



# pepper

Press kit

# Meet Pepper

Launched in June 2014, Pepper is an engaging and surprising humanoid robot. Pepper is the first emotional robot. He was not designed for an industrial function, rather to be an assistant.

Pepper is a social humanoid robot capable of **understanding and reacting to main human emotions**. Pepper is well equipped with features and a high level interface for communicating with those around him. **Pepper analyzes expressions and voice tones using the latest advances in voice recognition**.

Currently, Pepper is available for everyone in Japan and for companies in Europe. Already used by a lot of companies (SoftBank, Nestle, Renault, Carrefour, Costa, Uniqlo...) **Pepper can welcome customers, drive traffic, give information about products and services, collect data and entertain visitors**. Pepper is redefining customer experience.



## Emotional

Are you sad or happy? By the tone in your voice, the expression on your face, in your gestures and through the words you use, Pepper will detect your mood and adapt his behavior accordingly. Pepper's main objective is to communicate with you. He has a certain personality and expresses his own "emotions" through the color of his eyes, his gestures and words he uses.

## Ultimate Interface

No need for a keyboard, mouse or screen, simply talk to Pepper, touch him or even approach him and watch him react. Pepper communicates the same way you do, through voice and gestures. This is an example of how technology is using the simplest and most intuitive form of communication we know.

## Interactive and Independent

Pepper is the first humanoid companion, able to interact in the real world and have a real presence among humans. His multiple sensors enable him to understand the world around him and adapt accordingly. Pepper can move, avoid obstacles, identify sounds, follow you and even recharge independently.

