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Assessing Tools for Detecting AI-Generated Content in Higher Education

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Abstract:

Artificial Intelligence (AI) has rapidly transformed the world, particularly following the introduction of Chat Generative Pre-Trained Transformer (ChatGPT) on November 30, 2022. This innovation has sparked a surge of interest in AI, leading to significant investments and attention in both the private and public sectors. AI applications are now widespread, ranging from smart farming to automated cyber threat detection. In higher education, AI has emerged as a potential game changer, enhancing learning experiences and expanding educational access to diverse communities. For example, some institutions have utilized AI to reduce dropout rates, while others have employed AI for student assistance. Research has also shown that students primarily use AI tools like ChatGPT for academic tasks, such as writing assignments and conducting research projects. In South Africa, a recent survey of educational leaders highlighted a growing push to integrate new AI tools, like ChatGPT, into the educational system. However, the use of AI has raised ethical concerns, particularly regarding plagiarism. For instance, some students at the University of South Africa (UNISA) faced disciplinary action after it was discovered that they had used AI tools inappropriately. A gap exists in the ethical use of AI in higher education, although some universities, such as the University of Cape Town (UCT), are making progress. UCT has published student guidelines on the ethical use of AI tools, which include ensuring that any final product is the student's own work and not simply copied from an AI generator. Therefore, the objective of this paper is to evaluate free AI detection tools that can help students check their work and ensure they are not unknowingly submitting AI-generated content. This will also ensure that, if students do use AI, they properly acknowledge it, as another key clause in the UCT guidelines and similar policies requires individuals to acknowledge any use of AI in their work. Each tool was assessed based on its features, performance, usability, and support.

Keywords — **AI Detection Tools, Generative AI, Higher Education, Students, ChatGPT.**

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I. INTRODUCTION

The emergence of Artificial Intelligence (AI) has significantly impacted various sectors, from diagnosing patients and solving complex problems [1] to advancing smart farming practices [32]. AI lacks a universal definition, with interpretations evolving over time. This study adopts [3]'s definition, which describes AI as the use of computers to perform tasks by imitating human behavior. In education, AI is poised to enhance teaching and learning while standing out as a transformative technology with the potential to revolutionize the landscape of Higher Education Institutions (HEIs) [2]. Wang et al. [28] reinforces this perspective, asserting that AI technologies in HEIs open new frontiers of educational possibilities.

A lot of HEIs have begun adopting AI to enhance research capabilities, reduce student dropouts, improve student engagement, streamline administrative processes, and enable personalized

learning, among other things [2],[28],[29],[31]. The University of Michigan introduced the AI Services platform, a suite of generative AI tools available to all staff and students [40]. Similarly, Khan Academy launched Khanmigo, an AI-powered personal tutor and teaching assistant for parents, students, and staff [39]. Griffith University introduced "Sam," an AI assistant that helps students find information, while the University of Sydney implemented "FinBot" to assist its finance department. Additionally, the University of Canberra uses "Lucy," a chatbot designed to handle student inquiries [37].

AI is not new and has been around since the 1950s, in the early 2020s it transformed the world with the utilization of Large Language Models (LLMs) [4],[5]. LLMs are AI systems that are tasked with completing multiple tasks by processing generated text [19]. According to [6], ChatGPT was launched at the end of November 2022, using LLMs. Google's AI-powered Bard and Bing tools, which were built on its language model for dialogue applications (LaMDA) coupled with Google services and apps, were released in March 2023 because of the introduction of LLMs [7]. Thereafter, there has been an introduction of more LLMs. As depicted in Fig. 1. LLMs were initially released in 2019 and gained traction in May 2020 with the introduction of GPT-3 [19].

