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Article

A New AI Dialogue Framework with ChatGPT: Exploring Synthetic Man within the Context of Synthetic Biology

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Abstract: The article explores the concept of 'synthetic man' (SM) in the context of 'synthetic biology' (SB), analysing the potential, challenges, and ethical implications of these achievements. Through dialogue with ChatGPT 4, an in-depth understanding of the evolution, contributions of SM, ChatGPT's contribution, and concerns associated with SM is sought, providing insight into how this technology could affect our society. Our study uses a structured dialogue framework with ChatGPT that addresses essential SM questions regarding SM history, contributions, challenges, and concerns. ChatGPT responses are analysed to extract relevant information and identify trends and insights. The ChatGPT dialogue reveals that MS is still a theoretical and speculative concept with significant advances in gene therapy and genetic engineering. The potential contributions of SM in addressing global challenges such as health, environment and education are identified. Ethical and social concerns such as health risks and psychological impact are also highlighted. Differences in ChatGPT responses were observed between different sessions or even within the same session, which highlighted the limitations in the replicability of the research and sometimes the need for clarification of the questions. The article is distinguished by its unique approach of using an advanced language model to explore a complex and speculative topic. The LLM Dialogue Framework on Technology (LLM-DFonTech) framework proposal for structured dialogue with ChatGPT on various technological topics related to the original contribution provides an adaptable tool for interdisciplinary research in emerging technologies. This methodology opens up new possibilities for analysing and developing trends in technology and society.

Keywords: artificial man; humanoid robot; artificial society; synthetic biology; llm dialog framewor

Introduction

The conceptualization of the artificial human, a field at the nexus of humanity and technology, boasts a rich historical lineage. Starting from the 4th century BC with the narrative of the Chinese philosopher Lieh-Tzu, who chronicled the creation of an artificial humanoid by the artisan Yen Shih for King Mu of Chou (Needham, 1991), this concept underwent a significant evolution. A key advance in this trajectory was Hero of Alexandria's automaton in the 1st century AD (Grillo, 2019), personifying an embryonic effort to reproduce human life mechanically.

The field of philosophy undoubtedly influenced the evolution of the artificial human concept. In his seminal work 'Leviathan' (Hobbes, 1651), Thomas Hobbes metaphorically delineates the state as an 'artificial man', with sovereignty functioning as its life-giving soul. In a similar vein, René Descartes (1993), through his "Meditations on First Philosophy" (1641), delves into the essence of the soul and the dichotomy between mind and body, postulating the unique and unreplicable nature of the soul. These philosophical discourses have been instrumental in shaping contemporary understandings of artificial humans and demarcating the boundaries between human and synthetic.

The dawn of the 20th century heralded many achievements and innovations in robotics. Notable examples include Eric in Britain (1928) and Westinghouse Electric Corporation's Elektro robot (1939), each marking a significant step toward the realization of increasingly sophisticated artificial life forms

(Jade, 2016; Riley, 2009). Japan's Waseda University contributed WABOT-1 and WABOT-2, and Honda's foray with the E and P series and the ASIMO humanoid robot were instrumental (Norman, 2023; Hashimoto et al., 2002; Honda, n.d.). The development of Sophia by Hanson Robotics was a landmark in combining artificial intelligence with visual data processing (Parviainen and Coeckelbergh, 2021). In addition, Engineered Arts' unveiling of AMECA in January 2022 at The Consumer Electronics Show, which features humanoid facial expressions and interactive capabilities (BBC, 2022), along with Boston Dynamics' ATLAS robot, known for its advanced mobility and adaptability (Tugui, 2023), underlines the rapid progress in this field.

Synthetic man (SM), in particular, strives to reproduce the human form and emulate the cognitive and emotional faculties. This pursuit raises profound questions about the essence of humanity and the demarcation between artificial constructs and organic life. Lungarella et al. (2006) emphasize in 2006 the critical interaction between physical form and environment in the evolution of artificial intelligence and humanoid robotics.

Advancements in Synthetic Biology have forged a path toward both enthralling and formidable possibilities, particularly highlighted by the nascent concept of the "synthetic man" (SM) or "artificial man" (AM). This burgeoning epoch, wherein genetic engineering melds with cutting-edge technologies, holds the potential to transcend the traditional boundaries of scientific inquiry and fundamentally alter our comprehension of life and human existence. The synthetic man, conceived or substantially altered through sophisticated synthetic biology techniques, epitomizes the zenith of human endeavours to sculpt and enhance life via scientific means.

Hence, this article delves into how the synergy between Artificial Intelligence and Synthetic Biology could give rise to the notion of the SM. We scrutinize the ramifications, prospects, and challenges this novel frontier poses for humanity. In this pursuit, we will dialogue with ChatGPT to elucidate these essential aspects for conceptual clarification and understanding of AI's perspective.

