Material Management on Construction Sites using ICT Strategy

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Abstract—Recent studies shows that even though the materials and components used in construction costs more than 60% of the project cost in total, methods that exist for managing them totally depends on human skills. This traditional method is always unreliable, time and labour-intensive and error prone because of unwillingness of workforce to monitor and record large amount of materials present. To overcome this, automation can be done which will provide accurate and timely information to the manager. This paper deals with the new approach which will help in identifying and tracking materials effectively using wireless frameworks. In this approach the combination of Near Field Communication (NFC) and Global Positioning System (GPS) technologies are used which can facilitate low cost, easy to implement solutions to identify and track materials and components. This system is fully automatic and provides effective identification and tracking in all phases like production (offsite), en-route (transportation), construction site (onsite).

Keywords—Automation in Civil Engineering, material Management, Near Field Communication (NFC), Radio Frequency Identification (RFID), Wireless frameworks.

I. INTRODUCTION

Construction projects are usually complex projects which be uncontrolled, unprepared and takes place under dynamic environment. Due to that construction management needs real time and accurate information to share with the personnel who are involved in the project to make it effective and efficient.

Materials are considered as the important elements of a construction project since it contributes more to the cost associated with the projects. This is because the cost spent on the materials will be 60% - 70% of the total project cost which is higher than other inputs. Thus managing materials is difficult as they have direct impact on the construction cost and schedule. For example: lack of materials, inadequacy in identifying materials, bad storage management will cause increase in project cost and loss in workforce productivity.

Construction is the field which is labor and information intensive. Exchange of information between all the participants of the project is one of the most important factors in construction.

In last twenty years, real time information systems became an important one in construction management. Considering about the existing technologies, a number of technologies that are appropriate to construction have become more effective because of their low cost with high reliability, accuracy and integrity.

One of the recent technologies is Radio Frequency Identification (RFID). This has benefits like easy handling, ready availability and affordable. This is a wireless technology based on detection of radio frequencies and electromagnetic signals which are used to encrypt and decrypt data for the tags. This Radio Frequency Identification (RFID) technology deals with various types of frequencies which lead to the development of new technologies.

Near Field Communication (NFC) is one of such technology which uses high radio frequencies for capture and transforming data form or to tags. This paper deals with the NFC based system which effectively uses NFS and GPS technologies for obtaining real time information and sharing of information with all the participants of the construction project.

II. STUDY ON PRESENT SCENARIO

In present the traditional method of gathering information is followed widely, traditional method is nothing but recording the data in the records with human skills. Here separate individuals are placed for recording the amount of materials present and dispatched from the inventories or from the production site and on the construction site. This procedure sometimes will not be accurate and instant due to the mistakes of the personnel. There will be some misuse of records, missing of records, and improper communication of information among the labors. This careless procedure will lead to lack of materials when needed and delay of work which will have great impact on total project cost.

But this method is still in use though it has many demerits due to lack of knowledge about the technology advancement and inability to implement the advancements.
This paper suggests the usage of wireless frameworks which is a recent advancement of technology which reduces the risk associated with the present procedure and increases the efficiency of the management.

III. Utilization of ICT Tools

Recent studies show that material cost contribute more than half of the overall cost of the project. So managing them is a challenging process. For managing them effectively, recent technology advancements are utilized in many construction industries. One the advanced technologies used widely are ICT tools like RFID, NFC and GPS. These tools are also called as wireless frameworks which use the radio frequencies and electromagnetic waves for reading and sharing information.

These wireless frameworks help to identify and track the materials instantaneously and accurately. This technology also shares the information with all personnel who are responsible for the completion of the projects. In this project a study on material management using Near Field Communication (NFC) on construction site was carried out.

A. Near Field Communication (NFC)

Near Field Communication is a form of contactless communication between mobiles, tablets and radio frequency tags which allows the user to read and write information on tags without touching the devices together or go through multiple steps to setup a connection.

NFC tags are high frequency mifare tags which operate in 13.56 MHz. These tags are nothing but high frequency RFID tags in which information can be stored and retrieved using mobile devices.

