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ABOUT HOW TO ADVANCE THE RESEARCH ENVIRONMENT IN KOÇ UNIVERSITY.

In a candid interview, Professor Metin Sitti, the President of Koç University, provides an exclusive look into his vision for the institution and his current research endeavors involving tiny medical robots. Additionally, he shares intriguing details about the pivotal moments that led him to become a researcher, and delves into other captivating aspects of his journey.

‘Koç University has an excellent infrastructure for medical research. In the coming decades, my research objective is to develop tiny medical robots operating inside the human body. My dream is to achieve this goal to save more lives of patients at Koç University Hospital.’

BECOMING A RESEARCHER

I believe being a researcher is closely tied to one’s personality. Reflecting on my childhood, curiosity stands out as a major aspect of my identity. Curiosity has influenced not only my approach to research but also other areas of my life. The freedom in research, where you create your own problems and choose what to understand, is a profound aspect. The process of making it happen, ultimately leading to a deeper understanding of creating something impactful for society, is a significant reason why I cherish research. Being part of this unique human endeavor, absent in other creatures, distinguishes us. It goes beyond mere survival, as we strive to comprehend and reshape our surroundings through research and new knowledge.

What kind of environment do you think needs to be created to nurture a more thriving research climate?
Having been in many different top research environments around the world, I believe the most important aspect of top research environments is first, without a doubt, top people. The key to a successful research environment lies primarily in attracting the most internationally talented individuals to a given institution.

The second aspect is to provide them with the best research infrastructure, such as labs, staff, space, buildings, and other essential elements. Another aspect is the atmosphere. It’s important to have a collaborative research environment with effective communication for people to collaborate. Finally, it is crucial to consider how to fund and create research funding for both individuals and the research environment to facilitate the best research outcomes globally.

Your research often focuses on the intersection of interdisciplinary topics, could you share the specific areas on which your research focuses, given its interdisciplinary nature?
My research focuses on wireless miniature robots designed to operate inside the human body. This type of

research spans across various disciplines. First of all, robotics, as a field, involves engineering, as building a robot requires the expertise of engineers. Additionally, computer scientists are essential for programming robots. Depending on the type of robot being developed, collaboration with material scientists and experts from different fields is also necessary.

I specialize in constructing medical robots that navigate inside the body on a miniature scale, where my work involves collaboration with micro/nanotechnology engineers, chemical scientists, and medical doctors. This interdisciplinary approach allows us to understand optimal robot placement, functionality, and address clinical challenges. My team comprises of individuals from diverse backgrounds, including scientists, engineers, and medical doctors, fostering a collaborative effort that brings together a range of expertise to make our research possible.

Can we talk a little bit about your entry into robotics?

My interest in robots goes back to my childhood. When I was a child, I didn't have many toys, so I created my own. Building my toys sparked my interest in robots because they are machines that we can design, build, and ultimately make functional to help people. I once promised my mother that I would build a dishwashing robot, but now we have dishwashers that solve the problem anyway!

Robots are incredibly useful. By mastering the art of building a robot, you can physically and experimentally change people's lives. It transcends theoretical research; that's the allure of robots—we can work and live with them. More examples will emerge, and they will become parts of our lives. There is even the looming potential that they may gradually replace certain tasks, which is not fully science fiction but an unfolding reality.

In 1992, as an undergraduate, I considered becoming a theoretical physicist. Concurrently, I found myself drawn to engineering. While deciding on my graduation project, my advisor, from Yale University, who specialized in robots, showed me a project titled "How to make robots that can navigate without hitting obstacles." This captivating project ignited my interest in robots, combining

HIS NEW POSITION AS 'PRESIDENT OF KOÇ UNIVERSITY'

I perceive my new role as the President of Koç University as an extension of my long-standing dream to impact society through research. Over the last 20 years, I have taken pride in mentoring many top researchers; over 50 of them have gone on to become professors around the world, and more than 50 others contribute their expertise to various industries.

Since 2019, I've been a part-time professor at Koç University, a role I accepted after having received the 2018 Koç University Rahmi M. Koç Medal of Science. This connection and collaboration led me to consider what other impact I could generate. When the opportunity to become president at Koç University arose, it posed a challenging decision. I had to choose between continuing my role as a top researcher in the Max Planck Society environment, where everything I dreamed of in terms of research was provided, and taking on the responsibilities associated with being a university president.

