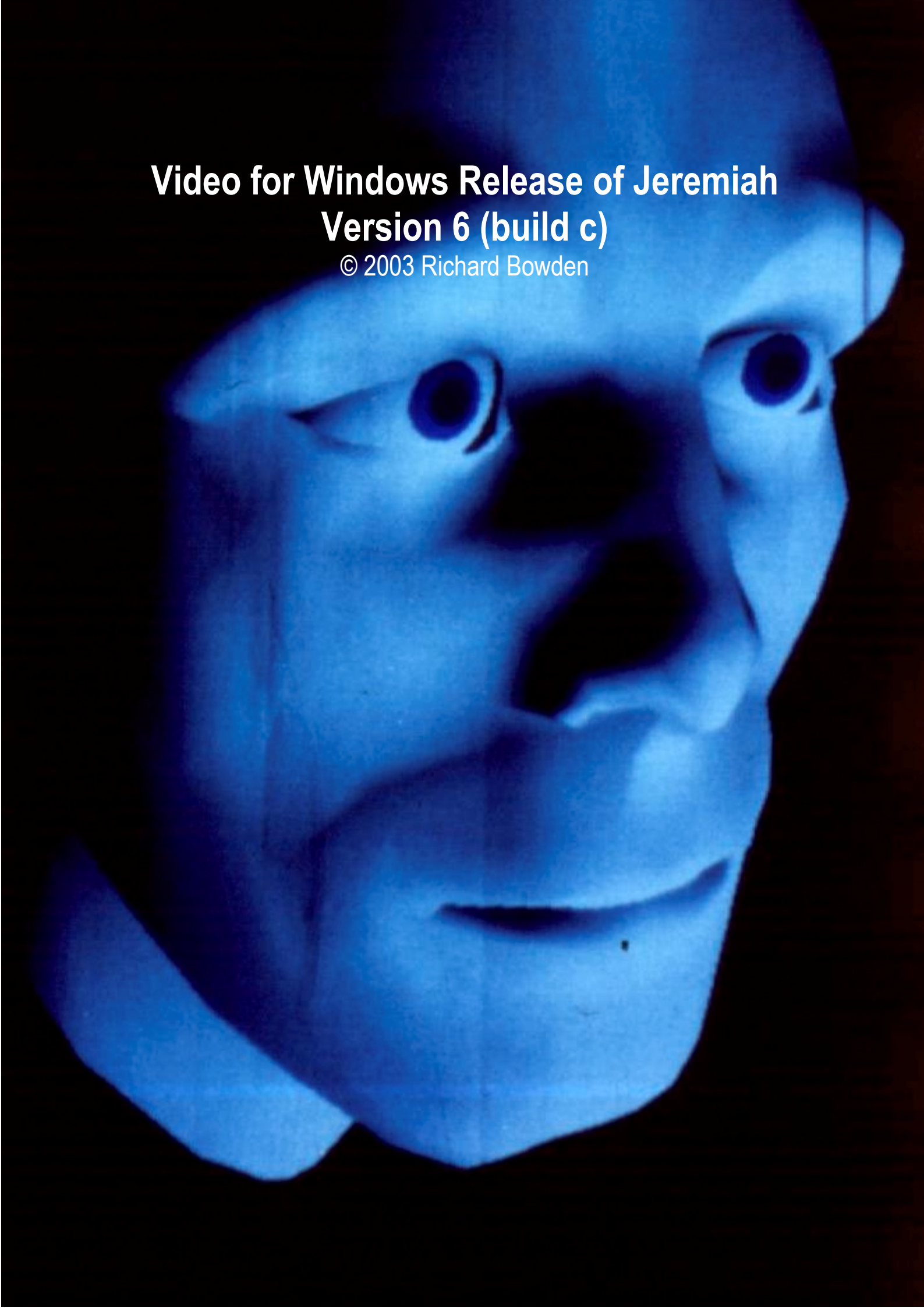

Video for Windows Release of Jeremiah Version 6 (build c)

