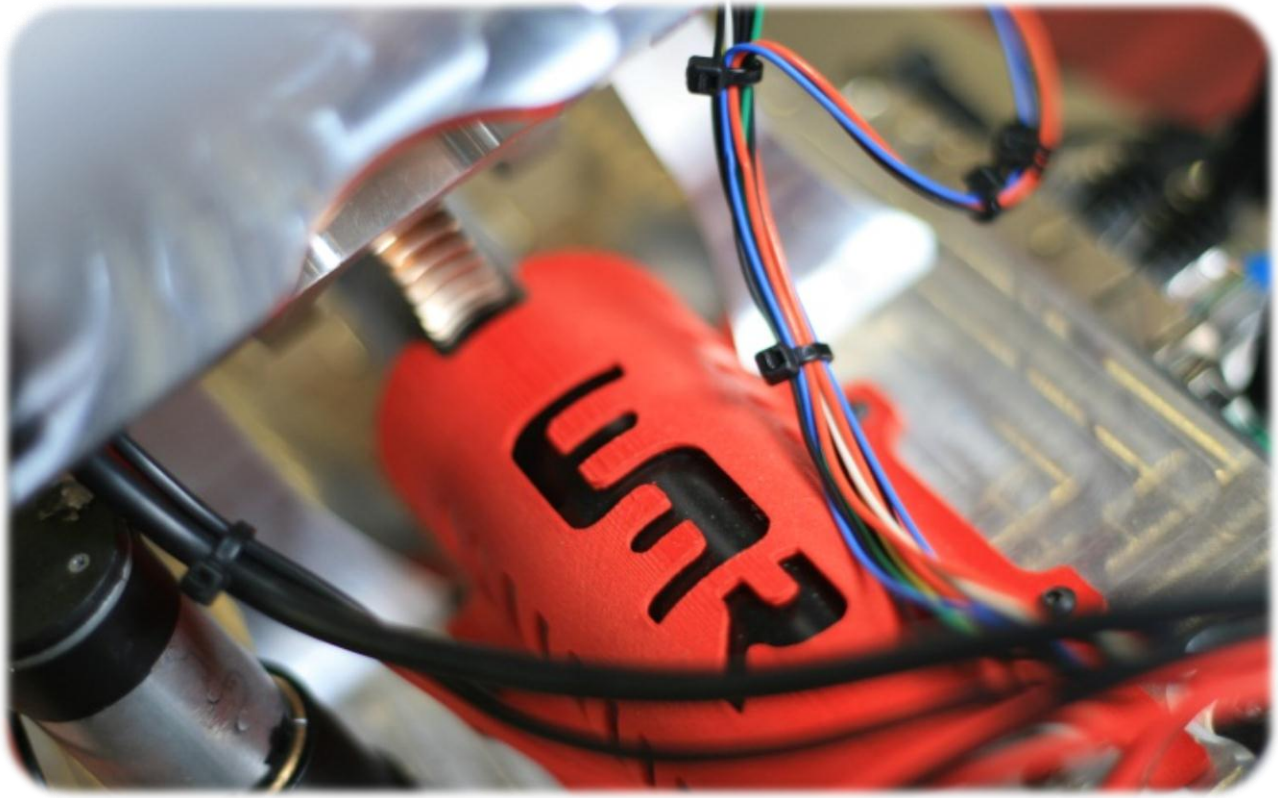
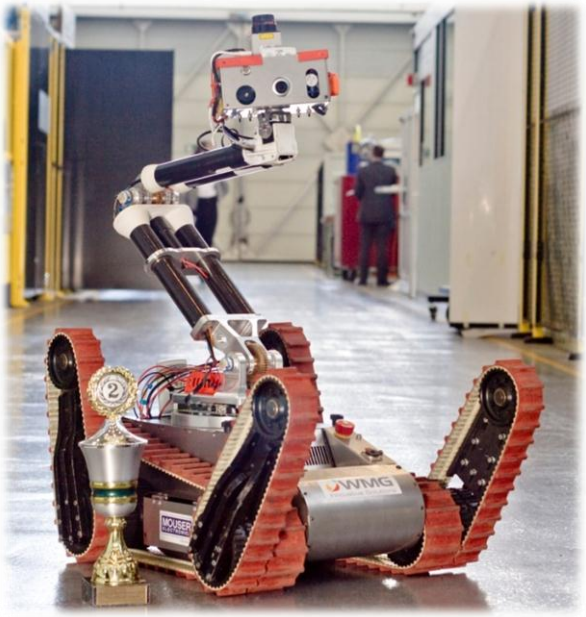


