

## ALTAIR: Automatic user location system using Active IR-tag

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## Background

- ◆ Ubiquitous computing expands working area
  - Gathering and transmitting information anywhere, anytime
- ◆ To Maximize the mobility
  - ↓
  - Location system should be prepared for
    - Locating yourself : Get navigation, Footprint
    - Collaborating with others : Provide navigation
- ◆ To acquire user's location
  - Outdoor → GPS
  - Indoor → ??

## Expected utilities of location system

- ◆ Spatiotemporal location information implies the worker's activity
  - Store
    - Which section → which commodity
    - Counter → accounting
    - Storage → commodity check
  - Hospital
    - Which bed → which patient
    - Nurse station → desk work / meeting
    - Moving in a group → doctor's round
- ◆ Dynamic monitoring and accumulating multiple workers' location is desirable utility.

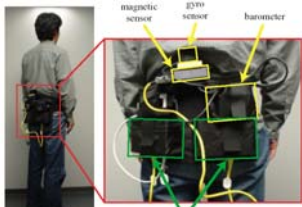
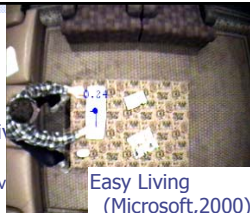
## Objective

### User location system for indoors

- ◆ Requirements
  - **High accuracy**  
ex.) in front of which desk, which part of the room
  - Don't disturb daily work
    - ◆ Automatic tracking and identification
    - ◆ Smaller user's equipments
  - Simple infrastructure

## Related work

- ◆ Autonomous positioning system (Konishi at al., Tokyo Univ)
  - No sensor in environment
  - × Large user's system / Accumulative
- ◆ Using Radio Wave and Ultrasound (Active Bat (AT&T,  
Easy Living (Microsoft,2000))
  - High positioning accuracy
  - × Too many sensors are needed
- ◆ Image processing using camera (Easy Living (Microsoft))
  - User has no devices
  - × Need some action to identify



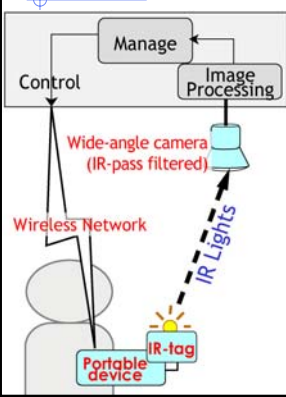
(Konishi at al., 2001)

## ALTAIR

(Automatic Location Tracking system using Active IR-tag)

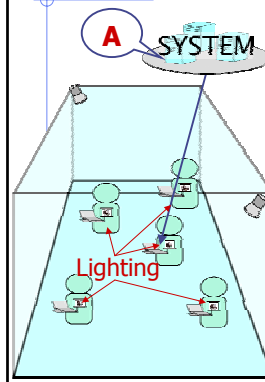
- ◆ **Automatic** locating and identification
- ◆ **~0.5m accuracy**
- ◆ **Simple** infrastructure
- ◆ ALTAIR uses
  - Wireless LAN
  - IR-tag
  - IR wide-angle camera

# Proposed Method



- ◆ IR tracking
  - IR wide-angle camera + IR marker(IR-tag)
    - ◆ Sparse set up with limited number of sensors
    - ◆ Stably extract the marker from IR image
- ◆ Control lighting pattern of IR-tag via network
  - “Roll-call” strategy

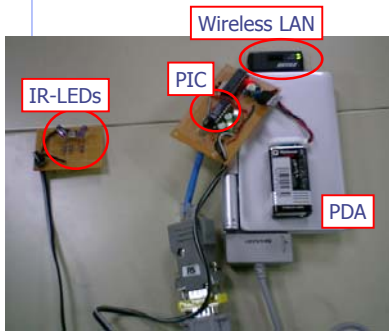
# “Roll-call” strategy



- ◆ Identify user
  - System makes IR-tag of a user who needs to be identified blink.
  - Detects the blinking IR-tag using image sequence from camera
  - Associates the user with the blinking IR-tag

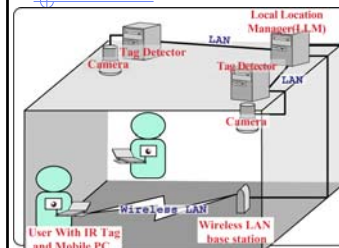
Repeat as if making a “roll call” and system can automatically identify all users.

