

Alumni Newsletter

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Issue 5

DEPARTMENT COMPUTER SCIENCE AND INFORMATICS



UFS
ALUMNI

Dear Alumni and Friends

Do you think virtual reality (VR) and augmented reality (AR) will change the world in the next five years? AR enhances what we see in the real world, while VR creates entirely new, immersive environments. Together, they are opening up a new frontier called the Internet of Experiences, which goes beyond the traditional Internet and the Internet of Things (IoT).

In 2024, businesses are ready to harness the power of AI-driven automation. Tools like OpenAI's ChatGPT have made significant strides in this field, with GPT-4 offering advanced capabilities and sophisticated features.

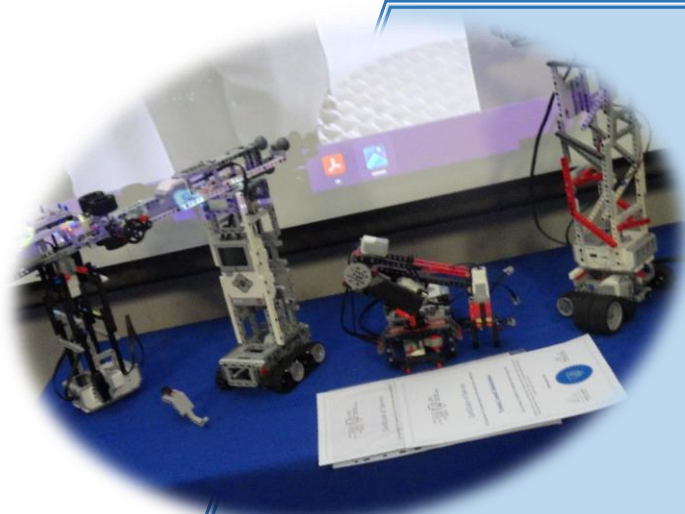
The U.S. Bureau of Labor Statistics projects a 21% growth in computer and information technology jobs by 2030, driven by the increasing demand for technology across all sectors.

Additionally, quantum computing is rapidly advancing as one of the fastest-growing technologies in the world. It offers much greater processing power than traditional computers, creating multi-dimensional spaces for algorithms to solve complex problems. This next-generation technology is set to revolutionize computing and problem-solving in ways we have never seen before.

Compiled by Ms Suretha de Klerk

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"Empowering Tomorrow's Problem Solvers: A Journey through Logic, Coding, and Robotics"

The Department initiated a community project aimed at introducing school learners to the concepts of logical, computational, and programmatic thinking, thereby nurturing problem-solving abilities. This endeavor commenced prior to the onset of the COVID-19 pandemic and consists of two distinct programs: Robotics, where participants engage in the construction and programming of robots employing LEGO EV3 Mindstorms, and Python, which focuses on teaching coding skills using the popular programming language Python.

In 2022, the project was revitalized and carried forward into the current year. Remarkably, we witnessed an unprecedented turnout, with 25 learners currently enrolled in the Robotics program and 46 individuals, including parents and UFS students, participating in the Python program.

The Robotics program achieved a significant milestone in 2023 when, on the 17th of August, students organized and participated in their inaugural informal competition of the year. This competition entailed the design and construction of slow-moving car-robots. The challenge stretched the boundaries of critical thinking, extending beyond mere coding, as the participants needed to ensure that the car-robot's mechanical design deliberately limited its speed. The culmination of their efforts materialized in a "slow car race," effectively determining the winner—or, more precisely, the last participant to cross the finish line. This learners not only enjoyed the experience, but also had valuable opportunities to refine their problem-solving skills along the way.



DEPARTMENTAL HIGHLIGHTS



As a testament to fruitful collaboration, the UFS Library and the Department of Computer Science and Informatics (CSI) unveiled the UFS Makerspace on 21 July 2023. Emerging from a partnership initiated in 2019, this dynamic space represents a fusion of technology and creativity. The project's success owes much to the guidance of Ms Sanah Mocwana from the Computer Science and Informatics department.



