Robot Code of Conduct

Designing pleasurable, fitting and coherent behaviors for robots and Artificial Intelligence

Introduction

"Every interaction reflects who we are. It contributes to how we, and the Lely brand, are perceived.
We must speak the same language. And use one tone of voice in all forms of communication." - Lely Brandbook

Why is this Code important?
We are close to farmers, but our products go even a step beyond that, coexisting and collaborating daily with them. Robots and Artificial Intelligence (A.I) are no longer mere tools but partners, impacting farmers' lives and businesses. They can also be considered as "ambassadors" of Lely, and for that reason, we should design them to behave in the desired way according to Lely values.

What does this Code say?
The Robot Code of Conduct contains guidelines on what is expected from our products to represent Lely. First, it introduces principles and qualities rooting the behaviour of the current and future Lely products. Then, it assists in implementing consideration from this robot nature to the design of shared, consistent, and pleasant product behaviours. The Code concludes with a detailed practical guide with a compilation of examples describing how our products act and express themselves for diverse purposes.

For who is this Code?
The Robot Code of Conduct targets all employees involved in the design or development of Lely robotic systems and artificial intelligence.

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Purpose

Regardless of place and time, we express our values through our actions.

We need to be cohesive and consistent with our communication to create trust in our systems and agents. This Robot Code of Conduct aims to facilitate a shared understanding between our products and users, for example, by clarifying the product capabilities, limitations, and next steps. The Lely Robot Code of Conduct provides:

1. **Why** should Lely robots behave in a certain way?
   Qualities grounding the robot actions
2. **How** can we develop those behaviours?
   Guiding flow with questions and considerations
3. **What** expressive mechanisms do Lely robots use currently?
   A practical guide to Lely language

Heritage

The Red Rules identified the need to unify our vision and establish design personalities to convey our values also through our non-human workforce. This Robot Code of Conduct arises from that vision and takes a step further towards achieving it, defining conducts and design directions without losing track of our root values and principles.

This scheme illustrates the evolution and connection between these values and conducts:

Our values					
Our Personality	Creative	Bright	Optimistic	Supportive	
Design Personalities	Human-Tech	Connectivity	Responsible Progress	Cow-Centered	
Robot nature	Accuracy	Reliability	Efficiency	Clarity	Friendliness

Vision

We are Lely. We look like Lely. We act and communicate like Lely.

In an envisioned future with full robotized barns, Lely offers an increasing variety of robotic farm solutions which work together as one well-oiled machine. Our robot-robot collaboration is the apex of optimization. The common language among our products and services allows farmers to familiarize themselves with their robots and learn how to communicate with them. Lely cares about farmers and animals, so we take our interactions a step further by envisioning a future where robots acknowledge, learn from and adapt to the different users and situations.

Your Robot
Personalization. It respects you and your space.
Situationalization. It adapts autonomously to changes.

Your Partner
Co-evolution. Building your future together.
Agency. Finding the balance and role that fits you.

Your Ally
Perception. Feeling safe, feeling in control.
User Experience. Feeling acknowledged, feeling understood.

Caring

At Lely, we are dynamic, in continuous progress, and so is our Robot Code of Conduct. When it comes to fitting interactions, we are in constant evolution. We affect our users which influence new needs and situations to address and account for. So, codes should evolve to acknowledge and tackle these new challenges.

We keep this code alive, sincere and relevant through our actions and decisions. Every Lely employee involved in product design and development is responsible of protecting the credibility of this code. We should all acknowledge the importance of the topics stated and use them as guidance in our process.

Additionally, the corporation is responsible for bringing attention to this topic, updating the codes, and providing resources to the concerned employees. These can be expert talks or other training that help them succeed in implementing the recommendations on this code.

Sharing

Get inspired by this code, share with others, compare and ask for different perspectives. Starting a conversation is the first step. Share your point of view, or perhaps additional documents and resources.

We are eager to hear from you and how we could make this code better. We made this code for you, so if you have any suggestions, doubts, or complaints, do not hesitate to reach out to us.

Robot Code of Conduct Committee:
Jan Jacobs jjacobs@lely.com
Jeroen van den Ban jvandenban@lely.com

Who to contact for **advice in human experience?**
To be decided

Who to contact for **advice in animal experience?**
To be decided

Lely Robot Nature

Fundaments of the behaviour of our Robots and Artificial Intelligence

Robot Nature

Accuracy

Lely robots are precise in their work...

Reliability

... consistently, making them trustworthy, ...

Efficiency

...doing it with the least amount of resources...

Clarity

... being understandable and transparent ...

Friendliness

... and creating comfort-able user interactions

Interaction, goal and user

This chapter describes the desired qualities of robots and AI behaviour to represent Lely. It is described from the voice of a robot as follows:

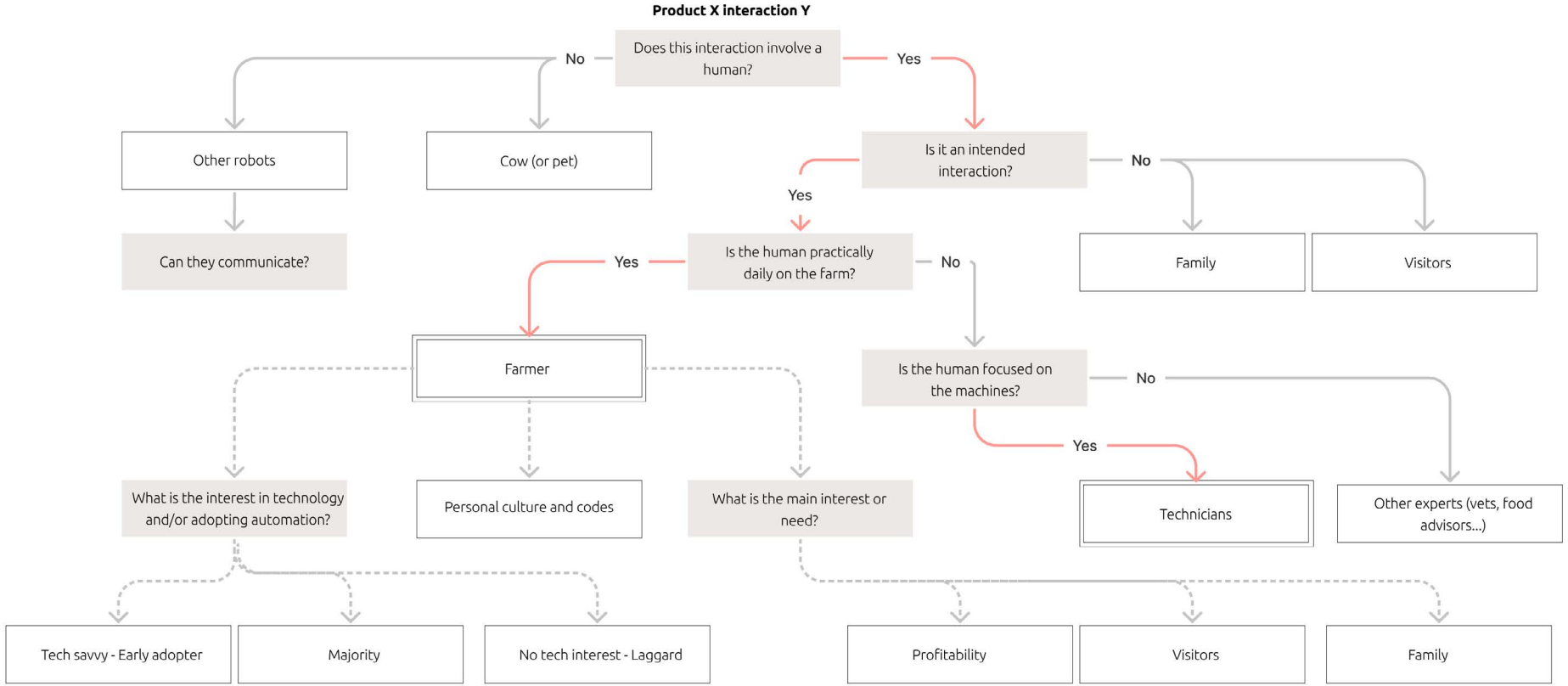
Nice to meet you. I am a Lely robot. My task is to narrate this chapter for you, the reader, the developer, so you can immerse in my perspective. Thank you for taking the time and interest in learning how to improve our coexistence and collaboration.

What is an interaction?
I interact when I engage in activities with someone or something having a one-sided or reciprocal influence. Thus, if my existence or action affects a human, animal, an object, or vice-versa there is an interplay and a message transmitted. The message can be more or less explicit and the interaction can either have a purpose, i.e. alarming, or be unintended i.e. mere movement.
Takeaway: Identify and aim to foresee all potential interactions to design appropriate conduct accordingly.

Which is your goal?
What do I want to achieve with this interaction? Should it happen in the real world or digitally? How should my actions be perceived? How should I communicate?
Takeaway: Define the context in which your interactions occur and the other users involved. Set your target and share it with your team.

Who is the user?

By “User”, I mean any individual or group of people, animals, or robots engaging with me in an interaction. Whom am I talking to? Who is acting along with me? Who is looking at me? Ignoring the diversity of users and needs, and acting equally with all, will get some enemies.
Start with this chart to discover some of the potential users. All of them have different characteristics and needs.



Accuracy

"The quality of being correct, or exact; freedom from error or defect."

