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HSI 2010 Conference Programme

	1st Conference room	2nd Conference room
	May 13, 2010	
8:00-8:15	**Opening ceremony**	
8:15-9:00	**Keynote lecture: Prof. Ryszard Tadeusiewicz "*Speech in Human System Interaction*"**	
9:00-9:30	**Coffee break**	
9:30-12:30	**Artificial Intelligence**	**Special Session: *Accessing, Structuring, Analyzing and Adapting Information in Web 2.0***
09:30	Adam Grzech and Agnieszka Prusiewicz. *Services Merging and Splitting in Systems Based on Service Oriented Architecture Paradigm*	Giuseppe Russo, Arianna Pipitone and Roberto Pirrone. *Semantic Sense Extraction From Wikipedia Pages*
09:45	Andrzej Pulka and Adam Milik. *Hardware model of commonsense reasoning based on Fuzzy Default Logic*	Antonina Dattolo, Felice Ferrara and Carlo Tasso. *The role of tags for recommendations*
10:00	Alexander Rotshtein and Hanna Rakytyanska. *Multiple-Inputs Multiple-Outputs Object Identification based on Fuzzy Relations and Genetic Algorithm*	Aravind Chandramouli, Susan Gauch and Joshua Eno. *A popularity-based URL ordering algorithm for crawlers*
10:15	Ciprian-Radu Rad, Milos Manic, Radu Balan and Sergiu-Dan Stan. *Real time evaluation of inverse kinematics for a 3-RPS medical parallel robot usind dSpace platform*	Angelo Di Iorio, Alberto Musetti, Silvio Peroni and Fabio Vitali. *Crowdsourcing semantic content: a model and two applications*
10:30	Jan Andreasik, Andrzej Ciebiera and Sławomir Umpirowicz. *ControlSem – distributed decision support system based on Semantic Web technologies for the analysis of the medical procedures*	Mirco Speretta, Susan Gauch and Praveen Lakkaraju. *Using CiteSeer to Analyze Trends in the ACM's Computing Classification System*
10:45	Bohdan Kozarzewski. *A Neural Network Based Time Series Forecasting System*	Luca Mazzola, Davide Eynard and Riccardo Mazza. *GVIS: a framework for graphical mashups of heterogeneous sources to support data interpretation*
		Special Session: *Human System Interaction and Wireless Sensor Networks*
11:00	Tiberiu Alexandru Antal and Adalbert Antal. *The use of genetic algorithms for the design of mechatronic transmissions with improved operating conditions*	Daniele Alessandrelli, Paolo Pagano, Christian Nastasi, Matteo Petracca and Aldo Franco Dragoni. *MIRTES: MIddleware for Real-time Transactions in Embedded Systems*
11:15	Yewei Tao and Xia Sun. *A Biometric Identification System Based on Heart Sound Signal*	Philipp Gorski, Frank Golatowski, Ralf Behnke, Christian Fabian, Kerstin Thurow and Dirk Timmermann. *Wireless Sensor Networks in Life Science Applications*
11:30	Andrzej Burda and Zdzisław S. Hippe. *Uncertain Data Modeling: The Case of Small and Medium Enterprises*	Orazio Mirabella, Michele Brischetto and Giuseppe Mastroeni. *MEMS based Gesture Recognition*
11:45	Yajun Wang and Qiunan Meng. *Application of CBR for Activity-Based Cost Estimation in Steel Enterprises*	Pablo Lopez-Matencio, Javier Vales-Alonso, Francisco J. González-Castaño, Jose L. Sieiro-Lomba and Juan J. Alcaraz-Espin. *Ambient Intelligence Assistant for Running Sports Based on k-NN Classifiers*
12:00	Shuyun Jia and Jiang Chang. *Design and implementation of MAS in renewable energy power generation system*	Giancarlo Iannizzotto, Francesco La Rosa and Lucia Lo Bello. *A wireless sensor network for distributed autonomous traffic monitoring*
12:15	GuoQing Yin and Dietmar Bruckner. *Daily Activity Learning from Motion Detector Data for Ambient Assisted Living*	
12:30-13:30	**Lunch**	
13:30-15:45	**Artificial Intelligence**	**Special Session: *HSI for Monitoring Elders and Disabled at Home***
