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Smart street light system with energy saving function based on the sensor network

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ABSTRACT

Our project for developing a smart street light system is reviewed. In this project, the street light system, in which lights on when needed and light-off when not needed.

Currently, in the whole world, enormous electric energy is consumed by the street lamps, which are automatically turn on when it becomes dark and automatically turn off when it becomes bright. This is the huge waste of energy in the whole world and should be changed.

Our smart street light system consists of a LED light, a brightness sensor, a motion sensor and a short-distance communication network. The lights turn on before pedestrians and vehicles come and turn off or reduce power when there is no one. It will be difficult for pedestrians and drivers of vehicles to distinguish our smart street lamps and the conventional street lights, since our street lamps all turn on before they come.

The present status and the future prospects of our smart start light project will be reviewed.

1. INTRODUCTION

Currently, in the whole world, enormous electric energy is consumed by the street lights, which are controlled by means of the embedded brightness sensors. They are automatically turn on when it becomes dark and automatically turn off when it becomes bright. This is the

huge waste of energy in the whole world and should be changed.

There are some attempts, in which the energy wastes of the street lights are reduced. A sensor light, which is controlled by the brightness sensor and the motion sensor, is sometimes used [1]. It only turns on for while when the motion is detected in front of the light and it is dark. However, it usually is too late to turn the light on when a person or a car comes in front of it. The light should turn on before a person or a car comes.

On the other hand, some companies and universities have developed centrally-controlled smart street light systems with the host computers [2,3]. They might be suitable for being applied to a large area or a newly developed area based on the total plan. However, they might not be suitable for being applied to a small area.

We propose an autonomous-distributed-controlled light system, in which the lights turn on before pedestrians come and turn off or reduce power when there is no one by means of a distributed-installed sensor network.

2. PROPOSED SYSTEM

Figure 1 shows the components, with which our smart street light system is realized.

(a) Lamp unit:

It consists of power-adjustable LED array, the brightness sensor, the motion sensor, the communication device, such as ZigBee module, and the controller. It turns on for several minutes under the conditions that a motion is detected in the defined area by the sensors including its own sensor. Then, it sends the message to other units. It

turns off or reduced power under the condition that any motion is not detected in the defined area.

(b) Sensor unit:

It consists of the motion sensor, the communication device and the controller. It sends out the message to other units under the condition that motion is detected. This unit is placed to many locations, such as at electric poles, at house gates, at house fence and inside or outside of the door, to ensure that every street light turn on before pedestrians notice that. As for power supply, the solar battery can be a good option.

(c) Access point:

It consists of the communication device and the controller. It is used in the case that the distance between the lamp units and the sensor units are too large to communicate each other.

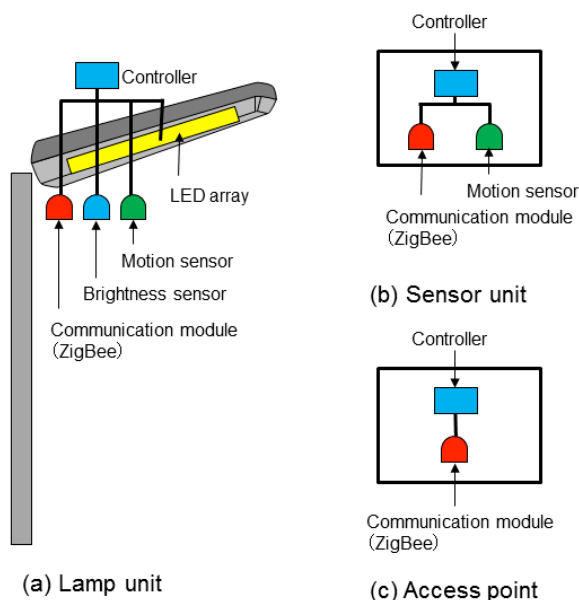


Figure 1. The components for the smart street light

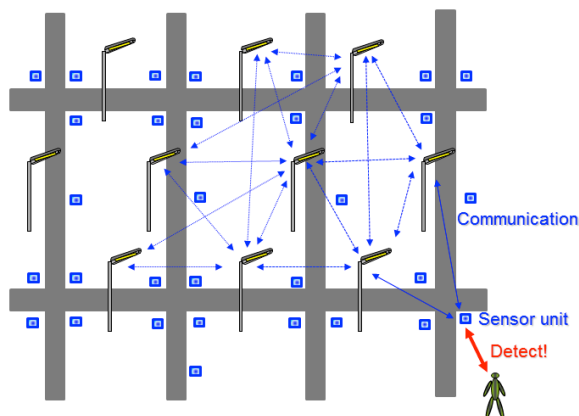


Figure 2. The components for the smart street light

As for communication devices, a power-saving short-distance device, such as ZigBee, is appropriate for our system. As for the position information, each controller has plural addresses, which correspond to the adjacent different networks.

Figure 2 shows an example of our smart street light system. The street lights turn on before the pedestrians come and turn off or reduce power when there is no one by means of a distributed-installed sensor network.

3. DISCUSSIONS

The targets of our development are as follows,

- Easy installation and extension: Each unit can be installed one by one to the network by setting the parameters. The system is autonomous-distributed controlled. No host computer is needed.
- Low cost: Only the parts of mass production are used.
- Easy update: The firmware of each unit can be updated easily. The control algorithms should be developed for the situations, such as a quiet residential area, a shopping street, a part, a main road and a mountain road.
- Self-diagnosis: The worst event is that the light does not turn on when the pedestrian come. Each unit records the failures, in which the motion is detected in front of it without the advanced notification from the other units.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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