DESIGNING RESPONSIBLE ROBOATS

QUESTIONS, IDEAS, STARTING POINTS

SEPTEMBER 2021

DESIGNING RESPONSIBLE ROBOATS

COMMISSIONED BY

AMS INSTITUTE

- ROBOAT ENGINEERING TEAM
  - YNSE DEINEMA
- REPONSIBLE SENSING LAB
  - THIJS TUREL
  - SJOERD VERHAGEN

WRITTEN AND DESIGNED BY

BITS OF SPACE

- TESSA STEENKAMP
- SIMON STEWART

MADE FOR ALL

- DESIGNERS, ENGINEERS AND PROJECT MANAGERS
- MAKING DECISIONS ABOUT ROBOATS,
- THEIR DESIGN AND WHAT THEY ARE USED FOR

A BOOK TO GET STARTED

This is a book to get started with important design decisions for the Roboats. What ethical concerns should be addressed in the design phase for Roboats? How is this reflected in choice of the use cases? How will the Roboats' behaviour interact with a non-robotic world, and who will they serve?

We see an increasing amount of technologies being integrated into our built environment, building connections between the digital and the physical. If not well designed, interaction with these applications can make the people using them get stuck - or feel lost between two realities.

To make multi-reality experiences better, designers are often asked to come up with an interface. The complexity than shifts from front-end to back-end. Designers distill the essentials out of complexity and make those accessible for the user by hiding the non-essentials. If this is taken too far, the seamlessness of the experience can end up hiding too much of the inner working, making power relations (or data extractions) unclear to the user.

After five years of research, Roboats are at this cross-road between the engineering and design phase. Roboat technology is getting ready to be implemented on public waters, but how will the boats behave in that context? Which elements are essential, and should be designed to stand out - and which can be hidden?

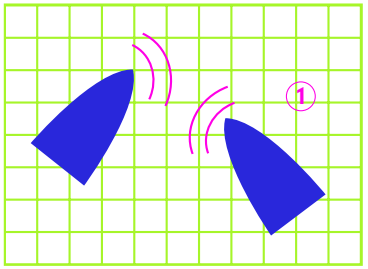
Over the summer of 2021, experts from AMS Institute, TU Delft, MIT and the City of Amsterdam came together for two workshops. The first one was for raising ethical questions around the potential use cases of the Roboat. During the second workshop, the experts brainstormed ideas and approaches to deal with such questions.

This book summarises the insights from that process, and contains ideas, approaches and ethical questions for the Roboats. It is not a guide book with answers, it is a research agenda. A place to get started with your design process. It is a book for researchers, engineers and designers, to be used for taking the Roboat further - and possibly other autonomous vehicles - along a responsible and exciting path.

NAVIGATING THIS BOOK

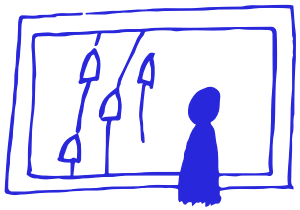
A BIG SCENARIO IMAGE

This book explores four different scenario's. Every scenario has one dominating theme, and visualises 6 to 8 different design questions or ideas within that theme. The pink numbers on the images correspond with the ideas on the next spread.



DESIGN ELEMENTS

The spread following the big scenario image elaborates on the ideas displayed, and asks relevant quesitons.



TAGS TO FIND THE STARTING POINTS YOU NEED

Designers and engineers reading this book might be looking for specific approaches or themes. That's what these icons are for. Every idea is tagged with them.

TAKING PART IN
THE NATURAL ECOSYSTEM

How should Roboats relate to all living creatures surrounding them in the canals? Look for the duck to find design questions and ideas.

MORAL
COMPASS

Which questions should be asked when designing ethically responsible roboats? What ideas did we come up with to answer those?

