Decoding the Future: AI Tools for Precision Periodontics and Research Excellence

Assistant Professor
Hadeel Mazin Akram

Objectives

OBJECTIVE 01

understanding of how AI can be seamlessly integrated into existing diagnostic protocols

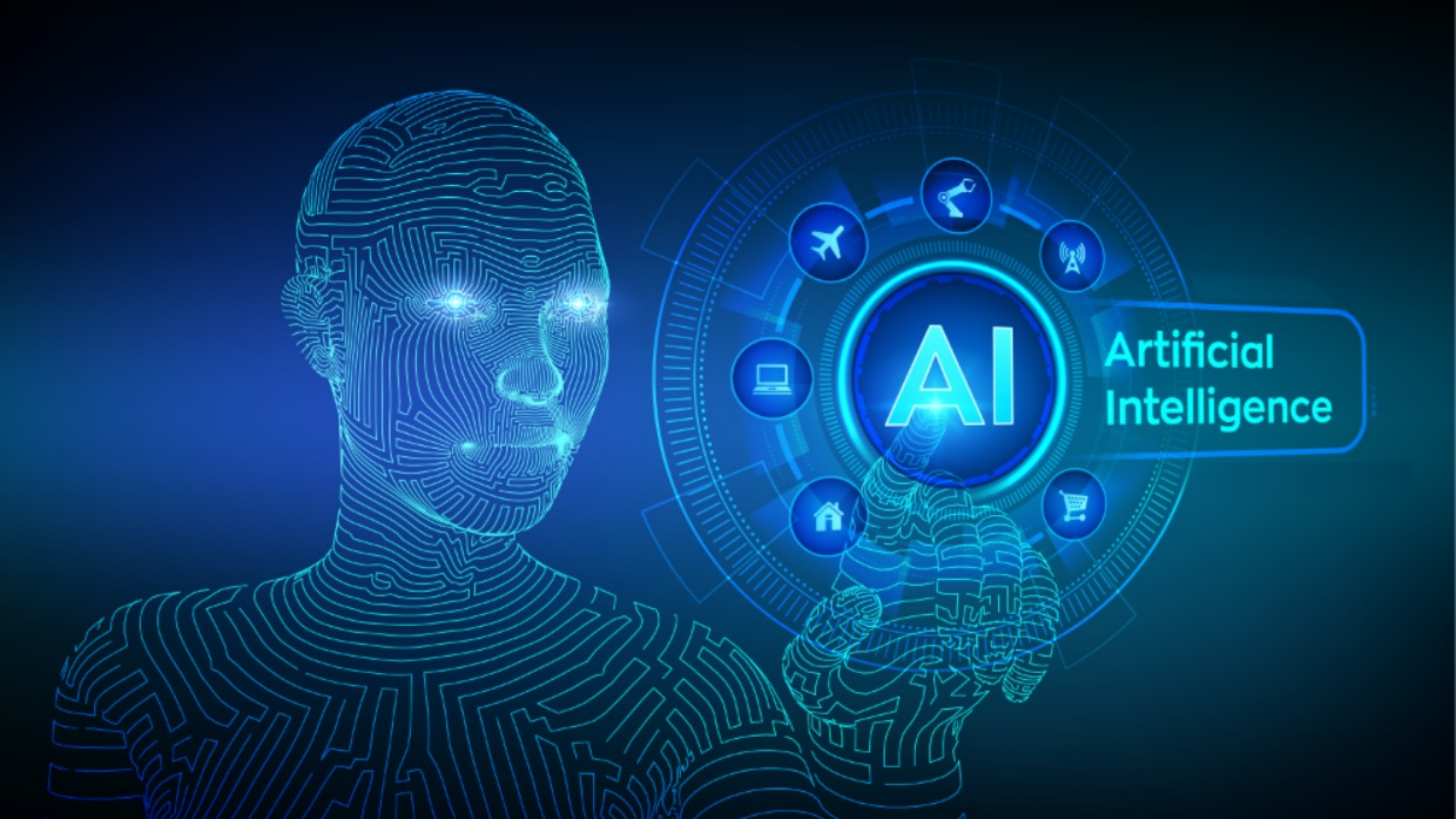
OBJECTIVE 02

Explore the unique features and applications of each AI tool in the research context

Periodontal Diagnosis

Despite the latest advances in treatment modalities, there has not been a significant improvement in the methodology for detecting alveolar bone loss and assessing the severity of the bone loss in the compromised teeth.

There is a lack of standardization relating to periodontitis diagnosis and management, resulting in instances of undiagnosed and untreated oral disease


AI
Artificial
Intelligence

AI stands for **Artificial Intelligence**. It is the ability of a computer or robot to perform tasks commonly associated with intelligent beings

AI approaches may be beneficial because they provide a more effective diagnostic process when combined with clinical assessment.

Using :

image recognition

classification

segmentation

AI may enhance dental efficiency

Image recognition

AI can be trained to recognize patterns in dental images that are indicative of periodontal disease. This includes things like the color and texture of the gums, the presence of bleeding, and the amount of bone loss

Classification

AI can be used to classify dental images into different categories, such as healthy, gingivitis, and periodontitis

Segmentation

AI can be used to segment dental images, which means that it can identify and isolate different parts of the image, such as the teeth, gums, and bone. This can help dentists to make more precise measurements of bone loss and other important features of the periodontal anatomy.

RESEARCH Open Access

Artificial intelligence (AI) diagnostic tools: utilizing a convolutional neural network (CNN) to assess periodontal bone level radiographically—a retrospective study

Ghala Alotaibi[1,2], Mohammed Awawdeh[1,2], Fathima Fazrina Farook[1,2*], Mohamed Aljohani[4], Razan Mohamed Aldhafiri[1,2] and Mohamed Aldhoayan[2,3]

Abstract

Background: The purpose of this investigation was to develop a computer-assisted detection system based on a deep convolutional neural network (CNN) algorithm and to evaluate the accuracy and usefulness of this system for the detection of alveolar bone loss in periapical radiographs in the anterior region of the dental arches. We also aimed to evaluate the usefulness of the system in categorizing the severity of bone loss due to periodontal disease.

Method: A data set of 1724 intraoral periapical images of upper and lower anterior teeth in 1610 adult patients were retrieved from the ROMEXIS software management system at King Saud bin Abdulaziz University for Health Sciences. Using a combination of pre-trained deep CNN architecture and a self-trained network, the radiographic images were used to determine the optimal CNN algorithm. The diagnostic and predictive accuracy, precision, confusion matrix, recall, F1-score, Matthews Correlation Coefficient (MCC), Cohen Kappa, were calculated using the deep CNN algorithm in Python.

Results: The periapical radiograph dataset was divided randomly into 70% training, 20% validation, and 10% testing datasets. With the deep learning algorithm, the diagnostic accuracy for classifying normal versus disease was 73.0%, and 59% for the classification of the levels of severity of the bone loss. The Model showed a significant difference in the confusion matrix, accuracy, precision, recall, f1-score, MCC and Matthews Correlation Coefficient (MCC), Cohen Kappa, and receiver operating characteristic (ROC), between both the binary and multi-classification models.

Conclusion: This study revealed that the deep CNN algorithm (VGG-16) was useful to detect alveolar bone loss in periapical radiographs, and has a satisfactory ability to detect the severity of bone loss in teeth. The results suggest that machines can perform better based on the level classification and the captured characteristics of the image diagnosis. With additional optimization of the periodontal dataset, it is expected that a computer-aided detection system can become an effective and efficient procedure for aiding in the detection and staging of periodontal disease.

Keywords: CNN, Artificial intelligence, Teeth, Bone level, Periodontitis, Learning machine, VGG-16

*Correspondence: fazrinaf@ksau-hs.edu.sa

Background

Periodontitis (PD), a multifactorial and complex inflammatory disease in tooth-supporting tissues, is categorized

Convolutional neural networks (CNNs)

- 1724 intraoral periapical images
- All periapical images were annotated and examined by three independent examiners
- The data set was divided randomly into 70% training dataset, 20% validation dataset, and 10% testing dataset
- The images were classified as in binary (healthy or disease) and multiclassification (normal, mild, moderate, severe).
- Accuracy was 73%

