BUG-BOT: Bluetooth Controlled Surveillance Robot

Pranav Santhosh[1], Divya Dinesh P[2], Nithin Kumar S[3], Vineeth U[4], Sithara Jayaraj[5]

[1,2,3,4] Student, Dept. of Electronics and Communication Engineering, MACE, Kerala, India [5]Assistant Professor, Dept. of Electronics and Communication Engineering, MACE, Kerala, India

---

Abstract – *When natural calamities like earth quake, land slide, flood occur, certain areas become inaccessible and people get isolated. There comes a need of robots that can move through rough terrains and collect information about the conditions. For this purpose, we are introducing an innovative six-legged robot. This robot can be used in spying, surveillance and in rescue operations. The six-leg concept inspired from ants gives the robot a better adaptability to the rough balancing areas. The six legs support more movement of freedom and have more stability than the traditional wheel concept robot. By attaching camera these robots can produce a visual result of the environment it stands.*

Key Words: **Bug-Bot, Arduino Mega, Raspberry Pi 3 B+, Fusion 360, Corel Draw**

1.INTRODUCTION

The most common way of designing a robot is by studying the environment it has to work and by creating a robot according to the inference. But when situations like calamities happen the area of working will be changing very quickly and the current algorithms can't do anything there. So a new algorithm is needed for this purpose.

The Bug-Bot is an answer to this problem. If we observe the history, we can see that bugs have overcome natural disasters like no other living beings. Inspired from the structure of bugs the Bug-Bot will have this adaptive nature. This peculiarity of the Bug-Bot gives it an upper hand in rescue operations over its competing models.

The Bug-Bot can be used in spying purpose too. The bug like shape gives more support to climb the walls and to pass through small gaps. When these features are included it will become a spying robot.

The walking algorithm[1] of robots is a new and very fast advancing branch in robots. So the Bug-Bot can improve its walking style in future and more features can be included to make more versatile robot.

Our Bug-Bot have the following features

1.Shape suited to versatile conditions.

2.Full body can be 3D printed.

3.Bluetooth or RF communication is possible.

4.Easily maintainable and modifiable.

5.Rechargeable batteries as power source.

6.Can be controlled using mobile app.

2. BUG-BOT CREATION

The design concepts, various software used, hardware Implementation will be explained in this section

2.1 Basic Concept of Bug-Bot

The bug-bot consist of a main body and six legs. Each leg consists of three pieces, coxa, femur and tibia[2].

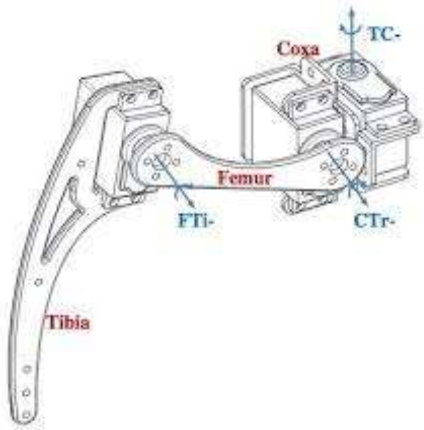

Fig -1: Structure of one leg

First is connected to the body of the bug-bot, it is termed as Coxa. Third one is the one that touches the ground, it is termed as Tibia. Second piece is connected between first and third piece, it is called Femur. Each leg consists of three motors. The first motor is connected to the joint between body and leg. It facilitates the to and fro motion. The second and third motors facilitate the height adjustment and body balancing. This design is inspired from the structure of ant. Bio-mimicking is always a better way to develop good designs.

2.2 Gait Planning

A gait is a sequence of leg motions coordinated with a sequence of body motions for moving the overall body of the robot in the desired direction and for orientation from one place to another[3]. A gait is described as periodic when similar states of the same leg during successive strokes occur at the same interval for all legs.

The gait mainly used here is tripod gait. Tripod gait is a regular, periodic gait where the anterior and posterior legs on one side lift in time with the contralateral middle leg, forming alternating tripods. This is a gait suitable for high speed walking over relatively flat ground. The gait can be made suitable to rough terrains by making the motion non-periodic. It is implemented by suitable pulse width changes in the programming part.

