

WIPO Technology Trends 2021
Executive summary

Assistive Technology



WIPO Technology Trends 2021: Assistive Technology looks at patenting and technology trends in innovation in assistive technology. It identifies the prominent technologies, top players and markets for patent protection across seven domains – mobility, cognition, communication, hearing, the built environment, self-care and vision. It aims to provide stakeholders with a fuller understanding of the rapid changes in this technology, to inform their decision-making. For the complete report and data, see www.wipo.int/tech_trends/en/assistive_technology

This report uses patent and other data to provide solid, factual evidence on innovation in the global assistive tech landscape, creating a knowledge base to inform and support business leaders, researchers and policymakers in their decision-making.

WIPO Director General, Daren Tang

Executive summary

Over 1 billion users currently need assistive technology. This figure is expected to reach 2 billion by 2050 as the population ages and consumer electronics and assistive products converge. The market is shaped not only by demographics and the demand for consumer electronics, and the investment this attracts, but by legislation and policies. The Convention on the Rights of Persons with Disabilities (CRPD) recognizes access to assistive technology as a human right, bringing with it state obligations and expected market influence.

Data shows that emerging products are usually not replacing conventional assistive products, but complementing them.

This study is the first to systematically look into patenting and technology trends across assistive technology at scale, analyzing data on patent filings from 1998 to 2019. Its unique taxonomy separates conventional assistive technology from emerging assistive technology, and identifies nine “enabling” technologies which allow for the development of emerging assistive products.¹ It also explores the technology readiness level (TRL) of the identified emerging assistive products filed for patent protection, to see how close they are to commercialization.²

Overall trends

Our findings show that patenting activity in the area of conventional technology is nearly eight times bigger than that of emerging assistive technology, with 117,209 patent filings compared to 15,592. However, filings in emerging technology are growing three times faster than conventional, with a 17% average annual growth rate (AAGR) compared to 6%. Most patent filings in conventional assistive technology relate to mobility, followed by the built environment, hearing and vision. Yearly filings in mobility are more than those of all six other domains combined.

In the emerging assistive technology space, the most active domain over the period is hearing, followed by mobility, vision and communication. However, since 2014 mobility has taken the lead among emerging technology filings too. Indeed, the fastest growing areas for patent filings relate to mobility and environment both in conventional (9% and 7% AAGR respectively in 2013-2017), and emerging assistive technology (24% and 42% AAGR respectively).

Convergence of assistive technology with other technologies, disciplines and markets

Assistive technology has traditionally been considered external to the human body and non-invasive. The field is now converging with medical technologies. Several emerging assistive products include implants and other products that would qualify as medical devices, with many of those moving beyond assistance towards augmentation or recovery of missing human functions.

Our analysis reveals that all identified emerging assistive products use one or a combination of several enabling technologies, such as artificial intelligence (AI), the Internet of Things, brain-computer/machine interface (BCI/BMI) and advanced sensors. These allow for smarter and connected assistive products which learn from the user's behavior and environment, optimize and customize their functions and support independent living and navigation, telemedicine and smart nursing.

The primary crossover disciplines in emerging assistive technologies are information technology, data science, materials science and neuroscience, while the overlaps with the consumer electronic goods market are mainly in the areas of communication, navigation and gaming. The convergence between disciplines, domains and markets increases the breadth of functionality of products for different user profiles and boosts the pace of innovation in emerging assistive technology.

The data shows that emerging products are usually not replacing conventional assistive products, but complementing them. As a result there are parallel product markets serving different user needs, preferences and settings.

Geographical trends in innovation in assistive technology

Patent protection for assistive technology is sought primarily in five markets: China, the U.S., Europe (as reflected by European Patent applications), Japan and the Republic of Korea. The previous dominance of the U.S. and Japan has declined in recent years as filings increase in China and the Republic of Korea. The widest patent protection being sought is for mobility assistive technologies. Protection for other domains, whether conventional or emerging assistive technologies, is largely focused in the five main target markets.

The same five territories also house the top origins of invention. Similar to the evolution in the markets for protection, the geographical profile of top players in assistive technology is also changing: traditional European, Japanese and U.S. players now face increasing competition from Chinese and Korean players.

Applicant profiles and patent portfolios

We find that big corporate players are leading the development of assistive technology (48% of conventional and 60% of emerging assistive technology), dominating in hearing and vision, and to some extent communication. Other domains are fragmented, with a big number of patent applicants and top patent applicants with small patent portfolios. The leading players are pursuing holistic strategies to protect their innovations, using not only patents and utility models but also industrial designs to protect the ornamental aspects of assistive products.