As a Lely robot, I have been created to carry out a set of tasks on the farm. Humans know that those tasks are my only purpose. They purchased me for that and have high expectations about my performance, so I should do my ultimate best to live up to these expectations and provide the **exact results** aimed for. Communication is key. I need to communicate appropriately and **show that I deliver the results promised**. I also need to involve the user when needed and to the desired degree. To achieve accurate communication, I first need to acknowledge that humans and animals perceive the world differently. I am more accurate than a human will ever be, which can sometimes scare them. If I want them to understand my message precisely, I first need to **translate my computational ego to the human language**.

You can ask yourself

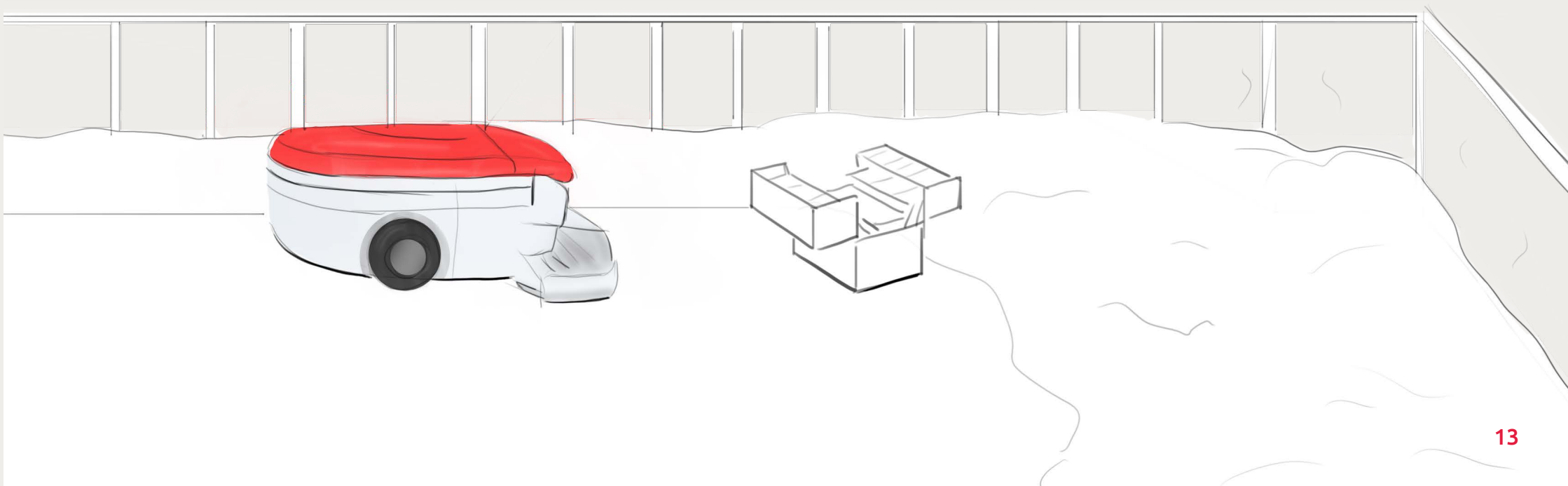
- Which is the exact goal of the interaction?
- How close am I to achieving it?
- How can this task be done to achieve an ideal outcome?
- How can collaboration with a user be transmitted to deliver the most precise results possible?

Obstacle race

To be accurate, I first need a goal. My goal as a Lely robot is to provide Bright farming. That is too broad for me, so I need to focus on a smaller achievable target. For example, as an expert on manure, I could aim to suction at least 80% of cow excretion in my designated area every hour. With that clear target, I should do my best to excel at it, 79% suction is not enough. I must be resilient, defeating enemies like forgotten toolboxes that want to block my path to success. Accuracy is a faculty that I like because I can measure it objectively and improve based on my analysis. I am picky with my job and always aim for the best results.

Remember to

1. Set precise, small, and achievable goals.
2. Identify potential obstacles and set preventative and resolutive mechanisms.
3. Analyze performance and seek perfection.



Example of Accuracy

Impossible mission

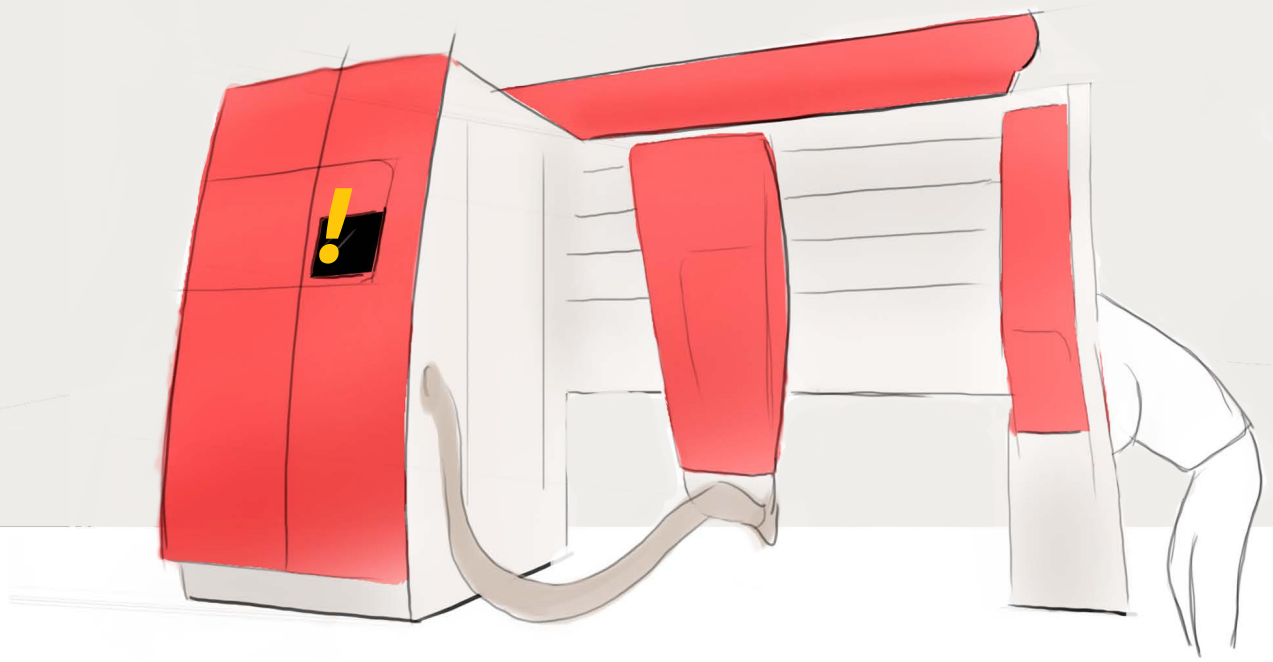
Sometimes collaborating with the user is essential to achieve the most optimal solution. As a milking robot, I cannot go anywhere. I sometimes need the physical or mental help of my users. My design should also account for this, understanding how the user will get involved in the task, and behaving accordingly to make it possible and smooth.
If the farmer is inspecting the teat-cups, we cannot work together anymore as my screen is out of the vision range.
I prefer to carry out my task and not involve less precise agents. But I need to be humble and admit that sometimes I just need them.

Remember to

1. Identify situations where users will work around the robot, with the robot, or for the robot.

2. Study the needs of the users to carry out the task accurately.

3. Allocate mechanisms to ensure the information is accessible when needed.



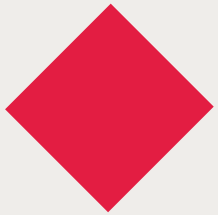
"The quality of being able to be trusted because of working or behaving well consistently"

To do my job and bring value to the farm, I need to **gain human trust**, which is easier said than done. In the end, I am an unknown entity working around and with their precious assets (i.e., family, cows, or belongings). Trust can be **achieved by consistent, transparent, and effective work**. The farmer should know about my current capacities and limitations. Reliability does not mean working flawlessly but **setting realistic expectations and fulfiling or exceeding them**.

You can ask yourself

- How confident are customers about their robot performance?
- How aware are they of its capabilities and limitations?
- What is the perceived safety of the users being around the robots? How confident are the farmers leaving the robots in charge?
- Are the users aware of when the robots change behaviour and why?

Reliability



Example of Reliability

International chef

Imagine me being an Artificial Intelligence model aiming to provide a suitable feed mix for cows. My goal is to make the proper mix for them to be healthy, thus living long and producing high quality and quantity of milk. After a long period of training day and night, I am in great shape. In the beginning, I received supervision, but now I achieve good results constantly, so the farmer gives me more control over the task. Everyone is so proud that humans take me to work at a new farm. Many challenges arise from being in a different context, but I should not give up. I am honest. I let the users know that I need to adapt, but regardless, I will always be safe, physically and with their data, and will notify whenever I need help.

