

# Automated Remote sensing GPS satellite system for managing resources and monitoring progress in construction projects

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**Abstract:** Many construction projects faces serious difficulties in tracking the progress of the construction packages and activities. Inaccurate estimation of progressive data during the execution of the construction packages could lead to delays in the project, in addition to over budget and unnecessary costs. In order to avoid such undesirable risky consequences, this poster presents an innovative technique to control construction projects successfully and accurately. Therefore, the proposed solution focuses on eliminating the risky factors using an automated remote sensing GPS satellite system for managing the major resources of the project. In addition to tracking the progress and cost of the construction project.

**Introduction:** The process of monitoring mega construction projects can be very complicated, time consuming and costly. Thus, the need for a change in the old school monitoring techniques is crucial. In addition to the long process of calculations and percentage of error that could arise during manual or computational matrix equation are risky for management team. Every construction project consists of three main resources. These are (a) Machinery, plants and heavy vehicles, (b) Manpower and (c) Material. Also, this process is very important and crucial when preparing invoices for the project owner with respect to the percentage of executed works in construction site. Therefore, this poster presents a new progress monitoring system which is more efficient, fast and cheap when comparing with the casual classic method of monitoring construction project works.

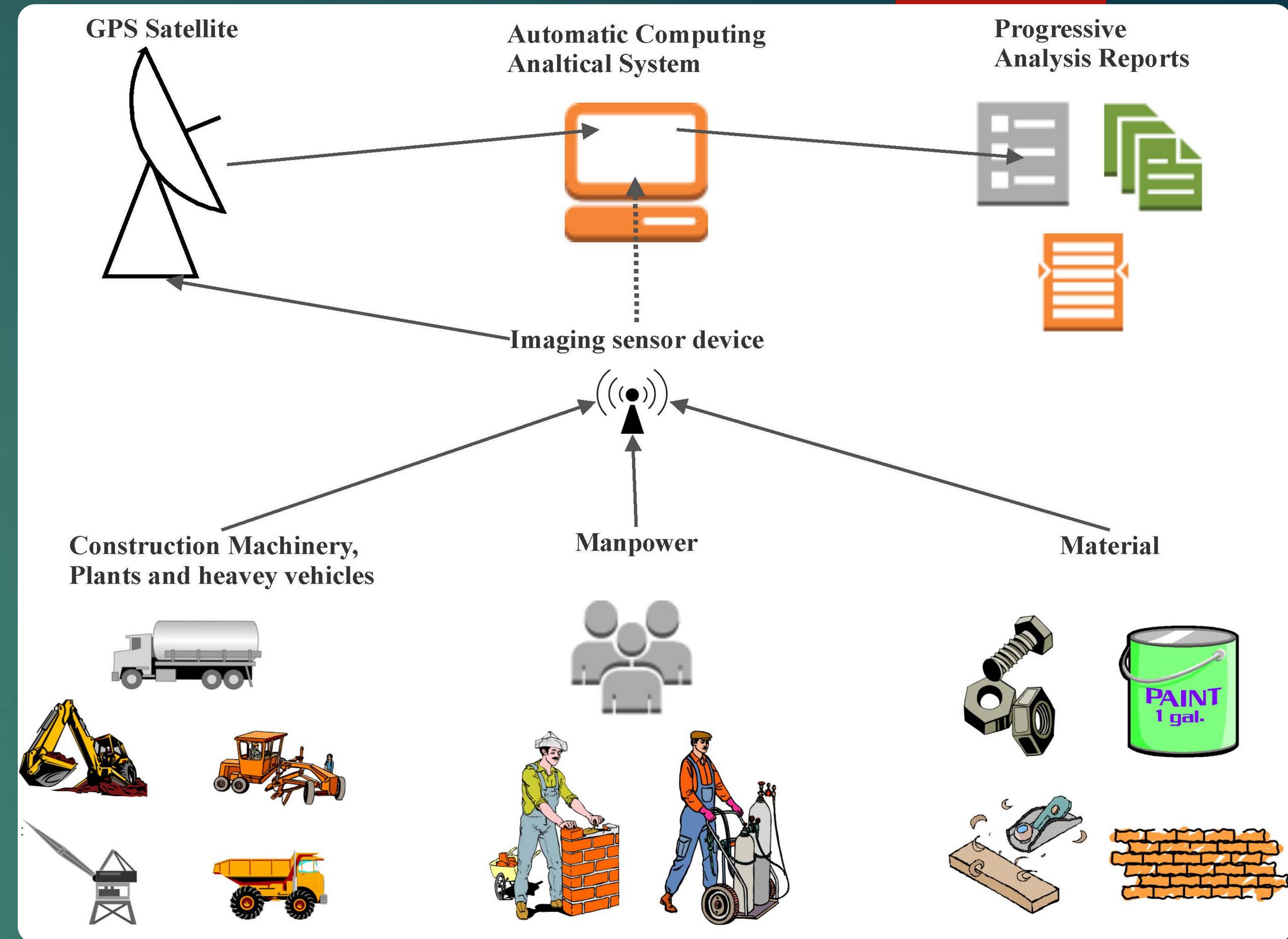
**Literature review:** Few studies has been conducted on the field of using satellite remote sensing in monitoring the progress of construction projects. Apart from tracking the progress of construction projects, the remote sensing system using GPS satellite has been used in other industries. For example, some studies has used such system in identifying the change in the geographical landscapes. Navon (2005) studied controlling construction project via automated project performance. Lagüela et al. (2012) used image fusion and image matching methods automated by thermographic 3D modelling. Kim et al. (2013) investigated monitoring the progress of projects through fully programmed recording of 3D data to a 3D CAD model. Brito and Ferreira (2015) proposed techniques for representation and analyses of 4D modeling in conjunction to construction project management. Behnam et al. (2016) researched an automatic progress tracking system for infrastructure construction projects via satellite remote sensing. Omar et al. (2016) presented a review paper on different techniques in collecting data for tracking the progressive construction works. Alizadehsalehi and Yitmen (2016) researched the Influence of site Data Capturing Skills on automatically monitoring the progress of a Construction Project. Pučko et al. (2018) used multiple workplace real time 3D scans to assist the continuation of automatic construction progress tracking system. Dixit et al. (2018) did a systematic state of art paper for the years between 2006 and 2017 on the evolution of studies in construction productive. Shirowzhan et al. (2019) did a comparative exploration of educational engine and point-based algorithms for noticing 3D variations in buildings over time using bi-temporal lidar data. Kim et al. (2019) analyzed the practice of remote nearness for observing between mobile construction resources using camera-mounted Unmanned Aerial Vehicle (UAV). Cui et al. (2019) investigated the usage of mobile laser scanning in detecting the deformations of a shield subway tunnel. Lehtomäki et al. (2019) used all-terrain mobile laser scanning in power line mapping system. Ashtiani et al. (2019) did a case study on the application of images captured by a satellite in approximating stockpiled Reclaimed Asphalt Pavement (RAP) inventory.

