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DESIGN OF GROUND BASED SURVEILLANCE ROBOT FOR MILITARY AND SECURITY APPLICATIONS

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***Abstract*— Robotics is evolving at a tremendous rate, and they are now in direct competition with people. The area of manufacturing and research has undergone numerous changes because of technological advancement. Initially used by humans to facilitate their work, robots are now being developed to mimic humans and replace labor in areas where even human presence is challenging. In addition to improving the production of robots, development is also concentrating on managing and enhancing the work that robots perform. In the fields of medicine, security, and education, there are countless applications for robots. The design of the robot and the necessary systems depend on the sort of application.**

Some serpent species can climb, navigate obstacles, and even fly. They can move by using the unevenness of the earth to propel themselves, which gives them the ability to change their behavior depending on the situation. It would be fun to turn this practice into a snake robot. The possible applications for such a robot in enemy detection, hazardous situations, and search and rescue operations served as a catalyst for its development. This robot has a night vision camera, so we can use it at night.

Keywords— Surveillance, undulating, defense.

I. INTRODUCTION

SNAKE ROBOT

A snake robot is a particular kind of robot that moves like a snake to travel through various environments, including cramped or small spaces. Due to the fact that it is made up of several segments linked by flexible joints, it can twist and spin just like a real snake. Snake robots are commonly used for a variety of tasks, including search and rescue operations, archaeological research, and pipeline inspections.

They are best suited for performing complex operations and navigating tight spaces due to their flexibility. They can also be used for activities like risk analysis and emergency missions that call for a high degree of maneuverability. Electric motors, pneumatic actuators, and hydraulics are used to propel snake robots. They have sensors and actuators to help them avoid obstacles, and they can be controlled manually or automatically.

HUMANOID ROBOT:

A humanoid robot is one that has human-like features like a head, torso, limbs, and legs. These robots usually have sensors and artificial intelligence built in to interact with people and carry out various tasks. Humanoid robots can be used in a wide range of applications, including entertainment, teaching, healthcare, and research and development. They are perfect for social connections with people in situations like companionship and customer service because of how much they behave and seem like humans. Humanoid devices have long captivated people's imaginations. People's interest in humanoid robots has been stirred for a very long time. Its design gives them a virtually lifelike appearance in terms of both behaviour and appearance. Automatic systems are being created to help those in need and to carry out tasks that are too risky or complex for humans to handle.

II. PROBLEM STATEMENT

SNAKE ROBOT

Create, implement, and manage the movement of a snake-like robot that can move steadily and effectively through uneven terrain and small areas. The robot should have the ability to adapt to various settings, avoid hazards, and perhaps carry out activities like exploration, search and rescue, or inspection. The difficulty lies in overcoming these inherent obstacles while maintaining the mechanical and electronic components of the robot to be durable, dependable, and energy efficient.

HUMANOID ROBOT

There are several obstacles to overcome in the creation of humanoid robots. Making a robot that can interact with humans and the environment well is one of the major challenges. The robot must be able to move naturally and fluidly when walking and moving, and it must be able to manipulate objects and carry out activities with the help of its hands and arms. To understand the environment and make

judgements based on that perception, the robot also has to have advanced vision and sensor skills.

Making humanoid robots safe for both the robot and the people it interacts with is another difficult task. The robot must have the ability to identify potential dangers and avoid them, and it must be built so that it doesn't endanger nearby people. The robot must also be able to function autonomously and make judgements without human assistance. A further challenge is designing a robot that can operate in a wide range of environments. The robot needs to be able to navigate rough terrain, climb stairs, and perform other tasks in a variety of conditions.

III. LITERATURE SURVEY

1. Kenji Kaneko, Hiroshi Kaminaga, "Humanoid Robot HRP-5P: An Electrically Actuated Humanoid Robot with High-Power and Wide-Range Joints" IEEE robotics and automati letters, vol. 4, no. 2, April 2019.

