ISSUE #2

Beyond Imagining

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Welcome to Beyond Imagining.

This new era belongs to cyber–physical systems that merge the capabilities of humans and machines. It is the period in which artificial intelligence (AI), genome editing, renewable energy, 3D printing, autonomous vehicles, big data and the Internet of Things combine our physical, digital and biological worlds.

— Professor Samuel Oluwatobi Oluwafemi, senior lecturer and researcher in Applied Chemistry at UJ

What does this mean for you? How do these innovations affect your life, your education, your work, your health and your happiness? In our first edition, we looked at the intersection of 4IR and education. This edition will examine how 4IR is affecting our health and well-being, and the impact it will continue to have as technology evolves.

Join us as we ask the most important questions of our time, and as we uncover their fascinating answers.
The point at which 4IR and healthcare come together has resulted in some of the most incredible feats of creativity and engineering the world has ever seen. And what makes these innovations even more profound is the real and tangible effect they have on people’s lives. We’re not talking about making homes and workspaces more tech savvy and convenient here. We’re talking about helping people with disabilities, curing complex diseases, and making lives healthy, happy and long lasting.

Bionic limbs. Exoskeletons. Cancer-targeting nanodrugs. Walking-navigation apps. Artificially intelligent diagnostic systems. All these, many of which can be hard to believe and difficult to understand, are transforming the way we treat various conditions and diseases.

The issue is not uncomplicated. This advanced technology isn’t always available to help the people who need it the most, people whose treatment is hindered by cost and access constraints. But that simply broadens the need and scope for further innovation: for inventions to be adjusted and optimised so that they are available to an increasingly larger group of people.

In Africa, the potential is enormous. There are huge opportunities – indeed demands – for the continent to absorb, integrate and optimise all aspects of 4IR to maximise its human potential.

Our societies must wholeheartedly embrace the best ways to create opportunities for universal progress. And our continent needs to be fully committed to a truly inclusive vision and to making advances in 4IR available for everyone.
4IR plays a critical role in global efforts to address COVID-19.

It’s hard to believe that there isn’t an individual, business or industry that hasn’t been affected by the outbreak of COVID-19. In a matter of weeks, all of our lives have been impacted in truly unprecedented ways. COVID-19 has brought with it repercussions no one could have anticipated: countries in lockdown and the near grinding to a halt of international travel.

We have all had to adapt quickly to the constantly evolving status quo. Overnight, we have had to reconsider how we work, how we educate our children, how we interact with others, and how we ensure our bodies and environments are healthy and hygienic. Navigating this seismic shift has resulted in a deepening dependency on the technology that has come to define 4IR.

As self-isolation and social distancing become critical measures in controlling the pandemic, remote working has become standard practice for many businesses. Companies have also had to introduce digital tools and solutions as a matter of urgency. Schools and universities that have the capacity and the means are teaching their learners and students online. More than ever before, the Internet has become a lifeline we all need to stay connected to the world.

But 4IR is also being used in more essential ways on the pandemic’s frontlines.

“The use of AI in dealing with the virus,” says UJ Vice-Chancellor Professor Tshilidzi Marwala, “has ranged from robotic cleaners spraying disinfectant at segregated wards, to AI voice assistants calling people to advise on home quarantine protocols. AI-powered infrared sensors that detect body temperatures have also been used to assess the health of commuters.”

Drones are being used in China to deliver medicines and quarantine materials while reducing contact between people, and a 3D printer was used in Brescia, Italy, to produce a valve for an intensive-care device when it couldn’t be delivered through traditional channels. Smartphones are also being used to track the movements of infected people, and to trace the people with whom they might have come into contact.

Data analytics and predictive model systems have proven essential in understanding how the disease is spreading and, as far as possible, preempting treatment measures that might be required.

We are living in remarkable times, but fortunately we are facing this crisis with remarkable tools. As the situation progresses, the innovation and creativity that developed these tools in the first places is only going to become more and more essential.
Right now, we are being forced to improvise solutions to address the lack of traditional equipment and devices. The dead frames for the face shields are made by 3D printers and the shields are laser cut from old transparency sheets. The sheets can either be sanitised between uses or replaced.

~ RUDIE STRAUSS
UJ MAKERSPACE MANAGER

The team at the UJ Makerspace is developing innovative solutions to help curb the spread of COVID-19. They are using 3D printing to produce face shields that protect healthcare workers working at the frontlines of the pandemic, as well as other medical staff and security personnel.

