Kyung Hee University Automatic Observing Software for 10cm Telescope (KAOS10)

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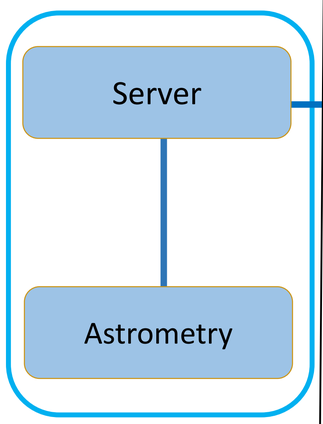
Abstract

The observation of transient objects such as supernovae or variable stars requires a survey of the wide sky and quickly extracting the results. In accordance with this purpose, we have been developing an automatic observing software, KAOS (Kyung Hee University Automatic Observing Software) as a series. KAOS30 was the first series of KAOS and it was applied to the 30-inch platform at the McDonald Observatory in the United States of America. KAOS76 controls the 76-cm telescope at Kyung Hee Astronomical Observatory. In this poster, we introduce KAOS10 for controlling a portable telescope with a small aperture size attaching a guiding camera as QHY5L-II. Kyung Hee University auto-guiding package which includes the auto-guiding function for small aperture size telescope was also developed. Additionally, the Telescope Control Package (TCP) can communicate with the main server to do astrometry for pointing and identifying targets efficiently. KAOS10 has a universal interface that will be useful for the research of both amateurs and professionals.

System Architecture

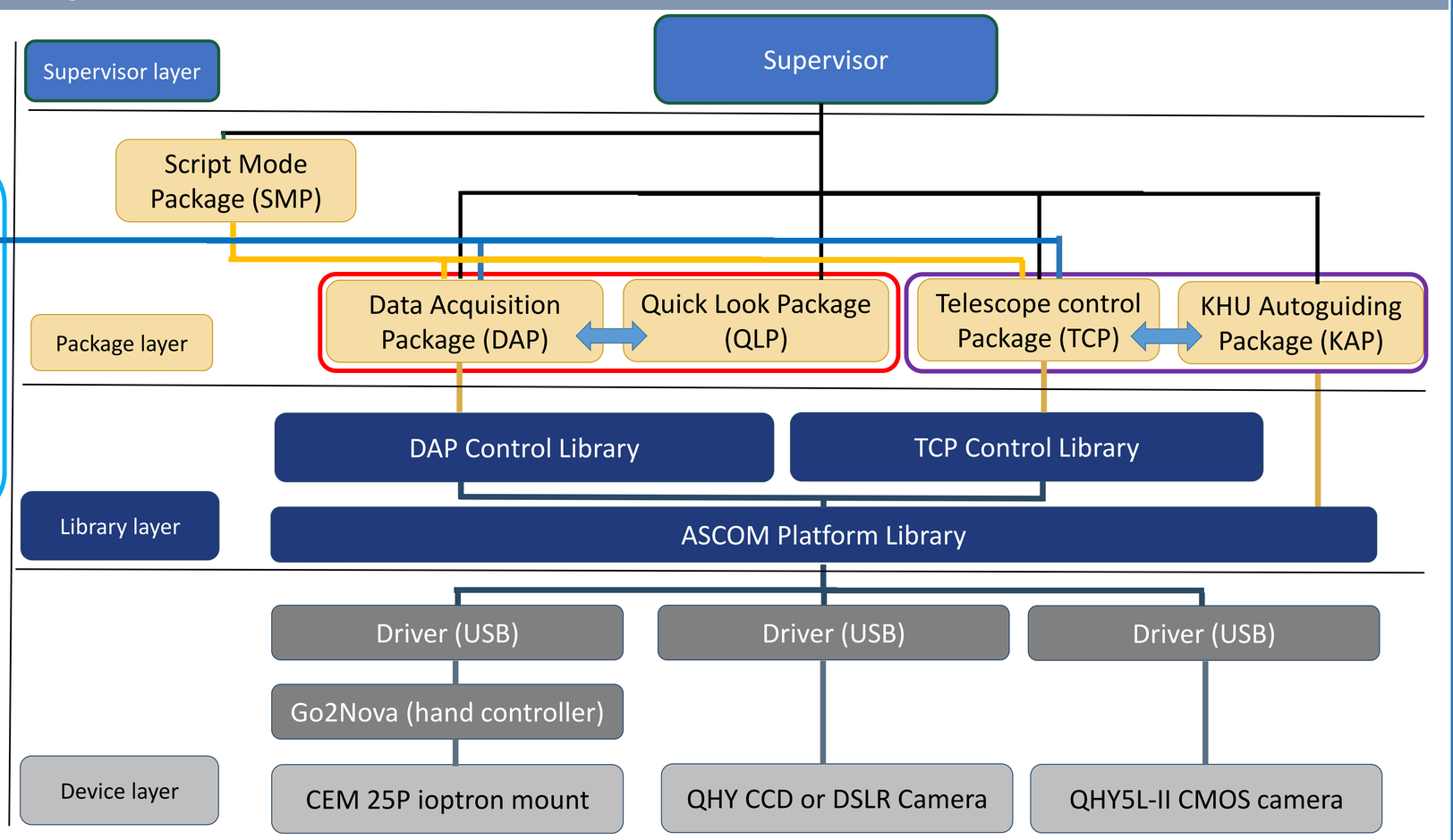
→ KAOS10 has a 4 layer structure. The package layer consists of 5 packages and each package interacts with other packages.