The humanoid robot HRP-5P, which stands for Humanoid Robotics Platform–5 Prototype. We have been developing the HRP series humanoid robots since 2000, and HRP-5P is the latest version of the HRP series as of 2018. It is developed as a prototype for our next generation humanoid robotics platform, aiming to realize the use of practical humanoid robots in place of humans within large-scale assembly industries such as construction sites, aircraft facilities, and shipyards. To realize it, electrically actuated high-power joints with wide movable range have been newly designed. Also, the arm configuration has also been redesigned to improve the physical ability of working on actual sites. The mechanism and the electrical systems are presented with its basic specification in this letter.

2. Optimal Bumping Avoidance for Snake-like Robot's Serpentine Movement Controlling

It is an automated robot where the sensors are attached at head this project makes use of different servo motors attached ke a snake one behind the other to replicate the snake and is more effective hen it goes into narrow path it uses detection switches and the disadvantage is the robot has to hit at least one time in order to test the function.

IV. INVESTIGATION OR FACT

1. Real-world uses: Snake robots have been employed in a variety of real-world uses, including search and rescue operations, pipeline inspection, examination of confined areas, and even medical procedures like endoscopies.
2. Natural inspiration: The snake robots' designs were influenced by the way real snakes move. The robots travel through confined spaces and over obstacles by simulating a snake's undulating motion using a sequence of linked segments.
3. Research obstacles: Creating snake robots with increasing movement, better sensing, and higher payload capacities continues to be difficult.
4. Technological developments: Technological developments, such as the introduction of new materials and more potent actuators, have allowed the development of ever-more complex snake robots.

Investigation or fact for humanoid robot:

1. Technological developments: Developments in robotics have allowed for the creation of humanoid robots that can carry out a variety of jobs. These robots mimic human mobility and dexterity using cutting-edge sensors and control algorithms.
2. Humanoid robots in the workplace: Humanoid robots are utilised to carry out jobs that are challenging or hazardous for people in a variety of workplace settings, including factories, hospitals, and warehouses.
3. Societal acceptance: As humanoid robots get more advanced; questions have been expressed regarding how they will affect society and whether they would eventually replace people in tasks that have been done by humans for centuries. Social acceptance of robots that mimic humans closely is another issue.
4. Ethical issues: As humanoid robots become more advanced, ethical issues such as how to make sure they are built and programmed to act morally and not harm people are brought up. The moral ramifications of building machines that can mimic human behaviour and emotions are also a topic of debate.

