

Smart About Smartphones

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The modern smartphone suddenly, within the span of a few years, became a must-have device for most people (Figure 1). We use it for almost everything: phone calls, texting, Web/Internet, taking pictures/videos, streaming shows, making payments, managing fitness and health, getting directions, and much more. We can do all this right in the palm of our hands. The smartphone represents the convergence of many modern technologies in one light-weight handset. Without question the smartphone has become a vital



Figure 1: Smart Phones Are Popular

part of our daily lives. It is important for all of us to know it better, use it more effectively and appropriately. That is the goal here in this article.

Who Invented the Smartphone?

We know Alexander Graham Bell won the first U.S. patent for the telephone in 1876. The smartphone, however, is another story.

As early as the 1940s, there were efforts to make phones *mobile* with radio transmissions so they could be used from automobiles, trains, and by the military in the field. In 1946-48, AT&T introduced *Mobile Telephone Service* to a number of towns and highways in the U.S. The first mobile phones weighed 80 pounds each.

Mobile phones became *cell phones* when coverage areas were divided into cells. Each cell has its own directional antennas on a transmission tower. This enables reusing radio frequencies and handing ongoing phone calls off from one cell to the next. The 1990s saw cell transmissions move from analog to digital and the development of the GSM (European) and CDMA (US) standards. The 2G era brought explosive growth of mobile phone use. In



Figure 2: IBM Simon 1994 (image: Irish Times)

August 1994, IBM released Simon (Figure 2) that rolled a cell phone, a pager, a fax machine, and a touch-screen PDA into one hand held device. Although not a commercial success (discontinued February 1995), it is perhaps the first smartphone. Then came the successful Blackberry from Research In Motion (Canada) which brought many advances to smartphones. Today the company is no more. Meantime, the Apple iPod shaped how people used portable devices leading to the iPhone (2007) which was the best smartphone consumers had ever seen. With a price about \$500, people stood in line to buy the iPhone and subscribe to its exclusive carrier AT&T.

What is iOS? Android?

These are the two dominant mobile operating systems for smartphones and tablets. The iPhone runs *iOS* which is Apple proprietary and built upon the same kernel as macOS. *Android* is an open source (free for all) system developed by Google based on the Linux kernel and other open source software around 2007-2008. Name any smartphone other than the iPhone, chances are it runs a version of Android. According to statcounter.com, for 2019, mobile operating system market share worldwide was about Android 75.8% and iOS 22.9%. The iPhone is usually three times more expensive than Android phones.

Smartphones are wonderful. One convenient handset can combine a touch-screen tablet, a mobile phone, still/video cameras, plus additional devices such as microphone, speaker, flash light, global positioning, and other sensors.

On top of all that hardware you have a huge variety of software (apps), a few are built-in but many others are easily installed by downloading from the Apple App Store or Google Play (Figure 3). Remember the App Store



Figure 3: Smartphone App Stores

or Google Play is your central control for all apps where you may find, download/install, uninstall, update, and configure apps either individually or as a whole. For example, you may consider allowing automatic update for all apps when the phone is connected to WiFi. The modern smartphone, providing so many useful functions, is no wonder a little complicated. Let's explore the many aspects of a smartphone.

Making Phone Calls

You can't call anyone except 911 if the phone does not have a SIM (Subscriber Identity Module) card from a wireless service provider such as Ver-

izon, AT&T, T-Mobile, and so on. With a SIM inserted all you need is a strong enough signal from a near-by cell tower to make/receive phone calls (Figure 4) and to send/receive text messages. Simply put, texting is nothing

