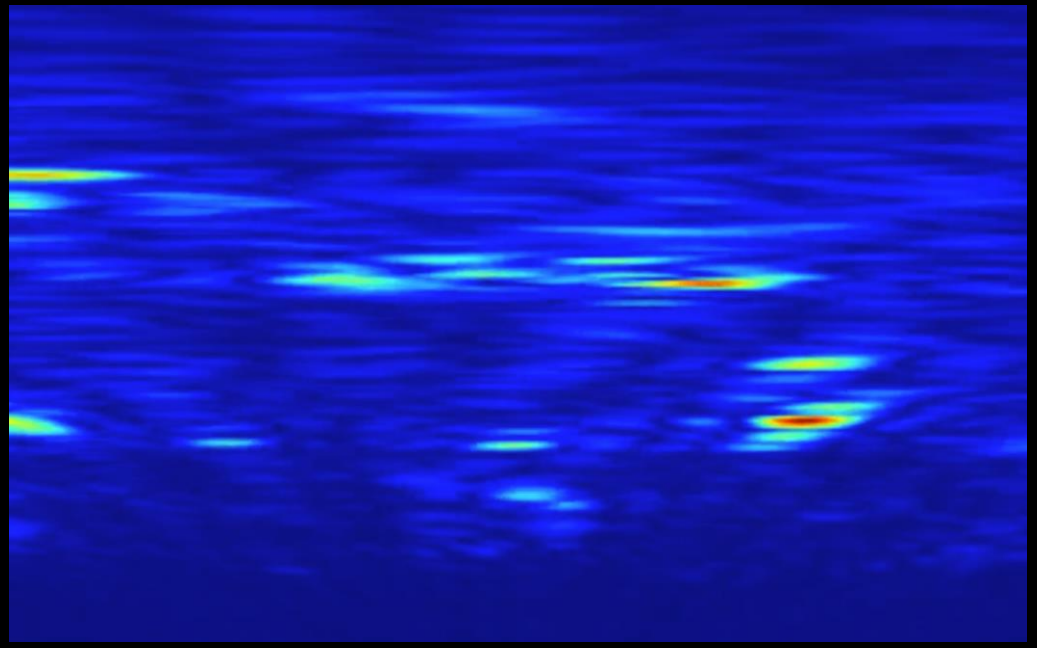
What about Radio-Frequency(RF) Signals?

