Hardware

From AMUC Wiki

Contents

VICON MX Motion Capture system

Cameras

- For each capture session, eight Vicon MX-13 cameras were mounted in a square formation, fixed onto a steel scaffholding suspended from the ceiling using a Manfrotto 029 3-way head and clamp. The cameras feature a circular array of near-infra red emitting LEDs. The near infra-red light emits from the camera and is reflected back into the lens from specially coated reflective plastic and foam balls.

The Ceiling-mounted Vicon MX-13 cameras at Culture Lab (circled red).

The Vicon MX-13 camera.

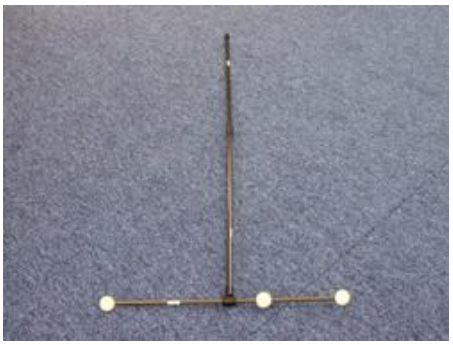
Camera Specifications

Imager :	**CMOS**
Aspect Ratio :	**5:4**
Pixel Size :	**12 microns x 12 microns**
Photosensitive Pixels :	**1280H x 1024V**
Sensor Size :	**15.36 mm (H) x 12.29 (V),19.67 mm (Diagonal)**
Sensor Dynamic Range :	**59 dB**
Digital Responsivity :	**Monochrome 1600 bits per lux-second @ 550nm ADC ref @1V**
Shutter Efficiency :	**>99.9%**
Lens Mounts :	**C and SLR Mount options**
Size (with 20mm SLR lens) :	**215mm (H) x 138 mm (W) x 255 mm (D)**
Weight (with 20mm SLR lens) :	**2.6 Kg**

- On-board image processing allows marker data to be processed close to the sensor in real time. Using Vicon's proprietary, algorithms and high-resolution grayscale images, marker centers and radii are easily identified; merged and occluded markers are handled effectively.
- The MX13+ camera connects via a single cable to the Vicon MX System. Custom-designed cables using robust Lemo connectors carry signal and power to the camera.
- Gigabit Ethernet protocol delivers vast amounts of data from the camera to the Vicon MX kernel in real time. The system allows different camera types from the MX range to be connected and used on the same system architecture. Therefore, camera types can be optimized for speed and resolution depending on requirement.
- Vicon MX offers a choice of high-power strobes with differing wavelengths, which can illuminate markers even at long distances. Moreover, the strobe characteristics can be tuned to the environment through the software.
  - Infrared - emits no visible light, allowing cameras to be inconspicuous.
  - Visible Red - provides the highest power and longest range.
  - Near Infrared - excellent range with almost no visible light*

Markers

A variety of marker materials have been used for the capture sessions. Based on the range of speed of movement and the variable proximity to the cameras, it was decided early on that larger markes would be most appropriate for the predominantly upper-body motion capture that this project involved. Therefore, a 14mm marker set was used and the cameras were thus calibrated. Below is the 390mm 'T' shaped marker wand used for camera calibration and the 'L-frame' used for floor plane calibration:

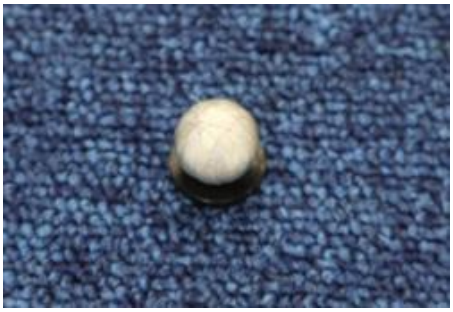


Calibration Wand

Calibration L Frame

Two different types of marker were used, one screwed tightly into to a hard, plastic base (left) and one affixed to a velcro base. The images to the left demonstrate how these were attached.

