

# Gesture Recognition with Smart MiGlove

## Facilitating Human-Robot Collaboration in Assembly Tasks

### Introduction and Context

- **40%** of workers believe they could **lose their jobs** to machinery [1].
- Collaborative robots (**cobots**) circumvent this issue by **working alongside humans**.
- **Improve** workplace **safety** and **efficiency** – help workers to complete tasks **faster**.
- **Limited task comprehension** – many manufacturers **not capitalising** on benefits.

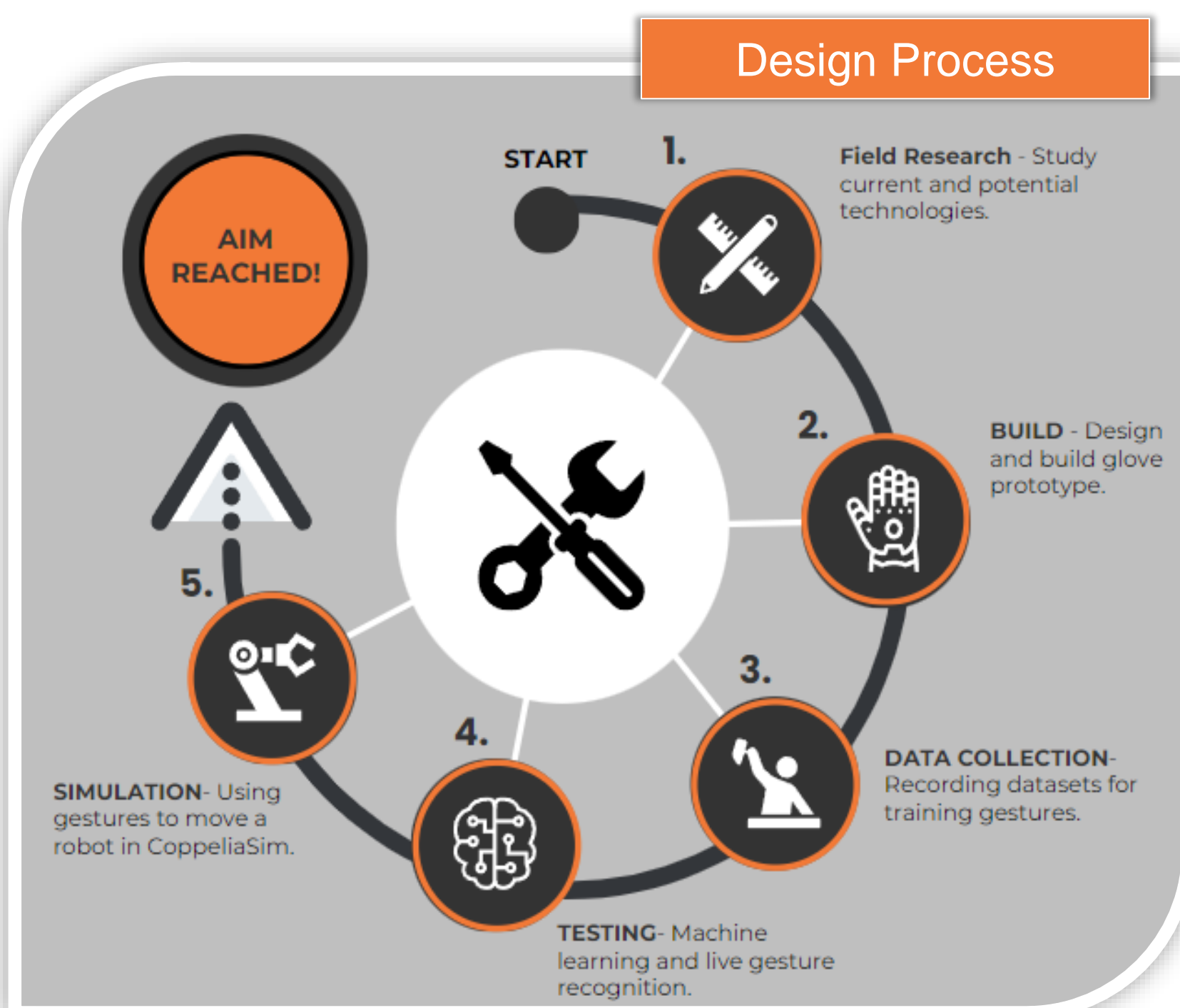


Worker and cobot collaborating in assembly tasks [2].