RF Device



RF signals are privacy-preserving …

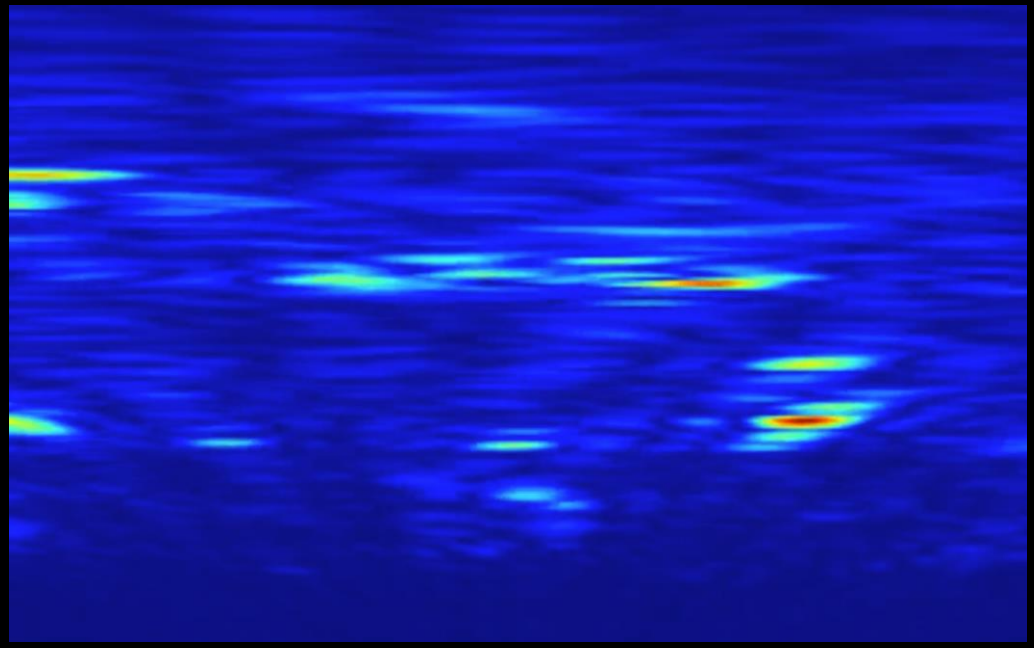
RGB Video



RF Signals

but are capable of capturing people's movements and activities

RGB Video



RF Signals

Challenge I. Object Information

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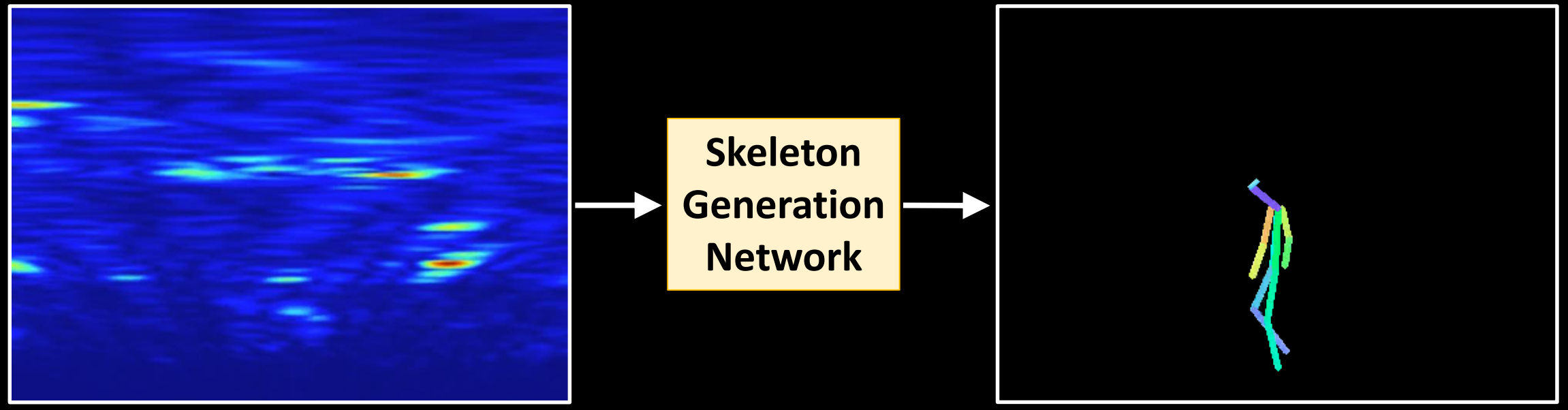
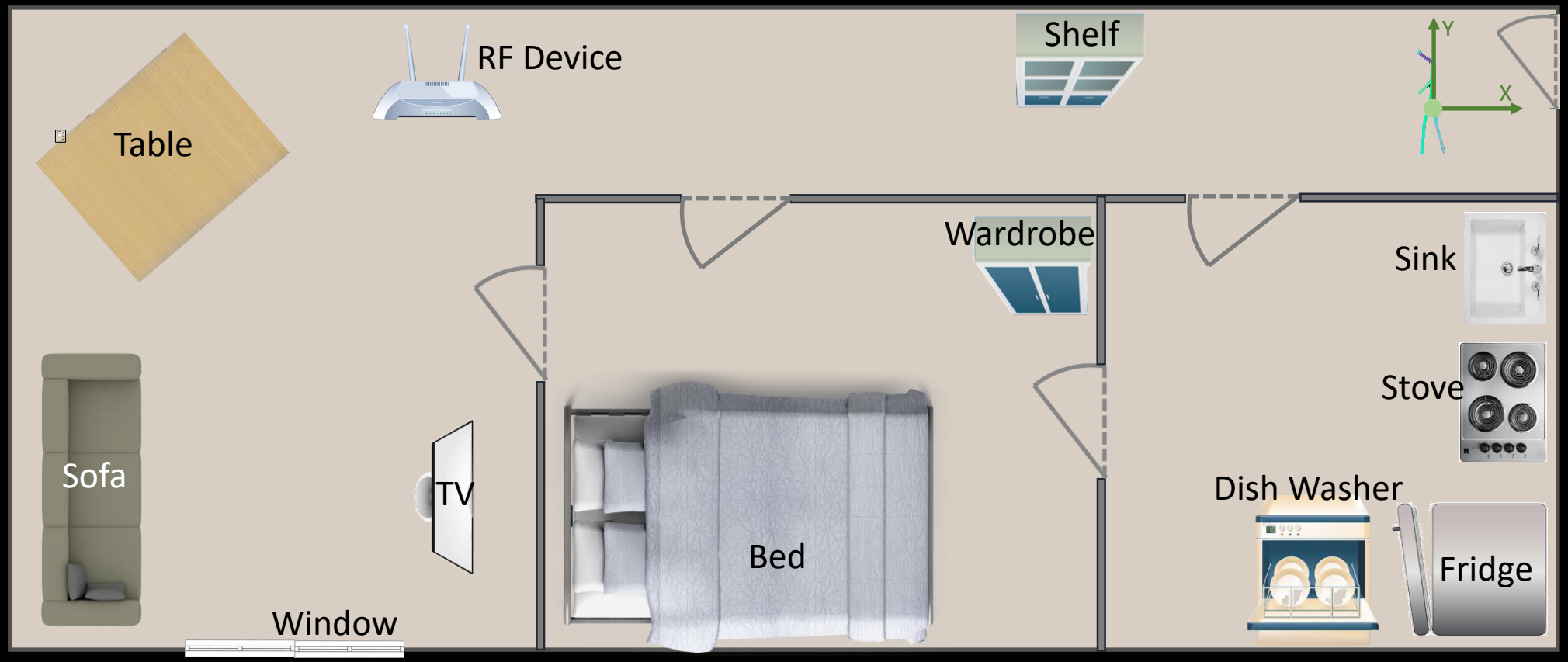
Solution I. Skeleton + Floormap



