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Implementation of Robotic Snake using Arduino Nano

Suganda.Pendem,Manjula.G.Pai, Aleem Sultana.Shaikh, S.Tamil
Dept of Electronics and Communication,Rural Engineering college Hulkoti
aleem.vlsi@gmail.com

ABSTRACT: Snakes have a unique feature of moving over all kind of terrains like rough, smooth, muddy, narrow paths, this inspired to create the 'Robotic Snake'. This Robotic snake can move in narrow path where human beings cannot move into. Robotic snake is a great innovation in India. Hence there is lots of scope in future India. Robotic snake can be used in inspecting the pipes in industry, search and rescue operation, disaster management and military applications. The Robotic snake movement is based on degree of direction, this makes motion like snake. For this robotic snake camera is mounted on the head to watch live videos in the android by connecting Wi-Fi network. Likewise further innovations can be done for new world of snake robots field for various applications.

INDEX TERMS: **Robotic snake using arduino nano, arduino IDE, Wi-Fi Network, Embedded C++.**

1.INTRODUCTION

Scientific innovations have always helped mankind to explore the extremes and reach to the avenues beyond our imagination from simple agricultural tools to sophisticated spaceships, satellites. Compared with other animals snake have a unique feature of moving all types of terrains, narrow paths, and this character are inspired to create the 'Robotic Snake'.Navigation through cluttered environments, often describing natural disaster aftermaths, subterranean collapses andsimilar scenarios, is a challenge that snake-like robotic platforms are well-positioned to address. Mimicry of snakelike morphologies and adoption of serpentine locomotion strategies potentially confer locomotive advantages similar to those employed by biological counterparts traversing similar environments. Given the current challenges associated to traversal of arbitrary, unknown, rugged terrains. A frequent characterization of these mission scenarios entails the absence of global environmental knowledge. Success requires adequate onboard sensing and navigation strategies in the presence of obstacles, which include self-localization, map construction and motion planning. Snake-like robotics research has focused on the latter, path planning and following, with less effort on addressing the former challenges. Morphological features that advantage snake-like platforms in obstacle-strewn environments also limit them with respect to the supported on-board sensory equipment. Head-mounted cameras obtain visual information which, in conjunction with proprioception-based dead reckoning, informs localization. Cameras on these robotic platforms have predominantly been used to address higher task-level objectives or monitoring needs rather than navigational autonomy.

2.LITERATURE REVIEW

For robotic snake, innovation started form 19 century. It started with the basic idea, that snake robot could move within destroyed buildings looking for people while simultaneously bringing communication equipment together with small amounts of food and water to anyone trapped by the shattered building. A rescue operation involving a snake robot is envisioned in Miller. Japanese government is promoting research in the field of snake robots. The researchers describe a new paradigm "snakes and strings" for rescue operations. According to this research snake like technology can be used for developing mobile robots which can move through narrow spaces under collapsed buildings. Pal Liljeback, et.al. (2010) conclude that there is need of smart snake robot locomotion in

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uneven surface environment. One design approach is based on measurement of joint constraint forces at the connection between the links of the snake robot. Another, taking the cylindrical surface of each link of a snake robot to rotate by a motor inside the link in order to produce propulsive forces on the robot from its environments. Blessy Mariam Markose , HarshithaLoke (2014) the researchers come to know that adoptability of snake robots in search and rescue operations and how these robots can reach place like narrow paths, rough surface and unconditional environments where human beings cannot reach. Although snake robots have certain limitations like poor power efficiency and lesser control but the researchers conclude that innovation can overcome these limitations and snake robots can be a very successful mechanism.

3. BLOCK DIAGRAM

In this model we have designed system that Robotic snake should have locomotion and navigate. We installed ESP32 camera module in it, to capture the pictures. We have used microcontroller as Arduino nano microcontroller which gives input to PWM module as servo motors accept only PWM signals. For locomotion of robot used servo motors. To control all the system we are writing embedded C++ program in it. That all arranged as in figure 1.

