HIGHLY INTERACTIVE ROBOGAMES

PART 1

ANDREA BONARINI
ARTIFICIAL INTELLIGENCE AND ROBOTICS LAB
DEPARTMENT OF ELECTRONICS, INFORMATION AND BIOENGINEERING
POLITECNICO DI MILANO

E-MAIL: andrea.bonarini@polimi.it
URL: http://www.deib.polimi.it/people/bonarini
What is a game?

An activity where two or more agents interact to reach their goals, according to (possibly shared) rules.
GAMES

What is a game?

An activity where two or more agents interact to reach their goals, according to (possibly shared) rules

This wide definition matches most of the current uses and definitions of the term “game”, as entertainment activity, money making (and losing) activity, psychological model (e.g., in Transactional Analysis (Berne)), mathematical models of interactive decision making (Game theory)

Quite a pervasive term ;-)
All entertainment games share the fact that:

- We enter in a *special state* different from real life: “let’s play”
- We play to *have fun* or *satisfaction*
- We *choose* to play
- We consider playing as a *re-creation*, as alternative to work
A SECOND ORDER SET OF AIMS

Entertainment games can also be used to:

- Learn and teach skills and knowledge
- Professional formation
- Rehabilitate
- Exercise
- Prepare for life
- ...

You have to learn the rules of the game, and then you have to play better than anyone else.
What is a Robogame?

An entertainment game where at least one of the players is an autonomous robot.

**Game**
- A set of rules
- Goals
- Roles
- Context

**Players**
- Agree on rules
- Aim at reaching their goals

**Autonomous robot**
- Moves
- Takes decisions according to sensors
  - (World model)
  - (Explicit goal)
  - (Contextual knowledge)

**Human player(s)**
- Would like to have fun
HIGHLY INTERACTIVE ROBOGAMES (HI-RG)

Inter-acting means that different agents perform actions so that each one can perceive (at least some of) what each other is doing, and acts accordingly.

A physical interaction happens when actions modify some physical quantity, e.g., position, light, sound, ... that can be perceived by the partner(s).

When people is involved, these modifications should be perceived by human senses.

If interaction is required along the whole game we have highly interactive robogames.
VIDEOGAMES AND HI-RG

HI-RG extends the experience of videogames in the real world

- Tendency in videogames to make the player *moving* (still in front of a screen)
- HI-RG introduce physical interaction with artificial, autonomous entities, which may occur *anywhere*
- The *real* world is there, while agents are playing in a fictional context
LARP AND HI-RG

Some LARP (Live Action Role-Playing) games are introducing technological objects in the performance

- The *real* world is there
- At present, no robots are involved: objects are remotely controlled, and do not play any character
- Robots might enter also here, becoming real actors
Some electronic devices have been introduced to drive games for children in generic environments, possibly exploiting sound interpretation, artificial vision, gyroscopes and accelerometers, or NFC and RFID

- The *real* world is there
- At present, no robots are involved
- Consoles tell what to do and possibly interact with wearables (bracelets, ...).
- Robots might enter also here, becoming real game companions
TECHNO GAMES AND HI-RG

Sorting hat
HI-RG AS AN HRI FRAMEWORK

- *Clear goal* for the interaction: win the game
- Rules are clear and have to be followed by all players, but each player can do whatever he/she/it wants: *shared, known framework, and freedom*
- The success of interaction can be *objectively* evaluated from game performance and user acceptance
- The “measurable”, ultimate goal of the whole interaction is that human players *enjoy playing*
- There is the need to share and/or *understand behaviors and strategies* for effective interaction
- No *fake* is acceptable
LET’S SEE A FIRST ROBOGAME

Jedi trainer
LET’S SEE ANOTHER ONE

Anki
Differences?

- First person vs. mechanical, tele-operated avatar
- Personal “life threat” vs. performance (or others threat)
- “Comparable” dimension (potentially threatening) vs. much smaller dimension (safe)
- Partially structured vs. completely structured environment
- Wait for event vs. continuous action
- ...

15
ROBOGAME DESIGN

Many aspects to consider to achieve the main goal:

make the player(s) have fun

• *Who?*  => Target player
• *Why?*  => Motivation
• *What?*  => Kind of game
• *Where?*  => Context
• *How?*  => Story, robot performance, rhythm, interaction
TARGET PLAYER

• Players categories by: age, genre, ...