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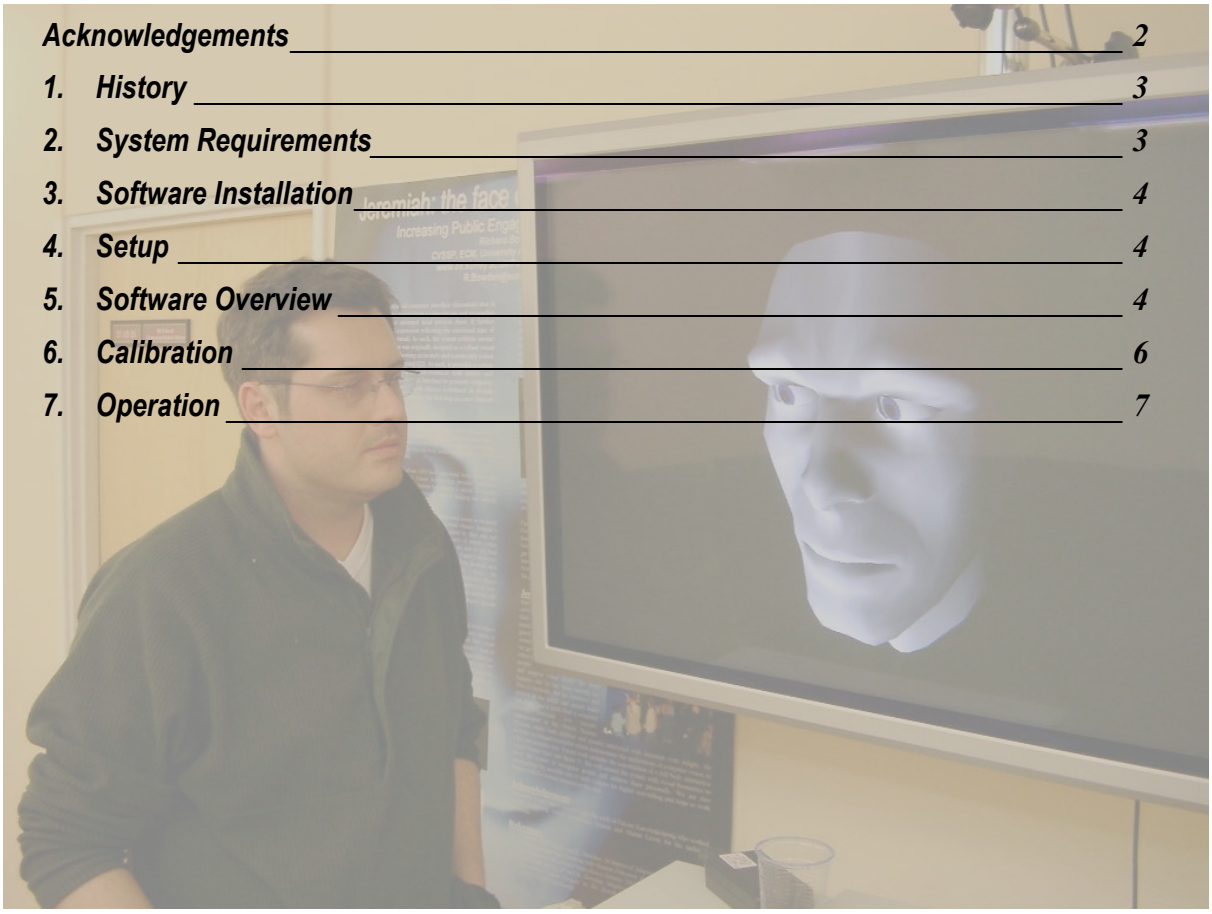
Video for Windows Release of Jeremiah
Version 6 (build c)



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Created by Richard Bowden 2-Feb-03.

Jeremiah's face is based upon GeoFace, a publicly available openGl example program. The basic modelling for Saul was provided courtesy of BBC Imagineering.

Jeremiah's vision system is based upon the base layer of a visual surveillance system developed by Pakorn Kaewtrakulpong and Richard Bowden and adapted for use within Jeremiah by Richard Bowden. Elements of this code are based on the MS Vision SDK and ownership of these elements remains with Microsoft. The authors would also like to thank Martin Lewin who contributed to the development and installation of the system through various releases and incarnations (see history).