→ For Astrometry, the DAP sends an image to the server computer that has the astrometry function. After proceeds the astrometry, the TCP receives the R.A and Dec coordinates from the server. The communication protocol between the server and the user PC is socket communication.



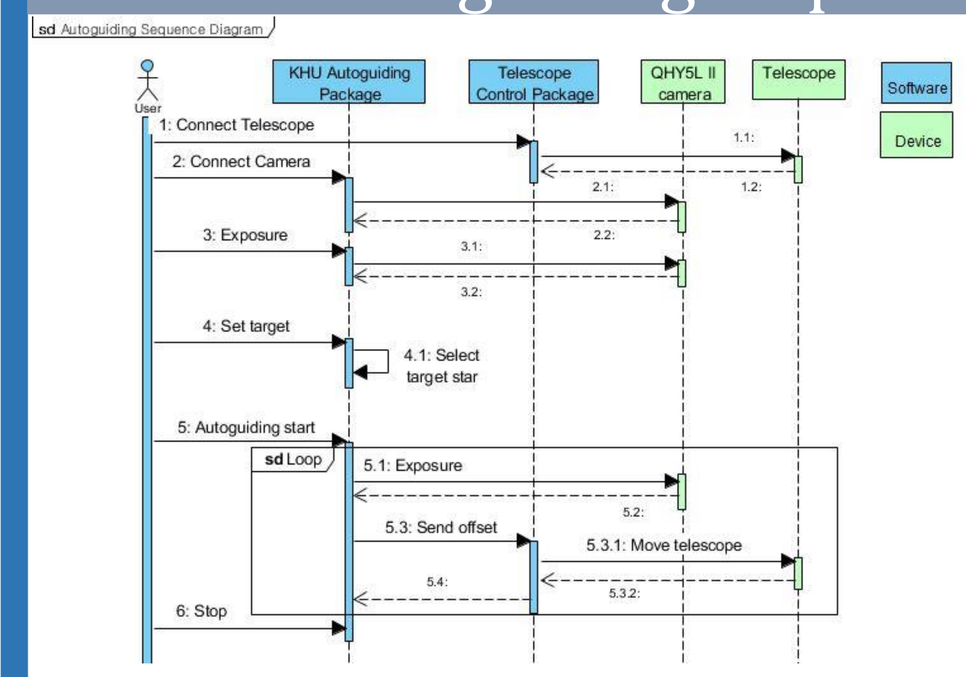
→ The DAP and QLP have immediate interaction. The DAP sends data and QLP quickly analyzes the data. The user can immediately extract information abo ut the target in order to fast BVR photometry using the RGB Bayer filter system.

→ KAP sends the offsets to the TCP. KAP can calibrate the tracking error that can be caused by various situations.



