

Assistive Kitchen Device to Aid the Visually Impaired in Meal Preparation: Roasting

Under the supervision of Prof. Swati Pal

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Integrated Masters in Interaction Design

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Background

Preparing a meal is a basic activity needed for survival

It is a complex multi-sensorial task

Many decisions taken when preparing a meal are dependent on sight

Being able to prepare a meal can affect the quality of the life of an individual^[1]

There is lowered nutrition levels among Visually Impaired Persons due to their reduced ability to shop and prepare meals independently^[2]

[1] Kestya, Eliza, et al. "Food shopping, sensory determinants of food choice and meal preparation by visually impaired people. Obstacles and expectations in daily food experiences." *Appetite* 113 (2017): 14-22.

[2] Ecosse L Lamoureux, Jennifer B Hassell, and Jill E Keeffe. 2004. The determinants of participation in activities of daily living in people with impaired vision. *American journal of ophthalmology* 137, 2 (2004), 265-270.

Background

Body of research that deals with Assistive Devices in the area of preparing meals is slim

Most of the existing aids take in ergonomic considerations^[3]

Very little there to indicate preparedness or the state of the food being prepared, and are mostly western centric

There are many smart devices available, with talkback and automation, but these are rarely affordable by Indian households

Also, these aren't designed specifically for the vision impaired, making it inconvenient for them to use as the learning curve is much steeper

Literature Review

While there are parts of studies that have focused on meal preparation by VIPs, they have **primarily been done with western audiences**, whose **learnings do not translate to the Indian context**^[1]

Solutions that broadly fall in the food category primarily cater to **enabling navigation in organised grocery stores through expensive technical equipment** and in some cases, through a **massive overhaul of infrastructure, which are resource intensive** and hence, not suited for a predominantly resource constrained society. Also, they **do not directly address difficulties faced when preparing meals**, but rather seek to aid in the background tasks^{[4][5][6][7]}

There are a few products in the market that have been designed to allow VIPs to perform tasks in the kitchen without fearing for their safety^[8], but these **tasks do not involve dealing with application of heat**, as is required by most Indian meals. It becomes even more of a priority to investigate current patterns and understand problems faced by Indian VIP cooks in order to design assistive devices

[1] Keetys, Eliza, et al. "Food shopping, sensory determinants of food choice and meal preparation by visually impaired people. Obstacles and expectations in daily food experiences." *Appetite* 113 (2017): 14-22.

[4] How to Make Your Kitchen Safer for Visually Impaired Person? medium.com/how-to-make-your-kitchen-safer-for-visually-impaired-person.. "How to Make Your Kitchen Safer for Visually Impaired Person?"

[5] Benjamas Kutintara, Pompun Sombon, Virajada Buaari, Metinee Srethananurak, Piyanooch Jedeeeyod, Kittikan Pornpratoom, and Veraya Janicham. 2013. Design and evaluation of a kitchen for persons with visual impairments.

[6] Sandra C Hartje. 2005. Universal design features and product characteristics for kitchens. *Housing and Society* 32, 2 (2005), 101-118.

[7] Mary H Yearns, Patrick E Patterson, and Andrew Bice. 2005. Developing cabinet prototypes for a universal design kitchen. *Housing and Society* 32, 2 (2005), 81-100.

[8] Kevin Chiam. [n.d.]. Folks Kitchenware for the Blind. <https://kevinchiam.com/folks-kitchenware-for-the-blind>

Primary Research

Primary Interviews

Secondary Interviews

Primary Research

Primary Interviews

7 interviewees

Secondary Interviews

5 interviewees

Primary Research

Primary Interviews

7 interviewees

Tried to gain a perspective of the problem area

Preparatory activities such as kneading, peeling, cutting, etc. do not rely solely on visual input and can be done with relative ease

Cognitive load is high while preparing meals and this forces VIPs to cook one dish at a time

Tasks involving the flame/heat are activities that VIPs at times require assistance with

Family members would prefer if they did not perform activities which involve heat application, as there is possibility of causing multiple handicap

Secondary Interviews

5 interviewees

Primary Research

Secondary Interviews

5 interviewees

Focused on problems involving application of heat

Four cooking techniques commonly used in India were identified

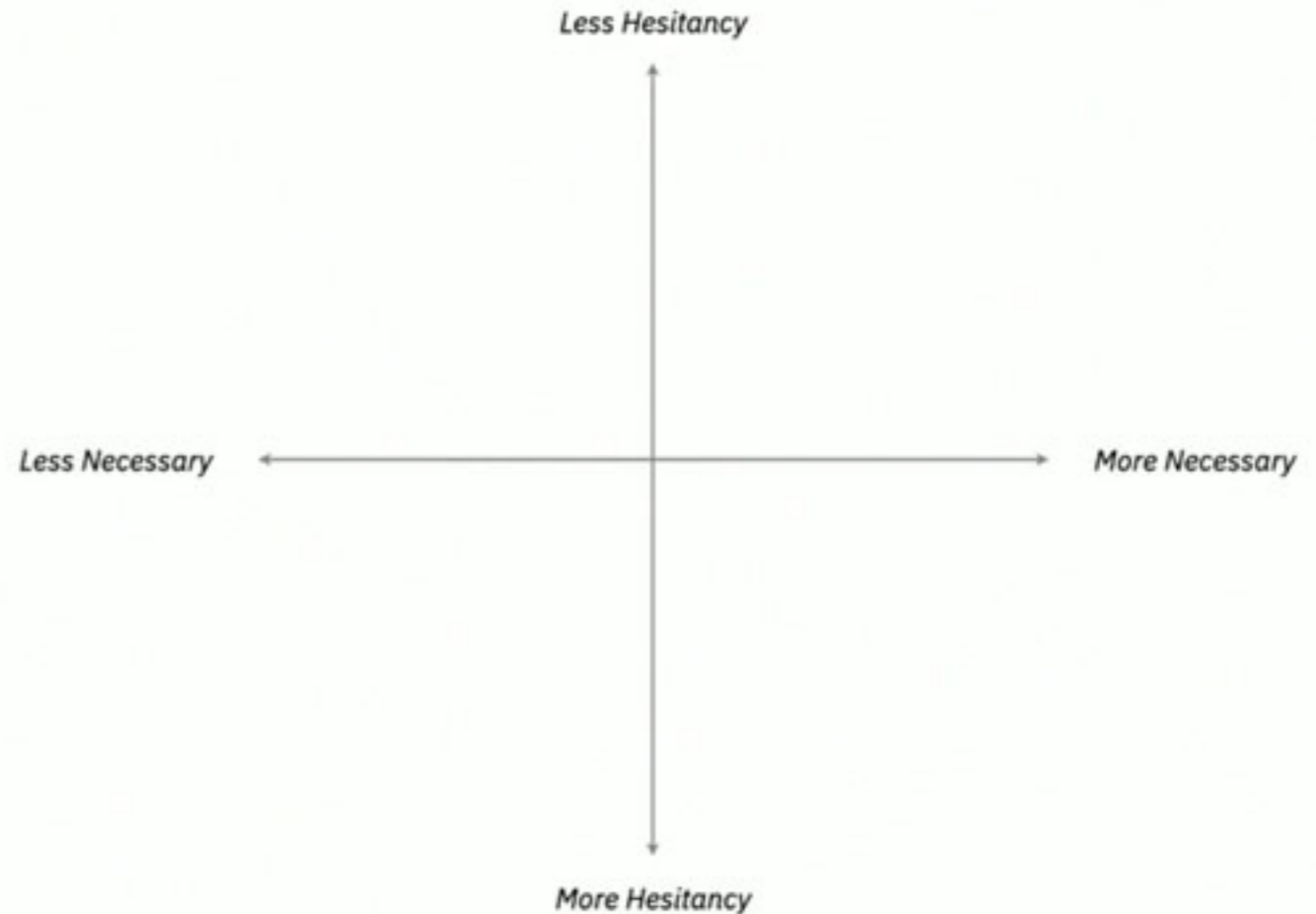
SWOT analysis was performed to decide on which technique to narrow down

Primary Research

Secondary Interviews

5 interviewees

Necessity vs Hesitancy graph was made based on the threats and weaknesses of the cooking techniques.