For a more technical insight into how Jeremiah works the interested reader is directed to:
www.ee.surrey.ac.uk/Personal/R.bowden

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1. History

Jeremiah was originally constructed as a virtual character in a collaborative performance project between science and arts and then later as a tool for the public understanding of science. In his original form he was completely written in openGl running on Silicon Graphics workstations. His migration to PC has gone through a number of incarnations from proprietary acquisition hardware to this, the latest Video For Windows (VFW) release. Version 6 build c is the first version designed to be used by a 3rd party. As such, much of the setup and tuning as been removed to try and make its operation transparent. As a consequence many aspects of the system have been revised. These include the auto-parameterisation of emotions and, as such, its behaviour and consistency over long term operation is unknown.

2. System Requirements

The system is designed to run on 2 separate machines termed “head” and “eyes”. The machine designated “head” generates the graphics for either Jeremiah, Saul or a virtual world while the machine designated “eyes” handles the computer vision elements. A similar specification machine can be used for both machines however it is important that the machine designated “head” should have a hardware accelerated graphics card and the machine designated “eyes” include a suitable Video for Windows acquisition card. A network connection between the 2 machines allows the computer vision and graphics components to communicate. This network connection should be operating at 100MB/s. Integration into an existing 100MB/s network is possible. However, as the system can use UDP network broadcast protocols, it is recommended that the network is isolated using a simple UTP crossover cable or small hub to connect the machines. Although the system can run on a single machine, the image processing places considerable demands upon processing power and the video for windows version of the software will periodically stall when ran on the same machine as the graphics. This is a known issue and there are no immediate plans to rectify it. For this reason it is recommended that all other programs are closed when Jeremiah is in operation.

Recommended Machine Specification:

HEAD:
P4 or Athlon 1GHz or greater (PIII 500MHz minimum)
Memory, >256MB
Windows 2000. (Software should run under Windows XP but not all components have been tested)
Hard Drive large enough to hold OS. (>1GB)
Hardware accelerated AGP graphics card supporting OpenGl, (GeForce2 or above recommended)
10/100 network card.

EYES:
P4 or Athlon 1GHz or greater (PIII 500MHz minimum)
Memory, >256MB
Windows 2000. (Software should run under Windows XP but not all components have been tested)
Hard Drive large enough to hold OS. (>1GB)
10/100 network card.
WinTV card with composite/S-Video input (should work with other Video for Window devices but all components have not been tested)

Other :
Network cross over cable
PAL/NTSC (Composite) Video camera with variable FOV and AGC/White Balance control.

3. Software Installation

Ensure that up-to-date drivers are installed for graphics and acquisition cards. Also ensure that network protocols are installed and the 2 machines are communicating. The network comms will run over what ever protocols are installed. If TCP/IP does not work, try IPX or NetBUI. If multiple protocols are installed the system will use the most appropriate.

Unzip the package into a temporary directory. The installation should contain five items:

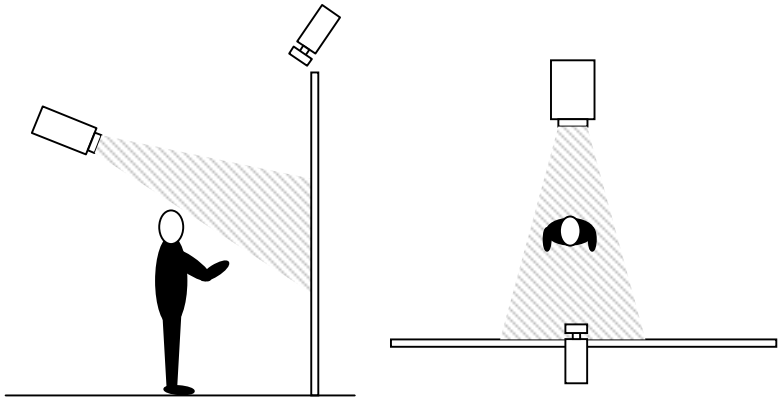
1. A directory called “eyes”
2. A directory called “head”

that constitute the two operational elements of the system.

