

Using VR and AR for social good.

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Introduction.

The use of technology to create positive social change for the wider social good is an area of untapped potential and is receiving increasing interest from policy makers. Virtual and augmented reality have the potential to make strides in this area; they can be used to challenge a wide range of social issues along with people's perceptions of these.

Because of their nature, it is sometimes all too easy for people to remain removed from social issues. If it is something an individual cannot directly see or experience, it is easy for them to forget it exists, not think about it and therefore not consider the steps they can take to challenge the issue. However, by changing our realities and the world around us, virtual and augmented reality can not only educate people on the impact of a wide range of social issues but make them more salient and relevant so to motivate people to take action and make changes.

Read this paper and follow us as we explore how these technologies are currently being used to generate positive social change, how these applications could go further in the future and the areas with the most potential for impact.

Virtual Reality and Augmented Reality.

Virtual Reality and Augmented Reality both have the potential to be used for 'social good'. They can be used to target issues which not only have an impact at an individual level, but also at both societal and global levels. However, before reviewing the potential applications of these technologies, it is important to define and distinguish the two.

Virtual Reality

Virtual reality (VR) is an immersive experience where a headset is worn, and so blocks out the physical world. As this is **completely immersive**, a customisable experience can be developed for the user that can be as realistic or unrealistic as they would like.

Augmented Reality

Augmented reality (AR) merges both the physical and virtual world. Rather than providing a fully immersive experience, it places virtual simulations **in the physical world.**

The most important difference between these technologies is the extent of their virtual experience. While VR is completely immersive by placing an individual into a virtual world, AR places virtual objects in the physical world. Both technologies, however, can be incredibly realistic, which is an important part in harnessing these technologies for social good.

Risks

Before discussing how VR technology and AR technology can be used to promote 'social good', it is important to note that using this technology can carry some risks.

These risks include:

- Motion sickness/nausea;
- Headaches;
- Isolation (spending too much time in the virtual rather than real world); and
- Being unaware of surroundings and potential dangers.

These risks are present across all applications of VR technology and AR technology. Although the degree of severity and likelihood of causing harm vary across different situations, caution needs to be taken to ensure that the user is engaging with the technology as safely as possible.

VR and AR for physical inactivity.

The impact of physical inactivity

Physical activity has wide ranging health benefits, from lowering risks of major illnesses by 50% to **lowering the risk of early death by 30%**. Despite this, 2018/19 figures suggest that just over a **third of men and women** are not achieving **the recommended minimum levels of physical activity**, making them more likely to experience the health risks associated with physical inactivity as opposed to the health benefits of activity. The impact of physical inactivity stretches across society; in the UK alone, **physical inactivity is directly linked to one in six deaths and estimated costs of £7.4 billion per year.** It is therefore important to find ways to motivate people to be more active, which is something VR technology and AR technology can help contribute towards achieving.

AR in making activity fun

AR games can be a way to make physical activity more fun, and thereby encourage people to move more and improve health. Placing fun activities in the physical world encourages people to go out and complete these, as demonstrated by the 2016 mobile app Pokémon Go.

Pokémon Go is an AR game which took the world by storm in 2016; you can find our review of the app **here**. This game places Pokémon creatures in the real world

for people to capture, and the only way to do this is to actively go out and explore the physical world – which is exactly what people did. Pokémon Go became a social activity, encouraging people to not only go out and capture creatures together, but to also go to specific locations where they could have 'battles' with their creatures. This prospect of competition made people even more likely to go out and capture Pokémon to increase their chances of winning these battles.

Achieving **6.1 million downloads** in the first month of its release, the app was widely successful for people within the smartphone community and helped to improve their health. Studies showed that Pokémon Go players were twice as likely to reach the **minimum recommended daily activity of 10,000 steps** and those with the lowest physical activity levels walked an additional 3,000 steps per day, **doubling their initial activity.** Pokémon Go is a prime example of how AR can be used to increase engagement in physical activity through making it more enjoyable, particularly amongst those who are least likely to take part.



VR in physiotherapy

Physiotherapy is used with people who have been affected by an injury, illness or disability in order to **help restore mobility.** Around **80% of adults** in the UK will experience pain in their muscles, bones or joints at some point in their lives, and physiotherapy can be used to help overcome this pain. However, research has shown that **people only do 30% of their physical therapy exercises** after leaving rehabilitation, which may be a result of the perception that exercise can often be quite tedious. This is where VR can help.

VR games can be used to disguise tedious exercise and make them into something more fun, thereby increasing engagement with treatment. This is already being seen from **Immersive Rehab, which is a UK start up** aiming to increase the effectiveness of physiotherapy by **making exercises more fun and engaging** through a range of interactive programmes. It allows patients to interact with virtual objects which may not be accessible to them in the real world, and therefore exercise their motor skills.