Literature Review

In our approach to documenting the international databases Scopus-Elsevier and Web of Science, we did not identify any papers in which the "synthetic man" concept was assumed for research by title. What we noticed is that a similar approach was carried out in 2023 by Tong and Zhang (2023) on the topic of "synthetic biology", three months (January 30th version of ChatGPT) after the appearance of ChatGPT. The methodology applied by Tong and Zhang (2023) is a simple one, whereby they set the objective of the ChatGPT discussion and asked for answers to a list of seven questions related to "Synthetic Biology", as shown in the extract below.

Q1: "What is **Synthetic Biology**?"

Q2: "How is **Synthetic Biology** changing our daily life?"

Q3: "Please list 10 most important milestones in the history of **Synthetic Biology**."

Q4: "Among the top 10 global challenges we are facing, what **Synthetic Biology** can contribute?"

Q5: "What kind of breakthroughs will **Synthetic Biology** make in the future?"

Q6: "What you can do to push forward the field of **Synthetic Biology**?"

Q7: "Give some advice to Ph.D. candidates who are aiming to become a **Synthetic Biologist**."

One year after the launch of ChatGPT, we refer to the seven questions as a model of good practice for research in the field to discuss with ChatGPT (OpenAI, 2023) all seven questions, systematized by us as follows: **What is <...>? • How is <...> chainging daily live? • Historical Milestones of <...>• Contribution of <...> to global challenges • Future breakthroughs of <...> • LLM's contribution of <...> • Advice for Ph.D. students in field of <...>**. This metastructure systematized by us constitutes a working framework for discussions with ChatGPT on any topic related to technology in general.

Material and Method

In order to fulfill our purpose, we will *first depart* from the dialogue framework assumed by the ChatGPT discussion model proposed by Tong and Zhang (2023), to which we will bring some updates regarding the questions asked to ChatGPT in order to conduct the research objective by obtaining answers from ChatGPT regarding **synthetic man** in the technological context assumed by **synthetic biology**. *In the second step*, we will generalize by resorting to the parameterization of the dialogue framework that can be used for any <technology> in a given <technological context> by reference to the societal challenges of a <reference period> and for any Large Language Model (LLM).

To complete the first stage of the methodology, we will proceed to apply the following updates to the ChatGPT discussion model proposed by Tong and Zhang (2023):

- The first update consists of completing the Q1 question indicating a technological context. Thus, Q1 becomes: "What can you tell us about <...> in the context of <...>?" Thus, in our case, Q1 will be: Q1: What can you tell us about **synthetic man** in the context of **synthetic biology**?
- The second update concerns question Q2 ("How is <...> chainging our daily live?"), where we will also refer to "our society", which will lead to a new Q2 ("How is <...> chainging our daily live and our society?").
- The third update is motivated by "limitations imposed by the concrete physical and logical issues of artificial intelligences design and those required by the ethical dimension of their existence" (Schwartz, 1986, p. 258) and by the fear of man/society "when such systems are out of control, as well as the methods and rules of human interaction with these systems" (Schwartz, 1986, p. 258). Thus, after question Q6, we introduce the additional question, "Is there cause for fear for humans in interacting with <...>?" which will be Q7 and the former question Q7 will become Q8.
- The fourth update will be about expanding the scope of inclusion in the ChatGPT discussion from PhD students to all researchers interested in the discussed area. Thus, the former coded question Q7 will become Q8: "Give some advice to researchers who are aiming to become senior researchers in the field of <>."

Q1: What can you tell us about **Synthetic Man** in the context of **Synthetic Biology**?

Q2: How is **Synthetic Man** changing our daily life and our society?

Q3: What are the 10 most important milestones in the history of **Synthetic Man**?

Q4: Among the top 10 global challenges we have been facing in the **last two decades**, what could **Synthetic Man** contribute? Please formulate this from the perspective of **Synthetic Man's** contribution point of view.

Q5: What kind of breakthroughs will **Synthetic Man** make in the future?

Q6: With your current capability, what can you do to push forward the field of **Synthetic Man**?

Q7: Is there cause for fear for humans in interacting with **Synthetic Man**?

Q8: Give some advice to researchers who are aiming to become senior researchers in the field of **Synthetic Man**.

In the above quadrant we present the exhaustive list of questions addressed to the GPT Chat on the topic "**Synthetic Man**", in the context of "**Synthetic Biology**", referring to the global challenges of the "**last two decades**".

Date and Results

Presented below is a documentation of our dialog with ChatGPT, conducted in a single session in English on November 22, 2023. During this session, we sequentially addressed eight questions. The text that appears after "🟢 **You**" represents our queries; conversely, the text following "🟡 **ChatGPT**" consists of responses generated by ChatGPT. We addressed each of the eight questions sequentially, ensuring a continuous and uninterrupted dialogue. We have not altered ChatGPT's generated texts in any way, nor have we paused the dialogue at any point. This discussion session was saved under 'Chatting with ChatGPT4 about Synthetic Man'. Finally, a summary of the questions and a synthesis of the responses for each of the eight questions will be requested.