Remember to

1. Prevent changes and variables in the environment and set mechanisms to adapt to them

2. Make the capabilities and limitations of the robots transparent when needed. Ensure data privacy and security.

3. Identify when the robot may need help from a user and make sure they can reach them.

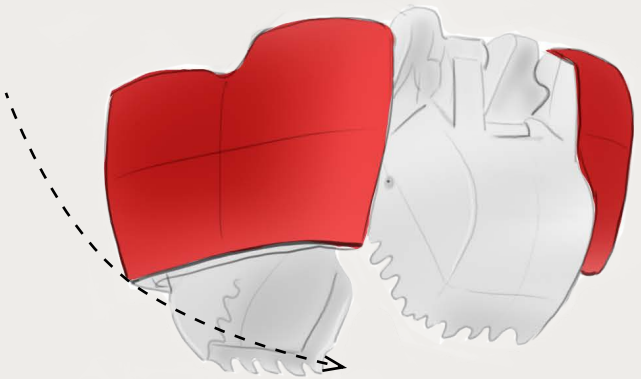
Example of Reliability

Choreographer

Trust develops as it increases the mutual understanding between the user and me. If mixing the food, I always grab the same types of food from the same positions and in the same order, soon a human observant will discern the pattern. Then, the person will predict my movements while I perform a studied choreography. I should assist this process by expressing my intentions and being consistent. I could, for example, light that indicates the direction of my next move.
However, I need to minimize the risk that users become overly confident around me and start defying my safety recommendations because I am a robot, I may change and improve.

Remember to

1. Be consistent with the current behaviour of the robot.
2. Help the user to make sense of what caused what reaction.
3. Put measures to clarify the robot intentions.



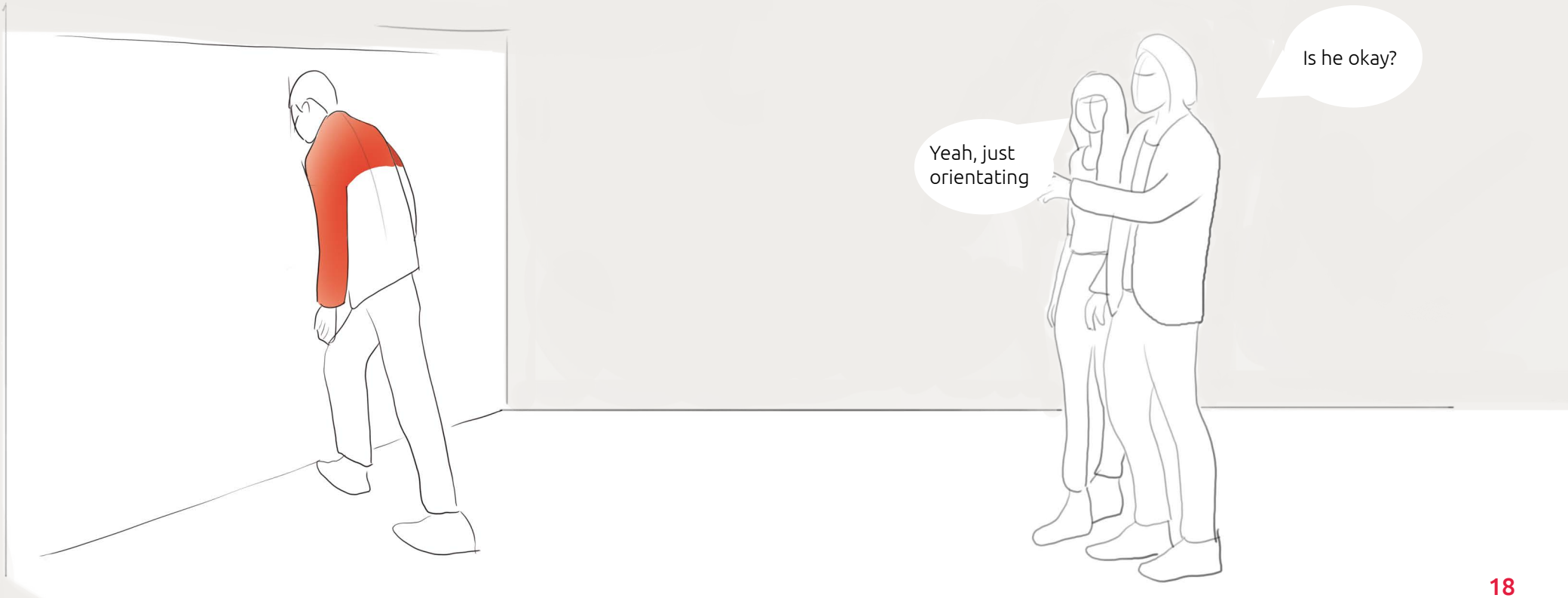
Example of Reliability

First impression

Perceived reliability is key to building trust. I should be a trustworthy team player that performs well consistently and appears as such. My actions should be transparent but also evoke intentionality and confidence: “I know what I am doing, and this is the best action to take”. That may not happen if my movements are loose or appear aleatory. Many users surround me and potentially perceive me differently. I should be aware of that and steer it to my advantage to represent Lely appropriately.

Remember to

1. Analyze how humans perceive the robot behavior.
2. Study how this conduct could evoke positive attributes or inform the user about it.
3. Aim for the robot to look confident, accurate and sturdy.



Efficiency

"The good use of time and energy in a way that does not waste any"

Optimization is a big part of my raison d'être as a robot. My calculative nature allows me to collect precise information and use it for the best output. Humans like that about me. I can make things **faster with less material and a lower error rate**. As I become smarter, I even learn to guide others with my maintenance. Moreover, I am learning to do it myself, and I am trying to prevent problems from happening in the first place based on my previous experiences. I am **an efficient actor and an efficient communicator**.

You can ask yourself

- How many steps does it take for your specific user to achieve the goal?
- Can you achieve the same goal using fewer resources (e.g. less time, energy, material, etcetera)?
- Can you communicate the message in fewer time or with less interaction points?

Example of Efficiency

All for one and one for all

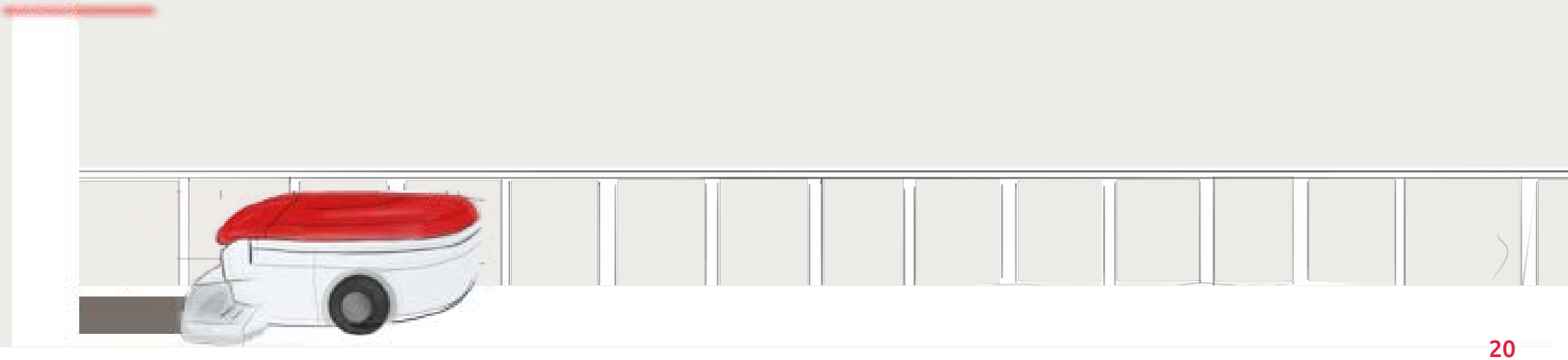
One plus one can equal three, meaning that if we properly align and join our forces, it can result in a smooth and exponentially efficient flow. In large farms, efficiency is key. If we synchronize as a Lely team, we can make the smartest use of our resources by, for example, having shared charging hubs. Standardizing our charging stations, saving space and energy consumption. Once I learn when to go where I become more flexible with my schedule and movement. It is obvious that we are a team, same Lely coach, same red uniform. It makes sense that we work as such. Playing together opens up many opportunities by taking advantage of each others' strengths.

