timesheet system. Although not shown, the management system comprises a camera monitoring system for providing images depicting at least one of a view from the crane, a view of the crane, a view from the construction site or a view of the construction site.

[0030] The crane system 410 communicates with a router 430 that is linked to a server, possibly located in a cloud 440. Information from other devices or sensors such as crane anti-collision monitoring systems (DCS60-SUP)(SMIE) 440 can also be transmitted to the router 440.

[0031] The server also communicates with processors, databases and servers that control and maintain various parameters, including individual parameters used by a crane 450; central logs for a crane 455; and information for all, user devices 460. The crane parameters 450 and logs 455 can also be hosted to allow for an active connection with the crane 410, which is useful for trouble shooting or problem rectification remotely. At the same time, a security system is also in place to ensure that remote access is only granted to authorized users, including the client, the crane operator, the crane manufacturer, or a crane maintenance crew, with varying levels of access if required.

[0032] The central logs 455 for a crane 410 can be recorded live, or periodically (every few seconds) and each movement of the crane 410 is recorded, logged, and time-stamped, along with the amount of load carried, radius, time taken, and environmental conditions such as wind speed and ambient temperature. The temperature of various points of the crane 410 can also be recorded via temperature sensors. The system is able to generate graphs to present information such as load spectrum and movement spectrum of the crane. Special logs can be created for alarms or events such as emergency stop, where the system can capture the location of the emergency button that

and/or control of the crane, and obtains the information 660 and either resolves it remotely 670 or guides onsite personnel to fix the problem 680. In the extreme scenario, the OEM may have to dispatch someone onsite to rectify and resolve the issue 690.

[0050] Figure 7 is a schematic diagram of two cranes 700, 702 and indicates respective sensors on the cranes including stationary cameras 704 and 712, sensors reading wind speed 706 and 616 a LMI sensor sensing a radius of the crane hook, height and weight on the hooks 708 and 714 and an active camera 710 that moves with the Jib and includes a sensor for luff angle and height.

[0051] Figure 8 is a flow diagram of a method of operation at the construction site management apparatus 100 of Figure 1. The sensor data is available in a store and the process accesses a sensor data batch and de-noises the sensor data by averaging or subtracting out noise using calibration data. The de-noised sensor data is used to evaluate one or more rules and/or compute a prediction 808. In response to evaluation of a rule or computation of a prediction an alert is triggered and a message sent. The message is a control message sent direct to equipment on the construction site and/or a message to a client device.

[0052] In some cases the sensor data comprises video and the process of Figure 9 is used whereby one or more video frames are accessed 900 and input to a trained object recognition system 902. The object recognition system 902 is a convolutional neural network or other trained object recognition system. In some cases the object recognition system has been trained to detect people depicted in the video frames and to output one or more regions 904 depicting a person. In this case the region depicting a person is input to a trained classifier 906 which classifies the region as depicting personal protective equipment or not.

[0053] In some cases the object recognition system 902 has been trained to

detect 920 presence of a load on a crane hook. In the case such a load is detected a synchronization step is carried out to synchronize the video frames with sensor data from an LMI sensor of the associated crane. Once synchronization is successful a comparison is done 924 between the load sensed at the crane hook in the presence of the visually detected load and the load sensed at the crane hook in the absence of the visually detected load. The comparison data is stored together with the video frames.

[0054] In some cases the object recognition system 902 has been trained to detect a concrete pour event 908 at the construction site. When a concrete pour event is detected a comparison is made between a time stamp of the video frame in which the concrete pour event is depicted and an expected time. Any discrepancy is stored and sent in a message together with the video frame to a site manager.

[0055] In some cases the object recognition system 902 has been trained to detect a tower crane 918. In this case the process moves to operation 1000 of Figure 10.

[0056] In some cases the object recognition system 902 has been trained to detect ceased work 912 at the construction site. A request for information 914 is then sent to a site manager or other operative.

[0057] In some cases the object recognition system 902 has been trained to detect an environment change 916 such as a change in a tree, an oil spill, a waste dump.

[0058] Figure 10 is a flow diagram of a method at the construction site management system in some examples. Video frames are accessed from three or more capture devices 1000. A 3D model of the construction site is computed 1002 from the video frames using conventional methods. If a tower crane has