Robotics4EU

Boosting Wider Adoption of Robotics in Europe

Graspian

Citizen Survey Results

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Introduction

This report presents the results of a collaboration between Graspian (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

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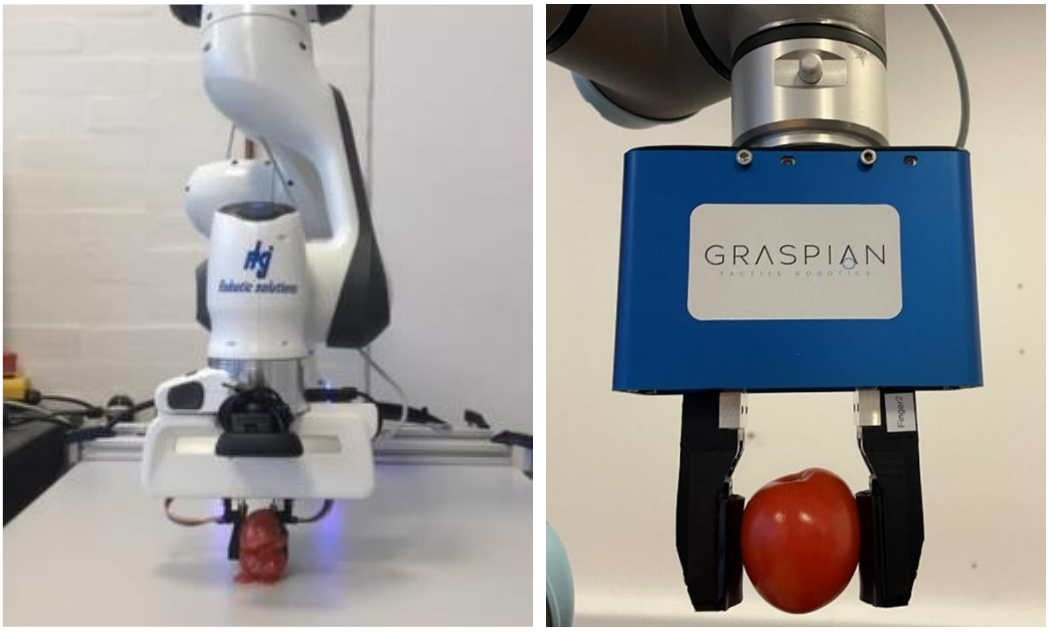
Graspian

Graspian is a robotics company adding the sense of touch to robots when grabbing objects. Just like humans combine visual and tactile sensing, Graspian make robot tools with the sense of touch, so that they are able to handle objects that are otherwise challenging to robots. A challenging object can be either:

1. Being of a fragile material,
2. Having a slippery surface,
3. Having an irregular shape, or
4. Working in a changing environment

5. By combining input from a camera and touch sensors, Graspian gives the robot much improved capability for navigating its surroundings using both visual and tactile sensing. Using this technology, the robot can avoid dropping, damaging or bruising of objects. One example of such objects is fruits and berries that require delicate handling.



Robot picking up a tomato with and without the Graspian technology

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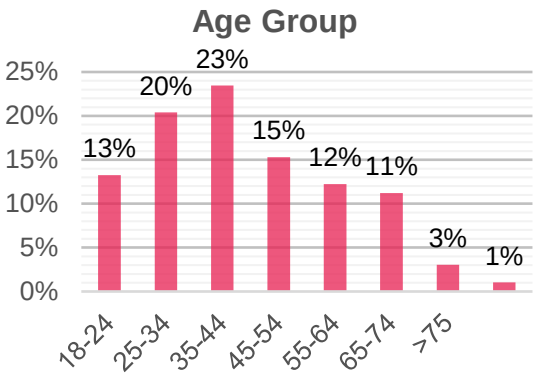
Demographics