Corporate applicants are either specialized assistive technology companies, consumer electronic goods companies or from the car industry. Consumer electronic

good companies have a diversified patent portfolio across several domains. This is in contrast to specialized assistive technology companies or car industry companies, which file mainly in the domain of mobility and to a lesser extent in environment. This reflects diverse commercialization interests among this group, as well as the impact and applications of enabling technologies and information and communications technology (ICT) in general in the assistive technology space.

The top corporate applicants are hearing aid and orthoses and prostheses manufacturers, reflecting the size of the hearing and mobility datasets and their dominance by larger companies, and large optics and ophthalmological companies.

Universities and public research organizations are more prominent in the emerging assistive technology dataset (23% of patent applicants versus 11%). Independent inventors, over one-third of whom are based in China, dominate simpler technologies (40% of patent applicants in conventional assistive technology versus 18% in emerging), as often reflected in the number of utility model filings (accounting for 25% of the conventional and 13% of the emerging assistive technology filings).

Trends in specific domains

Within specific domains of assistive technology, trends are not homogeneous. There are particular findings to note in each.

_____ Mobility

The profile of patent applicants in conventional technology is wide-ranging and diverse, led by European mobility specialists, Japanese conglomerates, and U.S. healthcare

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device companies, with a notable share of contributions by independent inventors. However, in emerging mobility assistive technology and all its functional categories, academic institutions dominate.

Emerging products and devices introduce advanced versions of conventional assistive products, namely advanced walking aids (balancing aids and smart canes), advanced prosthetics (neuroprosthetics, smart and 3D printed prosthetics), advanced wheelchairs (including self-driving wheelchairs and wheelchair control) and exoskeletons (full-body exosuits, lower and upper body exoskeletons and control thereof). Advanced wheelchair filings are growing at a rate of 34%, advanced prosthetics and exoskeletons at 24% AAGR, while 3D printed prosthetics/orthoses have the highest growth rate at 89% AAGR.

_____ Cognition

This is the smallest area of the conventional technology dataset, reflecting the recent recognition of the importance of assistive technology to support cognitive decline. This field includes memory support and medication dispensing devices, as well as timers. The more advanced assistive technology can be found in the emerging assistive

technology domains of self-care and environment, including functionalities of assistive robots.

_____ **Communication**

Technology companies are driving developments in software-based assistive technology in the area of communication. Two-thirds of emerging communication filings relate to smart assistants. Areas of recent development with great potential are brain-computer interface-based control of devices and sensory substitution technology, with growth rates of 71% and 21% AAGR respectively.

_____ **Hearing**

Technologies in hearing are dominated by companies based in Europe, while the top five players account for one-fourth of filings. Emerging assistive products include environment-controlling and mind-controlled hearing aids, with cochlear implants accounting for nearly half of the emerging filings. The areas of greatest growth in hearing are non-invasive bone conduction (31% AAGR) and gesture to voice and text (24% AAGR).

_____ **Environment**

Conventional assistive products for the built environment cover a wide range of technologies to facilitate independent living at home and work. These include structural building components, furniture, assistive products for sports and leisure, and alarms. This large, fragmented market is moving toward a smart, connected and robotic future involving smart homes (including smart appliances at homes and smart toilets), smart cities (smart pavements and navigation aids in public spaces) and assistive robots (companion and pet robots), all growing at fast pace with respective growth rates of 40%, 44% and 54% AAGR in 2013-2017.

_____ Self-care

Conventional assistive products in the area of self-care include adaptive clothing, incontinence products and adaptive eating devices. These same technologies form the basis for advanced products, such as smart diapers and feeding assistant robots. Among conventional patent applications, 59% are filed by independent inventors and one-third include utility models, reflective of the simpler technologies involved.

Wearable and non-wearable health- and emotion-monitoring devices (smart bands, clothing, insoles, smart mirrors and carpets) account for over half of emerging self-care filings and have a growth rate of 24% AAGR reflecting an overall trend in digital health and wearables. These products support independent living, active aging and telemedicine or smart nursing. Small and fast growing areas are smart medication dispensing and management and smart diapers (52% and 68% AAGR respectively).

_____ Vision

While most filings in conventional vision are related to spectacles and tactile devices, such as tactile screens, there are small portfolios which are growing fast, such as screen readers or phones with Braille (50% and 51% AAGR respectively).

