System for Digital 1D-Image Processing with 1024 Pixel CCD Sensor

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Abstract

The conception of system for digital 1D-images processing with digital CCD camera is presented. The system is created from these three basic parts: the digital CCD camera with linear image sensor CCD L133C, 8-bit interface and a personal computer. The scanning digital CCD camera generated a video signals, which are processed in the analog signal processor. The output signal is continually converted to 8-bit data words in A/D converter. This data words maybe transfer over a bus driver to the operation memory of personal computer, by setting one of the three work regimes of digital CCD camera. Some application possibilities and basic technical parameters of this system are given.

Keywords:

Linear CCD sensor, digital CCD camera, signal processor, interface, digital 1D-image processing.

1. Principle of the technical equipment

The technical equipment of the system for digital processing of optical information (1D-images) is created from the three basic parts: the digital camera with the linear image sensor CCD L133C, 8-bit interface and the medium for digital processing of optical information (e.g. personal computer). In Fig.1 is introduced the principle conception of the digital camera with the linear CCD sensor L133C.

The camera is created from optical lens, CCD sensor and some electronic blocks. Two output sensor's signals VO-A and VO-B are processed to camera output signal VIDEO 1 in the analog signal processor. This processor performs three basic signal operations:

- direct current reinsertion of input signals,
- multiplexing of these signals,
- limitation of the white level of multiplex signal.

The amplifying analog signal VIDEO 1 (with difference level about 10 Vpp) is continually converted

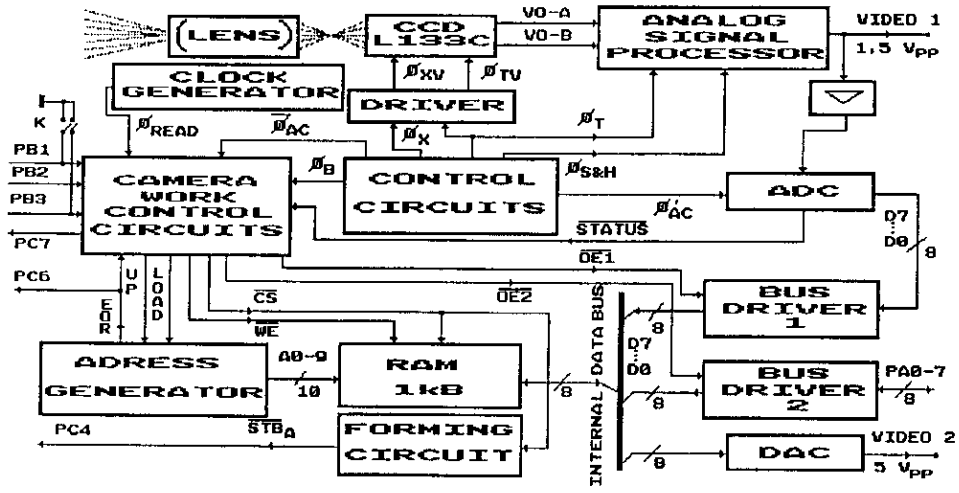

Fig.1
Conception of digital camera with linear sensor L133C

to 8-bit data words in the analog-digital converter ADC. These data words maybe transferred over the bus driver 1 to the read accessory memory where maybe written as 1024 point data vector. In memory written data vector maybe periodically read and converted to the analog output signal VIDEO 2 in the digital-analog converter DAC, or in the second case, the data vector maybe read as a package data words and transferred through the bus driver 2 and an interface to the operation memory of the personal computer. The autonomous control circuits and drivers control the dynamic work cycles of the image sensor CCD L133C. Camera work control circuits is operated by some input signals (e.g. from control circuits, ADC, clock generator and the external signals from PC) and produces the output signals (e.g. EOR, UP, LOAD, $\overline{WE}$, $\overline{CS}$, $\overline{OE1}$, $\overline{OE2}$) which enable to set three basic work regimes of the camera:

- 1. continuous writing the digital data into the RAM,
- 2. continuous reading the digital data from the RAM and its conversion to the output analog signal VIDEO2,
- 3. package read the digital data from the RAM and its transference to the computer operation memory through the 8-bit interface.

