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Source: [Nobuo IIZUKA] Company [CASIO Computer CO., LTD.]

Address [3-2-1, Sakaecho 3-chome, Hamra-shi, Tokyo, Japan]

Voice:[+81-42-579-7442], FAX: [+81-42-579-7744], E-Mail:[iizukan@casio.co.jp]

Re: []

Abstract: []

Purpose: [Contribution to IEEE 802.15 SG7a.]

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Low-speed OCC (software based OCC)

Adaptation to technical issues and Applications

Low-speed : pulse rate 5Hz-500Hz

CASIO COMPUTER CO., LTD

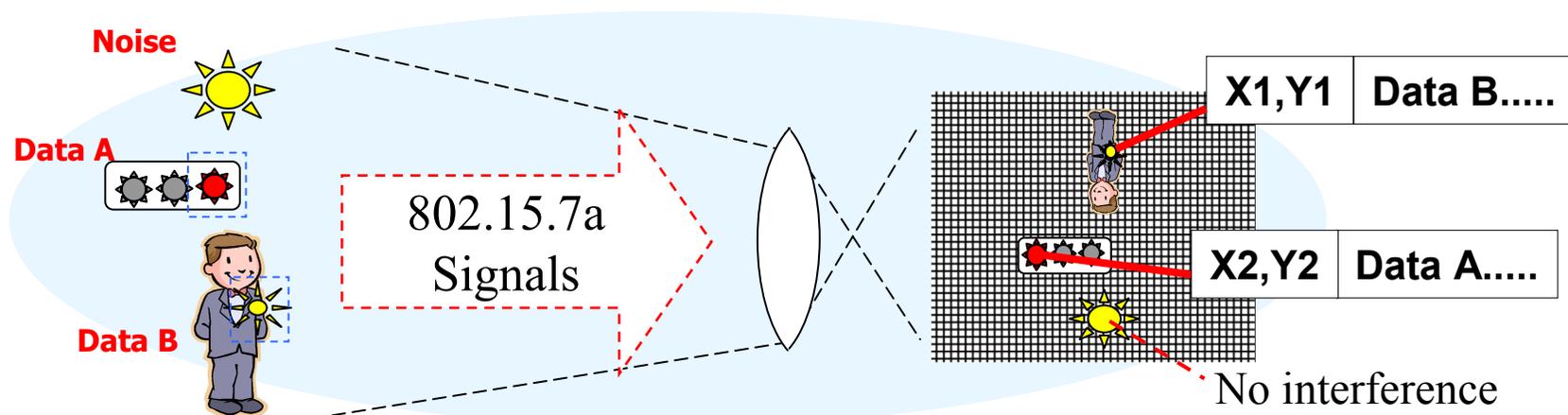
Nobuo IIZUKA

iizukan@casio.co.jp

Motivation of low-speed OCC

**These original features other than a bit rate can be given to OCC.
That is, big industrial application is expectable also by low-speed OCC.**

- Special separation capability
- Grasping the position in the Image
- Promising applications:
New user experiment, AR (Augmented Reality), Line of sight marketing, real-world-oriented interface, IOT (Internet of Things)