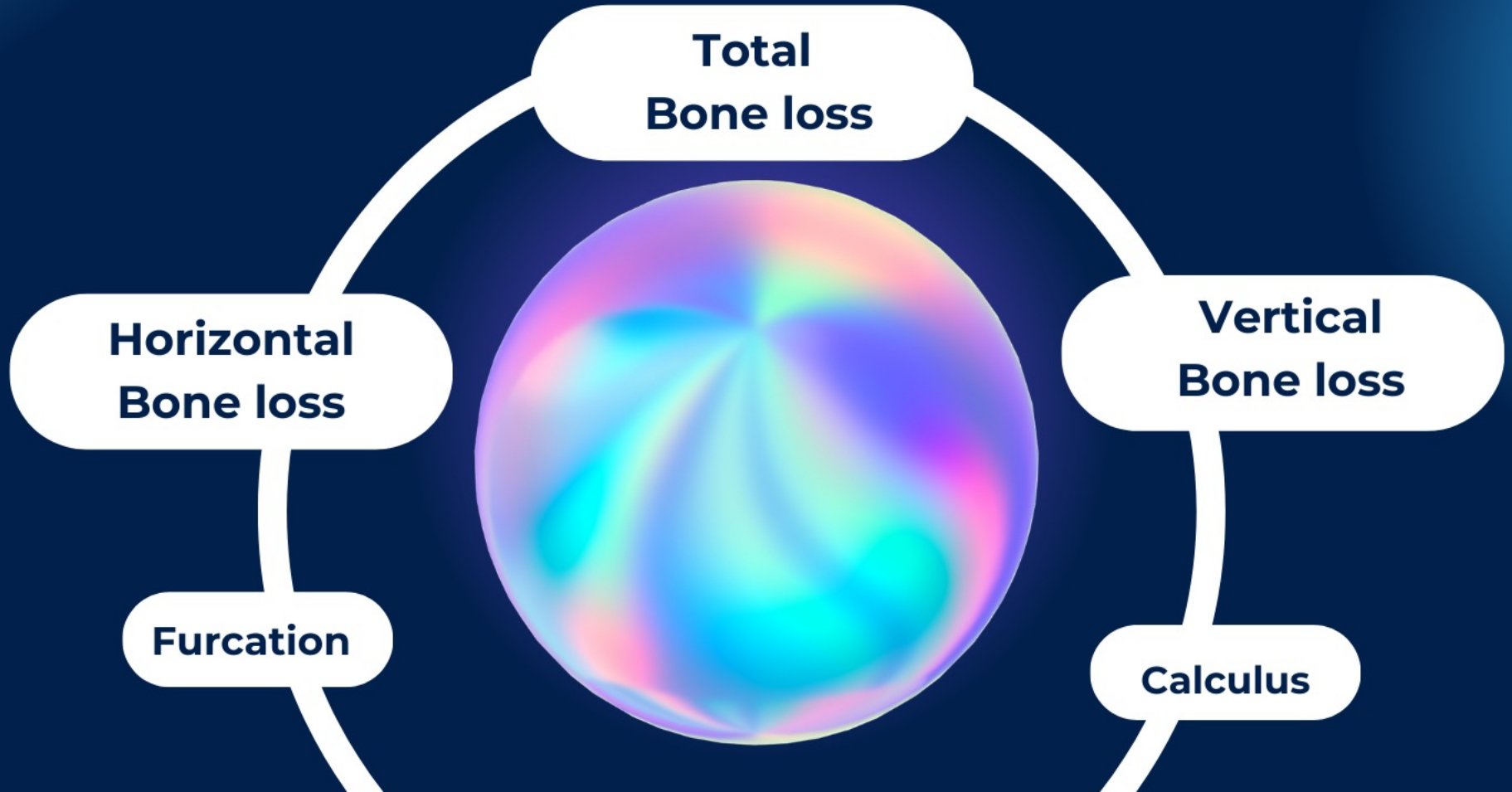
Study shows the potential for AI to automatically identify periodontal pathologies

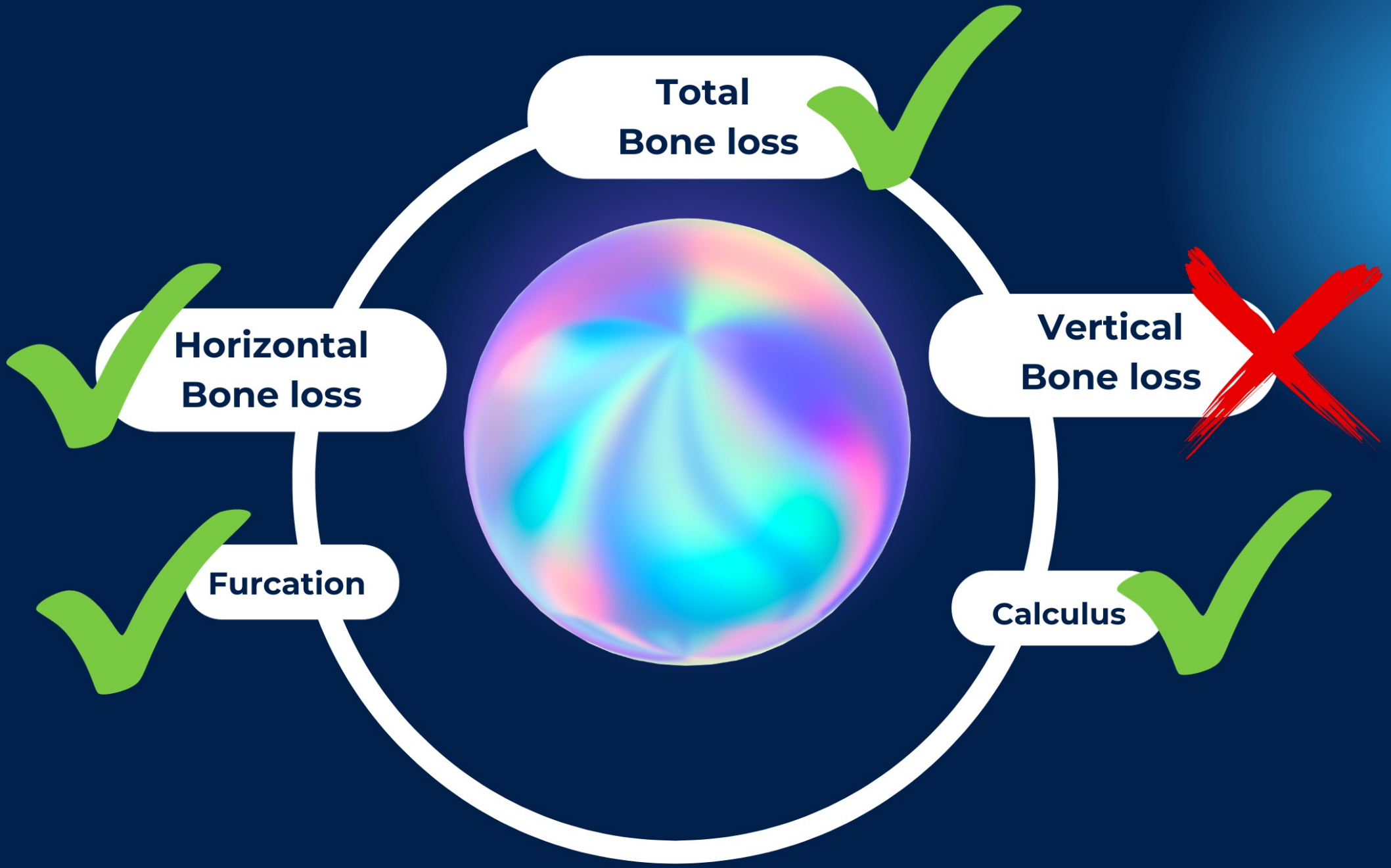
Reviewed by Emily Henderson, B.Sc. Jun 16 2022

A deep learning algorithm successfully detects periodontal disease from 2D bitewing radiographs, according to research presented at EuroPerio10, the world's leading congress in periodontology and implant dentistry organized by the European Federation of Periodontology (EFP).

> *"Our study shows the potential for artificial intelligence (AI) to automatically identify periodontal pathologies that might otherwise be missed. This could reduce radiation exposure by avoiding repeat assessments, prevent the silent progression of periodontal disease, and enable earlier treatment."*

434 bitewing radiographs from patients with periodontitis.
Image processing was performed with CNN to quickly and precisely segment images.
An experienced specialist also evaluated the images using the segmentation method.




Total
Bone loss
Horizontal
Bone loss
Vertical
Bone loss
Furcation
Calculus

Article | Open access | Published: 05 May 2020

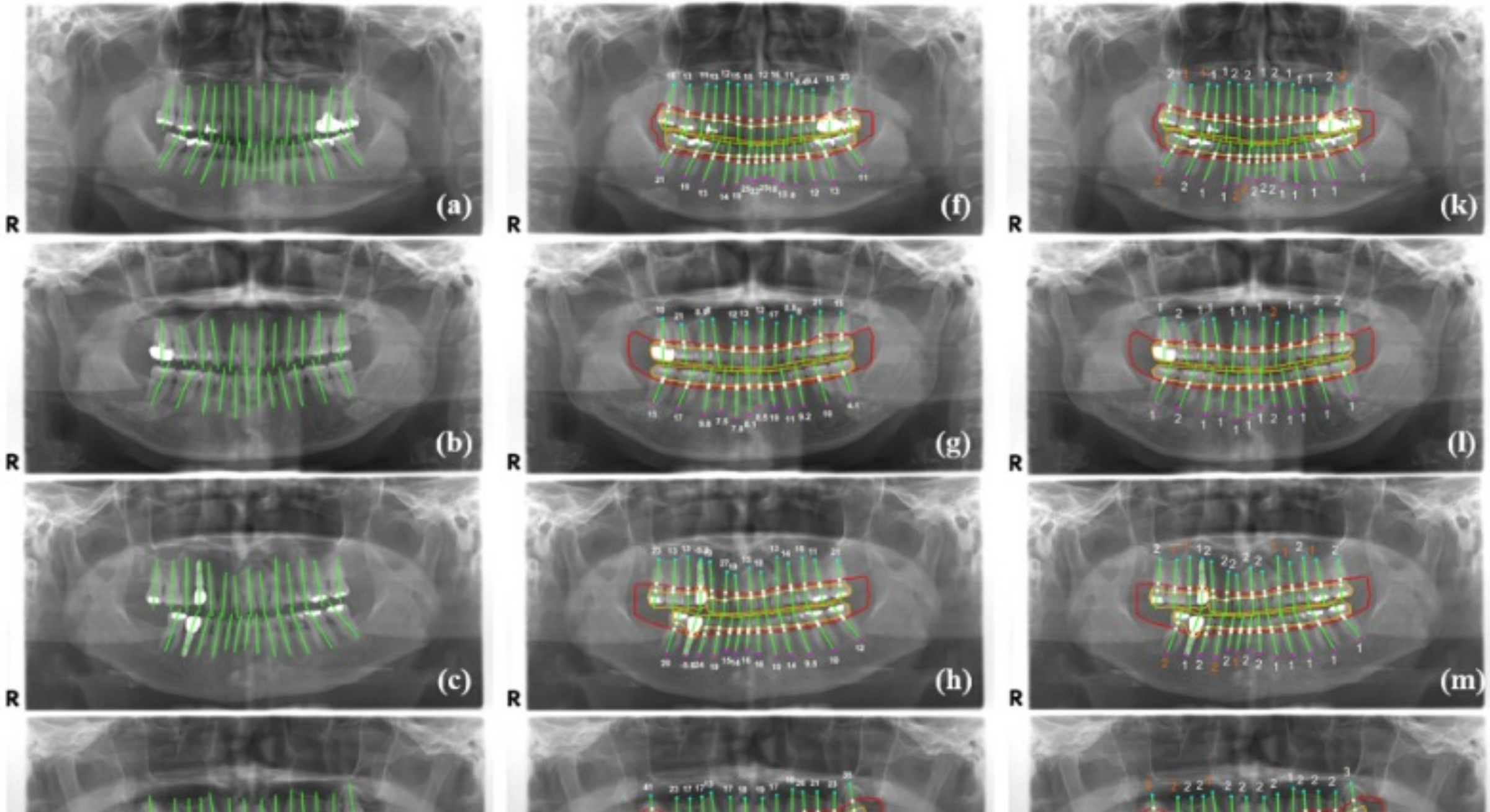
Deep Learning Hybrid Method to Automatically Diagnose Periodontal Bone Loss and Stage Periodontitis

