

# FoodChangeLens: CNN-based Food Transformation on HoloLens

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# Introduction: HoloLens

- ◆ HoloLens is a device that realizes Mixed Reality which Microsoft develops.
- ◆ When user wearing HoloLens, the hologram becomes visible in the real space, various functions are incorporated to realize that.

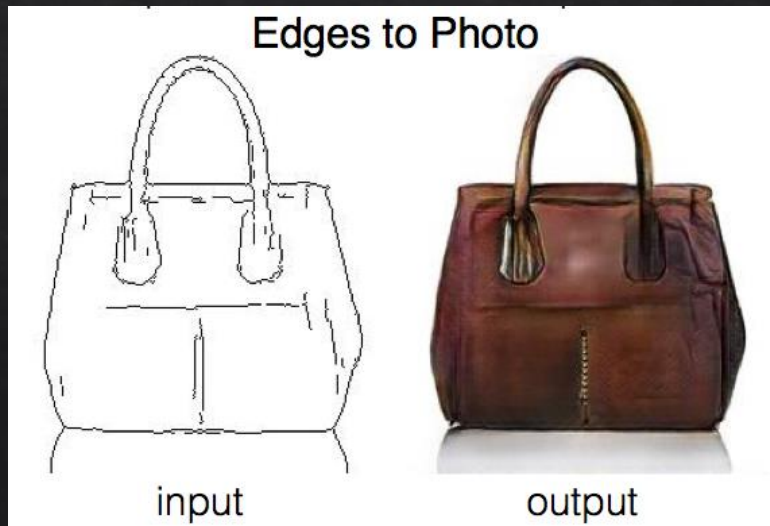


# Introduction: Convolutional Neural Network(CNN)

## ◆ Pix2Pix

[Berkeley CVPR 2017]

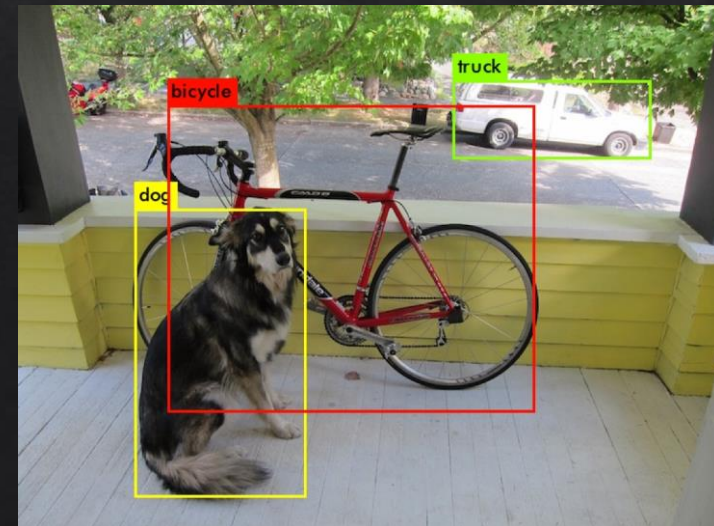
- ◆ learning a pair of line drawing and color image.
- ◆ Automatic coloring from line image



## ◆ You Look Only Once

[Joseph Redmon CVPR 2016]

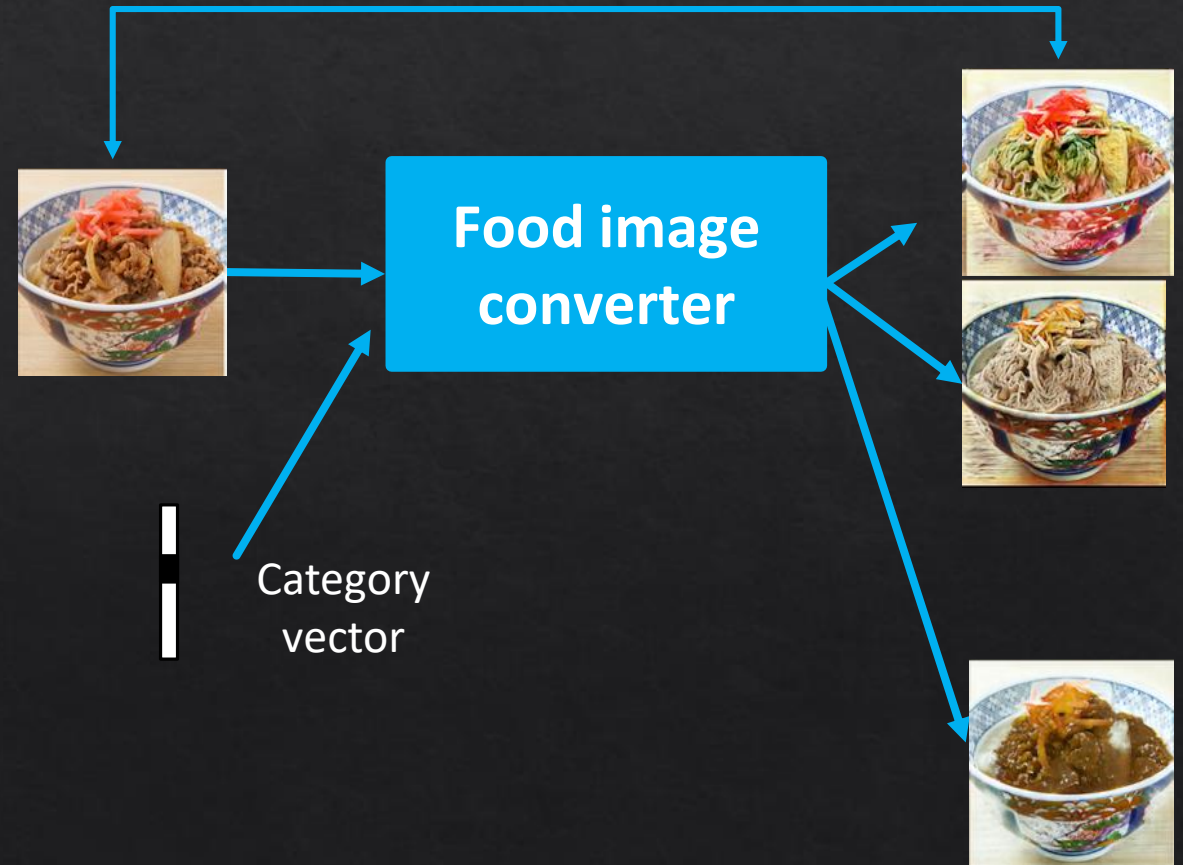
- ◆ Detection of position of object and classification



# Introduction: Convolutional Neural Network(CNN)

## ◆ Food image translation

- ◆ learning some category food image .
- ◆ Convert different category food image.

