# INFOLINE

## Volume XII Issue 2   October 2021

**DEPARTMENT OF COMPUTER TECHNOLOGY AND INFORMATION TECHNOLOGY**

**KONGU ARTS AND SCIENCE COLLEGE**

(Autonomous)
Affiliated to Bharathiar University,
Coimbatore
Approved by UGC and AICTE, New Delhi
Re-accredited by NAAC, DBT STAR College Scheme
An ISO 9001 : 2015 Certified Institution
Nanjanapuram, Erode - 638 107

KONGU
*Assuring the Best*

0

# CONTENTS

# SENTIMENT ANALYSIS USING PYTHON

## What is sentiment analysis?

Sentiment Analysis is the process of 'computationally' determining whether a piece of writing is positive, negative or neutral. It's also known as opinion mining, deriving the opinion or attitude of a speaker.

## Why sentiment analysis?

- **Business:** In marketing field companies use it to develop their strategies, to understand customers' feelings towards products or brand, how people respond to their campaigns or product launches and why consumers don't buy some products.
- **Politics:** In political field, it is used to keep track of political view, to detect consistency and inconsistency between statements and actions at the government level. It can be used to predict election results as well!
- **Public Actions:** Sentiment analysis is also used to monitor and analyse social phenomena, for the spotting of potentially dangerous situations and determining the general mood of the blogosphere.

## Installation

- **Tweepy:** tweepy is the python client for the official Twitter API. Install it using following pip command:
  pip install tweepy
- **TextBlob:** textblob is the python library for processing textual data. Install it using following pip command:
  pip install textblob Also, we need to install some NLTK corpora using following command:
  python -m textblob.download_corpora
  (Corpora is nothing but a large and structured set of texts.)

## Authentication

In order to fetch tweets through Twitter API, one needs to register an App through their twitter account. Follow these steps for the same:

- Open this link and click the button: 'Create New App'.
- Fill the application details. You can leave the callback url field empty.
- Once the app is created, you will be redirected to the app page.
- Open the 'Keys and Access Tokens' tab.
- Copy 'Consumer Key', 'Consumer Secret', 'Access token' and 'Access Token Secret'.

**M.BHAVAN**
**III B.Sc. (Computer Technology)**

## HOW AUGMENTED REALITY & ARTIFICIAL INTELLIGENCE WILL CHANGE EVERYTHING



Ten years from today, the center of our digital lives will no longer be the smart phone, but device that looks like ordinary eyeglasses: except those glasses will have settings for Virtual and Augmented Reality. What you really see and what is computer generated will be mixed so tightly together, that we won't really be able to tell what is real and what is illusion.

Instead of touching and sliding on a mobile phone, we will make things happen by moving our eyes or by brainwaves. When we talk with someone or play an online game, we will see that person in the same room with us. We will be able to touch and feel her or him through haptic technology. We won't need to search online with words, because there will be a new Visual Web 100 times larger than the current Internet, and we will find things by images, buy things by brands, or just by looking at a logo on the jacket of a passerby. Language will be irrelevant and a merchant in a developing world will have access to global markets.

Medical devices will cure schizophrenia, allow quadriplegics to walk. People will be able to touch and feel objects and other people who are not actually there for conversations, games and perhaps intimate experiences. From Kindergarten to on-the-job, learning will become experiential. Children will visit great battlefields and tour historic places in VR rather than read about them in text books. Med students and surgeons will learn and practice on virtual humans rather than cadavers; oil rig workers will understand how to handle emergencies, before the ever leave the home office. The Fourth Transformation is based on two years of research and about 400 interviews with technologists and business decision makers. It explains the technology and product landscape on a level designed to be interesting and useful to business thinkers and general audiences. Mostly it talks about how VR and AR are already being used, or will be used in the next one-to-three years. It explains how this massive and fundamental transformation will be driven, nit just by Millennials, but by the generation following them, which the authors have named the Minecraft Generation.

**R.JANANI**

**II B.Sc. (Computer Technology)**

## DEV BOARD FOR IMPROVED MACHINE LEARNING

Built by Google for accelerating neural network, the dev board allows faster inferencing and deployment of low-power embedded systems.



Dev Boards are fascinating hardware pieces. They come with great power and save us time in building complex electronic circuits. That's a big relief for faster time-to-market of a product. In this age of rapid advancements around machine learning (ML), every second counts in introducing a new product that can solve existing and new challenges.

With this objective, Coral has introduced a new development board called the Coral Dev Board Micro. The soon to be launched development platform combines Cortex M4 and M7 processors with the Coral Edge TPU for ML inferencing ranging from low-power to complex.

