A Review paper on Implementation of Snake Robot

Sneha Pramanik[1], Rajeshwari Patil[1], Ramya[1], Yenumulatimmareddygari Likitha[1],

Khamer Unnisa H[2]

[1]*UG Scholars, Department of ECE, Sambhram Institute of Technology, Bengalore-97*

[2]*SAsst.Professor, Department of ECE, Sambhram Institute of Technology, Banglore-97*

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Abstract - The project presents a snake robot able to pass different and difficult paths because of special physical form and movement joints mechanism. These snake robots have passive wheel. The robot moves by friction between the robot body and the surface on which it is. The joints have been designed and fabricated in a way that each joint has two freedom grades and it may move 228 degrees in every direction. Each joint has two DC servo motors and the power is transferred from the motors output to the joint shaft through bevel gear. The flexibility of the robot makes possible to move forward, back and laterally by imitating real snake's moves. In this project different measures have been presented in order to design and assemble the joints, motors driver, different ways to guide the robot and its vision. In this project ESP 32 node Arduino and IOT is used. IOT is for monitoring the battery volt and wifi camera for view of images.

Key Words: Snake robot, IOT, ESP32 node Arduino, Passive Wheel.

1.INTRODUCTION

Snake robots represent an ideal robotic platform for search-and-rescue applications, as well as tasks in constrained and hazardous environments. The simple structure of the snake body has the capability to traverse complex, constrained, 3-D environments. Snakes are capable of fitting though small gaps, moving over rough terrain, and climbing shear inclines, all of which are useful to navigate the dense undergrowth of a forest or the wreckage of a collapsed building. A range of snake robots have been developed using traditional robotic kinematics comprising rigid links and discrete joints. Wright et al. developed a simple, modular snake robot made of servo motors mounted in series, capable of moving in plain area and ruff and duff area.

Snake robots are made up of multiple joints in series and belong to a multi-degree-of-freedom hyper-redundant mechanism. They are suited for search and rescue, reconnaissance and surveillance in complex, hazardous and hard-to-reach environments because of their motion flexibility. Professor Hirose's team began to develop snake robots at the earliest in the 1980s, and they were very prominent in the design about snake robots, whose mechanism is very sophisticated so has to achieve a variety of complex movement and be suited for different environments. Carnegie Mellon University (CMU) has also made some research in miniaturized snake robots each module of whom has its own micro controller/Arduino which integrates power, sensing, communication and control. Swiss Federal Institute of Technology proposed a modular design method and developed three amphibious snake robots using wired or wireless communication. The Norwegian University of Science and Technology has developed an amphibious snake robot Mamba using 3D printing technology. The most snake robots listed above communicate with wire that may block the motion and limit the distance. Though some use wireless communication, the protocols is not reliable. Professor Ma proposed a wireless remote robot system with secure and reliable wireless communication protocol for snake robots. Internet of Things (IoT) whose application is very extensive is the third wave of the development of the world information industry after the computer and Internet. For instance, IoT can be used for intelligent perception and control of robots.

This aims at developing the 3D printed snake robot (Little Red, LR) based on modular design method. Each rotation module is equipped with a fully functional micro controller. At the meantime, a control system using IoT is proposed. Utilizing IOT technology with reliable wireless communication protocol to establish a wireless sensor network achieves the entire system of intelligent control at low power consumption. Finally, the validity and reliability of the snake robot and the control system are confirmed through experiments.

Urban Search and Rescue and certain industrial inspection tasks in hazardous environments have one need in common: small-sized mobile robots that can travel across the rubble of a collapsed building, squeeze through small crawl-spaces, and slither into small openings . One species of mobile robots that promises to deliver such great mobility is the so-called serpentine or snake robot. Serpentine robots typically comprise of three or more rigid segments that are connected by 2- or 3-degrees of freedom joints. The segments typically have powered wheels, tracks, or legs to propel the vehicle forward, while the joints may be powered or unpowered. Over the last decades, in the fields of the robotics, algorithms and mechanics inspired by the real-world have started to be used. In order to obtain realistic gaits for different robots, research has been focused on how to handle multiple degrees of freedom, various types of redundancies in movement and smooth transitions between gaits. It has been demonstrated that bioinspired robots only need to generate specific rhythms to produce a gait. However feedback and higher control center should also be implemented in order to strongly modulate these rhythms and optimize the gait.

