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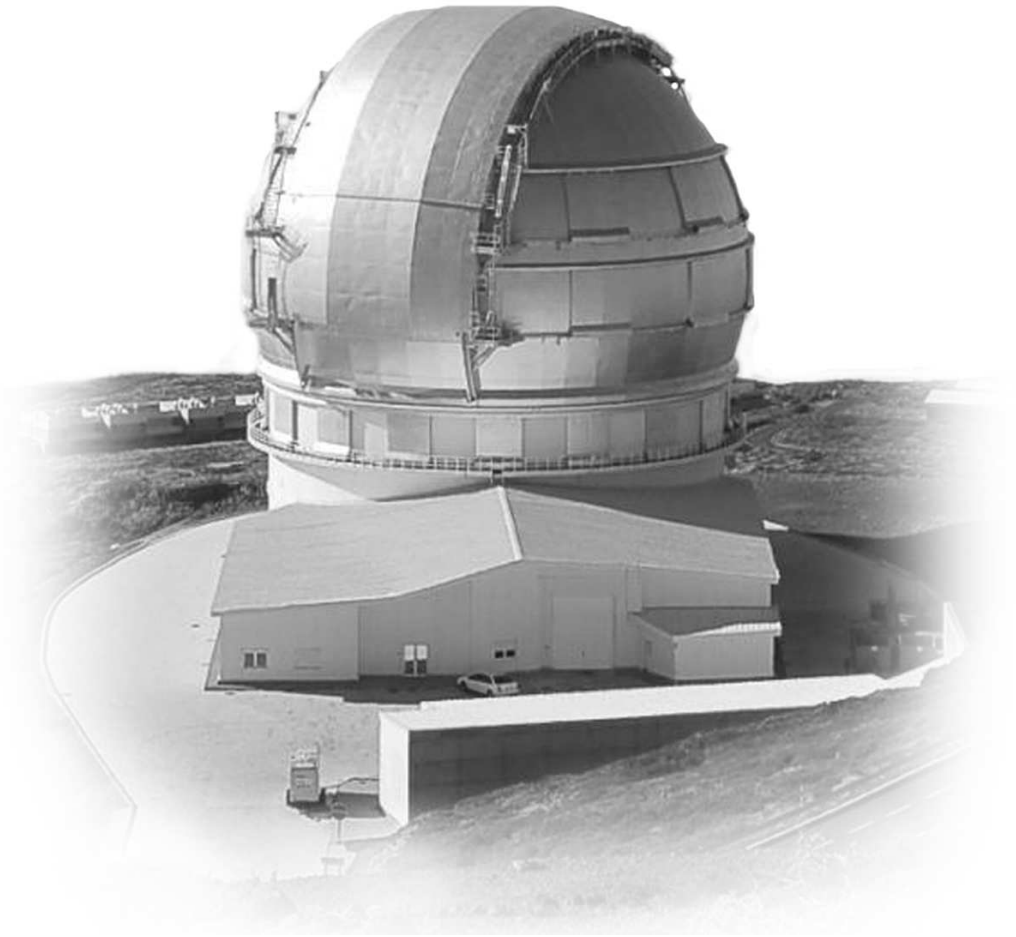

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All-Sky Meteor Orbit System (AMOS)

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In this paper, we present a new development of the Slovak Video Meteor Network. The All-Sky Meteor Orbit System (AMOS) is described from a technical point of view. The system can be used as a portable one on expeditions or as a remotely operated camera installed at a fixed location.

1 Introduction

The Slovak Video Meteor Network (SVMN), which is operated by the Astronomical and Geophysical Observatory (AGO) of the Comenius University, has been used on a regular basis since 2009 (Tóth et al., 2011). The main goal of the Network is the observation of double- and multi-station meteors in order to obtain their orbits. Meteors are detected automatically using the UFOCapture software[1].

The SVMN currently consists of three stations and the new camera of the All-Sky Meteor Orbit System (AMOS) was installed at Kysuce Observatory. This paper concerns the technical description of this camera.

2 Basic optical components

The basic optical components of the AMOS camera are as follows:

- all-sky lens : DG fish-eye 15 mm, $f/2.8$, Sigma;
- image intensifier : XX1332, Photonis;
- imaging lens: Video Opticon 1.4/16, Meopta;
- USB CCD camera: DMK41AU02.AS, Imaging-Source.

3 Mechanical setup of camera

The camera consists of three basic parts (Figure 1). The camera body incorporates all basic optical and electronic components, and inner protection housing ensures appropriate thermal conditions and mechanical protection.

The first two parts can be used together as an autonomous portable camera for expeditions. The third part (the outer shell) is intended for remotely controled cameras installed at a fixed location. It contains an engine and mechanic parts for two covers, light and rain sensors, and a protection against power failure.