13:30	Zbigniew Szymański and Marek Dwulit. *Improved nearest neighbor classifier based on local space inversion*	Tomasz Kocejko, Jerzy Wtorek, Adam Bujnowski, Jacek Ruminski, Mariusz Kaczmarek and Artur Polinski. *Authentication for elders and disabled using eye tracking*
13:45	Kevin McCarty, Milos Manic and Shane Cherry. *A Temporal-Spatial Data Fusion Architecture for Monitoring Complex Systems*	Jacek Rumiński, Jerzy Wtorek, Joanna Rumińska, Mariusz Kaczmarek, Adam Bujnowski, Tomasz Kocejko and Artur Poliński. *Color transformation methods for dichromats*
14:00	Szymon Chojnacki. *Optimization of Tag Recommender Systems in a Real Life Setting*	Piotr Augustyniak. *Complementary application of house-embedded and wearable infrastructures for health monitoring*
14:15	Mircea Coman, Sergiu-Dan Stan, Milos Manic and Radu Bălan. *Application of distance measuring with Matlab/Simulink*	Adam Bujnowski, Jerzy Wtorek, Mariusz Kaczmarek, Tomasz Kocejko and Jacek Rumiński. *Estimation of activity parameters by means of domestic media consumption analysis*
14:30	Ersin Kaya, Bulent Oran and Ahmet Arsalan. *A Rough Sets Approach for Diagnostic M-Mode Evaluation in Newborn with Congenital Heart Diseases*	Andrzej Sluzek and Mariusz Paradowski. *A Vision-based Technique for Assisting Visually Impaired People and Autonomous Agents*
14:45	Mehmet Hacibeyoglu and Ahmet Arsalan. *Reinforcement Learning Accelerated with Artificial Neural Network for Maze and Search Problems*	Jerzy Wtorek, Adam Bujnowski and Magdalena Lewandowska. *Simultaneous monitoring of heart performance and respiration activity*
15:00	Karol Przystalski, Leszek Nowak, Maciej Ogorzałek and Grzegorz Surówka. *Semantic Analysis of Skin Lesions Using Radial Basis Function Neural Networks*	
15:15	Radu-Emil Precup, Sergiu Viorel Spataru, Mircea-Bogdan Radac, Emil Petriu, Stefan Preitl and Claudia-Adina Dragos. *Model-based Fuzzy Control Solutions for a Laboratory Antilock Braking System*	
15:30	Izabela Rejer. *How to Secure a High Quality of an Expert Fuzzy Model*	
15:45-16:00	**Coffee break**	
16:00-17:30	**Telemedicine and e-Health**	**Special Session: *Designing Scada Systems in Industry (DESSI)***
16:00	Francesco Cardile, Giancarlo Iannizzotto and Francesco La Rosa. *A Vision-Based System for Elderly Patients Monitoring*	Igor Nai Fovino, Marcelo Masera, Luca Guidi and Giorgio Carpi. *An Experimental Platform for Assessing SCADA Vulnerabilities and Countermeasures in Power Plants*
16:15	Marek Jaszuk, Grażyna Szostek and Andrzej Walczak. *Ontology Building System for Structuring Medical Diagnostic Knowledge*	Salvatore Cavalieri, Giovanni Cutuli and Salvatore Monteleone. *Evaluating Performance of OPC UA Communication*
16:30	Elena Zaitseva. *Reliability Analysis Methods for Healthcare system*	Pere Ponsa, Ramon Vilanova, Alex Perez and Bojan Andonovski. *SCADA Design in Automation Systems*
16:45	Takumi Kato, Noppadol Maneerat, Ruttikorn Varakulsiripunth, Satoru Izumi, Hideyuki Takahashi, Takuo Suganuma, Kaoru Takahashi, Yasushi Kato and Norio Shiratori. *Provision of Thai herbal recommendation based on an ontology*	Jacek Pieniążek. *Adaptation of the display dynamics for monitoring of controlled dynamical processes*
17:00	Thomas Maier, Thomas Meschede, Gero Strauss, Tobias Kraus, Andreas Dietz and Tim C. Lüth. *Joystick Control with Capacitive Release Switch for a Microsurgical Telemanipulator*	**Workshop on Cognitive Sensor Fusion:** Gines Benet, José E. Simó, Gabriela Andreu-García, Juan Rosell and Jordi Sánchez. *Embedded Low-Level Video Processing for Surveillance Purposes*
17:15	Alice Ravarelli and Roberto Pazzaglia. *Analyzing Text Comprehension Deficits in Autism with Eye Tracking: A Case Study*	
18:00	**Departure to Conference Welcome Party - Campus in Kielnarowa**	
18:30-21:00	**Conference Welcome Party - Campus in Kielnarowa**	

