Singapore

NTU researchers develop smart device to harvest sunlight for underground use

Drawing inspiration from the magnifying glass, this device developed by Singapore scientists can harvest daylight and transport it underground. (Photo: Matthew Mohan)

By Matthew Mohan (/author/1038614.2)
31 Mar 2021 03:26PM
(Updated: 31 Mar 2021 03:43PM)

SINGAPORE: What looks like a crystal ball in a transparent glass case could soon be used to light up underground spaces in a sustainable way.

Drawing inspiration from the magnifying glass, several Singapore researchers have developed a smart device that can harvest daylight and transport it underground, reducing the need to rely on traditional sources such as LED bulbs.

It was designed and developed by a team of Nanyang Technological University (NTU) researchers, including Assistant Professor Yoo Seongwoo from the university's School of Electrical and Electronics Engineering as well as Dr Charu Goel, who is a principal research fellow at the NTU's “The Photonics Institute”.

The innovation was reported in scientific journal Solar Energy earlier this month.

Drawing inspiration from the magnifying glass, this device developed by Singapore scientists can harvest daylight and transport it underground, reducing the need to rely on traditional sources such as LED bulbs. (Photo: NTU Singapore)

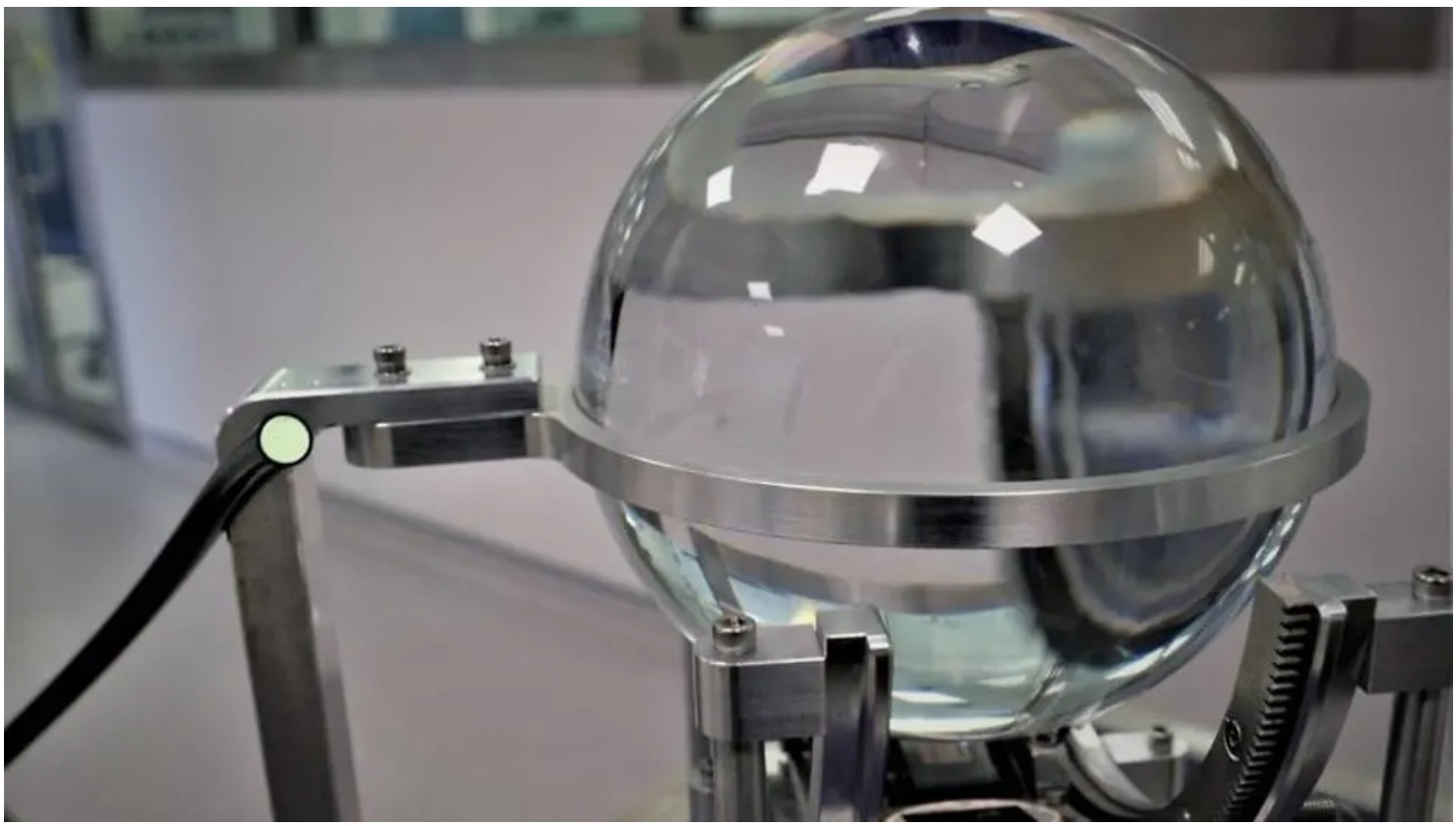
The device is made from an off-the-shelf acrylic ball, a single plastic optical fibre and computer chip assisted motors.