● You

Q1: What can you tell us about synthetic man in the context of synthetic biology?

● ChatGPT

"Synthetic man" in the context of synthetic biology refers to the application of engineering principles to the design and construction of biological components, systems, or organisms. This field is a sub-discipline of synthetic biology, which is an interdisciplinary area combining biology, engineering, genetics, chemistry, and computer science.

Here are some key points about synthetic man in the context of synthetic biology:

1. **Genetic Engineering:** At its core, synthetic biology involves the manipulation or creation of genetic material. This can include editing the DNA of existing organisms or designing entirely new genetic sequences. In the context of a synthetic man, this could mean altering human DNA to enhance certain traits, like increased resistance to diseases or improved physical abilities.
2. **Biological Systems Design:** Synthetic biology goes beyond genetic engineering by not only modifying existing biological systems but also designing new ones. This could involve creating new biological pathways in the human body or designing organisms that interact beneficially with humans.
3. **Ethical and Social Implications:** The idea of a synthetic man raises significant ethical, social, and philosophical questions. Issues like consent, the definition of being human, and the potential for inequality or abuse of such technology are central to discussions in this field.
4. **Healthcare Applications:** One of the more immediate applications of synthetic biology in humans is in healthcare. This includes developing more effective drugs, personalized medicine, and potentially curing genetic diseases.
5. **Challenges and Risks:** There are significant technical challenges in creating complex biological systems like a human. Additionally, there are risks such as unintended consequences of genetic modifications, biosecurity concerns, and the potential for ecological disruption.
6. **Regulatory and Safety Considerations:** Due to its profound implications, synthetic biology, especially as it relates to creating or modifying humans, is subject to stringent ethical guidelines and regulatory frameworks in many countries.

It's important to note that the concept of a fully "synthetic man" remains largely theoretical and speculative at this stage, with current technology focusing more on specific aspects of biology rather than the creation or comprehensive modification of an entire human organism.

● You

Q2: How is Synthetic Man changing our daily live and our society?

● ChatGPT

The concept of a "Synthetic Man," as it relates to synthetic biology and biotechnology, is still largely in the realm of theoretical and experimental science. However, the advancements in these fields are gradually influencing our daily lives and society in various ways. Here are some areas where such technologies are making an impact:

1. **Medical Advances:** Perhaps the most direct impact is in the field of medicine. Technologies derived from synthetic biology, such as gene editing tools like CRISPR, are revolutionizing the way we approach diseases, especially genetic disorders. These advances can lead to more effective treatments, personalized medicine, and potentially cures for previously incurable conditions.

2. **Agriculture:** Synthetic biology is also being used to improve crop yields, create pest-resistant plants, and develop more nutritious food products. These innovations can contribute to food security and have a significant impact on global agriculture.
3. **Environmental Impact:** Synthetic biology can aid in environmental conservation and cleanup efforts. For example, engineered microorganisms are being developed to break down pollutants, clean up oil spills, or capture carbon dioxide from the atmosphere.
4. **Ethical and Social Discussions:** As the field progresses, it raises profound ethical and social questions. These include concerns about genetic privacy, the modification of human embryos, and the potential creation of genetic "haves" and "have nots." These discussions are influencing policy-making, bioethics, and public perception of science.
5. **Economic Impact:** The growth of synthetic biology is fostering new industries and economic opportunities. Biotechnology companies are emerging in various sectors, from pharmaceuticals to biofuels, creating jobs and contributing to economic growth.
6. **Education and Workforce Changes:** The rise of synthetic biology is leading to changes in education and workforce requirements. There's an increasing demand for professionals with interdisciplinary knowledge spanning biology, engineering, computer science, and ethics.
7. **Biosecurity and Safety:** The potential for misuse of synthetic biology, whether intentional or accidental, raises concerns about biosecurity. This impacts policies and practices in science, healthcare, and national security.

While the idea of a fully synthetic human being is not a current reality, the technologies underpinning this concept are gradually changing various aspects of our daily lives and society. The pace of these changes will likely accelerate as the technology matures and becomes more integrated into different sectors.

 **You**

Q3: What are the 10 most important milestones in the history of Synthetic Man?

