Patent Application

Title: National Telescope Network for High-Resolution Sky Imaging and Moving Object Detection

Field of the Invention

The invention relates to the field of astronomy, planetary defense, and image processing. Specifically, it pertains to a networked system of amateur astronomers using standardized telescopes to capture high-resolution, long-exposure images of the night sky at assigned magnifications and fields of view. These images are compiled into a central database, processed into monthly master image files, and analyzed using a time-sequenced program to detect, track, and assess the risk of moving objects in space, particularly those that may pose a collision threat to Earth.

Background of the Invention

The detection and tracking of near-Earth objects (NEOs) such as asteroids and comets are critical for planetary defense. Current systems rely on professional observatories and space-based telescopes, which are limited in number and coverage. Amateur astronomers, while numerous and geographically dispersed, lack the coordination and tools to contribute systematically to NEO detection.

America's big glass dominance hangs on the fate of only two telescopes. The Thirty Meter Telescope and the Giant Magellan Telescope are outdated and cannot keep up with the ongoing requirement for NEO detection and ranking. Many astronomers had hoped that the US National Science Foundation (NSF) would contribute money to cover the funding shortfall. But last week the National Science Board, which oversees the NSF, recommended that the agency cap its giant-telescope contributions at $1.6 billion. The board also signaled that it was reluctant for the NSF to spend even that much, citing the need to build other facilities "across a wide range of science and engineering fields".

This invention addresses these limitations by creating a National Telescope Network (NTN) that integrates the efforts of 100 amateur astronomers into a unified system. By standardizing equipment, imaging parameters, and data processing, the NTN enables the creation of high-resolution, long-exposure master images of the night sky. These images are analyzed using novel software to detect moving objects, plot their trajectories, and assess collision risks.

Summary of the Invention

The invention comprises the following key components:

Network of Amateur Astronomers:

1. A coordinated system of 100 amateur astronomers equipped with standardized telescopes, cameras, and imaging software. (Exhibit A, B)

2. Each participant is assigned a specific magnification and field of view to ensure comprehensive sky coverage. (Exhibit C)

Central Image Database:

A cloud-based database that collects and stores high-resolution, long-exposure images submitted by network participants.

Monthly Master Image File:

Software that processes the collected images into a single, high-resolution master image file for each month.

Time-Sequenced Program:

A software application that overlays monthly master images in a frame-by-frame sequence to detect moving objects.

The program identifies objects such as asteroids, comets, and other NEOs by analyzing changes in their positions over time.

Trajectory Plotting and Risk Assessment:

Algorithms that calculate the trajectories of detected objects and predict their future positions.

A risk assessment module that evaluates the likelihood of collisions with Earth or other solar system bodies.

Detailed Description of the Invention

1. Network of Amateur Astronomers

a) Participants are selected based on geographic location, equipment capabilities, and experience.
b) Each astronomer is provided with a standardized telescope, camera, and imaging software to ensure consistency in data collection.
c) Participants are assigned specific regions of the sky, magnifications, and fields of view to maximize coverage and minimize overlap.

2. Central Image Database

a) A secure, cloud-based platform receives and stores images submitted by network participants.
b) The database includes metadata such as timestamp, location, and imaging parameters for each submission.

3. Monthly Master Image File

a) Image processing software combines the submitted images into a single, high-resolution master image file for each month.
b) The software corrects for distortions, aligns images, and removes artifacts to ensure accuracy.

4. Time-Sequenced Program

a) The program overlays monthly master images in a frame-by-frame sequence to create a time-lapse view of the night sky.
b) Moving objects are detected by identifying changes in pixel values between frames.
c) The program filters out noise and stationary objects to focus on genuine moving targets.

5. Trajectory Plotting and Risk Assessment

a) Detected objects are tracked across multiple frames to calculate their trajectories. The software uses orbital mechanics to predict future positions and assess collision risks.
b) A risk assessment module evaluates the likelihood of impacts with Earth or other solar system bodies, providing early warning for potential threats.

Claims

Claim 1: A system for creating a high-resolution, long-exposure image of the night sky, comprising:

a) A network of 100 amateur astronomers equipped with standardized telescopes and imaging equipment.
b) A central image database for collecting and storing submitted images.
c) Software for processing submitted images into a monthly master image file.

Claim 2: A time-sequenced program for detecting moving objects in the night sky, comprising:

a) A frame-by-frame overlay of monthly master images.
b) Algorithms for identifying changes in pixel values to detect moving objects.
c) Filters for removing noise and stationary objects.

Claim 3: A trajectory plotting and risk assessment system, comprising:

a) Algorithms for calculating the trajectories of detected objects.

