RMI

Mobile Intervention Robot

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During multiple operations carried out by military, law enforcement or rescue services situations which may be a potential thread for health and/or life of people who are involved in such activities can occur. In order to minimise this threat, humans are being replaced by robots which excecute dangerous tasks instead of them.

The integrated mobile system supporting CT and SAR operations developed as a part of the Proteus project is an answer for a numerous challenges faced by services responsible for public safety: natural disasters such as floods or terrorist threats including chemical and biological attacks.

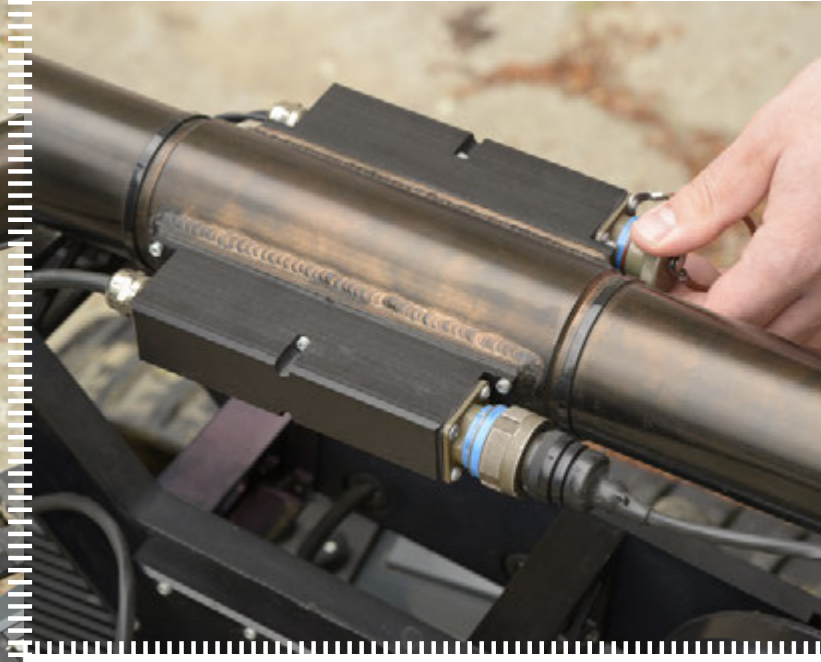
The Proteus Project is a result of more than 5 years of work over one of the largest research and development projects of this type in Poland (total project budget was around 20 million USD). It was realised by the consortium of science centres leaded by the PIAP Industrial Research Institute for Automation and Measurement. Its technical and operational requirements were defined in cooperation with the future users (the police, firefighters, crisis management centres).

The Proteus is an operational system which consists of the cooperating elements which provide effective solutions to defeat every kind of the threat. One of them is a RMI Mobile Intervention Robot developed in PIAP

The RMI is modular, medium-sized tracked UGV (unmanned ground vehicle) with a weight of 95 kilograms, intended for use everywhere where police officers, paramedics or members of the rescue services could be exposed to injuries or even death. First of all, it is about operating in the biohazard contaminated environment (or potentially threatened by the contamination), a neutralisation of the explosives or performing tactical operations under enemy fire.

The relatively compact dimensions, a low weight, suspension type and tracks enable the RMI to run inside the buildings or rough terrain. A modular construction and a size of the RMI enable its easy disassembling and transport inside the 4x4 truck or SUV. The robot perfectly fulfils a gap between other PIAP bots like IBIS heavy-weight UGV and a SCOUT lightweight UGV.

The modularity of construction of the RMI might be called two-level. The first level is available for a manufacturer and its based on components common for all variants of the RMI allowing to build vehicle to



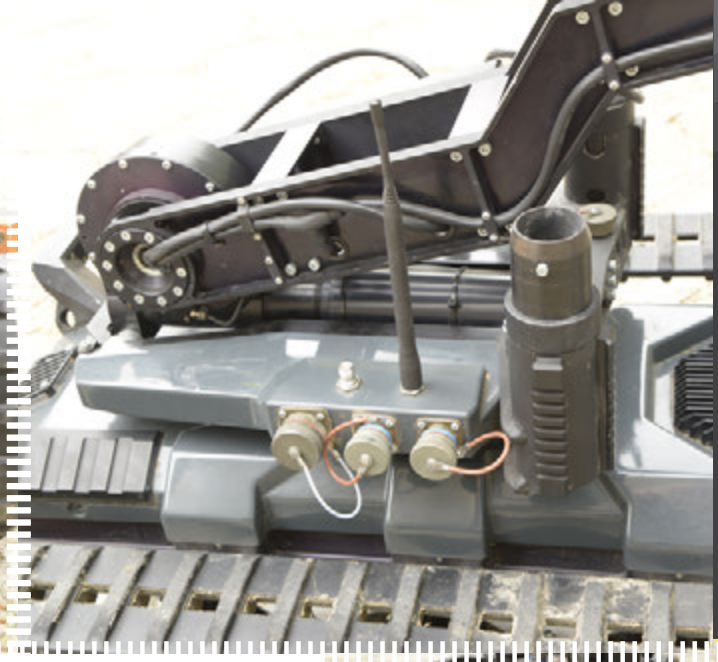
he specific requirements of end-user. For this purpose, different kinds of the chassis, drive system, power supply, communication modules, etc. might be used.