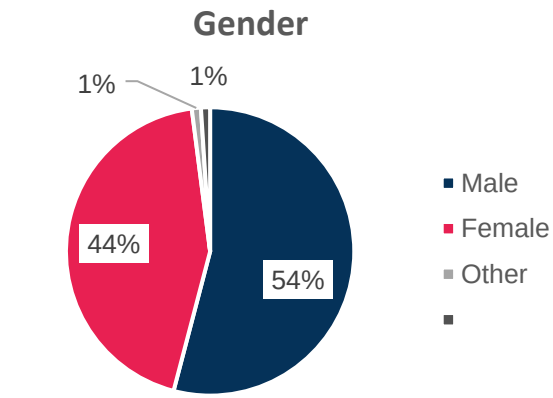
The survey received a total of 98 responses. The survey received a well distributed number of respondents from most age groups. Citizens in the age groups 25-34 and 35-44, were best represented accounting for 20% and 23% of the total responses. These were followed by the age groups 18-25, 45-54. 55-64 and 65-74 each accounting for 10% to 15%. The only age group not represented very well was the 75 and older with 3%.

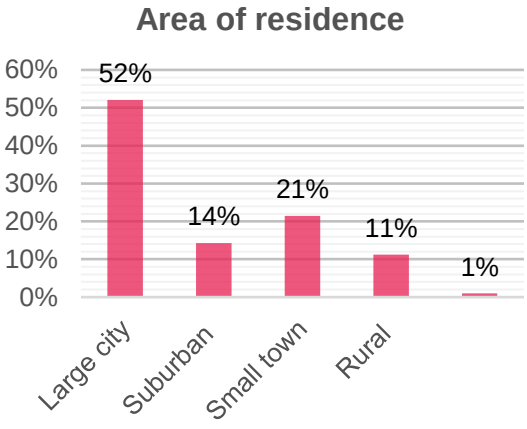
The gender distribution of citizens was relatively equal, with male participants accounting for 44% and female participants accounting for 54%. The remaining either answered 'other' or did not specify their gender.

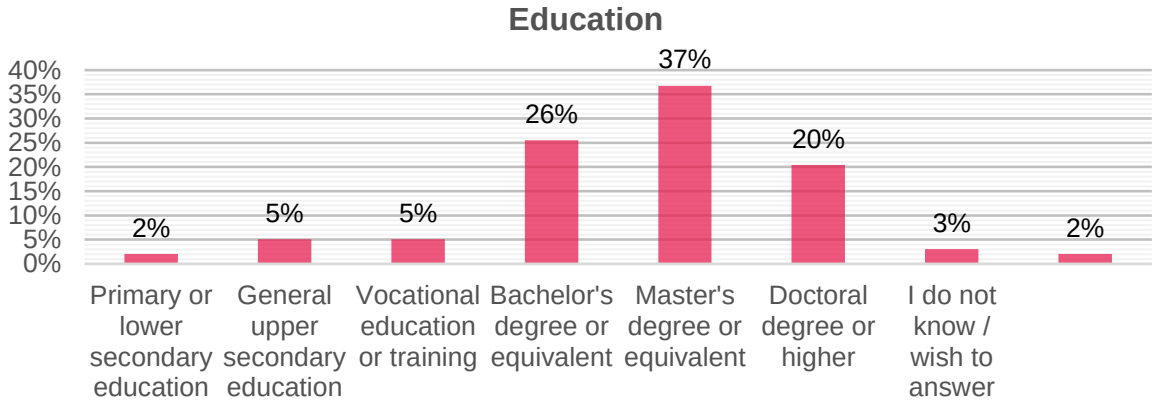
Looking at distribution of areas of residence, a total of 52% of the participants answered that they lived in a large city. The second most chosen option was small town with a total of 21%, followed by suburban with 14% and rural with 11%.

Participants were generally highly educated with 83% answering that they held either a bachelor, master's degree or higher, whereas only 12% held secondary education or vocational education.









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The survey received answers from participants from 16 different countries. However, 19% chose not to disclose their country of origin making it difficult to give exact information on where respondents participated from. But citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe.

As is evident from the above, most participants answering the survey were young and middle-aged people holding degrees and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

Survey results

Citizens were asked eight questions regarding their perceptions of the robot, exploring what opportunities there might be for a robot like Graspian and the company, but also evaluating the trustworthiness of the robot in different situations.