3. A directory called registry which contains the VFW entry to be added to the registry
4. A directory containing a non-operational demo of Saul
5. This readme document in pdf format.

First, copy the registry directory to the machine designated eyes and double click the registry file “VisVFWCamera.reg”. This will install the VFW capture device for the software. Copy the “eyes” directory to the machine designated “eyes” and the “head” directory to the other machine.

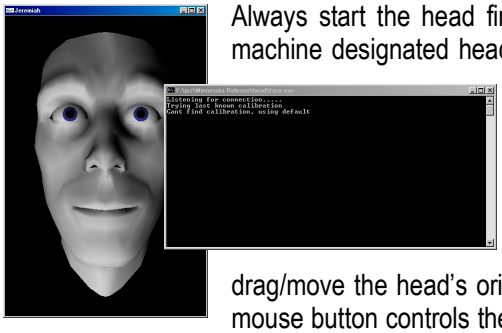
4. Setup



The hardware set-up of the system depends upon the environment and hardware used but in general the camera is placed above the display looking at the space directly in front of the display. This display can be a large back projection or alternatively projected from above the participant’s head as shown in the figure. The field of view of the lens of the camera should be selected so as to cover an appropriate area in front of the display, this typically involves 120° to 180° field of view. The picture shows a smaller installation on a plasma screen with the camera mounted above and pointing down. The viewable region for this setup can be seen in section 5.

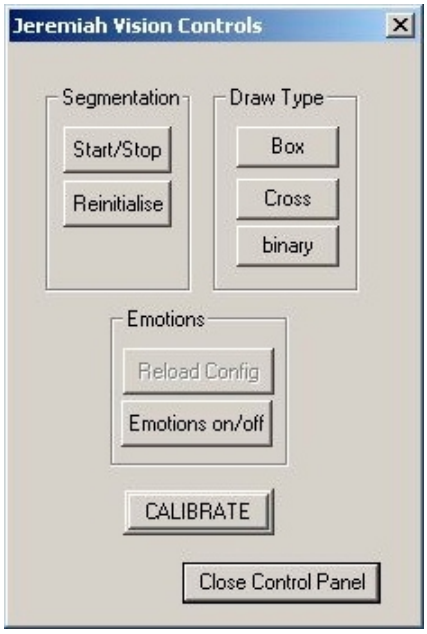
Connect the video camera to the input of the WinTV (or other VFW device) on the machine designated eyes and the VGA cable of the machine designated head to the display device. Switch Auto Gain Control (AGC) and White Balance (WB) to off and **fix** a suitable shutter speed and iris.

5. Software Overview



Always start the head first by double clicking the executable “face.exe” on the machine designated head. Two windows should appear, a MSDOS prompt and an openGl window containing a face. Ensure the face is selected and press ‘f’ to make it full screen. Pressing ‘f’ again will return to window view. Any errors or user feedback will be provided in the MSDOS window. Pressing ‘q’ or ‘esc’ at anytime will close the application. The left mouse button can be used to drag/move the head’s orientation within the window (see calibration). The middle mouse button controls the light in the scene. It will attempt to load the last known good configuration. If this cant be found, the default will be used. If the head is grey in appearance it is in normal operation and waiting to receive commands from the vision system. If the vision system is running you may find the head appears to be moving randomly.

Run the application “eyes.exe” on the machine-designated eyes. You should see an application popup called “Jeremiah Vision System VFW V6” Within this you should see the live video stream from the camera. Overlaid on this video stream are numerous grey boxes, which show the objects Jeremiah can see. The box with the blue cross is the object of most interest to Jeremiah at any one time. In the top right of the window is a bar chart illustration of his current emotional state. You should see these change depending upon the activity in the camera. You can switch the vision elements on or off using the “on/off” icon at the end of the tool bar. To the left of this icon is another called “C panel” which will bring up the control panel for Jeremiah. This can also be brought up via the menu option “Controls”. In the bottom right of the window you will see the current number of frames per second being processed. This should read 25fps (PAL) or 30fps (NTSC) for normal operation.



