A shaded-picture scanning attachment for incremental plotters

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The picture scanning attachment consists of a high resolution optical reflective sensor and associated amplification stages, in the form of a small probe which replaces the pen and pen holder in an incremental plotter and thus allows shaded pictures to be scanned for subsequent processing by digital computer.

(Received September 1980)

1. Introduction

A requirement arose for an inexpensive method of inputting shaded images to a digital computer. One project was concerned with comparing the relative merits of Fourier, Walsh and Haar transforms in data compression and noise reduction of images. During preliminary discussions related to accuracy requirements and project costs, it was decided to employ, where possible, existing equipment. We subsequently decided to investigate the feasibility of employing the department's incremental plotter, and to modify the pen carriage to accept a picture scanning device. Early experiments employing a probe constructed of glass fibres, a light source and photosensor were abandoned because of problems associated with ambient light filtering, light source attenuation and lack of precision workshop facilities.

2. The sensor

Work then began using a HEDS-1000 high resolution optical reflective sensor (Hewlett Packard, 1979) mounted at the end of a small plastic tube which replaced the normal pen and pen holder. Mounted within the tube was the associated circuitry comprising a current feedback amplifier utilising the sensor's internal transistor, thus providing moderate current gain and bias point stability. Further gain was provided by an operational amplifier with adjustable output voltage level, which allowed for optimum contrast to be selected for any given shaded picture. The output from the probe was converted by an ADC (Computer Technology, 1971a) which was connected to the department's Modular One computer.

Apart from the low cost aspect of this simple design approach, another favourable feature was that it enabled the employment of standard digital plotter software in driving the modified pen carriage during picture scanning. After image processing, the output can normally be presented to a matrix printer, using overprinting techniques. With an output voltage swing from the probe of 8 V for a high contrast picture, and a noise level of less than 20 mV peak-to-peak, a considerable number of grey levels can be attained.

3. Difficulties encountered

One problem occurred due to the poor quality of overprinted images obtained from the matrix printer. For these images sixteen levels of grey were chosen, which proved to be sufficient to test the sensor. Another problem area was due to picture wrinkling. The pictures were fastened on the plotter paper. The particular plotter (Computer Technology, 1971b) was of the small roller type, rather than the drum or flat-bed construction, and so there was a tendency for wrinkling to occur which caused image defocusing. A 0-5 mm high ridge caused a 50% drop in reflected photocurrent. Initially this was overcome by digitising mint postage stamps (Fig. 1), but the possibility of using sprung pressure stamps similar to those used on magnetic tape head recording systems is being explored.

Fig. 1 Mint postage stamps (digitised on a 0-1 mm grid using 16 grey scales)

4. Conclusions

The device is sufficiently sensitive to detect variations in whiteness (or blackness) quite unnoticed by the naked eye. The system has been employed by a number of project students with encouraging results. Most projects have utilised raster scanning of images, which is quite slow, but adequate for our purposes. The system also enables line following and other complex scanning routines to be programmed.

Acknowledgements

To produce the photographic output for reproduction in this paper it was necessary to use a high resolution TV monitor and we are grateful to Atlas Computing Laboratory for the use of their graphics facility. The authors are also grateful to the Post Office for granting permission to reproduce mint postage stamps and to Paul Rodgers, Senior Systems Programmer, for writing the programs.

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CCC-0010-4620/81/0024-0287 $00.50

THE COMPUTER JOURNAL, VOL. 24, NO. 3, 1981