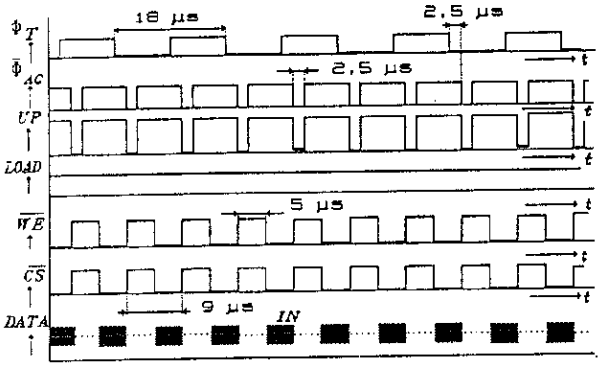

Fig.2a
The timing diagram of signals for work regime "continuous data write" of the digital camera

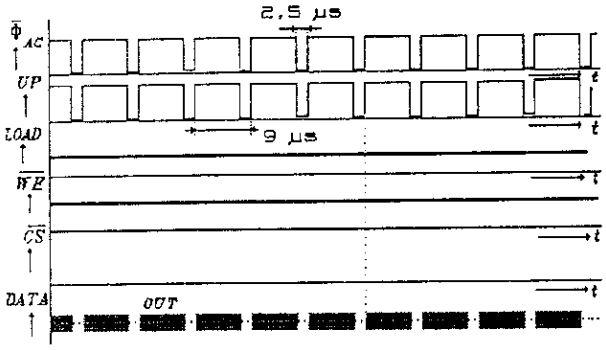

Fig.2b
The timing diagram of signals for work regime "continuous data read" of the digital camera

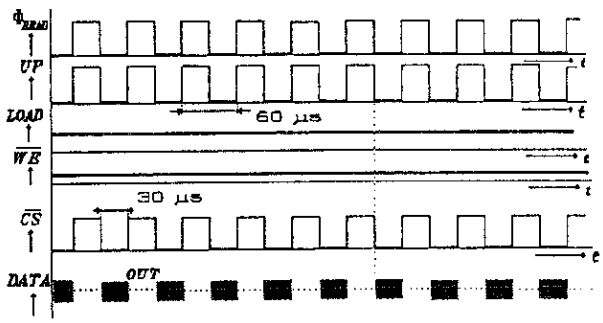

Fig.2c
The timing diagram of signals for work regime "package data read" of the digital camera

Some of these signals are shown in timing diagram in Fig.2a, Fig.2b and in Fig.2c.

In the end we can introduce, that in all work regimes the camera continually produces the output signal VIDEO1 and converts it to 8-bit data in real time For the completion in Fig.3 is given the block diagram of 8-bit interface, which is used in our system for digital

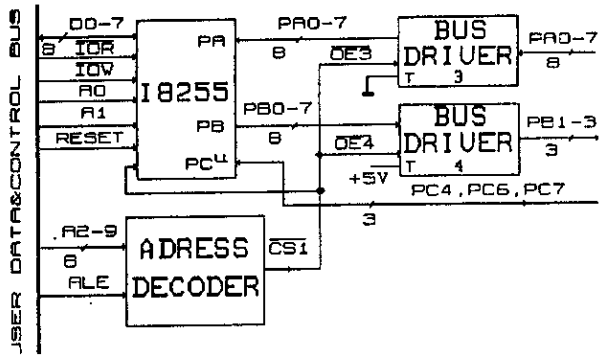

Fig.3
The block diagram of 8-bit interface

processing of optical information.

This relative trivial interface is constructed with basic circuits I8255 and connect the output camera's data & control bus and the input computer's user data & control I/O bus.

2. The basic technical parameters

Output signals:

- live analog VIDEO1 1 Vpp
- reconstructed analog VIDEO2 10 Vpp
- digital parallel 8 bits

Period of sampling signal:

- 9 μs

Scanning period of optical information:

- 9,5 ms

Used image sensor :

- L 133 C

Light intensity in sensor's plane :

- less than 1 lx for maximum level of output signals VO-A, VO-B

3. Review of the application possibilities

- Digital image processing of the 1D pictures,
- Without contact measurement of the object dimension,
- Refractive index measurement of the optical cables,
- Basic measurement of some parameters of CCD sensor (e.g. a transfer characteristic light-voltage, an accumulation characteristic, a modulation transfer function),
- Scan the 2D transparent or reflective image and its effective coding.

4. Conclusion

In this paper we introduced the principal description of the system for digital processing of optical information (1D-image) with the higher definition and its some possible applications. Construction of this system was finished at our department one year ago. We hope, it will find many applications in our pedagogical work in the next future, maybe in others technical spheres too.

5. References

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