A Computational Model of the Freud's "Pleasure Pump", and its Functioning on Virtual Robots

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***Abstract*— The contribution sketches a reformulation of S. Freud's concept of the so-called "pleasure pump" formulated in his manuscript Project of Scientific Psychology from 1895, into the computationalistic conceptual framework of multi-agent – or "resource", as M. Minsky has proposed in his book The Emotion Machine (2006) – systems, and provides its demonstration within a programmed system of software agents developed on the baser of the proposal. In this way we check Freud's concept: generation of behavior similar to sexual act based just on individual mechanisms of the concept implies both its correctness and completeness.**

Keywords: Multi-agent system, resource, emotion, computationalism, machine emotion, agent-space architecture.

I. INTRODUCTION

In [6] a possibility how to deal with emotions in a similar way as it was done in the case of the system *General Problem Solver (GPS)* [2] in the first decades of the development of AI is sketched.

The *GPS* is the system in which the so-called means and ends analysis, a hypothesis formulated on the base of (self-) observations of the mechanisms of human problem solving process has been tested [10]. The system has been constructed and its intelligence has been often put in opposition to human emotions. However, there exists also another position: "I think, it's a myth that there's any such thing as purely logical, rational thinking – because our minds are always affected by our assumptions, values, and purposes" [9]. On the base of that, and continuing in the contemplations from [6] we propose the following: (1) To start with a suitable psychological hypothesis on the emergence of (some kind of) emotions, and then (2) try to "translate" the selected psychological hypothesis into either a computationally sound form or into the form of a working system of computer (or robot) programs in order to have a system which will be able generate its own artificial and observable on its behavior "emotional states".

The psychological inspiration for our model has been adapted from Sigmund Freud's model of the growth of the sexual desire known as the mechanism of "pleasure pump" formulated in his manuscript *Project of Scientific Psychology* (in German original *Entwurf einer Psychologie*) from 1895, and published posthumously e.g. as [6].

This contribution presents in very short the system which partly embodied the suggestions from the above mentioned proposal. Nevertheless our approach is suitable for building of any so-called Machine Emotion System.

II. THE "PLEASURE PUMP"

The Freud's position to the "psychic" and to the "somatic", or to the body and the mind has been in certain sense "interactionistic" in the sense accepted today form discussions on architecture and functioning of a large number of our technical systems, for instance.

In this contribution we will study a particular example of his early views of physiological and psychic aspects of sexuality, as sketched in Freud's manuscript written in 1895 and published then e.g. as [3]. Freud proposed a cycle of the normal human sexual activity, usually called the pleasure pump; cf. [11].

According Freud, a normal cycle of sexual activity passes through the following eight phases; cf. [13] and [11]:

1. The organism perceives the sexual object.
2. Perception activates the group of sexual representations (in the brain/mind).
3. The activity of the representations causes that the body (the genital organs) produces sexual substances (hormones etc.)
4. The produced substances cause somatic sexual stimulation and increase the sexual tension (in the somatic-psychic boundary).
5. Sexual tension stimulates the sexual representations so as to cause the organism to undertake specific actions to reveal the tension.
6. If there are no obstacles and the organism succeeds in maneuvering the sexual object into a favorable position, it will proceed to direct sexual activity.
7. This motor activity further increases the sexual tension and ultimately brings about an orgasmic reflex in which the sexual tension is released.
8. The orgasmic discharge leads to a sensation of pleasure.

Freud in his above mentioned study paid crucial attention to the interactions in searching form the mechanisms of emergence of emotional states, when he decided to base the psychological explanations on natural sciences, and to follow the methodology of natural sciences in building psychological theories.

In his Project Freud presented not only the psychic, but also the somatic dimensions of the existence of human beings and the role of the interplay of both during the

process of emergence of the human sexual desire. Freud's goal consisted, among others, in explanation of (some of) the causes of (some of) psychic disorders on the base of disorders in interactions among different "quadrants" defined by the Ich and the somatic-psychic boundaries. So, he considered interplays between purely somatic causes, which have their roots purely in the (non-conscious, purely physiological) state of the body, and (sub-)conscious states of the human mind.