BLOCK DIAGRAM

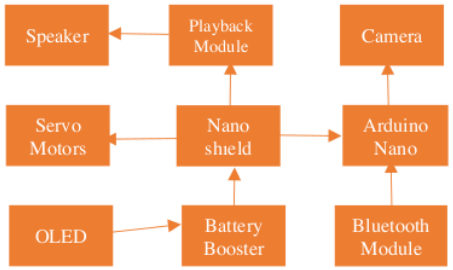

Fig Block diagram of Humanoid Robot

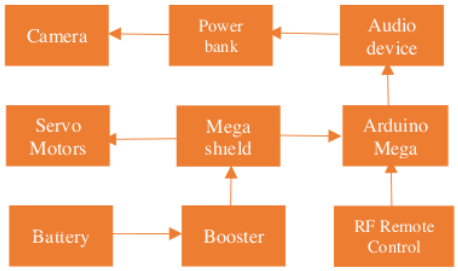

Fig Block diagram of Snake Robot

V. FLOW CHART

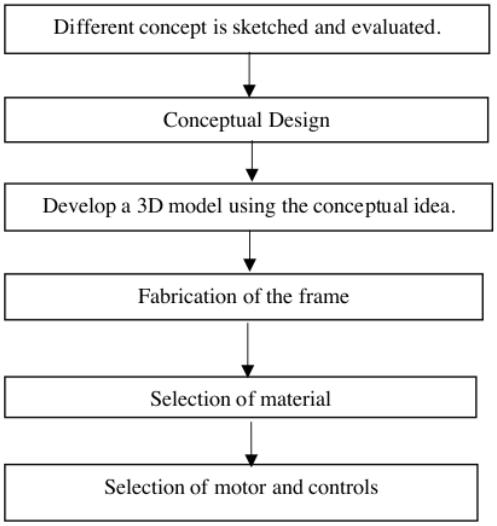

Fig: Flowchart Snake Robot

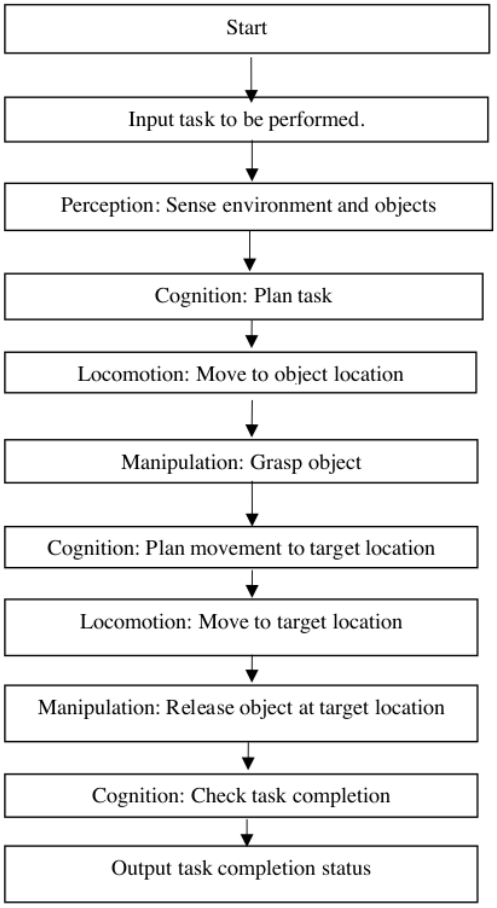

Fig: Flowchart of Humanoid Robot

VI. DESIGN

Design for snake robot:

Snake robots often possess a thin, flexible body made up of several linked segments that enables them to manoeuvre through confined spaces and over obstacles. The undulation of these segments, which is managed by a number of actuators and sensors, produces the motion of the robot.

The following elements are often present in a snake robot's design:

- Body: A robot's body is typically composed of a number of connected parts that enable flexible movements. The joints that attach the pieces together allow the robot to move in various directions.
- Actuators: Actuators are used to regulate the movement of the robot's bodily parts, such as motors or hydraulic systems. Together, these actuators produce the undulating motion that enables the robot to move.
- Sensors: Sensors, including cameras or infrared sensors, are utilised to identify potential hazards and other ambient elements that could influence the robot's path. The robot can modify its motion thanks to these sensors to avoid obstacles and move through small places.
- Power source: The robot's power source, which provides the energy required to power its actuators and sensors, often comprises of batteries or other rechargeable energy sources.

DESIGN FOR HUMANOID ROBOT:

Robots called "humanoids" are built to look and work like humans. They typically have a bipedal body form with highly mobile arms and legs.

A humanoid robot's design often contains the following elements:

- Body: With a head, torso, arms, and legs, a robot's body is often created to resemble the human body. To reduce weight and improve movement, the body is often built of lightweight materials like carbon fibre or aluminium.
- Actuators: The robot's limbs are moved by means of actuators, such as hydraulic or motorised systems. Together, these actuators provide motion that resembles that of a human being, such as running, grasping, and walking.
- Sensors: Sensors are used to identify environmental variables and human interactions. Examples include cameras, force sensors, and position sensors. These sensors enable the robot to modify its motion and react to alterations in its surroundings.
- Power source: The robot's power source, which provides the energy required to power its actuators and sensors, often comprises of batteries or other rechargeable energy sources.
- In general, humanoid robot design aims to achieve human-like motion and dexterity, while snake robot design aims to achieve flexibility and movement in small spaces.

VII. OPERATION

Because of its exceptional capacity to operate in constrained and challenging environments, snake robots are growing in popularity in the field of robotics. Controlling movement is among the most often done tasks on snake robots. Snake robots may move in a variety of directions

because they can be moved by delivering signals to each segment's separate motor. Complex algorithms that take into account the robot's current position and orientation as well as any potential obstacles or terrain it may encounter provide these signals.

Sensing and information gathering are two other frequent tasks performed by snake robots. In order to learn more about their surroundings, snake robots frequently come with a range of sensors, including cameras, temperature sensors, and proximity sensors. Then, this information can be utilized to create maps of the area, find interesting objects, or even carry out operations like search and rescue. Snake robots can also be equipped with specialist instruments like grippers or drills, which enables them to carry out certain jobs like maintaining or inspecting pipelines, exploring hard-to-reach places, or taking samples in dangerous settings.

