# HUMAN-COMPUTER INTERACTION (IS252) CHAPTER SIX



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### CHAPTER 6: DESIGN, PROTOTYPING AND CONSTRUCTION

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# **6.1 INTRODUCTION**

- DESIGN ACTIVITIES BEGIN ONCE A SET OF REQUIREMENTS HAS BEEN ESTABLISHED. BROADLY SPEAKING, THERE ARE TWO TYPES OF DESIGN: CONCEPTUAL AND PHYSICAL. THE FORMER IS CONCERNED WITH DEVELOPING A CONCEPTUAL MODEL THAT CAPTURES WHAT THE PRODUCT WILL DO AND HOW IT WILL BEHAVE, WHILE THE LATTER IS CONCERNED WITH DETAILS OF THE DESIGN SUCH AS SCREEN AND MENU STRUCTURES, ICONS, AND GRAPHICS.
- THE DESIGN EMERGES ITERATIVELY, THROUGH REPEATED DESIGN-EVALUATION-REDESIGN CYCLES INVOLVING USERS. FOR USERS TO EFFECTIVELY EVALUATE THE DESIGN OF AN INTERACTIVE PRODUCT, DESIGNERS MUST PRODUCE AN INTERACTIVE VERSION OF THEIR IDEAS. IN THE EARLY STAGES OF DEVELOPMENT, THESE INTERACTIVE VERSIONS MAY BE MADE OF PAPER AND CARDBOARD, WHILE AS DESIGN PROGRESSES AND IDEAS BECOME MORE DETAILED, THEY MAY BE POLISHED PIECES OF SOFTWARE, METAL, OR PLASTIC THAT RESEMBLE THE FINAL PRODUCT. WE HAVE CALLED THE ACTIVITY CONCERNED WITH BUILDING THIS INTERACTIVE VERSION PROTOTYPING AND CONSTRUCTION.
- THERE ARE TWO DISTINCT CIRCUMSTANCES FOR DESIGN: ONE WHERE YOU'RE STARTING FROM SCRATCH AND ONE WHERE YOU'RE MODIFYING AN EXISTING PRODUCT.
- IN CHAPTER 5, WE DISCUSSED SOME WAYS TO IDENTIFY USER NEEDS AND ESTABLISH REQUIREMENTS. IN THIS CHAPTER, WE LOOK AT THE ACTIVITIES INVOLVED IN PROGRESSING A SET OF REQUIREMENTS THROUGH THE CYCLES OF PROTOTYPING TO CONSTRUCTION.

# 6.2 DESIGN, PROTOTYPING AND CONSTRUCTION

#### • 6.2.1 WHAT IS DESIGN

- SO WHAT IS DESIGN? A SIMPLE DEFINITION IS:
- ACHIEVING GOALS WITHIN CONSTRAINTS
- THIS DOES NOT CAPTURE EVERYTHING ABOUT DESIGN, BUT HELPS TO FOCUS US ON CERTAIN THINGS:
- <u>GOALS</u> WHAT IS THE PURPOSE OF THE DESIGN WE ARE INTENDING TO PRODUCE? WHO IS IT FOR? WHY DO THEY
  WANT IT? FOR EXAMPLE, IF WE ARE DESIGNING A WIRELESS PERSONAL MOVIE PLAYER, WE MAY THINK ABOUT
  YOUNG AFFLUENT USERS WANTING TO WATCH THE LATEST MOVIES WHILST ON THE MOVE AND DOWNLOAD FREE
  COPIES, AND PERHAPS WANTING TO SHARE THE EXPERIENCE WITH A FEW FRIENDS.
- <u>CONSTRAINTS</u> WHAT MATERIALS MUST WE USE? WHAT STANDARDS MUST WE ADOPT? HOW MUCH CAN IT COST? HOW MUCH TIME DO WE HAVE TO DEVELOP IT? ARE THERE HEALTH AND SAFETY ISSUES? IN THE CASE OF THE PERSONAL MOVIE PLAYER: DOES IT HAVE TO WITHSTAND RAIN? MUST WE USE EXISTING VIDEO STANDARDS TO DOWNLOAD MOVIES? DO WE NEED TO BUILD IN COPYRIGHT PROTECTION?
- OF COURSE, WE CANNOT ALWAYS ACHIEVE ALL OUR GOALS WITHIN THE CONSTRAINTS. SO PERHAPS ONE OF THE
   MOST IMPORTANT THINGS ABOUT DESIGN IS:
- TRADE-OFF CHOOSING WHICH GOALS OR CONSTRAINTS CAN BE RELAXED SO THAT OTHERS CAN BE MET. HOWEVER, THE MORE COMMON SKILL NEEDED IN DESIGN IS TO ACCEPT THE CONFLICT AND CHOOSE THE MOST APPROPRIATE TRADE-OFF.

