



## **Camera requirements for video telephony with sign language**

There is a good potential in using Notebooks with built-in cameras as videophones for sign language communication with deaf people.

But often the cameras and drivers deliver too blurry pictures to be possible to use. There must be a change in the camera driver designs if it shall be possible to fully exploit the opportunities with this technology.

Modern webcams often cause severe problems for sign language communication, and annoyance for any user.

This is a description and explanation of the requirements, with the aim to give clear information to camera manufacturers and driver developers for meeting the user needs.

### **Summary**

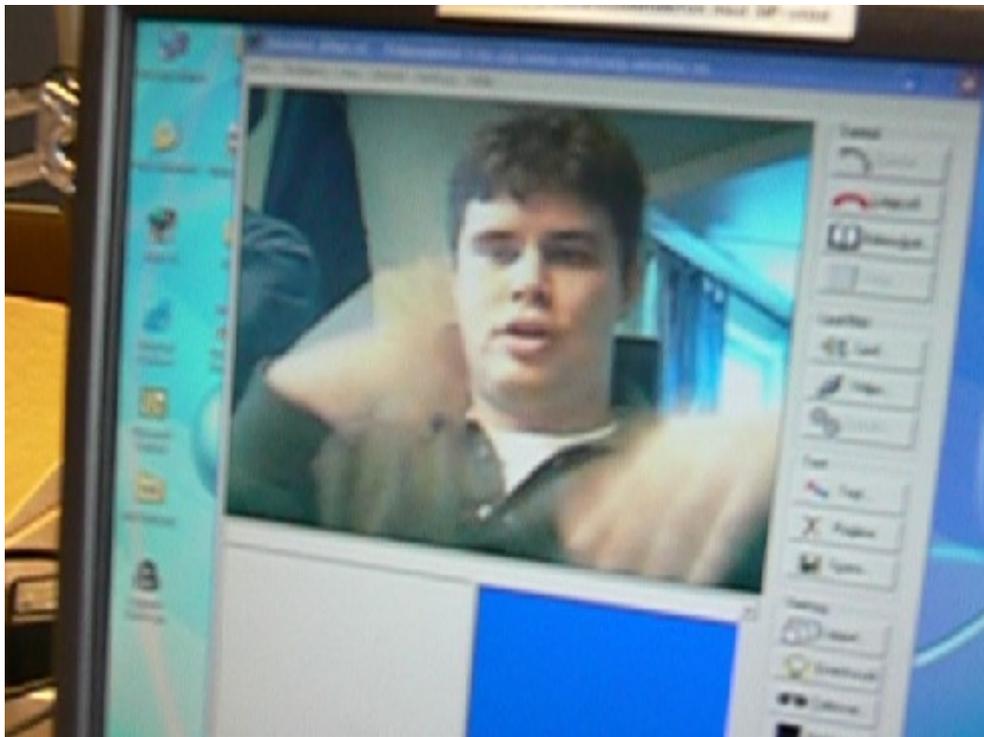
The cameras and drivers used for video communication should be designed according to the following rules:

1. Use 20 ms exposure time whenever possible.
2. Allow use of 40 ms exposure time but not more in dark situations.
3. Apply the exposure time limitation on the automatic exposure setting mode.
4. Store all settings and restore them every time the camera is initialized.
5. Design cameras so that the horizontal viewing angle is 52 - 64 degrees when using 4:3 picture proportions.
6. A good capturing resolution is 352\*288 pixels ( 0.1 Mpixels). The driver shall not give high load on the processor for capturing video. Processing power need to be available for video compression for transmission.
7. It shall be possible to use a frame rate of 25 fps or 30 fps.
8. Aim at good functionality in varying light conditions at least down to 30 lux illumination.

## Main problem - blur in motion

The most often occurring problem is that the exposure time for each frame gets too long, so that the result is blurred images. When the video is used for sign language, it is important to see the handshape even if the hands are moving.

This picture shows an example of the result when too long exposure time is used and it gets hard to perceive the handshape of the moving hands.



*Picture 1: Example of too blurry image during video telephony for sign language.*

## Investigation of required longest exposure time

In order to assess the best and the longest acceptable exposure time, a series of photos were taken of a signing person with different exposure times, and an evaluation made of to what degree the handshape is perceivable in the picture.