Along with a built-in camera and microphone, the Coral Dev Board Micro allows quick prototyping and deployment of low-power embedded systems built for ML

inferencing. The dev board supports TensorFlow Lite and TensorFlow Lite for Microcontrollers.

### Tech Features

- MCU – NXP i.MX RT1176 (Cortex-M7 and Cortex-M4)
- ML accelerator – Coral Edge TPU coprocessor: 4 TOPS (int8); 2 TOPS per watt
- RAM – 512 Mbit
- Flash memory – 1 Gbit
- Sensors – Colour camera (324 x 324 px); PDM mono microphone
- I/O – (2x) 12-pin GPIO header; (2x) 100-pin board-to-board connectors; USB Type-C (USB 2.0)

### More On Coral Technology

Built by Google for accelerating neural network inferencing at a low cost, the Coral Edge TPU coprocessor is a small ASIC capable of performing 4 trillion operations (tera-operations per second or TOPS) using 0.5 watts for each TOPS (i.e. 2 TOPS per watt).

The Edge TPU supports various model architectures built with TensorFlow, including models built with Keras. So no additional APIs are required to build or run your model; only a small runtime package can execute your model to the Edge TPU.

For easing product development via the Dev Board and System-on-Module, Google has

created a derivative of Debian Linux called Mendel. Besides offering a huge range of customisations, Mendel also includes various tools for building ML applications, including standard Python and C++ libraries, the Edge TPU API, and the Edge TPU runtime. The Mendel Development Tool (MDT) enables secure connection (using SSH/mDNS), file transfers and other commands from a remote computer.

Other highlights of the Coral technology include co-compiling the ML models for running them simultaneously and model pipelining for executing different segments of the same model on different Edge TPUs.

Coral by Google has made its code open-source so that everyone can collaborate and contribute. It is working with other machine learning teams to help build the next generation of neural networks for faster inferencing in low-power devices.

**B.THARNIKA**
**II B.Sc. (Information Technology)**

◆•••••••••••••••••••••••••••••••••◆

# XIAOMI SETS NEW STANDARDS FOR IOT DEVICE SECURITY

Xiaomi has published a new set of proposed global standards to support and reassure consumers about the security of their data while using IoT products.



The guideline entitled "Cyber Security Baseline for Consumer Internet of Things Device Version 2.0" aims to protect security and user privacy with a comprehensive set of requirements covering guidelines from device hardware, device software to device communication. It also states the requirements on data security and privacy, which include communication security, authentication and access control, secure boot, data deletion, etc. It is a security baseline that all Xiaomi smart devices should follow.

The guideline of Xiaomi meets the need of the consumer IoT industry as there is no such general standard that can be publicly queried and implemented. Now companies can use this guide to avoid some basic security and

privacy protection risks, and to quickly improve the security and privacy protection capabilities of their IoT products.

Xiaomi said it aimed to expand its cybersecurity credentials after its WiFi 6-enabled mesh system received the BSI IoT Kitemark certification. Cui Baoqiu, Xiaomi vice president and chairman of the company's security and privacy committee said the security and privacy of users is a top priority "and we promise that this applies to all markets where we operate," he said.

**N.R.SHARMILA**
**III B.Sc. (Information Technology)**

◆••••••••••••••••••••••••••••••◆

## MICROSOFT PARTNERS WITH NASA TO TAKE QUANTUM COMPUTING INTO SPACE

Microsoft had recently unveiled its partnership with the US space agency NASA to help coordinate with its spacecraft in a blog post.



"As NASA launches more frequent and complex missions into space, managing communications with the growing number of spacecraft is becoming increasingly challenging. NASA's Jet Propulsion Laboratory (JPL) has turned to Azure Quantum to explore ways to communicate more efficiently with spacecraft exploring our solar system and beyond."

JPL communicates with space missions through the Deep Space Network (DSN), a global network of large radio antennae located in California, Spain, and Australia that allows constant communication with spacecraft as the earth rotates.

The Azure Quantum team had developed a solution for a version of JPL's scheduling problem with a limited feature set with the eventual goal to incorporate a broader set of requirements. This is intended to reduce the need for lengthy negotiations and speed up the overall process.

At the beginning, the Microsoft team has recorded runtimes of two hours or more to produce a schedule.

By applying quantum-inspired optimisation algorithms, the Microsoft team used Azure Quantum to reduce the time needed to 16 minutes, and a custom solution reduced it to about two minutes. Schedules that are produced in minutes rather than hours not only allow JPL to create many candidate schedules

but also allow the organisation to be more agile as missions and demands increase.