## 6.2.1.1 THE GOLDEN RULE OF DESIGN

- PART OF THE UNDERSTANDING WE NEED IS ABOUT THE CIRCUMSTANCES AND CONTEXT OF THE PARTICULAR DESIGN PROBLEM. WE WILL RETURN TO THIS LATER IN THE CHAPTER.
   HOWEVER, THERE ARE ALSO MORE GENERIC CONCEPTS TO UNDERSTAND. THE DESIGNS WE PRODUCE MAY BE DIFFERENT, BUT OFTEN THE RAW MATERIALS ARE THE SAME. THIS LEADS US TO THE GOLDEN RULE OF DESIGN: UNDERSTAND YOUR MATERIALS
- FOR HUMAN–COMPUTER INTERACTION THE OBVIOUS MATERIALS ARE THE HUMAN AND THE COMPUTER. THAT IS WE MUST:
- 1) UNDERSTAND COMPUTERS
- 2) LIMITATIONS, CAPACITIES, TOOLS, PLATFORMS
- 3) UNDERSTAND PEOPLE
- 4) PSYCHOLOGICAL, SOCIAL ASPECTS, HUMAN ERROR.

#### 6.2.1.2 THE PROCESS OF DESIGN

- OFTEN HCI PROFESSIONALS COMPLAIN THAT THEY ARE CALLED IN TOO LATE. A SYSTEM HAS BEEN DESIGNED AND BUILT. IN OTHER COMPANIES USABILITY IS SEEN AS EQUIVALENT TO TESTING – CHECKING WHETHER PEOPLE CAN USE IT AND FIXING PROBLEMS, IN THE BEST COMPANIES, HOWEVER, USABILITY IS DESIGNED IN FROM THE START.
- IN THIS SECTION WE WILL LOOK IN DETAIL AT THE SOFTWARE DEVELOPMENT PROCESS AND HOW HCI FITS WITHIN IT. HERE WE'LL TAKE A SIMPLIFIED VIEW OF FOUR MAIN PHASES PLUS AN ITERATION LOOP, FOCUSED ON THE DESIGN OF INTERACTION (FIGURE BELOW).



