PlayPhysics:

Emotional games learning environment for teaching Physics

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Outline

- Aims & objectives
- Background & literature review
- Project proposal
- Methodologies & software analysis
- *PlayPhysics* design
- Relation to other work
- Project plan
- Conclusion

Aims & objectives

- Aim: To investigate new generation of adaptable affective ITS
- Explore Natural Language Processing (NLP), facial gestures, narrative progression, goal attainment or selection of colours for affective modelling
- Development of enhanced student model & adaptable tutor model using AI techniques, e.g. Bayesian networks, HMMs & influence diagrams
- Implement & test Develop *PlayPhysics* serious game virtual learning environment utilising Olympia architecture

Background & literature review

- VLEs
  (Du Boulay & Luckin, 2001;Sarrafzadeh et al., 2008)
- Educational games (Conati, 2002; Sykes, 2006)
- Affective computing & gaming
  (Picard, 1995; Barsalou et al., 2007; Sykes, 2006)
- Recognising emotion & personality using AI
  (Ekman & Friesen, 1978; Ortony et al., 1990; Conati, 2002; Abrahamian et al., 2004)
- Affective intelligent tutoring systems (Sarrafzadeh et al., 2008)
- Empathic feedback & pedagogical agents
  (Dias et al., 2006; Conati, 2002; Du Boulay & Luckin, 2001; D'Mello et al., 2008)

Project Proposal

- Aim: To investigate new generation of adaptable affective ITS
- Implement enhanced student model & adaptable tutor model
- Model student's personality, emotions & game modulation
- Select AI techniques, e.g. probabilistic models & emotion recognition
- Implement & test *PlayPhysics* serious game virtual learning environment utilising Olympia architecture

Project proposal

- Hypothesis

Precise comprehension

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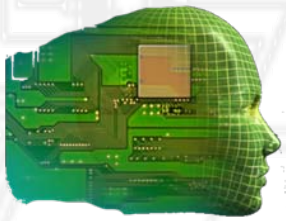

Cognitive feedback

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Significant effect on student's learning

- Research methodology

Olympia
- Student & tutor models

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PlayPhysics
- Control & experimental groups

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Questionnaires
- Quantitative & qualitative

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Results
- Statistical analysis