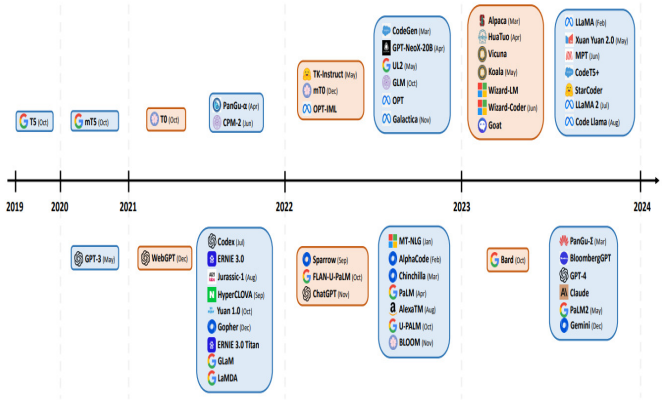

Fig. 1. Timeline of the release of LLMs [19]

Generative AI, also known as Gen AI, allows users to input prompts to solve problems, such as entering text and generating a variety of outputs such as essays, code, graphics, or even mimicking conversations [7]. This is often used by students in HEIs to automate their tasks [26]. Gen AI models, such as ChatGPT, can help with automation by providing insights, and with the generation of content across a variety of fields by responding to input prompts. Most HEIs are embracing AI as it is improving the learning experience for both the students and staff, however, using AI tools comes with ethical concerns as a result they have been a call to use these AI tools responsible and ethically [23]. HEIs are continuously encouraging students to strive for academic integrity even though AI tools are used to speed up the process of writing essays, code, etc.

A study by BestColleges [25] aimed to evaluate the use of AI by undergraduate and graduate students. According to the research, many students rely on AI tools, a finding supported by another study [26] that also examined students' use of AI. However, the use of AI raises significant ethical concerns, including plagiarism [28],[29],[30]. Lynott [38] reported numerous AI-related plagiarism cases at Irish colleges, including 37 cases at one institution, 49 at the University of Galway, and 35 investigated at University College Cork (UCC), resulting in various penalties. Such incidents pose a serious threat to academic integrity in HEIs and scientific writing [34].

In South Africa, students at the University of South Africa (UNISA) have been caught using AI tools for exams and assignments, leading to disciplinary actions for hundreds of them [20],[21]. UNISA stated that its AI policy and guidelines are still under development [22]. However, institutions such as the University of Cape Town (UCT) are making progress in that regard [35]. UCT has published student guidelines on the ethical use of AI tools, which include ensuring that any final product is the student's own work and not simply copied from an AI generator.

Therefore, the objective of this paper is to evaluate free AI detection tools that can help students check their work and ensure they are not unknowingly submitting AI-generated content. This will also ensure that, if students do use AI, they properly acknowledge it, as another key clause in the UCT guidelines and similar policies requires individuals to acknowledge any use of AI in their work.

The rise of unethical AI usage has driven the development of these detection tools [27]. According to [36], these tools assess perplexity and burstiness. Perplexity measures a document's complexity, evaluating how well the AI predicts the next word in a sequence. Burstiness looks at sentence structure variation, which helps identify machine-generated texts. Documents with high perplexity and burstiness are more likely to be human-written due to their complexity and structural diversity.

This paper assessed each tool based on its features, performance, usability, and support. The rest of this paper is structured as follows: Methodology in Section 2. In Section 3 there is a comparative analysis and section 4 is the overall evaluation. The conclusion is presented in Section 5.

II. METHODOLOGY

As previously mentioned, AI detectors are designed to identify whether a text was produced by an AI writing tool, such as ChatGPT. While some AI-generated content may appear convincingly human, these AI detection tools provide a means to verify the text's origin. This paper uses a list of leading AI detection tools, sourced from [8], however, focuses entirely on free tools. The tools under investigation are: QuillBot, Scribbr (free version), Sapling, CopyLeaks, ZeroGPT, GPT-2 Output Detector, CrossPlag, GPTZero, Writer, and AI Text Classifier (OpenAI) [9-18].

