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IOT based Snake Robot

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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 are equipped with a passive wheel. The robot moves due to friction between its body and the surface it is on. The joints were developed and manufactured so that each joint has two degrees of freedom and may travel 228 degrees in any direction. Each joint includes two DC servo motors, with bevel gear transferring power from the motor output to the joint shaft. The robot's flexibility allows it to move forward, backward, and laterally, mimicking the movements of a genuine snake. Various methods have been offered in this project in order to design and construct the joints, motor drivers, and various techniques to lead the robot and its eyesight. This project makes use of an ESP32 node, Arduino, and IoT. The Internet of Things (IoT) is used to monitor the battery voltage and to watch photographs from a wi-fi camera.

Keyword: Snake robot, IOT, ESP32 node Arduino, Passive Wheel.

1.INTRODUCTION

Snake robots are an excellent platform for search-and-rescue operations as well as jobs in confined or dangerous locations. The snake's body has a basic structure that allows it to move across complex, confined 3-D settings. Snakes can squeeze through narrow gaps, move across uneven terrain, and climb steep inclines, all of which come in handy while navigating dense forest foliage or the rubble of a collapsed building. Traditional robotic kinematics, which include rigid links and discrete joints, have been used to create a variety of snake robots.Wright et al. created a simple, modular snake robot made up of servo motors connected in series that can move in a plain area as well as ruff and duff areas. Snake robots are multi-degree-of-freedom hyper-redundant mechanisms made up of numerous joints in series. Because of their mobility, they are well suited for search and rescue, reconnaissance, and surveillance in complex, hazardous, and difficult-to-reach areas. Professor Hirose's team began developing snake robots in the 1980s, and they were very influential in the design of snake robots, whose mechanism is quite intricate, so they must be able to perform a variety of complex movements and be adaptable to various environments.Carnegie Mellon University (CMU) has also conducted research on miniature snake robots, each of which has its own micro controller/Arduino that integrates power, sensing, communication, and control. The Swiss Federal Institute of Technology presented a modular design approach and created three amphibious snake robots that communicate via wired or wireless connection. Using 3D printing technology, the Norwegian University of Science and Technology has created Mamba, an amphibious snake robot. The majority of the snake robots described above communicate through wire, which can obstruct mobility and limit distance..Wireless communication is used by few, however the protocols are unreliable. Professor Ma suggested a snake robot wireless remote robot system that uses a safe and dependable wireless communication protocol. After the computer and the Internet, the Internet of Things (IoT), which has a wide range of applications, is the third wave of the global information industry's development. IoT can be utilised for intelligent perception and control of robots, for example. The goal of this project is to create a 3D printed snake robot (Little Red, LR) using a modular design strategy. A fully functional microcontroller is included in each rotating module.

Meanwhile, an IoT-based control system is presented. The full system of intelligent control is achieved at low power consumption by combining IOT technology with a dependable wireless communication protocol to create a wireless sensor network. Finally, experiments are used to verify the snake robot's and control system's validity and reliability.Narrow-sized mobile robots that can traverse across the wreckage of a collapsed structure, squeeze through small crawlspaces, and slither into small apertures are required for urban search and rescue and some industrial inspection duties in hazardous conditions. The so-called serpentine or snake robot is one type of mobile robot that promises to provide such mobility. Serpentine robots are made up of three or more stiff segments linked by two or three degrees of freedom joints.

To push the vehicle forward, the segments usually contain motorised wheels, tracks, or legs, while the joints might be powered or unpowered. Algorithms and mechanics inspired by the real world have begun to be applied in robotics throughout the last few decades. Research has focused on how to handle

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many degrees of freedom, various forms of redundancy in movement, and smooth transitions between gaits in order to achieve realistic gaits for various robots.. It has been established that bioinspired robots can produce a gait by simply generating particular rhythms. However, in order to strongly adjust these rhythms and optimise the gait, feedback and a higher control centre need be incorporated.

2 LITERATURE SURVEY

[1] Junseong Ba's paper "Snake Robot with Driving Assistant Mechanism" was published in the year 2020. They propose a driving assistant mechanism (DAM) that aids locomotion without the use of additional driving algorithms or sensors in this work. Through dynamic simulation and testing, they confirmed that the DAM prevents a roll down a slope and boosts locomotion speed in this research. We learned from this work that grasslands and a 27-degree slope can be surmounted without the use of additional driving controllers. In conclusion, we expect that employing the proposed mechanism, a snake robot will be capable of performing a wide range of missions, such as examining disaster sites and tough terrain.

[2] XuesuXiao's work "snake robot testbeds in granular and restricted manoeuvrability spaces" was published in 2018. This article summarises the current state of the art in evaluating snake robots for small places like a collapsed structure, where the snake is either locomoting in restricted manoeuvrability locations like tight pipelines or tunnels, or pushing through granular regions like dirt and rubble. It offers advice on how to construct a testbed, and 20 testbeds were used to put snake robots through their paces in restricted mobility conditions. All of them were made particularly to put a snake robot to the test. According to this research, the snake robot will require two types of generic testbeds.