MAKERSPACE

UFS student's research project aims to protect the country's whistleblowers.

Article written by **News Desk**, November 30, 2023



Ricus Krause, an honours student in the Department of Computer Science and Informatics at the University of the Free State (UFS), receives his awards during the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (The South African Academy for Science and Arts) Student Symposium in Natural Sciences.

An honours student in the Department of Computer Science and Informatics at the University of the Free State (UFS) project on using blockchain technology to protect whistleblowers secured him first place for the best project and presentation in his session at the annual Suid-Afrikaanse Akademie vir Wetenskap en Kuns (The South African Academy for Science and Arts) Student Symposium in Natural Sciences.

Ricus Krause, who presented his project, titled “Blokskakel Fluitjieblaser-Stelsel” (Blockchain Whistleblower System), at the symposium, also received the Eureka DIY Solutions Prize for an Outstanding Contribution to Computer Sciences and Mathematical Sciences. The symposium was hosted by the University of Pretoria in October.

His research aimed to address the shortcomings of current systems for protecting whistleblowers and to design a robust computer system that ensures the confidentiality and integrity of information by using blockchain technology. This system had to protect whistleblowers’ identities and securely preserve evidence of corruption.

Interested in Cybersecurity

“I have been interested in Cybersecurity ever since I started studying. I approached Dr Wynand Nel (supervisor) at the start of my honours year to ask if he had any ideas for a security-focused project, and he introduced me to blockchain technology and the blockchain research group. Blockchain piqued my security interest and allowed me to explore the field further.”

“After meeting with the group, the idea of a blockchain-based system for whistleblowers was born, and I started researching South Africa’s biggest problems, where corruption is at the top. During my initial research, I also discovered that whistleblowers face extreme consequences much more frequently than we think,” says Krause.

He identified the main problem with whistleblowing as the revelation of a whistleblower’s identity before it is safe. Thus, a system was needed to protect a whistleblower’s anonymity and facilitate safe communication to contact investigators.

On winning the awards, Krause said he knew he was competing against master’s and PhD students and did not expect to win. “This was the first time I had presented my project at an event, so I was surprised when my name was called for the first prize in my session. I wanted to pinch myself to make sure I wasn’t dreaming.”

“I am genuinely grateful to have had the opportunity to present months of research to my peers and experts in their fields. I will always look back at the event with fond memories. I am proud of myself and my fellow students for presenting their research at the symposium when others did not dare to,” he says.

Address shortcomings of current systems

Krause is supervised by Dr Nel and Dr Rouxan Fouché, lecturers in the Department of Computer Science and Informatics and this research project falls within the department’s research focus area of Blockchain Technologies, headed by Dr Nel. The digital transformation of industries, known as Industry 4.0 has already started, and blockchain forms part of the digital revolution. The research areas include blockchain algorithms and data structures, blockchain security, blockchain applications and crypto assets.

With the recent high-profile killings of two whistleblowers in South Africa and with many other whistleblowers becoming victims of

intimidation and violence to silence them after their identities were exposed, the researchers believe it is necessary to conduct research and develop a computer system to address the glaring shortcomings of current systems.

“Our research identified blockchain technology as a potential solution that meets these needs. Blockchain provides an immutable structure, supports non-repudiation, and grants accessibility to all stakeholders. It has the potential to provide a security-focused system that preserves the confidentiality and integrity of evidence. The system involves the anonymous registration of whistleblowers, the processing and storage of evidence, and the use of cryptography to ensure the privacy of messages,” says Krause.

According to him, implementing this system in the real world, including the composition of the blockchain structure, seems daunting, especially regarding scalability and legal issues. With this project, he explains, they built a working blockchain system on a single computer. The project can be improved by expanding the blockchain system to multiple nodes communicating over a network. This improvement will take the Blockchain Whistleblower project from a concept to a valuable contribution to society.

