Electrically adjustable bracket for IP Cameras

Milan Adamek, Dora Lapkova, Rudolf Chovanec, Petr Neumann and Miroslav Matysek

Faculty of Applied Informatics
Tomas Bata University in Zlin
Nad Stranemi 4511, CZ 76005 Zlin
Czech Republic
adamek@fai.utb.cz; dlapkova@fai.utb.cz; neumann@fai.utb.cz

***Abstract*—** The paper deals with design of control for surveillance camera positionable stand over Ethernet. It describes the selected hardware solution based on development kit with ARM microprocessor and connected board with additional electronics.The objective of this paper is to create an electrically-controlled bracket for analogue or IP cameras. The mechanical construction of the bracket itself and the possibilities of its movement are also described. The control device/unit assures the control of every individual part of the bracket. The primary operation of the various sections of the adjustable brackets is assured by bipolar stepper motors which are inserted into the mounting guide-rails. It also includes the design and implementation software used to control the bracket.

***Keywords*—** camera, holder, bracket/arm, control device/unit.

I. Introduction

The camera can be placed either statically, for sensing one place, or on adjustable stands, which makes it possible with a single camera to cover a wider area. The position of the camera controls either the operator using the control panel or software. Modern security cameras with advanced software can detect movement themselves, sharpen it and watch or alert the operator. For cameras with advanced software is often a function of a certain store positioning for fast and accurate changes. A common feature of security cameras is recording, the

Some cameras allow you to start recording only when motion detected, which may be significantly save space for archiving records. Adjustable cameras can be handled as one unit or a combination of adjustable, stand and any camera. Manufacturers are generally positioned cameras PTZ designated by the abbreviation

Various sites used for installing cameras require specifically shaped brackets. Camera brackets exist in different colour and type designs. Brackets currently available on the market are designed for placement on the ceiling, walls, columns, etc. Their installation is simple and relatively quick.

II. Current camera brackets on the market

Various types of brackets are currently available on the market for reasonably low prices. The problem however is their effectiveness and the low level of effectiveness during positioning.

A. Camera brackets with rotational head

This type represents one of many types of camera bracket, whose simplicity influences the price of other brackets offered on the market. This bracket is most often mounted on ceilings, walls, etc.

B. Indoor hooked bracket with swivel head

Different sites require the specific installation of brackets. Their use is relatively extensive and their price is acceptable.

Fig. 1 Types of base-mount [1]

Fig. 2 Curved bracket-mount [2]

The holding bracket is bent into an L-shape, at the end of which is the mount for the camera. The length of leg of the bracket is usally 25 cm, and the cabling to the camera is led in the hollow space within the tube.

C. Domestic camera bracket-mounts

This is a practical bracket-mount specially developed for indoor cameras. This mount allows you to install the camera on the wall, and thus can increase the field of view of the camera. Its location versatility allows one to install the camera in places where the installation of an ordinary mounting is not suitable. The footage from the cameras is - if suitably located, much better and sharper - which is unachievable by supplementary processing of the image. Installation of the bracket is simple and quick, since the bracket is designed to ensure the security and stability of the dome camera [1].

Fig. 3 Bracket mounting for dome cameras [1]

D. Aluminium brackets

This has to do with a strong bracket for industrial cameras, ideal for outdoor use. It can, of course, be used indoors. The main advantage is its solid construction which provides great stability and a secure mount for cameras.

Fig. 4 Aluminium bracket construction [1]

III. The Construction Design of Our Own Bracket

A. Mechanical construction design

The bracket mounting is formed from aluminium profiles of various different sizes and wall thicknesses. Aluminium was selected for the construction due to its suitable physical properties. The design of the bracket mounting done using the VariCAD program is shown in Figure 5.