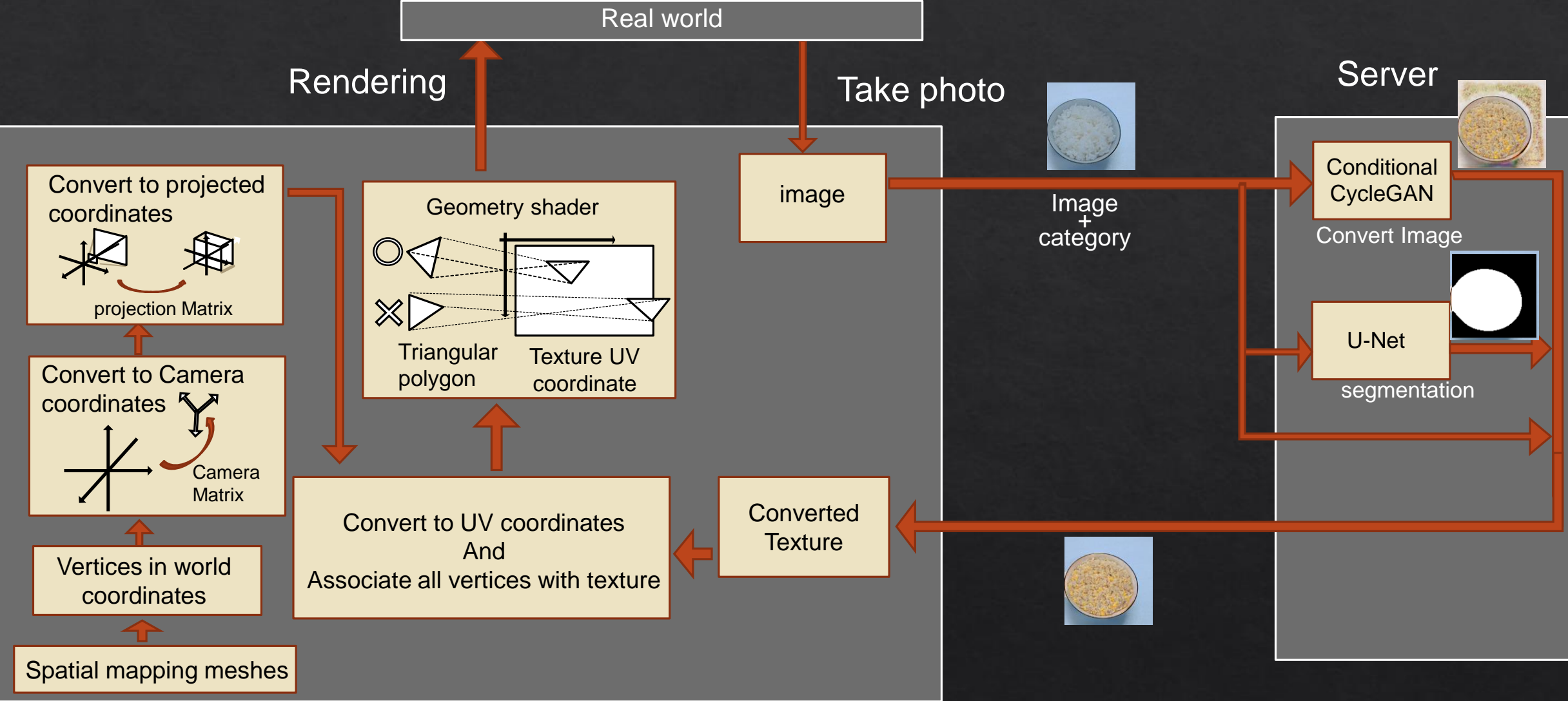


# Objective

- ◆ Deploy image generation technology on HoloLens and convert food categories in the real space.

