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Nanorobotics and Artificial Intelligence for Non-Invasive Clot Dissolution: A Breakthrough Approach in Thrombosis Treatment

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Abstract
Thrombosis is the formation of blood clots in veins and arteries. Blood vessels form at the injured site to prevent blood loss. Unfortunately, blood vessels are formed in vital organs, causing serious problems such as stroke, heart failure, varicose veins, and embolism. A small coat may dissolve against the coagulant.
Treatments available to remove cysts include thrombolysis and thrombectomy. Thrombolysis uses a catheter to remove medication from the site of the clot, while thrombectomy is a surgical procedure that manually removes the clot. Major complications include excessive bleeding, distal embolism, vascular damage, and tube failure. This procedure is not recommended for hypertensive, hypotensive, pregnant, stroke patients, and patients using antihypertensive medications.
We offer treatments that use artificial intelligence-controlled nanorobots that can reach and dissolve hair anywhere on the body. The nanobots have been programmed to target the precise site of the clot and then release the anticoagulant. The therapy is non-invasive, bloodless, with minimal recovery and healing time. We developed a nanobot prototype embedded with software to detect and automatically deploy bugs.

Keywords: Nanorobotics, Artificial Intelligence (AI), Thrombosis Treatment, Blood Clots, Thrombolysis, Targeted Drug Delivery.

1.INTRODUCTION

The intelligence displayed by machines is called artificial intelligence (AI). A computer is a famous example of such a system. Artificial intelligence (AI), despite its strong science fiction connections, is the branch of computer science that deals with intelligent behavior, learning, and adaptation in machines. AI research aims to develop machines that can perform tasks that require intelligent action. Handwriting, speech, and facial recognition are just a few examples of monitoring, planning, and scheduling, as well as the ability to diagnose and answer consumer questions.

Eventually, it became a scientific discipline devoted to finding answers to real-world problems. In addition to being incorporated into various home computer software and strategy games, AI systems are

now widely used in industries such as economics, medicine, engineering, and the military.

Advanced web search engines (e.g. Google), recommendation systems (e.g. YouTube, Amazon and Netflix), understanding of human speech (e.g. Siri and Alexa), self-driving cars (e.g. Tesla), automatic decision making and strategic planning competing at the highest level. in gaming systems are just a few examples of AI applications (such as wrestling and Go). The AI effect is a phenomenon that occurs as machines become more skilled and jobs that require "intelligence" are often eliminated from the concept of AI.

For example, optical character recognition is often left out of AI discussions, even though it has become a mainstream technology. Artificial intelligence (AI) was founded as an academic research in 1956 and has experienced many excitements, disappointments, and financial losses (known as the "AI Winter"), followed by new approaches, breakthroughs, and new investments. Since its inception, AI research has sought and rejected different methodologies, including brain simulation, modeling human problem solving, formal logic, general knowledge libraries, and mimicking animal behavior.

In the first decade of the twenty-first century, advanced mathematical statistical machine learning dominated the field, and this approach has been very successful, helping to solve many problems in industry and academia. Many subfields of AI research are based on specific goals and the use of certain techniques. Reasoning, knowledge representation, planning, learning, natural language processing, sensing, and the ability to move and manipulate objects are typical AI research goals. One of the long-term goals of the field is general intelligence (the ability to solve any problem).

AI researchers have adapted and combined many solution strategies to solve these problems, including mathematical search and optimization, formal logic, artificial neural networks, and statistical, probabilistic, and economic methodologies. Computer science, psychology, linguistics, philosophy, and many other disciplines are applied to AI. Nanotechnology is the branch of engineering that deals with tiny machines. Currently, it is done in factories or individual Nano factories that use strategies and tools developed to produce advanced products. There will be wind in the conversion of this installation.
A nanometer is a billion meters, about the width of three or four molecules. A human hair is about 25,000 nanometers wide. So we can imagine how big a nanorobot would be. Nanotechnology is also called targeted technology Its high-level structure will affect almost all businesses and almost all sectors of society, and it is a general purpose technology description.