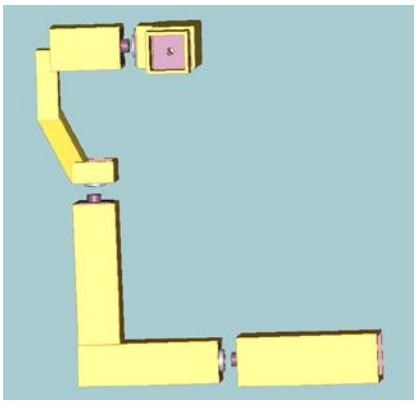

Fig. 5 Bracket-mounting design using the VariCAD programme

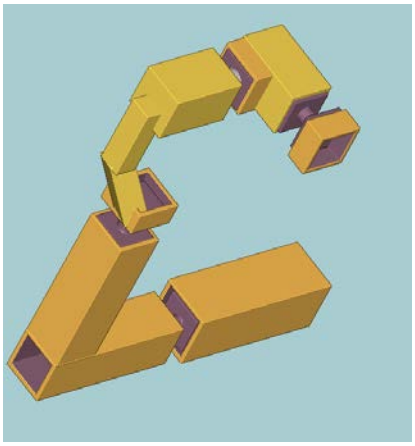

Fig. 6 Side view of the bracket mounting

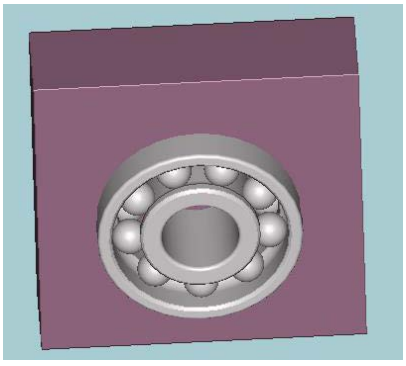

Fig. 7 A roller bearing set into aluminium material

Rotation of the individual components of the bracket mounting is assured through roller bearings. Roller Bearings allow the mutual relative movement of parts and the transfer of the forces and are characterized by the insertion of the rolling elements between two relatively moving elements.

IV. Electrically-equipped bracket mounting

Panning and rolling of the bracket is assured by four stepper motors, which are inserted into aluminium profiles. 23HS8430 type designation bipolar stepper motors with a step angle of 1.8 ° were used for the construction [3].

Tab. 1 Basic parameters of a 23LC76 step motor

Type	Step angle	Current	Resistance	Induction	Moment	Weight
23LC76	1.8°	3A	1 Ohm	3.5 mH	180N.cm	1050g

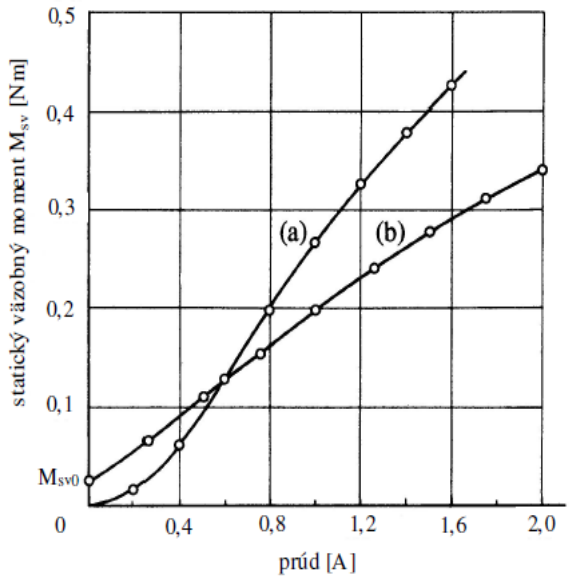

Fig. 8 Static characteristics of a step motor

Four-stroke control with two-phase magnetisation was used for the rotation of the stepper motor. It has to do with the control of a motor, with two adjacent phases switching. In this method of power supply, the equilibrium lies between the excited adjacent stator poles. Unlike four-stroke control with one magnetic phase, the rotation of the rotor is half-sized, while the step size remains unchanged. Then the time course of switching between each phase AB - BC – CD - DA is used for one direction; and switching phases AD - CD - BC - AB for the second direction to rotate clockwise [3].

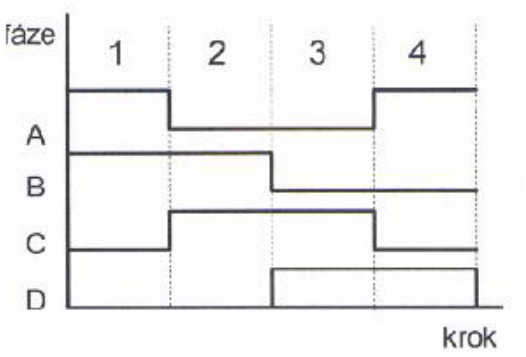

Fig. 9 Time course of a four-stroke control mechanism

V. Bracket mounting electrical rotation

Control of the step motor is assured by means of an H5controller, which controls the individual motors one after another. The controller is connected to a computer by a data cable. The computer is equipped with software which assures communications with this control device. The controller can be connected to a computer in a number of ways, e.g. USB, RS232 or even an LPT - 25 pin cable [4].

