**PROJECT REPORT**

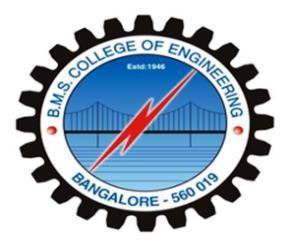
ON

**“SERPENT BOT”**

**MINIPROJECT**

IN

**ROBTICS CLUB, BMSCE**

****

**B.M.S COLLEGE OF ENGINEERING**

(Autonomous College Affiliated to Visvesvaraya Technological University, Belgaum)

Bull Temple Road, Basavanagudi, Bangalore-560019

SUBMITTED BY:

**Team Slytherin**

**Adithya Adiga 1BM20IS010**

**Bhojraj Anand Kumbar 1BM19ME033**

**Bukkapatnam Meghana 1BM19EI017**

**Prachetha P Vasishta 1BM19EC105**

**Sree Suryadatta M Vadhoolas**  **1BM19EC161**

**Concept:**

The Serpent Bot is a mimic to the actual Snake which is capable of different modes of reptile locomotion. It is a wireless Wi-Fi controlled Bot whose motion is controlled by an Android Application. This simple Robotic model of a Snake has various use-case applications from a simple children toy to many Medical, Surveillance, Disaster management applications. Traditional Snake Bots locomote purely by changing the shape of their body, just like snakes. Many variants have been created which use wheels or treads for locomotion. No Snake Bots have been developed yet that can completely mimic the locomotion of real snakes, but researchers have been able to produce ways of moving that do not occur in nature. Hence this simple project’s objective is to mimic the near similarity to Slithering Motion.

**HARDWARE ARCHITECTURE:**

The hardware of Snake-Bot primarily consists of building blocks, in this case five, motion between which is controlled by the Servo Motors (SG90 Micro-Servo). The Servo motors are driven by external 5V power supply from the LM2596 DC to DC buck regulator to provide adequate current to the motors as well as supply the NodeMCU. The angle of motion for each Servo is calculated and controlled via NodeMCU using Servo Library which provides the required PWM wave for servo rotation. On the top, the Wi-Fi application communicates with the NodeMCU to provide motion commands using in built ESP8266 Wi-Fi Library.

**CIRCUIT DIAGRAM:**

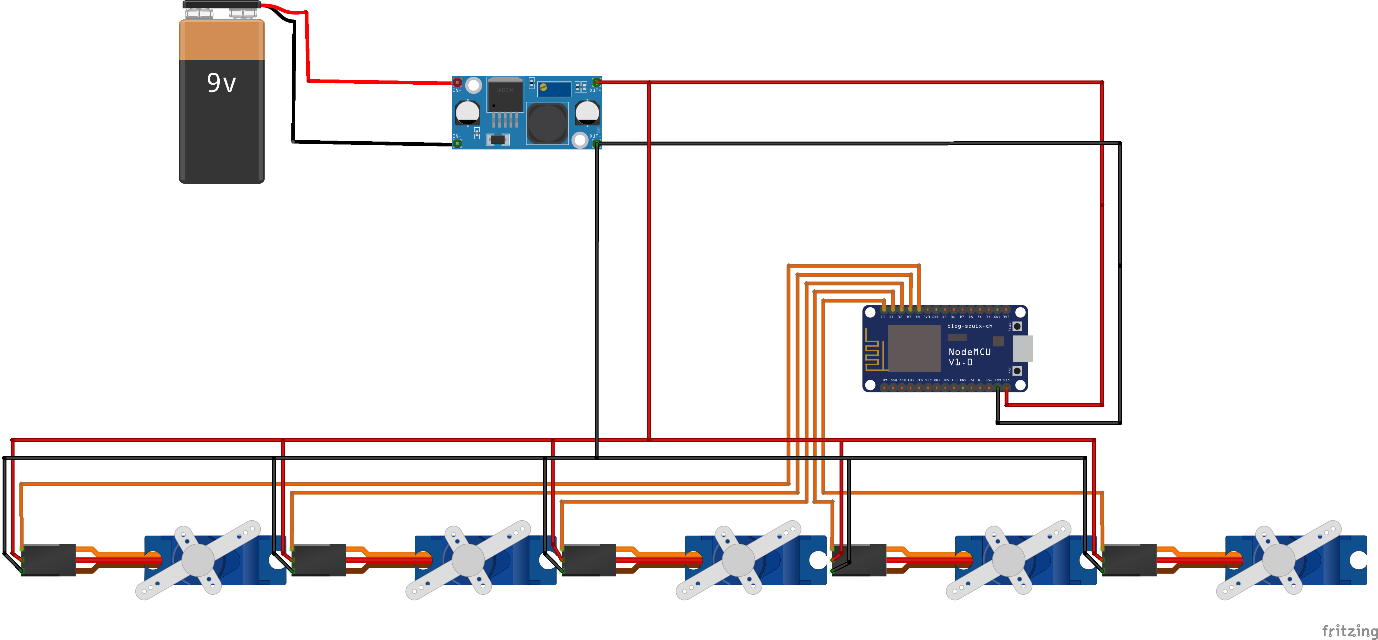


Fig: The Circuit diagram of NodeMCU Wi-Fi controlled 5-servo configuration for a 5-joint Serpent Bot.