RF Signal

Skeleton

Solution I. Skeleton + Floormap

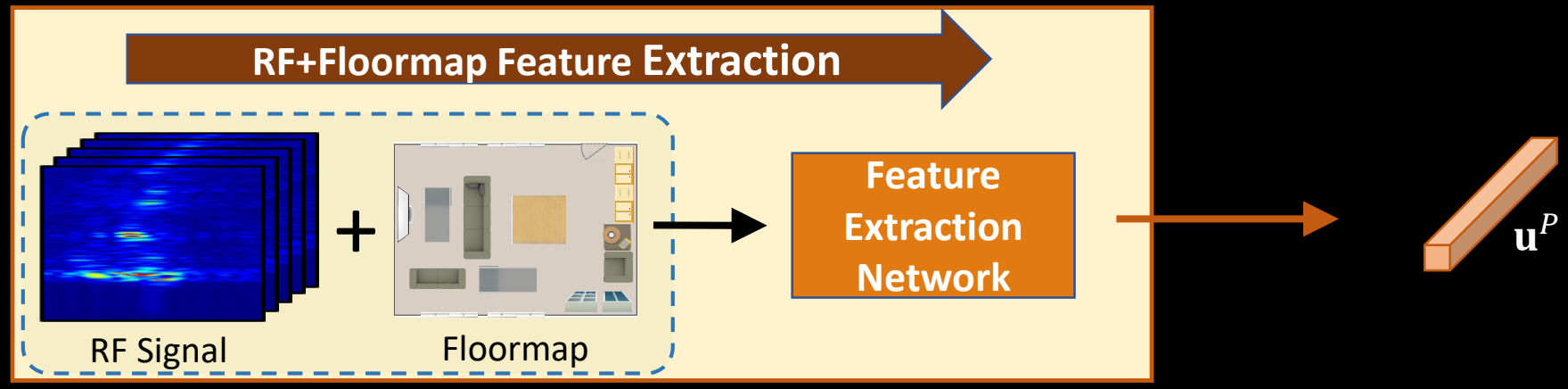


Floormap Illustration

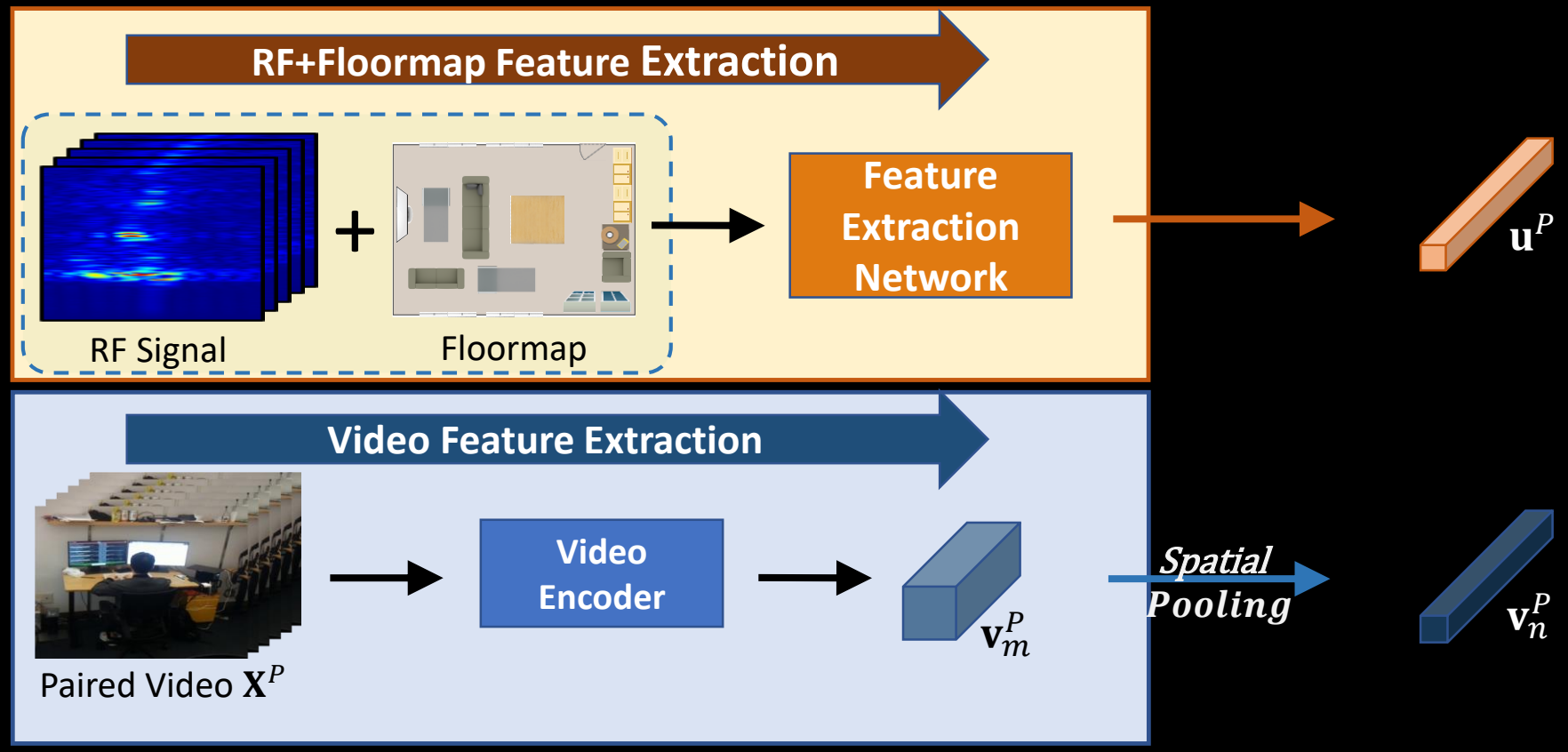
Challenge II. No Existing RF Captioning Dataset!

