VOL 4 | ISSUE 2 | JULY 2019

MECHZINE

GET TO KNOW THE WORLD !

GRAVITY JET SUIT… The Next Frontier In Human Flight

A STUDENT INITIATIVE TECHNICAL MAGAZINE

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Alumni Article

How Automotive HMI Solutions are Transforming in-Vehicle Experiences

- Surya Teja K, Sr. Industrial Designer, ZF Automotive, Germany

All the modern day vehicles are equipped with different sorts HMI technologies. Innovation in connectivity solutions, low cost HMI software and enhanced UX has increased its demand in the auto market. Their sophistication, applications, and features keeps on adding as we move up in the economic segments of the cars. Human- Machine interfaces in automotive environment are incorporated in every possible touch point and assists driver and passengers to control infotainment, connectivity solutions and ADAS applications.

The product wise installation of the automotive HMI solutions in a vehicle:

HEADS-UP DISPLAY:

HMI through heads up display (HUD) displays information directly in the driver's line of sight and enable driver to intuitively access vehicle's infotainment system. HUD is considered as key interface to control all the functions of the vehicle like media, connectivity, navigation, parking assistance, entertainment, smart-phone integration etc. Latest HMI for HUD use OLED display technology for virtual dashboards with curved screen.

REAR SEAT ENTERTAINMENT SYSTEMS:

Rear Seat Entertainment displays are passenger based automotive HMI solutions with high clarity. Latest rear seat systems supports in-car entertainment like movies, games, music, apple car-play, Android Auto, navigation etc.

STEERING BASED CONTROLS:

Steering wheel based HMI solutions enables driver to automate the process of driving to some extent. Intuitive steering wheel uses touch technology to react to touch or tap by the driver to manage functions like volume, call connect, hands free etc. It also manages gesture control to detect whether vehicle is in driver's control or not.

DIGITAL INSTRUMENT CLUSTERS

In-vehicle digital cockpit with digital instrument clusters are in great demand in high-end vehicles. Digital instrument clusters include speedometers, tachometer, function displays, route planning graphics, display video feeds from vehicle cameras etc. HMI of the instrument clusters can be personalized as per user's requirement and helps in managing driving information like speed, fuel level, trip, temperature, air vent control and more.

VOICE RECOGNITION AND VOICE GUIDANCE:

Voice Assistants and Voice-Guided Interfaces are in huge demand as they reduce driver distractions and provide advanced comfort and convenience features in the vehicle. Companies like Apple and Google with their in-car applications like apple car-play and google android auto helps drivers to find directions, send emails, make phone calls, and play music, all by using voice recognition and voice guidance systems.

➢ ADVANTAGES OF AUTOMOTIVE HMI SOLUTIONS:

The automotive HMI solutions are evolving very fast to provide unprecedented experience to the driver and passengers. Here are some of the advantages of automotive HMI solutions:

IMPROVED INVEHICLE EXPERIENCE

Automotive HMI solutions provide improved in vehicle experience by enabling drivers to interact with the outer environment via touch-screen, head unit, three dimensional heads up display, instrument clusters, steering push buttons, control panels, and advanced infotainment systems.

MULTIMODAL HMI SOLUTIONS

Multi-modal HMI solutions allow drivers to simultaneously manage in-vehicle functions and prioritize information to reduce the driver's efforts while driving. Multi-modal interfaces along with ML capabilities helps in dealing with vehicular functionalities through visual display systems, face and gesture recognition, voice recognition, surface and mid-air haptics and more.

KEY TO AUTONOMOUS DRIVING:

A highly sophisticated HMI solution helps in achieving features of autonomous driving and take control on some of the applications of the vehicle while driving. Automotive HMI helps in surround view parking, object recognition and detection, notify driver in case of distraction, improves safety by interacting with other vehicles, and objects around the vehicle.

- **FUTURE OF AUTOMOTIVE HMI:**

HAPTICS TECHNOLOGY:

Driver distraction is a big issue while driving and automotive companies are coming up with innovative technologies to minimize the same. Most of the companies are using capacitive touch screens, buttons and knobs in in-vehicle HMI applications, which do not generate tactile feedback to the driver. This leads in driver's distraction while visually confirming if the given input is accepted or not. This is where haptics technology comes into picture. When integrated with in-vehicle devices, haptics provides tactile feedback or a sense of touch into human-machine interfaces.