Question 1: Could you think of some situations where a robot with the ability to gently touch an item could do something that is not possible today?

To explore the potential business opportunities for Graspian the citizens were asked to think of situations where the use of such a robot could be beneficial. The most frequent ideas for usage can be categorized to be within healthcare and fruit/vegetable picking.

Several respondents thought of using the robot as a medical tool for situations that would need tactile interactions with humans. A few mentioned high precision surgeries, as robots can be more calculated and accurate than humans. A couple of respondents also imagined that Graspians technology could be useful when helping the elderly or disabled people. For instance, help people going to the toilet, bathing, or lifting. Some also mentioned that it could be used as a prosthesis for persons missing one or more limbs.

Many thought that the robot's capabilities would be ideal in agriculture especially for picking fruit, berries, sprouts and to handle objects in food-production such as putting cucumbers in jars for pickling.

"Handling objects with different density, fruits being a good example. Some are not fully grown and hard, some are very soft"

A few mentioned that the technology could be useful for managing tasks that either involves touching hazardous materials/chemicals or operating in hazardous environments or too confined spaces for humans.

Other ideas for usage included: working in fields with fragile materials such as glass production or archaeology, production of sensors and springs, packaging or parcel handling, collecting chicken eggs, changing a lightbulb, snail collection and a few even indicated it could be used in the sex industry.

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Question 2: Could you think of a better – or more descriptive – name than Tactile robotics?

The company would like to receive feedback on using the name Tactile robotics. Most respondents thought the name was good or did not have any other suggestions for a better alternative. Among those who came with concrete suggestions several made use of the word sense/sensory and touch wanting to put emphasis on this special capability. Some mentioned that people do not understand the word tactile, and others found it very fitting. Below a selection of suggestions are highlighted:

Sensitive Robotics	Tactile Robotics	Sensory Robotics	Haptic Robotics	GentleBot
Haptronics	Sensory	TouchRobots	SoftTouch Robotics	Light-Touch Robotics
RobotTactile	SensoBot	Soft Roboitcs	Tactilobotics	Sensible Robotics

Question 3: If a robot arm acts as your extended limb, how would you like to receive feedback from the robot when it touches an object?

To explore the potential of using Graspians technology as a co-bot the participants were asked how they imagine receiving feedback from the robot if the robot acted as their extended limb. The responses can be categorized into four different kinds of feedback: ***visual indication, audio indication, haptic feedback*** **and** ***though the nerve system*****.** When analysing the answers to this question it became clear that the respondents interpreted this question in two different ways. Some understood the questions as if the robot was a prosthetics to a missing limb and others understood it as teleoperation where they see themselves as the operator from either a nearby or distant location.

Haptic Feedback

Many respondents wanted to experience the feedback through touch or tactility by applying forces, vibrations, heat/cool transfer, or motions to the user. For the respondents it was important that the sensation is as comparable to how they would feel the object themselves and that they somehow also can feel how soft and heavy the object is through return of resistance: *"I would say a return from force to resistance, probably also a subtle change in surface texture if the technology exists"* and *"I would like to know the size, texture, and weight"*. Some imagined this to be through a wearable like a glove and/or VR/AR.

Visual and Audio Indication

Feedback through visuals such as lights or screens were also highlighted. Two respondents suggest using LEDs that softly changes colors to indicate how hard the user

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is pressing. Many also said that audio signals such as beeping noises or speech would be a good way to receive feedback. One respondent mentioned a function similar to the beeping sensors new cars use to communicate distances to objects when parking.

Through the nerve system

Some respondents even imagined that the robot can be linked to the human neurological system so they both can control it and feel it via the brain's impulses. One respondent said: *"I want it directly to go into the brain, but that is not really possible yet. For now, gentle taps or weak electric signals on the limb end could work."* And another commented that: *"In my wildest imagination: via a chip in my head or something similar that is not so intrusive"*

Question 4: How can a robot such as this be designed to tell a person in its vicinity that the robot knows what it is doing?

To explore how the robot can give reassurance to the humans in its environment the respondents were asked to give information on how they think a robot can signal a person that it knows what it is doing.

