Quantum Beings

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Abstract

We propose to use quantum circuits to generate atomic scale simulations of Quantum Beings. For this purpose we have developed an adapted version of quantum cellular automata, which work with qubits and quantum gates that allow to explore the possibilities of state superposition, entanglement, teleportation of information, etc.

The creation of Quantum Beings is here structural, and their viability is measured at the output of the circuits, giving us results (dead or alive) echoing the well known Schrödinger's Cat experiment.

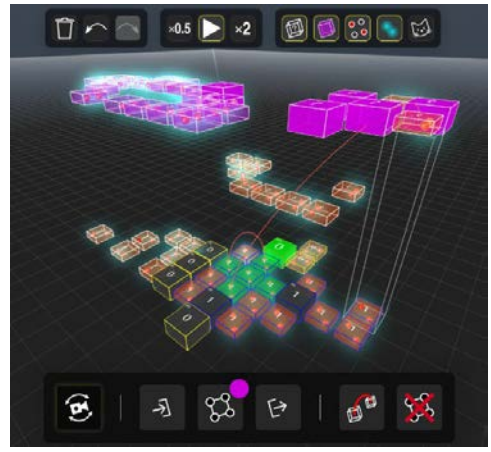

Fig. 1. A Quantum Being
(Alain Lioret, 2022)

1 Quantum Beings exploring a new field for Generative Artistic Animats

Since their first mention by Stewart Wilson in 1985, animats have experienced a considerable growth and a large amount of work has been done around this concept. We do not pretend here to propose new algorithms around animats, but rather to introduce them in the emerging field of quantum computing.

The particularities of this new computing are numerous (see below). One can legitimately ask the question: in what way can quantum computing allow new perspectives for the development of future beings ? While some authors are starting to explore Quantum Artificial Life but also Quantum Biomimetism, we can no longer ignore the potentialities of quantum computing.

This article aims at opening a new door on a still unexplored domain. We don't have enough time to see where it will lead us. But we bet that the advances in prospective will lead us further than we can imagine with our current knowledge.

2 Quantum computing since Richard Feynman's idea

Since the discovery of quantum physics at the beginning of the twentieth century, many technologies have been developed and some are in the process of revolution. This is notably the case of quantum computing, which was introduced by the Nobel Prize winner Richard Feynman (19) about forty years ago.

Since the arrival of classical computing, many algorithms have been developed, and the recent advances in Machine Learning have allowed very big advances in many computing fields.

However, the advent of quantum computing goes much further. First of all, it uses qubits instead of the classical bits of our good old computers. We thus go from a basic element with two possible values to a new element (the qubit) which can theoretically manage an infinite number of values, stored in the space of a sphere (called Bloch Sphere).

The new major ingredients of this new computer science are the superposition of states (being able to be worth 0 and 1 at the same time), the entanglement of qubits (instantaneous link between two qubits whatever the distance that separates them), and by direct consequence the teleportation of data (also instantaneous).

Since 40 years, this new computing is no longer a simple utopia: quantum computers have appeared and become more and more powerful. They already allow to obtain absolutely incredible performances (to produce calculations in a few minutes which would currently take... millions of years on the best current computer).

But beyond these astronomical performances, it is also a new way of thinking that emerges, and it is in this that we are interested here.

When humans invented the computer, they moved away from nature: basing calculations on lamps and therefore binary machines sent us on methods far from animal and human functioning. This is why it took so many years to come back to biomimetic methods and try to reproduce human or animal behaviors.

The arrival of quantum computing which works on the basis of particles (photons, ions, electrons, etc.) finally brings us closer to the creation and the natural order of the universe. Let's bet that this will bring us much further than we think today.

Therefore, the main idea of this article is to generate Artistic Beings using quantum computing, in order to explore what may appear possible.

3 Quantum cellular automata

The applications of quantum artificial intelligence are already very numerous and a new field of research: Quantum Machine Learning (QML) has appeared (7).

Of course, Artificial Life algorithms are not left out. And the first attempts in this direction were made around the creation of quantum cellular automata (8). These are based on how to use quantum annealing to compute the deterministic game of life using a less direct encoding.

Several works have been carried out around cellular automata, first proposed by John Conway in 1970. Cellular behaviors that use quantum principles (superposition of states, entanglement) give very interesting results that open new exploratory possibilities. For example, the QCA application, developed by Lioret & al, allows to test the use of such automata in an interactive way.

This QCA tool simulates Quantum Cellular Automata Circuits and supports three-dimensional (3D) circuits and quantum entanglement, includes a tutorial, demos and missions to learn Quantum Cellular Automata, works on computers, tablets and cell phones and gives a playful visualization of the famous Schrödinger cats.