**G.AAKASH**
**I B.Sc. (Information Technology)**

◆••••••••••••••••••••••••••••••◆

## BLE SoC ENABLED DEVELOPMENT KIT FOR RAPID APPLICATION DEVELOPMENT

TMicroelectronics' evaluation platform consists of its BlueNRG-2, BLE System-on-Chip (SoC) for better power efficiency. The board simplifies integration of the BlueNRG-M2SA module with STSW-BNRG-MESH software.

STMicroelectronics introduces the STEVAL-IDB008V1M Bluetooth Low Energy 5.0 (BLE) evaluation platform for accelerating application development with modules featuring BlueNRG-2, the company's second-generation BLE System-on-Chip (SoC).
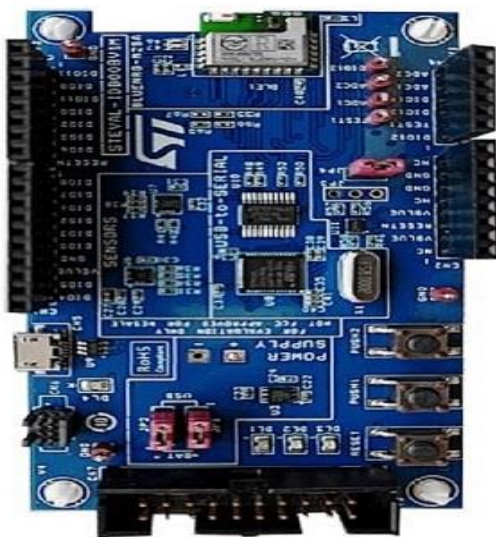


BlueNRG-2 supports the Bluetooth 5.0 certification, which allows enhanced security with LE Secure Connections, power-efficient privacy with Link Layer Privacy 1.2 and up to 2.6-times higher throughput with LE Data Length Extension. The SoC contains an Arm Cortex-M0 core operating at up to 32MHz to handle the Bluetooth stack and application processing, and integrates new features including a 32kHz ring oscillator, 24KB RAM and 256KB Flash program memory. A decreased standby power is a further allows drawing just 0.9µA in sleep mode with active Bluetooth stack and full RAM retention.

The BlueNRG-M2SA module combines a compact 13.5mm x 11.5mm form factor BlueNRG-2 SoC with an efficient ceramic antenna, RF balun circuit and 32 kHz crystal oscillator and SMPS inductor to further reduce power consumption. The module greatly reduces engineering costs and enables designers to create wireless devices with minimal radio-frequency engineering expertise. BlueNRG-M2SA is qualified as a Bluetooth End Product which relieves customers of additional testing to complete their own product qualification.

The STEVAL-IDB008V1M plug-and-play kit enables rapid evaluation and product development using the BlueNRG-M2SA module. The board combines the BlueNRG-M2 module with sensors including a MEMS pressure and temperature sensor and motion

sensors suitable for 9-axis sensor-fusion library. There is also a low-latency, low-power ADPCM codec, ready to use with BlueVoice middleware for voice over BLE streaming. Arduino R3 connectors are provided, which allow access to all the module's peripherals and enable users to further extend functionality by adding expansion shields. The associated development-software package, STSW-BLUENRG1-DK, contains a simple and intuitive BlueNRG-Navigator GUI (Graphical User Interface) that lets users design applications without an external programmer or hardware.

The kit also simplifies integration of the BlueNRG-M2SA module with ST's STSW-BNRG-MESH software to explore emerging application opportunities in industrial and smart-building markets. STSW-BNRG-MESH implements the Bluetooth SIG Mesh Profile v1.0 for facilitating two-way communication and range-extending mesh networks, with cyber-security with integrated features of the BlueNRG-2 SoC.

With an operating temperature range of -40 degress Celsius to 85 degrees Celsius and 5dBm RF output power, the BlueNRG-M2SA module can be powered directly with a pair of AAA batteries or any power source from 1.7 to 3.6 V. BlueNRG-M2SA is well suited for industrial applications.

The modules are pre-certified according to US FCC, Canadian IC, European RED, Japan TYPE radio-equipment regulations and will also meet China SRCC requirements. The STEVAL-IDB008V1M evaluation kit is available now.

