Moving Screens

The background of a stage is formed of screen segments, each hung from Artnet controlled winches. Ai calculates position and rotation of each segment, and maps the contents accordingly.

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moving, winch, quaternion, uv-map

Background

This project was done for a friend of mine who is the lighting designer for one of Germany's most wellknown comedians. He designed the stage elements and wanted to use Ai to map on the moving segments. This project was used on tour for more than a year.

The background of the setup is formed from a number of segments, each a flat surface of approx. 1 x 2 meters. Five such segments are hung from the rig, each with 3 Artnet-controlled winches. Per segment there is one winch for the top/left corner, one for the top/right corner, and one for the bottom-center point, this winch being suspended more upstage. With the winches in such a setup it is possible to hoist the segment, and to rotate and/or tilt it (within limits). The winches used in this setup feed their current position back via Artnet - and these data are used by Ai to calculate the current position and rotation of each segment. Likewise, more such segments were standing on the ground, on Artnet-controlled rotators, which also fed their current position back. This way it was possible to map contents onto the whole surface.



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Here, Ai was not only used as visualiser, but was the main mapping machine. The show was controlled from a GrandMA2 command wing, and most of the parts were timecoded to be in sync with the music.

Some of the special aspects of this project:

- it was necessary to mimic the real behaviour of the segments, in order to reproduce it from the position data
- something what was completely new to me: we ran into a gimbal lock, and Mr. Dave Green was kind enough to explain this and provide a solution see tbd. (Euler to Quaternions)
- the handles of the projectors and of most of the screen fixtures were hidden from the stage construction page, in order to gain overview
- it is not possible to do a proper softedge on surfaces which can dynamically tilt. Hence it was decided to go for a hardedge, and only some segments were displayed per projector
- as the entire background was always mapped as one big canvas, only one screen was exposed to the Ai GUI. The part each segment was to show was set in the UV map hence, each segment needed to have its designated model.

Used Modules and Patches

- Constant
- Rectangle
- Window
- video out
- Monitor
- Euler To Quaternion
- Formula
- ArtNet Input Large
- Patch IO
- Notepad
- Vector Math

Stage Patch

Again, the whole stage patch can be devided in some sections:

- in the middle there are the main inputs and outputs
- the upper part holds the upper (hung) segments the screens, inputs, and calculations
- the lower part holds the segments which were standing on the ground
- at the bottom there are the projector definitions

Middle: the main inputs and outputs



- there are a few Constant modules to make it easy to set some parameters globally:
 - \circ Height in m sets the general height of where the winches are hung
 - BackChan Univ. sets the ArtNet universe for the data for the background segments' winches
 - MediaSpinn Univ. sets the ArtNet universe for the rotators on the ground
- the little cluster of a Rectangle, a Window and a video out (Output_0) gets its signal from the first screen fixture (which is the only one shown in the GUI) - this allows a quick preview, in a window or on a screen
- the AI OUTPUTS patch and the Multi MonitorOut button are simply moved here when moving modules and patches around they belong to any proper stage patch/project
- Mixer_0 is the only mixer in this patch it stems from the beginning of this project when only one screen was in the patch. Note that as there was only one mixer needed (all screen elements get the same contents and apply their UV map), all other mixers were simply removed, and all screen fixtures get their video input from this one mixer
- Patch IO is not the module but the main IO which is there in every project, to allow connectivity to your network. Here, the DMX Send port needs to be connected to various other patches in order for them to receive the ArtNet data
- the MediaSpinner ArtNet subpatch belongs (technically) to the ground rotators and is explained further down

Upper part: the hung segments

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Y_Pos in m Up1	Y_Pos
0.0	Z_Pos
Z_Pos in m Up1	
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Susp_Width in m Up1	
128	Aleft ≜bs
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Z Position -3.0	In Out
Scale Width 0.01	0.358101
Scale Height 0.01	
Scale Depth 0.0115	EulerToQuaternion Up1
Y Botation 188.0	📤 Heading (Y)
Z Rotation 8.0	Altitude (Z)
Canvas Res X 1280.0	Bank (X)
Canvas Res Y 720.0	x Quaternion
Canvas Scale X 10	U Quaternion
Canvas Scale Y 10	
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For each of the 5 hung segments there are some patches and modules in order to calculate positions and rotation data, and to display the screen segment:

- top-left, there are some constants to define the general position: X_Pos, Y_Pos and Z_Pos set where the segment generally is (its origin), and Susp_Width and Susp_Height let us fine-tune how the segments are rigged (the smaller the suspension distance, the more tilt can be acchieved with a little winch travel)
- Winde 1-3 is a subpatch. It takes the global Artnet Input, Artnet Universe and Height. Also, the IDs of the winches are exposed as inputs and need to be set to match which winch is located where. The patch then takes the Artnet data and calculates the height of each of the three points (left, right, back). These results are then send to the next subpatch Calculate. For an explanation of the calculations see below.
- Calculate is the subpatch where the magic happens: from the height data for each point the absolute position and rotation of this segment is calculated. Inputs are the constants defined

and the positions from the previous subpatch - outputs are position and rotation (angle) data. For an explanation of the calculations see below.

- two Monitor modules were inserted here only to monitor the computed angels
- Euler To Quaternion is another subpatch which is explained below. It converts the computed rotation data to another dimension (Quaternions).
- x_corr is a fader to allow for minor corrections of the x position its value is also sent into the Calculate subpatch
- finally, bottom-left is the screen fixture for this very segment:
 - only the first one is left with its original name AddictFixture_0, and all others were renamed to some other name. This is how Ai works: only fixtures with names in ascending order are displayed with handles in the GUI. Renaming the other screen fixtures removes their handles, but lets them still show up, in the GUI
 - $^{\circ}\,$ make sure to load the correct model into each screen fixture (drag and drop the 3ds file onto the fixture)
 - $\circ\,$ Canvas Res X and Canvas Res Y need to be set to the values the contents is produced in
 - $\circ\,$ Screen Fixture Output is sent to the projectors at the bottom of the stage patch
 - the green Canvas Out is connected only for the very first screen (the one with the mixer) and is patched to our little monitor window (see above)
 - Mix Return gets the main video mix from our only mixer (see above)
 - \circ x/y/z Pos Adj are connected to our Calculate subpatch where they get the positions from
 - x/y/z/w Quat get the special rotation data from the EulerToQuaternion subpatch

Winde 1-3: getting the absolute height data

As described above the subpatch Winde 1-3 takes the Artnet dat and returns the absolut heights for the three points. Double-click the module to reveal its contents:



This should be easy to understand - simply read it left-to-right:

- the (exposed to the parent patch) constants take the Id per winch, and based on this, the following Formula modules compute the two channel numbers per winch
- the ArtNet Input Large module (with the Server Input and Universe ports patched to the Patch IO) return the Artnet values for the 6 channels in question (here it was decided to get the values normalized, i.e. 0..1)
- the 2×8-Bit to 16-Bit subpatch uses a little Vector Math to combine the high and the low channel into one value

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