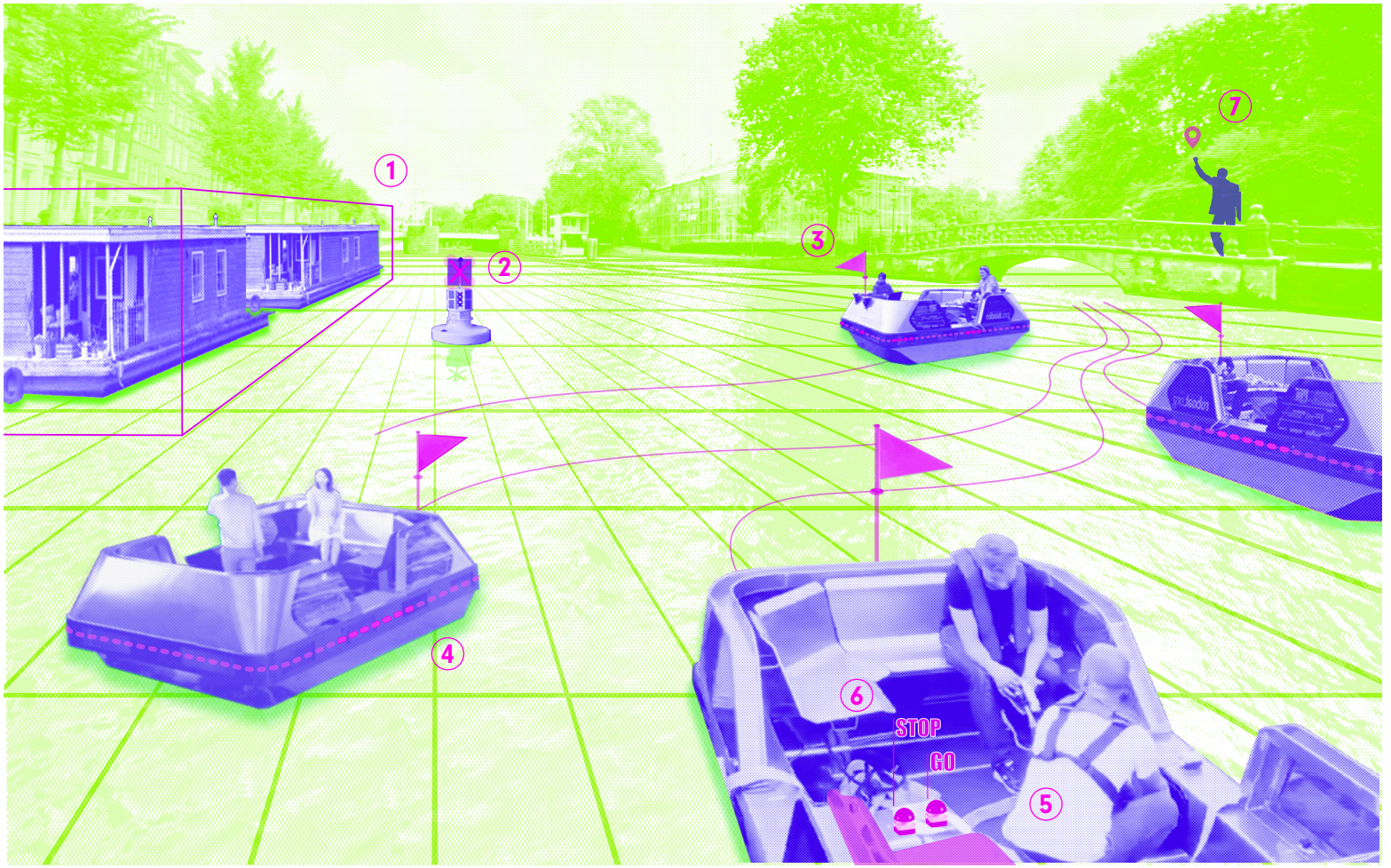
LEGIBLE AND
COMMUNICATIVE SYSTEMS

Roboats create the opportunity to code the behaviour of boats. How do we make the underlying values, decisions and constraints visible to regular people - even those without a smart phone?

INCREMENTAL
AUTONOMY

Not all boats will be autonomous from one day to the other. It will be a transition. Which questions and ideas will we run into during that transition?

NEGOTIATING CONTROL AND REPONSIBILITY THROUGH DESIGN



When a machine makes the decisions, who is responsible for the consequences of those decisions? This is a question concerning all fields of digitisation, and it will also concern the Roboat.

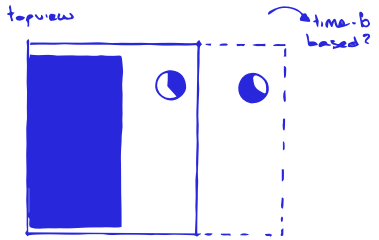
In the event of an accident, are the users of a Roboat expected to behave in a certain way? And if not, what does it mean if responsibility and control are divided between two different entities?

If we assume people on the boat are not responsible for the boats actions, does this give them the same rights and actions as bystanders? Can a bystander demand to take the empty seat on a Roboat with the other seats taken by a group of friends? Can a houseboat resident control the path of Roboats when they come too close?

If the passengers are not responsible for the boats actions, then who is? What does this mean for other boats interacting with the Roboat? How can they tell they are dealing with the boat rather than the captain, and how does this divide materialise?

