NTU researchers develop smart device to harvest sunlight for underground use

By **The Bharat Express News** - March 31, 2021

SINGAPORE: What looks like a crystal ball in a clear glass case may soon be used to illuminate underground spaces in a sustainable way.

Drawing inspiration from the magnifying glass, several researchers in Singapore have developed a smart device capable of harvesting daylight and carrying it underground, reducing the need to rely on traditional sources such as LED bulbs.

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It was designed and developed by a team of researchers from Nanyang Technological University (NTU), including assistant professor Yoo Seongwoo from the university's School of Electrical and Electronic Engineering as well as Dr. Charu Goel, who is Principal Investigator at NTU "The Photonics Institut".

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

Taking inspiration from the magnifying glass, this device developed by scientists in Singapore 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 a standard acrylic ball, a single plastic optical fiber, and computer chip assisted motors.

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"In Singapore, authorities are examining the possibility of digging deeper underground to create new spaces for infrastructure, storage and utilities. The demand for 24-hour underground lighting is therefore expected to increase in the future, "the university said in a press release on Wednesday (March 31st).

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HOW IT WORKS

Much like a magnifying glass, the acrylic ball acts as the solar concentrator, focusing the sun's rays to form a sharp focus on its opposite side.

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

Focused sunlight is then collected in one end of the fiber optic cable and carried to another end which is deployed underground.

The light is then emitted through the end of the fiber cable.

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

At the same time, small motors – assisted by computer chips – automatically adjust the position of the collecting end of the fiber. This allows the device to optimize the amount of sunlight that can be received and carried as the sun moves.

During rainy or cloudy days, an electrically powered LED bulb installed right next to the emitting end of the fiber cable will automatically turn on. This ensures that the device can illuminate underground spaces throughout the day without interruption.

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

"In conventional solar concentrators, the large curved mirrors are moved by rugged motors to align the mirror cup with the sun. The components of these systems are also exposed to environmental factors such as humidity, increasing the need for maintenance." , said the university.

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

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

To protect the acrylic ball from environmental conditions, the researchers also constructed a 3mm thick polycarbonate domed cover.

The researchers believe that the device is perfectly suited to be mounted like a conventional lamppost above the ground.

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

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A MORE EFFICIENT SOLUTION

NTU researchers found that the device offers higher luminous efficiency – the measure of how well a light source produces visible light using 1 watt of electrical power – compared to commercially available LED bulbs. .

During experiments in a dark reserve used to simulate an underground environment, the researchers found that the luminous efficiency of the device was 230 lumens per watt. Commercially available LED bulbs have a typical output of 90 lumens per watt.

The light output qualities of the NTU device are also "comparable" to current, more expensive, commercially available daylight harvesting systems, the university said.

"The luminous efficiency of our low cost device proves that it is well suited for low level lighting applications, such as parking lots, elevators and underground sidewalks in dense cities," added Dr Charu.

"It's also easily upgradeable. Since the light capturing ability of the spherical lens is proportional to its size, we can customize the device to the desired output optical power by replacing it with a larger or smaller ball. "

Lighting company Technolite is exploring ways to potentially integrate the smart device or its associated concepts into industrial projects to "improve efficiency and sustainability," NTU revealed.

Technolite was an industry collaborator in the research study.

"Our innovation includes commercially available materials, which makes it potentially very easy to manufacture on a large scale. Due to space constraints in densely populated cities, we intentionally designed the daylight collecting system to be light and compact, "said Professor Asst Yoo.

"This would make it easier to integrate our device into existing urban infrastructure."

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