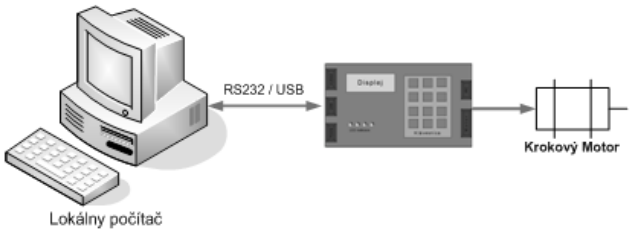

Fig. 10 The connection of a step motor [4]

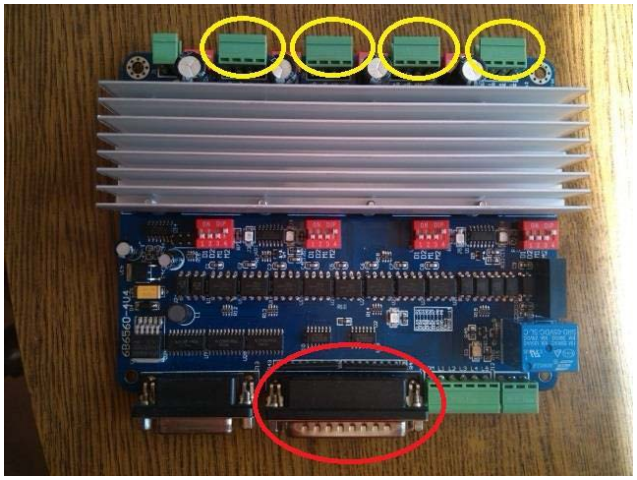

Fig. 11 The controller

The H5 Controller, which can concurrently control four step motors, also has inputs which can be connected to five different switches or various inductive loads. The inputs are protected by diodes and 1 kΩ resistor. The relay outputs can be controlled by switching a stepper motor [5].

Connection of the motors is by means of four conductors, labelled: A1+, A1-, A2+, A2 [6].

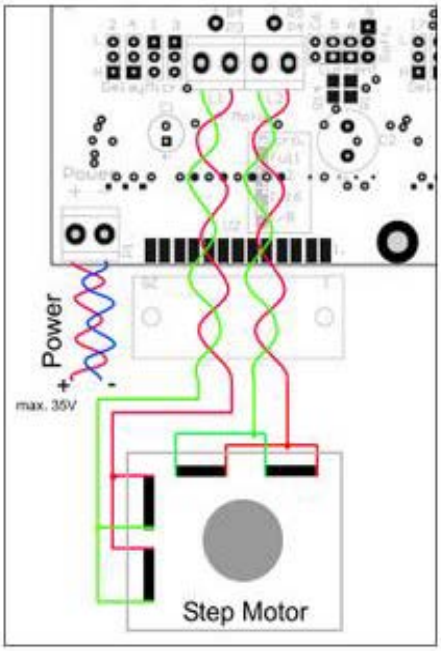

Fig. 12. Connection of a stepper motor [6]

VI. Camera control over Ethernet

For management positions over Ethernet was chosen as a suitable microprocessor type Atmel AT91SAM9260. It is advantageous for such applications due to favorable price support standard OS1, Ethernet, USB and high performance. Another significant advantage is the availability of a PTO housing allowing for manual soldering. With performance of up to 210 MIPS2 would be possible in the future not only to stream image from a connected camera, but also to perform its complex processing. In this work were designed with two possible variants of electronics. The first version allowed for a custom designed board microprocessor. Use the second option is to use low-cost development kit Olimex SAM9-L9260 based on the type of microprocessor. The kit is connected via expansion slot plate with exciter engines and other necessary electronics.

A. AT91SAM9260

AT91SAM9260 is a 32-bit microcontroller from Atmel ARM9-based core. With the performance up to 210 MIPS and memory management unit MMU3 allows running standard OS (Linux, WinCE, etc..) Its use for this work is also advantageous because the ISI interface for connecting cameras and easy transfer of images from her memory. The camera (or other device) but you can also connect using the USB host port. The following chapters will describe the peripherals used at work and requiring the Linux OS configuration from the user program or driver. Description interface (USB, Ethernet) functionality provides the OS can be found in [1].

B. Bootloader

Memory ROM integrated microprocessor includes a bootloader (similar to eg. BIOS on PC). Bootloader program is in charge of the initial configuration of the microprocessor (DBGU - serial port for debugging, USB device port, initialization SRAM) and run the user program. The order in which the individual seeks executable program memory is as follows: DataFlash connected to the SPI, NAND Flash. If there is some memory of the found executable code (usually a second-level bootloader, such as U-Boot), held its move into SRAM and running. If the search is unsuccessful, will start the SAM-BA monitor and a USB interface DBGU waiting for the connection to the PC, where it is then possible to download the program into memory.