Warwick Mobile Robotics

Urban Search and Rescue Robotics

Contents

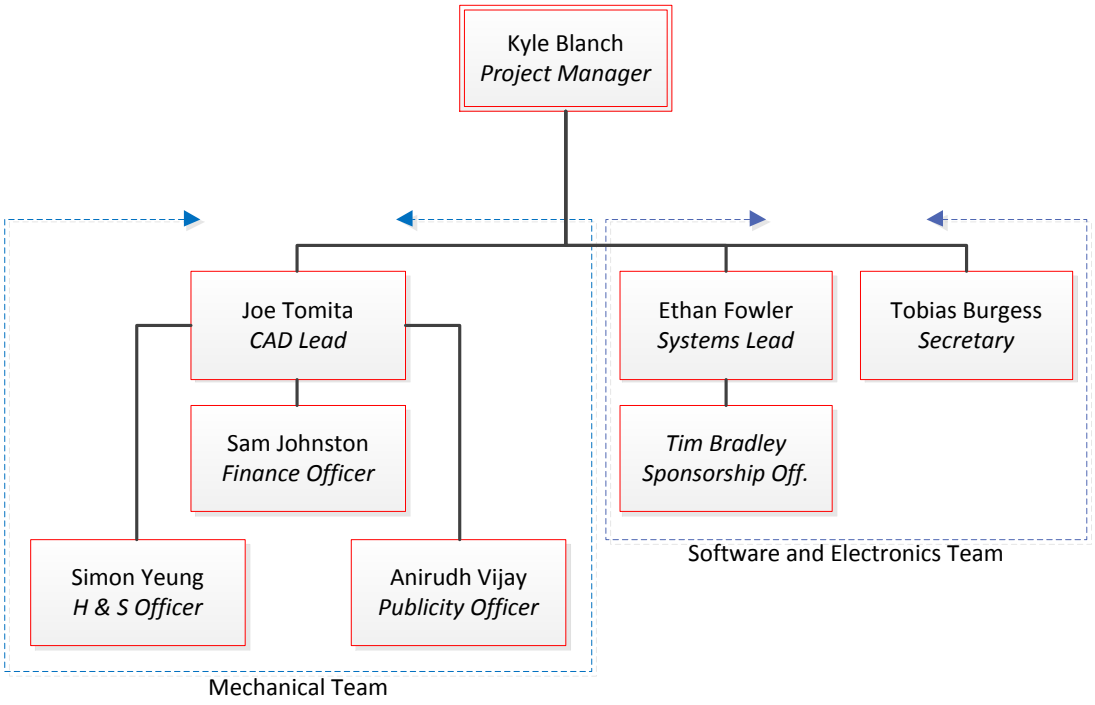
- Introduction
- Technical Improvements
- RoboCup Rescue Competition
- Publicity and Sponsorship
- Finance
- Conclusions
- Recommendations for Future Work

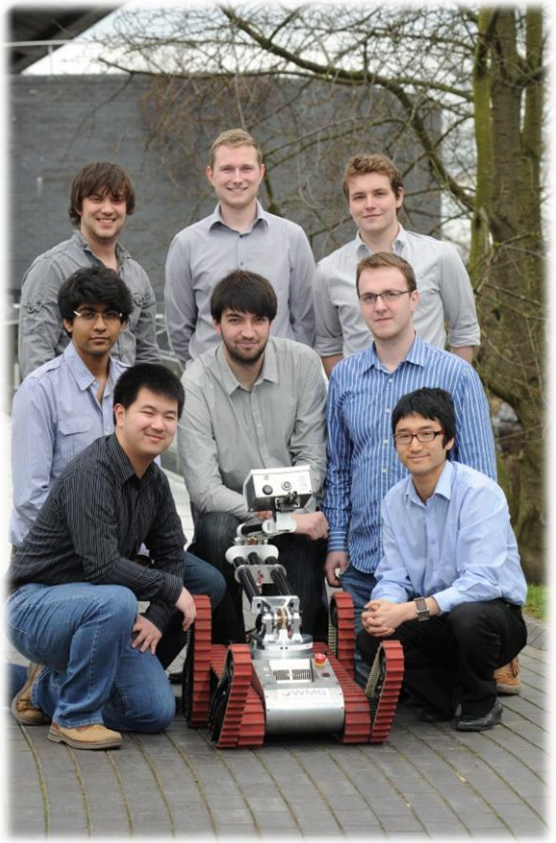


The Project

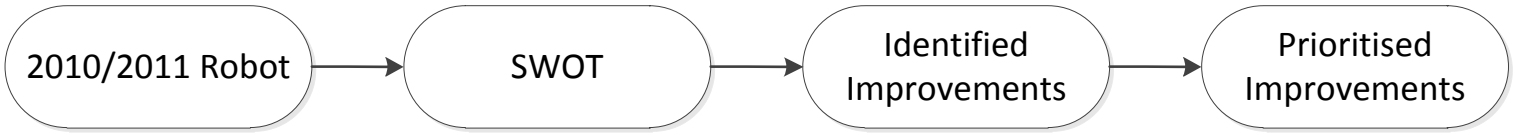
- Urban Search and Rescue Robotics
- Construction of Tele-Operated Robot
- An Evolution of WMR

The Team


Kyle Blanch
Project Manager
Joe Tomita
CAD Lead
Sam Johnston
Finance Officer
Simon Yeung
H & S Officer
Anirudh Vijay
Publicity Officer
Mechanical Team
Ethan Fowler
Systems Lead
Tobias Burgess
Secretary
Tim Bradley
Sponsorship Off.
Software and Electronics Team