Can We Leverage Existing RGB Captioning Dataset?

Solution II. Multi-modal Feature Alignment



Solution II. Multi-modal Feature Alignment



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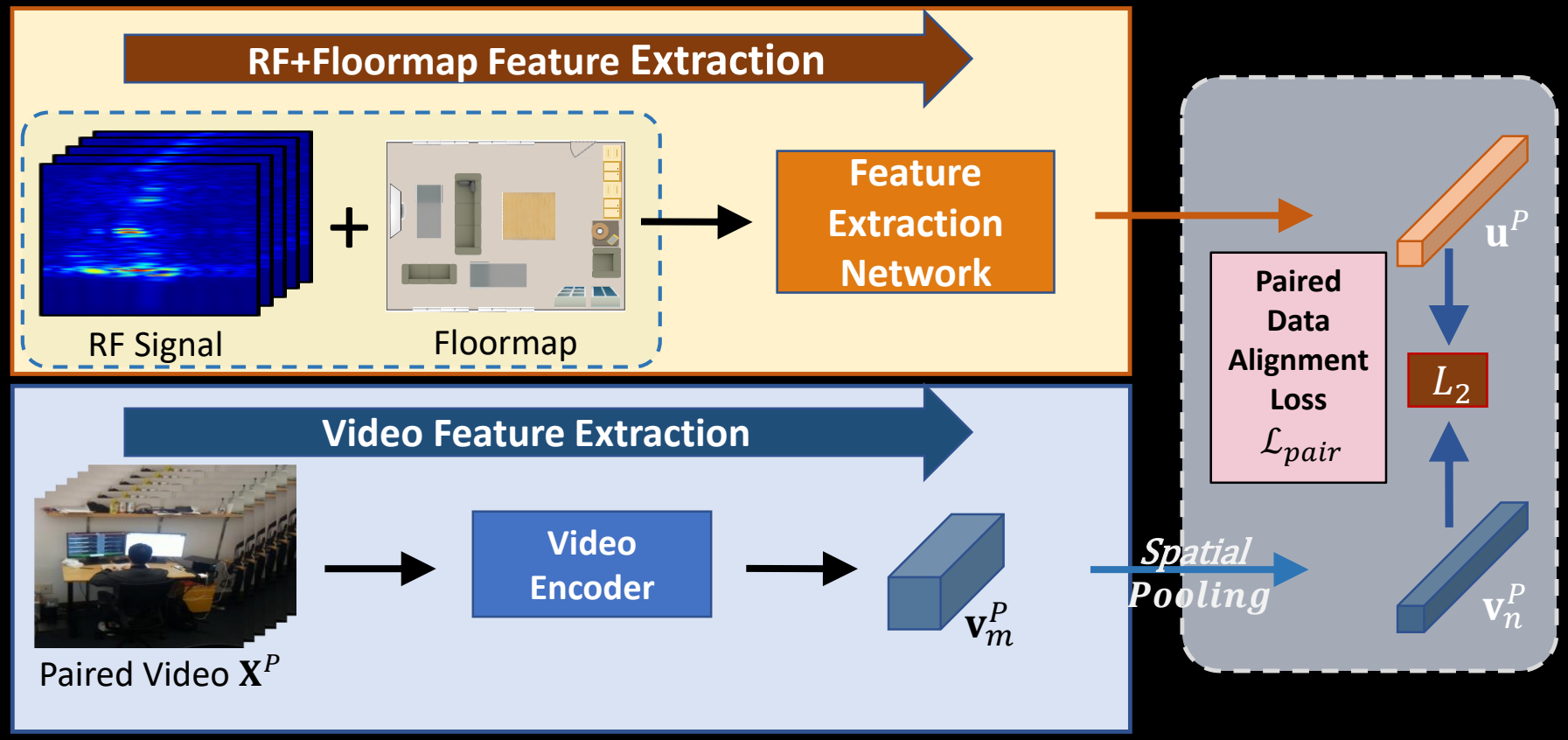