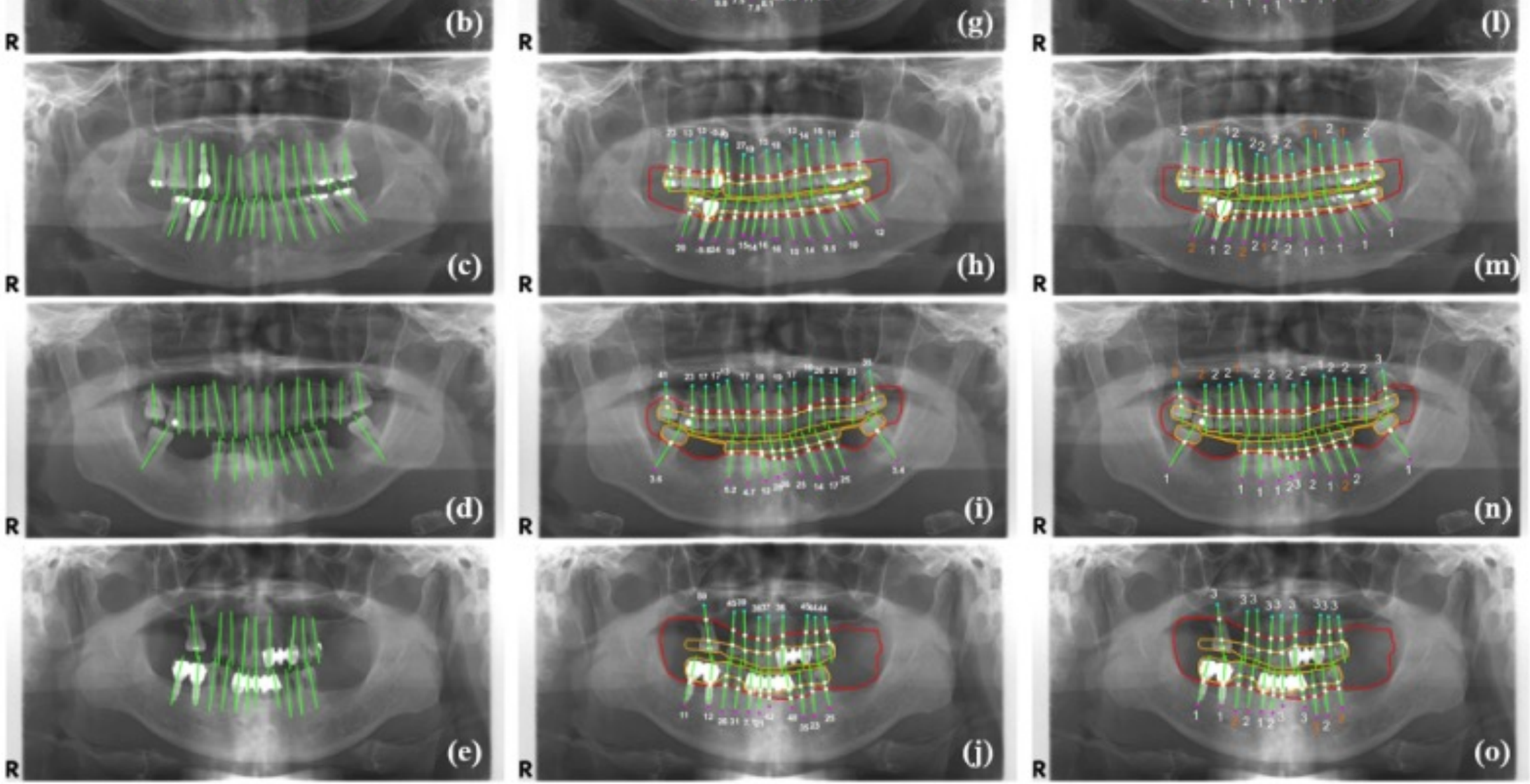
Hyuk-Joon Chang, Sang-Jeong Lee, Tae-Hoon Yong, Nan-Young Shin, Bong-Geun Jang, Jo-Eun Kim, Kyung-Hoe Huh, Sam-Sun Lee, Min-Suk Heo, Soon-Chul Choi, Tae-Il Kim & Won-Jin Yi

Scientific Reports **10**, Article number: 7531 (2020) | Cite this article

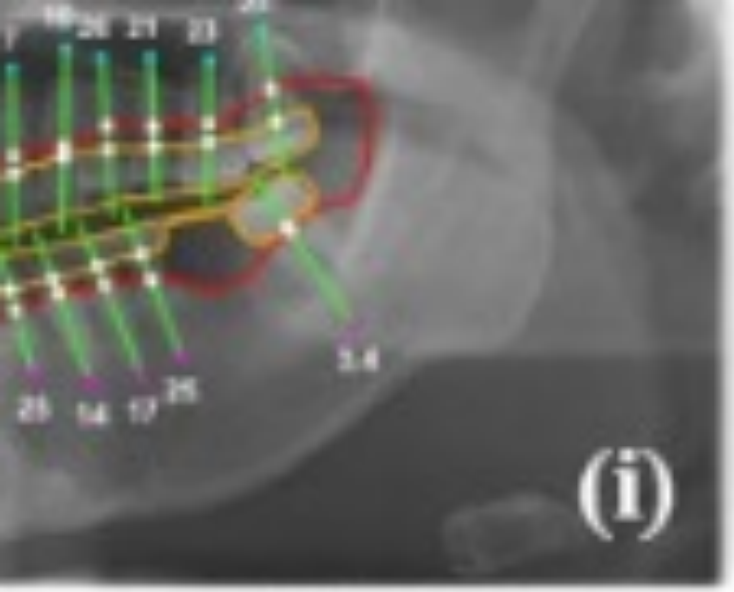
Abstract

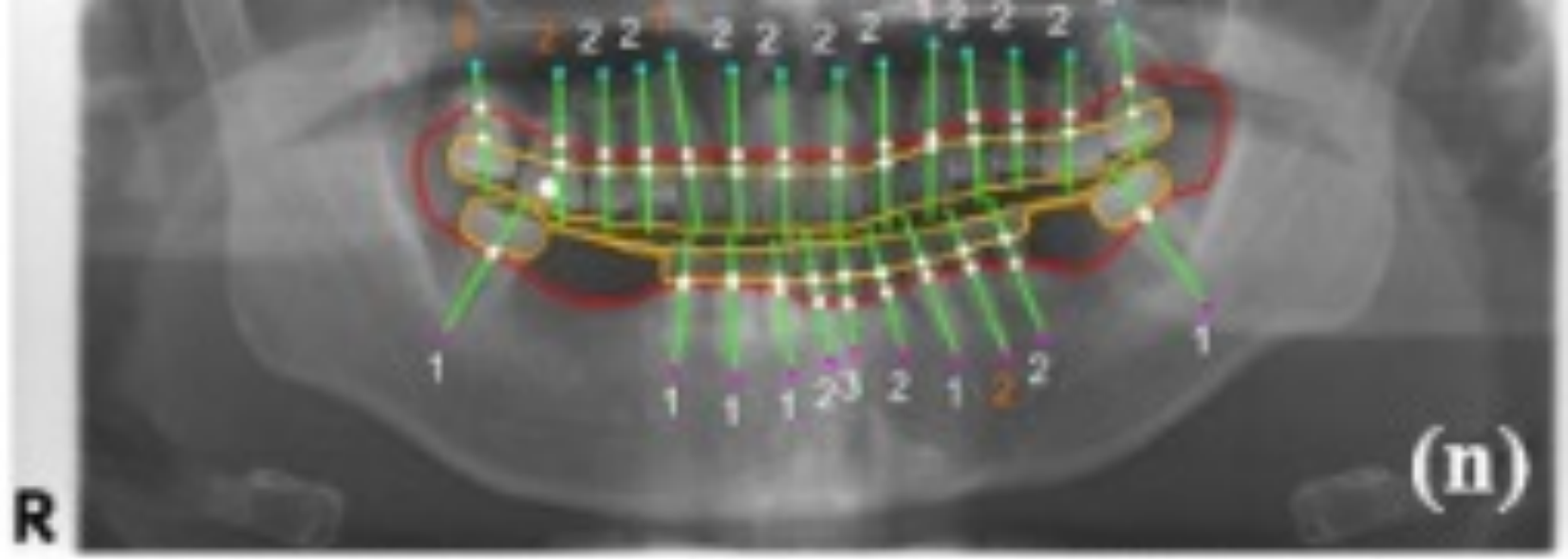
We developed an automatic method for staging periodontitis on dental panoramic radiographs using the deep learning hybrid method. A novel hybrid framework was proposed to automatically detect and classify the periodontal bone loss of each individual tooth. The framework is a hybrid of deep learning architecture for detection and conventional CAD processing for classification. Deep learning was used to detect the radiographic bone level (or

