FIELD ROBOT EVENT

VENLO * THE NETHERLANDS 2012

Program Booklet

Fontys

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Content

Field Robot Event 2012

10th edition

We are very glad to present you the 10th edition of the FieldRobotEvent. Fontys University of Applied Sciences participated first in 2008 and – with the upcoming Floriade in Venlo – took the opportunity to be the host for the FieldRobotEvent 2012.

Because the Floriade has been chosen as ‘the playground’, we had to cope with some limitations or challenges as you like. The most important limitation was the prohibition to seed *anything*.

We took this limitation as an opportunity to make the 10th edition of the FRE a very special edition. We have chosen for potted roses. New environment, new circumstances and new challenges for the teams. These potted roses will make the event a very colourful event.

At the moment of writing 20 teams have registered for the event, which is an overall record! 130 Students will be living on the venues of the Floriade for three days.

Next to these 130 students, pupils from Dutch and German schools will join the students on Thursday and prepare their Mindstorms Robots for 3 challenging junior tasks. These kids are the FieldRobotters in 2018!

Two members of the organization staff prepared for 3 years, participated all meetings to know what should be prepared to make a successful new event. Although we had a lot of information, it appeared still to be a huge amount of work.

My special thanks go to my colleague, Odiel Coopmans, who has assisted me during 3 years in thinking, writing, organizing and being present! We had good discussions at times when mountains seem too high.

For every pupil and student I wish to say: Make this 10th edition of the FieldRobotEvent an unforgettable and extraordinary edition. With your continuing participation and with the help of the Scientific Committee and our sponsors, the FieldRobotEvent will last forever…

Best regards,

Ir. J.W.M.H. (Frank) van Gennip
Team Leader/Coordinator Mechatronics
Fontys University of Applied Sciences

Projectleader FRE2012

Program Field Robot Event

Thursday, 28 of June: Field Robot Preparation

10.00 – 18.00 Arrival and registration of the teams at ‘Floriade’

All day

- Teams can test in the field
- Workshop Field Robot Junior Event
- Contest Field Robot Junior Event

10.00 – 18.00 Exploring the Floriade

Evening Teams organize dinner themselves

Friday, 29th of June: Field Robot Contest

07.00 – 12.00	Finishing robots / testing in the field
08.00	Breakfast[1]
10.30	Jury meeting
11.15	Team Captains meeting
12.00 – 12.45	Lunch
12:45	Contest opening by Prof.Dr.Ir Eldert van Henten
13.00 – 18.30	Contest (Task 1 – Task 4)
19.00 – 23.00	

Awards (Task 1 – Task 4)
BBQ & After-event-part
Live music by:

- Big band KCV
- Cover band Sweet Fanny Adams

[1] *Only for teams who paid for additional "Low budget accommodation"*

Saturday, 30th of June: Final contest Field Robot Event

08.00	Breakfast[2]
09.00 – 09.15	Information about Co-op task
09.15 – 11.45	adjusting robots / testing in the field
11.45	Closing of test area
12.00 – 13.00	Contest (task 5)
13.00	Awards and closure of FieldRobot Event

[2] *Only for teams who paid for additional "Low budget accommodation"*

10th anniversary of the Field Robot Event

A design competition in agricultural robotics

It was in September 2002 when the story started: in a train back home from Budapest, where Wageningen Agro technology students won the vision award of the EurAgEng-Conference. That price-winning vision was about robots in agriculture. Why shouldn't this vision become more real and why shouldn't more students participate in such exciting activities – e.g. in a contest for small robots competing in a real field? The idea was born and preparations started immediately to invite students from all over Europe for the 1st Field Robot Event in June 2003 in Wageningen, The Netherlands. I wish to thank Prof. Joachim Müller for his visionary approach to agricultural engineering and initiation of this robot competition.

The main ideas behind the Field Robot Event were and still are:

- The robots are acting outdoors, in a harsh and unstructured environment with varying light and climatic conditions – a challenge even for professional research groups;
- The robots are not attacking each other, but competing in an Olympic manner to identify the best;
- The choice of components is not limited to a standard kit to allow unhampered creativity;
- The cost/performance relation of the robots is taken into consideration;
- The student teams present their creations on a conference-like robot fair and write a paper to be published in the Proceedings of the Field Robot Event.

And this has been a success. Whereas in 2003 hardly any of the robots was able to properly finish the required tasks, in 2011 quite a number of robots demonstrated smooth and robust autonomous behaviour. Technology has progressed the past decade. More advanced sensors like cameras and laser scanners have replaced less expensive and less effective ultra sound and infrared range sensors. Control schemes became more and more advanced and robust. And last but not least, we have seen some very nice innovative custom built platforms. I am quite sure we will see some new developments this year as well and you will certainly enjoy the technology and performance of this year's competitors!

With a steady amount of around 15 participating teams from different countries around the world, the event has gained momentum throughout the past ten years. Countries represented the past 10 years were Germany, Finland, The Netherlands, Malaysia, Czech Republic, Slovenia, Denmark, USA, Chile, Japan. This year we welcome 20 teams from 9 different countries!

To attract an even broader public in 2007 a Field Robot Event Junior was initiated. This competition focusses on the youngsters who compete with LEGO or similar kinds of robots under indoor conditions.

The event has raised considerable interest in the academic world as well. Recent academic conferences like the VDI Tagung, the Conferences of the European Agricultural Engineers (EurAgEng) and the European Conference on Precision Agriculture (ECPA) hosted presentations, demonstrations or even a full session devoted to these small field robots. The Field Robot Event also inspired the growing interest of farmers and suppliers of agricultural machinery for agricultural robotics. Robots will definitely be needed to supply a growing world population with food and fuel.

This year we celebrate the 10th anniversary of this event. And an anniversary calls for a special treat. Therefore, this time, the Field Robot Event is organized on the venue of the Floriade 2012. Floriade 2012 is the world horticultural expo taking place between the 5th of April 2012 and 7th of October 2012 in Venlo, The Netherlands. It is an exhibition with a wide international exposure.

The veteran visitors of the Field Robot Event will also notice a change in the game. This year the robots compete in a setting with potted roses instead of the usual corn field. Flowers for the anniversary and a new challenge for the robots.

The 10th Field Robot Event is organized by Fontys, University for Applied Sciences, Venlo with support of Wageningen University. I wish to thank Frank van Gennip and his team for the excellent organization of the event. Looking simple and easy from outside, behind the stages it is quite a complex event and a challenge to organize as I know by experience. Thank you and well done!

Also a big thank you for our sponsors! Without their support it would not be possible to organize an event like this.

I wish all participants and visitors a pleasant 10th Field Robot Event – an untroubled festival amongst friends with plenty of inspiring impressions.

Prof. dr ir E.J. van Henten
Farm Technology Group
Wageningen University

Contest Information

Jury members:

Prof.dr. J. de Baerdemaeker
Katholieke Universiteit Leuven (B)

Prof.dr. S. Blackmore
Bristol Robotics Laboratory (UK)

Dr.ir. D. Goense
Wageningen UR (NL)

Prof.dr. H.-W. Griepentrog
University of Copenhagen (DK)

Prof.dr. H.-J. Harms
Technische Universität Braunschweig (D)

Prof.dr.ir. E.J. van Henten
Wageningen University (NL)

Prof.dr. J. Müller
University of Hohenheim (D)

Prof.dr. A. Ruckelshausen
Fachhochschule Osnabrück (D)

Prof.dr.ir. G. van Straten
Wageningen University (NL)

Prof. A. Visala, D. Sc (Eng)
Helsinki University of Technology (SF)

Disciplines for the 2012 contest

The tasks for the FieldRobotEvent 2012 are related to the tasks of all previous events, except for the maize. Instead of maize, potted roses have been chosen, positioned on grass on so called container fields. The tasks consist of navigating through straight, curved and partly fragmented rows of ‘plants’, recognition and detection of different types of plants, as well as orientating in the field: these are the same key aspects as in the previous events.

