Giotto

Retina-like Camera

## High performance & low user cost space-variant CMOS digital camera

Information saving

Giotto - mimicking the information saving approach of the human retina - is able to soften the trade-off between image resolution and image dimension.

The sensor has an increasing resolution from the periphery up to the center achieving at the same time a high resolution in the focus point and a broad field of view while limiting the amount of information to be acquired and processed.

The pixels are randomly accessible allowing - if required - the acquisition of smaller regions.

The retina-like configuration gives a more than 30 times reduction in the image dimensions still providing a good perceptual representation thanks to the optimal match between sensor's resolution and retinal resolving power. Such an advantage can be used for a faster frame acquisition or for a lower processing load.
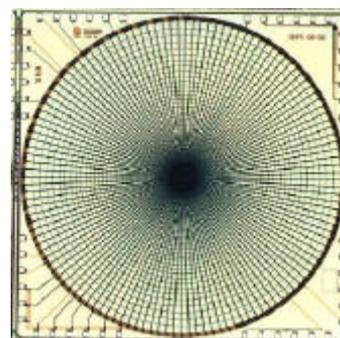
Chip Lay-out
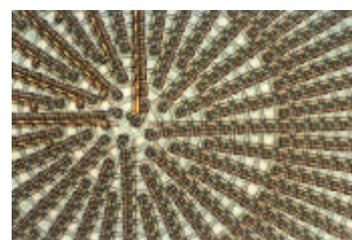
Detail of the central part

Dynamic response

Giotto retina-like sensor is manufactured in CMOS technology. Each photoreceptor has a non-integrating logarithmic response to lighting variations and consequently a wide dynamic range and a good quality image under different illumination conditions.

Log-polar image

Regular image

Optimized images

Giotto retina-like camera has a digital output with a rectangular image in *log-polar* format where each ring of the sensor is mapped into a line of a rectangular grid. The log polar mapping is conformal and any "traditional" local processing can be used without modifications (e.g. edge detection, filtering etc.). A simple remapping through a look-up table is sufficient to convert it into a *regular* image.

At present with about 8,000 photosites the sensor produces a rectangular array of 128x76 pixels with a field of view/max resolution equivalent to about a 360,000 pixels uniform sensor.

Giotto is supplied as a system:

- the driving software running under Windows '95, Windows-NT 4.0 and Linux
- the camera, acquiring images up to 100 frames/sec.

When interfaced with the parallel port of a Pentium PC, Giotto system performances are:
- limited by the parallel port speed on the EPP mode - max. 50 frames/second
- linked to the processor power of the host machine.

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Potential areas of application

The trade-off between image resolution and image size is a critical issue for applications where bandwidth and/or computing power is limited.

The intrinsic information saving characteristic of Giotto offers a strong potential for high performance/low user cost applications in fields such as:

- **remote surveillance**, where it is possible to connect several cameras and transmit useful images on a single physical support (even a twisted pair)
- **robotics, automation and inspection**, reducing the computational requirements and therefore increasing system performance
- **emergency communications**, where the quality of a line connection is not guaranteed and therefore it is necessary to operate in minimal conditions
- **space applications**, where power consumption and volume of computational devices have an enormous cost
- **videotelephony** where strong image compression is key for reaching at the same time a good image quality and a fast frame rate.

In particular as to videotelephony, Giotto exclusive features can be used for:

- a **high performance videophone on analog lines**. It has been successfully tested in a EU research program by achieving the high resolution and fast frame rate required for communication among deaf people through lip and gesture reading
- a **high performance/low cost videophone for corporate use**.

Giotto Technical features

Sensor

- CMOS Technology, 8013 sensible elements, 8mm diameter
- continuous operation in time (non-integrating)
- logarithmic light intensity to output voltage conversion

Geometry	76 circles: 56 circles with 128 pixel / 20 circles with a number of pixels decreasing towards the center
Image definition	Field of view/max resolution equivalent to a uniform sensor array 600×600 pixel
Pixel addressing	Programmable: Random access - Sequential

Camera system

Software	Windows95, NT 4.0, UNIX
Interface	Parallel port (EPP). RS485 available on request
Frame Rate	Maximum sensor frame rate: up to 100 frame/sec / Frame rate on EPP Parallel interface: 50 frame/sec
Bit per pixel	B/W 8 bit (256 gray level) / Color 24 bit (8 Red, 8 Green, 8 Blue)
Lens mount	C-mount
Dimensions	Cylindrical - 5.5 cm diameter x 7 cm length
Power supply	12 V DC