

The ultimate challenge in automation: robots endowed with imagination

Lucio Cañete Arratia

Universidad de Santiago de Chile, lucio.canete@usach.cl



Abstract: This essay proposes a line of investigation related to decisional processes in robots, specifically through the concept of imagination. The diversity of behaviours in these automatons can be enhanced by means of an increment of the alternatives which the robot has to evaluate and by means of an increment in the number of variables of the utility function in each alternative. In this context, with prior revision of the concept of imagination in human beings and taking keys both from Biologically Inspired Cognitive Architecture and Cybernetic, this article introduces the concept of Imagination Potential as a measure of decisional capacity that can be expanded in the robots.

Keywords: imagination, robot, decision making, behaviour, challenge.

1. Problem

Humans have always desired that robots have certain capabilities that *Homo sapiens* has, and higher the productivity due to these capabilities, more will be desired.

Imagination, that ability to conceive new images never captured from the environment is a feature highly valued because it allows automata to enhance the decisional set and thus increase their performances. In effect, such as an imaginative person is able to deploy new solutions, it is assumed that an imaginative robot can also to do the same.

However, Imagination is an intellectual ability poorly studied in automata and therefore its incorporation by artificial way is delayed. While the delay persists, robots will be deprived of improving their performance with that capacity.

2. Objectives

In the absence of a conceptual basis to provide Imagination into robots, this essay presents some considerations for in the near future, to produce robots with such intellectual capacity.

3. Estate of Art

There are many definitions related to the process that allows us to create entities in our minds, in spite of

the fact that they are absent from our body's surroundings [1].

In the present article, the imagination is defined in simple terms as: the capability to construct in our minds, spatially and temporarily, elements that are not present in our environment. Without a doubt, the imagination is a vital phenomenon to confront a changing world [2]. In fact, according to the principles of economics, human beings are always faced with alternatives, and the choice of the best alternative is an action that conduces to success [3]. A frequent problem associated to this, is that the best alternative is not always selected due to it is not imagined.

4. Method

For reaching the goal, this essay takes some methodological keys from Biologically Inspired Cognitive Architecture (BICA) whose focus is: "...the integration of many research efforts in addressing the challenge of creating a real-life computational equivalent of the human mind" [4].

The method also takes keys from cybernetics [5], mainly from process of heuristic designs.

5. Results

Potential Imagination or how imaginative one can be.

The problem stated previously has two causes that are discussed as follows, and that are related to each other through a decisional model.

Limitation of the set of variables X. All human beings try to maximize a certain utility function, which consists in a set of (m) variables of costs and benefits. In some occasions, an inferior number of these variables (p) are identified. In other words, (m-p) variables are left out of the model.

Limitation of the set of alternatives A. All human beings evaluate the utility function with mutually excluding alternatives, in relation to a set of (n) alternatives. Sometimes, only a smaller set than the first one of (q) alternatives are identified. That is (n-q) alternatives are left out of the model.

As a result of this, two decisional situations present themselves: "Actual" and "Potential". If each alternative is symbolized by A_i and its utility function by F , this is represented mathematically as follows

Actual

$$\begin{aligned} A1 &= F(X1, X2, X3, \dots, Xp) \\ A2 &= F(X1, X2, X3, \dots, Xp) \\ A3 &= F(X1, X2, X3, \dots, Xp) \\ &\vdots \\ Aq &= F(X1, X2, X3, \dots, Xp) \end{aligned}$$

Potential

$$\begin{aligned} A1 &= F(X1, X2, X3, \dots, Xp, \dots, Xm) \\ A2 &= F(X1, X2, X3, \dots, Xp, \dots, Xm) \\ A3 &= F(X1, X2, X3, \dots, Xp, \dots, Xm) \\ &\vdots \\ Aq &= F(X1, X2, X3, \dots, Xp, \dots, Xm) \\ &\vdots \\ An &= F(X1, X2, X3, \dots, Xp, \dots, Xm) \end{aligned}$$

Undoubtedly the potential decisional situation is more optimal than the actual. Because, errors are less probable to occur based on sentences such as "I didn't consider those costs" or "I didn't consider that possibility". In this context, the concept of Potential Imagination (I) emerges, which represents all that in the process of decision making may be extended:

$$I = (m-p) \times (n-q)$$

Robots do not have Imagination; but they could.

If a human has a superior Potential Imagination than another, the first one has greater possibilities of success when he/she is making decision. In the same way, a robot with Potential Imagination would be more successful than one that does not. In other words, if the variety absorbed by a robot increases from p to m and the alternatives perceived by it increase from q to n; evidently such an automaton would have a better performance.

6. Conclusions

Since the elements of $I = (m-p) \times (n-q)$ are not caught by the robot from its environment, the automaton must generate them from others. This process requires images for being combined in order to generate a third with absent properties in the first one.

Regarding each image captured from the outside can be represented in matrix, the robot can take elements from two of these images and randomly form a third. Then, through its artificial vision the automaton can interpret this new image. For example, from an image containing a herd of elephants, the internal processor acting as a mind can separate one of these animals, while from another image of a bird the same processor can separate its wings. Combining both parties robot can generate a winged elephant. This new entity does not exist outside; in fact it is impossible the robot had seen a winged elephant in its environment. This winged elephant is the product of imagination.

Certainly these internal processes require time and energy, as they are required by the human mind when it imagines. Therefore the challenge is not only limited to achieving an internal machine vision; but also to improve the provision of time and energy.

References

- [1] Paz Díaz y Pedro Palominos, "Conceptual basis for the management of the Imagination in changing environments". Journal of Technological Possibilism. Volumen 1 N° 1, 2012, páginas 38-54.
- [2] Hugo Gravato Marques y Owen Holland, "Architectures for functional imagination". Neurocomputing. Volumen 72, Issues 4–6, 2009, páginas 743-759.
- [3] C.F. Camerer, G. Loewenstein y D. Prelec. "Neuroeconomics: why economics needs brains". Journal of Economics, 106 (3), 2004, páginas 555–579.
- [4] Owen Holland, Alan Diamond, Hugo Gravato Marques, Bhargav Mitra y David Devereux. "Real and apparent biological inspiration in cognitive architectures". Biologically Inspired Cognitive Architectures, Volumen 3, 2013, páginas 105-116.
- [5] F. Lhote, Ph. Chazelet y M. Dulme. "The extension of principles of cybernetics towards engineering and manufacturing". Annual Reviews in Control, Volumen 23, 1999, páginas 139-148.

Journal of Technological Possibilism

Paper Info

Fecha de recepción: Diciembre 2014

Fecha de aceptación: Diciembre 2014

Cantidad de revisores: 3.

Cantidad de revisiones consolidadas: 1.

Total de observaciones: 7.

Índice de Novedad: 0,84.

Índice de Utilidad: 0,55.