Lecture 3: *Analyzing and Synthesizing in Human–Computer Interaction (HCI)*

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1. Introduction: The Role of Analysis and Synthesis in HCI

- **Analysis** = **understanding** users, their goals, behaviors, and contexts.

    - Example: **observing** how nurses record patient data to reveal pain points in hospital software.

- **Synthesis** = **transforming** insights into design goals, interfaces, and prototypes.

    - Example: after observing nurses, **designing** a single dashboard for patient vitals to reduce time recording — for example, heart rate at 10:00, blood pressure at 10:05, etc. The new dashboard should automate that time-entry process.

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2. User Needs

- **Key insight:** "Needs are **verbs**, not nouns."

    - Wrong: *Users need a **faster horse*** (solution).

    - Correct: *Users need a way to **move faster** from one place to another* (need).

- **Why verbs matter:**

    - They describe *what users want to do*, not *how to do it*.

- **Real-world examples:**

    - *Users need a way to **pay easily*** → led to Apple Pay.

    - *Users need to **stay connected visually*** → led to video calls.

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3. Human-Centered Design (HCD) Process

- **HCD** emphasizes designing *for* and *with* people.

- **Core stages:**

    1. Observe and analyze users.

    2. Define needs and goals.

    3. Ideate and prototype.

    4. Test and iterate.

- **Iterative cycle:**

- o Research for needs → Design goals → *Prototype* → Evaluation.
- **Examples:**
  - o In healthcare apps: design goals must consider *patients' ability to understand data*, not just provide graphs.
  - o In banking apps: design goals may focus on *reducing anxiety about transactions*.

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4. Design Goals

- **Purpose:** Intermediate layer between user needs and concrete UI features.
- **Design goals** clarify *what outcome* the interface should enable.
- **Examples of Goals:**
  - o "Enable quick rebooking of canceled flights" (Airline app).
  - o "Reduce mental load when tracking expenses" (Fintech app).
- **Example:**
  - o Need: "I need to **keep** track of expenses."
  - o Goal: "Help the user *visualize monthly spending*."
  - o Interface: A dashboard with charts.

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5. Tasks

- **Task** = set of activities a person performs to achieve a goal.
  - o Describes **what** the person wants to do, not *how*.
- **Levels of task complexity – Example 1:**
  - o **Simple:** basic, frequent actions (e.g., sending a message).
  - o **Moderate:** require several steps (e.g., setting up two-factor authentication).
  - o **Complex:** infrequent or for expert users (e.g., configuring system integrations with AI).
- **Example 2:**
  - o Task: *Plan a trip*.
    - ▪ **Simple**: Book a flight.

- **Moderate**: Reserve hotel + car rental.

- **Complex**: Coordinate multi-city travel for a group.

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6. Task Analysis

- **Definition:** studying **_how_** _people perform their activities_.

- **Why Task Analysis?** To understand

  o What they do (steps)

  o What they use (artifacts/tools)

  o How well they succeed (pain points, goals).

- **Example of task analysis:** _To clean the house_

  o Steps: get vacuum → attach tool → clean → empty bag → store vacuum.

  o Artifacts/Tools: vacuum, dust bag, power source.

  o Pain point: bag fills fast → insight for product redesign → Designers could create a **self-cleaning vacuum** or an **IoT-enabled robot cleaner**.

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8. Task–Goal–Action Hierarchy (Benyon Model)

Level	Description	Example
Goal	Desired end state	"Submit an assignment successfully."
Task	Activities to reach goal	"Upload file → Confirm submission → Get confirmation email."
Action	Atomic/small step	"Click 'Submit' button."

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10. Why Task Analysis Is Useful

- Helps in:

  o Identifying necessary app features.

  o Prototyping early designs.

  o Running usability testing.

- **Example:**

- In e-learning platforms: task analysis showed students spent too long searching for assignments → redesign placed "Assignments" upfront.
- In an e-commerce app, task analysis may reveal users repeatedly filter the same items → lead to "Saved Filters."

13. Techniques for Task Analysis

- **Task Decomposition:**
  - Break tasks into subtasks.
  - Example: "Order pizza" → choose restaurant → select pizza → pay → track delivery.

- **Knowledge-Based Techniques:**
  - Map what users must *know* to perform tasks.
  - Example: flight booking requires knowing airport codes.

