INTERACTIVE & ENGAGING ROBOTIC SYSTEMS

CHALLENGES AND INTERACTION DESIGN

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Are you a...

... BSc student?

... MSc student?

... PhD student?

... even more senior
(maybe a Professor even?)

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LONG-TERM AUTONOMY - ADAPTATION AND INTERACTION

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STRANDS project

Long-term Autonomy and Deployment

Robust, intelligent, autonomous behaviour

Long run-times in everyday environments

Novel opportunities to learn structure

Exploitation of structure for improved performance

INTEGRATION CHALLENGE

“ROBOTICS IS INTEGRATION SCIENCE !”

Renaud Champion,
co-founder and partner of
ROBOLUTION Capital,
Berlin, 2013

Software AND Representations

INTEGRATED SYSTEMS

integrating projects

Autonomy

Interaction

Uncertainty

Long-term experience

Context

- Been in charge for System Integration and Deployment in 5 EU projects since 2002 (and many other)
- Most of this is based on work in STRANDS (2013-2017)
- Software engineering challenges in (mostly) academia

STRANDS

FINANCIAL TIMES

Home World Companies Markets Global Economy Lex Comment Management Life & Arts

August 3, 2014 9:15 pm

G4S powers up robotic security

By Gill Plimmer Author alerts

It's not exactly RoboCop. But it is a robot security guard – and it could be patrolling office floors within just 10 years, according to G4S, the world's biggest security company.

These automated watchmen, which have already been trialled, are the latest examples of the growing trend for companies to use robots alongside humans – in the same was that carmakers are giving drivers ever more autonomous driving systems.

Spatio-temporal representation and activities for cognitive control in long-term scenarios

- Long-term autonomy requires robust software
- 6 robots, shared software, 2 application domains
- > 30+ developers

Challenges

Heterogeneous (and independent) group of developers

“Hacking for paper” attitude

not well-trained developers

Supervisors’ focus on publications (rightly so)

Robustness

Reproducibility & facilitation of system science (for team and community)

Deployment to test-sites

Some (for us) working solutions

Heterogeneous (and independent) group of developers

not well-trained developers

Robustness

open robotics

Adopt OSRF (ROS) build farm and extend it

- ❑ “Force” developers to share code (github) and adopt fork and pull model and continuous integration with email notification
- ❑ Team of 3-4 software managers, who review code and approve releases

Some (for us) working solutions

"Hacking for paper" attitude

Reproducibility & facilitation of system science
(for team and community)

Deployment to test-sites

Build debian/ubuntu packages and Docker images

Anyone can request new release, project managers approve

Auto-generate met-packages, documentation,...

Developers base their work on released packages

	Version	Xsource	X64
	0.2.0-0		
	0.2.0-0		
	0.2.2-0		
ros-kinetic-strands-movebase	0.0.23-0		
ros-kinetic-strands-navfn	0.0.23-0		
	1.0.4-0		
	1.0.4-0		
	1.6.0-0		
	0.4.0-0		
	0.2.0-0		
	0.1.0-0		
ros-kinetic-strands-visualise-speech	0.2.0-0		
ros-kinetic-strands-webserver	0.1.0-0		
ros-kinetic-strands-webtools	0.1.0-0		
ros-kinetic-task-executor	1.2.1-0		
ros-kinetic-thin-navigation	0.0.3-0		

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Remaining Challenges

Team discipline, “control” of developers

Multi-platform deployment

“Integration is not science”

Declaration of Dependencies

Long-term Maintenance

Unit/regression tests

These slides: https://lcas.lincoln.ac.uk/s/erf18-1
https://github.com/lcas/rosdistro/wiki
https://lcas.lincoln.ac.uk/
http://hanheide.net

CHALLENGES OF INTERACTION

STRANDS

The Story of STRANDS
The CARE story

WP 7/8
User Expec-tations and Require-ments
WP 6/8
tasks: bellbot, walking group, info-terminal
WP 6/8
Upgraded walking group and bellboy
WP 6/8
new Info-Terminal, optional walking group
WP 1/2
Basic Navigation and Object Checks
WP 3
Wheel Chair Detection
WP 6
Adaptive Info-Terminal
Evaluation
Usability Winter School Feb 2015
Evaluation
Evaluation
Evaluation
CARE deployment
CARE Deployment
CARE Deployment
CARE Deployment
2013
2014
2015
2016
2017

What can I even do in a care environment??
WP 7/8
User Expec-tations and Require-ments
WP 1/2
Basic Navigation and Object Checks
Evaluation
CARE deployment

What can I even do in a care environment??

