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High Speed Photometry with Synchronous Network of Telescopes

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Abstract.

During the last several years the author developed an electro-photometric system for synchronous high speed photometry. The system allows synchronous observations from several distant observational points connected in a network. Time synchronization is achieved using the Global Positioning System (GPS). Real-time monitoring of the observational data received in the distant points of the network is possible through the Internet. For the time being the system works at three observatories: Crimean Astrophysical Observatory in Ukraine on AZT-11, 1.25 m telescope, National Astronomical Observatory – Rozhen on Zeiss 2 m telescope and Astronomical Observatory Belogradchik on Zeiss 60 cm telescope, both in Bulgaria.

1 Introduction

The observations of variable stars, especially those which show fast changes in their brightness, like flare stars, require high speed photometry. In order to prove the existence of the small amplitude oscillations and fluctuations in their light curves synchronous observations are required. These observations are made simultaneously on two or more, preferably distant, sites [3]. This way the artifacts produced by the equipment are identified and the atmospheric interferences are eliminated.

2 System Design

In the last years, with GPS and Internet wide-spread, the solution comes naturally. GPS can be used for an accurate time synchronization between the observing sites and Internet can be used for the instant real-time data exchange between the sites. This idea was applied in the design of the presented system. The core of the system is the Photon Counting Module (PCM) and the software created to control it.

The software uses client-server architecture which allows the system to be controlled or monitored from a distance, and also allows real-time data exchange between the observing sites. This design is illustrated on Figure 1.

Observatory A and *Observatory B* are observing the same object at the same time. Both observations can be controlled from a single place, for example *Observatory A* or another *Control site*. At the same time all other sites involved can monitor and collect the data in real time.

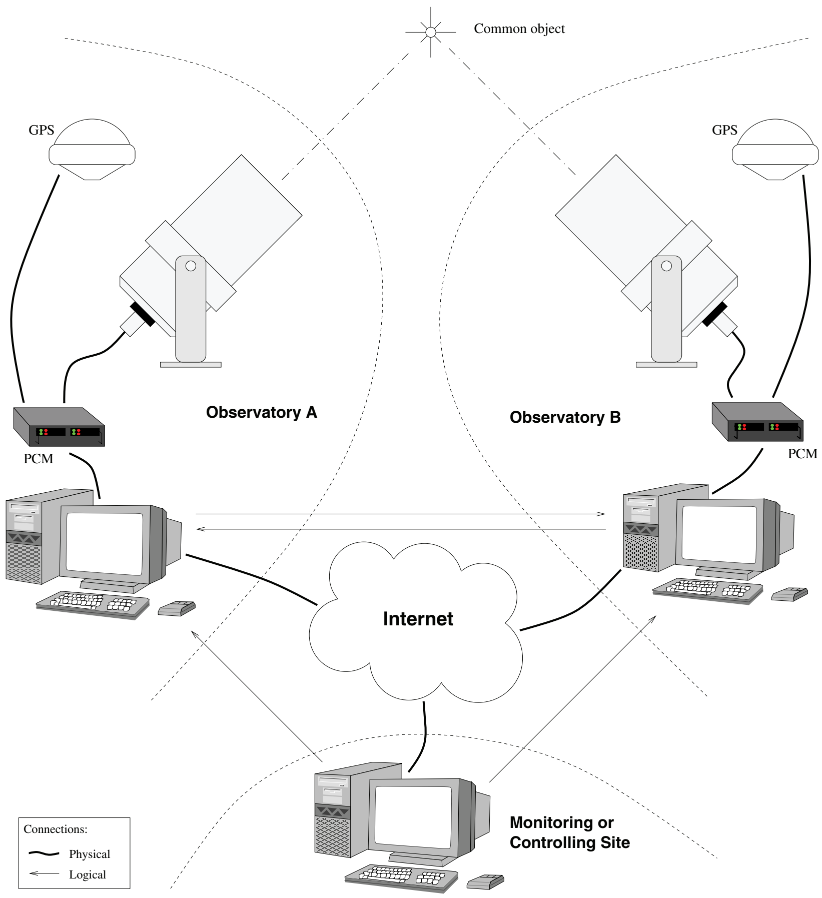

Figure 1. The architecture of the synchronous photometric network of telescopes.