 **ChatGPT**

The concept of a "Synthetic Man," particularly in the context of synthetic biology and related fields, is an evolving area with numerous significant milestones. Here are ten of the most important milestones in the history and development of this concept:

1. **Discovery of DNA Structure (1953):** James Watson and Francis Crick's discovery of the double helix structure of DNA laid the foundation for modern genetics and biotechnology, paving the way for the development of synthetic biology.
2. **First Recombinant DNA Molecule (1972):** Paul Berg and his colleagues created the first recombinant DNA molecules, demonstrating the possibility of combining genetic material from different species, a foundational step for synthetic biology.
3. **Development of PCR (Polymerase Chain Reaction) (1983):** Kary Mullis's invention of PCR revolutionized molecular biology by allowing for the rapid amplification of DNA sequences, essential for genetic engineering and synthetic biology.
4. **First Transgenic Mammal (1984):** The creation of the first transgenic mouse, where a foreign gene was introduced into its genome, marked a significant step towards the genetic modification of complex organisms.
5. **Human Genome Project Completion (2003):** The completion of the Human Genome Project, which mapped all the genes in the human genome, was a monumental achievement, providing a comprehensive 'blueprint' of human genetic material.

6. **Synthesis of the First Synthetic Bacterial Genome (2010):** Craig Venter and his team created the first synthetic bacterial cell, where the genome was entirely chemically synthesized and transplanted into a recipient cell.
7. **CRISPR-Cas9 Gene Editing (2012):** The development of the CRISPR-Cas9 system for gene editing by Jennifer Doudna and Emmanuelle Charpentier revolutionized genetics, allowing precise and relatively easy modification of DNA in living organisms.
8. **Creation of Synthetic Yeast Chromosomes (2014):** The Synthetic Yeast Project, which aims to build the first synthetic eukaryotic organism (yeast), achieved a major milestone by synthesizing several yeast chromosomes.
9. **First CRISPR-Cas9 Human Trials (2016):** The first clinical trials using CRISPR-Cas9 for gene editing in humans began, marking a significant step toward potential genetic therapies for various diseases.
10. **Ongoing Ethical and Policy Debates:** Alongside these scientific achievements, ongoing ethical and policy debates surrounding genetic engineering, synthetic biology, and the concept of modifying or creating synthetic life forms are significant milestones. These discussions shape the direction and regulation of the field.

These milestones highlight the progression from understanding the fundamentals of genetics to manipulating and creating synthetic life forms. They reflect the intersection of science, technology, and ethics in the journey towards the concept of a "Synthetic Man."

You

Q4: Among the top 10 global challenges we have been facing in the last two decades, what Synthetic Man could contribute? Please formulate this from the perspective of Synthetic Man's contribution point of view.

ChatGPT

The concept of "Synthetic Man," largely rooted in the advancements of synthetic biology and biotechnology, offers potential contributions to several of the top global challenges faced in the last two decades. Here's how Synthetic Man, or the technologies associated with it, could contribute to these challenges:

1. **Healthcare and Disease Control:** Synthetic biology offers groundbreaking tools in combating diseases, including pandemics. Genetically engineered organisms or therapies can be designed to target specific pathogens, improve vaccine development, and offer personalized medical treatments.
2. **Environmental Conservation and Climate Change:** Synthetic organisms or engineered biological systems can play a role in mitigating climate change and environmental degradation. For example, microbes engineered to capture carbon dioxide or plants designed for more efficient photosynthesis could help reduce greenhouse gas levels.
3. **Food Security:** Synthetic biology can contribute to agricultural advancements, such as creating crops with higher yields, improved nutritional value, or resistance to pests and diseases. This can be crucial in addressing food shortages and malnutrition, especially in vulnerable populations.
4. **Clean Water and Sanitation:** Engineered bacteria or plants could be used for bio-remediation, helping to clean up polluted water sources. Synthetic biology could also lead to more efficient ways of desalinating water or purifying contaminated water.
5. **Energy Sustainability:** Synthetic biology offers avenues for sustainable energy production, such as biofuels generated from engineered organisms. These renewable energy sources can reduce dependency on fossil fuels and contribute to a more sustainable energy landscape.

6. **Global Inequality:** While synthetic biology itself is a high-tech field, its applications can be tailored to address global inequalities. For instance, affordable, personalized healthcare solutions or agricultural innovations can be developed for low-income regions.
7. **Biosecurity:** The advancements in synthetic biology necessitate and thus contribute to stronger biosecurity measures. By anticipating and addressing potential risks, such as the misuse of synthetic organisms, the field contributes to global safety and security.
8. **Ethical Governance and Policy Development:** The ethical challenges posed by synthetic biology drive the development of more comprehensive and nuanced governance structures and policies. This can have broader implications for how emerging technologies are regulated and managed globally.
9. **Education and Skill Development:** The multidisciplinary nature of synthetic biology encourages a more integrated approach to science education, fostering skills that are critical for addressing complex global challenges.
10. **Public Health and Aging Population:** Synthetic biology might contribute to developing therapies and interventions that address age-related diseases and improve overall healthspan, thus helping to manage the challenges associated with an aging global population.

The potential contributions of Synthetic Man and related technologies are vast, but they also come with significant ethical, safety, and societal considerations that must be carefully navigated.

 You

Q5: What kind of breakthroughs will Synthetic Man make in the future?