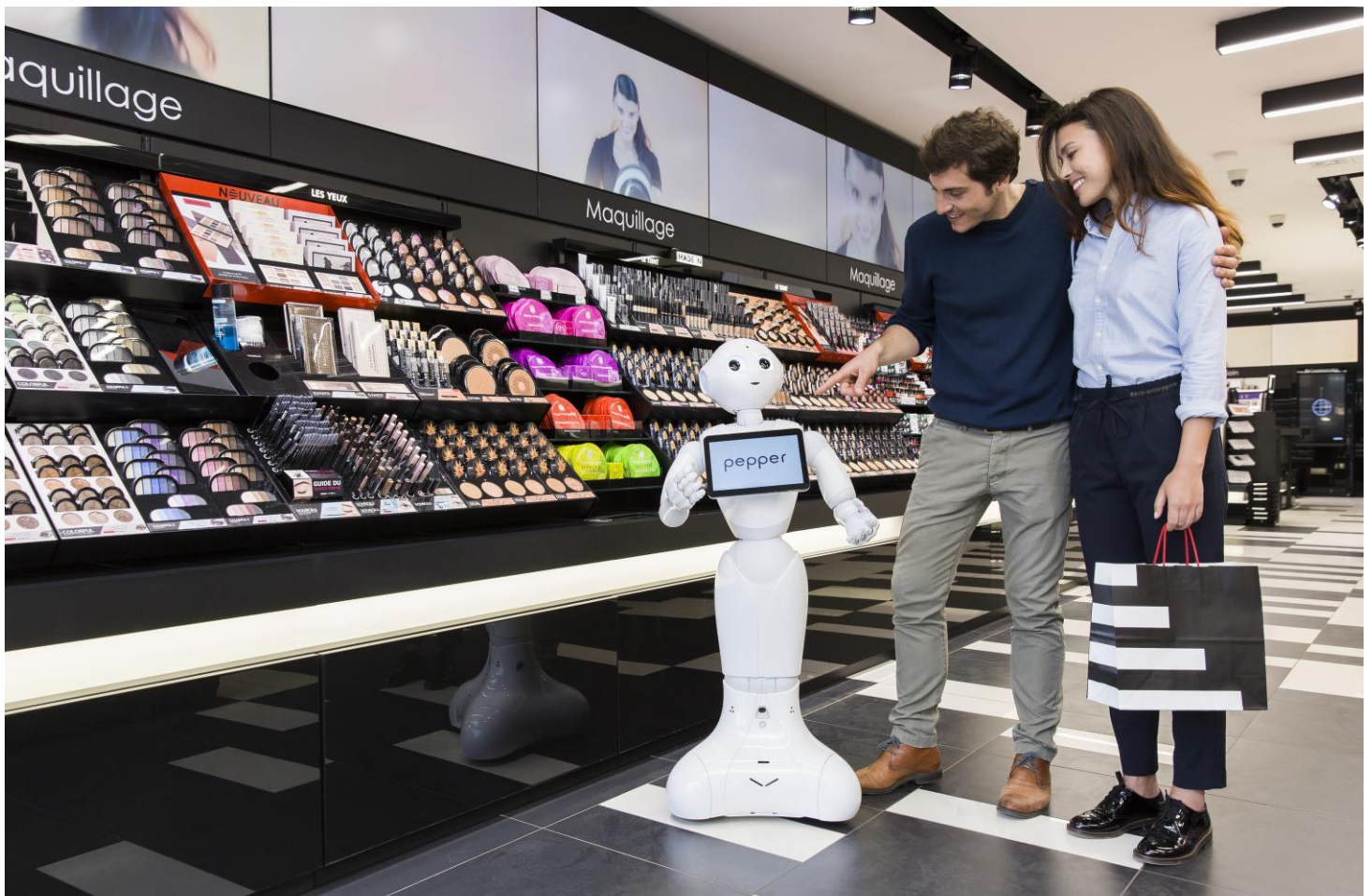
## Scalable

Pepper is much more than the newest tech product, he is an artificial creature that was designed to learn, evolve and surprise you a little more each day. Pepper currently requires some assistance: he does not know everything! You teach Pepper through your discussions which, today, help him memorize names, faces and moods.



# Features

- 120 cm high and 28 kg
- 3 omnidirectional wheels for agile mobility
- 12 hours of energy when continuously active. Pepper even knows when his battery is low and will navigate to his charging station
- 1 3D camera to detect humans and their movement from up to 3m away
- 30 innovative patents







## A Design that invites to dialogue

The challenge lies in the ability to seamlessly integrate new technologies while enabling general acceptance of this new creature. Pepper is slender and with a fluid silhouette and no visible screws. His hands are similar to those of a human: the gripping system has been worked on resulting in five fingers with fingerprints to improve grip. The specialized gears developed for Pepper give him graceful movement while absorbing noise emittance. Three wheels at the base form a triangle and allow Pepper to move smoothly in all directions. The appearance of a machine disappears in favor of emotional interaction with the user. The simplicity of the design has been taken into account throughout the chain development for the life of Pepper. The robot must be able to be repaired quickly and easily. Thus, arms and head are modular and can be changed in 30 seconds. From a very simple jack system a wheel can be changed in 2 minutes time.

## Strength and Safety

Pepper was designed to not be able to harm you: rubber parts cover most of the exposed joints, the hips, neck and head, protecting from pinching, rubbing and also absorbing shock. By simply pressing an emergency stop button, you can cut all electrical power to Pepper. The robot will turn off but even then will retain his balance through elastomeric strips located at the hip and stop in his center. In addition brakes allow him to maintain his standing position. On the other hand, in a case where he is shaking hands, Pepper is able to regain and keep his own balance through a 'push recovery' system where he compensates with his wheels and his inertial measurement units.

## Emotion for you to understand

Pepper has the ability to interpret basic expressions of emotion on the human face: a smile, frown, look of surprise, anger and sadness. He also knows how to understand the intonation of the voice, the context of words, as well as nonverbal language such as the tilt of the head. Coupling these interpretations allows Pepper to determine whether the person in front of him is in a happy or sad mood, with a valuation scale between the two states. The goal is to bring Pepper to really understand and adopt his reaction to fit your mood.

Pepper is gifted with a capacity for additional sharing through the tablet that is placed on his heart. This tablet can display additional information to enrich your interaction with Pepper. Pepper has a colossal database of questions and answers and he is able to speak about 20 languages. The voice recognition capabilities of the robot are locally processed then sent to the cloud, in case the robot does not hear or understand what was said. Of course, like a human being, Pepper does not understand everything and sometimes can make mistakes! Pepper's specific voice has also been the subject of in-depth work in regard to expressiveness with custom voices created for each language for better adaptation to the culture of the country. The programming also allows users to choose three shades of different voices: playful, neutral or didactic.