Nanorobot can be used to update articles:
• Better built
• Lasts long
• Cleanser
• More secure
• Smart applications for home, communication, medical, transportation, agriculture and general industry.

At the nanometer scale, materials can exhibit unusual properties. If we change the size of the particle, it can change its color, for example. The orientation of nanometer-sized particles, atoms, reflects light

differently. Silver appears yellow or bluish, gold appears dark red or purple.

Nanotechnology can expand the surface area of materials and allow more particles to connect with different materials. The expansion in surface area is one of the biggest explanations for why nanometer-sized materials can be more compact, stronger, and more conductive than their larger counterparts.

Nanotechnology is not minute. "Nanotechnology does not work in the simplest aspect," says the National Nanotechnology Initiator. "Instead of working at the nano scale allowing researchers to take advantage of unusual physical, mechanical, bonding, and optical properties of materials that normally occur at that scale. "

2.TARGETED DRUG DELIVERY

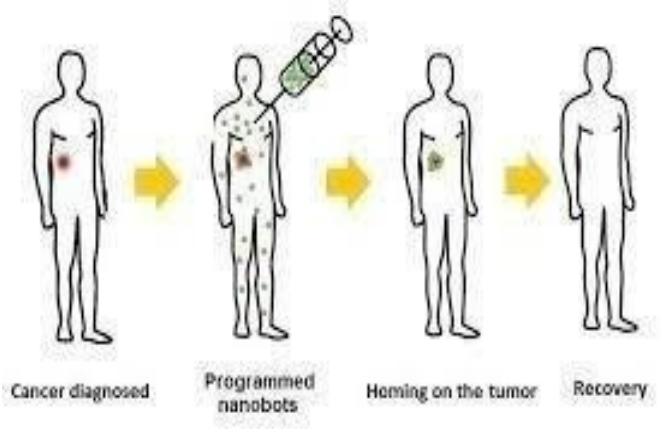
The idea of "magic bullet" is not uncommon in medical science. It was first proposed by Nobel Prize winning physician Paul Ehrlich over 100 years ago. The biggest challenge in achieving this is the difficulty in managing targeted measures.

For most of medical history, the best option for treating various conditions was medication that had some effect on the body or brain. This method can cause some collateral damage that should be considered. Drugs whose benefits outweigh the risks will be prioritized. The possibility of intervening at the cellular level has become possible with the development of nanotechnology.

Targeted induction in our brain (Figure 2.1) can increase and decrease the effects of drugs in neuroscience. It has been proven to work in clinical trials for treatment-resistant depression. Targeted drug delivery therapy is applicable to almost all branches of medicine.

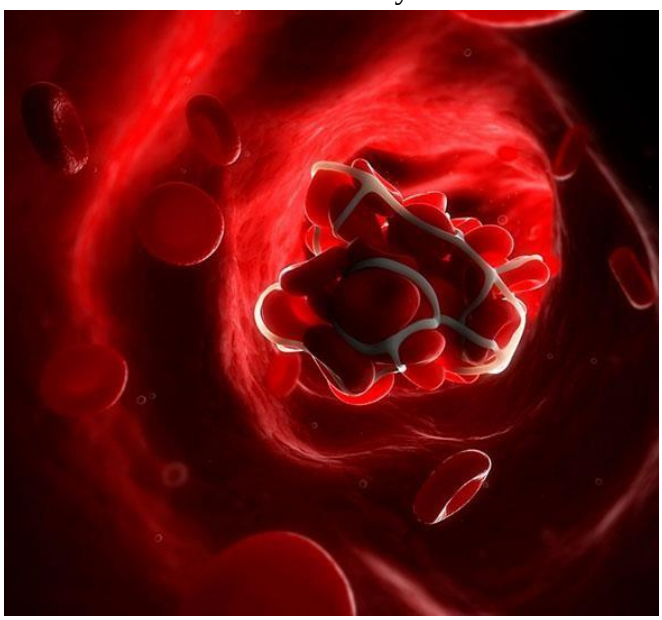
The main weakness in oncology is that chemotherapy also kills healthy cells, leaving researchers to explore the nature of nanocarriers and chemotherapy agents used to assemble stable nanoparticles. Researchers have also worked with nanotechnology to transport cardiac stem cells into damaged heart tissue.