The second level of the modularity concerns directly a user who can independently configure the RMI, tailoring the equipment to the specific task. These might be selected from the entire range of the additional equipment as gripping devices, arm manipulators, sensors (e.g., sensors of contamination, radiation, explosives, etc.), pyrotechnic guns (the latter are to be replaced by the shotgun used as a device for neutralisation of the suspected objects). Besides, a robot can have assembled an X-Ray device and directional microphones. All mentioned devices can be quickly connected to the RMI through the integrated connection interface which sockets are localised near equipment attachment points. All works as simply as possible – just plug and play.

The PIAP RMI is tracked propulsion vehicle which might be used in various terrain and environment including off-road drive. It consists of two drive wheels, two idlers and two carriages (each with two wheels), as well as rubber tracks. It is characterised by a small mass obtained thanks to an application of the relevant materials and an openwork wheel design. The idlers are equipped with spring tensioners which adjust a tension of the tracks to the terrain and speed which a robot moves. A wheels and steering system is an independent in-house development of PIAP It is constructed so that it is less sensitive to the disturbance in its functioning by the objects which can get between the wheels and tracks.

The wheels and steering system is assembled to the body where most of electronic circuits of the robot, power packs and a drive system are installed. The body is set relatively low, what in the conjunction with placing in it the heaviest sub-assemblies results in lowering a gravity centre and ensures a stabile base to the rotating platform and equipment installed on it. It also has a crucial impact on the off-road performance of the RMI which is able to move through the harsh terrain without risk of rolling over. In the corners of the body there are for drag handles (RMI can be easily carried by two) and its assembling during transporting in the vehicles. Driving lights and four outline cameras (directed inversely to the illumination and driving direction) which greatly improve driving a robot in the narrow spaces were integrated into the drag handles. The outline cameras are a supplement for the driving cameras on the special vehicles, which are placed in the centre of the front and rear wall of the body.

The basic device of the RMI is a robotic arm manipulator placed on the rotary platform with five degrees



of freedom, with more than two metres range and a maximum weight capacity of nearly 35 kilograms. It is characterised by a large movement range in each direction, and after folding to the transport position it takes a small amount of place. A lower arm of the manipulator is profiled so that while a platform rotates it does not interfere with the equipment placed on the robot body, and simultaneously enables reaching with a gripping device, e.g. under the cars. The manipulator together with a rotary platform might be easily disassemble, what decreases overall dimensions during a transport. The platform itself is a base for mounting of additional equipment and parts of the antennas. The eyes of the RMI is a Pan Tilt Zoom (PTZ) sensor turret which allows 360-degree observation as well as, thanks to the 30x zoom, observation of objects which are at the significant distance from it. The turret can be fitted with one or two cameras, daylight camera or thermal/night vision device. Thanks Direct Drive implemented in the turret construction, it can be operated in very quick or very slow and precise modes depending on the situation. The RMI is controlled with the mobile operator console aka control station equipped with two LCD touchscreens and two joysticks and a set of buttons for controlling the robot functions. On the lower touchscreen following data can be present:

- current configuration and setting of the robotic arm manipulator in 3D model.
- GPS position on map.
- Data from the sensors.

On the second screen feed from the robot cameras is displayed. It might be configured individually and video feed from up to four different cameras might be displayed simultaneously.

Basic way of controlling the robot is wireless digital encrypted data transmission. It ensures a secure connection between the RMI and an operator's station within a radius of 1 000 metres. On demand, and as the need occurs (e.g. very strong transmission interferences) one can easy switch to the optical wire transmission expanded from the automatic wind-up reel mounted to the trunk (there is 300 meters of the optic fibre on the wind-up reel drum). Single control station enables a cooperation of even few robots in one operational areas, and additionally it has also a possibility of controlling a few types of robots without reconfiguration. In the operator station are also integrated a microphone and loud speakers – a similar set is in the front part of the robot therefore it can be used as well as a communication device, e.g. while providing negotiations with the surrounded terrorists.

RMI control is not complicated and although it requires some skills, it is not difficult to learn it. It can be mastered after a few hours of the training.

The RMI unmanned ground vehicles might be a great addition to the equipment of multiple services like military, law enforcement and rescue services.

PIAP RMI UGV TECH SPECS

Dimensions (L x W x H)	**96 x 60 x 51 cm**
Weight	**95 kg**
Maximum speed	**9 km/h;**
Manipulator range vertically from the ground level	**215 cm**
Manipulator range horizontally from the axis of the rotary platform	**200 cm**
Maximum load capacity of manipulator	**25 kg**
Gripping device clamp opening	**25 cm**
Body clearance	**10 cm**