**R.SHOBIKA**
**III B.Sc. (Computer Technology)**

◆•••••••••••••••••••••••••••••◆

## WORLD'S FIRST MEMS MICROSPEAKER FOR INTELLIGENT AUDIO PRODUCTION

Its DynamicVent technology enables benefits of True MEMS speaker and DynamicVent in a single silicon die.

The Montara Pro by xMEMS Labs is the world's first monolithic MEMS μspeaker that enables smart TWS earbuds and hearing aids to become intelligent closed-fit (occluded) and open-fit earbuds based on ambient noise levels detected by microphones or movement from motion sensors.

Thanks to the integrated DynamicVent technology, Montara Pro eliminates the background noise to create a listening environment with the best passive isolation for music and media when the vent is closed. With the vent open, Montara Pro improves spatial awareness, increases listening comfort and reduces occlusion effects, such as the perception of the user's voice being too loud, "boomy" or "hollow".

The DynamicVent technology also eliminates traditional static vents that create a persistent low-frequency roll-off. This effect generally impacts music and media quality and also consumers with low-frequency hearing loss. The DynamicVent can also eliminate the need for oversized speakers in earbuds that are commonly used to compensate for low-frequency loss caused by persistent, static vents.

The DynamicVent technology implements a differential design that eliminates open/close noise. The large vent opening creates relief equivalent to a 1.5 mm2 hole and offers 20dB of attenuation from 500Hz to 20Hz. Unlike other non-MEMS approaches to active venting, the DynamicVent achieves an IP58 rating, providing better resilience to particulate and moisture ingress and improving the longevity of the end-product.

"Achieving the highest quality sound reproduction remains job one, but now with DynamicVent technology we enable system designers to balance the benefits of open and closed-fit earbud architectures that lead the way to more intelligent and higher-performance solutions for consumers in a variety of listening environments," said Dr Chiung Lo, xMEMS Co-Founder and VP of Design.

"In the past, trade-offs had to be made when selecting either an open-fit/vented or closed-fit/occluded implementation. Neither choice provided the best listening performance in all environments and life situations," said Dr Abram Bailey, AuD. and CEO of Hearing Tracker, Inc. "The emergence of active venting technologies, like DynamicVent, is a windfall for both consumers and hearing care professionals, eliminating trade-offs and enabling consumer audio products and listening performance that can adapt to any environment."

Montara Pro's μspeaker delivers a flat frequency response, achieving 115dB SPL up to 1kHz and providing up to 18dB of gain above 1kHz for improved voice and instrument clarity. Montara Pro is a monolithic, single-die architecture implementing both the speaker and the DynamicVent in silicon that results in unmatched part-to-part frequency response consistency and reduced speaker matching or calibration time at manufacturing.

This innovative transduction mechanism has also eliminated spring and suspension recovery of coil speakers which has improved audio quality and sound field reproduction. Montara Pro is available in a side-firing (5.15 x 1.15 x 10.8mm) LGA package. Montara Pro is paired with the xMEMS Aptos Class-H audio amplifier (1.92 x 1.92 x 0.6mm WLCSP).

**D.UDHAYAKUMAR**

**II B.Sc. (Computer Technology)**

◆ . . . . . . . . . . . . . . . . . . . . . . . . . . . . ◆

## GRAPHENE-BASED MEMORY RESISTORS ORBRAIN-BASED COMPUTING

As progress in traditional computing slows, new forms of computing are coming to the forefront. At Penn State, a team of engineers is attempting to pioneer a type ofcomputing that mimics the efficiency of the brain's neural networks while exploiting the brain's analog nature. Modern computing is digital, made up of two states, on-off or oneand zero. An analog computer, like the brain, has many possible states. It is the difference between flipping a light switch on or off and turning a dimmer switch to varying amounts of lighting.

Neuromorphic or brain-inspired computing has been studied for more than 40 years, according to Saptarshi Das, the team leader and Penn State assistant professor of engineering science and mechanics. What's new is that as the limits of digital computing have been reached, the need for high-speed image processing, for instance for self-driving cars, has grown. The rise of big data which requires types of pattern recognition for which the brain architecture is particularly well suited is another driver in the pursuit of neuromorphiccomputing.