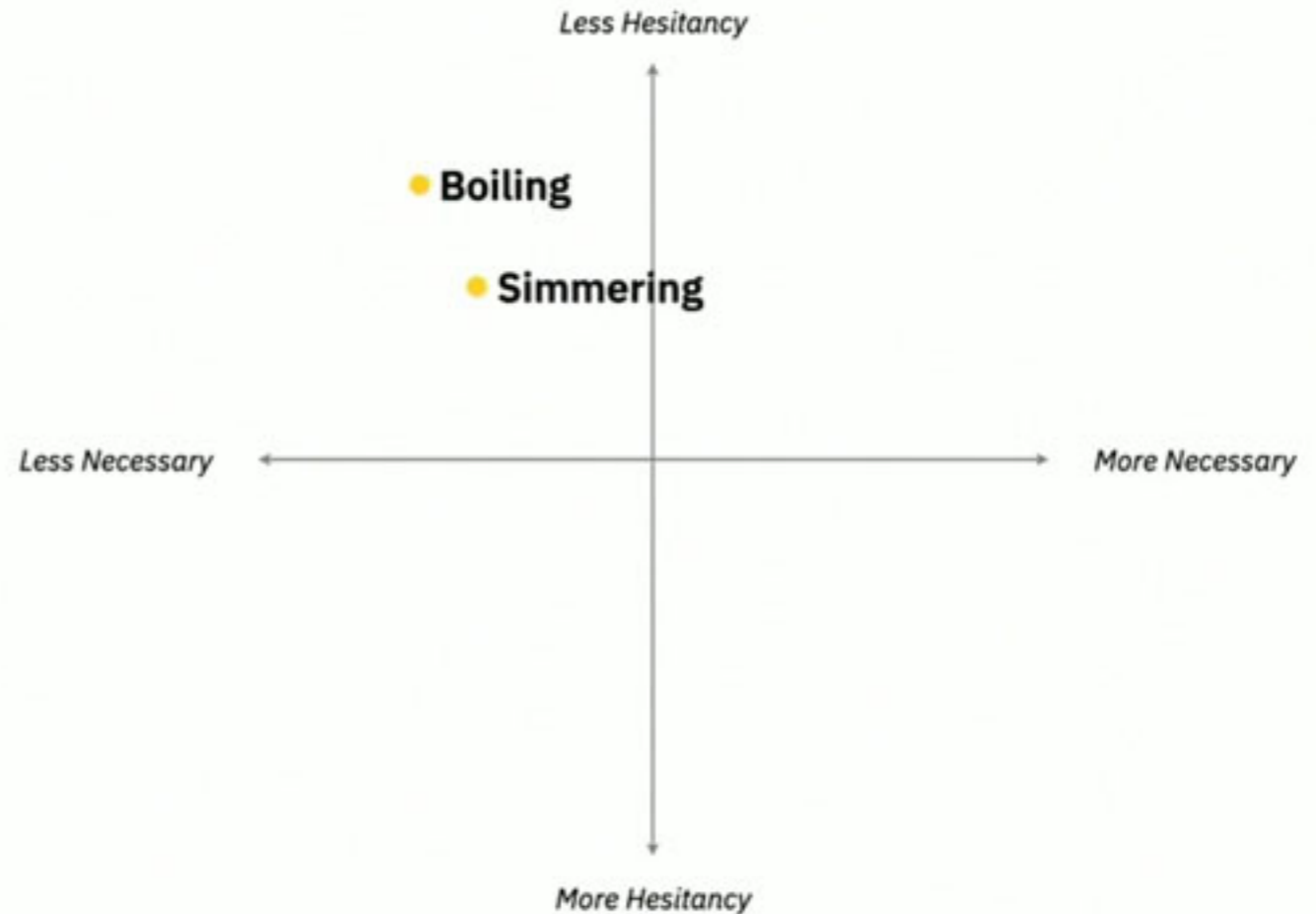
**Necessity refers to the necessity of the interventions and Hesitancy refers to the hesitancy of the VIP to try out the cooking technique*

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Secondary Interviews

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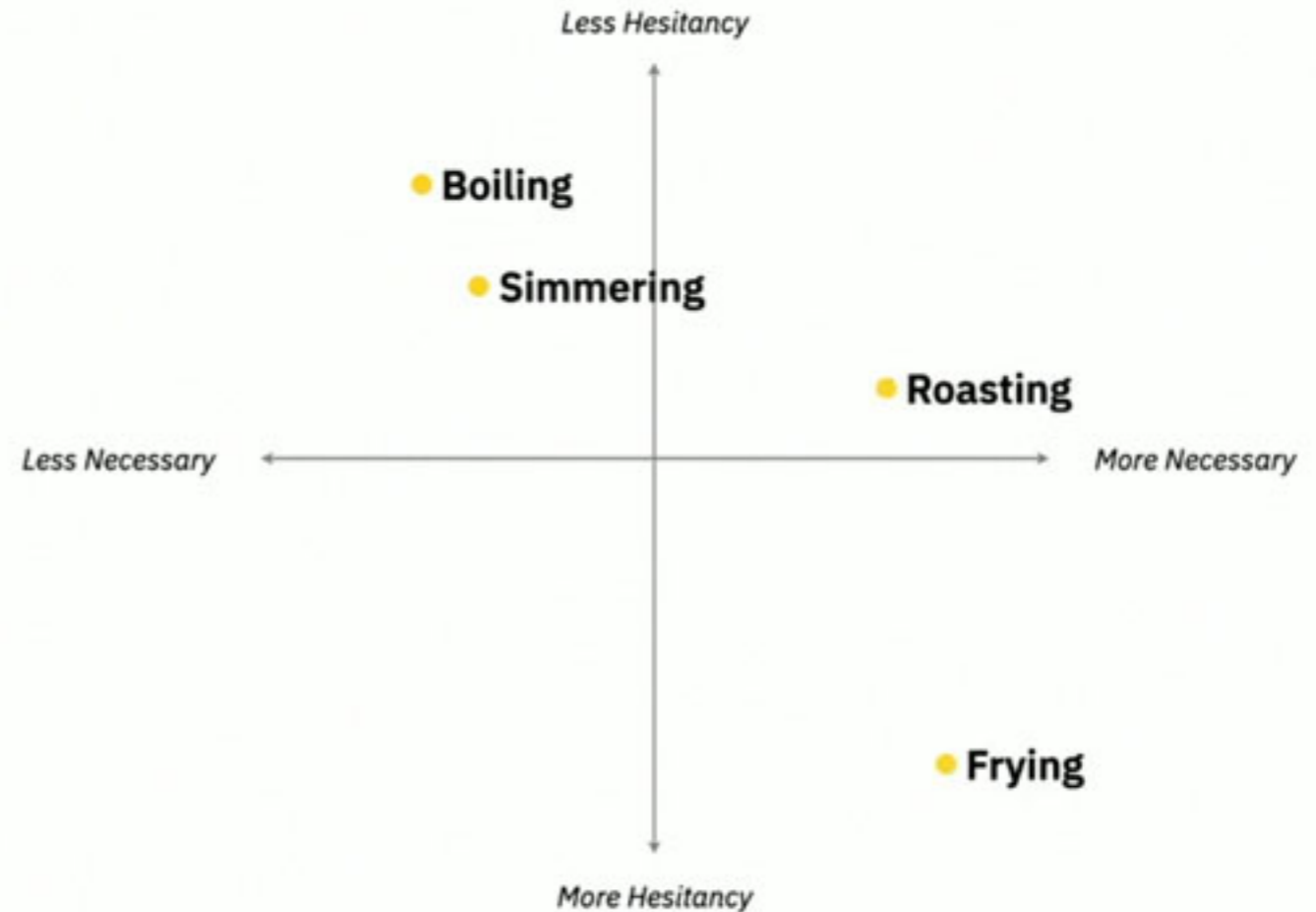
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**Necessity refers to the necessity of the interventions and Hesitancy refers to the hesitancy of the VIP to try out the cooking technique*

Roasting

Roasting is a technique that involves cooking food with dry heat resulting in caramelisation on the surface of the food. When roasting in a pan, generally a small amount of cooking oil is used to prevent the food from sticking to the pan. Foods commonly prepared in this method are rotis, dosas, and processed meats.

Roasting

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Heat the pan

Place dough/batter/foods
on the heated roasting pan

Let the food
cook

Pick food up with
spatula

Flip food back onto
the pan

Cook the food on
the other side

Lift off the pan onto
serving plate

Roasting

Heat the pan

Place dough/batter/foods on the heated roasting pan

Let the food cook

Pick food up with spatula

Flip food back onto the pan

Cook the food on the other side

Lift off the pan onto serving plate

Where is the centre of the pan?

Is it done cooking?

Is it on the spatula?

Where has the centre gone now?

Is it done cooking?

How do you place multiple foods on the same pan?

Which ones are done cooking?

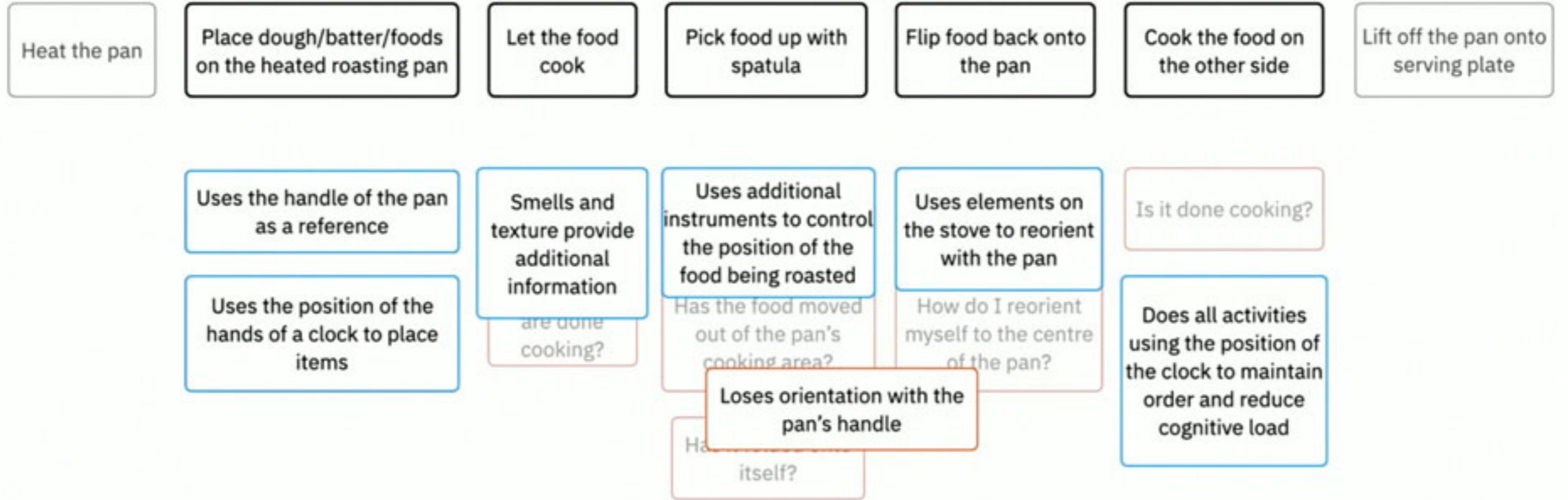
Has the food moved out of the pan's cooking area?