The authors have assessed these AI detection tools based on several criteria's. To evaluate their effectiveness, we tested various types of texts, including completely generated ChatGPT text, a mix of AI and human text, entirely human-written text, and AI text altered by QuillBot, a paraphrasing tool. Each of these texts was processed through all ten AI detectors to determine the effectiveness of each tool. The text data is listed below in Table I:

TABLE I
TEST DATA

Source	Text
Human	The emergence of ChatGPT has shined light on AI technology, as before ChatGPT most people did not know anything about AI technology. People always assumed it is one of those technologies that is not applicable to their daily lives. However, the scientific community has always been doing live-charging research on AI. Today, private sector and government institutions are leveraging the power of AI. Higher education institutions as well, as they are now offering AI-related courses as most people see that AI technology is here to stay, and user usage will grow.
Human and AI	The emergence of ChatGPT has shined light on AI technology, as before ChatGPT most people did not know anything about AI technology. People always assumed it is one of those technology that is not applicable to their daily lives. However, the deployment of AI also requires careful consideration of ethical concerns, including data privacy, algorithmic bias, and the potential erosion of academic integrity. Institutions must navigate these challenges by implementing robust governance frameworks and fostering transparency in AI applications, ensuring that technological advancements complement rather than compromise educational values and outcomes.
ChatGPT- Generated	The integration of AI into HEIs indicates transformative implications for academic and administrative practices. AI technologies, such as intelligent tutoring systems and automated grading tools, promise to personalize learning experiences and streamline administrative tasks, enhancing efficiency and accessibility. However, the deployment of AI also requires careful consideration of ethical concerns, including data privacy, algorithmic bias, and the potential erosion of academic integrity. Institutions must navigate these challenges by implementing robust governance frameworks and fostering

	transparency in AI applications, ensuring that technological advancements complement rather than compromise educational values and outcomes.
AI Paraphrased	The introduction of AI into universities portends revolutionary changes to administrative and scholarly procedures. AI technologies promise to customize learning experiences and streamline administrative duties, improving efficiency and accessibility. Examples of these technologies include intelligent tutoring systems and automated grading tools. The use of AI also means that ethical issues like algorithmic prejudice, data privacy, and the possible degradation of academic integrity must be carefully considered. To ensure that technological innovations complement rather than contradict educational principles and outcomes, institutions must implement strong governance frameworks and enhance transparency in AI applications.

III. COMPARATIVE ANALYSIS

AI technology is expected to grow, meaning students' dependence on these AI tools will likely grow as well, which will lead to HEIs' increased challenge in preserving academic integrity. This section reviews and compares a variety of AI detection tools that students can leverage to avoid their work being flagged for plagiarism which in turn will assist HEIs in maintaining academic integrity.

A. GPT-2 Output Detector

Feature set – As illustrated in Fig. 2. this AI detector is simple and basic in its form and the interface only tells a user if the text is real or fake.

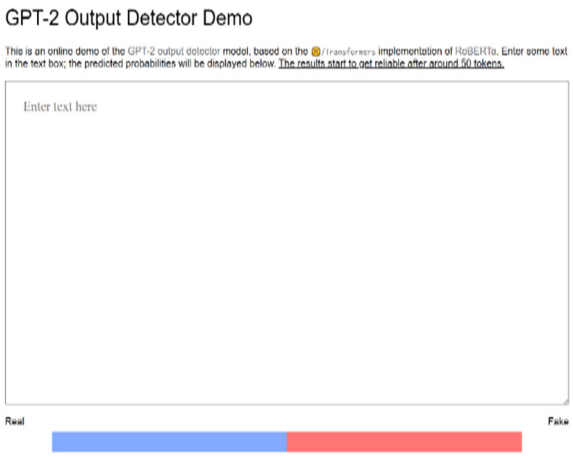

Fig. 2. GPT-2 Interface [9]

Performance Metrics – The human text got a 99.81% score that it is real. The Al and human mix, ChatGPT generated, and AI paraphrased text got the same score of 99.98% that it is real, the authors assumed that the real meant it is real text and not AI written.

Usability – Its simplicity makes it a bit confusing as there are no instructions to guide a user on what the real and fake mean.

Support – No support exists.

B. Writefull

Feature set – Compared to GPT-2, this AI detector looks more advanced and user friendly as depicted in Fig. 3. This AI detector also offers access to its Application Programming Interfaces (API's). Further, this tool doesn't store data but rather the data is encrypted [16].

