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Can GPTZero detect if students are using artificial intelligence to create assignments?

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Abstract

The use of generative AI material created by sources such as ChatGPT has become a topic of debate in higher education. Students are using AI tools to create content and then submit it as their own for assignments. The purpose of this research paper is to test GPTZero's capabilities for detecting if assignments are written by a human or created using AI. A set of 100 samples was created to validate this experiment. The sample set was anonymized by the researchers and then tested to analyze the results. The two sets of data were then compared to determine the accuracy of GPTZero in detecting AI written material. GPTZero was able to identify all 100 samples as being human, AI or a combination of human and AI written material.

Keywords: artificial intelligence, GPTZero, ChatGPT, detection, large language models

Introduction

Since the release of OpenAI's ChatGPT in November 2022, generative AI has become a regular topic for discussion and debate in academic conversations in higher education (Coffey, 2023). Chat Generative Pre-Trained Transformer, more commonly referred to as ChatGPT, is a generative AI application developed by OpenAI in the form of a chatbot that can generate answers to prompts almost instantaneously. The chatbot can write essays, summarize books, write poems and songs, generate computer code, and explain difficult math problems (Tyson & Kennedy, 2024; Nam, 2023). ChatGPT is one of the most well-known generative AI tools, with over a million users downloading and using the software within the first week of its release (Stokel-Walker, 2022). Another example of a generative AI tool is DALL-E 2, an image generation tool. DALL-E 2 can produce art based on a text prompt.

Young adults are the largest user group of generative AI tools (Tyson & Kennedy, 2024). In addition, students are adopting generative AI tools more quickly than faculty at universities are adopting them (Coffey, 2023), making this an issue worthy of discussion for higher education.

Tools like ChatGPT can offer several benefits to both students and faculty. For example, they can aid instructors by helping to facilitate group work and collaboration, developing more engaging or game-based assessments and activities, and even assist with grading of student work. Further, they can potentially be used to create more personalized assessments for students, targeting the assessment to the student's level

of learning to ensure steady progress. Generative AI tools can also act as a virtual tutor, helping students to better understand concepts covered in class by providing them with immediate responses to their questions, providing feedback about assignment progress in real-time, and generating study guides and lecture notes (Johnston et al., 2024; Cotton, Cotton, & Shipway, 2023). They can even help to improve a student's feeling of connection in an online course by providing just-in-time personalized responses to a student's actions and questions (Seo et al., 2021).

However, in addition to all of these positive uses, the tools can also be used to fully generate essays and other types of written assignments, raising concerns about academic dishonesty and plagiarism. It can be difficult for an instructor to distinguish text written by a student from a response generated from an AI tool. When students are able to submit written assignments that are not their own work, it undermines the learning process that is the purpose of higher education. Over time, this could potentially lead to a devaluation of college degrees (Cotton, Cotton, & Shipway, 2023).

Given the complex landscape of benefits and challenges provided by generative AI tools, their emergence has caused much debate and concern within the realm of higher education. Universities now face challenges in understanding how to incorporate generative AI tools into both their curriculum and their academic integrity policies (Johnston et al., 2024). Cotton, Cotton, and Shipway (2023) recommend incorporating clear guidelines on how and when generative AI tools can be used in assignments into university academic integrity policies. However, universities vary in how they provide these guidelines. Where some universities adopt an institution-wide policy, others allow instructors to implement their own policies in the classroom, while others do not address the issue at all. Johnston et al. (2024) found that students desire guidance on how these AI tools should be used, and that the majority wanted an overall policy to be adopted by their university that would be applicable to all of their academic work.

Cotton, Cotton, and Shipway (2023) also recommend the use of plagiarism and AI detection tools that can help to identify when AI tools have been utilized in student writing assignments. Several companies have released AI detection tools, including the popular plagiarism tracker Turnitin (Nam, 2023). Drozdowski (2024) tested Turnitin's new AI detection tool that was released in early 2024 and found it to be remarkably accurate in a small-scale test.

GPTZero is an artificial intelligence (AI) detector used to determine if a document was written by a human or by a large language model such as ChatGPT, GPT-4, LLaMa or other AI models (Tian, et al, 2024). As of 2024, there has not been a sufficient amount of research on the validity and accuracy of such tools. The purpose of this research paper is to test GPTZero's capabilities for detecting if assignments are written by a human or created using AI. A set of 100 samples was created to validate this experiment. The sample set was anonymized by Researcher A and given to Researcher B to analyze the results. The two sets of data were then compared to determine the accuracy of GPTZero in detecting AI written material.

