

the 1st COE Postdoctoral and Doctoral
Researchers Technical Presentation

Automatic user location system using Active IR-tag



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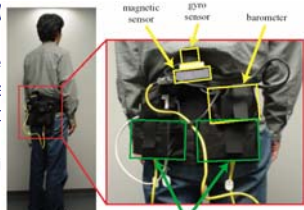
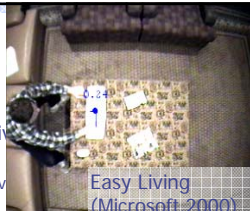
Background

- ◆ 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 → ??



Related work

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



(Konishi et al., 2001)

Objective

User location system for indoors

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



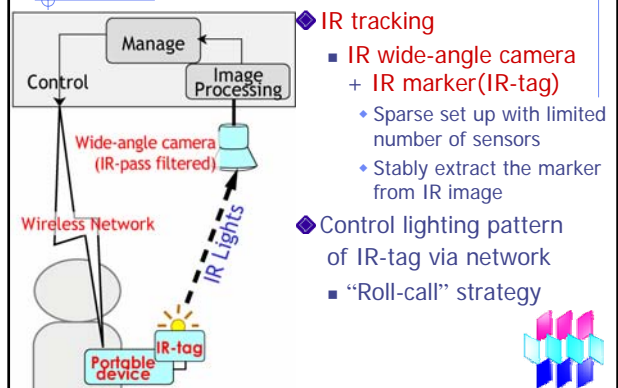
ALTAIR

(Automatic Location Tracking system using Active IR-tag)

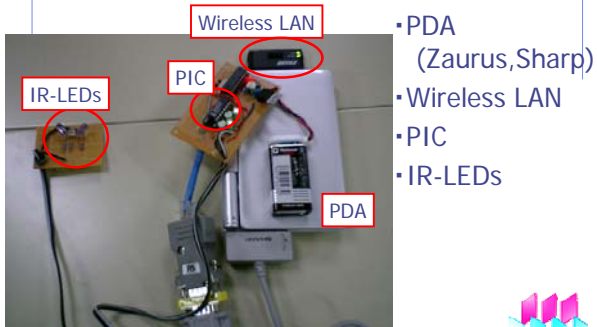
- ◆ Automatic locating and identification
- ◆ ~1m accuracy
- ◆ Simple infrastructure
- ◆ ALTAIR uses
 - Wireless LAN
 - IR-tag
 - IR wide-angle camera



Proposed Method



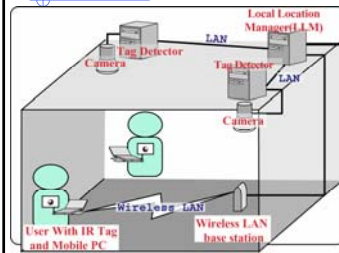
System (user's system)



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



System(one area)



IR wide-angle camera

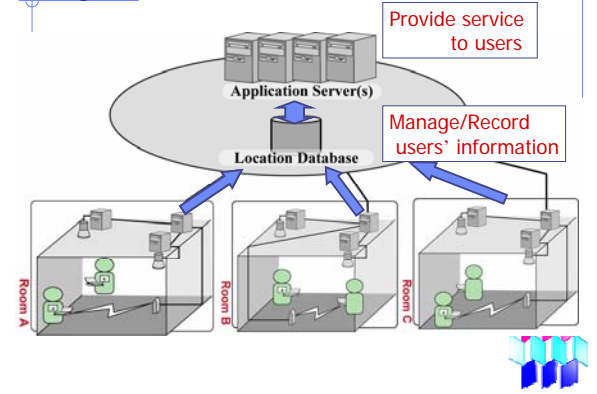
- Tracks lights of all IR-tags
- Calculates IR-tags' positions
- Detects blinking IR-tag

Local Location-Manager(LLM):

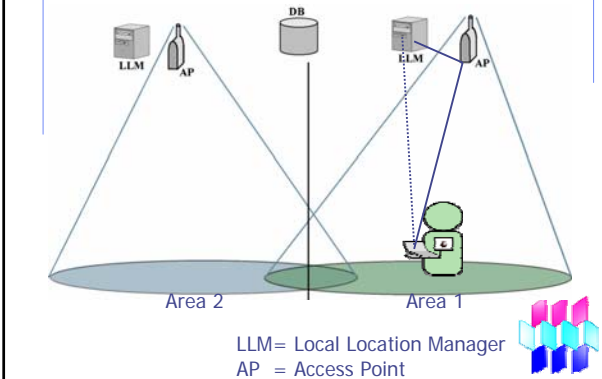
- Merges information from cameras
- Sequentially instructs IR-tags of all users to blink
- Updates user location and identification



