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A Preliminary Study on an Indoor Guidance System through Fluorescent Lights

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1. Introduction

Fluorescent light has been regarded as a potential media for an indoor guidance system. In 2003, Yamanouchi et. al. proposed a stand alone indoor guidance system, which uses fluorescent light, wireless LAN, and control equipment [1].

In this system, when the user walks under the fluorescent lights, the speed of the user can be variable, either fast or slow, or even both. Here is a problem: can the actual users walking at different speeds catch complete data from fluorescent light?

The most important condition that can affect the result is the data transmission speed. Here I present a theoretical formula to simulate the condition and then conduct an experiment to validate this formula.

2. Method

2.1. Simulation Formula

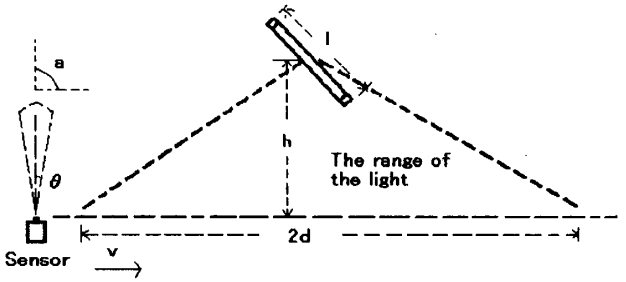

Figure 1 Experiment Condition

Figure 1 shows the experiment condition. Table 1 shows the meaning of the experiment parameter and some fixed data.

Table 1 Experiment Parameter

Parameter	Meaning	Data
H	Distance between the sensor and the fluorescent light in the vertical direction	1.1m
L	The length of the light	0.3m
A	The angle between the sensor and the horizontal	90°
Θ	The receiving angle of the sensor	10°
D	The maximum distance that the sensor can catch the light signals	— (0.35 m)
Tr	Data transmission speed	1200-9600 bps
V	The user's walking speed	0.5-3 m/s
N	The length of the data that the sensor can get with 100%	20-1k bytes
R	Result of the experiment	—

Here I represent the relation between "v" and "Tr" by the simulation formula as follows.

$$R=\begin{cases}0, v>\dfrac{2dTr}{10n}\\ 1, v\le\dfrac{2dTr}{10n}\end{cases}$$

Formula 1 Simulation formula

In this formula, the value of R means whether the user can catch a complete set of signals.

2.2. Formula Verification

The experiment consists of two parts: (1) to measure the maximum distance; and (2) to change the variable parameter to verify the formula. By the first part of the experiment, we find that the maximum distance at which the user could catch the complete set of signals was up to nearly 0.35m. In this indoor guidance system, users are supposed to catch information by walking under fluorescent light. In our experiment, the walking speeds of users are roughly divided into 3 levels: normal, slow, and fast (0.5, 1.3, 3 m/s).

3 Result

In the experiment, the relation between user's walking speed and the data transmission speed was examined and confirmed. The result of the experiment is shown in table 2. When the transmission rate was at 1200 bps, the maximum data was 63 bytes, and at 2400 bps, it was 40 bytes.

Table 2 Experiment result

Transmission rate	1200bps		
Speed	0.5m/s	1.3m/s	3m/s
Short data(20bytes)	○	○	○
Normal data(63bytes)	○	○	○
Long data(100bytes)	○	○	—
Transmission rate	2400bps		
Short data(40bytes)	○	○	○
Normal data 126bytes	○	○	—
Long data(200bytes)	○	—	—
Transmission rate	9600bps		
Short data(200bytes)	○	○	—
Normal data 604bytes	○	○	—
Long data(1k bytes)	—	—	—

4. Conclusion

The relation between walking speed and data length at three levels of transmission rate in the given fluorescent communication system was successfully examined and confirmed by our theoretical simulation formula and the following experiment. This theoretical formula proposed in this paper will be useful to design a more reliable and sensitive photo sensor and accordingly a communication system using fluorescent light for practical use.

Reference

[1] H. Yamanouchi, H. Makino et. al., A position guidance system using light apparatus －Guidance method using network of fluorescent light－, Proc IEICE general conference, A-19-11, 2005