Ultimately, I considered the impact I could have beyond my individual research efforts. I realized that returning to my native country and giving back to both Türkiye and Koç University, by leading the institution and influencing not only a group of researchers but the entire university, the country, and potentially even the world in different ways was an opportunity I could not have passed on. Accepting this position was influenced by a convergence of many factors, with one of the primary motivations being the question of how I could contribute to my country at this moment.

HIS GREATEST ACHIEVEMENT

I consider my greatest achievement to have my family—my wife and my two daughters—and the experience of becoming a father. Balancing the roles of a researcher, father, partner, and active member of society is a significant challenge. I take pride in successfully navigating and maintaining this balance.

Also, our work has led to the creation of remarkable robots, particularly the breakthroughs achieved with the soft, tiny machines we've developed. Additionally, our gecko-inspired microfiber adhesives for robotics are not only in the market but also being used by people. It brings me immense satisfaction to see how our research has translated into reality, found its way into the market, and impacted the lives of many.

my scientific interests with my passion for building things. It began on a large scale at the Marmara Research Center at TÜBİTAK*. We pioneered the construction of robotic arms in Türkiye. I was responsible for making it intelligent with a camera vision system to track unknown objects. This initiative later evolved into creating tiny robots in Japan. Subsequently, I immersed myself in the development of exceedingly small machines for various applications, driven by a deep appreciation for miniaturization.

Is it more challenging to work on a small scale?

Working on small-scale robots presents significant challenges as every part must be reduced significantly in size, resulting in less weight and different physical behaviors. The manufacturing, operation, observation, and communication of these tiny robots pose many challenges.

*TÜBİTAK: The Scientific and Technological Research Council of Türkiye

In 1999, while exploring options for my doctoral studies during a conference in the United States, a famous robotics professor at UC Berkeley introduced me to a remarkable “fly” machine, comparable in size to a real fly or a bee. At that time, the concept of a robot resembling an insect or being that small was unprecedented. Overwhelmed by this discovery, I decided to relocate to California and work on that project at the University of California, Berkeley. Berkeley proved to be transformative, marking the beginning of my journey into constructing very tiny and nature inspired robots.

How do you foresee your discoveries and research contributing to science? Which branches of science will they impact and what kind of new projects might they yield?

In the scientific field, our research on small-scale robotics aims to revolutionize physics and devices operating at miniature scale. Therefore, when examining these tiny robots, it is crucial to understand how, on this small scale, one can build a machine capable of operating in a complex environment like the human body. This requires a comprehensive understanding of material sciences, physics, chemistry, and biology. Understanding how our body will interact with these tiny machines is crucial as they involve intricate immunological interactions and biological processes. Addressing these issues contribute to the advancement of science in both robotics and medicine.

What do you envision the future of your field will look like two decades from now?