Furthermore, there will be a ‘Freestyle’ task for the teams to demonstrate their own designs. This task will also be set within an agricultural setting.

Finally, there will be a special cooperation task (co-op task) to work together with another team. For example: one team’s robot detects the missing plants whereas the other team’s robot seeds new plants. For these tasks it is absolutely necessary to cooperate, with another team. The team with whom you are to cooperate will be announced in the morning on day 3!

General rules

- Because we are developing autonomous robots, it is NOT allowed to follow the robot with laptop, controller or other devices. One person is allowed to follow the robot, without any electronics. This person only can reposition the robot in case the path is not followed or in case of emergency press a button on the robot.
- Before the start every team has to explain to the officials, which kind of hardware they are using. If they are using simple hardware (e.g. infrared or ultrasonic distance sensors combined with cheap microcontrollers) instead of high end equipment (e.g. embedded PCs, laser range finder), they will get more points.

- During the tasks the robots will have to wait in a Parc Fermé, so that no further testing or modification is possible. Between the tasks there will be a 10 minute break for the teams to prepare their robots for the next challenge (change batteries, etc.).
- From the moment a robot is given permission to start, it must start within one minute. If the robot doesn't start within this time, it has one more chance to start after all other teams. If it does not start within one minute for the second time, the robot is disqualified for that task.
- Large robots and/or robots with a probability of destroying the field will always start after the other robots have performed their tasks AND after all second chances restarted.

Awards

- There will be jury points for the basic, advanced and professional tasks. Not only will the "hard facts" be considered by the officials, also the execution of the tasks.
- There will be an award for the first three ranks of each task. The basic, advanced and professional tasks together will yield the overall winner of the Field Robot Event 2012.
- If two or more teams have the same number of points for the overall ranking, the team with the better placements during all three tasks will be ranked higher.

Task 1 "Basic"

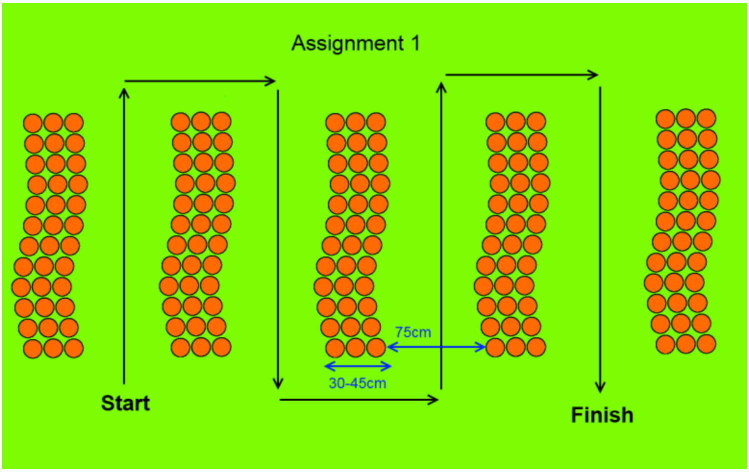
Within three minutes the robot has to navigate through long curved rows in a container field of potted roses. The goal is to cover as much distance as possible. On the headland, the robot has to turn and return in the adjacent row. There will be no plants/pots missing in the rows. This task is all about accuracy and smoothness of operation within the rows.

At the beginning of the match it will be told whether starting is on the left side of the field (first turn is right) or on the right side (first turn is left). This is not a choice of the team but of the officials. So, make sure your robot is able to perform both options!

Assessment:

- The distance travelled in 3 minutes is measured. If the end of the field is reached within 3 minutes, the total time counts. Distance and time are measured by officials;
- Manual intervention within the rows results in a penalty of 3 meters (per touch). The number of touches is counted by the officials;
- A manual intervention at the end of a row to help the robot entering the next row will be punished with a penalty of 5 meters. The robot should make the turn by itself;
- The robot is allowed to touch a potted plant, however, when a potted plant is tipped over, this will result in a penalty of 2 meter (per fallen plant). The officials will count the number of pots that were tipped over.

The calculated distance and time result in a team ranking. Numbers 1 to 3 will be rewarded with a price for their achievements in this task. This task, together with tasks 2 and 3, contributes to the overall FieldRobotEvent2012 Championship. Points will be given as follows (similar to Formula1 point system): First place in this task: 10 points - Second place: 8 points - Third place: 6 points - ...5-4-3-2-1-1-1-1... points. Participating results in at least 1 point. Not participating in this task results in 0 points.



Task 2 "Advanced"

In practice, some potted roses are taken out of the field of roses because of customer orders. The effect will be that the rows contain gaps, moved plants, etc. Navigating through such a field is a challenge!

The robot should cover as much distance as possible within 3 minutes while navigating between straight rows of potted roses. The robot has to follow a certain pre-defined pattern over the field. At various places in the container field, plants will be missing in either one or both rows over a length of maximally 1 meter. Further plants can be moved IN the rows and block the path of the robot. The robot has to move backwards and continue with the coded pattern. The coded pattern takes blocked paths into account.

The headland border may not be perpendicular to the crop row orientation. The difference in length of two subsequent rows will be less than 1 meter. A headland of only 1.5 meters will be available for turning.

Coding of the row-pattern through the container field is done as follows. S means start, L means left-hand turn, R means right-hand turn and F means finish. The number before the L or R represents the row that has to be entered after the turn and the single number 0 means return in the same path. So, 2L means: enter the second row after a left-hand turn. 3R means: enter the third row after a right hand turn. The code row-pattern will be given as (example): S - 3L - 0 - 2L - 2R - 1R - 5L - F.

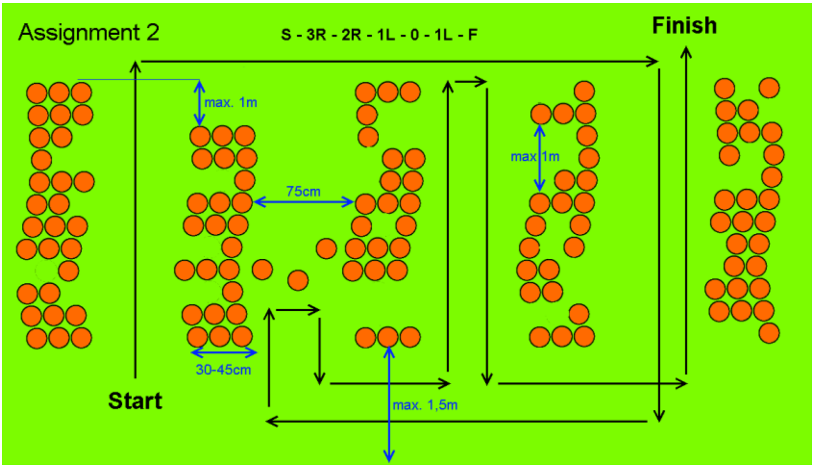
The code of the pattern is made available to the competitors 10 minutes before the start of the competition. Competitors do not have the opportunity to test it in the container field.

Assessment:

- The distance travelled in 3 minutes is measured. If the end of field is reached within this time, the total time counts. Distance and time are observed by officials;
- Manual intervention results in a penalty of 3 meters (per intervention). The number of interventions is counted by the officials;
- If the robot enters the wrong row after the headland turning or if there is intervention during the headland, it results in a penalty of 5 meter. The robot must be set into the correct row by hand if the headland turning was not successful. The number of interventions is counted by the officials;
- Crossing the headland boundary located at the end of the rows by a distance of more than 1.5 meters or twice the length of the robot (if the length is larger than 75 cm) results in a penalty of 5 meters per crossing; number of crossings is counted by officials;
- The robot is allowed to touch a potted plant, however, when a potted plant is tipped over, this will result in a penalty of 2 meter (per plant tipped over). The officials will count the number of pots that have been tipped over.