The application of VR to physiotherapy is not limited to exercises and can be extended to make appointments easier to attend. In the future, VR may allow patients to attend follow up appointments in their own living rooms – they can just put the headset on and have a conversation **as if the physiotherapist was right there with them.** The implementation of VR in physiotherapy therefore has wide-reaching benefits. By increasing activity, it will help improve patients' recovery time and provide them with the health benefits of doing more physical activity.

The future of VR and AR in physical inactivity

All of these applications are examples of how VR and AR can be used to improve the activity levels of many people within society, which would lead to improvements in health and potentially vast savings in healthcare. However, this technology not only has the potential to increase physical activity by making it fun, but also by making it more inclusive and accessible, especially with regards to people with disabilities or mental health conditions, such as agoraphobia.

For people with disabilities or mental health conditions, some activities may not seem accessible due to the level of support that they require or, in the case of people with agoraphobia, due to the fact that it takes place in **an environment which is perceived to be unsafe.** VR technology can therefore be used to enable them to have the experience of taking part in the activity in a safe and controlled environment. For example, a surfing simulation could be incorporated into VR, which would enable the individual to do all of the actions required for the activity, without actually being in the environment where they need support or would potentially feel unsafe. This experience could be adapted to the needs of the individual, i.e. if someone's disability impacts their mobility, then it would take this into account. VR can therefore be used to increase physical activity levels through making activities accessible for everyone.

There is already great potential for VR technology and AR technology in supporting people to be more physically active, with much of their applications having already being realised. However, further development is required to ensure that these potentials are reached and continue to work towards the 'social good' through promoting physical activity.

Key points! 🌀

- Healthcare spending was £125 billion in 2017/18.
- Physical inactivity contributes £7.4 billion to these healthcare costs.
- AR can encourage those who are inactive to move more and go outside.
- VR can improve physiotherapy recovery rates.

- AR games which encourage people to go out in the world can distract them from potential dangers, e.g. when crossing a road.
- The popularity of mobile games is frequently short-lived for many people, therefore making the increased activity levels short-term.
- Being able to complete physiotherapy exercises and appointments from the comfort of one's own home may remove the need to leave the house which can be important for recovery.

VR and AR for mental health.

The impact of mental health

In the UK alone, mental illness is estimated to cost up to **£100 billion** per year through healthcare, unemployment, homelessness, police time and prisoner places. It is therefore important that we continue to develop treatment pathways to help those affected by ill mental health to lead the best life possible. VR technology and AR technology can be used alongside therapeutic techniques to help treat mental health conditions, particularly with regards to anxiety disorders. The mobility of these technologies allow treatment to take place where it is best for the patient and help minimise the impact of their chronic condition.

VR for Post-Traumatic Stress Disorder

Post-traumatic stress disorder (PTSD) is an **anxiety disorder caused by a traumatic event.** It can develop days or even years after the event and manifests itself through a range of symptoms, including nightmares, flashbacks and loss of sleep. It is estimated that **1 in 3 people** who have a traumatic experience are affected by PTSD and there are range of psychological therapies which are used to treat the disorder. The use of VR in treating PTSD **is already being trialled by Bravemind facilities** in the US, where governmentsponsored research is being undertaken into the application of how VR technology can be used to treat PTSD in veterans.

A new study has suggested that the rate of PTSD among army personnel and military veterans **has risen in the past ten years**, as has the number of veterans seeking treatment. One of the Bravemind projects uses VR to send veterans back to Middle Eastern areas of conflict, where they are taken through a war simulation. The room in which they undergo this treatment is also adapted to make the experience as close to the reality as possible.

There is no doubt that VR has potential for future treatment of PTSD, and this does not have to be limited to war-time experiences. Other traumatic experiences can be recreated through simulation, such as a natural disaster, in order to support the individual to process their trauma and overcome their subsequent symptoms. However, it would not be appropriate to recreate all traumatic experiences; recreating sexual abuse for example, would not be ethical. When applying this technology to PTSD, it is also important to remember that there is a fine line between helping an individual to process their trauma and forcing them to re-experience it.



VR and AR for Phobias

A phobia is the most common type of anxiety disorder and can have a range of triggers, including particular situations or objects. This affects many people and can range in severity, with varying degrees of impact on everyday life. One way in which phobias are treated is through gradually exposing an individual to their phobia, stage by stage. This type of therapy provides the perfect opportunity for VR and AR.

