

How can computing increase the productivity of the construction industry?

## **Machine learning and way to retrieve on-site information in the construction industry**

### **Machine Learning**

#### **Problem on design stage**

With an ever-increasing rate of development, there are less resources around the globe. People are starting to emphasize on sustainability and quality of the building, especially in some developed countries. Therefore, people are finding ways to tailor-made their design of the building to suit different purposes under different circumstances.

#### **Solution**

Machine learning can help with improving the quality of the design. With machine learning, you can make the spaces better for its ultimate users. Like the company WeWork, they aimed to match the spaces with the way people would be using it. Therefore, they can make the design to best fit the needs of the occupants. For example, people would use the pantry and the conference room the most in the office. These two places would have much higher accessibility than other places like the document rooms. The same philosophy can be applied to the residential and commercial area too. By analyzing the big data of people's habits, we can design the construction to fit the needs of the people before building like the frequently used facilities or places can be located at the most accessible place. It saves time and spaces for commuting. Therefore, it can make the most out of the gross floor area.

For sustainability, the use of machine learning can be used to predict the building performance. Machine learning provides a fast prediction and simplified parameter structures matching early design phases (Geyer, & Singaravel, 2018). It allows designers and engineers to obtain the overall performance and the systemic dependencies of the building. System interdependencies play an important role in the overall performance of the building (Geyer, & Singaravel, 2018). From that, professionals can draft a suitable design to meet their target in the early design process.

#### **Problems on automatic construction management**

For large construction sites, there are lots of construction workers from different sub-contractors. In a congested environment, it is difficult to manage the construction workers and the construction activities to prevent collision between the use of equipment and manpower. If there are collisions of location and equipment, it would delay the work schedules, lowering the productivity of the project.

## **Solution**

Application of machine learning can help the automatic construction management. To enhance the construction management, machine learning can be adapted to improve the management of human recognition (Anumba & Wang, 2012). If we can track the workers' pathing and habit they worked, we can arrange a better working schedule for the whole construction site. Though machine learning, people can be recognized in the images by different features like their poses, the colors of their garment or their equipment. To reinforce the adaptability and the accuracy of human recognition, "training" can be carried out using the machine learning algorithm. Some ideas have been researched in the study of the autonomous driving. The training is called "Reinforcement learning" which can teach the machine to interact with features in the environment and learning from the mistakes (Abdou, Perot, & Yogamani, 2017). The classifier will be constructed to determine whether the feature is matching with the image. Positive images and negative images will be classified, therefore enhancing human recognition.

Based on human recognition, we can also analyse the unsafe worker behaviors from mining the data collected from the construction cameras. We can use the classifier algorithm to identify any potential unsafe behavior or practice. It can help the project managers to promote suitable training and education, avoiding injuries and incidents from happening. It saves the extra costs and makes sure the project running smoothly without any delays, enhancing the project productivity.

## **Way to retrieve on-site information**

### **Problems**

Traditionally, it is hard for engineers or surveyor to explore building information on site. First, the drawings are usually in large size because there is so many information needed to be shown from different disciplines. It is inconvenient to carry the bulky drawings around. Secondly, the 2D drawings cannot show the spatial relationships between the information and the real-world 3D environment (Anumba & Wang, 2012). Users have to imagine the 3D representation by their own based on different 2D drawings. It is time-consuming and inefficient. Moreover, the size of data and information will be increased continuously due to the proliferation of mobile devices and development of advanced modelling (Hashem et al, 2015). Finally, there are many predefined symbols in the drawings for different construction components. The symbols would also vary from different construction sites. It takes time for the users to study and get familiar with the drawings

## **Solution**

Anumba and Wang (2012) developed a lightweight device called the iHelmet where it combines with the AR and BIM technologies, we can provide a simple and easier way to retrieve the on-site information. AR can improve the access and utilization of information by providing an overlay digital information of an artefact through device like smartphone camera (Chu, Matthews, & Love, 2018). BIM can deliver federated building information as its features of centralization of information support information structuring and exchanges. For the iHelmet, there are display module, positioning module, and manipulation module. First, the user can select what information he or she would like to retrieve. Then the helmet will locate your position and automatically match the correct information with the surrounding. Then, through the display module on the helmet, the on-site information will be projected to the near object like the wall for users to retrieve the 2D or 3D information. The projection made by the display module can minimize the imagination from the users to picture the 3D environment from 2D elements. This device can provide a convenience and efficiency way to browse on-site information.

## **Further Improvement**

What can be improved with this device is the ability to edit the information through cloud computing. In the construction industry, there is an increasing number of sophisticated modeling or application like 3D modeling. It is hard and unusual to use a desktop computer in the site to handle this enormous amount of calculating work. Also, it is not convenient to use a desktop computer because of its poor mobility. With the application of cloud computing, all the storing, processing, analyzing work will be done in the cloud server instead of in the device the users have (Hashem et al, 2015). Users can input or edit the information through media like tablets. With a good internet connection, users can do the editing of the information like draft during the site visit. It ensures that the information on the drawings or drafts can be matched with the real-world environment. It also minimizes the problems occurred when there are incidents of delays and changes in design. Users can read the new changes immediately on the devices instead of preparing and searching for the updated drawings.

## **Limitation**

However, according to Anumba and Wang (2012), the performance of the above suggestion would be limited by internet access. For cloud computing, lots of data have to be uploaded or downloaded. Data inconsistency may happen when the data transmission is interrupted because of poor connection problem. Especially in some rural construction sites, the internet connection is much worse. It adversely affects the performance of the cloud-based systems.

In the future, with the implement of the 5th generation mobile networks, the data transmission would be enhanced comprehensively in terms of stability, availability, and coverage. We would experience a whole new working environment with the different device using cloud-based systems, enhancing the overall productivity in the construction industry.

### **Summary**

In the construction industry, there are still lots of room to be improved in terms of the application of the newest technology. Construction industry is an ever-changing industry which facing different challenges from time to time. With the use of the computing, lots of sophisticated and repetitive works can be eased and our construction professionals can obtain information which they needed. In this article, it introduces how machine learning and the combination of BIM and AR can help improve the productivity of the industry. Still, lots of effort is needed to be done on promoting the implementation of the technologies for the shareholders in the construction industry.

### **Reference**

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