[1] http://sonotaco.com/e-index.html.

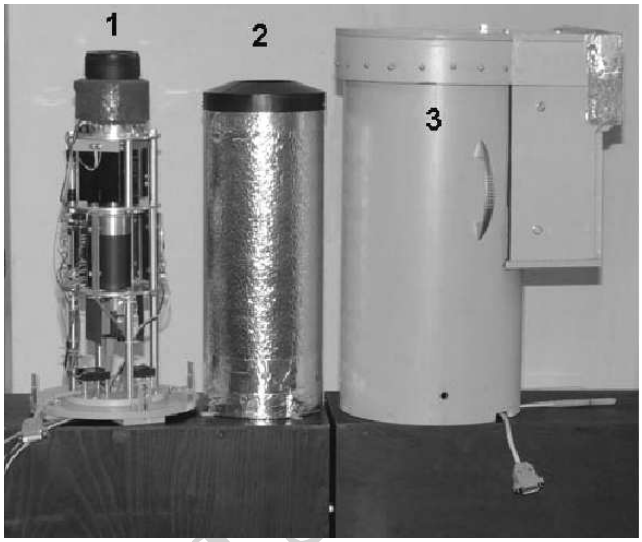

Figure 1 – Three main parts of AMOS camera: (1) camera body; (2) inner protection housing; and (3) outer shell.

3.1 The camera body

A detail of the camera body is shown in Figure 2. All optical components are mounted in a three-stage solid cylindrical aluminum framework. Both lenses are accessible for fine focusing.

3.2 The inner protection housing

The tube of the inner protection housing is made of plastic. It is easily removable from the base of the camera body. The bottom of the tube is equipped with a series of horizontal holes that allow a current of air for the camera body fans. The upper part consists of a series of vertical holes and a removable cap which together with the fish-eye lens forms a narrow slit. This slit is used for an in-flow of hot air which protects the lens against water vapor condensation. The outer side of the inner protection housing is coated with aluminized polyurethane foil.

3.3 The outer shell

The outer shell (Figure 3) consists of a robust polypropylene cylinder (1) and an engine-powered main cover (7). There is a gear (gear ratio 1:30) with a DC engine at-

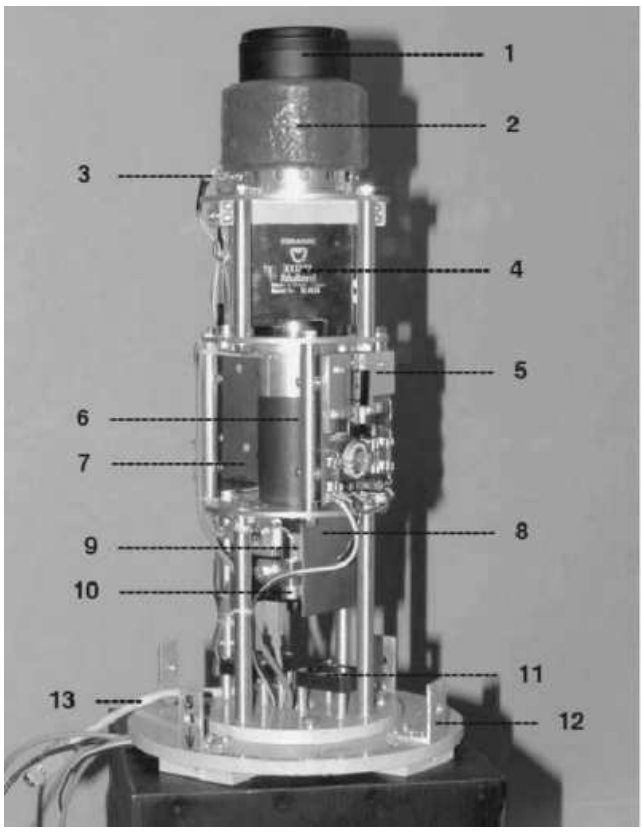

Figure 2 – The camera body: (1) fish-eye lens; (2) heating cylinder; (3) lens temperature sensor; (4) image intensifier; (5) power supply board; (6) imaging lens inside the tube from light-absorbing blackout material; (7) control unit board; (8) camera heating plate; (9) USB CCD camera; (10) camera temperature sensor; (11) two fans; (12) outer shell bolt fittings; and (13) cable to outer shell.

tached between the cylinder and the main cover. This set-up allows a great motive force at low speed. The upper and lower positions of the main cover are scanned with magnetic sensors.