Just as in the previous question many respondents thought that the best way is through audio and visual cues. Some suggest that the robot could make the people around it aware of its doing by either saying it out loud before or as it is doing it. Others suggest showing it through a screen or with light indicators e.g., *"with a panel/screen showing the tasks as it is in the process of".* A few also suggested exploring how the robot can mimic body language we know from humans such as mimicking eye movements so that it is visible what it is looking for.

> *"The robot's 'arms' should be equipped with small camera devices, so each time it grabs an object it would observe it before handling it. Then it can describe what objects it is touching or seeing"*

Others also made suggestions for the design and look of the robot beyond audio and visual feedback features. For them, the robot can reassure people around it by making sure that the robot looks lightweight, does not move too fast, integrate a good flow between movements (to look less like robot movements), and either have repetitive actions that are easy to foresee, or it could also be the opposite and should be more flexible.

A few also indicated that the robot should be so well designed and trained that it is clear instantly that the robot knows what it is doing and that it would only need to communicate when it detects a system error.

The participants in the focus group interviews conducted during the Robotex festival also pointed out that as an industrial robot and in an industrial environment, the attitude towards it is significantly milder, because you get the feeling that it is doing it in its usual environment. "It is important that you understand what it is for and what it does. If you don't know what it is, it makes you feel uncomfortable."

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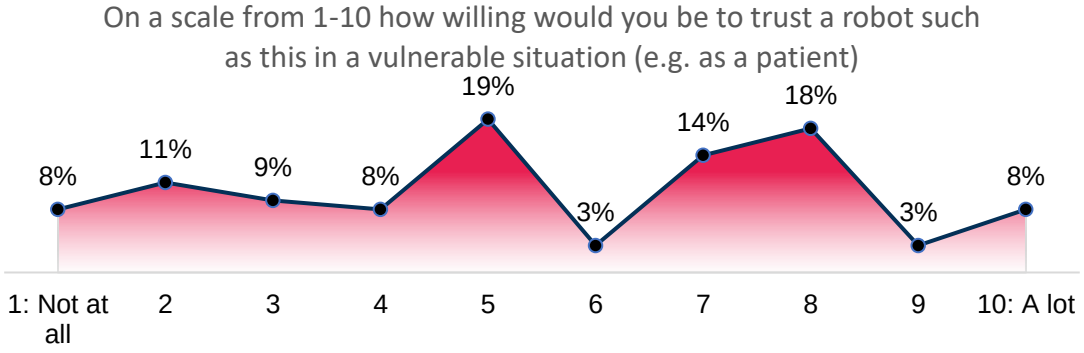
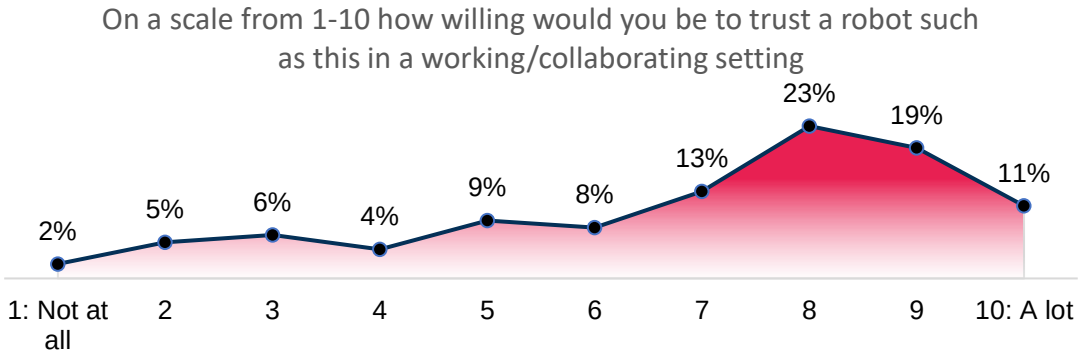
Question 5, 6 & 7: Evaluating trust in different situations