Remember to

1. Be on the lookout for opportunities to use fewer materials.

2. Take profit from efficient concepts like standardization. Explore the potential of interoperability.

3. Carefully evaluate the value and costs of developing a robot-robot collaboration.



Example of Efficiency

Minimalism

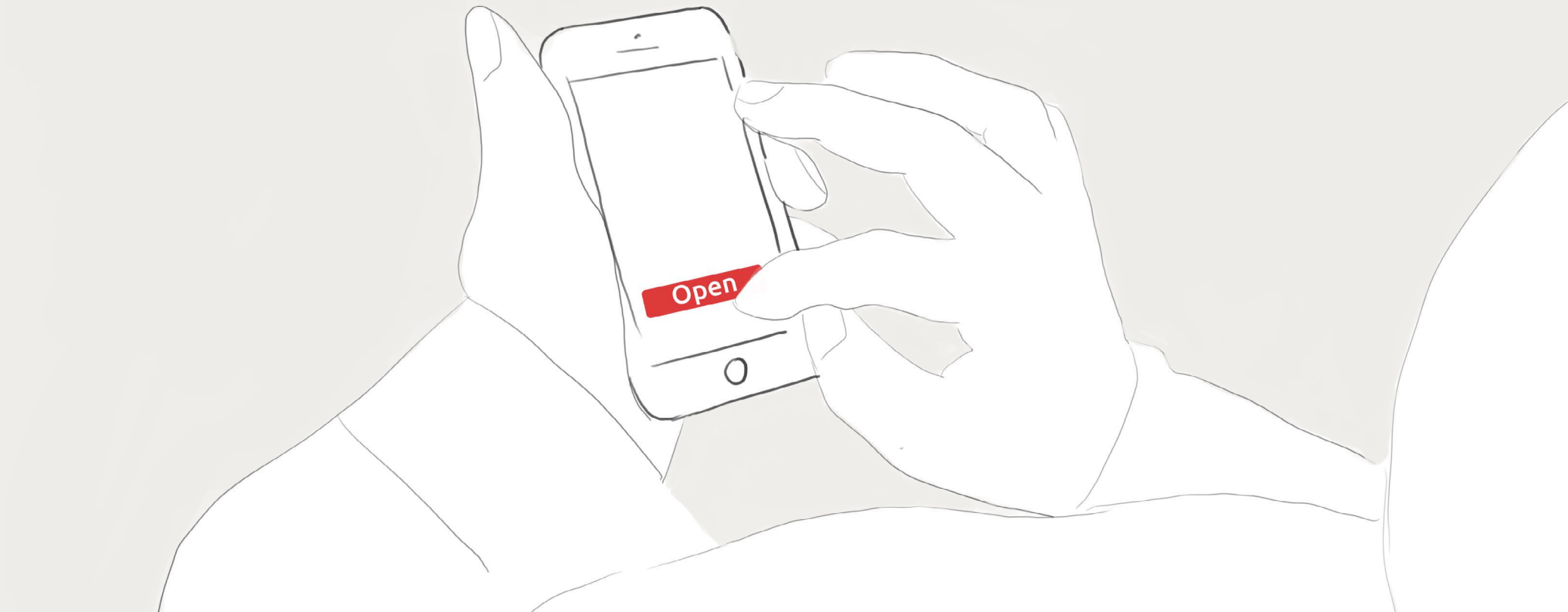
My communication should also be efficient and become even more through time as I get to know the users. If I talk only with the information needed, they save time and mental effort. When informing on my results, I first check which user requires this information, if any. Probably some farmers want this information. They use the phone application, a controlled environment where I know whom I am talking to. During my first interactions with the app user, I ensure that my information is explanatory. Yet, as time passes and we learn about each other, I can optimize my messages. Then, I could reduce their content to simpler expressive mechanisms or provide shortcuts.

Remember to

1. Look for ways to say more with less information.

2. Identify whether there is potential for a shortcut and implement it wisely.

3. Study the interest of the user in getting involved in the task, and adapt to it.



Example of Efficiency

The morse code

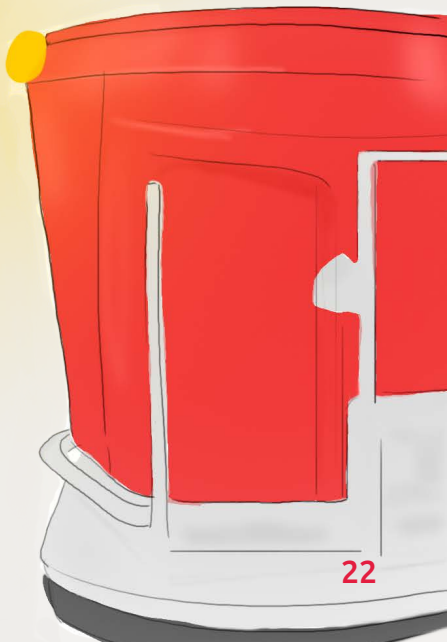
Before deciding on a channel to convey a message, I should first check if the user can decrypt it, make sense of it. Using only LED lights would work deficiently to explain my problem or result. The user may make unnecessary mistakes, get frustrated and eventually lose more time. The virtual platforms can reiterate my messages and develop exponentially further on them. I can use the potential of the apps to deliver more efficient messages using cohesive language. Nonetheless, consider that sometimes, for example when carrying out a manual task, using the phone may be more complicated.

Remember to

1. Select mechanisms that are not only fast to detect and recognize but also to remember.

2. Adapt the complexity of the message to the user that needs to receive it .

3. Choose the right moment and format for the communication.



Clarity

"The quality of being easy to understand"

As a robot, I am built differently than anything humans have ever known. They are unaware of what I can see and what I am oblivious to. I need to be clear for humans to understand me. **We must be consistent**, as Lely robots, **with what we say and how we say it**. I work on a farm, a complex environment where several things happen simultaneously. Farmers need to be experts in a variety of disciplines, and that is complex enough by itself. **I should not demand their mental energy to make sense of my actions and needs**. I communicate clearly to reduce their mental effort and prevent misunderstandings.

You can ask yourself

- How do different people perceive the message or action you are designing? Do they do it similarly?
- How long does the sense-making process of the user take?
- How sure is the user about having understood the message correctly?

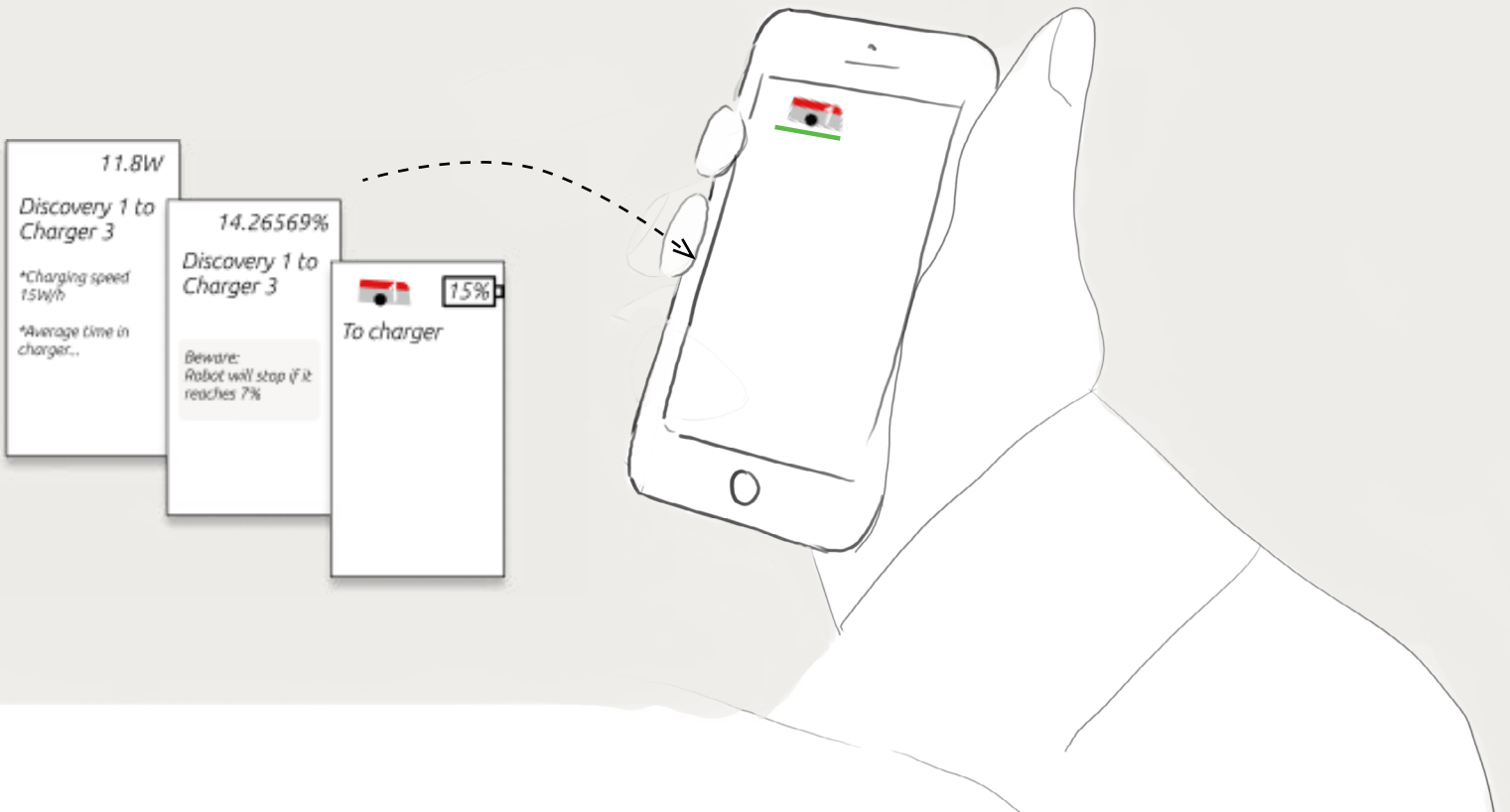
Example of Clarity

The battery puzzle

To communicate a message, I first define whom I am talking to, when, where, and what information the user needs. Then I present it in his/her/its language, removing any in-between step of sense-making. If I were a moving robot I would have a battery that I autonomously charge. Nonetheless, some users may still want to know the state of my battery, the technician for instance, to program some tasks manually or be alerted if something goes wrong. I use digital platforms to inform about my battery. I identify which information the user needs, and deliver a message that is objective, yet simple to understand and act upon.

Remember to

1. Bring information to the user language, adapt it to his/her/its needs.
2. Make messages obvious and simple.
3. Be objective, do not leave room for personal interpretations.