Advances in engineering will enable the development of intelligent nanomedical devices and nanorobots that can even move under their own power and self-heal areas that need intervention.



3.EXISTING SYSTEM

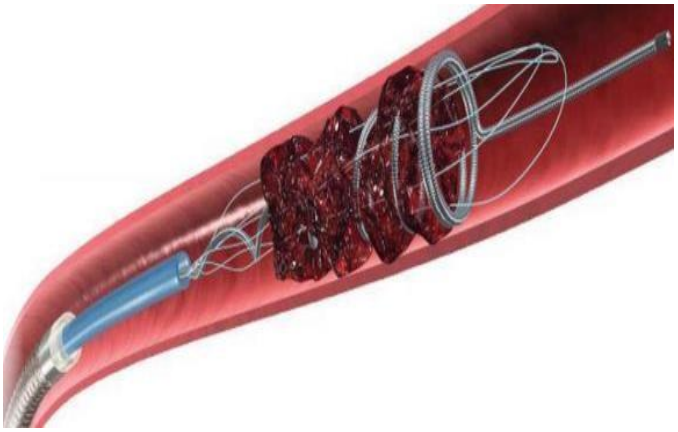
The human body has the ability to stop bleeding inside or outside the body by making a chemical reaction between platelets and proteins called thrombus. Internal thrombosis is caused by obesity, trauma, certain medications, autoimmune disorders, inherited genetic disorders, alcohol consumption, and smoking. It obstructs blood circulation inside the body and causes discomfort to people.



The two types of thrombosis are:

- **Venous thrombosis**: Clot in the vein that carries blood back to the heart from the body. Causes swelling, redness and pain atthe site
- **Arterial thrombosis**: Clot in the artery that carries blood from the heart to the body. Causes heart attack and stroke.

A thrombus in the vein can travel to the lungs. This is called pulmonary embolism. A blood clot in an artery can travel to the brain. This can lead to a stroke. A thrombus in the femoral artery in the leg can cause tissue death in the leg. A thrombus in an abdominal artery can cause pain and vomiting.



Thrombolysis may involve the injection of clot- busting drugs through an intravenous (IV) line or through a long catheter that delivers drugs directly to the site of the blockage. If the clot is relatively small, the process may take several hours. Buttreatment for a severe blockage might take several days. Although thrombolysis can safely and effectively improve blood flow and relieve or eliminate

symptoms in many patients without the need for more invasive surgery, it's not recommended for patients who use blood-thinning medication, severe high blood pressure, hemorrhagic stroke, kidney disease, recent surgery,pregnant or advanced at age.

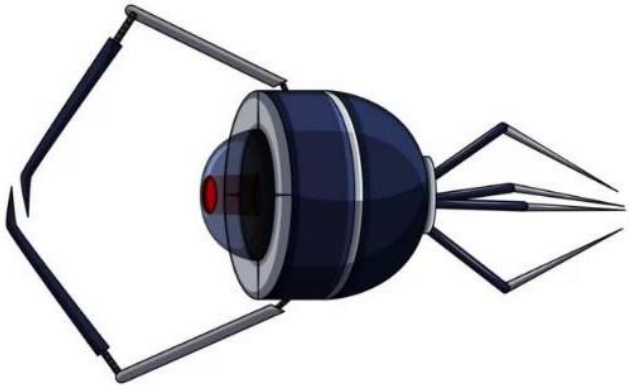
Patients undergoing thrombolysis are at risk of infection, as well as allergic reactions to contrast dyes required for imaging, vascular damage, and intracranial bleeding. These treatments fail to dissolve blood vessels in up to 25% of patients. Another 12% of patients develop plaques or clots in their blood vessels again. Furthermore, even if thrombolysis is successful, it cannot repair tissue that has been damaged by blood clots.