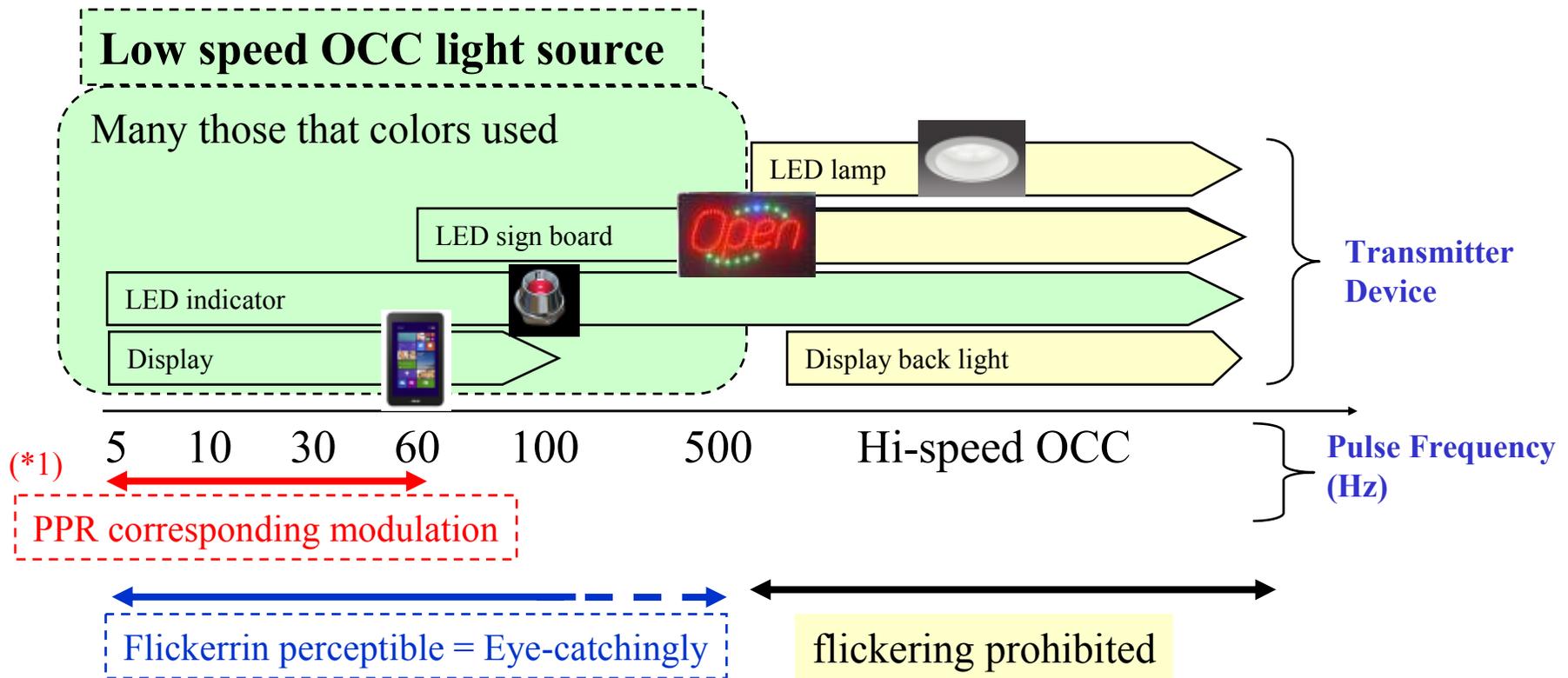
Good points of low speed OCC software implementable

fast market realization

Technology implementation is simple, would be to facilitate the many players.

- At Appliances which has a camera (PC, smart phone, ..etc), **simply add the software of application layer**, it is possible to enable the OCC.
- At display devices, you just change the display content.
No additional hardware, software.
- Embedded devices with the LED would be realized, simply by changing the blinking control. (some need to change the type of LED's color when it use color modulation)

Low speed OCC - Transmission side



(*1) PPR = Photoparoxysmal Response

PPR (Photoparoxysmal Response)