DESIGN IDEAS AND STARTING POINTS

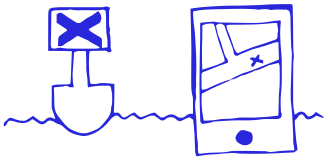
1



BOUNDING BOXES

Roboats can read invisible, flexible bounding boxes around houseboats, protecting them from waves. Can the box change in shape when residents are not home? Who is in charge of defining the area?

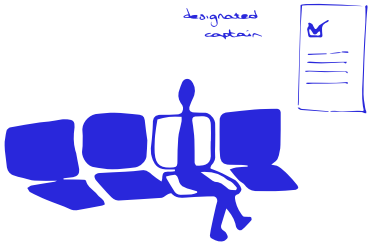
2



VISIBLE CANAL BLOCKS

Who owns the canal, the boat passengers or the residents? With this visible marker, residents can claim temporary ownership, and book the canal for a quiet evening.

5



DESIGNATED CAPTAIN

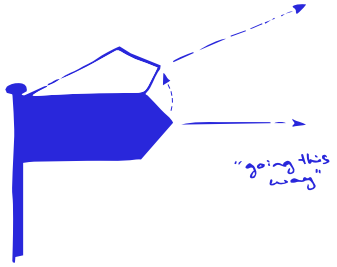
Do passengers sign a waiver? Does someone need to stay sober? We've designed a designated captain seat, just in case.

6

STOP AND GO BUTTONS

What is the minimum intervention a passenger should be able to conduct, to still carry responsibility?

3



POINTERS FOR DIRECTIONS

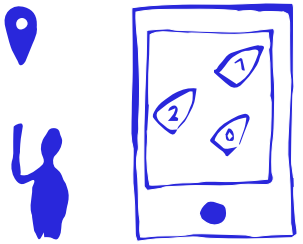
How might a Roboat make their algorithmic decisions visible to people? This arrow points at where the boat is heading.

4

SURROUND RADAR LEDS

Am I being seen? On the surround radar LED strips, you can look the Roboat in the eye: the LEDs illuminate where it has seen other objects on the water.