Project Approach



Aims & Objectives

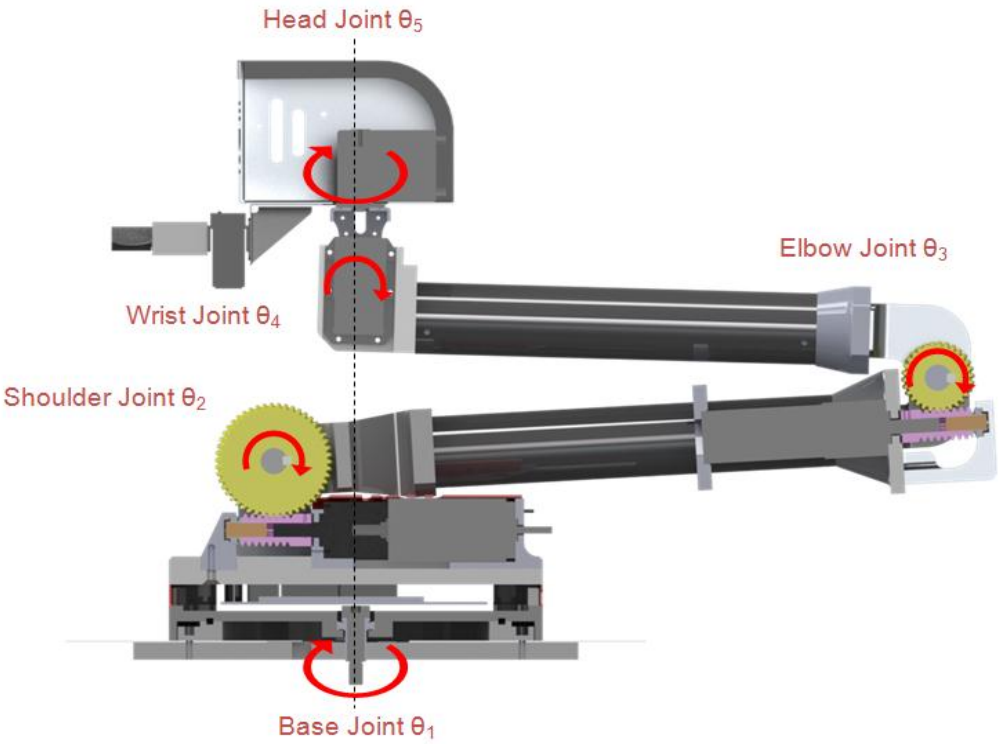
- Re-engineer the 2010/2011 robot to deliver a greater level of performance in terms of functionality and reliability
- Successfully compete in the 2012 German Open RoboCup Rescue Competition and the associated mobility and manipulation challenges

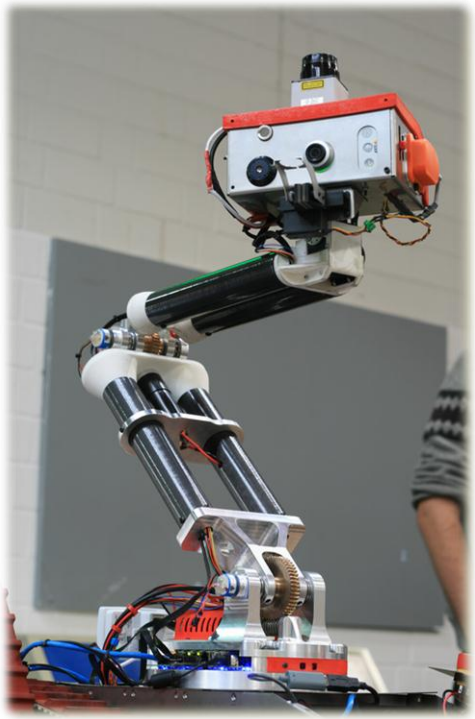
Lower Level Targets

- Set Specifications and Goals

The Mechanical Arm

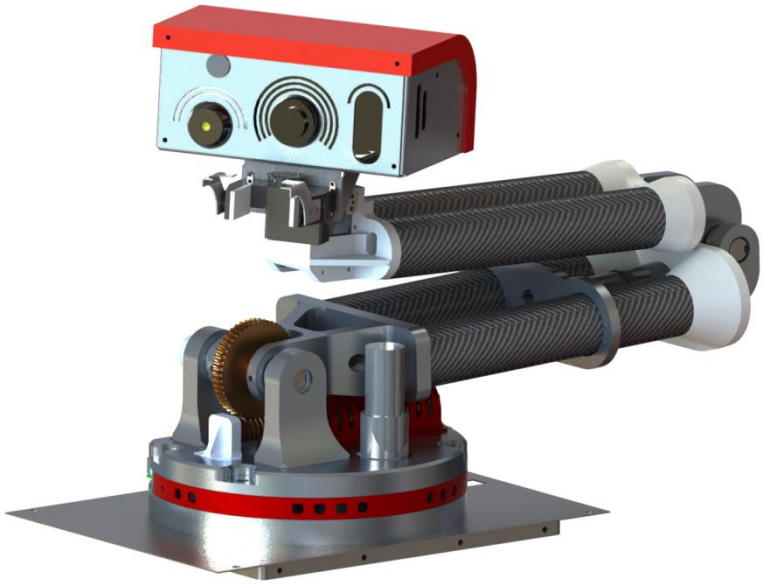
- 5 revolute joints move the sensory elements and gripper into positions that will allow victims to be identified and supported

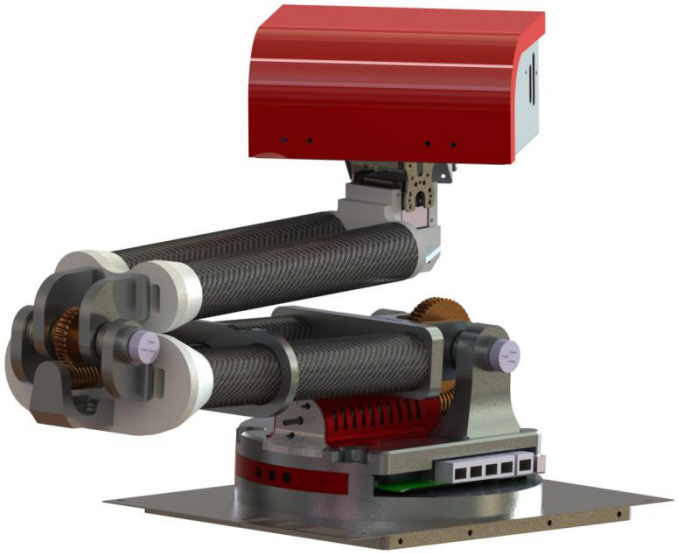




Design Aims

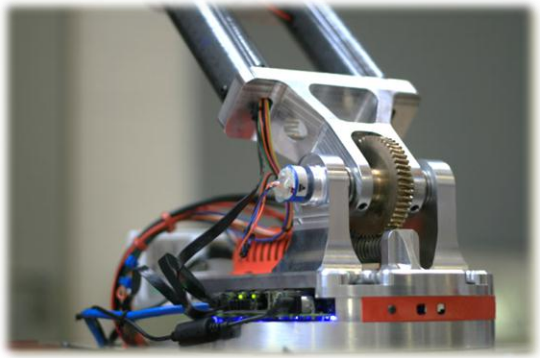
- Redistribute weight to reduce the inertia of the arm
- Reduce levels of backlash in the arm joints
- Modular Design of the arm assembly for ease of manufacture