How it works

“In a nutshell, this research has highlighted the potential of a blockchain-based whistleblower system to overcome the challenges surrounding corruption. It is a step forward in the fight against crime and the protection of those with the courage to expose misconduct. However, it is essential to continue with research and implementation to make this system a reality and fulfil its promise,” Dr Nel says.

Traditionally, Krause explains, a central system is used where a single organisation controls the system. The potential danger is that the system provider becomes a single point of failure for the system and, thus, a target for cyberattacks. Another concern of a centralised system is the organisation’s ability to manipulate data and uncover the identities

of whistleblowers. The integrity of the evidence can also be questioned when it is stored in a centralised database where modifications from a single point of access can affect all data.

A centralised system, therefore, would not be reliable enough for the high-risk circumstances of whistleblowers. They have concluded that a distributed or decentralised system would be an appropriate solution to the problem. A distributed system will continue to function as a whole even if a part is compromised.

The Blockchain Whistleblower System aims to make a proof-of-concept contribution to the field of blockchain technology. The system is installed locally on the user's computer, where whistleblowers and investigators use an anonymous profile to interact with the system, which interacts with the blockchain. After signing in, users can choose to report a new incident or view messages on the blockchain.

Reporting a crime

If the user wants to blow the whistle on a crime, the process starts with a report to gather more information about the incident. The whistleblower then selects the evidence of the crime on their computer. A hash function algorithm processes the evidence to create a fixed-length evidence hash. Hashing is a one-way cryptographic process that uniquely represents the input data. It is important to note that only the evidence hash is stored on the blockchain, not the evidence itself. The selected evidence is stored in a password-protected encrypted folder on the whistleblower's computer. Investigators can later use this evidence hash to verify the integrity of the evidence when they eventually receive it.

What is next for this project?

Krause says he would like to implement his project with nodes communicating via a network in the future. A network opens a new box of security considerations to explore and discover and would also enable the programme to be used at any location, making it accessible to whistleblowers everywhere.

"This project started with the idea to protect whistleblowers' identities and provide a platform for them to contact investigators safely. The end goal is for the project to provide a platform where whistleblowers can anonymously report misconduct, safely communicate with investigators, and verify the integrity of their evidence.

"My hope for the project is to build a better South Africa by fighting corruption, one of the biggest obstacles to our country's growth. By solving the many challenges whistleblowers encounter, I hope to foster a culture where whistleblowers are not afraid to speak out against crime."

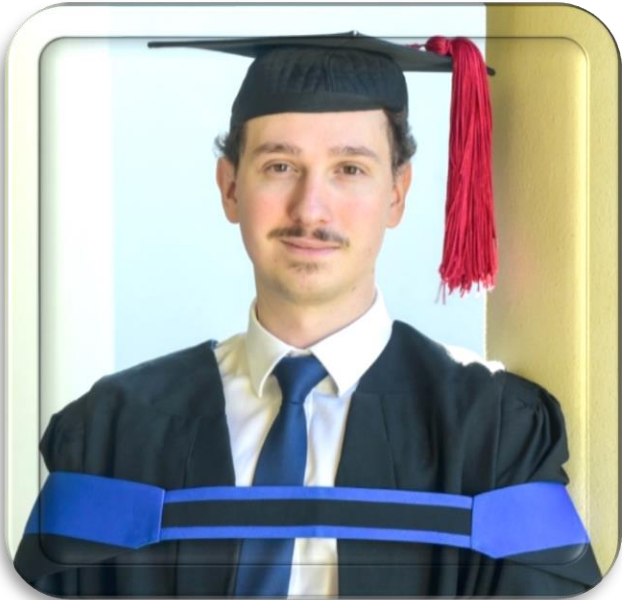
What lies ahead for 2024.....

Ricus is currently working on his Master's degree and continues to build on his honors project.

We wish Ricus all the best for his project. Ricus has given his consent with the sharing of the above information.