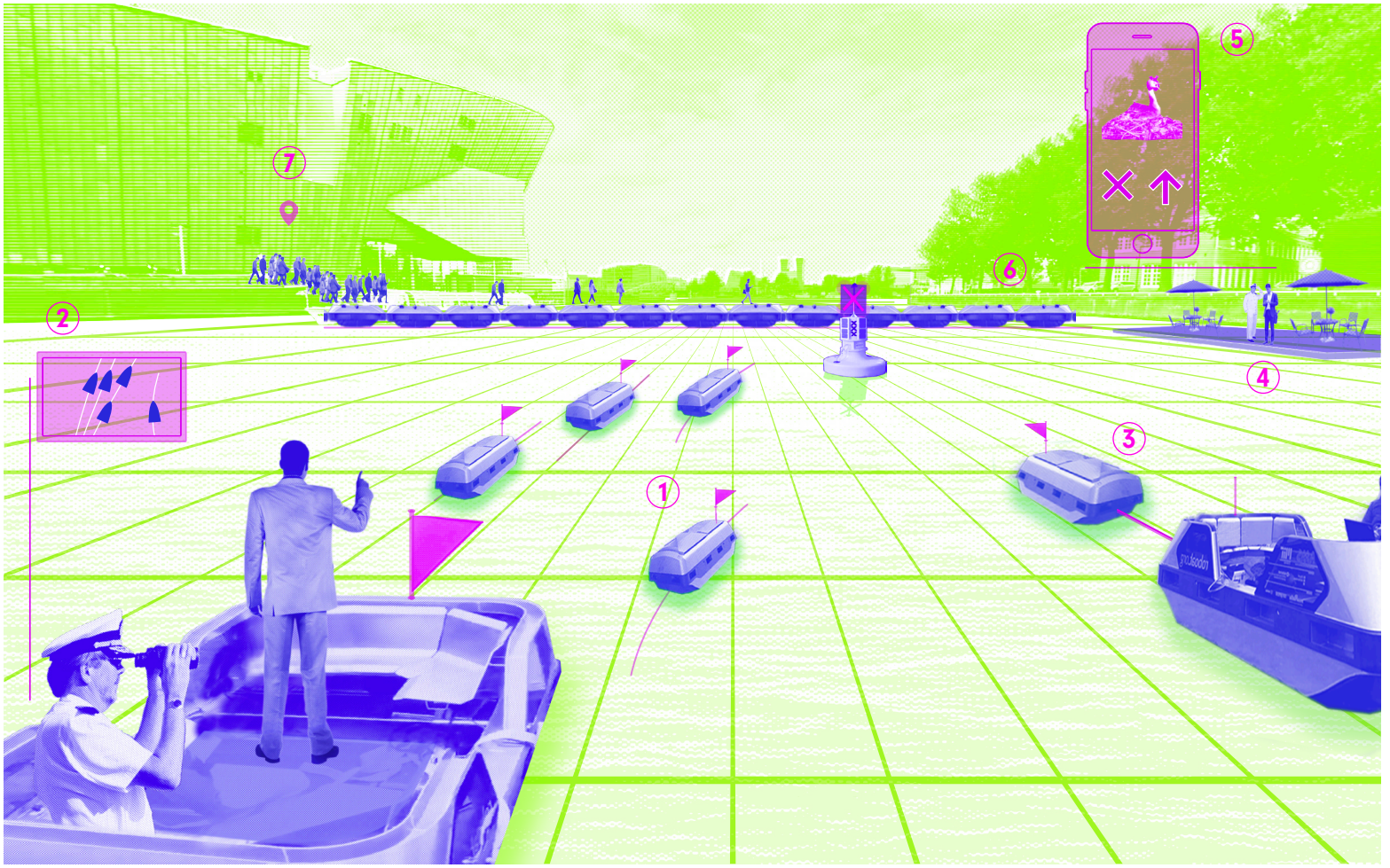
7



PICK ME UP

If the Roboat is part of the public infrastructure, will it be possible to catch a ride? Who gets priority in using the boats?

BUILDING ONTO THE SKIPPERS' KNOWLEDGE AND CULTURE



Amsterdam has a shortage of skippers, so the Roboats might be a welcome intervention. Being a skipper requires skill and knowledge of maritime laws, but also of its own professional culture and its unwritten laws. Not all just as easy to programme into autonomous decision-making.

How might we empower the existing skippers rather than replace them? Ask yourself: is it the technology we want to grow, or do we want to let the people grow using the technology?

What extra powers would it give a skipper, if autonomy means they could be in charge of a whole fleet of boats?

Not all boats will become autonomous at the same time. Autonomous boats need to be able to communicate with skippers on other boats. How might we integrate skippers culture into the Roboats behaviour - and programme the unwritten social laws on the water? Can skippers and programmers work together to define socially acceptable, behavioural patterns?

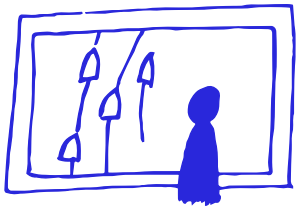
DESIGN IDEAS AND STARTING POINTS

1

LEADING THE FLEET

Amsterdam has a shortage of skippers. Could a skipper lead more than one boat - a mother goose of an autonomous fleet?

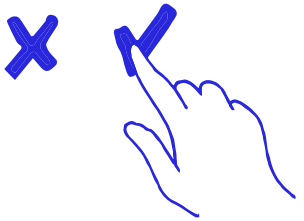
2



CONTROL CENTRE ON BOARD

Through an on-board screen, a skipper has a small control room for its fleet. He can steer the group, or appoint tasks to individual boats. Or, should this happen in a centralised shore control centre?

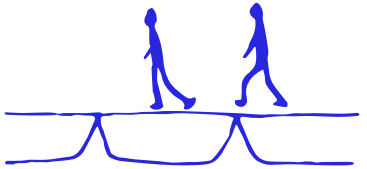
5



TEACH THE ALGORITHM

How to relate to other life on the water, while being a skipper? When to stop, and when to go? Skippers train the algorithm.

6



PONTOON BRIDGE

The skipper can tell its fleet to form a pontoon bridge when they feel this necessary, turning the city into a flexible network of roads and bridges.

3

APPOINTING LITTLE HELPERS

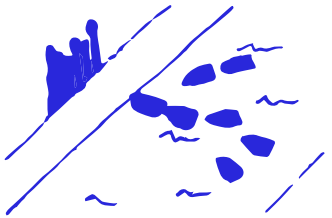
The little boats can be appointed tasks such as: towing a boat that stranded, or take certain waste out of the water.

4

SKIPPER - CODER HANGOUT

A hangout close to the Roboat R&D centre, where skippers meet up with engineers to teach them about boating behaviour.