↑**Fig 1.System architecture of KAOS10**

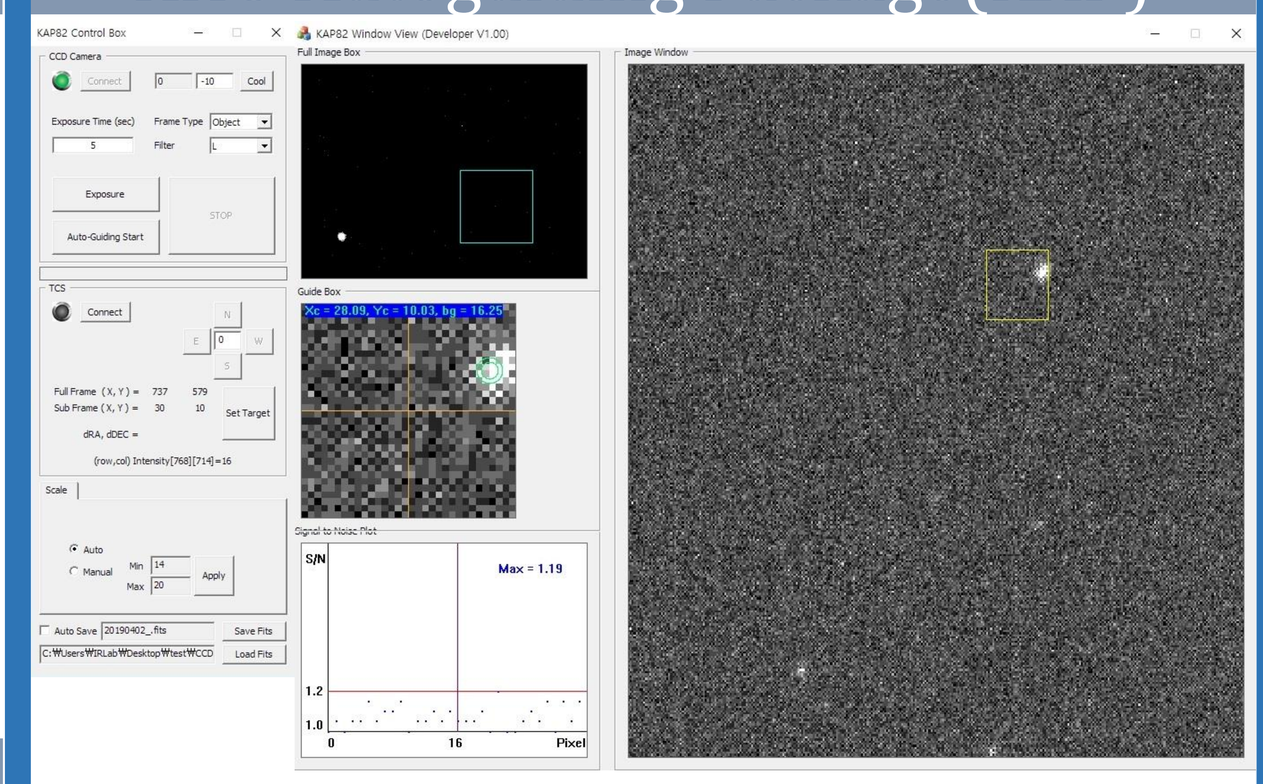
Autoguiding Sequence



↑**Fig 2.Sequence diagram of Autoguiding mode**

→ The user can connect separately with the telescope and the camera in each package. After the exposure to find the guide star, the user can select the target for guiding. Finally, the sequence of exposure, sending offset, and moving telescope is repeated as guiding the target.

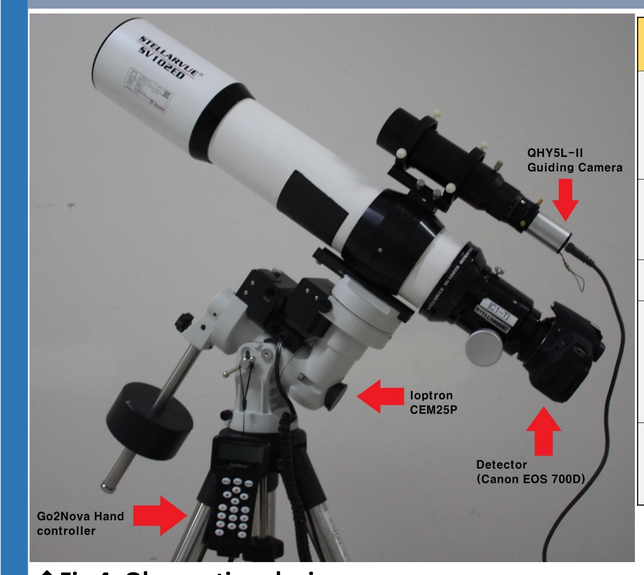
KHU Autoguiding Package(KAP)



↑**Fig 3. KAP GUI, Control box dialog(left) and Autoguiding dialog(right)**

→ The KAP proceed autoguiding using the 2D Gaussian method. The package calculates the offsets of the center of the selected star that position changed by the tracking error. Then it sends the offset to the TCP.

Device



↑**Fig 4. Observation devices**

Device	Model	Specification	
Guiding camera	QHY5L-II	Image Size (pixel)	1280 × 960
		Pixel Size (μm)	3.75
Guiding scope	Olivon OLGS-US	Diameter(mm)	50
		F- ratio	4
Mount	iOptron CEM25P	Mount Type	German equatorial
Telescope	Stellarvue SV102ED	Optical Type	Refractor
		Diameter (mm)	101.5
		F-ratio	7
Detector	Canon EOS 700D	resolution	5184*3456
		Pixel Pitch(μm)	4.29

↑**Fig 5. Device Specification**

→ The guiding camera connects directly to the control PC by the USB cable. Otherwise, the telescope mount connects with the user PC through the Go2Nova hand controller. The detector can be changed from DSLR for amateurs to CCD camera for professionals. Both can be used for extracting scientific data.

Current Status & future work

→ A jogger that can control microscopic movements is added at the TCP.
→ The Astrometry function can send the result to the TCP.
→ The KAP sends the offset to the TCP.

→ Add a function to calculate the axis alignment automatically in KAP.
→ Add a function to control DSLR camera.
→ Increasing the accuracy of astrometry function.
→ Test observation for eclipsing variables or asteroids.