



emission of light. (9)The output register has 1094 pels (horizontal register, 1040 of them are effective, there are 27 empty registers in both ends of the register).

The require of walking and shifting time sequence is showed in Fig.2. VM2 run 1/2 pulse width before VM1 (VS1 the same as VM1, VS2 the same as VM2), during the walking and shifting , PH2 is high, PH1 is low. VM1 and VM2 are both low level when the light is accumulated , it has no restrictio on PH1, PH2 level. After accumulating , transfer one line to the

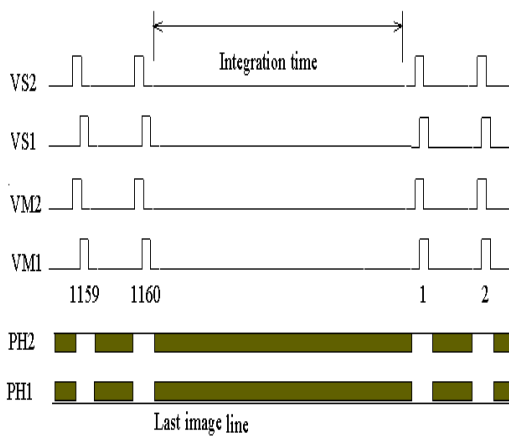


Fig.2 Clock diagram of row transfer for full frame operation

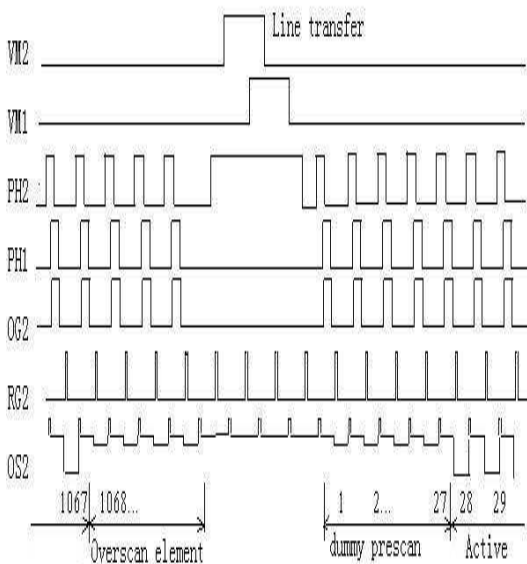


Fig 3 Horizontal transfer Time sequence of CCD Two-stage preamps mode

horizontal register under the function of VM1 and VM2 under the function of PH1 , PH2 , OG2 and RG2 , one bit with one bit outputs when transfer one. As Fig. 3 shows ,it is the require of location shift time sequence . PH2 is leading half pulse width than PH1 , OG2 is the same as PH1. It can be reseted from reading at this time to next time. So pulse of RG2 can be chosed according to the actual conditions in actual applying(the pulse of reseting is not essential during the walking and shifting). Require of the width and level of each signal and the detailed materials can be seen in the list of references<sup>[2]</sup>.

### 3 The Scheme of Data Acquisition

General scientific grade cameras adopts PCI card to gather and transmit the pictures to the computer, its advantages are gathering quickly, in good general use, the function of the software is strong, but the software and hardware are complicated in designing, and with high costs, short distance of transmitting (usually within 5m). As science grade of cameras is used in the formation of image under the faint mere condition , the time for exposure is long (generally from several seconds to several hours ), so the meaning of fast data transmission is not big. Because of the exposure of X-ray imaging system which the author designed is from dozens of seconds to several hundred seconds, So the target pursued totally is moderate gathering speed (transmission time of one frame picture is several second), little noise, far distance to transmit ( $\geq 25m$ , 25m from ray room to control room), the design is simple , and with low costs.

