

Current Science Reports

Automatic Road Extraction

From satellite imagery

Automatically extracting features of roads from real time satellite images is useful in emergency situations like floods and landslides. But applying machine learning on high resolution satellite imagery increases computing and bandwidth costs. Researchers from NIT, Rourkela recently collaborated with a researcher in Italy to work around the problem.

They configured a system with an edge layer, a fog layer and a cloud-based Internet of Things architecture. The edge layer acquires images from satellites and transfers them to the fog layer. The fog layer downsizes the image using simple linear iterative clustering of colour and spatial features.

It is the downsized images, or superpixels, that are transmitted to cloud computing. This can be achieved using low bandwidth resources.

To automatically extract road features from cloud systems, the team used the deep learning algorithm, U-net. This layer downsamples the data using localization and context, identifies bottlenecks and then upsamples the results. This reduces computation costs.

To train, test and validate the system, the researchers used two datasets. The DeepGlobe dataset has images of large areas with various kinds of roads and the Massachusetts road dataset has images that cover smaller areas with city roads: altogether nearly 2000 satellite images.

The researchers tried out various superpixel image sizes and found that clustering 5 pixels by 5 pixels had the highest accuracy.

The superpixel technique preserved essential natural features with reduced memory space. The images were transmitted to the ground station using low bandwidth cost.

The three-layer fog framework can be implemented for real time scenarios like flood warning alarm systems.

Satellites of varying resolution are imaging the earth every day. Huge amounts of data are collected. Extracting and interpreting useful information from such huge amounts of data col-

lected within a short span of time is slowly becoming possible. Such advancements in data analytics and machine learning will help decision makers make evidence-based actions in near real time.

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Low-cost Disinfection

Using radiations

Many dispensaries and small hospitals, especially in rural areas do not have proper systems for disinfecting contagious waste before disposal. A simple, cost-effective instrument is necessary to prevent the spread of infections. Recently, researchers from IIT Guwahati made a cost-effective disinfection box for the purpose.

They fabricated a wooden box with two parts, one for keeping electrical equipment, and another acted as disinfection chamber. The disinfection chamber was fitted with one infrared lamp and two ultraviolet lamps. To prevent heat loss from the chamber, the researchers fitted a highly reflective galvanized iron sheet inside the box.

There was a digital temperature controller to maintain the optimum temperature in the disinfection chamber and a limit switch on the top cover to switch off the ultraviolet lamps once the chamber is opened. And a timer to turn off the system after a predetermined time.

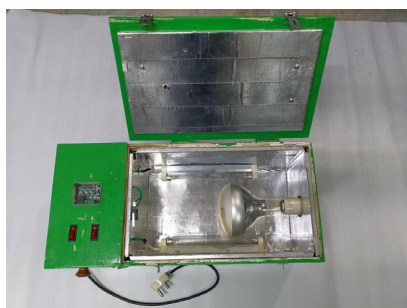


Image: Uday Shanker Dixit

The researchers tested the antibacterial effect of the radiation treatment on Gram-negative and -positive bacteria by introducing cultured bacterial strains into the disinfection box.

They found that either ultraviolet radiation or the temperature produced by infrared can injure the bacterial cell but not kill the microbes. Combined infra-

red heating and ultraviolet treatment, however, showed bacterial inhibition within 15 minutes at about 65°C.

The researchers examined the introduced bacteria using a field emission scanning electron microscope. They found that the bacteria were killed via multiple routes, including rupture of the cell membrane, inactivation of genetic materials and proteins, and interference with cell division.

The researchers then checked the efficiency of the disinfection box against spike and RNase proteins, which are responsible for the infective effect of the COVID-19 virus. The disinfection could inactivate the COVID-19 virus by unfolding viral proteins responsible for the infection.

The total cost of this box is only about Rs. 3000. So start-ups can approach the team for cost-effective disinfection systems for our rural hospitals.

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Detecting Bacterial Growth

A handheld lab

Detecting bacterial growth is time consuming. Small samples have to be cultured in a laboratory before the growth can be detected. But that is now poised to change.

Researchers from the Hyderabad campus of BITS Pilani have come up with a lab-on-chip device useful for clinical and field microbiology and for food testing. The 3D printed device integrates a microfluidic device, a heater and an electrochemical sensing device to detect bacterial growth, ranging from a few thousand to one billion colony-forming units per millilitre.