The Automatic Detection of Abusive Language in Dota 2 Chat Messages



Johannes Louis du Toit

Jan-Louis du Toit's study addressed the pervasive issue of abusive language in online video game communication channels, focusing on Dota 2 chat messages. The aim was to employ diverse traditional machine learning algorithms and advanced deep learning architectures to identify and classify toxic and abusive language effectively. By leveraging TF-IDF, GloVe word embeddings, and self-trained embeddings, the research compared various classical machine learning models such as Naïve Bayes, Logistic Regression, and Support Vector Machine with convolutional and recurrent neural network models. The results revealed a consistent trend where deep learning models, particularly those employing GRUs and LSTMs, outperformed classical machine learning models. The experiments also demonstrated that self-trained embeddings generally outperformed GloVe embeddings in the domain of online video game chat messages."

The full article can be read on the following link:

<https://ieeexplore.ieee.org/document/10467500>

We wish you all the best with your future project, and the department is confident that you will make a meaningful impact in your field with your dedication, skills, and passion.

Keep pushing the boundaries of innovation, and know that we are all cheering for your success!

Compiled by Prof Eduan Kotzé

Information Technology Service Learning PROJECT

The CSIS2642 service-learning students provided computer literacy training to participating community members through the annual ITSL project. The ITSL project was organised and implemented for the tenth year by Dr Rouxan Fouché, assisted by Dr Wynand Nel. Individuals from Mangaung and surrounding communities were recruited with the help of community partner organisations (Mangaung Concerned Residents Organisation, the South African Red Cross and loveLife) responsible for the selection process. The ITSL project included computer literacy training in Microsoft (MS) Word and (MS) Excel. The training was presented over ten weeks



DEPARTMENTAL RESEARCH

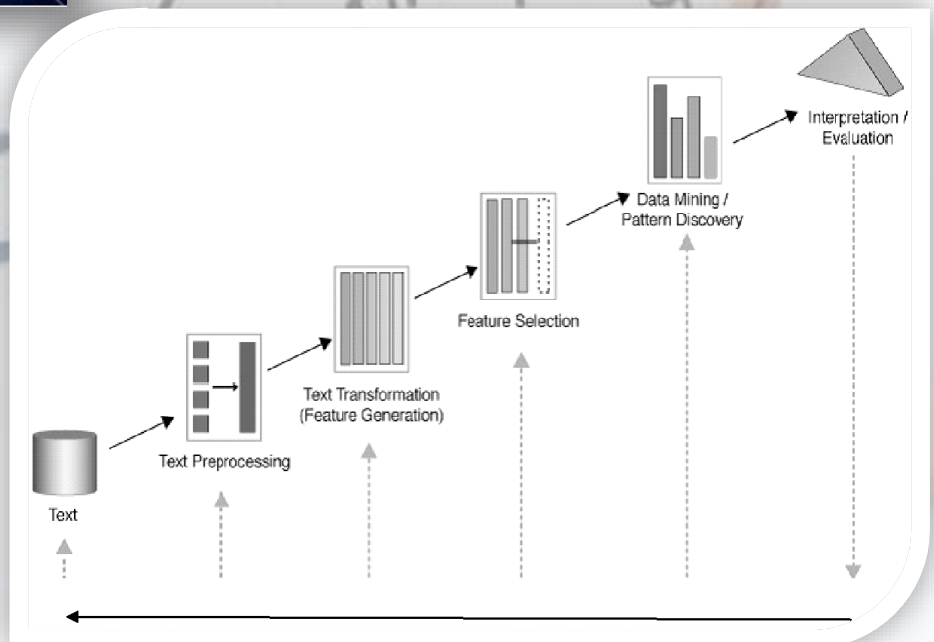


BLOCKCHAIN TECHNOLOGY

The Blockchain Technology research area falls in the 4IR domain and is led by Dr Wynand Nel, assisted by Dr Rouxan Fouché.

BUSINESS INTELLIGENCE AND TEXT MINING

The BITM research group, is led by Prof Eduan Kotzé.



COMPUTER SCIENCE EDUCATION

Prof Liezel Nel is the research group leader.

EYE-TRACKING

Prof Tanya Stott is the research leader in this field



The HCI research is led by Prof Lizette de Wet.