The shuttling of this data from memory to logic and back again takes a lot of energy and slows the speed of computing. In addition, this computer architecture requires a lot of space. If the computation and memory storage could be located in the same space, this bottleneck could be eliminated. "We are creating artificial neural networks, which seek to emulate the energy and area efficiencies of the brain," explained Thomas Shranghamer, a doctoral student in the Das group and first author on a paper recently published in Nature Communications. "The brain is so compact it can fit on top of your shoulders, whereas a modern supercomputer takes up a



Image courtsey of Dr. Stephen Hanson, RUBIC, Psychology, Rutgers-Newark
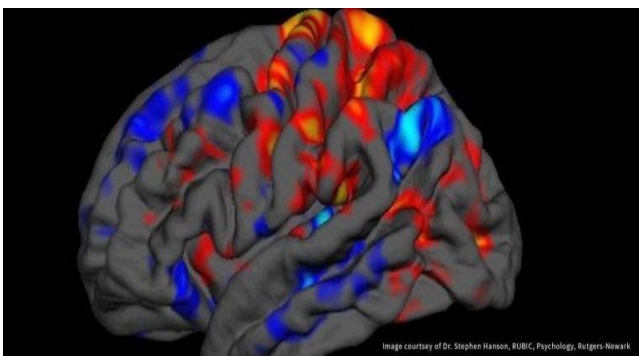
space thesize of two or three tennis courts."

Like synapses connecting the neuronsin the brain that can be reconfigured, the artificial neural networks the team is building can be reconfigured by applying a brief electric field to a sheet of graphene, the one-atomic-thick layer of carbon atoms. In this work they show at least 16 possible memory states, asopposed to the two in most oxide-based memristors, or memory resistors. The team thinks that ramping up this technology to a commercial scale is feasible. With many of the largest semiconductor companies actively pursuing neuromorphic computing. The Army Research Office supported this work. The team has filed for a patent on this invention.

<div align="right">

**S. GOKUL RAJ**

**I B.Sc. (Computer Technology)**

</div>

◆•••••••••••••••••••••••••••••◆

## IT SECURITY: COMPUTER ATTACKS WITH LASER LIGHT
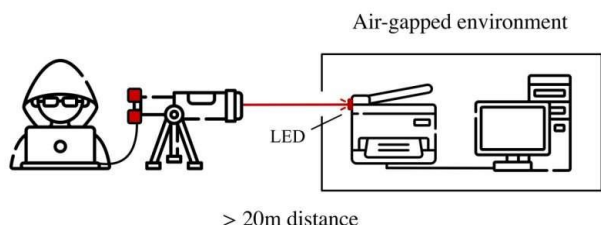


Computer systems that are physically isolated from the outside world (air-gapped) can still be attacked. This is demonstrated by IT security experts of the Karlsruhe Institute of Technology (KIT) in the LaserShark project. They show that data can be transmitted to light-emitting diodes of regular office devices using a directed laser. With this, attackers can secretly communicate with air-gapped computer systems over distances of several meters. In addition to conventional information and communication technology security, critical IT systems need to be protected optically as well.

Hackers attack computers with lasers. This sounds like a scene from the latest James Bond movie but it actually is possible in reality. Early December 2021, researchers of KIT, TU Braunschweig, and TU Berlin presented the LaserShark attack at the 37th Annual Computer Security Applications Conference (ACSAC). This research project focuses on hidden communication via optical channels. Computers or networks in critical infrastructures are often physically isolated to prevent external access. "Air-gapping" means that these systems have neither wired nor wireless connections to the outside world. Previous attempts to bypass such protection via electromagnetic, acoustic, or optical channels merely work at short distances or low data rates. Moreover, they frequently allow for data exfiltration only, that is, receiving data.
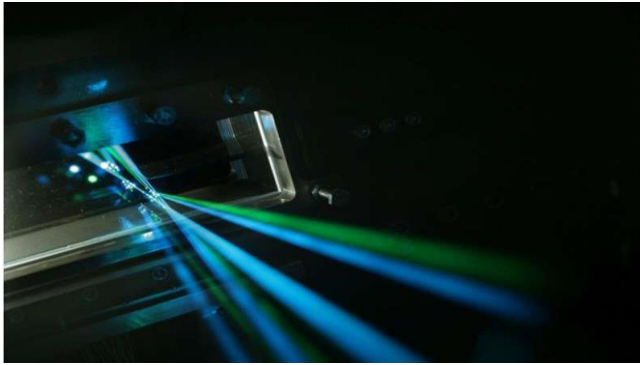
The Intelligent System Security Group of KASTEL Institute of Information Security and Dependability of KIT, in cooperation with researchers from TU Braunschweig and TU Berlin, have now demonstrated a new attack: With a directed laser beam, an adversary can introduce data into air-gapped systems and retrieve data without additional hardware on-side at the attacked device. "This hidden optical communication uses light-emitting diodes already build into office devices, for instance, to display status messages on printers or telephones," explains Professor Christian Wressnegger, Head of the Intelligent System Security Group of KASTEL. Light-emitting diodes (LEDs) can receiving light, although they are not designed to do so.