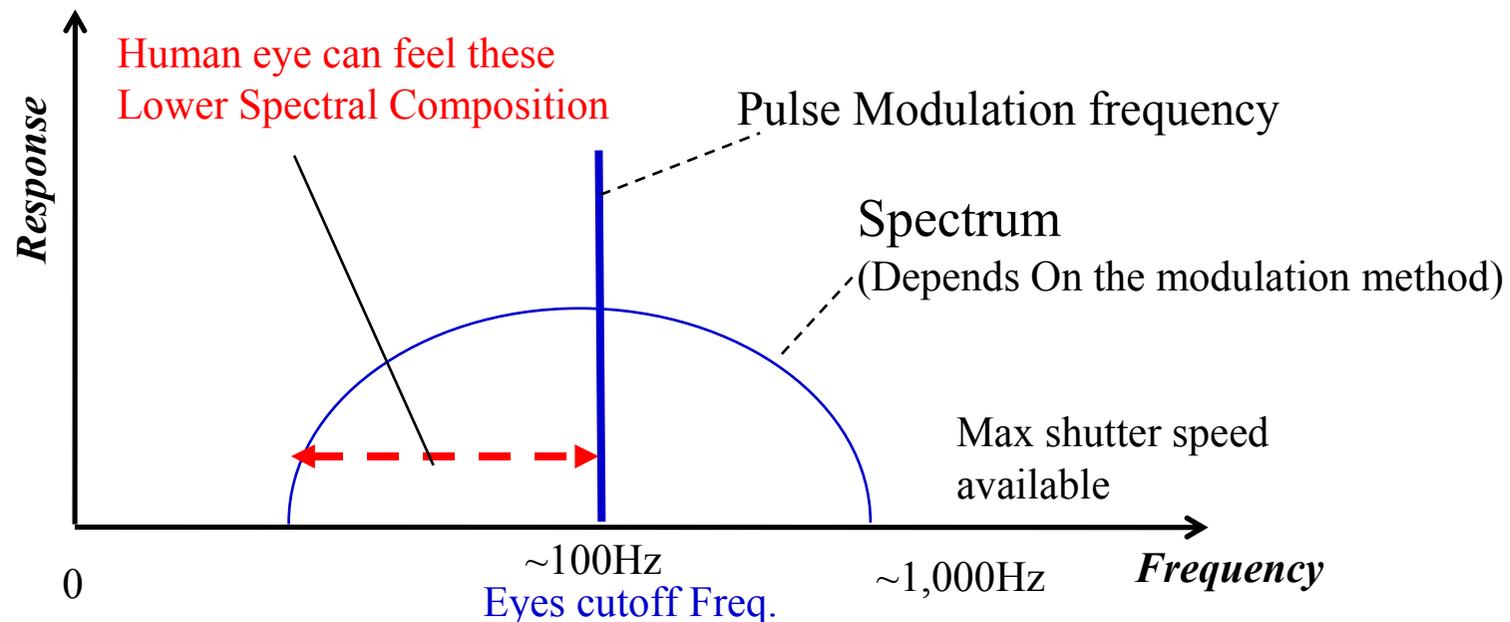
- Age and gender
 - Generally, a range of 0.5% -5% for adults having a predisposition to PPR is found. It is more likely to occur for young generations and women.
- Frequency
 - **96% predisposition to react to blink component of 15-20Hz. Some people react in 3Hz, some people react at 60Hz.**
 - **Many guidelines, prohibits the peak of more than 3 times per second**
 - Unfortunately, all studies in the simple blinking, there is no research about spectrum, modulation.
- Color
 - Red causes to the strong reaction, and the shift pattern with red and blue also causes worse.
- Field of View
 - There are studies that says **less than 0.65 steradian (sr) is safe**. It has not been pursued much detail.
Their premise is the application you are looking at, the TV monitor or PC display. Small markers and indicators are not covered much.
 - 0.65sr => about 2.5 degree square => 5cmObject at 1m
- Guideline for display Flashes of W3C
 - <http://www.w3.org/WAI/GL/UNDERSTANDING-WCAG20/seizure.html>
- Guideline of Japanese TV