In Fig.1 the black spot shows the legs are in air and white shows the legs are in ground.

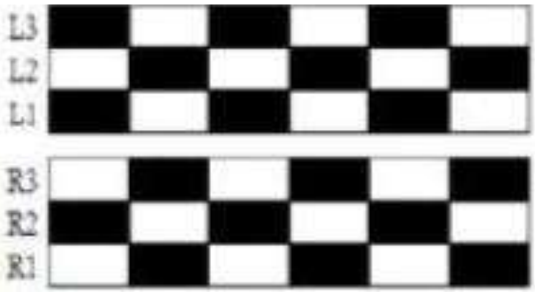

Fig -2: Gait control in legs

2.3 Mechanical Design

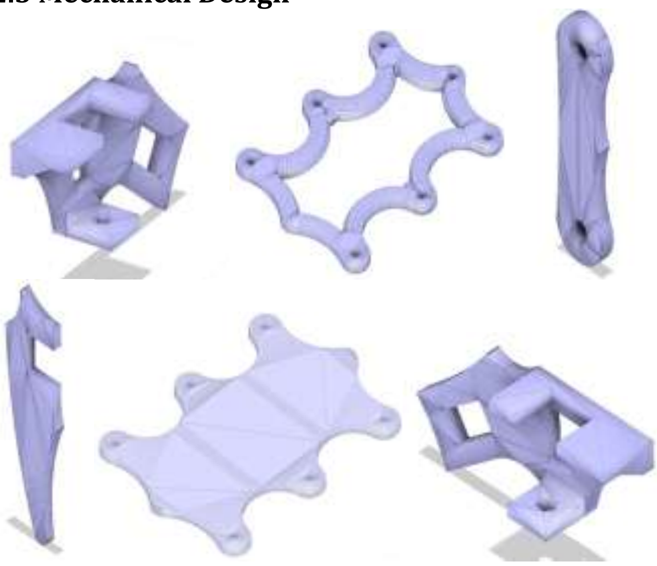

Fig -3: 3-Dimensional view of parts

To create the bot six parts were 3D printed and fourteen parts were laser cut. All the parts were created using Fusion 360 software[4]. Fusion 360 is a cloud-based 3D CAD modelling software with many advanced features. The six parts for 3D printing designed in Fusion 360 were printed using Ultimaker 3D Printer. The rest twelve were edited in Corel draw and laser cut. CorelDraw[5] is a vector graphics editor developed and marketed by Corel Corporation.

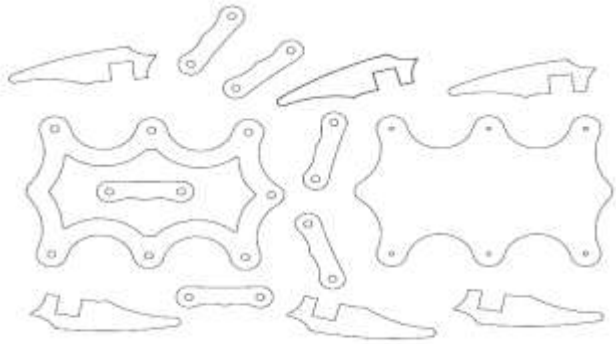

Fig -4: Corel Draw design for laser cut

2.4 Electrical Design

The Bug-Bot contains an Arduino mega[6], HC-05 bluetooth module, Raspberry pi 3B+, Pi Camera, DC to DC buck convertor and 18 servo motors. All the 18 servo motors are metal geared MG92B servos. The power supply used here is 11.1 V Li-PO rechargeable battery. The buck convertor is used to step down the voltage from 11.1 V to 6.2 V. The 18 servo motors are connected directly to the buck convertor for power. The control pins of the motor are connected to the Arduino mega board from Pin 22 to Pin 33. The Arduino board is powered through Vin and GND pins. The HC-05 module is directly connected to the Arduino board for power and data transmission.

The Raspberry Pi is connected to the buck convertor for power. Pi Camera is connected to the Raspberry Pi[7].