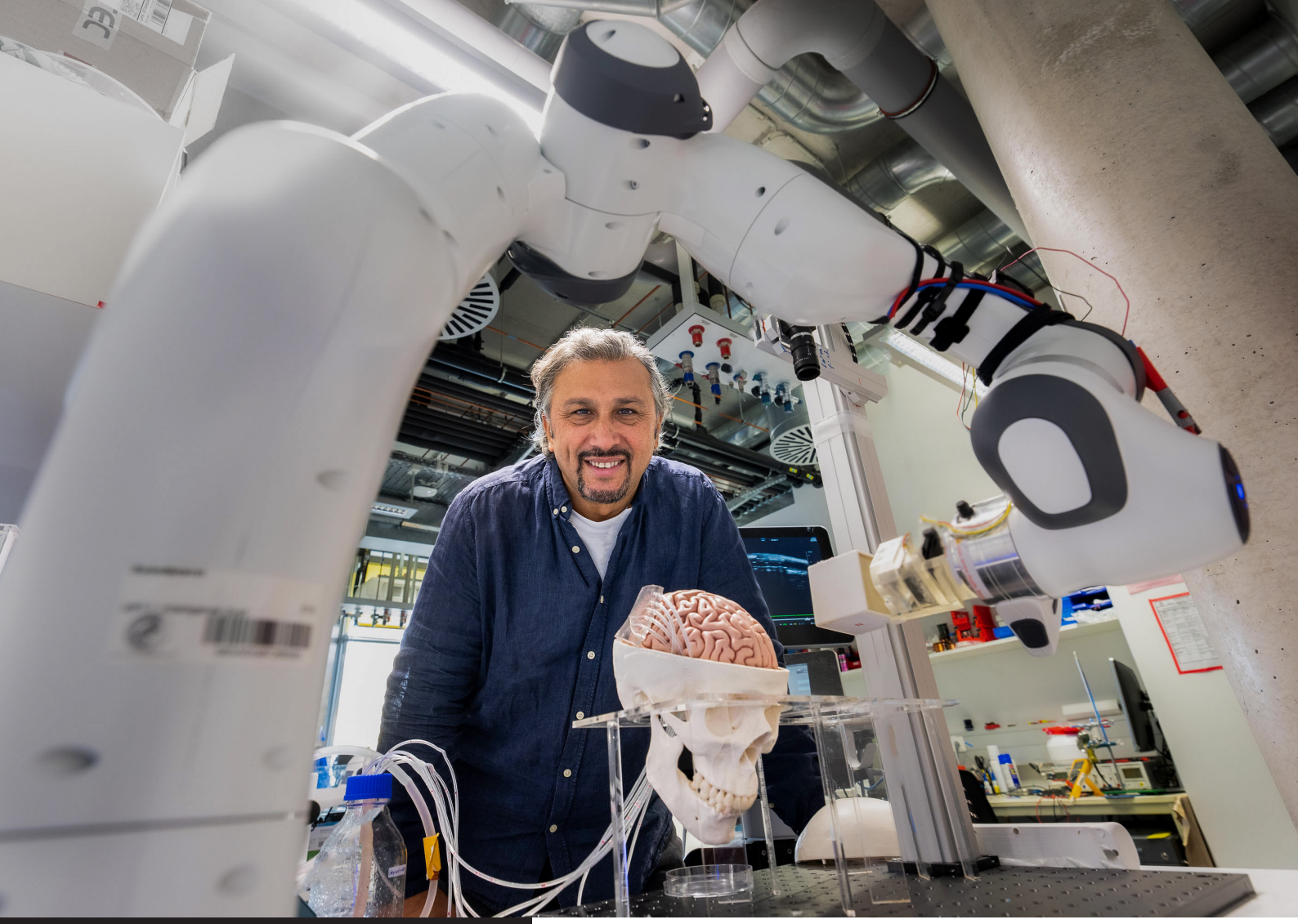
Innovative research indeed, stems from the imagination of the arts. You may recall a popular movie from the 1960s, *Fantastic Voyage*. The film envisioned a submarine shrinking into a tiny machine navigating inside the body to cure a patient with a brain stroke. In our field, the aspiration is nothing short of turning that movie into reality!

In the coming decades, our goal is to demonstrate that these tiny machines can truly function within humans. Currently, we’re in the laboratory design phase, testing them in non-human environments. We have just begun animal testing, inserting these machines into rats, moles, and later, larger animals. Success in their medical functions, like treating patients with cancer or stroke minimally invasively, would pave the way for human testing. However, achieving this requires extensive development in engineering, science, and medicine and the clinical implementations of these machines.

HIS CHILDHOOD HERO AND HIS FAVORITE CHILDHOOD TV SHOW

My most admired hero was Captain Cousteau. As a child, my biggest curiosity was what lies beneath the deep water. My dream was to become a crew member on his boat. I found immense inspiration in Captain Cousteau’s discoveries and his profound impact on nature, environment and the sciences. In many ways, he was an inventor. He was also one of the first people to show the drastic effects of climate change on underwater life.

The animated sitcom The Jetsons (Jetgiller), and Hop Hop Tonton (Barbapapa), featuring a shape-changing creature, were among my favorite TV shows. “Barbarpapa” inspired me to build a shape-changing robot! Childhood interests, games, and heroes have a profound influence on you when young, and provide subconscious inspiration. Once, Cahit Arf, a famous Turkish mathematician, told me when he was a child, he would often look at our flag, focusing on the geometric positioning of the moon, and the star. Inspired by that, he created a new mathematical theory!