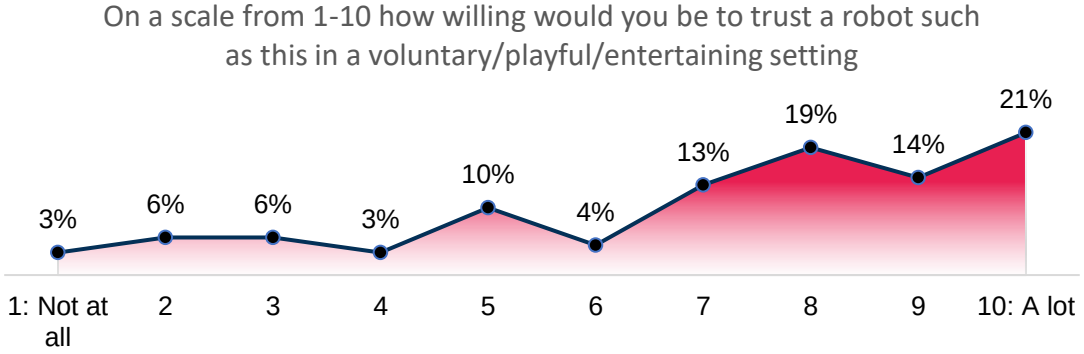
To explore the acceptance and trust of a robot like Graspian the citizens were asked on a scale from 1-10 how willing they would be to trust the robot in three different situations:

1. How willing would you be to trust a robot such as this **in a vulnerable situation (e.g. as a patient)**
2. How willing would you be to trust a robot such as this **in a working/collaborating setting**
3. How willing would you be to trust a robot such as this **in a voluntary/playful/ entertaining setting**

The questions were asked to explore whether level of trust is dependent on the use of the robot. This was done to give the company indications on potential barriers for different use-cases, they should consider exploring further if the robot is to operate in such situations.







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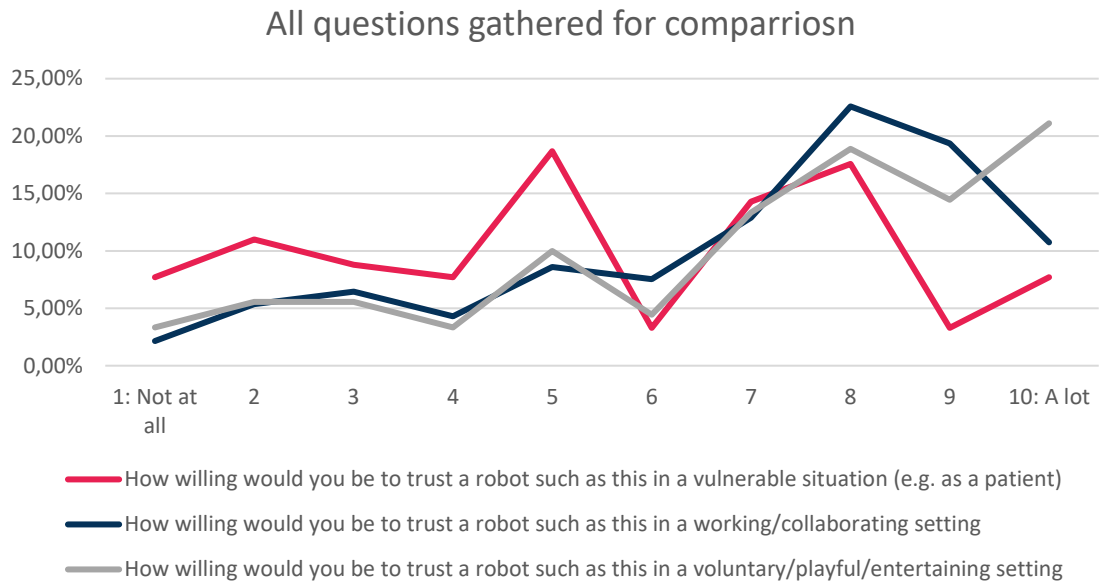
Comparing the responses from all three situations, it is clear that there is a higher degree of trust to working/collaborating with a robot like this and to engage with it in a voluntary/playful/entertaining setting over engaging with the robot in a vulnerable situation for example for healthcare purposes as a patient.