A module for predicting future positions and assessing collision risks.

a) A risk assessment tool for evaluating the likelihood of impacts with Earth or other solar system bodies.

Claim 4: A method for engaging amateur astronomers in planetary defense, comprising:

a) Standardizing equipment and imaging parameters for network participants.
b) Providing training and resources to ensure consistent data collection.
c) Integrating amateur observations into a centralized system for scientific analysis.

Advantages of the Invention

- Enhanced Planetary Defense: The NTN provides a cost-effective, scalable solution for detecting and tracking NEOs, complementing existing professional systems.
- Public Engagement: The network engages amateur astronomers in meaningful scientific contributions, fostering public interest in space science and planetary defense.
- Comprehensive Sky Coverage: By leveraging the geographic diversity of amateur astronomers, the NTN achieves unparalleled coverage of the night sky.
- Early Warning System: The risk assessment module provides critical data for mitigating potential impacts, protecting Earth from catastrophic events.

Conclusion

The National Telescope Network represents a novel and innovative approach to planetary defense and space science. By integrating the efforts of amateur astronomers, standardizing data collection, and developing advanced software for image processing and risk assessment, the NTN provides a powerful tool for detecting and tracking moving objects in space. This invention has the potential to significantly enhance our ability to protect Earth from potential impacts while advancing scientific understanding of the solar system.

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Exhibit A

Features:

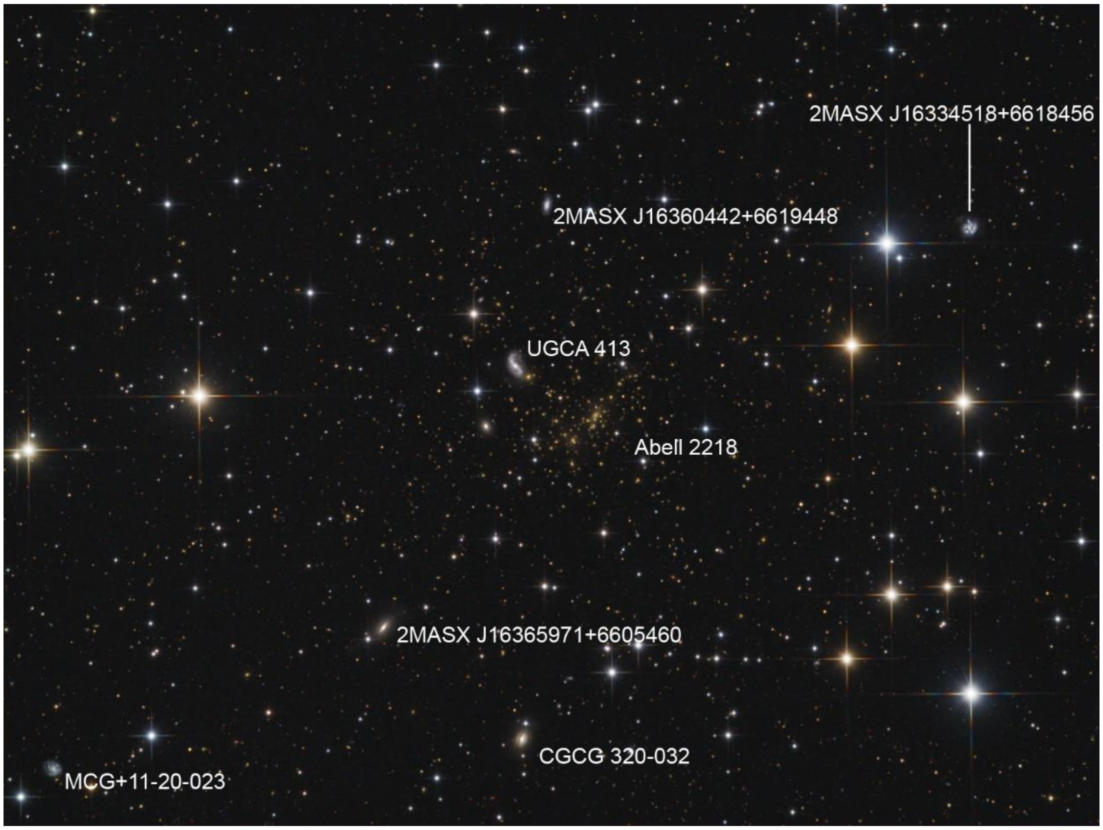
- SV605CC telescope camera is suitable for deep space photography enthusiasts; suitable for deep space photography; panoramic astronomy; meteor monitoring and lucky imaging
- IMX533 color 1-inch chip; square frame; 3008x3008 resolution; the quantum efficiency is 80%;
- The glow of CMOS will affect the signal-to-noise ratio of the glow affected area; resulting in residual glow or reduced signal-to-noise ratio of the area.
- IMX533 chip uses 3.76µm pixel; easy to analyze 10 angle split field of view
- TEC secondary refrigeration; double layer semiconductor refrigeration is adopted; which can cool to 30 ℃ lower than the ambient temperature, stabilizing the image and reducing thermal noise
- SV605CC telescope camera adopts 1-inch chip; and the best composition direction can be found by slightly rotating the square chip within 45 °
- Support system; compatible with windows; linux; mac os; chrome os and raspberry pi systems by running astrodmx capture; for windows system; also support sharpcap; theskyx and other softwares run through ascom platform by using ascom driver