RQ1: *How accurate is the detection method used by GPTZero in determining if artificial intelligence was used to create written materials?*

Literature review

Generative AI tools such as ChatGPT are seeing widespread adoption and use. This is particularly concerning for the field of education, where there are both benefits and challenges associated with the use of these tools.

According to Braswell (2023), 65% of educators are utilizing AI technologies in comparison to 61% of students that reported using them. In addition, a greater population of educators shared their excitement about using AI tools, while students tended to be more neutral on how AI will impact education. Students that are exploring the capabilities of AI are doing so as a means for research, information synthetization, and generation of study materials (Braswell, 2023). Some students note an area of controversy in regard to how AI was impacting studying. Braswell (2023) found that students that study three or more hours per night were more likely to utilize ChatGPT or a similar AI tool. This is interesting because it shows that the students who are spending numerous hours studying are utilizing AI to enhance their materials and provide even more valuable insights on course content.

In March 2023, a study of AI tool adoption by both university students and faculty found that 27% of students were already using the tools, while only 9% of faculty were using them (Coffey, 2023). In September 2023, the study was repeated with 1,600 students and 1,000 faculty across more than 600 institutions, and found that 49% of college students are using AI tools, while only 22% of faculty members are using them (Coffey, 2023). Though students are clearly adopting AI more quickly than faculty, the adoption rate for both groups have grown significantly in a short period of time.

For U.S. university students, daily users reported using generative AI tools for paraphrasing text, answering homework questions, and helping to organize their schedule. For students who reported using AI tools only weekly or monthly, the top tasks the tools were used for included paraphrasing text, assisting with writing assignments, and understanding difficult concepts (Coffey, 2023). Similarly, in a study of 6,300 German university students, 63% reported using AI tools for their academic work. Students in this study reported using AI for a variety of academic tasks including for: research and literature reviews, concept development, data analysis and data modeling, clarifying questions of understanding, text analysis, language translations, programming and simulations, and exam preparation (Garrel & Mayer, 2023).

A survey of 5,000 higher education leaders and students across 11 countries found that the students in the U.S. were more likely to utilize AI tools and that this usage was only going to increase over time. With this in mind, it is also interesting to note that approximately 46% of the surveyed students felt as though this increase in AI usage would further enhance both their engagement and interactivity across campus and the classroom. In contrast to this, an equal percentage (46%) of the educators surveyed felt as though the AI tools being used by students were unethical and should be prohibited from higher education. The largest concern with this was in regard to plagiarism. Educators are now on the search for new and innovative ways to assess their students that make them use critical thinking skills. One of the ways they are working towards this is by creating newer, more intuitive assessments and prompts that are harder for AI tools to generate responses for. In addition to this, some universities have implemented policies in response to AI; some of which prohibit the use of the tools altogether (Anthology, 2023).

Faculty reported using the AI tools to "'see' what their students see" (Coffee, 2023, para. 11). Additionally, 29% of faculty reported using the tools to assist with creation of in-class activities and 35% reported teaching students how to effectively use the AI tools for writing (Coffey, 2023). The majority of students, 75%, noted that they would be likely to continue using generative AI writing tools even if their institution banned their use (Coffey, 2023).

Higher education has begun implementing policies to regulate the use of generative AI tools. Coffey (2023) reports that 26% of private, 4-year universities have created institution-wide policies, while 32% are relying upon instructors to set their own policies for their classrooms, and 21% have no policies. Public, 2-year institutions had the lowest rate of adoption and 52% of faculty at these schools reported that they did not know if they had a policy.

Generative AI tools are trained by reviewing large amounts of information, such as books, news articles, and works of artists (Tyson & Kennedy, 2024). Because these tools create text or image-based content that pulls from this content, there are some people who argue that it is a copyright violation, while others think that it is fair use under copyright law (Tyson & Kennedy, 2024). A study by the Pew Research Center found that among U.S. adults, 75% say that AI tools should have to credit sources. Additionally, 67% say that sources should be credited if an AI tool imitates the style of a current artist or writer (Tyson & Kennedy, 2024).