This innovation comes at a time when state suppliers are scrambling to secure essential equipment such as ventilators, masks, gloves, respirators and sanitisers from local and international manufacturers. Worldwide, institutions and organisations, universities included, have stepped up to the plate to use new, accessible and affordable technologies to protect public health.

“Right now, we are being forced to improvise solutions to address the lack of traditional equipment and devices,” says UJ Makerspace manager Rudie Strauss. “The dead frames for the face shields are made by 3D printers and the shields are laser cut from old transparency sheets. The sheets can either be sanitised between uses or replaced.”

UJ’s face shields have already been developed and distributed to the clinics on UJ’s campuses, and to healthcare professionals in the Netcare 911 network free of charge. At the moment, the UJ Makerspace lab can produce 10 to 15 shields a day, but the team is working on a new design that could increase the rate of production to more than 50 shields a day.

Rudie adds that although the shields are not made to medical standards, they are providing a necessary layer of additional protection at a time when better alternatives are not yet available.

Click here to watch the video.
“Simulation training limits the risk of human error in real-life situations,” says Robert. “By the time you’re on a mountain in the middle of the night dealing with a seriously injured and hypothermic patient, you’ve done the training. You know what to do.”

But that’s not where UJ’s simulation practices end. As technology improves in the wake of 4IR, so are the devices and training methods available to EMC students. “Simulation mannequins, drones, GoPros and our high-tech mobile command posts are all part of the day-to-day now, and help us to teach our students to be experts in what they do,” says Connor Hartnady, EMC lecturer and the head of rescue.

Although they have been around for some time, the technology involved in the mannequins the EMC department uses is nothing short of state-of-the-art.

The mannequins breathe, bleed, cry and vomit; vibrate if they are experiencing a seizure; and respond immediately to any real medication the students administer intravenously.

To train the next generation of emergency medical practitioners using the very latest technology, UJ is preparing to launch a new clinical simulation laboratory and rescue simulation centre over the next few years. These laboratories will include a wind and rain simulator and the ability to place students in wet, dark and seemingly uncontrolled environments.

This training proved invaluable to Robert Westwood, a UJ graduate with his Bachelor of Health Sciences degree in EMC. On one of his first call-outs as an emergency care practitioner, Robert had to rescue a 19-year-old German tourist who had fallen off a hiking trail in Wilderness in the Western Cape, splintering his pelvis. Fortunately, the thorough and extensive training Robert had received as a student, including advanced simulation training, had prepared him for exactly this kind of situation.

“Simulation training instils confidence in our students,” says Emergency Medical Care (EMC) lecturer Andrew Makkink. “The high-fidelity scenarios we create help them to be better prepared.”

Robert’s rescue in Wilderness was the culmination of countless simulation training experiences that equipped him with the skills and expertise necessary to rescue his patient and return him to safety. In his new position as an operational emergency care practitioner for the Western Cape Provincial Government, he will be using his knowledge and expertise to treat and rescue some of South Africa’s most vulnerable people. In this way, Robert’s training and his work cut to the core of 4IR, which is fundamentally focused on helping humanity.

Simulation training limits the risk of human error in real-life situations.

~ Robert Westwood, UJ EMC graduate

How advances in simulation training save real lives.

Simulation training – the process of recreating all the conditions of a rescue or medical scenario so that students can gain first-hand experience – is an integral part of UJ’s educational approach.

Click here to download the video.
Drones are increasingly being used to transport drugs and vaccines, especially when other forms of transport and infrastructure fail during medical emergencies or when disaster strikes. Drones were used extensively during the earthquake in Haiti in 2010, for example, and when Typhoon Haiyan hit the Philippines in 2013.

In Africa, drones carrying medicine have been used in Madagascar, Malawi and Tanzania. Rwanda is home to one of the most well-documented examples of using drones for healthcare. There, the government and a private company use drones to deliver medical supplies to five local hospitals.*


UJ’s Professor Heidi Abrahamse has been widely recognised for her work in the fields of photobiology and photodynamic theory (PDT). While photobiology is the study of how light can be used to benefit or harm living organisms, PDT uses light-activated photosensitizers to diagnose and treat cancer, eye conditions, and multidrug-resistant infections involving bacteria, viruses and fungi.

Professor Abrahamse is an expert in PDT oncology, wound healing and stem cell research, and is the Director of the Laser Research Centre at UJ’s Faculty of Health Sciences. The centre is leading efforts to use various forms of light and laser therapy to prevent and treat diseases, and its work has prompted the Department of Science and Technology to focus on and invest in this critical field.