**COMPONENT DESCRIPTION:**

|  |  |  |
| --- | --- | --- |
| Sl. No. | Components | Quantity |
| 1 | NodeMCU 0.9 (ESP8266) | 1 |
| 2 | SG90 Micro-Servo Motors | 5 |
| 3 | LM2596 Buck Regulator | 3 |
| 4 | Lithium-ion Batteries | 1 |
| 5 | Connecting Jumper Wires |  |

1. **NodeMCU**



Fig: NodeMCU

NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.

1. **SG90 Micro-Servo Motor:**



Fig: SG90 Servo Motor

Tiny and lightweight with high output power. Servo can rotate approximately180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with 3 horns (arms) and hardware.

Specifications

• Weight: 9 g

• Dimension: 22.2 x 11.8 x 31 mm approx.

• Stall torque: 1.8 kgf·cm

• Operating speed: 0.1 s/60 degree

• Operating voltage: 4.8 V (~5V)

• Dead band width: 10μs

• Temperature range: 0 ºC – 55 ºC

• Position "0" (1.5ms pulse) is middle, "90" (~2ms pulse) is all the way to the left.ms pulse) is all the way to the right, ""-90" (~1ms pulse) is all the way to the left.

1. **LM2596 Buck Regulator**



The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixedfrequency oscillator. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators. Available in a standard 5-pin TO-220 package with several different lead bend options, and a 5-pin TO-263 surface mount package.

**SOFTWARE ARCHITECTURE**

The Serpent-Bot is built on NodeMCU ESP8266 module which has a built-in Wi-Fi. The firmware for NodeMCU is made in Arduino IDE with ESP8266 board setup. Wi-Fi controller used in this project is an Android App called Wi-Fi RC Car ESP8266 which is built for ESP8266 module to send HTTP GET request to the host ESP module. Hence the NodeMCU acts as a server which on receiving a GET request move command, responds to that particular motion by calculation of Servo angles and give appropriate PWM waves. This is done using the Servo Library. Hence the move commands from the Android App which are forward, backward, left and right are possible in the motion of Snake-Bot.

The Flowchart representation of NodeMCU software architecture:

Start

While 1

If command received (Wi-Fi)

no

yes

Command-value: f/b/l/r/s?

no

End

Write Servo angles via I2C: Move according to command

Calculate Angles for Servos: forward/backward/right/left/stop

**Project Scope:**

There are few qualities that all Snake Bots share:

1. First, their small cross section to length ratio allows them to move into, and maneuverer through, tight spaces.
2. Second, their ability to change the shape of their body allows them to perform a wide range of behaviours, such as climbing stairs or tree trunks.
3. Additionally, many snake robots are constructed by chaining together a number of independent links. This redundancy makes them resistant to failure, because they can continue to operate even if parts of their body are destroyed.
4. The locomotive flexibility of Snake Bots makes them useful to operate in different terrestrial conditions.
5. Snake Bots can move on difficult geographical reliefs like mountain or hilly surface, deserts, rough terrains, wild forests underground and in narrow & difficult places like pipes, drains, gaps, holes, sewers and can climb trees, pipes, ladders, etc.
6. Snake is one of the creatures that exhibit excellent mobility in various terrains.
7. Snake robots most often have a high number of degrees of freedom (DOF) and they are able to locomote without using active wheels or legs.
8. In comparison to wheeled and legged mobile robots, the snake robots have high stability and good terrainability. The exterior can be completely sealed to keep dust and fluids out.

There are many applications for a Serpent like Bot due to its terrainability and wide range of motion behaviour, to mention a few are:

1. Rescue missions in earthquake area: The snake robot could crawl through destroyed buildings looking for people. It could also carry small amounts of food or water to people trapped by the building prior to the arrival of rescue personnel.
2. The snake robot can also be used for surveillance and maintenance of complex and possibly dangerous structures such as nuclear plants or pipelines.
3. In a city, it could inspect the sewer system looking for leaks or aiding fire-fighters.
4. NASA engineers are developing an intelligent robot snake that may help explore other worlds and perform construction tasks in space. The Snake Bot, able to independently dig in loose extra-terrestrial soil, smart enough to slither into cracks in a planet’s surface and capable of planning routes over or around obstacles.