# System (user’s system)



- PDA (Zaurus, Sharp)
- Wireless LAN
- PIC
- IR-LEDs

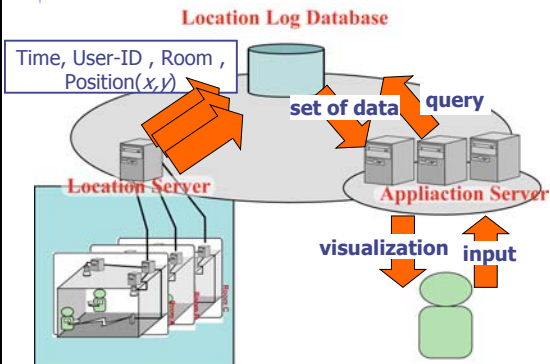
# System(one section)



- ◆ IR wide-angle camera
  - Tracks lights of all IR-tags
  - Calculates IR-tags’ positions
  - Detects blinking IR-tag

- ◆ Local Location-Manager(LLM):
  - Merges information from cameras
  - Sequentially instructs IR-tags of all users to blink
  - Updates user location and identification

# System(servers)



# Sample application

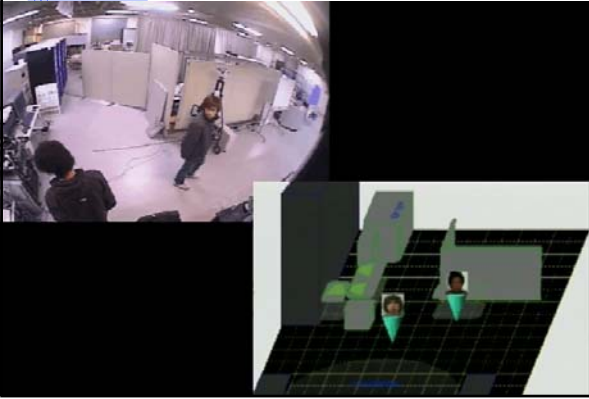
◆ Trace the user’s move

Room	User name
MC 601	Munenori Ozaki
A211	Yoshihiro Yasumuro
	Masataka Imura
	Yoshitatsu Manabe

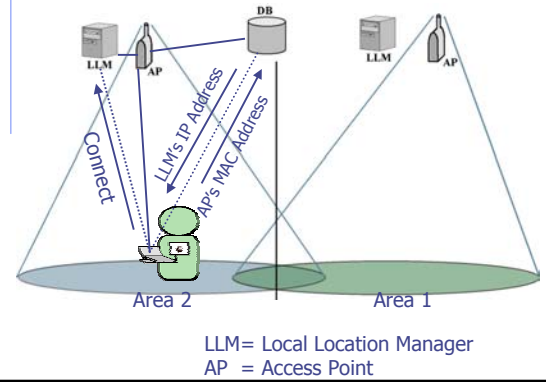
  

date	from	to
2004-02-22	00:19	08:37
2004-02-22	00:20	08:38
	01:14	08:29
	01:29	08:40
	08:37	08:42
	08:38	08:43
	08:39	08:44

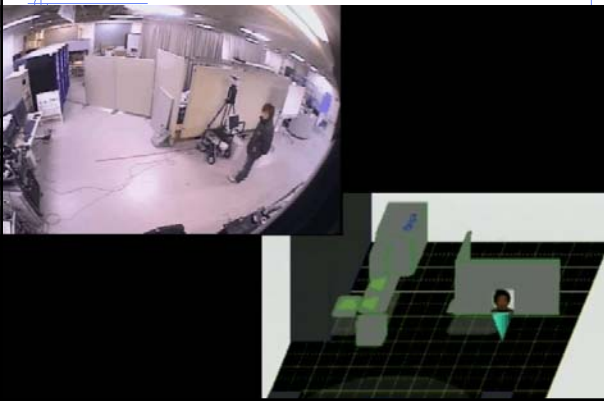
## Sample Application



## Automatic detection of entering / leaving a section



## Movie



## Future Work

- ◆ Some experiments
  - Verification of Prototype system
    - ◆ Rate of tracking user
    - ◆ Visible angle of IR-tag
- ◆ Sample applications
  - Analyze user's location from various aspects
  - Linking to other data resource
    - ◆ Video Streaming, Meeting log, Output of other devices...

## Summary

- ◆ In order to maximize the ability of ubiquitous computing, **dynamic monitoring** and **accumulating** user's location are considerable.
- ◆ I proposed **automatic user location system** using **active IR-tag** and made a prototype system.
- ◆ In my future work, I'll make some experiments to verify the prototype and make some applications using the location system