For instance, if driver want to change the radio station while driving, with capacitive HMI technology he will be just touching the glass, and will have to look and confirm whether the radio station has changed or not. While, automotive HMI solutions based on haptics generate gesture and pressure driven tactile response and provide acknowledgement to the driver on his action to change the radio station. Haptics is a sensory thing; it eliminates the habit of visual check of the actions given to HMI interfaces and reduces driver distraction while driving. Haptics signals (particularly for ADAS) are very personalized and transmitted just for the driver to sense and act. Its quick reaction time, connectivity and sense of control has made it a trending technology, which has great acceptance in the automotive HMI market.

Inventions That Changed the World

Lightbulb: The light we use today in our homes and offices comes from a bright idea from more than 150 years ago. Electric lights were pioneered in the early 19th century by Humphry Davy, who experimented with electricity and invented an electric battery. When he connected wires between his battery and a piece of carbon, the carbon glowed, producing light. His invention was known as the electric arc lamp. Over the next seven decades, other inventors also created "lightbulbs" but these were not capable of commercial application. In 1850 an English physicist named Joseph Wilson Swan created a "light bulb" by enclosing carbonized paper filaments in an evacuated glass bulb. But without a good vacuum, his bulb had too short a lifetime for commercial use. However, in the 1870's, better vacuum pumps became available and Swan was able to develop a longer-lasting lightbulb. Thomas A. Edison improved on Swan's design by using metal filaments and in 1878 and 1879 he filed patents for electric lights using different materials for the filament. He eventually discovered that a carbonized bamboo filament could last over 1200 hours. This discovery made commercially manufactured light bulbs feasible, and in 1880, Edison's company, Edison Electric Light Company began marketing its new product.

Battery

The prehistoric battery may date back to the Parthian empire, which is around 2,000 years old. The ancient battery consisted of a clay jar filled with a vinegar solution, into which an iron rod surrounded by a copper cylinder was inserted. These batteries might have been used to electroplate silver. But, as mentioned in the previous entry, the inventor of the first electric battery is Alessandro Volta, who developed the pile battery. After that, in 1802, William Cruickshank invented the Trough battery, an improvement on Alessandro Volta's voltaic pile. Batteries had a breakthrough in 1859, with the invention of the first rechargeable battery based on lead-acid by the French physician Gaston Plante. The Nickel-Cadmium (NiCd) battery was introduced in 1899 by Waldemar Jungner.

Alumni Article

TOP OF THE BEST MECHANICAL ENGINEERING SOFTWARE

- Venkata Krishna Reddy, Asst. Manager at thermax

3D modeling software is now an essential tool for a lot of industries. Engineers and designers are actually making the most of these advanced software tools, useful for many applications, from simulation to manufacturing. There are many software solutions with advanced features that will allow you to work on really technical projects. Here is the selection of the best software to work with for your next mechanical engineering projects. Find out all the modeling and design tools that you need.

KeyCreator: KeyCreator is a geometry centered 3D modeling software tool, perfect to create your 3D design concepts. KeyCreator offers direct CAD modeling, 2 and 3 axis machining and a flexible design strategy. You can both work on 2D and 3D projects with this CAD program in order to design engineering projects. This software tool has 3 different versions: Standard, Pro or Max, all offering different features.

CATIA: Catia is a professional software tool developed by Dassault Systèmes. Mostly used for aerospace projects, this program is particularly useful for complex and detailed designs. With this program, you can actually work on any product. If you are an engineer, it will perfectly meet your expectations to create your 3D CAD models, and it is really perfect for mechanical engineering projects.

ProE: ProE (also known as PTC Creo or Creo Parametric) is developed by Parametric Technology Corporation and is an engineering design software tool. It is 3D CAD software providing assembly modeling, finite element analysis, NURBS surface modeling, but also great features dedicated to mechanical designers. This is a good and complete software solution to do some rapid prototyping for your mechanical parts, but also to produce your end-use products.

Mathematica: Mathematica is a technical computing system that could totally allow you to create solid parts for your future 3D printed mechanical parts. It is offering advanced features, such as 2D and 3D data visualization, function and geo-visualization and animation tools. This program is particularly convenient for any scientific, mathematical or engineering project.