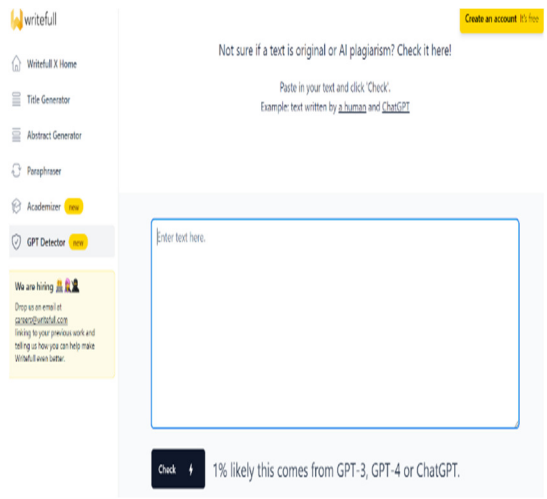

Fig. 3. Writefull Interface [16]

Performance Metrics – On ChatGPT generated text, AI paraphrased, and human and AI mix the results revealed a 1% chance that the texts are likely from GPT-3, GPT-4, or ChatGPT. On human-written text, the results revealed a 12% chance that the text was written by ChatGPT.

Usability - Straightforward usage but only checks GPT-3, GPT-4, or ChatGPT text. Furthermore, the user is given the option to enter their text into the text box and click 'Check'. After which they instantly get their results. The results come in the form of a percentage of the likelihood that a text was written by GPT.

Support – The platform provides answers to frequently asked questions and if your specific question is not available, they have an email address provided to get more information or clarity.

C. QuillBot

Feature set – As illustrated in Fig. 4. it is available in four different languages and can be added as an extension on a web browser. This AI detection can detect text that is AI-generated, AI-generated & AI-refined, Human-written & AI-refined and Human-written. Furthermore, this tool allows users to upload documents [10].

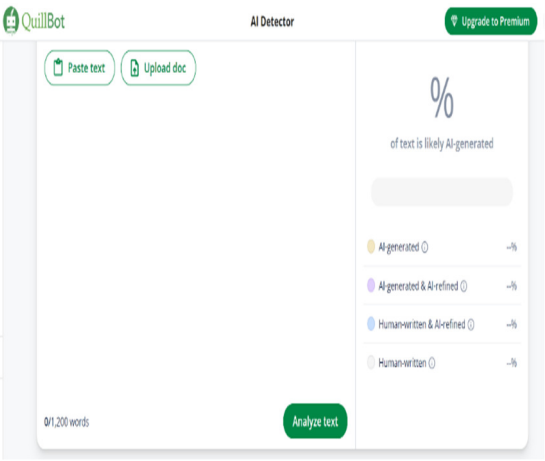

Fig. 4. QuillBot Interface [10]

Performance Metrics – On the human text, human and AI mix text, and ChatGPT-generated text the tool results revealed that the texts were 100% AI-generated. On the other hand, the AI paraphrased text, results revealed that it was indeed AI-generated & AI-refined.

Usability – The four different indicators make this tool efficient and effective. It is straightforward and user-friendly. However, the free version is limited to 1200 words per scan.

Support – On the platform, there's a FAQs section where a user can get answers and alternatively there is also a Contact Us option.

D. ZeroGPT

Feature set – This tool as shown in Fig. 5. has the capability to highlight AI-generated sentences, allows for batch uploads, and after every scan provides a PDF document proving that a user's document is AI-free. Finally, it supports a variety of languages with a high detection rate and allows for document upload [14].

