comparethemarket™

LIFE MORE AUTOMATED
REPORT

#lifemoreautomated

CONTENTS

#life**more**automated

THE HISTORY OF HOME AUTOMATION

FROM THE WHEEL TO THE FIRST SMART HOME SYSTEM

HOME DEVICES TODAY HAVE BECOME SEEMLESSLY CONNECTED

2020
Future automation

1975
The first general-purpose home automation networking technology

1950
The invention of the computer chip

1966
The world's first smart home system

1901
The first vacuum cleaner appeared

1898
Nicola Tesla's invention of the remote control

1904
The introduction of the refrigerator and dishwasher
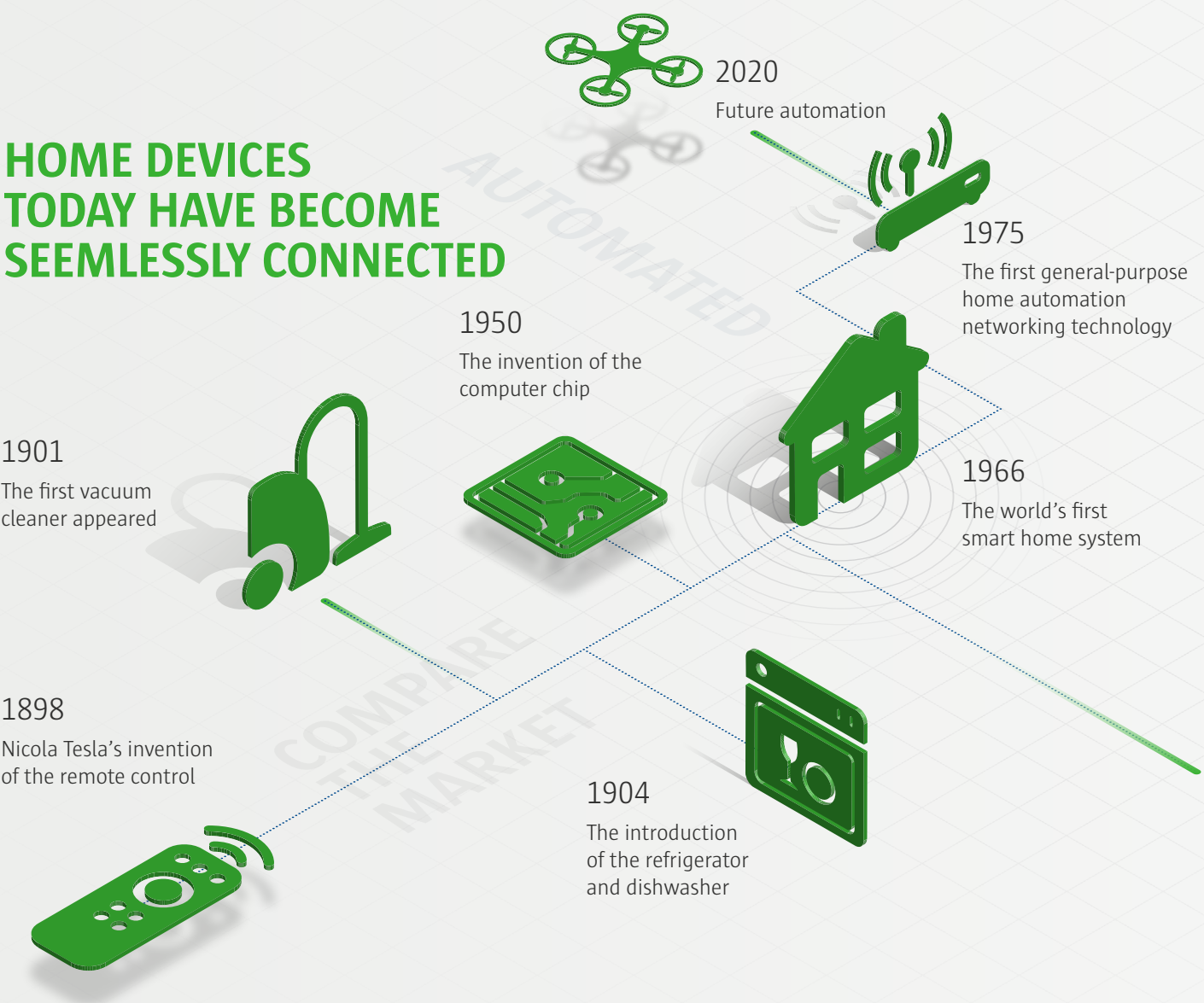
Home automation didn't start with Dyson's super-sexy hoover in the 90s nor did it start with Nicola Tesla's invention of the remote control in 1898. No, it all started a million years back with early humans' ability to control fire and then got another boost in 3500BC with the invention of the wheel. Our homes back then were caves and the ability to automate – reliably reproduce a recurring process important to our homes and amplifying our convenience – should be considered home automation.