• It is difficult to match the characteristics, skills, mood of a single player:
  • Design a game “good” for a category
  • Dynamic adaptation of parameters
  • Intrinsic adaptation
TARGET PLAYER: AGE

Robotower
Kids
TARGET PLAYER: AGE

Robotower
Teens
TARGET PLAYER: ADAPTATION

Jedi trainer
Scared guy
Without motivation, nobody would play

A player might be motivated to play by:

- **Curiosity**: “What’s happening next?”
- **Competition**: “I’m better than you!” (where “you” might be another player or the robot itself: the “opponent” of the game)
- **Challenge**: “I must succeed!”
- ...


MOTIVATION: CURIOSITY

Curiosity can be induced by:

- **Story**: a sequence of events are expected since the beginning and the player knows that something will happen (intermediate achievements, mentioned characters, mentioned game elements, ...)
- **Character**: the robot shows itself as able to introduce new elements: gestures, key events, abilities, ...
- **Direct challenge**: what-if, requests, ...
MOTIVATION: COMPETITION

Some people is competitive by nature, others might be induced in competition

- Competition *against other human players* (e.g., races, direct or indirect comparison on performance), in the interaction with robot(s)
- Competition *against the robot(s)* (e.g., shoot’em all, direct race, hide-and-seek)
MOTIVATION: CHALLENGE

Challenge is a kind of competition against ourselves to reach a goal which is:

• Clear: a score, a time, a position, a relational action, ...
• Not too difficult: the players should perceive that they can actually reach it
• Not too easy: an easy goal is not a challenge, it is boring
KIND OF GAME

There are many kind of games according to:

• Goal: score, direct competition, challenge, ...
• Category: strategy, skill, ...
• Interaction with robot: direct, through avatars (e.g., a tele-operated robot)
Different kind of games stimulate different aspects (so, they may match different players’ interests):

- Physical skills: muscular force, resistance, speed, precision, ...
- Neuro-physiology: stress, patience, ...
- Cognitive abilities: strategy, planning, forecasting, ...

Each of these is related to specific timing
PHYSICAL STIMULATION

Robowii
PRECISION

Kartbot
COGNITIVE CHALLENGE

RushRace
A part of the context is the real world we play in. It could be:

- an arranged playground, separate from real world (a maze, a race circuit, ...)
- the real world: a sleeping room, a corridor, augmented with elements of the game, possibly delimited
- just the real world

Of course, from the robot point of view, the difficulties are different ;-)
CONTEXT: SEMI-STRUCTURED

Drone laser game
CONTEXT: STRUCTURED

Pac-Bot
CONTEXT: UNSTRUCTURED

R.GAML
The story frames the game and provides the metaphor for this design activity.

Metaphor is needed to give the players a “hook” to what is familiar, so to reassure them.

It may:

• Introduce and share the goal
• Motivate to play
• Define the relationships, as a script
• Help to “enter” in the game (Flow (Csikszentmihalyi))
ROBOT PERFORMANCE

The robots should be credible in their role play

They have to:

• Be reliable
• Follow the rules
• Behave coherently with their role and goals
• Be perceived as rational agents

The game should be designed to keep into account the limitations of the available robots
RHYTHM

Rhythm is important

• It may provide emotional structure to the interaction
• Functional constraint: the player should have the time to understand and (re)act
• Wrong timing may kill the game
TIMING AND RELATIONSHIP

- Opponent behavior detection time
  - How long does it take to understand how the robot is playing?
- Credibility
  - Timing of the action coherent with the story
- Activity pace
  - “Let’s take a breath” ↔ “We are not here to sleep”
- Subjective time
  - Perception of time altered by the context
RHYTHM AND TIMING

Robowii 2.0

Stage 3: Robot wins, reaching home after recharging its energy at the red cone.
INTERACTION

Players and robots interact in the game

To *play is the aim* of the interaction

Effective interaction: channels, content, effect, ...

- Interaction channels: sound, voice, movement, light...
- Content is related to the need for interaction in the story
- Effect: the interaction has a goal that should be achieved. Possible failures have to be detected and managed.
NICE...

... but what’s wrong as a robogame?

(actually, it was designed as a “useless machine”, so don’t blame the designers)