How do I reorient myself to the centre of the pan?

Which ones are done cooking?

Has it folded onto itself?

Roasting



Roasting

Heat the pan

Place dough/batter/foods on the heated roasting pan

Let the food cook

Pick food up with spatula

Flip food back onto the pan

Cook the food on the other side

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Where is the centre of the pan?

How do you place multiple foods on the same pan?

Smells and texture provide additional information

are done cooking?

Is it on the spatula?

Has the food moved out of the pan's cooking area?

Has it folded onto itself?

Uses elements on the stove to reorient with the pan

How do I reorient myself to the centre of the pan?

Loses orientation with the pan's handle

Is it done cooking?

Does all activities using the position of the clock to maintain order and reduce cognitive load

Design Objectives

Develop a device that can provide the user with a reference to the pan

Develop an assistive device that will aid the user in picking the food off the pan and flipping it back on to ensure it is cooked on both sides while maintaining orientation with respect to their environment

Perform the above two objectives, while multiple foods are being cooked on the pan

Ensure the user gets the necessary feedback to perform the tasks required

Design the basic formal aspects to ensure user safety

Roasting

Problems to Tackle

Locate the centre of the pan



Roasting

Problems to Tackle



Locate the centre of the pan

Pick the food up and flip it back onto the pan

Roasting

Problems to Tackle

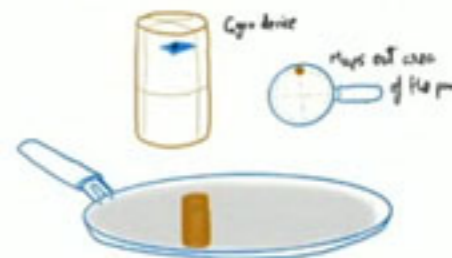
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Pick the food up and flip it
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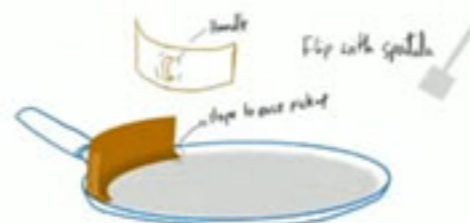
Roast multiple foods at the
same time

Problems to Tackle

Locate the centre of the pan



Pick the food up and flip it back onto the pan



Roast multiple foods at the same time



Approach tackled individual problems with small assistive tools rather than as a holistic solution

Redefining the Approach

Locate the centre of the pan

To place the food in a location they can track

It needs to be trackable to be able to pick it up

Reference of handle is an estimate, requires acclimatisation, and provides no feedback about correctness

Pick the food up and flip it back onto the pan

To provide heat on both sides

The processes involved are highly sight dependent and extremely error prone

Roast multiple foods at the same time

To minimise the time spent while cooking when possible

Keeping track of individual foods places high cognitive loads

Large set of the problems stem from needing to individually pick and flip back onto the pan

Redefining the Approach

Locate the centre of the pan

This is a necessary step as the roasting process starts with the user placing the uncooked food on the pan

Pick the food up and flip it back onto the pan

Is this a necessary step?
Can we not just heat the food from both sides?

Roast multiple foods at the same time

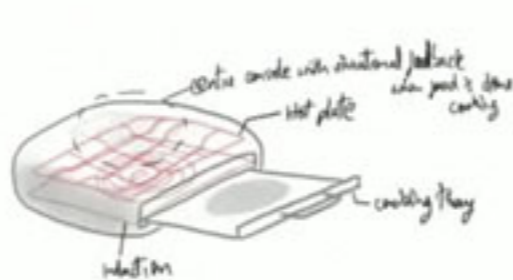
Do we need to keep track of all the individual foods, if we are able to heat them evenly on both sides, essentially cooking them as a single entity?

Redefined Problems to Tackle

Locate the centre of the pan



Apply heat from both sides



Final Concept

Final Concept

Safety

Final Concept

Safety

Ease of use

Final Concept

Safety

Ease of use

Familiarity in daily surroundings

Final Concept

Safety

Ease of use

Familiarity in daily surroundings

Costs

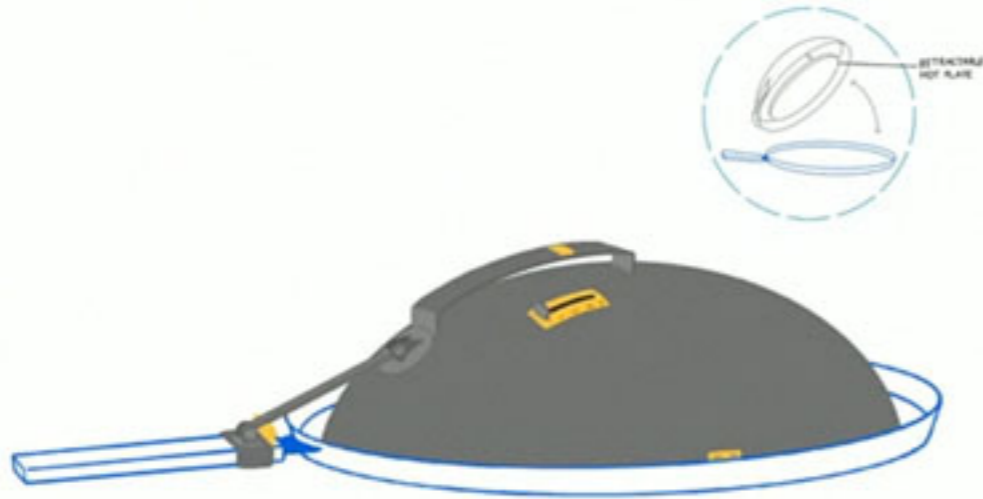
Final Concept

Safety

Ease of use

Familiarity in daily surroundings

Costs



Safe to use as the heated elements are shielded from the users

Is a familiar tool that VIPs would have worked with

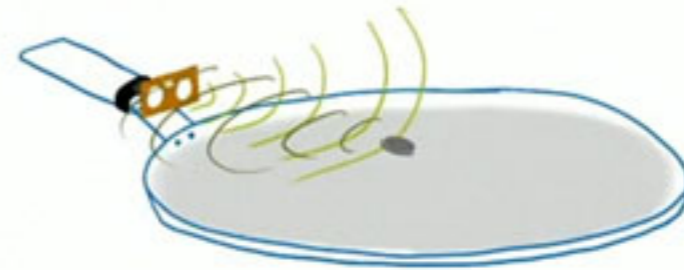
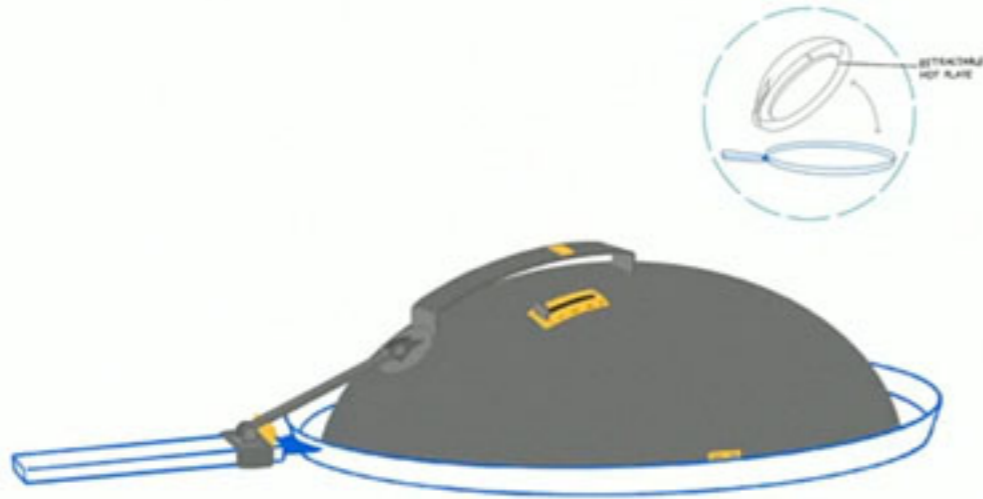
Final Concept

Safety

Ease of use

Familiarity in daily surroundings

Costs



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Is a familiar tool that VIPs would have worked with

Mechanical solutions increased the number of steps necessary to prepare a single round of the dish

Ultrasonic sensors help make the device more versatile to the user by providing a reference to the centre