Cues and triggers can be worked into the VR world, and then brought to the physical world using AR. One example would be arachnophobia, which is a fear of spiders – this is one phobia many of us are familiar with. Starting with VR, patients can be put in a virtual world with spiders, to help them process their fears and overcome these cues and triggers. This is something which is already being done by the **Human Interface Laboratory at the University of Washington**, who add more and more spiders to each of their twelve virtual worlds to help an individual overcome their arachnophobia. Once this first stage is complete, AR can be used to simulate spiders in real world settings. This would provide a more realistic situation for them to process their fears. The final stage will involve patients applying what they have learned in virtual settings to the real world, in the hope that they will be able to overcome their phobia when faced with it in the physical world.

VR can also be applied to social phobias. By placing patients in the very situation they fear, they can work to overcome their cues and triggers in a safe and controlled space, from which they can remove themselves at any time.

The future of VR and AR for mental health

Further research into the effectiveness of VR and AR in treating anxiety disorders should be undertaken so that we can gain a better understanding of how this technology can help. However, this research should not be limited to anxiety disorders, as there is potential to apply the use of this technology to other mental health disorders. For example, VR may be used to support treatments for depression by simulating a positive experience, tailored to the individual, to try and support the regulation of brain chemicals which affect mood – **norepinephrine, serotonin and dopamine.** However, this alone would not be effective and would need to coincide with other treatment methods, such as cognitive behavioural therapy, in order to maximise success of the intervention.

The use of VR or AR do not have to be limited to the treatment of mental health conditions but can also challenge misconceptions and negative perceptions of people with mental health conditions, which may in turn have a positive impact on quality of care. Both VR and AR can be used to simulate what life is like for someone suffering from a mental health condition; VR can create the environment and AR can distort it. For example, AR technology could be used to simulate episodes of psychosis, which are prevalent in **bi-polar disorder** and **schizophrenia**. A mobile app or glasses could be developed which place noises and images into an everyday environment, thereby showing what people with the above disorders may experience. This could be used to increase understanding and awareness of the disorders and thus combat unhelpful stereotypes.

Both VR and AR are therefore shown to have strong potential in supporting mental health both currently and in the future. Further research and development are required so that we can better understand the impact of these technologies, how they can help and how they can become more widely available.

Key points!

- Mental health costs society £100 billion per year.
- VR can help people with PTSD to process their trauma.
- Both VR and AR can be used in traditional phobia therapy.

Limitations!

- Some traumas would not be appropriate to recreate in virtual settings.
- Virtual experiences can be nauseating, so it may not be able to accurately depict real life.
- Patients may struggle to look past the virtual nature of the experience, reducing the effectiveness of the therapy.

VR and AR for dementia.

Dementia in society

It is estimated that someone in the world develops dementia **every three seconds**, and figures indicate there are **around 50 million people worldwide** living with the disorder. This is expected to rise to **75 million by 2030.** Dementia impacts an individual's ability to carry out everyday activities, along with their **thinking**,

behaviour and memory, and early signs include:

- difficulty concentrating;
- difficulty carrying out daily activities;
- difficulty in following conversations or finding the right word,
- being confused about a time and place; and
- changes in mood.

The effects of dementia are not only felt by the individual with it, but also by their families and caregivers. It is therefore important that research is conducted further into dementia and how quality of life can be improved for everyone affected by the disorder. VR technology has the potential to not only ease the severity of dementia symptoms, but to also act as an early screening tool for the disorder. It can also provide people with a greater understanding of what it is like for an individual to live with, or care for someone with, dementia.

VR in diagnosing dementia

VR games have been developed which have a hidden capability to screen users for early signs of dementia. For example, Alzheimer's Research UK (ARUK) helped produce a VR game called Sea Hero Quest VR, which was developed to be a screening tool for early signs of dementia and requires users to navigate a boat across water bodies and towards checkpoints. In 2016, there were an estimated

10.8 million users worldwide, and there is expected to be over 16 million users in the UK by 2021. Not only is this a fun game for users, but the navigation element was produced with the intention to test the memory and spatial awareness of someone who is thought to be in the early stages of dementia, as difficulty in these areas are considered to be symptoms of the onset of dementia. This game has been widely popular across audiences. It is estimated that **two minutes playing this game equates to five hours of lab-based research.** This shows that applications such as these can provide a wide array of information in a short amount of time, and that they therefore have the potential to improve diagnosis and diagnostic tests.

Another VR game which can be used for screening purposes is VStore. Developed by Vitae R, this game requires the user to **navigate their way around a supermarket** in order to find things which are on their shopping list. This can again be used to screen for the early signs of dementia through assessing the difficulty users may have in carrying out this everyday task and whether they get confused when doing so.