- **Entity-Relationship Analysis:**
  - Identify objects, relationships.
  - Example: *User → Product Selection → Payment → Delivery*.

- **Ethnography:**
  - Observe users in real contexts; rich for qualitative insights.
  - Example: ATM redesign → ethnographic studies showed older adults struggled with card orientation → design changed to clearer arrows.
  - Example: Microsoft Office usability lab → observed real users editing documents to find friction points.

- **Protocol Analysis (Think-Aloud):**
  - Users verbalize thoughts while performing tasks → reveals mental models.
  - Example: "I think this button saves it…" exposes misunderstanding of icons.
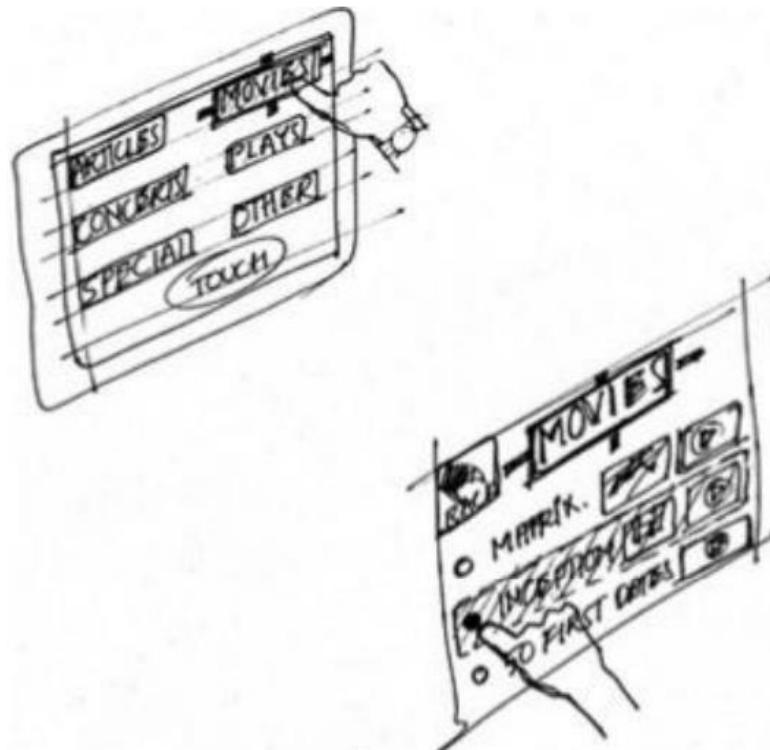
14. Sketches in HCI

- **Definition:** quick drawings to express interface ideas or interactions.
- **Benefits:**
  - Visualize early ideas.

- o Cheap and fast.

- o Encourage discussion.

- o Focuses on ideas, not design polish.

- **Examples:**

  - o Paper sketch of a mobile banking app → user says "Where do I see my balance?" → informs placement of balance at top.

- **Teaching tip:** emphasize *speed and idea communication*, not beauty جمال التصميم .

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15. Scenarios in HCI

- **Definition:** stories describing how users achieve goals using a system.

- **Formats:**

  - o Written story.

  - o Flowcharts or storyboards.

