

6.Summary of the final works

Monitoring the settlement and crack of engineering facilities around the subways—based on Remote Sensing, Deep Learning and Image Processing technology

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Abstract

While the construction and operation of subways bring convenience to urban transportation, it causes some issues to surrounding engineering facilities, such as ground settlement and cracks. The traditional manual detection methods to monitor settlement and inspect crack have certain limitations, such as the difficulty of all-weather and all-region dynamic monitoring, the traffic burden during monitoring, the difficulty of detecting the parts of bridge bottom and sheltered buildings, and the inefficiency to quantify the cracks. To overcome these drawbacks, this study develops a crack detection method for subway surrounding facilities based on PS-InSAR technology, drone monitoring, VGG16 Convolutional Neural Networks and digital image processing technology. It can conduct all-weather and full-region dynamic monitoring of subway facilities, and effectively quantify the length and width of cracks. The experimental data of subway Line 5 and subway Line 9 in Qianhai Section in Shenzhen are used to verify the proposed model, and Shenzhen University Section of subway Line 9 is employed as a case to illustrate the operation process of the crack detection model. The proposed model can effectively reduce the time cost and economic cost of settlement monitoring and on-site investigation, and it can protect the safety of detection engineers.

Eldervision: Proactive Safety Monitoring System for the Falling Injury of the Elderly

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Abstract

Fall is one of the major reasons that cause injuries for aged people. Preventing and monitoring elderly fall is an important way to ensure the health of the elderly at home. Today, there are various products for detecting elderly fall, such as smart bracelet, domestic camera and vibration sensors. However, all of these products have some critical defects which make them unpopularity. For example, the elderly may forget wearing smart bracelets and setting the domestic camera may cause the feeling of invasion of privacy. Besides, the vibration sensors are extremely expensive.

In order to tackle these issues, our team propose a novel method for monitoring elderly fall. This method is based on the domestic camera but analyzing using vibration information rather than the image of the elderly posture. It is obvious that the vibration amplitude is different between walking and falling. So the camera judging whether the fall happens base on it. The camera is put in some public places, such as on the desk of living room. When walking or falling, the vibration will transmit from floor to desk, and cause the camera vibration. The video in camera will be amplified by using Eulerian video magnification, which is a computer vision technique that is able to amplify sub-pixel motion to be visible. Then, optical flow algorithm is used to obtain vibration amplitude from the amplified video. The experiments were conducted both in laboratory and actual house and the results show that our product have good performance and robustness.

Our product is suitable for old solitary people and has a lot of advantages, such as low price, high comfort, high robustness and protecting the privacy of the elderly. We believe that this product can be an effective solution to monitor the elderly fall

Research on the Integrated Evaluation Method of Construction Workers ' Ability of Working at height from the Perspective of Human Factors

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Abstract

This study is based on improving the phenomenon of frequent accidents caused by unsafe behaviors in the current construction industry and selects the most serious working at height field to study the evaluation of the safety operation ability of construction workers from the perspective of human factors. By referring to the operating system of epidemic prevention and control health QR code and integrating the existing physiological, psychological and industrial system requirements, the integrated evaluation system of construction workers ' working at height ability from the perspective of human factors is constructed at the theoretical level, and the safety QR code system is constructed at the application level, aiming at the safety management of construction workers in advance and preventing the safety risks of workers in the working at height process.

Boom——intelligent glasses for assisting pipe detection based on BIM and MR technology

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Abstract

Pipes are important parts of equipment engineering, which are responsible for conveying media, energy, information, and power. In the design, construction, operation and maintenance stages of building pipelines, there are problems such as insufficient accuracy, unreasonable laying, low efficiency of construction and maintenance. This has a negative impact on both the time cost and capital cost of the project. Through a large amount of data search and research, our team designed a building pipeline detection assistant glasses based on BIM and MR technology, which carried out high-precision modeling of the pipeline through BIM technology, and then combined with MR glasses and cloud platform to present relevant pictures to the operator. During the construction phase, users can simulate the layout and operation of pipelines to reduce construction losses. In the operation and maintenance stage, users can visually inspect and simulate the entire pipeline, which can reduce unnecessary time loss in the troubleshooting of operation and maintenance problems in the later stage, and improve the scientific nature and accuracy of the design, construction, operation and maintenance of the integrated pipeline of the building.