The second component of the main cover is the protective cover which closes the lens in case of power outage. It is attached normally to the main cover with an electromagnet. In case of power outage, it is lowered to the fish-eye lens by an attached weight. The mechanical part of the outer shell includes sensors for rain (5) and light (9), which are active when the main cover is open.

4 Electronic control system

The electronics of the camera (Figure 4) consists of three printed circuit boards. Two of them, the control unit board and the power supply board, are installed in the camera body, and the third is part of the outer shell.

The control unit board contains a single chip microcontroller ATMEGA16 (Atmel), an optically isolated RS232 converter, and a set of relays. Three sensors DS18S20 (Maxim) are connected to the board, and used for the measurement of the ambient temperature, the temperature of the fish-eye lens, and the temperature

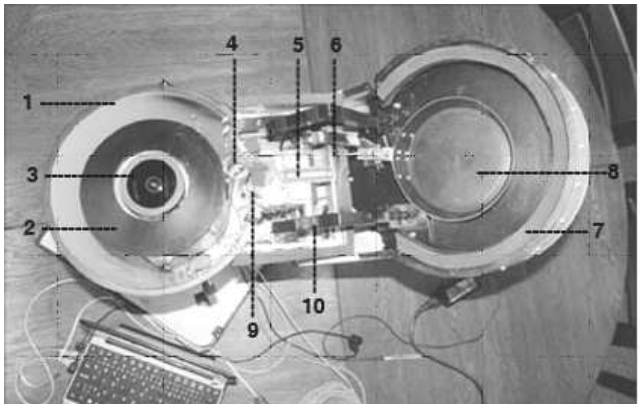

Figure 3 – Top view of the outer shell: (1) cylinder of the outer shell; (2) inner protection housing; (3) fish-eye lens; (4) weight of protective cover; (5) rain sensor; (6) cable of protective cover weight; (7) main cover; (8) protective cover; (9) light sensor; (10) steel arms of main cover

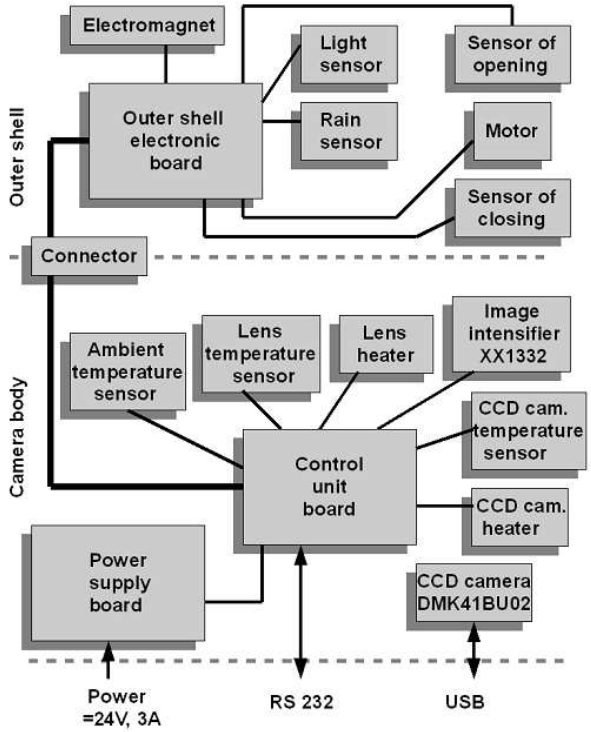

Figure 4 – Electronic control system of the AMOS camera.

of the CCD camera. Signals from and to the outer shell board are delivered through a connector between the camera body and the outer shell.

The firmware of the microcontroller samples the status of all sensors and relays with a period of approximately 60 ms. This status can also be read by the control application from the master computer.

The microcontroller uses the watchdog system with a period of 1 s. The firmware is upgradeable through a serial line. If signals from the sensors for rain and light are active for more than about 10 s, the main cover is automatically closed. The algorithm for the heating control switches the camera heater on in case the temperature drops below +1° C. The lenses are heated when the ambient temperature drops below +15° C and

their temperature is less than (an ambient temperature of) about +10° C.

The power supply board is connected to an AC-DC converter with an output of 24 V/3 A. The output voltages are 24 V for the motor and heaters; 12 V for the fans, 6 V for the image intensifier, and 5 V for the control unit board.

The AMOS system requires three cables to be fully functional: a power cable (24 V/3 A), an RS232 cable, and a USB cable.

5 The computer control software

The camera is controled from a remote computer by a command line application `cokdigi.exe`. This application controls the serial communication with the camera and obtains a set of arguments for controling the particular components of the camera and reading their status. The communication is of a master-slave kind, so it does not need any hardware resources during automatic meteor detection.

Acknowledgements

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