Home automation in modern homes, however, would not have emerged without the first Industrial Revolution. It was over the duration of the 19th century, when our place of work (such as a factory) and place for family (our homes) were physically separated and scaled to dimensions not seen before. There was less and less time for daily chores with more and more fairly equally-run homes – a perfect breeding ground for innovations in home automation.

Once home electric power distribution systems were introduced, it didn't take long for the first wave of ground breaking labour-saving and convenience-boosting home automation, or domotics, inventions to appear. For instance, home water heaters were introduced in 1889;

the first vacuum cleaner appeared in 1901; and the first washing machine in 1904. It was followed by the introduction of the refrigerator, dishwasher and clothes dryer. All these inventions were mainly mechanical designs, powered by electricity which was becoming more affordable.

The second wave of home automation added another element to the designs: intelligence. Triggered by the invention of the computer chip in 1950 and later boosted by scale and diminished costs, the world's first smart home system appeared in 1966. Invented by Jim Sutherland, ECHO, or 'Electronic Computing Home Operator', could control a home's temperature or turn appliances on or off.

The third wave added yet another element: connectivity. Early developments can be traced back to the introduction of the first general-purpose home automation networking technology, X10, in 1975. The true breakthrough in networking, however, came with the widespread adoption of the modern internet, and the ability of home devices to get seemlessly connected.

THE 21ST CENTURY
A DAY IN THE LIFE
OF A TYPICAL FAMILY

AS OF 2000, WE THUS HAD DEVICES AT HOME
WHICH ENJOYED AMAZING MECHANICAL
DESIGNS, WERE COMPUTER CONTROLLED
AND WERE CONNECTED TO THE WIDER DIGITAL
FABRIC OF THE INTERNET. AND WHAT FOLLOWED
AS A RESULT WAS PURE MAGIC: THE RISE OF
THE INTERNET OF THINGS (IOT). WHILE THE
INTERNET OF THINGS ALLOWS ANY TYPE
OF INTELLIGENT MACHINE TO BE CONNECTED
TO THE INTERNET, ITS IMPACT ON DOMOTICS
HAS BEEN ESPECIALLY REVOLUTIONARY.

THE 21ST CENTURY
A DAY IN THE LIFE
OF A TYPICAL FAMILY

Morning
Time to make the morning coffee using an internet-enabled smart coffee machine

Daytime
Time to give the plants a dose of nutrients as they are automatically watered

THERE ARE MORE THAN 20 CORE HOUSEHOLD CHORES FULLY AUTOMATED TODAY

Afternoon
Time to relax using Alexa to listen to some soothing piano tunes

Night-time
Time to check the outdoor security system to ensure the safety of the family

Morning: A smart sleep tracker (introduced in 2015) monitors the sleep of the parents and individually wakes them up at the perfect moment when the sleep cycle is shallow. An hour earlier, the smart thermostat (introduced in 2011) heats up the areas in the house which are most frequented by the young family. Mr and & Mrs Smith like their breakfast toasts differently, so they use their smart phone and internet-connected smart toaster (introduced 2017) to get that personalised and perfected slice of toast. The same goes for the coffee: They use environmentally friendly, compostable capsules in their internet-enabled smart coffee machine (introduced in 2016) to get that perfect morning espresso. After an intense brush with their Bluetooth-enabled toothbrushes (introduced 2014), off they go: Mr Smith to bring Ms Smith to the kindergarten before going to work; and Mrs Smith straight to her executive job in the City.

Daytime: An empty, yet very active house! The thermostat lowers the temperature in the house. The automated fish feeder (introduced in 1985 and perfected over the decades) makes sure that their beautiful guppies get their daily food. Plants are also automatically watered (introduced in 2014) with each plant getting their precise dose of nutrients and water. In the meantime, the robotic vacuum cleaner (introduced in 2002) ensures the dirt of the morning is taken care of. And just past midday, a postman with a parcel rings the bell just to talk with Mr Smith via the internet-enabled smart door camera (introduced in 2013).