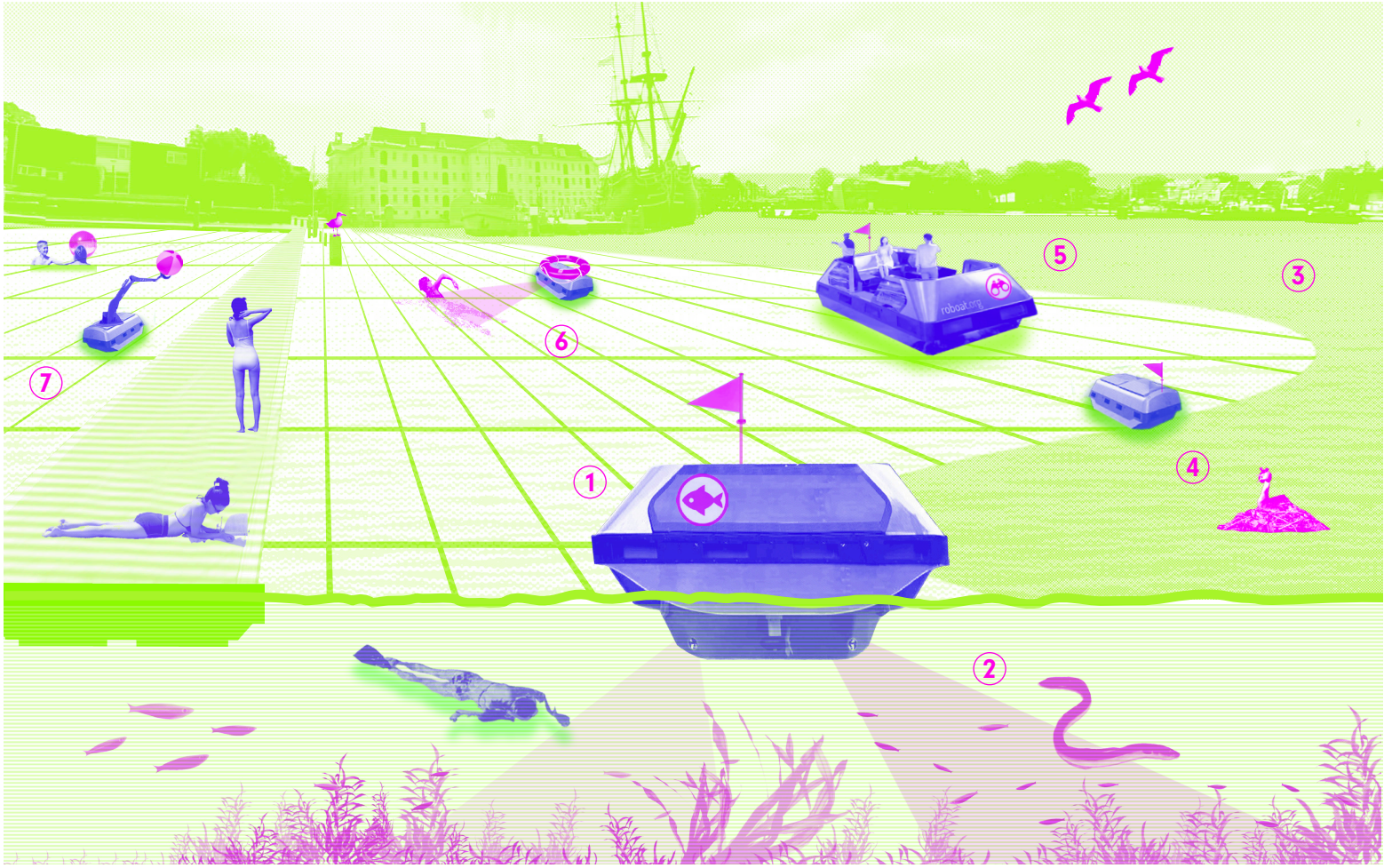
7



CRITICAL MASS

Pontoon bridges have the possibility to make the urban infrastructure interactive. Where and when are bridges most useful? Can crowds request bridges too? Is it a self-learning mechanism?

ROBOATS AS CANAL RANGERS, PROTECTING THE ECOSYSTEM



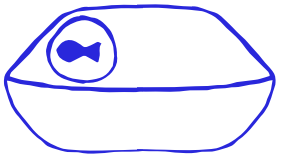
Part of a canals' charm is its fluidity, also figuratively speaking: waterways cannot be structured like roads. It is not as easy as implementing road lanes or traffic bumps. At one point canals can form the stage for a canal parade, and at another they are a rowing or even ice skating track. Moreover, in between all these human activities there are birds, fish and plants using the same infrastructure.

Many digital innovations in the built environment aim to make life in the city more efficient. What if Roboats does the opposite, and serves the spontaneous sides of life on the canals? Can we utilise this innovation to establish and guard a symbiosis between human behaviour and wildlife around the canals?

What if a waterbird is protecting its nest? Will the Roboat turn around? What if the Roboat has to choose between colliding with a little duckling, or with the quays? It becomes tricky when these decisions have to be written in code: will we have to assign the Roboats a place within the natural hierarchy?