- REQUIREMENTS WHAT IS WANTED: THE FIRST STAGE IS ESTABLISHING WHAT EXACTLY IS NEEDED? AS A PRECURSOR TO THIS IT IS USUALLY NECESSARY TO FIND OUT WHAT IS CURRENTLY HAPPENING.
- THERE ARE A NUMBER OF TECHNIQUES USED FOR THIS IN HCI: INTERVIEWING PEOPLE, VIDEOTAPING THEM, LOOKING AT THE DOCUMENTS AND OBJECTS THAT THEY WORK WITH...ETC.
- ANALYSIS: THE RESULTS OF OBSERVATION AND INTERVIEW NEED TO BE ORDERED IN SOME WAY TO BRING OUT KEY ISSUES AND COMMUNICATE WITH LATER STAGES OF DESIGN. WHICH ARE A MEANS TO CAPTURE HOW PEOPLE CARRY OUT THE VARIOUS TASKS THAT ARE PART OF THEIR WORK AND LIFE. IN THIS CHAPTER, WE WILL LOOK AT SCENARIOS, RICH STORIES OF INTERACTION, WHICH CAN BE USED IN CONJUNCTION WITH A METHOD LIKE TASK ANALYSIS OR ON THEIR OWN TO RECORD AND MAKE VIVID ACTUAL INTERACTION. THESE TECHNIQUES CAN BE USED BOTH TO REPRESENT THE SITUATION AS IT IS AND ALSO THE DESIRED SITUATION.
- DESIGN: WELL, THIS IS ALL ABOUT DESIGN, BUT THERE IS A CENTRAL STAGE WHEN YOU MOVE FROM WHAT YOU WANT, TO HOW TO DO IT. THERE ARE NUMEROUS RULES, GUIDELINES AND DESIGN PRINCIPLES THAT CAN BE USED TO HELP US. WE NEED TO RECORD OUR DESIGN CHOICES IN SOME WAY AND THERE ARE VARIOUS NOTATIONS AND METHODS TO DO THIS, INCLUDING THOSE USED TO RECORD THE EXISTING SITUATION. WE USED THIS SIMPLE NOTATIONS FOR DESIGNING NAVIGATION WITHIN A SYSTEM AND SOME BASIC HEURISTICS TO GUIDE THE DESIGN OF THAT NAVIGATION.
- ITERATION AND PROTOTYPING: HUMANS ARE COMPLEX AND WE CANNOT EXPECT TO GET DESIGNS RIGHT FIRST TIME. WE THEREFORE NEED TO EVALUATE A DESIGN TO SEE HOW WELL IT IS WORKING AND WHERE THERE CAN BE IMPROVEMENTS. SOME FORMS OF EVALUATION CAN BE DONE USING THE DESIGN ON PAPER, BUT IT IS HARD TO GET REAL FEEDBACK WITHOUT TRYING IT OUT. MOST USER INTERFACE DESIGN THEREFORE INVOLVES SOME FORM OF PROTOTYPING, PRODUCING EARLY VERSIONS OF SYSTEMS TO TRY OUT WITH REAL USERS.
- IMPLEMENTATION AND DEPLOYMENT: FINALLY, WHEN WE ARE HAPPY WITH OUR DESIGN, WE NEED TO CREATE IT AND DEPLOY
  IT. THIS WILL INVOLVE WRITING CODE, PERHAPS MAKING HARDWARE, WRITING DOCUMENTATION AND MANUALS EVERYTHING
  THAT GOES INTO A REAL SYSTEM THAT CAN BE GIVEN TO OTHERS.

# **6.2.2 PROTOTYPING**

IT IS OFTEN SAID THAT USERS CAN'T TELL YOU WHAT THEY WANT, BUT WHEN THEY SEE SOMETHING AND GET TO USE IT, THEY SOON KNOW WHAT THEY DON'T WANT. HAVING COLLECTED INFORMATION ABOUT WORK PRACTICES AND VIEWS ABOUT WHAT A SYSTEM SHOULD AND SHOULDN'T DO, WE THEN NEED TO TRY OUT OUR IDEAS BY BUILDING PROTOTYPES AND ITERATING THROUGH SEVERAL VERSIONS. AND THE MORE ITERATIONS, THE BETTER THE FINAL PRODUCT WILL BE.

#### • 6.2.2.1 WHAT IS A PROTOTYPE

- WHEN YOU HEAR THE TERM PROTOTYPE, YOU MAY IMAGINE SOMETHING LIKE A SCALE MODEL OF A BUILDING OR A BRIDGE, OR MAYBE A PIECE OF SOFTWARE THAT CRASHES EVERY FEW MINUTES. BUT A PROTOTYPE CAN ALSO BE A PAPER-BASED OUTLINE OF A SCREEN OR SET OF SCREENS, AN ELECTRONIC "PICTURE," A VIDEO SIMULATION OF A TASK, A THREE DIMENSIONAL PAPER AND CARDBOARD MOCKUP OF A WHOLE WORKSTATION, OR A SIMPLE STACK OF HYPERLINKED SCREEN SHOTS, AMONG OTHER THINGS. IN FACT, A PROTOTYPE CAN BE ANYTHING FROM A PAPER-BASED STORYBOARD THROUGH TO A COMPLEX PIECE OF SOFTWARE, AND FROM A CARDBOARD MOCKUP TO A MOLDED OR PRESSED PIECE OF METAL. A PROTOTYPE ALLOWS STAKEHOLDERS TO INTERACT WITH AN ENVISIONED PRODUCT, TO GAIN SOME EXPERIENCE OF USING IT IN A REALISTIC SETTING, AND TO EXPLORE IMAGINED USES.
- SO A PROTOTYPE IS A LIMITED REPRESENTATION OF A DESIGN THAT ALLOWS USERS TO INTERACT WITH IT AND TO EXPLORE ITS SUITABILITY.