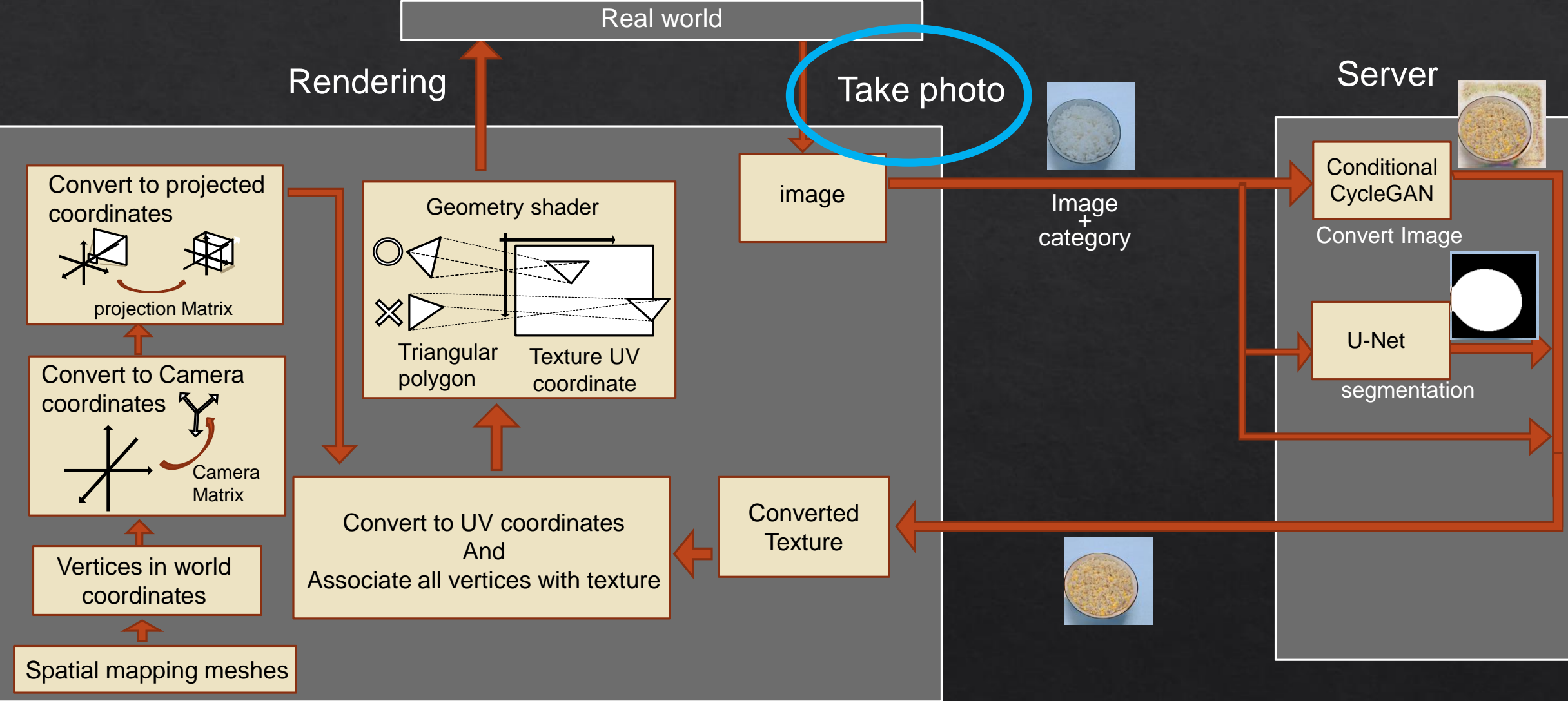
◆ VIDEO

# Application overview



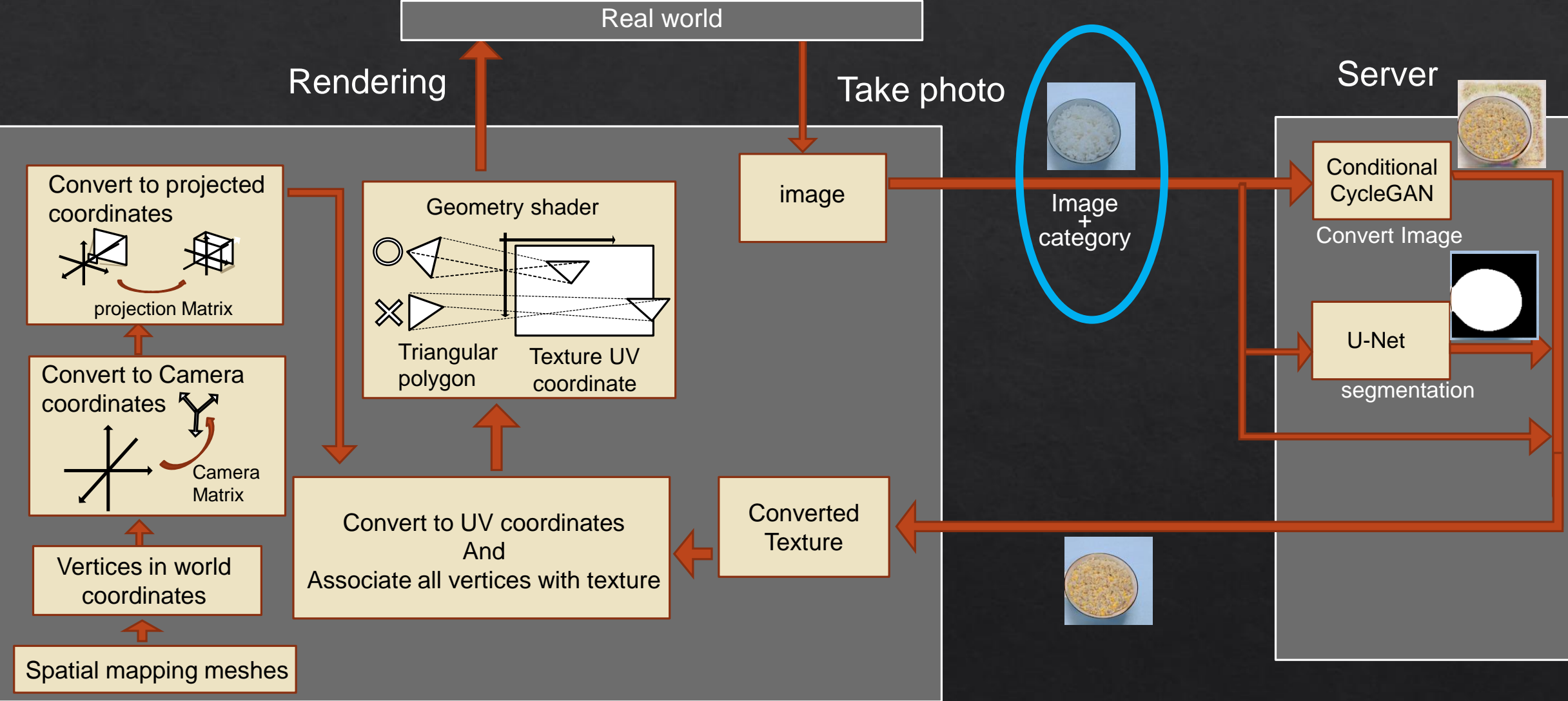
HoloLens

# Application overview



HoloLens

