An Approach for Site Progress Monitoring Using Mobile Crowd Sensing

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***Abstract*— Monitoring of construction progress plays a very significant role in any infrastructural construction. It is an exact and sure manner in which we check the quality, progress and accuracy of our construction activity. In order to get a clear glimpse of our project's progress, we need to monitor the activities well so as to avoid or address the problems before and as they arise. Normally, a project manager has to walk around the site so as to monitor the progress of the work done. In this paper, we introduce a concept which uses Mobile crowd sensing and Image processing in a combining way to monitor the construction sites in Metro environment. The user sends an image of construction site which gets stored on the cloud. The admin who wants to check the progress of site can ask for the image of any area of his interest. Image processing module aims to match the captured image with the referenced one. Finally, we integrate the system to get the final progress done to get some value in percentage.**

***Keywords* -** Mobile Crowd Sensing, Image Processing, construction management, progress monitoring.

I. INTRODUCTION

A well-timed progress monitoring is very important for the successful completion of any construction project. Lately, mobile crowd sensing and image processing have been examined as a trending means of automated progress monitoring. Mobile Crowd Sensing is advantageous in recording, retrieval and transfer of wireless data, whereas Image Processing is able to analyze the site images to extract progress information[1] .

Mobile crowd sensing is defined as the process of obtaining required information, or asking for contributions from a large group of people. It can be called as a trending sensing technique based on the group of crowd mutually with the sensing capabilities of various sensors such as mobile devices, vehicular sensors etc. Recently, the mobile internet and mobile social networking techniques have been developed so fast, that it has given rise to the increased scope of crowd problem solving systems using mobile devices. The traditional internet crowd sourcing is turning into a new benchmark that is Mobile Crowd Sensing. MCS promotes the increasing number of mobile device users to participate in crowd sensing tasks[2]. There have been introduced many projects related to infrastructural construction which made the use of equipments like digital camera or closed circuit television camera (CCTV) to record the images of construction site[3]. However it is not always so convenient to set up CCTV camera or screens to verify the progress. In this paper, an effort is used where we can use the crowd sensing and image processing combined together in order to monitor the construction operation in Metro Environment.

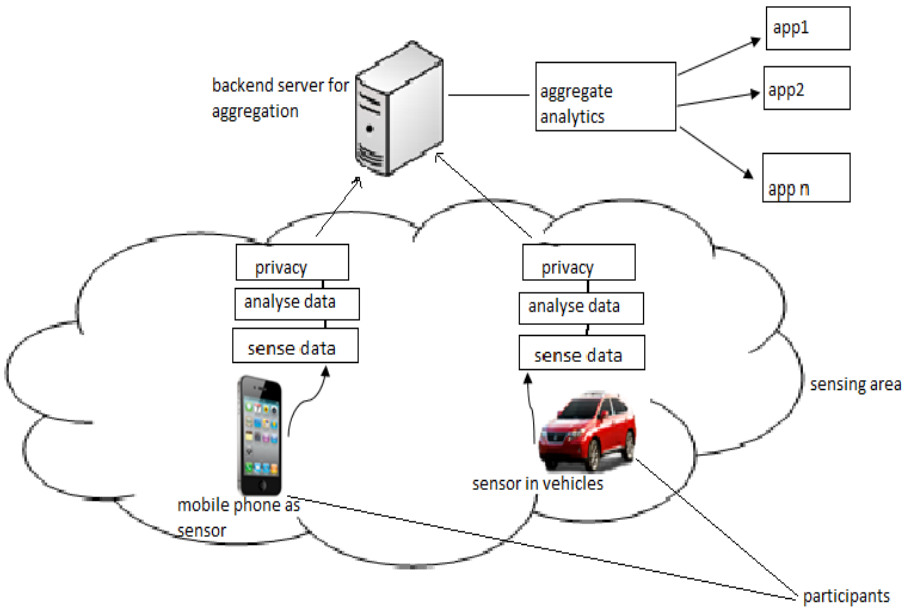

Figure 1: MCS functioning

The figure(1) depicts the general idea around which the working of mobile crowd sensing revolves. The naïve data is sensed by various mobile devices or sensors and is analyzed to get some required data. Some logical algorithms are run in order to keep its privacy safe and is given to the backend server. This data finally becomes available to be used by various applications. This appears to be a similar way in which our system is going to work. The user will be sending the raw data in the form of images, locations and timestamps to the central server. This data will be processed by the image processing module in order to get the matching of images. Some statistical analysis will be done to get the final progress done. This value will be in some percentage displaying the progress of construction done so far.

