Project Bigfoot: A Multi-purpose Unmanned Ground Vehicle Platform

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Abstract

This document is a proposal to the Louisiana Tech University Intel Galileo Board Donation entry request. Project Bigfoot is a personally funded research project by a Louisiana Tech University Mechanical Engineering undergraduate student using Louisiana Tech University and its research support facilities such as the Proto-lab and Thingery. The following document provides a brief insight into the scope of the project.

Introduction

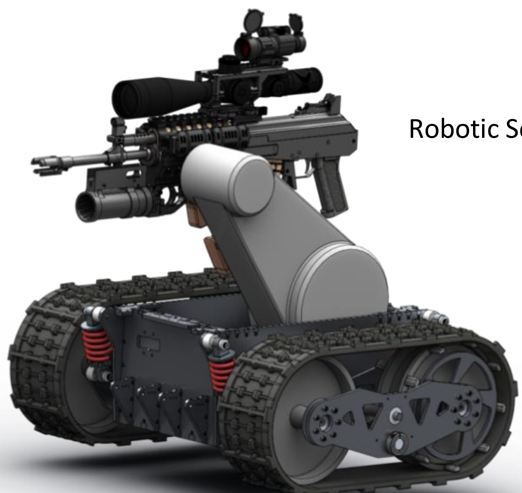
It is estimated that over 97 million lives were lost during World War I and II combined. More than half a century later, today, the way nations fight wars or engage in conflicts has changed dramatically to reduce the number of causalities and collateral damages. As a pioneer in developing and implementing unmanned robotic systems, the United States armed forces actively recruit robots as the next generation of warriors. For instance, according to Wired magazine, one in 50 US troops in Afghanistan is a Robot. More than 2000 ground robots fight alongside flesh-and-blood soldiers. The rise of a full blown robotic army is in the horizon to reduce the collateral damage and improve the efficient execution of the rules of engagement. Moreover, robots are widely used in industrial settings to make the production more cost effective and error free. However, robots that can be used as a quick response to dangerous industrial settings or to avert industrial disasters are gaining attention and popularity in the wake of Fukushima nuclear plant disaster. Furthermore, just as DARPA's 2004 Grand Challenge made the rise of autonomous vehicles, the 2014 DARPA Robotic Challenge (DRC) is expected to be first step to the next generation of multipurpose robots. In a world that sees an increased need for such systems, Bigfoot will serve as a research platform to explore the possibilities.

Project Objective

The primary objective of the Project Bigfoot is to provide the Swiss-Army-Knife equivalent of a robotic platform that a solider or a civilian can use as a mode of transportation and as a defensive, offensive or even as a rescue gear.

Figure 1

The tracked platform as shown in figure 1 can be equipped with different gears and accessories to suit the needs of the moment. For instance, the system can serve as an armed solider, fire-fighter, mine-sweeper, off-road mobility and rescue platform, payload carrier, bomb disposal, and surveillance and terrain mapper and even as a first responder to an industrial accident. The incredible flexibility of the remotely operated Bigfoot will allow the robot to perform dangerous tasks without putting lives at risk. Figure 2 shows few of many transformations Bigfoot can undertake after installing various accessories



Robotic Solider

Civilian Off-road
power sport deck

Industrial rescue
robot

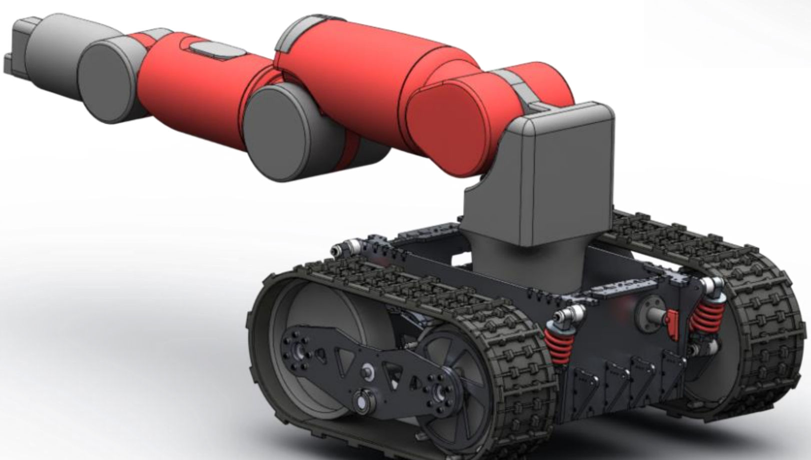


Figure 2

Goals of the Project

The primary goal of the project is to achieve certain mechanical specifications and operational capabilities. Considering the complexity of the system, the completion would be achieved in different phases of development to better focus and apply engineering principles in detail. There will be 3 phases in Bigfoot's development.