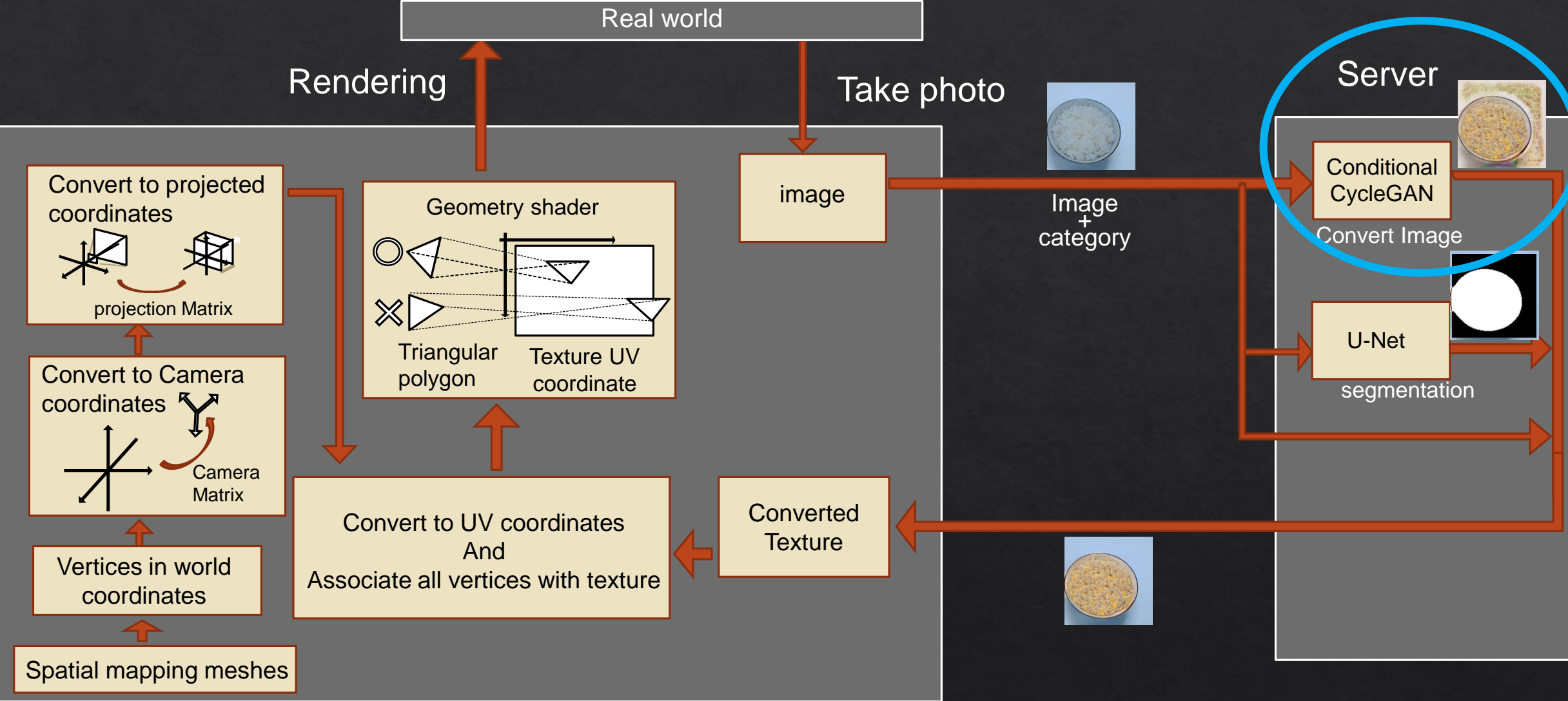
# Application overview



HoloLens

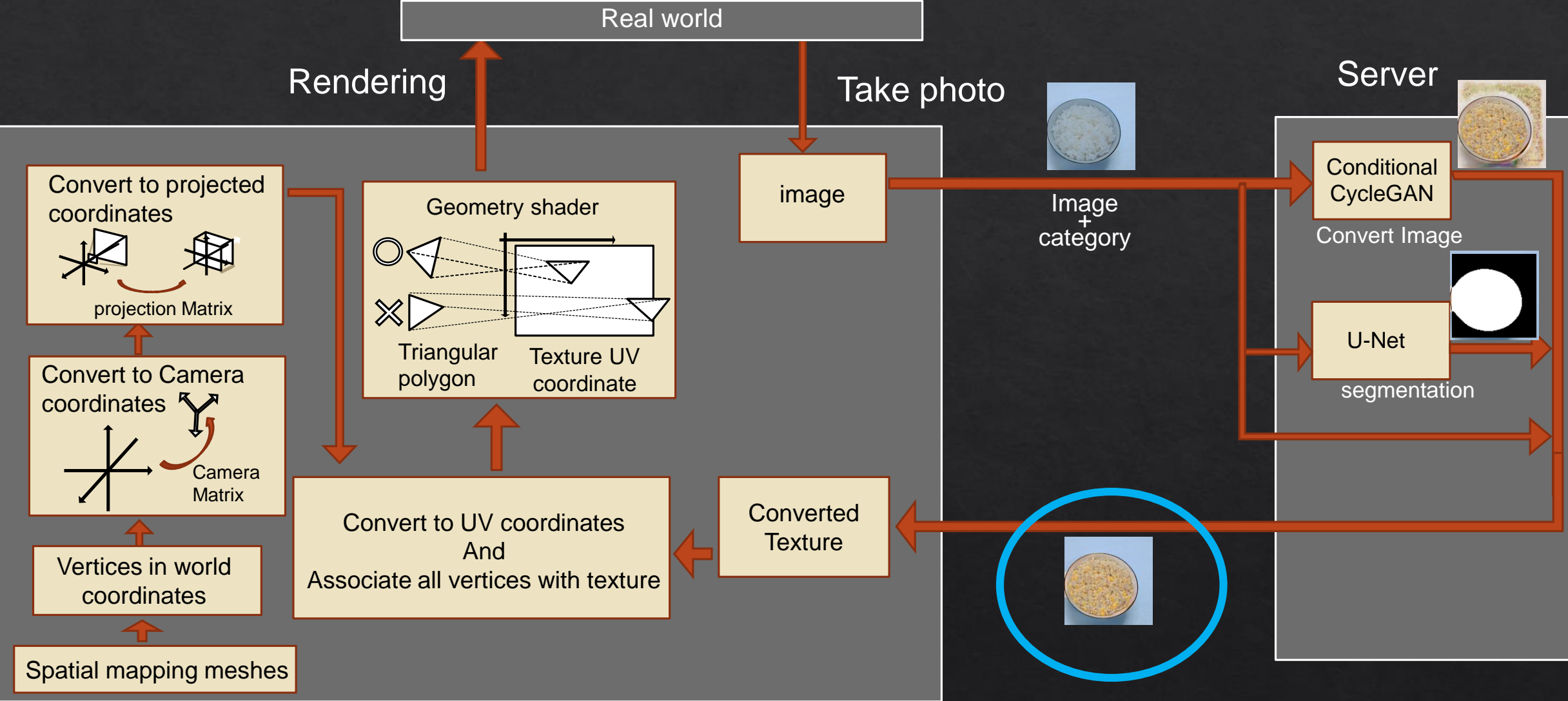


# Application overview



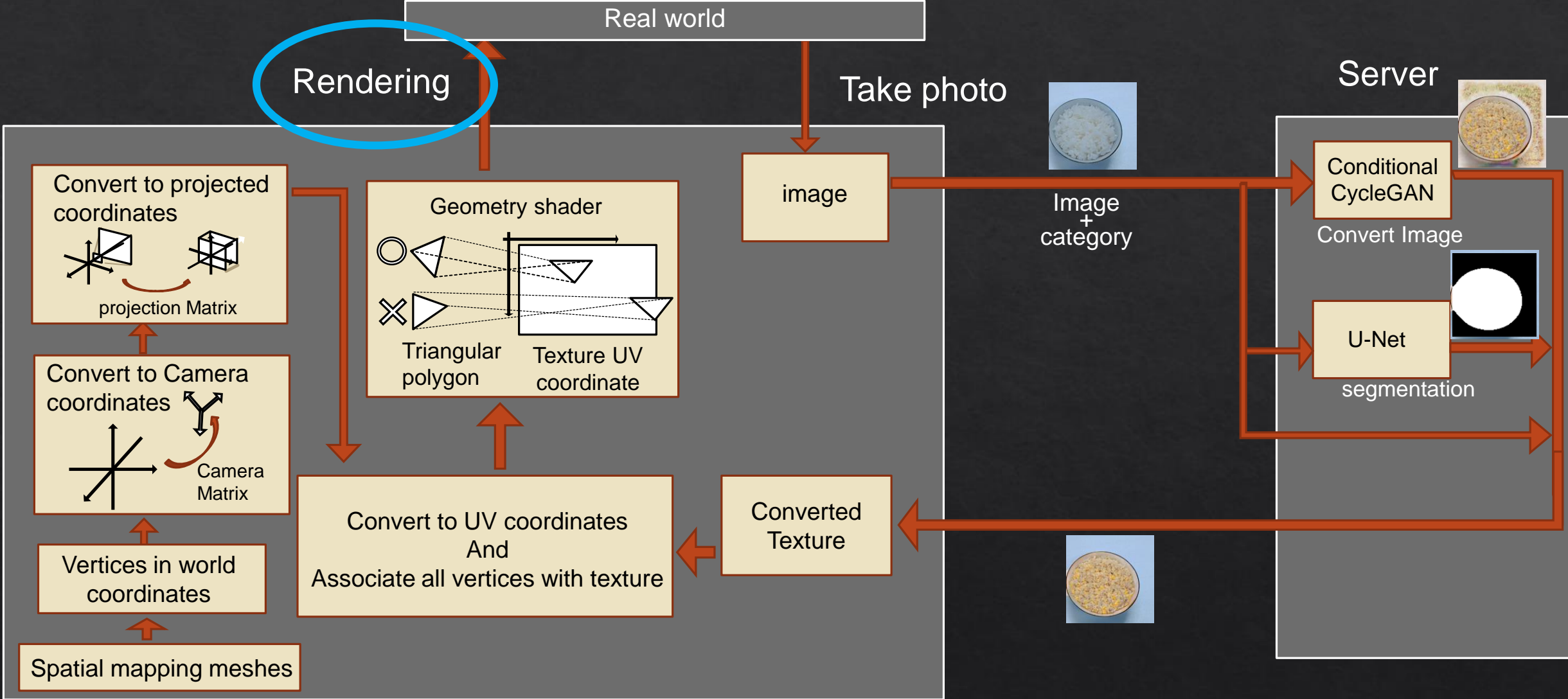