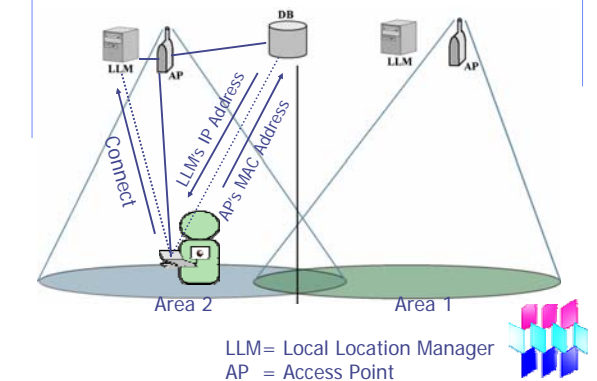
System(servers)



Automatic detection of entering / leaving an area



Automatic detection of entering / leaving an area



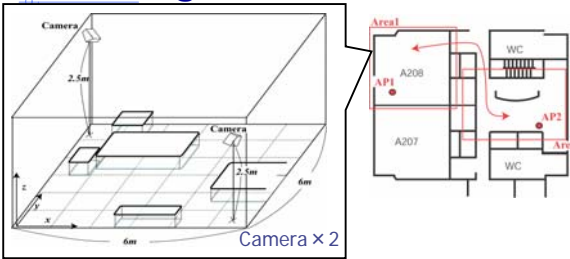
Experiment

Validate 2 points

- Automatic detection of user's entering and leaving area & automatic start and termination of tracking user
- Recording users' activity using Location Database & managing the location data for basic applications



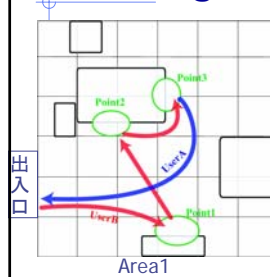
Settings -area-



- ◆ 2 areas: Area1, Area2
 - AP1, AP2 are set in each area
- ◆ 2 user: User A, User B



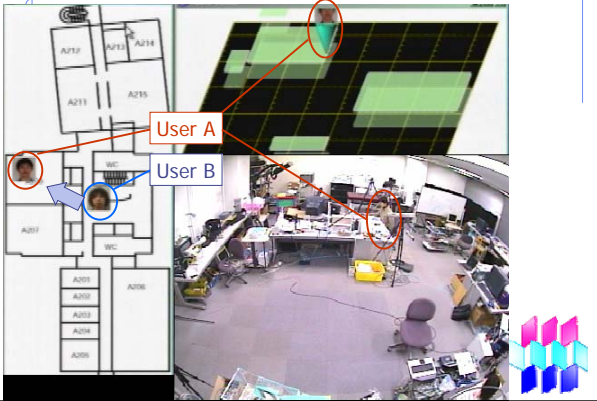
Settings -task-



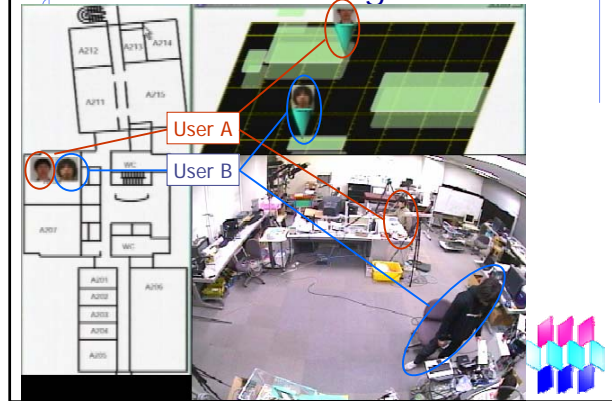
- i) Area1 : User A
Area2 : User B
- ii) User B enters Area1 from Area2
- iii) User B moves to Point 1, Point2, Point3, then exchanges position with User A at Point3
- iv) User A leaves Area1 to Area2