Example of Clarity

Follow the light

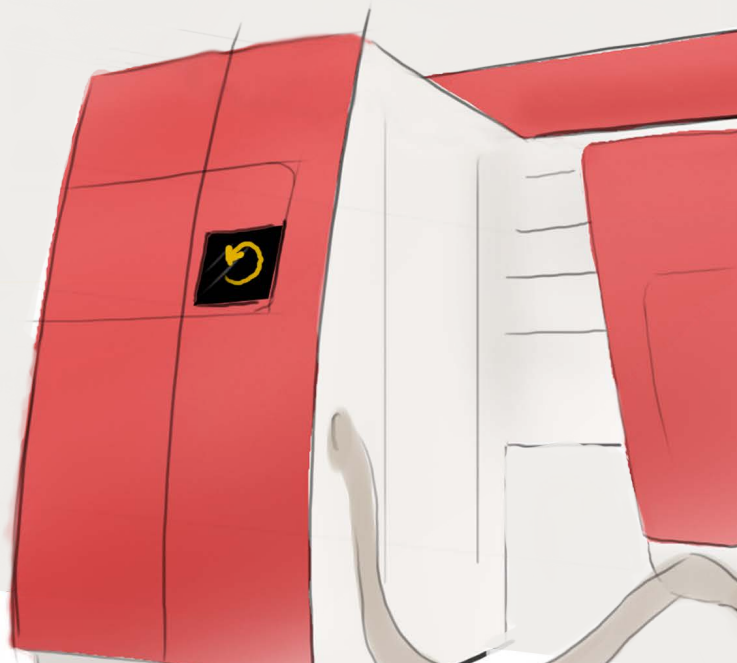
I have the power to be ubiquitous, with both physical and virtual representations. Digital platforms allow me to explain myself while using my body helps me link that information to the real world. As a milking robot having problems, I could notify the human digitally and use my body to indicate potential problem sources to check, saving time and effort for the user. My design is transparent. I use affordances to give cues to the user about how I behave and how they can behave with me. My handles help open the cabinet and show users that they can open this space. The farmer has no time to spare wondering about me, so I work hard to make all the information available. I provide an overview in real-time.

Remember to

1. Study how to use physical and virtual presence to ease communication.

2. Prevent misleading information and use affordances to align user expectations.

3. Try to prevent users from wondering about the robot's state and intentions.



"The quality of behaving in a pleasant, good, helpful, or suitable way"

I wear the Red with pride. As a good Lely ambassador, I should show the company values through my actions and daily interactions with the diverse users in the context. I have to be **respectful, harmless, and supportive, but most of all, helpful and caring**. Always friendly, regardless of the bad mood of a user or the continuous efforts to trick my system. It is the farmers' environment. I need to adapt to it and behave accordingly to their specific needs. I should **become a valuable partner, enhance and never disrupt the flow and routine of the farm**. I am an ally that aims to improve the life of cows and humans, and they should perceive me as such.

You can ask yourself

- How do different users on the farm feel around the robots?
- How much do users feel that the robot adapts to its needs and preferences?
- Are there moments where users feel misunderstood?

Friendliness

Example of Friendliness

Are you ready? Here I go

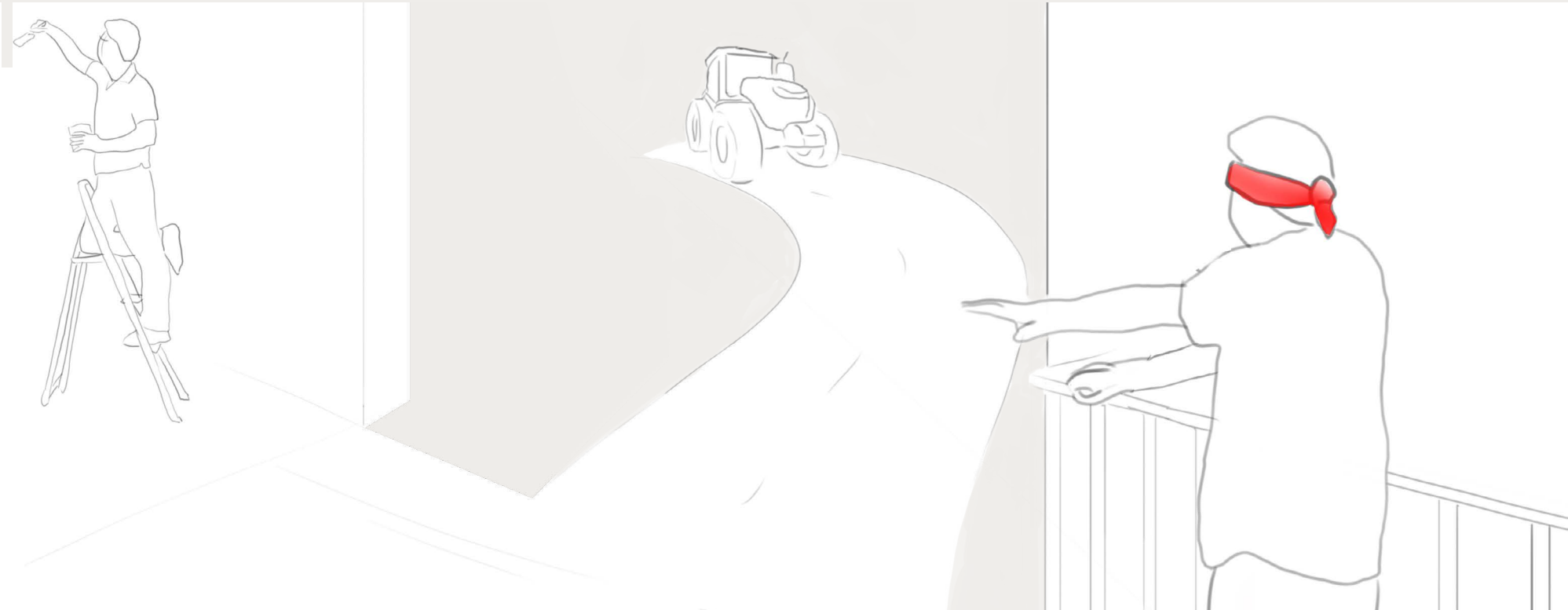
Do not do to others what you do not want to be done to you. The core principle of empathy also applies to robots like me. I care about the welfare of humans and cows. For example, if I were a robot moving both inside and outside the barn, I would share the space with many users, even with other vehicles. I do not want cars to touch me, why would I invade the personal space of others? In other words, bumping into people is rude. I joined someone's business and often living space, so I should not expect everyone to adapt to me and my movements.

Remember to

1. Study and acknowledge the presence of other users around the robot. Ensure that it does not harm anyone.

2. Show that robots care about human and animal welfare. They should also be perceived as safe.

3. Show that robots care about their own welfare. Identify potential dangers for them and allocate preventative mechanisms.



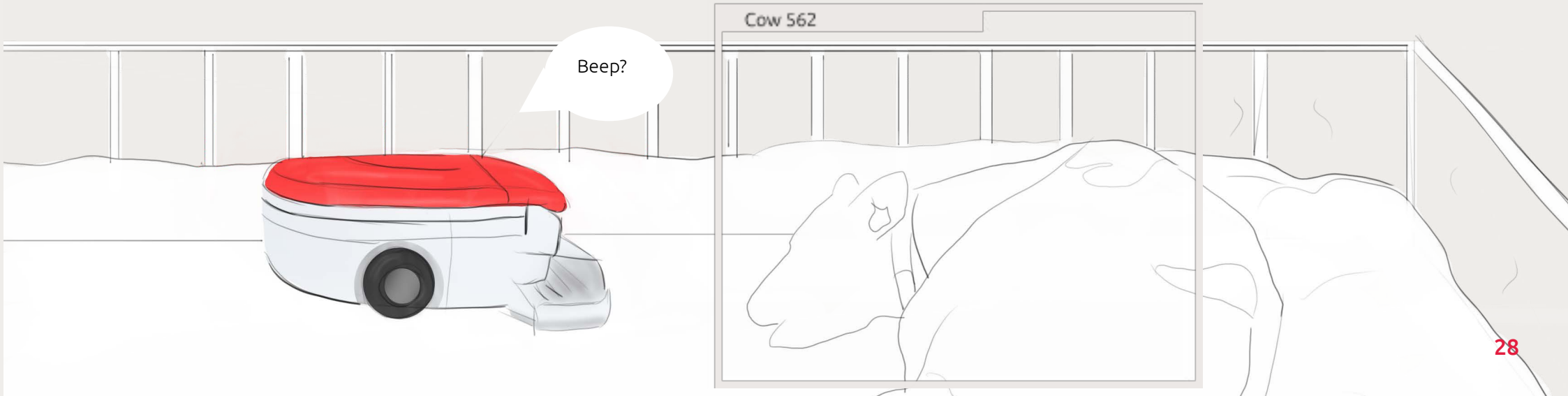
Example of Friendliness

Moo... moo?

Once I acknowledge that there is a user, I can steer my interactions with it. Before knowing how to act to free my path, I first need to know which user is blocking it, as they require different treatments. In this case, the ideal outcome would be to identify that it is a cow and access the data on her state. Is she feeling strong enough to be nudged with some careful pushes, or should I notify the farmer? I act with control and care, showing that I am safe and preventing actions that could lead to users feeling threatened or uncomfortable.

Remember to

1. Adapt the designed action and treatment to the user.
2. Study your audience and how to best communicate with them.
3. Beware not to hinder accuracy when improving friendliness.