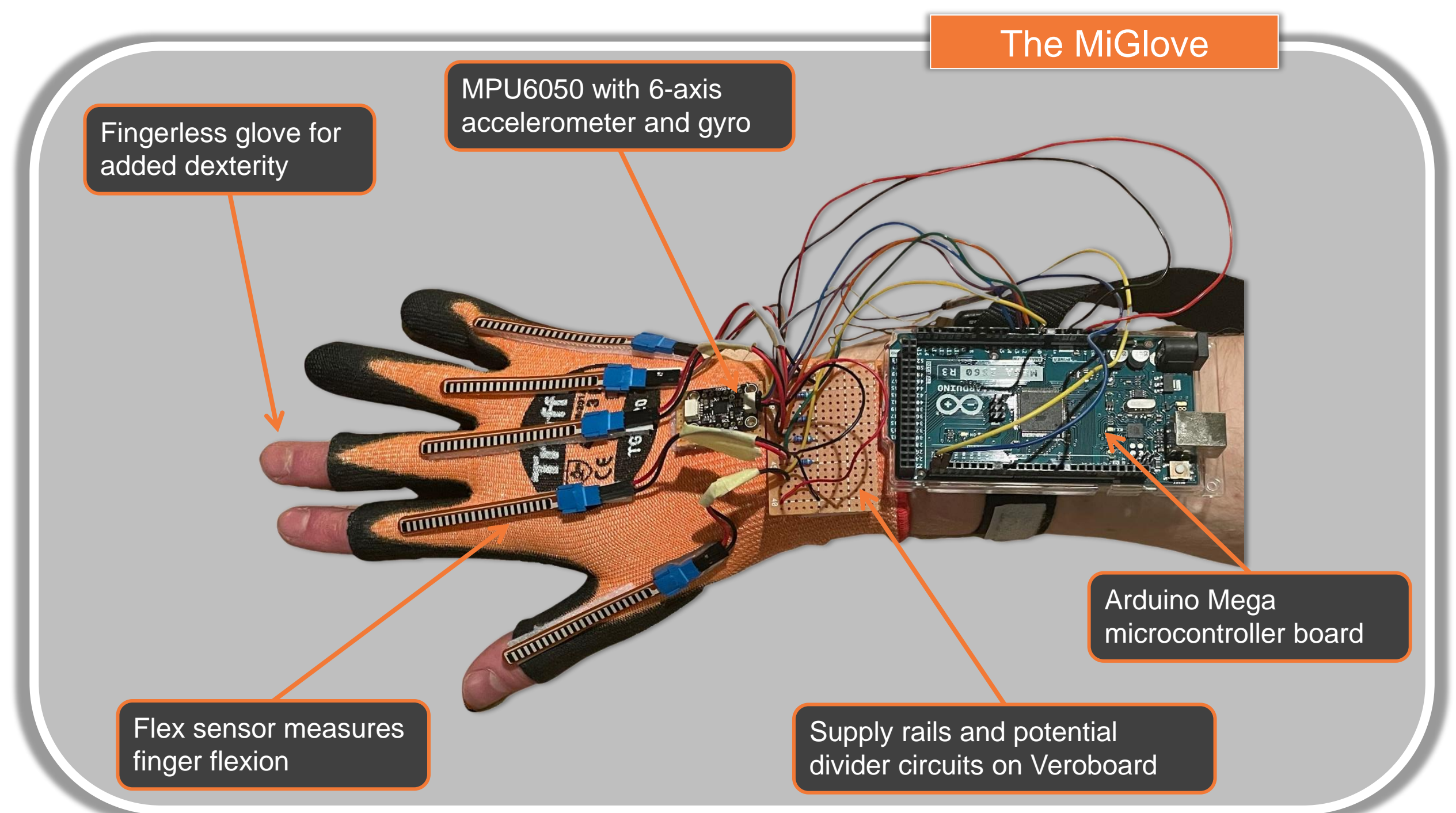
**Aim:** To design a wearable system which will allow humans to interact collaboratively with robots in assembly tasks.