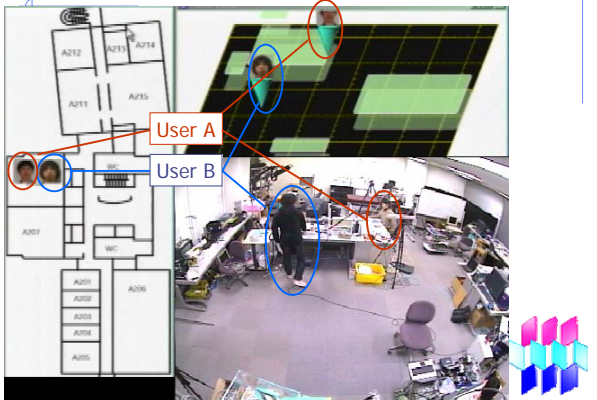
Results: Initial state



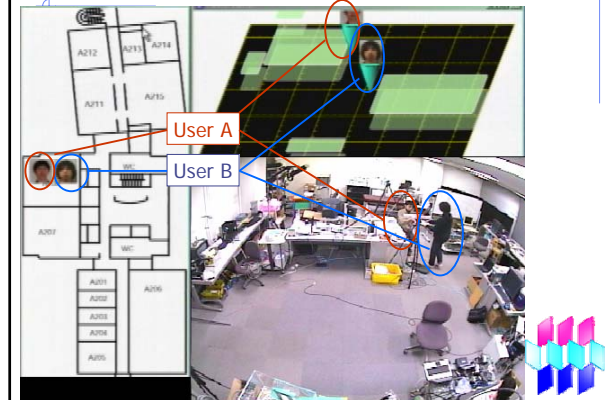
Results: Entering area

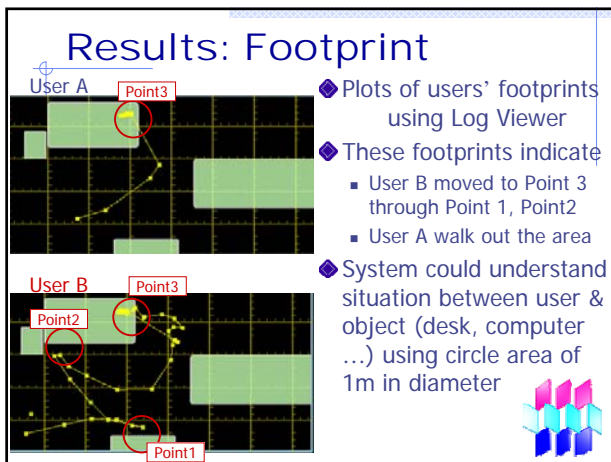
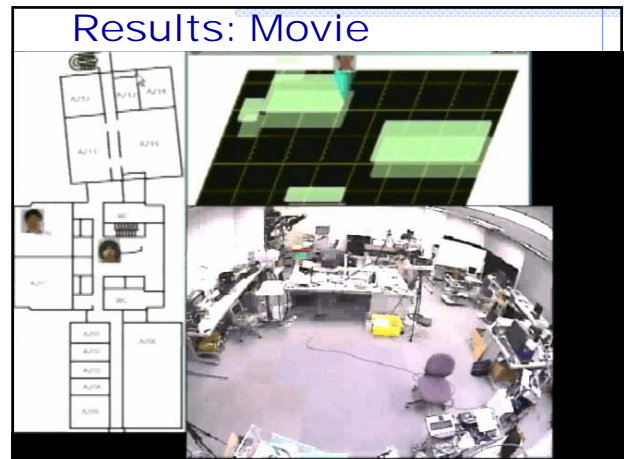
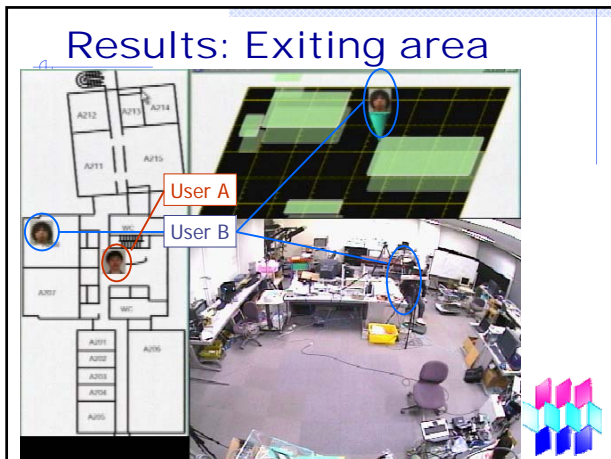


Results: Move to Point 2



Results: Move to Point 3





- ### Discussion
- ◆ The system can ...
 - detect user's entering and leaving area automatically
 - start and terminate tracking user automatically
 - ▶ **The system needs no user's prearranged action in all operation of getting users' location**
 - ◆ Detection user's entering and leaving area requires 3~10 seconds
 - Arrangements of AP's position and radio map are necessary
 - ◆ By monitoring in real-time and plotting user's footprint, system can monitor and record user's activity
 - The system could analyze user's activity

- ### Expected application
- ◆ **Location system for workers in office / store**
 - Nurse support system in hospital
 - ◆ Spread of wireless network & mobile computers
 - ◆ **Spatiotemporal location information implies the nurse's activity**
 - Around bed → which patient
 - Nurse station → desk work / meeting
 - Moving in a group → doctor's round
 - ◆ Validation of effective staff assignment
 - ◆ Information of location links to other data resources
 - Electronic medical chart , Input / Output of equipments

- ### Summary & Future work
- ◆ **User location system for indoors**
 - System can get users' location automatically, and it doesn't prevent users' activity
 - Simple settings
 - ◆ 2 sensors(cameras) in one area
 - **High accuracy (~1m)**
 - ◆ Which desk, which bed, which computer...
 - **Location data can be used in multi application**
 - ◆ Monitoring in real-time
 - ◆ Analyzing of accumulated location data
 - ◆ Linking with other data resources
 - ◆ **Future work**
 - Making application and experiment for actual situation