Alibre: Alibre is a parametric CAD software tool dedicated to mechanical systems. It is possible to use this 3D program to create quite complex parts. This mechanical software solution also has a good rendering tool. This 3D software tool has great features, perfect to develop, prototype or produce all of your projects.

TurboCAD Deluxe: This mechanical engineering software offers a lot of different features. It has an easy learning curve, but at the same time, is quite powerful. You will be able to work in both 2D and 3D, customize UI, and use tailored mechanical tools for engineering projects. Product designers will also benefit from rendering options such as different materials and lighting.They will be able to produce photorealistic visualizations. Additionally you will be able to easily share your work with other 3D software such as AutoCAD or SketchUp. Also, your 3D models can be prepared for 3D printing with TurboCAD Deluxe.

AutoCAD Mechanical: Autodesk produces the classics of 3D modeling and AutoCAD is certainly one of them. As mechanical engineering 3D software evolves, so did this program. Autodesk produced a version that combines the reliable tools and functionality of AutoCAD with customized mechanical tools: AutoCAD Mechanical. This 3D program allows you to document CAD models, reuse mechanical drawing detailing tools, but also to create rectangles from the ribbon, restore and isolate layer groups and much more. Most importantly, AutoCAD Mechanical will provide you with a huge library (over 700 000) of standard parts and international drafting standards support. This is a true game-changer in the world of mechanical engineering.

Student Article

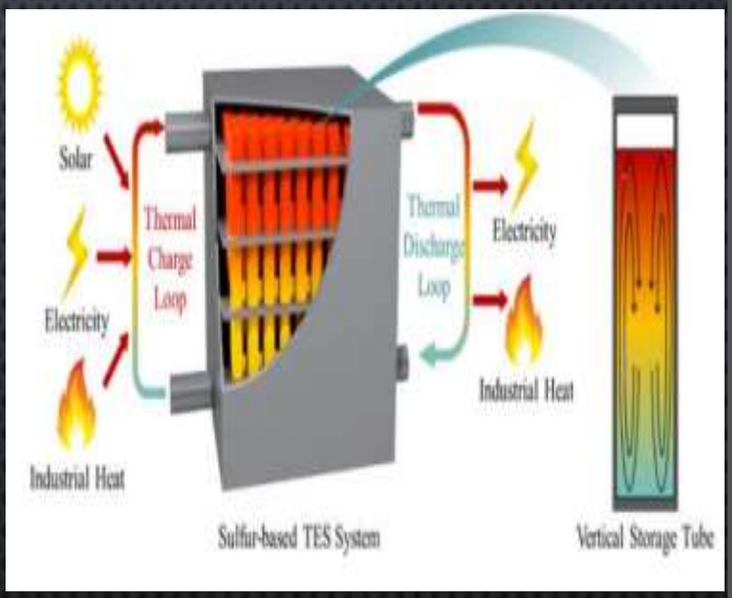
Next-generation Thermal Energy Storage

- Keerthana Kotha, TCS

Renewable energy sources are promising alternative energy sources for lessening the global energy crisis and reducing the overdependence on fossil fuels which contributes to the highest percentage of carbon footprint. Energy storage system is a critical component for power generation facilities with intermit renewable energy by providing significant dispatch ability and operation flexibility. Unfortunately, the high cost and limited stability for current energy storage devices, such as battery, have greatly hindered the development of relevant renewable energy technologies.

The use of thermal energy storage has recently been on the rise due to its attractive cost efficiency and long-term reliability. However, this technology is still under development and currently facing several challenges: limited operation temperature range for molten-salt thermal energy storage and poor thermal performance for the thermal storage with phase-change or solid materials. To this end, addressing these performance challenges and developing effective energy storage methods is highly desirable. Professor Richard Wirz at UCLA proposed a novel high-temperature thermal storage solution (Sulfur TES) by using elemental sulfur as storage medium. With low cost for the storage and containment materials, high thermal stability from room temperature to above 1000˚C, and high heat transfer rate at liquid stage, Sulfur TES shows great potentials to be a competitive technology for the next-generation thermal storage in future commercial renewable power generation infrastructures.