VR for understanding dementia

VR can be used to **simulate the cognitive disturbance** that are faced by people living with dementia, in order to help the public in understanding what it is like living with it. This helps to both raise awareness of the disorder and improve understanding of it, which may evoke empathy from the public for people living with dementia. ARUK have developed another application for this, which can be viewed both as a video or a VR experience, called A Walk Through Dementia.

A Walk Through Dementia has **360-degree videos** which show users what people with dementia experience when completing everyday tasks, such as making tea for visitors. The videos allow users to move around in the environment and experience the situation from the eyes of someone getting increasingly confused or having cognitive disturbances. Improving awareness and understanding of dementia has the potential to then improve perceptions and behaviours towards people with dementia, and may help others in identifying someone seemingly in distress.

VR for alleviating symptoms

The virtual capabilities of VR can help people with dementia through **reducing stress, unlocking lost memories and encouraging communication.** It is therefore being increasingly used to try and connect with patients and ease their symptoms, particularly repetitive and compulsive behaviours brought on by stress. VR experience can simulate a familiar environment to help distract patients from such behaviours and calm them down, which has benefits for both the patient and their caregivers. **Research has shown that it can reduce stress by 70%**, making it an effective nonmedical alternative to calm patients. The ability to visit locations which dementia patients cannot physically access by themselves can also help alleviate a range of symptoms, including loneliness, isolation and memory loss. Experiencing a specific location through VR can be done as a group, where each person has their own experience of the same place. They can then talk about what they are seeing together and **experience social engagement**, thereby decreasing feelings of loneliness. These places do not have to be limited to those which they have not experienced, but can also include tours of places from their past, such as a family home, in order to **unlock memories and encourage communication.**

VR and AR for the future of dementia

Although applications of virtual technology in dementia are predominantly being pioneered by VR, there is still potential for AR to be used as **assistive technology**. Glasses could be worn which label things in the individual's immediate environment, to make everyday tasks, **such as making a cup of tea**, easier for the wearer to be able to do. This notion of using glasses could also be used to support individuals experiencing difficulty with spatial awareness, through providing directions to a given location. However, these concepts need further research and development. With this further research and development, glasses could go on to provide labels and information for people with dementia in areas outside of their immediate environment, such as in supermarkets or streets to prevent them from getting lost.

In addition to building on assistive technology, AR developers could also build on the already established use of VR to alleviate symptoms by providing a familiar, safe environment. Rather than using a completely new environment to simulate the sense of familiarity and safety, AR can be used to place things which are familiar in the environment. For example, AR glasses could be developed to place a family portrait or valued ornament in the immediate environment. Although these are small changes, it is the smallest of things which provide comfort, and allows these individuals to adjust to new environments and begin to see them as places of safety.

Key points! 6

- Every three seconds, someone is diagnosed with dementia.
- VR games can be used to screen for early signs of dementia.
- VR experiences can alleviate stress induced symptoms.
- VR can help people gain an understanding of what life is like with dementia.
- AR can be developed to provide assistance and alleviate distress for those with dementia.



- Motion sickness may exacerbate distress and confusion.
- AR technology may not be accessible for patients with severe dementia.
- Wearing the equipment may exacerbate rather than ease distress.

VR and AR for Autism.

Autism in society

The National Autistic Society defines autism as a **"lifelong developmental disability that affects how people perceive the world and interact with others".** As it is a spectrum condition, people with autism may share difficulties but will be affected in different ways. Around **700,000 people in the UK are on the autism spectrum**, and challenges faced by these individuals include difficulties with social interaction and finding that the world can be overwhelming for them. However, there is the potential to use both VR and AR to help alleviate some of these challenges and provide the public with a better understanding of the disorder in order to improve attitudes and behaviours towards people with autism.

VR and AR for social interaction

People with autism find **social interaction difficult**, and this can be exacerbated by difficulty in recognising and understanding emotions. VR can be used to simulate social situations that users can engage with so that they can gain experience of different social interactions and how to respond to particular situations. This application can therefore help alleviate the challenges faced by people with autism with regards to social interaction, as it can help them in **learning and developing important social skills**, such as being able to recognise and understand another's emotions.

VR is not the only technology which can be used to alleviate difficulties with social interaction; the **Autism Glass Project** is trialling the use of AR in helping people learn to identify identify emotions and social cues. Here, people with autism wear glasses incorporating a camera which has facial recognition software, designed to identify emotions and social cues. This then projects back a verbal cue to the wearer, informing them of these cues. Not only does this provide valuable social information to the wearer, but also allows them to use this experience to develop their own skills in identifying emotions and other social cues.

It is clear that both VR and AR have potential with regards to social difficulties, and therefore warrant further research and development. However, the use of VR technology to improve the lives of people with autism is not limited to alleviating difficulties with social interaction.