In a study of 1,000 U.S. undergraduate and graduate college students, 56% reported using AI tools to help complete assignments or exams. Despite this, more than half of the students who responded, 54%, agreed that using AI on assignments or exams counts as cheating or plagiarism. Twenty-five percent remain neutral on the issue, while the remaining 21% said that using AI to complete assignments or exams was not cheating or plagiarism (Nam, 2023). However, faculty are making students aware of issues surrounding the use of AI tools; 79% of students noted that an instructor had talked to them about the ethics of using AI in the classroom and 53% said that an instructor had required them to use AI as part of an assignment (Nam, 2023).

Higher education has been encouraged to use AI detection tools to help determine whether a piece of writing was created by a human or by AI (Cotton, Cotton, & Shipway, 2023). Habibzadeh (2023) tested the accuracy of GPTZero on 50 pieces of medical texts and found that GPTZero had an accuracy rate of 80% for identifying AI-generated texts. The 80% accuracy rate could be due to the complexity of medical terminology. Habibzadeh (2023) calls for further studies on the performance of GPTZero in larger samples and samples using texts from other disciplines. Bellini et al. (2023) tested two texts created by AI and one text created by a human author in several AI detection tools: GPTZero, ZeroGPT, Writer ACD, and Originality. Findings revealed much variability in the detection capabilities of the four tools, noting that different results were found by each tool. Though these limited studies have looked at the issue of accuracy in AI detection tools, further research is needed.

GPTZero Explained: How Does it Work?

GPTZero, developed by Edward Tian and Alex Cui in 2022, became the first commercially viable AI detection tool. The creators wanted a platform that could be used to help identify and detect the usage of AI. “Our classifier is intended to be used to flag situations in which a conversation can be started (for example, between educators and students) to drive further inquiry and spread awareness of the risks of using AI in written work” (Tian, et al, 2024). As of May 2024, GPTZero has served over 2.5 million users around the world. On the front page of GPTZero it reads “More than an AI detector: Preserve What’s Human” (Tian, et al, 2024). GPTZero detects whether something is written by AI tools such as ChatGPT, GPT3, Google-Gemini, LLAMA and newer AI models or if the material is written by a human.

There are three main ways that GPTZero can be used. The first is a text upload where you can copy and paste text from another source page or application into GPTZero. The second is a file upload which allows users to create a Word document or another application and directly upload it to GPTZero for analysis. Lastly, is the Origin Google Chrome and Microsoft Word extensions which allows for direct analysis while creating a document or reviewing a website. All three use the same model and can detect if the text was written entirely by a human, written entirely by AI or written by a mix of human and AI. Each gives a breakdown for detections of the usage of AI in a text with a description of the results in a sentence-by-sentence breakdown (Tian, et al, 2024).

GPTZero uses seven machine learning components to determine the probability of the use of AI in text: Education Module, Burstiness, Perplexity, GPTZeroX, GPTZero Shield, Internet Text Search and Deep Learning. Each component provides a weighted score to the Document Classification and Document Breakdown that calculates an estimation of the amount of Human, AI or Mixed writing that has been used.

In the Education component, the text is run against other texts that have been human written specifically by students. This allows the module to focus on student's writing styles and correlates that information against the text being provided by the GPTZero platform. If the provided text deviates from what the model expects a student to be writing this increases the probability of the use of AI. When writing a paper or any document, a format is normally used for the appropriate writing style. The Burstiness component analyzes the text to see if there are patterns in the writing. A human-written text usually flows between patterns throughout the writing, whereas AI writing stays consistent throughout. Documents that have a high-level of Burstiness between writing patterns usually means that it was written by a human.

The Perplexity component was created to determine words that might come after one another in writing. The "model develops suggestions of what word is coming next" (Tian, et al, 2024). It checks to see if GPTZero's suggestions match what is in the writing. GPTZeroX is a component that is able to provide sentence-by-sentence classifications for human-generated, AI-generated, and mixed-generated text. Not only does GPTZeroX analyze a single sentence word-by-word, but it also looks at each sentence in relation to the sentences throughout the document being scanned. Being able to show sentence-by-sentence classifications allows for the best understanding of the origins of the provided text.

The ability to detect AI is sometimes hindered by exploits in the text. The GPTZero Shield component defends against other tools looking to exploit the AI detector. The written text is run against a database of the most common methods used to bypass AI detection such as homoglyph which leverages the similarities to create look-a-like words and spacing attacks. The Internet Text Search component analyzes direct quotes from existing websites through May 2023 at the time of this writing in May of 2024. This can be considered a limitation of the GPTZero.