Prototypes

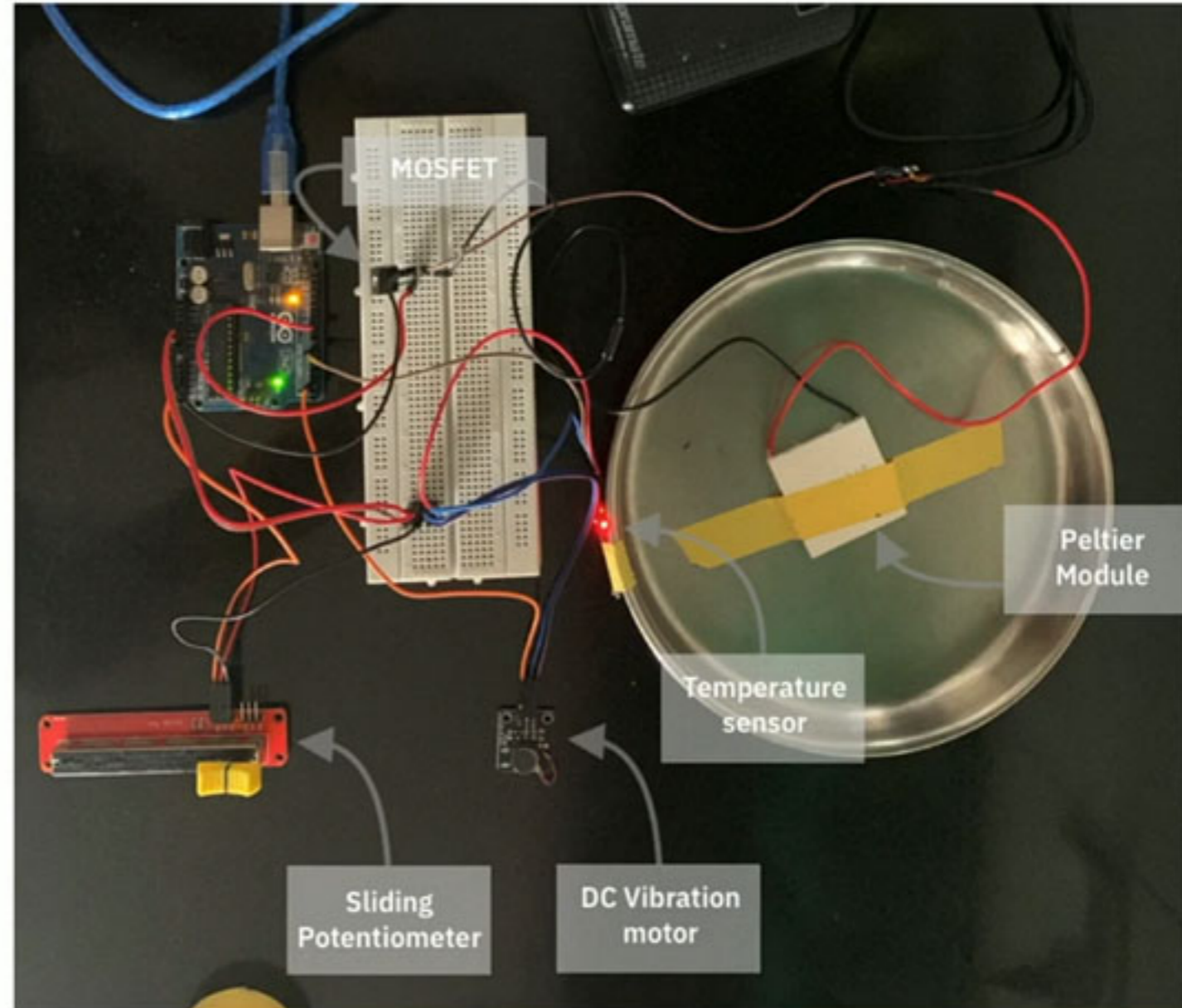
Sensor Prototyping: Heating elements

A Proof of Concept of the heating element was built using thermoelectric generator

The heating of the hotplate takes less than 15 seconds to get up to maximum temperature

Vibrational feedback is provided for change in heat level and once optimum temperature has reached to let the user know that the food might be done cooking

Temperature of the plate is checked via a temperature sensor placed on the side wall of the plate

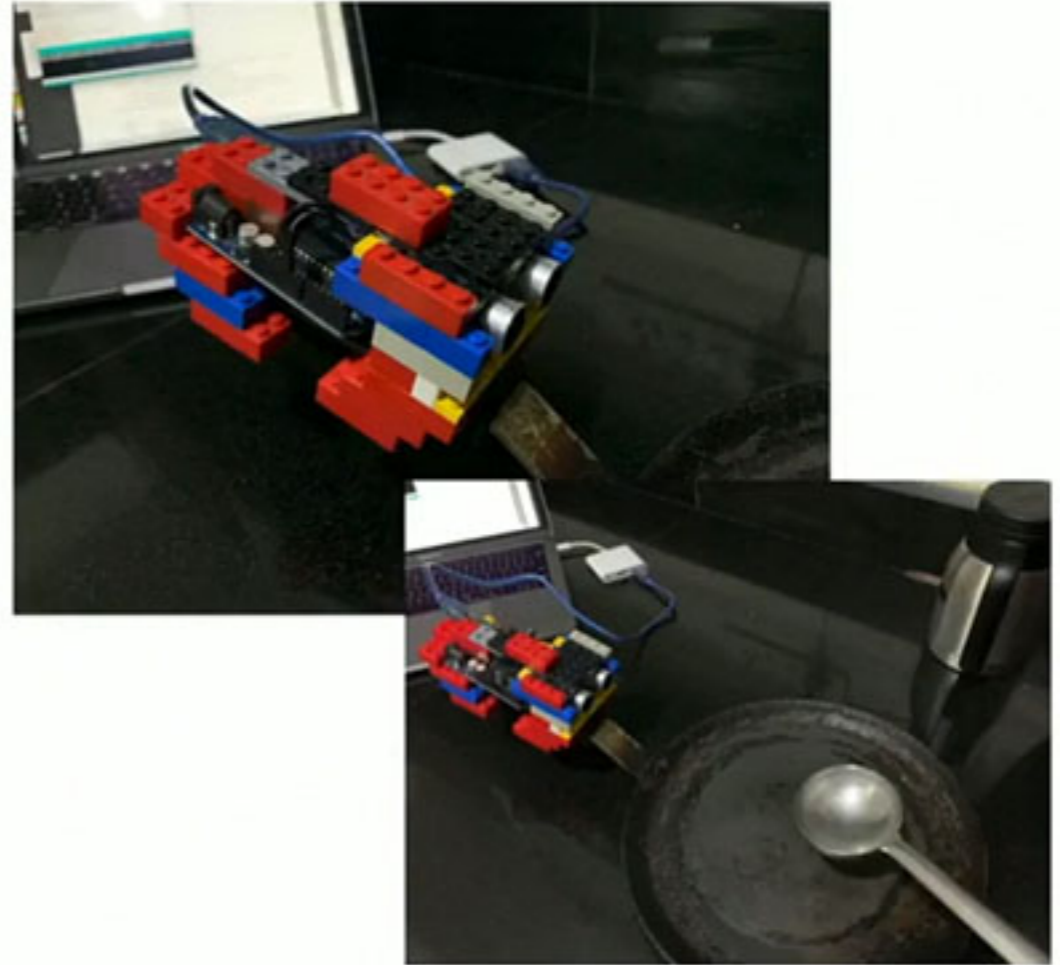


Prototypes

Sensor Prototyping: Ultrasonic sensor

US Sensors were used to gauge the distance to the centre of the pan

A rig was built to hold them in place over the handle and test runs were done to see if the centre could be identified



Prototypes

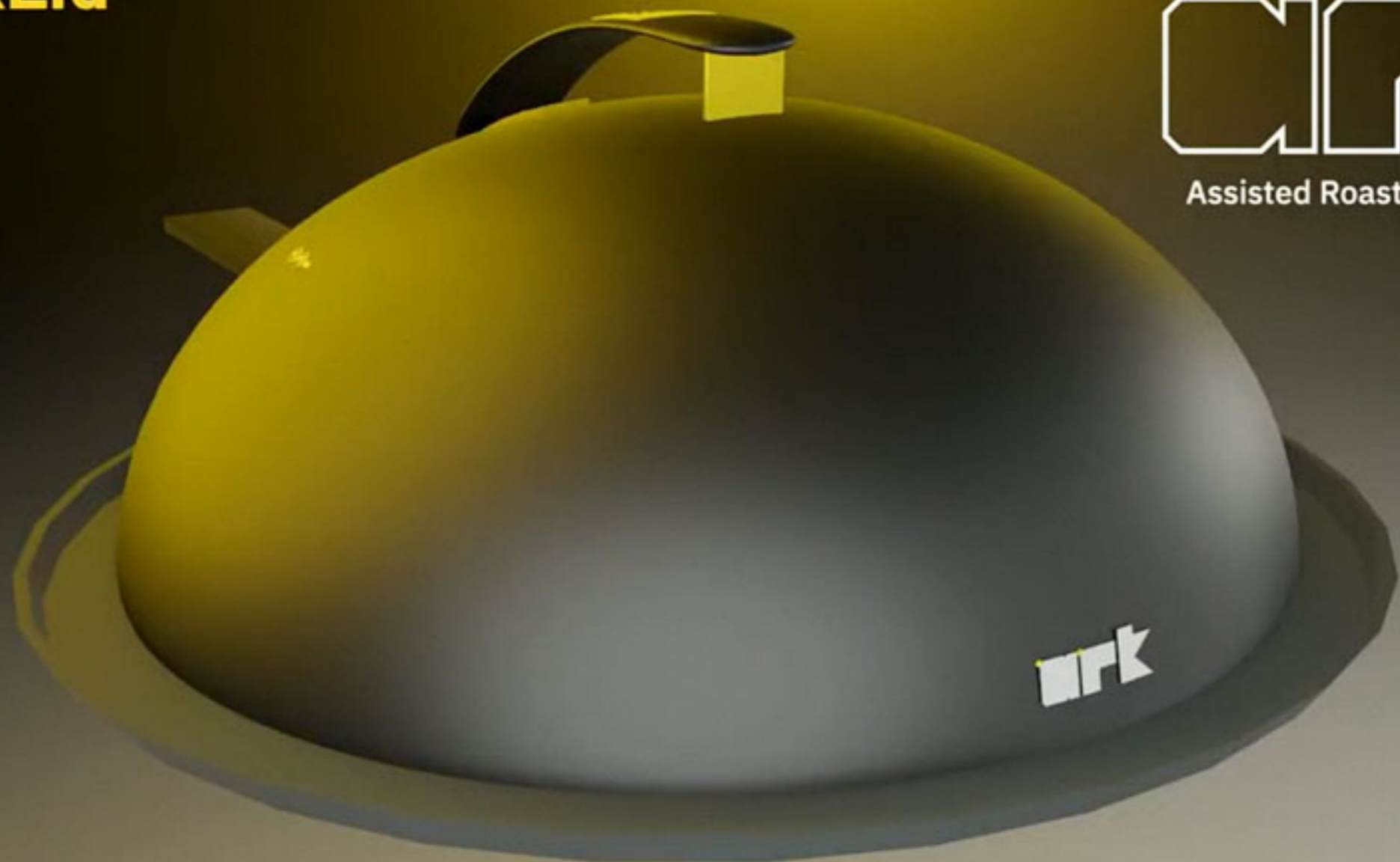
Physical Prototyping

An scale model of the device was made to check for obtrusiveness when used with other utensils on a stove

