Smart street light system based on IoT

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Abstract. Enormous electric energy is consumed by the street lights, which are automatically turn on when it becomes dark and automatically turn off when it becomes bright. Even if there are no people or cars, the street lights turn on. This is the huge waste of energy in the whole world. This talk gives a smart street light system. The smart street light system turns on lights when there are people or cars and turns off lights when not. Moreover, the smart street light system in this paper behaves like usual street lights that turn on all night. The ideal behavior of the smart street light system is that no one finds turn-off of street lights at night. Realization of the smart street light system uses IoT technology. The system consists of sensors and lights. These elements of systems communicate with each other for smart street light systems.

1. Introduction

Street lights consume enormous electric energy. The number of street lights is not known accurately, but it is said that one hundred million or one billion street lights exist in the whole world. LED lights have been used and reduced electric energy that is consumed by street lights. In the future, however, many developing countries will install many street lights and consume much electric power for street lights. Thus, to save electric energy that is consumed by street lights is important to reduce greenhouse gases even if LED lights are used.

Ideally, smart street lights look like usual street lights; no one notices that smart street lights are usual street lights. Smart street lights have turned on whenever anyone sees them. Smart street lights have been researched by many researchers. Some companies or universities have developed centrally-controlled smart street light systems with the host computers [2,15]. They might be suitable for being applied to a large area or a newly developed area based on a wide area. However, they might not be suitable for being applied to a small area. Moreover, centrally-controlled smart street light systems are expensive because the host computers, which support many street lights, must have high ability and it takes much cost to maintain networks of smart street lights. In [10], smart street lights that cooperate with each other to shine a light on pedestrians are proposed. This kind of smart street lights exchange information of detecting moving objects and turn on so that neighborhood of the moving objects lightens. In [13], the method of pedestrian tracking is proposed for smart street light systems. Detection of existence of pedestrians or vehicles is important for smart street light systems. In [9,12], several kinds of sensors are used to detect existence of pedestrians or vehicles. In [14], image processing is used to decrease electric power of street lights; the method proposed in [14] obtains the pictures of street lights at night by security cameras and and adjusts brightness of street lights by the pictures. In [8], smart street light systems are considered to be important for smart cities and there are several network technologies such as 6LoWPAN [5, 7], GLoWBAL IPv6 [6] and so on. In [11], ZigBee, which is one of network technologies of personal area network (PAN), is used for outdoor light systems. In [9], Vehicular Ad Hoc Networks (VANETs) are used for smart street light systems. In [1], photovoltaic panels are attached to smart street lights to save energy. This research revises street lights themselves but does not focus on smart street light systems. There are many

researches of smart street lights but few researches focus on smart street light system that behaves looking like usual street lights based on sensor networks.

The author of this paper is a member of E-jikei Network Promotion Institute [16], which provides security cameras [4] and also develops security cameras that are combined with street lights. In [3], the institute proposed the street lights system in which a distributed-installed sensor network is used to detect pedestrians or vehicles. To realize the method of [3], this paper introduces the smart street lights by using Zigbee network and the experiments of the prototype of implementation of smart street lights.

2. Smart street lights by Zigbee

The proposed smart street lights use Zigbee to communicate with the servers, sensors, other smart street lights. Fig.1 shows an example of an installation of the smart street lights. When the sensors detect pedestrians or vehicles, notify the servers. The servers decide the smart street lights that should turn on so that the pedestrians or vehicles do not find the smart street lights that turn off. The servers send the message to the smart street lights so that they turn on. Each of the smart street lights and the sensors has Zigbee communication module (Fig.2). The sensors and smart street lights communication with each other and servers. The smart street lights work well in prototype implementation.
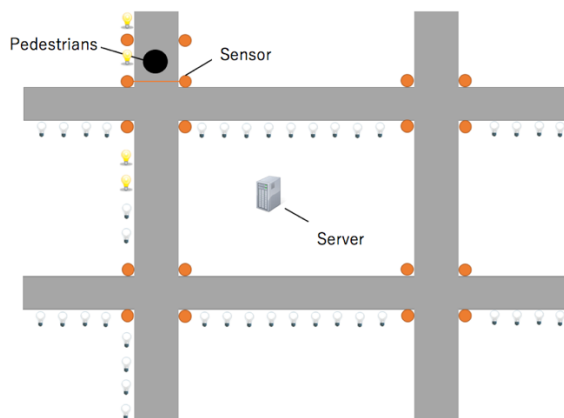

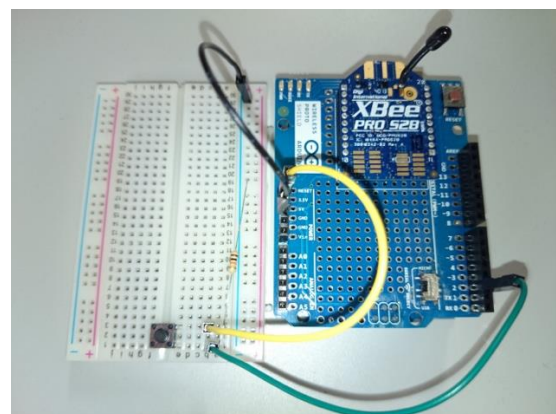Fig. 1 Components of smart street lights

Fig.2 Zigbee module

4. Conclusion

This paper introduced smart street lights and the prototype implementation by using Zigbee. We are planning to create actual smart street lights by using the implementation.

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