2. LITERATURE SURVEY

[1] Junseong Ba,"Snake Robot with Driving Assistant Mechanism", 2020. In this study, they propose a driving assistant mechanism (DAM), which assists locomotion without additional driving algorithms and sensors. In this paper, they confirmed that the DAM prevents a roll down on a slope and increases the locomotion speed through dynamic simulation and experiments. From this paper we have got the idea that it is possible to overcome grasslands and a 27 degrees slope without using additional driving controllers. In conclusion, we expect that a snake robot can conduct a wide range of missions well, such as exploring disaster sites and rough terrain, by using the proposed mechanism.

[2] XuesuXiao, "snake robot testbeds in granular and restricted maneuverability spaces", 2018. From this article it reviews the state of the art in evaluating snake robots for small spaces such as a collapsed building where the snake is either locomoting in restricted maneuverability spaces, such as narrow pipes or tunnels, or pushing through granular regions, such as dirt and rubble. It makes recommendations on designing a testbed ,20 testbeds were used to test snake robots in restricted maneuverability environments. All of those were built specifically to test a particular snake robot. From this paper it suggests that two kinds of general testbeds are in need for the snake robot community: a testbed with high physical fidelity for measuring suitability for a target application, and a testbed which provides a dimensionless comparison of different snake robots.

[3] Guoyuan Li, "A Screw-less Solution for Snake-like Robot Assembly and Sensor Integration", 2017. Assembly or repair of snake-like robots are often time consuming and low efficiency. From this paper we took the idea of novel approach for module improvement that can efficiently integrate sensors, micro-controllers and batteries into the snake like robot, without needing of any tools. The implementation is built upon the GZ-I module—an open frame structure with only servo motor involved. Based on the sliding mechanism, an intermediate module accommodating two infrared sensors, one force sensor, one battery and one micro-controller, together with a terminal module used for mounting infrared sensor at each end of the snake-like robot is designed. Thus, screw-less assembling a snake-like robot can be achieved.

[4] Aksel Andreas Transeth, "snake robot modeling and locomotion", 2009. From this paper we have took the idea of the various mathematical models and motion patterns presented for snake robots. Both purely kinematic models and models including dynamics are investigated. Moreover, the different approaches to biologically inspired locomotion and artificially generated motion patterns for snake robots.

3. PROPOSED SYSTEM

Aiming at high performance requirements of snake-like robots under army environment to monitor the enemy movement, we present a control system of our proposed design which utilizes a esp32 as the node micro controller unit incorporates real-time image acquisition, multi sensor fusion, and wireless communication technology. We use Solid works to optimize the design of head, body, and tail joint structure of the snake-like robot. The system is a real-time system with a simple-circuit structure and multi degrees of freedom are attributed to the flawless design of control system and mechanical structure. Finally, experimental results show that the snake-like robot can tackle challenging problems.