The calculated distance and time result in a team ranking. Numbers 1 to 3 will be rewarded with a price for their achievements in this task. This task, together with tasks 1 and 3, contributes to the overall Fieldrobotevent 2012 championship. The following sequence for the overall points is used: 10-8-6-5-4-3-2-1-1-1-1… Not participating in this task results in 0 points.

The following picture shows an example of how the track could look like for task 2. The gaps in the rows and the drive pattern will be different at the real event!



Task 3 "Professional" – Customer Order

The "Professional Task": Customer order consists of a number of subtasks, Identify, Pick and Place. First the robot has to find the ordered plant in a container field and show that the ordered plant has been found (Identify). Second, the ordered plant should be marked AND/OR the ordered plant should be taken and third, the ordered plant should be delivered at the starting point.

As in the rose business, the plants will be indicated with tags.

Subtask 1: Navigate in a 'chaos'-field and identify the ordered plant;

Subtask 2: Pick the identified plant;

Subtask 3: Deliver the plant.

The tags can be chosen by the teams themselves, one can think of barcode identification (stickers on the pots), RFID tags, plant pins, etc… The officials will place the tag on a random plant, taking into account the wishes of the team (height, visibility). We do not want to force teams to work e.g. with RFID, because of the limitations of some (embedded) systems.

Assessment:

➔ The robot has 3 minutes to show the identification of a plant. Finding (and signalling) the ordered plant within a radius of 0.5 m results in 10 points, within a radius of 1.0 m results in 9 points, within 1.5 m in 8 points etc. (points = 11-2*radius). Navigating to the right row will give a bonus multiplication of 1.5 to the gathered points in this subtask.

➔ Picking the ordered plant within 2 minutes.
Picking the ordered plant WITHOUT any manual intervention gives a bonus of 20 points.

Picking the ordered plant with manual intervention (put robot in right row and in front of ordered plant) gives 10 points.

➔ Last, the robot delivers the plant, for this task a maximum of 2 minutes is allowed.

Delivering the ordered plant gives a bonus of 10 points. Penalty of 1 point per 0.5 meter distance from starting point is subtracted.

- Touching other plants is allowed in this assignment. When a pot tips over, a penalty of 1 point per pot is given.
- The total score of sub-tasks 1 – 3 is added.
- Numbers 1 to 3 will be rewarded with a price for their achievements in this task.
- As this task, together with tasks 1 and 2, contributes to the overall FielRobotEvent2012 championship,. the teams are ranked based on the total score. The winning team gets 10 points, second team 8 points, etc. The following sequence is used: 10-8-6-5-4-3-2-1-1-1-1…
- The following picture shows an example of how the track could look like for task 3. The gaps in the rows and the drive pattern will be different at the real event! In comparison to task 2 the field will be less chaotic. There will be less gaps in the rows and there won't be a barrier in a row.

Task 4 "Freestyle"

Robots are invited to perform a free-style operation on the field. Fun is important in this task as well as an application-oriented performance. One team member has to inform the jury and the audience about the idea.

For the “Freestyle” challenge, the potted roses can be positioned as required. It is not necessary to keep the pots in curved or straight rows.

Assessment:

The jury ranks the idea and the robot performances at the end of the task, both with a mark from 1 – 10. These points are added and the team with the highest score gets 10 points, second position 8 points etc. according to the previous mentioned sequence: 10-8-6-5-4-3-2-1-1-1-1……

This task is optional and will be awarded separately. This task does not contribute to the overall FieldRobotEvent 2012 championship.

Task 5 “Cooperation”

On the third day groups of two teams will participate in a cooperative freestyle task. The teams will be chosen by the organizer and will be pronounced as early as possible. So there is much time to prepare. The groups choose their own task but it has to be a task with two robots working together. The field can be changed as desired. For this purpose there has to be a communication between the robots. This is a nice step forward in technology because communication between field robots will be very important in the future.

This communication should be done with Wi-Fi and ISOBUS as protocol. Nevertheless every other way of communication is possible and we are open for good ideas. Also the robots could “communicate” via pressure sensors or vision. Everything is possible in this task as long as it is cooperative.

Assessment:

The jury ranks the idea and the robot performances at the end of the task, both with a mark from 1 – 10. The idea and the quality (communication) of the co-op task are most important. These points are added and the team with the highest score gets 10 points, second position 8 points etc. according to the previous mentioned sequence: 10-8-6-5-4-3-2-1-1-1-1……

This task is optional and will be awarded separately. This task does not contribute to the overall FieldRobotEvent 2012 championship.

Examples of possible cooperative tasks:

- Find a rose
- The first robot finds the marked rose pot and the second gets it to the start point
- The first robot finds the marked rose pot and the second prints a barcode on it
- Labyrinth
- First robot explores and second navigates directly to finish
- Follow the leader
- Sort roses
- One robot gets roses and the second sorts them by color

Map of the Floriade terrain

Your car is parked on the parking place marked with a P.

Our Terrain on the floriade is marked with a X.

Map of the fieldrobot terrain

Your stay at the Field Robot Event 2012 / House rules

We have an environment of 50m x 60m reserved for the event. Everything will happen in this environment (testing, contest, eating, party, sleeping, shower, etc.).

For every participant, we organized breakfast and lunch on Friday, barbecue and party on Friday evening (with live music), breakfast on Saturday.

There are a lot of eating and drinking facilities on the Floriade. You can go as you like. During these 3 days, you have full access to all activities and are free to go around. You can buy food and drinks there, but you also can bring your own drinks.

ATTENTION: Glass is not allowed on the terrain! (No beer bottles, but canned beer, plastic bottles for refreshment/water!)

Every team has 2 tents (both 4x4m). One tent for sleeping and one tent for 'adapting robots'. The tents are placed on grass. You should bring sleeping bed and airbed (if you need one).
Every tent has a lot of power outlets, for recharging batteries for the robots, laptops, mobiles, etc.

At the night, there is light available. Also, free WIFI is available. Toilets, showers are on the environment.
NOTE: Visitors have a limited time frame to enter and leave the Floriade. This is also applicable for us.

Opening times are:

Wednesday, June 27th:	10:00 – 20:00
Thursday, June 28th:	10:00 – 20:00
Friday, June 29th:	10:00 – 23:00
Saturday, June 30th:	10:00 – 23:00

Teams that booked INCLUDING low budget accommodation can stay on the Floriade. This is a special arrangement! After closing time and before opening time, you cannot leave the Floriade.

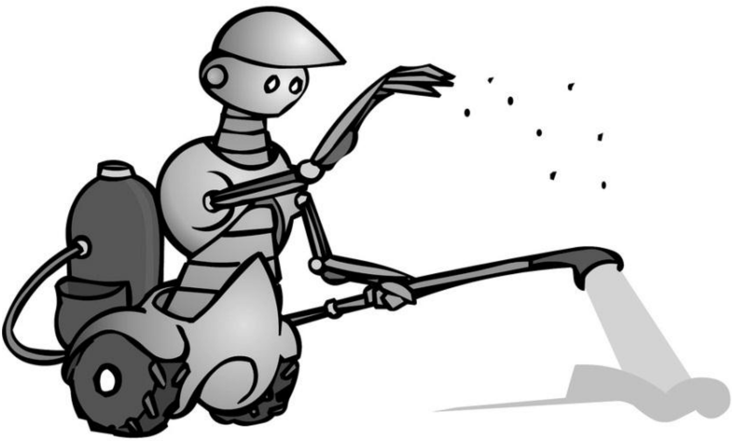
Teams that arranged hotel do need to leave before closing time and can enter the event after opening time.
We wish everybody a good trip, a good contest and we hope (and expect) you will have a great stay at the 10th edition of the FieldRobotEvent.