The interactionistic understanding of the participation of the body and the mind in the process of emerging the human emotional states offers its reconsideration in the nowadays computationalistic framework of multi-agent systems. Now, we will proceed by short characterization of agents executing the activities appearing in the Freud's proposal, according the list of phases described in the previous Section. We will consider a special type of agents and multi-agent system proposed in [7]. These agents represents individual modules of mind, they run in parallel and the overall behavior of the multi-agent system compounded from them emerges from their mutual interaction provided by indirect (blackboard based) communication.

III. FRAMEWORK FOR IMPLEMENTATION

Our system has been implemented by Agent-Space architecture [7] which was proposed for building modular systems based on decentralization, parallelism and operation in real-time. It enables to develop control systems of robots as a set of autonomous modules - so called agents - which mimics modules of mind.

Behavior of each agent is relatively simple and can be specified by developer, while the overall behavior of the system is complex and emerges from mutual interaction among the agents.

Each agent has own control (it has potential to be independent from other agents) and performs own code, running in endless sense-select-act cycle. Each course through the loop is dedicated for computing of appropriate actions upon perception of the current situation of the agent and other information stored in its internal state.

These agents are able to exchange data by indirect communication through a blackboard called space – it is so called stigmergic communication and it is similar to LINDA [5]. The space is designed to keep named data called blocks and agents are able to read, rewrite or delete them and can act upon their change (trigger) or upon a time schedule (timer).

Details of the mechanism are tuned to allow establish dataflow from many producers to many consumers, thus e.g. the first agent can rewrite block written by the second agent even before it is read by the third agent which is not able to recognize who is producer of the written content.

Moreover the written content can have limited period of validity (after the period, the content automatically disappears - this is known also as so called “data leasing”). Thus it is possible to assign data to a block for a given period.

Finally, it is possible to read a block even when there is no stored content. For this case it is possible to define a default value which is used when there is no value to be read.

The mechanism supports also real-time operation by so called implicit sampling which resides in the fact that when a producer writes a next value to a block before the former value is read by a consumer, the former value is simply lost and the consumer has no idea that it was present in space. Thus the system prefers to process current data and tends to forget automatically data for which it has lack of performance to process them in real-time.

So we implemented each psychic pathway related to the modeled part of mind as a chain of the above mentioned agents communicating via blocks in space. Agents were representing transformations of information while blocks were representing operational memory. Regulation of one pathway by another pathway has been implemented as overwriting of blocks laid in the regulated pathway by agents from the regulating pathway (similar to suppression mechanism from Brook’s subsumption architecture [1]). See Figure 1.

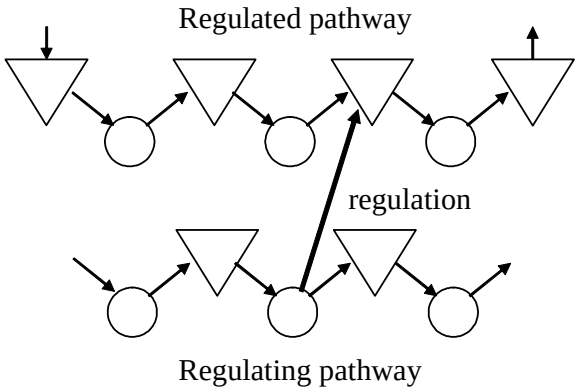

Figure 1. Control system based on the agent-space architecture (agents are depicted by circles and blocks in space by triangles).

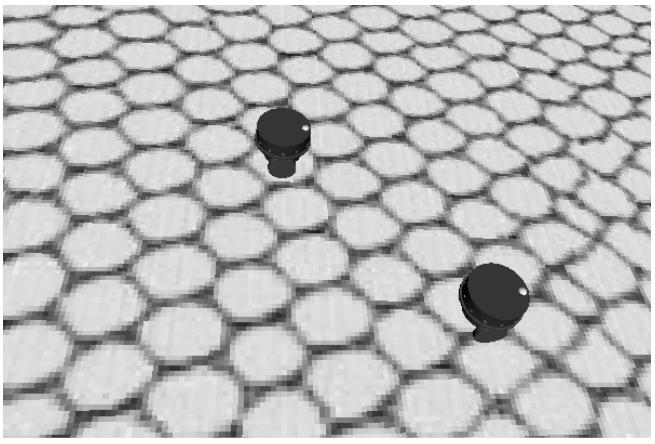

Figure 2. Simulated scene enriched by dynamics provided by the control systems of simulated robots

We have used the above architecture for implementation of the control system of robots in virtual reality environment.