PlayPhysics design

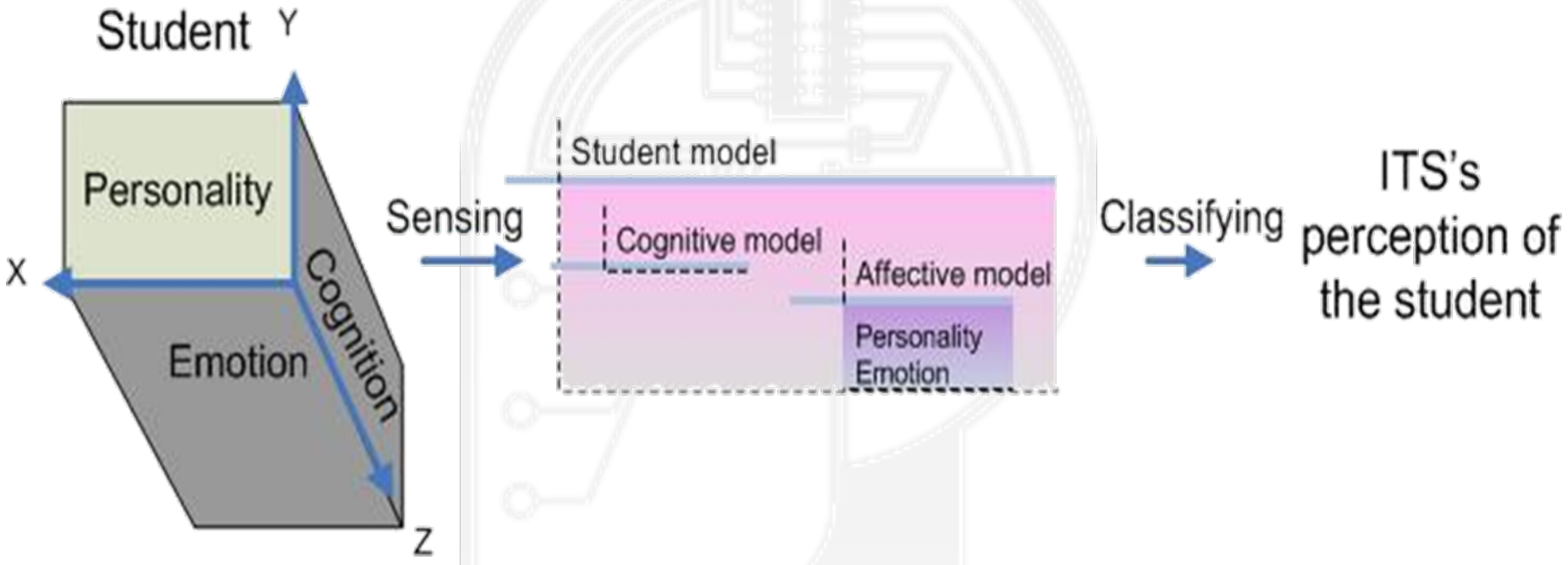

Figure A.1. Enhanced student model

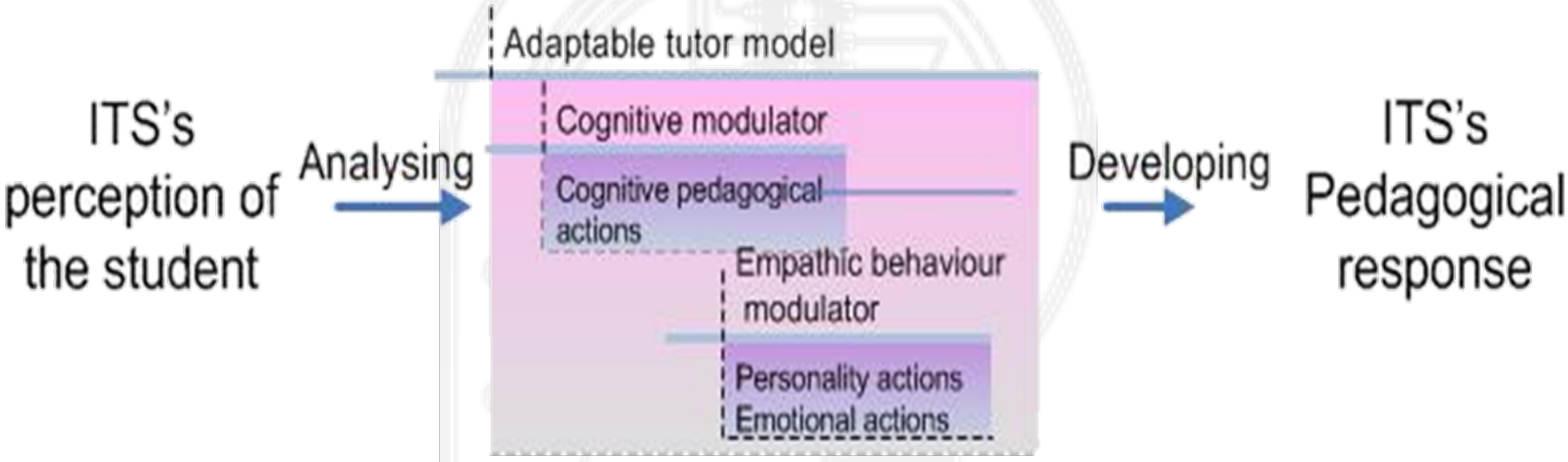

Figure A.2. Adaptable tutor model

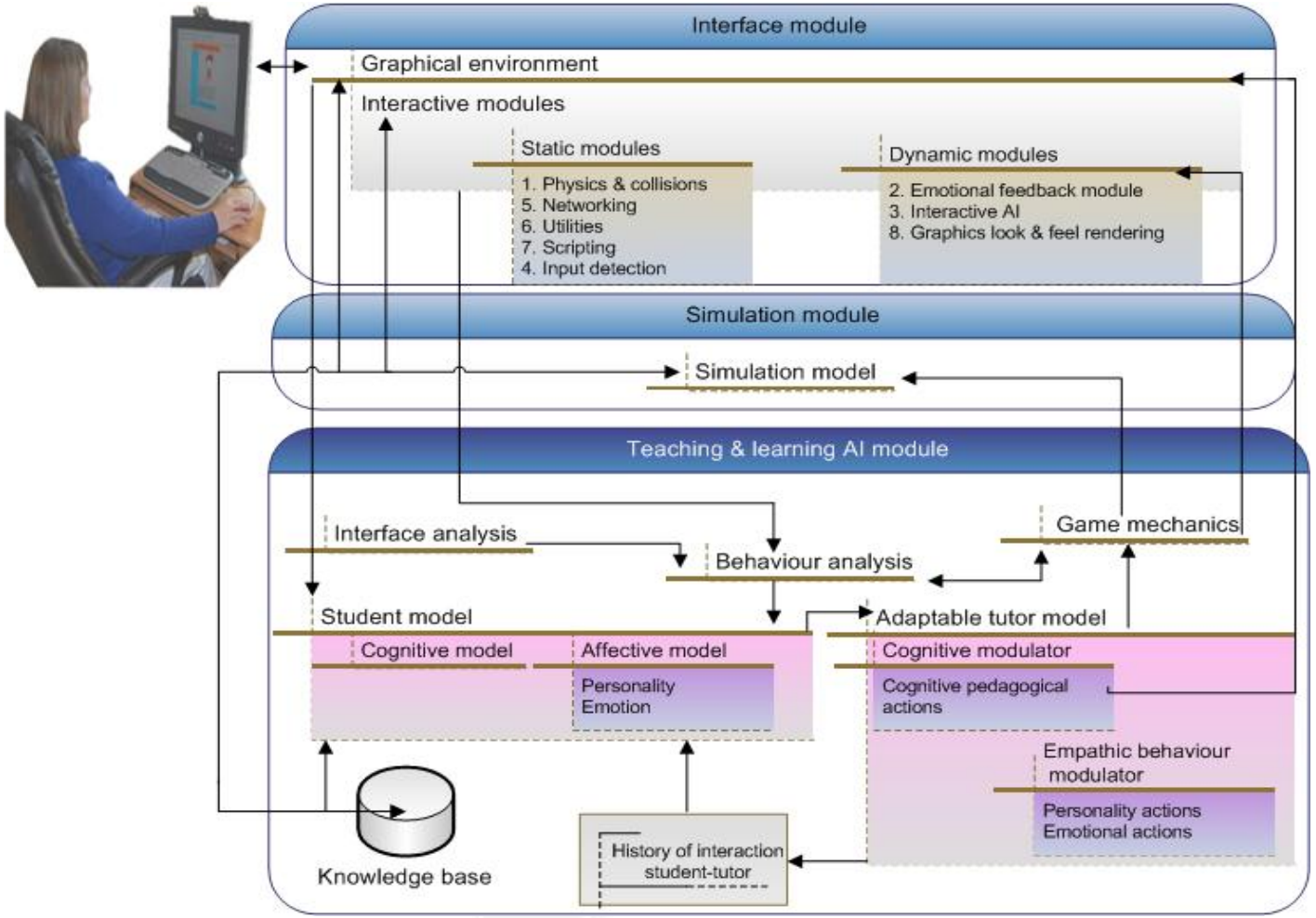

Figure A.3. Architecture of PlayPhysics

Methodologies

Web-based learner-centred paradigm
(Du Boulay & Luckin, 2001)

Constructionist Design Methodology
(Thórrison et al., 2004)

