

Marker SLAM User Manual

For Windows, Mac, and Linux

Purpose

Determine the position and orientation of a webcam in real time using fiducial marker SLAM (simultaneous localization and mapping).

See the location information on any device using OSC (open sound control).

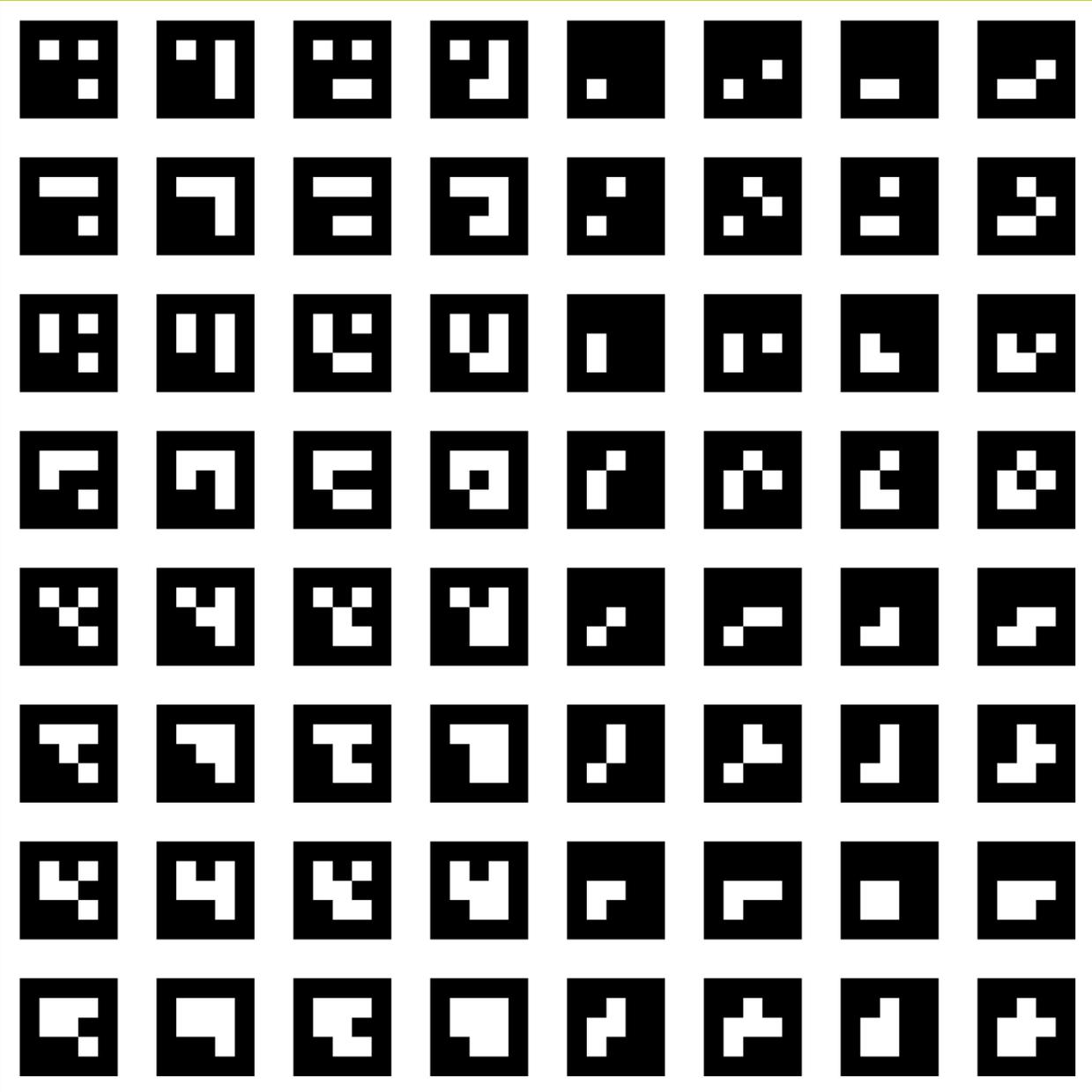
Getting Started

You will need:

- A room
- Printed fiducial marker/s (see list of acceptable markers on next page)
- Webcam/s

Step 1: Markers

Acceptable markers are shown below.
Print out up to 64 different markers on individual pages.
Print out each marker in any size.



Step 2: Webcams

Connect all webcams to your Windows, Mac, or Linux device that will be running the application.

