Operation of a digital camera (Fujifilm MX-500) with BASIC-Tiger®

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1. Basics

Digital technology spreads itself more and more, especially in the segment of cameras. Digital cameras do not work anymore with film and photo lab, but electronically with built-in sensors and storage media, as they are also employed in computer technology. In this application note is shown how such a digital camera can be used with the BASIC-Tiger®. "Unfortunately" there is meanwhile a great number of such cameras with of course different features, so that the solutions being introduced here can not be universal - the approaching onto such tasks is, however, always similar, from that you do not have to put away this application note now if you do not own a Fujifilm MX-500.
The normal use of a digital camera begins generally with the "snap" of pictures (like with a traditional camera). After that, however, there are serious differences. While you were taking up to now the illuminated film to the photo lab and collecting your paper pictures later, as a digital photographer you now connect your camera with a special cable to the computer and transfer the pictures to the hard disk. With suitable viewer programs the pictures can be immediately displayed on the screen, can be printed with the printer or be sent via email. We do not want to change anything in this system - it is sophisticated technology and BASIC-Tiger® is not necessary here.
It becomes interesting if we use further possibilities of the digital cameras. Almost all devices can be controlled with suitable software (via the above-mentioned special cable) also from the computer. The camera of the author as well as almost all others of Fujifilm and other manufacturers can be used also as web cameras or under program control from the personal computer. That is charm-full if for example you want to photograph the blossoming of a rare blossom every 10 minutes and to create a small film from that. Or you need a surveillance camera which takes photos secretly if somebody is in the room. Still everything can be managed by the personal computer, it only becomes difficult when the personal computer is far away as for example at a bird's nest. Here it would be interesting to leave the operation of the camera to a small microcomputer - a case for the BASIC-Tiger®!

What do we want to do? A digital camera MX-500 is supposed to be brought from the BASIC-Tiger® to take photographs independently, to store these in its own memory and to wait for the next control command. In this application note it is fully described how one approaches such a task so that the reader can solve also other, similarly located problems.

2. The camera MX-500

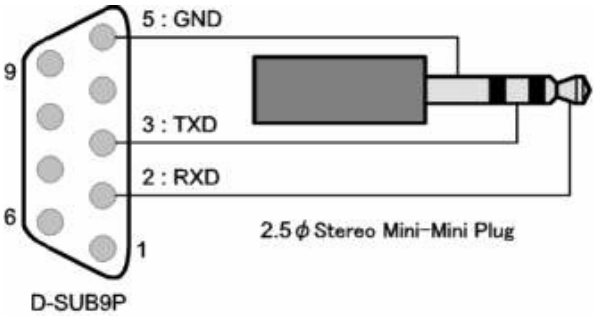
This type is a little bit older camera which is settled in the medium price range and offers a maximum resolution of 1280x1024 pixels in different picture compression (Fig. 1). All

parameters, like resolution, flash or not, white adjustment and so forth can be preset in the set-up of the camera. The camera carries out the motive-dependent settings as focusing, aperture, exposure time, flash and others automatically.

Fig. 1 The camera Fujifilm MX-500

Fig. 2 Storage medium SmartMedia Card

The pictures themselves as well as some further data are stored by the camera onto so-called SmartMedia Cards which are available in different capacities (Fig. 2). The MX-500 works currently with SmartMedia Cards of 2 MB, 4 MB, 8 MB or 16 MB. These approx. 1 mm thick dies work with Flash-EPROMs (just the same as the BASIC-Tiger® !), are shifted into the side of the camera and take up, depending on capacity, picture resolution and compressing, up to about a hundred pictures.
The camera has a color display, with which on one hand immediately the motive to be taken or the stored pictures can be viewed and on the other hand the user guidance (Setup menu etc.) is made possible. With aid of the display the necessary pre-settings for the “automatic operation” of the camera can be carried out.
For our case of application it is now interesting how the camera communicates with the personal computer.
The delivered cable is needed to connect the camera with a serial interface of the personal computer for this purpose. The wiring can be seen in fig. 3, thus you can also simply make such a cable yourself.



The cable supplied with the camera is equipped with a 9-pin Sub-D socket, it fits therefore directly into the serial interface of the personal computer. A socket is also at the Plug-and-Play-Lab, there you need an adapter with two 9-pin Sub-D connectors. You connect all pins with the same number, except for pin 2 and 3 which are cross-wired.