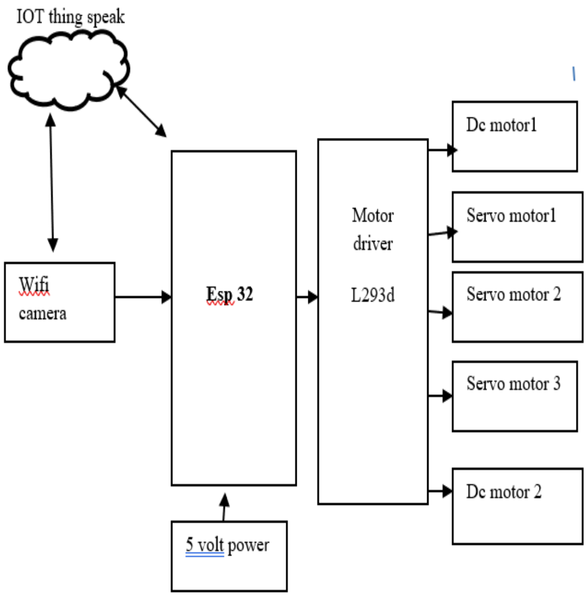

Figure1: Block Diagram of IOT Based Snake Robot.

FLOW CHART

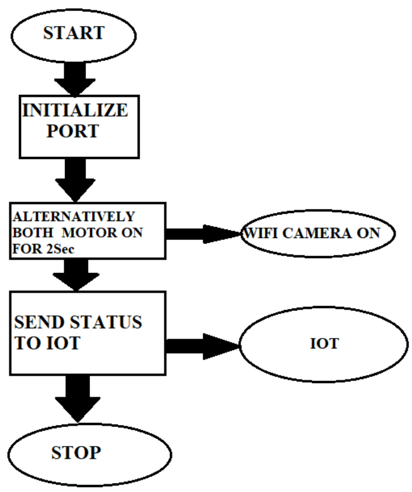

Figure2: Flow Chart of IOT Based Snake Robot

When the Power Supply is given the circuit starts working. Then all the ports (input, output) are initialized. After that alternatively both the DC gear motors ON for 2sec for the movement of the snake left and right side. At a time WIFI-Camera will Capture Images of surrounding Area. Then all the data captured by camera is sent to IOT and it will be Stored in the IOT Cloud computing. We can get all the information about Surrounding through IOT Thing Speak to our computer/PC. As it is a Loop process the same procedure will be continued. We can control the system through our PC/Computer.

ADVANTAGES:
Move across uneven terrain, since it is not dependent on wheels. Move across soft ground such as sand, since it can distribute its weight across a wider area. Small in size. As the snake robot can be very modular with many redundant segments as well as it is very easy to replace broken segments and we can also shorten or lengthen the robot.

DISADVANTAGES:

High cost of servo meters. Difficult to control high number of degrees of freedom.

APPLICATION:

For the application of the snake robot based on the presented design, it may include several fields such as:
In search and rescue operations, the snake robot can help us in finding blockages and detecting live humans under debris as in case of earthquakes. It can generate a map of its surrounding and send environmental parameters to the PC.
We found out that the snake robot is suitable to explore unknown environment; this is possible due to the support achieved from the distribution of mass of the snake robot over a wide area.
To camouflage its identity with real animals so that animal behaviour could be studied better as the snake robot can be modelled exactly as a real biological snakes if the number of modules is increased and the appropriate locomotion of snakes is achieved.
Snake robots can also be implemented in areas of military application where it can help in knowing the whereabouts of the enemy by sneaking into their territory.
An application being investigated by academic and corporate groups is the inspection; maintenance and decommissioning of nuclear power plant. In addition to the obvious benefits of replacing, or augmenting human operators by robots in such a hazardous environment, snake robots offer the additional capability of reaching inaccessible locations within a reactor facility.

4. CONCLUSIONS

This robot is a low-cost, lightweight, modular system, where each module has its own slave controller, distributed sensing, and actuation. We performed experiments with the Snake robot, achieved during serpentine locomotion, but that side winding could also be achieved with a maximum and found that a maximum velocity of 40 mm/s (0.1 body lengths- per-second) could be velocity of 35 mm/s (0.09 body-lengths per- second). In this work the Snake robot used an external power supply to drive the motors. This was mainly done for the sake of simplicity to control the maximum current during testing. The use of on-board batteries is unlikely to be detrimental to the performance of the snake. In fact, during initial testing, we found that the snake was too light.

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