During the event (27–30 June) you can contact the organization on:

+31 6 57 20 14 02
Frank van Gennip

Competitors - Fieldrobots

Agrotech

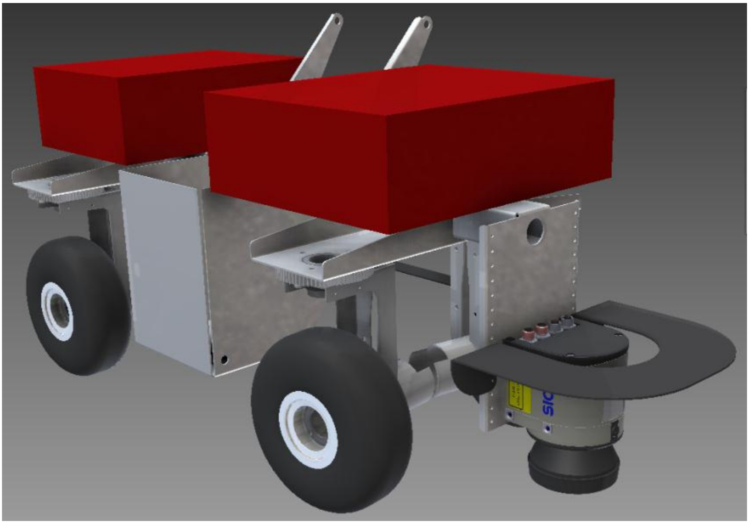


Banat

Team Data		
Team & Robot name		Banat
Team members		Bungescu Sorin, Craciun Andrei,
		Fitz Cristian, Tucu Dumitru +2 unknown yet
Team captain	Name	Fitz Cristian
	email	fitzcristian@gmail.com
Affiliation	Institution	USAMVB-Timisoara
	Department	MIAIA
	Street/Post Box	Aradului, No.119
	Zip-Code	

	City	Timisoara
	Country	Romania
Robot Data		
Chassis	W x L x H (in cm)	41x46x20
	Ground clearance (cm)	3
	Weight (kg)	10
	Model/Make	Own design
Drivetrain	Engine	2xT55 Crawler
	Speed (approx. In m/s)	2,5m/s
Control	Microcontroller/pc	Arduino
Sensors		Ultrasonic Ping
Costs (€)	**Total**	(approx.) € 750
Work (h)		Hours (approx.)240
Sponsors		Claas Stiftung

Bullseye



Team Data		
Team & Robot name	Team Robatic	Robot name: Bullseye
Team members	Albert Jol	Toon Tielen
	Arjen van Dueren den Hollander	Matthijs van Haperen
Team captain	Name	Krijn Schetters
	email	Krijn.schetters@wur.nl
Affiliation	Institution	Wageningen University
	Department	Agrotechnology
	Street/Post Box	Bornsesteeg 48
	Zip-Code	6708 AK
	City	Wageningen
	Country	The Netherlands
Homepage		www.robatic.nl

Robot Data		
Chassis	W x L x H (in cm)	40*80*45
	Ground clearance (cm)	7.5
	Weight (kg)	35
	Model/Make	Custom made
Drivetrain	Engine	Maxon motor RE40
	Conception	Direct wheel on motor
	Power	Battery
	Speed (approx. In m/s)	1.6
Control	Microcontroller/pc	M4N78-AM
	Interface	Labview
	Software	Windows
Sensors	Laser range finder (Sick)	Camera
Strategy	Task	Strategy
	Task 1	As fast as possible
	Task 2	As fast as possible
	Task 3	As fast as possible, total autonomous
	Task 4 freestyle	As inventive as possible
	Task 5 cooptask	As inventive as possible
Costs (€)	Frame	100
	Motors	500
	Computer	40
	Total	640
Work (h)	1600	Hours (approx.)
Own judgement	Strengths	Design
	Problems	Time
Sponsors	Agrifac	Mammoet
	Reesink Technische Handel	SBG
	Agri 2.0	Maxon Motor

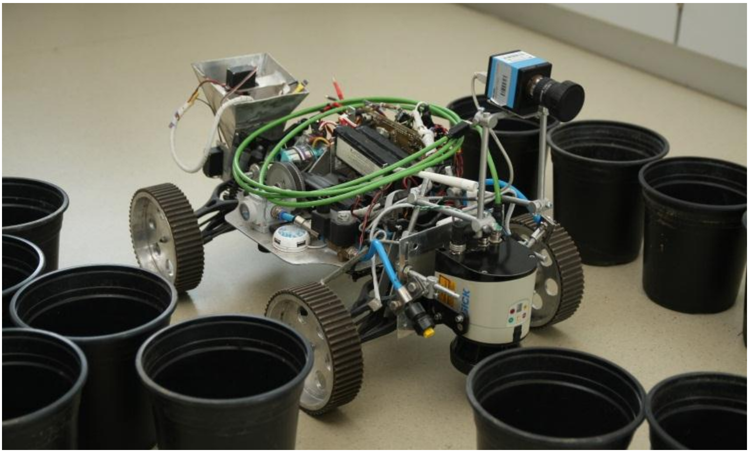
Ceres

Team Data		
Team & Robot name		Ceres II
Team members		Aal,Rens Arts,Martijn Creemers,Roel van Os, Daan Sackers,Martin Stoks,Roy Tietema,Stefan Verhappen,Willem Winkelmolen,Rik Kuijpers,Wouter
Team	Name	Kuijpers,Wouter

captain		
	email	wouter.kuijpers@student.fontys.nl
Affiliation	Institution	Fontys Hogescholen FHT&L
	Department	Mechatronics + Mechanical Engineering
	Street/Post Box	Tegelseweg 255
	Zip-Code	5912 BG
	City	Venlo
	Country	The Netherlands
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	40 x 55 x 44 cm
	Ground clearance (cm)	7 cm
	Weight (kg)	+- 35
	Model/Make	Self built
Drivetrain	Engine	Maxon 24v
	Conception	4-wheel drive, two independent axles
	Power	150W (2x)
	Speed (approx. In m/s)	T.b.d
Control	Microcontroller /pc	Cerebot + NI EVS
	Interface	LabView
	Software	LabView + MPlab
Sensors		(2x) FireWire Camera
		(1x) USB Camera
		(2x) Quadrature Encoder
Strategy	Task	Strategy
	Task 1	Using the speed of the robot and flexibility of the robot arm.
	Task 2	Using the camera on top to see trough the “chaos.”