### Methodology and Results

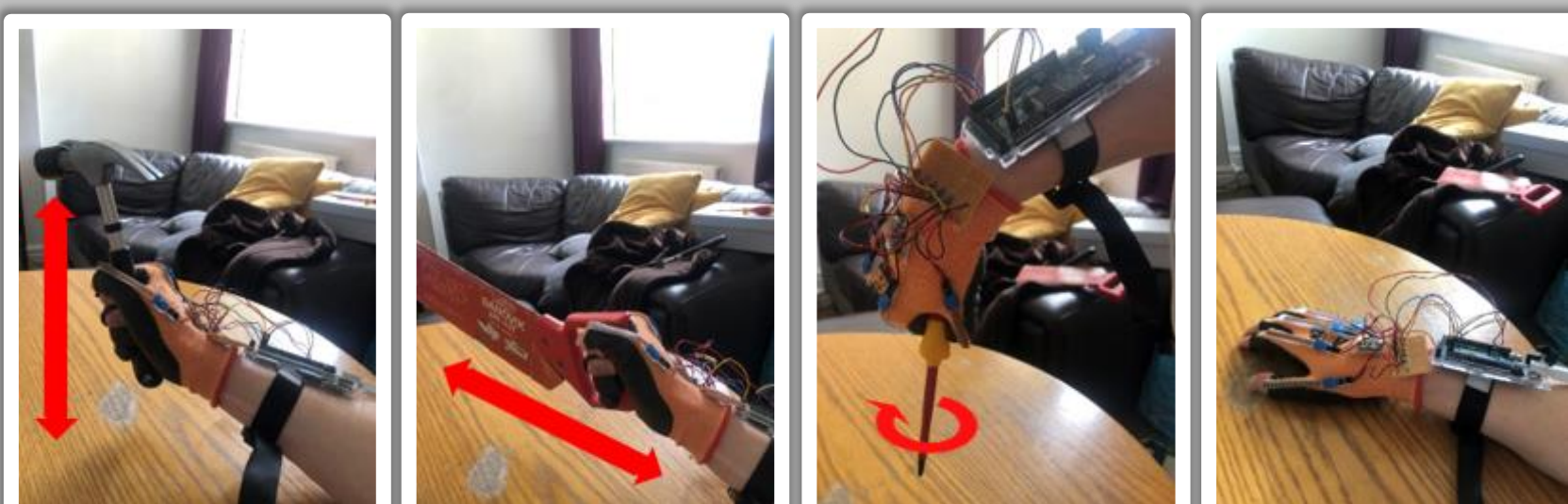
#### Design Process



#### The MiGlove



#### Gestures



Hammering

Sawing

Screwdriving

No Gesture

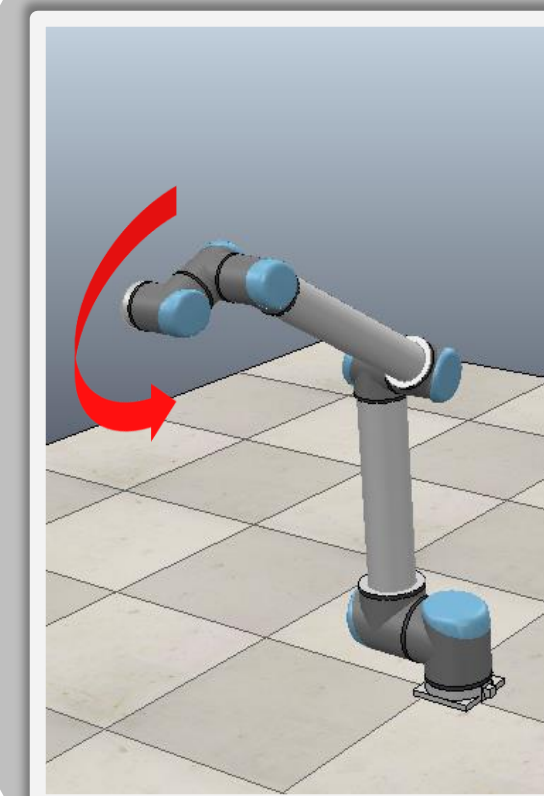
- 30 iterations of each gesture collected using the **MiGlove**.
- Saved to CSV files in preparation for **training** the model.

#### LSTM Model

lstm_input	input:	[(None, 150, 11)]
InputLayer	output:	[(None, 150, 11)]
lstm	input:	(None, 150, 11)
LSTM	output:	(None, 150)
dense	input:	(None, 150)
Dense	output:	(None, 4)

- LSTM model achieved 100% accuracy on unseen test data.

#### UR10 Response



- Connected **MiGlove** to **UR10** robot in **CoppeliaSim**.
- Robot **mimics** wearer's gesture.
- Demonstrates **live task comprehension**.

### Conclusions

Actual	Predicted			
	6	4	0	0
	0	8	0	2
	0	0	10	0
	0	0	0	10

Updated hardware,  
Filtered datasets



Accuracy increased  
from **85% to 100%**.

Confusion matrix shows predictions **mostly** match gestures.

Actual	Predicted			
	10	0	0	0
	0	10	0	0
	0	0	10	0
	0	0	0	10

Confusion matrix shows predictions now match **all** gestures.

- Results are comparable to other studies.
- Affordable (**£120**) yet very high accuracy.
- Flexible solution for workplace implementation.
- Can be updated to include more gesture types.

Provided with **task comprehension**, cobots can dynamically allocate tasks to **increase productivity**, and provide **adaptive assistance** to the worker based on the current workload.

### References

[1] M. Golin and C. Rauh, "Workers' responses to the threat of automation," CEPR, [online], 2023.

[2] Robots.com, "Collaborative Robot Safety," Robots.com, 9 June 2018. [Online]. Available: <https://www.robots.com/articles/collaborative-robot-safety>. [Accessed 16 May 2024].