HUMANOID ROBOT

In order to operate a humanoid robot safely and effectively, there are a number of actions and factors that must be taken into account. The operator must first be fully aware of the robot's capabilities, constraints, and control interface. Understanding the robot's motion range, sensors, actuators, and programming language are all part of this. Before issuing any commands, the operator must make sure the robot is powered up and calibrated correctly.

The operator can start programming and controlling the robot's movements after they are fully aware of its capabilities. There are numerous ways to accomplish this, such by using a control panel, a remote control, or a computer software. In order to make sure the robot is operating safely and accurately, the operator must constantly watch its movements and sensors. To avoid harm or injury, any anomalies or faults should be fixed as away. The robot should be carefully shut down and placed in a secure location once the operation is finished.

VIII. CONCEPT

A snake robot is a robot that can move like a snake and has an undulating, flexible body that enables it to fit through narrow areas and over obstacles. The body of the robot is typically composed of a number of interconnected parts that are managed by a number of actuators and sensors. The snake robot idea has potential uses in fields like search and rescue, where the machine may be employed to look for survivors in locations that are hazardous or difficult for people to access.

A humanoid robot is a robot that can be designed to mimic the human body in both shape and function, with a bipedal frame, arms, and legs that can move and manipulate objects with human-like dexterity. The body of the robot is typically built of lightweight materials, and a number of actuators and sensors regulate its motion. The concept of a humanoid robot has potential uses in fields like manufacturing, where the robot might carry out tasks that are risky or impossible for people to do, or in the field of medicine, where the robot could help with patient care.

In general, the ideas behind snake robots and humanoid robots both centre on building machines that are capable of carrying out jobs that are challenging or dangerous for people to complete because of either their physical constraints or the hazardous nature of the surroundings. These ideas offer innovative chances for robotics technology to develop and have a big influence on a range of businesses and applications.

IX. RESULTS

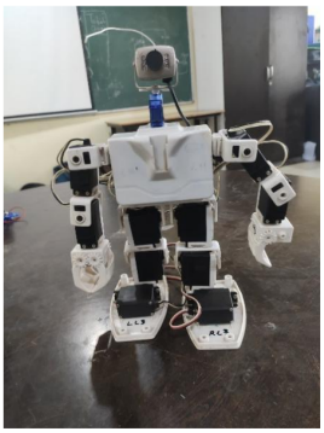

Fig: Resultant Humanoid Robot

Robots that resemble humans in both look and behaviour are called humanoid robots. They frequently have artificial intelligence systems, sensors, and actuators so they can interact with the environment and carry out numerous activities. Following are some current advancements and uses for humanoid robots:

- Companion robots: Humanoid robots designed to be companions for the elderly or those with impairments are now being created. These machines can offer emotional support, carry out activities like reminding people to take their medications, assist with household chores, and even carry on discussions.
- Education and research: Humanoid robots are employed in both of these fields. They can act as research subjects or teaching assistants in disciplines like cognitive science, psychology, and robotics.
- Entertainment: Humanoid robots are becoming popular in the entertainment industry as well. They can be used in movies, TV shows, and even amusement parks to provide an immersive experience for visitors.
- Manufacturing: Humanoid robots are also utilized in the manufacturing sector to carry out operations like assembling and quality monitoring. They can support human employees and help with laborious or hazardous activities.
- • Exploration of space: Humanoid robots are being created for this purpose. These robots can help astronauts with maintenance and repair jobs and can also investigate places that are too hazardous or inaccessible for humans to access. The most cutting-edge humanoid robots include Sophia by Hanson Robotics, Pepper by Softbank Robotics, and ASIMO by Honda. These robots can carry out a variety of jobs and communicate with people in a natural way thanks to their sophisticated sensors, actuation systems, and artificial intelligence algorithms.