Fig. 3 Wiring of the connection cable

On software side there are several starting points. Besides the transmission of ready pictures (for example in the JPG format) especially the externally controlled operation is important for us. Fuji offers for using the personal computer as a camera trigger a TWAIN driver (Snap Twain driver) which comes with the camera and makes it possible more badly than right. Fig. 4 shows a screenshot of the program that is available under:

http://www.fujifilm.de/support/camdrive.htm#mx500

in the Internet.
Much more comfortable is the shareware program EZ-Autocam from Beausoft, which can be downloaded from the Internet and can be tried out for free:

http://www.beausoft.com/index.html

This program allows many settings of the camera under the menu item AutoCam, fig. 5 shows a screenshot of the camera console with some options:

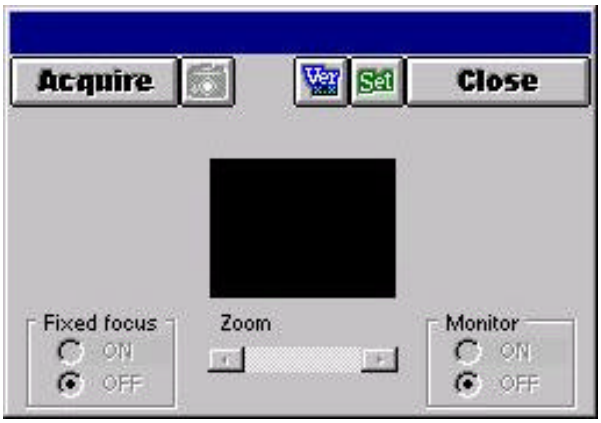


Fig. 4 The Twain driver Fujifilm Snap

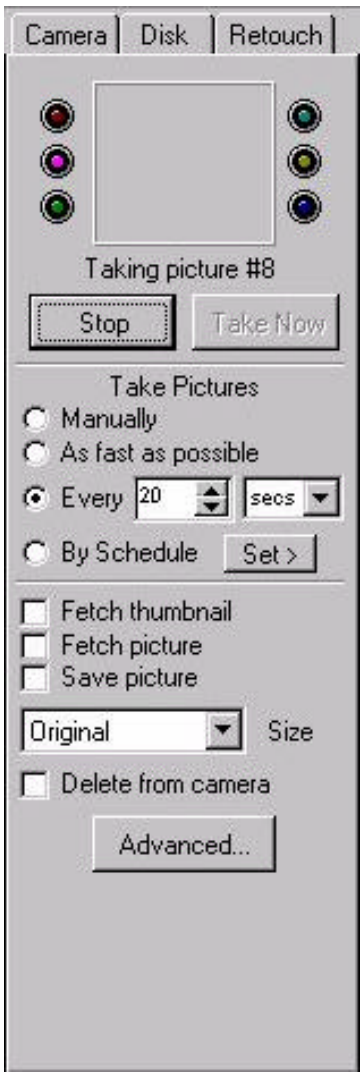


Fig. 5 EZ-Autocam, menu Autocam with the settings for automatic photos with the MX-500

One reaches this menu area "AutoCam" after the start of the program by clicking with the right mouse button on the point Camera (on the right part of the screen). In fig. 5 the setting-parameters that are needed for the simple release of the camera are shown, here every 20 seconds. All fetch options (Transfer of thumbnails and pictures onto the PC screen), the storage of pictures as well as the deletion of camera pictures are deactivated.
If the communication works, pictures should be now taken automatically and stored in the memory of the camera.

All that is, however, only preparation for our task of letting the same be done by BASIC-Tiger®. Our next "stage goal" is to "eavesdrop" the communication between the personal computer and the MX-500. Only when we know what the personal computer transmits to the camera and what it answers, the personal computer becomes superfluous.

3. The great listening-attack

We selected ourselves the simplest variant of the camera control to be analysed, here no pictures are transmitted, which otherwise would mean a large effort. In addition the BASIC-Tiger® would not know at all what to do with it.
At the beginning of such a task one should inform himself in the operating manual of his camera, in the Internet or in technical journals and/or books as good as possible - perhaps somebody already has solved the problem. In the case of MX-500 there are such references, here only a few information:

- Setting for the serial interface: 9600 bauds, even parity, 8 data bits, 1 stop bit
- A comprehensive analysis of the communication of a Fuji camera (DS-7, a relative of our MX-500) can be found under:

  http://www.yk.rim.or.jp/~mamo/Computer/DS-7/detail-e.html

- An interesting software tool, ComLite32 from Realtime Control for the analysis of the serial data communication is available free under

  http://www.rtcomm.com/comlab32.html

With the program ComLite32 it is easily possible to register the current data exchange between personal computer and camera. One starts for this purpose first the program ComLite32 which behaves similar as a cassette recorder. Fig. 6 shows a screenshot with already registered data. At the upper left there are buttons as in a genuine cassette recorder. The green triangle starts the recording, the red “stop sign” ends it. With the cross the recording can be deleted.