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16. Levels of Scenario Detail
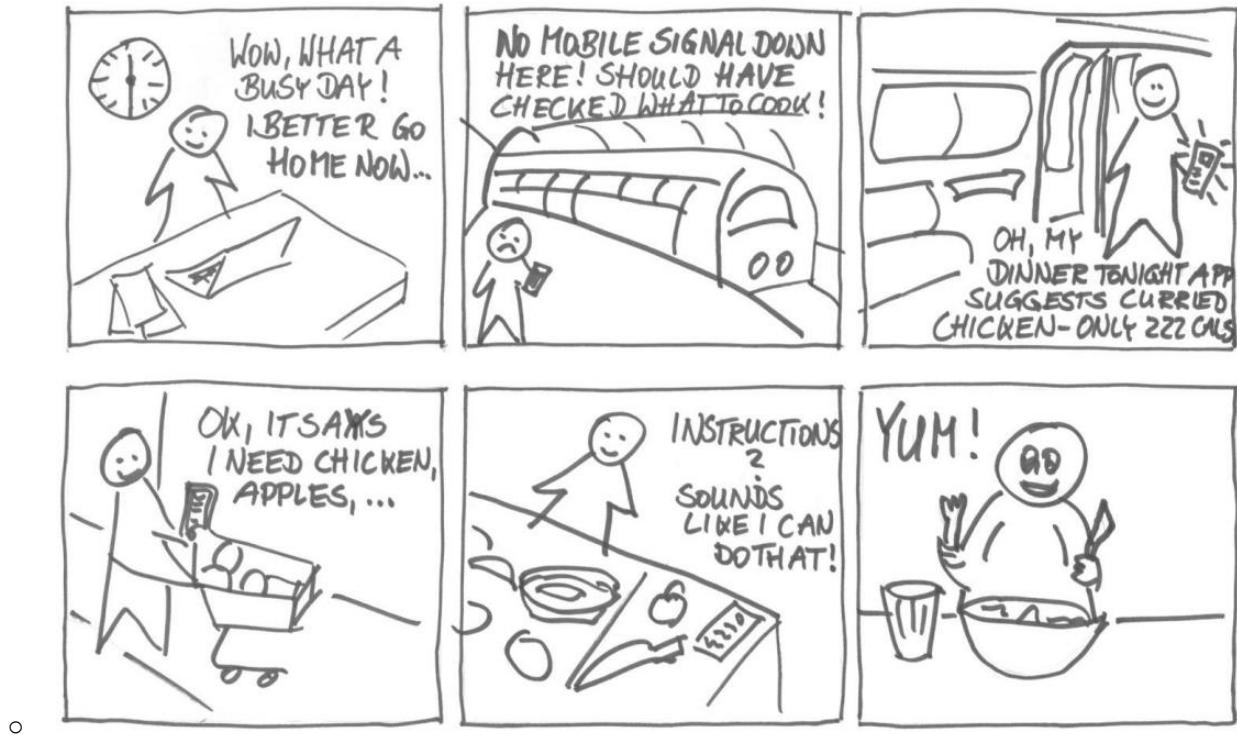
- **Story:** what people **do** and **want**, independent of tech.

- o **Example:** "Sara often forgets to drink water during work. She wishes something reminded her to stay hydrated."

- **Conceptual Scenario:** what people **want**, no technology reference.

  - o Example: "A user wants to manage daily hydration levels without effort."

- **Concrete Scenario:** one solution using technology.

  - o Example: "Sara's smartwatch automatically detects low activity and vibrates to remind her to drink water. She taps 'done' on her wrist."

- **Use Case:** Structured format with *actors*, *triggers*, *preconditions*, *steps*, and *outcomes* **for software engineering**.

  - o **Example (Use Case Template):**
    - ▪ **Actor:** Commuter
    - ▪ **Goal:** Check transport delays
    - ▪ **Precondition:** App installed and connected
    - ▪ **Trigger:** User opens the app
    - ▪ **Main Flow:** User selects route → sees delay alert → chooses alternative route
    - ▪ **Postcondition:** User reaches destination on time

- **Example of Detailed Scenario (Commuter Case)**

  - **Scenario:**

    - o *Ali, a daily commuter, uses the transport app "MoveNow" every morning before leaving home.*

    - o He opens the app at 7:30 a.m. to check for train delays.

    - o The system shows a 15-minute delay and suggests an alternate bus route.

    - o Ali switches plans, takes the bus, and reaches work on time.

  - **Design takeaway:** real-time data + intelligent recommendations improve trust and user satisfaction.

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17. Storyboards

- **Definition:** comic-like visual sequence showing how users accomplish a task using the system.

- **Purpose:**

  - o Visualize flow of interactions.

- o Communicate design to stakeholders.

- **Example:**

  - o A storyboard showing a user checking recipes on the subway before shopping.

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18. **What a Storyboard Should Convey** ما يجب أن تنقله القصة المصورة

- **Setting:** users, environment, and goal context.

- **Sequence:** steps and how UI assists.

- **Satisfaction:** final success state.

- **Example:**

  - o Trigger: hunger → opens meal app → finds quick recipe → cooks → feels satisfied.

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20. Why Hand-Drawn Storyboards?

- **Advantages:**
  - Quick and cheap → encourages iteration.
  - Imperfect غير كامل drawings → invite feedback.
  - Avoids focusing on colors too early.
- **Example:**
  - Sketching login flow on paper before Figma.

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21. Benefits of Storyboards

- Focus discussion on *tasks*, not *UI details*.
- Avoid debate over buttons/colors too early.
- Align team on user goals.
- Example: a storyboard clarifies why a "Skip" button is necessary before debate starts about UI details(e.g., color or shape).