**Methodology:** The proposed new system consist of five major stages. Where the first stage consists of monitoring the main resources of any construction project. Furthermore, the progressive analysis of machinery and heavy construction vehicles can be monitored daily based on a small remote sensor device that can be installed in any machinery to send processed information of the quantity of work that has been conducted with respect to the number of manhours. Moreover, the progressive daily manpower work can be monitored by installing a tracking ship in the safety hamlet of the labor to monitor the progressive work for each package by sector based on the number of manhours. Additionally, the progress of the installed construction material can be tracked on a daily bases based on a number of imaging cameras installed in construction site to send the daily images to automatic computing analytical system to analysis the information and to produce daily, weekly and monthly progressive report to the construction management team. One the other hand, the second stage of the monitoring process works by sending the collected information from the imaging sensor devices to the main image sensor station. Where the third stage takes place by transferring the collected information from the image sensor station to the regulated GPS satellite. During this stage the images are distributed to the fourth stage of the monitoring system to the automatic computing analytical system. At this stage the progressive information are analyzed to give an overall picture of the whole project. Moreover, the information are analyzed using an open-sees inhouse programme, software or application which will calculate and control the progressive and cost information by areas, zones, trades and sectors for each part of the construction project. Furthermore, the fifth and the final stage of this system consists of producing full progressive and cost report to the managerial team and the main client of the project. This includes all the involved parties of the construction project, such as the contractor, the consultant and the project owner. Moreover, the format of these reports are initiated during the mobilization stages. After the mobilization stage of the construction project, the progressive reports are automatically produced on a daily, weekly and monthly bases to give the actual and cumulative progress of the construction project. In addition to the progressive reports, the new tracking system produces cost and risk management reports. Furthermore, figure 1 illustrates the automated remote sensing system.

**Discussion:** There are many pros of using the automated remote sensing GPS satellite system for managing resources and monitoring progress in construction projects. For example, the suggested monitoring system can be used for several construction projects. The image capturing cameras, the remote sensors, the computing analytical system and the main remote sensing station can be assembled and disassembled at the beginning and at the end of each and every construction project. In addition, it reduces the number of staff in project, for instance, data collectors, progress analyzers, project planners and cost controllers. Moreover, this technique are very accurate, effective, efficient and reduces the percentage of error between estimated progress and the real progress in the construction field. Furthermore, both the consultant and the project owner could rely on accurate automated progressive data instead of waiting for the contractor to give unrealistic progress and cost reports. On the contrary, the author believes that the system may have few cons. For instance, the remote sensors and the image capturing cameras may need regular maintenance to ensure the continuation of producing efficient progressive and cost data. In addition, the systems should be tested for its accuracy in different weather climates.

**Conclusion:** Automated remote sensing GPS satellite system for managing resources and monitoring progress in construction projects is the key solution for successfully delivering construction projects on time, within the planned cost and budget. It is a very accurate system in giving the actual executed progressive works on construction fields. Additionally, the suggested system gives the construction management team daily, weekly, monthly alerts if the actual works are not in line with the planned target. This includes risk and cost analysis. However, the author of this poster believes that the proposed monitoring system may need further investigations to assist its capabilities and accuracy in diverse climate conditions. This is crucial point to investigate the efficiency of image capturing cameras during frosty, hot, windy and foggy weather conditions.

Figure 1: The new proposed process of monitoring progressive construction works via automated remote sensing GPS satellite.



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