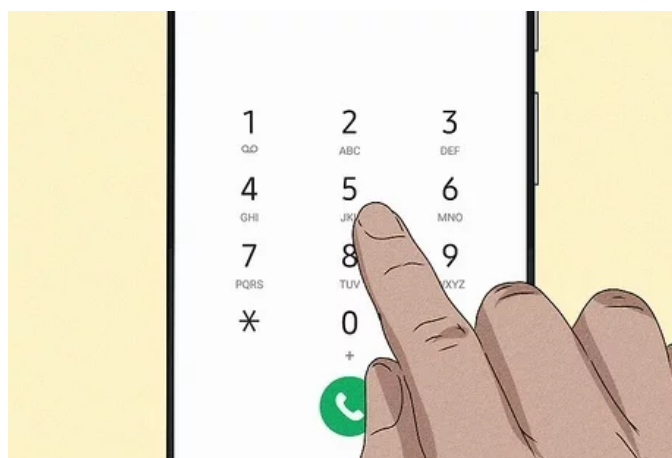


Figure 4: Dialing A Phone Number

more than sending a textual message to a particular phone number. The phone will automatically log all calls and text messages made and received.

Be aware that prolonged phone use, especially texting or watching videos, can hurt your neck. The syndrome, known as *text neck*, is caused by the head bent downward and not moving which puts additional pressure on the neck.

Radiation can be another concern. If you don't want the phone next to your ear, you can use the *speaker mode* which also allows several people around the phone to join the conversation. You can put the phone call *on hold* to pause the call and resume a bit later. While holding a call, you may use the phone to check email, look up a web page, or make another phone call.

While on the phone, you can answer another incoming call. You may also add a call to turn it into a conference call. An audio recording app, such as Easy Voice Recorder or Audio Recorder, allows you to record incoming phone calls or to make recordings in general. A video recording app, such as DU Recorder or AZ Screen Recorder, can record video calls.

You can customize the ring tone or put the phone in vibrate mode to avoid bothering others. It is polite to do in movie theaters and such. If you don't want to be bothered at all, turn on the *airplane mode* which turns off

all wireless transmissions including cellular, wifi, bluetooth, GPS. Many also use this feature to save battery power. Airplane mode let's you use what you already have in the phone while preventing any wireless communication to/from it. Turn off airplane mode and your phone comes back alive to the outside.

Other things you can do include block/unblock calls, call forwarding, log calls, and manage caller IDs.

Short Codes

The *Unstructured Supplementary Service Data* (USSD) is a protocol allowing cell customers to access/set account information and features by dialing *short codes* right from their phone. For example, dialing the short code **#BAL#** (**#225#**) displays your account balance, **#NUM#** (your phone number), ***#06#** (Phone's IMEI number).

Other codes control call forwarding, call waiting, voice mail, and so on. The complete list of short codes are available from your cell service provider. You can check them online and use them as you like.

Protecting Your Phone

Your SIM card stores data such as subscriber identity, billing information, mobile phone number, network authorization data, personal security keys. It may also store contact lists and text messages.

Each SIM card comes with a default PIN code (usually "0000"). When you turn on your phone, it asks you to enter the PIN and connects to your cell network only after getting the correct PIN. This is important protection and you should always set your own PIN to replace the default one.

If incorrect PIN codes have been entered 3-5 times in a row, the SIM card becomes *locked*. But it can be unlocked with a *PIN Unblocking Key* (PUK) which is given to you when you first got your SIM card. Keep your PUK in a safe place away from your phone as it is the key to unblocking your SIM and establish a new PIN code. Note that if you enter the wrong PUK 10 times in a row, the SIM will be permanently blocked, and you'll need to purchase a new SIM card.

In addition to the SIM PIN, you should also set up a phone unlock pattern and/or fingerprint, face recognition unlock feature on your phone.

Don't leave your phone lying around, always keep it with you, and don't leave home or any other place without it.

The Tablet Aspect

For your smartphone to function as a tablet computer, it needs an Internet connection. There are two ways: through a WiFi connection and through a cellular data connection. Of course your home WiFi as well as public WiFi hot spots do not incur additional cost. Data plans by cell carriers can be expensive.

