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IMAGE ACQUISTION AND PROCESSING FOR PHYSICAL COAL TRADING

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Introduction

Physical coal traders assume significant risk when transporting coal around the world. This basis risk hinges on the future price of coal at specific terminals around the world. While they stand to gain great returns when they bet correctly, they also stand to lose a great deal of money when specific prices move in a direction they aren't anticipating.

Summary

Satellite image acquisition is well known in the art. Many companies provide commercial satellite imagery. Existing imaging systems also allow the determination of polygons representing places on Earth from satellite and other imagery. Utilization of such imagery to detect coal inventory can create value by allowing global coal traders to more efficiently transport coal to the most needed locations, at the right time, by providing more timely and accurate assessments of dry bulk inventories at various terminals where data is not currently available.

Detailed Description

Described are systems, methods, computer programs, and user interfaces for image location, acquisition, analysis, and data correlation. Results obtained via image analysis are correlated to non-spatial information useful for commerce and trade. For example, images of regions of interest of the Earth are used to detect coal inventory. Many coal terminals and mines store inventory in open-air facilities, which can be analyzed through imagery to detect changes in inventories, such as by determining angles of coal stockpiles. By providing granular and timely transparency into local coal inventory levels, such data can help traders predict where coal is needed the most or the least. As one of the primary drivers of short-term price fluctuations, inventory level transparency can increase profitable trades and reduce unprofitable trades.

The geographical coordinates of features on Earth, for example a particular type of coal terminal or mine, can be mapped to textual descriptions. From these mappings, a polygon of interest on the surface of the Earth is determined. The polygon of interest's dimensions and coordinates control an image acquisition system. This system finds relevant and timely images in an image database and/or controls devices to acquire new images of the area. With one or more images of the polygon of interest available, various image enhancement techniques can be performed. Image enhancements can be performed to increase human and/or machine perception and discrimination of items of interest from the background.

Enhanced images, can then be presented to human workers to perform the visual analysis. The resulting counts are processed by analytic and statistical processes. These processes incorporate the results from many different images, and/or many results from the same image counted by different workers. The processes may include filtering functions to improve the resulting data.

Results of the processing can be correlated with non-spatial data, for example economic activity data. Over time these correlations allow the results of this analysis to be used in predicting the non-spatial data. For example, utilization of imagery to detect coal inventory can create value by allowing global coal traders to more efficiently transport coal to the most needed locations, at the right time, by providing more timely and accurate assessments of coal inventories at various terminals or mines where data is not currently available.

In some embodiments of this system, feedback from the image acquisition, image analysis, and non-spatial correlation is used to improve the data collected. For example, feedback may be used to refine the dimensions of the polygons of interest, the quality of the imagery, and the accuracy of the image analysis.

FIG. 1 shows a block diagram of one example of an imaging system 100, according to one embodiment. Input control parameters 105 specify the operation of the system. These parameters include textual non-spatial descriptions of areas of interest on Earth. Examples of non-spatial descriptions include “Coal Terminal.” Other control parameters may include the type of data to be collected (e.g., coal stockpile angle), time and date ranges for image collection, the frequency of derived data measurement, or requirements for confidence scores of derived data.

The location search subsystem 110 determines polygons of features of interest on the Earth. The geographical coordinates of features on Earth, for example a particular coal storage stockpile, are mapped to textual descriptions. The geographical coordinates may be obtained from geographical databases or prior imagery of the site, for example. The textual descriptions may, for example, be the Coal Terminal in South Africa. From these mappings, a polygon of interest on the surface of the Earth is determined.

The location search subsystem 110 can also be configured to receive feedback 169 from the non-spatial correlation subsystem 140. This may be the case where the non-spatial correlation subsystem 140 determines that additional information needs to be obtained by the location search subsystem 110. For example, the non-spatial correlation subsystem 140 may determine that the correlation between the count at a given location and the relevant economic data is inconsistent, suggesting a need for more or different data that can be obtained by location search subsystem 110. The feedback provided to the location search subsystem 110 may include an updated search location, thereby resulting in different locations being searched for use in obtaining results.

The polygons of interest can be passed 115 to the image acquisition subsystem 120. The image acquisition subsystem 120 determines the quality and appropriateness of the polygons based on real images. For example, the image acquisition subsystem 120 may determine that a polygon is enlarged, shifted or refined relative to the real images. This polygon discrepancy information may be provided as feedback 167 to the location search subsystem 110 to improve the quality and appropriateness of polygons determined by the location search subsystem 110.

The image acquisition subsystem 120 can also use the spatial information describing the polygons of interest and the other control parameters to acquire an image, or set of images, that satisfy the control parameters for each polygon of interest. In some cases, image data is accessed from an existing image archive 150. Additionally, if needed, these images are sourced from image archives, including a social image archive. In other cases, image data is obtained from an image collection subsystem 160, such as a satellite or satellite network, array of security cameras, drones, or other purpose built image acquisition systems. Images may be acquired from either or both of the image archives 150 and image collection 160 depending on which images are the most economical and appropriate for the task.

