



MAGNETICALLY GUIDED ORIGAMI ROBOT

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ABSTRACT :

Peptic ulcer disease makes open sores, or ulcers, appear in the lining of your digestive tract. Peptic means that it has to do with the stomach. Pepsin is the main digestive enzyme that your stomach makes, and that's where the word comes from. This article is about how a robot made of origami that is guided by magnets was built and used. It has flexible printed circuit units that let *Helicobacter pylori* be treated with phototherapy for a long time.

INTRODUCTION

About half of the people in the world have *Helicobacter pylori*, a common bacterial infection that can lead to stomach issues like gastritis, peptic ulcer disease, and gastric cancer. About half of the people in the world have *Helicobacter pylori*, which can cause ulcers, gastritis, and stomach cancer. More and more bacteria are becoming resistant to antibiotics, which makes standard treatments less effective. This research suggests that a Kresling origami robot with a magnetically guided arm could be used for photodynamic therapy (PDT) and biopsies. The robot's triangular panels make it easier to move around, and its bistable structure lets you make thin, stable holes with thin needles. It doesn't need any power from inside; magnetic fields control it from the outside. This is a new, minimally invasive way to treat *H. pylori* infections that don't respond to other treatments.

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- *Helicobacter pylori*, a pervasive bacterial infection associated with gastrointestinal disorders such as gastritis, peptic ulcer disease, and gastric cancer.
- About half of the people in the world are affected by it.
- Standard clinical eradication therapies are becoming less effective because antibiotic-resistant strains are becoming more common.
- There is also photodynamic therapy (PDT) that can help with the disease.
- This study shows how to make and use a magnetically-guided origami robot with flexible printed circuit units for long-term, stable phototherapy of *Helicobacter pylori*. This study is a big step forward in using technology to find new ways to treat medical problems, especially *Helicobacter pylori* infections that don't respond to antibiotics.
- A robot that moves with magnets and is made of Kresling origami

Here are the main reasons why the Kresling pattern was picked:

1. The middle part of the Kresling origami pattern is a triangular panel that is tilted. This stops the robot from sliding around as much.
2. The Kresling origami pattern's bistability and the flexible hinge's elasticity work together to make the biopsy puncture motion more stable.
3. Fine needles are better for diagnosing because they can get inside the lesion. Biopsy tools like forceps or brushes can only reach the surface tissue.
4. An outside magnetic drive system tells the robot how to roll and take biopsy samples. This lets you control it from far away and doesn't need a drive unit or internal power source.

Kresling origami was used to make a biopsy robot. An external magnetic drive system controls the robot's rolling and biopsy. Here is how the biopsy process really works: **Design of biopsy robot based on Kresling origami**

- The rolling motion and biopsy of the robot are controlled by an external magnetic drive system, whose actual biopsy process is as follows.

The patient swallows the robot



The robot is directed by an external magnetic field to the target collecting spot if a suspicious lesion is found.

(The biopsy needle does not protrude during this movement)

The robot then performs biopsy sampling operations in a strong gradient magnetic field



After the completion of the sampling process, the target tissue is saved in a biopsy needle, and subsequently, the robot is retrieved.

APPLICATIONS

- *Medical Treatments*: Targeted drug delivery, minimally invasive surgeries, and phototherapy for antibiotic-resistant infections.
- *Microfluidics*: Precise manipulation of micro- and nanoliter droplets for biochemical assays and diagnostics.
- *Environmental Monitoring*: Detection and analysis of contaminants in various environments.
- *Exploration*: Navigation through complex terrains for planetary exploration or search and rescue missions.

REFERENCES

1. Yuan S, Liang B, Wong PW, Xu M, Li CH, Li Z, Ren H. Magnetic-Guided Flexible Origami Robot toward Long-Term Phototherapy of H. pylori in the Stomach. In 2024 IEEE International Conference on Robotics and Automation (ICRA) 2024 May 13 (pp. 9851-9857). IEEE.
2. Huang L, Xie T, Yin L. Magnetically-actuated intracorporeal biopsy robot based on Kresling Origami. Theoretical and Applied Mechanics Letters. 2025 Jan 1;15(1):100500.
3. Danilo CO, Leanza S. A review on treatment of perforated peptic ulcer by minimally invasive techniques. Maedica. 2022 Sep;17(3):692.
4. Ying B, Huang H, Su Y, Howarth JG, Gu Z, Nan K. Theranostic gastrointestinal residence systems. Device. 2023 Aug 25;1(2).
5. Xu J, Xu B, Yue H, Xie Z, Tian Y, Yang F. Origami-Inspired Bionic Soft Robot Stomach with Self-Powered Sensing. Advanced Healthcare Materials. 2024 Sep;13(22):2302761.