### 6.2.2.2 WHY PROTOTYPE

- PROTOTYPES ARE A USEFUL AID WHEN DISCUSSING IDEAS WITH STAKEHOLDERS; THEY ARE A COMMUNICATION DEVICE AMONG TEAM MEMBERS
  - EFFECTIVE WAY TO TEST OUT IDEAS FOR YOURSELF.
  - THE ACTIVITY OF BUILDING PROTOTYPES ENCOURAGES REFLECTION IN DESIGN.
  - LOW-FIDELITY PROTOTYPING: IS ONE THAT DOES NOT LOOK VERY MUCH LIKE THE FINAL PRODUCT.
  - FOR EXAMPLE, IT USES MATERIALS THAT ARE VERY DIFFERENT FROM THE INTENDED FINAL VERSION, SUCH AS PAPER AND CARDBOARD RATHER THAN ELECTRONIC SCREENS AND METAL.
  - HIGH-FIDELITY PROTOTYPING: USES MATERIALS THAT YOU WOULD EXPECT TO BE IN THE FINAL
     PRODUCT AND PRODUCES A PROTOTYPE THAT LOOKS MUCH MORE LIKE THE FINAL THING.
  - FOR EXAMPLE, A PROTOTYPE OF A SOFTWARE SYSTEM DEVELOPED IN VISUAL BASIC IS HIGHER FIDELITY THAN A PAPER-BASED MOCKUP; A MOLDED PIECE OF PLASTIC WITH A DUMMY KEYBOARD IS A HIGHER-FIDELITY PROTOTYPE OF THE "PALM PILOT" THAN THE LUMP OF WOOD.

### 6.2.3 CONSTRUCTION: FROM DESIGN TO IMPLEMENTATION

- WHEN THE DESIGN HAS BEEN AROUND THE ITERATION CYCLE ENOUGH TIMES TO FEEL CONFIDENT THAT IT FITS REQUIREMENTS, EVERYTHING THAT HAS BEEN LEARNED THROUGH THE ITERATED STEPS OF PROTOTYPING AND EVALUATION MUST BE INTEGRATED TO PRODUCE THE FINAL PRODUCT.
- ALTHOUGH PROTOTYPES WILL HAVE UNDERGONE EXTENSIVE USER EVALUATION, THEY WILL NOT NECESSARILY HAVE BEEN SUBJECTED TO RIGOROUS QUALITY TESTING FOR OTHER CHARACTERISTICS SUCH AS ROBUSTNESS AND ERROR-FREE OPERATION. CONSTRUCTING A PRODUCT TO BE USED BY THOUSANDS OR MILLIONS OF PEOPLE RUNNING ON VARIOUS PLATFORMS AND UNDER A WIDE RANGE OF CIRCUMSTANCES REQUIRES A DIFFERENT TESTING REGIME THAN PRODUCING A QUICK PROTOTYPE TO ANSWER SPECIFIC QUESTIONS.
- THE DILEMMA BOX BELOW DISCUSSES TWO DIFFERENT DEVELOPMENT PHILOSOPHIES.
- ONE APPROACH, CALLED EVOLUTIONARY PROTOTYPING, INVOLVES EVOLVING A PROTOTYPE INTO THE FINAL PRODUCT.
- AN ALTERNATIVE APPROACH, CALLED THROWAWAY PROTOTYPING, USES THE PROTOTYPES AS STEPPING STONES TOWARDS THE FINAL DESIGN. IN THIS CASE, THE PROTOTYPES ARE THROWN AWAY AND THE FINAL PRODUCT IS BUILT FROM SCRATCH. IF AN EVOLUTIONARY PROTOTYPING APPROACH IS TO BE TAKEN, THE PROTOTYPES SHOULD BE SUBJECTED TO RIGOROUS TESTING ALONG THE WAY; FOR THROW-AWAY PROTOTYPING SUCH TESTING IS NOT NECESSARY.