Having connected to the Internet, you can do *video call/chat* (Figure 5) which is, in many respects, better than phone calls because the calling parties can see one another and you can share views of on both ends. Why not do



Figure 5: Making a Video Call

video calls especially it can often be made free of charge. Simply install a video call app from your app store. Popular chat apps include Skype, Google Duo/Hangout, FaceTime, Viber, WhatsApp, Facebook messenger, etc. Better yet, these usually are free. But remember, the chat parties must first start and login to their video chat app. A big advantage of video chat is the fact that you can share live images of people, objects, and scenery via the smartphone's front and back cameras. Taking this one step further, you can conference on-line (Figure 6) with apps such as Zoom. Playing video is



Figure 6: Video Conferencing on a Smartphone

of course popular and a smartphones allows you to stream video anywhere with an Internet connection. What displays on your small screen can usually also be *cast* to your big-screen smart TV. Basically, anything you can do on a laptop computer you can do on your smartphone including listening to music, radio programs, and audio books. Of course, you can surf the Web, send/receive email, shop online, and much more.

Working Out

Do you exercise for better fitness? You can use a smartphone to track the distance or count the number of steps while jogging or walking, not to mention playing your favorite music to keep you in rhythm. With various fitness apps and associated gear, you can time your workout, log your progress, monitor heart rate, even estimate blood pressure.

You can also find many weight loss apps to manage your overall fitness.

Mobile Payments

You can use your smartphone to make payments at stores and vendors. It is convenient and contact-less, avoiding physically touching the payment terminal.

Basically you first install a mobile payment app such as Apple Pay, Google Pay, Alipay (Figure 7). Then follow instructions to add one or more *payment methods*, usually credit cards, debit cards, Paypal and so on. Once set up,



Figure 7: Mobile Payment Systems

you can use your smartphone to make payments usually by simply placing it next to the vendor's payment terminal. Data is transferred via NFC (*Near Field Communication*) between two devices next to each other. Make sure your phone has NFC turned on. When you have no need for NFC, turning it off makes sense and saves power.

For most people mobile pay is simply pay by credit card without using the physical credit card. It is more convenient and also more secure. With mobile pay you can also directly send/request money from family and friends.

Vendors can receive payments with their smartphones. Popular apps include Square, Paypal/Venmo, Zelle, Cash and Payanywhere. They all make sending and receiving cash/credit-card payments via your phone quick and easy with little or no cost involved.

Voice Commands

Perhaps one of the most satisfying experience with a smartphone is to say what you want and get it done (Figure 8). The underlying speech recognition and generation technology is amazing but we won't go into details except to say that rapid pattern matching and big data are involved. Thus, the phone needs to be Internet-connected. Personal assistant apps such as Google Assistant, Alexa, and Siri all rely on speech technologies to listen to user commands and to give verbal answers. When giving a voice command, we need to say a short *wake-up phrase* to activate the speech recognition program. Examples are *OK Google*, *Hey Google*, *Alexa*, *Hey Siri*. You can also set your own wake-up phrase to something you like. It is also possible

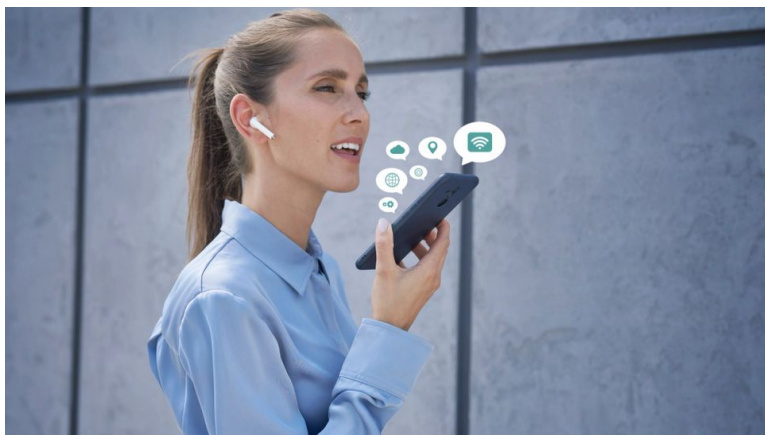


Figure 8: Comamnd Your Phone to Do Things

to touch a microphone icon or holding down the home button to give a voice command directly.