Because effective pixel is  $1040 \times 1160$ , every pixel have 3 course: Read  $\rightarrow$  A/D changing  $\rightarrow$  Write in the computer. Each picture needs such  $1094 \times 1160$  course and 1160 walking and shifting to carry on . Consider the speed of gathering in data, the quality of the picture , reading of the noise, the random noise in circuit, outputs -figure number of A/D converter, the interface of the computer and software, the total cost ,etc., the author has designed the scheme illustrated in Fig.4. Making the chip refrigeration of CCD cold by independent electric circuit (have the functions of measuring temperature and feedback controlling), this electric circuit and other electric circuit are not the same. CDD signal reads the driving

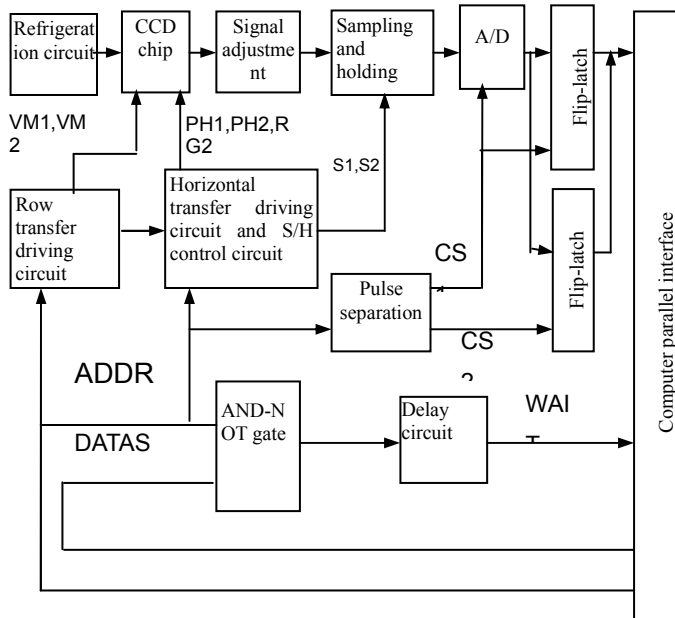


Fig.4 Total scheme of CCD data readout and computer acquisition

clock signal and keep the sample of data, dispel the noise of resetting, A/D changing, by address of way read ADDRSTB and data read DATASTB signal of EPP run side by side in the computer(it runs side by side mouth to strengthen) in step ,such control signals as data transmission are produced in hardware electric circuit, and adopting the flowing water line to gather .

Utilize computer's resource and adopt assembly

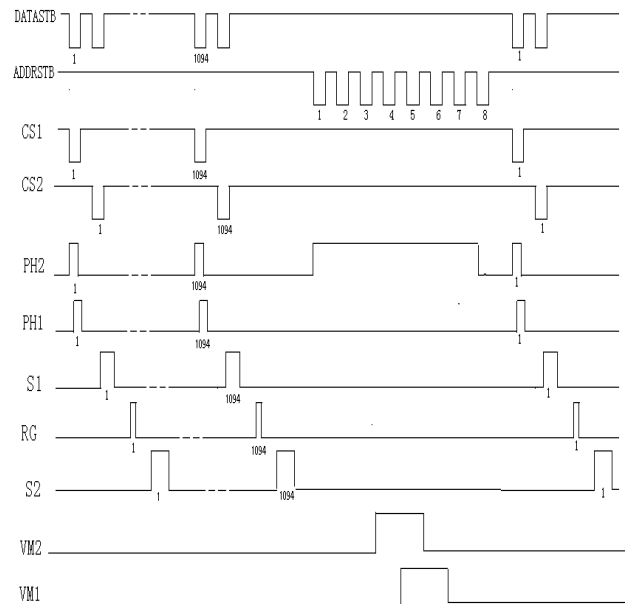


Fig.5 The time sequence request of image acquisition

line gather method to reduce A/D change and CCD reading speed ( don't reduce whole picture gather speed), to reduce cost , noise and main method of the realizes difficulty degree, it is key technology and innovation of this text. It is also an important technology of this text that make use of CPLD (complicated programming device ) to realize mouthfuls of CCD picture assembly line to gather control signal under the way of EPP .

### 4 Image Acquisition Time Sequence

By the analytical study, we can use the computer's address read of EPP with data word to produce synchronous signal DATASTB and ADDRSTB. By the control of these two signals,make use of CPLD to produce necessary control signal VM1 , VM2 , PH1 , PH2 , RG , S1 , S2 , CS1 , CS2 in Fig. 4, make these signals suffice for the time sequence demand for Fig. 5. In the picture, 3 location of cycle shift with data gathering relation and 1 competent every relation of signal when shift the cycle of control signal have been drawn.