 ChatGPT

The future breakthroughs that could arise from the concept of "Synthetic Man," rooted in synthetic biology and related fields, are poised to be transformative across multiple domains. Here are some potential breakthroughs we might see:

1. **Advanced Gene Therapy and Genetic Engineering:** We could see breakthroughs in curing genetic diseases, extending human lifespan, and enhancing physical and cognitive abilities through precise and safe genetic modifications.
2. **Regenerative Medicine:** Synthetic biology could lead to significant advances in regenerative medicine, including the growth of organs and tissues for transplantation. This could solve the issue of donor organ shortages and reduce transplant rejection rates.
3. **Neuroscience and Brain-Computer Interfaces:** The integration of synthetic biology with neuroscience could lead to advanced brain-computer interfaces, potentially allowing for enhanced cognitive abilities or the treatment of neurological disorders.
4. **Personalized Medicine:** Tailored treatments based on individual genetic profiles could become the norm, leading to more effective and efficient healthcare with fewer side effects.
5. **Biofabrication and Biomaterials:** The development of new biomaterials through synthetic biology could revolutionize various industries, including manufacturing, construction, and textiles, with materials that are more sustainable, self-healing, or have novel properties.
6. **Environmental Bioremediation:** Engineered organisms capable of cleaning pollutants, breaking down plastics, or capturing greenhouse gases could significantly impact environmental conservation efforts.
7. **Synthetic Ecosystems:** There may be breakthroughs in creating synthetic ecosystems for terraforming or rehabilitating damaged environments on Earth, potentially even extending to extraterrestrial ecosystems for space exploration and colonization.

8. **Advanced Diagnostics:** The development of highly sensitive, rapid, and accurate diagnostic tools using synthetic biology could revolutionize disease detection and monitoring.
9. **Biosecurity and Defense:** In the future, we might see sophisticated approaches to biosecurity, using synthetic biology to detect, prevent, and respond to biological threats, including emerging infectious diseases.
10. **Artificial Life Forms:** One of the most speculative but profound breakthroughs could be the creation of entirely synthetic life forms, with potential applications ranging from industry to exploration.

These potential breakthroughs, while promising, also come with significant ethical, social, and regulatory implications that will need to be thoughtfully addressed. As with any rapidly advancing field, the balance between innovation and responsibility will be key to harnessing the full potential of synthetic biology in the context of Synthetic Man.

● You

Q6: With your current capability, what can you do to push forward the field of Synthetic Man?

● ChatGPT

As an AI developed by OpenAI, my capabilities can support and augment research and development in the field of Synthetic Man and synthetic biology in several ways:

1. **Data Analysis and Processing:** I can assist in analyzing large datasets, which is crucial in genetics and synthetic biology. This includes genomic data, experimental results, and simulation data. My ability to process and interpret large volumes of information quickly can help researchers identify patterns, anomalies, or trends.
2. **Literature Review and Research Assistance:** I can rapidly sift through scientific literature to provide summaries, extract relevant information, and keep researchers updated on the latest developments in their field. This can include new discoveries, technological advancements, and ethical discussions.
3. **Hypothesis Generation and Testing:** Utilizing my capabilities in pattern recognition and data analysis, I can help generate hypotheses for experiments or suggest potential avenues for research. I can also assist in designing experimental setups or simulations.
4. **Educational Resource:** I can serve as an educational tool for students and researchers entering the field. By providing explanations, answering questions, and offering resources, I can help demystify complex concepts in synthetic biology and related disciplines.
5. **Ethical and Social Implications:** I can assist in exploring the ethical, legal, and social implications of Synthetic Man and synthetic biology. This includes providing information on current debates, regulatory frameworks, and ethical guidelines.
6. **Collaboration Facilitation:** By connecting researchers with relevant studies, experts in the field, or potential collaborators, I can facilitate cross-disciplinary collaboration essential for advancing the field of synthetic biology.
7. **Grant and Scientific Writing Assistance:** I can aid in drafting grant proposals, scientific papers, and presentations, helping researchers communicate their ideas and findings more effectively.
8. **Predictive Modeling and Simulations:** While my capabilities in predictive modeling are limited compared to specialized software, I can assist in conceptualizing models and simulations that could be used in synthetic biology research.

9. **Public Engagement and Discussion:** *I can play a role in engaging the public in discussions about synthetic biology, addressing concerns, and disseminating knowledge about the potential benefits and risks associated with these technologies.*
10. **Supporting Innovation and Idea Generation:** *I can help brainstorm and explore creative applications of synthetic biology, potentially leading to innovative solutions or new research directions.*

While I can provide support in these areas, it's important to note that I am a tool to augment human capabilities and should be used in conjunction with expert knowledge and professional judgment in the field. My contributions are informational and educational, rather than experimental or practical in a laboratory setting.

 **You**

Q7: Is there cause for fear for humans in interacting with Synthetic Man?