II. LITERATURE REVIEW

A numerous research activities have been performed in the sphere of mobile crowd sourcing. MCS has been largely used in smart city applications. In the road transportation department, a large scale data about various traffic patterns is collected along with the speed, sensed by the GPS sensors embedded in cars. Based on this kind of data collected from cars, drivers can receive real time information about the traffic conditions [4]. Drivers can also get the real time information about the parking slot availability using ultrasonic sensors equipped in cars [5]. Minho Shin, Cory Cornelius et al. have well proposed a traffic monitoring system, which gathers the raw data about the travel information from cars' sensors and readily presents a complete estimation of travel time required [6]. Leye Wang, Daqing Zhang et al. in their paper have tried to minimize the number of allocated tasks to participants in location centric MCS applications where the authors have attempted to lessen the number of sensing cells needed. They have considered the spatial and temporal correlation among the sensing data from various cells. CCS-TA, a good task allocation framework has been intended by them, combining the state-of-the-art compressive sensing, Bayesian interface, and various mechanisms for learning to select a smallest number of sensing cells in each cycle while calculating the missing values of remaining cells, at the same time assuring that we get the maximum accuracy [7]. An issue of load balancing in MCS is studied by Julia Buwaya[8] in her paper. A game-theoretic selfish routing model has been created and has a systematic mechanism for automation of task allocation in MCS system has been developed. The model's truthfulness has been proved by author. An application "Creek Watch" monitors the levels of water and its quality by integrating all the reports from individuals. Photographs of creeks in area are taken at various locations or text messages about the amount of trash are sent. S Kim, C. Robson [9] have presented an efficient way to utilize this information to be used by water control boards to track the pollution level in water resources. Mobile crowd sensing has also been widely used in Environmental applications. Pollution tracking sensors are equipped on the mobile devices to map with the highest accuracy of polluted areas around the country. Environmental agencies can use this data. The participants may claim "fake" pollution to harm the business of rivals by yielding the sensed polluted data associated with false locations[10] . MCS uses different modalities of sensing such as numeric values(GPS coordinates), audio, images, videos says Bin Guo[11]. Among these all, Visual Crowd Sensing(VCS) uses camera sensors built-in smart devices. This application captures the details of interesting views or items in the real world. These are captured in the form of pictures or videos. This has achieved a huge attention because of rich information that can be provided by images and videos. Min Huang et al. in their paper have presented the need for storing the huge amount of data that is growing with the sensing

technologies[12]. This data is stored on file system or data warehouse. To conquer this problem, the hybrid file storage method is designed which supports hybrid storage for all kinds of files from sensors of crowd sensing process. Files, as either big or small files are classified and these two types of files are stored using different storing and transferring strategies. A load balancing method of metadata servers based on a genetic algorithm is used.

Image processing has gained an outstanding dedication in the field of construction monitoring. Hongjo Kim, Kinam Kim et al.[1] have designed an interactive progress monitoring system to check the quality of progress monitoring methods used. The user selects an object on the site and a list of attributes appears before that allows him to match with the attributes of his interest (such as location or material type). This allows automatic matching of objects on the site. A 3D CAD model has been designed by Wu et.al [13] which is a robust method for object recognition at construction sites. Use of this model gave the highest accuracy in object recognition at the sites. Kim et al.[14] in their paper have suggested a 4D CAD model. A CAD model where the system needs repeated updating and after updating the system gives correct output. However, updating requires more time and manual power, they have used 4D CAD model combined with image processing. A regular 3D CAD model is given all the schedule in batch processing modes, and a 4D CAD model is obtained.

III. PROPOSED SYSTEM

In construction monitoring, MCS and image processing techniques are gaining emerging position. The concept we are introducing is the use of Crowd Sensing in monitoring site progress in metro environment. A supervisor does not always voluntarily be requiring to be present at the site of monitoring is the major benefit of this system. The prime advantage is the time-saving and effortlessness as he can simply look over it from geographically dispersed area. As the final outcome, we will be calculating the percentage of construction activity completed to the date.