Use or coexistence with the flickering

Comment for doc.: IEEE 802.15-14-0041-00-007,

[Synchronization and Flickering Issues of OCC] slide-9 : Flickering

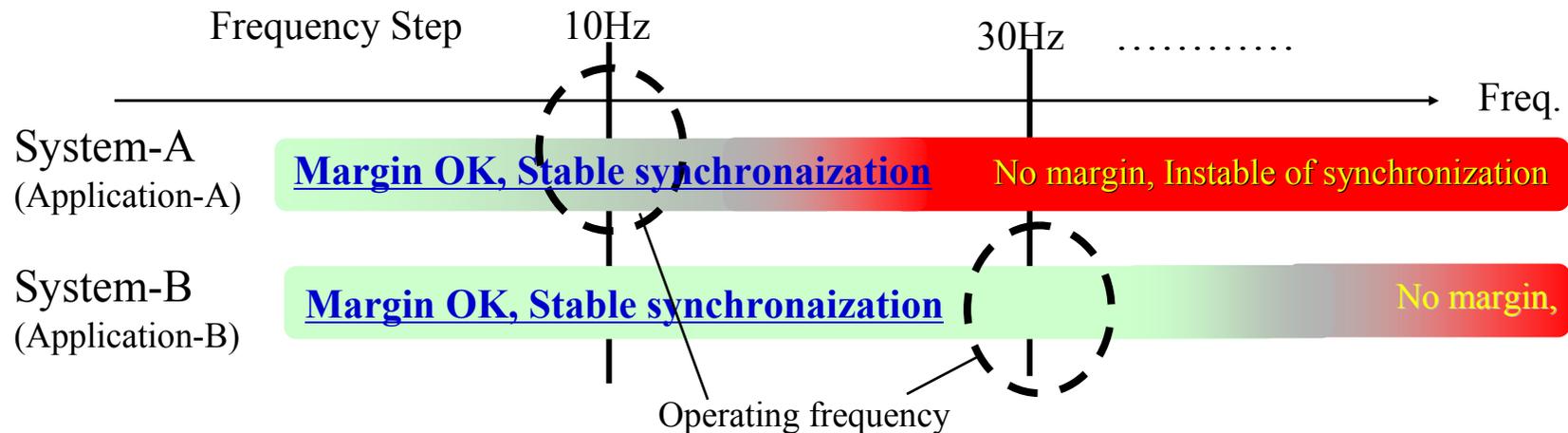
- With the exception of the specific modulation, the general method OOK ,PPM and Manchester, flicker appears in modulation of 1KHz.
- In low speed OCC, flicker should be utilized or acceptable



Adaptation for synchronization issue

Comment for doc.: IEEE 802.15-14-0041-00-007,
[Synchronization and Flickering Issues of OCC] slide-7 : Synchronization of OOK OCC System

- By setting the decrease fps or resolution and process margin can be secured, the synchronization is stabilized.
- This is a implement issue.
Considering as a standard, “define of the frequency steps” is sufficient to higher compatibility and coexistence.



Application case studies

(Flexibility of software based OCC)

- software based OCC can be varied very widely the corresponding frequency very easily.
- Since information density is increased in a ultra low speed (tens of Hz or less) , color modulation is used.
- It can accommodate a wide range with the parameter setting.

Example of the achievement of our prototype

- 640x480 [30fps](#) – 1600x1200 [5fps](#)
 - By Consumer USB camera / Web cam
- 2048x1088 [11fps](#) – 320x240 [380fps](#)
 - By Industrial USB camera