VR for Anxiety

For people with autism, seemingly minor situations can be overwhelming, such as starting a new job or school, using public transport and going shopping. However, VR can provide a simulation of the situations in question and help people with autism be better able to deal with the cues which trigger their anxiety and thus work to manage or overcome their anxiety. Researchers at Newcastle University have already developed an application called **'The Blue Room'**, which uses VR to expose children (and adults) to their psychological triggers in a safe and controlled environment, so that they can work to overcome these. This works for a range of phobias, including situational ones such as classrooms.

With only **32% of adults with autism in the UK in paid work**, this has the potential to improve lives through providing the opportunity for people to experience a workplace before their first day of work, so that they are familiar with the environment and have strategies in place to help them manage or overcome any difficulties they may face. This could be pivotal in making paid work more accessible for people with autism.

VR in understanding autism

Although there are high levels of awareness of autism, there is little understanding of the disorder and what life is like for people living with it. This is reflected in the fact that **over a quarter of people with autism in the UK** have been asked to leave a public place. VR technology can be used here to help people to understand what it is like to live with autism, so that statistics like these can be reduced.

The National Autistic Society (NAS) produced a VR film in the summer of 2016 which **simulated the experience of a shopping trip through the eyes of a young boy with autism.** In this simulation, the viewer experiences the sensory overload felt by the young boy with autism as they walk around the store. This film was taken to various supermarkets across the UK in order to allow as many people as possible to experience this simulation, understand what it is like to live with the disorder and encourage them to empathise with those living with autism. A 'Quieter Hour' has already been introduced across Morrisons stores in the UK, which is designed to **make shopping easier for people with sensory difficulties.** Perhaps VR simulations such as these could encourage further businesses, not limited to supermarkets, to have a 'Quieter Hour' where people with autism are do not have to feel so overwhelmed.

The future of VR and AR in autism

VR and AR clearly have the potential to help improve many of the challenges faced by people with autism and eliminate much of the stigma arising from a lack of public understanding of the disorder. However, with further research and development there is the potential to go further by using AR technology to support their processing of sensory information.

People with autism can have difficulty processing sensory information and can sometimes experience **sensory overload**, which may result in challenging behaviours. Their senses may be **under- or over-sensitive** and have an impact on their everyday life. For example, a blinking light coupled with a distant car alarm may merely be annoying for most, but for someone on the spectrum with oversensitive sight and hearing, this can cause **stress**, **anxiety and even physical pain**. AR technology could be developed to ease these sensory difficulties. If information about an individual's sensory difficulties were able to be programmed into AR glasses, these could be used to automatically adjust the environment to be more manageable for the individual. For example, the glasses would automatically detect harsh lighting and produce a dimming effect for the wearer, thereby making the sensory information easier to process.

There is both current and future potential for the use of VR and AR in supporting people with autism, both of which need further development. Alleviating difficulties faced by people with autism and increasing understanding among their peers would go a long way in improving the lives of these individuals.

Key points!

- 700,000 people in the UK have autism.
- VR and AR can help people living with autism develop social skills and improve social interaction.
- VR can be used to overcome and alleviate anxiety amongst people with autism.
- VR can help the public in understanding difficulties faced by people with autism.

Limitations!

- In some cases, autism can include difficulty applying hypothetical scenarios to real life situations, which may limit the effectiveness of virtual technology.
- For some people with autism, the sensation of wearing VR or AR technology may make them uncomfortable and cause more distress.

VR and AR for environmental issues.

The impact of environmental issues

We are all well aware of the dangers that our planet faces due to man-made pollution. However, as this is not something which everyone can directly see happening over a short period of time, knowledge of environmental issues is not necessarily enough to encourage positive changes in behaviour. VR and AR, however, have the power to change this. They have the ability to show people the direct impact that their behaviours are having on the environment in the longer-term and therefore make environmental issues more relevant to them, which would in turn drive changes in behaviour to lead more environmentally friendly lives.

VR and AR in climate change

The UN has warned that **we have until 2030 to take action** to reduce the impact of global warming and prevent climate change. However, people can become disconnected with these issues if they are not able to directly witness the impact that warming is having on our planet due to their location or the gradual nature of this impact; for example, the melting polar ice caps. In order to encourage people to take action, the effects of climate change need to be made personal, so that individuals fully understand the impact that certain actions are having on the planet and to motivate them to take action against this. This is something that could be achieved by VR and AR.

