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TOWARDS SDG 10: WEARABLE SENSORS TO HELP PEOPLE WITH SPEECH DISABILITIES

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YOUNG REVIEWERS:


AILA
AGE: 15


AMARTHYA
AGE: 13


AYESHA
AGE: 14

The United Nations' Sustainable Development Goal 10 (SDG 10) is all about making sure everyone gets treated fairly, no matter who they are or where they live. It focuses on giving people equal chances in life and stopping unfair treatment. For those who have lost their ability to speak, or were born that way, everyday life can feel lonely—imagine being unable to chat with friends, ask a question in class, or request help in a store. But there is hope! Scientists are developing a new solution that can help these people speak without using their voices! In this article, we present a new system that uses magnetic patches placed on people's lips to track lip movements, and sends them to a phone app. The app can then "speak" for them by transforming their lip movements into sounds and readable words, allowing people with speech problems to communicate vocally with others.

Watch an interview with the authors of this article to learn even more! (Video 1).

REDUCING INEQUALITIES AROUND THE WORLD

We all want a fair and sustainable world to live in. To achieve this, the United Nations (which is an organization that includes almost all countries) has created a plan to solve the world's problems, like war, hunger, and climate change. This plan, called the 2030 Agenda, resulted in the creation of 17 Sustainable Development Goals (SDGs) targeting each of those challenges, that countries must aim to achieve by 2030. SDG 10–Reduced **Inequalities** aims for the world to be a fair place where everyone can succeed and have equal chances, no matter their gender, race, religion, disability, or how much money they have. In a nutshell, SDG 10 is about making sure everyone is treated equally and that countries work together to make this happen. There are several things that need to be done to achieve equality for all. We need to make sure most people have the essentials needed to live, create laws that protect people against **discrimination**, include people from developing countries in global decisions, and create ways that people with disabilities can have equal opportunities.

INEQUALITIES

Things that are unfair or unequal for different people, like when some people do not get the same chances, rights, or treatment as others, even though they should.

DISCRIMINATION

When someone is treated unfairly just because of who they are, like their skin color, gender, or abilities.

REDUCING INEQUALITIES WITH SCIENCE

Science can help us achieve SDG 10 by finding ways to make the world fairer for everyone. One way science can help reduce inequalities is through **assistive technologies** (ATs). ATs help people with disabilities live more independently and allow them to have the same opportunities as people without disabilities [1]. You might already be familiar with several ATs. For example, glasses or contact lenses that help people see better, hearing aids that help people who are hard of hearing, braille textbooks that allow blind people to read, or even wheelchairs that help people with mobility issues to move around more easily (Figure 1) [2].

ASSISTIVE TECHNOLOGY

Any tool or device that helps people with disabilities do things more easily, like communicating, moving, or learning.

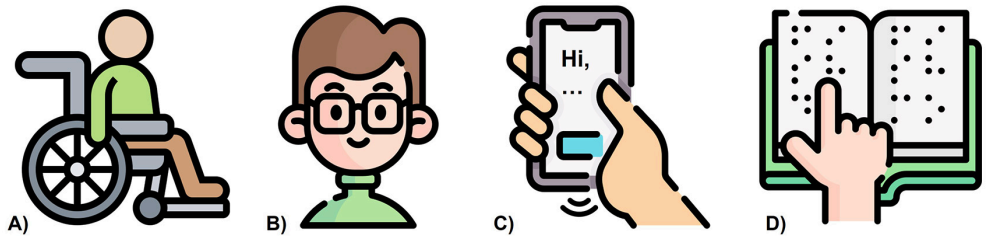

Figure 1

Examples of assistive technologies that help people with disabilities live better lives: **(A)** a wheelchair for getting around, **(B)** glasses for seeing, **(C)** a phone app for speaking, and **(D)** Braille for reading.

Reaching SDG 10 also helps us achieve other goals. For example, it supports SDG 4 (Quality Education) by making sure people with disabilities have access to new ways of learning, like braille books or

screen readers, or that they have access to online learning if they cannot physically go to school. It also contributes to SDG 3 (Good Health and Wellbeing) by ensuring that people have the tools they need to access healthcare—for example **telemedicine**—to help them live healthier, more independent lives. When we reduce inequalities, we create a fairer world where everyone can thrive.

TELEMEDICINE

A system that lets people talk remotely to doctors, get advice, and even get medicine using a phone, tablet, or computer—all without leaving home.