A possible limitation of the device was its inability to be accessed from the side the pan's handle is located as it obstructs the movement of the utensils that need to come in contact with the pan



ARKLid™



ark

Assisted Roasting in Kitchens

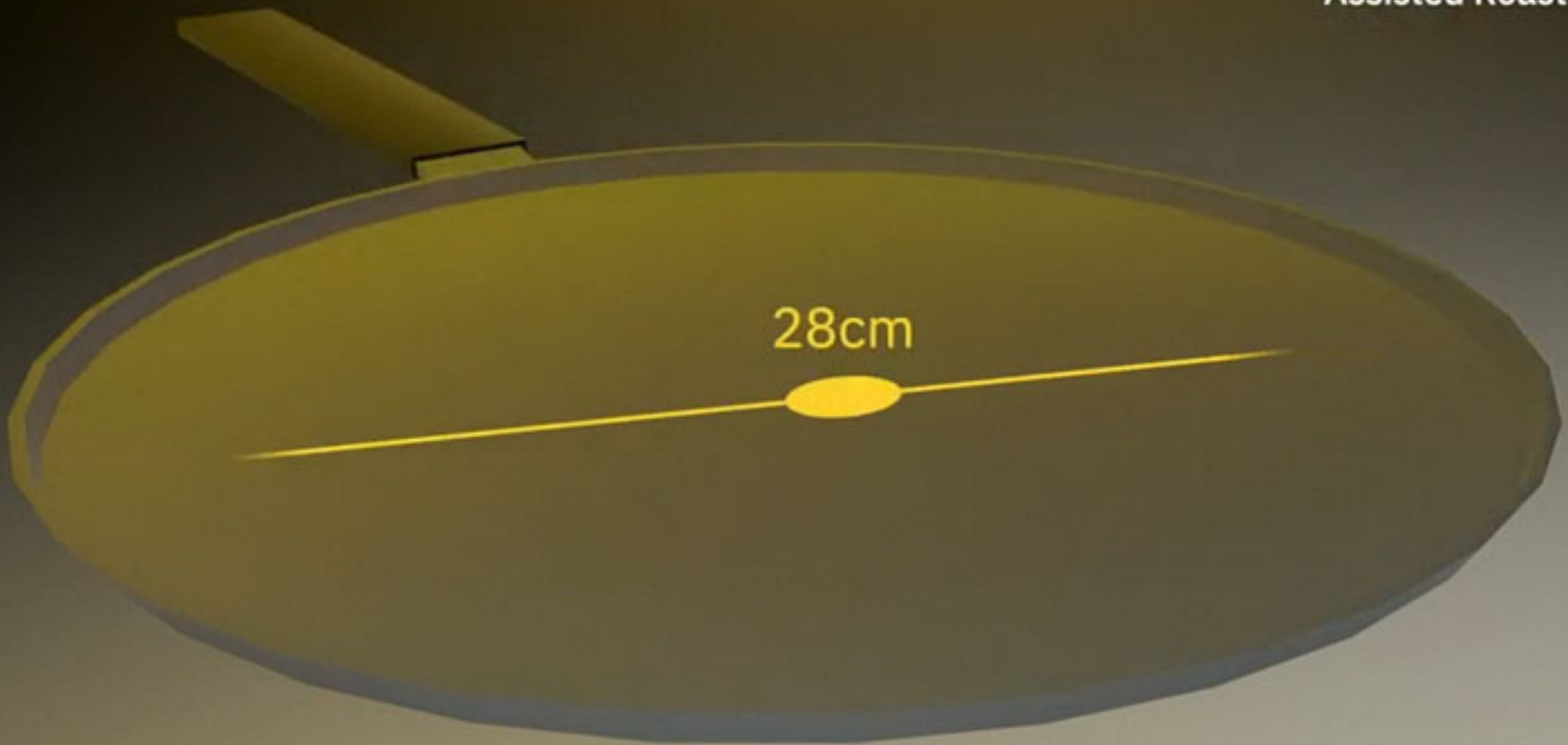
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Assisted Roasting in Kitchens