Based on the efforts by the researchers, configuration changes in the orientation of the sulfur-based thermal storage elements was found to significantly affect the heat transfer performance for the Sulfur TES systems. The authors experimented to investigate the effect of unique viscosity variation and solid-liquid phase change of sulfur on the heat transfer behavior of vertical sulfur tube from room temperature to 600˚C. Low heat transfer rates were observed in lower-temperature sulfur, i.e. from 25˚C to 275˚C attributed to low thermal conductivity of solid sulfur and high viscosity for liquid sulfur in this temperature range. However, a drop in the sulfur viscosity beyond 275˚C was found to significantly increase the heat transfer rate.



Acharya Kanad - The Father of Atomic Theory

John Dalton is often said to be the inventor of the atomic theory, but the concept of the atom and atomic theory appeared 2600 years ago, being invented by the sage Acharya Kanad. He was the first man in history to describe atoms and molecules. He explained that: “every object of creation is made of atoms which in turn connect with each other to form molecules.”

Guide to your world of robotics: ATLAS !

ATLAS is the world's most dynamic humanoid robot, Atlas is a research platform designed to push the limits of whole-body mobility. Atlas's advanced control system and state-of-the-art hardware give the robot the power and balance to demonstrate human-level agility.

EFFICIENT

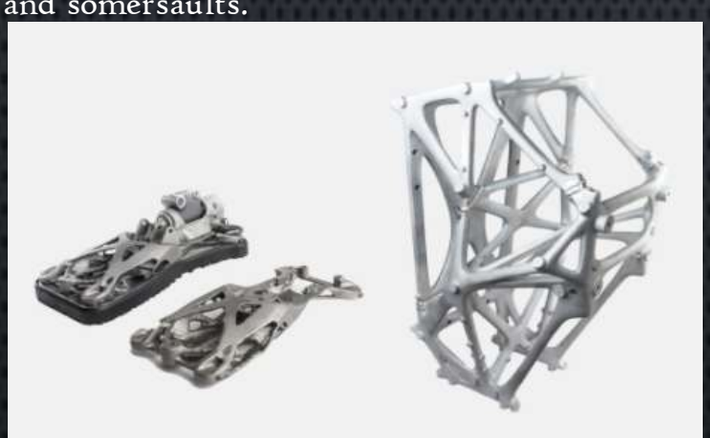
Atlas has one of the world's most compact mobile hydraulic systems. Custom motors, valves, and a compact hydraulic power unit enable Atlas to deliver high power to any of its 28 hydraulic joints for impressive feats of mobility.

DYNAMIC:

Atlas's advanced control system enables highly diverse and agile locomotion, while algorithms reason through complex dynamic interactions involving the whole body and environment to plan movements.

LIGHT WEIGHT:

Atlas uses 3D printed parts to give it the strength-to-weight ratio necessary for leaps and somersaults.



In the 2015 DARPA competition of robotics, Atlas was able to complete all eight tasks as follows:

- ❑ Drive a utility vehicle at the site.
- ❑ Travel dismounted across rubble.
- ❑ Remove debris blocking an entryway.
- ❑ Open a door and enter a building.
- ❑ Climb an industrial ladder and traverse an industrial walkway.
- ❑ Use a tool to break through a concrete panel.
- ❑ Locate and close a valve near a leaking pipe.
- ❑ Connect a fire hose to a standpipe and turn on a valve.

- ✓ **ACTUATION:** Hydraulic
- ✓ **JOINTS:** 28
- ✓ **SPEED:** 1.5 m/s
- ✓ **HEIGHT:** 1.5 m
- ✓ **WEIGHT:** 80 kg

GRAVITY JET SUIT…
The Next Frontier in Human Flight

- J.P Karthik, Asst. professor

It contains a pair of micro jet engines on each arm situated just below the elbow and between them it feels like the thrust is coming up through your arms. Then there is the larger engine on the back, either side of the larger engine we have twin fuel bladders which hold jet fuel or road diesel and can hold around 20 liters of fuel. Between those 5 engines there is enough thrust to lift a human off the ground," explains Browning.

Gravity's Jet Suit can typically fly for approximately 3-4 minutes. When fully fueled, it weighs around 30kg, it is 1050bhp and produces 144kg of thrust. "The Jet Suit is controlled by vectoring, meaning you control your flight by altering the direction of your arms. Pointing down to go up and when you 'flare' your arms a little out to the sides you go down, the rest of the control becomes very intuitive, not dissimilar to how effortless it becomes to ride a bicycle with your subconscious balance system doing all the work," notes Browning. He tells us how it feels to fly using the Suit. "As you squeeze that trigger and feel the thrust come in, you feel your weight get lighter and lighter off your feet and then suddenly you're free, the ties of gravity fall away and it's just peaceful, and then you realize you can go anywhere you want. You can simply think about where you want go and you go there, it is the ultimate realization of the dream of human flight."

