A CONCEPTUALIZATION FOR THE AUTOMATION OF A LIFT CAR OPERATION IN HIGH RISE BUILDING CONSTRUCTION

Jong Hyun Lee¹, Soon Wook Kwon²*, and Mi Na Lee³

¹ Department of u-City Design and Engineering, Sungkyunkwan University, Suwon, Korea
² Professor, Department of u-City Design and Engineering, Department of Civil, Architectural and Environmental System Engineering Sungkyunkwan University, Suwon, Korea
³ Department of Civil, Architectural and Environmental System Engineering Sungkyunkwan University, Suwon, Korea

*Corresponding author (swkwon@skku.edu)

ABSTRACT: The objective of this study provide a conceptualization for the automation of lift car operations on high-rise building construction sites, in order to build high-rise building effectively and make a proper lifting plan. We got the week point of a hand-operated lift car, and got problems of an automatic lift car up to now. And we proposed the improvement schemes considered the week points and the problems for the automation of the lift car.

Keywords: Lift Car, High-rise Building, Automation of Lift Car, USN, WSN

1. INTRODUCTION

1.1 Background and Object of the study

The quantity of high-rise buildings in the construction industry market is growing. High-rises have multiplied because the values of construction sites are going up as cities become more congested. Also, citizens want to build high-rise buildings because they can be landmarks for their cities. For the construction of high-rises, construction engineers have to consider more parameters than a normal building. One of the major considerations is the vertical lifting plan for workers and materials. Therefore, it is important that existing hand-operated lift cars are automated for high-rise building projects. However, the study for the automation of lifting equipment is not enough, particularly when workers are using the lift car at a site, they have to call for the car via walkie-talkie. It is not an effective way to communicate with each other, for workers in the lift, and for workers who want to use the lift. Today, hand-operated lift cars are still used on many construction sites, because the way the existing lift car is used, is highly inefficient on account of long vertical moving distances. The study of the automation of the lift car is necessary.

2.1 Scope and way of the study

Fig. 1 Research process
In this study, we examine necessary part of the studies about the automation of lift cars which are not very enough among the automation in construction. We get the point of some week points of hand-operated lift and existing automatic lift. And we try to propose an improvement scheme for the automation of lift car using USN(Ubiquitous Sensor Networks).

2.1 Literature review about the automation of the lift

Recently, the study of automation in construction has been conducted for developing sensor technology. In addition, the skills which can send construction data to a main server by sensors is shown. Software and hardware have also been studied. One study, by Cho C.Y et al. [4] reported that the information of workers and materials can be sent to main server by wireless sensor networks. So they tried to develop hardware and software of lift car toolkit. The research by Shin T.H et al. [5] reported that a seamlessly integrated information management framework that can provide logistics information to project stakeholders for their decision making. And the research by Wang Y. et al. [6] reported that the formal design, specification, and modeling of the LDS system using a denotation mathematics known as Real-Time Process Algebra (RTPA). And the research by Jang W.S et al. [7] showed that advanced wireless sensor technology can be used by engineers to monitor conditions in and around buildings. Using these studies, many researchers have tried to automate construction sites by making use of sensors. The current proposal is to solve the problems of both communication when the existing lift car is used, and of the necessity for an accurate stop mechanism for the lift.

Table.1 Patents for the lift automation

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<th>Improving factor</th>
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A: A moving-communication cable supporting apparatus of lift car for construction[1]
B: Automatic opening and shutting system of lift for construction[2]
C: A RFID reading tool kit for automatic systems of managing vertical material movement by using intelligent hoist[3]

Recently, the automatic lift car has recently been used, in order to compensate for the problems of the hand-operated lift car, recently. However the automatic lift also has some weak points, because of the lack of worker training, skills and experience.

Among the challenges are, firstly, the problem of accuracy when the lift car stops. When the lift arrives at the destination, there must be little error in the arrival position of the car in relation to the slab. The error should be only a few centimeters, but as the lift operates over time, the gap between the bottom of the lift and the slab can shift to more than 10 - 20 centimeters. The gap between the lift bottom and slab can be even larger for a high-rise building. If there is a gap, workability, safety, and efficiency will be hindered. Improvement in this system is a priority.

Secondly, an accurate communication system between workers and lifts is necessary. There are many cases in
which workers find it difficult to communicate with the lift
driver because the RF is often jammed or weak. This
problem is especially acute on a high-rise building
construction site. If a cable is used instead of RF, the cable
will be cumbersome for the high-rise, so using a cable is
worse than using RF.

2.2 Proposal for the automation of the lift
USN (Ubiquitous Sensor Network) and WSN (Wireless
Sensor Network) have been studied in many fields, recently.
They are being used in building and bridge monitoring. We
have found that USN and WSN can be useful methods to
solve the problems of the automation of lifts on
construction sites, as stated above. In response, we have
developed a proposal for the use of these networks.
Firstly, to solve the problem of RF communication, we
propose to set Zigbee sensors on the slabs. In this case,
each sensor node can communicate with all others, so even
though the building is very high, communications can still
be accurate. Through Zigbee communication, jamming and
weak signals can be improved.

Secondly, the proposal is for the accurate stopping of the
lifts. By placing monitors on every floor, fine adjustments
can be made whenever necessary. A laser finder can be set
on the bottom of the lift, which can consistently measure
the distance between the lift and the building. Before using
the lifts, the distance can be set for the lifts to conform to
the building project. If the distance between the lift and
building is longer or shorter than the standard distance, the
lift can recognize the incongruity and 'know' exactly where
to stop. By this lift stop monitoring system, automatic lifts
can stop accurately in various buildings which have many
different heights of slabs.

3. Conclusion
With the current research, we studied the problems of
hand-operated lifts and existing automatic lifts, in order to
propose a necessary improvement of the lifts through
automation. The accurate stop monitoring of a lift and
communication by Zigbee can be effective in addressing
the problems inherent in tall building construction. Further
study will clarify the efficacy of this model technology.

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