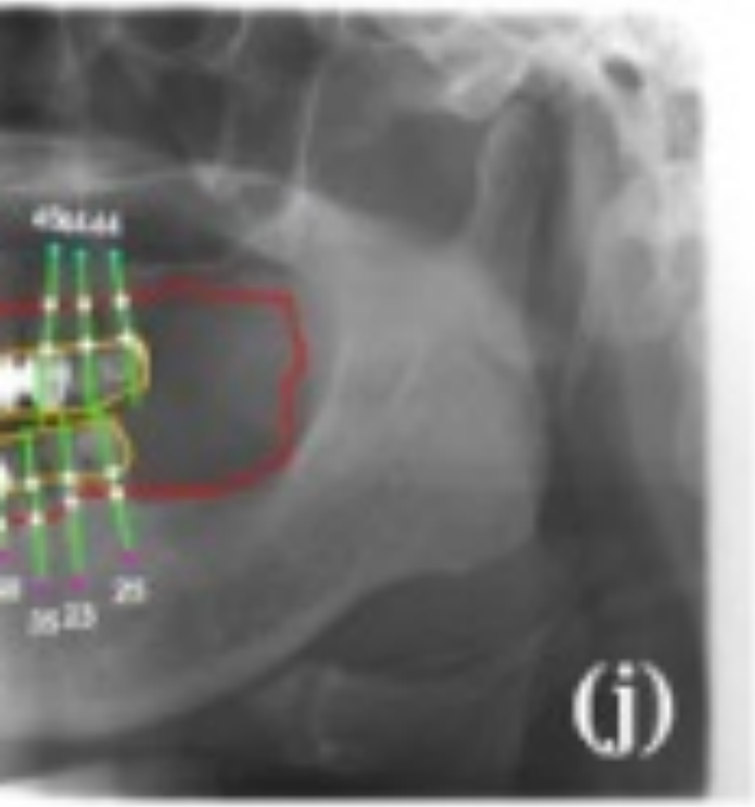

R
(a)
R
(b)
R
(c)
R
(f)
R
(g)
R
(h)
R
(k)
R
(l)
R
(m)

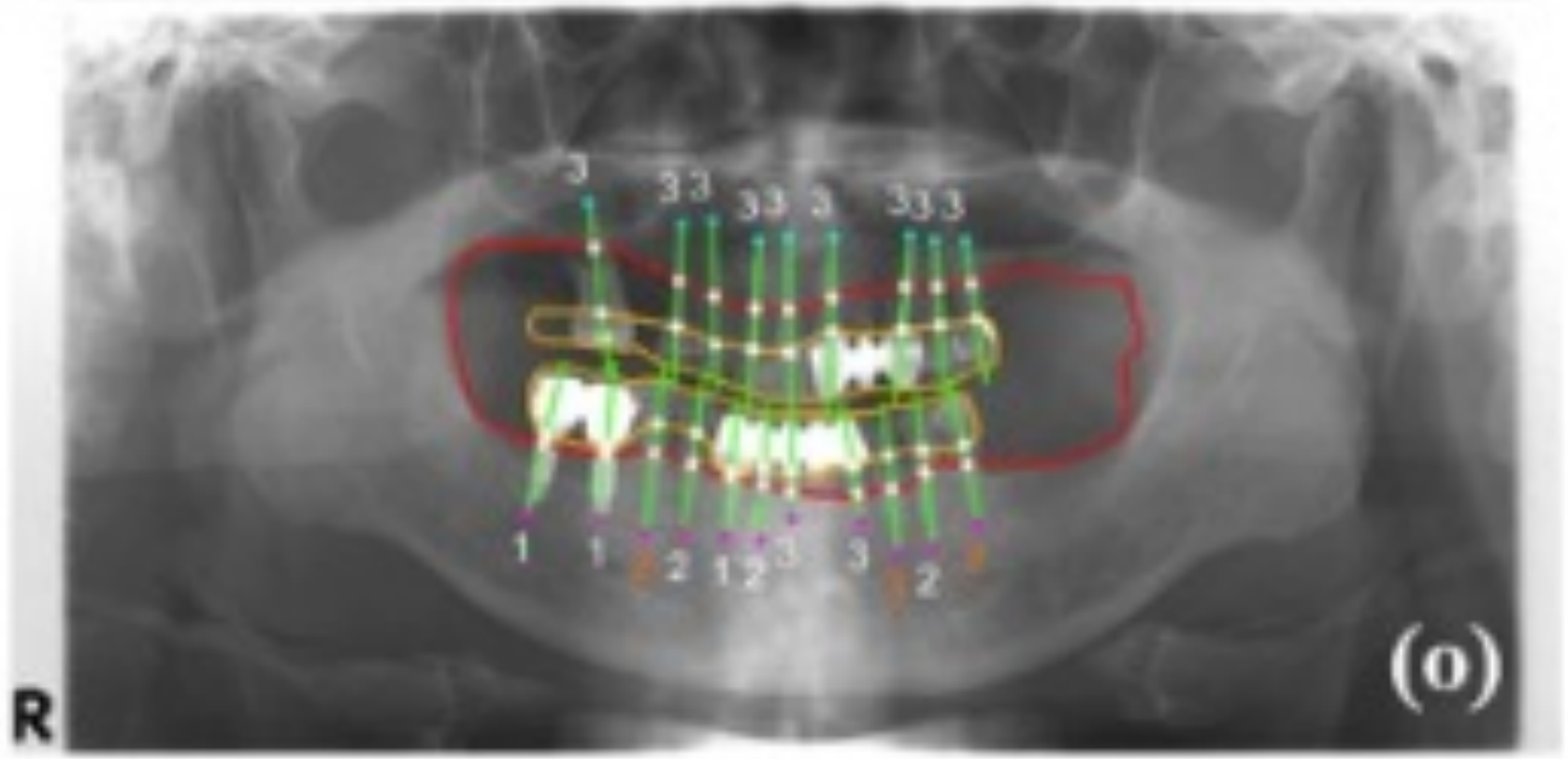


The long-axis orientations of the tooth and the implant (**a–e**), the intersection points of the tooth (implant) long-axis with the periodontal bone level and the CEJ level (fixture top level), the percentage rate of the radiographic bone loss (**f–j**), and the stages of the periodontitis for each tooth and implant (**k–o**) (correctly classified stages in white color, and incorrectly classified stages in orange color).


(i)


R
(n)


(j)


R
(o)

Bioengineering (Basel). 2023 Jul 4;10(7):802. doi: 10.3390/bioengineering10070802.

Deep Learning for Dental Diagnosis: A Novel Approach to Furcation Involvement Detection on Periapical Radiographs

Yi-Cheng Mao [1], Yen-Cheng Huang [1], Tsung-Yi Chen [2], Kuo-Chen Li [3], Yuan-Jin Lin [4], Yu-Lin Liu [2], Hong-Rong Yan [4], Yu-Jie Yang [4], Chiung-An Chen [5], Shih-Lun Chen [2], Chun-Wei Li [1], Mei-Ling Chan [1 6], Yueh Chuo [1], Patricia Angela R Abu [7]

Affiliations + expand

PMID: 37508829 PMCID: PMC10376376 DOI: 10.3390/bioengineering10070802

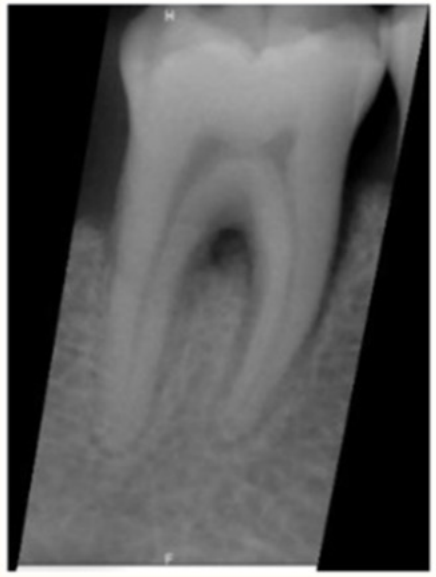
Free PMC article

Abstract

Furcation defects pose a significant challenge in the diagnosis and treatment planning of periodontal diseases. The accurate detection of furcation involvements (FI) on periapical radiographs (PAs) is crucial for the success of periodontal therapy. This research proposes a deep learning-based approach to furcation defect detection using convolutional neural networks (CNN) with an accuracy rate of 95%. This research has undergone a rigorous review by the Institutional Review Board (IRB) and has received accreditation under number 202002030B0C505. A dataset of 300 periapical radiographs of teeth with and without FI were collected and preprocessed to enhance the quality of the images. The

convolutional neural networks (CNN) with an accuracy rate of 95%.

Compare the impact of various training sets on training results.

	Original Images	Gaussian High-Pass Filter	Gaussian High-Pass Filter + Mask
Validation Accuracy	84.16%	87.21%	94.97%
Validation Loss	0.7634	0.4578	0.1822
Model	GoogLeNet	GoogLeNet	GoogLeNet
Image			

Denti AI Voice

Introduction to Voice Perio Charting

Explore the Roboflow Universe.

The world's largest collection of open source computer vision datasets and APIs.