28cm

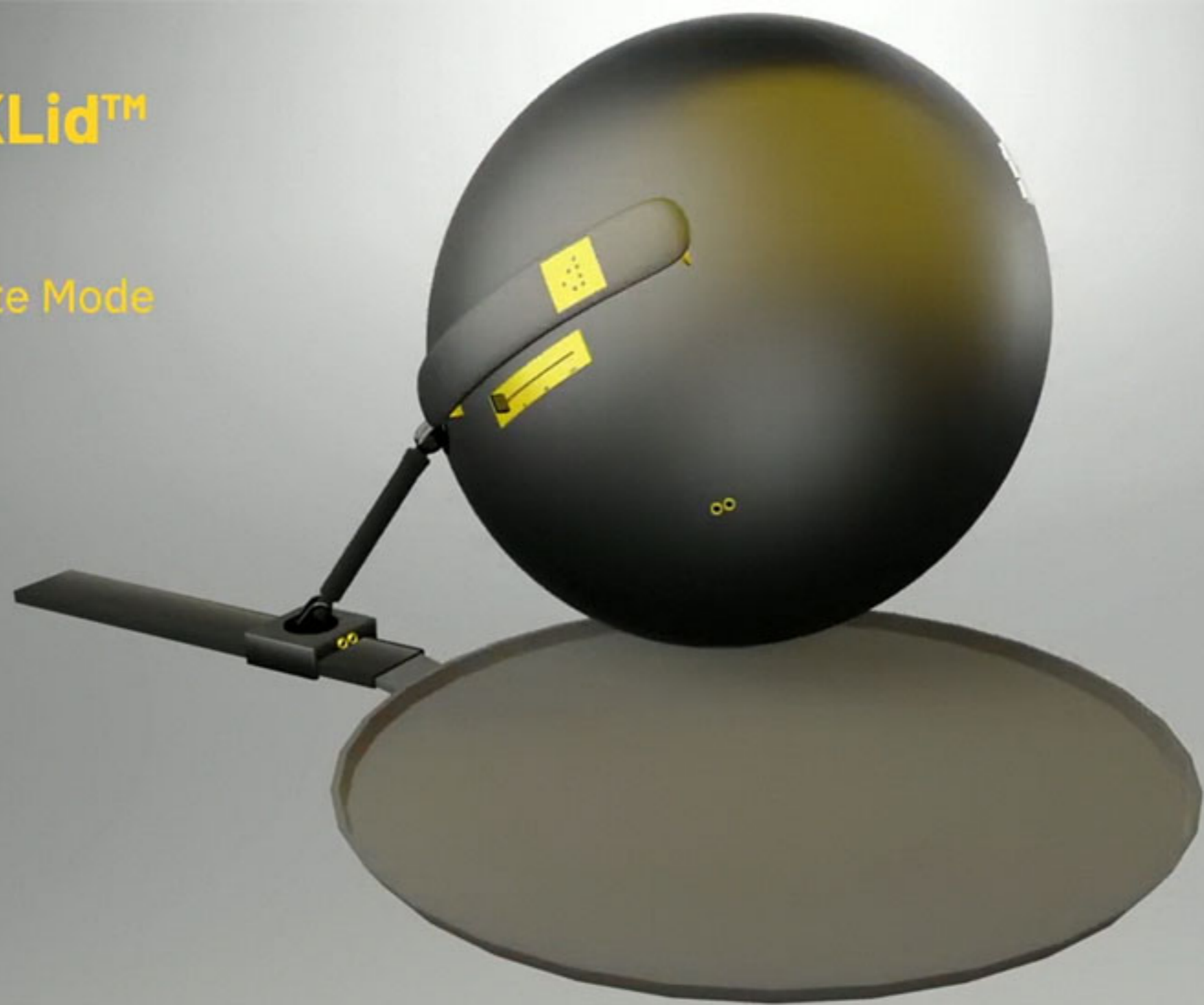


ARKLid™



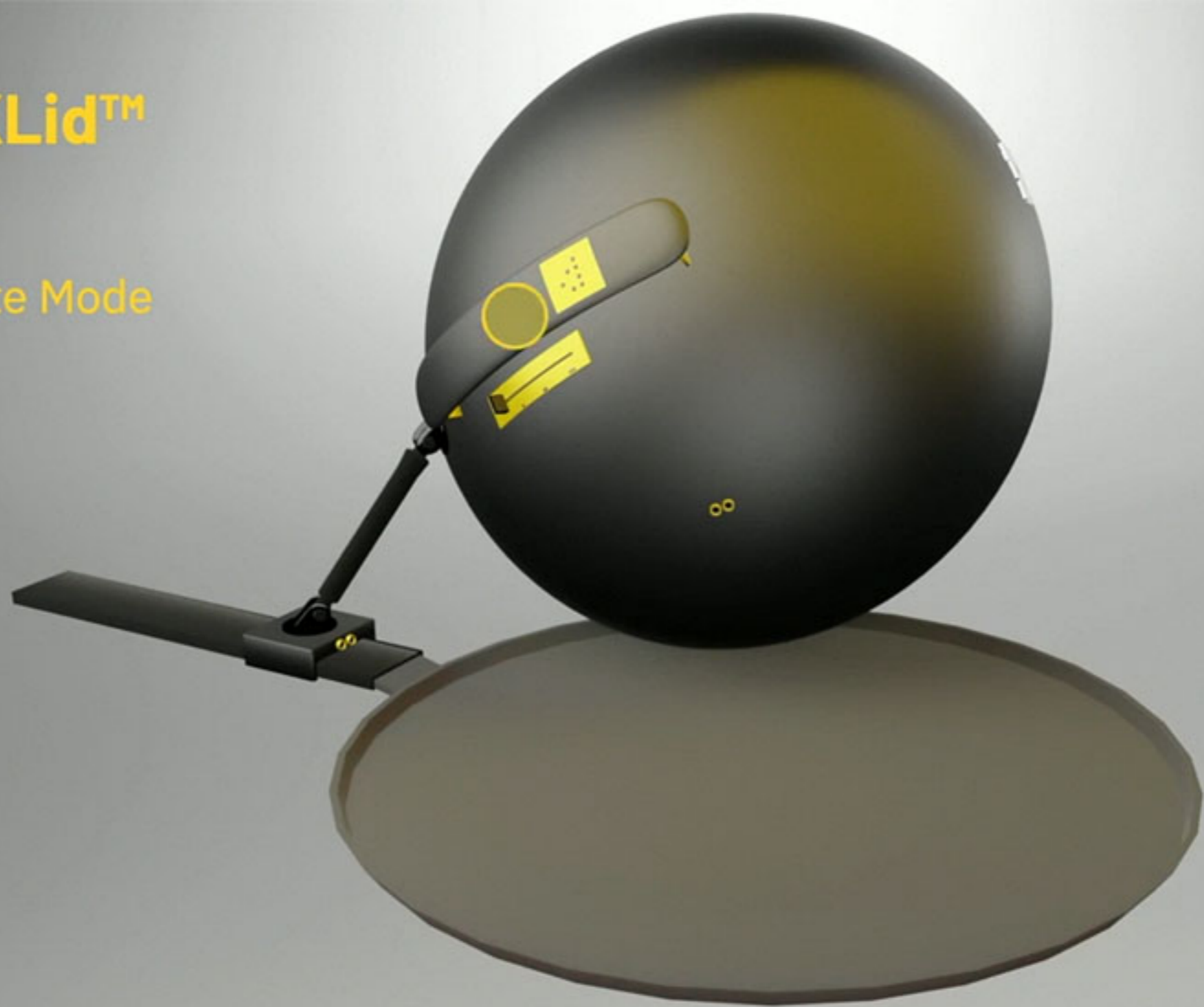
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Locate Mode



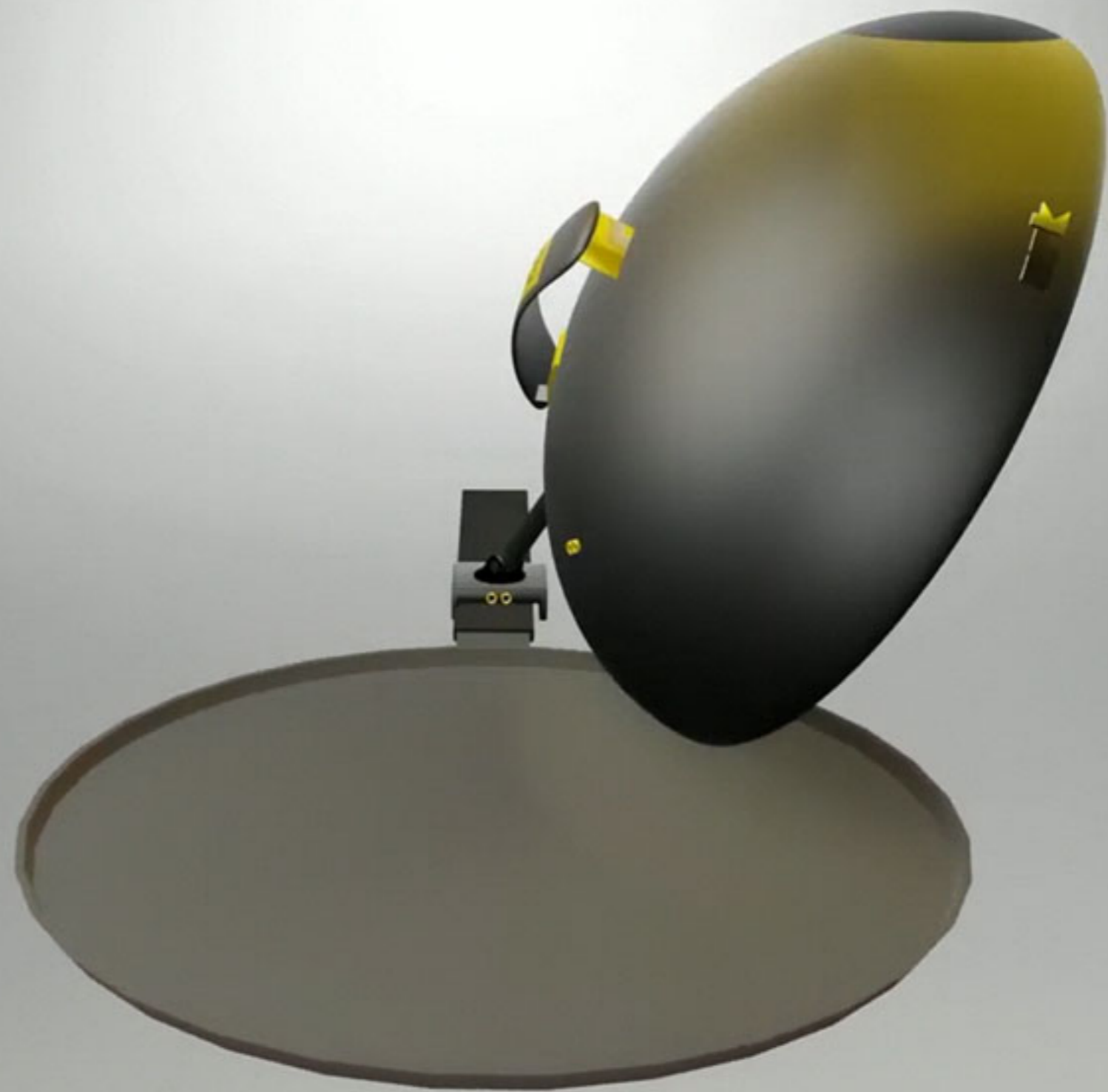
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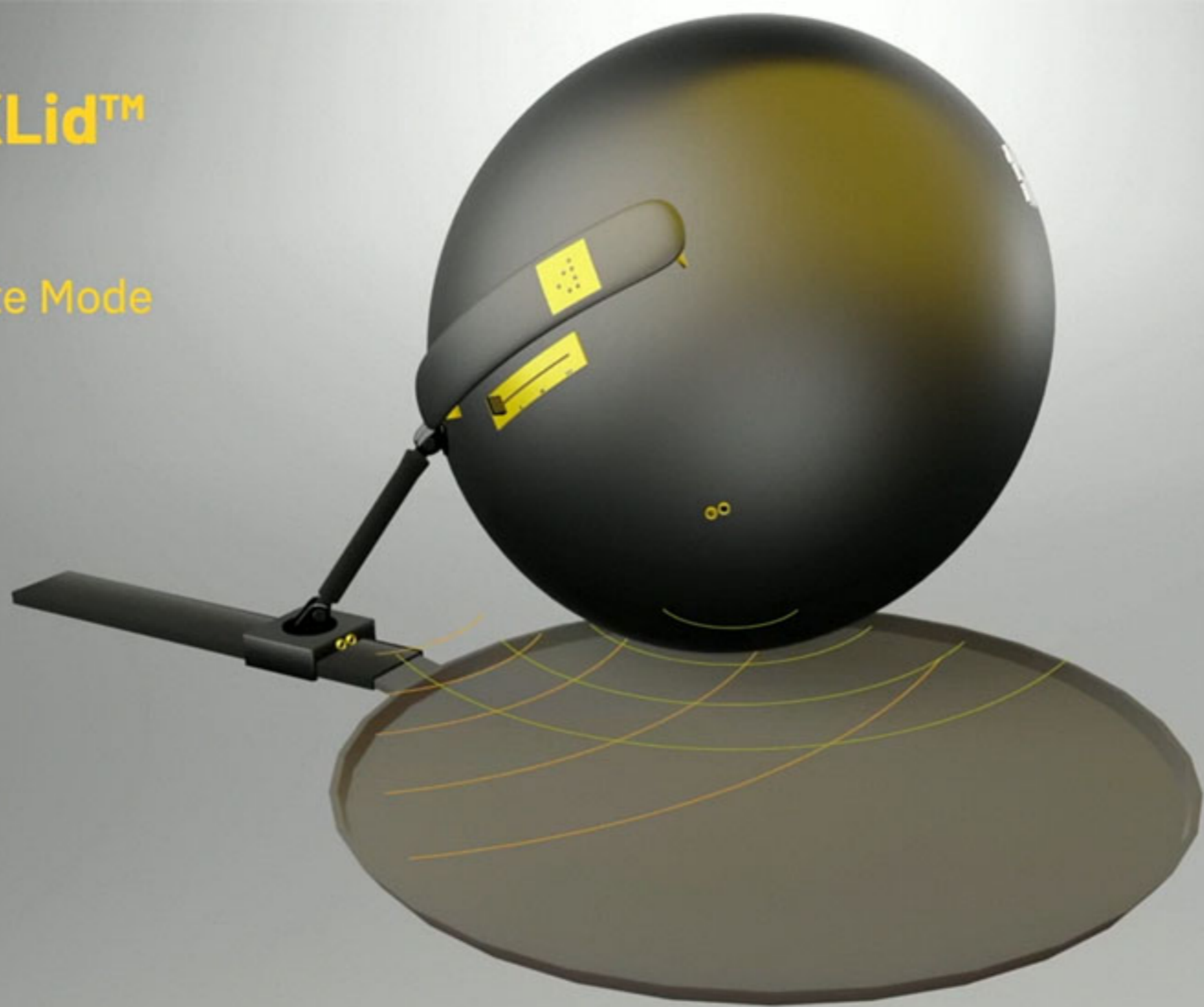
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Locate Mode