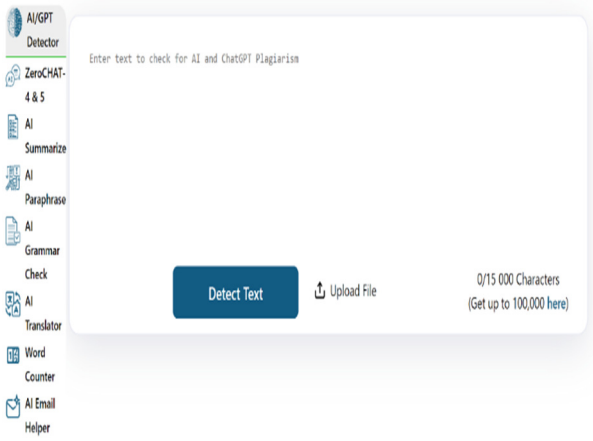

Fig. 5. ZeroGPT Interface [14]

Performance Metrics – On human text, the tool results revealed that it was human-written, and 0% AI was detected. On the human and AI mix, the tool failed as it didn't pick up any AI text indicating a 0% AI detection. On AI-generated, the tool results revealed a 100% score of text being AI-generated. On AI Paraphrased, the tool results revealed that the text was human written with a 0% AI detection.

Usability – This tool is friendly to use and not complicated. However, the tool contains too many advertisements which makes for a not pleasant experience.

Support – On the platform there's a FAQs section where a user can get answers and alternatively an email address is provided to ask any further or unanswered questions.

E. GPTZero

Feature set – This tool, depicted in Fig. 6. leverages the newest discovery in AI detection research, it provides color-coded highlights for most AI and Human sections of writing, it provides document uploads and API's. Further, after creating a free account, this tool provides batch document upload and a dashboard feature where users can view previous scans [15].

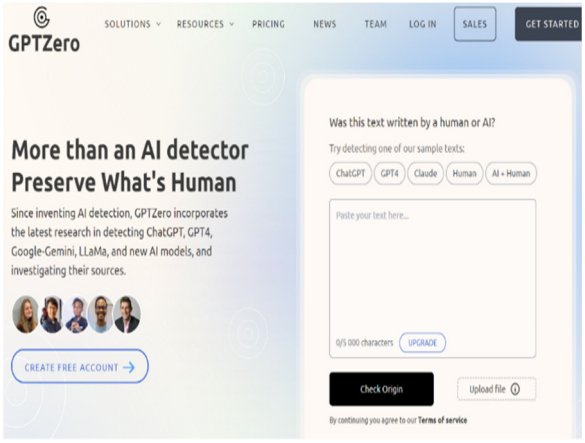

Fig. 6. GPTZero Interface [15]

Performance Metrics – On human text, the tool results revealed that the text was written by a human with a 98% score. On mixed text, the tool revealed that it was indeed mixed and highlighted the AI text, the score was 77% mixed. ChatGPT and AI paraphrased text was highlighted with a 100% score to be AI-generated.

Usability – This tool is a joy and fun to interact with, however, it is limited to 5000 characters and to get additional features such as viewing your scan report, a user needs to create a free account and for more added features upgrade to the paid version.

Support – On the platform there's a FAQs section where a user can get answers and alternatively an email address is provided to ask any further or unanswered questions.

F. Scribbr AI Content Detector

Feature set – This tool as depicted in Fig. 7. offers built-in advanced algorithms for detecting AI-generated content. Unlimited free AI checks and the tool doesn't store or share user data [11].

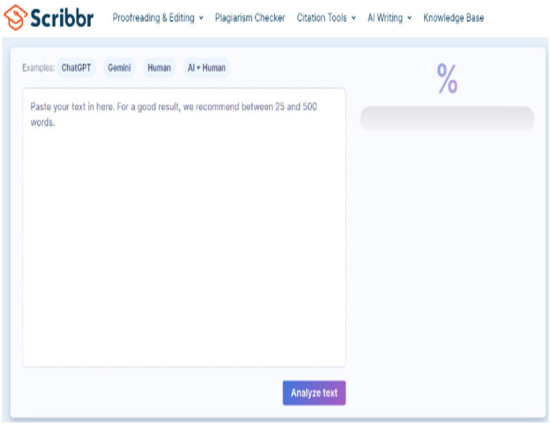

Fig. 7. Scibbr Interface [11]

Performance Metrics – On human text, the tool results revealed that it was human-written, and 0% AI was detected. On mixed text, the tool revealed that the text contains AI writing with a score of 67% AI text. ChatGPT and AI paraphrased text was highlighted with a 100% score to be AI-generated.

