Warwick Mobile Robotics

Urban Search & Rescue Robotics

Sponsored By

WMG Innovative Solutions · CATAPULT High Value Manufacturing · MOUSER ELECTRONICS · NORTHROP GRUMMAN · AUTODESK · HARWiN Interconnect Design & Manufacture · MakerBeam.eu · The University of Warwick

Aims & Objectives

1) Design and build a micro Urban Search & Rescue (USAR) robot:
   - A lightweight, low cost design, deployable by one person
   - Design for easy build, upgrade and maintenance
   - Develop a flexible modular architecture
   - Introduce mapping capabilities

2) Maintain the existing larger USAR robot:
   - Upgrade & enhance the existing USAR robot
   - Instigate a rigorous operator training program
   - Remove major software bugs to improve reliability

3) Enter both robots into the search and rescue category of the RoboCup German Open in April 2014

The Problem

Urban Search & Rescue robots are designed to locate survivors in hazardous environments, such as earthquake disaster zones; removing emergency service personnel from danger. **Existing USAR robots tend to be large, heavy and expensive.**

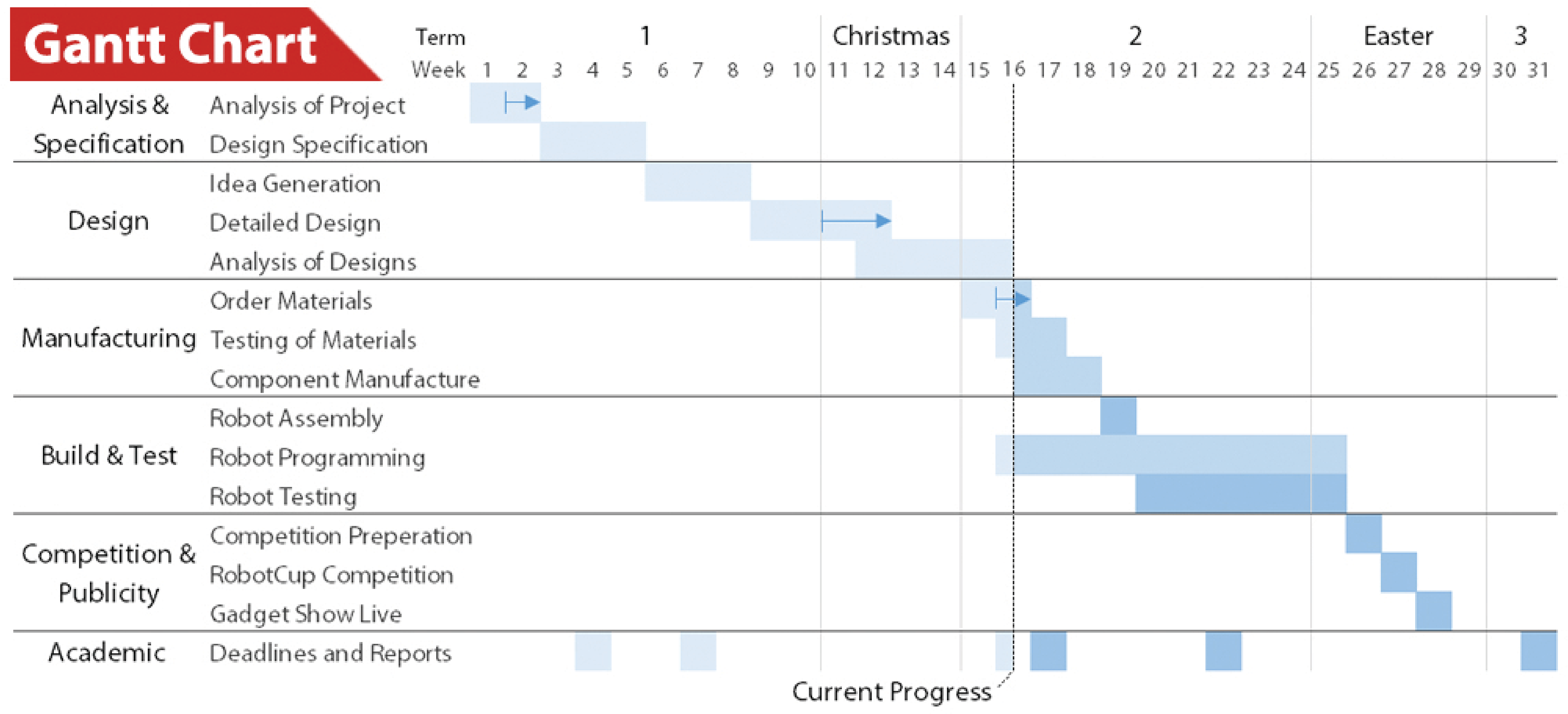
Competition

Location | **Magdeburg, Germany**

Date | **1st April to 5th April 2014**

The RoboCup Rescue League is a global competition designed to test a robots' search and rescue capabilities in a simulated disaster environment.