Although in reality the effects of climate change occur over many years, VR can be used to place people in environments which they otherwise would not be able to visit, such as polar regions and show them the effects of climate change within minutes. One example of this is Google expeditions, a VR and AR educational programme **being trialled with one million students**, which allows them to experience different environments. This programme could be developed further to explain environmental issues and show the negative impacts that have already happened or may happen in the future.

In addition to this, AR apps can be used to visualise what areas of the world will look like if we don't reduce global emissions by 2030. **Apps like these are already in development**, although only a few are currently available. When hovered over the sea, current apps use location and AR technology to visualise how high the sea level is projected to rise in the future if current levels of global emissions continue. However, these tend to be specific to certain water locations and so need further development to be made applicable across locations worldwide.

VR in ocean acidification

Ocean acidification refers to the decreasing ocean pH as a result of man-made carbon dioxide (CO2) emissions. The ocean pH has already **decreased by 30%**, **and acidity will increase by 150%** by 2100 if we continue to emit our current levels of CO2.

It is easy to ignore ocean acidification, as it is not something people can easily see, meaning it can be **difficult to feel a connection** to its effects. However, VR can overcome this disconnection and make the issues more personal by creating a virtual world in which a person can be submerged into a watery environment and can see the impact of ocean acidification in minutes, **either as a diver or an underwater creature.** The Virtual Human Interaction Lab (VHIL) for example, has produced an **immersive VR documentary and game** which explains the issue and shows people the detrimental impact that man-made carbon dioxide emissions are having on ocean life. This programme aims to break people's disconnection with the issue of ocean acidification and encourages them to think twice before carrying out a potentially environmentally damaging behaviour.



VR in changing behaviour

Behaviour change needs to occur on a global scale in order to be effective in tackling the above environmental issues, but this behaviour change is difficult to achieve when people are so disconnected from the issues due to their time-scale or location. Fortunately, using VR and AR to visualise the direct impact of these issues can break this disconnection, thereby **promoting more concern for the environment and increasing motivation to be more environmentally friendly** amongst users of VR technology and AR technology.

Studies from the VHIL have shown that VR experiences can influence behaviour change. These studies involved providing people with immersive experiences which engaged all of their senses to make the experiences as realistic as possible. The studies found that these experiences had the potential to influence changes in the behaviours of their users; people who experienced an ocean acidification dive were more likely to care about the issue and were more likely to conserve paper after undergoing a VR experience of cutting down a tree. Another experience involved the user taking a virtual shower, and showed their virtual avatar eating lumps of coal in order to demonstrate how much energy they were using. Following this experience, users were more likely to conserve water.

These examples demonstrate how VR technology can be used to make environmental issues more personal to an individual and encourage them to make environmentally-positive behaviour changes. In order to make this as effective as possible, further experiences need to be developed and made accessible for people on a global scale.

The future of VR and AR for environmental issues

The potential of VR to combat environmental issues is undeniable, but we're just scratching the surface of the potential of AR technology. Although apps visualising rising sea levels are already in development, we can go one step further and use AR to visualise what our everyday environments will look like if we don't take action against climate change.

AR can simulate this visualisation in our physical (rather than virtual) world, making it more personal and further breaking that disconnection. Examples could include showing the effects of ocean acidification through nearby seas or the effects of severe weather changes on local plant life. Additionally, apps could include tips on how an individual could reduce their carbon footprint and simulate what their future environments would look like if these changes were made on a bigger scale.

Key points!

- VR and AR can be used to show past, current and future impacts of environmental changes.
- VR and AR can make abstract and long-term issues, such as climate change personal, and encourage behaviour change.

Limitations!

- AR apps would require extensive development to enable users to experience environmental changes from anywhere in the world.
- Seeing the effects on a distant location may not be enough to break people's disconnection with the issue and being able to adapt the immediate environment may take some time to develop.

Applications of VR and AR in additional areas for 'social good'.

There are many areas in which VR technology and AR technology can be utilised to improve the lives of those affected by a range of issues, such as educational attainment, poverty or prejudice, but in very different ways. Whilst educational applications would involve engaging with the individuals directly, applications for poverty would involve engaging others beyond the individuals directly affected by the issue in order to encourage them to take action. Below are some examples of the wider, but lesser known, applications of VR and AR, and how they have to potential to contribute towards the 'social good'.

VR in education

Education is not always accessible or enjoyable for everyone, which can have a negative impact on engagement and therefore attainment. For example, attending school for students with special educational needs and disability (SEND) can be difficult, and the noisy classroom environment can often be overwhelming. However, the use of VR allows students to attend school through a simulation of their classroom in a safe and controlled environment, **from which they can remove themselves if it begins to overwhelm them.** This is beneficial for both the student, who can still engage with learning, and the other students as they can maintain focus on the learning topic. This can be extended to students who do not feel able to attend school due to personal circumstance or severe bullying.