Usability – User-friendly interface and requires no sign-up.

Support – On the platform, there's a FAQs section where a user can get answers and alternatively contact details are provided to ask any further or unanswered questions.

G. Sapling

Feature set – This tool depicted in Fig. 8. offers both Microsoft Word and PDF document upload. Furthermore, it offers APIs, web browser extensions, and certif-icates that users can share [12].

Fig. 8. Sapling Interface [12]

Performance Metrics – On human text, the tool results revealed that it was human-written, and 0% AI was detected. On mixed text, the tool revealed that the text contains AI writing with a score of 58% AI text. ChatGPT and AI paraphrased text was highlighted with a 100% score to be AI-generated.

Usability – Friendly and not complex. This tool also provides instructions on how to best use the tool.

Support – On the platform, there's a FAQs section where a user can get answers and alternatively there's a contact tab where a user can reach out to ask any further or unanswered questions.

H. Copyleaks

Feature set – This tool as depicted in

Fig. 9. is more advanced than most and offers free scans. Detection is offered in multiple languages, it allows for scanning multiple files simultaneously, users can even schedule recurring scans and share similarity reports [13].

Fig. 9. Copyleaks Interface [13]

Performance Metrics – On human text, the tool results revealed that it was human-written. On mixed text, the tool revealed that the text contains AI writing. ChatGPT and AI paraphrased text was highlighted to be AI-generated.

Usability - The platform is simple to use but a user gets limited scans up until they open a free account on the platform, after which additional features are released.

Support – On the platform, there's a FAQs section where a user can get answers and alternatively there's a Contact Us tab where a user can reach out to ask any further or unanswered questions.

I. CrossPlag

Feature set – This tool as shown in Fig. 10. apart from checking if a text is AI-written or human-written, it offers a dashboard where users can view past documents, suspicious documents, or upload a document [18].

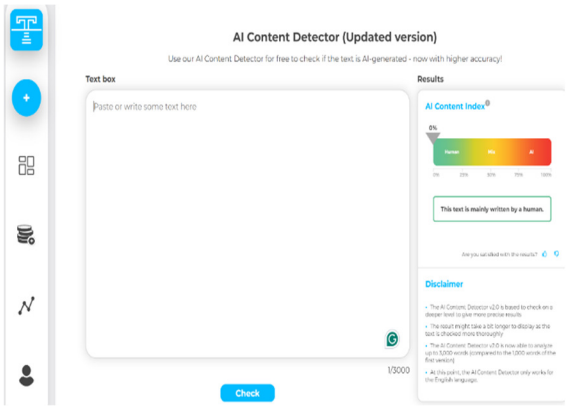

Fig. 10. CrossPlag Interface [18]

Performance Metrics – On human, mixed, ChatGPT generated and AI paraphrased texts the tool revealed that the texts were written by a human with a 0% AI detection score.

Usability – This tool is user-friendly but before you can run any scans a user must create a free account. However, this account is limited, and a user is required to buy tokens to run additional scans.

Support – On the platform, there's a help center that contains a FAQs section where a user can get answers and alternatively there's a Contact Us tab where a user can reach out to ask any further or un-answered questions.

J. AI Text Classifier (OpenAI)

This tool was the last on the list and the authors were excited about testing it since it's from ChatGPT. However, the tool didn't run and that is why in Table 2. under the name of this tool the authors simply put in dashes. In terms of features, what we observed is that it provides, or it provided API's and that's all we can mention about this tool.

