Real-time Bridge Monitoring System Based on Wireless Sensor Networks

In recent years, there has been an increasing interest in wireless based real-time bridge monitoring. The structural engineering field has begun to consider the wireless sensor network (WSN) technology as substitutes for traditional wired-based monitoring systems. Since there are no cables between sensors and the data acquisition system, a lot of money and efforts to install extensive wiring can be saved. There are some studies of bridge monitoring based on WSN, but some problems especially on network protocols are still remained yet. Unlike other applications of WSN, wireless sensors on bridge suffer high-congested traffic loads. For example, to monitor a concrete bridge, over 9 vibration sensors should be placed on each span (around 50m) and each sensor generates 100-bytes per a second (with 50Hz sampling rate). There are other requirements to monitor a bridge in real-time manner. Therefore, we need to consider these requirements and constraints carefully in order to design efficient monitoring solution.

In this project, we develop a total system for real-time bridge monitoring with WSN technology. Firstly, we develop vibration and strain-gauge sensor boards for TelosB mote to estimate a bridge's state. Secondly, we make a PXA272-based coordinator board which has ZigBee and WiMax radios in order to transfer information acquired from sensors to database station through the Internet. Thirdly, we develop MAC and network protocols to gather information from all sensors fast and energy-efficiently with very few packet losses. Fourthly, we produce a management program which let an administrator be able to access to the database, and control sensor nodes and coordinator in a remote place. We work with several civil engineers in Konkuk and Kaist universities to make meaningful results. Also, the developed system is evaluated and completed with several experiments in real bridge deployments. The results from the two year researches will provide total structural health monitoring (including bridge) solution that is contributable to not only WSN technology but also electronics and civil engineering.

Overall Concept

Protocol Development

Hardware Development

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