Afternoon: The Smiths are finally together again. An hour earlier, the thermostat has heated up the house to make everybody feel warm and cosy as they step through the door. Mr Smith is doing the laundry but has run out of detergent; he simply presses the pre-programmed and internet-connected Amazon button Dash (introduced in 2014 but superseded by Alexa) which ensures the detergent arrives within a few hours. Mrs Smith is relaxing by using Alexa (introduced in 2014) to listen to some soothing piano tunes by her favourite composer. At the same time, little Ms Smith is having the time of her life playing with internet-connected smart toys (market-ready in 2014) which has conversation and learning objectives tailored to her individual level of development. Later, Mr Smith prepares dinner using an internet-connected cooking device (introduced 2015) which seamlessly connects to IBM's Chef Watson (introduced in 2015, but now discontinued) to conjure the most amazing dishes using artificial intelligence.

Night-time: As the sun sets, the Wifi-enabled smart lamp (introduced in 2012) slowly dims the lights and the Smiths make their way to bed. A smart baby monitoring system (Internet-enabled in 2015) ensures the safety of little Ms Smith and the outdoors security system ensures the safety of the family. The tired couple falls onto their smart mattress (introduced in 2017) before drifting off to sleep.

THE PRESENT DAY
EXPONENTIAL GROWTH
IN HOME AUTOMATION

TRACK FORWARD JUST A FEW YEARS TO THE PRESENT DAY AND THE NUMBER OF HOUSEHOLD TASKS THAT HAVE BEEN AUTOMATED TO DATE IS STAGGERING. TRADITIONAL TOOLS, SUCH AS THE WASHING MACHINE, ARE NOW INTERNET-CONNECTED; AND NEW AUTOMATION TOOLS APPEAR ALMOST ON A MONTHLY BASIS.

In the kitchen, for instance, you will discover that smart automation is embracing your dishwasher, oven, fridge, standalone cooking devices for soups or slow cooking, scales, an iPad filled with recipes, toaster, microwave oven, coffee machine, and even your saucepans. Upstairs in the bathroom, you will discover that your toothbrush has become smarter, and so have your scales, shower and hair comb, among others. In the bedroom, we have smart devices helping you to sleep including smart mattresses.

Throughout the household, common items are internet-connected and smart: the washing machine, clothes dryer, smart speakers, robot vacuum cleaners, smart cameras for security, door locks, thermostat, smart meters, smart lamps; and even automated pet toys and plant-watering devices. A growing amount of home automation devices designed to cater to the elderly and to kids are now on the market. Overall, there are more than 20 core household chores fully automated today, and dozens more niche tasks.

The above automation has not appeared overnight. Indeed, automation, internet-connectivity and smartness in home energy management, entertainment, control and connectivity and security has increased slowly over the past 150 years. The rate of automation enjoyed a few pivotal moments including the industrial revolution of the Victorian era and the invention of the computer chip but the Internet of Things has led to almost exponential growth ever since 2010.

FOUR FACTORS DRIVING INNOVATION

MINIATURISATION, ATOMISATION, AI AND IOT

The factors which have most disrupted the home automation industry, leading to innovation becoming supercharged, are miniaturisation, atomisation, the Internet of Things and AI. These four pillars are responsible for the most noteworthy leaps and bounds in technological innovation.

Miniaturisation: Mechanical and electronic devices got smaller over the years, and thus became more portable and power efficient, as well as cheaper – thus facilitating scale.

AI-driven automation: With the consolidation of artificial intelligence algorithms, devices were able to make intelligent decisions autonomously. This greatly diminished the need for human intervention and so allowed for another quantum leap in convenience.

Internet-enabled networking: An important step occurred when home devices were able to connect to the wider Internet, rather than the early embodiments using only a local "intranet" through e.g. Bluetooth. This not only allowed devices to be part of the wider

digital fabric but also drove stronger social interaction between people in different homes. For instance, Internet-enabled scales could suddenly power platforms where people competed on losing weight.

Atomisation: Leveraging all of the above, each device can now be adapted to the individual needs of each person using them in the household which, of course, is a compelling consumer proposition.

PRIVACY AND SECURITY
KEEPING CONSUMERS SAFE

One key challenge currently out ranks all others if home automation, or domotics, is to continue its promising growth trajectory: privacy and security. As the amount of internet-connected devices in our households increase, cyber security has become a burning issue. While news of remotely hacked home devices, be they toasters, cameras or toys is dropping, there is no reason to become complacent. Cyber security must be top of the agenda of any domotics company to ensure safety and privacy. Consumers are increasingly worried about their privacy as internet-connected devices potentially have access to a lot of very private information in the home. More work needs to be done here, particularly with regards to putting consumers in control of devices which have no screen or keyboard, and so making them trust that smart tech isn't listening in.