The result is the following.

<b>Exposure time</b>	<b>Usability for sign language</b>
10 ms	Good ( but experience from real use indicates that there is a risk that fingers look doubled)
20 ms	Good

40 ms	Possible to use with some limitation
67 ms	Barely usable
100 ms	Unusable
> 100 ms	Unusable

**Conclusion for exposure time 20 ms is optimum, 40 ms is permissible**

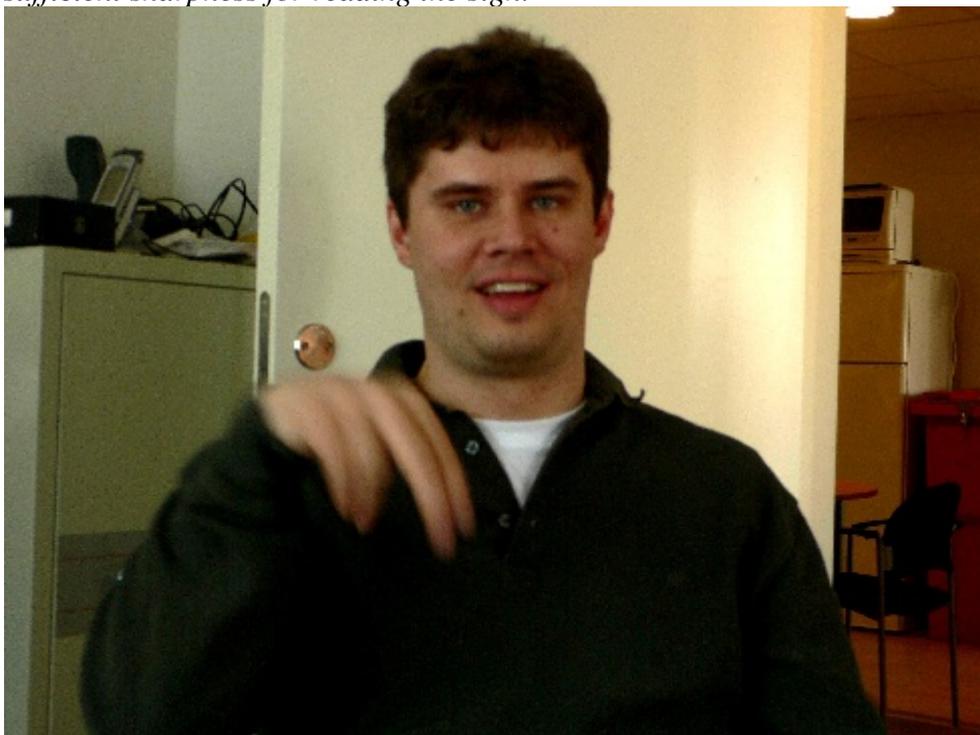
A design rule should be to use 20 ms exposure time whenever possible. In dark conditions it is acceptable to increase to 40 ms to maintain brightness. Longer exposure times must not be used. Pictures showing the background of this design rule.



*Picture 2: from making the sign for Norway taken with 10 ms exposure time, showing good sharpness for reading the sign.*