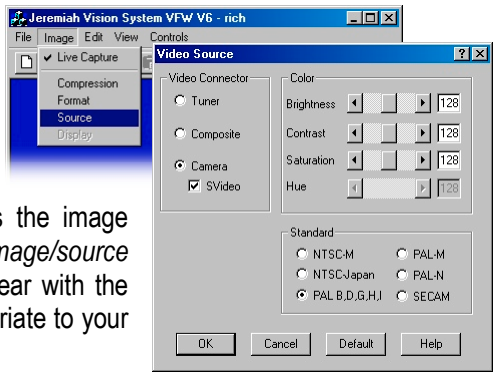
The control panel contains 3 basic groups of buttons:

Segmentation: The first button starts or stops the image processing and performs the same function as the on/off button on the tool bar. The “reinitialise” button restarts the algorithm and relearns the scene. The system will take approximately 40 secs to become stable, although reasonable operation should start to resume within 5-15 seconds.

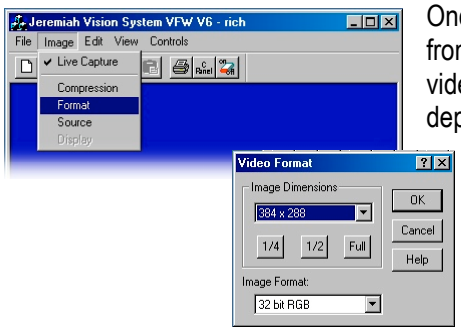
Draw Type: Refers to what information the algorithm displays. The only one of interest is the "binary" button which displays the binary segmentation that Jeremiah sees. It shows what the system thinks is background in black and foreground objects in white.

Emotions: Contains a disabled button for emotion configuration (“Reload Config”) which has been replaced by an automated version in this release (v6c, See section 1. History). The “emotions on/off” button turns the emotions on or off while the object tracking continues.

Finally is the calibration button, this allows you to correlate the camera to the direction of gaze (see section 6. Calibration).



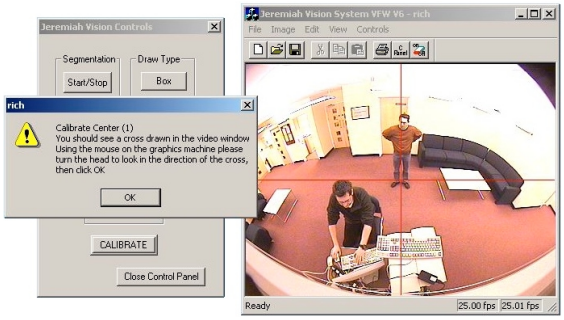
When the Vision System initialises you may see a blue video window. If this is the case the software is either not configured to use the correct video source or the camera is not connected correctly. If this is the case, click the on/off icon to stop the application attempting to process the image stream (as this can slow down mouse interaction). Select *image/source* from the Vision System menu. A pop up window will appear with the configuration details for the video source. Set these appropriate to your configuration and camera type.



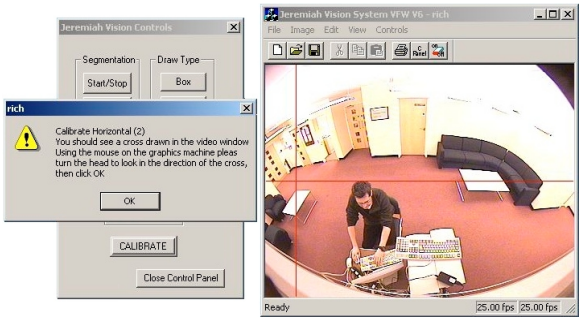
Once done close this window and select the video format option from the same *image* drop down menu. Choose half resolution video dimensions (the exact dimensions of which will vary depending upon PAL or NTSC video signals) and set the image format to 32 or 24 bit RGB. Once closed you should now see the live video feed in the window. Ensure that the frame rate (in the lower right corner) says 25-30fps with the image-processing running.