Thrombectomy is used when the clot is large and other treatments or procedures are not working or are not successful. This is an open surgical procedure where the surgeon opens and repairs the vessel. Risks include infection, blood loss, age factors, allergic reactions, vascular perforation, and stenosis. When treating a thrombus, it can break free and short in different locations (embolus). The main disadvantages include surgical errors, costs, and time required for patient recovery. Thrombectomy can be open surgical thrombectomy or percutaneous mechanical thrombectomy.

4. PROPOSED SYSTEM

A medical nanobot that uses artificial intelligence to detect and operate on patients. It does not require external control of the procedure. The location and size of the tumor was analyzed using a CT/MRI scan. The scan report is used as initial input. The DICOM viewer software calculates the direction and time taken to access the arch site. After reaching the location, the drugs are administered The amount of medicine needed to dissolve the amount of nanobots needed is determined by the size and shape of the coating. Nanobot measures the blood flow pressure in the vessel. It softens the skin and dissolves blood flow.

Nanobot has a camera, a beak, and a tail. The camera is connected to the computer and displays images inside the body when the nanobot moves. Allows doctors and technicians to track bots. The container carries an anti-coagulant drug that is delivered at the target site.



We use a targeted drug delivery method because when the drug is taken orally or through an IV to dilate the vein, the drug is distributed throughout the body. Thus, the rate of drug absorption is reduced and the effect is reduced. When the drug is administered at the right site, the absorption rate and effect are relatively high. The tail is used for movement. The tail is designed to move in the blood stream for bot movement.

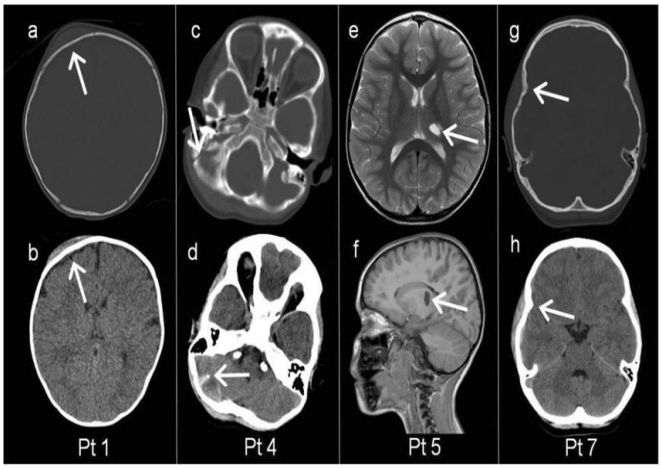
Nanobots are made up of compounds of proteins and polynucleotides that dissolve in the body. It remains in the human system for up to ten days to treat unwanted embolism and monitor the patient's health. When organic material is used, it does not cause side effects or major toxicity. Waste management in this system is more efficient than conventional methods.

It is a non-invasive procedure that requires a surgeon or surgical instruments. It does not require a qualified doctor. The patient recovery rate is high and it is a straightforward treatment. There is no need for several hours of open surgery that causes trauma to the patient's body. Do not damage the veins in the treatment of acne. There is no unnecessary damage during the process. No bleeding, scarring, infection or allergic reactions. It is suitable for patients with various problems. The patient does not have to wait for the treatment, but can do it immediately, as if he had received the medicine by injection. If there is contact, the nanobot can be controlled by the computer system. The main disadvantages are that it takes years of research and bots are expensive to get started.

In developing this Nanobot prototype (Figure 4.2), we received input in the form of CT scan images in DICOM format. The scanner image is provided as input to the software that reads the image and locates the tile using .NET (More specifically, the white color on the scanner represents a tile). We built a prototype using a Raspberry Pi as a skeletal structure that uses Python to control actions and functions.