In addition to making education accessible for children everywhere, VR can also be used as a tool to make education more engaging and therefore improve learning. Being able to engage with learning is key for a successful education, but traditional 'textbook' teaching methods are **not always the best way to engage every child;** if a child is not engaged with their learning, it can negatively impact their educational attainment. However, the potential of VR technology to provide fun, virtual experiences to better engage children is receiving increasing attention and exploration. One example of this is Google Expeditions, which is an educational VR programme aiming to increase engagement by allowing students to visit locations which they would otherwise be unable to see. It is currently being **trialled with one million students** and allows them to interact with environments or locations which are the subject of their learning. This not only has the potential to make education more fun and therefore more engaging, but to also instil a richer understanding of the very environments which children are learning about.

Finally, immersive experiences from VR can provide students with the opportunity to **experience different job roles** and begin to develop important vocational skills for the workplace to prepare them for future apprenticeships or employment. This would not only support them in thinking about their future career path, but also help ease the transition between education and working life. It is therefore clear that VR has a lot of potential in an educational setting, particularly with regards to ensuring that education is accessible to everyone.

VR in poverty

The effects of poverty costs the UK alone **£78 billion each year**, which includes a range of services such as healthcare, children's services, housing and more. As this is a societal problem, it is important to work as a society to overcome this. VR technology has the potential to do this through evoking empathy and encouraging people to take action to tackle poverty, such as donating clothes or food. Using VR to encourage people to take action to support people living in poverty can therefore help alleviate some of these costs.

As VR places the user in a fully immersive environment, it can be used to simulate situations that people don't experience and are otherwise removed from in order to generate an emotional response. The United Nations (UN) is using this technology to **raise awareness and engagement with a range of social issues in vulnerable communities** across the world.

According to 2015 figures, **10% of the world's population are living in extreme poverty.** This means 10% of the world's population are living with inadequate levels of sanitation, safe drinking water, shelter and more. Although this is something most people are not experiencing, it is one of the biggest social issues we face. However, because many people are not directly experiencing the effects of poverty, there is a disconnect with the issue. VR technology can be used to overcome this. The ability to place people in a fully immersive environment allows the opportunity for people to experience poverty first hand and interact with the environment to learn more about living in poverty.

One way in which the UN is using VR technology is through a mobile app, which provides people with an experience of living in poverty and has a 'take action' button to allow people to engage with this social issue. Bill Gates has also used this technology to produce a VR video of a trip to South Africa, where he visited areas of extreme poverty. Products such as these are designed to evoke empathy and compassion for those living in these environments and encourage people to take action to address the underlying social issues, which may include donating money, clothes or food. Although it is unlikely that this application will eradicate poverty completely, it is certainly working towards alleviating some of the challenges people living in poverty are facing.

VR in fighting discrimination and prejudice

Too many people are subject to everyday discrimination and prejudices, which can take many different forms. For example, people with disabilities are **more likely** to be victims of crime and experience unfair work treatment, **one in five people** from the LGBT community experienced hate crime in 2016/17 and **76% of hate crimes** recorded by police in England and Wales across 2017/18 were racial hate crimes. However, as discrimination and prejudice are not experiences that everyone will face, the impact of discrimination and prejudice is not always understood; people may not realise how harmful some behaviours can be, no matter how small they may seem. VR can be used to create experiences where the user is subject to instances of discrimination or prejudice, so that they can gain a better understanding of its impact and how they can work against it.

Current research is looking into how using VR to place someone in the virtual shoes of another can **challenge and change their perceptions of others**, and thus work towards a better understanding of the impact of discrimination and prejudice, and encourage people to take action against it. This research involves placing users in the shoes of someone who is experiencing some form of discrimination to evoke feelings of empathy towards the individual in question. Through evoking empathy, it is anticipated that this can help people better identify instances of discrimination or prejudice, discourage them from engaging in these behaviours themselves and encourage them to take a stand when they see it taking place in the future. Although this research is not extensive, it shows that there is potential for using VR to decrease instances of discrimination and prejudice.

The future of VR and AR

The potential of VR technology in the aforementioned areas has already been well established, but there is potential to go further yet. As already mentioned, VR can be used to provide people with experiences of discrimination and/or prejudice in order to change their perceptions and behaviours towards those who experience this on a regular basis. This application could be extended to supporting the rehabilitation of offenders, through enabling them to re-experience their crime through the eyes of the victim. This of course is not applicable to all offences, as some crimes would be unethical to recreate, i.e. sexual assault. However, things like hate crime, robbery or other threatening behaviour could be recreated so that the offender can gain an understanding of the psychological harm they caused to the victim.