**Data are transmitted in both directions**

By directing laser light to already installed LEDs and recording their response, the researchers establish a hidden communication channel over a distance of up to 25 m that can be used bidirectionally (in both directions). It reaches data rates of 18.2 kilobits per second inwards and 100 kilobits per second outwards. This optical attack is possible in commercially available office devices used at companies, universities, and authorities. "The LaserShark project demonstrates how important it is to additionally protect critical IT systems optically next to conventional information and communication technology security measures," Christian Wressnegger says.

**B.THARANIKA**

**II B.Sc. (Information Technology)**

◆•••••••••••••••••••••••••••••◆

## ARTIFICIAL INTELLIGENCE NETWORKS

Researchers at the University of Surrey have successfully demonstrated proof-of-concept of using their multimodal transistor (MMT) in artificial neural networks which mimic the human brain. This is an important step towards using thin-film transistors as artificial intelligence hardware and moves edge computing forward, with the prospect of reducing power needs and improving efficiency, rather than relying solely on computer chips.

The MMT, first reported by Surrey researchers in 2020, overcomes long-standing challenges associated with transistors and can perform the same operations as more complex circuits. This latest research, published in the peer-reviewed journal Scientific Reports, uses mathematical modelling to prove the concept

of using MMTs in artificial intelligence systems, which is a vital step towards manufacturing.

Using measured and simulated transistor data, the researchers show that well-designed multimodal transistors could operate robustly as rectified linear unit-type (ReLU) activations in artificial neural networks, achieving practically identical classification accuracy as pure ReLU implementations. They used both measured and simulated MMT data to train an artificial neural network to identify handwritten numbers and compared the results with the built-in ReLU of the software. The results confirmed the potential of MMT devices for thin-film decision and classification circuits. The same approach could be used in more complex AI systems.

Unusually, the research was led by Surrey undergraduate Isin Pesch who worked on the project during the final year research module of her BEng (Hons) in Electronic Engineering with Nanotechnology. Covid meant she had to study remotely from her home in Turkey, but she still managed to spearhead the development, complemented by an international research team, which also included collaborators in the University of Rennes, France and UCL, London.

Isin Pesch, lead author of the paper, which was written before she graduated in July 2021, said:

"There is a great need for technological improvements to support the growth of low cost, large area electronics which were shown to be used in artificial intelligence applications. Thin-film transistors have a role to play in enabling high processing power with low resource use. We can now see that MMTs, a unique type of thin-film transistor, invented at the University of Surrey, have the reliability and uniformity needed to fulfil this role."

Dr Radu Sporea, Senior Lecturer at the University of Surrey's Advanced Technology Institute, said:"These findings are a reminder of how Surrey is a leader in AI research. Many of my colleagues focus on people-centred AI and how best to maximise the benefits for humans, including how to apply these new concepts ethically. Our research at the Advanced Technology Institute takes forward the physical implementation, as a stepping stone towards powerful yet affordable next-generation hardware. It's fantastic that collaboration is resulting in such successes with researchers involved at all levels, from undergraduates like Isin when she led this research, to seasoned experts."

**J.KAVIYA SHREE**
**I B.Sc. (Information Technology)**

# BIG ADVANCES IN QUANTUM COMPUTING

Like the transistors in a classical computer, superconducting qubits are the building blocks of a quantum computer. While engineers have been able to shrink transistors to nanometer scales, however, superconducting qubits are still measured in millimeters. This is one reason a practical quantum computing device couldn't be miniaturized to the size of a smartphone, for instance.

MIT researchers have now used ultrathin materials to build superconducting qubits that are at least one-hundredth the size of conventional designs and suffer from less interference between neighboring qubits. This advance could improve the performance of quantum computers and enable the development of smaller quantum devices.

The researchers have demonstrated that hexagonal boron nitride, a material consisting of only a few monolayers of atoms which can be stacked to form the insulator in the capacitors on a superconducting qubit. This defect-free material enables capacitors that are much smaller than those typically used in a qubit, which shrinks its footprint without significantly sacrificing performance.

In addition, the researchers show that the structure of these smaller capacitors should greatly reduce cross-talk, which occurs when one qubit unintentionally affects surrounding qubits.