Particularly we had two robots interacting at simple scene. For virtual reality implementation we used VRML viewer Cortona 4.2 (respective Cortona Movie Maker when we had captured video from the simulation). Dynamics of the simple VRML scene with flat floor and two wheeled robots was based on two scripts in Java corresponding to individual control systems. Each such script was interacting through space (blackboard) with couple of agents running in separated threads under the same Java virtual machine. There was no communication between the robots - their interaction has been carried out through their environment as they were able to percept the relative position of the each other robot (and act by wheels movements). See Figure 2.

The simulation has been performed in real time. The simulated framework had no direct relation to the simulated subjects ("man and woman") and reflected just their pure abstraction ("robot and robot").

IV. THE MODEL

Using this framework we will propose set of agents (see Figure 3) which implements the "Pleasure pump" mechanisms. For any agent we declare its general role in the mechanism and then we provide very particular – though very simplified – implementation for the demonstration within the above mentioned virtual scene.

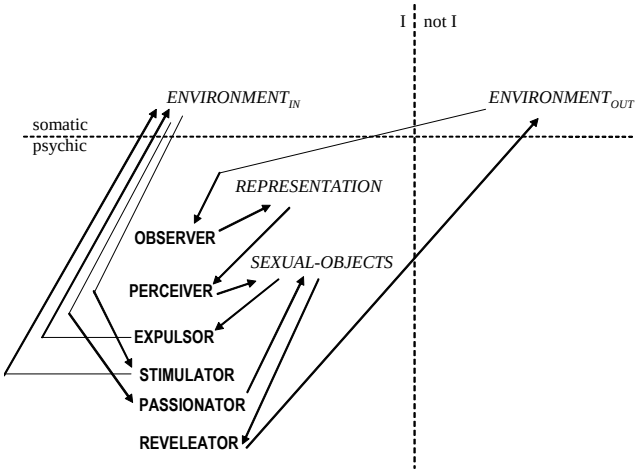

Figure 3. The Freud's pleasure pump as a Minsky's multi-agent system (system of resources).

First of all, we will suppose a specific agent **OBSERVER** (not mentioned explicitly in the Freud's proposal) which senses the agents outer ***ENVIRONMENT$_{OUT}$***, and acts in the inner ***REPRESENTATION*** of it.

As we had to implement a very concrete part of perception, we reduce sensed information to position of the other robot. Thus the formal description of this agent in the above mentioned environment looks like follows (block manipulation is depicted by cursive):

```
Agent OBSERVER
when abs_pos* changed:
  point1 = abs_pos1;
  point2 = abs_pos2;
  rel_pos = point2 - point1;
```

where absolute positions represents perception of the outer scene and relative position internal representation of the sensed objects. It is very simplified, but enough to carry out the simulation.

Thus the agent is implemented to wake up when position of any agent is changed. After that, it finds own position and position of the potential partner and calculates internal representation of the partner simplified to its relative position.

We will suppose that the phases in which the organism perceives the sexual object, and the phase of perception activates the group of sexual representations (in the brain/mind). Both of them are performed by the agent **PERCEIVER** which senses the results perceived by the ***REPRESENTATION***, where the sexual objects may - among other objects as parts of the world where the human body is situated - occur, and act in the environment of **SEXUAL-OBJECTS** as a specific, but for this model relatively separated, part of representations in the human brain/mind. The formal description of this agent:

```
Agent PERCEIVER
when rel_pos changed:
  pos = rel_pos;
  distance = length(pos);
  angle = atan2(pos);
  if in_front_of_me(angle) or
    very_close(distance) then
    sex_obj_at = pos for short_period;
```

(very_close was defined as less than 2 meters and in_front_of_me as ±10° in our simulation. short_period was 2 seconds)

This agent wakes up when relative position representing internal model of a potential partner is updated. Then checks that the partner is in front of the robot and it is not too far. Just then indicates that the partner is interesting. Since robots move, this decision has just limited time validity.