	Task 3	Positioning the arm very precise with help of the front camera.
	Task 4 freestyle	T.B.D.
	Task 5 cooptask	T.B.D.
Costs (€)	Parts	Cost
	EVS	1500 €
	Firewire Camera (2x)	Unknown
Work (h)		6500 hours
Own judgement	Strengths	Speed, Electrical Planning, Low Camera Position
	Problems	Intelligence of Vision, Weight
Sponsors		National Instruments, Maxon Motors Inalfa Roofsystems Fontys University (T-shirts)

Cornstar



Team Data		
Team & Robot name		Biosystems Engineering CornStar
Team members		
		Miran Lakota Peter Berk Nino Golčman Peter Lepej Katarina Plevnik Jurij Rakun Matej Zupanc
Team captain	Name	Prof. Dr. Miran Lakota
	email	miran.lakota@uni-mb.si
Affiliation	Institution	Faculty of Agriculture and Life Sciences, University of Maribor

	Department	Biosystems ingeneering
	Street/Post Box	Pivola 10
	Zip-Code	2311
	City	Hoce
	Country	Slovenia
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	40x60x40
	Ground clearance (cm)	7
	Weight (kg)	15
Drivetrain	Engine	X-Power Eco BL
	Conception	3-phase brushless motor
	Power	400 W
	Speed (approx. In m/s)	3
Control	Microcontroller/pc	AVR128/ARM (Super-scalar Cortex-A8)
	Interface	WiFi/ZigBee
	Software	Linux, custom written SW
Sensors		SICK LMS111 DKB31UA03 colour camera
Strategy	Task	Strategy
	Task 1	Using custom developed SLAM navigation algorithm.
	Task 2	Using custom developed SLAM navigation algorithm + counting rows.
	Task 3	Looking for plants with known colour

		markers.
	Task 4 freestyle	Smart sprinkle system.
	Task 5 cooptask	Not competing.
Costs (€)	Parts	Cost
	Electronics	Circuit – 300 € Embedded computer – 200 € Batteries, servos, motors and controllers – 500 € Sick laser scanner - 2000 € Digital camera – 500 €
	Mechanics	1000 €
	Total	4500 €
Work (h)		Stopped counting a few years back. ;)
Own judgement	Strengths	Good design.
	Problems	None that cannot be overcome!
Sponsors		SICK The Imaging Source

Eduro Maxi

Team Data		
Team & Robot name	Eduro Team	Eduro Maxi
Team members		Martin Dlouhy
		Stanislav Petrasek
Team captain	Name	Milan Kroulik
	email	kroulik@tf.czu.cz
Affiliation	Institution	Czech University of Life Sciences Prague
	Department	Department of Agricultural Machines
	Street/Post Box	Kamycka 129
	Zip-Code	16521
	City	Prague
	Country	Czech Republic
Robot Data		
Chassis	W x L x H (in cm)	37 x 50/64 x55

	Ground clearance (cm)	6
	Weight (kg)	25
	Model/Make	three-wheel with a differential drive
Drivetrain	Engine	electric
	Conception	SMAC (Stepper Motor – Adaptive Control)
	Power	24V battery
	Speed (approx. In m/s)	0.7
Control	Microcontroller/pc	board computer with AMD Geode CPU, 256 MB RAM
	Interface	CAN bus
	Software	python
Sensors		LMS100, camera, compass
		Odometry
Strategy	Task	Strategy
	Task 1	basic
	Task 2	Basic with blocked row detection
	Task 3	Find, collect and return
	Task 4 freestyle	Navigation on paved roads + map based on OpenStreetMap data
	Task 5 cooptask	Follow other robot
Costs (€)	**Total**	Hard to estimate, 1000EUR??
Work (h)		Hours (approx.)
Own judgement	Strengths	Long term project
	Problems	Limited time
Sponsors		SICK (laser scanner from SICK Robot Day 2010)

Floribot

Team Data		
Team & Robot name		FloriBot
Team members		Torsten Heverhagen Peter Schiffmann Felix Herrmann
Team captain	Name	Torsten Heverhagen
	email	Torsten.Heverhagen@hs-heilbronn.de

Affiliation	Institution	Heilbronn University of Applied Science
	Department	Technology 1
	Street/Post Box	Max-Planck-Str. 39
	Zip-Code	D-74081
	City	Heilbronn
	Country	Germany
Homepage		www.floribot.de
Robot Data		
Chassis	W x L x H (in cm)	42 x 65 x 45
	Ground clearance (cm)	10
	Weight (kg)	20
	Model/Make	Coroware Explorer
Drivetrain	Engine	4 DC motors
	Conception	4 Wheel Drive Articulated Chassis with Skid Steering
	Power	13AH NiMh Rechargeable
	Speed (approx. In m/s)	0.9
Control	Microcontroller/pc	VIA C7 1GHz
	Interface	USB, Wifi, Bluetooth
	Software	ROS electric (Linux)
Sensors		Hokuyo Laser Scanner
		camera
		(imu)
Strategy	Task	Strategy
	Task 1	slam-gmapping, feature extraction
	Task 2	slam-gmapping, feature

		extraction
	Task 3	slam-gmapping, feature extraction, camera for finding pot
	Task 4 freestyle	?
	Task 5 cooptask	?
Costs (€)	Parts	Cost
	robot base (incl. Sensors)	9000
	Pan-Tilt Unit	2000
	Gripper and minor additions	1000
	imu sensor	1500
	Total	13500
Work (h)		2000 Hours (approx.)
Own judgement	Strengths	
	Problems	can't carry pots with more than 1kg
Sponsors		Heilbronn University

Flowerpower

Team Data		
Team & Robot name		FlowerPower
Team members		8
Team captain	Name	Hendrik Oltmann
	email	Hendrik.oltmann@hs-osnabrueck.de
Affiliation	Institution	University of Applied Science Osnabrueck
	Department	Engineering & computer science
	Street/Post	Albrechtstraße 30

	Box	
	Zip-Code	49076
	City	Osnabrueck
	Country	Germany
Homepage		http://www.ecs.hs-osnabrueck.de/teamfieldrobot.html
Robot Data		
Chassis	W x L x H (in cm)	45 x 70 (100 with picker arm) x 55
	Ground clearance (cm)	70 cm
	Weight (kg)	35Kg
	Model/Make	VolksBot
Drivetrain	Engine	Two DC motors (each 150W)
	Conception	One motor for each side
	Power	Two x 150W
	Speed (approx. In m/s)	1,5 m/s
Control	Microcontroller/pc	Industrial PC
	Interface	Ethernet, Rs 232
	Software	ROS
Sensors		
		2D Laser scanner (Sick)
		PMD 3D Camera (TOF) (IFM 03D2019)
		LeanXcam (SmartCam)
Strategy	Task	

	Task 1	Drive through as fast as possible
	Task 2	Drive through as fast as possible
	Task 3	Search the flowerpot, Drive through and pick the flowerpot
	Task 4 freestyle	- / -
	Task 5 cooptask	Relaxe and see, what we have to do ;)
Costs (€)	Parts	Cost
	Chassis (+motors, etc)	4000 €
	Laserscanner	3000€
	3D- Cam	800€
	LeanX- Cam	350€
	Other Parts	650€
	Total	8800€
Work (h)		Hours (approx.)
Own judgement	Strengths	robust
	Problems	
Sponsors		
	AMAZONEN-Werke H. Dreyer GmbH & Co. KG	SICK AG
	Nanotec Electronic GmbH & Co. KG	EXSYS Vertriebs GmbH

Gonzales

Team Data		
Team & Robot name		Gonzales
Team members		M.Kerk, M.Lambers, C.Schlieker, M.Völkening, F. Böing, C. Bargel, S. Bruns, M. Lambers
Team captain	Name	M. Lambers
	email	Manuel.kerk@gmx.de
Affiliation	Institution	Kopernikus Gymnasium

		Rheine
	Department	
	Street/Post Box	Kopernikusstraße 61
	Zip-Code	48429
	City	Rheine
	Country	Germany
Homepage		http://www.kopernikus-rheine.de
Robot Data		
Chassis	W x L x H (in cm)	30*45*25
	Ground clearance (cm)	12
	Weight (kg)	10
	Model/Make	Tamiya
Drivetrain	Engine	2 x electromotor
	Conception	4WD
	Power	2 x 7.8V battery à 5.1 Ah
	Speed (approx. In m/s)	3
Control	Microcontroller/pc	2 x AVR ATMega 32
	Interface	2 x serial Port
	Software	Visual C++, Bascom
Sensors		5 x ultrasonic, 1 x compass sensor, 1 x speed indicator
Strategy	Task	Strategy
	Task 1	Find the way using our

		ultrasonic sensors
	Task 2	Our goal is taking part!
	Task 3	Our goal is taking part!
	Task 4 freestyle	Feel free
	Task 5 cooptask	-
Costs (€)	Parts	Cost
	Wheels	2 x 30€
	Total	
Work (h)		Hours (approx.) 100
Own judgement	Strengths	Creative, Hopeful
	Problems	Relative primitive hardware, short preparation time
Sponsors		
		Förderverein Kopernikus-Gymnasium