HIS BIGGEST WISH

My personal scientific aspiration is to see the machines we have been designing and building over the last few decades truly functioning in real-life medical scenarios. I genuinely want to contribute to saving the lives of actual patients. I envision sitting alongside doctors, witnessing our robots effectively treating patients who may have been considered incurable by traditional means. My dream for the next few decades is to realize this technology's potential and, for the first time, save a patient's life using these advancements.

As we explore your vision for the future of Koç University in this interview, considering that diverse perspectives are crucial in all education institutes, what strategies or initiatives do you believe can be implemented to enhance diversity and inclusivity within a university community?

Diversity is a major factor, or the main catalyst, in both nature and human systems. In the absence of a diverse system, one cannot adapt to changing conditions or create novel ideas and solutions. This is why, not only in science but also in our universities, it is crucial to create diverse environments. This means bringing together individuals from different backgrounds, ethnicities, genders, knowledge bases, and cultures so that we can truly have adaptable and enjoyable perspectives from different angles.

Inclusion is equally vital because it ensures that diverse people can live and work together. In university environments, fostering a diverse and inclusive atmosphere entails creating

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ON DIVERSITY BEING A REQUIREMENT FOR SURVIVAL.

promotions and incentives to attract individuals from diverse backgrounds and genders during faculty and staff hiring or recruitment processes. Additionally, providing an environment where diversity allows freedom of expression, collaboration, and the sharing of opinions is essential in building a nice community. This is particularly important for maintaining a healthy and too many diverse community in a given research environment and also in universities.

Examining evolution reveals the critical role diversity plays in its success. Throughout the ages, the coexistence of diverse animal species, ranging from birds, fish, and countless others, has been instrumental for sustaining life on earth against changing environments. The variety among species facilitates swift adaptation to changing conditions, ensuring the survival of those capable of adapting.

This principle also applies to communities and societies. If everyone is similar and drastic negative changes unfold, everyone would face significant issues and struggle to adapt to these societal transformations. Diversity, in this context, provides flexibility and adaptability against major societal and institutional shifts, ensuring that diverse perspectives thrive even amid drastic conditions.

As the new president of Koç University, what is your vision for the institution and what top priorities do you aim to focus on during your presidency?
As the new president, I have a vision and specific goals to further elevate Koç University. My top priority is excellence across teaching, research, and entrepreneurship. Quality is fundamental; it's not just about numbers but ensuring a top-notch environment. This commitment extends to our students, faculty, staff, and the overall academic atmosphere.

My goal is to push the boundaries of excellence further and advance the overall quality of Koç University to become a top university in the world. As a university, our mission is to create a positive impact not only in the realms of science and technology but also within our society, industry, and people's lives. This entails creating new jobs, nurturing industry-ready individuals, and promoting startups, innovation, and entrepreneurship. We strive to make a positive impact on society by contributing to advancements in healthcare, technology, artificial intelligence, and robotics, ultimately positively enhancing people's lives.

Additionally, diversity and inclusion remain top priorities, as mentioned earlier. While our university is already strong in this aspect, I aim to further enhance it to ensure that everyone not only enjoys being part of this institution during their studies but also maintains a connection and sense of pride even after graduation.

Another mission I envision for Koç University revolves around sustainability. I believe that in Türkiye, insufficient attention is attributed to this subject. It is crucial to raise awareness and knowledge about environmental issues and climate change. As a university, it is our responsibility to contribute to the preparation of our country and the world for upcoming challenges and to prevent them with proper measures. In the years ahead, we aim to have fully solar energy-powered campuses at both Rumelifeneri and Topkapı, including our

hospital. I aspire for our university to take an active role in a prestigious network, similar to the recently founded School of Sustainability at Stanford University, and we are actively working to achieve this goal.

What excites you most about Koç University?
What excites me most about Koç University is its remarkable journey to excellence in education, research, and its societal impact within just 30 years. The unique synergy between high-caliber individuals—students, faculty, and staff—has positioned this university as one of Türkiye's leading universities.