With your own voice, you can initiate a call or text (*call Mom, text/tell Joe Smith*), change settings (*flashlight on/off, battery saver on/off, WiFi on/off, Bluetooth on/off*), play music/radio/video (*play Pandora, Watch Star Wars*), set alarms, timers, calendar entries, reminders (*set an alarm for 3:30 PM*), get facts, ask for directions, and search the Web (*what is the weather, what is the time/date in Beijing, what is 15 percent of 58*), and much more.

Search for the complete list of voice commands for your phone online or say *the complete list of voice commands*. Remember voice recognition works not only in English but also in other major languages such as Chinese, Japanese, French, Spanish, etc.

Other apps that accept voice input include Google Translate, Google Maps, speech to text conversion apps, and many others. Consult instructions for individual apps for details.

In-car Use

Whether you are driving or walking, modern GPS navigation devices make going to places as simple as following turn-by-turn directions. A smartphone can become a navigation tool because it usually has a build-in global positioning sensor. That, plus a navigational map, then you are in business.

This usually means you need to have an Internet connection while mov-

ing or you had the needed maps already downloaded into your phone. For example, with the Google Maps app you can download and save regional maps for offline use.

Dedicated GPS devices have maps built-in but that can become outdated. Then you need to pay for updated maps. With the smartphone approach you will be always working with the most current maps. You can pair your phone via Bluetooth to an in-car media system for an improved experience.

Apps such as *Android Auto* (from Google) and *CarPlay* (from Apple) are examples that pair with compatible car systems for messaging, hands-free calling, audio streaming and navigation.

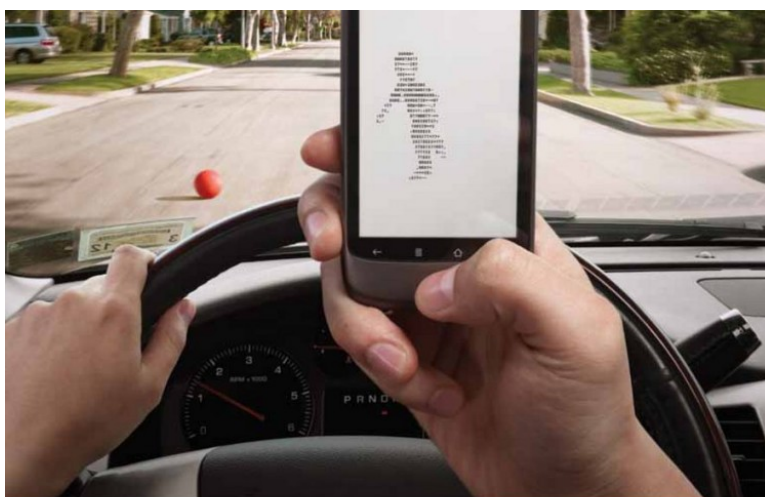


Figure 9: No Texting While Driving (image: bmwblog.com)

Talking on the phone while driving is dangerous (Figure 9). Set your phone's *drive mode* options to refuse incoming calls. The phone can even go into drive mode automatically when the car is moving.