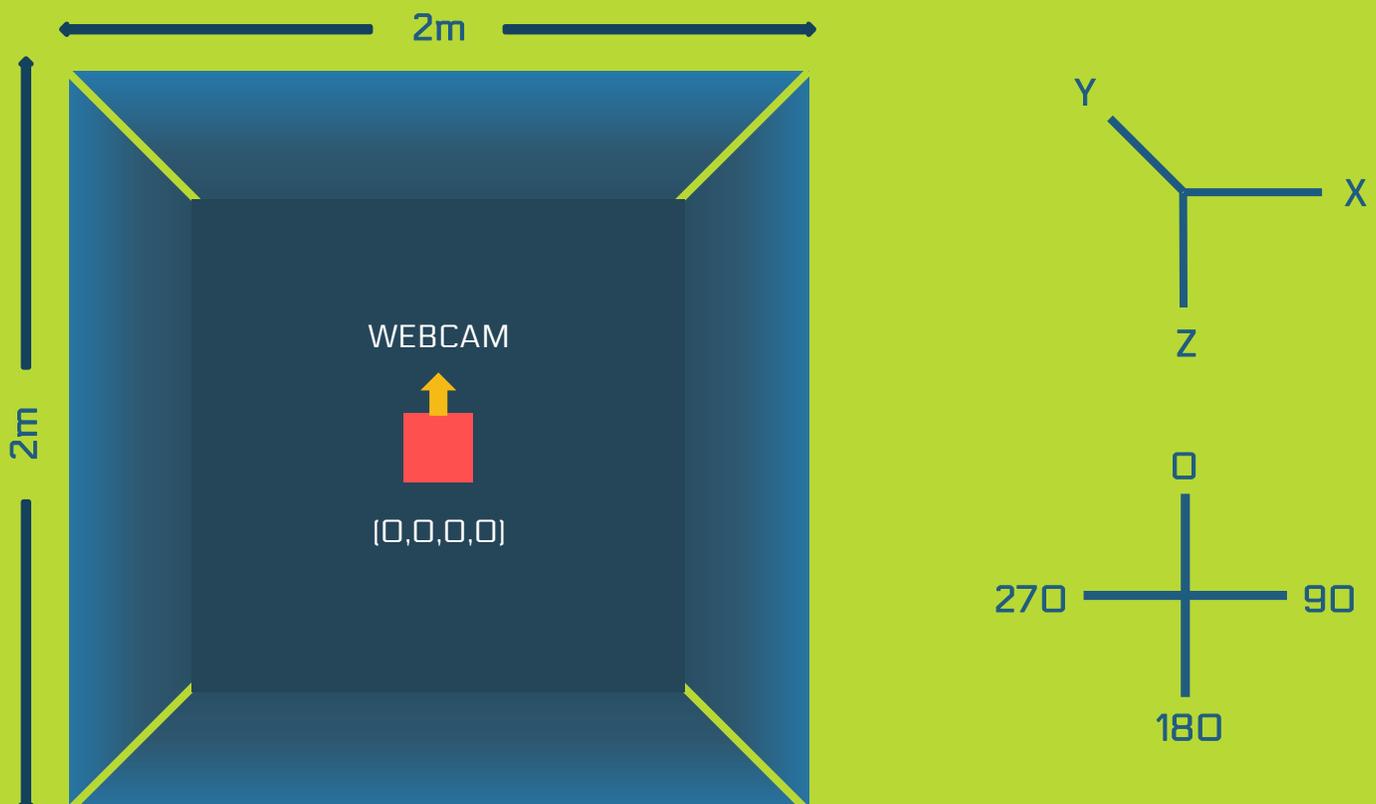
Tip: Try adjusting your webcam's contrast/sharpness so that the image appears sharper. This will allow the program to work better.

Step 3: Find Your Starting Point

Pick any spot in the room to be point $(0, 0, 0)$.
Pick any direction to be the 0° orientation.

Example:

I will choose $(0, 0, 0)$ to be in the center of the room, and 0° will be in the North direction. (See picture below)



Step 4: Place Your Markers

Choose where you would like to place the markers relative to the origin point.

Determine the orientation of the marker first. Then determine the x, y, z position when you are in that orientation. Make sure to measure to the center of the marker.