[3] The paper titled "A Screw-less Solution for Snake-like Robot Assembly and Sensor Integration" authored by Guoyuan Li in the year 2017. Assembly or repair of snakelike 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, microcontrollers 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] In 2009, Aksel Andreas Transeth published a study titled "snake robot modelling and locomotion." We took the concept of the numerous mathematical models and motion patterns offered for snake robots from this study. Ones that are solely kinematic as well as models that include dynamics are studied. Furthermore, the community has developed a testbed with high physical fidelity for determining appropriateness for a particular application, as well as a testbed that allows for a dimensionless comparison of various snake time picture acquisition, multi sensor fusion, and wireless communication technology. We use Solid Works to optimise the design of the snakelike robot's head, body, and tail joint structures. Because of the immaculate design of the control system and mechanical structure, the system is a real-time system with a simple circuit structure and several degrees of freedom. Finally, the snakelike robot's experimental results reveal that it is capable of tackling difficult issues.

3. RESEARCH METHODOLOGY

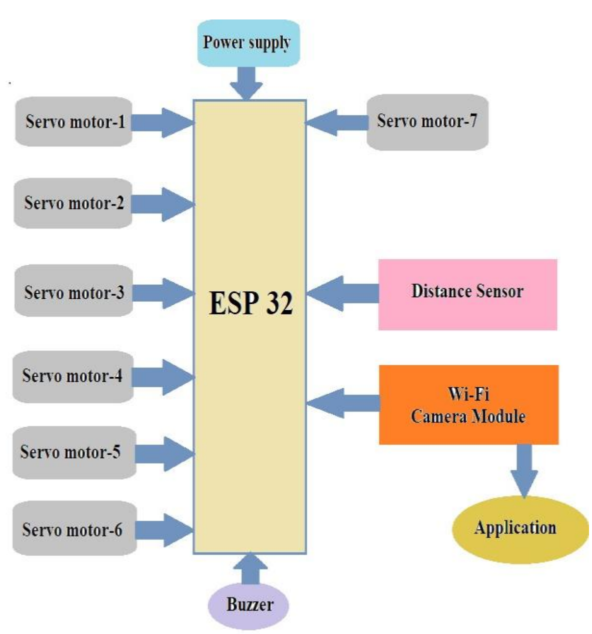

Fig1 : Blockdiagram of IOT based snake robot

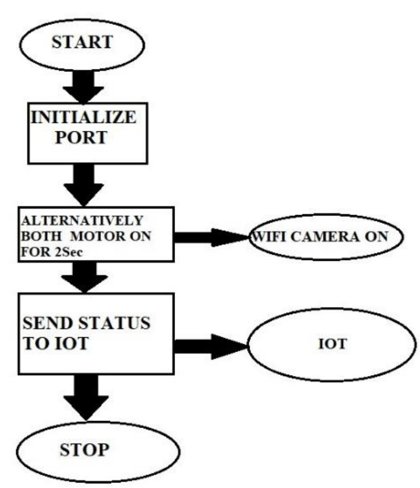

Fig 2: Flow Chart of IOT based Snake Robot

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

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.

APPLICATIONS

- 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 RESULT AND DISCUSSION

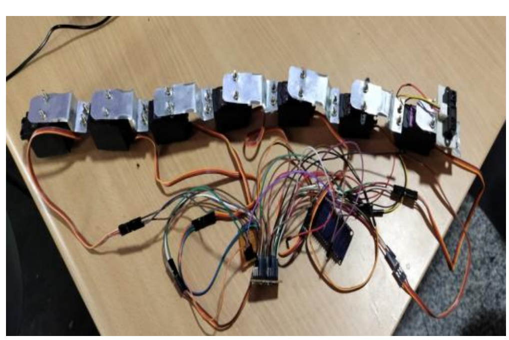

Fig 3: Model of the snake robot

Result

- The model results in a prototype of methodology to implement a snake robot mechanism system within the limited available source and economy.
- This device will be able to capture the image and sends captured images to the personal computer.

Discussion

This snake robot has potential to capture the current time photo of the area and send environmental parameters to the personal computer. Hence there is need to promote the technology to improve the strength or to support the military. Even in the collapsed building area it is able to go inside and capture the image and sends to the outside person, who is handling the robot.

Through the captured images we get the information that whether any living body is present under the building .So this snake will make help in the rescue and save operation as well as in the boarder area. Head plays most important role in designing Snake Robot. The body of the snake robot moves based on the instructions given by ESP32 which is programmed to control the body and also connected with the IOT Cloud.

The images captured by the WIFI Camera present in the head part are sent to the IOT Cloud-ThingSpeak and are stored in this cloud. So the data stored in Cloud is sent to PC/Phone. WIFI camera is used for Capturing the places. The camera switched on when snake has movement. For the snake motion we use two dc gear motors. Passive wheels are attached under each modules to give the robot anisptropic ground friction properties, which enable the robot to slither forward over flat surfaces.

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