14mm marker on plastic base



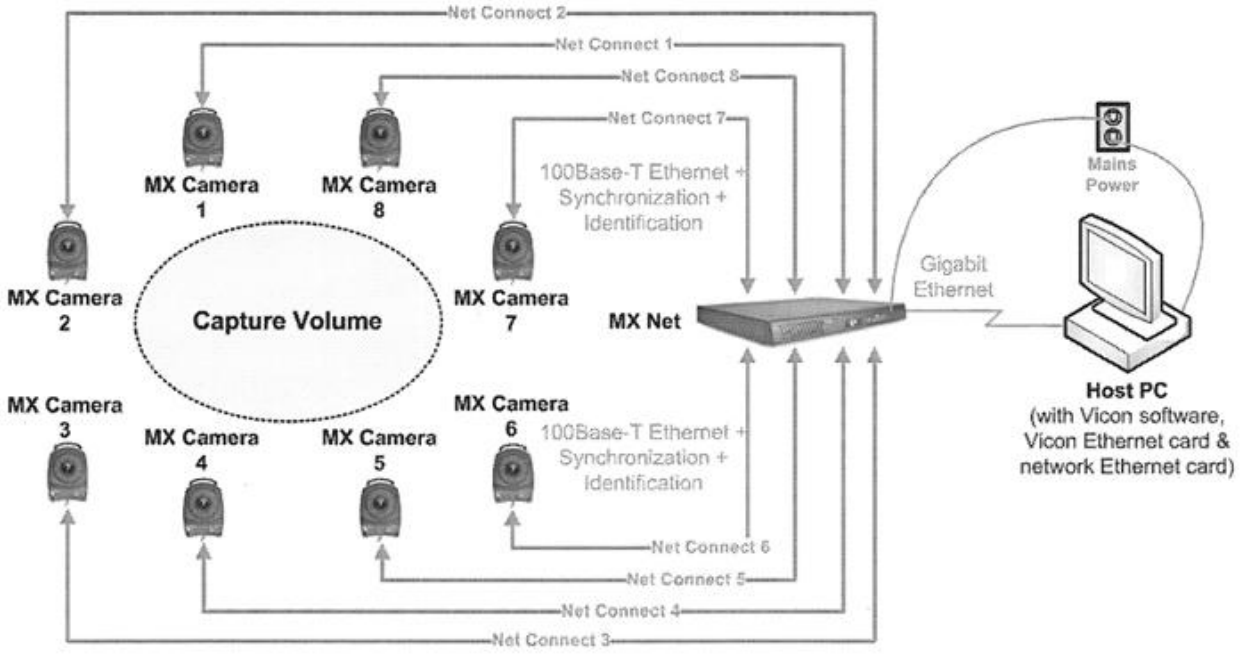
14mm marker on a velcro base

MX Architecture

The Tarsus realtime engine

MX Control units

Vicon MX



- Throughout the project, we used an MX Control unit, linked via proprietory MX cables to an MX Link unit and an MX Net unit. The MX Link allowed for expansion of the number of cameras (each MX Net connects to 8 cameras, therefore an MX Link serves as a 'hub' for additional MX Net units with additional cameras). Since only 8 cameras were used for this project, the MX Link was not used. The MX Net unit connects to each individual camera via the same proprietory MX cables as the rest of the system - these cables were extended into the scaffholding in order to connect to the suspended cameras. This can be seen in the diagram to the right

MX Camera suspended from the ceiling

- A Host PC running Vicon iQ software (see the software section of this wiki) was used to capture the motion data and this was connected via standard ethernet connection. The name given to the real-time engine which collates the data is 'Tarsus'. Using Tarsus, Vicon iQ re-creates the data as a 3 dimensional visualisation with the ability to rotate through 360°, zoom in and out and traverse through the workspace. Tarsus can be seen in the image to the right.
- During the capture, real-time video footage was captured at 25fps using a Panasonic AG-DVX100B miniDV camera. This was split into two seperate signals using an ADVC-300 digital converter and trasmitted into the Host PC using a firewire - as well as into a projector, affording the capture subjects the opporuninty to view real-time feeback of their gestures. An Vicon iQ application plugin entitled 'refvidserver' allowed simultaneous capture of video footage and motion capture data. Thus, for each capture, synchronised video material was captured and automatically archived and labelled with the same description as the capture data.
- In addition to the video projection, capture subjects were able to view trajectories of their performances and gestures via a live feed taken from the software itself. As the image to the right shows, the motion capture trajectories could be re-presented from the raw data via a process of recontruction using a series of pipeline operations (including circle-fits and trajectory labellers). Since this process required a number of calculations, this data was not available in real time, but was rather presented to the subjects immediately following the performance of their gestures.