ASSISTIVE TECHNOLOGIES FOR PEOPLE WHO CANNOT SPEAK

Some people cannot speak because their bodies work a little differently. For example, some are born with conditions that make it hard for them to control the body parts used for speaking, like the mouth, throat, or brain. Others might have had an accident or a sickness, or something happened to their bodies that affected the ability to speak. It is just like how some people need glasses to see clearly—everyone's body works differently.

Sound is made when air from the lungs moves through the throat and makes the vocal cords (two tiny bands inside the throat) vibrate. The sound then comes out of the mouth, and we use our tongue, lips, and teeth to turn it into words. Some people cannot make these vibrations, either because their vocal cords do not work, they do not have enough control over their muscles, or their brains cannot send the right signals to make speech happen. But even if they cannot talk, many people use other ways to communicate, like sign language, pictures, or translators [3]. The problem is that most people do not understand sign language and there are almost as many different sign languages as countries in the world!

To help people communicate in a more natural way, scientists studied the reasons why some people cannot speak. They found out that many people with voice problems can still move their lips and sometimes their tongues, but they just cannot make sound. With this in mind, we thought about how we could use the movements people could make to help them communicate without their vocal cords (Figure 2). This way, people could more naturally communicate as if they were talking. We thought it would be great if people with speech difficulties could use their mouths to communicate naturally again!

MAGNETIC SKIN

A flexible, stretchable material that acts like a magnet and can be attached to your body, like a sticker or bandage.

USING MAGNETIC SKIN TO HELP PEOPLE SPEAK

So far, you have learned that some people who cannot speak cannot create sounds, but they can move the muscles of their lips. So, what if we could find a way to read these small movements and turn them into sound? That is what we did in our research at KAUST. Our team developed a flexible **magnetic skin** that is safe to wear [4]. It is a thin, stretchy magnet that sticks to the bottom lip and uses wireless sensors

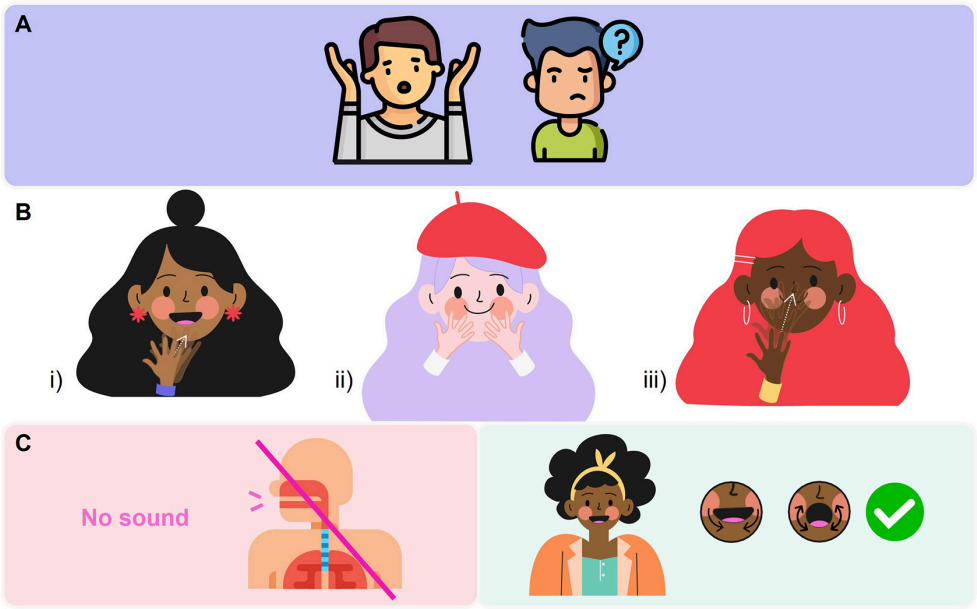

Figure 2

Figure 2

(A) For a person who cannot verbally speak, not being able to communicate with people who do not know sign language can be frustrating...for both sides! **(B)** Sign language is as diverse as all spoken languages. For example, the phrase "thank you" in **(i)** American Sign Language, **(ii)** Spanish Sign Language, and **(iii)** Pakistani Sign language is made differently. **(C)** Many people who cannot speak can still move their lips. This means that new technology that can read lip movements might help them "speak" again through external sources, instead of their vocal cords.

ARTIFICIAL INTELLIGENCE

Also called AI, is when computers or machines are made to think, learn, or solve problems like humans do—but without actually being alive.

WEARABLE TECHNOLOGY

Technology designed to be worn on the body, just like clothing or accessories, so that you use it while you are wearing it.