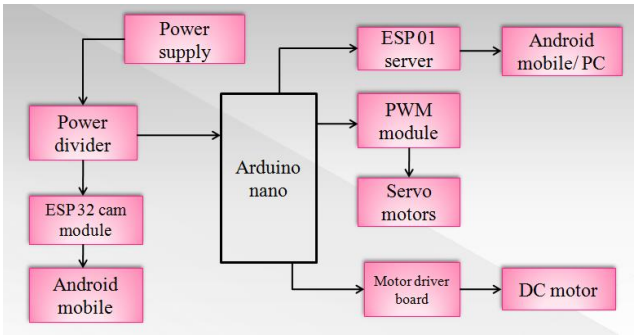

Fig.1: Block diagram of robotic snake

4. HARDWARE DESIGN

To keep the modules lightweight and torque requirement low -Fabric glass sheets were used for its construction. Laser cutting of these Fabric glass sheets were done in order to get the precise shape of modules.

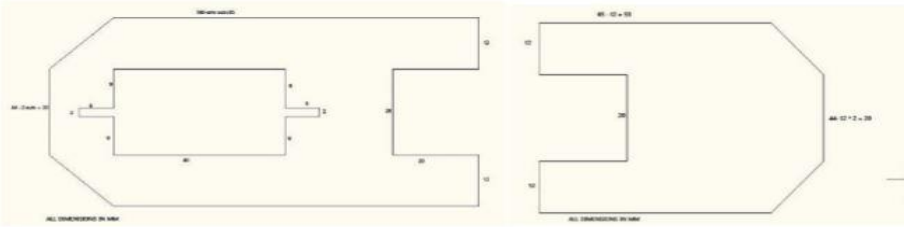

Fig.2: AutoCAD drawing of fiber glass

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AutoCAD drawing of each module: Each module consist of 2 parts which were attached with each other via clips made manually, using tin. The dimensions of the above module were all decided by keeping in mind the size of servo motors, wheels and batteries to be used.

Metal gear standard servo motors of torque capacity 13.5kg/cm were used to make the joints active. Wheels, made from nylon, of 3.3cm diameter were used. (Lego wheels of 3cm diameter were the most ideal choice, but due to unavailability we selected the next best possible) Batteries were added in order to make snake self-contained in terms of power. Connection wires were soldered to batteries to avoid loose connections. Every connecting wire either had an insulating covering or was covered properly to avoid short circuiting. All drilling work, construction of hinges (via clips), cutting of wheels and Fabric glass in proper and precise shape was done manually. Arduino nano is used as microcontroller. It is mounted on a separately designed front module which is made three wheeled, in order to give stability to the whole body.

Fig.3: Mechanical design of servo motor\

4.1 SERPENOID CURVE FORMATION

Biological snakes occupy a wide variety of ecological niches, ranging from arid desert to tropical forests as well as swimming in rivers and oceans. Their body construction and locomotion technique has proved to be an extremely effective and efficient strategy. By attempting to build robots that emulate and perhaps match the capabilities of their biological counterparts, it is possible that we will create useful tools capable of carrying sensors or surveillance operations by operating in challenging environments where physical human presence is unfeasible or impossible. Snake robots are robots inspired from biological snakes – in structure, path trajectory and mechanism of movement. Biological snakes have inspired a variety of robotic designs since 1920s. One of the earliest Biomechanical studies of snakes was done by Shigeo Hirose, in 1970 who modelled a snake body as a continuous curve that could not move sideways.

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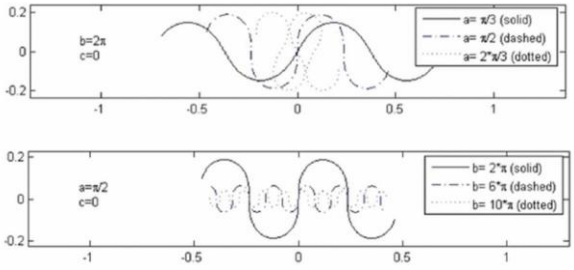

Fig.4: Serpenoid curve formation

5. SYSTEM DESIGN AND IMPLEMENTATION

The snake contains four segments motivated by servo motors and joined with fabric glass brackets. The servos are controlled by an Arduino Nano through PWM Module and powered by a 9-volt battery pack. The snake can be controlled by an android app using Wi-Fi. The snake is also capable of autonomous movement. Such a robot can be constructed with many different types of servos and brackets. Each of the4 segments consists of a servo motor, a C-bracket, a side bracket, a wire clip and a set of Lego wheels. Two screw holes got to be drilled into the Lego wheel axle to permit it to be connected to the C-bracket. After all, 4 segments are connected; head and tail sections need to be added in order to accommodate the Arduino and batteries. To make them a side bracket and two long C-brackets connected. The servos are powered by a separate supply, the 9-volt battery pack, which went into the head of the snake. On the receiver, the bottom pin is connected to the Arduino ground. The voltage pin is connected to a 5-volt pin from the Arduino nano.