"Right now, we can have maybe 50 or 100 qubits in a device, but for practical use in the future, we will need thousands or millions of qubits in a device. So, it will be very important to miniaturize the size of each individual qubit and at the same time avoid the unwanted cross-talk between these hundreds of thousands of qubits. This is one of the very few materials we found that can be used in this kind of construction," says co-lead author Joel Wang, a research scientist in the Engineering Quantum Systems group of the MIT Research Laboratory for Electronics.

Wang's co-lead author is Megan Yamoah '20, a former student in the Engineering Quantum Systems group who is currently studying at Oxford University on a Rhodes Scholarship. Pablo Jarillo-Herrero, the Cecil and Ida Green Professor of Physics, is a corresponding author, and the senior author is William D. Oliver, a professor of electrical engineering and computer science and of physics, an MIT Lincoln Laboratory Fellow, director of the Center for Quantum Engineering, and associate director of the Research Laboratory of Electronics. The research is published today in Nature Materials.

## Qubit quandaries

Superconducting qubits, a particular kind of quantum computing platform that uses

superconducting circuits, contain inductors and capacitors. Just like in a radio or other electronic device, these capacitors store the electric field energy. A capacitor is often built like a sandwich, with metal plates on either side of an insulating, or dielectric, material.

But unlike a radio, superconducting quantum computers operate at super-cold temperatures less than 0.02 degrees above absolute zero (-273.15 degrees Celsius) and have very high-frequency electric fields, similar to today's cellphones. Most insulating materials that work in this regime have defects. While not detrimental to most classical applications, when quantum-coherent information passes through the dielectric layer, it may get lost or absorbed in some random way.

"Most common dielectrics used for integrated circuits, such as silicon oxides or silicon nitrides, have many defects, resulting in quality factors around 500 to 1,000. This is simply too lossy for quantum computing applications," Oliver says.

To get around this, conventional qubit capacitors are more like open-faced sandwiches, with no top plate and a vacuum sitting above the bottom plate to act as the insulating layer.

"The price one pays is that the plates are much bigger because you dilute the electric field and use a much larger layer for the

vacuum," Wang says. "The size of each individual qubit will be much larger than if you can contain everything in a small device. And the other problem is, when you have two qubits next to each other, and each qubit has its own electric field open to the free space, there might be some unwanted talk between them, which can make it difficult to control just one qubit. One would love to go back to the very original idea of a capacitor, which is just two electric plates with a very clean insulator sandwiched in between."

They thought hexagonal boron nitride, which is from a family known as van der Waals materials (also called 2D materials), would be a good candidate to build a capacitor. This unique material can be thinned down to one layer of atoms that is crystalline in structure and does not contain defects. Researchers can then stack those thin layers in desired configurations.

To test hexagonal boron nitride, they ran experiments to characterize how clean the material is when interacting with a high-frequency electric field at ultracold temperatures and found that very little energy is lost when it passes through the material.

"Much of the previous work characterizing hBN (hexagonal boron nitride) was performed at or near zero frequency using DC transport measurements. However, qubits operate in the gigahertz regime. It's great to see

that hBN capacitors have quality factors exceeding 100,000 at these frequencies, amongst the highest Qs I have seen for lithographically defined, integrated parallel-plate capacitors," Oliver says.

## Capacitor construction

They used hexagonal boron nitride to build a parallel-plate capacitor for a qubit. To fabricate the capacitor, they sandwiched hexagonal boron nitride between very thin layers of another van der Waals material, niobium dieseline.

The intricate fabrication process involved preparing one-atom-thick layers of the materials under a microscope and then using a sticky polymer to grab each layer and stack it on top of the other. They placed the sticky polymer, with the stack of 2D materials, onto the qubit circuit, then melted the polymer and washed it away.

Then they connected the capacitor to the existing structure and cooled the qubit to 20 millikelvins (-273.13 C).

"One of the biggest challenges of the fabrication process is working with niobium diselenide which will oxidize in seconds if it is exposed to the air. To avoid that, the whole assembly of this structure has to be done in what we call the glove box, which is a big box filled with argon, which is an inert gas that contains a very low level of oxygen. We have to do everything inside this box," Wang says.

The resulting qubit is about 100 times smaller than what they made with traditional techniques on the same chip. The coherence time, or lifetime, of the qubit is only a few microseconds shorter with their new design. And capacitors built with hexagonal boron nitride contain more than 90 percent of the electric field between the upper and lower plates, which suggests they will significantly suppress cross-talk among neighboring qubits, Wang says. This work is complementary to recent research by a team at Columbia University and Raytheon.

In the future, the researchers want to use this method to build many qubits on a chip to verify that their technique reduces cross-talk. They also want to improve the performance of the qubit by finetuning the fabrication process, or even building the entire qubit out of 2D materials.