RECORD-BREAKING SPEEDS

The suit is very much tried and tested, with Mr. Browning having flown it at over 70 locations across 22 countries. In 2017, he broke what was then the record for fastest jet suit by flying at 32.03mph. In a statement, Mr. Browning says the jet suit is primarily designed for use by the military and rescue services.

THE COMPANY BEHIND THE JET SUIT

Gravity Industries is headed up by CEO Richard Browning and says on its website that they have a mission to be "the next frontier in human flight". The Gravity Jet Suit is part of the company's innovative and technologically advanced product portfolio that aims to "enable unparalleled human flight", much of which is patent pending. The flying suit has been in development for more than two years, and while the company filed the request in 2017, the patent was finally granted by on 13 March 2019. The company claims to be the first in the world to be awarded an official patent for a jet suit.

The Physics of Flight

Let's start off with some fundamental physics. How does this jet suit fly? I'm going to say it's all about the momentum principle. This says that the net force on an object changes its momentum where momentum is the product of mass and velocity. Here is the equation form of this idea.

$$\vec{F}_{\text{net}} = \frac{\Delta \vec{p}}{\Delta t} \qquad \vec{p} = m\vec{v}$$

There is one other important idea about forces—they are an interaction between two objects such that for every force there is an equal and opposite force. OK, now for flying. Suppose I have a human that is hovering above the ground. There is of course the gravitational force pulling down on the human so that there must also be an upward force to make the total force zero (so the human stays hovering). This upward force comes from the thrust of the micro jets. But how does a jet produce thrust? The answer comes from the momentum principle

Basically, this jet engine takes stationary air from above the engine and pushes it down so that it is moving with some new speed. This change in speed means that there is a change in momentum of the air such that it requires a force. If you push down on the air, the air pushes up on the human—and that is the trust.

This thrust force depends on a number of factors:

- The density of air (this will probably be some constant value around 1.2 kg/m3).
- The speed of the air coming out of the jet engines—I will call this "thrust speed."
- The area of the jet thrust (that comes out of the engine).

Notice that all three of these factors change either the mass or speed of the air—which changes the momentum of the air. As an equation, it would look like this:

$$F_{\text{thrust}} = \frac{\rho A v^2}{2}$$

If you want a flying human to hover, this thrust force would have to be equal to the human's weight. But I don't really care so much about the thrust force: What I want is the power. Power is a measure of the rate at which you do work—the work in this case is going into the increase in kinetic energy of the air. Putting this together (again, refer to the human-powered helicopter post for the details), I get the following expression for power.

$$P = \frac{\rho A v^3}{4}$$

You can use these two expressions together to calculate the hovering power. First use the thrust force to calculate the speed of the air to hover and then use this speed to calculate the power.

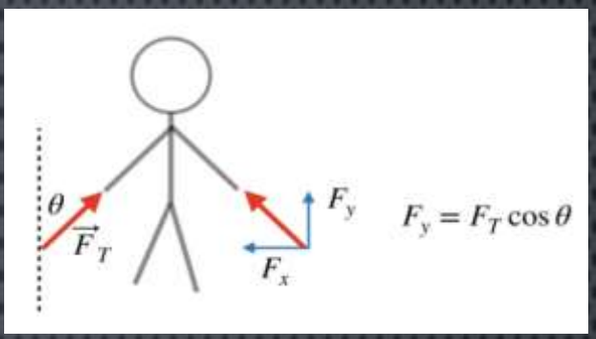
Estimations

Now I need some values to calculate the power. Here are my estimations.

- Mass of human (plus all the gear) = 90 kg (total guess).
- Number of jet engines = 6. Technically, I think the newest suit has five jet engines and one of them is larger.
- Area of jet engine = 0.0079 m2 (based on a engine diameter of 10 cm).
- With these values, I get a thrust air speed of 176 m/s (394 mph)
- Using this thrust speed, I get a power of 77,889 Watts or 104 horsepower. Yes, this is quite a bit lower than the listed 1,000 hp in the video but I think this is OK. I have calculate the hovering power, not the flying power. But there is another reason that I will now describe.