Example of Friendliness

“My apologies”

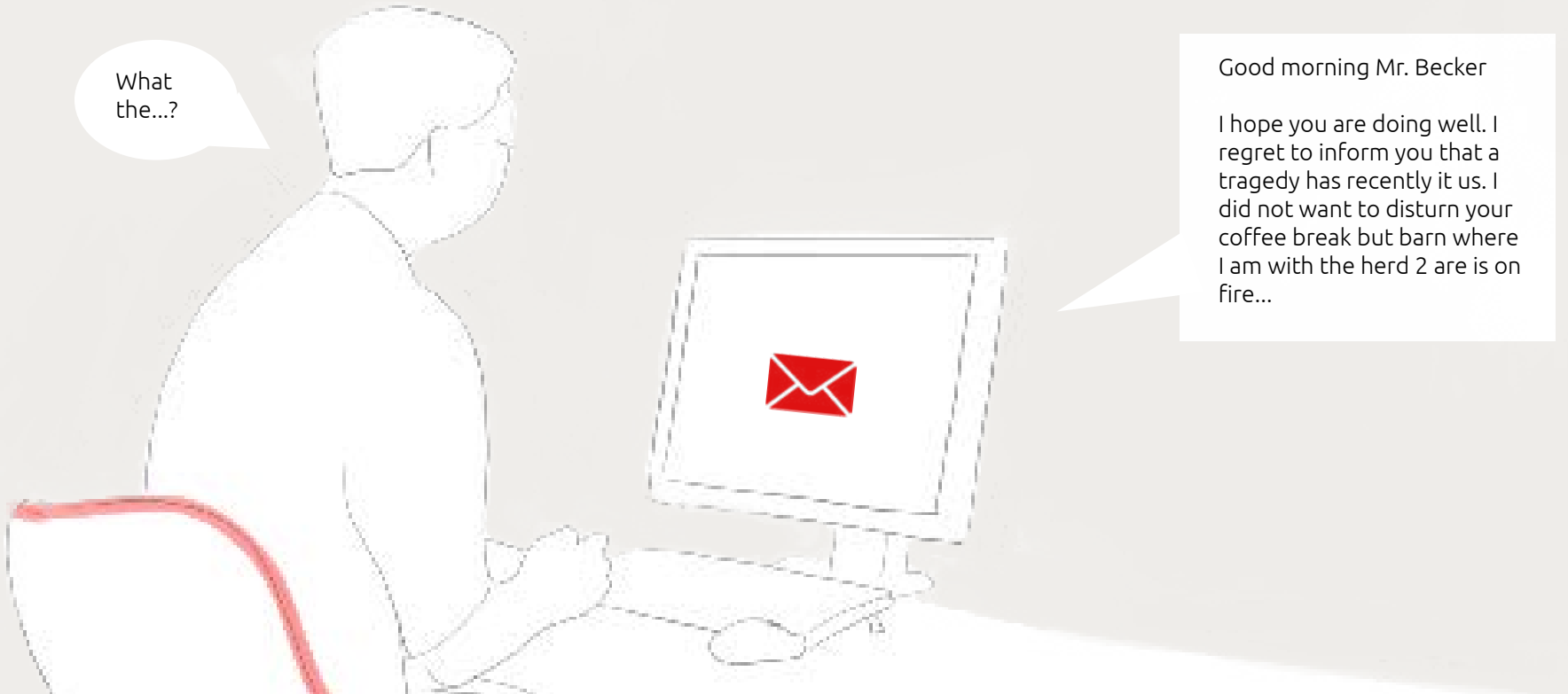
Formality and politeness depend on the person and culture. Gratitude, apology, and asking for consent are basic and international politeness strategies. Thus, saying thank you, sorry, or please. Mechanisms like those portray me as an intentional and respectful agent. However, sometimes I need to sacrifice my manners for the sake of efficiency. I should recognize the degree of urgency of a message and adapt the friendliness of my tone and actions, perhaps becoming more direct and intrusive. Sometimes it is justified to make a thousand phone calls or display a disturbing alarm sound. Even bumping into the user to be urgently heard or respected is necessary in some cases.

Remember to

1. Identify the urgency of the message and adapt the robot attitude and tone of voice.

2. The robot should recognize its mistakes and show interest in improving and solving them.

3. Aim to allow robots to adapt to the farm. Provide the most pleasant treatment.



Designing Robotic Behaviours

Steps and considerations to take when designing robots and artificial intelligence

Introduction

How can the qualities of Robot Nature be implemented into the current and future products?

Lely portfolio covers a wide variety of tasks on the farm. Lely solutions are unique in the goals they have and situations they encounter. To accommodate this diversity, we must be flexible while still working as one towards the desired direction. This chapter aims to guide the development of robot behaviours moving from the robot nature to considerations, recommendations and actions for the developers.

The following pages contain templates to map the interaction and point to preferable solutions. These templates are available as a separate document for you and your team to fill in, start a discussion and identify when you might need help from one of Lely experts in user experience. It also includes a use case example with a proposal on filling such templates. Use this tool to establish a common direction and overview among your team and a shared vocabulary to discuss interaction design.

Before going through this chapter, consider that:

- The Practical Guide (page 39) provides a detailed overview of the current Lely Robot Conduct

You can use this chapter to evaluate whether a Lely expression would fit your design. In the event of it not covering the needs of your project, use this chapter to assist you in designing a new expression, and remember to:

- Involve users throughout the process.
- Share with the Robot Code of Conduct Committee to serve other teams and become part of the Lely Robot Conduct.

Goal

1. What problem are you trying to solve or need/desire to fulfil?

2. Because....

3. How should it behave to achieve this goal?

Product name

Communication channels available

4. What are the stages of communication?

5. How complex are these messages?

5a. Easy (Example: “Yes/no” or “Okay/Help”)
You could use simple mechanisms (e.g. colour, sound or light).
5b. Medium (Example: “Low Level”, or “Alley 3”)
You could use internationally recognized icons.
5c. Complex (Example: Explaining a problem or result)
You could use graphics and text descriptions. Keep it actionable.

6. How does time influence your design?

6a. Learning curve. It becomes easier to understand/use through time
You could change to simpler communication (beware of other users).
You could add volunteer shortcuts and options to skip.
6b. Operation. Unattended issues can get more urgent over time
You could change the tone of voice or attitude to reflect the urgency.

Example of Goal

1. What problem are you trying to solve or need/desire to fulfill?

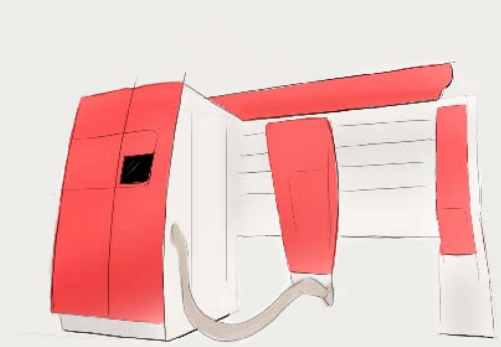
"I want to prevent the machine from pausing its work"

2. Because....

"It will not function without the needed chemical resources and pauses disrupt the business affecting production"

3. How should it behave to achieve this goal?

"It has to alert the user on time, in case he/she forgot, to refill the tanks"



Milking Robot - Astronaut A5

Can communicate through:

- *Door light*
- *Arm and door movement*
- *Embedded UI*
- *Platform Horizon"*

4. What are the stages of the communication?

"1. It needs to catch the attention of the farmer
2. It needs to explain the need for replenishment
3. It needs to guide on what type of resource (and perhaps how to refill it)"

5. How complex are these messages?

5a. Easy (Example: "Yes/no" or "Okay/Help")
You could use simple mechanisms (e.g. colour, sound or light).
5b. Medium (Example: "Low Level", or "Alley 3")
You could use internationally recognized icons.
5c. Complex (Example: Explaining a problem or result)
You could use graphics and text descriptions. Keep it actionable.

"Stage 1 (5a), Stage 2 (5c), and Stage 3 (5b) "

6. How does time influence your design?

6a. Learning curve. It becomes easier to understand/use through time
You could change to simpler communication (beware of other users).
You could add volunteer shortcuts and options to skip.
6b. Operation. Unattended issues can get more urgent over time
You could change the tone of voice or attitude to reflect the urgency.

"Routinary task for the farmers with a consistent procedure.
Below certain thresholds, it becomes more urgent"

User

7. Who is the user(s) intended to be involved in the interaction?

8. What are the needs and motivations of the user(s)?

9. Would other non-intentional users be affected by the interaction?

9a. Humans, animals, and robots moving on a shared space
You could add mechanisms to express the robot intention
9b. Other humans or animals will perceive the action
You could analyse how they would and should perceive the robot

Target user

10. What is the tone of voice/attitude of the message? (Convincing, Alerting, Informing, Apologizing...)
Check table page 40

11. Should the system recognize the user?

12. How could the system communicate in the users' "language"?

12a. Phrasing and jargon. Selecting the right words.
You could make simple messages and test with the target group.
12b. Tailored politeness. Depending on culture or even per farm
You could start defining and respecting human personal space.
12c. Personalization to their life rhythm and interest
You could start allowing humans to decide on their involvement.
and adjust their alarming system to their needs.

13. How do you assess if the behaviour is achieving the desired effect on the user?

13a. Usability test and SUS (System Usability Scale)
You could test intuitiveness, comfort, preference and perception.
13b. Feedback loop
You could integrate mechanism collecting data to iterate on

Example of User

7. Who is the user(s) intended to be involved in the interaction?

"The farmer(s) that maintain the milking machine or any temporary substitution of those."