Exhibit B

Cassegrain Telescopes

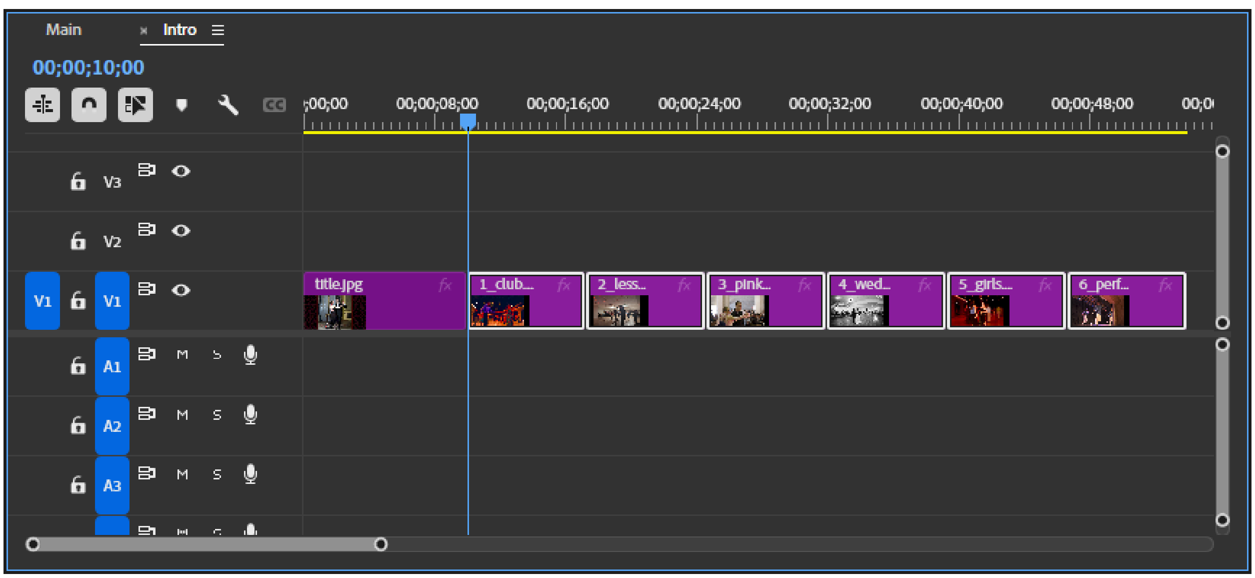
The original Cassegrain reflector design was attributed to Laurent Cassegrain of France in year 1672. The Cassegrain based telescopes design have a concave (shaped inwards) primary mirror (that “Zooms in” or magnify the image) converging the light rays with a focal ratio of f/2 to f/2.5 and a convex (shaped outwards) secondary mirror with a focal ratio of f/4 to f/5. The secondary mirror “zooms out” the image diverging the light rays to increase the telescope’s effective focal length just like cars’ side mirrors with the “Objects in mirror are closer than they appear” warning do. Both primary and secondary mirrors are squared facing each other frontally. The secondary mirror reflects the concentrated light from the primary mirror perpendicularly through a hole in the same primary mirror and the focal plane is behind of it. Cassegrain reflector telescope variants that are commercially available are the Schmidt-Cassegrain, Maksutov-Cassegrain, Ritchey-Chretien, Corrected Dall-Kirkham (CDK) and the Classical Cassegrain.

Exhibit C



Space Image Download

Just a few short years ago, even the thought of capturing an astronomy anomaly with what's considered an "amateur telescope" was absolutely unthinkable.



The master image sequencer will sequence the master image files. A basic algorithm to detect movement between pictures is called "frame differencing." Subtracting the pixel values of one image from the next in a sequence identifies areas with significant pixel value changes as potential movement zones; this is commonly used in video analysis. The extremely large file size of the master images will require special software to identify, plot, and rank moving objects in the master image files.

Exhibit D