200 MILLION+ IMAGES 200,000+ DATASETS 50,000+ FINE-TUNED MODELS

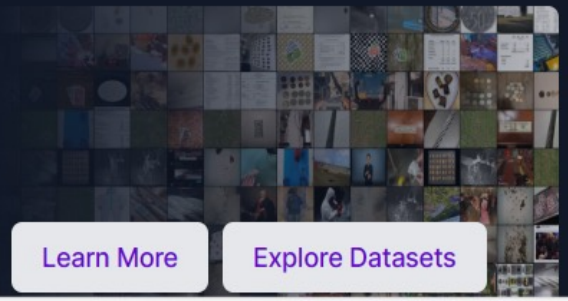
Search 200,000+ Open Source Computer Vision Projects...

BY PROJECT TYPE: All Projects Object Detection Classification Instance Segmentation Semantic Segmentation

BY MODEL: All Models YOLOv8 YOLOv5 Snap AR Lens Studio

Introducing Roboflow 100: A New Object Detection Benchmark

Advancing SOTA in object



Learn More Explore Datasets

YOLOv8 is here! Try it now

Dozens of fine-tuned YOLOv8 models are now available on

Train Your Own Explore Models

Roboflow projects

Gingivitis

Model & API (roboflow.com)

Smoker

Model & API (roboflow.com)

Caries

https://universe.roboflow.com/tauseef-ahmed-memon-8to7r/dental-cavities/model/1


AI in
Periodontal
Research

These aren’t futuristic dreams, but today’s reality. Welcome to the transformative world of AI-powered research tools!

ChatGPT (openai.com)

[Bard (google.com)]

Image: Google

Bing Chat with GPT-4


consensus
Search - Consensus: AI Search Engine for Research

EvidenceHunt

CHAT SEARCH SETTINGS LOGIN

Sources

Internet Medical Databases:

- [x] PubMed

International Medical Guidelines:

- [ ] NICE Guidelines

To chat with country- and language-specific content (like national medical guidelines), fill in your country of residence.

Select
Other

Change settings in your user profile

Login or create account to view your history

Chat

EH

Hi 👋, how can I help you?

example questions:

can mindfulness prevent burnout? | how to assess stroke risk in atrial fibrillation? | is tucatinib cost-effective in breast cancer?

Ask your question...

SUBMIT

*This tool provides a chat-interface to assist users in locating evidence within PubMed and various medical guidelines. It is not a source of medical advice. This is **not** a medical device or clinical decision support tool and should never be used as such. All information retrieved should be verified and utilized by healthcare professionals in conjunction with their clinical judgement. Always consult a healthcare professional for appropriate medical guidance.*

Chat Page (evidencehunt.com)

SCISPACE

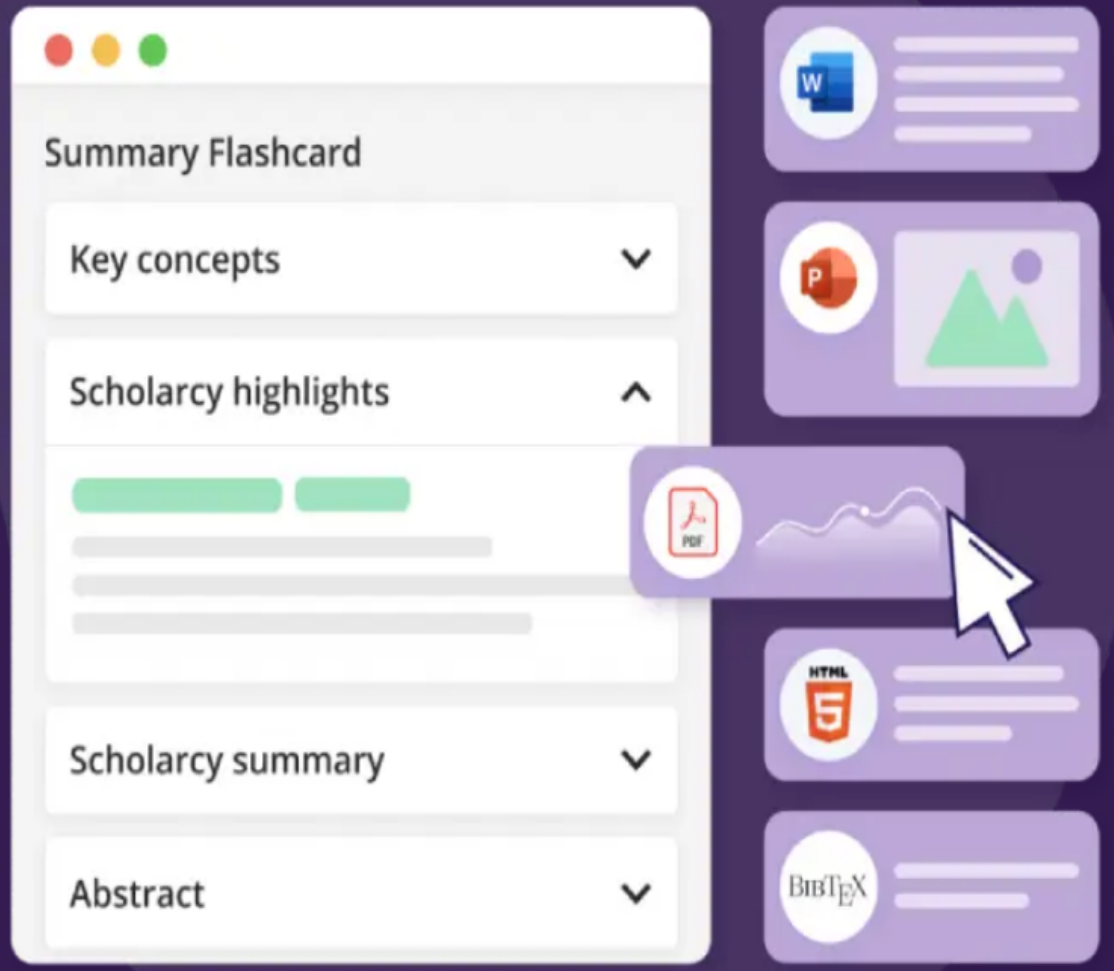
[AI Chat for scientific PDFs | SciSpace (typeset.io)]

scholarcy

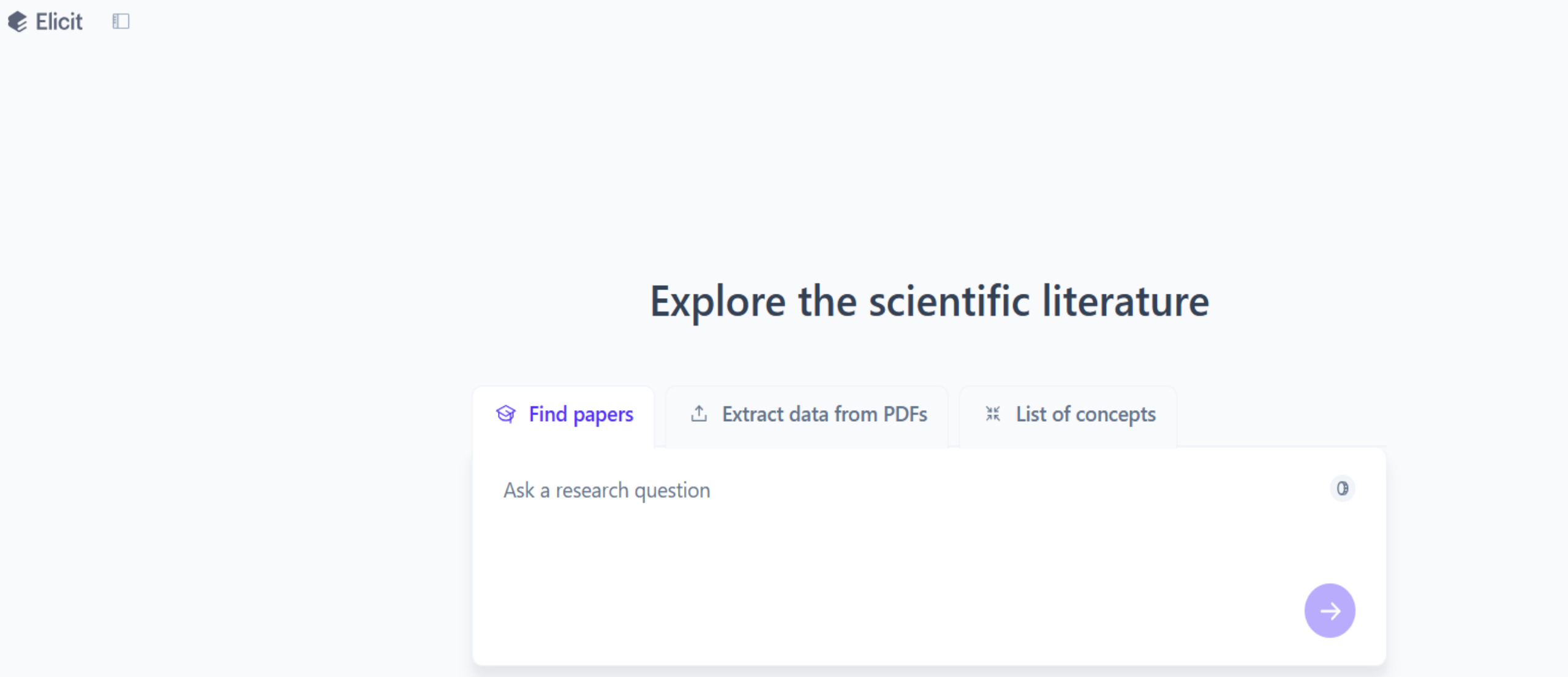
Home | Scholarcy Features | Who Is Scholarcy For? | Pricing | About Us | Blog | Contact Us | Login | Start Free