Components of Thrust

One of the cool things about this flight suit is the method that is used to control vertical thrust. Of course there is a throttle for the jet engines so that you could increase or decrease the thrust, but you don't need to do that. Instead, the human pilot can increase the angle of arms so that the jet engine thrust is directed only partially down. Here, let me draw a force diagram.



Each of these hand jets has a thrust force in which part of the force (the x-component) pushes inward and part (the y-component) pushes upward. If the arm angle is θ degrees (as measured from the vertical), then the vertical component of force would be the total force multiplied by the cosine of θ. Yes, you need to be careful here.

I see physics students make this mistake quite often. Just because it's a y-component doesn't automatically mean that it depends on the sine of θ—you have to look to see how the angle is measured. Just be careful. OK, let's assume that the arm angle is at 40° from the vertical. That means the total thrust (ignoring the jet engines on the back) would have to be greater in total magnitude to get a component to balance out the gravitational weight. If I include this in the power calculation, I get a thrust speed of 202 m/s with a power of 116 thousand Watts (115 horsepower).

That's still lower than the listed power, but this is a calculation based on a bunch of estimates. I suspect my value for the diameter of the jet engine is too large—but you can change that in python calculations if you like (see above). Also, this is the theoretical power with no energy losses. I assume that an actual engine wouldn't be perfect. But even if I get the wrong answer, it's still fun to make these estimations.

A Peer to Peer Electronic Cash System

WHAT IS BITCOIN ?

Bitcoin is a cryptocurrency that was created in 2009 by an unknown person using the alias Satoshi Nakamoto. Transactions are made with no middle men – meaning, no banks! Bitcoin can be used to book hotels on Expedia, shop for furniture on Overstock and buy Xbox games. But much of the hype is about getting rich by trading it. The price of bitcoin skyrocketed into the thousands in 2017.

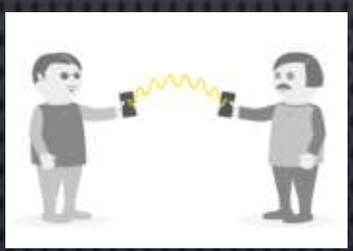
THE ANONYMITY OF BITCOIN: Though each bitcoin transaction is recorded in a public log, names of buyers and sellers are never revealed – only their wallet IDs. While that keeps bitcoin users' transactions private, it also lets them buy or sell anything without easily tracing it back to them. That's why it has become the currency of choice for people online buying drugs or other illicit activities.

WHY BITCOIN?

Bitcoins can be used to buy merchandise anonymously. In addition, international payments are easy and cheap because bitcoins are not tied to any country or subject to regulation. Small businesses may like them because there are no credit card fees. Some people just buy bitcoins as an investment, hoping that they'll go up in value.

BUYING BITCOINS:

Many market places called "bitcoin exchanges" allow people to buy or sell bitcoins using different currencies. Coinbase is a leading exchange, along with Bitstamp and Bitfinex. But security can be a concern: bitcoins worth tens of millions of dollars were stolen from Bitfinex when it was hacked in 2016.



BITCOIN'S FUTURE IN QUESTION:

No one knows what will become of bitcoin. It is mostly unregulated, but some countries like Japan, China and Australia have begun weighing regulations. Governments are concerned about taxation and their lack of control over the currency.

TRANSFERS

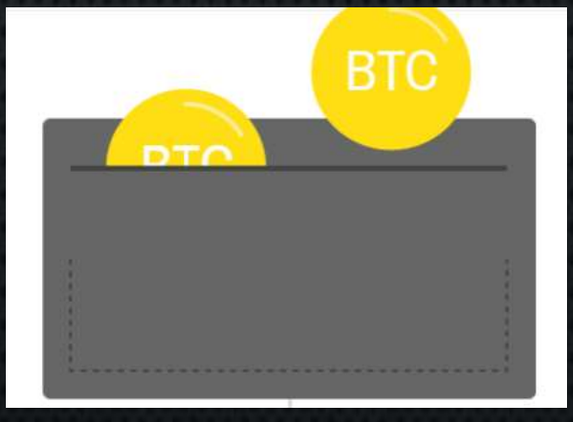
People can send bitcoins to each other using mobile apps or their computers. It's similar to sending cash digitally.

