

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

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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

2 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 weak 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.

2.2 Problems and improvement of the automation of lift car in high-rise building construction site

The lift car is usually operated by a specified worker or 'lift operator/driver who controls the lift on normal construction sites. When someone wants to use the lift, he/she calls the lift driver by walkie-talkie. The driver moves up or down to the position of the caller. In this way, hand-operated lift cars are used on construction sites.

Because of the difficulty involved in the job, most workers avoid the duty of driving the lift, so it is hard to find people to fill the position. In addition, lifts can only be operated by a trained operator, therefore, when an operator is not on site, the lifts are not operational. Finally, communication by Radio Frequency (RF) is made difficult because there are many jamming and weak signals. Researchers have been seeking solutions to these specific problems.

Table.1 Patents for the lift automation

Improving factor Patents	Safety	Work ability	Automation	Communication
A				
B				
C				

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.

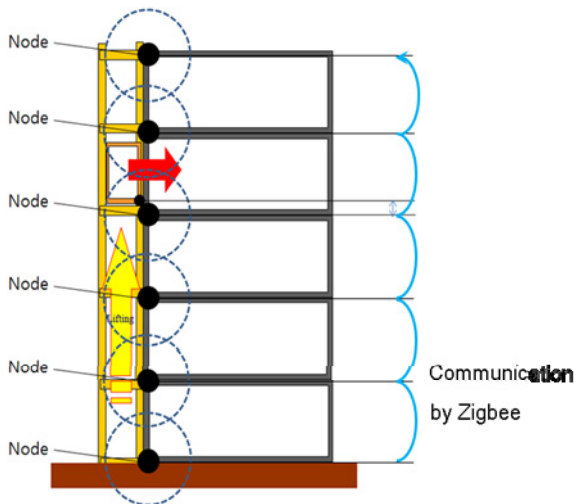


Fig. 2 Lift use by Zigbee communication

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,

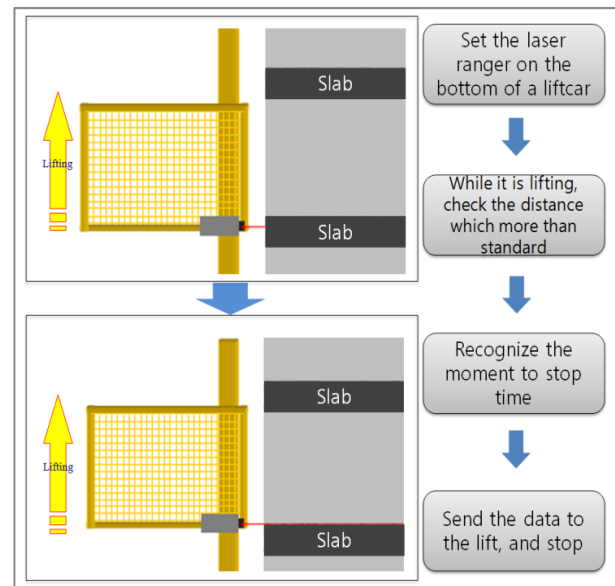


Fig. 3 Proposal for accurate stop monitoring of a lift

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.

Acknowledgments

This research was supported by a grant (Code#’09 R&D A01) from Cutting-edge Urban Development Program funded by Ministry of Land, Transport and Maritime Affairs of Korean government.

This work is financially supported by Korea Minister of Ministry of Land, Transport and Maritime Affairs(MLTM) as U-City Master and Doctor Course Grant Program

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