The Camera

The quality and capabilities of cameras on modern smartphones vary a lot, ranging from very very good to just OK. Usually you will find front and back cameras and a built-in camera app. You can take photos (with/without flash assist) in day/night mode, portrait/scenery mode, zoom in/out, take selfie (use the front camera) and so on (Figure 10). Timer delay is supported but

rarely useful. You can also take video in 720P, 1080P, and even 4K. Slow motion videos are also possible. For better and more advanced camera apps,

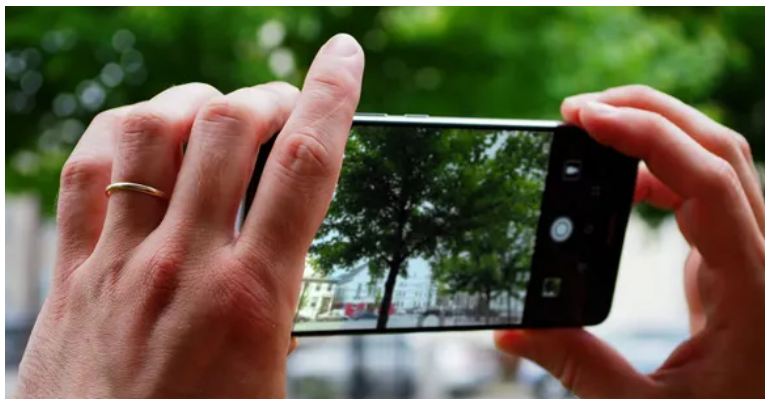


Figure 10: Taking a Picture

search for recommendations online and download from your app store. For more detailed control of the camera and how to take professional or studio quality photos/videos, you need to really study not just the manuals but learn digital photography, subjects way beyond this article.

The best thing about taking photos/videos with your smartphone is that you can share them immediately with others by simply tapping the share icon in the camera app or the gallery app. For email consider using the JPEG format with a 640x480 or 800x600 pixel size (4:3 aspect ratio). If your camera app does not have a setting for the pixel size, use a photo resizer app to scale down the full resolution photos (usually too big to go through email) to the desired size before emailing.

Other apps use the camera to scan QR codes, Barcodes (i-nigma), even documents (Adobe Scan). To capture your smartphone screen, you don't need a camera, just push the power button and choose screen capture to get an image of the screen.

Phone Security

Because you depend on your smartphone so much, and because others use your phone to authenticate you (send security codes to you, for example), and because it stores so much private data, it is of the utmost importance that you keep your phone secure and always with you. Make sure you set

up a lock screen for your phone, it is easy and a necessary security measure (Figure 11). Always keep your SIM PIN and phone unlock key to yourself.

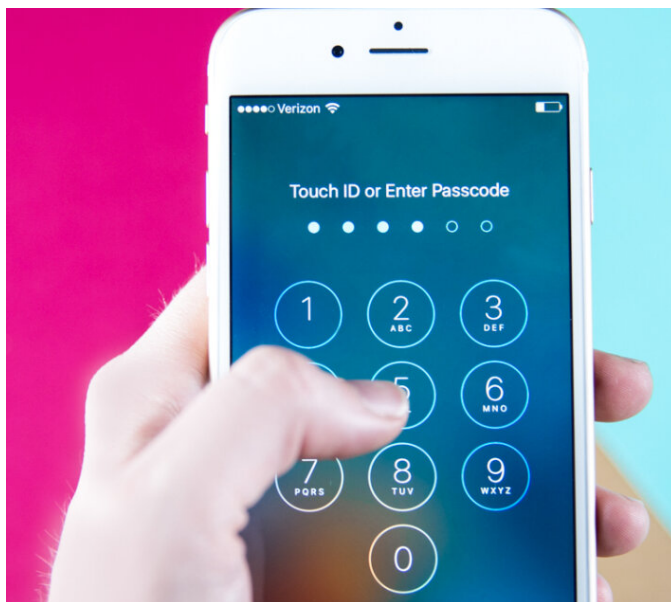


Figure 11: A Lock Screen

Keep them together with your other login information in an encrypted file on another computer. For convenience, you can keep that same file in your phone as long as it is encrypted with an app such as *TextSecure* and *Crypt4All*.