Adopting CPLD of XC95108 type of XLINX

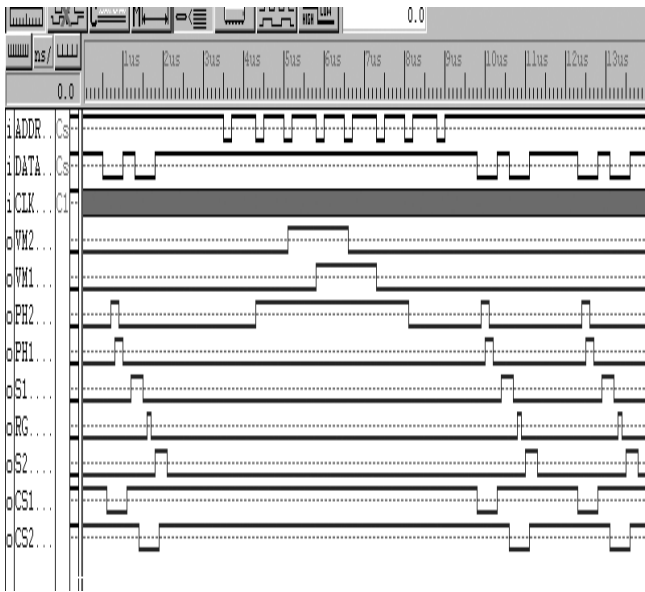


Fig.6 Simulation waveform of image acquisition control circuit by CPLD implement

Company, adopting the component principle picture of the module's input method to design the component method of the module and designs the hardware circuit with VHDL. Fig.6 is the realizing time sequence wave form artificial when the design have been actualized, CLK and crystal oscillator signal of 50MHz is adscitiou that in the picture , known from the artificial result, it totally meet the demand designed.

5 Software Design and Camera Characteristic Introduce

Utilize computer's enhancemence walk abreast address of mouth read with data word to realize

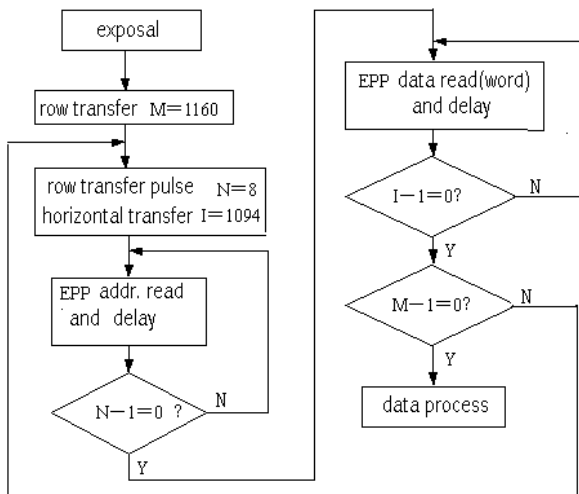


Fig.7 CCD image acquisition flow chart by EPP mode

synchronous signal DATASTB and ADDRSTB that data's gathering need to read (computer combines EPP way and sees list of references 2). Fig.7 is that gather the flow chart by data with the way for EPP to show, ADDRSTB signal of the address read shifts the conduct, two DATASTB signal of the data word read carry on the bit shifting, adopt protecting , A/D , exporting ,etc. controlments.

Utilize the hereinbefore CCD chip and circuit and other auxiliary circuit ,etc. designed CCD digital camera which is computer walk abreast mouth science magnitudes to gather picture. For the transmittion remotely to be realized, author utilize a high speed line urge and receive device to design a circuit of 8 No. TTL and RS422 level change [3].

The main technical indicator and characteristic of this camera are: (1)CCD effective picture element: 1040 x 1160; (2)A/D converter: 12bits; (3)The transmission time of one frame picture : 3.1s; (4)Transmission speed of the data: 400KB/s; (5)Whether can realize remote picture transmit (6)peak value that spectrum respond wavelength:550nm; (7)High purple light sensitivity; (8) low cost; (9)Do not need the PCI image gather card , EPP to join computer. This camera has been applied in high-performance X-ray slow-scan digital testing system.

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