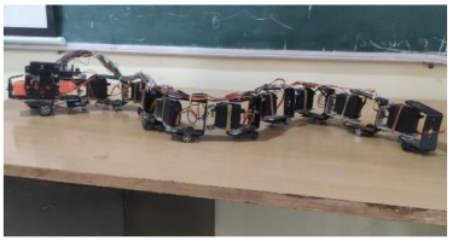

Fig: Resultant Snake Robot

Robots that move like snakes to navigate different settings are known as snake robots. These robots are useful in a variety of tasks, including search and rescue missions, inspections, and exploration. Their distinctive form enables them to travel through constrained spaces and difficult terrain.

These are some recent advancements and applications for snake robots:

- Search and rescue activities: Snake robots have been deployed in earthquake response and building collapse attempts to look for survivors in difficult-to-reach areas. They can access locations that are inaccessible to human rescuers by navigating through rubble and debris.
- Industrial inspections: Snake robots are widely utilised to inspect pipes, tanks, and other restricted locations in industrial environments. These robots can do visual inspections, find leaks, and gather data in risky settings.
- Medical applications: Less invasive operations will utilise snake robots that are now being developed. These robots can access difficult-to-reach locations by entering the body through tiny incisions and moving through constrained spaces. This can lower the possibility of problems and enhance.
- Exploration: Robot snakes are utilized in planetary exploration, in particular, in space exploration. In situations where human exploration is impossible, these robots can traverse rocky terrain and gather samples.

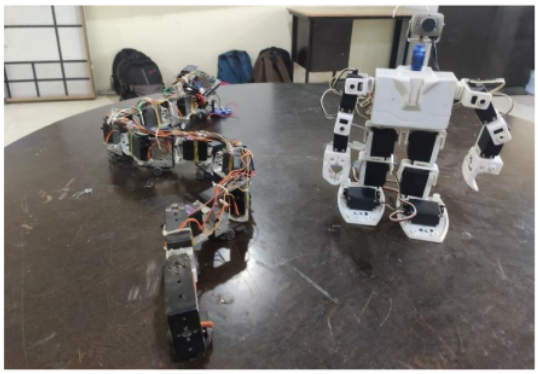

Fig: Snake Robot and Humanoid Robot

X. CONCLUSION

Robots that resemble snakes and humanoids are two very different types, each with their own special powers and constraints. Snake robots are often made to maneuver through narrow passageways and over challenging terrain that would be inaccessible to more conventional wheeled or legged robots. They can go through tight spaces and harsh terrain thanks to their capacity to bend and twist in different directions, which makes them ideal for jobs like search and rescue, inspecting dangerous surroundings, and exploring hard-to-reach places.

Components	**Specifications**
Servo Motor	Weight 55g, Torque 10kg/cm
No of servo motors	9
Cost moderate	High
Maximum Speed	16 sec/60 degree
Degree of Freedom per segment	2 DOF
Battery time	60 Minutes
Operating Angle	One 360 degree and Eight 180 degrees
Camera Operating Voltage	DC - 9 V
Required Pulse	900us – 2100us
Resolution	1600 x 1200 pixels
Range	30 – 60 Feet

Table: Snake robot specifications

Humanoid robots, on the other hand, are made to look like and move like people. They often have arms, legs, and a head, and are capable of carrying out activities that call for dexterity and accuracy comparable to those of humans. They have a wide range of uses, including manufacturing, healthcare, and entertainment.

There are several instances where the capabilities of snake robots and humanoid robots overlap, despite the appearance that they have quite different uses. Both kinds of robots, for instance, could be employed in search and rescue missions. A humanoid robot may be utilized to carry the survivors to safety while a snake robot could search through debris and tight spaces to find survivors.

Components	**Specifications**
Servo Motor	Weight 55g, Torque 10kg/cm
No of servo motors	14
Cost moderate	High
Maximum Speed	16 sec/60 degree
Degree of Freedom	14 DOF
Battery time	60 Minutes
Operating Angle	One 360 degree
Camera Operating Voltage	DC - 9 V
Required Pulse	900us – 2100us
Resolution	628x582 pixels
Range	50 meters
Night Vision	Supported

Table: Humanoid robot specifications

A fascinating and quickly developing area of technology is humanoid robots. They have the ability to transform a variety of sectors and offer essential help and aid to people.