Her research has also earned her international accolades. Professor Abrahamse recently received the prestigious Humanitarian Award at the International Photodynamic Association World Congress in Boston in the United States. While laser therapy is well established elsewhere in the world, its full spectrum of uses is yet to be fully realised in South Africa.

But Professor Abrahamse is pioneering a way forward and the impact of her work is far reaching – it has the potential to fundamentally transform people’s health and quality of life.
How political shifts and sporting wins affect our happiness.

How did you feel when Mmusi Maimane resigned as the leader of the DA towards the end of 2019? How did you feel when South Africa won the Rugby World Cup soon after? And how have you felt in the wake of COVID-19?

Talita Greyling, a researcher in the field of well-being economics and development at UJ, has been looking into what makes South Africans happy. Together with Auckland’s Dr Stephanie Rossouw and technology monitoring company AFSTEREO, she recently released a study on the topic, The Happiness Index. The index analyses sentiments on Twitter, and uses this information to gauge levels of happiness on a scale from one to 10 (where 10 is the happiest) among South Africans as they respond to certain events.

After the disruptions in the DA, South Africa’s happiness index rose to 6.66. Many tweets suggested that people were pleased about the breakaway and hoped for new political developments that would help address poverty, unemployment and inequality. This level of happiness jumped even higher a couple of weeks later, when the Springboks won the Rugby World Cup final.

Happiness in the country, however, has since plummeted. Since the first case of COVID-19 was announced in South Africa on 6 March, The Happiness Index has recorded an all-time low of 5.29. This figure is 15% below daily averages and is expected to decrease further as South Africans deal with the reality of living in the COVID-19 era. The majority of the emotions expressed on Twitter recently spoke of distrust, anticipation and fear.

We are living in uncertain times, and our happiness is a reflection of this. There is no doubt that The Happiness Index will be an interesting tool to follow in the weeks and months to come.

Tips on coping with stress.

How well or poorly you manage stress can be a major factor in your levels of happiness. If left unmanaged, stress can lead to major mental health problems, including depression, anxiety and personality disorders.

The following tips may help you cope with stress:*  
*Source: Healthline

Talk to a friend  
Eat healthily  
Exercise regularly  
Meditate and be mindful  
Avoid caffeine  
Spend time outside  
Get enough sleep  

How political shifts and sporting wins affect our happiness.
Identifying depression through smartphones.

How you use your smartphone could be an indication of whether you’re depressed or not. A California healthcare and tech company called Mindstrong is using data on how people tap, scroll and click on their phones to determine whether they’re showing signs of depression or other mental disorders.*


Studies suggest that about 10 to 20% of children and young people experience mental health disorders worldwide. These disorders pose serious risks. “If untreated, mental health conditions severely affect children's development, including their educational abilities and their potential to live fulfilling and productive lives,” says Professor Jace Pillay, the South African Research Chair in Education and Care in Childhood at UJ.

To better understand and meet the mental healthcare needs of children, Prof Pillay, his research team and the Gauteng Premier’s Office have introduced a web-based mental health profiling system. The system uses rapid real-time 4IR technologies to enable researchers to commission and receive evidence on child and youth depression, anxiety, stress and suicidal tendencies.

4IR is helping researchers to treat mental health conditions in children.

It helps researchers to analyse mental health problems and to provide specific interventions in specific areas.

“The need for such a research project is clearly evident in the escalating school, gender and community-based violence prevalent in our country – much of which is linked to mental health challenges,” says Prof Pillay.

By understanding the issues at hand, researchers and educators will be able to assess, diagnose, counsel and treat children and youth, which will help to reduce school dropouts and mental problems that persist into adulthood.
At the Charlotte Maxeke Academic Hospital in Johannesburg, Professor Qing-Guo Wang from UJ’s Institute for Intelligent Systems is developing technology that will transform South Africa’s healthcare system. Together with a team of experts in the fields of theoretical and experimental physics and computer science, Professor Wang is using AI to improve the diagnosis of critical diseases. His goal: nothing short of saving lives.

“I’m researching how AI can be applied in real life,” he says. “I want to explore how it can advance technology and improve services so that people can access a better quality of life.”

For months, Professor Wang and his team have been collecting open data on 20,000 breast cancer cases from Charlotte Maxeke’s archives. They are digitally uploading this data to their unique AI model, a software platform that is becoming increasingly “intelligent” as more and more information is added to it. The cases the team are using are massively varied, and include both positive and negative diagnoses.

Once this work is complete, the software will be able to automatically compare a brand-new X-ray against the vast repository of X-rays it has in its database. The result is an affordable and accurate diagnostic system that will be made widely available in health institutions across the country.