DESIGN IDEAS AND STARTING POINTS

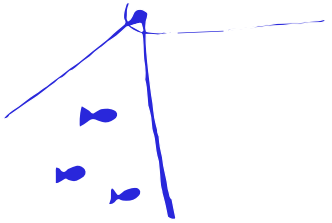
1



ROBOAT AS RANGER

Innovation such as Roboats should not just serve the efficiency of human life, it should take a place in our ecosystem and relate to other forms of life as well.

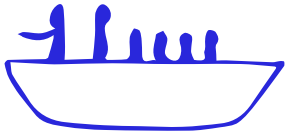
2



SCANNING UNDERWATER LIFE

The Roboat as ranger scans underwater to monitor wildlife and its diversity.

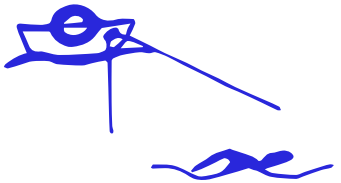
5



EDUCATIONAL TOURS

Knowing exactly what can be seen where, the ranger Roboats can give educational tours to school classes and visitors.

6



PROTECTING SWIMMERS

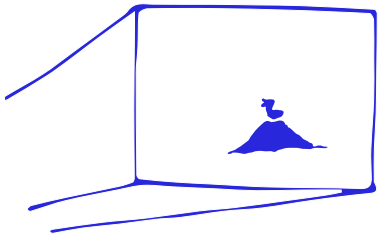
Amsterdams canals are increasingly popular for swimming. Can Roboats play a role in this? When you're going on a long distance swim, just take along a Roboat!

3

QUIET AREAS

Some areas can be programmed as a no-go zone for boats, leaving more space for fish and birds.

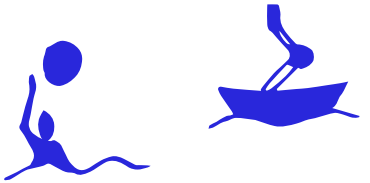
4



PROTECTING SPECIES

Roboats can count and monitor nests. Should they also protect them against preditors? Which place in the ecosystem do the Roboats as autonomous crea-