5. SOFTWARE REQUIREMENTSCT scan image:

A computerized tomography (CT) scan, showcased in the captivating imagery of Figure 5.1, stands as a marvel of modern medical imaging. It employs a sophisticated approach, capturing a sequence of X-ray images from diverse angles encircling the patient's body. These images are then skillfully processed by a computer, conjuring exquisite cross-sectional portraits, akin to slices, that unveil the intricate tapestry of the body's inner sanctum, encompassing its bones, intricate network of blood vessels, and delicate soft tissues. What sets CT scan images apart is their unrivaled richness in detail, a stark departure from the relatively more rudimentary snapshots offered by traditional plain X-rays. These masterpieces of medical imaging are meticulously preserved in the esteemed DICOM format, an acronym signifying Digital Imaging and Communications in Medicine, a testament to their universal acceptance and compatibility with a diverse array of cutting-edge medical imaging systems and software. In the realm of contemporary medicine, the CT scan technology emerges as a radiant beacon, illuminating the path to enhanced diagnosis and treatment. It empowers healthcare practitioners with unparalleled insights into the human anatomy, unlocking the secrets concealed within. In this mesmerizing journey through the body's innermost enclaves, CT scans play an instrumental role, helping in the precise identification and remediation of an array of medical conditions. Their allure lies not just in their visual splendor, but in their profound impact on healthcare, rendering them indispensable in the modern medical landscape..



Python

Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use ofsignificant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

Python is dynamically-typed and garbage- collected. It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985- 1990. Like Perl, Pythonsource code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages usepunctuation, and it has fewer syntactical constructions than other languages. Python is a MUST for students and working professionals to become a great Software Engineer specially when they are working in Web Development Domain.

I will list down some of the key advantages of learning Python:

Python librariesFlask

Flask is a micro web framework written in Python.It is classified as a microframework because it doesnot require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and several common framework related tools.

Werkzeug

Werkzeug (German for "tool") is a utility library for the Python programming language, in other words a toolkit for Web Server Gateway Interface (WSGI) applications, and is licensed under a BSD License. Werkzeug can realize software objects forrequest, response, and utility functions. It can be used to build

a custom software framework on topof it and supports Python 2.7 and 3.5 and later.

Jinja

Main article: Jinja (template engine)

Jinja, also by Ronacher, is a template engine for thePython programming language and is licensed under a BSD License. Similar to the Django web framework, it handles templates in a sandbox.

MarkupSafe

MarkupSafe is a string handling library for the Python programming language, licensed under a BSD license. The eponymous MarkupSafe type extends the Python string type and marks its contents as "safe"; combining MarkupSafe with regular strings automatically escapes the unmarked strings, while avoiding double escaping of alreadymarked strings.

ItsDangerous

ItsDangerous is a safe data serialization library for the Python programming language, licensed under a BSD license. It is used to store the session of a Flask application in a cookie without allowing users to tamper with the session contents.

TIME LIBRARY

In this article, we will discuss the time module and various functions provided by this module with the help of good examples. As the name suggests Python time module allows to work with time in Python. It allows functionality like getting the current time, pausing the Program from executing, etc. So before starting with this module we need toimport it.

Importing time module

The time module comes with Python's standard utility module, so there is no need to install itexternally. We can simply import it using the import statement.

import time What is epoch?