8. What are the needs and motivations of the user(s)?

"For this goal, after XXXX research, we found that farmers need to understand at first glance what they need to refill and when and get encouraged to embed this practice in their routine."

9. Would other non-intentional users be affected by the interaction?

9a. Humans, animals, and robots moving on a shared space
You could add mechanisms to express the robot intention
9b. Other humans or animals will perceive the action
You could analyse how they would and should perceive the robot

Target user

Mike 35 years old
Recently took over the family farm...

10. What is the tone of voice/attitude of the message? (Convincing, Alerting, Informing, Apologizing...)
Check table page 40

"Informing on the status of the tank, and convincing user on filling it"

11. Should the system recognize the user?

"No, probably only the desired user will pay attention to this routinary task."

12. How could the system communicate in the users' "language"?

12a. Phrasing and jargon. Selecting the right words.
You could make simple messages and test with the target group.
12b. Tailored politeness. Depending on culture or even per farm
You could start defining and respecting human personal space.
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13b. Feedback loop
You could integrate mechanism collecting data to iterate on

Context

14. What is the situation of the robot system?

14a. Visibility. If the robot is not visible enough for light or display
You could locate the display elsewhere or virtually.
14b. Movement. If it moves or it has moving parts
You could use movement to express intention.
14c. Connectivity. If robot collaboration is worth the expense
You could optimize data by linking robots or having an orchestrator

15. What is the situation of the users? Are they expected to be in the barn? To be carrying out a task?

16. What mean of communication would be the best fit?

16a. Physical. Useful to bring information/action to the real world.
16b. Digital. Useful for descriptions/interactions outside the barn.
16c. Both. Useful to combine both, for overviews and alarms.

Situation

17. Should the user(s) intervene? Which influence should they have on the behaviour?

17a. Immediate intervention. Often for interruption of the task
You could use buttons (physical for immediate reaction and safety).
You could use sensors triggering an action like bumpers.
17b. Contestability. For when the user needs extra information
You could add mechanisms to provide more info when needed.
17c. Other interventions such as maintenance, repair and feedback.
You could collect data and aim for the robot to adapt and prevent.

18. Is it obvious the need for the user intervention? Are the intervention mechanisms accessible, easy to find, reach and use?

19. How do changes in the environment influence the interaction?

20. Can a user understand the reasons behind the robot action and its limitations? If your design will affect the way the robot acts, who and how should be notified?

Example of Context

14. What is the situation of the robot system?

14a. Visibility. If the robot is not visible enough for light or display
You could locate the display elsewhere or virtually.
14b. Movement. If it moves or it has moving parts
You could use movement to express intention.
14c. Connectivity. If robot collaboration is worth the expense
You could optimize data by linking robots or having an orchestrator

15. What is the situation of the users? Are they expected to be in the barn? To be carrying out a task?

The user should be able to access the information at all times. However, he/she is supposed to be in the machine unit to fill the tank.

16. What mean of communication would be the best fit?

16a. Physical. Useful to bring information/action to the real world.
16b. Digital. Useful for descriptions/interactions outside the barn.
16c. Both. Useful to combine both, for overviews and alarms.

Situation

A clear objective with actionable data
The farmer needs to receive the alert with time enough to plan it properly and must understand the resource to be filled.

17. Should the user(s) intervene? Which influence should they have on the behaviour?

17a. Immediate intervention. Often for interruption of the task
You could use buttons (physical for immediate reaction and safety).
You could use sensors triggering an action like bumpers.
17b. Contestability. For when the user needs extra information
You could add mechanisms to provide more info when needed.
17c. Other interventions such as maintenance, repair and feedback.
You could collect data and aim for the robot to adapt and prevent.

18. Is it obvious the need for the user intervention? Are the intervention mechanisms accessible, easy to find, reach and use?

It becomes clear thanks to displaying messages, else it will only be noticeable by checking the tank level personally.

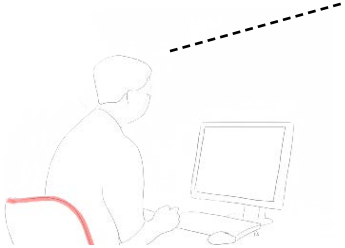
19. How do changes in the environment influence the interaction?

There could be factors altering the speed at which the resource gets consumed or obstacles blocking access to the machine.

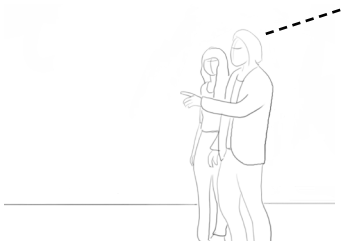
20. Can a user understand the reasons behind the robot action and its limitations? If your design will affect the way the robot acts, who and how should be notified?

Yes, it is visible how the machine uses the consumable to clear the udders
The farmer should be notified not intrusively.

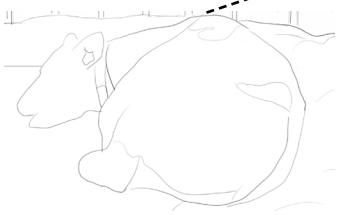
Attitude and Tone



Farmer
Technician



Everyone



Cows

Informing	Alerting	Apologizing	Convincing
Overview of system state or feedback on results. Be objective & neutral. How: no room for interpretations, clear actionable data. Technician needs explanations Farmer need solutions	I need you Be transparent How: clear message on time (app & physical) ...now! Becoming cold How: Increase intensity/frequency	There is an error for robot malfunctioning Be reflective How: acknowledge the error, show interest in improving ... the error is for another cause Be supportive, be cooperative How: suggest options, think along with the farmer	Suggestions and predictions for improved decision-making Be an adviser, put your knowledge to use and become the farmer's counsellor. How: shape your data respect agency, trigger and evoke.
Announcing robot presence to prevent threats. Be obvious, especially to cars and tractors. How: Preventative, one sound/flash at the right time		Invading personal space Be respectful How: for example, a subtle backing up gesture or apology	
Announcing robot movement to prevent being perceived as a threat Be acknowledged without demanding much attention, be predictable, be calm How: "Beep" = I am moving "Light" = Towards there "Soft tempo" = You are safe		If not moving... →	Nudging them to move Be determined with cows when possible How: persisting action so they learn that you need to pass
Announcing food or cleaning. Be consistent to the cows How: always Beep type X	Preventing cows from tricking the system Be deterrent How: locating components, haptic feedback		Luring them into actions like being milked Be seductive How: offer something attractive in exchange

Disclaimer: We are working on getting more answers to translate into concrete recommendations and guidelines.

Practical Guide

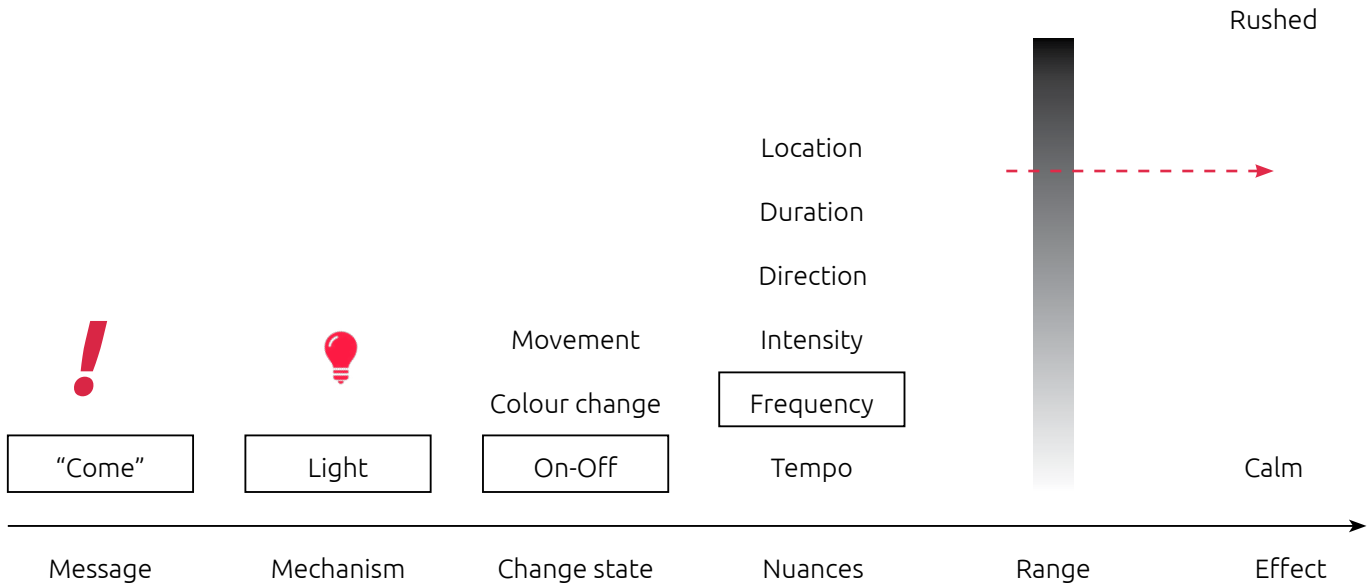
Detailed overview of current expressions per type of product

Introduction

We must communicate as one, as Lely. This chapter contains a detailed overview of the expressive mechanisms used by Lely products. These mechanisms are rooted in the guidelines from the previous chapters.