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Locate Mode



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Locate Mode



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Cook Mode



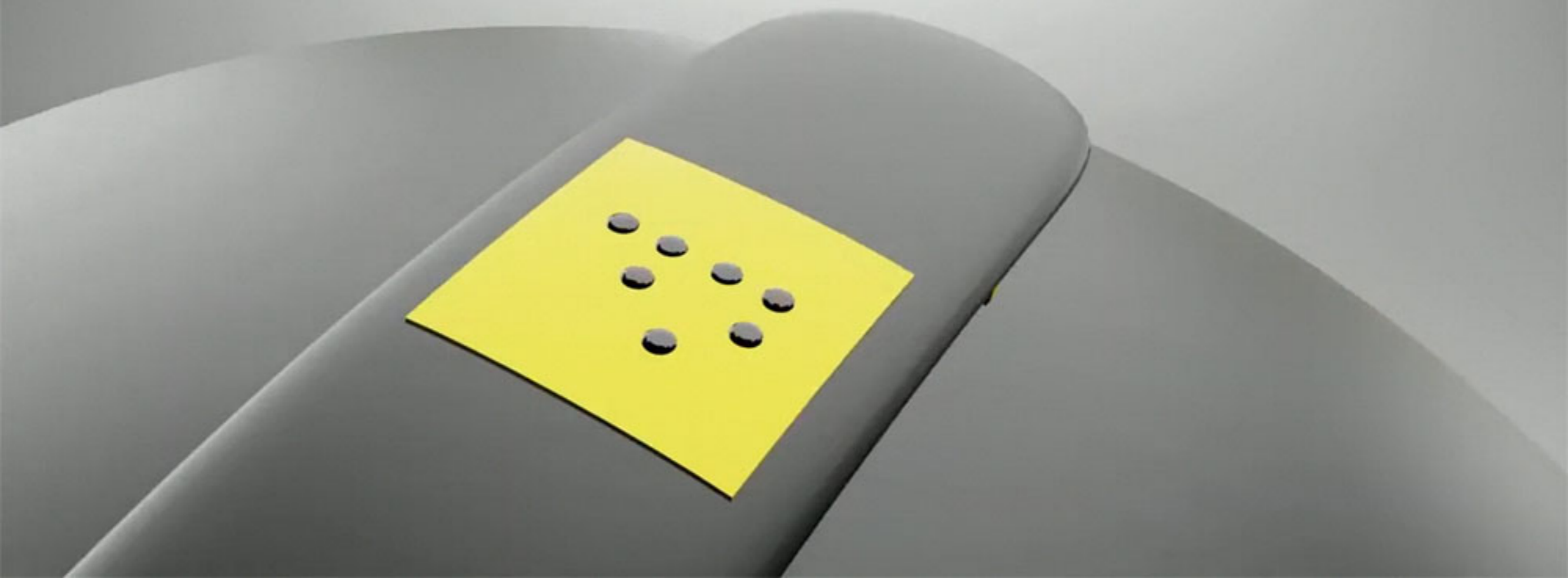
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Cook Mode



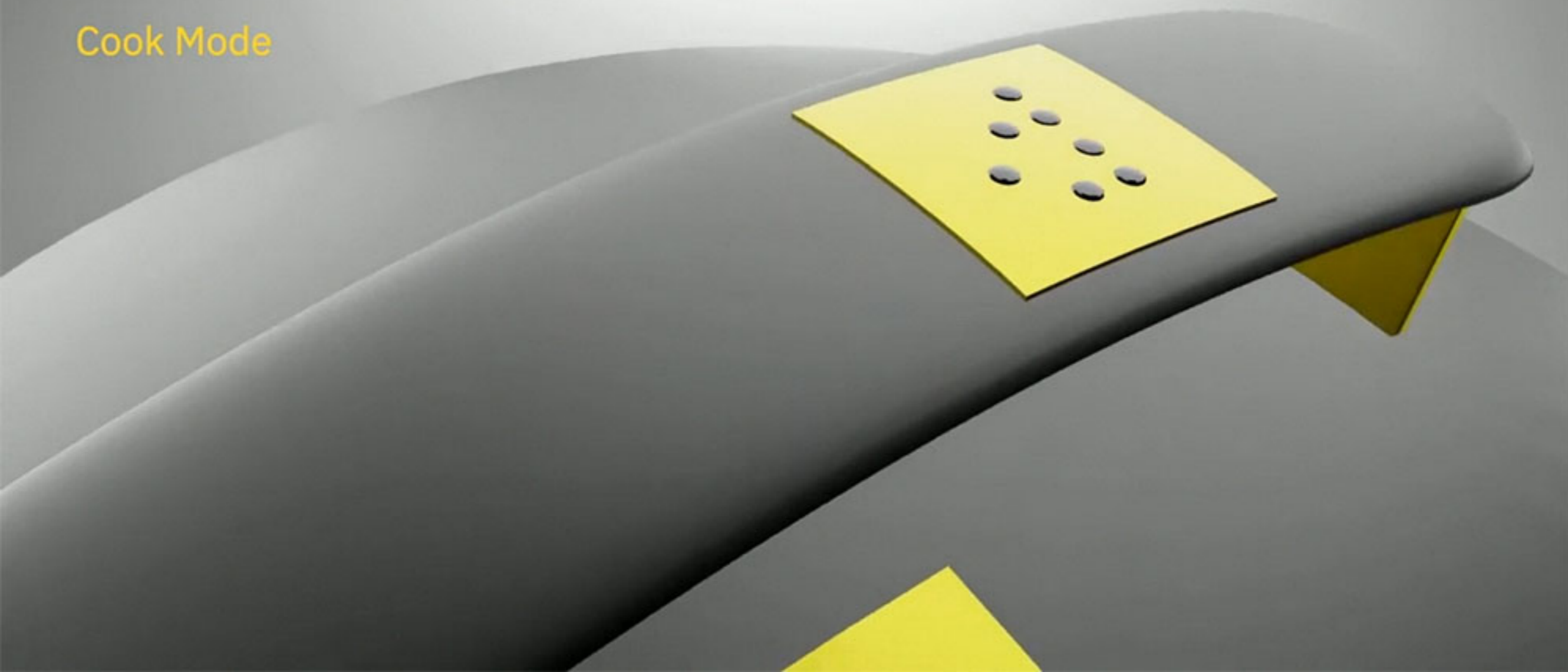
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Cook Mode



ARKLid™

Cook Mode



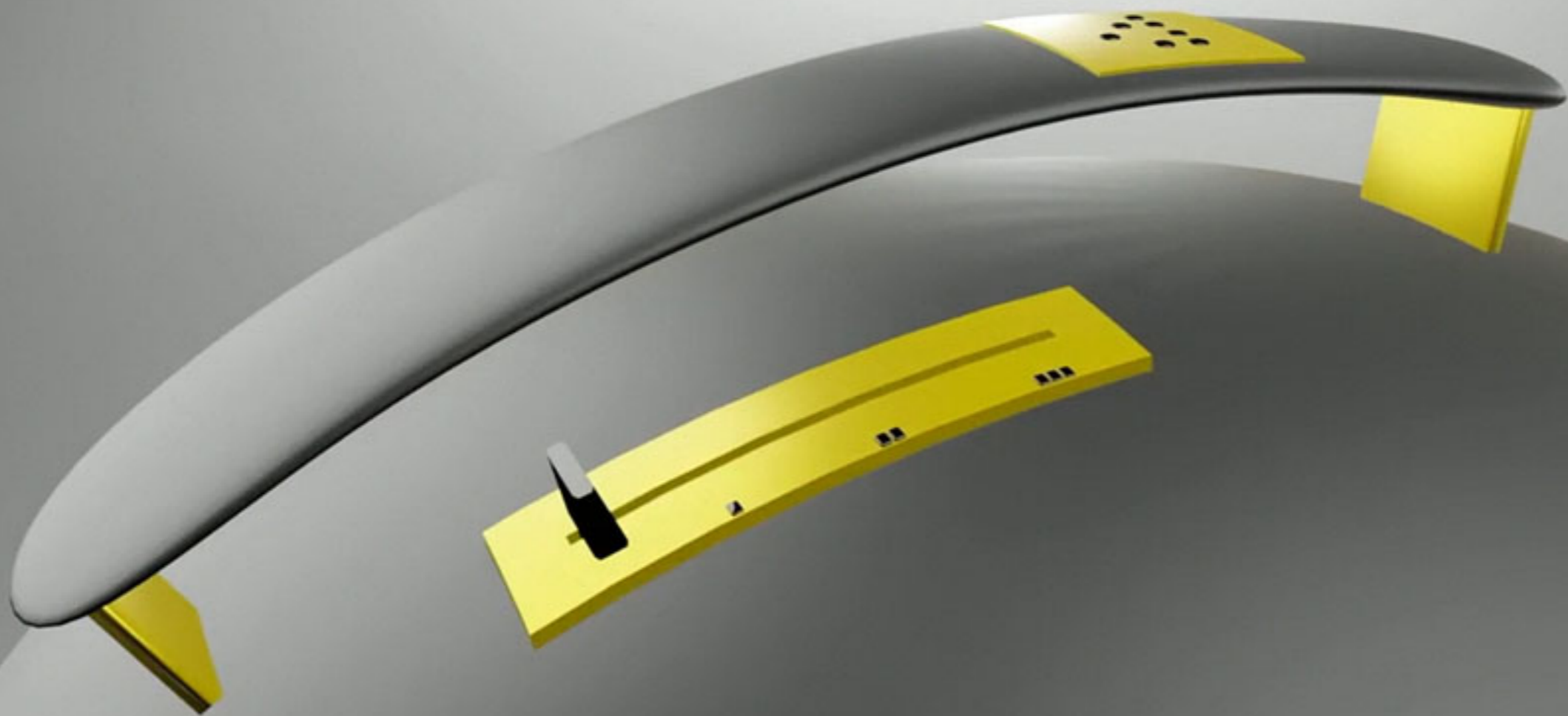
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Cook Mode