The AI-powered article summarizer

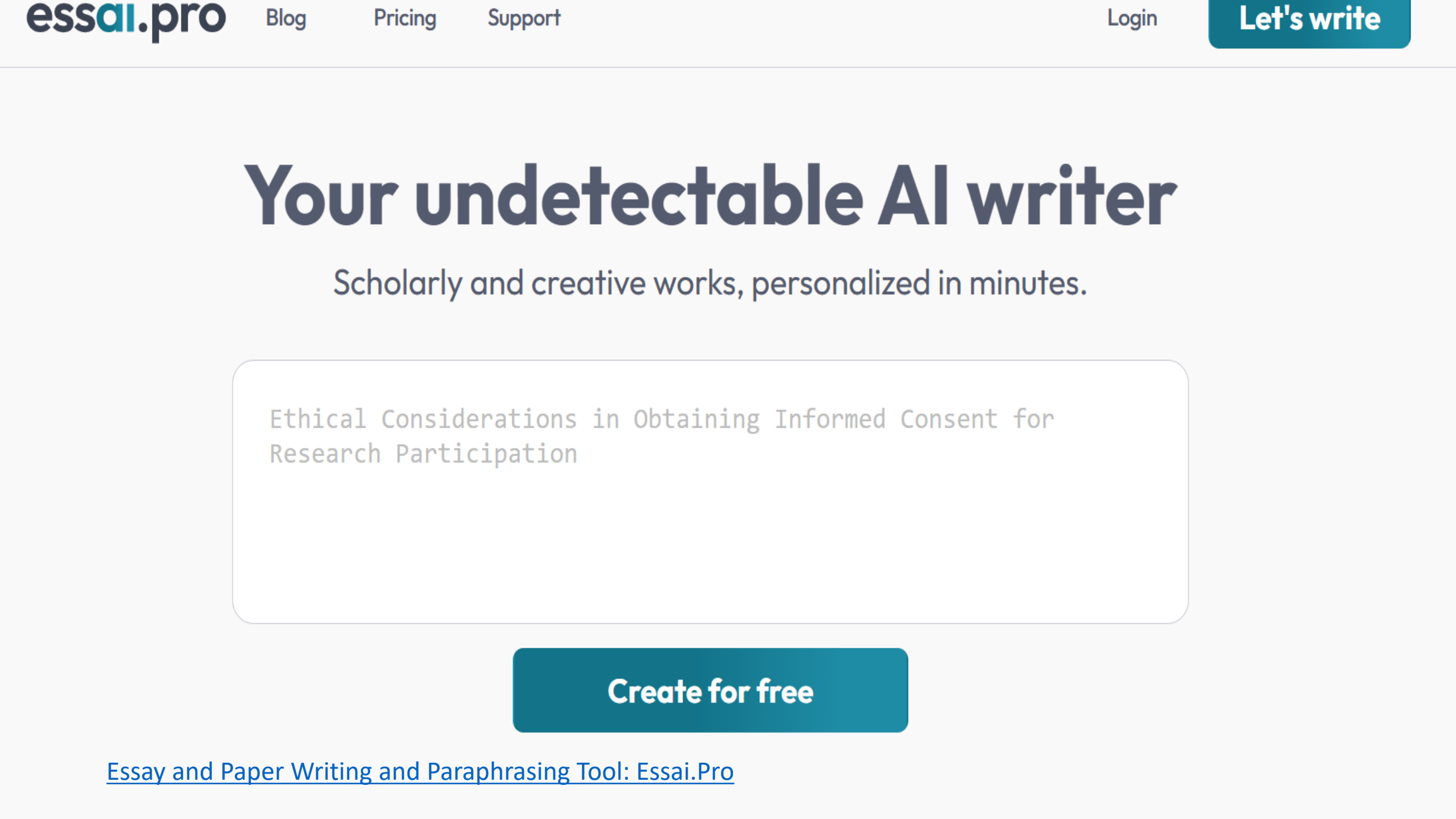
Try it now



[Scholarcy - Article Summarizer and Flashcard Generator]



[Elicit: Find scientific research papers]



[Essay and Paper Writing and Paraphrasing Tool: Essai.Pro]

Jenni AI now comes with a free ChatPDF Plus plan

jenni

Pricing About Blog Log In Start writing

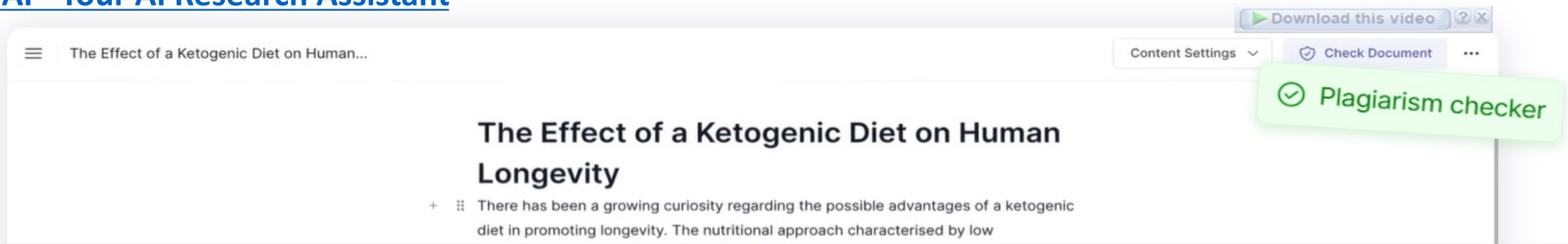
Supercharge Your Next Research Paper

Research and write your next paper with Jenni AI

Start writing — it's free

Loved by over 2 million academics

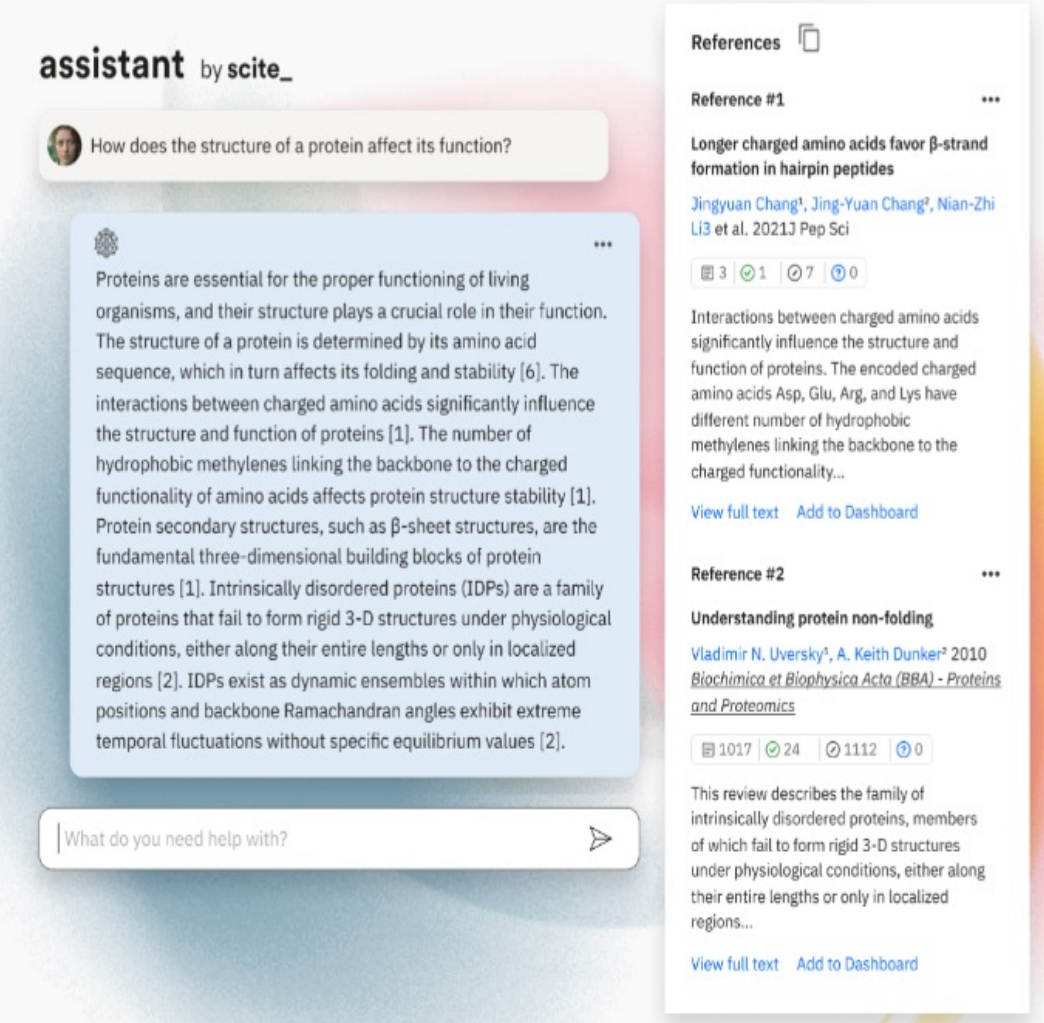
Jenni AI - Your AI Research Assistant



scite_ Search by title, author, keywords or DOI Assistant Product Discover Pricing Blog