HSI 2010 Conference Programme

	1st Conference room	2nd Conference room
	May 14, 2010	
8:00-9:30	**Keynote lectures: Dr. Yasuhiro Ota *"Toyota Partner Robots - From Development to Business Implementation"*, Prof. Paweł Strumiłło *"Electronic Interfaces Aiding the Visually Impaired in Environmental Access, Mobility and Navigation"***	
9:30-10:00	**Coffee break**	
10:00-13:00	**Human-Centered Design**	**Human Machine Interaction**
10:00	Ivo Maly, Zdenek Mikovec and Jan Vystrcil. *Interactive Analytical Tool for Usability Analysis of Mobile Indoor Navigation Application*	Akinori Sasaki, Hiroshi Hashimoto, Sho Yokota and Yasuhiro Ohyama. *Image-Based Finger Pose Measurement for Hand User Interface*
10:15	Rita Wong, Norman Poh, Josef Kittler and David Frohlich. *Towards Inclusive Design in Mobile Biometry*	Yasin Guven and Duygun Erol Barkana. *Bone Cutting Trajectory Generation using a Medical User Interface of an Orthopedical Surgical Robotic System*
10:30	Avid Roman Gonzalez. *System of Communication and Control Based on the Thought*	Krzysztof Skabek, Marek Francki and Ryszard Winiarczyk. *Implementation of the View-Dependent Progressive Meshes for Virtual Museum*
10:45	Junko Ichino, Tomohiro Makita, Shun'ichi Tano and Tomonori Hashiyama. *Support for Seamless Linkage between Less Detailed and More Detailed Representations for Comic Design*	Daisuke Chugo, Hajime Ozaki, Sho Yokota and Kunikatsu Takase. *Seating Assistance Control for a Rehabilitation Robotic Walker*
11:00	Marco Porta and Alice Ravarelli. *Eye-Based User Interfaces: Some Recent Projects*	Peter Nauth. *A Method for Goal Understanding and Self Generating Will for Humanoid Robots*
11:15	Ding-Hau Huang and Wen-Ko Chiou. *The effect of using visual information aids on learning performance during large scale procedural task*	Tomasz Zabinski and Tomasz Mączka. *Human System Interface for Manufacturing Control - Industrial Implementation*
11:30	Ersin Karaman, Yasemin ÇETI.N and Yasemin Yardimci. *Angle Perception on Autostereoscopic Displays*	Ryo Saegusa. *Visuomotor coherence based robot hand discovery*
11:45	Wen-Ko Chiou, Ming-Hsu Wang and Chien-Yu Peng. *Landmark effect in digital human model simulation tasks by using the biomorphic tool*	Stefan Sieklicki, Wiktor Sieklicki and Marek Kościuk. *Mobile wireless measurement system for potatoes storage management*
12:00	Pawel Rozycki and Janusz Korniak. *The influence of the control plane mechanisms on the quality of services offered by the GMPLSnetwork*	Leon Palafox and Hideki Hashimoto. *Human Action Recognition using 4W1H and Particle Swarm Optimization Clustering*
12:15		
12:30-13:30	**Lunch**	
13:30-15:00	**Cyber Security**	**Special Session: *Modeling the Mind***
13:30	Teresa Mendyk-Krajewska and Zygmunt Mazur. *Problem of Network Security Threats*	Heimo Zeilinger, Andreas Perner and Stefan Kohlhauser. *Bionically Inspired Information Representation Module*
13:45	Igor Ruiz-Agundez, Yoseba K. Penya and Pablo García Bringas. *Optimal Bayesian Network design for efficient Intrusion Detection*	Roland Lang, Stefan Kohlhauser, Gerhard Zucker and Tobias Deutsch. *Integrating Internal Performance Measures into the Decision Making Process of Autonomous Agents*
14:00	Zhi-Ming Yao, Xu Zhou, Er-Dong Lin, Su Xu and Yi-Ning Sun. *A Novel Biometric Recognition System based on Ground Reaction Force Measurements of Continuous Gait*	Dietmar Dietrich, Roland Lang, Dietmar Bruckner, Georg Fodor and Brit Müller. *Limitations, Possibilities and Implications of Brain-Computer Interfaces* **Special Session: *Human Sensory Factors and Their Applications***
14:15	Ivan Enrici, Mario Ancilli and Antonio Lioy. *A Psychological Approach to Information Technology Security*	Mitsuki Kitani, Tatsuya Hara, Hiroki Hanada and Hideyuki Sawada. *A taking robot for the vocal communication by the mimicry of human voice*
14:30		Sho Yokota, Hiroshi Hashimoto, Yasuhiro Ohyama, Jin-Hua She, Daisuke Chugo and Hisato Kobayashi. *Classification of Body Motion for Human Body Motion Interface*
14:45		Seiji Hata, Daisuke Nakatani and Junichiro Hayashi. *Detection of Buildings in Observing Images Using Map Information*
15:00-15:30	**Coffee break, arrangement of poster session**	
15:30-17:00	**Poster Session will perform in the upper stair case. All Authors are kindly requested to be present in vicinity of their posters**	**Workshop on Cognitive Sensor Fusion:** Dietmar Bruckner and Gerhard Zucker
17:30	**Departure to Gala Dinner - Lancut Castle**	
18:00-22:00	**Gala Dinner - Lancut Castle**	
	May 15, 2010	
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09:30-11:00	**Education and Training**	**Special Session: *Computational Intelligence in Human Activity***
09:30	Leonidas Deligiannidis and Erik Noyes. *Visualizing Creative Destruction in Entrepreneurship Education*	Krzysztof Pancerz and Zofia Matusiewicz. *Prediction with Temporal Rough Set Flow Graphs: the Eigen Fuzzy Sets Perspective*
09:45	Joanna Marnik, Sławomir Samolej, Tomasz Kapuściński, Mariusz Oszust, Marian Wysocki, Piotr Szczerba and Przemysław Ogorzałek. *Computer Vision and Graphics Based System for Interaction with Mentally and Physically Disabled Children*	Thierry Luhandjula, Karim Djouani, Yskandar Hamam, Ben van Wyk and Quentin Williams. *A hand-based visual intent recognition algorithm for wheelchair motion*
10:00	Katarzyna Haręźlak and Aleksandra Werner. *Extension of the MOODLE e-learning platform with database management mechanisms*	Edy Portmann, Aliaksei Andrushevich, Rolf Kistler and Alexander Klapproth. *Prometheus - Fuzzy Information Retrieval for Semantic Homes and Environments*
10:15	Claudia-Adina Dragos, Stefan Preitl, Radu-Emil Precup and Emil M. Petriu. *Magnetic Levitation System Laboratory-based Education in Control Engineering*	Jerzy Gomuła, Wiesław Paja, Krzysztof Pancerz and Jarosław Szkoła. *A preliminary attempt to rules generation for mental disorders*
10:30	Cagin Kazimoglu, Mary Kiernan and Elizabeth Bacon. *Enchanting E-learning through the use of interactive-feedback loop in digital games*	
11:00	**Closing of the 3rd Human System Interaction Conference**	
12:00-13:00	**Lunch**	