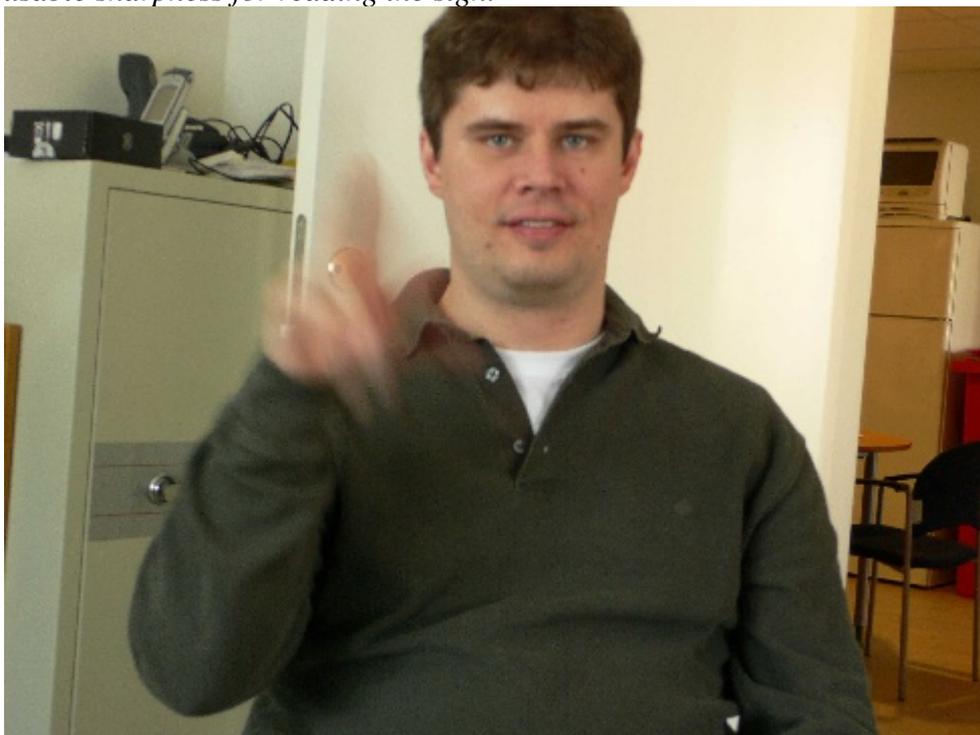
*Picture 3: from making the sign for Norway taken with 20 ms exposure time, showing sufficient sharpness for reading the sign.*



*Picture 4: from making the sign for Norway taken with 40 ms exposure time, showing usable sharpness for reading the sign.*



*Picture 5: from making the sign for Norway taken with 67 ms exposure time, showing barely usable sharpness for reading the sign.*



*Picture 6: from making the sign for Norway taken with 100 ms exposure time, showing unusable sharpness for reading the sign.*

### **Use of automatic exposure setting**

It is very desirable to have automatic exposure control. Otherwise the user is required to make manual exposure settings for all changes in lightning. The experience is that with some cameras and drivers it is impossible to use the automatic setting because it easily generates

too long exposure time. With some cameras it has been possible to temporarily use manual settings of exposure time and brightness to achieve a reasonable result. It is desirable that the brightness control is possible to operate when in automatic exposure setting mode. The exposure time requirements should be applied in the automatic exposure setting mode. Save and restore selected parameters

It is very important that all settings done to the camera drivers are stored, and restored each time the camera is opened.

### **Viewing angle**

The viewing angle of the camera must be sufficient for use with sign language in convenient usage distance. When used in a normal personal videophone call for sign language, the distance between the person and the camera is usually around 800 mm.

On this distance, the camera view needs to be wide enough to allow hands to move in sign language from stomach to top of head and to slightly beside shoulders.

The resulting requirement is that with standard 4:3 image proportions, the viewing angle should result in between 800 and 1000 mm horizontal width on 800 mm distance from the camera. This corresponds to a horizontal viewing angle of 52 - 64 degrees.

### **Resolution**

There are two common resolutions used in communication. CIF: 352\*288 and QCIF 176\*144. For personal communication it is not needed with any higher resolution than CIF. It is important that the camera drivers do not overload the processor with work to capture and downsample video images with too high resolution.

It has become too common in camera designs, to increase number of pixels sacrificing other performance figures. Many 2 MP cameras and higher have very poor low light characteristics compared to 0.3 MP cameras and 1.3 MP cameras.

CIF resolution only requires 0.1 MPixels. A camera resolution of 0.3 MPixel is therefore more than sufficient, and higher resolutions should only be tried if they meet all other requirements in low light conditions. (see below on Light Conditions).

### **Frame rate**

The frame rate for sign language communication should be higher than 20 frames per second. The standard figures of 25 fps or 30 fps are good and sufficient.

### **Light conditions**

A computer can become used in largely varying light conditions. The problems described above are most common in low light conditions. Many users are using the devices in home environments, where the lighting often is as low as 30 lux, and sometimes even lower, in the 10 lux range.

So, all requirements above should be met in light conditions at least down to 30 lux.

## **Contact information**

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