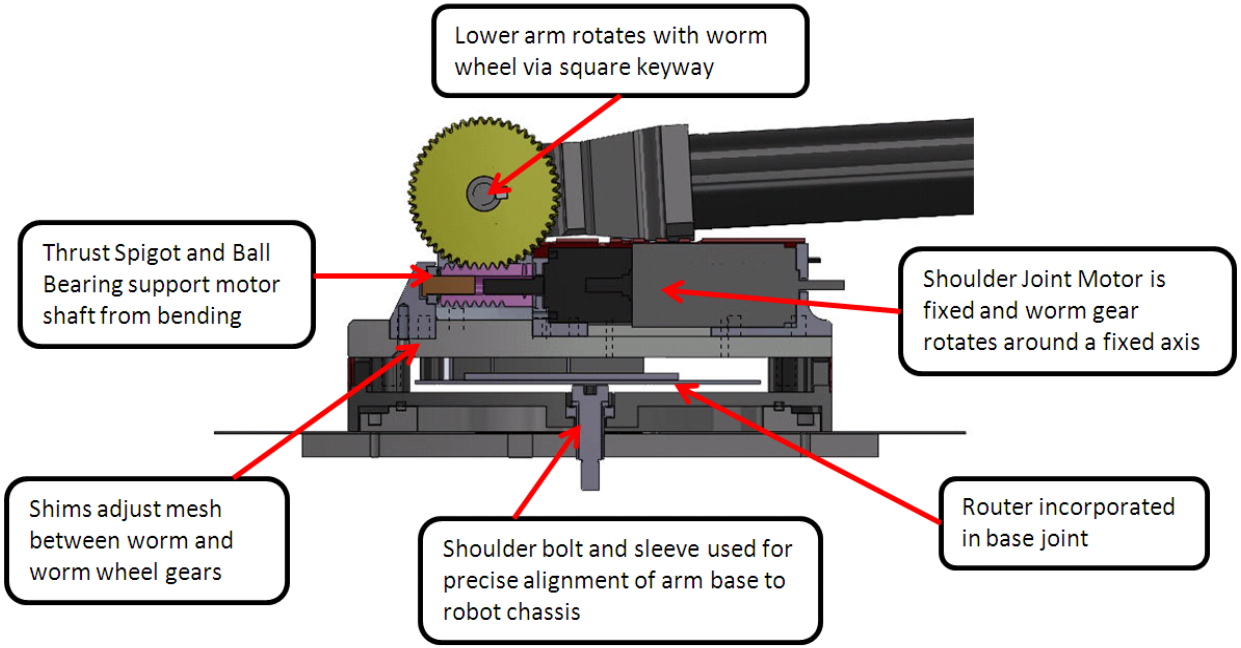




Design Changes

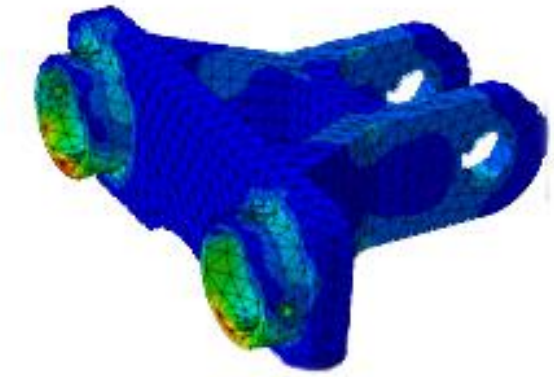
- The following design changes were made to increase the reliability and functionality of the arm:

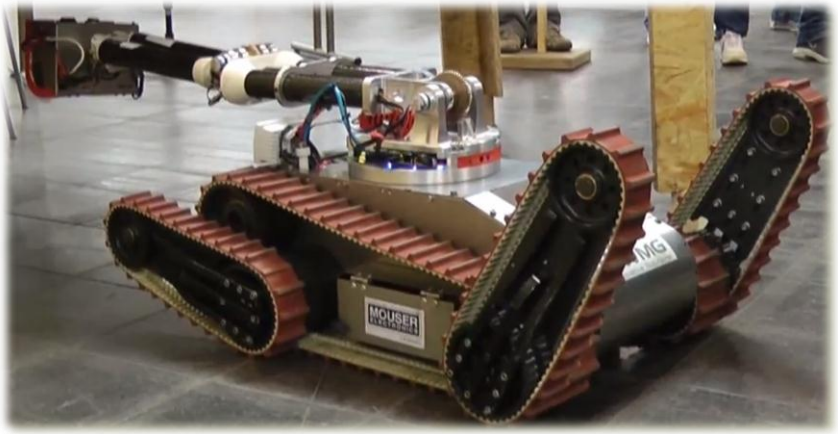




Arm Manufacture and Testing

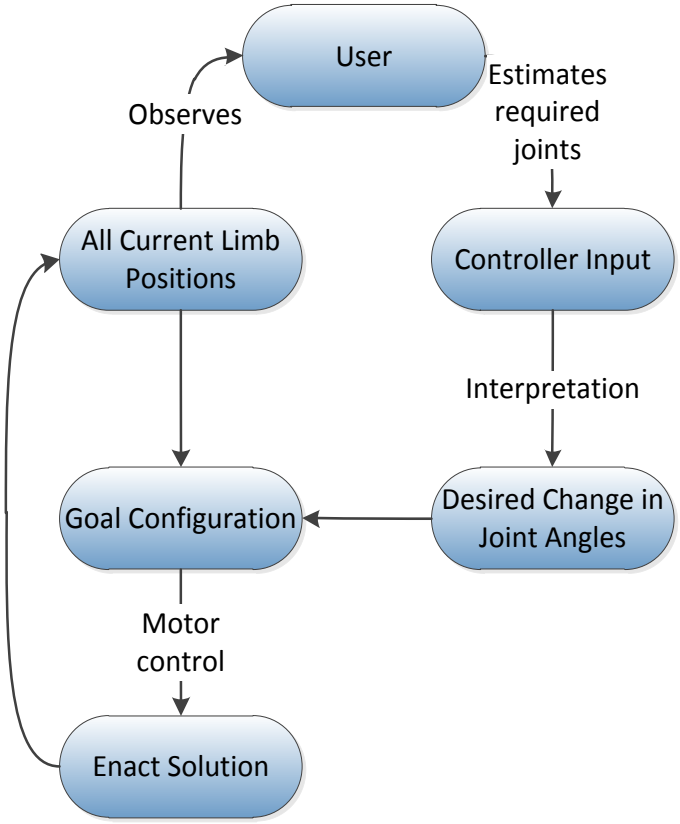
- Individual Parts, Assembly files and Technical drawings created
- FEA analysis carried out on critical parts
- Testing of shoulder and elbow joints before the competition