Example:

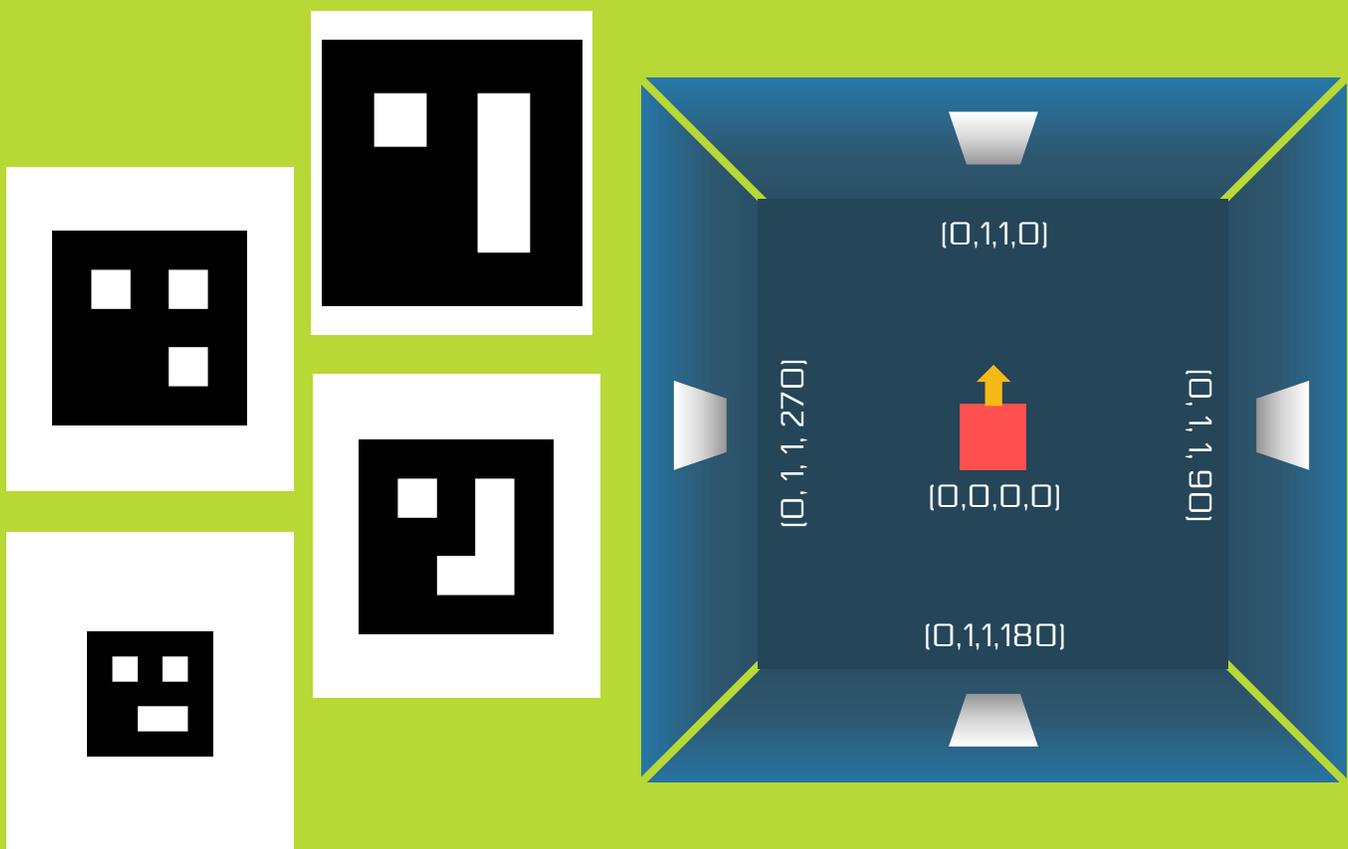
I printed out 4 markers. (See picture below).

Marker 1: Orientation: 0, Position: (0, 1, 1)

Marker 2: Orientation: 90, Position: (0, 1, 1)

Marker 3: Orientation: 180, Position: (0, 1, 1)

Marker 4: Orientation: 270, Position: (0, 1, 1)



Step 5: Basic App Setup

Select a webcam and whether it is front or back-facing.
If desired, view the help screen.