The phase of the activity of the representations so that the body (the genital organs) produces sexual substances (hormones etc.) is carry out by the agent **EXPULSOR** which senses the ***SEXUAL-OBJECTS*** and influences the inner ***ENVIRONMENT$_{IN}$*** of the inner biochemical environment of the given (human) body.

```
Agent EXPULSOR
every Δt:
  sex_obj = sex_obj_at default none;
  if sex_obj != none then
    hormones = hormones default 0.0;
    increase(hormones);
    hormones = hormones;
```

(Δt used for simulation was 100ms, increase was implemented by addition of random number between 0 and 1. It is necessary to point out that at any time instant the

value of hormones has to be read from space and after increase written to space - if it is stored in internal state of **EXPULSOR**, it would not be possible to discharge the still increasing value by other agent.)

This agent is regularly waking up and checking presence of the interesting sexual object. If it is present, the agent increases value of hormones representing sexual urge.

The process continues by the phase in which the produced substances cause somatic sexual stimulation and increase the sexual tension (in the somatic-psychic boundary).

So, an agent seems to be necessary which will be sensitive to the **ENVIRONMENT$_{IN}$** and will act the same environment by changing in a substantial way the somatic state of the organism. This agent will be called the **STIMULATOR**.

```
Agent STIMULATOR
when hormones changed:
  hormones = hormones default 0.0;
  if hormones > critical_value then
    tension = half for short_period;
```

(short_period was 2 seconds, critical_value 50.0, half tension was 0.05 - for our purpose tension is measured in meter per tenths of second as it used directly for acceleration of motor activities)

Thus this agent wakes up when value of hormones is updated and if it finds that their value is over critical limit, it modifies tension (from zero) to half value. Never it renews zero value since the modification has limited time validity, thus after the chosen period its value expires and next time the agent concerns the value as zero (what is default applied during its reading).

Then, because of the sexual tension stimulates the sexual representations so as to cause the organism to undertake specific actions to reveal the tension, two new agents seems to be necessary: the agent **PASSIONATOR** which, on the base of the sensed state of ***ENVIRONMENT$_{IN}$*** enriches the ***SEXUAL-OBJECTS***, and the agent **REVELEATOR** which senses the tension in the ***SEXUAL-OBJECTS*** and reveals the tension in the ***ENVIRONMENT$_{IN}$***. We note that the **REVELEATOR** as well as the above mentioned **OBSERVER** are the parts of the body (as the sexual and sensuous organs).

```
Agent PASSIONATOR
when rel_pos changed:
  pos = rel_pos;
  distance = length(pos);
  if very_close(distance) then
    // oh, yes, I am pleasured
    tension = full;
    duration++;
  if (duration > critical_duration)
    // discharge
    hormones = 0.0;
    duration=0;
```

(very_close has been implemented as robot radius + 0.02m - robot body had shape of cylinder. So the sexual contact has been repesented just by tight contact of robots. critical_duration was 15seconds - what is unrealistic for people but enough for the simple behavior of the robots. full_tension is 0.1)

If the faster speed caused by half level of tension brings the robot to very position of the partner, PASSIONATOR - waken up partner representation is updated - increases the tension to full value. This helps robot to keep close to partner. However the agent starts to measure time period and when the counter reaches a critical threshold, it put hormones to zero. That simulates consumption of critical amount of energy during sexual act.

```
Agent REVELEATOR
every Δt:
  t = tension;
  sex_obj = sex_obj_at default none;
  if t > 0 and sex_obj != none then
    speed = t;
    angle = atan2(sex_obj);
    if (angle > 0) rotation = Δrot;
    else rotation = -Δrot;
```

(Δt was 100ms, Δrot was 8.5°, rotation had to keep the robots face to face during simulated sexual act when apparently the robots are moving quickly but in fact remain in mutual collision.)

