Department of the Navy SBIR/STTR Transition Program

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Topic # N092-123

Multipurpose Automated Steward (MAS): A Versatile System for Autonomous Shipboard Cleaning

ProtoInnovations, LLC

WHO

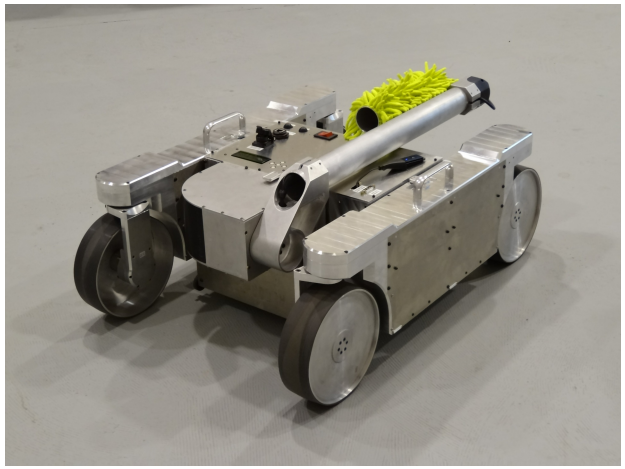
SYSCOM: NAVSEA

Sponsoring Program: Team Ships, PMS 501

Transition Target: LCS Ships, Freedom Class and Independence Class

TPOC:
(508)233-4103

Other transition opportunities: DDG 51 Class, Expeditionary Fast Transport (EPF) ships, Zumwalt Class, Military SeaLift Ships, Virginia Class submarines, Aircraft Carriers



WHAT

Operational Need and Improvement: Currently, the cleaning of all naval shipboard spaces is performed manually. The task is very laborious, requiring numerous man hours and manpower to perform on a daily basis. As the Navy shifts to smaller crew sizes, it is imperative that workload requirements be correspondingly reduced so that personnel can perform their tasks in a more timely and efficient manner. Current state-of-the-art industrial autonomous cleaning system technologies are bulky and have a limited mobility in confined spaces, as would be encountered onboard naval vessels; are heavy and not easily portable; have not been designed or tested for pitch and roll handling; and are neither self powered nor energy efficient.

Specifications Required: This program has sought unique, innovative, integrated and autonomous robotic systems to perform shipboard cleaning functions such as cleaning floors, walls, overheads, and counters. Such systems should be self powered, lightweight, and energy efficient to support optimized crew sizes and reduce labor intensive functions at sea. The robots must withstand shipboard motions and vibrations, be able to function within tight ship areas, and auto-adjust to accommodate various floor, wall and ceiling surfaces. They should automatically determine the areas to be cleaned and execute various cleaning schemes.

Technology Developed: To meet the needs of this program ProtoInnovations has developed an autonomous robotic platform for cleaning floors, walls, and raised surfaces onboard Navy ships. The robot dubbed Multipurpose Automated Steward (MAS) is modular allowing for quick change-out of cleaning payloads. MAS uses a combination of dry brushing and wet mopping to clean floors, and dry dusting to clean walls and raised surfaces. The robot is equipped with sensors, computing, and software for autonomous real-time cleaning.

Warfighter Value: The MAS robot will alleviate the burden of intensive and laborious cleaning tasks from sailors, allowing them to focus on their main mission. The use of MAS will automate the cleaning of numerous areas onboard ships and reduce time devoted to manual cleaning by 80%. Cleaning will be performed around the clock, optimized for minimal interference with sailors.

WHEN

Contract Number: N00024-11-C-4137 **Ending on:** August 27, 2015

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Concept robot demonstrated	N/A	Demonstrated mobility and module interconnect	3	May 2010
CDR completed	N/A	Demonstrated scripted sweeping with Gen1 MAS robot	3	May 2012
Government evaluation completed	N/A	Demonstrated all facets of Gen1 MAS robot at Government facility	5	February 2013
Ruggedized MAS robot demonstrated	N/A	Demonstrated autonomous cleaning with Gen2 MAS robot	6	February 2015
Government training completed	N/A	Trained Navy personnel on operations and maintenance of the MAS robot	6	June 2015

HOW

Projected Business Model: ProtoInnovations intends to license the MAS technologies to one or more commercial entities that can manufacture and productize the complete system and/or its modules. Specifically in relation to the needs of the Navy or another branch of the U.S. Armed Forces, ProtoInnovations is interested in partnering with a contractor that has the ability to further mature the MAS system and productize it in the context of a program of record. As part of that partnership, ProtoInnovations would support further development of MAS's general autonomous operational and specialized cleaning capabilities.

Company Objectives: In relation to the FST ProtoInnovations seeks to speak with Navy stakeholders who would be interested in adopting and funding the MAS robot and its technologies for other shipboard applications such as real-time CBRN inspection, fire-fighting, automated FOD, etc. In addition, ProtoInnovations would like to meet with defense contractors and commercial entities who are interested in robotics and automation.

Potential Commercial Applications: Because of the modularity and scaleability of its design the MAS can be used in a vast array of cleaning and servicing applications:
Shipboard cleaning: The MAS concept is directly applicable to commercial-shipping and cruise-ship vessels.
Commercial / industrial cleaning: A scaled-up MAS would automate industrial and commercial floor scrubbing, vacuuming, and sanding/polishing. Warehouses, hospitals, airports, supermarkets are only a few of many environments that cost savings be realized through cleaning automation.
Decontamination: The MAS concept would be applicable in cleaning and decontamination of nuclear facilities. Clean-up of high-radiation environments is one of the oldest robotic applications, although the MAS represents a potentially lower-cost alternative to monolithic systems developed in the past.

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