# Four Legged Walking Robot with Smart Gravitational Stabilization

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## Abstract

There are many dangerous jobs which could be safely replaced with an adequately designed robot: bomb disposal; construction in high rise buildings; examination of radioactive environments and combat oriented police/military operations. A machine must then achieve a level of dexterity and reliability greater than that of a human worker.

One of the most versatile dynamic robots that can be seen today was made by Boston Dynamics: the quadruped robot named Spot Mini is capable of handling objects, climbing stairs and operating in an office, home or outdoor environment (Bostondynamics.com, 2017).

One of the main shortcomings of such robots are their size, cost and inherent need for power. Additionally, a dog inspired gait structure is not optimal for climbing.
The aim addressed in this study was to design a robot that would be inconspicuous, capable of maneuvering through small environments and be able to climb inclined surfaces with minimum processing power and cost. To this end, the robot was programmed with an insect inspired gait mechanism for maximum surface area while climbing and a novel ability to maintain the center of gravity by leg movements as shown in figure 1A. Table 1 shows a direct comparison of mobility between the finished robot and an average human being. It would either walk or stabilize once instructed via Bluetooth. The newfangled placement of legs ensured bipod gait during locomotion for faster and efficient motion and monopod gait during the stabilization phase for agility. The desired positions were calculated by the use of inverse kinematics and data from the IMU.

*Table 1: Mobility Comparison between the robot and a human*

| | | Robot | Human |
|---|---|---|---|
| Angle of motion per leg | Hip | 180° | 130° |
| | Knee | 180° | 130° |
| | Ankle | 180° | 45° |
| Max. Climbable Inclination | | 55° | 30° |
| (DOF) Degrees of Freedom | | 12 | 6 |

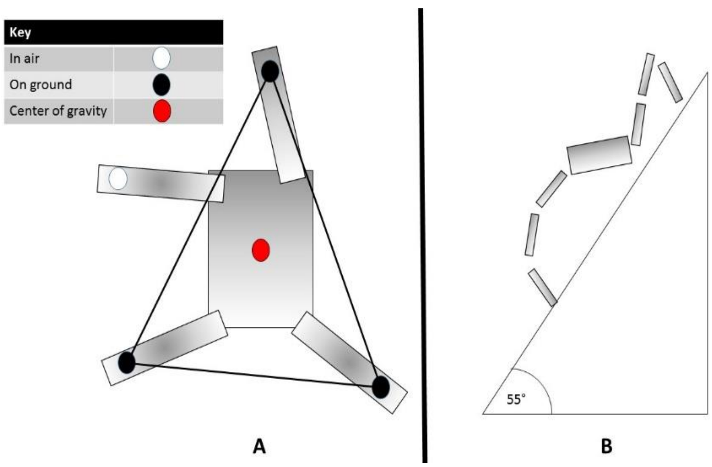

*Figure 1: A: Robot's novel balancing algorithm; B: Depiction of robot's posture at maximum inclination*

The finalized robot was able to successfully walk and proceed through various terrain including grass, sand, small stones and miscellaneous household objects such as books, bags, pencils etc. The auto balancing function worked for as steep an angle as 55°.

***Keywords:*** *Smart Robot, Auto Balancing, Microcontroller*