CUSTOMER APPLICATION

Ghost Robotics

Semi-autonomous robot dogs

concurrent REAL-TIME

RedHawk's guaranteed hard real-time performance was essential for Ghost Robotics' mission-critical military application

REDHAWK

"Concurrent Real-Time's RedHawk Linux operating system has been a game changer for us. The platform is completely open to customers yet it's difficult to interfere with the mission-critical control loop which ensures prevention of a catastrophic failure. **Having RedHawk lets me sleep well at night."**

– James Laney, Director of Development and Solutions, Ghost Robotics

Tyndall Air Force Base is first military installation to employ rugged semi-autonomous robot 'dogs' — powered by RedHawk Linux's advanced real-time operating system — for perimeter monitoring and Base security

Introduction

Since its founding in 2015, Ghost Robotics has been developing state-of-the-art mobile, legged robots that expertly mimic how animals move over rough, unstructured terrain. Ghost Robotics recognized early on that there was a need outside of a laboratory setting for robots that could traverse unstructured terrain where a typical wheeled or tracked device cannot operate efficiently.

This functionality is especially critical for customers with varied needs where a legged system is superior to wheels and tracks. The core technology of Ghost Robotics' legged robots is the concept of 'back-drivable actuators. Resembling a four-legged robotic dog, this technology gives Ghost Robotics' robots the capability of 'proprioceptive' sensing, where the robots respond to stimuli that gives them the ability to essentially touch and feel.

Ghost Robotics' products appeal to a variety of commercial and military & defense customers. Military & defense customers in particular have a need for rugged, small robots that are superior at traversing unstructured terrain for countless security and defense applications. Reliability and endurance are essential for military applications where the need to keep workers, civilians, K9s and others out of harm's way under ever-shifting circumstances is paramount.

Challenge

Tyndall Air Force Base near Panama City, Florida, is a pioneer among Air Force bases in the deployment of semi-autonomous robot 'dogs' to assist with ensuring the security and safety of the base's population. Military installations tend to be sprawling facilities that can encompass a variety of terrains. Base security is traditionally performed by human and K9 patrols, who follow a patrol route and continuously monitor the environment to ensure the base's safety and security.

Tyndall AFB recognized that employing semi-autonomous robot dogs to assist humans and K9s with labor-intensive security tasks such as perimeter patrolling would free up defenders to instead focus on other tasks and security operations that required a physical presence.

Ghost Robotics' solution for Tyndall AFB was the VISION 60® Q-UGV® 5th, a mid-sized, high-endurance, agile and durable all-ground drone 'robot' ideally suited for use in a broad range of unstructured urban and natural environments for defense, homeland and enterprise applications.

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The Vision 60 robotic solution is small, has great endurance, is able to carry a payload, is able to traverse multiple types of uneven terrain, and is highly reliable. This robotic solution is able to negotiate various terrains just like a human would but is unaffected by hazardous or dangerous conditions.

However, in order to provide the functionality Tyndall AFB required from a legged robot platform, Ghost Robotics needed to expand the capacity of its micro controller and gain real-time throughput in order to allow for expanded robot functionality. The need for real-time throughput was essential to avoid a catastrophic failure should the critical control loop be interrupted - a failure which would cause the robot to collapse.

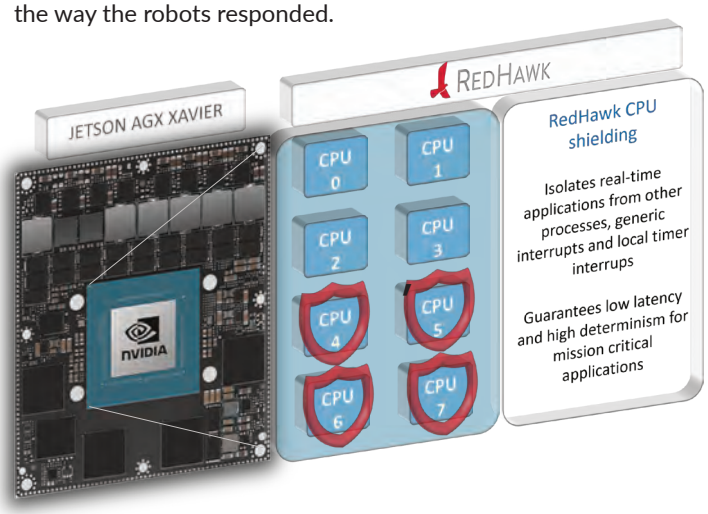

Photo by TAFB Airman 1st Class Anabel Del Valle

Ghost Robotics' existing hardware solution with the NVIDIA® Jetson AGX Xavier™ hardware worked well most of the time. However, Ghost Robotics occasionally observed 'hiccups' or jitter, in the robot's performance due to latency and interrupted control loops. For deployed autonomous systems, even occasional hiccups are not acceptable, as these issues could result in mission failures. Ghost Robotics' engineers were able to trace the cause of these hiccups to the non-real-time nature of the operating system in use. A hard real-time solution was mission critical for the robot functionality required by Tyndall AFB. This required Ghost Robotics to make an architectural jump to incorporate a real-time operating system platform to ensure its legged robot platform met Tyndall AFB's requirements.

Solution

That architectural jump for Ghost Robotics was to Concurrent Real-Time's RedHawk™ Linux® platform, the most advanced, open-source, real-time operating system (RTOS) available in the marketplace today. As an NVIDIA Preferred Partner, Concurrent Real-Time has been supporting the RedHawk Linux real-time operating system on the NVIDIA Jetson platform since 2016. Thus, Ghost Robotics could be assured of RedHawk's proven track record.

Concurrent Real-Time's RedHawk Linux was a game changer for Ghost Robotics, giving its robots the ability to operate reliably, smoothly and fluidly without any jitter. Because it is easy to use and compatible with the NVIDIA L4T kernel, RedHawk allowed Ghost Robotics to essentially use it straight 'out of the box'. RedHawk's hard real-time determinism and advanced CPU shielding features gave Ghost Robotics the ability to easily prioritize individual tasks and protect these tasks from unwarranted interruptions. This, in turn, significantly improved the way the robots responded.



Ghost Robotics has incorporated RedHawk Linux into its entire fleet of legged robots. In the future, Ghost Robotics plans to incorporate even more of RedHawk's unique features, further improving and expanding their robots' mobility and autonomy.

In addition to providing the superior real-time RedHawk Linux software solution, Concurrent Real-Time also provides comprehensive support to Ghost Robotics and its growing team as they push the envelope on their legged robotic platform and beyond. This is an enormous benefit to Ghost Robotics, giving them peace of mind as they further develop their robotics platforms.

Benefits

- Vastly improved latency resulted in more fluid, smoother robot operation with assured reliability
- Real-time throughput on gate control was critical to preserve integrity of control loop
- Additional features of RedHawk Linux can easily be added on as robot functionality is expanded
- Comprehensive support provided by Concurrent Real-Time ensures peace-of-mind for Ghost Robotics and its end customers

Summary

Tyndall AFB is extremely pleased with their robots' performance, as well as communication and support from Ghost Robotics to improve systems and functionality for operations in diverse weather conditions and environments.