TECH TALK: Collaborative robot – Universal Robot UR10e

UR10e is an industrial robotic arm which is speed and force limited. Designed with reduced pinch-points and built-in safety sensors, it does not need to be ‘caged’ like other industrial machinery.

The table below is intended to be a technology selection decision support tool and not a substitute for business procurement processes. Information is correct at time of last update.

What’s in the box

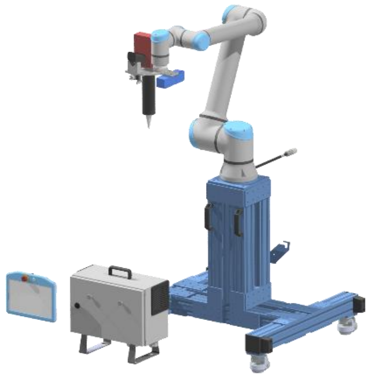

Photo source: AITI stock

Hardware

Manufacturer:	Universal Robots (UR)
Model and release date:	UR10e, 2018
Price (est):	$52,000 AUD
Device:	Collaborative Robot
Mounting requirements:	Any orientation. Needs 4 x 8.8 strength bolts
Power source requirements:	100-240VAC, 47-440Hz, 10amps
Power consumption:	350W (typical)
Cobot, control box & pendant weights:	33.5kg, 13.6kg, 1.6kg
Cobot, control box & pendant surface materials:	Aluminium, steel, plastic
Control box size:	475 mm x 423 mm x 268 mm
Teach pendant screen:	260mm x 160mm, 1280x800 pixels

Technical specifications

Features

Payload capacity:	10kg
Reach:	1300mm
IP classification:	IP54
Noise emitted:	Less than 65dB(A)
Max Speed:	1m/sec
Repeatability:	±0.05mm
Force-sensitivity resolution:	2N (force) 0.02 Nm (torque)
Degrees of Freedom:	6dof
ISO 14644-1 Cleanroom:	5
Pendant cable:	4.5m
I/O Power Supply:	Tool: 12V/24V Controller: 24V 2A
Operating Temperature:	0-50°C
Robot Tool Flange Connectivity:	2 digital in/out, 1 analogue in, 1 UART (9.6k-5Mbps), 12/24 V, 600mA continuous, 2A for shorter periods
Robot control box connectivity:	8 digital in/out, 2 analogue in/out, 4 safety in, 8 configurable digital in/out.
	1 x USB 2.0 type A, 1 x USB 3.0 type A ports. ModbusTCP, ProfiNet and EthernetIP all with 500 Hz signal frequency.

For more information go to https://www.universal-robots.com/products/ur10-robot/

Set up investment and required skills

Operating System

- Polyscope – Native cobot pendant operating system. Well documented tutorials are available on the UR Academy portal.

Key Knowledge

- Windows 10 – Accessing additional software for robot and end effectors and for other additional offline robotic simulation or programming software such as RoboDK.
- Experience with Python programming language helps – it translates well to using the URScript proprietary programming language, which may be required for more advanced functionality.

Practical Task Setup (as experienced by trial engineers)

- Programming through the Polyscope software is straightforward. It is strongly recommended that the “Core Track” course is completed through the UR Academy before starting work.
- CAD tools such as Autodesk Inventor were used to visualise work cell layout and for designing additional mounts which were fabricated through 3D printing and laser cutting.
- This trial integrated the UR10e with 2 end effectors: Milwaukee Electric Caulking gun and Ensenso Stereo Inspection Camera

Further info

- UR have a strong ecosystem (UR+) of 3rd-party accessories from industry collaborators such as OnRobot, RobotIQ, Piab and Soft robotics.
- Attaching new UR+ end effectors is plug and play, with easy to install drivers called URCaps.

For more information go to: https://www.universal-robots.com/plus/products/?

PEOPLE PERSPECTIVE: Collaborative robot - Universal Robot UR10e

Task/Environment Suitability	Usability Features	Task/Environment Constraints	Usability Constraints	Key Opportunities & Applications	Guidance for Implementation
High precision tasks (e.g., need consistent product - welding, wiring electrical circuits etc) **Repetitive tasks** (e.g. gluing, screwing, lifting) **Easily accessible, relatively open, uncluttered spaces** (i.e., allow for cobot arm and sufficient clearance for its required reach and movement) **Flat or stable flooring/base** (i.e. pedestal with adjustable feet or other support structures may assist)	**Easy to Operate** Teaching task via hand-guiding reduces need for programming knowledge **Customisation** <u>Manoeuvrability of arm</u> Resistance when moving arm is adjustable, depending on the nature of work undertaken (e.g. greater resistance, 'snail' setting, more effective for fine movements) <u>Working height</u> Each user can determine and set a comfortable working height; preferred handedness easily accommodated <u>Changeable end-effectors</u> Allow for quick reconfiguration to complete different task components	**Low force/payload capacity** Applications are limited to processes that involve relatively light payloads **Lower complexity tasks** Lower levels of human-robot collaboration tend to be the norm (i.e. coexistence or cooperation) with fewer examples of human and robot working simultaneously on a shared object in shared space. **Fixed workstation** Robot and pedestal not light; effortful to move regularly **Industrial environments** Inadequate lighting, extreme temperatures, unstable surfaces and space constraints are common job site conditions which may impair or prevent cobot performance (i.e. interfere with their sensors) Cobot may require a protective sleeve or similar if dust or other substances are present; the performance impacts or restrictions of this are untested here	**Interface design** Appropriate instructions and good interface design of the teach pendant are essential if fast set-up times and straight forward use are to be experienced <u>Consistency and standards across technology</u> Some conventions used in the teach pendant were found to be counterintuitive to user expectations (e.g. for active drive, the red symbol signifies recording, not 'stop' or 'off') resulting in time delays and frustration **Performance** At times, the accuracy of the recorded taught path was questioned by users (i.e. appeared to 'run wide' in places when played back*). Few were motivated to 're-teach' the path but this could cause delays, frustration and lack of trust if implementing **Possibly a result of 3rd party hand-guiding software applying minor path smoothening to optimise the toolpath*	**Improve wellbeing & safety** <u>Reduce musculoskeletal risk</u> Improves posture and reduces physical demands which are problematic when engaging in repetitive tasks <u>Reduce exposure to hazardous jobs</u> Capable of executing hazardous tasks (e.g. dispensing harsh substances) with supervision by human **Generate productivity & quality gains** Can achieve a significant time reduction in completing tasks with greater consistency in output (e.g. glue coverage) **Minimise material waste** The cobot provides the ability to test or dry run the accuracy of a process without consuming product (e.g., end-effector, housing a laser beam, can indicate glue dispensing path)	**Performance gains are relative to current state of operations** Performance and design are interdependent. Well-designed existing tools, equipment and layout may provide a good person and task fit, limiting the improvements a cobot can deliver If bespoke end-effectors are needed to support quality and efficiency outcomes, this will involve additional time and costs **Provide good job design** Whether tasks are completed manually or by/with a cobot, skill variety, task identity, task significance, autonomy and job feedback are critical to maintain employee motivation and satisfaction. **Run size thresholds** For a low complexity task, a run size of ten or more was suggested as a threshold between using a manual versus cobot approach. This threshold is subjective and will vary between individuals and businesses

These suggestions are formulated from a human factors research trial examining use of the technology in a brief glue-dispensing task within a laboratory environment. Selection and implementation of a technology should consider the abilities of the person doing the task, the task requirements, and the environment in which the work is to be undertaken.