Deep Learning, the last component, is used to detect the usage of AI. Human-written work is continuously fed into GPTZero so that it learns the latest trends and technologies to help determine the likelihood of AI produced text. The model is trained from creating writing, scientific writing, blogs, news articles and more. The submissions are tested against a large-scale dataset of human and AI created material (Tian, et al, 2024).

GPTZero's writing analysis of text copied into the tool breaks down the material into six additional categories of analysis: readability, precent SAT, simplicity, perplexity, burstiness and average sentence length. Readability will display sentences with short words. Percent SAT measures what percentage of words used in the writing are from the SAT exam used to get into college. Simplicity measures the percentage of words used that are in the top 100 most common words in the English language and average sentence length looks at variance in writing patterns. Perplexity and Burstiness were explained above when discussing the machine learning components. Below in Figure 1., you can see how the text is broken down into the six writing analysis categories.

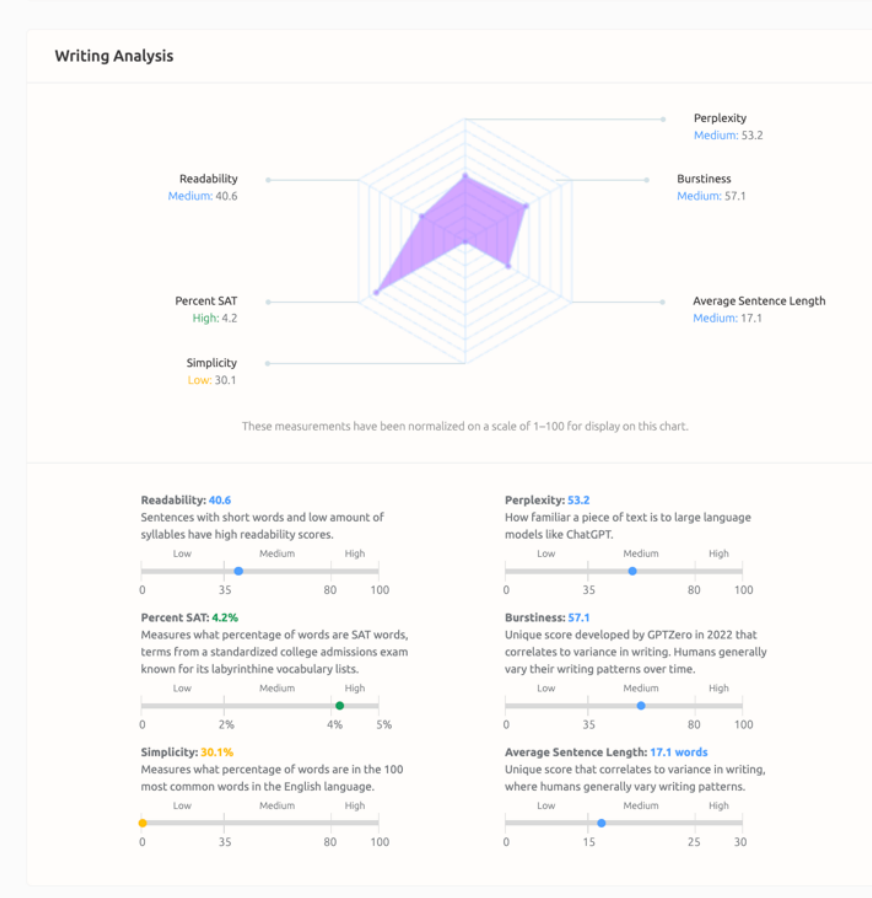

Figure 1: GPTZero Writing Analysis of Text

GPTZero has both a paid and unpaid plans. The software works the same for both. However, the difference between the two versions is the number of submission characters that can be reviewed by GPTZero. The free version allows for seven submissions per day limited to 5000 characters for each. GPTZero tracks the IP address to determine if the limit of seven has been reached. There are three plans that can be purchased. The first is the Essential Plan which gives you unlimited scans up to 150,000 words per month which is equivalent to 300 pages of scanning. The Premium Plan allows 300,000 words per month which would be 600 pages of scanning and included advanced AI deep scanning and is multilingual. The final plan that can be purchased is the Professional Plan which allows for 500,000 words equivalent to 1000 pages of text, everything in the previous plan, up to 10,000,000 words in overage and military grade security (Tian, et.al, 2024).