First Principles method
(Bateman & Boon, 2006)

Expert teachers & psychologists
(Du Boulay & Luckin, 2001)

Software analysis

Myers-Briggs & DGD1

OCC model

Elvira, Hugin Lite & JAHMM

Psyclone

UML

MySQL

JAVA

Relation to other work

Application	Research Reference	Tutoring modeling		Education technologies		Teaching subject	Teaching strategy	Emotion detection modalities	Detection of personality aspects	Online	Feedback resource			AI technique to recognise emotions	AI technique to adapt feedback
		ITS[6]	IA[5]	Educational game	VLE[7]						Game modulation	Pedagogical agent	Synthetic characters		
Prime Climb	Conati (2002)	✓	×	✓	×	Maths	GBL[2], Learning by doing, collaborative learning, learning by teaching	Biometrics	×	×	×	✓	×	Influence diagram	Production rules
Fear Not!	Dias et. al (2006)	×	✓	×	✓	Personal, social & health education	Collaborative learning & dynamic narrative	×	×	✓	×	×	✓	×	Agents architecture
EMASPEL	Neji & Ben Ammar (2007)	×	✓	×	✓	Communications technology	Learning by teaching, learning by observation & collaborative learning	facial gestures	×	✓	×	✓	×	Multi agent system	Tutoring agent
Easy with Eve	Sarrafzadeh et. al (2008)	✓	×	×	✓	Maths	PBL[1], enquiry, collaborative learning, learning by teaching,	facial gestures & body language	×	✓	×	✓	×	ANN[3]	Case-based reasoning
AutoTutor	D'Mello et. al (2008)	✓	×	×	✓	Newtonian Physics	PBL[1], learning by teaching, enquiry, learning by observation	natural language, facial gestures & body language	×	×	×	✓	×	Supervised learning methods	Production rules
PlayPhysics	Muñoz et. al (2008- 2011)	✓	×	✓	✓	Physics	PBL[1], GBL[2] & learning by observation	natural language, facial gestures, narrative progression, goals definition or selection of colours	✓	✓	✓	✓	×	HMM[4] or Bayesian network or influence diagram	HMM[4] or Bayesian network or influence diagram

Project plan

Milestones
Designing, testing and deploying phases
Data collection
Experimentation
Background and focal theory
Writing up thesis
Publications
Research training program

Activities	2008	2009				2010				2011		
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep
Literature Review: Background and focal theory												
Research development program												
100 Day Review report and viva												
Applying for ethical approval												
39th Annual Conference, Frontiers in Education (FIE)												
IEEE Transactions on Learning Technologies - Journal Transactions on education												
Preparing a survey to find functional and non-functional requirements and justify the execution of the research												
Applying the survey												
International Symposium of Electronic Arts (ISEA 09)												
Irish Conference on Artificial Intelligence and Cognitive Science (AICS 09)												
Selecting the tools to develop the web application												
Selecting the tools to develop the 3D design of the educational game												
Selecting the tools to manage and produce sound												
Selecting the tools and methodologies to recognise aspects of emotion												
Selecting the tools and methodologies to recognise aspects of personality												
Selecting the AI tools to implement the enhanced student and adaptable tutor model												
Testing the viability of the research work by carrying a pilot study												
Designing PlayPhysics												
Planning publications for the next doctorate year												
Confirmation report and viva												
2nd year poster presentation												
Developing PlayPhysics												
Testing and deploying the PlayPhysics												
Experimentation over the subject sample												
Data collection and analysis												
3rd year presentation												
Writing up thesis												
Submission of thesis												

Conclusion

- Computer based tutoring ≈ one-to-one human tutoring
- New generation of affective adaptable ITSs
- Enhanced student representation & adaptable tutor models
- Student's personality & emotion & modulation of educational game
- Reflection – affinity seeking strategies
- Hypothesis: Positive influence on student's learning
- Implement &test PlayPhysics system

Questions