IV. Methodology

To establish the objective the study, it is necessary to define the needs and problems in present material management methods. For that literature review and studies were made on automation in material management, NFC and present methods of material management. Based on the literature review various available automation technologies and the problems associated with the present methods were known. Improvements needed on various levels of material management were identified and a new technology for automating identification and tracking of materials using NFC was selected.

A. Problems associated with present method

Presently traditional method is being used for material management on construction sites by many firms. Traditional method is nothing but conducting material management using humans. Tough this method is beneficial as it don’t need any computational skilled labours but this method is prone to errors and lack of accuracy. There are chances of missing records, less storage space for record keeping, poor record maintenance and missing of values due to the carelessness of the workers. This method also has less accuracy and poor communication among the labours which will affect the information sharing between the employees. Improper sharing of information and less accurate information cause delay projects and increase the overall project cost.

B. Practical issues with some automation techniques

To overcome the problems faced in the old method, some construction firms adopted automated material management methods like barcodes and RFID. These new technologies were accurate and instant in data collecting and sharing of information but still have some practical issues which make them costly and difficult to follow. From the studies made following are the issues that makes automation difficult.

In the case of Barcode, these codes are printed in papers which can be spoiled by water and dust. Designing and printing of these barcodes cost high since they need special devices to make it. So some firms used RFID technology which has more advantage and efficiency when compared to Barcodes. These RFID tags are safe from dust, water and also capable of storing more information than Barcodes. But the only factor which makes it difficult to implement is cost.

These RFID tags need separate devices for writing and reading information from the tags. These devices are complicated to use and also cost high. So some of the medium and small firms couldn’t able to implement it effectively. To overcome these problems this research suggests the implementation of NFC in material management.

C. Material Management Using NFC

Near Field Communication (NFC) is a new technology which is invented first to share files among the mobile devices with wireless communication using electromagnetic waves. But later it was found that this technology can be used to receive radio frequencies from the RF tags, which will be used of identification purposes in various fields. This research states that this technology can be used for identifying and tracking of materials effectively.
This NFC uses high frequency Mifare RFID tags for the communication. These tags are also called as NFC tags which operates on a frequency of 13.56 MHz. This method is almost similar to RFID but the only difference which makes it more efficient than RFID is that, by using this technology one can easily write and read information on tags using simple mobile phones or tablets with NFC capability. Thus NFC eliminates the need of special devices and complex setups for reading and writing information on tags which is not possible with RFID technology.

To check the possibility of the implementation of this NFC technology, test was done with NFC tags and devices. Here a mobile phone that runs on windows 8.1 platform with NFC capability is used. Mifare Tags with 13.56MHz frequency were got from the retailer and the application named NFC commander which is needed to read and write information on tags was downloaded from the windows app store. This application is a free application with read, write and share options.

**D. Working of NFC**

T NFC tags can be encrypted with data using the NFC commander application via mobile phone. Then the data can be read anytime and can be edited with the same application. This communication between tags and the devices can be done with the mobile phone or tablet with NFC feature and the app installed. This process won’t need any special devices. Once the tags are read, that information will be shared with the other device also. These tags can also be tracked using the computer cum mobile application called map your tag application which uses GPS technology to locate tags across the globe. This application is very effective in tracking the tags with the tag numbers that are registered with it.

**Figure 1: NFC application and tags**

**V. Conclusion**

This research presented a new technology to increase the efficiency of material management process in construction site with minimal or no human work. This suggested technology is more efficient than other advance technologies in the field such as Barcodes and RFID. This technology helps in obtaining real time and accurate information about the construction resources. It also helps in sharing the information with all the players of the project immediately. This technology facilitates the low cost, infrastructure free, easy to implement and low maintenance solution which will help the construction industry in a great way. This approach uses the combination of NFC and GPS as a powerful portable tool which enables to collect, store, share and reuse of field data accurately, completely and almost instantaneously.

**REFERENCES**