C. The input output pins

AT91SAM9260 microcontroller features three 32-bit ports - total is therefore available 96 programmable input-output pins (GPIO). GPIO Administration is in charge of the unit PIO4 that sets the individual pins as input, output, or assign special functions performed by any of the peripherals (each pin may have up to two special functions).

For pins configured as inputs can activate the integrated pull-up resistor, set an interrupt is generated when the status, enable filtering of short pulses. The output can be set to the open collector. The PIO allows synchronous change of up to 32 GPIO by writing to a 32 bit register, where each bit corresponds to one pin. It is therefore possible to simultaneously set or reset an entire port. Should it be required at any one time, some pins of one port and another set to zero, it is possible for selected pins to enable writing to the registry PIO_ODSR. If you are only required output, the unit can be deactivated PIO, thus reducing consumption. To use the break and the opportunity to read the state of pins on the contrary be using this unit allow PMC5. Interrupt pin status changes are not used at work and will not be further described.

To access the registers is necessary to know the base address of the port and the added offset of the desired register.

D. Counters timers

AT91SAM9260 microcontroller includes two blocks Triple-channel 16-bit timer counter (TC). You can set the frequency, generate periodic interrupts or PWM6. In this work are used to generate a PWM signal with variable duty cycle control for motors stand. Each channel has two outputs (TIOAn, TIOBn) on which can be generated by a PWM frequency and duty cycle different. Overall, it is possible to generate up to 12 different PWM, but because one of the block's counter timers (which can be set in the kernel configuration) uses a Linux OS

as clock source for the process scheduler, it is possible to use this OS to use only one of the blocks.

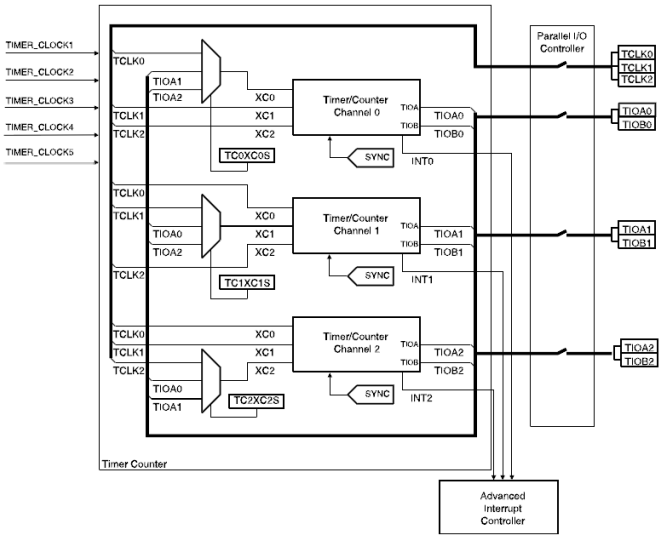

Fig. 13 Block diagram of the timer counter

VII. SOFTWARE FOR CONTROLLING THE BRACKET

The MACH3program was used to control the controller, which is relatively simple for users, while at the same time ensuring minimal loss of communication at start-up. At first glance, a great range offered by the given program is obvious. All offers are grouped into a few logical groups, which are called control element families. The term control elements can be thought of as buttons and their assigned keyboard shortcuts to control not only the Mach3, but also to display information (i.e. DigitalReadOuts), tag-badges and LED indicators [7].

Fig. 14 Elements for switching between screens

ScreenDesigner can be used to adjust the control elements of individual screens. One can modify or suggest screens from the beginning, thus it is also possible to add various control elements to each individual screen as required.

A. *Manual positioning using a keyboard*

This program offers three regime modes for manual positioning:

- Continuous
- Stepper
- MPG

The individual modes can be selected using the JogMode, where the selected mode is indicated by a lit LED.

Fig. 15 Manual positioning

In the continuous mode, the bracket mounting rotates around its axis throughout the compression of the keyboard pad. The speed of movement is selected by means of the SlowJog Rate menu. Positioning speed in "continuous" is defined as the percentage of the maximum speed option values in the Slowpercentage DRO. This value can be entered within the range of 0.1% to 100%. Using the + / - buttons, one can change the value by 5%. The set positioning speed can be exceeded by just pressing the Shift key and the appropriate jogging key [8].

Apart from the LED diodes that indicate the continuous mode, the LED diode immediately indicates the activation of the maximum positioning speed [5].

VIII. Conclusion

The positional bracket proposed here can be operated in both internal and external environments. It is suitable for positioning analogue or IP cameras. The ideal location of the proposed bracket mounting is on the corner of a building such that the camera can be used to capture, for instance, two entrances to the building.