 **ChatGPT**

The interaction between humans and Synthetic Man, or more broadly with advanced synthetic biology applications, does raise several concerns and potential causes for fear, which can be categorized into ethical, safety, and social considerations:

1. Ethical Concerns:

- *Playing God: The idea of creating or significantly altering life forms, including humans, raises ethical questions about the extent of human intervention in natural processes.*
- *Consent and Autonomy: Issues of consent, especially in altering human genetics, are of concern. The rights and autonomy of individuals who are genetically modified, or even created, in a lab are yet to be fully defined.*
- *Equity and Access: There's a risk that these technologies could exacerbate social inequalities if they are only accessible to the wealthy or certain groups, leading to a new form of genetic divide.*

2. Safety and Health Risks:

- *Unintended Consequences: Genetic modifications, especially in complex organisms like humans, can have unforeseen effects, potentially leading to new health issues or exacerbating existing ones.*
- *Biosafety: The release of synthetic organisms or modified humans into the environment could have unpredictable ecological impacts. There's also the risk of accidental exposure to harmful biological agents.*
- *Dual Use and Biosecurity: There's a concern about the potential misuse of synthetic biology for harmful purposes, such as bioterrorism or creating pathogens with enhanced virulence.*

3. Social and Psychological Impacts:

- *Identity and Discrimination: Genetically modified or synthetic humans might face identity issues or discrimination, leading to new forms of social conflict.*
- *Cultural and Religious Reactions: Such advancements could clash with various cultural, religious, or philosophical beliefs about the nature of humanity and life.*
- *Workforce and Economic Disruption: The introduction of enhanced humans into society could disrupt job markets and exacerbate economic inequalities.*

4. Regulatory and Governance Challenges:

- *The pace of technological advancement in synthetic biology may outstrip the ability of regulatory bodies to create appropriate guidelines and safety protocols.*

These concerns underscore the need for careful and responsible development in the field of synthetic biology. It involves not only scientific and technological considerations but also ethical, social, and regulatory frameworks that ensure the benefits are maximized while minimizing potential harms.

While there is cause for cautious consideration, it's also important to balance these fears with the potential benefits that synthetic biology and the concept of Synthetic Man could offer.

● You

Q8: Give some advice to researchers who are aiming to become senior researchers in the field of Synthetic Man!

● ChatGPT

For researchers aspiring to become senior researchers in the field of Synthetic Man, a domain that bridges synthetic biology, biotechnology, and potentially aspects of artificial intelligence and robotics, here are some valuable pieces of advice:

1. **Deepen Specialized Knowledge:** As you progress to a senior level, deepen your expertise in specific areas of synthetic biology and related fields. Stay abreast of the latest research, techniques, and technological advancements.
2. **Develop Leadership Skills:** Senior researchers often lead teams or projects. Enhance your leadership and management skills, including team management, project planning, and conflict resolution.
3. **Broaden Interdisciplinary Understanding:** Expand your understanding of related disciplines. This could include AI, robotics, ethics, policy, and other areas intersecting with Synthetic Man research.
4. **Engage in Collaborative Research:** Foster collaborations with other researchers and institutions. Interdisciplinary projects can lead to innovative approaches and solutions in the field.
5. **Publish and Review Scholarly Work:** Regularly publish your research in respected journals. Also, involve yourself in peer-reviewing others' work, which can provide deeper insights into emerging research and contribute to your field's knowledge base.
6. **Mentor and Teach:** Mentor junior researchers and students. Teaching and mentoring can refine your understanding of the subject and develop your skills in communication and leadership.
7. **Continuous Learning and Adaptation:** Stay open to learning new methods and technologies. The field is rapidly evolving, and adaptability is key to staying at the forefront.
8. **Ethical and Societal Considerations:** As a senior researcher, engage with the ethical, legal, and societal implications of your work. Your research could have significant impacts, and it's important to consider these responsibly.
9. **Secure Funding and Resources:** Develop skills in writing grant proposals and securing funding. This is crucial for advancing your research and supporting your team or department.
10. **Networking and Conferences:** Actively participate in conferences, workshops, and seminars. Networking with peers can open up new research opportunities, collaborations, and insights into your field.
11. **Innovation and Risk-Taking:** Don't be afraid to explore uncharted territories or unconventional ideas in your research. Senior researchers are often at the forefront of breaking new ground in their fields.
12. **Balance Practical and Theoretical Work:** Ensure a balance between theoretical research and practical applications. This balance can lead to more impactful and comprehensive research outcomes.

Remember, becoming a senior researcher is not just about advanced knowledge in your field but also about leadership, ethical considerations, and the ability to drive the field forward through innovation and collaboration.

Note: All the answers with italic font of this section are from the part of ChatGPT 4 (OpenAI, 2023).

Discussion

- **A summary of the answers given by ChatGPT**

This discussion in its content brings to our attention the fact that through his answer from **Q1**, we notice a particular emphasis placed on the contribution of the field of **synthetic biology** because *"the concept of a fully "synthetic man" remains largely theoretical and speculative at this stage, with current technology focusing more on specific aspects of biology rather than the creation or comprehensive modification of an entire human organism"* (OpenAI, 2023).