“Receiving an accurate breast cancer diagnosis in South Africa is difficult,” says Professor Wang. “Most South Africans can’t afford private medical aid, and those who are dependent on the public system battle to speak to the doctors they need. The system is simply too over-rum, specialists are in short supply and demand is significant.” In some instances, doctors who are either over-committed or poorly qualified are also more likely to give inaccurate results, threatening patients’ lives.

With the arrival of this new AI-modelled software, however, staff at even the most basic hospitals and clinics will require only rudimentary training and an ordinary PC to reap the benefits. The software will demand no specialist expertise and, once installed, will incur no running costs. Once an ordinary X-ray is inserted into the software, it will be able to offer a free and accurate breast cancer diagnosis, and any medical practitioner will be able to read the results.

This increased accessibility has massive advantages in a country as vast, as rural and as under-resourced as South Africa. And the software will also have more knowledge than any real-life oncologist, purely by virtue of the number of cases to which it has virtual access. The sheer volume of data it has to draw on increases its level of accuracy to unprecedented levels.

In order for projects such as this to develop, however, there needs to be ongoing and concerted national interest, commitment, investment and action, Professor Wang explains. “4IR is about technology. AI is about technology. It’s about people finding new and innovative solutions to context-specific problems and delivering on these ideas. These new services have the potential to improve people’s lives—that’s what matters.”

An accurate breast cancer diagnosis, soon just a click away.
The warning signs of breast cancer.

If you experience any of these symptoms in your breasts, it’s important that you go and see a doctor straight away.*

- A puckering of the skin of the breast
- A lump in the breast or armpit
- A change in the skin around the nipple
- A dimpling of the nipple
- An unusual increase or decrease in the size of one breast
- A decrease in the height of one breast
- An enlargement of the glands
- An unusual swelling in the armpit

*Source: CANSA

Reusable sanitary pad helps women overcome cultural taboo.

Pia Findlay, a Master’s student in the Department of Industrial Design at UJ, has developed a new menstrual hygiene product that helps to address cultural issues around menstruation in South Africa. Reusable, easy to clean, environmentally sustainable and cost effective, it is helping young women to overcome the taboo of having to insert a menstrual product.

Click here to watch Pia Findlay’s introduction video.
There’s no doubt that 4IR will continue to have a significant impact on the evolution of global healthcare in the decades to come, and nanotechnology will be an important contributor to this space.

According to Professor Samuel Oluwatobi Oluwafemi, a senior lecturer and researcher in Applied Chemistry at UJ, biotechnologists and nanotechnologists are in the process of developing technology that will provide renewed hope to patients diagnosed with cancer.

“Unlike current therapies, which attack the whole body, nanodrugs can be directed to specific tumours and activated when they reach it,” he explains.

“These nanorobots, which carry nanodrugs, are small enough to enter the human bloodstream and perform a wide array of functions, such as targeting cells, delivering drugs, cleaning arteries, killing viruses and potentially conducting surgery from the inside.”

This pioneering technology provides an alternative form of treatment than chemotherapy and will help to improve the rate of survival of cancer patients.
Local learner invents affordable prosthetic hand.

At the age of just 18, Farida Cajee from Hoërskool Schweizer-Reneke in the North West Province has developed an affordable, 3D-printed prosthetic hand that can be controlled by brainwaves.

“My project started simple because I wanted to prove that it could work, and at first, it didn’t,” Cajee said in an interview with News24. “It was such a mission to get the parts, figure out a control unit and to think how it was going to use brainwaves to work and still be cheap.”

Her research took her several months to complete, and ultimately brought with it an electroencephalograph headset that measured brainwaves and an Arduino microcontroller, which she programmed and connected to the headset. Together with the hand she had created from recycled plastic bottles, she had a working prosthesis.

But perhaps the most important aspect of Cajee’s invention is its price tag. At just R9,000, her prosthetic hand costs significantly less than other prostheses, which usually start around the R140,000 mark. “So many people are forced to live without prosthetics because they can’t afford it,” she said.

Cajee’s creation won a gold medal at the 2019 Eskom Expo for Young Scientists. When she finishes matric, Cajee has dreams of studying medicine.
Developments in 4IR have led to an important rise in assistive technology – technology intended to revolutionise the capacity, and therefore actualise the potential of people with disabilities. But how can we best guide these technologies so that their impact, potential and effect is maximised to everyone’s benefit?

In a recent UJ Cloudebate™, a panel of experts explored the ins and outs of this issue.

You can watch the full Cloudebate™ here.
The Future. Reimagined.