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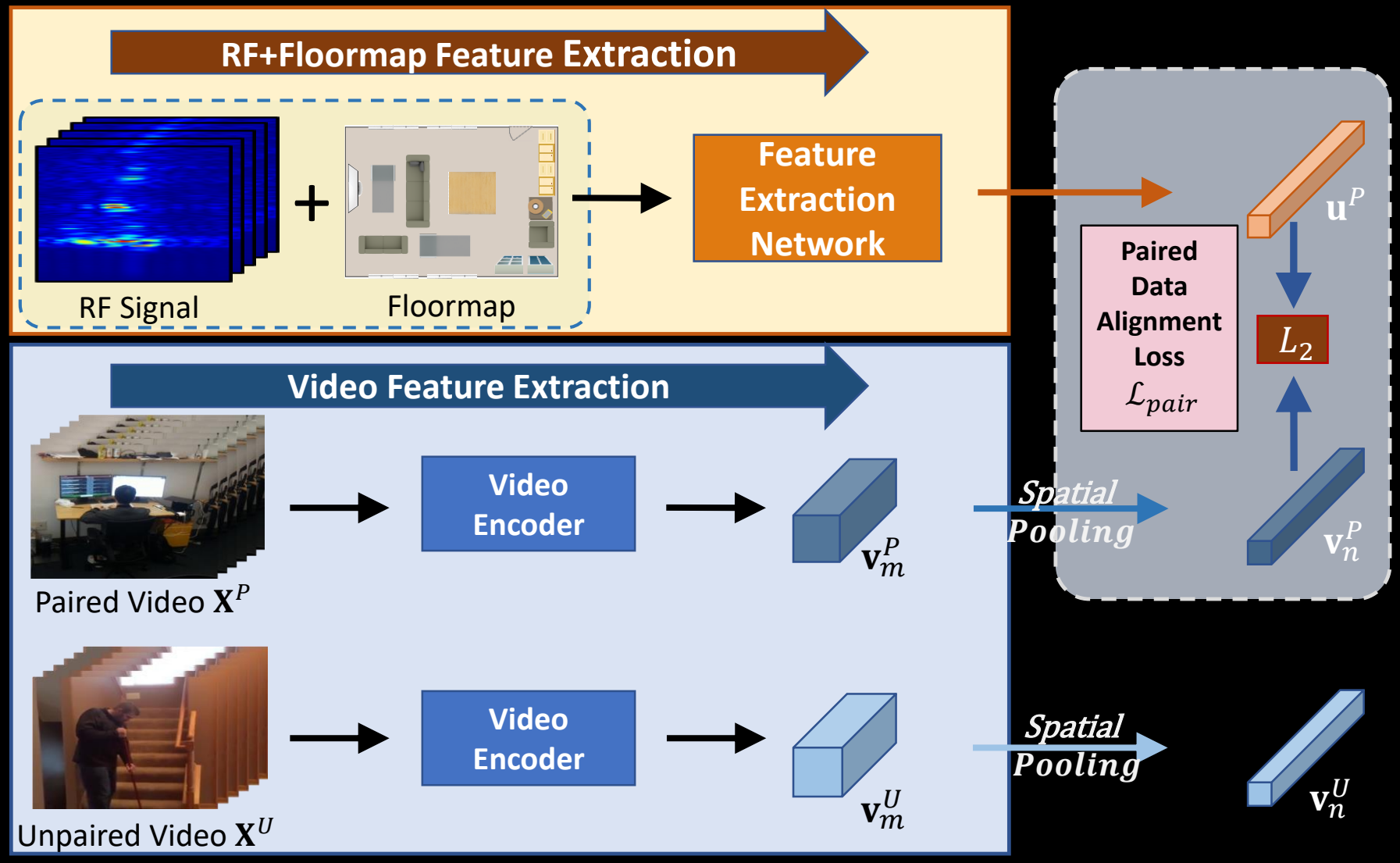