The proposed system can be divided into five modules as follows-

i. Development of Mobile Application for location and image capture.
ii. Development of Central Cloud for reading images and location.
iii. Development of Admin Panel to view location and request for images.
iv. Development of Image Processing component for site progress monitoring. The Image processing module has three sub-modules which will perform the following -
    a) Preprocessing will be performed to remove noise from the image using median filter
    b) Feature extraction to be done by using shape map and color map
    c) Feature matching will be performed by using multi class Support Vector Machine (SVM)
v. System Integration.

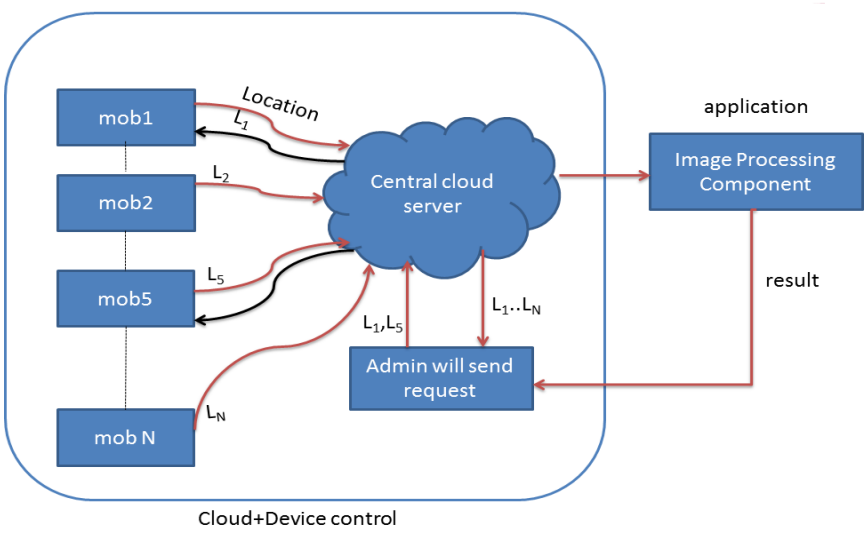

Figure 2: block diagram of proposed system

The general working idea of the project is shown in figure(2). The sensing technique used will be participatory crowd sensing and the application will be accessible by Android users. The users through their mobile devices, will share their respective locations with the central cloud server. These locations will be given to the admin by the cloud server. To obtain and check the progress information of the particular location, the admin will send request to the central cloud server. All the images of metro construction environment coming from distinct locations will be stored on central server. These images (as per admin's interest) will undergo processing in the image processing component and the final outcome will be given back to the Admin. The outcome of this

system will show some value in percentage, which would display the percentage of progress of metro construction done so far.

In the practical context, we'll be using a fully communal progress monitoring system dependent on MCS and Image processing. The image of the construction site coming from mobile device of the user is stored on central cloud server and passed for processing at image processing component. At image analysis and processing, the original input RGB (Red, Green, Blue) color image will be converted into Grayscale image. To perform preprocessing, we'll use median filter in order to remove noise from the image. For performing post-processing, the edge of the object will be detected by using canny edge detector using Gaussian filter with certain threshold value set (high threshold TH, and low threshold TL). Morphological binary operations like closing and filling will be performed if we find any holes or gaps in the edges to close and fill those. For the sake of building some derived values(called as features) being informative, we need to extract features of the input image. Thus in feature extraction, for defining the color scheme for various visualizations like surfaces or patches, we will use color map. To present corresponding comparisons of the regions by assigning different colors to different regions, shape map will be used. For finding relative features, classifying and matching those from the dataset is said be to done by feature matching. We'll use multi class SVM (Support Vector Machine) for this purpose. Site progress checking will be done by using the statistical analysis (based on the images we capture). Finally, the site progress is given to the admin for further actions to be carried out on the construction site.

IV. CONCLUSION

Construction monitoring has been observed as the key factor that ensures a successful completion of a construction activity. In some conventional site progress monitoring methods, an engineer or a site manager has to be unfailingly present at the sites to monitor the proper progress done, or he has to arrange some photogrammetric techniques. For efficient utilization and results, this system is going to be fairly remarkable one. The system is going to be a real time monitoring system, where an image from construction site is going to be sent to the server. On admin's request, the image on being passed to image processing module, will be matching the captured image with the referenced one. The result the system, in the form of some percentage value is going to be more beneficial to depict the actual progress done. This will enable a project manager to conveniently make a proper interpretation of ongoing work, and also make the resources available for further construction activities.

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