THE FUTURE OF AUTOMATION
THE RETURN OF HOME HELP

WHILE THE HOME AUTOMATION OR DOMOTICS INDUSTRY HAS CONTINUED ITS GROWTH TRAJECTORY OVER THE PAST 150 YEARS, ITS CONSUMER HAS CHANGED BEYOND ALL RECOGNITION. DOMOTICS MAY HAVE LEAPFROGGED AT CERTAIN KEY POINTS, SUCH AS THE INVENTION OF THE COMPUTER CHIP OR THE INTRODUCTION OF THE INTERNET OF THINGS, BUT THIS IS NOTHING COMPARED TO THE WHOLESALE SHIFT OF HOW THE CONSUMER IS LIVING.

The 'typical' nuclear household of previous centuries is now just one way of life: the vastly increased likelihood of all adult members of a household working; the rise of the single parent family; and the blurring of work and home lives has led to the consumer feeling busier than ever. While home automation has continued to evolve, consumers are hungrier than ever for innovations that will take on larger or increasingly complex tasks, such as managing loads of laundry or ensuring a fully stocked fridge.

We have already seen the consumer appetite for outsourcing and delegating household tasks with the rise of delivery firms and errand-running businesses. Now, we will see automation developing to meet such demands. Two key innovations will evolve to cater to this desire: butlers and robots.

Home butlers will be one of the biggest game changers: powered by both AI and either augmented or virtual reality, it's easiest to imagine such butlers as very advanced Siris or Alexas. Working in a similar fashion as a next generation smart speaker, consumers would treat their butler in much the same way. Connected to a microphone to allow it to follow voice-activated commands

and potentially housed in a drone so that it could follow its owner, it would look after all of the routine life-admin that most of us find so unrewarding and time consuming: paying bills, renewing mobile phone contracts, managing subscriptions and making sure that its owner is accessing the best possible deals.

Food shopping would also come under a butler's remit, as would choosing entertainment. One key distinction would be its brand-agnostic approach: it will likely use an app that allows ordering across various supermarkets and be able to scan through multiple entertainment apps such as Netflix and Prime Video to find the best options for that evening's entertainment. Because the AI powering the butler will know its owner so well, the algorithm will be much more powerful and accurate than the ones currently used by entertainment apps themselves.

What is less clear is how our future butlers will look, although there are likely to be several options: a human, animal – maybe even a meerkat – a cloud or some other element found in nature. AI butlers will also have the potential to be customisable so consumers can add different 'skins' – just as they do with video games now.

ROBOTS
PART OF OUR HOMES BY 2030

While AI-powered butlers will take control of our mental life-admin, robots will take care of physical tasks. Having made the leap from the factory floor to the shop floor, household robots will begin to become commonplace in the 2030s and will cost around £25,000. While that's a significant financial outlay, it will be lessened by increased renting – rather than owning – of cars, which will likely be self-driving or at least a hybrid of self-driving and human-controlled.

Whilst one-step tasks such as washing the dishes (once inside the dishwasher) have become automated, and so more convenient, we are still occupied with big tasks such as putting plates into the dishwasher; or putting clothes into the washing machine, taking them out, drying them, folding them and putting them back into the wardrobe. We should expect more disruption in this space over the coming years as robots take over multi-step physical tasks.

Expect robots to be able to rearrange a room's furniture, pick up a sofa so that an accompanying robot vacuum cleaner can clean underneath it, and even measure a room to allow an AI butler to present its owner with options for new furniture or decorating schemes Fifteen-times

stronger than humans, they will likely appear similar to humans – to allow the consumer to bond with their robot and not feel threatened – but we cannot expect them to appear indistinguishable to us until 2050. Likewise, when first introduced in the 2030s, they will not be markedly quick or intelligent but will improve fast – as all consumer electronics do when first introduced to the wider market.

We can expect our homes to be designed differently in the future too, so that they better accommodate our robots' methods of stacking plates in a cupboard or putting clothes in a wardrobe.

MULTI-DRONE HOUSEHOLDS
CHEAP, TINY AND MANY

Alongside butlers and robots, a host of smaller, task-specific automated tools will likely help us to manage our homes over the coming decades. With almost every aspect of the home connected to the Internet of Things, technologies from drones to holographic recipe instructors will help us to maximise everyday household tasks.