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23. Summary

- **Key takeaway:**

  - **Analysis → understanding users.**

  - **Synthesis → turning insights into designs.**

<u>Case Study: SmartCity Bus App</u>

Objective:

Create a **mobile app** that helps city residents **track buses in real time**, **plan routes**, and **reduce waiting uncertainty**.

PHASE 1 — ANALYSIS

Goal: Understand users, their environment, and the real problems before designing.

Step 1: User Research

Methods used:

- **Field observation:** Watch people at bus stops during rush hours.

- **Interviews:** Talk to 15 frequent bus users (students, workers, elderly).

- **Surveys:** Gather data from 500 users about frustrations and habits.

Findings:

- 60% complain they **don't know when the next bus will arrive**.

- 40% said **buses are often late**, causing stress.

- 30% said **existing apps are too complex** (show too much data).

- 25% of elderly users can't read **small text or confusing maps**.

Step 2: Task Analysis

Main user tasks:

1. Check the nearest bus stop.

2. See when the next bus arrives.

3. Plan a route to a destination.

4. Get alerts if the bus is delayed.

Current workflow (as observed):

1. Open existing app → search manually for route.

2. Wait for GPS → app loads multiple screens.

3. Confusing results → user gives up or asks others.

Pain points:

- Too many steps to find simple info.

- Data not updated in real time.

- Overloaded interface.

- Not accessible for elderly users.

Step 3: Define User Needs & Requirements

From analysis, we extract **user needs:**

Type	Need
Functional	Real-time bus tracking
Functional	Simple "Find My Bus" button
Emotional	Reduce stress of uncertainty
Accessibility	Large font and voice alerts for elderly
Performance	Fast loading within 3 seconds

Step 4: Personas

Create **representative personas** based on findings.

Persona 1 — Ahmed, 24

- Student, uses buses daily to university.

- Wants real-time updates to avoid missing class.

Persona 2 — Fatima, 65

- Retired, visits clinic weekly.

- Needs clear text, simple navigation, and voice alerts.

Persona 3 — Karim, 35

- Office worker, values time.

- Wants alerts when bus is delayed or canceled.

PHASE 2 — SYNTHESIS

Goal: Turn analysis insights into design concepts, features, and prototypes.

Step 5: Define Design Goals

Goal	Derived From
Reduce time to find bus info	Confusion in current apps
Improve accessibility	Elderly users' difficulties
Increase reliability	Users' frustration with delays
Simplify interface	Overloaded screens

Step 6: Conceptual Design

Before creating screens, define **how the system should work conceptually.**

Concept: "Bus at a Glance"

- Home screen shows *nearest stop*, *next bus time*, and *delay alerts* — nothing else.

- Voice assistant reads the next bus arrival ("Bus 12 arriving in 3 minutes").

- Favorite routes are pinned for one-tap access.

- AI-based prediction adjusts time based on traffic.

Step 7: Prototyping

Low-fidelity sketches:

- Simple home screen:
    - Large "Next Bus" button
    - Current stop name
    - Bus number + ETA
    - Alert icon

High-fidelity prototype (Figma or Adobe XD):

- Clean UI with high contrast colors.
- Arabic & English localization.
- Voice-over compatibility (for accessibility).
- GPS integration with real-time tracking.

Step 8: Evaluation & Feedback

Conduct **usability testing** with 10 users from each persona group.

Feedback:

- "Easy to find my bus now."
- "Voice alert helps a lot."
- "Would love to save my usual route."

Metrics after testing:

Metric	Before	After
Time to find bus	90 sec	25 sec
Task success rate	60%	95%
Elderly user satisfaction	55%	92%

Step 9: Iteration

Adjust design based on testing:

- Added "Favorites" feature for common routes.
- Increased font size and button contrast.

- Simplified navigation bar to only 3 tabs: *Home, Favorites*, *Settings*.

Final Outcome

The **SmartCity Bus App** now:

- Shows live arrival times.

- Learns user behavior (e.g., usual routes).

- Works for all age groups (inclusive design).

- Improves public transportation experience city-wide.

Summary Table

Stage	Description	Example Output
Analysis	Understand users, context, and tasks	Interviews, observations, personas, user needs
Synthesis	Generate and evaluate design solutions	Prototypes, usability testing, refined UI