HoloLens

# Application overview



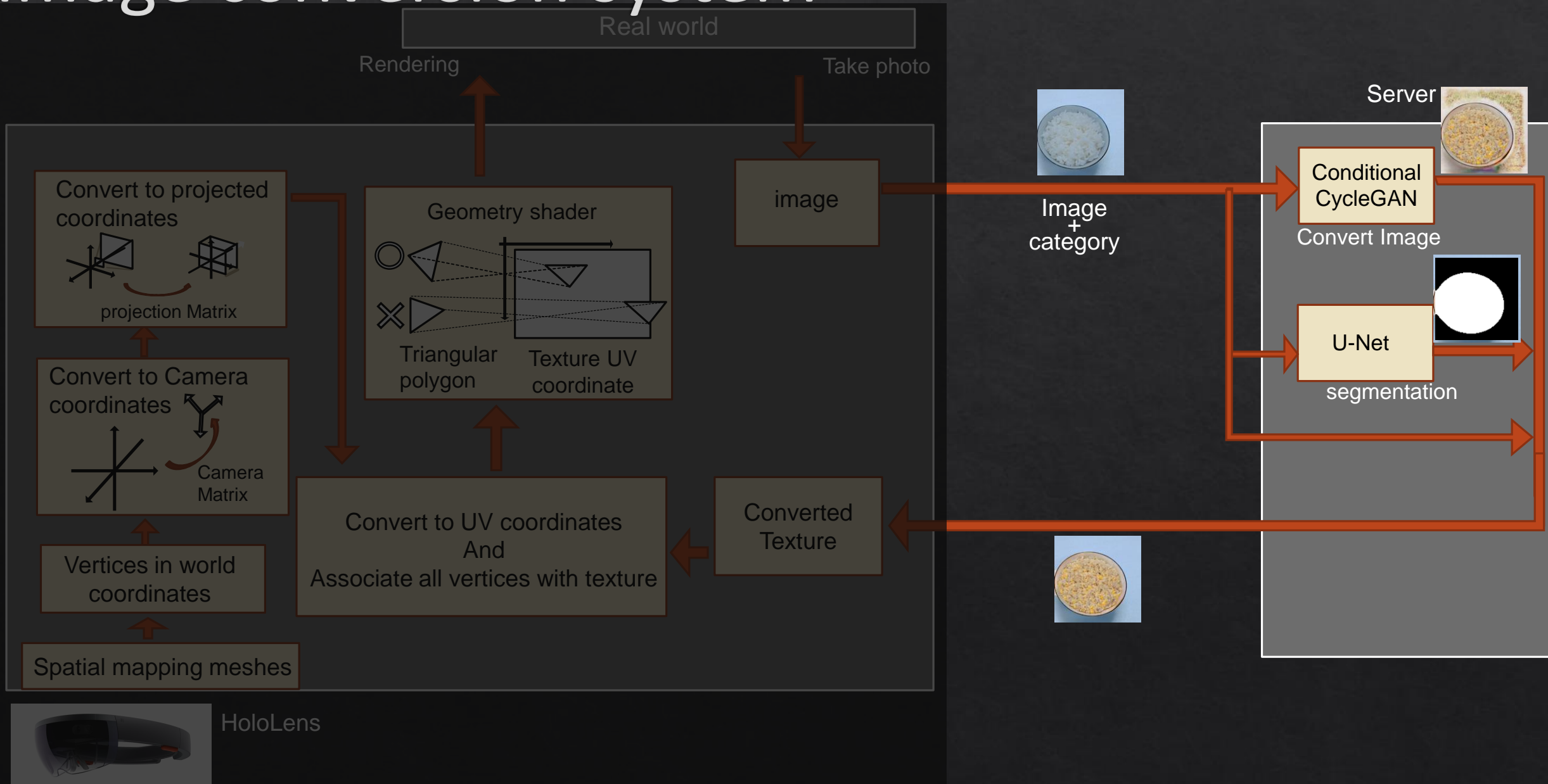
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# Application overview