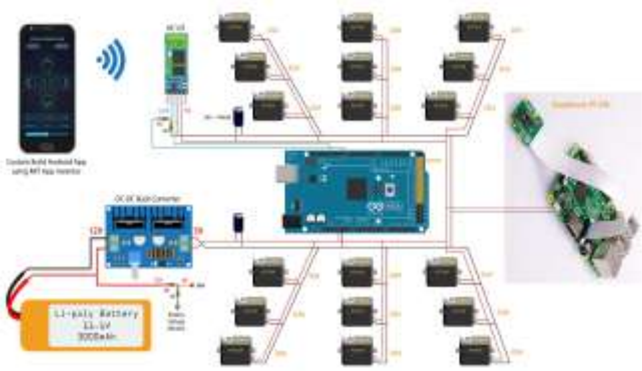

Fig -5: 3-Electrical Design

2.5 Operation of Bug-Bot

The forward motion is done by the simple tripod gate algorithm. The anterior and posterior legs on one side lift in time with the contralateral middle leg, forming alternate tripods which cause forward motion.

The lifted legs move forward and touches ground. The resting legs will now be lifted upwards and will move forward along with the backward movement of the ground touching legs. When ground touching legs try to go backwards the friction will stop them from being move backwards thus the body will move forward as a relative motion. Thus, one step in forward motion is done. The same movement of the group of legs produce one complete cycle of motion. The backward motion is obtained by doing this same process in backward direction.

The sideways movement is made by grouping one side legs together and moving them simultaneously. When motion is to right side the right-side legs will move backwards and the left side legs will move forward. As a result, the body will get tilted to right side.
Movement control signal from application:

Forward motion :2
Left side motion :4
Right side motion :6
Backward motion :8

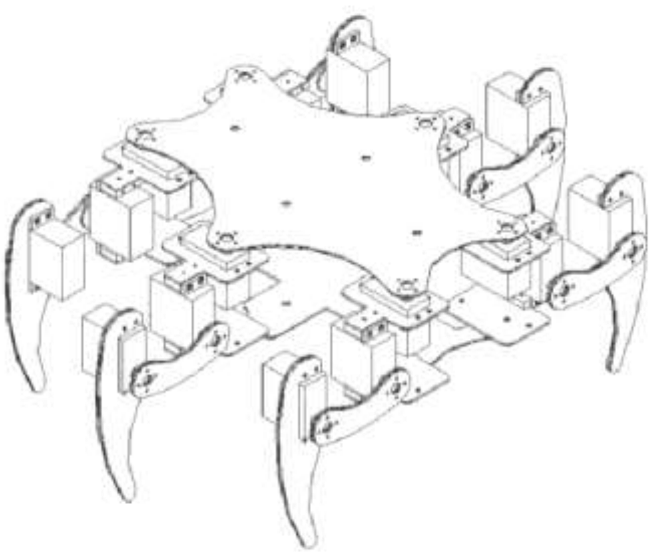

Fig -6: Basic structure of Bug-Bot

3. EXPERIMENTAL RESULT

Our project was experimentally tested in the laboratory and it exhibited the desired result. The communication between the mobile application and the bug-bot has been achieved through Bluetooth and it has a range over ten meters.

4. FUTURE SCOPE

The walking algorithm for robots is an advancing branch in robotics. So more innovative ideas can be brought to the bug-bot in the future like wall climbing and gliding over the water surface.

5. CONCLUSION

In this paper, we have described the design concepts, hardware and software used, schematics, simulator details and experimental results.

REFERENCES

[1] Uluc Saranli. Dynamic locomotion with a hexapodrobot. PhD thesis, The University of Michigan

[2] NASA. All-terrain hex-limbed extra-terrestrial explorer. http: //athlete:jpl:nasa:gov/

[3] Boston Dynamics. Boston dynamics: Dedicated to the science and art of how things move.http://www:bostondynamics:com/ robot bigdog:html

[4] Fusion 360, https://academy.autodesk.com/course/126271/introductio n- 3d-modelling

[5] CorelDraw, https://www.coreldraw.com/en/pages/tutorials/coreldraw /

[6] Arduino. Arduino - arduinoboardmega2560. http://arduino:cc/en/Main/ ArduinoBoardMega2560

[7] Raspberry Pi Foundation. Raspberry pi. http: //www:raspberrypi:org/