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## What Authentication Technology Should Be Chosen for Construction Manpower Management?

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### Abstract

The objective of this paper is to analyze the feasibility and limits of various authentication technologies such as radio frequency identification (RFID), quick response (QR) codes, and fingerprint, vein, iris, and facial recognition for manpower management and access control at construction sites. Based on the analysis of limits and features of authentication technologies, requirement analysis in construction field operations through interviews and site visits, and video study based on construction workers' actual use of the technologies, this study identified that the false rejection rate (FRR) and the processing time (PT) per person of an authentication technology are among the governing factors for making decisions to adopt an authentication technology for manpower management and access control. This study developed an equation to estimate the total process time using FRR and PT for each of the technologies, and the estimation results show that the difference in total process time can be up to 4 – 5 times larger for each technology. This can have a significant effect on the number of units to be installed at the level of about 2,000 or more construction workers.

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### 1. Introduction

Manpower management is one of the most critical jobs and should be handled on a daily basis at construction sites since manpower information can be utilized for access control, productivity analysis, labor payroll, progress, and

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safety management. A labor-intensive construction project attracts tens of thousands people every day, and manual-based manpower management is practically useless in such a condition. Meanwhile, some construction projects require high-level security control at construction sites.

Currently, various authentication technologies, such as radio frequency identification (RFID), quick response (QR) codes, and fingerprint, vein, iris, and face recognition, are adopted for manpower management and access control at construction sites. However, due to a lack of understanding of authentication technologies and their applications in construction environments, limits in adopting such technology for manpower management have been discovered. In addition, there has been a lack of research on the feasibility and adoptability of various authentication technologies at construction sites from a construction manager's point of view. Further verification and validation of these technologies based on the requirement analysis of construction sites are necessary for successful and practical application in manpower management and access control.

Therefore, the objective of this research is to develop a method to evaluate the feasibility and limits of various authentication technologies for manpower management at construction sites. Considering the features and requirements at construction fields, this study analyzes characteristics of the authentication technologies of RFID, QR codes, and various biometric recognition technologies such as fingerprint, vein, iris, and face recognition. Requirements of construction field operation, limits and problems, and decision-making factors for authentication technologies are derived based on site visits, interviews with construction practitioners, and video study. Finally, a guide framework consisting of consideration factors and an equation to estimate the total process time and number of units required for access control are proposed.

## 2. Authentication Technologies

### 2.1. Radio Frequency Identification (RFID) & Quick Response (QR) Codes

RFID is a touch-less, non-line of sight, electromagnetic spectrum-based technology consisting of a reader and tags [1]. Passive tags are typically used for construction manpower because of their low cost for tags compared to active RFID tags. Passive RFID cards are assigned to each construction worker so that they scan their cards at the gate of a construction site for access control and time tracking of working hours. Due to its touch-less feature for recognition, RFID supports fast identification of workers and is particularly effective for a construction site that involves a large number of workers. For example, a Samsung E&C-adopted RFID-based manpower management system can handle 12,000 workers at its peak time [2]. However, using RFID can provide a burden to managers at the construction site since they have to issue cards to construction workers and manage lost cards.

The features of QR code, a type of 2D barcode, are described as follows [3]. QR codes are easy to generate and can store much more information (maximum 7,089 characters) than barcodes. As QR codes are resistant to dirt and damage, data in QR codes can be restored even if the symbol is partly damaged or dirty. Further, they support high-speed reading from 360-degree directions and can be printed on paper or viewed as images on a smartphone. Due to these features, it is easy to generate QR codes with embedded essential information on a worker such as name, birth year, and blood type. QR codes are also inexpensive since they can be printed on paper or sent to a worker's smartphone. When there is a new worker or a visitor at a construction site, a new QR code can be immediately generated and printed for that person. However, using QR codes under direct sunshine should be avoided because they are a line of sight reading technology using a camera or scanner. In addition, QR codes can be easily copied and so are subject to false reporting.

### 2.2. Biometric Recognition

Various types of biometrics have been developed and applied, even in the construction industry, and they include fingerprint, vein, iris, and face recognition. These technologies use pattern-recognition and artificial intelligence based on images of fingerprints, veins, irises, and faces. Therefore, obtaining a good quality image and an algorithm to detect and recognize a person's identity are key to the technology [4,5,6].

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