HoloLens

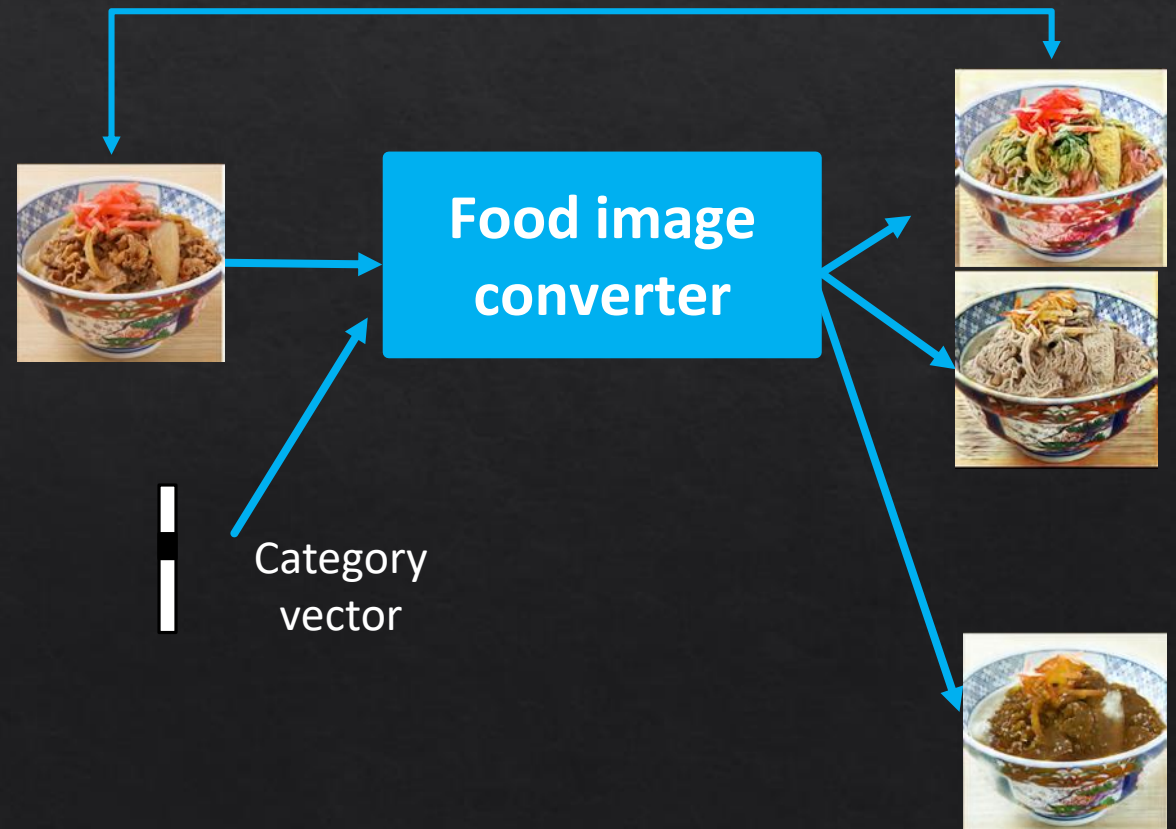
# Image conversion system



# Image conversion system : Conditional CycleGAN

1. Convert with high quality
2. Convert to multiple food category by one network

## Conditional CycleGAN



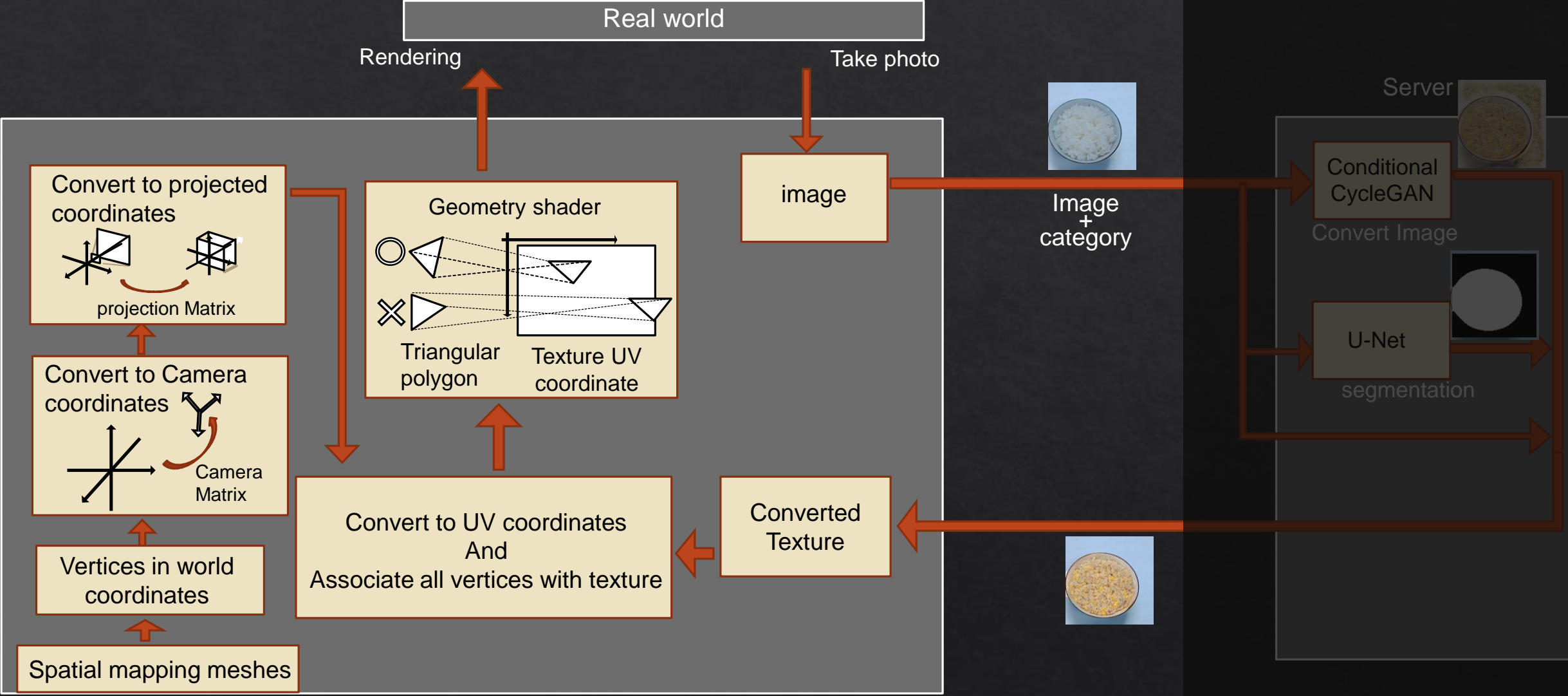
# Image conversion system : Dataset

◆ Total amount : 230k images



Category	Amount
Ramen	74,007
Curry rice	34,216
Fried rice	27,854
Fried noodle	24,760
Rice	21,324
Beef bowl	18,396
Chilled noodle	13,499
Meat spaghetti	7,138
Eel bowl	5,329
Buckwheat noodle	3,530
<b>Total</b>	<b>230,053</b>

# HoloLens application



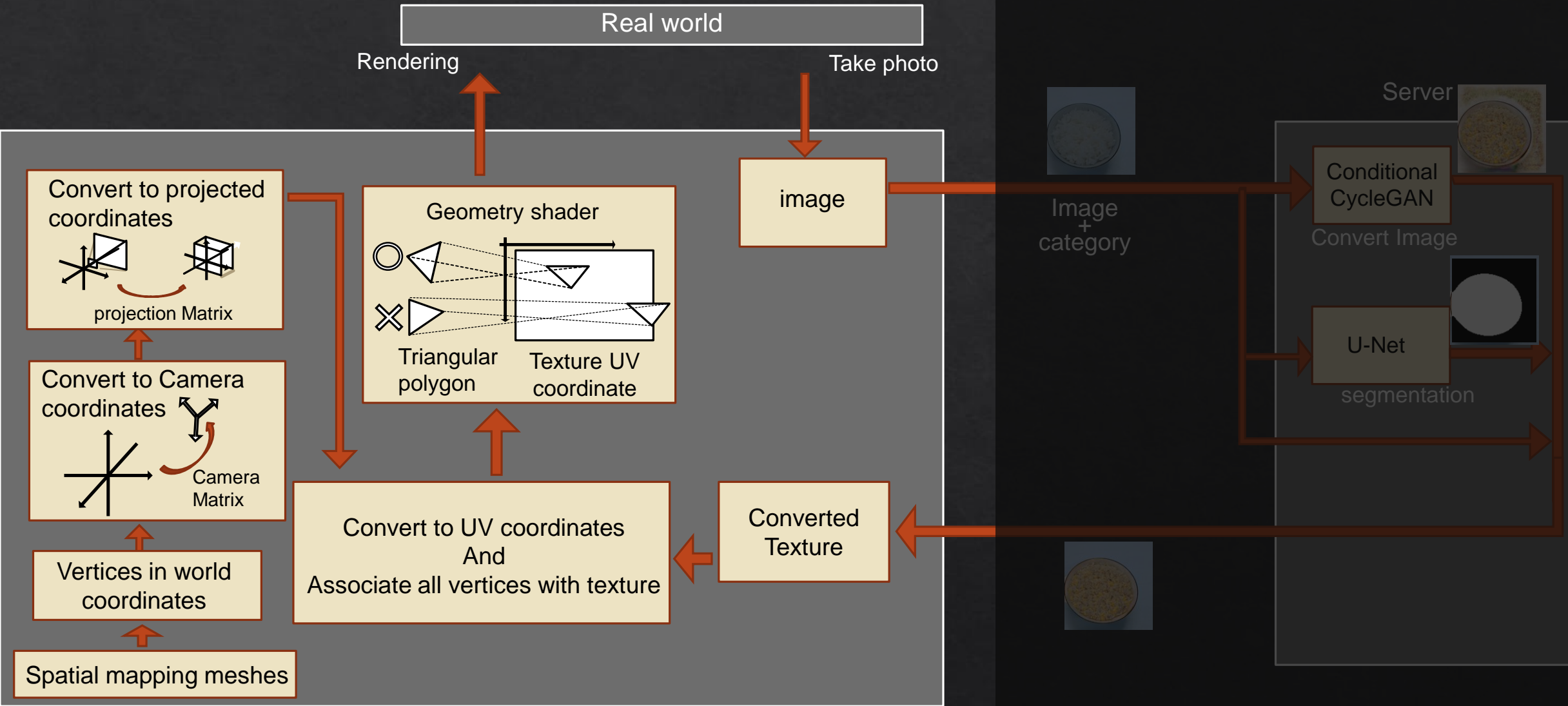
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# HoloLens application : main used functions