For detecting and quantifying bacterial growth, the researchers used electrochemical techniques. They created a three electrode system over a glass substrate using an elegant procedure. A mask of poly vinyl chloride sheet of 250 micrometres thickness was placed on the glass using a laser. Conductive carbon ink was laid over the mask as per design: 1000 micrometres wide with a spacing of 350 micrometres. After the ink dried, the PVC sheet was removed, leaving the three electrode system on the glass substrate. One of the

three electrodes was modified with silver, using silver chloride ink. This works as a reference electrode. The other electrode was modified into a working electrode with multiwalled carbon nanotubes.

The team fabricated the microfluidic component using polydimethylsiloxane. The design was prepared earlier using CAD software. The pattern was cut on polymethylmethacrylate using a laser, attached to a glass substrate and placed in a mould. Polydimethylsiloxane mixture was poured over the mould and cured. The required holes were punched on the polymer sheet and then bonded to the glass slide with screen printed electrodes using oxygen plasma.

To make the third component, a miniature heater, the researchers laid a polyimide sheet of 250 micrometres on a glass substrate and used a laser to induce graphene. The graphene created an area of about four square centimetres. Electrical contacts were then provided using silver paste and copper tape. A potential of two volts applied to the graphene film maintained a temperature of about 36°C, adequate to stimulate bacterial growth.

The microchannel can accommodate a volume of 300 microlitres of sample. For their experiments the researchers used Luria Bertani media for culturing bacteria.

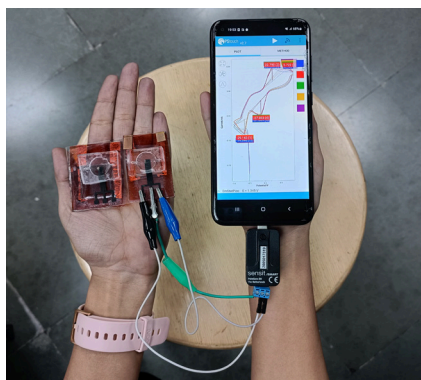


Image: Courtesy Sanket Goel

'We cultured and measured the growth of different bacteria using the device. Fluorescence imaging establi-

shed the viability of the bacterial cultures,' says Sangam Srikanth.

'The culture of bacteria on the microfluidic device is as good as culture in a conventional incubator,' adds Arshad Javed, his colleague.

'The number of dead bacteria is a bit higher than found in a sample cultured in an incubator,' admits Satish Kumar Dubey.

'But the metabolic activity of bacteria cultured in the microfluidic device was close to that of the sample cultured in the conventional incubator,' adds U. S. Jayapiriya.

'The miniaturization of the device minimises not only the sample volume, but also the cost and power consumption,' says Sanket Goel, BITS Pilani, Hyderabad.

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Mental Health Literacy Shorter assessment tool

After the onset of the COVID-19 pandemic, mental health problems are rising globally. How can we assess the early symptoms of the problems to enable adopting effective preventive and therapeutic strategies?

Mental health literacy, the knowledge of signs and symptoms as well as prevention and treatment options, is a reliable resource to reduce the problems. The Mental Health Literacy questionnaire was adapted to suit young adults to assess their level of mental health literacy. But the questionnaire is in English and applicability to other linguistic and cultural groups has not been tested.

So, Neera Pant, Gargi College, New Delhi recently collaborated with researchers from Portugal, the US, Indonesia, India, Thailand and China to revise and develop a shorter version of the questionnaire, more suitable to Portugal, Indonesia, India, Thailand and China.

They translated the questionnaire into the predominant languages of these countries. In these countries and the US, they gave the questionnaire to a total of nearly two thousand participants, aged between 17 and 25. Offline and

online methods were used as practicable, before and during the COVID-19 pandemic.

Besides a sociodemographic section, the questionnaire has 29 items divided into knowledge of mental health problems, erroneous beliefs or stereotypes, first-aid skills, and self-help strategies. Statistical analysis showed that the items fitted well as a single group.

The participants rated each of the items on a five-point scale from strongly disagree to strongly agree.

The researchers checked for relationships between observed variables in the questionnaire and underlying latent constructs on data from Portuguese participants, as a test case. After evaluating the variables using local and global adjustments, they found some erroneous correlations. The findings helped remove 13 items from the questionnaire.

Statistical tests confirmed the reliability of the variables in a shortened version containing only 16 items. After confirmation, the team tested the shortened version on samples from the other five countries.

Data from the US had the highest consistency and could be considered globally acceptable. Portugal had higher rates of mental health literacy. In India, it was 13.7%. Except in India, in five countries, there was a negative correlation between beliefs/stereotypes and mental health problems.

The shorter version is more reliable and reduces the time needed to assess the mental health literacy of young adults. It may be useful for multicultural and multilingual comparisons of populations around the world. Of course, the shorter version also needs to be tested in other countries.

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