Drones will likely go from being used by businesses to deliver small items or take aerial photographs to being used by individual consumers inside their homes. Becoming commonplace by the 2030s, they will shrink to minute proportions (for more, see Four factors driving innovation: Miniaturisation; atomisation; AI and IoT) of around 4-5mm. The size of insects, prices will start at £1 – depending on household income, some families could own hundreds.

Drones will be used to complete specific routine tasks and will be purpose built for their tasks. Drones for different tasks will function differently: some will walk – likely on six legs for balance – while some will fly; some will have lasers, while others will have cameras or even pincers.

Drones' functions will vary widely, from managing heating to ensuring a household is secure. Catering to the increased need for sustainable living, a two-tier heating system could involve a smart thermostat ensuring that a room is kept at a functional – but hardly cosy – 15 degrees while a drone could shine an infrared beam at a room's occupant, making sure they were cocooned in a 24-degree bubble as they moved around the house. Drones' mobile nature could also be used to constantly check for any sign of danger – from smoke to an intruder or a ground floor window left open.

On a lighter note, we can expect camera drones to be used to take 'candid' selfies for social media and larger drones to take over from music entertainment systems by acting as speakers which automatically follow the user around their dwelling.

KEEP IT CLEAN
HOW AUTOMATION WILL
LEAD TO SPARKLING HOMES

As well as being used for entertainment, security and heating, drones will likely be used for keeping our homes clean. UV light drones could be programmed to sterilise surfaces, meaning that kitchen and bathroom surfaces would automatically be cleaned overnight, ready for the next day's use, while heavily used objects around the house – such as door handles and buttons – would no longer become sources of bacteria, likely resulting in healthier inhabitants. Dusting could become obsolete as insect-sized drones are programmed to fly around, constantly picking up lint and dust from the air, before it has a chance to collect on surfaces.

While multiple drones will be used for very specific cleaning tasks, such as collecting dust from the air, other innovations will likely include windows being coated in a dirt-repellent substance – eliminating the need for cleaning – and robot vacuum cleaners. While they will bear a resemblance to some of today's models, the next generation of robot vacuums will be much more efficient, with a much stronger suction.

While our environments will be kept clean by a combination of drone and robot, automated devices will also be used to wash our clothes. Next-generation washing machines will not just remove biological germs from our garments but may also be deployed as malware detectors, washing technological viruses off our newly-smart clothes. As urbanisation increases and the population grows, our homes will likely shrink in size, especially in our cities – which a greater proportion of the population is expected to reside in. This means that consumers will favour smaller household devices, so that they can maximise liveable space. Technologies such as a 'wash ball' – a tennis ball-sized ultrasonic panelled device, which uses ultrasound to clean – could be placed inside a bucket of clothing to clean clothes without the use of a bulky washing machines.

Outside of pure cleaning, our belongings' connection to the Internet of Things will mean that we are able to change their texture or appearance on command. Self-plumping cushions and wallpaper that changes colour in an instant will be controlled by the use of our home butlers.

CULINARY CONNOISSEURS
HOW AUTOMATION WILL
HELP US IN THE KITCHEN

From super-smart fridges to 3D printing, a host of automated technologies will help us to have healthier diets, advance our culinary skills and lessen the burden of routine kitchen tasks we often see as dull and unrewarding.

Artificially intelligent fridges will be able to communicate with our AI butlers, with algorithms learning over time what we like to eat and how often we buy a certain item. This will help to ensure that our fridges are automatically stocked with fresh produce – with our AI butlers (for more, see The future of automation: The return of home help). They will even be able to automatically provide recipes to use up food close to expiry dates, helping to lessen food waste – which will become an increasingly common and urgent concern among consumers as the global population grows and climate change potentially affects crop and livestock availability.

Optimising wellness by tailoring diets to individual members of the family will be a key aspect of kitchen-based automation: existing technology such as Fitbits and burgeoning DNA-based wellness programmes such as DNA Fit will interact with smart fridges and AI butlers. This will inform consumers which food types they

should be eating and avoiding based on their bespoke profile (for more, see Four factors driving innovation: Miniaturisation; atomisation; AI and IoT).

While iPads have, for many consumers, replaced the traditional cookbook, new culinary technologies could include a hologram of a celebrity chef guiding consumers through their recipe. With devices such as Microsoft's Hololens (the first self-contained holographic computer) already used in healthcare, it is possible to foresee cheaper and more accessible versions of this technology being employed to demonstrate how to best carve a joint of meat or the precise method needed to turn out perfect croissants.