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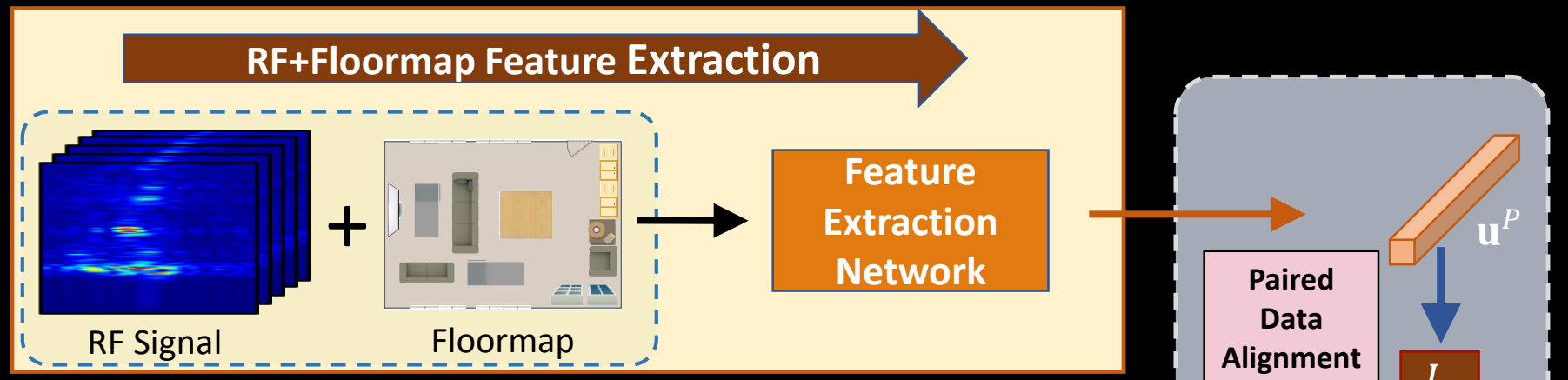