The screenshot shows the app's main interface. At the top, there are three callouts: 'See the Help Screen' pointing to the 'Help' button, 'Select a Webcam' pointing to the 'TOSHIBA Web Camera - HD' dropdown, and 'Show/Hide List of Markers' pointing to the 'Registered Markers' dropdown. The main view is a camera feed showing a red square marker on a white paper, labeled 'Marker #1 [0,1,1,0]'. A blue callout 'List of Markers' points to a table on the right side of the screen. At the bottom left, a 'Flip Camera' callout points to a camera icon. At the bottom, a status bar displays 'Position: 0.14, 0.97, 0.31', 'Orientation: 1.42', and 'Count: 4'. Below this bar are five callouts: 'Webcam Position x, y, z direction (in meters)', 'Webcam Orientation y direction (in degrees)', '# of Markers /Add More Markers' (pointing to a '+' button), 'Save Marker Data' (pointing to a save icon), and 'Load' (pointing to a folder icon).

ID	Icon	0	1	2	3	4	5
1.		0	1	1	0	0.15	-
2.		0	1	1	90	0.2	-
3.		0	1	1	180	0.05	-
4.		0	1	1	270	0.1	-

Step 6: Register Your Markers

Click on the + sign by *Count* to add a marker to the list of registered markers.

For each marker register, select a marker. Then type in its position and orientation.

Measure the width of the marker. Type it in.

Click on the – sign by a marker register to delete it.

A marker will not be detected unless registered by the user.

The image shows a software interface for managing markers. At the top, a blue header bar contains the text "Registered Markers" and a dropdown arrow. Below this is a table with four rows, each representing a marker. Each row has a number (1-4), a square icon with a dropdown arrow, and five input fields labeled X, Y, Z, θ , and Width. A minus sign is at the end of each row. At the bottom of the table, there is a "Count: 4" label, a plus sign, and two folder icons. A callout box labeled "Show/Hide List of Markers" points to the dropdown arrow in the header. Another callout box labeled "Add More Markers" points to the plus sign. A detailed view of one marker register is shown below, with callouts: "Select a Marker" points to the square icon; "Marker's Orientation in degrees" points to the θ field; "Marker's width in meters" points to the Width field; "Marker # 1" points to the number 1; "Marker's Position in meters" points to the X, Y, and Z fields; and "Delete this Marker Register" points to the minus sign.