A Blockchain-AIoT Based Supervision Platform for Off-site Production in Modular Construction

Liupengfei Wu, Rui Zhao, Jiajia Wang, Zhe Chen, Muting Wang

Abstract

By manufacturing housing products, off-site, and assembling on-site, modular construction can significantly improve the housing supply efficiency, particularly for high-density cities. However, the supervision of off-site production in modular construction (OPMC) is currently problematic. The production parties are reluctant to provide detailed private data; even worse, the submitted operation records can be easily fabricated, tampered with, or hard to trace the responsibility. This study aims to develop a blockchain-AIoT based supervision platform for OPMC. To this end, it has two specific objectives, including proposing an effective system architecture of the platform and validating the system architecture by implementing a prototype. Firstly, this article outlines the modular construction, its benefits, and off-site production. Secondly, it summarizes the problems existing in the off-site production process of modular construction. Thirdly, it introduces the basics of the Internet of Things (IoT), artificial intelligence (AI), and blockchain, which we use to improve the identified problems. Fourthly, it proposes the overall system architecture of the blockchain-AIoT platform. Fifthly, it implements the system architecture by developing a prototype platform. Sixthly, it discusses the novelties and limitations of the platform. Finally, it concludes the study. The findings of this study can pave the avenue for an innovative and strict supervision mechanism in the architecture, engineering, and construction industry.

Risk Factors Recognition and Design Optimization of Campus Road Traffic Based on BIM

Qiaoyuan Zhou, Bingfeng Yang, Danhong Liu, Jianhao Liu and Xu Yang

Jie Jiang and Fengyun Liu

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Abstract

BIM technology can be used to simulate real construction projects and help design and evaluation. Xie Haiming (2021) proposed in the research of BIM-oriented highway safety design and evaluation: to establish a real three-dimensional model based on the real environment, as well as the road isolation belt of surrounding buildings. Other infrastructure models such as buildings, landscapes, rivers, etc., and analysis of regional uses, allow designers to plan and design urban roads directly on the three-dimensional model in a three-dimensional environment (Xie, 2021), which can greatly improve the efficiency of road design. Nowadays, the plan and design of urban road are well-developed. But not all the situations are considered in the existing design standards. For closed regions, e.g. campus, the detailed design standard is missing which will lead to various traffic safety hazards. Therefore, based on the real campus road environment, the project team used BIM to simulate the campus road environment to analyze and optimize campus traffic risks.

TRG——JiangGong • A whole-process-based technical training service platform for construction industrial workers

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Abstract

As a pillar industry in China, the construction industry plays a crucial role in the economic growth and social stability. Construction workers are the foundation of the construction industry, and the workers'skills are significant to the transformation and upgrading of this industry. However, the survey shows that the technical training for workers have many problems, including the old concept of training, single mode and content. That means the training system hasn't been systematic. Therefore, the team intends to use the technical methods of web development to build a whole-process technical training platform that possesses Multi-window interaction and diversification. The platform names TRG (a whole-process-based technical training service platform for construction industrial workers). It provides workers with "TRG" concept-based whole process technical training services. "TRG" consists of training, recruitment and guarantee. Training means the platform help workers to obtain qualification certificates through diversity training modes such as basic training and order-type training. Recruitment means platform offer service port, realizing labor service cooperation between construction industrial workers and construction enterprises. Guarantee refers to some follow-up services and supports provided for technical training by the platform. The team have designed the concepts, framework and interface, analysed the feasibility of platform development from economics, technological and risk perspective. The platform aims to improve the workers' skill, promote the sustainable and high-quality development of construction industry.

Keywords: Construction industrial workers ; Technical training ; TRG ; Whole-process service ;

Panoramic Simulation and Intelligent Improvement of Healthcare Facility Resilience under Epidemic Outbreak

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Abstract

In contemporary high-risk society, a variety of infectious diseases occur frequently, which may lead to public health emergencies. In emergencies, large number of people may require medical attention, the healthcare facility may be over-stretched, and public order may be threatened. In such epidemic disruptions, the concept of “healthcare facility resilience” (HFR) has been proposed to facilitate the healthcare facilities’ sustainable operation.

This report uses the CNA (complex network analysis) to evaluate HFR and then conducts the CBR (case-based reasoning) method to develop resilience improvement strategies. In the case study, a hospital outpatient building’s interior functional space and their links were integrated as a complex network. The network efficiency is calculated to represent the HFR. And the CBR tool develops the best-matched resilience improvement strategies in response to different HFR levels. After, to realize panoramic simulation, *3ds Max* software is used for modelling the healthcare facility and simulating its whole epidemic response process. In addition, this research designs the prototype of HFR-E&I (evaluation and improvement) system, which is named as “safe-max”.

