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DESIGN AND IMPLEMENTATION OF IOT BASED NETWORK WITH ACCELERATION SENSORS FOR STRUCTURAL HEALTH MONITORING

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The long term security and safe maintenance of the buildings is the primary goal for individuals and organizations. The early damage detection and safety of the structures can be enhanced by real time monitoring. In this paper, a novel IoT (Internet of things) based structural health monitoring system for real-time monitoring and damage detection is presented. The implemented system consists of three dimensional acceleration sensors, LoRa (Long range) wireless links, gate ways, and a network server. The proposed system has a star topology which means that the groups of the acceleration sensors are connected to gateways via LoRa wireless links, while the gateways are connected to the network server via TCPIP connections.

The novel approach in online processing data from sensors based on multiple criteria and specify state of the structure. The implemented acceleration sensors feature 200 Hz sampling rate (200 samples per second) and dynamic range more than 100dB. The sensors data are transmit by LoRa communication module. Therefore, the installation and maintenance costs of the system are reduced. LoRa is one of the predominant LPWANs (low-power wide-area network) in recent years, due to its low complexity and use of unlicensed Industrial Scientific and Medical (ISM) bands. The novel solution for problems, such as data processing, data extraction, synchronization, modelling, and accuracy are presented. This paper presents a comprehensive study of SHM using the implemented system. The required information of the structure, such as relative displacement, modal properties and spectrum intensity are obtained and analyzed. As a result, the real-time damage detection and related costs are obtained and analyzed in detail. In this study, a three-story building model is used to examine the efficiency of the proposed system. All components of the proposed system are developed and implemented in house by stated authors. The proper operation of the proposed system is verified with experimental measurement. It is expected that the proposed LoRa based network of acceleration sensors can be used for structural health monitoring of the buildings on a massive scale.

Table 1. Damage state of model stories after external excitation.

Story No.	Drift Ratio (%)	State of damage
1	0.338	Repairable damage - Moderate damage
2	0.543	Irreparable damage
3	0.404	Repairable damage - Moderate damage

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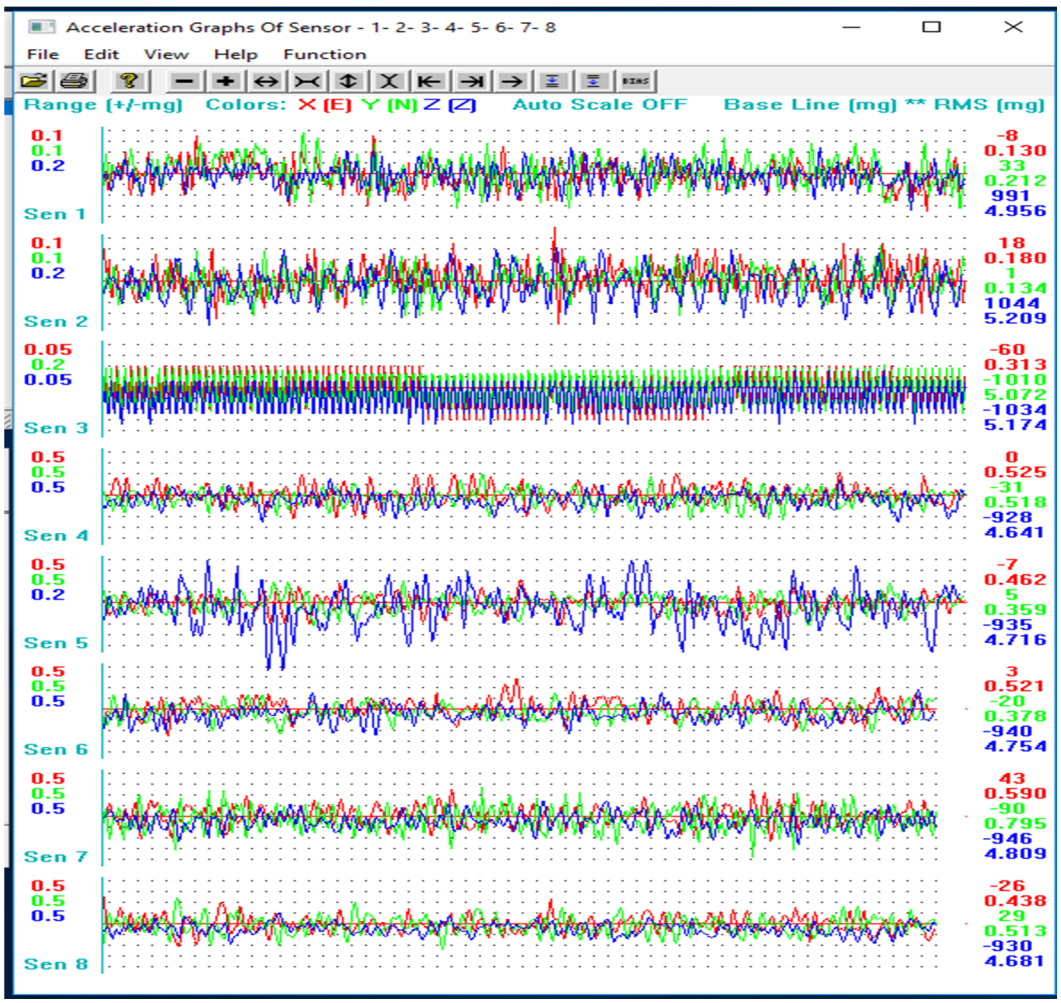

Figure 1. Time response of the mounted proposed 3D-acceleration sensors on the building model.