Our campus features a unique cultural environment, harmonizing beautifully with our diverse faculty and staff, all working toward a common goal. Koç University distinguishes itself not nationally but also on international platforms, showcasing a unique identity. My goal is to propel Koç University's status beyond its current standing one of Türkiye's premiere universities, elevating it to becoming a globally recognized institution, strengthening its position among the world's foremost academic institutions.

How can Koç University further advance interdisciplinary research?
Interdisciplinary research has become the global standard in research environments, given that nearly every advanced research topic involves multiple disciplines. Encouraging and intensifying interdisciplinary research within a university is crucial. The first important goal is to ensure that individuals from different disciplines can work together in the same environment.

That means we need to provide spaces and labs without physical barriers as much as possible. Traditionally, departments and disciplines have operated within silos, isolating themselves to some extent. However, the current trend is to break down these barriers. Labs without walls enable individuals from different disciplines to work side by side.

At our university, we have implemented programs at undergraduate, MSc, and PhD levels, fostering collaboration among engineers, medical professionals, business experts, and individuals from various disciplines. This inclusive approach creates a culture of interdisciplinary teamwork, a mission that is vital for our university. We have successfully incorporated this philosophy into our educational and research programs, buildings, and overall culture at Koç University, promoting a collaborative and interdisciplinary environment across all colleges and schools.

What do your current new research endeavors at Koç University promise?
In the coming decades, my research objective is to develop breakthrough tiny medical robots for clinical applications. Initially, the emphasis will be on testing these robots in live animals, as this step is crucial to demonstrate their effectiveness in animal models and validate their potential to save lives in vivo. Once we achieve positive results, we can proceed to the next phase of testing, which involves human patients.

Koç University has an excellent infrastructure for medical research in the sense of testing drugs, robots or other devices on small animals. Once we demonstrate the safety functions, we can then progress to testing on humans in our Koç University Hospital Clinical Trials Unit. Thus, we will develop medical devices that can operate in the clinic. My dream is to ultimately make these tiny robots that will save lives of more patients at Koç University Hospital.

This would mark a breakthrough on a global scale, not only at our university. These new machines have not yet shown life-saving capabilities. With the advanced infrastructure and the collaboration of our faculty members, I look forward to driving this research in the next few decades.

ABOUT PROF. METİN SİTTİ

Prof. Metin Sitti, appointed as the new President of Koç University in Fall 2023, worked as a Director at the Max Planck Institute for Intelligent Systems in Stuttgart, Germany, during 2014-2023 as the only Turkish fellow of the Max Planck Society in Germany. Prof. Metin Sitti has opened up new horizons and achieved many scientific breakthroughs with his work on the improvement of human health at the very intersection of sciences, engineering and technology. His research encompasses a wide variety of subjects in small-scale robotics and intelligent systems, including wireless miniature medical robots, miniature robots and new materials inspired by nature, and physical intelligence.

Having completed his undergraduate studies at the Boğaziçi University Department of Electrical and Electronics Engineering in 1992, Prof. Sitti received his Master's degree from the same department in 1994. He completed his doctoral research at the Tokyo University Department of Electrical Engineering in Japan in 1999. From 1999 to 2002, Sitti worked as a research scientist and lecturer at the University of California at Berkeley in the United States. From 2002 to 2014, he was a tenured professor at the Robotics Institute and the Department of Mechanical Engineering at Carnegie Mellon University in the United States. From 2011 to 2012, he was a Visiting Professor at Harvard University, EPFL and Sorbonne University.

Prof. Metin Sitti was the recipient of the 2018 Koç University Rahmi M. Koç Medal of Science and worked as a part-time professor at Koç University School of Medicine and College of Engineering from 2018-2023. He received the "Breakthrough of the Year" Award in Engineering and Technology at the Falling Walls World Science Summit in Berlin in 2020.

He has been a Highly Cited Researcher in 2021, 2022, and 2023 by Clarivate* and has been elected as a Member of the National Academy of Engineering (NAE) in recognition of his distinguished contributions to engineering, "for bioinspired adhesives and small-scale mobile robotics" in 2024.

* Each year, Clarivate identifies the small fraction of the global research scientists and social scientists who have demonstrated significant and broad influence in their field(s) of research.