MINING

People compete to "mine" bitcoins using computers to solve complex math puzzles. This is how bitcoins are created. Currently, a winner is rewarded with 12.5 bitcoins roughly every 10 minutes.

BITCOIN WALLET

Bitcoins are stored in a "digital wallet," which exists either in the cloud or on a user's computer. The wallet is a kind of virtual bank account that allows users to send or receive bitcoins, pay for goods or save their money. Unlike bank accounts, bitcoin wallets are not insured by the FDIC.



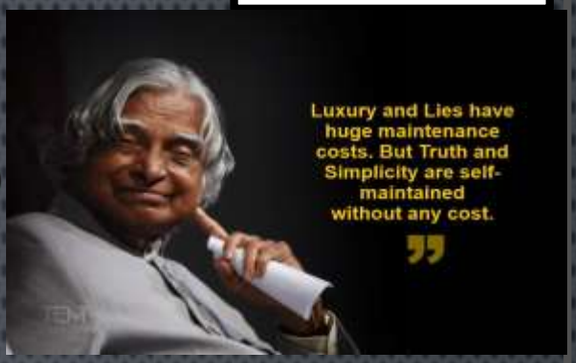
Memorizing Pi

To remember the first seven digits of pi, count the number of letters in each word of the sentence:

"How I wish I could calculate pi."

This becomes 3.141592.

Fun Zone



SOLVE SUDOKU

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
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	6					2	8	
			4	1	9			5
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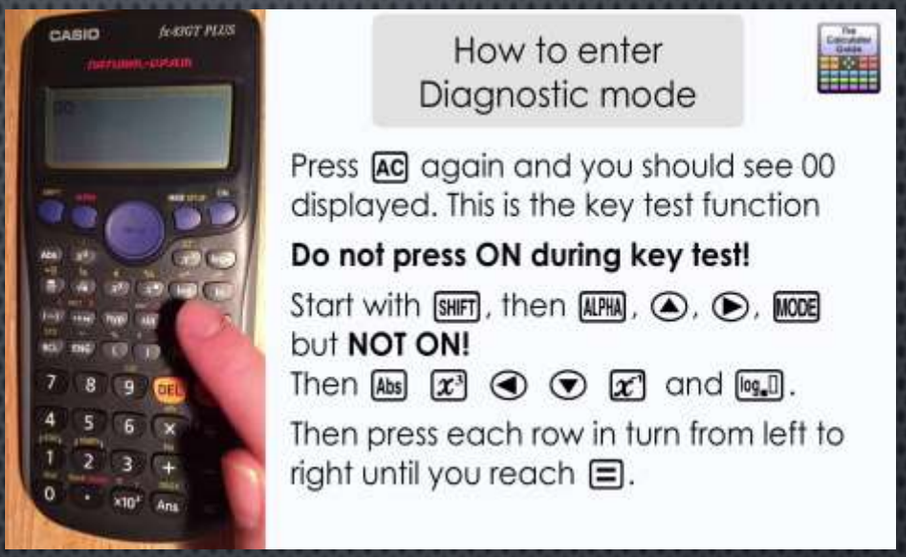

TRENDING APPS IN 2019

TikTok, known in China as Douyin, is a video-sharing social networking service owned by Chinese company ByteDance. The social media platform is used to make a variety of short-form videos, from genres like dance, comedy, and education, that have a duration from three seconds to one minute.

GATE 2020

GRADUATE APTITUDE TEST IN ENGINEERING

Organising Institute

IIT Delhi

GATE Online Application Processing System (GOAPS) Website Opens	Tuesday	3rd September 2019
Closing Date for Submission of (Online) Application (through Website)	Tuesday	24th September 2019
Extended Closing Date for Submission of (Online) Application (through Website)	Tuesday	1st October 2019
Last Date for Requesting Change of Examination City (an additional fee will be applicable)	Friday	15th November 2018
Admit Card will be available in the Online Application Portal (for printing)	Friday	3rd January 2020
GATE 2020 Examination Forenoon: 9:30 AM to 12:30 PM (Tentative) Afternoon: 2:30 PM to 5:30 PM (Tentative)	Saturday Sunday Saturday Sunday	1st February 2020 2nd February 2020 8th February 2020 9th February 2020
Announcement of the Results in the Online Application Portal	Monday	16th March 2020

Formula imperial -2019, BIC Noida. Electrical vehicle

GOKART

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