The epoch is the point where the time starts and is platform-dependent. On Windows and most Unix systems, the epoch is January 1, 1970, 00:00:00 (UTC), and leap seconds are not counted towards the time in seconds since the epoch. To check what the epoch is on a given platform we can use time.gmtime(0).

import time print(time.gmtime(0))

Getting time string from seconds

time.ctime() function returns a 24 character time string but takes seconds as argument and computestime till mentioned seconds. If no argument ispassed, time is calculated till the present.

import time

getting current time by passing

the number of seconds since epoch curr = time.ctime(1627908313.717886)print("Current time:", curr)

Delaying Execution of programs

Execution can be delayed using time.sleep()method. This method is used to halt the program execution for the time specified in the arguments.

import time

for i in range(4):

using sleep() to hault executiontime.sleep(1)
print(i) time.struct_time Class

Struct_time class helps to access local time i.e. non-epochal timestamps. It returns a named tuple whose value can be accessed by both index and attribute name. Its object contains the following attributes –

time.localtime() method

localtime() method returns the struct_time object in local time. It takes the number of seconds passed since epoch as an argument. If the seconds parameter is not given then the current time returned by time.time() method is used.

importing time moduleimport time
Convert the current time in seconds# since the epoch to a
time.struct_time object in Local time

obj = time.localtime(1627987508.6496193)

print(obj) time.mktime() method

time.mktime() is the inverse function of time.localtime() which converts the time expressed in seconds since the epoch to a time.struct_time object in local time.

# importing time moduleimport time
obj1 = time.gmtime(1627987508.6496193)# Convert the time.struct_time
# object to local time expressed in# seconds since the epoch
# using time.mktime() method time_sec = time.mktime(obj1)# Print the local time in seconds
print("Local time (in seconds):", time_sec)time.gmtime() method

time.gmtime() is used to convert a time expressed in seconds since the epoch to a time.struct_time object in UTC in which tm_isdst attribute is always
0. If the seconds parameter is not given then the current time returned by time.time() method isused.

importing time moduleimport time
Convert the current time in seconds# since the epoch to a
time.struct_time object in UTC

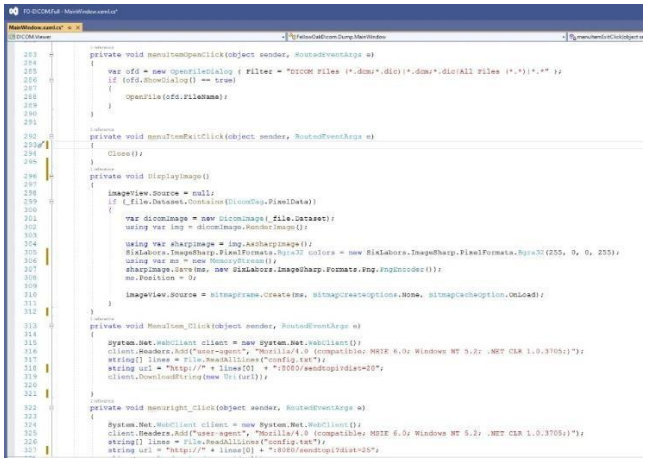
obj = time.gmtime(1627987508.6496193)# Print the time.struct.time object
print(obj) time.strftime() method
time.strftime() function converts a tuple or struct_time representing a time as returned by gmtime() or localtime() to a string as specified by the format argument. If t is not provided, the current time as returned by localtime() is used. Theformat must be a string. ValueError is raised if anyfield in t is outside of the allowed range.

```
from time import gmtime, strftime

# using simple format of showing time

s = strftime("%a, %d %b %Y %H:%M:%S",gmtime(1627987508.6496193))
print(s)
```