ChatGPT considers that the leading scientific and technological milestones in the success of the Synthetic Man project were represented by the Discovery of DNA structure (1953), the First Recombinant DNA Molecule (1972), the Development of PCR (Polymerase Chain Reaction) (1983), First Transgenic Mammal (1984), Human Genome Project Completion (2003), Synthesis of the First Synthetic Bacterial Genome (2010), CRISPR-Cas9 Gene Editing (2012), and Creation of Synthetic Yeast Chromosomes (2014). We note that the crucial moments of this history of Synthetic Man are primarily shared with those of Synthetic Biology.

The technological revolution of a genetic nature predicted for the end of the 21st century by Cornish (2004) is fully supported by the technologies assumed by the design and implementation of SM at the levels of medicine, societal ethics, agriculture and industries in the field of biotechnology, biosecurity and safety, but also by changes in education and workforce.

On the list of contributions that SM could have in the context of global challenges when the ChatGPT expressed itself, it had a report on synthetic biology, claiming that it would be favourably influenced in areas such as healthcare and disease control, environmental conservation and climate change, food security, clean water and sanitation, energy sustainability, global inequality, biosecurity, ethical governance and policy development, education and skill development, and public health and ageing population.

The potential breakthroughs brought by SM technology refer to advanced gene therapy and genetic engineering, regenerative medicine, neuroscience and brain-computer interfaces, personalised medicine, environmental bioremediation, synthetic ecosystems, advanced diagnostics, biosecurity and defence, and artificial life forms.

As an LLM, ChatGPT considers that it can contribute to catalysing the SM field through data analysis and processing, literature review and research assistance, hypothesis generation and testing, educational resources, ethical and social Implications, collaboration facilitation, grant and scientific writing assistance, predictive modelling and simulations, public engagement and discussion, supporting innovation and idea generation. Regarding ChatGPT's contribution to catalysing the development of the SM field, he states that its skills are mainly oriented towards the informational and educational side and less towards the experimental or practical laboratory side. However, after the announcements made by Sam Altman (Bote, 2023), one year after the launch of ChatGPT (a day before being fired by the board of OpenAI), this contribution will be reconsidered.

Concerning the fear that man (society) should have in the interaction with SM, in addition to the aspects related to safety and health risks, social and psychological impacts, and regulatory and governance challenges, we mainly draw our attention to the concerns ethics that refer to *"playing God"* regarding *"the idea of creating or significantly altering life forms, including humans"* (OpenAI, 2023) from the perspective of getting out of control of these technologies and dangerous manipulation for humanity. The solution recommended by ChatGPT consists of calling for prudence and balance, especially on the human side, regarding the creation and use of these intelligent technologies to avoid the manifestation of these fears.

At the end of the discussion, among the 12 tips offered by ChatGPT to become a senior researcher in the field of SM, we draw our attention to those that refer to *deepening specialised knowledge, broadening interdisciplinary understanding, engaging in collaborative research, continuous learning and adaptation, ethical and societal considerations, networking and conferences, and innovation and risk-taking.*

- **About limitations of interaction with ChatGPT**

Overall, the interaction with ChatGPT was interesting. However, it is essential to highlight that there were several simulations before the session in this study, both in ChatGPT 3.5 and ChatGPT 4. Thus, we noticed differences in the response approach between the two versions, which is expected considering the different performances and facilities. With maximum certainty, we could find differences in the formulation of responses from ChatGPT 4 within the same and in different sessions. These intra- and extra-session response differences are minimalistic while preserving the essential ideas. However, we sometimes had to be more explicit about a particular question. This is the case of question Q4, where to avoid ambiguities, we have added the clarification "Please formulate this from the perspective of Synthetic Man's contribution point of view."

These limitations and characteristics of ChatGPT lead to the impossibility of 100% replicating the answer to each of the eight questions, which is also characteristic of natural intelligence, in the sense that the same open-ended question addressed to the same person at different times will not imply an identical answer.

- **General framework for dialogue with an LLM about a technology**

This section corresponds to the second step in the methodology of this study. In the first stage, we chatted with ChatGPT (version November 22, 2023) about SM by asking eight questions about SM with reference mainly to the concept, past, present, future, challenges, contributions, and fears. The questions addressed are those in the quadrant presented at the end of the **Material and Method** section.

We believe that this list of questions can be used for other technologies (e.g. biological computer, quantum computer) but also in the use of other LLMs, such as Bart, Claude, Galactica, Lamda, Llama, Palm (Lutkevich, 2023). Thus, a generalization of this working framework (dialogue) with ChatGPT on any topic of interest to us is justified by parametrizing the model as follows: "**Synthetic Man**" from the list above becomes <Parameter1>, "**Synthetic Biology**" becomes <Parameter2>, and <last two decades> becomes <Parameter3>. Thus, we propose that this dialogue framework be titled LLM Dialog Framework on Technology (LLM-DFonTech) and take the form of the one in the quadrant below.