In some cases, feedback information about the quality and alignment of the imagery is passed back 166 to the image acquisition subsystem 120. Based on this feedback, the image acquisition subsystem 120 can acquire more imagery. The image acquisition subsystem 110 is also configured to receive feedback 168 from the non-spatial correlation subsystem 140. The feedback may be used to alter the acquisition of images. For example the feedback may be used to change the frequency or time of day of image acquisition.

The acquired images can be sent 125 to the image analysis subsystem 130. The image analysis subsystem 130 evaluates the images, enhances and prepares the images, presents the images to the human workers with a task specific user interface, statistically processes the results, and passes those results 135 to the non-spatial correlation subsystem 140.

The image analysis subsystem 130 can include a number of methods for improving accuracy and throughput in image analysis. The capabilities of the image analysis subsystem 130 are described with respect to the example of determining the angle of coal stockpiles. However, the principles discussed are general and can be applied to many different image analysis tasks. Image enhancement and analysis can be performed with automated systems and/or human-in-the-loop systems. In some cases, the image analysis subsystem 130 receives feedback information 165 about the accuracy and adequacy of its results from the non-spatial correlation subsystem 140. In these cases, the data is modified, or the image analysis is re-performed according to the feedback information.

The non-spatial correlation subsystem 140 can receive result data 135 from the image analysis subsystem 130, and calculate temporal correlation between that data and economic data of interest. For example, the angle of a coal stockpile can be correlated to coal volume in such stockpile and total inventory of coal across many stockpiles. By providing granular and timely transparency into local coal inventory levels, such data can help traders predict where coal is needed the most or the least.

The non-spatial correlation subsystem 140 can collect correlation data over time. The collected data is used to create a prediction of future economic metrics based on previously collected correlations between image analysis data and economic data. For example, utilization of imagery to detect coal inventory can create value by allowing global coal traders to more efficiently transport coal to the most needed locations.

Coal traders make money by assuming basis risk, essentially betting on the relative price difference between two distinct locations. Though there are many, many, factors which impact the price of coal at a specific location, in the short term, one of the larger influencers of price changes is local inventories due to basic supply/demand economics. By providing coal traders with supply information, they can potentially better assess future price fluctuations. At a few key terminals where supply information is readily available, such as the API 3 benchmark in South Africa, physical supplies are a key input informing expected future prices by the industry.

Figures

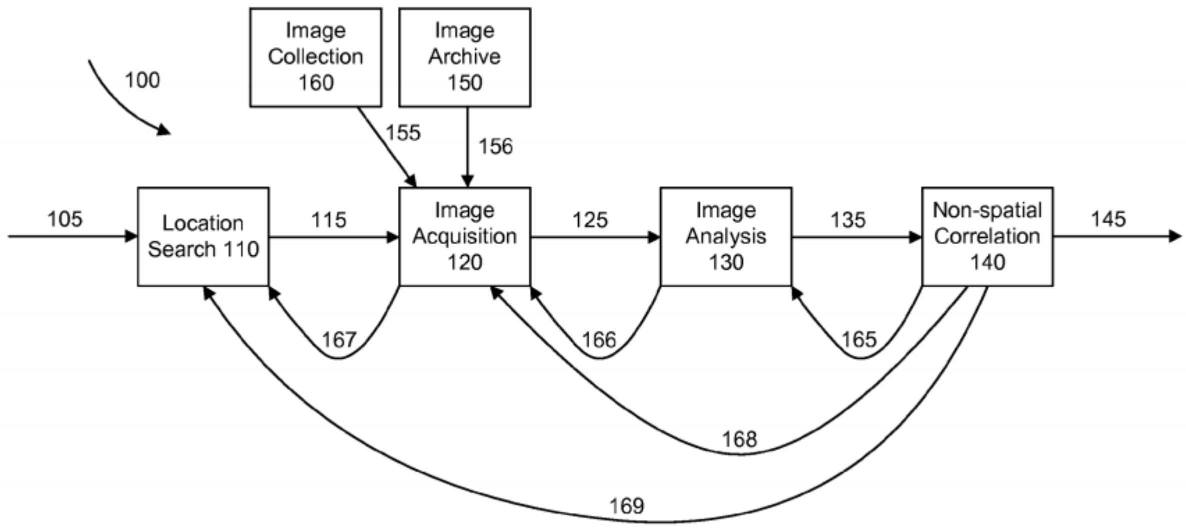

FIGURE 1

Abstract

Described are systems, methods, computer programs, and user interfaces for image location, acquisition, analysis, and data correlation. Results obtained via image analysis are correlated to non-spatial information useful for commerce and trade. For example, images of regions of interest of the Earth are used to detect coal inventory. Many coal terminals and mines store inventory in open-air facilities, which can be analyzed through imagery to detect changes in inventories, such as by determining angles of coal stockpiles. By providing granular and timely transparency into local coal inventory levels, such data can help traders predict where coal is needed the most or the least. As one of the primary drivers of short-term price fluctuations, inventory level transparency can increase profitable trades and reduce unprofitable trades.

Keywords associated with the present disclosure include: image acquisition, satellite imagery drone imagery, coal, coal inventory, coal trading, coal stockpile angle.