1.		X	Y	Z	θ	Width	-
2.		X	Y	Z	θ	Width	-
3.		X	Y	Z	θ	Width	-
4.		X	Y	Z	θ	Width	-

Count: 4

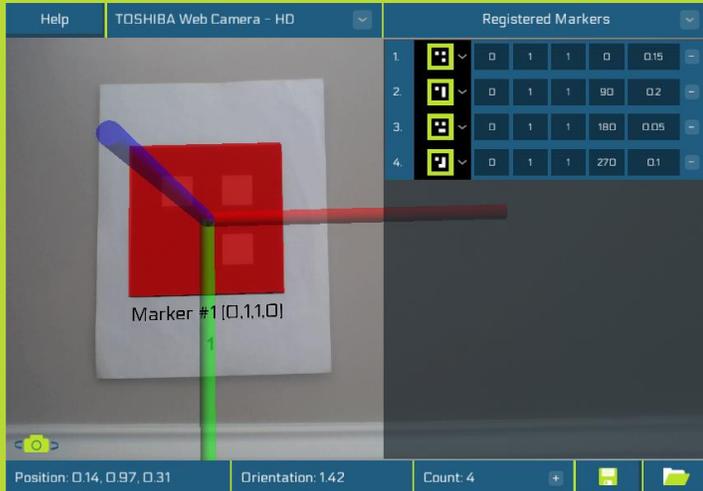
1. X Y Z θ Width -

Step 7: Determine the Webcam Position/Orientation

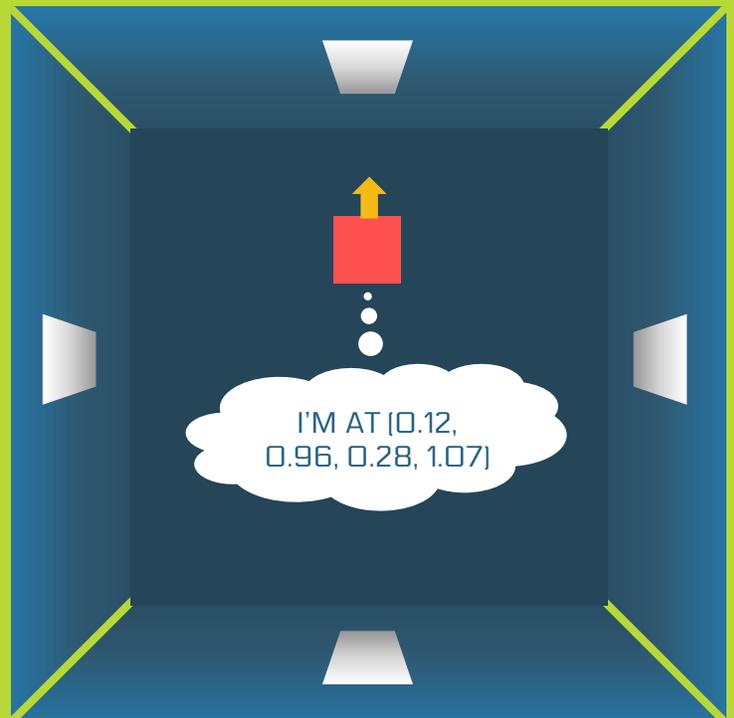
Once a marker has been registered, it can be detected by the program.

A set of axes and a red cube will be overlaid on the marker if it has been detected. The marker's registered number, position, and orientation will also be displayed on the marker.

In the bottom left hand corner of the screen, the webcam's position and orientation will be displayed, once the program has detected at least one marker.



Current Location
of Webcam



Step 8: See the Webcam Position/Orientation on Any Device

The program sends out a packet of information containing the webcam's position and orientation every few seconds via OSC.

To receive this information on another device, make sure you have Python installed. Then make sure you have the file `reader.py`

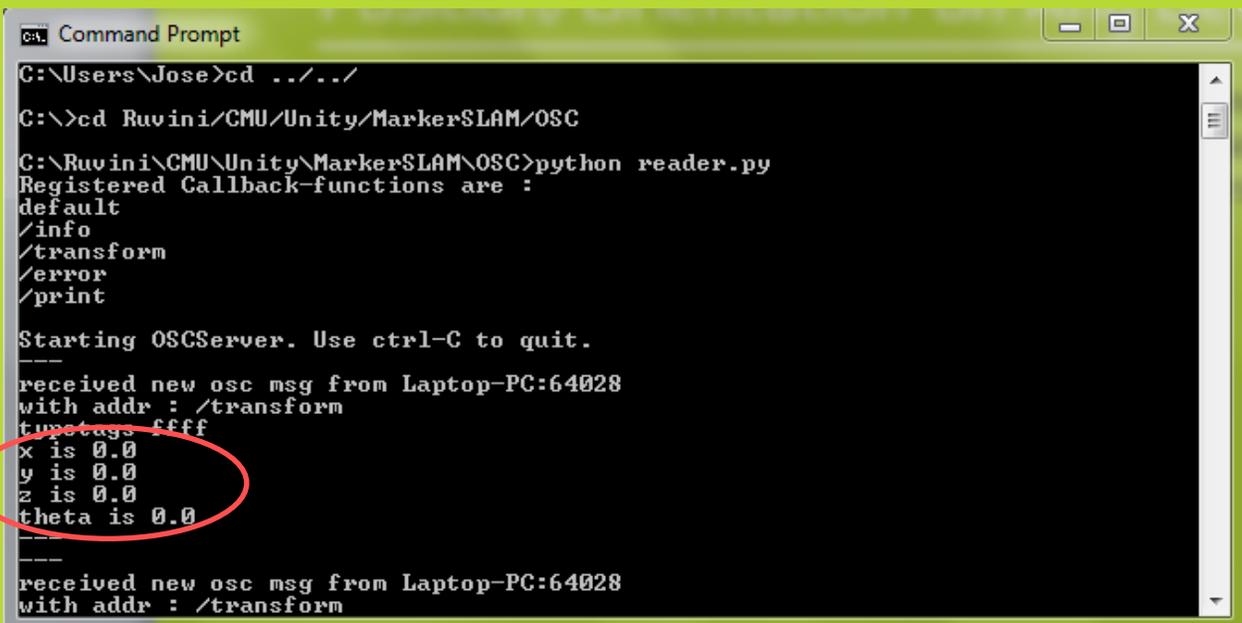
Open Command Prompt, or Terminal.

Go into the folder containing `reader.py`

Type in "`python reader.py`" and click Enter.

If working correctly, Command Prompt should display, "Starting OSCServer..."