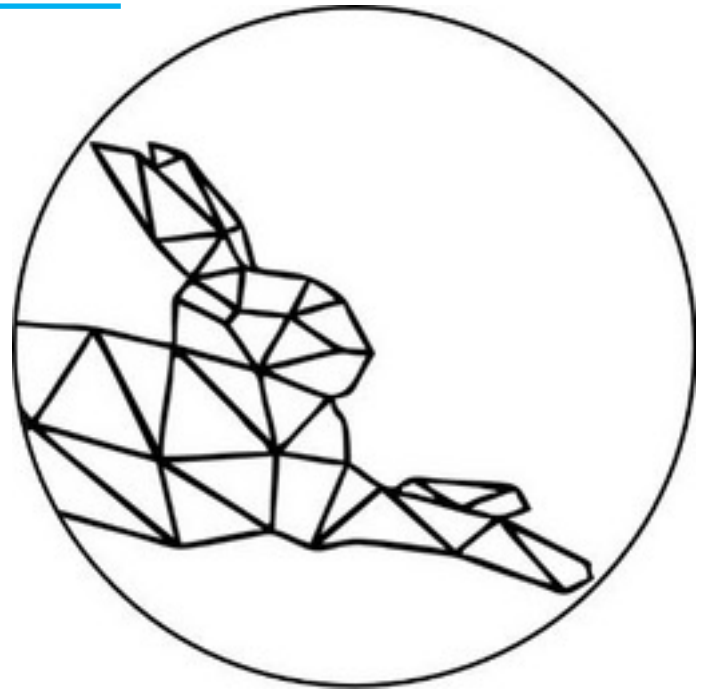
Ask a question, get an answer backed by real research

Start now Book a demo →



AI for Research - scite.ai

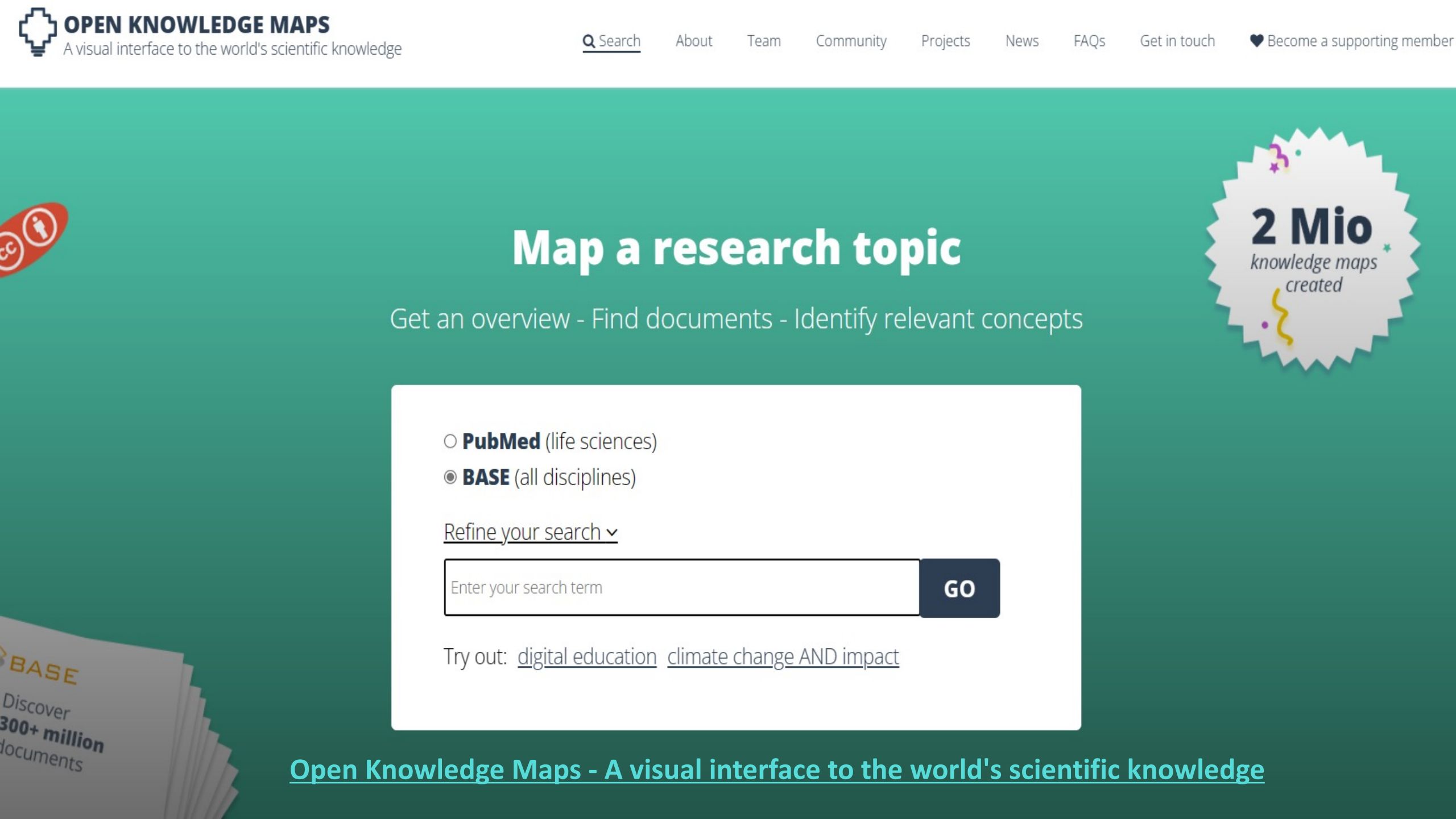
Research Rabbit



Research Rabbit (researchrabbitapp.com)

CONNECTED PAPERS

[Connected Papers | Find and explore academic papers]


OPEN KNOWLEDGE MAPS
A visual interface to the world's scientific knowledge
Search
About
Team
Community
Projects
News
FAQs
Get in touch
Become a supporting member
Map a research topic
Get an overview - Find documents - Identify relevant concepts
2 Mio
knowledge maps created
PubMed (life sciences)
BASE (all disciplines)
Refine your search
Enter your search term
GO
Try out: digital education climate change AND impact
BASE
Discover
300+ million
documents
Open Knowledge Maps - A visual interface to the world's scientific knowledge

[Sourcely | Research-AI]

Explainpaper

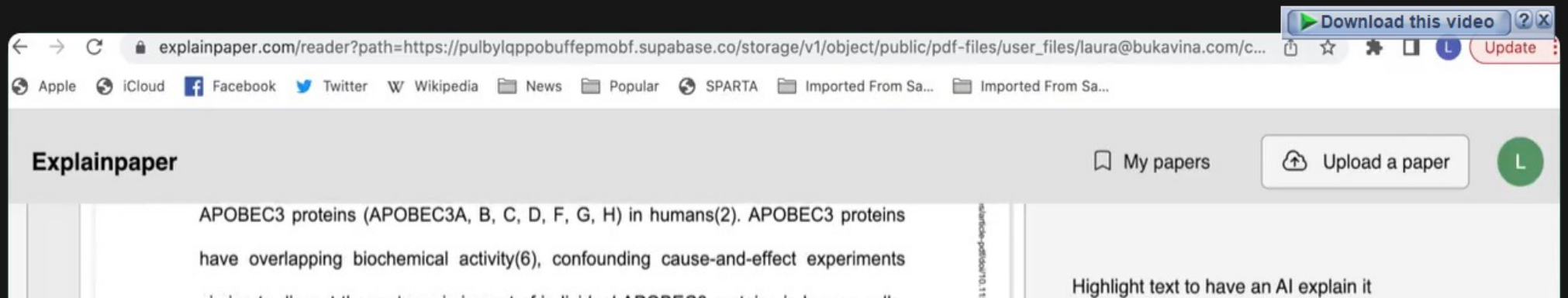
Pricing Sign Up Get Started

The Fastest Way to Read Research Papers

Upload a paper, highlight confusing text, get an explanation. We make research papers easy to read.

Start for free

Explainpaper



NEW Accurately extract PDF data with ChatDOC API- Join ChatDOC PDF Parser Waitlist →

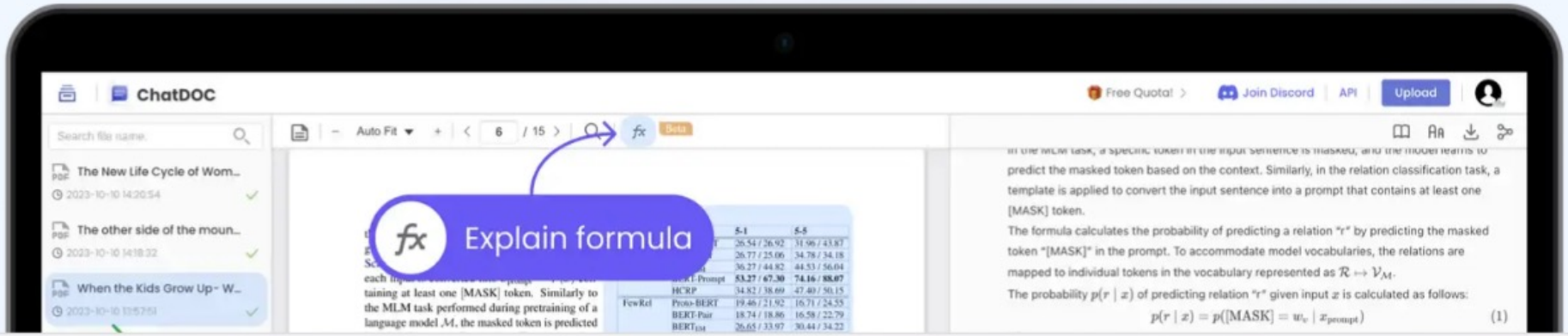
Chat with documents.
Get instant answers with cited sources.

Dive into PDFs like never before with ChatDOC. Let AI summarize long documents, explain complex concepts, and find key information in seconds.

→ Try for Free

[ChatDOC - AI Chat with PDF Documents]

Supported Formats PDF DOC DOCX SCAN WEBSITE EPUB MD TXT



Write your papers and essays better with Yomu AI

Transform your academic life. Save time and write superior papers and essays using Yomu AI

https://www.yomu.ai/

More than an AI detector
Preserve what's human.