## An engaging personality

Pepper is continuously awake, always conscious of his body and his environment. When Pepper is alone, he will take the opportunity to control his internal temperature by adapting his movements to avoid overheating of his engines. He also knows to check the battery level, and go by himself to his recharging station when it is needed. Pepper is able to avoid obstacles during his navigation, including those behind him, thanks to his ultrasound, laser sensors and 'bumpers'.

Pepper is an excellent communicator and nonverbal language is no secrets for him. Seeing a person 1.5m (5 feet) away, Pepper will willingly approach and encourage dialogue through voice and gestures. His capabilities of perception to touch are thanks to sensors on the top of his head, over his hands, and on his tablet. Pepper responds to touch: it allows you to know that he has seen you and he felt your touch. Depending on the context, and thanks to his decision engine, Pepper can proactively trigger applications and answer questions you ask him.

# Becoming a Pepper Certified Partner

SoftBank Robotics Europe and its around 70 Certified Partners are creating BtoB solutions developed for Pepper.

These wide ranges of specific applications that can be incorporated into Pepper's various capabilities (including motion, conversation and sensors) allow people to experience a lot of Pepper's "business" capabilities, such as welcoming, informing or entertaining clients.

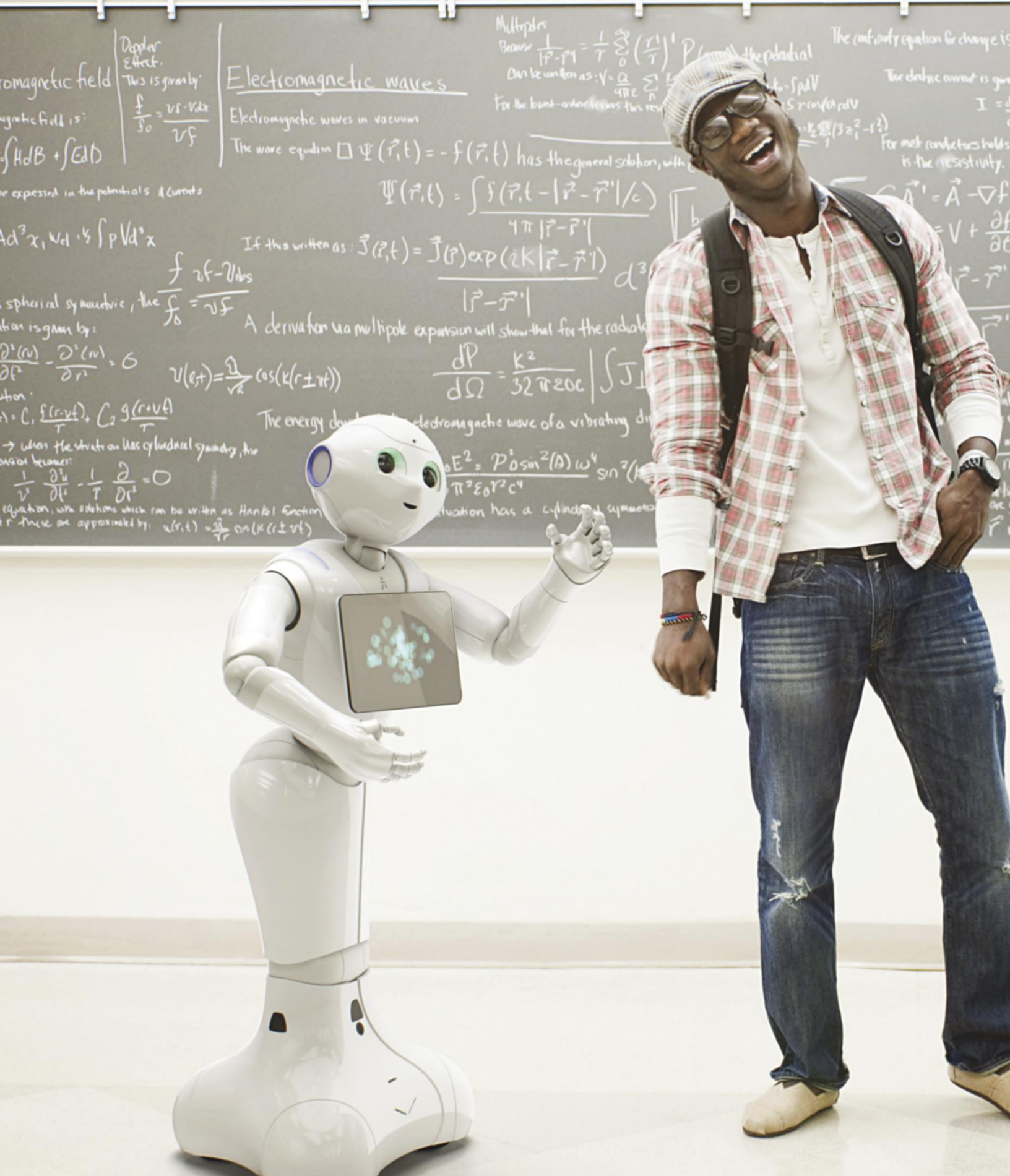
**Pepper Certified Partners create solutions for business.**