Once the Marker SLAM app is running, it will send out the position/orientation information. Command Prompt will then start displaying "received new osc msg..." with the information every few seconds.



```
ca: Command Prompt
C:\Users\Jose>cd ../../
C:\>cd Ruvini\CMU\Unity\MarkerSLAM\OSC
C:\Ruvini\CMU\Unity\MarkerSLAM\OSC>python reader.py
Registered Callback-functions are :
default
/info
/transform
/error
/print

Starting OSCServer. Use ctrl-C to quit.
---
received new osc msg from Laptop-PC:64028
with addr : /transform
type tags: ffff
x is 0.0
y is 0.0
z is 0.0
theta is 0.0
---
received new osc msg from Laptop-PC:64028
with addr : /transform
```

Step 9: Save

Save your all of your registered marker data to use again later.

Click on the floppy disk icon in the bottom right-hand corner.

The program will take a screenshot that will be displayed in the save browser.

Choose a destination to save, type in a filename, then click Save.



Step 10: Load

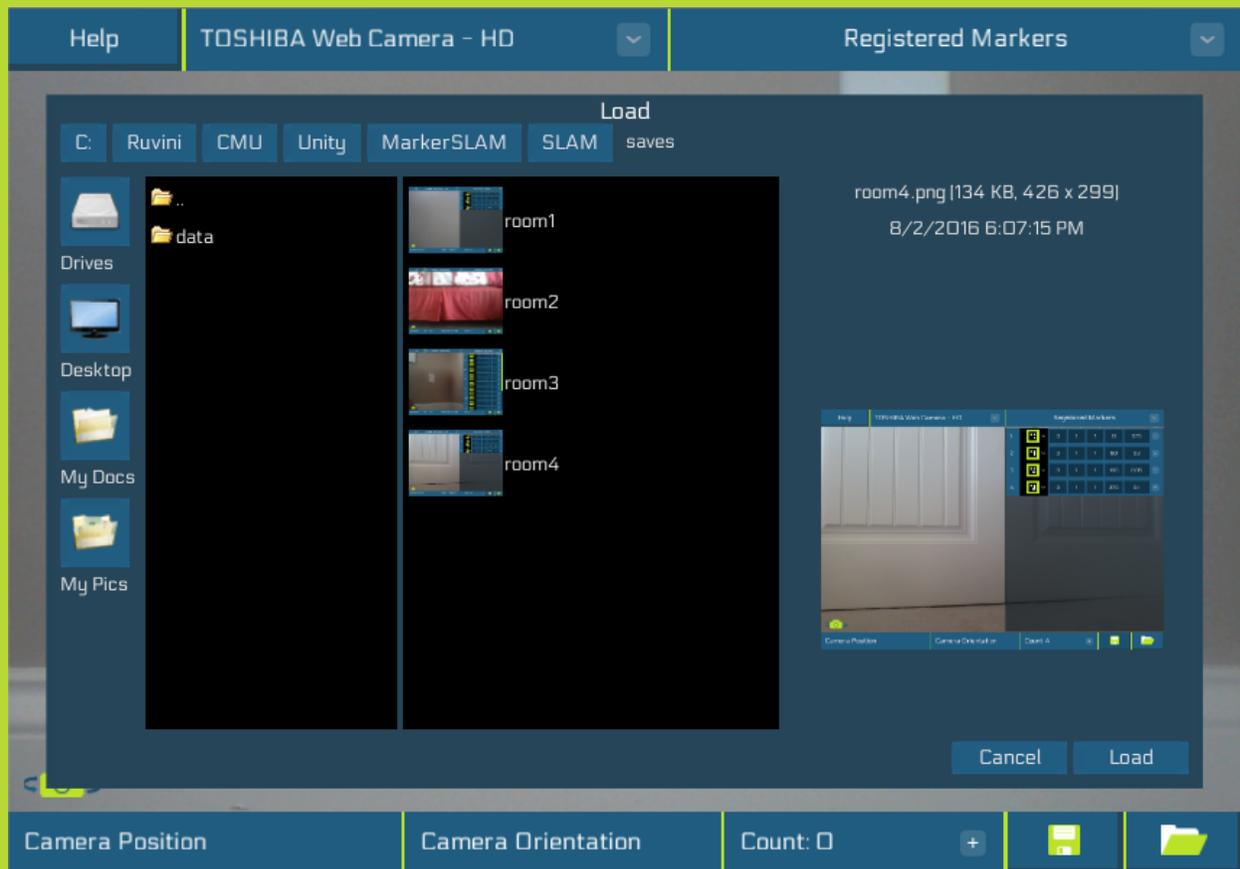
Load a previously saved set of registered markers.