Integrating Internal Performance Measures into the Decision Making Process of Autonomous Agents

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Abstract. **Integrating performance measures into the process of decision making of an autonomous agent is a common method in artificial intelligence. Reinforcement learning is one possible application that can be realized with this methodology. Recent findings in artificial intelligence showed the importance of the body and the tight connection to the decision making processes. This article introduces a model for integrating internal performance measures into such a decision making process. The introduced theory is based on psychoanalytical concepts that are technically specified and realized in a virtual robot, situated within a simulated environment. Furthermore, it is shown how the concept can be applied to already existing cognitive architectures and their implementations, such as the BDI (Belief-Desire-Intention) architecture. The results show the dynamics in decision making that become possible with the newly applied performance measures.**

***Keywords*: artificial intelligence, bionic approach, decision making, psychoanalysis, reasoning unit**

I. Introduction

TECHNICAL systems today face the challenge of increasing complexity, both in available data sources and in processing algorithms. Engineers shall optimize system towards many different goals: In building automation we want a high level of comfort in climate and lighting, low energy consumption with a high share of renewable energy sources, and of course safety for both the building and the inhabitants. All these goals are partially contradicting and require a high degree of interconnection to master a global optimal solution. Fine grained interconnection, on the other hand, makes it difficult to control and maintain the system, because changes in one subsystem may have unintended effects on other subsystems. Thus we see the need to find new ways of controlling complex systems and have found an approach in interdisciplinary cooperation with sciences, who are experts at describing the most complex control system that we know of: the human mind. The findings of psychoanalysis, neurology and its novel combination neuropsychoanalysis can support engineers a great deal to understand how the human mind works and help us to create complex technical systems that employ their principles. This way we enable engineering to handle system complexity, which is unavoidable if we want to take, for example, building automation to the next level.

Research at the Institute of Computer Technology, Vienna University of Technology has yielded interesting results in the cooperation with psychoanalysts, neurologists and neuropsychoanalysts [1]. An outcome of the last years has been a functional model of the human psyche that is derived from Sigmund Freuds second topographical model and adapted to technical systems. This model clearly showed the advantage of psychoanalysis over other psychological disciplines: The focus is on the functional description and not on the output of a system, i. e. its behavior. While there are many disciplines that follow a behavioristic approach (that is, observing a system and deducing functions that create this behavior) psychoanalysis has a clear description of the different functions that make up the human psyche. Behavior is not explained by claiming the existence of modules that create the behavior, but by the sum of all system elements.

In this paper we focus on a specific part of the model that has been created at Vienna University of Technology. A description of the complete model can be found in [2]. In [3], the model was investigated with respect to its minimal parts that are necessary to construct a running decision unit. In this article, we focus on the possibility of integrate agent-internal performance measures into the implementation of the model and thus make way for a different, more dynamic way of decision making.

The rest of the paper is organized as follows: section 2 gives an overview of existing approaches with a focus on BDI architectures (Belief-Desire-Intention); section 3 describes the parts of the model, which are relevant for this publication; in section 4 we concentrate on the technical system that resulted from the translation of the neuropsychoanalytic model into a technical implementation; finally, section 5 sums up the paper and gives conclusions and outlook.

II. State of the Art

Decision making is one of the main topics in agent based modeling. There exist various architectures that were designed to handle the process of decision making in order to deduce an action out of the current perceptions

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and a stored world model. One possible approach for designing agents is to use the BDI architecture. In this article, the BDI architecture is used to show the integration of the introduced concept into this existing architecture as an example. In the following paragraphs, the BDI architecture shall be briefly discussed. It provides practical reasoning by defining what is to be accomplished and how it should be done. The fundamental work for BDI-agents was done by Bratman [4], who defined the theoretical background, and Georgeff [5], who implemented a first practical application. The BDI-architecture is supposed to provide means-end-reasoning and the weighing of alternative actions. This should happen under the restriction of bounded resources. This restriction calls for solutions which constraint the amount of necessary reasoning the agent has to do.

The BDI architecture consists of three basic components, which define the state of the agent:

- *Believes:* These are the facts the agent knows about the world, which are stored in a database. This knowledge is the basis for all further decisions and planning.
- *Desires:* The agent has specified goals which he wants to achieve. They provide a reason for him to get active. What goals he wants to pursue in a situation is decided dynamically.
- *Intentions:* These are plans which are either actually adopted or are stored as plans-as-recipes that the agent knows about. They provide action sequences in order to achieve a goal or how the agent should react to a certain situation.

An agent needs the ability to sense his environment in order to interact with it. Implementations of the BDI architecture are using belief revision, described in more detail in [6]. The perceptions and the knowledge of the agent are used to update the agent's knowledge about the world. The knowledge about the current situation is used to determine what actions are possible for the agent. The possible actions are used to determine what desires of the agent can be pursued. These desires represent the goals of the agent, which are predefined and activated according to the external perception. The subset of realizable desires is called options. One of these options, which seem most promising for reaching the goal, is selected.