Q1: What can you tell us about <Parameter1> in the context of <Parameter2>?

Q2: How is <Parameter1> changing our daily life and our society?

Q3: What are the 10 most important milestones in the history of <Parameter1>?

Q4: Among the top 10 global challenges we have been facing in the last <Parameter3>, what could <Parameter1> contribute? Please formulate this from the perspective of <Parameter1>'s contribution point of view.

Q5: What kind of breakthroughs will <Parameter1> make in the future?

Q6: With your current capability, what can you do to push forward the field of <Parameter1>?

Q7: Is there cause for fear for humans in interacting with <Parameter1>?

Q8: Give some advice to researchers who are aiming to become senior researchers in the field of <Parameter1>.

where: <Parameter1> is the technology to be analyzed, <Parameter2> is the technological context, and <Parameter3> is the reference period.

We believe that this framework can be translated into a Large Language Model (LLM) plugin function like ChatGPT, as can be seen in the similar code sequence generated in Python (Figure 1) using the parameters ("Synthetic Man", "Synthetic Biology", "two decades").

```

class LLM_DFonTech:
    def __init__(self, parameter1, parameter2, parameter3):
        self.parameter1 = parameter1
        self.parameter2 = parameter2
        self.parameter3 = parameter3
    def generate_questions(self):
        questions = [
            f'What can you tell us about {self.parameter1} in the context of {self.parameter2}?',
            f'How is {self.parameter1} changing our daily life and our society?',
            f'What are the 10 most important milestones in the history of {self.parameter1}?',
            f'Among the top 10 global challenges we have been facing in the last {self.parameter3}, what could {self.parameter1}
            contribute?
            Please formulate this from the perspective of {self.parameter1}'s contribution point of view.",
            f'What kind of breakthroughs will {self.parameter1} make in the future?',
            f'With your current capability, what can you do to push forward the field of {self.parameter1}?',
            f'Is there cause for fear for humans in interacting with {self.parameter1}?',
            f'Give some advice to researchers who are aiming to become senior researchers in the field of {self.parameter1}."
        ]
        return questions
# Example usage:
plugin = LLM_DFonTech("Synthetic Man", "Synthetic Biology", "two decades")
questions_list = plugin.generate_questions()
for question in questions_list:
    print(question)

```

Figure 1. Code generated in Python.

Conclusion

The discussion about the synthetic man, the artificial man and the humanoid robot is a hot topic in the context of the expansion of Artificial Intelligence, against the background of the idea of transhumanism launched in France in the first part of the previous century (Moatti, 2020), highlighted to some extent and of the pessimism of the society-technology relationship by Jack Ellul (1954) through his book "La Technique ou l'enjeu du siècle", translated in the USA ten years later with the title "The Technological Society".

Inspired by the work of the authors Tong and Zhang (2023), in which a dialogue with ChatGPT on the subject of "synthetic biology" was presented empirically, we considered it interesting to apply the same dialogue approach with ChatGPT on the subject of "synthetic man" as a technological pool and as a subsequent technology of synthetic biology. We conceptualized the dialogue held by the two authors on the subject as the **LLM-DFonTech** framework, through which three of the seven initial questions were updated and an additional question was added.

Our contribution to this work consists of organizing and implementing, from a conceptual perspective, a dialogue with ChatGPT 4 on the topic of *synthetic man* as a subsequent topic to *synthetic biology*, updating three questions and adding a question to the original Tong and Zhang (2023) dialogue model to be applied in any analysis on another technology by parameterization. We have also provided a Python code sequence for this generalization, indicating that a plugin function could be developed to make it available to interested users.

From the systematization of the answers, we find that the synthetic/artificial man is not yet an imminent technology for society, this being at this moment still a speculative idea; nevertheless, several points of reference (familiar with those of synthetic biology) have been passed towards the realization of the synthetic man; that the interdisciplinary achievements that will contribute to the realization of the synthetic man will have favourable implications in societal terms and even in terms of some global challenges, such as the environment and human health; and that we should not have a societal fear of implementing such technologies as long as our actions are ethical, responsible and prudent.

A challenging aspect of a future approach is the annual realization of such a dialogue with ChatGPT on the subject of synthetic man in order to dynamically analyze the progress made by LLMs in general and ChatGPT in particular. This type of dialogue can be conducted on any technology or technology pool, depending on the societal interest at a given time.

Declaration of Generative AI and AI-assisted technologies in the writing process: During the preparation of this work the authors used ChatGPT 4 to facilitate the research process as defined by

the research methodology. After using this tool, the authors reviewed and edited the content as necessary and take full responsibility for the content of the publication.

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