Looking at the elaborative answers it appears that people are less confident in a robot in a vulnerable situation due to a general mistrust and skepsis in robots being in contact with patients, *"I don't feel confident that a robot can be as gentle as a human."* Some explain that they would be okay with the situation if a medical professional or human was present or supervising the robot *"Upon surgery, I would trust the doctor who assured me of the robot".* Several also indicate that it is difficult to imagine a situation like this and that they would have to see it in action to get a feel for its reliability. Some also saw great potential in the robot technology highlighting that perhaps the robot could do better precision work than humans and not be affected by tiredness and long working hours.

> The participants in the focus group interviews conducted during the Robotex festival also pointed out that the attitude towards robots in industry is better. They seem safe. "It would be interesting to see how it works, but this robot doesn't make me worry".

Regarding willingness to trust the robot in a working/collaborating environment the respondents had a high degree of trustworthiness but multiple pointed out that it very much depended on the situation and that it would take some time to get used to. When it came to the voluntary/playful/entertaining setting people did not see any big issues of mistrust other than some highlighting that it depended on what kind of entertainment it could be used for and emphasised as long as it doesn't propose any risks to its environment or humans *"No problem, as long as it is clear that it is not harmful in a predictable way".*

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Despite the clear difference of level of trust in the situations it is still interesting to note that the level of trust towards the first situation actually scores rather high, having more people choosing the higher numbers on the scale compared to the lower numbers. 46% of the respondents are leaning towards the positive side of the scale choosing 6 or above and 35% are leaning towards having less trust choosing below 5 on the scale. The high number of respondents choosing the middle of the scale can either indicate that they are in between, but it can also indicate that they were unsure how to answer the question and therefore deliberately choose the middle of the scale.

Question 8: What is your opinion on collaborative robots in general? E.g. are you concerned about your job being made redundant? Are you concerned about robots taking control?

The majority of the respondents had positive attitudes towards collaborative robots and did not have major concerns towards the technology. Many saw a great potential in robots as a tool to tackle labour shortages and freeing up people from manual and repetitive work tasks *"If we get more robots in the community, there will probably be more room for fun and creativity. We get rid of the dangerous, repetitive and boring work. And that's good".* Many see this as an inevitable and necessary future to which we will adapt just as we have done previously with new technology like computers and smartphones. The majority do not fear a future where robots take control over work-places or society as they believe robots only to some extent will be more effective than humans and jobs will instead be redefined, one even mentions: *"A robot can never take over the control, you can just turn it off."*

Few had concerns regarding a future with robots replacing human jobs and mentioned that they fear a society with less interaction between humans and a future in favour of the rich. *"I worry about my job being more boring and mechanical because I have to interact with an object instead of a fellow human being."* A few also mentioned that it was not so much robots they feared but more the development of AI.

The results of the focus group conducted among the participants of the Robotex International festival show that the attitude towards industrial robots is milder and friendlier than towards robots used in the city or at home. "Such machines can be seen in factories. You might not want to have one at home, but I have nothing to do with it there either. In the case of industrial robots, a lot of attention has been paid to safety already in its nature."

We can conclude that in general the respondents seem to be optimistic towards collaborative robots as long as the human factor remains a priority, and that the robot is sufficiently tested and developed under ethical and security regulations.

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Conclusion

In conclusion, the survey suggests that Graspian, a robot with the ability to gently touch an item, has a wide range of potential uses across various industries such as healthcare and agriculture. Respondents also suggested different types of feedback they would like to receive when the robot touches an object, including visual, audio, haptic, and through the nerve system. Additionally, most of the respondents had positive attitudes towards collaborative robots and saw their potential as a tool to tackle labor shortages and free people from manual and repetitive work tasks. However, there were also concerns among some respondents regarding trust in a vulnerable situation and the need for human supervision. Overall, we can conclude that in general the respondents seem to be optimistic towards collaborative robots as long as the human factor remains forefront and a priority, and that the robot is sufficiently tested and developed under ethical and security regulations.

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