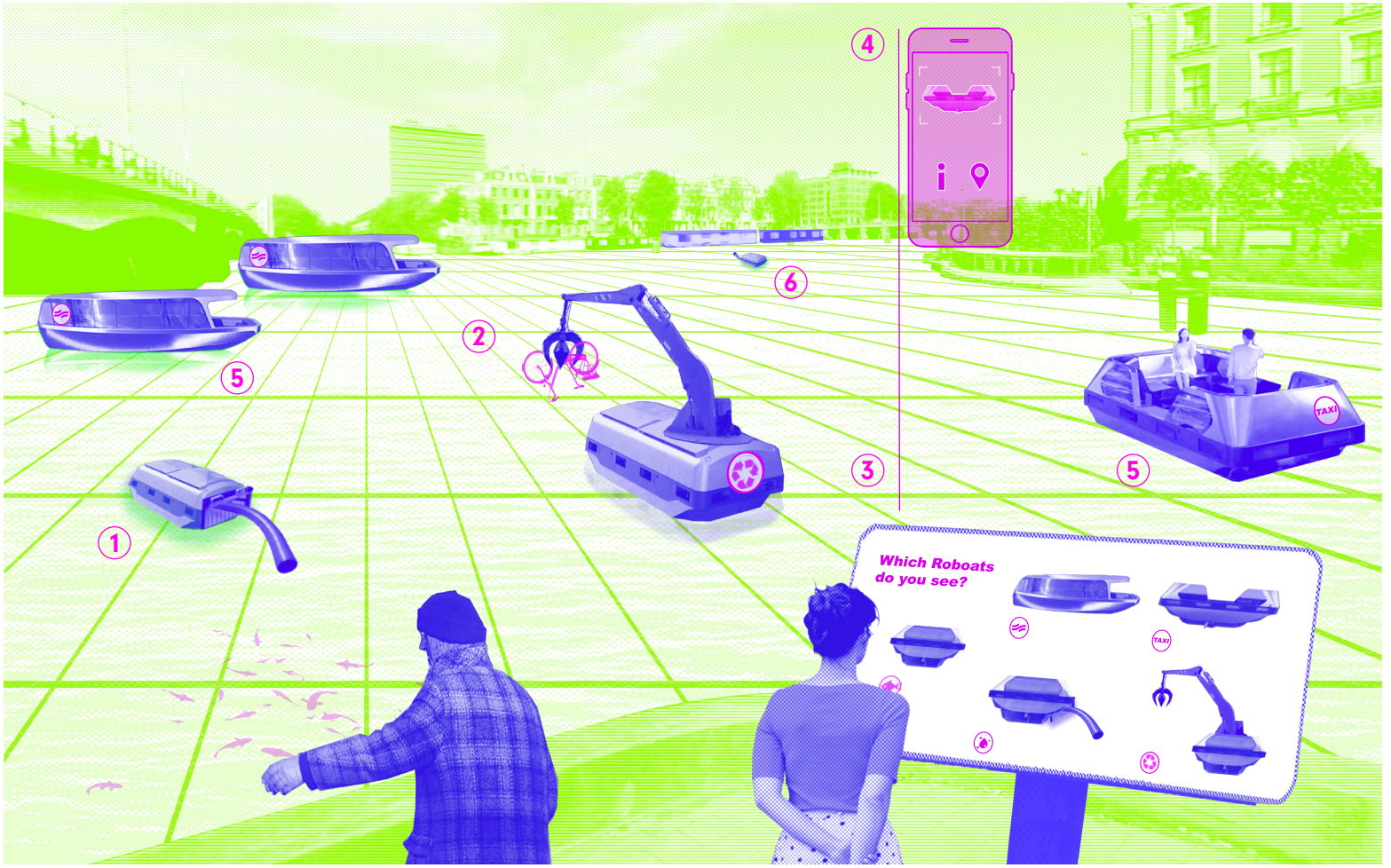
7



PLAYING ALONG

When there's nothing else to see or do, how do the Roboats relate to us? Will they play along?

SPECIES OF ROBOATS, FORM FOLLOWS FUNCTION



Roboats will be performing a variety of tasks, requiring varying tools and sensors. Differentiating in the way Roboats look, will make it possible to read the Roboat's function from its form. Legibility is important for being able to have a public discussion about the technologies integrated in our cities.

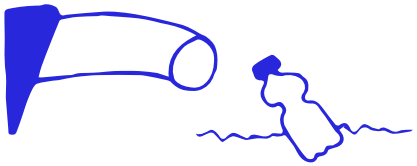
As one of our invited experts said: "A boat should clearly state what it does and what is senses. Please do not use a QR code for this, a QR code is not a legible thing."

Can the design of the Roboat facilitate the collective decision making on what we should use these autonomous vehicles for? Which tasks legitimise which use of sensors?

Will it be possible to privately own a Roboat? If so, how will their design differ from the public ones? Will it still be possible to recognise them as an autonomous boat? If not, does that have any consequences for how people will interact with them? Will they still be based on the same privacy-protecting standards, and how can we tell?

DESIGN IDEAS

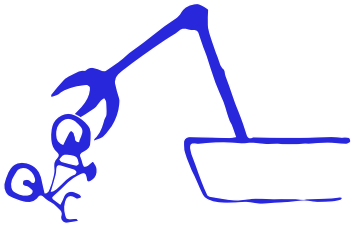
1



A CLEANING TRUNK

To know what a Roboat is performing, and what kind of sensors it carries for that task, the Roboat's form should communicate what it is doing. This Roboat uses its trunk to clean leftovers of bread out of the water.

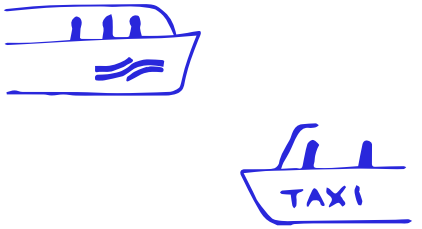
2



FISHING FOR BIKES

Which public causes do we find important enough to invent a new species of Roboats for? And how do we make these species visible, to be able to discuss them in the public realm?

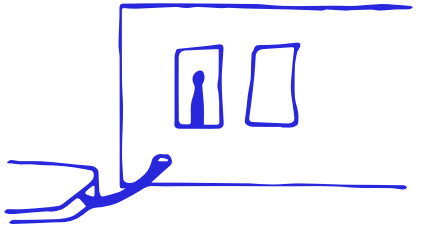
5



PUBLIC VERSUS PRIVATE

Is it a bus or a taxi? Cars have different colours license plates, how do the Roboats differ? How do we make both their accessibility as the values on which they are coded visible?

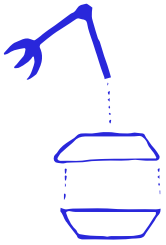
6



CLEAN QUAYS AND BOATS

Can publicly owned Roboats be used for private purposes in idle times? Which percentage of their time are Roboats performing public activities? Do private users pay a fee?