> **One more note!** This (free!) program is a beta version with errors. It is not possible to print the data and there are sometimes error messages at saving and opening of files. In spite of that it suffices for our purposes.

If ComLite32 has begun the recording, only the camera must be started with the program EZ-AutoCam, in the present case 3 photos have been taken. The communication is being recorded and can be viewed in fig. 6 (Personal computer red, camera blue!).

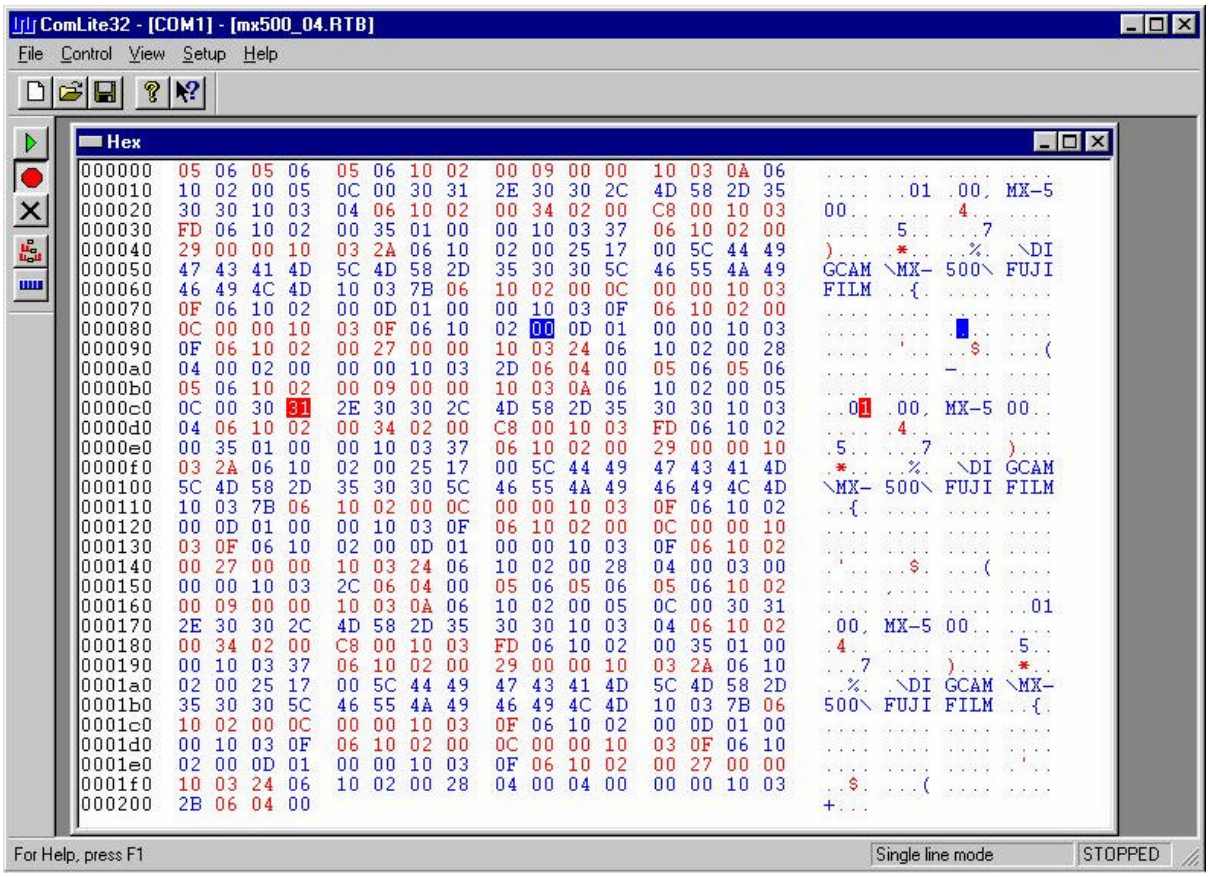


Fig. 6 ComLite32 with recorded communication between personal computer and MX-500 (red personal computer, blue camera) – here 3 photos were taken

The dialog occurs always in the same manner as one can see (in hexadecimal code):

Personal computer says:	06
Camera answers:	05
Personal computer says:	06
Camera answers:	05
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Camera answers:	05
Personal computer says:	10 02 00 09 00 00 10 03 0A
Camera answers:	06 10 02 00 05 0C 00 30 31 2E 30 30 2 C 4D 58
:	:
:	:
Camera answers:	06 10 02 00 28 04 00 02 00 00 00 10 03 2D
Personal computer says:	06 04
Camera answers:	00

Apart from two positions in the entire dialog (highlighted in red) everything is repeated at every photo. With that the BASIC-Tiger® could already replace the personal computer, the Tiger program simply sends out the determined bytes sequentially. If an answer from the

camera is expected, it is switched to reception and the received bytes are checked onto correctness.
But it is even more simply going. The author tried out that in fact the answers of the camera do not have any influence on the procedures so that one can renounce their evaluation. However, one must give the camera time to send the answers and to carry out the settings. That indeed works, nevertheless we want at least approximately to know what is happening here.