Methodology

GPTZero has a 99% AI accuracy rate compared to its competitors Originality.ai has an 80% accuracy and ZeroGPT has a 78% accuracy for detecting AI generated material. On August 22, 2023 GPTZero released a benchmark dataset for third parties to evaluate (Cui, 2023). In order to measure the 99% accuracy, rate the researchers created their own dataset and analyzed it using GPTZero. Since the free version of GPTZero only allows for seven submissions per day the researchers purchased the Professional Plan version of the

software. In order to test the validity of GPTZero a pilot test was first conducted. Researcher A created a sample of 20 papers. The papers were created using prior work written by the research team. The work used by the researchers was written before November 30, 2022 which was the release date of ChatGPT. This was done so that it was impossible for any of the researchers work to be generated by AI.

Of the 20 papers, 6 were created by a human, 7 were generated by AI and 7 were mixed meaning a combination of human created writing and AI generated writing. The samples were numbered 1 through 20 and were then given to Researcher B to run through GPTZero. The papers given to Researcher B were anonymous and only displayed numbers. Researcher B had no idea the origin of each paper. After running the 20 papers through GPTZero Researcher B compared the results from the blind test to those of the known test with Researcher A's information. The 6 papers that were human generated and the 7 papers created by AI resulted in 98% accuracy rate with a 2% false positive rate. The results of the 7 papers that had a mix of human and AI generated material had an accuracy rate of 70%. GPTZero will show, as indicated in Figure 2, the percentage it believes was created by a human, the percentage it believes was created using AI, the percentage that is mixed and a percentage that is listed as uncertain. The researchers realized that the reason for the percentages being off by 30% had to do with the word count in the document. When the documents that had a mix of AI and human writing were copied into the Word document there were numerous font sizes. The researchers were essentially guessing the percentage instead of taking the overall word count of the document and dividing it by the percentage of AI writing and the percentage of human writing. This method was implemented into the actual testing of the written material.

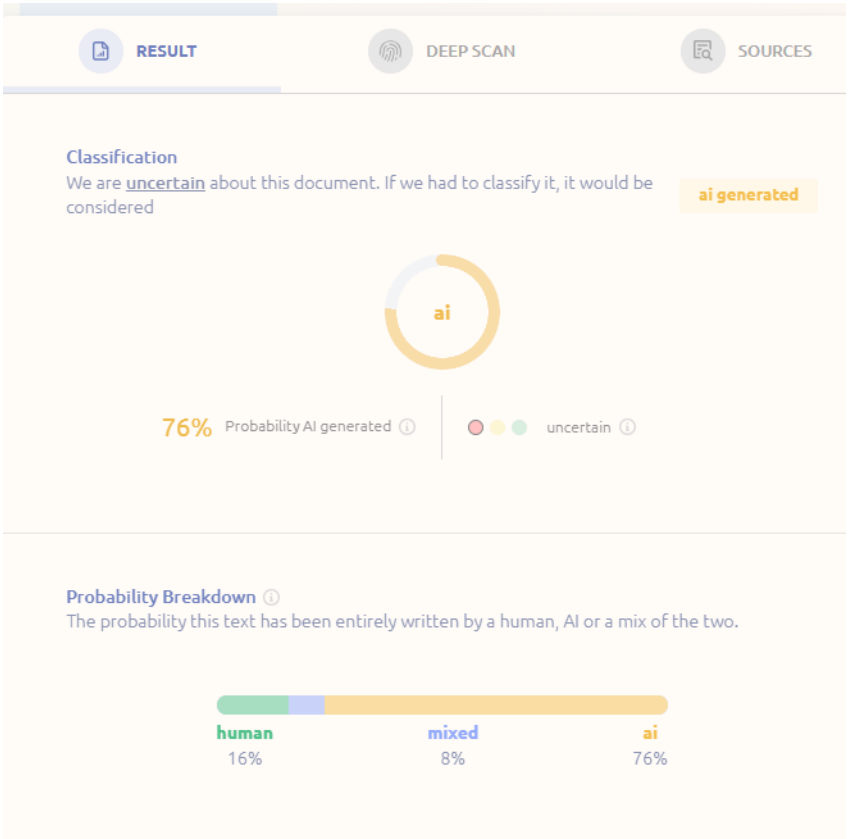

Figure 2: GPTZero Probability Breakdown

Results

The researchers created an experiment to text the validity and accuracy of GPTZero. A pilot test was conducted to test the validity of the experiment. Improvements were made based on the results of the pilot test. Researcher A created 100 writing samples to include human, AI and combination of human and AI writings. There was a total of 39 human generated samples using the authors writings prior to November 2022 when ChatGPT launched. ChatGPT and the use of artificial intelligence (AI) being used to create writings simply did not exist during the time period used from the author's personal work. An additional 27 writing samples were created using 100% AI and 34 writing samples were created using prior work of the authors plus AI generated content.