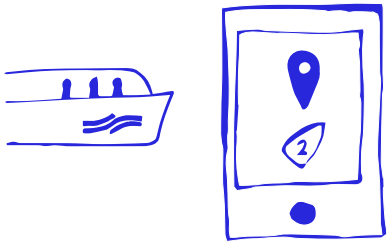
3



TYPOLOGIES SIGN

It takes a while to learn about the species and its several sensors. It's the designer's task to make this as legible as possible. Public signs and school posters can help too.

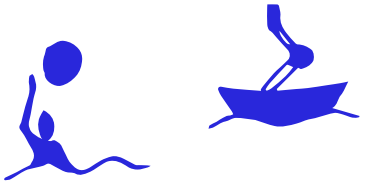
4



HOW MANY AND WHERE

Track the different species real time, and see what they are up to.

7



CRITICAL MASS

Pontoon bridges have the possibility to make the urban infrastructure interactive. Where and when are bridges most useful? Can crowds request bridges too? Is it a self-learning mechanism?

WITH INPUT FROM THE FOLLOWING EXPERTS

VNG
- DIRK VAN BREDERODE

MIT SENSEABLE CITY LAB
- PIETRO LEONI
- TOM BENSON

FREEDOMLAB THINK TANK
- SEBASTIAAN CRUL

TU DELFT
- JARED VROON
- MARCO ROZENDAAL
- IBO VAN DE POEL

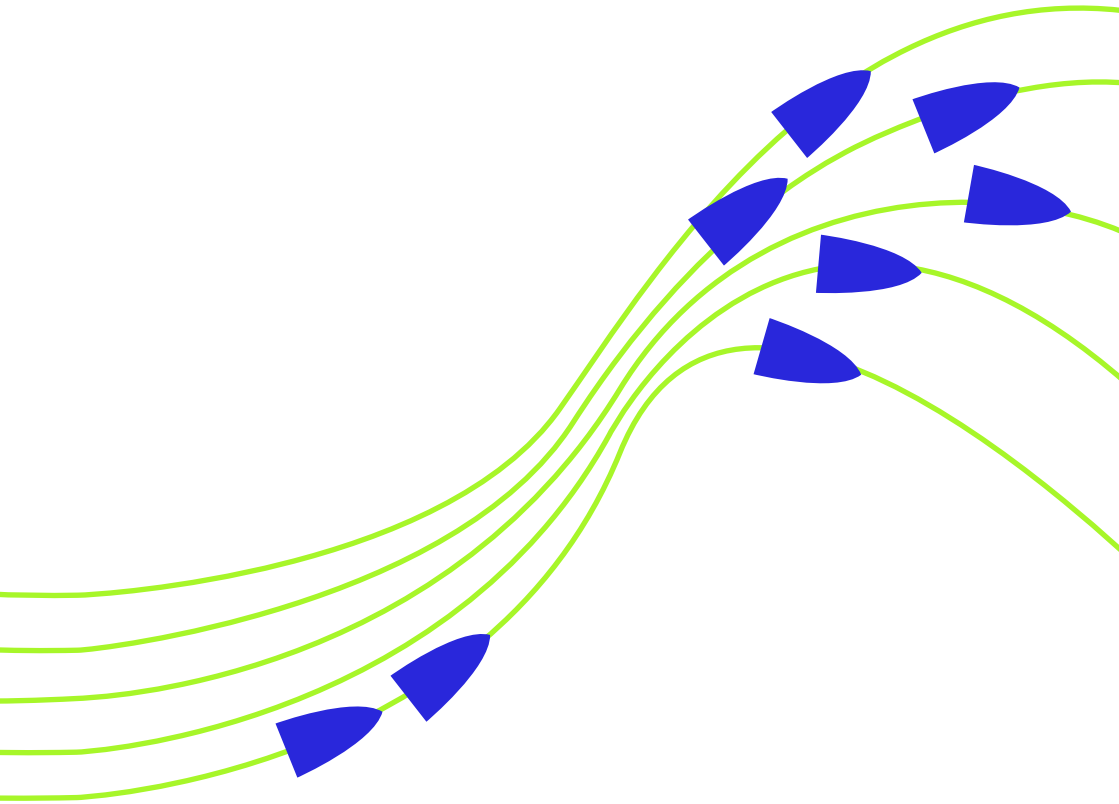
TILBURG UNIVERSITY
- MEREL NOORMAN

GEMEENTE AMSTERDAM
- BERYL DREIJER
- YUKI TOL
- CLÁUDIA PINHÃO

VRIJE UNIVERSITEIT AMSTERDAM
- AAFKE FRAAIJE

AMS INSTITUTE
- YNSE DEINEMA
- THIJS TUREL
- SJOERD VERHAGEN

BITS OF SPACE
- TESSA STEENKAMP



AMS

AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS