Nyquist point **511**. The human eye is most sensitive to low frequencies, so the attenuation should be maximum at twice the Nyquist frequency to minimize the aliases at low frequencies. An alias at a low frequency appears to make the picture shimmer, like French Moire silk, giving this effect its name of a "moire pattern".

The initial filter **502** does a good job of removing low frequency aliases, however no narrow window filter can remove aliases near the Nyquist point. These aliases near the Nyquist point are now removed by the second filter **505**. This filter can afford to have a much wider window than the prefilter for reasons mentioned above, and therefore introduces very little aliasing of its own, thereby taking from the first signal response **503** that low frequency portion that has minimum aliases. The final response **515** can be extremely flat within the passband allowed by the spacing of pixels in the final chosen output C resolution **507**, giving excellent image sharpness, while the residual aliases **517** remain very low at all important frequencies, giving a smoothness to the image. Combined, the image is described by observers as looking "clear", and can produce equivalent clarity with far fewer pixels than in a prior art system that samples by physically placing the sensor elements at the locations of the final chosen output resolution pixels.

In summary, this invention achieves image clarity by physically oversampling the object to be scanned. This oversampling pushes aliases out to very high frequencies. The resolution is then reduced with digital filtering in a way that preserves both flat frequency response and low aliasing. This digital filtering is made practical using a two filter process. The first step makes a rough cut to bring the response close to final resolution. The second step makes a precision cut by trimming the edges of the rough cut image.

While the invention has been shown and described with reference to particular embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and detail may be made therein without departing from the spirit and scope of the invention.

I claim:

1. A scanner for converting an image on a substrate comprising:

a sensor for converting the substrate image into an array of analog pixels at a first sampling frequency;

a digital converter for converting the array of analog pixels into a first array of digital pixels stored in a digital memory;

a sinc digital filter for converting digital pixel values contained in the first array of digital pixels which are linearly representative of the brightness of light as the image is intended to be displayed to digital pixel values stored in a second array of digital pixels at a second sampling frequency lower than the first sampling frequency; and

means for outputting from the scanner apparatus the digital pixel values of the second array of digital pixels.

2. The scanner as recited in claim **1** wherein the second sampling frequency is lower than the first sampling frequency by an arbitrary ratio.

3. The scanner as recited in claim **1** wherein the output means comprises means for outputting numbers the digital pixel values of the second array of digital pixels.

4. The scanner as recited in claim **1** wherein the sensor comprises means for deriving a signal corresponding to a generally square root function of the brightness of light sensed by the sensor means.

5. The scanner as recited in claim **4** wherein the sinc digital filter produces the second array of digital pixels from numbers corresponding to generally the square function of the digital pixel values contained in the first array of digital pixels.

6. The scanner as recited in claim **1** wherein the sinc digital filter further comprises means for adding a portion of a first digital pixel value of the first array of digital pixels and subtracting a portion of a second digital pixel value of the second array of digital pixels for deriving a digital pixel value in the second array of digital pixels.

7. The scanner as recited in claim **6** wherein the sinc digital filter passes a set of frequencies from the first array of digital pixels, lower than half the second sampling frequency, with an attenuation substantially the inverse of an attenuation with which the optical system attenuates the frequency.

8. The scanner as recited in claim **1** wherein the first and second array of digital pixels, and an intermediate array of digital pixels, contain substantially perpendicular rows and columns of pixels, and wherein the sinc digital filter further comprises means for converting the digital pixel values contained in a column of pixels of the first array of digital pixels to digital pixel values that are stored in a column of pixels of the intermediate array of digital pixels.

9. The scanner as recited in claim **8** wherein the sinc digital filter further comprises means for converting the digital pixel values contained in a row of pixels of the intermediate array of digital pixels to digital pixel values that are stored in a row of pixels of the second array of digital pixels.

10. The scanner as recited in claim **9** wherein a prescaled digital array of pixels contains mutually perpendicular rows and columns of pixels, and wherein the sinc digital filter further comprises a prefilter for converting the digital pixel values contained in a set of rows of pixels of the first array of digital pixels to digital pixel values that are stored in a row of pixels of the prescaled digital array of pixels, and wherein the intermediate array of digital pixels is derived from the prescaled array of digital pixels.

11. A method for converting an image on a substrate comprising the steps of:

a sensor for converting the substrate image into an array of analog pixels at a first sampling frequency;

a digital converter for converting the array of analog pixels into a first array of digital pixels stored in a digital memory;

a sinc digital filter for digitally converting digital pixel values contained in the first array of digital pixels which are linearly representative of the brightness of light as the image is intended to be finally displayed to digital pixel values stored in a second array of digital pixels, at a second sampling frequency lower than the first sampling frequency; and

means for outputting from the scanning apparatus the digital pixel values of the second array of digital pixels.

12. The method as recited in claim **11** wherein the second sampling frequency is lower than the first sampling frequency by an arbitrary ratio.

13. The method as recited in claim **11** which further comprises the step of adding a portion of a first digital pixel value of the first array of digital pixels and subtracting a portion of a second digital pixel value of the second array of digital pixels for deriving a digital pixel value in the second array of digital pixels.

14. The method as recited in claim **13** further comprises the step of passing a set; of frequencies from the first array of digital pixels, lower than half the second sampling frequency, with an attenuation substantially the inverse of an