This research can visualize the healthcare facilities’ response processes and help the decision-makers to improve HFR in an intelligent way. And this proposed approach provides the guidelines for digital transformation of emergency management.

Living Skyscraper: An Integration Platform of Skyscraper Collaborative Network Based on Big Data

Guo Guisong

Tongji University Abstract

Abstract

As megaprojects tend to be larger and more complex, they require higher levels of specialized workforces and exhibit more complicated organizational relationships. To examine the characteristics of megaproject collaboration from a dynamic network perspective, this research selected skyscraper projects as a featured megaproject field and develop an integration platform to facilitate researches. 4379 completed skyscraper projects over 100 meters in height that were built from 1980 to 2020 worldwide, as well as more than 5610 participating organizations, were analyzed using social network analysis. We found that design firms played a vital role by holding central network positions over time, indicating the importance of the design phase in skyscraper projects. The distinctive inter- and/or intra-regional collaboration features were revealed at different geographical settings. Organizations from the United States, especially design firms, were more active in skyscraper projects around the world. The study not only contributes to a holistic understanding of the status quo and development trends of the skyscraper industry integrating network theory with megaproject management, but also provides a reference for corporate practices and decision making in the specific megaproject field.

Keywords: Skyscraper collaborative network; Integration platform; Social network analysis; Big data

SYNAESTHETIC CITY: INTELLIGENT GARBAGE MANAGEMENT SYSTEM

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Abstract

To fill the gap existed in today's waste management system, WELL+ equips the Intelligent Garbage Management System not only with emerging technology like Convolutional Neural Network, 5G, sensor and big data, but also integrate in-depth thinking about human well-being in the system design. Remainder of this paper unfolds with hardware as well as software design, algorithm, virus detection model and integrated city-information model in order to create a Synaesthetic city. Combining with the whole system design of WELL+, we can approach a future in which waste in the city can be mined for information that can inform policy makers, health practitioners, designers, researchers, and most importantly, the citizen in the city. Such is the idea behind our mission: a cross-disciplinary data platform for monitoring urban health patterns, shaping more inclusive public health strategies, and pushing the boundaries of urban epidemiology as well as the Synaesthetic city.

Recognizing Risk Events in Construction Workers' Material Handling Tasks Through Smartphone

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Abstract

Construction workers' material handling tasks are highly relevant to workers' work-related musculoskeletal disorders. However, there are still many problems to be resolved in determining the categories and recognizing risk events accurately. This research proposes a method to recognize and classify those events by collecting specific acceleration and angular velocity patterns through built-in sensors of smartphones. The events were simulated by anterior handling and shoulder handling methods in laboratory. By comparing the accuracy of five different classifiers, cross-validation results shown that the classification accuracy of random forest algorithm was the highest (76.71% in anterior handling method and 80.13% in shoulder handling method) when the window size was 0.64 s. The classification result of shoulder handling method was slightly better than the other one. This study provided a simple and objective way to judge the risk events in construction workers' manual material handling tasks automatically, which can be used as an essential way for managers to improve labor productivity.

Keywords: Construction workers; Manual material handling; Smartphone; Risk events; Supervised machine learning; Event recognition

Light U Go——Smart Blind Cane and Terminal Interaction System

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Abstract

As one of the disadvantaged groups, the blind still have problems such as "the last 20 meters of the blind track" and the inability to cross the road safely by themselves. Their demand for safe and convenient travel is not effectively realized, which seriously hinders their pursuit of a better life. How to improve the "sense of access", "sense of happiness", and "sense of security" of the blind is an important issue that needs to be addressed. However, the existing blind corridors, blind canes and guide dogs are still unable to efficiently assist the blind to travel. In order to improve this situation, this project combines simultaneous localization and mapping (SLAM) and Machine to Machine (M2M) technologies to design a system for interaction between the smart blind cane and the terminal: Light U Go——Smart blind cane and terminal interaction System. The system is composed of two parts: the PROP cane and the Helen Keller data cloud platform, in which the PROP cane contains four modules: Perception, Relation, Output, and Prewarning. The Helen Keller data cloud platform includes four modules: data collection, blind mapping, people management, and environmental guidance. The system is designed to improve the safety and convenience of travel for the blind, and on this basis, the big data collected by the blind cane can be analyzed to efficiently help the blind and promote smart urban management, so that the blind, a marginalized and disadvantaged group, can enjoy relatively equal social resources and social participation as normal people.

Keywords: blind people; Smart blind cane; data platform; smart city managem