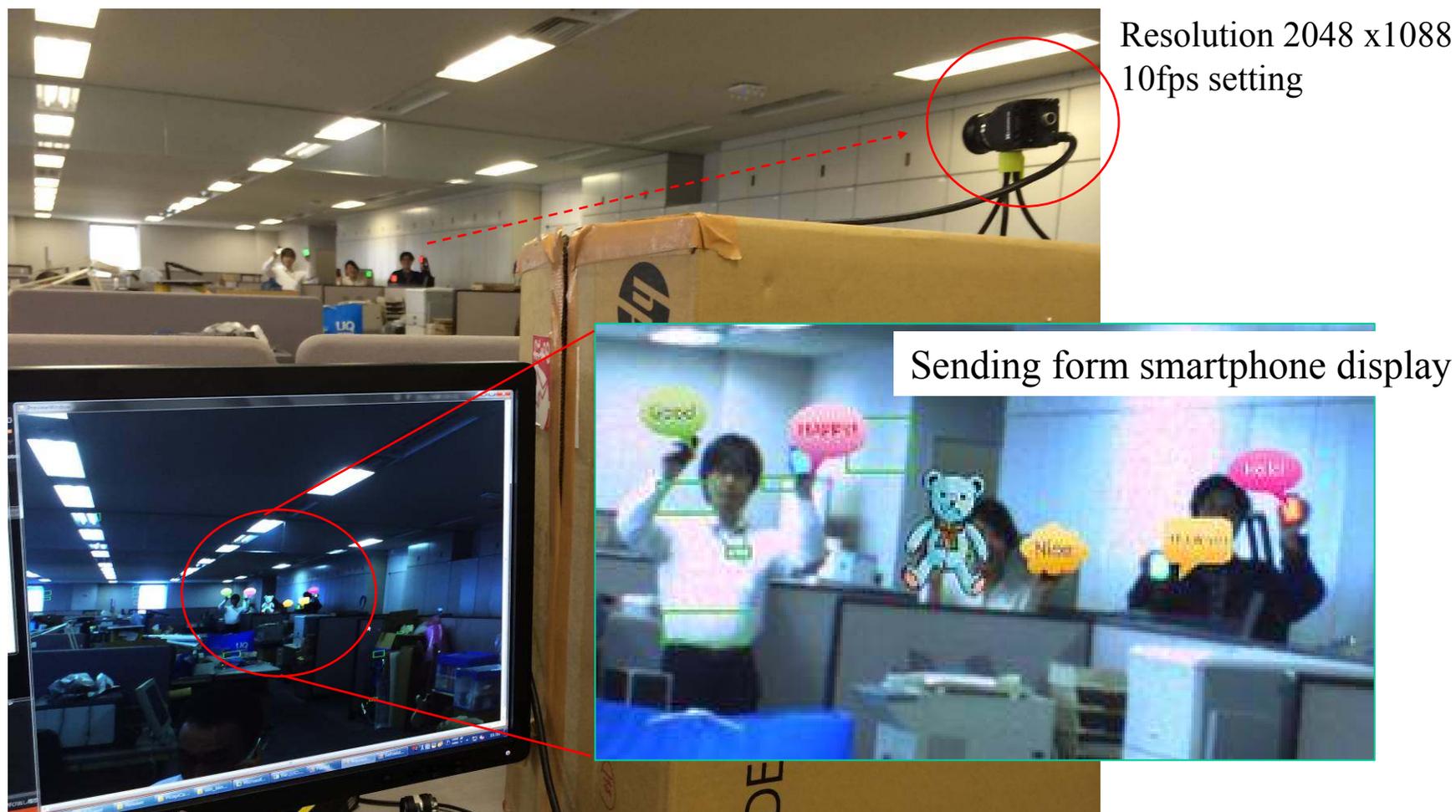
Digital signage and smart phone OCC

(5Hz color signal from Signage and smartphone app)