XI. ADVANTAGES

SNAKE ROBOTS:

- Extremely maneuverable: Snake robots' flexible joints allow them to move through confined and challenging environments. They are perfect for exploring remote areas since they can climb over rough terrain and wrap around obstructions.
- Snake robots are adaptable and may be tailored to fit a variety of purposes. They can be used, for instance, for industrial inspection and maintenance activities, for search and rescue operations, or for exploration of dangerous regions like deep space or the ocean.
- Efficient: Compared to humanoid robots, snake robots are often lighter and use less energy to function. They are therefore perfect for operations that must last a long time or take place in isolated areas with little energy resources.
- Remote Control: Because snake robots can be operated from a distance, they are perfect for a circumstance in which having a human nearby is challenging or hazardous.
- Flexibility: Because snake robots are so adaptable, they can readily man oeuvre through confined places and avoid an obstruction, which makes them perfect for exploration in difficult and complicated environments.

HUMANOID ROBOT:

- Capable of carrying out human-like tasks: Humanoid robots are made to move and communicate like people. This makes them perfect for jobs requiring a high degree of dexterity, such putting together products, conducting surgery, or helping those with disabilities.
- Capable of engaging in social interactions: Humanoid robots include sensors and algorithms that enable them to detect and react to human speech, gestures, and expressions. They are therefore perfect for uses in customer service, instruction, and entertainment.
- Capable of navigating challenging environments: Humanoid robots are frequently outfitted with sensors and cameras that enable them to comprehend their surroundings and avoid hazards. They are therefore perfect for tasks like search and rescue operations or the study of dangerous regions that call for navigation in intricate surroundings.
- Dexterity: Humanoid robots are very dexterous and capable of completing a variety of activities, including delicate procedures and precise manipulations, because they are designed to mirror human movements.
- Interaction: Humanoid robots may be trained to recognize and react to human movements, expressions, and voice. They are made to interact with people.

XII. DISADVANTGES

SNAKE ROBOT:

- Limited mobility: Despite being great at negotiating small spaces, snake robots may struggle to move over uneven ground or climb steep inclines.
- Energy usage: Snake robots frequently feature a number of tiny actuators that need a lot of energy. As a result, they may be less resilient and effective than other robots.
- Complex control systems: Given the numerous degrees of freedom and the requirement for complex control algorithms, controlling a snake robot can be difficult.
- Limited payload capacity: Because of their diminutive size, snake robots have a limited capability for big payloads.
- Limited ability to manipulate objects: Although certain snake robots feature end-effectors that can be employed for manipulation tasks, their capacity to do so is typically less than that of other robot kinds. This is because they lack hands and arms.

HUMANOID ROBOT:

- Complex mechanical design: Because of their human-like designs and sophisticated control systems, humanoid robots are sometimes difficult and expensive to construct.
- Energy consumption: Due to their extensive degrees of freedom, humanoid robots often consume a lot of energy. As a result, they may be less resilient and effective than other robots.
- Maintenance: Because of their intricate mechanical designs and the requirement for routine maintenance, humanoid robot maintenance can be challenging.
- Limited mobility: Despite being built to move like people, humanoid robots might have trouble navigating some types of terrain or carrying out duties that call for a lot of mobility.
- Electricity consumption: Because humanoid robots use a lot of electricity to function, their battery life may be limited, and they may do some tasks less effectively than other robot kinds.

XIII. FUTURE SCOPE

SNAKE ROBOT

- Search and Rescue: In disaster-stricken locations where human access is difficult or risky, snake robots can be utilised in search and rescue operations. They can find and aid people who are stranded by navigating through wreckage and debris.
- Medical Applications: Snake robots can be employed in minimally invasive operations to execute delicate treatments by navigating through the body's intricate and confined spaces.
- Exploration: Snake robots can be employed in space exploration missions to travel through constrained and challenging areas, such as confined tunnels or cracks on distant planets.

HUMANOID ROBOT

- Healthcare: Humanoid robots can help with patient care in healthcare environments by helping with movement, offering emotional support, and even helping with simple medical procedures.
- Education: Humanoid robots can be used to teach youngsters with special needs or to acquire languages in educational settings.
- Manufacturing: Humanoid robots can help with assembly line duties like handling materials or carrying out repetitive operations in the manufacturing industry.

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