Don't download any file or open any email attachment from strangers. According to The Guardian, Amazon.com boss Jeff Bezos' iPhone was "hacked in 2018 after receiving a WhatsApp message that had apparently been sent from the personal account of the crown prince of Saudi Arabia ... included a malicious file."

Backup your contacts, list of apps and their associated data as well as other useful information on cloud storage (Google Drive or Dropbox, for example). Phone backup/restore apps make this very easy.

What is 5G?

In the USA, current cell phones operate on 4G LTE networks which are up to ten times faster than 3G networks. 5G is the next evolution sponsored by

the 3rd Generation Partnership Project (3GPP) and International Telecommunications Union (ITU).

5G promises much faster speeds (up to 100 times faster than 4G) and serving much more densely populated mobile devices, opening the door for *Internet of things*, *Smart Cities* and more.

Because 5G uses new radio spectra and new tower stations, it will be rolled out in stages. The first stage involves adding new spectra to the current 4G LTE for more speed (about 20% faster). And you need compatible phones to enjoy the added speed. Eventually 5G will be separated from 4G in stand-alone mode. In the USA, we are a few years away from that. China is ahead and moving much faster to deploy and use 5G in and outside China.

Too Much of A Good Thing?

Smartphones are convenient and powerful. But, as with any tool, misuse or overuse would be inappropriate or downright dangerous.

Have you seen a couple, sitting face to face across a table of fine food, looking down and playing with their phones and not talking or relating to each other? Is that not sad?

Smartphones can be a distraction in many other situations, including answering calls during a conversation/meeting. Doing so while walking or driving is known to cause accidents (Figure 12). According to Reuters, “*The Metrolink commuter train plowed into a Union Pacific freight locomotive on September 12 in Chatsworth, California, killing 25 people and injuring 135 ...*” And records indicate that the train engineer was texting seconds before the crash. This example is among many accidents worldwide related to operator cell phone use.

In the USA, all states have passed their own *Distracted Driving Laws* restricting/prohibiting cell phone use, especially texting, while driving.

Too much cell phone radiation might lead to health problems such as brain tumors and skin cancer. With nonstop use, light from the display screen can lead to eye-strain and sleep deprivation.

Overuse may also cause many psychological issues such as loneliness, being suspicious all the time, feeling self-centered and so on. Texting too much not only isolate you from face-to-face human interactions but also can cause text neck.

Children, and some adults, can easily become addicted to the smartphone and that can cause many problems.



Figure 12: Walking into an Accident?

Another concern is privacy. Your smartphone gives away your location and your travels because cell towers track your phone. The phone also has cameras, microphone, and many other sensors that can be accessed by apps (legitimately or not) to spy on you. According to The Verge (Feb. 27, 2020), “*The Federal Communications Commission plans to fine four mobile phone carriers a total of \$200 million for making consumers’ real-time location data available to third parties ...*”

In short, too much of a good thing is always a bad thing. And we all need to be smart about smartphones and not put all our eggs in one basket.

Social Distancing

Cellphones and online communication keep all of us going during the difficult days of the COVID-19 pandemic, making it easier to practice social distancing without becoming isolated or feeling alone.

Even when we have to meet face to face, we can keep a safer distance by talking on the cellphone, walkie-talkie style, instead of shouting loudly. What a smart idea!

Finally

Modern smartphones are great yet complicated. Basically, you have many devices rolled into one and even mastering one of those functions takes time and effort.

One concept from *Computational Thinking* (CT) is **abstraction**, focusing on the important features of a complicated system by ignoring unimportant details. A smartphone is a great place to apply abstraction. With time and familiarity, everyone can become an expert user. Another CT principle says: *With deeper understanding, and better interfaces, comes more effective usage.*

As a technological advance, the smartphone is as, if not more, impactful on human society and culture as the automobile or the TV, for example. The benefits are enormous, everywhere, and unavoidable. Yet remember, your smartphone can save or destroy your life, it is up to you. Hope you enjoyed this article. Happy smartphoning everyone.