3 Photon Counting Module

The Photon Counting Module is the heart of the synchronous network of telescopes. It obtains the data, provides the accurate timing (synchronized with the GPS), controls the filter wheel, and transfers the data to the computer. PCM can work with up to 8 channel photometers. The block diagram of the PCM is shown on Figure 2.

PCM has its own *Timing Unit* which controls the *Photon Counters* and strobes them precisely for each integration. The PCM *Timing Unit* is synchronized with the time provided by the GPS receiver. The *Control Unit* is responsible for gathering the observational data from the *Photon Counters*, controlling the Filter wheel, initializing the *Timing Unit* and sending data to the computer using the *Communication Unit*. Further data transfer is done on a software level on the computer connected to the PCM.

The software which has to be run on the computer connected to the PCM is acting as a server providing two types of connections: Read/Write and Read Only. The Read/Write connection allows full control over the PCM and the Read Only connection is used only for monitoring and data gathering. The client software is used to make connections to the server and to control or monitor the observation. These connections can be made over the Internet or over the local network.

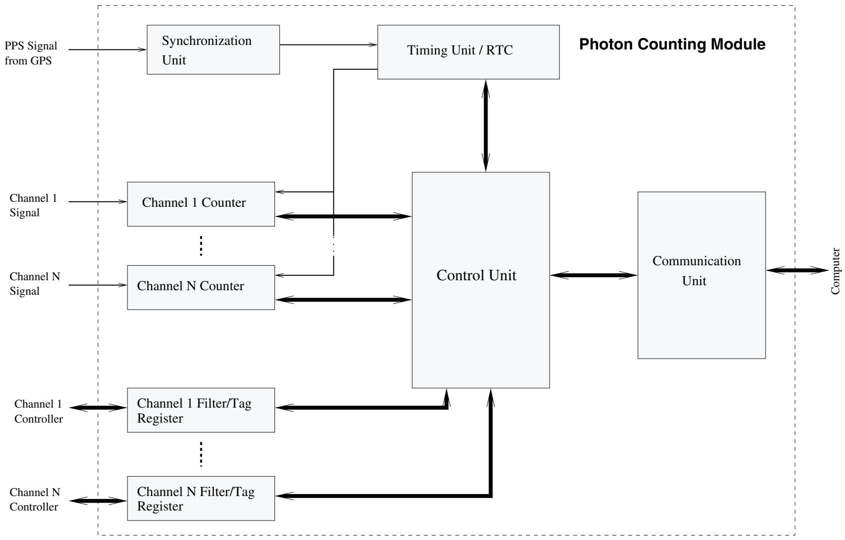

Figure 2. Block diagram of the Photon Counting Module.

4 System Specifications

Min. integration time	0.01 sec
Max. integration time	655.35 sec
Integration time increment	0.01 sec
Resolution of the internal real time clock	0.001 sec
Time synchronization drift (with GPS)	$\leq \pm 1$ μsec
Time adjustment resolution	0.1 μsec
Counter max. value (per channel)	2^{24}

5 Conclusion

This system proved to be easy to operate and reliable and is currently used at three observatories: two of them in Bulgaria – Belogradchik (Zeiss 600) and Rozhen (Zeiss RC 2000), and one in Ukraine – the Crimean Astrophysical Observatory (AZT-11 1.25 m). There is also a strong interest in installing the system on one more telescope (Zeiss 50") in Crimea and one at the Terskol observatory (Zeiss RC 2000).

The first paper, based on data collected with the system at the above mentioned observatories, is due for publication.

References

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