Gantt Chart



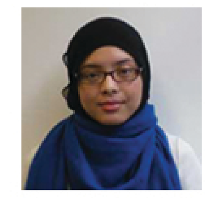
The Team

Project Manager

Chris Chavasse
Electronics & Software

Systems Team

James Yardley
Power Systems



Shafiri Aljafri
Battery Monitor

Mechanical Team

Lauren Rutter
Chassis Design

Trevor Whales
Drivetrain Design

Andrew Parkin
Arm Design

Vishal Dhanji
Gripper Design

Mechanics

1) Head & Gripper

Flexible | Head mount allows for different configurations of devices including cameras, lights and sensors

Versitile | Four fingers allow controlled manipulation of real world objects

Protected | A spring loaded clutch prevents motor damage

2) Arm

Modular | The use of repeated joints allows the arm to be easily adapted to perform a specific task

Lightweight | Extruded aluminium and steel tensioned cables give the arm its innovative lightweight framework

Low Cost | Construction from off the shelf components reduces manufacturing costs

3) Chassis

Lightweight | Extruded aluminium space frame provides a rigid structure

Adaptable | Internal components can easily be mounted to the framework

Simple | Quick and easy to design, assemble and alter

4) Drivetrain

Mobile | Four flipper tracks allow complex terrain negotiation by rotating 360°

Efficient | Regenerative braking increases battery life and overall efficiency

Compact | Drive motor and controller are contained within each track unit to save space and provide active cooling

5) Shell

Transparent | You can see inside the robot!

Tough | A polycarbonate shell provides toughness

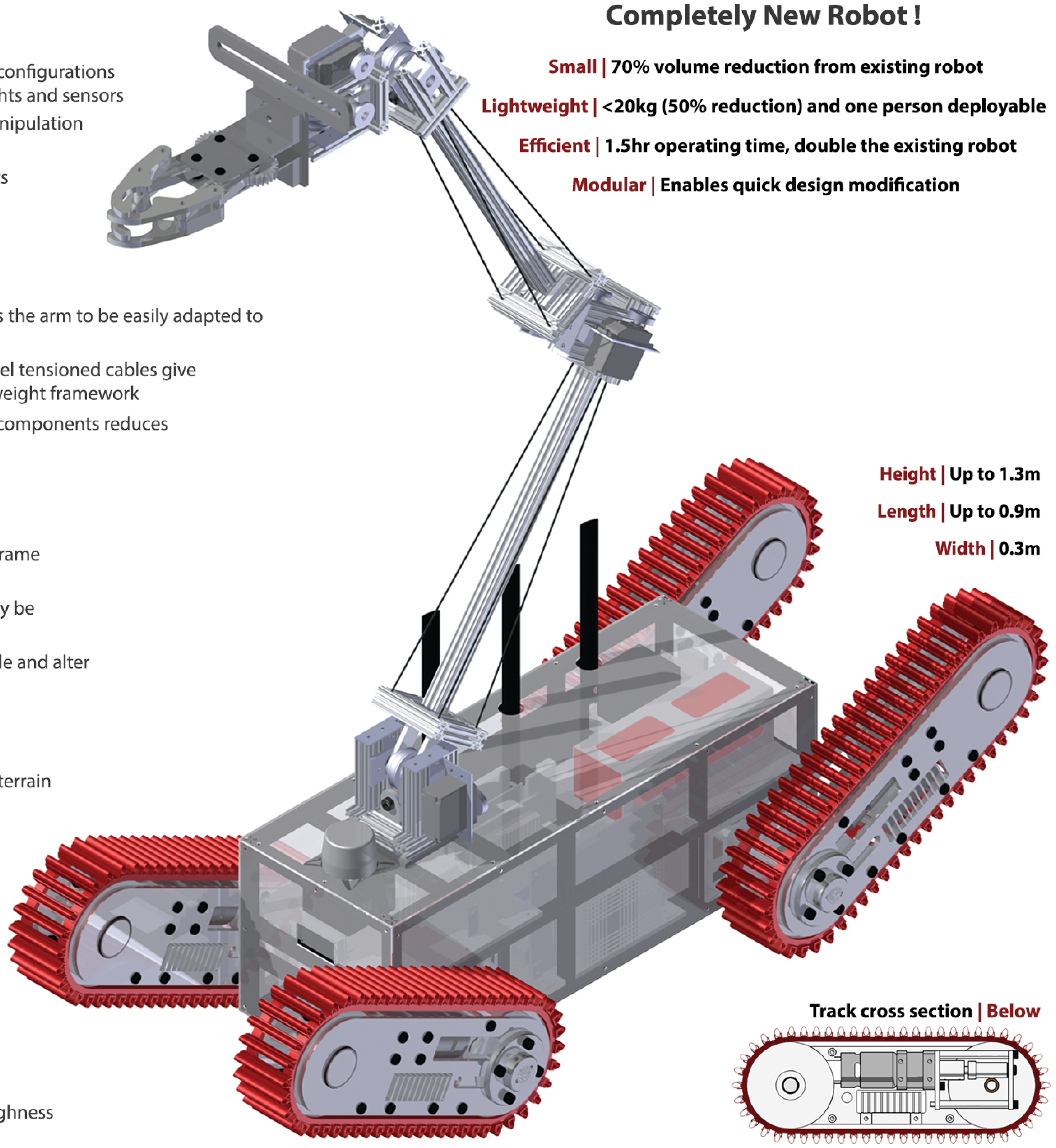
Completely New Robot !