This field of research is led by Dr Pakiso Khomokhoana.

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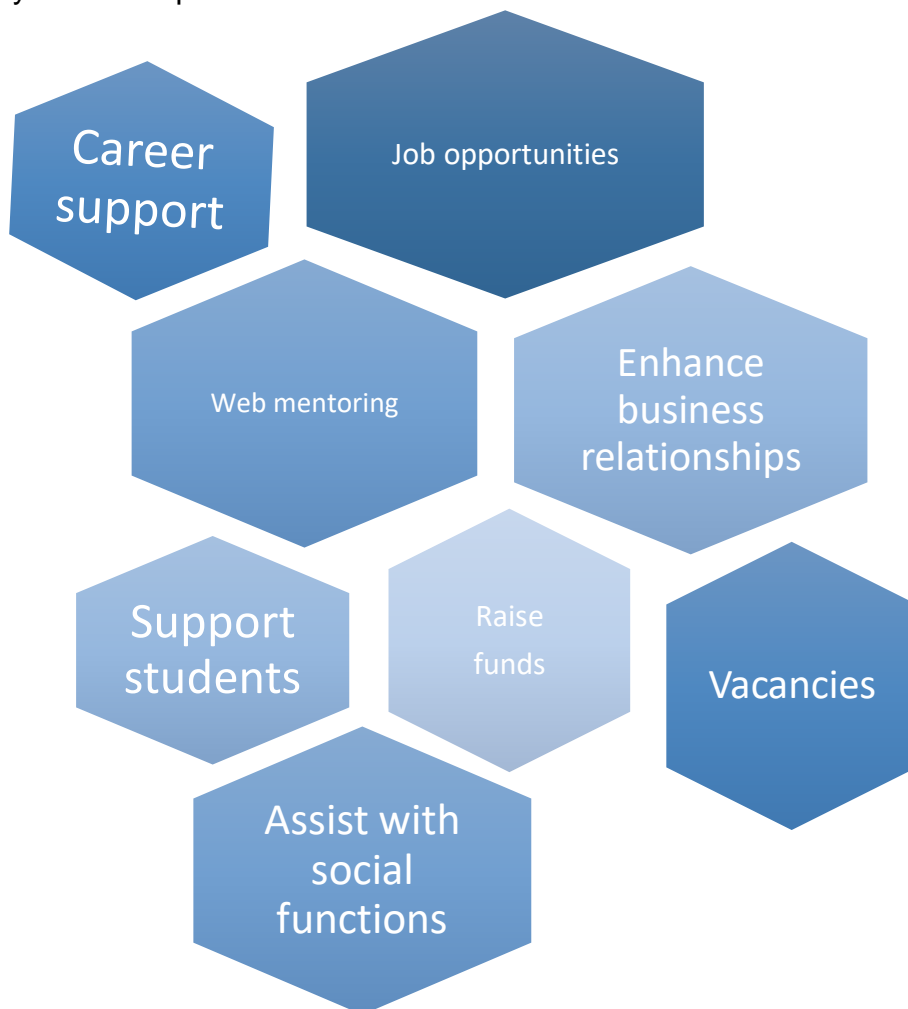
Dr Andronicus Akinyelu's areas of research.

**DEEP LEARNING-BASED DRONE
ORTHO MOSAIC LAND COVER** lead by
Gavin Dollman

A white DJI Mavic Air drone is shown from a top-down perspective, highlighting its four propellers and central camera. Below the drone are two grey battery packs and a grey remote control with a screen displaying a landscape image.



Our Mission Our mission is to maintain a lifelong relationship with our alumni; and facilitate the contributions of our alumni to the advancement and success of the department. How you can help



Let's stay connected

- ❖ Tell us your story – where you are and what you are doing
- ❖ Share your updated email address to receive the latest news
- ❖ Make suggestions of what to include in the Newsletter

You can send an email to Ms Suretha de Klerk at deklerks@ufs.ac.za

www.ufs.ac.za/it