"In Singapore, authorities are looking at the feasibility of digging deeper underground to create new space for infrastructure, storage and utilities. Demand for round-the-clock underground lighting is therefore expected to rise in the future," said the university in a press release on Wednesday (Mar 31).

► **READ: As the buying and selling of solar energy becomes reality, Singapore could gain further ground on solar target (/news/singapore/solar-energy-panels-buying-selling-platform-local-12989290?cid=h3_referral_inarticlelinks_24082018_cna)**

HOW IT WORKS

Just like a magnifying glass, the acrylic ball acts as the solar concentrator, focusing rays of sunlight to form a sharp focus at its opposite side.



The acrylic ball of the device acts as the solar concentrator. (Photo: NTU Singapore)

The focused sunlight is then collected into one end of the fibre cable, and transported to another end that is deployed underground.

Light is then emitted via the end of the fibre cable.

Drawing inspiration from the magnifying glass, this device developed by Singapore scientists can harvest daylight and transport it underground, reducing the need to rely on traditional sources such as LED bulbs. (Photo: NTU Singapore)

Concurrently, small motors - assisted by computer chips - automatically adjust the position of the fibre's collecting end. This allows the device to optimise the amount of sunlight that can be received and transported as the sun moves.

During rainy or overcast days, an LED bulb powered by electricity installed right next to the emitting end of the fibre cable will automatically light up. This ensures that the device can illuminate underground spaces throughout the day without interruption.

The device overcomes several limitations of current solar harvesting technology, said NTU.

"In conventional solar concentrators, large, curved mirrors are moved by heavy-duty motors to align the mirror dish to the sun. The components in those systems are also exposed to environmental factors like moisture, increasing maintenance requirements," said the university.

"The NTU device, however, is designed to use the round shape of the acrylic ball, ridding the system of heavy-duty motors to align with the sun, and making it compact."

The prototype designed by the researchers is 50cm tall and weighs 10kg.

To protect the acrylic ball from environmental conditions, the researchers also built a 3mm-thick polycarbonate dome-shaped cover.

Researchers believe the device is ideally suited to be mounted as a conventional lamp post above ground.

This would allow it to be used in two ways: To harvest sunlight in the day to light up underground spaces; and as a street lamp to illuminate the ground at night using electricity.

► **Commentary: Why hasn't solar energy in Singapore taken off in a big way after so long? (/news/singapore/solar-energy-singapore-panels-cloudy-unpredictable-electricity-14117980?cid=h3_referral_inarticlelinks_24082018_cna)**

A MORE EFFICIENT SOLUTION

NTU researchers have found that the device boasts a higher luminous efficacy - the measure of how well a light source produces visible light using 1 watt of electrical power - compared with commercially available LED bulbs.

In experiments in a pitch-black storeroom used to simulate an underground environment, researchers found the device's luminous efficacy to be at 230 lumens per watt. Commercially available LED bulbs have a typical output of 90 lumens per watt.

The qualities of the light output of the NTU device is also "comparable" with current commercially available daylight harvesting systems that are more costly, said the university.

"The luminous efficacy of our low-cost device proves that it is well-suited for low-level lighting applications, like car parks, lifts, and underground walkways in dense cities," added Dr Charu.

"It is also easily scalable. Since the light capturing capacity of the ball lens is proportional to its size, we can customise the device to a desired output optic power by replacing it with a bigger or smaller ball."

Lighting company Technolite is exploring ways to potentially incorporate the smart device or its related concepts into industrial projects for "improved efficiency and sustainability", revealed NTU.

Technolite was an industry collaborator in the research study.

"Our innovation comprises commercially available off-the-shelf materials, making it potentially very easy to fabricate at scale. Due to space constraints in densely populated cities, we have intentionally designed the daylight harvesting system to be lightweight and compact," said Asst Prof Yoo.

"This would make it convenient for our device to be incorporated into existing infrastructure in the urban environment."

Source: CNA/mt

Tagged Topics