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ABSTRACT

In recent years, there has been an increasing interest in robots designed to assist with information, communication and way-finding at airports, hospitals, shops and other public areas. This poster includes an overview of available commercial-off-the-shelf robot platforms designed for public relation tasks. The physical and technical attributes of the identified robot platforms are described and compared, along with a short analysis of the applications proposed by the vendors. The platforms can potentially be used to accelerate HRI research and the implementation of robot applications for public relation tasks.

CCS CONCEPTS

• **Information systems** → *Information systems applications*; *Computing platforms*; • **Social and professional topics** → *Automation*; • **Computer systems organization** → *Robotic autonomy*.

KEYWORDS

public relation robots, service robots, hospitality, mobile robot, autonomy, human-robot-interaction, robot applications

1 PUBLIC RELATION ROBOT PLATFORMS

Public relation robots are a subset of the broader term "service robot", which is defined as a robot that performs useful tasks for humans or equipment excluding industrial automation applications [24]. According to this standard, robots require a degree of autonomy, which is defined as the ability to perform intended tasks based on current state and sensing, without human intervention. For public relation robots, autonomy is mostly related to autonomous robot navigation; meaning that the robot is able to plan its path and execute its plan without human intervention.

In recent years, there has been a substantial increase in the number of public relation robots sold worldwide. According to the International Federation of Robotics, almost 10.000 units were sold in 2017, which is 56 % more than in 2016. In the same period,

the total value of public relation robots sales increased by 41 % to USD 177 million. Most of these robots were for mobile guidance, information and entertainment. A forecast by IFR claims than more than 40.000 robots will be sold in 2022 [25]. However, at the time of writing it is unclear how the COVID-19 outbreak will impact this forecast. This paper gives an overview of commercial-off-the-shelf (COTS) robots that are currently available on the market. The list of COTS robot has been assembled using desk research. It is not exhaustive but provides good coverage of the area.

Table 1 describe each of the identified COTS robot platforms.

As can be seen in Table 1, vendors of COTS public relation robot are globally distributed. In total, seven robot platforms are from China, eight are from the EU (including the UK), four from the US, two from Japan and two from Korea. China is a relatively new player as a robot producing country, but the region has rapidly entered the market with several new platforms within the last 2-3 years. A few robots vendors also address the fact that their robots can be used for research, and are somewhat hybrids between commercial platforms designed with a specific business purpose and more opened ended research platforms. This includes the platforms REEM, Scitos, Pepper and Socibot. Only 10 of the robots platforms have been identified to be open an open application programming interface, however this specific piece of information is often not available.

Although all the identified robots are designed for public relation tasks, there are some fundamental differences in their physical design and their technical specifications. A common configuration is a combination a laser scanner, RGB-Camera, Depth Camera (RGB-D), Infrared or ultrasound sensors, Microphone (array), Bump sensor(s) and touch sensors and touch screen. Some robots are equipped with more exotic devices, e.g. the robot Furo-D which is equipped with a receipt printer, bar code scanner and a credit card reader. The robot Socibot has a built-in projector for displaying images on external surfaces and the robot XR-1 has a smoke detection sensor. Less than half of the robots have been designed without any limbs (arms or legs).

In order to do a systematic analysis of the applications proposed by the vendors, description text about use cases, features and applications have been scraped from vendors' web pages, resulting in 6.020 word document. Product names and high-frequent words ("user", "customer", "robot") have been removed, resulting a 5.598 word text document. This document has been visualized using a word cloud (see Figure 1) displaying the most frequent words as large and more centrally placed than less frequent words.

By manual analyzing the text, is possible to filter out a total of 81 different application areas. The most frequent words are thematically related and can be ordered in the following 5 word clusters.

- **Retail:** Stores (5), shopping centers (5), shopping mall (2), supermarkets (2), retail (2)