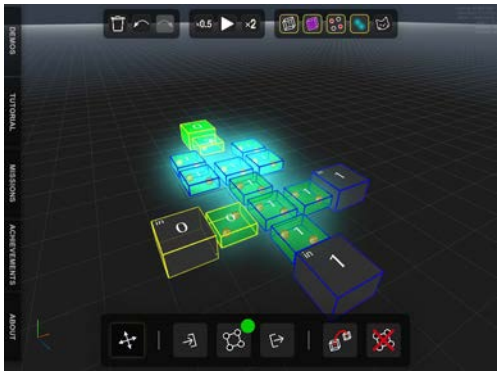

Fig. 2. Quantum Cellular Automata (Alain Lioret, 2022)

4 Quantum Artificial Life

To go further, new attempts are being made to generate Quantum Artificial Life, which seems to us very relevant. We can quote the excellent work of Alvarez-Rodriguez who with his colleagues is one of the first to use quantum computers (those proposed by IBM) to try to create Artificial Life. [4][5]

Alvarez-Rodriguez present the first experimental realization of a quantum artificial life algorithm in a quantum computer. The quantum biomimetic protocol encodes tailored quantum behaviors belonging to living systems, namely, self-replication, mutation, interaction between individuals, and death, into the cloud quantum computer IBM.

"Thereafter, these and other models of quantum artificial life, for which no classical device may predict its quantum supremacy evolution, can be further explored in novel generations of quantum computers. Quantum biomimetics, quantum machine learning, and quantum artificial intelligence will move forward hand in hand through more elaborate levels of quantum complexity".

5 Towards a Quantum Being

Our goal here is to try to put in place the elementary bricks to generate quantum beings. Many tracks are available to us, especially those based on quantum cloning [10].

One of the works that inspired this article is the one proposed by Grand-Pierre [3]. This one is based on the little known work of Ervin Bauer who proposes a very original biological theory of life. [15][16]. This theory combines perfectly well with quantum principles and gives us innovative and exciting points of study.

We take up here our QCA tool in order to experiment the implementation of Quantum Beings put into action in the form of quantum circuits. The principle is simple: the quantum circuits will be used here to generate logical micro-organisms, which will behave according to the use of various quantum gates.

We make here a parallel with the first living organisms, appeared on Earth (multicellular beings with a DNA). Here the DNA of our virtual Quantum Beings is composed of quantum gate networks.

While many researches currently tend to give explanations to consciousness thanks to quantum physics (beyond matter), this approach seems to us relevant: indeed, as long as the result of the quantum circuit is not measured, the qubits which constitute it are in undetermined quantum states. This allows us to simulate the states of consciousness of our Quantum Beings.

The measurement of the quantum circuits makes it possible to fix a state of the Quantum Beings thus produced: they thus have a simulated structure whose results depend on the measurement of the qubits. This approach is still very experimental. However, it has the merit of adding a layer of structure that can be added to Quantum Beings created by more classical methods.

It is the measurement of these quantum structures that allows us to have this or that kind of Quantum Beings. Far from us the idea to introduce a mystical notion in the creation of our experimental Quantum Beings, but to use the quantum capacities which seem to be able to create very strong variations at the time of the creation (by measuring the values of states vectors in the Hilbert space (Bloch Sphere).

The combination of these values of state vectors in the Bloch Sphere is thus used to adjust the parameters of the generated Quantum Beings, which can be created in a very interesting way as strange creatures with no less singular behavior.

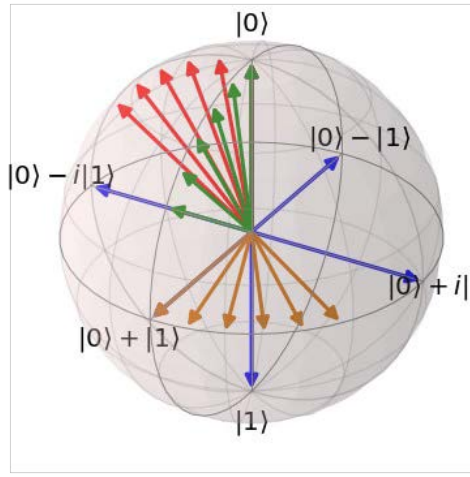

Fig. 3 : Multiple statevectors in a Bloch Sphere.

This is a generative production of Quantum Beings models, whose structure is in some way composed of a simulation of atoms, which are themselves structured in a quantum circuit. This experimental work is an exploratory research draft which aims at using quantum circuits for simulation.

Our work now consists in exploring the artistic possibilities offered by these new structures, by considering the creation of Quantum Beings from the smallest possible atomic level. In this, the use of qubits is a very good way to open this new research field.

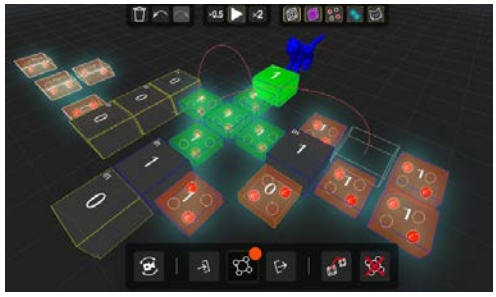

Fig 4 : A living Quantum Being

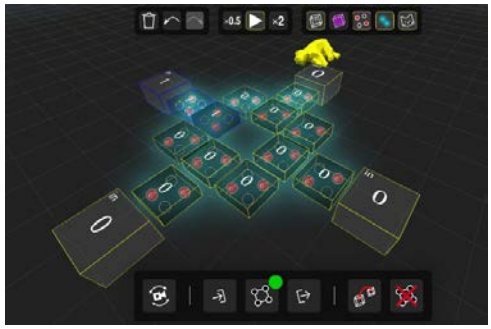

Fig 5 : A dead Quantum Being

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