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Remote Telescope - Education over the Network -

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PART 1 BACKGROUND

Outline of GOTO OPTICAL MFG. CO.

1926 GOTO OPTICAL MFG. CO. (GOTO) was founded by Seizo Goto after departing Nippon Kogaku (present called Nikon) Starting production and sales of astronomical telescopes.

1959 Achieved Home Production of medium size Planetarium Projectors and supplied many systems into science centers and museums both in domestic in Japan and overseas.

1962 Developed large size Planetarium Projector and installed in St. Louis, U.S.A.

1969 Developed a Large Format Motion Film system (ASTROVISION) and installed the first system at Fujikyu Highland.

1970 Installed a Large Format Motion Film system (ASTRORAMA) at Midori Pavilion in Osaka World Exposition and gained great popularity.

1971 Organized "Goto Users Planetarium Conference" (present "Japan Planetarium Society") which is now joined by more than 180 planetarium theaters.

1981 Software Developing Section was internally organized and it is supplying 150 to 200 shows every year.

1984 Developed a Four Axes Controlled Space Simulator "GSS-I" and it has been evolved into GSS-HELIOS, URANUS and SUPER-HELIOS.

1996 Developed a Full Color Digital Dome Projection system, "VIRTUARIUM" and installed at Minamimakimura village, Fujikawa machi and Matsue City.

From all this history, GOTO is well-known as a planetarium vendor. But as you see, GOTO was once regarded as a major telescope manufacturer in the world.

1. Pioneer for small astronomical telescope

GOTO started as a small astronomical telescope manufacturer. What we made first then was a simple set of cardboard with a 30mm lens in between. (Focal length 25mm=1inch). It was just an alt-azimuth mount. This telescope was sold in a set of 100 to 150 every month. Later on, a telescope with 2 sets of objectives was developed and released.

2. Science Education Promotion Act and telescopes

1954 the Science Education Promotion Act was enacted. 6cm and 8cm telescopes were supplied for this demand at schools.

3. Small astronomical telescopes for amateurs

With a trend of amateur astronomy and my-car era, MARK-X was released with motor drive. It targeted amateur astronomers and users could choose components such as telescope tube, mount, tripod. This was the first of its kind for portable astronomical telescopes.

4. Medium Aperture Stationary Telescope

Apart from all the small aperture telescopes I talked about, there are medium aperture telescopes for science centers, museums and educational facilities. These are 15cm, 20cm, 25cm stationary equatorial telescopes. In total, 230 sets were made and sold. In 1988, with the rapid development of computers in general, 20cm COUDE telescope was developed with concepts of easy-operation and astronomical data storing. Also, at the same time, GOTO released ASTROCAR mobile observatory which contains 20cm COUDE telescope and multi-synchronized 20cm COUDE telescopes. There are nearly 30 installation sites of these kinds.

5. Reflectors

GOTO has mainly focused on refractors rather than reflectors. But, reflectors were not new to GOTO. Portable reflectors such as 10cm and 20cm were available from the beginning. Moreover, 30cm, 40cm, 45cm and 60cm reflectors were available for educational universities and public observatories. They were Newtonian and Cassegrain types. But, the sales of refractors just outnumber the ones of reflectors.

6. Remote Telescope System

Now, with variety of telescopes in apertures and kinds, astronomers all wish to see heavenly bodies with big images. However, it is surely expensive to build one at schools and nearly impossible for public observatories. With this Remote Telescope System, we give a solution to this by widening accessibility through by the Internet and now everyone can share images of heavenly bodies.

PART 2 TECHNICAL ASPECTS

1. Preface

On behalf of Media i Corporation, I would like to introduce the technical aspects of the Remote Telescope System.

2. The network

As we discussed and experienced these days, the network has become an essential tool to our life style. Also we can't work and/or study any more without the network. I reported about the project called "Eclipse Live '98" at the IPS conference in London, 1998. We have been broadcasting chiefly with moving pictures via the Internet. You might imagine that we could see rather poor quality images and jaggy motion with limited bandwidth.

However even low bit rate images of the Total Solar Eclipse inspired pupils and students as well as ordinal people. This fact is proved because we had huge number of accesses from all over the world. So if we could use higher bit rate network, pupils, students and people can enjoy themselves and learn more about Science and Nature.

3. Live Broadcast System

This time we are using high bit rate network to broadcast heavenly body images captured by the telescope at Yamanashi Prefectural Science Center to the Planetarium dome and schools in Yamanashi prefecture. The network which we use is based on JGN - Japan Gigabit Network that consist of fiber optic cables throughout Japan built by TAO - Telecommunications Advancement Organization of Japan, a subsidiary body of MPT - Ministry of Posts and Telecommunications in Japan. This network has gigabit bandwidth and we can exchange higher bit rates data than usual.

With the Live Broadcast system, heavenly body images taken by the 20cm coudé telescope by Goto are captured by a PC(Encoder) and the captured data is transferred to the server PC(Broadcast Server). You can browse those images by PCs(Clients) set in the planetarium dome and/or in classrooms via LAN and JGN.

For example, people in a planetarium dome can watch the solar image captured at the observatory in real time.

We usually use 1Mbps bandwidth to relay image data. But in case we connect to the Internet, viewers can use lower bandwidth simultaneously.

4. Remote and On-demand Operation System

Currently 20cm/25cm coudé telescope and 45cm reflection telescope by Goto are operated by the system called "CATS-II". This has quite a fine user interface and reliability. However this system was developed so that an operator uses at the site. To gain accessibility to the telescopes as we mentioned above, we are upgrading this system to "CATS-III". The new system has following abilities.

Application Control

Pupils, Students, People and also Researchers can offer observation program proposals and get images of heavenly bodies.

Observation Control System

By the observation application, the system controls the telescope and other facilities automatically.

Realtime Control System

Also Pupils, Students, People and Researchers can connect to the telescope system and use it in real time.

CCD Camera Control System

Users can get images from the attached CCD camera.

Database System

Captured images are stored into the internal database. You can refer to it via the network.

You can "use" telescopes and see stars even if your are at the opposition site of the earth, even in the middle of the daytime with this system.

5. Conclusion

This new CATS-III utilizes modern IT and the network to allow pupils and students to lean and study about astronomy more in detail with vivid experiences. Also teachers can show the latest information of heavenly bodies by using the system. I believe this system helps you opening a new way of teaching and making people feel pleasure to know in your classrooms and dome theaters.

PART 3 DEMONSTRATION

Demonstration using the Internet with staffs at Yamanashi Prefectural Science Center in Japan.
We will control the coudé telescope and show heavenly body images by requests from audience.

PART 4 Q&A

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This paper was written for the Workshop made by Remote Telescope System Development Group at the International Planetarium Society Conference 2000 in Montréal, Québec, Canada.

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