TABLE III
SUMMARY OF RESULTS

Detection Tools	Human	Human & AI	ChatGPT	Para-phrased	Accuracy
GPT-2	Passed	Failed	Failed	Failed	25%
Writefull	Passed	Failed	Passed	Passed	25%
Quillbot	Failed	Failed	Passed	Passed	50%
ZeroGpt	Passed	Failed	Passed	Failed	50%
GPTZero	Passed	Passed	Passed	Passed	100%
Scribbr	Passed	Passed	Passed	Passed	100
Sapling	Passed	Passed	Passed	Passed	100%
Copyleaks	Passed	Passed	Passed	Passed	100%
CrossPlag	Passed	Failed	Failed	Failed	25%
OpenAI	-----	-----	-----	-----	-----

IV. OVERALL EVALUATION

A summary of the results of the AI detection tools is presented in Table II. GPT-2 and Writefull were the first two tools reviewed, and the results showed that both tools failed to identify AI-generated text, whereby the tools categorised all test data as human-written. Similarly, CrossPlag revealed the same result as GPT-2 and Writefull, with an accuracy rate of 25%. These three tools did not detect any AI-generated text effectively. However, the authors cannot conclude that these tools can't distinguish between human and AI text with complete accuracy, as [12] indicates that false positives and false negatives are possible limitations of these AI detection tools. Furthermore, according to [10], these tools should never be used alone in situations affecting people's career or academic standing.

Quillbot and ZeroGPT achieved an accuracy score of 50%, both of these AI detection tools were able to detect ChatGPT-generated text successfully. However, Quillbot failed to recognise the human-generated text and the human-AI-generated text. ZeroGPT failed to recognise the human-AI generated text and AI paraphrased text. As a result, this paper concludes that Quillbot and ZeroGPT need some re-finement or to be tested on different data sets. Therefore, until such time, the au-thors do not recommend Quillbot and ZeroGPT as viable AI detection tools.

Copyleaks [13] according to their website offer 99% accuracy in AI detection. In this paper, Copyleaks, along with Scribbr, Sapling, and GPTZero, achieved that perfect accuracy score of 100%. However, Copyleaks, Sapling, and GPTZero pro-vide advanced features such as certificates for sharing (Sapling), simultaneous file scanning and scheduled recurring scans (Copyleaks), and color-coded text high-lights and API support (GPTZero). The authors recommend Scribbr as the best option for students. This is primarily because Scribbr is effective and does not require a sign-in, unlike its counterparts, which restrict certain features until a free account is created and still

may not offer full functionality without a paid subscription.

As AI technology continues to grow, AI detection tools will likely play a critical role and the need for these AI tools to be more accurate cannot be overstated, particularly across various applications and domains of AI technology. For example, [24] study which investigated the impact of AI on the realism and prevalence of deepfakes. The findings highlighted that the advancement in AI, particularly in machine learning algorithms and generative models, has made it possible to create more convincing deepfakes. The study underscored the importance of employing effective AI detection tools to identify AI-manipulated content.

V. CONCLUSION

This paper has compared AI detection tools including QuillBot, Scribbr, Sapling, CopyLeaks, ZeroGPT, GPT-2 Output Detector, CrossPlag, GPTZero, Writer, and AI Text Classifier (OpenAI) to recommend the most suitable option for students in HEIs. Copyleaks, Scibbr, ZeroGPT and Sapling emerged as the most suitable choices for HEIs students with their 100% accuracy, offering a good balance between features and usability. However, Scibbr was the recommended choice since it offers the best balance between functionality and features. It also provided students with ease of use with its no sign up flexibility. Copyleaks, Sapling, and ZeroGPT while highly accurate needed users to have an account to have access to additional functionalities and features.

It is crucial to acknowledge that while the authors primally focused on students, the academic staff, including lectures can use these tools to identify potential misuse of generative AI. Nonetheless, the 2023 PricewaterhouseCoopers (PwC) Higher Education Leaders Survey for South Africa cautioned against over-reliance on these tools due to their limitations [33]. Therefore, we also propose that, alongside these tools, HEIs should establish guidelines for effective AI usage, like the AI usage guidelines developed by UCT [35]. Additionally, HEIs should integrate these tools into the learning environment and teach students how to use them effectively [30]. This also applies to lecturers; those unfamiliar with AI should be trained in its use [28].

Finally, this study was limited to single data sets per category which may have impacted on the results of some AI detection tools. For future work, authors recommend testing these tools against multiple data sets per category.

ACKNOWLEDGMENT

The authors would like to thank

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