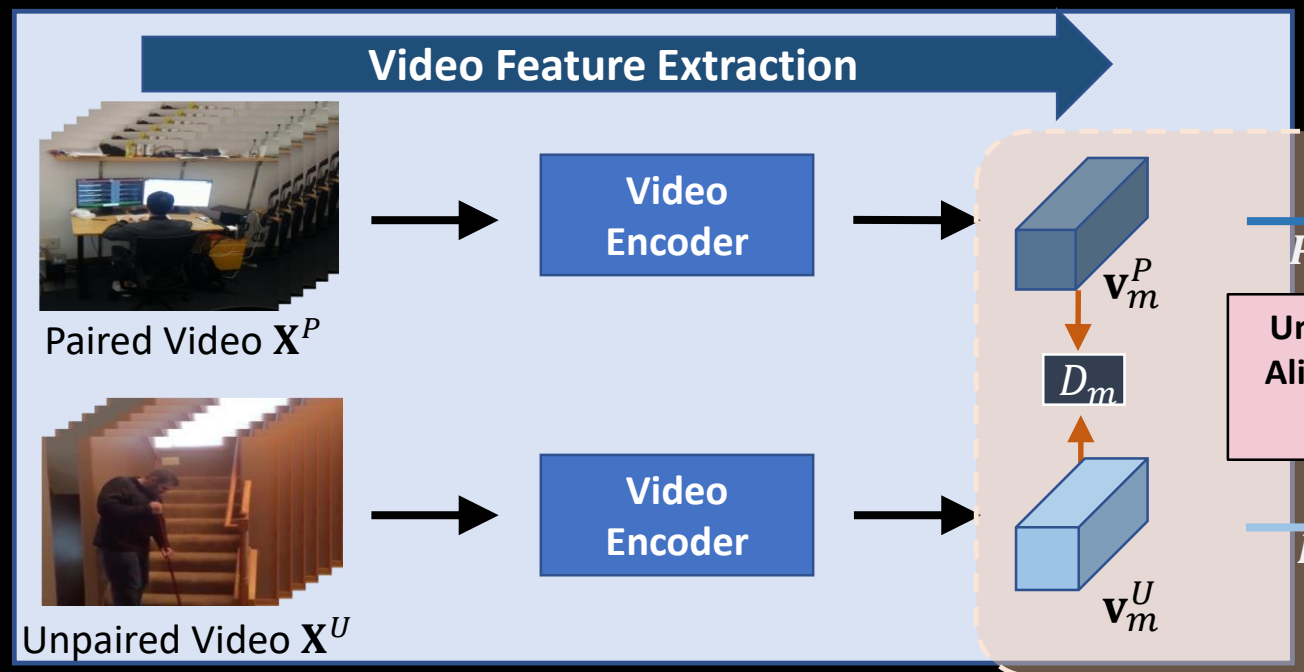
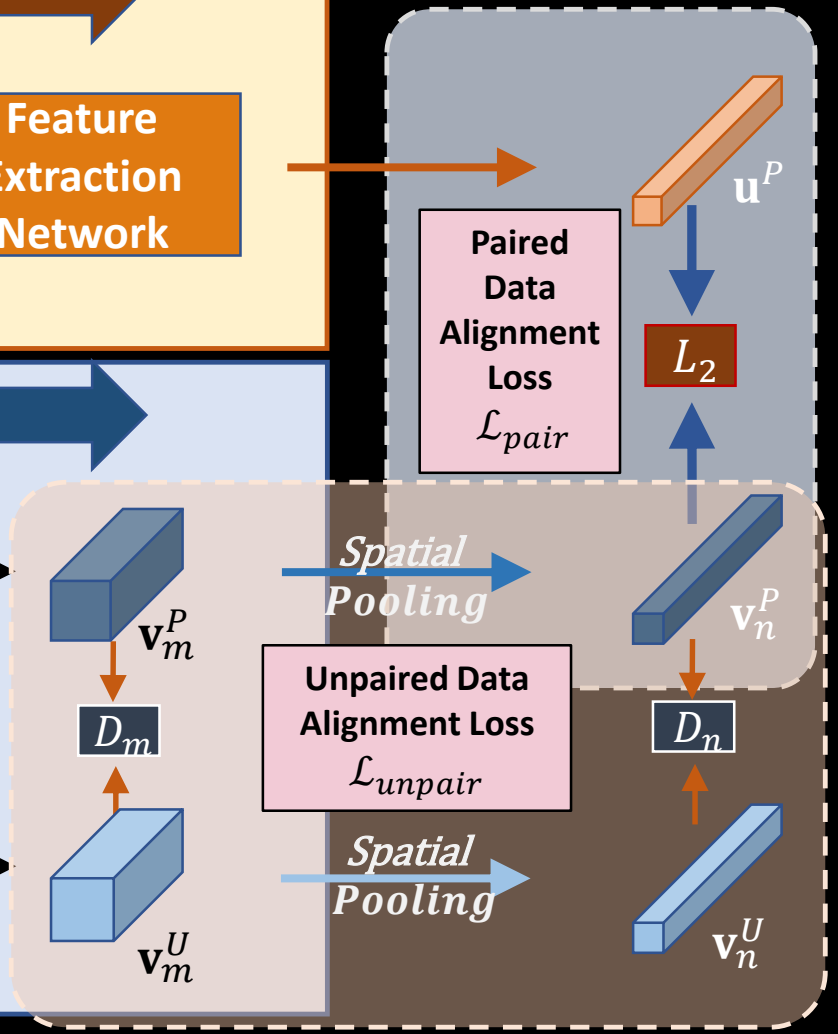
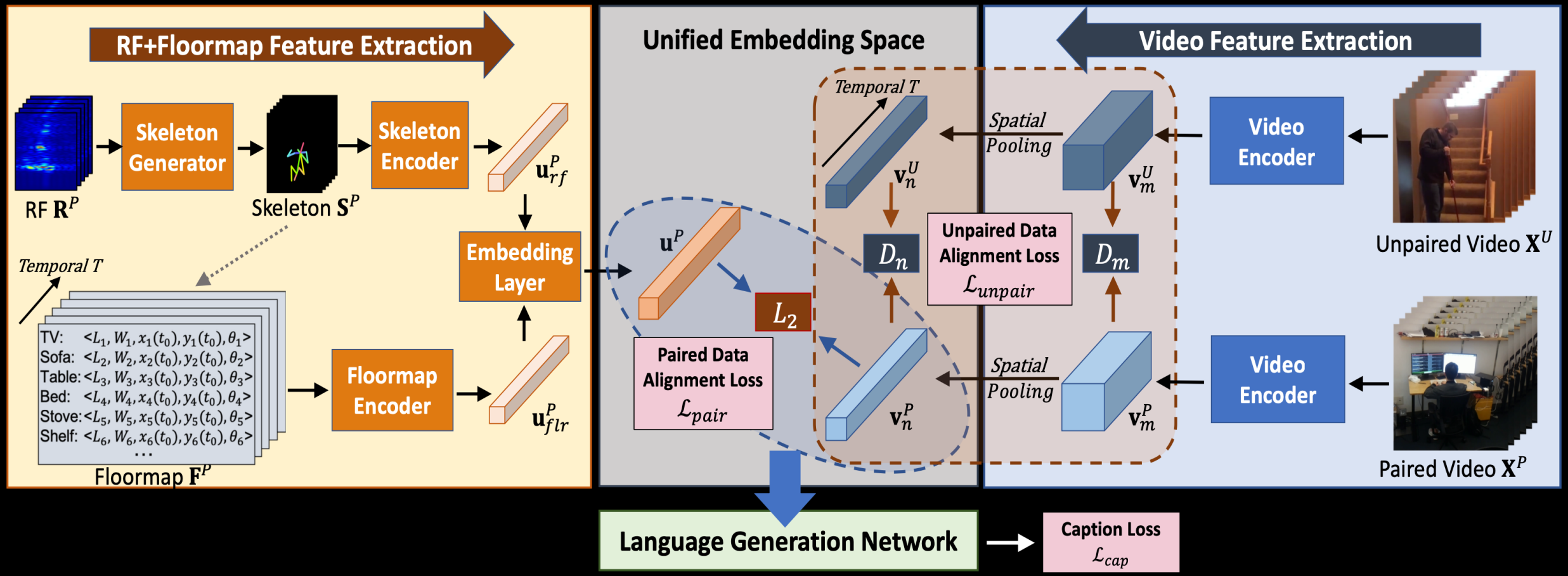