"Now we have cleared a path to show that you can safely use as much hexagonal boron nitride as you want without worrying too much about defects. This opens up a lot of opportunity where you can make all kinds of different heterostructures and combine it with a microwave circuit, and there is a lot more room that you can explore. In a way, we are giving people the green light you can use this material in any way you want without worrying too

much about the loss that is associated with the dielectric," Wang says.

**S.P. VISHVA**

**III B.Sc. (Information Technology)**

◆ • • • • • • • • • • • • • • • • • • • • • • • • • • • • ◆

## IMAGE SENSOR WITH SMALLEST PIXEL SIZE FOR HIGH END SMARTPHONES

The high resolution image sensor has great features that allows better preview and video quality even in low-light conditions.

OMNIVISION, one of the leading developers of semiconductor solutions, including advanced digital imaging, analogue and touch & display technology has launched the world's smallest 200MP image sensor with pixel size at just 0.61 µm for smartphone cameras.



The unique 16-cell binning of the OVB0B delivers 4K2K video quality in 12.5MP mode with 2.44 µm-equivalent pixel size using near pixel 4×4 binning, especially in low light. The OVB0B is the first 200MP to offer 100% quad phase detection (QPD) technology for excellent fast autofocus performance.

"Consumers want high resolution captures and high-quality preview and video. As the image sensor technology leader, we have applied our PureCel Plus-S stacked die technology to dramatically push mobile main cameras to a new level," said Arun Jayaseelan, staff marketing manager at OMNIVISION. "With the new OVB0B, we now offer the industry's highest resolution in a small package for high-end smartphones along with the best low-light performance in its class."

An on-chip remosaic enables 50MP at 24 frames per second (fps) and 8k video at 30

fps with 1.22 μm-equivalent performance. The OVB0B can also output 12.5MP at 30 fps with 3-exposure staggered HDR timing. The OVB0B supports CPHY, DPHY and dual DOVDD (1.8V and 1.2V).

"The introduction of 200MP image sensor products for smartphone cameras promises to capture stunning details within images, meeting the needs of smartphone vendors who are aggressively looking to differentiate their devices with enhanced cameras that feature high-resolution image sensors. We estimate more than 40 million image sensors with 100MP+ resolution are expected to be shipped to smartphone vendors in 2022," says Jeffrey Mathews, Senior Analyst at Strategy Analytics.
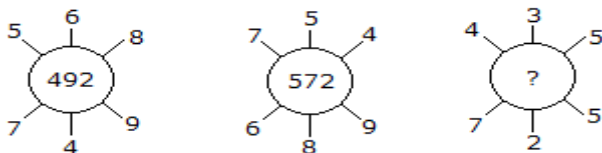
<div align="right">

**M.NAVEEN**

**II B.Sc. (Computer Technology)**

</div>

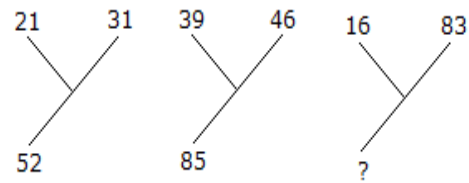◆ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ◆

## VERBAL REASONING : CHARACTER PUZZLES

1.Which one will replace the question mark?



A.115

**B.130**
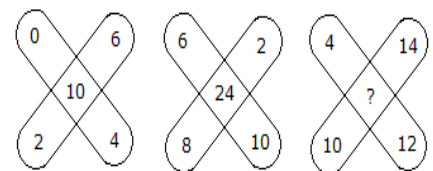
C.135

D.140

2.Which one will replace the question mark ?



A.92

B. 72

C. 62

**D.99**

3.Which one will replace the question mark?

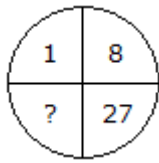| 18 | 24 | 32 |
|----|----|----|
| 12 | 14 | 16 |
| 3 | ? | 4 |
| 72 | 112 | 128 |

A.2

**B.3**

C.4

D.5

4. Which one will replace the question mark ?



A.36

B.48

**C.38**

D.30

17

5. Which one will replace the question mark ?



A.41

**B.64**

C.35

D.61

**K.SATHYA**

**I B.Sc. (Information Technology)**

◆• • • • • • • • • • • • • • • • • • • • • • • • • • • •◆

**THE GREAT MYTH OF OUR TIMES IS THAT TECHNOLOGY IS COMMUNICATION**

**- LIBBY LARSON**