A Robot to Protect Your Home

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Engineers at the University of Malta are developing a robot to protect your personal space. **Dr Ing. Marvin Bugeja** *speaks with* **Jonathan Firbank** *about a Bachelor of Engineering final year project: a sentry robot being developed by* **Carsten Karl Grech**.

The future is now. The self-driving cars from *Total Recall* navigate busy streets. Trains have long been automated, as close to *Logan Run*'s sleek monorails as they are to the steam engines of old. And in the home, the little cleaning droids from *Star Wars* have escaped into the real world, gently vacuuming around furniture while fascinating family pets. Find a rich enough neighbourhood, and you'll discover their lawn-mowing cousins, diligently preventing their owners from having to touch grass.

These technologies are masterpieces of convenience. But convenience is not as important as security. *Robocop's* ED-209 wasn't an appealing depiction of automated security, but spare a thought for the robot in the dire 90s sci-fi-comedy, *Flubber*. It was a compact, adaptive, and responsive home sentry, complete with cameras for eyes and microphones for ears, less intrusive than a robot vacuum but with vastly superior utility. Mercifully, we no longer have to watch *Flubber* to see this tech in action, thanks to engineers at UM.

A UM student, Carsten Karl Grech, is developing a robot under the tutelage of Dr Ing. Marvin Bugeja. Beyond detecting home intrusion, it can detect fire and gas. It can also be remote-controlled to surveil for the many other things that threaten our personal spaces, whether they be as minor as leaving a window open or as dangerous as leaving the stove on.

ENGINEERING THE FUTURE

Bugeja is a senior lecturer at UM's Department of Systems and Control Engineering, an expert in control systems engineering and robotics. He is overseeing Grech's final year project for the Bachelor of Engineering degree. The project is firmly in its final stage, with a working prototype. As Bugeja explains, 'Engineering students select a project with practical and experimental components, implementing skills learned directly from the course or even from additional personal research. Projects are either suggested by students or, more commonly, proposed by supervisors, being tailored to students' interests either way.' Grech's interests formed the right 'spread of components' that this project demanded, extending through engineering theory and practice to more multidisciplinary factors – 'not just robotics but electronics, communications, and web development.'

Bugeja remarks that, 'the idea originated through observing cleaning robots', those *Star-Wars*-esque

The sentry robot navigating obstacles autonomously.


Rosbot 2 PRO: The mobile platform turned into a sentry robot.

roombas. 'These robots park themselves in a place at home then, when called upon, they can clean a room, having learned a map of the house. They do this autonomously,' Bugeja says. Another staple of smarter homes are security cameras. 'Wouldn't it be nice to have a camera on a similarly autonomous robot? Modern security systems, whether personal or commercial, consist of cameras and sensors fixed around the environment. The problem with this is that they have blind spots and buying multiple cameras is costly.'

This robot, on the other hand, does not need to be duplicated to adequately surveil a house, instead mapping the home then travelling to points of concern automatically or by remote control. Conventional security cameras are often more preventative than reactive; they tend to be placed at elevation, meaning that an intruder can avoid them or simply hide their face with a baseball cap. Their limited reactivity also means they have limited functionality when it comes to more common risks to our personal space. Bugeja recalls being overseas at a conference, wondering if he'd left a window open at home. 'Wouldn't it be nice if you could just use your mobile phone to send a robot to check?' This phone integration represented the biggest challenge of the project.

Bugeja and Grech are 'comfortable working with control systems, automated machines and robotics. But to develop a system like this, you need to develop an application that can observe and control the robot,' incorporating aspects of IT
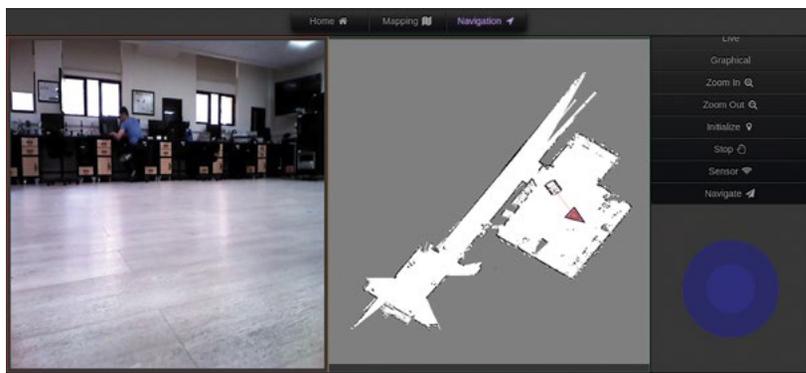
Right: Realistic simulations in a virtual environment.

Top: The developed GUI showing: the robot's camera view, the robot–generated map, and the robot's controls.

Photos courtesy of Dr Ing. Marvin Bugeja

as well. This hurdle was crossed, and the robot is now controllable from 'any mobile device, anywhere in the world'.

MORE THAN A CAMERA

A key idea developed during the project was the installation of fixed sensors in each room of a housing unit, capable of detecting motion, noise, gas, and fire. The robot would inspect spaces where an alarm had been triggered, sending a notification to the owner's phone, where they could then see through the robot's eyes via video. This has broadened its utility by magnitudes, conveying sensory information that security cameras, with their blind spots and visual-only surveillance, simply can't. The project has room to grow even further. The fact that the robot is a mobile, physical part of the home means that this utility can be scaled up once more by giving it the ability to interact as well as observe. This would thrust it into a role long explored by science fiction. 'You never have an idea which is wholly your own,' continues Bugeja. 'An ultimate, futuristic goal has been to have a mechanical servant at home. For now, we've put a camera on the servant's head. But in the future, we

could give it a robotic arm.' Returning to the example of the open window, 'it could not only show you it's open, the robot would close it for you.' Another multiplicative feature suggested by Bugeja would be image processing: the ability for the robot to not only convey information but interpret it. For example, it might visually identify an open flame in addition to responding to a fire alarm, greatly increasing the precision of its threat detection.

Our homes are increasingly interconnected and remote-controlled. Our electronics can respond to voice commands; our utilities can be controlled via apps. This sentry robot has the potential to integrate perfectly with these smart homes, a physical extension of our increasingly intelligent personal space. And should it be sold to the public, the barrier to entry does not need to be high. Extensive market research is, understandably, not an important part of an undergraduate engineering degree project. But do a little online shopping, and you'll spot a gap in the market exactly where this robot would sit.

At the cheap end, there are barely functional novelty items accruing negative reviews on Amazon. At the

high end, there are bulky, all-terrain automatons that would look more appropriate on the surface of Mars than in the living room. The middle ground – a quality, integrated device that saves money instead of burning it – is tantalisingly uncontested. Grech's project would occupy this niche, a fact that's demonstrated by how its parts were sourced.

The robot is built from a commercially available robot designed for academic research. The model has been heavily adapted and paired with the in-house app and sensors. It is affordable and, pleasingly, looks more like Wall-E than ED-209 – two things that could catch consumers' eyes. But perhaps its biggest selling point is its sci-fi heritage.

The idea of robot servants has fascinated us for over a century – over a millennia, in fact, if we include mythological automata. Thanks to engineering researchers like Bugeja and Grech, these ideas are spilling into reality. It seems likely that, very soon, a robot guarding our personal space will become a perfectly normal part of our lives. We don't often see the stuff of myth and movies becoming real. Let's enjoy the show. **T**