The Capture Area

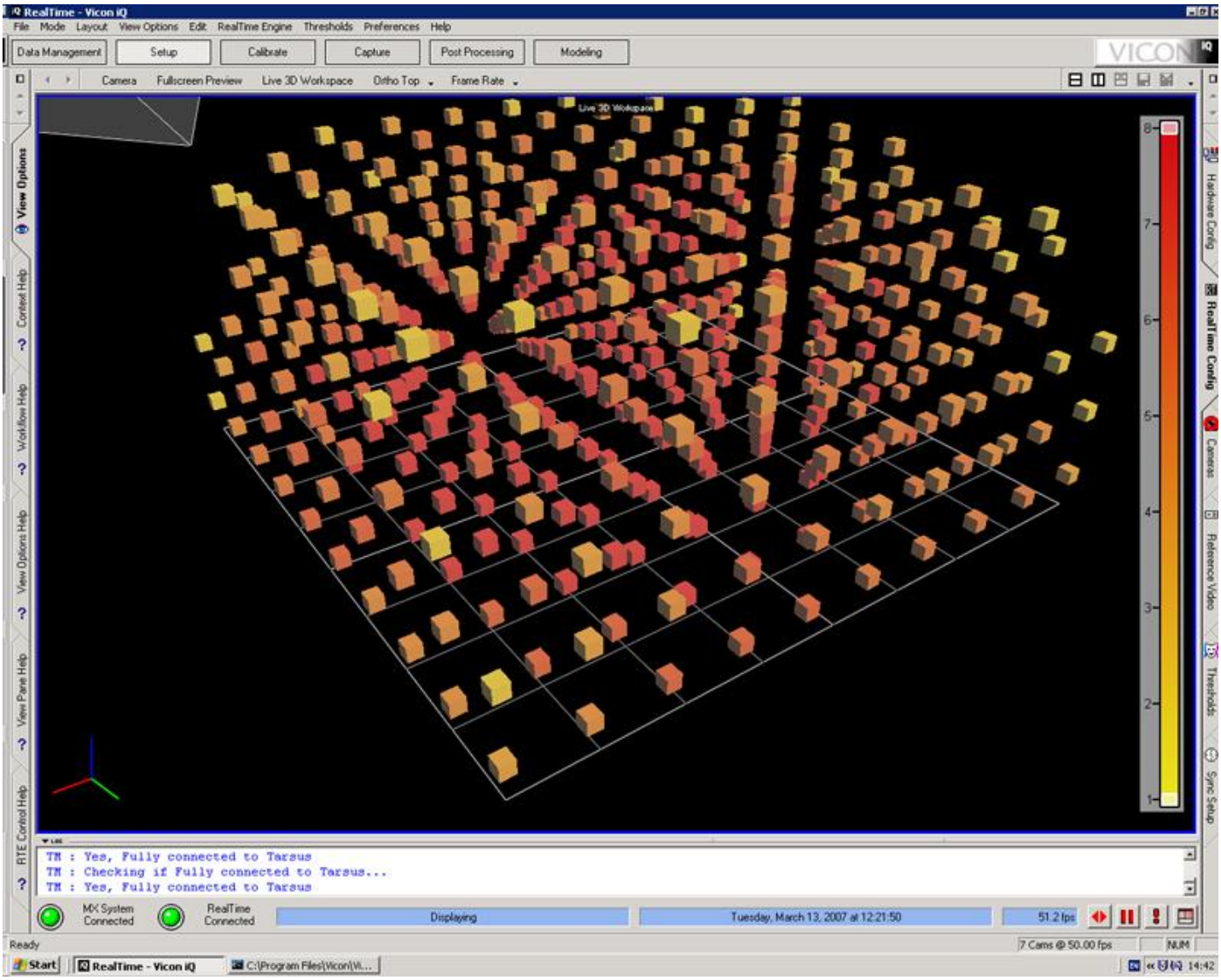
- The Capture Area is a 5m x 5m square, constructed from 6 strips of 1m wide rubber matting material. It is re-configurable, but taped tightly to the floor using high-visibiliy electrical tape. The volume of the capture area is calculated depending upon the position of the cameras. For most of the AMUC capture sessions, the edge of the capture area roughly equated to the the edge of the rubber matting.

The 5m x 5m capture area is comprised of an array of 4mm thick rubber matting in a square formation that emulates the floor-

plane of the projected capture area of the semi-permanent, ceiling-mounted camera arrangement.

- The diagram below is Vicon iQ's 'volume visualisation' tool. This tool uses coloured blocks to represent the areas viewable by 1, 2, 3, 4, 5, 6, 7 and 8 cameras. In this example, red blocks represent the most highly visible areas, whilst yellow blocks represent low visibiliy areas. Since all the cameras are pointing towards the centre of the capture area, the most reliable area for capture is in the red, central zone.

This image shows a labelled, fully reconstructed data model. The lines linking the markers are taken from the rigid model (vsk), created at the post processing stage and used to create continuous tripartite coordinates, and applied to the subject, using algorithms to trace the movement of the model



Drawing materials for live annotation of movement

NEC WT615 multimedia projector Equipped with built-in interactive whiteboard capability, and designed to ensure an ultra-short focal distance, this projector allows graphic notation to be used for data retrieval purposes, and is being used in AMUC as an "intuitive", non-text interface for identifying and annotating motion capture data as a function of different user mappings.