6. Calibration

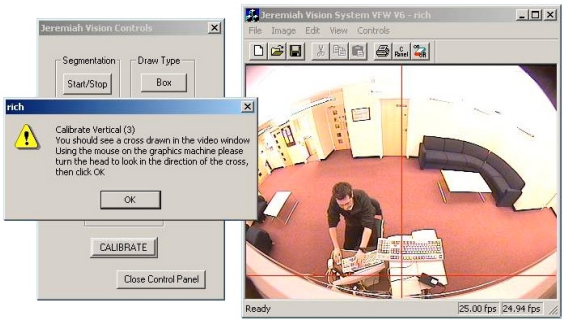
Press the calibration button. The head should turn red and a popup window should appear asking you to line up the direction of gaze with the cross. Using the left mouse button on the machine designated “head” turn the head so it is looking directly at that position. As a useful aid get someone to stand with the cross-centred on their middle and turn the head to look at them. Then click “ok” on the machine-designated eyes.



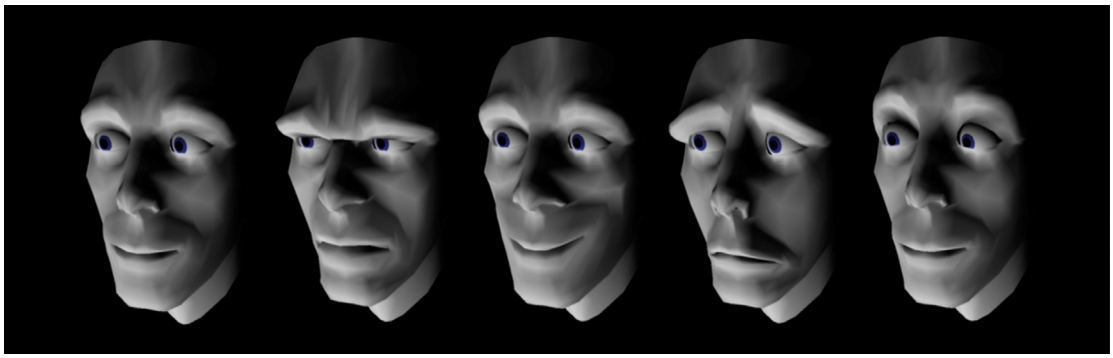
The head should now turn yellow and the cross should move to the left of the video screen. Repeat the procedure, be careful not to over compensate for perspective, it’s easy to overestimate this angle.



After clicking “ok” again, the head will turn blue and you should again repeat the procedure to align the head in the vertical direction.



Clicking ok again should finish the calibration, you should receive a message box asking you to try the calibration. The head should have returned to its default colour and it should be tracking any objects it can see. Walk around and see how well the calibration performs. If it is not suitable you can repeat the procedure until you are happy with the results. Each time the calibration is performed it is saved to disk and automatically loaded again when the system is restarted. Each time a calibration is performed the last calibration is copied to “calibration.old” on the machine designated “head”.

7. Operation

Within a few seconds Jeremiah is capable of learning a background sufficiently accurately to segment moving foreground objects. The model is constantly updated so subtle changes in scene structure or lighting are accommodated by the model and do not lead to failure. If a chair is placed in his field of view then he will see the chair. But if the chair remains static eventually he will get bored of the chair and will incorporate the chair into his model of the world. However, if the chair is then removed he will not get confused by the change in scene structure as he remembers what it looked like before the chair was present. Therefore, any object which enters Jeremiahs field of view can be seen by him. From all visible objects a specific object of interest is randomly selected weighted by its size and motion i.e. large fast objects are more likely to attract Jeremiahs attention. Once an object of interest has been selected the eyes of Jeremiah look in that direction. Depending upon the physical difference between the orientation of the head and eyes the head may follow to turn and face the object. Given multiple objects of interest this results in Jeremiah sharing his attention between objects. The simple emotions gained from this visual stimulus are reflected by the current facial expression of Jeremiah i.e. the happier he is, the more he will smile. The figure shows the basic expression of Jeremiah (default, angry, happy, sad and surprised). All this results in an artificial system that exhibits similar behaviour to that of a child.