Acknowledgment

The work was performed with financial support by grant No. IGA/FAI/2014/052 from IGA (Internal Grant Agency) of Thomas Bata University in Zlin, of research project NPU I No. MSMT-7778/2014 by the Ministry of Education of the Czech Republic and also by the European Regional Development Fund under the Project CEBIA-Tech No. CZ.1.05/2.1.00/03.0089.

References

[1] Ubiquiti [online]. Bratislava, 2010, 10.1.2014 [cit. 2014-04-28] . In: http://www.ubiquiti.sk/abracam-dome-bracket-drziak-na-stenu-pre-kameru-aircamdome/

[2] Eltrex: Camera systems [online]. Svidník, 2012, 2014 [cit. 2014-04-28]. In: http://www.eltrex.sk/kategoria/konzoly-na-kamery/aluminium-drziak-na-kamery-montazna/stenu-sab-06-6708/

[3] Novak, P. Mobilné roboty. Praha: Ben - Technická literatúra, 2005. ISBN 80-7300-141-1.

[4] Timko, J. Electrical engineering. Košice. Košice: Technická univerzita, 2008. ISBN 978-80-8073-779-5.

[5] Hobby CNC [online]. Bratislava, 2012, 23.1.2014 [cit. 2014-04-29]. In: http://cnc1.eu/sk/h5controller.htm

[6] POSPISILIK, M, KOURIL, L, MOTYL, I, ADAMEK, M: Switching Power Supply for an Autonomous Monitoring System. In: 14th WSEAS International Conference on Systems: Latest Trends on Systems. 1. Greece : [s.n.], 2010. s. 431-434. ISBN 978-960_474-241-1.

[7] POSPISILIK, M, KOURIL, L, MOTYL, I, ADAMEK, M:: Single and Double Layer Spiral Planar Inductors Optimisation with the Aid of Self-Organising Migrating Algorithm. In: Proceedings of the 11th WSEAS International Conference on Signal Processing, Computational Geometry and Artificial Vision. Venice : WSEAS Press (IT), 2011, ISBN 978-1-61804-027-5.

[8] Electronics for transportation E4T [online]. 2010 [cit. 2013-04-28]. In: http://e4t.cz/Vyrobky/CAN4t.aspxVACULIK, E., VACULIKOVA, P.: *Electromagnetic compatibility of electrotechnical systems: A practical guide to technology limitations HF electromagnetic interference*. 1. ed. Grada Publishing, Prague (1998), p. 487. ISBN 80-716-9568-8.

[9] CSN EN 55022 ed. 3 *Information technology equipment-Radio disturbance characteristics - Limits and methods of measurement*. The Czech Office for Standards, Metrology and Testing, Prague (2006).

[10] SVACINA, J.: *Electromagnetic compatibility: Principles and comment*. University of Technology, Brno (2001), 156 p. ISBN 80-214-1873-7.

[11] CSN EN 50130-4 ed. 2: *Alarm system. Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems*. The Czech Office for Standards, Metrology and Testing, Prague (2012)

[12] IAGĂR, Angela, Gabriel Nicolae POPA a Ioan ŞORA. *Study about Electromagnetic Compatibility of Line Frequency Coreless Induction Furnaces*. In: MAZA ..], Host and sponsor: University of Cantabria ... [Ed.: José Ma. Zamanillo Sáinz de la..]. Power systems and power technology: proceedings of the 8th WSEAS International Conference on Power Systems (PS 2008) ; Santander, Cantabria, Spain, September 23 - 25, 2008. S.l.: WSEAS Press, 2008, s. 95-100. ISBN 9789604740062ISSN 1790-5117.: http://www.wseas.us/e-library/conferences/2008/spain/ps/ps14.pdf

[13] HRUSKA, Frantisek. *Aspects of electromagnetic interference*. In: EDITORS, Bazil Taha Ahmed [and three others]. Recent advances in electrical engineering: proceedings of the international conference on circuits, systems, control, signals (CSCS'13), proceedings of the 1st international conference on electronics and electrical engineering (ELEL'13) : Valencia, Spain, August 6-8, 2013. 2013, s. 33-36. ISBN 9789604743186. : http://www.wseas.us/e-library/conferences/2013/Valencia/ELCS/ELCS-04.pdf

[14] STOIAN, Elena Valentina, Cristiana RIZESCU a Gheorghe IONITA. *Composite Materials with Polymeric Matrix*. In: AL]., [editors: V. Niola ... et]. New aspects of automatic control, modelling: 12th WSEAS International Conference on Automatic Control Modelling. S.l.: WSEAS, 2010, s. 35-40. ISBN 9789549260014ISSN 1790-5117. http://www.wseas.us/e-library/conferences/2010/Catania/ACMOS/ACMOS-04.pdf