time.asctime() method

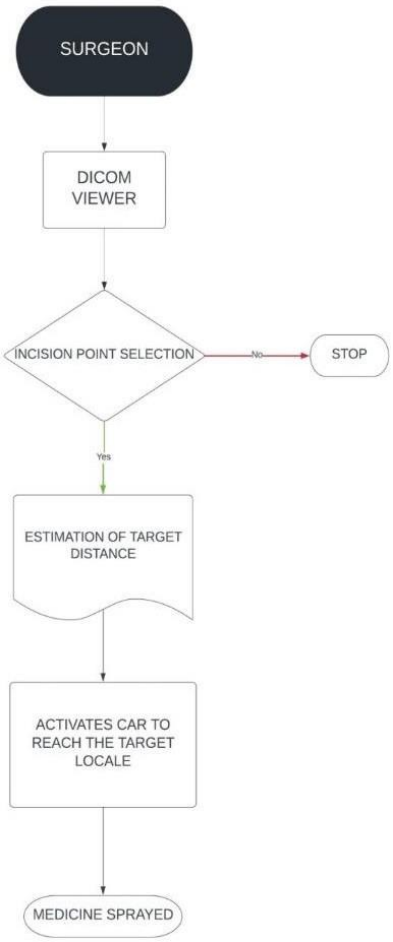
time.asctime() method is used to convert a tuple or a time.struct_time object representing a time as returned by time.gmtime() or time.localtime() method to a string of the following form:

As mentioned before the Dicom viewer is developed in C# programming language. The below code is the significant working module that encompasses several functions.



Screenshot of Dicom Viewer code

The private void menuItemOpenClick creates a button link to open the file where the required patients scan images are brought into the software for further treatment. Another option along with file -> open, is the file -> exit button where the opened file is closed.
The private void DisplayImage displays the image. However, the original file is not taken directly as such, few attributes are changed according to the software requirements.



Conclusion

In conclusion, the paper introduces a highly promising and innovative approach to thrombosis treatment by harnessing AI-controlled nanorobots. This non-invasive method not only has the potential to revolutionize the management of blood clots but also to significantly enhance its effectiveness while mitigating the limitations and complications associated with traditional treatments. Although the technology is currently in the prototype stage, further research and development hold the promise of ushering in a new era of more effective and precise medical interventions for thrombosis. With continued advancements, this visionary concept may lead to substantial improvements in patient outcomes and represent a major leap forward in the realm of healthcare.

References

1. Nano-robotic based Thrombolysis: Dissolving Blood Clots using Nanobots,Puru Malhotra and Nimesh Shahdadpuri- 2020
2. Progress in nanorobotics for advancing biomedicine Mi Li, Ning Xi, Yuechao Wang, and Lianqing Liu – 2020
3. Nanorobots-assisted Natural Computation for Multifocal Tumor Sensitization and Targeting Shaolong Shi, Yizhen Yan, Junfeng Xiong, U Kei Cheang, Xin Yao, and Yifan Chen – 2020
4. Control System for Autonomous MedicalNanorobots, S. M. Masudur Rahman Al-Arif –2019
5. Benefits of Artificial Intelligence in Medicine, Samira Yeasmin – 2019
6. Algorithm for Medical Nanobots using C++, Manu Mitra – 2018
7. Spintronics based Systems for AI Nano Robots, Sampreet Sarr, Syed Intekhab Alam, Varun

Ravindran, Arpan Banerjee, Arghya Debnath, Ankush Ghosh – 2018
8. A Bacterial Swarm Algorithm to Control Drug Release by Multi-Nanorobots Haonan Yang, Min Li, Jinge Cao, Dong He -2018
9. Review of Artificial Neural Network Application in Nanotechnology, Alma Jakupovic,Zivorad Kovacevic,LejlaGuberta,Almir Badnjevic-2018
10. Surgical Robots of the Next Decade, Tamás Haidegger – 2017
11. Current and Future Ethical Issues in Nanotechnology , Donna M. Schaeffer, Patrick C. Olson-2017
12. An Acoustic Communication Technique of Nanorobot Swarms for Nanomedicine Applications, Valeria and Anna Maria -2015
13. Nanorobotics as medicament, R. Hariharan, J.Manohar- 2010
14. Simulation of Swimming Nanorobots in Biological Fluids, Rwitajit Majumdar, J.S.Rathore and N. N. Sharma – 2009
15. Magnetic Resonance Propulsion, Control and Tracking at 24 Hz of an Untethered Device in the Carotid Artery of a Living Animal: An Important Step in the Development of Medical Micro- and Nanorobots, Sylvain Martel – 2007