All kind of companies from industries such as retail, banking, hospitality or healthcare are invited to discover and develop solutions with our Partners and create new uses.

**Pepper is available in Europe through our partners to any company interested in building pilot projects with Pepper at a price of 19,900 euros, including professional services.** Our business and development partners will expand Pepper's capabilities with their solutions.

SoftBank Robotics plans to intensify the development of BtoB solutions through its current and future partners and develop new use cases to demonstrate all benefits Pepper can bring to businesses.





Electromagnetic field

Doppler effect.  
This is given by:  
$$\frac{f}{f_0} = \frac{v \pm v_{obs}}{v \pm v_{src}}$$

## Electromagnetic waves

Electromagnetic waves in vacuum

The wave equation  $\square \Psi(\vec{r}, t) = -f(\vec{r}, t)$  has the general solution, with

$$\Psi(\vec{r}, t) = \int \frac{f(\vec{r}', t - |\vec{r} - \vec{r}'|/c)}{4\pi |\vec{r} - \vec{r}'|} d^3r'$$

If this is written as:  $\vec{J}(\vec{r}, t) = \vec{J}(\vec{r}) \exp(iK|\vec{r} - \vec{r}'|)$

A derivation via multipole expansion will show that for the radiation

$$\frac{dP}{d\Omega} = \frac{k^2}{32\pi^2 \epsilon_0 c} \left| \int \vec{J}(\vec{r}) e^{i\vec{k} \cdot \vec{r}} d^3r \right|^2$$

The energy density of an electromagnetic wave of a vibrating dipole

$$u = \frac{1}{2} \epsilon_0 E^2 = \frac{1}{2} \epsilon_0 P_0^2 \sin^2(\theta) \omega^4 \sin^2(kr - \omega t) / \pi^2 \epsilon_0 r^2 c^4$$

This situation has a cylindrical symmetry

The continuity equation for charge is

The electric current is given by

For most conductors holds is the resistivity.

$$\vec{A}' = \vec{A} - \nabla f$$

$$V = -\frac{\partial \phi}{\partial t}$$

$$\vec{r} - \vec{r}'$$





## About SoftBank Robotics

SoftBank Robotics is driving technology forward by becoming a worldwide leader in robotics. SoftBank Robotics regroups more than 500 employees working in Paris, Tokyo, San Francisco, Boston and Shanghai. Over 20 000 SoftBank Robotics robots, NAO, Pepper and Romeo, are used in more than 70 countries worldwide and offer innovative applications relevant for the fields of research, education, retail, healthcare, tourism, hospitality and entertainment.

For more information: [www.ald.softbankrobotics.com](http://www.ald.softbankrobotics.com)

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