A database is used to store all the plans the agent is able to use. These are the intentions an agent can have structured into plans. Once the current goal is defined, the agent adopts one of these plans which becomes his current intention. The process of creating an intention from his knowledge, possible actions and personal preferences is called deliberation. Once the deliberation process has selected an intention for execution this intention can be refined under the consideration of the agent's knowledge. This allows the definition of sub goals, which can be handled in a similar way as the superior goals. This process can be continued until a single action is selected, which the agent can actually execute. In order to adapt to changes and uncertainty the agent uses partial plans. The plans can be temporally partial, so an action can be used at some occasions but not on others. Structural partiality means making decisions that are necessary at the moment and postponing decisions which are not immediately important. The agent only stops, if his goal is reached, the goal seems not reachable anymore or the intention becomes obsolete. The process of finding a plan from believes, desires and intentions is widely used for agents. A central characteristic of an agent is to be autonomous. However, BDI agents usually hold believes, desires, and intentions, which are predefined by the system designer. This makes the decisions of the agent strongly dependent. They can be generated dynamically, however concepts are still missing that define the process of such a generation. A model for integrating an intrinsic motivation, which influences the agent's plans and actions is still missing. Therefore, in the following sections a model, inspired by concepts of psychoanalytical metapsychology, will be introduced and it will be shown how it can be realized and used within the decision unit of an agent.

III. Model

The project ARS (Artificial Recognition System) founded at the Institute of Computer Technology (Technical University of Vienna) is searching for new, efficient methods of processing and interpreting data and decision making in order to react. A first, functional model was introduced in [2], that covers the processes of perception, decision making, and acting. It is based on the theory of psychoanalytical metapsychology. In a top down design process, described in more detail in [7], the three functional instances of the human psyche as described in the second topographical model (namely the Id, Ego, and Super-Ego) are sub-divided into their specific functions. These functions were technically specified with respect to a computational implementation. The entire functional model includes three different types of symbolic inputs: environmental, bodily, and homeostatic. Environmental input represents perceived symbolic data from the environment. A video camera of a robot that is able to recognize objects in the pictures would be one example of a sensor. A typical bodily input would be the position of a robot arm. The focus of this article lies on the homeostatic inputs. An autonomous agent, such as a robot, may be able to measure the energy level of its battery pack - an essential criteria for determining the possible working time until the robot has to connect to the next power supply. A typical example, where this scenario has to be considered is the vacuum cleaner Roomba, first developed on the MIT by the team of R. Brooks and now sold by the iRobot Corporation. Other internal values that can be measured are e.g. current CPU-load, internal network-traffic, or temperature and average activation of pin joints. Terms, that are very distant to the object of investigation in psychoanalysis: a human. In the following paragraphs, the model therefore will be first described with respect to a human rather than a technical device like a robot. A typically sensed homeostatic value would be the more or less intense feeling of hunger. It will be used to describe the psychoanalytical theory first. With the described functionality, the following chapter will introduce one possible implementation and shows its advantages.

The central element in the model is the drive. It is, according to Freud [8, p. 122] a pivotal element of the psychoanalytical mediation process between the outside world and the needs of the organism. The origin of the drive therefore lies within homeostasis and the organs of the human body. A drive is the first psychic representative of the demands of the bodily organs and signals a bodily need. Organic processes from the body of the individual are transferred into psychic processes and are represented by a structure called drive. The drive representation consists of occurrences of two main components: the thing presentation and the affect. Thing presentations are containing qualities and are able to describe the origin of the psychic representation in a more abstract form. As shown in the next chapter, these thing presentations can be technically treated as symbols originated from symbolized sensor data. Thing presentations of a drive contain information of its content (the origin of the bodily tension itself is not accessible, but conclusions can be drawn [8, p. 122] during the deliberation process). The affect holds the information of the amplitude of the tension -- the quantity. The higher the tension within a bodily origin, the greater the affect that quantifies the corresponding thing presentation. However, the concept of drives is defined in a more complex fashion in metapsychology. According to [8, p. 122], a drive additionally consists of (or is at least closely associated with) the following drive-contents that are each represented in a corresponding thing presentations:

The *source of the drive* represents the organ that is generating the bodily tension and is not accessible in the psyche.

The *aim of the drive* is to reduce the tension of the bodily organ but can be reached in different ways.

The *object of the drive* is the necessary object that reduces the tension of the organ.

Depending on the actual situation, the drive object and the aim of the drive can be changed during the psychic processes of decision making. In psychoanalysis, drives are not classified according to their originating organ (which is not accessible during the mental processes) but according to their *drive contents*.

Drive contents can be differentiated regarding their constructive and destructive content. To nourish, repress, sleep, breath, relax or reproduce are typical constructive drive contents and are representatives of the so called *life instinct* or *libido*. To bite, excrete, kill, regress, disintegrate, halt and retreat are examples for destructive drive contents and are representatives of the so called *death instinct*. In our example of feeling hungry, the libidinous drive is ‘to nourish’ whereas the corresponding aggressive drive is ‘to bite’. Both drives are tightly connected to each other and are always represented. Without any aggressive component, we would not be able to bite into an apple in order to nourish our selves. On the other hand, a human individual would be dead without any libidinous component left. Together, the drive for ‘nourish’ and the drive for ‘bite’ constitute a pair of opposites [8, p. 127].