We bring transparency to humans navigating a world filled with AI content. GPTZero is the gold standard in AI detection, trained to detect ChatGPT, GPT4, Bard, LLaMa, and other AI models.

Check out our products →

Was this text written by a **human** or **AI**?

Try detecting one of our sample texts:

ChatGPT | GPT4 | Llama 2 | Human | AI + Human

Paste your text here ...

0/5000 characters UPGRADE

Check Origin

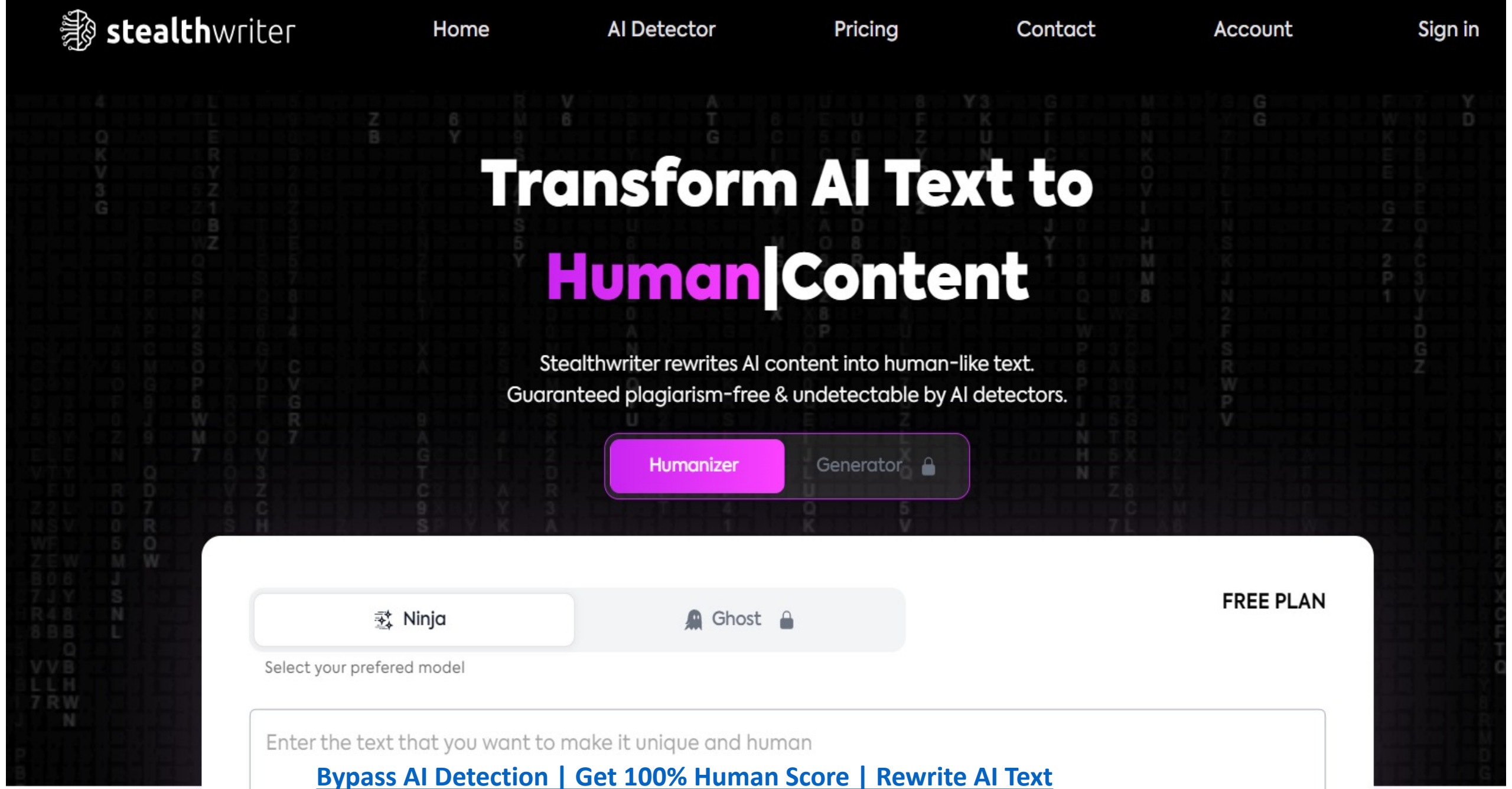
Upload file ⊕

.pdf, .doc, .docx, .txt

By continuing you agree to our **Terms of service**

[GPTZero | The Trusted AI Detector for ChatGPT, GPT-4, & More]

Paraphrasing Tool - QuillBot AI


stealthwriter
Home
AI Detector
Pricing
Contact
Account
Sign in
Transform AI Text to Human|Content
Stealthwriter rewrites AI content into human-like text.
Guaranteed plagiarism-free & undetectable by AI detectors.
Humanizer
Generator
Ninja
Ghost
FREE PLAN
Select your prefered model
Enter the text that you want to make it unique and human
Bypass AI Detection | Get 100% Human Score | Rewrite AI Text into Human Content (stealthwriter.ai)

writefull

- Writefull X Home
- Title Generator
- Abstract Generator
- Paraphraser
- Academizer new
- GPT Detector new

We are hiring 👨‍💻👩‍🎤🥷

Drop us an email at careers@writefull.com linking to your previous work and telling us how you can help make Writefull even better.

Paraphraser

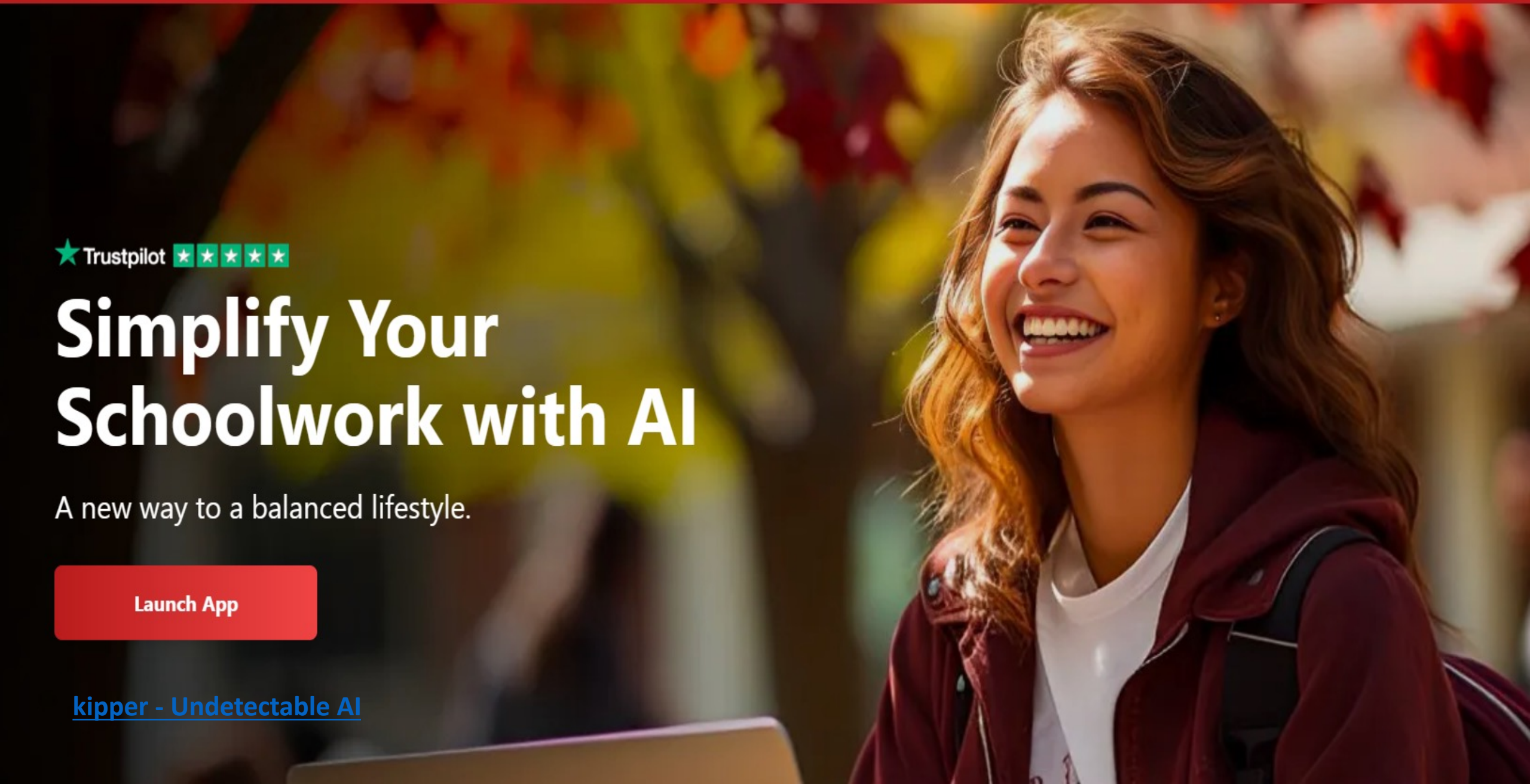
Paraphrasing tool.

Writefull's Paraphraser gives you alternative ways of writing something.

Enter a sentence or paragraph and click one of the three paraphrasing levels.
Here's an example.

Enter a sentence or paragraph here.

Automatically Paraphrase your Academic Text - Writefull's Paraphraser


kipper
Pricing
Contact Us
Sign Out
Launch App
Trustpilot
Simplify Your Schoolwork with AI
A new way to a balanced lifestyle.
Launch App
kipper - Undetectable AI

#chatgpt


VEED.IO