As with the VR experiences of discrimination and prejudice, these experiences would hope to evoke a degree of empathy and remorse from the offender, which would discourage them from engaging in similar criminal activities in the future. In addition to preventing recidivism, this application could help to inform decision-making about whether they are safe to be released back into the community based on their feelings of empathy and remorse following the experience. This application again reinforces the benefits of using VR technology, and further research into this can help establish VR technology as a tool for 'social good'. AR technology, however, is seemingly a different story.

Although AR technology has yet to make an impact in these areas, this does not mean that there is no place for it. It can work towards engaging school children by placing things in their environment, therefore making education more fun and encouraging children to be more proactive in their learning; for example, using AR to support an educational 'treasure hunt' which encourages children to solve and search for clues in the outside environment. Like VR, this use of AR could engage children who do not respond to traditional 'textbook' teaching methods and therefore help improve their educational attainment. This shows that despite the dominance of VR in these areas, AR technology still has the potential to be developed in the aid of 'social good'.



Key points! 👩

- VR and AR can engage children in learning and help develop skills for the workplace after leaving education.
- Poverty costs the UK £78 billion per year.
- VR allows the public to experience what it is like to live in poverty and evoke empathy to take action.
- VR can evoke empathy for those who experience discrimination or prejudice and victims of crime.

Limitations!

- Being able to use VR technology to be able to go anywhere may discourage people from actually going to these places, leading them to become isolated indoors and thus may actually limit educational opportunities.
- VR and AR can only recreate sounds and images and so may not be effective in providing realistic experiences, therefore making it difficult to apply to the real world and thus reducing its impact.

Which area has the most potential?

VR technology and AR technology can be used to promote 'social good' in a variety of ways. While the impact of some of their applications can be seen almost immediately, others will take time for the impacts to be seen. For this reason, we have put forward the areas with the most potential on an immediate and long-term basis.

Immediate: dementia

It is estimated that there are **850,000 people** in the UK living with dementia and due to our ageing population, this expected to rise to around **1 million by 2025.** Providing adequate care and support is difficult, particularly when there is a growing demand for care. It is not possible for everyone within a given population to have someone there to support them every second of every day. It is for this reason we suggest VR and AR applications for dementia have the most potential for immediate impact.

By alleviating symptoms and providing assistance to those who need it, this technology can both make the lives of those suffering from dementia easier and relieve some of the pressure experienced by carers. Assistive technology can help people with dementia to live as independently as possible, and the potential to use the technology to alleviate symptoms can reduce distress and perhaps reduce the need for extensive intervention by carers.

Further research into the use of VR and AR with regards to supporting people with dementia, their families and carers is yet to be fully undertaken. There is no doubt, however, that this technology has wide reaching potential with regards to supporting the battle against dementia.

Long term: environment

Environmental issues are at their peak, with no sign of de-escalation. We have been given until **2030** to take action to stop, change or limit environmentally-damaging behaviours in order to prevent catastrophic climate change. However, widespread behaviour change is not always possible overnight. For this reason, the environmental applications of VR and AR have been put forward as ones with the most potential for bringing long-term change.

Long-term changes in behaviours will in turn have a long-term, beneficial impact on the environment and perhaps prevent the catastrophes put in motion by man-made pollution. Virtual experiences showing people the impact that they, and others, are having on the environment encourages them to make the long-term changes in behaviour which reduce this impact. Further research and development of this application could help make it more widespread, and therefore encourage global change.

Which Technology has the most potential?

Both technologies clearly have current and future potential uses for encouraging 'social good'. VR technology, however, has so far been shown to be highly applicable across all areas mentioned in this paper.

Its ability to provide a customisable, virtual world which can be tailored to any individual or situation means that its possibilities are endless, from seeing a melting polar ice-cap to revisiting a childhood home. This virtual world can however also be considered as VR's biggest flaw. Although AR technology is somewhat behind the advancements and applications of VR, its ability to place things in the real world make it better equipped in addressing real world issues.

Despite VR having wider applicability, it can limit people to the comfort of their own home, stopping them from interacting with the social world and in turn may limit their potential for 'social good'. The current and future potential of AR applications, however, actively encourage people to go out into the world and interact with other people, as can be seen by Pokémon Go and emotion identifying glasses. It is therefore important that AR technology is further explored in the context of achieving 'social good'.

Despite its need for further development, AR technology shows the most promise for achieving 'social good'. Its use of the real world brings a sense of realism to its applications and could therefore make it more effective in working towards 'social good'. However, it is clear that both technologies can be used to work towards 'social good', despite both having their limitations and drawbacks, and should be further researched and developed in order to make them effective in working towards this ideal.

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