- **Usability**

1) Users missed robot-arm
2) Users had difficulties when interacting with robot
3) Uni-directional comunication mode
4) Users found robot-behaviour occasionally not legible

- **Acceptance**

1) Robot was well integrated
2) Necessity of robot-service in care contexts is seen as quite ambivalent
3) Willingness of sharing work-space with a robot is ambivalent
4) Interest in functionalities ↔ Loss of interest when functions are not working
5) In stressful situations robot can disturb staff

Bellbot

Info Terminal

Walking Group

Bellbot

Info Terminal

Walking Group

Bellbot

Info Terminal

Walking Group

Bellbot

Info Terminal

Walking Group

“The first autonomous mobile robot engaged in physical therapy”

WP 6/8
tasks: bellbot, walking group, info-terminal
Usability Winter School Feb 2015
Evaluation
CARE Deployment

Bellbot

Info Terminal

Walking Group

Work
Amsterdam
Berlin
Netherlands
London
Brussels
Cologne
17 h 23 min
1,050 miles
17 h 47 min
1,072 miles
Czechia
17 h 37 min
1,089 miles
Haus der Barmherzigkeit
Austria

AAF-Strands 6 members
11:40 AM
some upda...
11:40 AM
update for yo...
I have some update for you from topic " /notification ":
11:12:27 AM
data: A virtual bumper event has been trigered near Cafeteria at 11:12:10 and ended at 11:12:27 near WayPoint90the total distance was 8.50849939429 metres
I have this image for you from topic " /notification_image ":
11:12:28 AM
11:12:29 AM
I have some update for you from topic " /speak/goal ":
11:12:31 AM
header:
seq: 13
/look
MH
AS
SEND

Demo “Care”

y2: fully autonomous

y3: more control requested, quote “too autonomous”

y4: Voluntary participation by therapists

Y3 Result: higher acceptance by therapists (now expressing they want to use it again)

WP 6/8
Upgraded walking group and bellboy
WP 6
Adaptive Info-Terminal
Evaluation
CARE Deployment

ADAPTIVE INFO-TERMINAL

Total 63 days >4000 clicks!

- data recorded:
  - **where** is the robot **when**?
  - **did** people use the robot where it was? (success!)

l t

$a_l(t)$

SPATIO-TEMPORAL MODELLING

l t → Frequency Map Enhancement „FreMEn“ → $a_l(t)$

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CHOOSING THE NEXT LOCATION

- predicted utility of a location *l*: $u_l(t) = \epsilon\, h(p_l(t)) + (1-\epsilon)\, p_l(t)$
- use utility to sample next location to go, greedily, new place every 10 minutes
- Here we set **ε=*0.5*** (exploration-exploitation ratio)
- start with $\boldsymbol{p_l(t) = 0.5}$ at the beginning
- more on exploitation-exploration and planning horizons in
  Kulich, M., Krajnik, T., Preucil, L., and Duckett, T. To explore or to exploit? Learning humans' behaviour to maximize interactions with them. In Proceedings of the Workshop on Modelling and Simulation for Autonomous Systems (MESAS)

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Successful Info-terminals %

30% 70%

Clicks per interaction %

2.07 6.67

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MORE AND MORE INTERACTIONS

- Linear regression on average success rates per day.
- rejection of H0 (constant number of interactions) with *p=0.000674*.

WP 6/8
new Info-Terminal, optional walking group
Evaluation
Evaluation
CARE Deployment

“Virtual Bumper” was used approximately twice a day!

Therapist used the robot although they didn’t have to!