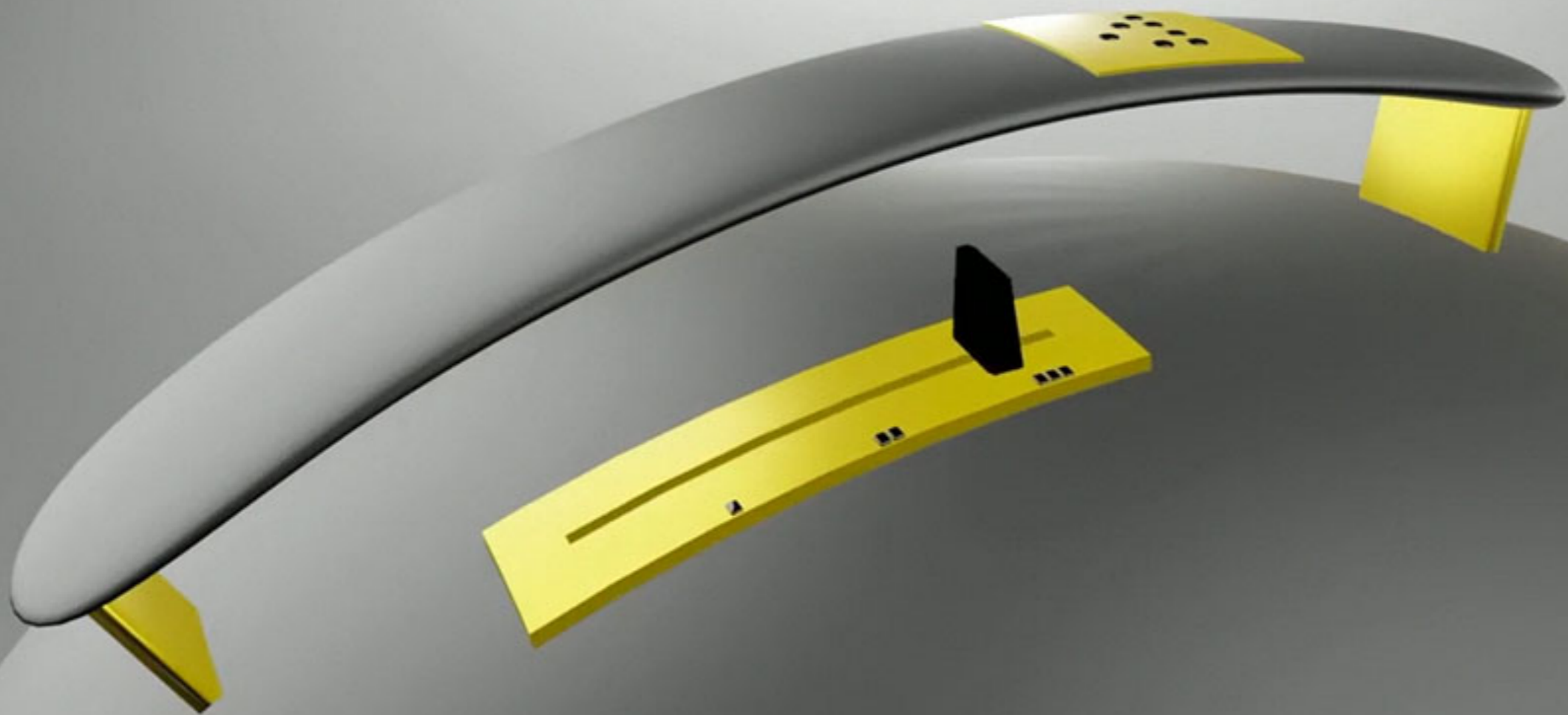
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Cook Mode



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Cook Mode



ARKLid™

Cook Mode

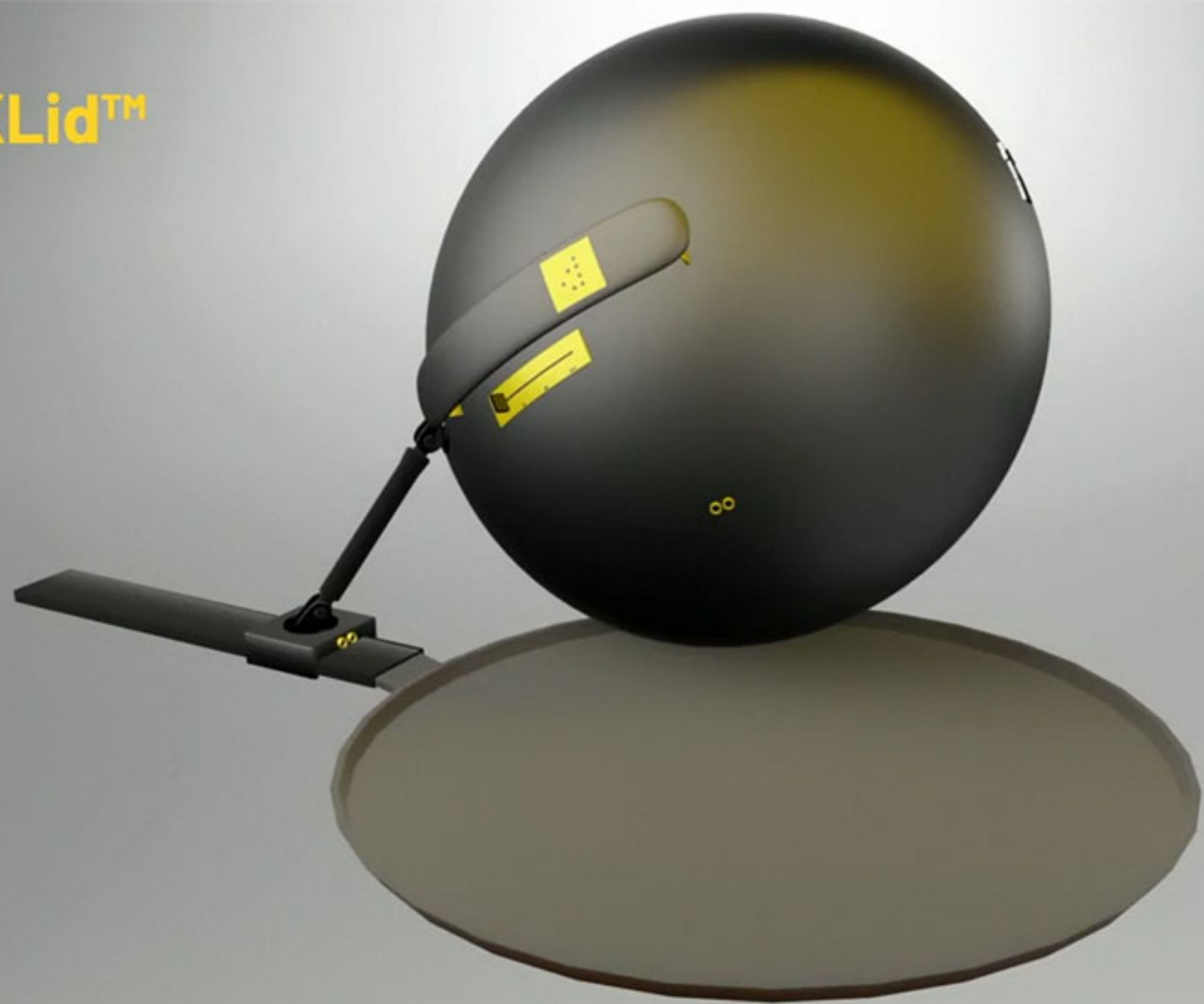


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Cook Mode



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Assisted Roasting in Kitchens

Limitations

Material and formal aspects to help the user navigate the product were not explored and tested in depth when designing

The design uses four thermoelectric generators to heat the hotplate, but this needs testing to confirm the efficacy

The design of the product is based on theoretical and logical assumptions with limited mockup testing

What does the future hold?

Limited research in the area of assisted cooking opens up many opportunities for design

Defining the form and materials would open up possibilities in allowing new and more intuitive ways to interact with the product

The product, while designed with visually impaired users in mind, can be used by a host of other users, such as the elderly or even those with arm injuries

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