- ◆ HoloLens has an API that can acquire
  - ◆ camera matrices
  - ◆ projection matrices.
- ◆ Spatial mapping (Spatial recognition)
  - ◆ HoloLens uses spatial recognition using cameras, depth cameras, etc., and creates 3d meshes according to the shape of real objects.

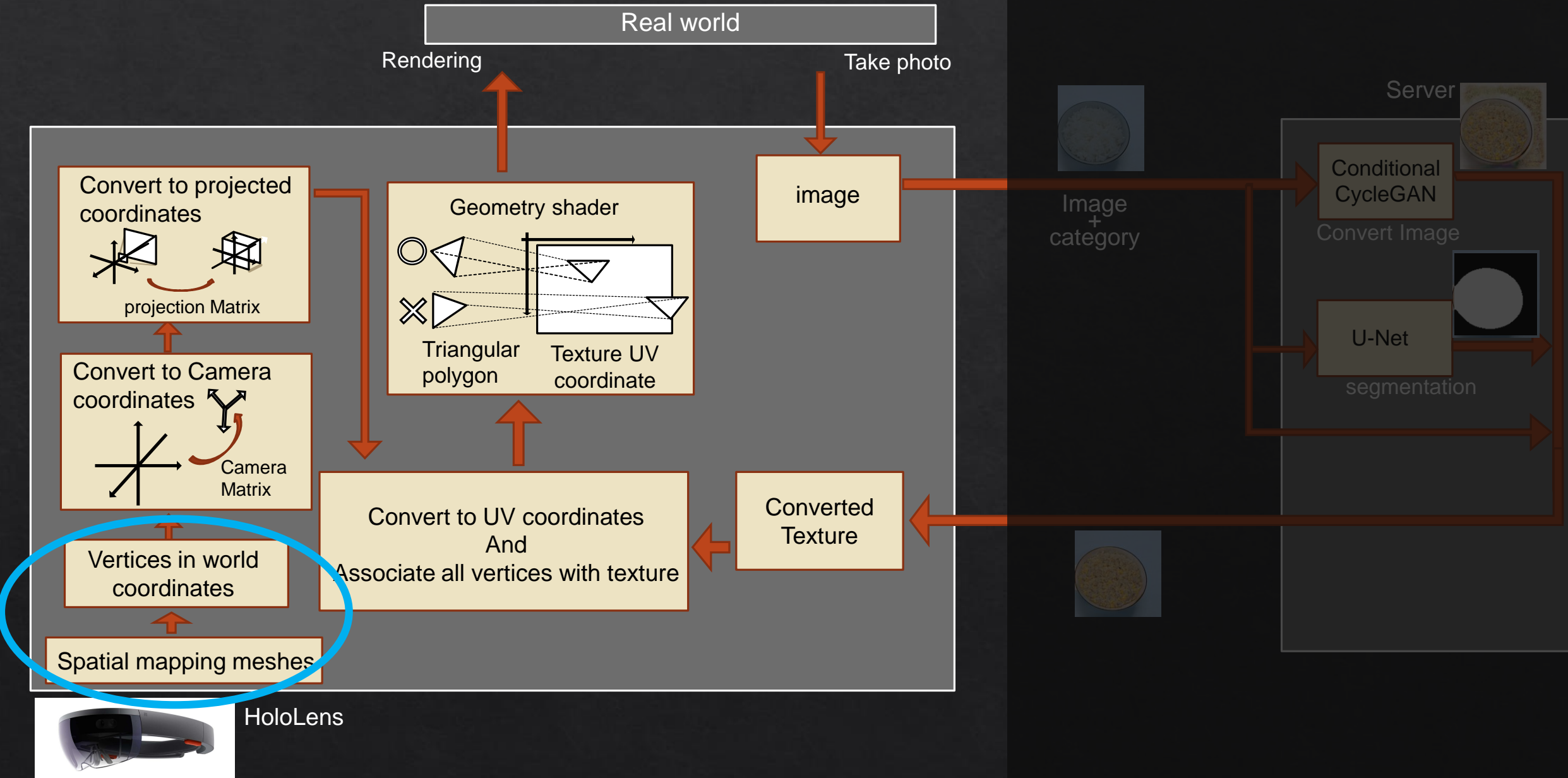


# HoloLens application : System

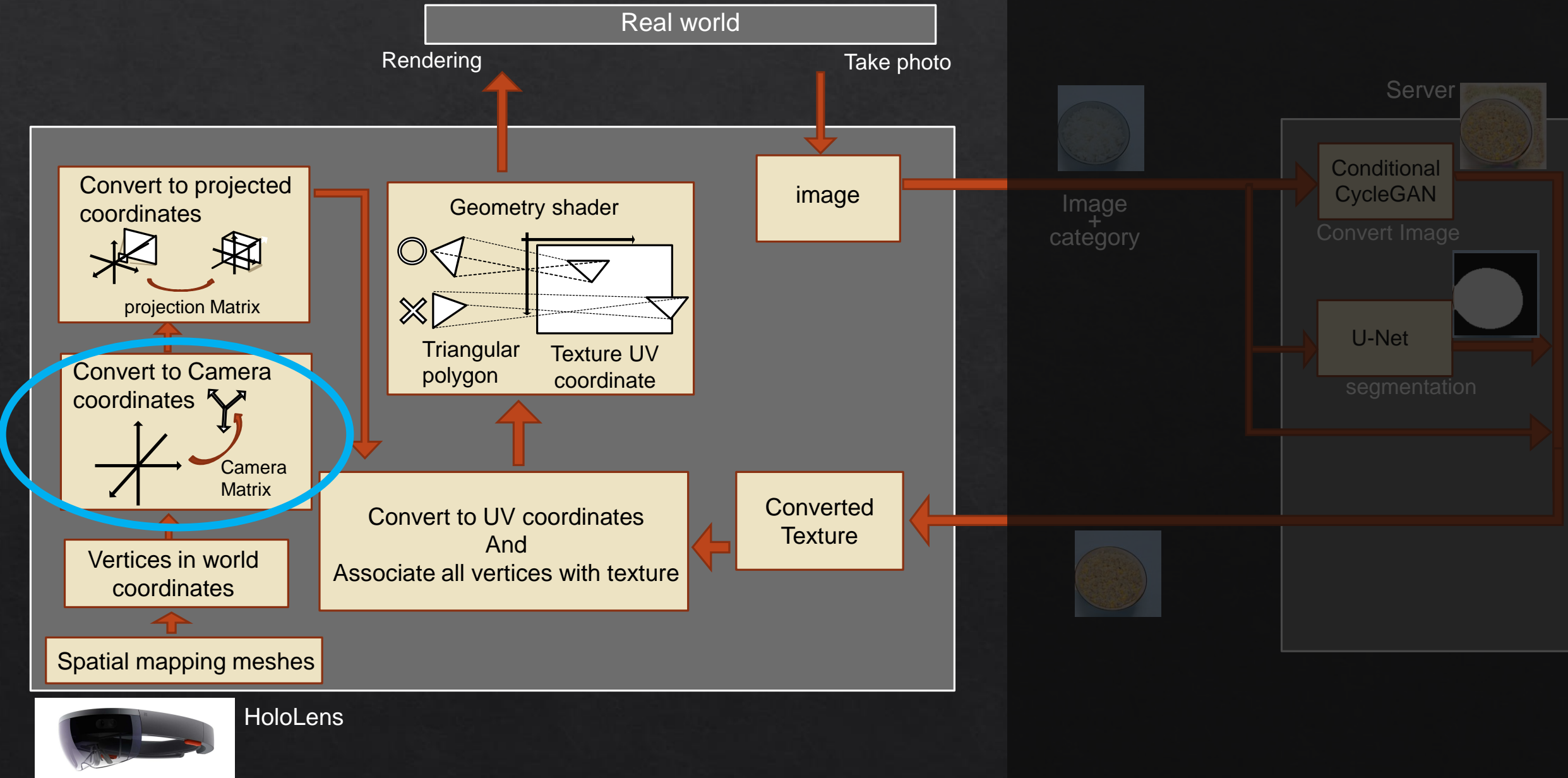


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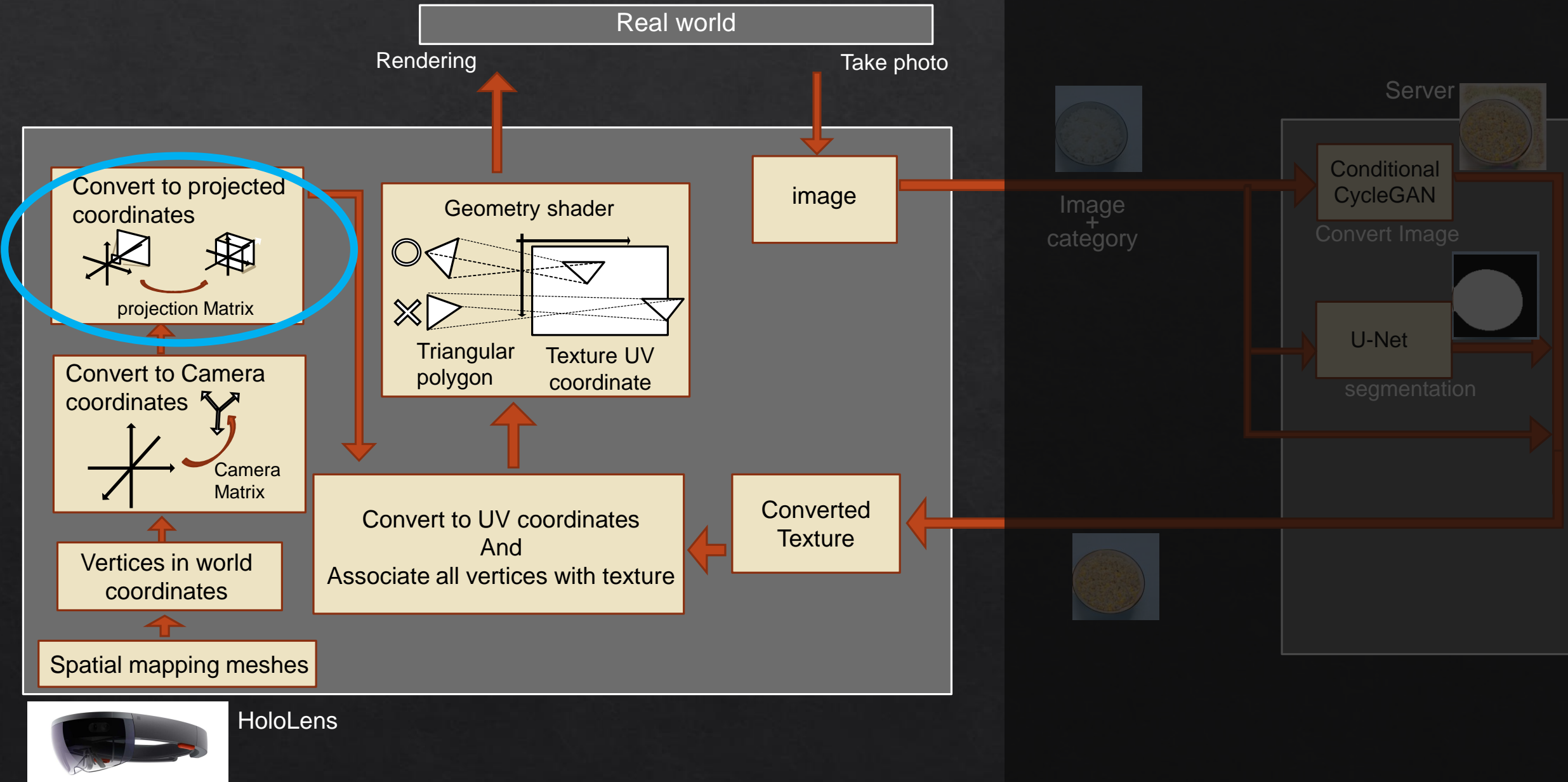
# HoloLens application : System