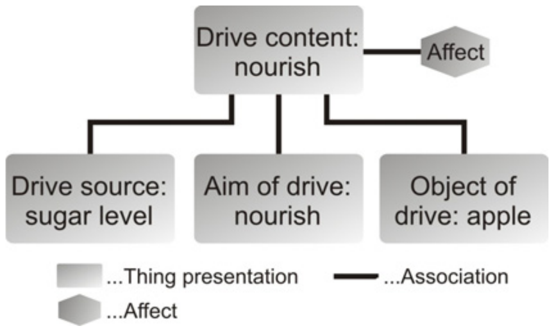

Fig. 1. Data structure of a drive that represents: nourish

Based on this definition, the drive can be considered a data structure that holds the information of its drive content directly in the form of a thing presentation for qualification and an attached affect for quantification. Additionally, it is attached to one or more thing presentations representing appropriate drive objects or aim-actions that can reduce the tension. Figure 1 shows the constellation of one drive (nourish) including its data structure.

The quantification of the affect is the level of displeasure caused by the corresponding bodily urges. A decrease of displeasure results in an increase of pleasure. Although it is widely accepted that the spectrum of affects is more diverse [9, p. 65], in this concept additional information is always contained within the combination of an affect and a thing presentation (or also a word presentation in the case of pre-consciousness or consciousness, that is not the case in this lower part of the described model). In connection with a thing presentation, affects can cover all these constructs, therefore within this article the authors will not use the term emotion or feeling. Following a neuro-psychoanalytical approach presented, affects have their origin in both, the body in the form of drives as well as the environment in the form of being part of the perception through the body. They are intimately related to bodily, yet unconscious experience of the changes in our environment and represent the most basic evaluation of incoming sensory stimuli. This circumstance makes it necessary to extend the above described concept of the affect. Instead of holding only information regarding the level of displeasure caused by the tension of a bodily organ, the construct also has to deal with the gain in pleasure that is connected to an environmental object that satisfies the respective drive and therefore reduces the tension. Therefore, affects that reflect the tension of a bodily organ represent only the level of displeasure, while affects associated with environmental sensations can contain either a level of pleasure or displeasure.

Artificial intelligence (AI) and cognitive science also realize the importance of emotional evaluation in perceptual systems of reasoning units, in particular regarding autonomous embodied agents. In [10], a brief overview of the main concepts in AI is given, including the theories of Minsky, Brooks, Sloman, Picard, Varela, etc., where emotions increase the quality of perception and reasoning.

With the basic data structures of thing presentations and affects that are forming the containing data structure of a drive, the functional sequence has to be identified that transforms pure homeostatic values, like the blood sugar level as depicted in Figure 1 into corresponding pairs of opposite drives. Figure 2 shows the decomposition of the main psychic instance *Id* in order to determine its sub-functionalities by applying a top down design approach. The *Id*, which is itself responsible to handle the demands of the individual, is consisting of two sub-functionalities in Figure 2 (in the picture, only for this article relevant functionalities are depicted). The module *Drive handler* contained in the Id can be decomposed into two further functions. The first functional module *Drive generation* composes a drive as described earlier in this section. Based upon the already known patterns provided by the memory trace structure, bodily processes are transferred into psychic processes. This module has the functionality of mapping the tensions originating in a variation of the homeostasis to the corresponding thing presentations, which are the psychic representation of the drive.

The second functional module of the *Drive handler* has been identified as the *Fusion of drives*. The generated thing presentations for the occurred drives are strictly separated and are connected with weighted associations of affects to the corresponding pairs of opposites within this module. With these two sub-functions, the module *Drive handler* is considered as sufficiently described. Both sub-functions can be considered as the hierarchically lowest functional module.

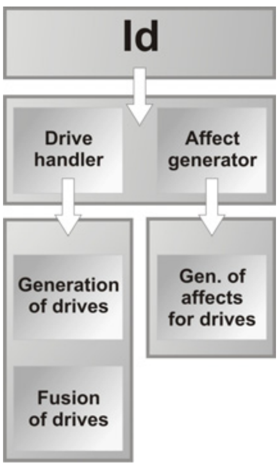

Fig. 2. Top-down design of the Id an its functional modules that are necessary to form the drives

Each perceived thing presentation has to be assigned with a corresponding affect that represents the quantity of the sensation. This pair represent the drives. The functional block *Generation of affects for drives* attaches the corresponding affect to the thing presentation that represents the drive. This affect together with the thing presentation is forming the drive. The affect itself is -- in the case of a drive -- the psychic representation of a corresponding bodily tension.

The *Drive handler* is discussed first due to its importance for the perception of a homeostatic imbalance. The input information of this component consists of symbols containing the information of the quality of the part of the homeostasis (which represents the actual state of the body parameters like the stomach fill level or the blood sugar) as well as the quantity of the deviation of the representing value. The input interface labeled I1.2 in Figure 3 holds this information.