Phase 1

In its initial phase, the mechanical components for the tracked drive platform will be designed and built. All the parts that are associated with the drive platform will be machined and assembled in this phase. The mechanical components were completely designed using SolidWorks Computer Aided Design capabilities before they are cut using CNC water-jet and laser cutters to avoid unnecessary waste of material.

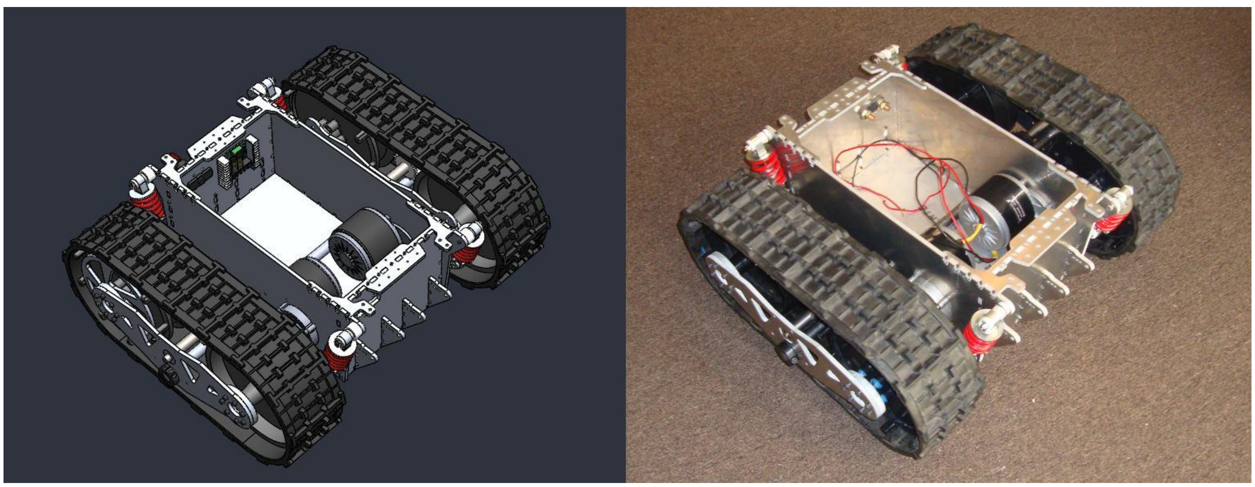


Figure 3

Phase 2

The second phase will oversee the integration of electrical circuitry. The circuitry will be consists of its wireless motor control components and the sensory data management components. The motor control is managed by Dimension Engineering's Sabertooth 2x25A circuit board in conjunction with a Turnigy 9x radio transmitter-receiver. The sensory data management system that processes many sensors such as GPS, accelerometer, gyro, thermocouple etc. will require a micro-controller's processing capabilities.

Hardware	Software
Intel Galileo Micro-controller or Arduino	Labview
Microsoft Kinect	Intel/Arduino driver
Sabertooth 2x25A	
Xbee	
Microsoft Lifecam	

The role of Intel Galileo

The role of Intel Galileo will be as the robot's brain that can process sensory data and communicate with its operator and provide vital information. The microcontroller will also manage the navigation in its autonomous mode by processing sensory data to make better awareness of its surroundings and make appropriate decisions.

Figure 4

Phase 3

The third and final phase of the development of Bigfoot will be reserved for the design and integration of various modular accessories that can be integrated to expand the robot's capabilities to wider aspects of the world.

Conclusion

Despite the unprecedented usefulness, today's in-service robots lack true multipurpose capability. The existence of Bigfoot with such capability will do a great service in areas that are inaccessible or dangerous to human beings. Industrial disasters such as the Fukushima Nuclear Plant underscore the need for remotely operated multipurpose robots that can be transformed to do the required tasks in a short notice. In today's world, the role of the Bigfoot could be as humble as turning an industrial safety valve that could avert a disaster or it could function as a solider fighting on the frontline to defend freedom. In either situation, Bigfoot would require an "Intel Inside" patch to perform its assigned duties in the most reliable and efficient way.