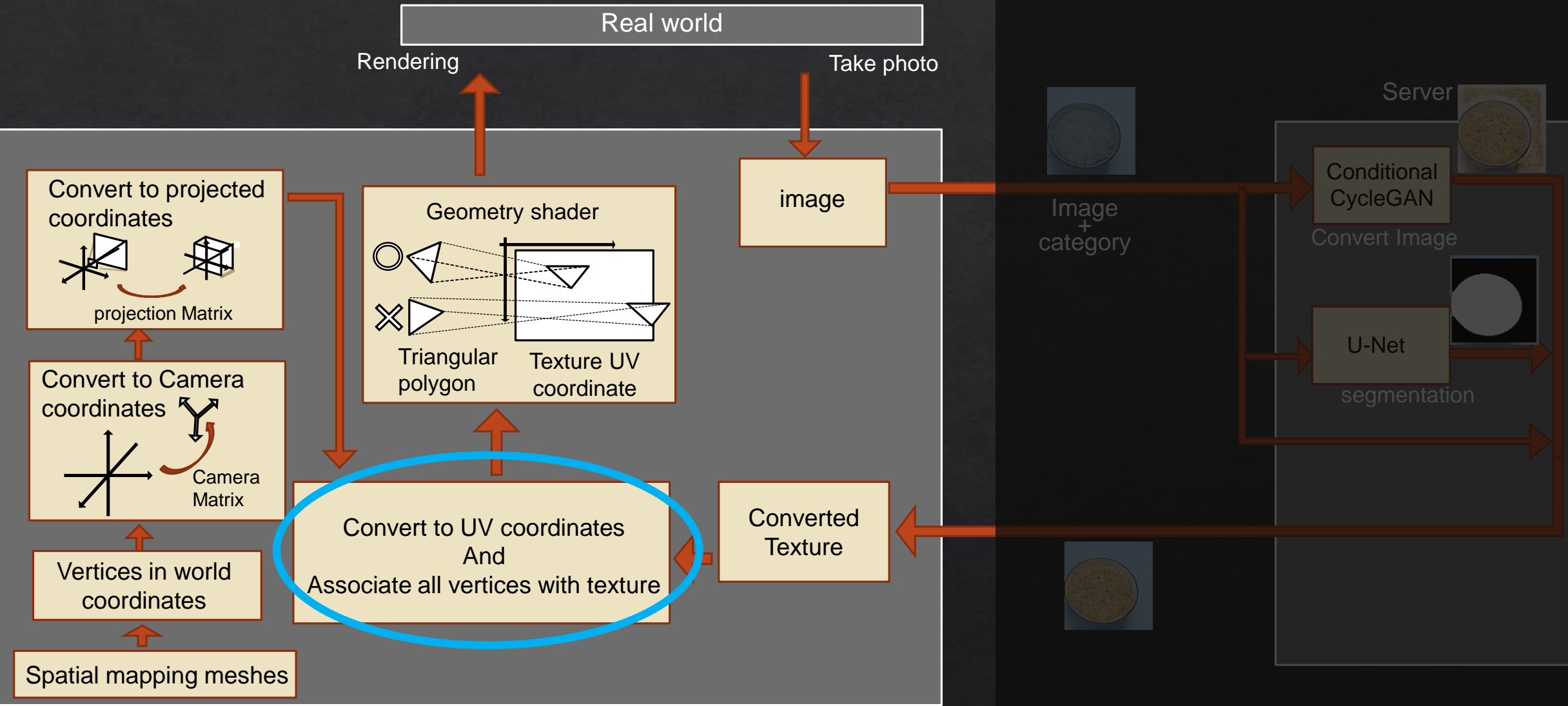
# HoloLens application : System



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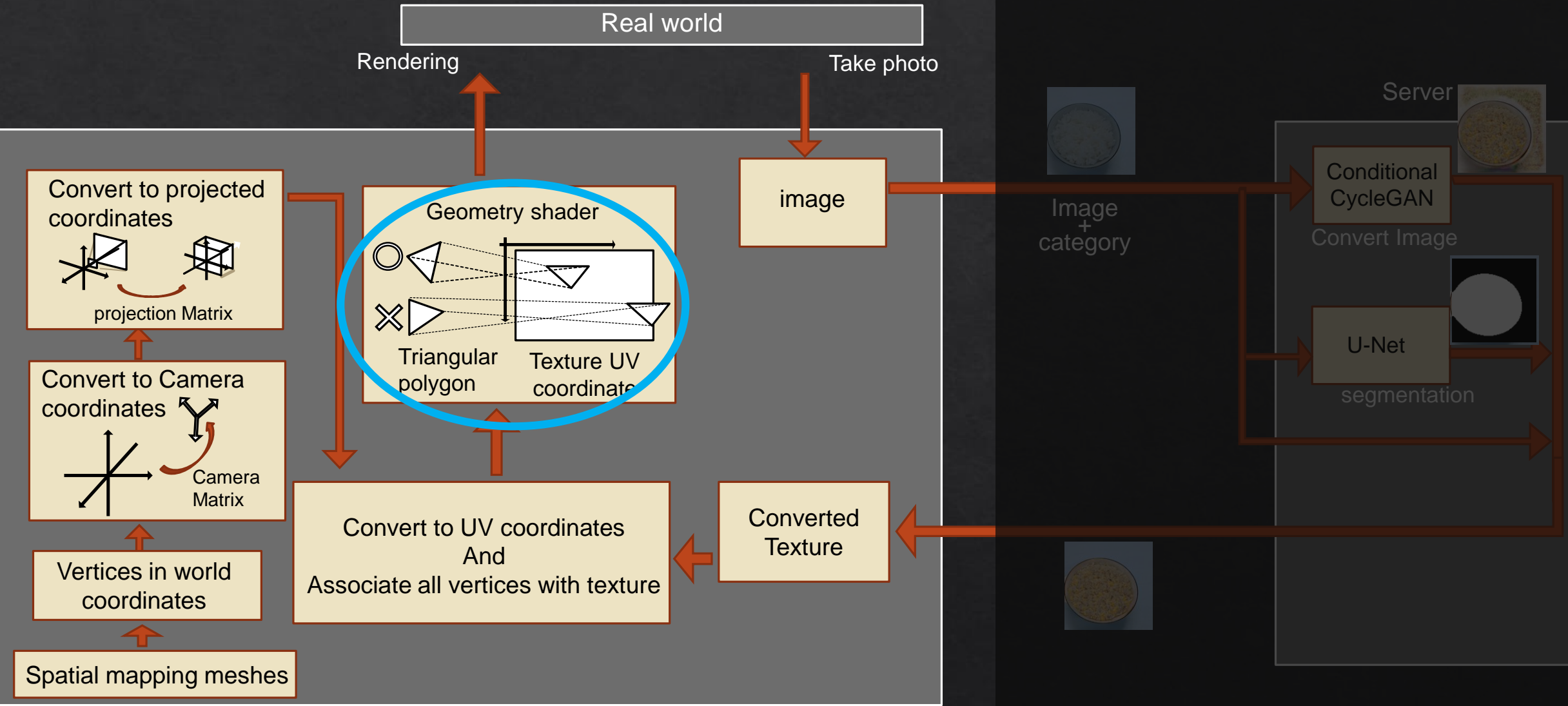


# HoloLens application : System



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# HoloLens application : System

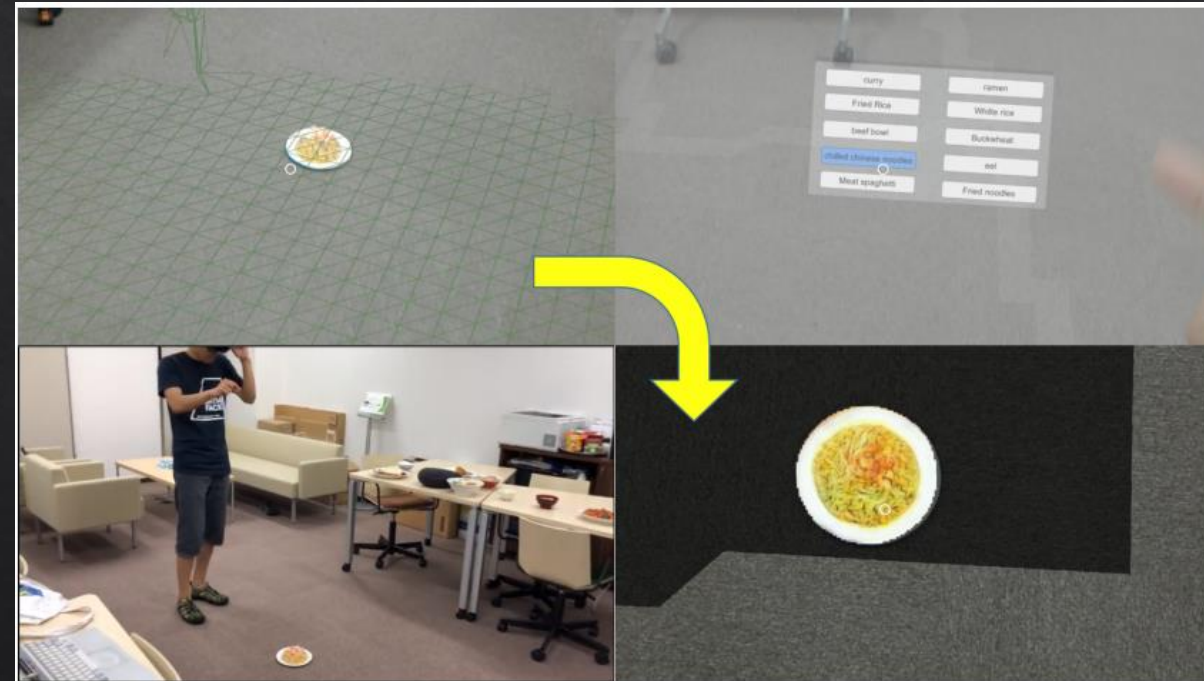


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# Conclusion

## ◆ Summary

- ◆ Combined both image transformation using Deep Learning with MR on HoloLens
- ◆ Potential of virtual meal experience which make meal enjoyable.



## ◆ Future Works

- ◆ Implement advanced visualization and real time transformation

# Application examples

- ◆ Convert diet restricted meal to your favorite meal.
- ◆ Convert simple food into luxurious meals.



# System limitations

- ◆ Real time processing on HoloLens is difficult.
  - ◆ A spatial map is fixed.
  - ◆ A high computation cost of correspondence between each vertex and a texture taken by the camera.

# Future works

- ◆ Implement advanced visualization.
  - ◆ Improve ease of operation.
- ◆ Real time transformation.
  - ◆ Combination of 3D reconstruction from images.
  - ◆ Reduce computation cost on HoloLens side.

# 応用先

- ◇ 病院とかダイエット食とかに使えるといいかもしれない。

# QA

- ◇ これはなんの役にたつの？
  - ◇ 病院食やダイエット食などの貧相な食事を視覚的にリッチな食事にする事ができる。
  - ◇ 拒食症などの場合はまともな食事を貧相にみせることも。

# QA

- ◇ 画像のデータセットはどうしたの
  - ◇ 柳井研究室ではtwitter streamを利用して食事画像を収集していた
  - ◇ Alex NetをUEC FOOD 100でfine tuneしたものを利用。
- ◇ インタラクティブ?
  - ◇ ではありません。はったら貼りっぱなし。

# QA

- ◇ 領域分割はどうなっているの？
- ◇ なんでリアルタイムじゃないの？