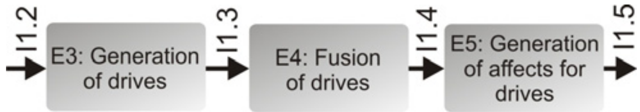

Fig. 3. Functional sequence necessary to generate the data structures for drives

The *Generation of drives* then maps the organic processes to psychic processes and creates an instance of a thing presentation that represents the quality of the homeostatic value within the psyche. The thing presentations themselves can be seen as the pattern or templates that defines such sensory constellations and are available within the entire net of memory traces. When a sensory constellation matches one of those patterns, a certain instance of the thing presentation is created. The attached quantity remains but will be assigned to other drive representatives in the module *Generation of affects for drives*. The interface I1.3 contains a list of drives and a list of bodily tensions. The drives are consisting of associated thing presentations, holding content, aims, and objects of the drive. With this list as an input, the module *Fusion of drives* now joins the generated drives together in pairs of opposite drives. Here, the drive nourish is coupled with the drive bite. The interface labeled I1.4 therefore holds a list of pairs of opposite drives and -- again -- the list of bodily tensions. This output is finally passed to the *Affect generator*, or more specific to the module *Generation of affects for drives*. The list of bodily tensions has to be assigned to their corresponding pairs of opposite drives. Assuming, as an example, that the inverse value of the blood sugar level is representing the bodily tension responsible for a feeling of hunger it has to be converted as an affect for the drives nourish and bite. Depending on the current situation, the individual is in and depending on the strength of the tension, the value of the tension is shifted from the libidinous drive (for lover values of tension) to the aggressive drive (for higher values of tension).

The final output therefore transfers a list of pairs of opposite drives and their specific data structure as already shown in Figure 1. This functional description of the psychic process that transforms sensations of bodily tension into drive-structures, themselves consisting of thing presentations and an affect, will be discussed in the next chapter with respect to a possible implementation in the decision unit of an autonomous agent. It will be shown that the thing presentation can be directly used in concepts of symbolic AI.

IV. TECHNICAL SYSTEM

The described functionality was realized in a decision unit of a simulated, robot-like agent. The simulation platform used MASON (Multi-Agent Simulator Of Neighborhoods... or Networks... or something...) as a basic framework for the agent based simulation including a simple, two-dimensional physics engine. The agents were equipped with a set of environmental and internal sensors and had the possibility of interaction with the virtual environment by using their available actuators. A first simple goal of these agents was to navigate through the environment in order to find energy and consume it. The simulation framework, realized in Java, was designed to embed different decision units, such as BDI-implementations. The decision unit is supplied with the three different input types: environmental, bodily, and homeostatic values. Starting at the sensed, homeostatic tensions, the module *Drive Handler* has to transform information about organic processes regarding the homeostasis into information that is the basis of further, psychic processes. Depending on the deviation of the different homeostatic values, the total quantity of the drive can be determined. Each drive has to be associated with the aim of the drive (this information includes specific actions that are capable to potentially reduce the internal tension) and the object of the drive (this information includes the object that is able to tentatively reduce the tension). This information was predefined within XML-Files[1] that were loaded during the instantiation of the agent-entity. The module *Fusion of drives* also loads a list of corresponding pairs of opposite drive during the initial phase and searches in each simulation step for such occurring pairs in order to join them. The calculated quantity of the drive is also transferred to the affect generator, which is, according to Figure 2 the next functional unit in the information flow.

The Affect generation finally converts the quantity of the drive that is representing the tension of the corresponding organ or drawback of homeostatic values to an affect. This affect is associated to the thing presentation, which is representing the quality of the drive. In the implementation, a new class `clsAffect` is created that holds the value of the described tension. In the case of environmental perception, the corresponding affects of the perceived thing presentations are results of the subjective associations that are describing the subjective meaning of the thing presentation to the individual. The consumption of an apple for example satisfies the drive related to the content to nourish. It is representing the drive that can be satisfied including its quality in the form of a thing presentation and its quantity in the form of an affect. Therefore, the output values of the module *Drive handler* is supplemented with a further list that holds the information of the corresponding affects.

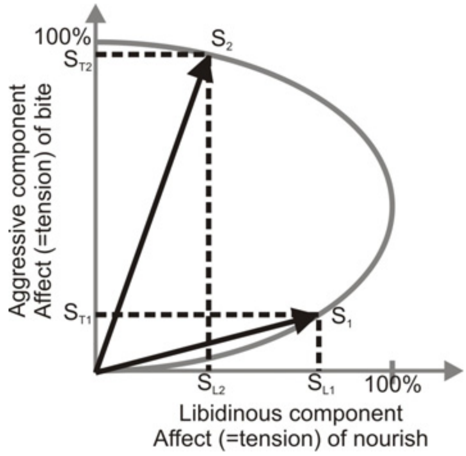

Fig. 4. Implemented Distribution of Drives

To briefly describe the outcomes, the pair of opposite drives NOURISH (assigned to the life instinct) and BITE (assigned to the death instinct) will be discussed. The life instinct contains two further drives. The drive, responsible for nourishing is one of them. Each drive has an assigned drive target and one or several drive objects. The drive target assigned here is `to nourish', which implicitly defines the types of action that has to be aspired. The drive objects are the objects that are necessary to satisfy a certain drive. The system holds this information in a flat list of objects that are not hierarchically assigned to each other in this first implementation. The drive objects FOOD, CAKE, and CARROT (all available energy sources in a virtual, simulated testenvironment) are corresponding virtual objects that can exist within the simulated environment. The drive that is responsible for nourishing is also connected to an opposite part, its death instinct component. This is the drive responsible for biting, the aggressive component of nourishing. Even though, these are different drives, the drive objects are the same objects within the pairs of opposite drives.