Clever cooking and food preparation methods such as 3D printing will also enter our kitchens. While 3D printing will not be suitable for preparing fresh foods, snacks such as sweets or cake decorations will be able to be manufactured at home, while wines and beers will be chilled in seconds rather than hours thanks to reverse microwaving.

2020 AND BEYOND
AUTOMATION WILL HUMANISE
OUR HOMES

Automation will soon affect every aspect of our
home lives, from drones programmed to keep us
safe by monitoring and reporting on potential
threats and smart-fridges designed to minimise food
waste, to AI-powered butlers responsible for managing
life admin and smart washing machines able to scan
and cleanse our smart clothing of technological viruses.
In the next few decades, we will see the original vision
of domotics come to fruition: enabled by the Internet
of Things, our homes' devices will be able to meaningfully
communicate with each other, solving domestic chores
collaboratively and with support of the wider internet.
It is then when smart devices will make our houses
smart homes. And it is then when automation will finally
humanise our homes, enabling them to think and react
as we do.

THE ADOPTION OF NEW TECHNOLOGIES BY AGE GROUP

MILLENNIALS ARE LEADING ADOPTION

13%
+55 year olds

15%
45-54 year olds

25%
35-44 year olds

32%
25-34 year olds
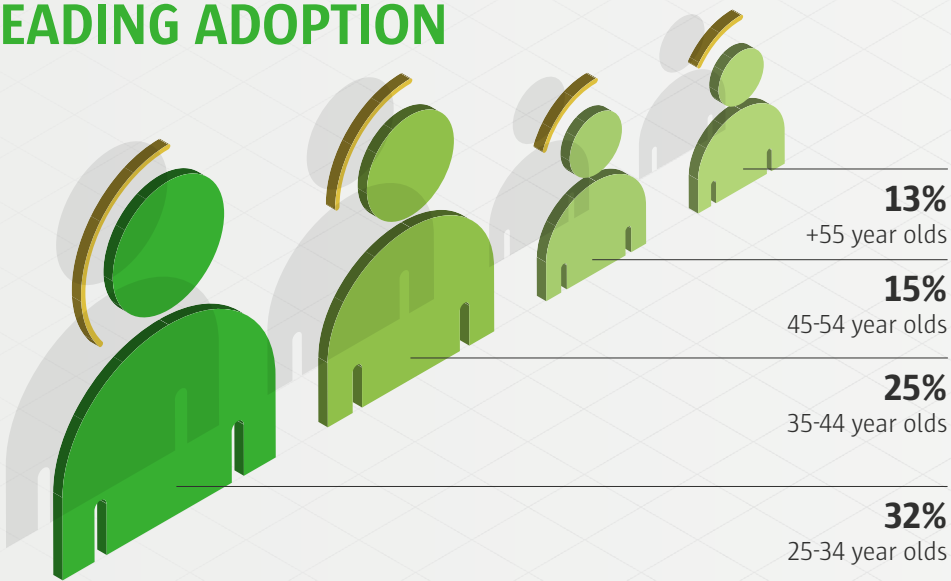
Source: Statista, Smart Home, 2019

WHAT DEMOGRAPHICS WILL EMBRACE AUTOMATION THE MOST?

The adoption of new technologies is often centred around younger demographics with today's millennials (25-34 years old) and Gen Z (18-24 years old) spearheading the take-up of many new technological developments, such as the rise of social media and the dominance of video and music streaming over the purchasing of physical media. To some extent, the same can be said for home automation.

In the UK, millennials are leading adoption, forming 32% of the smart home market. They are followed by Gen X (35-44 years old), who are responsible for 25%. Gen Z and those aged 45-55 years old hold around 15% each with the remaining 13% held by those 55 years old or older. When split by gender, the market is 60% male and 40% female.

However, to expect the home automation market to continue to be dominated by younger generations would be short-sighted. While millennials can be expected to drive the market for low to middle price technology and for smaller items which may be more suitable for low square footage inner city dwellings, home automation devices will hold significant appeal for the ageing population of future decades.

While today's seniors are unlikely to adopt what is currently expensive and nascent technology, today's boomers are tomorrow's seniors. This cohort has already proved itself to adapt quickly to new technologies and, as they become less able to perform routine household tasks, they may become prime customers for home automation devices that help manage their life admin and day-to-day routines as well as those which keep their homes clean and secure or their fridge well stocked.