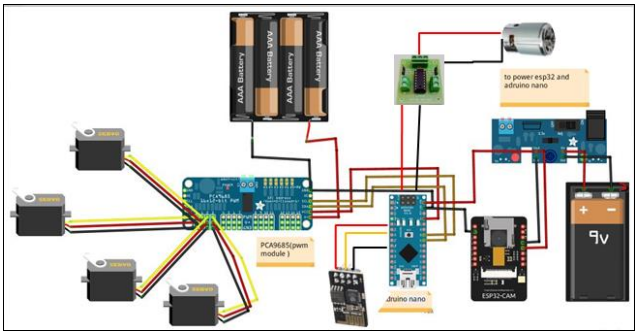

Fig.5: Connection of all components

SOFTWARE IMPLEMENTATION

For Robotic snake, finally need to write a code and upload it to the nano which will bring out our robot to life. To program the robot first make sure we have arduino IDE installed on our computer. And let's start writing the code. First we declare the require variable. These will control our servo motor driver through

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PWM signal pins which will help use control the speed of our robot. Input pins control the degree in which motors will turn.

6. RESULT

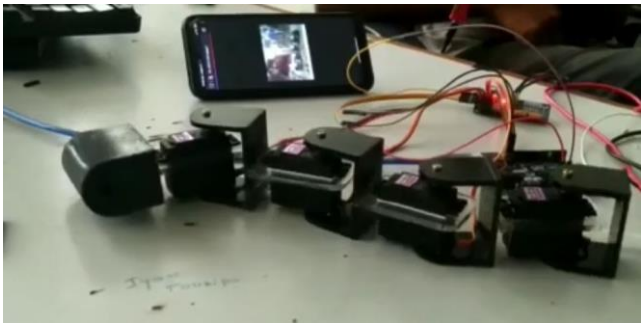

Fig.6: Robotic snake visuals in android mobile connecting through Wi-Fi

Camera module programming is a very basic sketch and most of its functionality comes from the Wi-Fi library, that install with the ESP 32 board. We need to modify this sketch with our SS ID and Wi-Fi password, just as we did for the camera web server example sketch. These values are assigned to a couple of constants. In the set up the serial monitor is installed and then and attempt is make to connect to the Wi-Fi access point using the tredentrals is applied.

7. FUTURE SCOPE

Further innovations on snake robots can help to overcome their limitations of poor power efficiency, by using a stereo camera and appropriately upgrading the algorithmic system components. And hence snake robots are not future technology rather a near future technology soon to become present technology and holds lot of scope in India. Many research challenges still remain before we will see useful applications of snake robots, and much remains to be understood about the dynamics of these fascinating mechanisms. An important topic which the researchers are currently investigating concerns new models and control strategies to support intelligent and adaptive snake robot locomotion in challenging and cluttered environments which are otherwise difficult, life threatening or inaccessible for human beings. With further innovations, the potential of snake robots can be exploited and give way to infinite applications.

8. CONCLUSION

The robotic snake using arduino designed to control model for the trawling wave rectilinear gait of a snakelike robot. Reduction of the complex gait dynamics to a simpler kinematic unicycle model, in the steady-behaviour motion, admits the application of tools and strategies such as pipes, small holes and gaps and generates mapping information of the surrounding environment.

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We augment the snake-like robotic platform with a wireless monocular head camera to capture images of the environment once every gait cycle. Initially feasible trajectories are re-synthesized to navigate around detected obstacles. Using the presented navigation framework the robot successfully negotiated a scenario, avoiding obstacles as they came into view, and eventually exited the obstacle field.

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