REVELATOR control motor activities of the robot. The agent regularly wakes up, check own trial for sexual act indicated by non-zero value of tension and still presence of interesting sexual object. Then compares own heading with relative position of the potential partner and adjust heading to be oriented to the partner. As the same mechanism is insides both robots, they tends to be oriented face-to-face, if they both are ready concerning their level of hormones.

As a result, if there are no obstacles and the organism succeeds in maneuvering the sexual object into a favorable position, it will proceed to direct sexual activity. This motor activity further increases the sexual tension and ultimately brings about an orgasmic reflex in which the sexual tension is released. Finally, the orgasmic discharge leads to a sensation of pleasure need no special agents from our point of view because the interplay between the **OBSERVER** and the **REVELEATOR** which leads to direct sexual activity, seems to be the simple direct consequence based only on the activities of the body.

If we does not pay any attention to the different specific **CENSOR** agent(s) which may suppress the activities of the body, and may sense the ***REPRESENTATION*** and act - by suppressing the activities of agents focused to the direct sexual activities - a in the ***ENVIRONMENT$_{OUT}$***).

Similarly, the mechanism of the post-orgasmic changes in the organism seems to be out of the picture sketched in the model presented in this contribution. We simply suppose that it means no more that immediately after the intercourse the biochemical state in the ***ENVIRONMENT$_{IN}$*** stabilizes in the

homeostasis which does not cause any new activation of the agent **PASSIONATOR**.

The above sketched multi-agent system is schematically depicted in Figure 3. Its implementation (simplified but concrete) is depicted in Figure 4. Generated video is available on http://youtu.be/Kmk2Ll2rRpQ. Source codes can be downloaded at www.agentspace.org/download/PleasurePump-ver3.zip

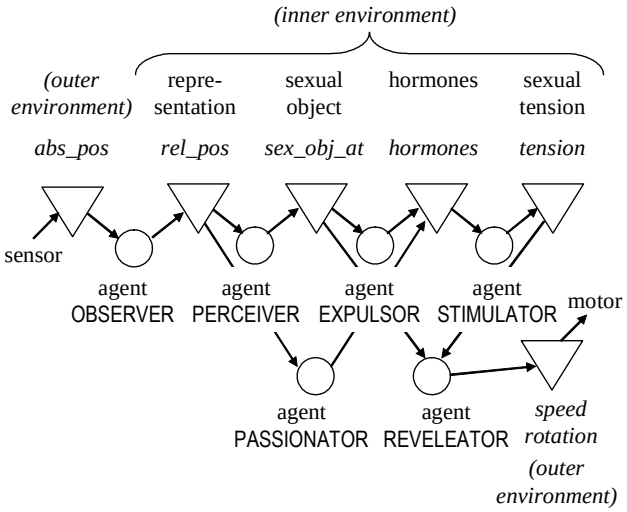

Figure 4. Multi-agent system implemented for simulation

V. CONCLUSION

Starting with the Freud's concept of the pleasure pump we have sketched a multi-agent specification of the process of the sequential growth of sexual desire, using the concept of resources or agents as proposed in [8] and [7].

A computer simulation of the described mechanism (as well as the embodiment of the above sketched mechanisms using robotic platforms) and corresponding experimentation with the concept seems to be necessary to test the functioning of the concept.

The simulation has been based on abstract structures corresponding to sexual act abstracted from any details. The generated behavior of robots looks rather like predation which indicates that same abstract scheme can correspond to various behaviors of similar nature (in fact male is playing role of predator and female role of prey here). Anyway it is possible to recognize courting followed by sexual act. Further it is clearly visible that during the whole simulation behavior of partners varies between shyness and passion. Of course, this is just observation of an external observer: everything emerges from mind internal organization of the simulated partners. In this way our results support relevancy of the used Freud's concept of the "pleasure pump". Although this work has no practical use, it enlightens how behavior can be coded by set of agents and analogical method can be used for various applications.

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