Helios

Team Data		
Team & Robot name		FREDT & Helios
Team members		Jan Roesler Thomas Niedfeld Niko Brasch Lukas Jurek Thore Pfeiffer Michaela Pußack Frederik Armbrecht Matthias Kemmerling Phillip Koitsch

Team captain	Name	Jan Roesler
	email	janroesler@gmx.de
Affiliation	Institution	TU Braunschweig
	Department	Institute of Mobile Machines and Commercial Vehicles
	Street/Post Box	Langer Kamp 19 a
	Zip-Code	38106
	City	Braunschweig
	Country	Germany
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	38x62x40
	Ground clearance (cm)	5,5
	Weight (kg)	15-20
	Model/Make	
Drivetrain	Engine	Dunkermotoren brushless DC-Motor
	Conception	4-wheeled drive, both axes steered
	Power	250 W
	Speed (approx. In m/s)	3
Control	Microcontroller/pc	Intel Atom Dual Core mini ITX-board, DVM 6437 DSP board, Various Micro Controllers
	Interface	

	Software	C++, MATLAB/Simulink
Sensors		Sick LMS 100, Sick CLV 503, Infrared Sensors
Strategy	Task	Strategy
	Task 1	Win
	Task 2	Win
	Task 3	Win
	Task 4 freestyle	Impress People and Win
	Task 5 cooptask	Not to Participate
Costs (€)	Parts	
	Chasis	Self-made, sponsored
	Atom PC	200,-
	Drive Engine	Sponsored
	Steering Servos	200,-
	Electronic Devices	600-
	LMS 100	Sponsored
	Total	1000,-
Work (h)		Too much
Own judgement	Strengths	Self-constructed chassis and drivetrain,
	Problems	Integrating DVM 6437 DSP board into existing environment
Sponsors		Sick, Dunkermotoren

Hilde

Team Data		
Team & Robot name	Hilde	
Team members	Morten Ege Jensen	Klaus Kryhlmand
	Leon B. Larsen	Kent S. Olsen
Team captain	Name	Nis Sarup
	email	nis@sarup.dk

Affiliation	Institution	University of Southern Denmark
	Department	Faculty of Engineering
	Street/Post Box	Niels Bohrs Alle 1
	Zip-Code	5230
	City	Odense M
	Country	Denmark
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	52x40x35
	Ground clearance (cm)	10
	Weight (kg)	?
	Model/Make	
Drivetrain	Engine	Electric
	Conception	
	Power	Battery
	Speed (approx. In m/s)	0.6
Control	Microcontroller/pc	
	Interface	SSH
	Software	ROS / Frobomind
Sensors		
Strategy	Task	Strategy
	Task 1	
	Task 2	
	Task 3	
	Task 4 freestyle	
	Task 5 cooptask	

Costs (€)	Parts	Cost
	SICK Laser Range Finder	3359
	The rest (Approximate)	800
	Total	**1149**
Work (h)		Hours (approx.)
Own judgement	Strengths	
	Problems	
Sponsors		

Idefix

Team Data		
Team & Robot name		Team Idefix / Idefix
Team members		Long Hoang, Jakob Frick, David Lippner, Marcel Kosiedowski, Lukas Locher, Timo Widmaier
Team captain	Name	Timo Widmaier
	email	widmaier@gymueb.de

Affiliation	Institution	SFZ Südwürttemberg
	Department	Robotics
	Street/Post Box	Obertorstraße 16
	Zip-Code	88662
	City	Überlingen
	Country	Germany
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	50x80x120
	Ground clearance (cm)	4
	Weight (kg)	45
	Model/Make	Eigen
Drivetrain	Engine	2 Maxon
	Conception	4 WD
	Power	24 V Pb-batteries
	Speed (approx. In m/s)	1
Control	Microcontroller/pc	Car-PC Intel DUAL CORE 4 Maxon epos drive controller
	Interface	CAN-BUS/ Ethernet/ USB
	Software	Linux / Player Framework/ C++
Sensors		Sick LMS 100/ SICK TIM 310 / Swissranger 4000
Strategy	Task	Strategy
	Task 1	Laserscanner based navigation

	Task 2	Laserscanner based navigation
	Task 3	high weight
	Task 4 freestyle	In work
	Task 5 cooptask	not decided yet
Costs (€)	Parts	Unknown, lots of parts sponsored
	Total	
Work (h)		Hours (approx.) not countable
Own judgement	Strengths	youthful enthusiasm for technology
	Problems	robot to heavy/ overexposure
Sponsors		SICK, ZF, Maxon, Mogatech, Mesa Imaging

KaMaRo 12

Team Data		
Team & Robot name		KaMaRo Engineering e.V. KaMaRo 12
Team members		Bernd Klein, Christoph Straub, Ekkehart Schmidt, Ferdinand Horn, Florian Weber, Jérôme Urhausen, Joachim Schönmehl, Lisa Siebel, Martin Stähler, Melanie Magin, Nilan Marktanner, Peter Merkert, Sebastian Banz, Simon Merz, Thomas Hummel
Team captain	Name	Sebastian Banz
	email	Kamaro.engineering@googlemail.co

		m
Affiliation	Institution	Karlsruher Institut für Technologie (KIT)
	Department	
	Street/Post Box	Rintheimer Querallee 2
	Zip-Code	76131
	City	Karlsruhe
	Country	Germany
Homepage		Kamaro-engineering.de
Robot Data		
Chassis	W x L x H (in cm)	40 x 70 x 40
	Ground clearance (cm)	4.2
	Weight (kg)	30
	Model/Make	Self-built construction
Drivetrain	Engine	Dunkermotoren BG 75x25 SI main engine, 2 Dunkermotoren BG 31 servo motors
	Conception	Electric drive, four-wheel drive, two steering axles
	Power	1x 22.2 V 6 cell 5000 mAh lithium polymer battery pack 1x 14.8 V 4 cell 5000 mAh lithium polymer battery pack 1x 22.2 V 6 cell 2600 mAh lithium polymer battery pack
	Speed (approx. In m/s)	2 m/s
Control	Microcontroller/pc	miniITX board with Core2Duo 3 GHz
	Interface	CAN-Bus, (W)LAN
	Software	Self-written C/C++ code, MRPT