Small | **70% volume reduction from existing robot**

Lightweight | **<20kg (50% reduction) and one person deployable**

Efficient | **1.5hr operating time, double the existing robot**

Modular | **Enables quick design modification**



Height | **Up to 1.3m**

Length | **Up to 0.9m**

Width | **0.3m**

Track cross section | **Below**

Electronics

1) Oculus Rift

Immersive | Oculus Rift is a head mounted display which provides a 3D augmented reality experience

HUD | The Heads-Up-Display overlays crucial data onto the display, such as battery level and robot orientation, to improve the drivers awareness

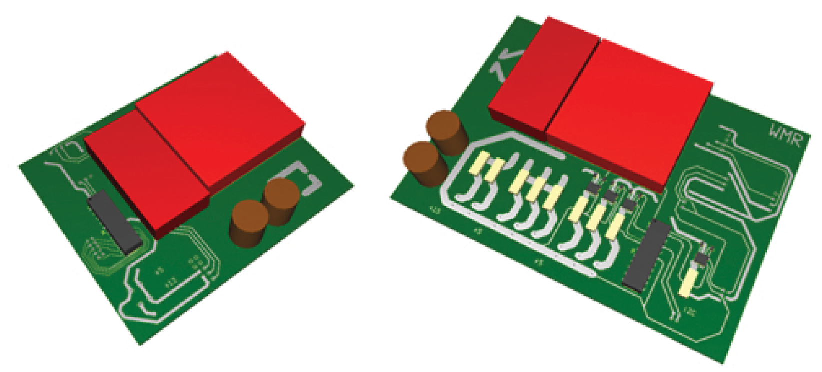
Above | **Webcam images displayed on Oculus Rift with overlayed HUD**

2) Power System

Smart | To save power and improve the robots efficiency a microcontroller switches devices on only when required

Modular | Partitioned power boards allow independant control of the arm and main robot

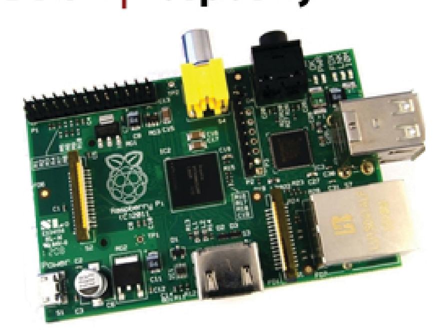
Monitoring | Battery cell levels are monitored to calculate drive time



Above | **Custom designed power boards**

3) Raspberry Pi

Below | **Raspberry Pi**



Low Cost | Two Raspberry Pis distribute the computing requirements

Efficient | Raspberry Pis only draw 700mA

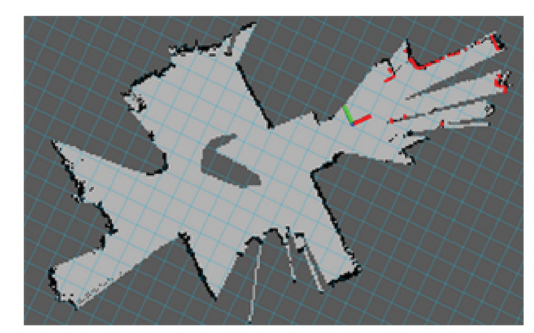
Modular | The arm is controlled by a single Pi, allowing easy removal of the arm system, saving weight and power

4) Mapping

SLAM | Simultaneous Location And Mapping technology creates a map of the robots environment with a laser scanner

Identification | The robot marks important information on the map such as identified victims locations

SLAM creating a map of the RoboCup Arena | **Right**



Future Work

1) Parts have been purchased and the robot assembly has been scheduled
2) The reliability of the existing USAR robot will be simultaneously addressed
3) A visit has been planned to a local MOD facility to test both robots, get to grips with Oculus Rift and refine driving skills ready for the competition
4) These robots could be developed for commercialisation and one day, **save lives!**

Connect

www.mobilerobotics.warwick.ac.uk

@WMRobotics

facebook.com/WMRobotics