Beneath the drive objects two further parameters are included. The drive sources are representing the sensors that are able to measure the tension of the `artificial organs'. In the case of nourishing, the system uses the inverse value of the blood sugar to sixty percent and the stomach tension to forty percent for the generation of an *affect candidate* that will be converted together to the affect of a drive in the corresponding module *Generation of affects for drives*. The maximum value defines the highest possible occurring value of the corresponding source sensor. The values used within this example are not reflecting psychoanalytical findings and were used for test

[1] Extensible Markup Language

purpose only. Figure 4 shows an oversimplified and mathematical function the was used to distribute the single value of the bodily tension to two different drives. When the value of the tension that is depicted as a black arrow in the figure increases, the vector follows the circular path. In the beginning (vector S1), the libidinous component increases faster than the aggressive component. At an angle of 45 degrees, the libidinous component reaches it's maximum and decreases if the bodily tension still increases. Finally, the aggressive component prevails.

As described above, the pairs of opposite drives are predefined and their relation between homeostatic deviations and their affect are following the predefined associations shown in Figure 4. These definitions, together with the functionality in the modules *Drive handler* and *Affect generator* are forming the final output. These instances of thing presentations are representing pairs of opposite drives, and their associated drive target and drive objects. This loaded structure is static during runtime. The only variable component that is associated to each drive is the affect. The value of the affects are additionally displayed in a chart form. A screen-shot is shown in Figure 5.

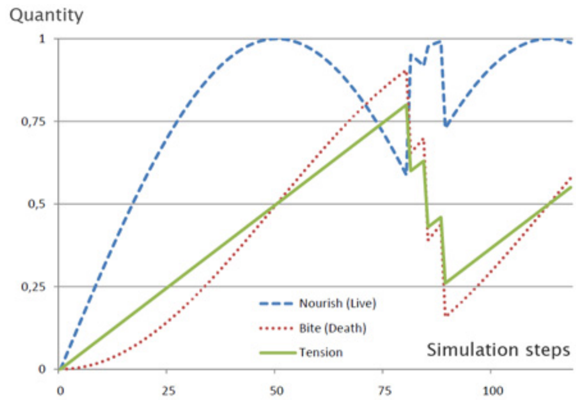

Fig. 5. Distribution of drive-tension to the libidinous and aggressive component

The value itself is the current quantity of the affect. Figure 5 shows the time diagram of the pair of opposite drives *nourish* and *bite*. During runtime, the virtual blood sugar level decreases in relation to the driven effort of currently executed actions. Therefore the drive *nourish* increases. At the same time, the drive *bite* increases but in the beginning not as fast as its counterpart. The more the organic tension increases, the more dominant becomes the affect of the aggressive component *bite*. The first reduction of the tension after the libidinous component reached its maximum is generated because of an initiated consumption of energy by the agent. It happened around the eightieth simulation step. A few simulation steps later, the agent repeats his action for further two times. The currently implemented transfer function that determines the ratio of the aggressive and libidinous part is the circular function described above that produces the plot in Figure 5.

With this output, it becomes possible to transform homeostatic values of an automation system, such as a robot, into psychoanalytically defined drive structures. These drives can be integrated either in the entire, psychoanalytical functional model described in [1] or into other existing implementations of decision units for autonomous agents. BDI is a great example of embedding the introduced model, because the interfaces between them perfectly fit. On the one hand, the BDI framework already holds a representation of so called *Desires*. These desires are defining the agents goals that can include or are highly influenced by internal values of the agent. They can be complemented with a new sort of desires -- internal desires -- that are equal to the introduced drive-structures. On the other hand, most BDI-implementations are based upon symbolic representations of perceived data. Drives are consisting of affects (only holding a value) and thing presentations. These thing presentations can be equalized to the symbolic strings that are used within a BDI implementation. Especially planning and learning algorithms can benefit on these new integration of agent-internal values. The separation in normal drives and really urgent drives can be further used as an alarming system for decision making and would trigger different planning strategies.

V. Conclusion

In this article, the authors presumed that the quality of a system like an autonomous agent needs relevant performance measures in order to increase the performance of planning and learning algorithms. Internal performance measures are a great deal for reinforcement learning as long as they are influenced by both, environmental and bodily impacts.

The energy consumption of a robot is one example for such an internal performance measure. The introduced, psychoanalytically inspired approach offers a description for human-like handling of internal performance measures. We elaborated two main criterions that make the usage of such internal performance measures. First, new possible dynamics in decision making become possible by integrating the psychoanalytically-inspired, technically specified concept. A first realization was shown in a simulated environment. Here a virtual robot was equipped with the introduced model for integrating the internal measurement system. Second, it was shown how to apply the concept in standard decision making implementation (in this paper the BDI implementation Jadex as one possible example).

This concept can be easily applied to future integration in robots and not only within simulated agents. It can be applied also in multi-agent systems like wirelessly connected, ultra-low power consumption smart-dust. In these applications, low cost agents have to work reliably within a wireless sensor network, being themselves sensors. A measurement of their internal values is mandatory for the reliability of the entire network. The concept of libidinous drives for normal operation and aggressive drives for e.g. energy-alert operation of such agents can be easily applied and will increase the possibilities in decision making of these agents.

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