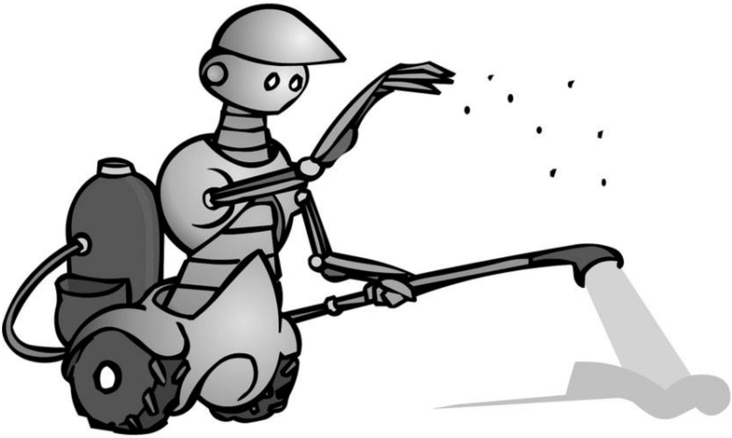
		library
Sensors		Sick Lidar
		USB Web-Camera
Strategy	Task	Strategy
	Task 1	Lidar-based navigation via predefined evaluation fields in front of the robot to avoid the walls.
	Task 2	The same as in Task 1.
	Task 3	Navigation as in previous tasks. Find the right flower by searching a colored marking at the pot with the camera
	Task 4 freestyle	Not yet defined
	Task 5 cooptask	Not yet defined, maybe communication via WLAN
Costs (€)	Parts	Costs(€)
	Chassis	150
	Drivetrain	250
	Lidar	~3000
	Motors and control units	600
	LiPo battery packs	400
	Mainboard and CPU	150
	Others	100
	Total	4650
Work (h)	5000	Hours (approx.)
Own judgement	Strengths	High in-house production depth
	Problems	Missing lifting unit for plants
Sponsors		Dunkermotoren, John Deere, UHU Mädler,Mobima, Sick, SLS – Stefans lipo-Shop, WVMA

Mark III

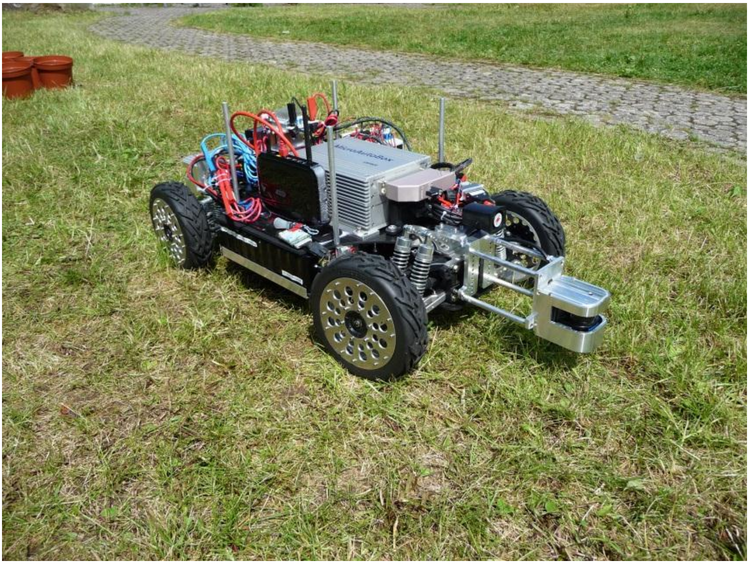
Team Data		
Team & Robot name	Mark III	
Team members		Dan Mathiasen, Jonas Ammundsen, Martin Søndergaard, Nicolaj Thomas Olesen, Rathesan Ravendran, Søren Trillingsgaard Pedersen
Team captain	Name	Jonas Ammudsen
	email	mp631c@m-tech.aau.dk

Affiliation	Institution	Aalborg University
	Department	Department of Mechanical and Manufacturing Engineering
	Street/Post Box	Fibigerstræde 16
	Zip-Code	9220
	City	Aalborg Ø
	Country	Denmark
Robot Data		
Chassis	W x L x H (in cm)	52x58x40
	Ground clearance (cm)	25
	Weight (kg)	29
	Model/Make	Dr Robot
Drivetrain	Engine	4x 24V DC motors
	Power	24V battery and 2x 7,2V batteries
	Speed (approx. In m/s)	1m/s - 1,5m/s
Control	Microcontroller/pc	Arduino Mega 2560 and PC104
	Software	Ubuntu 10.04 and ROS
Costs (€)	Total	€ 4600
Work (h)	6 x 350	Hours (approx.)
Own judgement	Strengths	Simplicity
	Problems	Turning, the width of the robot
Sponsors		Aalborg University

Persia



Robot TU Kaiserslautern

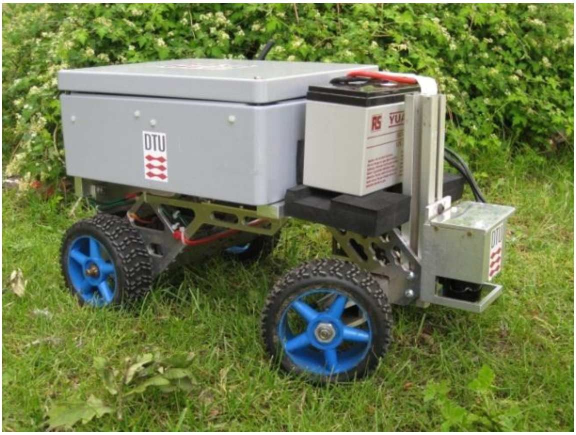


Team Data		
Team & Robot name		Robot TU Kaiserslautern
Team members		Mezhgan Rasul, Thomas Golas, Maitsetseg Ravdandorj, Patrick Laux, Alexander Babski, Meike Heck, Varun Jain, Viktor Leonhardt, Daniel Mörsdorf, Max Morsch, Lucian Flieder, Kiarash Sabzewari, Roland Werner
Team captain	Name	Roland Werner

	email	roland.werner@mv.uni-kl.de
Affiliation	Institution	University of Kaiserslautern
	Department	Mechatronics in Mechanical and Automotive Engineering
	Street/Post Box	Gottlieb-Daimler-Straße 44
	Zip-Code	67663
	City	Kaiserslautern
	Country	Germany
Homepage		http://www.mv.uni-kl.de/mec/lehre/labor-mechatronik-field-robot/
Robot Data		
Chassis	W x L x H (in cm)	45 x 112 x 45
	Ground clearance (cm)	7
	Weight (kg)	25
	Model/Make	Hurrax Yukon Monster Truck (strongly customized)
Drivetrain	Engine	Central Brushless DC Motor
	Conception	4 Wheel Drive, 4 Wheel Steering
	Power	2 kW
	Speed (approx. in m/s)	8 m/s
Control	Microcontroller/pc	dSPACE MicroAutoBox II + Embedded PC
	Interface	MATLAB/Simulink, ControlDesk + SSH
	Software	dSPACE Real-Time OS + Linux

Sensors		2 x Hokuyo UBG-04LX-F01 Laser Scanner
		1 x Continental IMU (1 Yaw-Rate / 3-Axes Acceleration Sensor)
		6 x Minoru Stereo Webcam
Strategy	Task	Strategy
	Task 1	Speed
	Task 2	Speed
	Task 3	360° Vision + Speed
	Task 4 freestyle	-
	Task 5 cooptask	-
Costs (€)	Parts	Cost
	Sensors (approx.)	5000 €
	Chassis (approx.)	5000 €
	MicroAutoBox II + Embedded PC (approx.)	35 000 € (Sponsoring)
	Total	45 000 €
Work (h)		1500 h (approx.)
Own judgement	Strengths	Forward and Backward Operation, Robustness, Speed, Expandability
	Problems	Turning Radius
Sponsors		John Deere, dSPACE

Rosebot



Team Data		
Team & Robot name		RoseBot
Team members		Thomas Falkenberg Simon Bagger Nicolai Pedersen Nanna Einarsdóttir
Team captain	Name	René Tavs Gregersen
	email	renetavs@gmail.com
Affiliation	Institution	Technical University of Denmark, DTU
	Department	DTU Electrical Engineering, Automation and Control
	Street/Post Box	Elektrovej Building 326
	Zip-Code	DK-2800
	City	Kgs. Lyngby
	Country	Denmark
Robot Data		