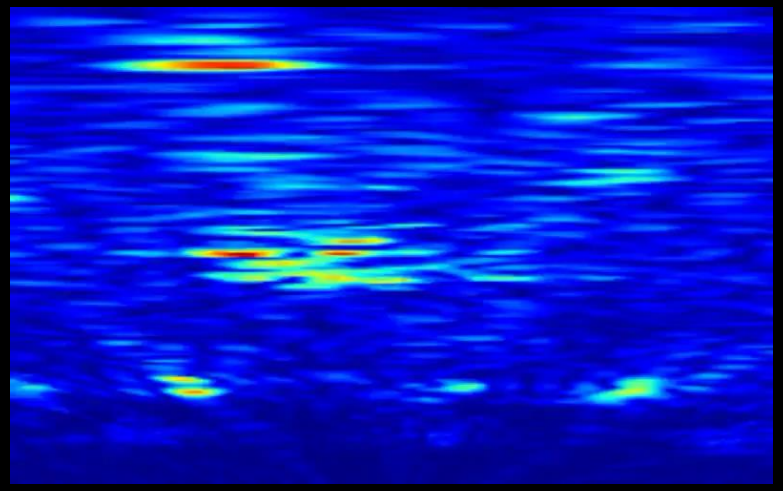




RF-Diary System Structure



RF-Diary can caption people's daily life in home …



RF Signals

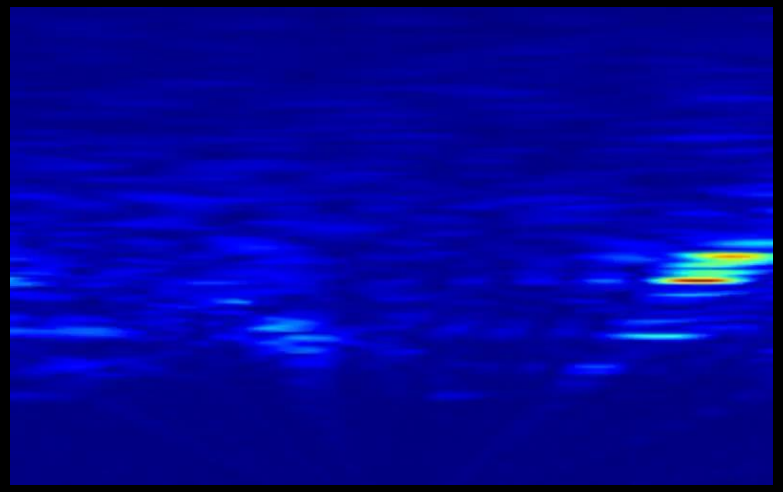
RGB Video

Floormap

A person enters the kitchen. He takes off his clothes, sits at table and starts playing laptop.

RF-Caption

Even when the light is off …



RF Signals

Not Applicable

RGB Video

Floormap

A person walks to the kitchen. He then pours water into a cup and drinks from it.

RF-Caption

Quantitative Results

Methods	Visible Scenario							Dark/Occlusion Scenario						
	B@1	B@2	B@3	B@4	M	R	C	B@1	B@2	B@3	B@4	M	R	C
S2VT [33]	57.3	40.4	27.2	19.3	19.8	27.3	18.9	-	-	-	-	-	-	–
SA [37]	56.8	39.2	26.7	19.0	18.1	25.9	22.1	-	-	-	-	-	-	–
MAAM [10]	57.8	41.9	28.2	19.3	20.7	27.1	21.2	-	-	-	-	-	-	–
HTM [17]	61.3	44.6	32.2	22.1	21.3	28.3	26.5	-	-	-	-	-	-	–
HRL [35]	**62.5**	45.3	32.9	**23.8**	**21.7**	28.5	**27.0**	-	-	-	-	-	-	–
RF-Diary	62.3	**45.9**	**33.9**	23.5	21.1	**28.9**	26.7	**61.5**	**45.5**	**33.1**	**22.6**	**21.1**	**28.3**	**25.9**

Summary

- RF-Diary enables captioning people’s daily life in their home.
- RF-Diary uses radio signals as input to address the privacy issues of camera.
- RF-Diary achieves comparable results of camera-based captioning and keeps working under poor lighting or occluded scenarios.

For more information, please visit our webpage:

http://rf-diary.csail.mit.edu