The 100 writing samples created by Researcher A were anonymized and numbered 1 through 100 and put into an Excel spreadsheet. The samples were then given to Researcher B to run through GPTZero. The free version of GPTZero only allows for 7 submissions per day with a 5000-character limit. Due to this limitation the researchers purchased the Professional plan which allows for unlimited submissions up to 500,000 words per day. GPTZero offers academic pricing which was used to purchase the plan.

GPTZero allows for a single document to be uploaded or numerous documents at one time. Researcher B uploaded the 100 documents at one time and ran a report of the output results of the experiment. The results were transferred to an Excel file for comparison with the known samples. Table 1 below lists the results of the experiment. GPTZero was able to identify the 39 human created samples as being "human". Of the 39 samples, 37 showed a 99% chance of being written by a human and 2 samples had an output of 95-98% chance of being written by a human. GPTZero also correctly identified all 27 AI generated writing samples as being AI.

Table 1: Validated Dataset

Sample Type	Number Created	1% Margin	2-5% Margin	6-10% Margin	More Than 10%
Human	39	37	2	0	0
AI	27	24	3	0	0
Mix of Human & AI	34	6	19	7	2

Of the 27 samples, 24 showed a 99% chance of being written by AI and 3 samples resulted in a 95-98% chance of being AI generated. The final set of results were for the samples where a combination of both human writing and writing created by AI were combined. There was a total of 34 mixed samples. Of the 34 samples that had both AI and human content, 6 had a 99% accuracy to the numbers generated by Researcher A. For example, one of the samples was created with 70% of the writing being human and 30% created from AI.

The percentages were calculated by taking the total number of words in the document divided by the number of words used in the human created content and then the total of the AI created content. Six of the samples had a 99% accuracy rate, with 19 of the samples showing a 95-98% accuracy rate, 7 samples had a 94-90% accuracy rate and 2 of the samples were more than 89%. The 2 samples stuck out to the researchers. The two documents that had the lower accuracy rate were examined further. It is interesting to note the findings.

When the mixed documents were created, Researcher A put either all human content first, followed by the AI content or vice-versa in the sample. Of those samples following the same pattern showed a 95% or higher accuracy rate. The samples that were below 95% were samples where the AI content was spread between paragraphs of the human created content. It is important to note that only 2 samples were less than 90% accurate with the lowest accuracy rate being 82%. Even at 82% it yielded a high enough result showing what was human created compared AI created.

GPTZero was able to identify all 100 samples answering the research question of whether GPTZero accurately detects if artificial intelligence is used to create assignments or written material. Sixty-seven samples were 99% accurate, 24 samples were 95-98% accurate, 7 samples had a 90-94% accuracy rate and only 2 samples showed 82% or higher accuracy. Based on the results of the experiment, GPTZero can be used to identify content that was created using AI.

Conclusion and Future Research

GPTZero created an AI detection tool to assist educators and the like in identifying content that was not created by a human. A statement under the education section of GPTZero's website states, "More than AI Detection. Understand how AI is used in your classroom to restore confidence and understanding with your students.". GPTZero should not be used to punish students, but rather it should be used to bring awareness to students on the dangers of submitting content that they did not write. As indicated in GPTZero's site it is a trusted tool of Duke University, Purdue University and Berkeley, to name a few. Based on the results of this experiment, the researchers also trust the tool. Anti-virus software is updated regularly. However, if a new virus arises between updates the software will not protect our computers. This same premise should be used when it comes to GPTZero. GPTZero might not be able to accurately detect material created with new versions of ChatGPT or other AI tools until there is an update.

Using only 100 samples could be seen as a limitation to the study. Future research is needed to determine the accuracy of content created with a combination of human and AI generated content. GPTZero does break down the document by the areas it identifies. The researchers will look to see if GPTZero accurately identifies which sentences are human created and which have been created by AI. Also, GPTZero has a feature similar to TurnitIn. The researchers plan on testing the accuracy of this feature as well.

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