Chassis	W x L x H (in cm)	30x50x30
	Ground clearance (cm)	4
	Weight (kg)	8
	Model/Make	Custom
Drivetrain	Engine	Electrical
	Conception	Ackerman steering, 2wd
	Power	Battery 12V 7Ah
	Speed (approx. in m/s)	< 1.0
Control	Microcontroller/pc	pc
	Interface	WIFI/LAN, RS485
	Software	DTU Mobotware, C, C++
Sensors		Encoders, Laser scanner, Gyroscope, camera
Strategy	Task	Strategy
	Task 1	Find clear space and go
	Task 2	Added row counting
	Task 3	Added tag finding and picking
	Task 4 freestyle	*NA*
	Task 5 cooptask	*NA*
Costs (€)	Parts	Cost
	Laser scanner	1300
	Camera	135
	Pc	400
	Misc	400
	Total	2235
Work (h)	200	Hours (approx.)
Own judgement	Strengths	Small size, agility
	Problems	Pot lifting, torque

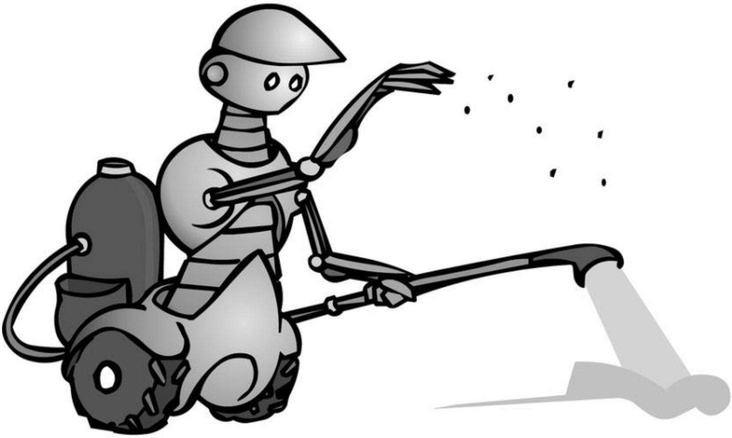
Roserunner

Team Data		
Team & Robot name	RoseRunner	
Team members	Janne Hafren, Sami Alaiso, Esko Karppanen, Matti Koskinen, Jarkko Kostiainen, Joni Rannisto, Roberto Sosa, Antti Valli, Antti Virta	Instructors: Timo Oksanen, Jari Kostamo, Matti Pastell
Team	Name	Janne Hafren

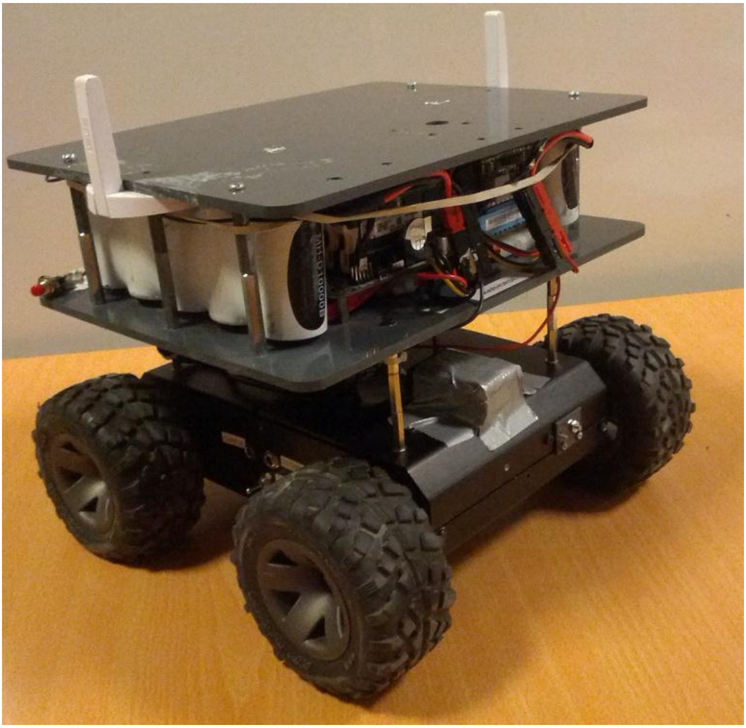
captain		
	email	janne.hafren@aalto.fi
Affiliation	Institution	Aalto university & University of Helsinki
	Department	Automation and Systems Technology, Mechanical Engineering, Space Master, Agrotechnology
	Street/Post Box	PO.Box 15500
	Zip-Code	FI-00076 Aalto
	City	Espoo/Helsinki
	Country	Finland
Homepage		http://autsys.tkk.fi/en/FieldRobot2012
Robot Data		
Chassis	W x L x H (in cm)	40 x 80 x 118
	Ground clearance (cm)	5,2
	Weight (kg)	22
	Model/Make	Custom made
Drivetrain	Engine	2 x RS-540 DC-motors
	Conception	2x compact axle modules
	Power	3x 5Ah LiPo batteries
	Speed (approx. In m/s)	1,5
Control	Microcontroller/ pc	3 onboard computers (1x eBox running WinCE + 2x FitPC running WinXP), 18 x Atmel AVR 8bit micro controllers
	Interface	CAN bus / ISOBUS backbone
	Software	Matlab, Visual Studio, LabVIEW, CodeVisionAVR, SolidEdge
Sensors		SICK LMS100 laser scanner, SRF04 + GP2D12 ranging sensors in each corner, compass & attitude

		sensors, industrial camera
Strategy	Task	Strategy
	Task 1	Row navigation + direct turn to next row
	Task 2	Row navigation + intelligent headland behaviour
	Task 3	Localize the plant, pick it up and bring it to the start
	Task 4 freestyle	Intelligent fertilizing
	Task 5 cooptask	TBD
Costs (€)	**Total**	4000€
Work (h)	3600	Hours (approx.)
Own judgement	Strengths	Advanced chassis, modular construction, comprehensive sensors
	Problems	Both electronics and software complexity (=> greater risk of failure)
Sponsors	Yara Finland, Laserle, Suomen Kulttuurirahasto, Murata/VTI, Koneviesti, Junkkari, Suonentieto, Maatalouskonei den Tutkimussäätiö, SICK, Linak, HP InfoTech	

Tractacus



Warhorse



Team Data		
Team & Robot name		Team Warhorse
Team members		Thomas Iversen, Kasper Jeppesen, Jeppe Pedersen, Simon Mathiesen, Søren H.

		Nielsen and Kjeld Jensen
Team captain	Name	Jeppe Pedersen
	email	Baronjeppe@gmail.com
Affiliation	Institution	University of Southern Denmark
	Department	Faculty of Engineering
	Street/Post Box	Østerled 19 1. th.
	Zip-Code	5000
	City	Odense
	Country	Denmark
Homepage		
Robot Data		
Chassis	W x L x H (in cm)	28.6 x 29.0 x 23.8
	Ground clearance (cm)	3.2
	Weight (kg)	10
	Model/Make	Home made
Drivetrain	Engine	
	Conception	
	Power	
	Speed (approx. In m/s)	0.7
Control	Microcontroller/pc	Intel-based PC
	Interface	
	Software	ROS
Sensors		
Strategy	Task	Strategy
	Task 1	Partice filter based localization and waypoint navigation

	Task 2	Partice filter based localization and waypoint navigation
	Task 3	Yet to come
	Task 4 freestyle	Yet to come
	Task 5 cooptask	Yet to come
Costs (€)	Parts	Cost
	MMP-5 mobile robot platform (base with motors, motorcontroller and batteries)	506,42
	Computer and sensors	477,52
	Total	983.94
Work (h)		225 Hours (approx.)
Own judgement	Strengths	
	Problems	Small platform with limited motor power
Sponsors		

Organization

Sponsors