4. Decrypted messages

The above dialog is quite complicated so that we can put only the most necessary in this application note. There are following control characters:

05	ENQ (Enquiry)	used during the start of a communication
06	ACK (Acknowledge)	confirmation when received data are o.k.
04	EOT (End of text)	used during the termination of a communication
15	NAK (Negative acknowledge)	Date not o.k
10	DLE (Data link escape)	is send before a control character
02	STX (Start of text)	is send before data
03	ETX (End of text)	is send at the end of data
17	ETB (End of Transmissions block)	

With that already some things become clear. First of all it is asked three times back and forth, the personal computer identifies itself with 05, the camera acknowledges that with 06. After that the personal computer announces with 10 02 the start of the following text, the sequence 00 09 00 00 follows. This text requests information from the camera. The text is concluded with 10 03. The byte 0A is a kind of checksum that is calculated in a complicated way. The camera answers first with 06 (“understood”), before itself announces with again 10 02 its text. As you can impose from the text standing to the right in fig. 6, a dialog in which the camera reports its data follows. Interesting is the sequence is 00 0 C 00 00, here the camera is requested not to do anything at all by the personal computer! Is that used for waiting for time-consuming settings of the camera? All details for the MX-500 are not known by the author yet, further information which could be used to clear up this dialog are very welcome!
With the freely programmable BASIC-Tiger® can in contrast to the ready PC programs still many interesting experiments be conducted, information and new functions be gained.

5. Programming of the BASIC-Tiger®

We want to convey the communication between the personal computer and the camera without change onto the BASIC-Tiger®. The serial interface Ser1 is supposed to be programmed with the parameters 9600 bauds, even parity, 8 data bits, 1 stop bit. From hardware side must be considered still, that we use either a BASIC-Tiger® with built-in RS232 interface, the Plug-and-Play-Lab (to which that is alike!) or employing a BASIC-

Tiger® with attached level converter MAX232. In the last case it is to be noted that the logic signals must still be inverted on the TTL sides (Manual !). In addition it is important that the TxD and RxD lines must be connected with the other line of the opponent side, therefore

TxD (BASIC-Tiger®) → RxD (Camera)
RxD (BASIC-Tiger®) → TxD (Camera)

If everything is connected correctly, both components are in operation and the camera was switched to PC mode, the program MX500_01.TIG should already take first photos. The program at the end of this application note is very simple and in a clear form, that is supposed to facilitate you own experiments.

6. Practical references

After the first euphoria is gone, here a few more tips that you should consider in case of building and experimentation with digital cameras.

- Digital cameras are energy-eaters. Our MX-500 has 4 batteries of 1,5 V resp. 1,2 V (NC-accumulators), however, also an external power input. Here you should connect a power supply or a stronger battery (5 V) when operating with the BASIC-Tiger®. Take care of polarity and stability of the added current. Possibly BASIC-Tiger® and MX-500 can also work with one power supply, they both need 5 V.

- A programmed picture counter could be used for switching off the complete system if the camera memory is full.

- Next to the application as a time controlled camera many further applications are conceivable. One could make for example panorama pictures in this way automatically. The BASIC-Tiger® rotates a rotary table with mounted camera always at a specific angle further, a photo is taken, the camera turns again, a new photo is taken and so forth. Or you let take photos depending on specific conditions (Alarm systems, photograph bird's nest if bird comes or similar).

- The MX-500, but also almost all other digital cameras do not have any remote release. The detour to implement a remote release via the BASIC-Tiger® is not really low-priced, but probably the easiest way.

- Further investigations of the communication between personal computer (BASIC-Tiger®) and camera could solve still existing problems, as for example:

  Can the energy-intense display of the camera be somehow switched off in PC mode?

  Can the camera remotely controlled be switched on or must it always be activated with the power button?

Can the setting conditions of the camera be changed via the serial interface?

We wish you lots of fun while trying out further interesting possibilities with BASIC-Tiger® and digital camera!