WP 1

WP 6

WP 8

WP 3

WP 7

Care scenario provided very **end-user focused** challenges

Over the years, Care was the **more "robust" scenario**, as more conservative in integration

foto: tu wien, acin, markus vincze
erten Projekt "Strands" wird ein
Henry getestet, der informieren
und überwachen soll.

prägen den Alltag zunehmend. Anstatt nur Autos zusammenzuschrauben und Fußböden zu saugen, dauert es wohl nicht mehr lange, bis sie den Menschen eine Vielzahl von Tätigkeiten abnehmen. Dass Roboter einmal unsere zuverlässigen Freunde werden, daran arbeiten Ingenieure im privaten Sektor und auch Wissenschafter. Einer von ihnen ist Markus Vincze vom Institut für Automatisierungs- und Regelungstechnik der TU Wien.

Ein Schwerpunkt seiner Forschung ist es, den Robotern das

many unexpected **environment changes**

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Robot deployment in long-term care

Case study on using a mobile robot to support physiotherapy

Served as excellent test-bed for real changes
=> comprehensive **data sets**

ONTO NEW SHORES: TAKING THE ROBOT TO THE MUSEUM

NATURAL HISTORY MUSEUM LONDON (2015)

The Collection
Art and Archaeology in Lincolnshire

Open Daily 10am - 4pm
Free Entry

Home | Visiting us | What's on | Explore | Learning | Fun | Blog | About us | Hire us | Getting involved | Get in touch

Interacting with a diverse demographic (young & old)

Audience-specific tours

Intuitive Interaction also with Speech

Investigate our fascinating and varied collections and download artic

Welcome to The Collection

The Collection brings together an award winning archaeology museu
gallery, the Usher Gallery, in the heart of historic Lincoln.

PRACTICAL DIALOGUE DESIGN

What would you want to ask a robot in a museum?

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Materials

Linda

Lindsay

Activity Description

In this activity, we will be using a number of tools that have been integrated to allow us to program a virtual robot to respond to commands and perform a range of tasks. The context for this is a robot acting as a museum guide: specifically for The Collection Museum, Lincoln. If all goes well with the groups of children and their programming efforts, there may be a possibility to see their efforts being run on a real robot in the actual museum!

The tools we will use are as follows:

- **DialogFlow**: a tool from Google that allows us to design language-based interaction for our robot. This technology underlies the Google Assistant, and so is based on the latest technology. Part of the activities of this event are based on learning how to do basic tasks with DialogFlow.
- **Robot Simulator**: in order to help us to develop our behaviours, we have created a bespoke simulation that can be accessed online, which shows a robot in The Collection Museum. This means that you will be able to continue to work on your systems after you leave the University. We use the same robot commands for both the simulator and the real robot.

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http://lncn.eu/uvatut

DEMO SYSTEM

http://lncn.eu/simrob

LiveSlides web content

To view

Download the add-in.

liveslides.com/download

Start the presentation.

Dialogflow

tryitout

en

Intents

Entities

Fulfillment

Integrations

Training

History

Analytics

Prebuilt Agents

Small Talk

Docs

Forum

Intents

CREATE INTENT

Search intents

- abilities
- about node
- close_eyes
- code_card
- Default Fallback Intent
- emergency_stop
- ev_help_needed
- ev_place_reached
- gotonode
- Name explain
- open_eyes
- person_detected
- say utterance
- show_collection_website
- show_website
- What are you called?
- What did you say?
- what is this project about
- where are you?
- Wikipedia

Try it now

Please use test console above to try a sentence.

Set-up Google Assistant integration.

SETTING UP

- Activity 2, from Task 3 onwards
- Activity 4-6
  - be creative

List of activities, in order of use:

1. Group setup and team name
2. Computer and information setup
3. Variability in speech
4. Robot small talk
5. Starting the robot programming
6. Planning what the robot should do
7. Turning the plans into actions

TASK 3: Set up your simulated Robot

[*On the same computer as task 2*]

Step 1: Go to a new tab in the internet browser and copy/paste the following into the address bar (do not press Enter when you have done this!):

https://lcas.lincoln.ac.uk/simrob/

LET'S GO!

All the Systems: Please paste the URL to your system here and then vote up the systems you like and down on those you are not so impressed by.

Top

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