In the emerging vision assistive technology space, most filings relate to intraocular lenses (IOL) with several sensors and functionalities. Filings related to artificial silicon retina (ASR), smart eyewear and augmented reality (AR) devices are growing at rates of 38% and 35% AAGR respectively.

Top players in the field are major U.S. and European optics manufacturers, as well as some players from the Russian Federation and Israel, while electronics

companies are starting to enter into the space of vision assistive technology.

Commercialization

A number of factors may influence commercialization, particularly in low- and middle-income countries. Regulation and standards assure quality and safety, but can present delays in or obstacles to commercialization, particularly when devices are classified as medical devices. Manufacturing, training and maintenance have resource implications while presenting significant opportunities, such as 3D printing for the development of prosthetics.

Some of these factors are particularly challenging for smaller companies and individual inventors, featuring prominently across several assistive technology areas. They need a supportive ecosystem, where the many actors in the innovation chain, from developers and academia to investors and venture capitalists, are incentivized to bring assistive technology to market.

The recognition of access to assistive technology as a human right, as set out in the CRPD, contributing to social and economic development objectives for persons with disabilities, could be an additional impetus for policymakers in supporting the availability of assistive technology, while market-shaping approaches by different multi-stakeholder initiatives and partnerships could also contribute to increased availability.

The future of assistive technology

The changing market demographics for assistive technology, including the aging population, present opportunities to inventors and a potential change of

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paradigm in the market share, with an increased number of end-users and more varied needs for assistive technology.

As some emerging products are tested, approved and accepted by end-users, certain types of technologies could become mainstream rather than specialized, particularly if developers of mainstream technology employ inclusive design principles. However, these potential developments need to be discussed alongside ethical considerations around social exclusion, collection of and access to data and privacy, as well as issues related to intellectual property, particularly in relation to fast-paced developments such as artificial intelligence- or brain-computer interface-based products.

Currently, fully commercialized emerging products do not seem to be replacing conventional ones, while many other emerging assistive technologies exist in a stage between prototyping and commercialization. Conventional and emerging assistive products appear to be developing in parallel to serve different user needs. This could change in future, as emerging products are perceived as more acceptable by end-users.

Increased end-user involvement (co-design of assistive products) and supporting policies are needed for the development of assistive technology, while global initiatives are important in ensuring a sensitive approach to innovation that takes into account user needs. Understanding these

developments will help support continued investment in and use of assistive technology by identifying new opportunities for industry, providing guidance for developers and stakeholders and giving end-users the confidence to take up new assistive technologies.

New technologies bring with them new challenges in terms of data, privacy and intellectual property (IP). This is the case with assistive technology, as the development of emerging assistive products relies heavily on the use of enabling technologies. AI in particular solicits debate over patentability requirements and inventorship; as other enabling technology, such as brain-computer interface, develops further, similar or new IP-related questions may emerge. The unprecedented collection and use of data and the related insights it provides are essential to enabling technology, but are not without challenges: data and privacy issues are more accentuated in the area of assistive technology, given the more vulnerable groups involved. Trends towards wearables and health diagnostic software may add to the IP-related concerns.

Licensing will need to evolve at the speed of these innovations if it is to encompass fully the implications of enabling technology in the creation of new IP, as will approaches to ownership of datasets and access to and use of data for training purposes. The responsiveness of the IP system to these debates could in turn influence the speed of development of assistive technology and its commercialization.

Notes

1 The categorizations used in the report are illustrated on pp. 28-30.

2 These data can be explored via an online tool: https://www.wipo.int/tech_trends/en/assistive_technology

WIPO Technology Trends 2021: Assistive Technology is the first large-scale landscaping and analysis of patenting and technology trends in assistive technology.

The combined information presented – patenting activity and trends across emerging assistive technology, and the stage they are in the innovation chain and product development – is complemented by information related to the wider ecosystem, including regulation, policy and standards. The report benefits from comments and inputs from 72 subject matter experts and includes case studies to illustrate examples from innovation in assistive technologies.

This groundbreaking report will be an essential reference for the assistive technology community, innovators, researchers, business leaders and policymakers wishing to understand the rapid changes in this technology and to inform their decision-making with empirical data.

World Intellectual Property Organization
34, chemin des Colombettes
P.O. Box 18
CH-1211 Geneva 20
Switzerland

Tel: +41 22 338 91 11
Fax: +41 22 733 54 28

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External Offices visit:
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Printed in Switzerland