Disclaimers: The following data is an initial proposal of a cohesive re-design. These solutions are not decisive and should be periodically revised. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

The communicative power of expressive mechanisms can be immense. If you decide to use a light to convey a message, a world of possibilities opens up even for such a simple mechanism. Only seeing a light bulb creates expectations, and any behaviour is full of nuances that impact the perception of the message and even the user behaviour.



Lights and Colour

Potential of using lights and colours:

- Ideal to convey basic expression (e.g. positive or negative).
- International codes are clear and efficient (e.g. traffic lights)
- Easy to point areas or directions

Limitations of using lights and colours:

- Lights only work if you see them
- Limited range on well-illuminated environments
- Lights and colours only work if you can decrypt their message (Not fitted to express complex messages).

We use LED lights as they are more durable, sustainable, and affordable. From the vast amount of light options available in the market, our products use the following ones

Type 1

K30L2RGB7Q - 30 mm
Banner Engineering

K50L2RGB7Q - 50 mm
Banner Engineering

Type 2

Werma Signal Tower
698.110.75

Type 3 -

5mm basic LEDs
Multicolour

Type 4

Notification light integrated
on the device or virtual agent
Cutomizable

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

Guide Lights and Colour
All products

Our goal is to communicate cohesively with all our products. Therefore, we established common expressions and we are careful not to communicate different messages with the same expression. The diagram below displays how Lely products use light and colour to inform users about their state, intentions, and needs.

To inform on intervention or charging: Signaling something	Blue Wavelenght 460 nm Until charged or confirmation info received	
To inform state Solved	Green Wavelenght 524 nm One single pulse 2 sec	
To inform state Status of consumables	Red: Out of stock Wavelenght 631 nm Orange: Middleway- Wavelenght 615 nm Green: Full Wavelenght 524 nm	

Guide Lights and Colour
All moving products

Light is integrated into the product when it is visible. Light external (Type 2) on a fixed visible location at the barn when the product is not visible, or to reinforce the message.

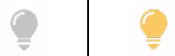
Positive state: "On"	Green Wavelenght 524 nm Pulse 3 sec on + 2 sec off	
To alarm: Attention required Urgency Medium/Low	Orange Wavelenght 615 nm Fade 0-max and back for 4 sec	
Positive state- Moving outside the barn	Green Wavelenght 524 nm Flash 1 sec on + 1 sec off	
To alarm: Object detected <300cm front ,150 side	Orange Wavelenght 615 nm Pulse 2 sec on + 4 sec off	
To alarm: Stopped working Urgency High	Red Wavelenght 631 nm Flash 1 sec on + 1 sec off	

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

Guide Lights and Colour

All visible moving products

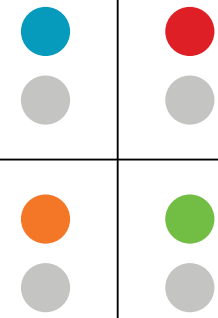
This applies to moving robots outside the cow area and stationary robots with moving parts. Lights integrated on the robot.

To inform on action: Moving back-wards	Orange Wavelenght 615 nm Flash 1 sec on + 1 sec off	
To inform on action: Direction of movement	Bulb on each side No colour 2 sec before the move-ment + off when moved there	
To inform on action: Start task	Blue Wavelenght 460 nm Fade in 0-max intensity for 4 sec	
To inform on action: Stop task	Blue Wavelenght 460 nm Fade out max-0 intensity for 4 sec	

Guide Lights and Colour

Virtual interactions

User interfaces should maintain the consistency of the colour and meaning assigned to them. Colours and lights can be used in infinite ways, and supplement texts and images.

To inform on state Notification	Default blue light of the device + default pauses	
To alarm Urgency high	Default red light of the device + continuous	
To inform State or response	Use colour accordingly to their meaning in the physical entities Red: Negative/urgent (#E01212) Green: Positive (#73BD07) Orange: Attention (#FF7921) Blue: Informative (#0099BB)	

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

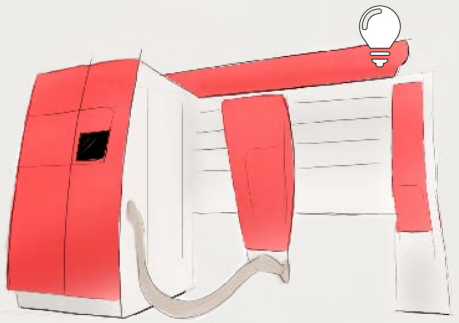
Guide Lights and Colour

Location

Multiple robots can benefit from displaying information using Type 2 lights on a visible fixed spot at the barn.

Main informative light on the top.
Directional lights on the sides of the robot.

Moving robots outside cow area



Stationary robots with moving parts

Main informative light in the most visible location.
Ideally, tailored to the farm, else top front right corner facing the barn.

Moving robots cow area

Light not an adequate expressive mechanism for them.
Future possibilities placing the light external to the robot.

Virtual interactions

Light often on the front middle top but can also be at the bottom and corners. Colours can be used and displayed anywhere on the screen.

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

Potential of using sounds and beeps:

- Highly efficient mechanism of expression
- Accurate in nudging and alerting

Limitations of using sounds and beeps:

- Only basic information can be properly communicated with unarticulated sound
- Depending on the accuracy of the device
- Depending on the external sounds
- Exposure to loud or repetitive sounds can be disturbing or annoying. At a certain point we start ignoring the sound.

Sounds and Beeps

From the vast amount of light options available in the market, our products use the following ones

Type 1 -

Exciter ASX07008-WP-R
>80dB

Type 2

Cone speaker CES-503528-28PM-67
>80dB

Ptiches:
Different sound types for different expressions

Low pitch - Do	Medium pitch - Mi	High pitch - Do	Medium pitch - Sol

Guide Sounds and Beeps

All products

The following expressions should be kept consistent through all products, especially to those that move or contain moving parts.

To inform on state: Error	870 Hz at 50 Hz for 1 sec max intensity	
To inform on state: Solved	3 970 Hz for 1 sec max intensity	
To inform on action: Start movement	2 550 Hz for 1 sec increasing intensity until max	
To alarm: Attention required Urgency Medium/Low	660Hz for 2 sec on + 4 sec off middle intensity Until the situation is solved or worsens	

To alarm: Stopped working Urgency High	660Hz for 2 sec on + 1 second off middle to max intensity Until the situation is solved	
To inform on intervention: Listening/interacting with you	2 550 Hz for 4 sec oscilation to max intensity	
To inform on state: Interacting with other robot	2 550 Hz for 1 sec on + 2 sec off oscilation to middle intensity	

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

Guides Sounds and Beeps

Moving robots

Circulating robots have concrete needs to ensure safety and transparency, becoming trustworthy robots easy to predict and work with. Exciter and/or speaker should be embedded on the products in the most suitable point for the sound to be audible and clear within 5 meters.

To inform on state: Moving preparing mix	2 550 Hz for 1 sec on + 4 sec off oscilation to 0.333 intensity	
To inform on state: Moving feeding	2 550 Hz for 1 sec on + 4 sec off oscilation to middle intensity	
To inform on action: Moving suctioning manure	1 680 Hz for 1 sec on + 4 sec off oscilation to middle intensity	
To alarm: Moving backwards	970 Hz for 1 sec on + 2 sec off to middle intensity Until it stops moving backwards	

Guide Sounds and Beeps

Virtual interactions

The expressive capacity of speakers goes beyond that on the exciter leaving the door open for future developments (e.g. VUI).

Notification: Attention required Urgency Medium/Low	660 Hz for 1 sec middle intensity	
Call to alarm: Stopped working Urgency High	660 Hz for 2 sec increasing intensity until max Alarm depending on product and urgency	
To inform on result: Error	870 Hz for 1 sec max intensity	
To inform on result: Solved	3 970 Hz for 1 sec max intensity	
Notification: Other information	2 550 Hz for 1 second at max intensity	

Disclaimer: Solutions not decisive. Please, contact the Robot Code of Conduct committee for questions and suggestions so we can communicate as one.

Buttons

It is essential to enable human intervention, for safety reasons and convenience, especially on moving robots. We make use of buttons that are internationally recognized: start, pause, and emergency button. This is the first step towards the robot acknowledging and reacting to users around it.

Limitations

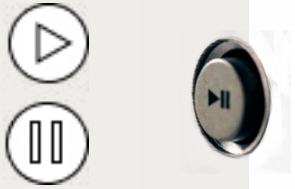
- Buttons need to be accessible to be useful
- Buttons that are too accessible can lead to unnecessary work interruptions

Type 1 - Press and remain

Only use as an emergency button. Essential for safety on robots that move or have moving pieces

Type 2 - Press and release

These buttons are illuminated if they are active.



Guide Buttons

All products

All robots must contain a physical mechanism to interrupt their functioning in emergencies. Buttons ease direct communication onsite with the robots. The buttons mentioned in this chapter are physical, virtual representation can vary.

To immediately stop the robot interrupting its functioning	Diameter 22mm Model YW1B Visible and accessible at all times	
To temporarily pause the robot	Diameter 15mm Model YX5M Light fade in/out 0-max for 4 sec while paused	
To manually initiate a robot task	Diameter 15mm Model YX5N “On” light when the robot is ready to be initiated	