Table 1: Overview of COTS public relation robot platforms

Company / origin / link	Platform name	Specification	Limb	Autonomy	Voice I/O	Touch Screen	Open
botsandus (UK) [1]	Bo	Mic. array, HD camera, ultrasonic and infrared sensor array, 3D LIDAR, Speaker	No	Yes	N/A	Yes	N/A
Cybedroid (FR) [5]	Alice	Lidar sensor, RGB-D camera, mic and speaker	Yes	Yes	N/A	Yes	N/A
Engineered Arts (UK) [7]	Socibot	Actuated neck, mic, speaker, camera, optical projector	Yes	N/A	N/A	Yes	Yes
Temi (US) [16]	Temi	LIDAR, 2 RGB-D, RGB camera, 5 proximity, IMU sensor, 6 ToF sensors	No	Yes	Yes	Yes	Yes
Follow Inspiration (PT) [9]	Wgo Curator	Speakers, 3D, Stereo, RGB Cameras	No	Yes	N/A	Yes	N/A
Fraunhofer IPA (GE) [2]	Care-O-bot	3 Laser scanners, 3D-RGB-D camera, Wi-Fi, Bluetooth, Speakers	No	Yes	Yes	Yes	Yes
Future Robot (KR) [10]	Furo-D	Credit card reader and printer, RGB-D, ultrasonic sensor, camera	No	Yes	N/A	Yes	N/A
GBLRobotics (EST) [11]	Grammy	Wide angle camera, Infra-Red, LIDAR	Yes	Yes	Yes	Yes	N/A
HIT Group (US/CH) [22]	Will	Laser scanner, RGB-camera, mic, speaker	No	Yes	Yes	Yes	N/A
Hitachi (JP) [21]	EMIEW3	Multiple microphones, camera	Yes	Yes	Yes	No	N/A
LG (KR) [23]	CLOi	N/A	No	Yes	Yes	Yes	N/A
MetraLabs (GE) [12]	Scitos A5	Frontal camera, safety laser range finder, 24 ultrasonic sensors	No	Yes	Yes	Yes	Yes
Padbot (CH) [13]	P3	HD camera, Flexible head, Microphone array, 4G LTE enabled	No	Yes	Yes	Yes	Yes
Pal Robotics (ES) [14]	ARI	Microphone, stereo-camera, force control, IMU and gyroscopes	Yes	Yes	Yes	No	Yes
Promobot (US) [15]	Promobot	Ultrasonic, 3D sensor, 4 touch sensors, printer, speakers	Yes	Yes	Yes	Yes	N/A
QIHAN (CH) [8]	Sanbot Max	Mic x 7, RGB Camera x 2, 3D sensor x 1, Touch sensor x 7	Yes	Yes	Yes	Yes	Yes
Savioke (US) [17]	Relay	Camera, laser scanner, bump detection, RGB-D, sonar	No	Yes	No	Yes	Yes
Chuangze Int. Robot (CH) [3]	Chuangze	Laserscanner, camera, microphone	Yes	Yes	Yes	Yes	N/A
SoftBank (JP) [18]	Pepper	LIDAR, RGB-D camera, infrared, microphone array, touch sensor	Yes	Yes	Yes	Yes	Yes
Suzhou Pangolin (CH) [6]	Alice	Wide angle camera, touch screen, Infra-Red, LIDAR sensor	Yes	Yes	Yes	Yes	N/A
UBTECH (CH) [19]	Cruzr	RGB, speakers, microphone array, RGB-D, Lidar, sonar, 12 IR, 9-axis IMU	Yes	Yes	Yes	Yes	Yes
Cloudminds (CH) [4]	XR-1	Lidar, 2D/3D camera, Mic Array, Smoke sensor	Yes	Yes	Yes	No	N/A
CheetahMobile (CH) [20]	Cheetah	N/A	No	Yes	Yes	Yes	N/A

Figure 1: Word cloud illustrating frequency of application related words used at vendors web pages

- **Museum:** Museum (9), science museums (4) and technology museums (2)
- **Finance:** Banks (4) and financial institutions (3)
- **Hospitality:** Hotel (4) and receptionist (4)
- **Expos:** Exhibitions (5) and events (3)

The top 5 most frequent word related to technological features are: autonomous navigation (6), voice interaction (6), face recognition (5), touch screen (5), and remote control (5). This illustrate the main features that vendors focus on, and gives an overall impression of what the capabilities of the platforms. These features can be clustered into to the following tasks:

Information, greetings and feedback. Robots used as attractions and mobile information kiosks to promote goods and services. All the identified robots can be used for providing information, greetings and feedback, but difference in physical design impact exactly how they provide this service. A total of 18 of the identified robot platforms have positively been identified to use voice recognition as a part of their control mechanism, and almost all robots (20) have a touch screen. A total of 13 robot platforms have been designed with movable arms used for gesturing, and only one robot (EMIEW3) is intended to be a full humanoid robot with both arms and legs.

Guidance and way finding. Robots that can assist or replace guides and are usually designed as autonomous mobile platforms with multimedia features added. According to the vendors, all robots can be used for guidance and way finding, as all support autonomous navigation. However, it is often unclear based on vendor information how this is implemented and how well it works in dynamic environments for long term use.

Bringing objects. Robots able to carry or handle small items, e.g. delivering room service at hotels, carrying goods in supermarkets or delivering food at restaurants. One robot is specifically designed for bringing objects, i.e. the robot Relay is aiming at solving transportation and storage of smaller objects in hotels as its primary task. However, the robots Alice, Temi, Care-o-bot and CLOi are also able to carry small objects and are therefore also able to solve this task.

2 CONCLUSION

A total of 23 commercial robot platforms have been identified. Although the hardware configuration across platforms is similar, the robots differ in their physical design - especially when it concerns having movable limbs. All robots are found suitable for tasks related to providing information, greeting, collecting user feedback, guidance and way-finding, whereas only a small subset are able to carry physical objects. Only 10 robots have been positively identified to be open for custom made applications, which is a prerequisite for many research purposes.

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