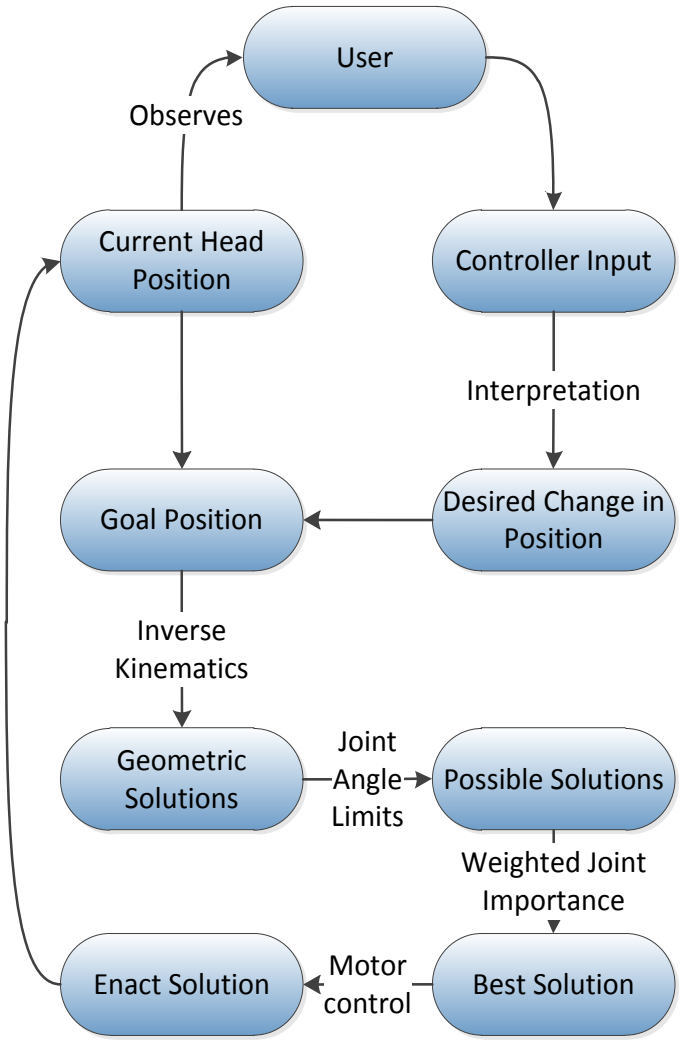


Arm Control Methods

Joint Control

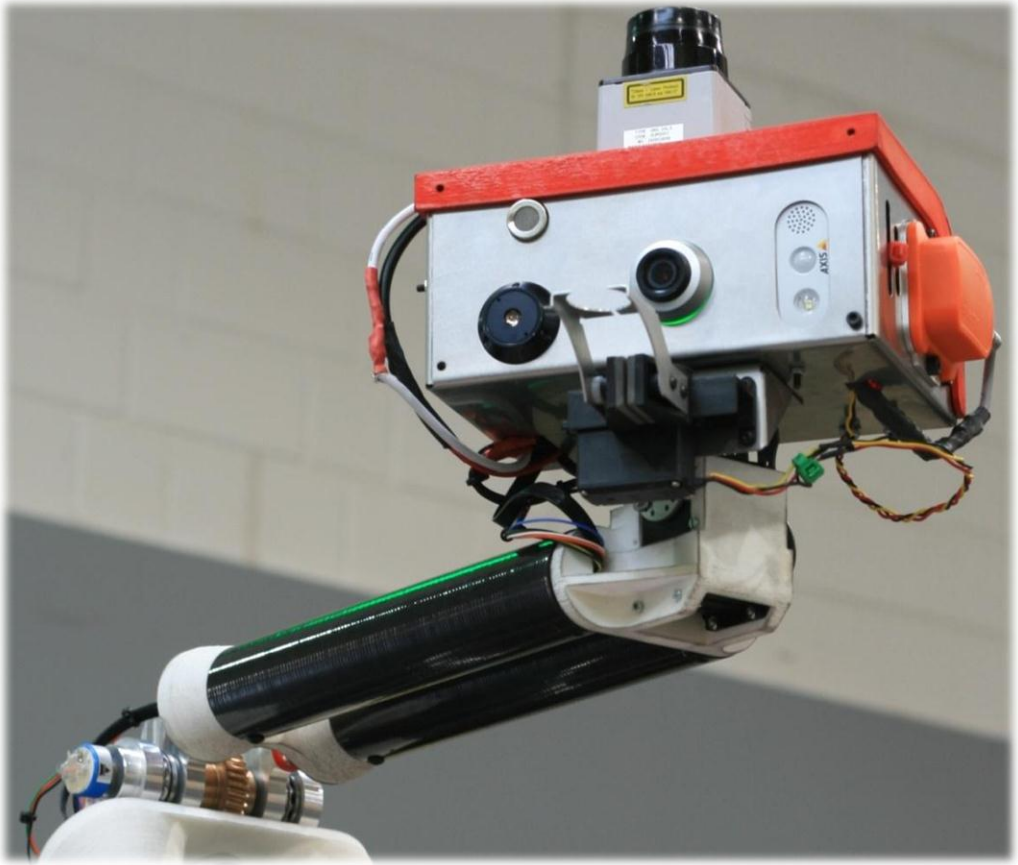


Inverse Kinematics



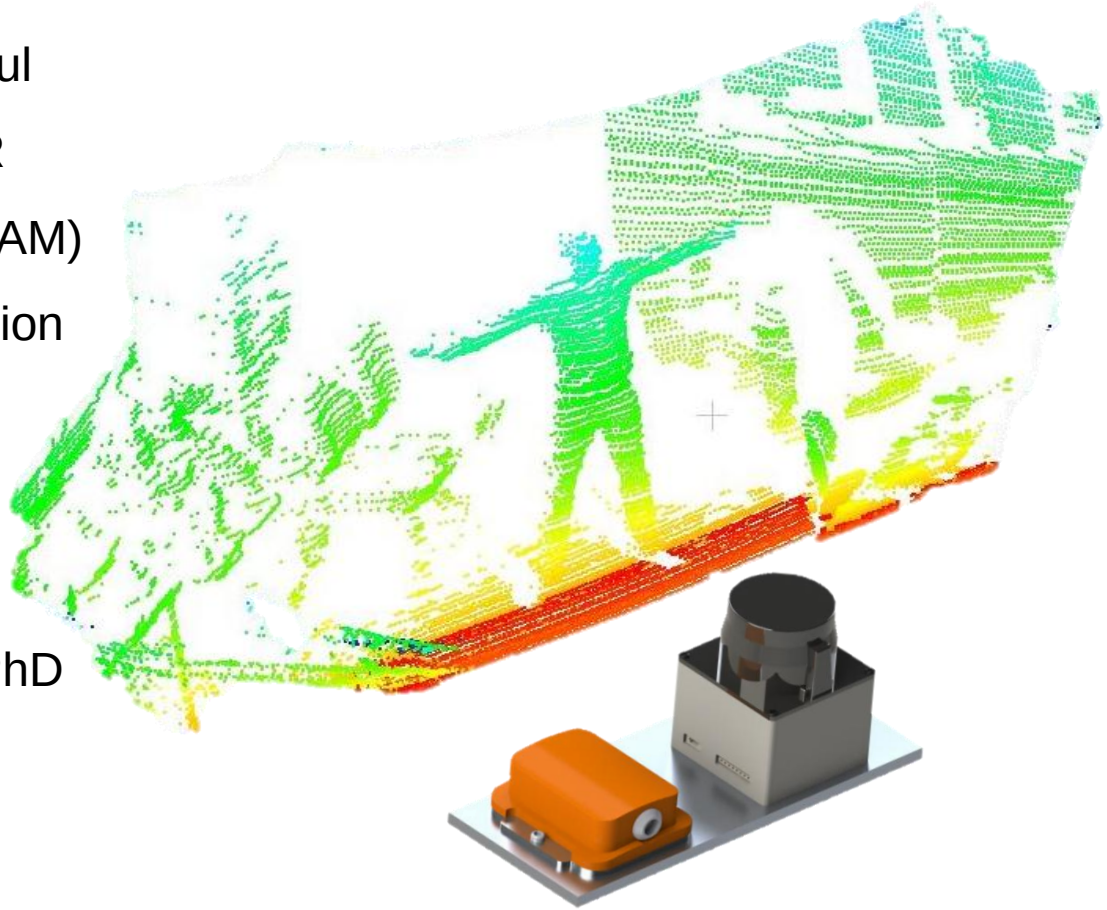
Sensor Locations

- CO_2 Sensor
- IR Camera
- RGB (IP) Camera
- Duplex Audio
- Illumination LED
- Gripper
- xSens Module
- LiDAR



Mapping and 3D Scanning

- Mapping hugely useful
- 2D plane from LiDAR
- Map constructed (SLAM)
- 3D scan by combination with xSens data
- 3D SLAM very difficult
- Stephan Winkvist's PhD proof of concept