MAGNETIC FIELD

An invisible force surrounding magnets or magnet-like objects, allowing them to move or interact with each other without direct contact. It is what makes magnets stick to certain metals.

and **artificial intelligence** to detect and predict the words someone is trying to say. This helps people have normal conversations, even if they have trouble speaking [5].

Magnetic skin is a big step forward in **wearable technology**: it is unnoticeable, its shape, size, and color can be changed, and it is comfortable to wear. As a person moves their mouth, the **magnetic field** coming from the magnetic skin moves as well. A headset with magnetic field sensors can sense the small mouth movements. These tiny movements change the magnetic field around the sensors, and the sensors turn these changes into digital signals. A program detects the changes and patterns in the signal and is integrated into a phone application that "translates" the patterns into a corresponding letter or word. To achieve this, the program was trained with men and women from six different countries, languages, and accents. The system has correctly predicts 91% of the words a person is saying! The word or phrase the person is saying shows up on the person's phone screen, offering a new and more natural way for people with voice disorders to communicate (Figure 3).

WRAPPING IT UP

SDG10–Reduced Inequalities is about making the world a fair place where everyone has the same chances to succeed, no matter who they are. This matters because everyone deserves to live their best life and be treated equally. Science helps by creating incredible tools like magnetic skin technology, which helps people who cannot speak turn their lip movements into words. This groundbreaking invention

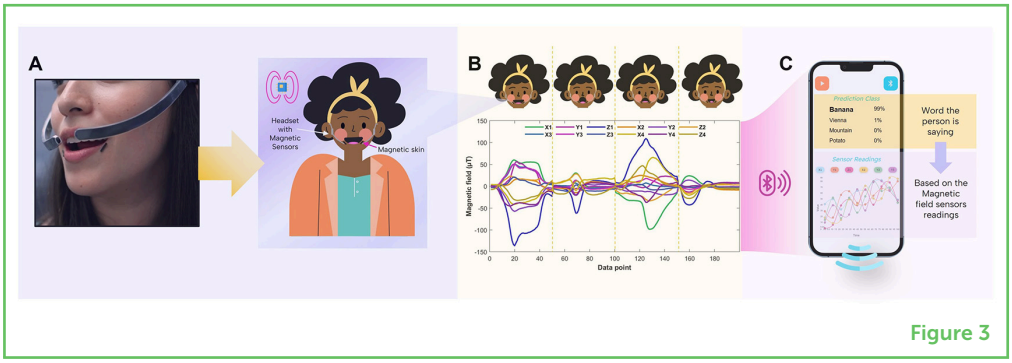

Figure 3

Figure 3

Wearable technology to detect lip movements and translate them into a voice. **(A)** The person wears magnetic skin patches on their lower lip. **(B)** As they move their mouth, the magnetic sensors in the headset pick up changes in the magnetic field. These changes create patterns that artificial intelligence can recognize as letters or words. **(C)** The headset sends this information to a phone *via* Bluetooth, showing what the person is saying in real time. You can also see the wave patterns on the screen as the person "speaks".

makes it easier for people with speech disabilities to communicate naturally and feel included. Magnetic skin is just one way science is helping achieve SDG 10, by reducing inequalities and creating a more inclusive world. With tools like this, people with disabilities can connect with others and be understood more easily. The future of assistive technology is exciting, and there are endless possibilities for even more amazing inventions. You can help too—keep learning about inequality, support new ideas, and use your creativity to build new things that help make the world fairer for everyone. Together, we can make it happen!

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

AILA, AGE: 15
Hello my name is Aila. I enjoy reading books in my free time, and I particularly like books with continuous and well-written character development as well as good descriptions and attention to detail. I also enjoy swimming, I & S, and L & L. I am hoping to start learning piano this year.

AMARTHYA, AGE: 13
I am Amarthya, a 13 year old who loves sports and arts, currently based in KAUST. I mainly love dancing, singing, drawing, painting, badminton, and chess. I am more of an extracurricular person but still, I do aim on focusing on my studies over all these activities. I also love writing essays, novels, and uncommonly... quotes as well. On top of that, I am an animal enthusiast! I have had rabbits, parrots, and cats over the years. Sadly, I lost a cat of mine a year ago, and that is why it is my profile picture.

AYESHA, AGE: 14
My name is Ayesha and I am passionate about exploring new scientific discoveries, and I love to read articles that expand my understanding. I am a naturally curious person, and always look forward to learning new stuff every day.

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