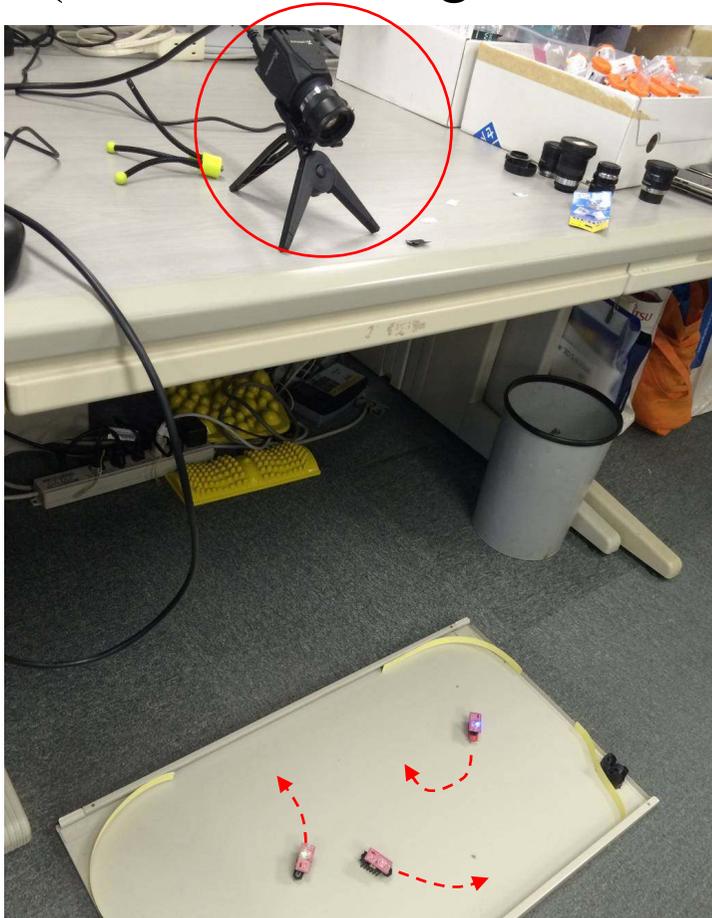
<http://casio.jp/picalico/topics/20140227/>

OCC hi-resolution (5Hz color signal and PC Webcam)

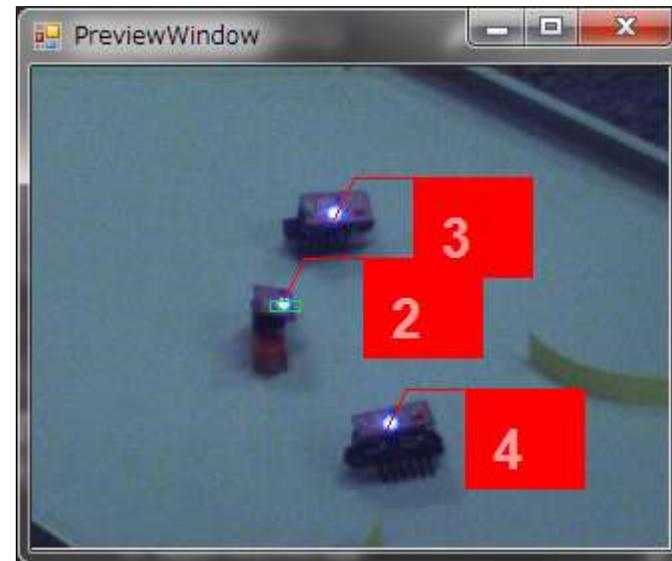


OCC for object tracking

(140Hz color signal and PC+Industrial USB cam at hi-speed)



Industrial USB Cam
Resolution 320x240 pix
380fps setting



Moving toys with LED-tag 0.25m/s speed
140Hz color modulation

Conclusion-1 Frequency and modulation

- In order to start an early OCC market, taking OCC of a software base into consideration has an effective scope of standardization.
- The following requirements should be included in the standard of the OCC for the
 - Frequency 5Hz – 500Hz (*)
 - Frequency steps
 - PPR safety in the modulation wave below 100Hz. (*)
 - Modulation method
 - Color modulation
 - Bright base, doesn't use color

(*) Frequency limit should be discussed

Conclusion-2 Data format

Standard that should be included two standards.

- Short block format (e.g 16-32 pulse)
 - Suitable for ID transmitting
 - Repeated transmission assumption.
Sufficient error detection

- Long data block format
 - Suitable for normal data transmission