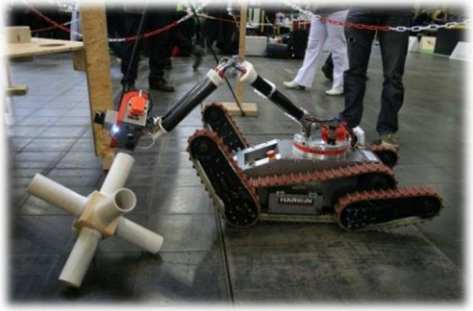


User Interface

RoboCup Rescue Competition

Awards

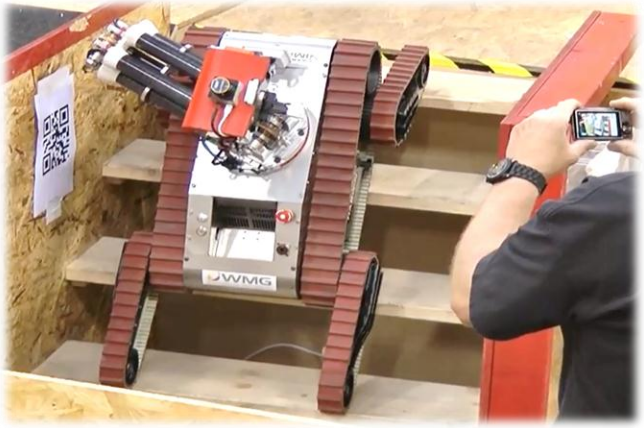
2nd Place Overall



Best in Class for Manipulation

Best In Class for Mobility

Robot Issues

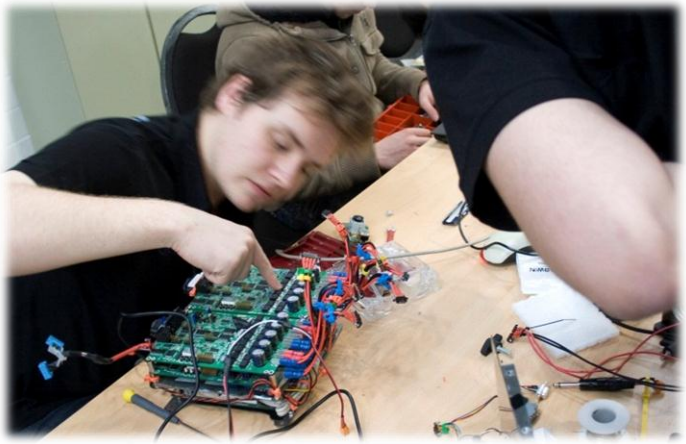


Problems

- Software Feedback
- Camera Positioning

Solutions

- Centre of gravity, Visual Representation
- Higher Fixed Driving Position



Sponsorship

- **Used sponsorship pack, leaflets and specialised e-mails**
- **Total of £11,500 generated along with other non monetary support**
- **Sponsors for 2011/2012:**

WMG Innovative Solutions

School of Engineering

MOUSER ELECTRONICS a tti company

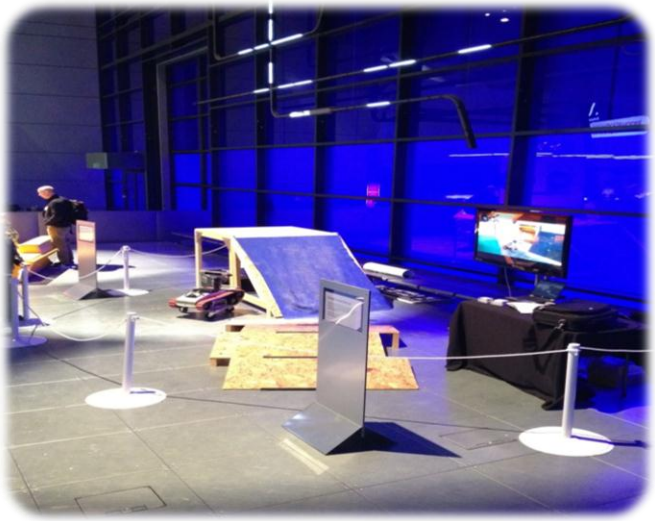
The Vice Chancellor
The University of Warwick

