The Evolving Metropolis
2019 IABSE Congress
New York City

IABSE 90 YEARS

Design and Practice of Structural Health Monitoring System for Large Span Urban Rail Transit Bridge Based on Internet of Things

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1 Abstract

Rail transit bridges in Chongqing are of considerably complexed structure and enormous scale, thus even a minor impairment of the bridge structural performance could cause significant consequences in the daily operation of rail transit systems. To answer the realistic needs and requests brought up by the rail transit bridges, this paper introduces a framework of structural health monitoring system that is based on Internet of Things (IoT) and intelligent cloud platform. The system is designed to improve the safety of bridges by performing real-time intelligent acquisition and information transmission on subjects such as natural environment, stress status of the bridge structures, status of trains operation, and etc. The system realizes a series of functions: reception and storage of real-time information of the structure's behavior, remote monitoring, early warning, and etc. Those functions empower the decision-maker to act more efficiently and more effectively in different scenarios, both at management, maintenance and trains operational levels.

Keywords: Large Span Bridge; Rail Transit Bridge; Urban Rail Transit; Internet of Things (IOT); Structural Health Monitoring; Cloud Platform.

2 Introduction

Chongqing is one of the four municipalities directly administrated under the Chinese Central Government. It is also known as the "City of Bridge" in China. As the city is separated into regions by the Yangtze River and the Jialingjiang River, Chongqing Urban Rail Transit relies on a bridge system consisting of eleven rail-road bridges and five rail transit bridges to overcome the geographic barriers. The network of Chongqing Rail Transit is illustrated in Figure 1.

The technology of structural health monitoring is applied in many large bridges, and it has become a popular technique of disaster prevention [1]. The existing bridge health monitoring technology is based on three basic features of Internet of Things (IOT) technology, namely the full-range sensing, the reliable transmission and the intelligent processing. In respect of the application of IOT on engineering, Zhang Quansheng (2010) proposed a concept of integrating the bridge safety technology and health sensing system [2]. However, the traditional computing and storing technology is not adequate to process the massive data acquired from bridge structure health monitors. Later, Zhu Shicun et al. (2011) proposed the concept of "structural health monitoring cloud" [3]. Although the cloud technology is promising due to its superiority in terms of calculating and storing, however it is operated and managed independently by different institutions. Another

https://doi.org/10.2749/newyork.2019.0891
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