Click on the open folder icon in the bottom right-hand corner.

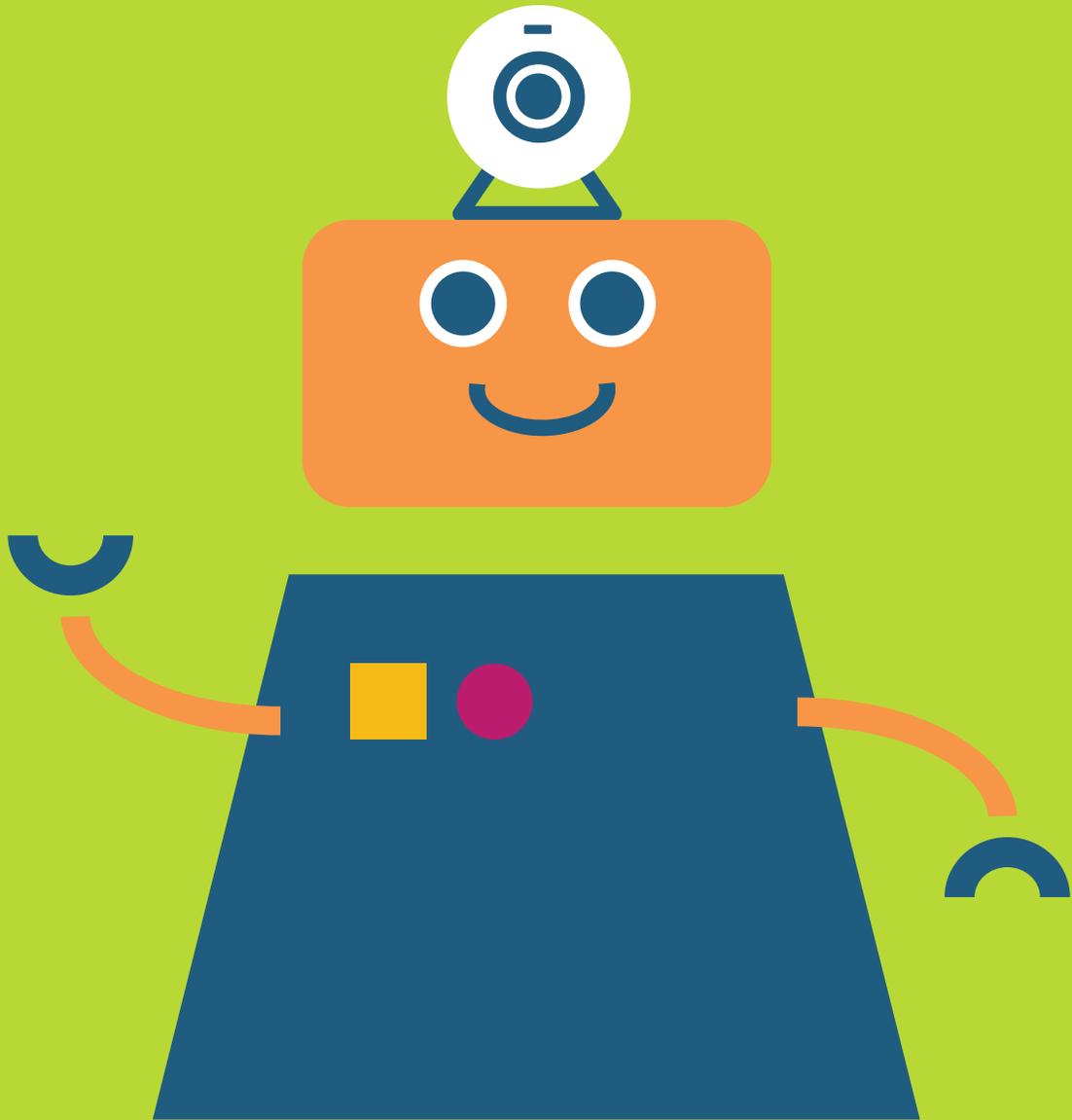
Find the destination where you last saved the marker data.

Click on the file that you want to load.

Confirm this is the correct file by looking at the screenshot that appears.



Thanks for using the app!



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