HARWiN INTERCONNECT DESIGN & MANUFACTURE

WARWICK IMRC Innovative Manufacturing Research Centre

Publicity Events

Outreach Program

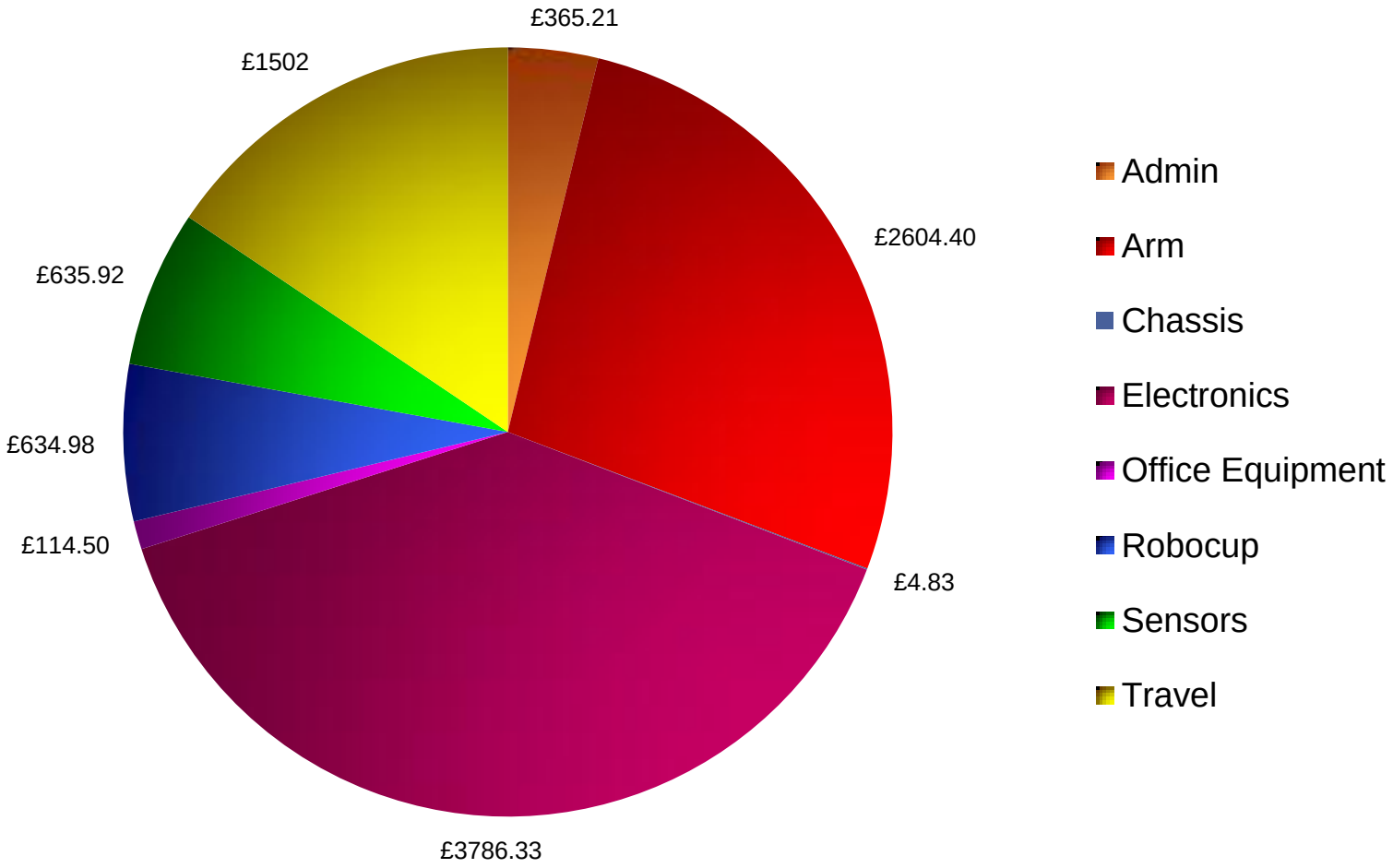


Antennae Live at The Science Museum

Media Presence

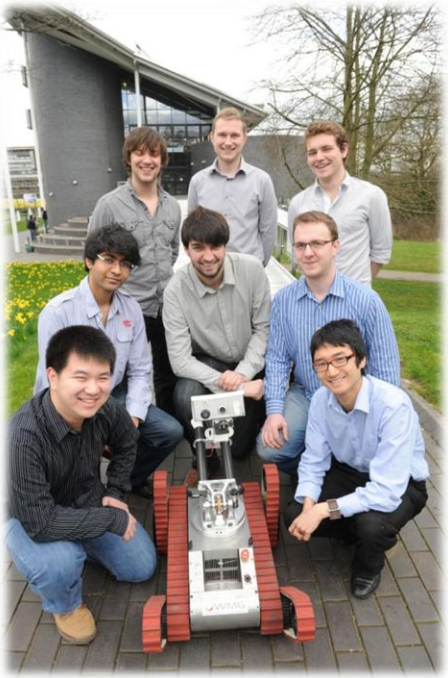
Format	Publisher	Date Published
Newspaper	Coventry Telegraph	Mar-12
	Manchester evening News	
	Liverpool Echo	Apr-12
	Coventry Telegraph	
	Evesham Observer	
	Evesham Journal	
	The Boar	
Websites	Warwick University	Mar-12
	Culture 24	Feb-12
	Talk Science Museum Learning	
	View London	
	Referenced in BBC Article “Kinect for Windows gesture sensor launched by Microsoft”	
	Rex Press Agency	
	London Mums	
	Science Business	
Other	BBC Focus Magazine (66,445 readers)	Mar-12
	Facebook and Twitter	Nov-11

Finance – Areas of Expenditure



Summary

1) **The Robotic Arm was the biggest improvement**
2) **Electronic reliability was improved in the stack and wiring**
3) **A lack of remote operator feedback and awareness is evident**
4) **Arm manufacturing delays led to limited testing**
5) **Achieved at RoboCup Rescue 2012 German Open:**
   - 2nd Place Overall
   - Best in Class Mobility
   - Best in Class Manipulation

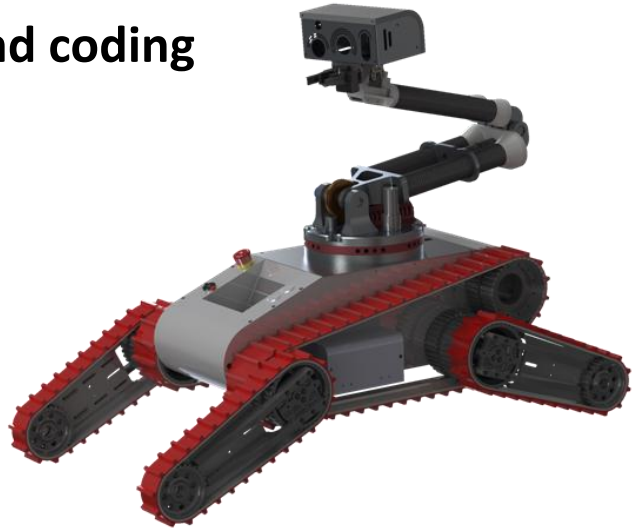


Conclusions

- Publicity should be independent of project progress
- Both internal and external lead-times are unpredictable
- Stress analysis of isotropic sintered materials inaccurate
- Geometric accuracy of rapid-prototyped parts can be poor
- Cantilever loading is a strong source of worm-drive backlash

Recommendations for Future Teams

- Mounting of webcam to view the robot and surroundings
- Additional degree of freedom in arm (rotation in the x-axis)
- Implement a 3D visual representation and Centre of Gravity
- Redesign the robot chassis to aid flipper motion
- Greater expertise in electronics, software and coding
- Partnership with another institution



Thank you for listening

Feel free to ask any questions, or request a specific feature demonstration