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View Discussion Improve Article Save Article process images and videos to identify objects, faces, or even the handwriting of a human. When it integrated with various libraries, such as Numpy, python is capable of processing the OpenCV array structure for analysis. To Identify image patterns and their various features we use vector space and perform mathematical operations on these features. OpenCV is a library used for real-time image processing through a camera. It is used to do various image processing operations like image capturing, applying real-time filters like Snapchat and Instagram, cropping of images and many more. There are lots of applications that are solved using OpenCV, some of them are listed belowface recognitionAutomated inspection and surveillancenumber of people - count (foot traffic in a mall, etc)Vehicle counting on highways along with their speedsInteractive art installationsAnomaly (defect) detection in the manufacturing process (the odd defective products)Street view image stitchingVideo/image search and retrievalOpenCV FunctionalitiesImage/video I/O, processing, display (core, imgproc, highgui)Object/feature detection (objdetect, features2d, nonfree)Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)Computational photography (photo, video, superres)Machine learning & clustering (ml, flann)CUDA acceleration (GPU)Steps Required to Add OpenCV library into Android Application Here are the steps required to perform in the same way to add OpenCV i.e here you will see various releases with the version name mention above it. You need to download the same version of OpenCV as your android studio version. Here download the android package you will see the android package option there as shown in the image below: Just click on the android option there and you will be redirected to the page where the download will start automatically. After downloading the android package with the version same as with your android studio you have to extract the zip folder to your desired location. Now open Android Studio and create a new project. After creating a new project go to File > New > Import-Module Now, import the module of OpenCV. So open the location where you extracted the OpenCV library so go to that location. In this case download location was This PC > downloads. Go to the location > OpenCV > SDK > java and done, the android studio will automatically fetch the module from there. Click on Next > finish. Now you have to modify the project structure also. So go to File > Project Structure > Dependencies in All Dependencies folder click on the + icon then add the module dependency. Click on the app and then select the OpenCV dependency and then next then OK. Now, some files are needed for the android project. So go to app > New > folder > JNI folder Then check the Change Folder Location then rename src/main/JNI to src/main/jniLibs then finish. Then go to the android studio and the paste all the copied folder into the newly created JNI folder. And all done! Now OpenCV is added into the android project. If one wants to check that whether it is added successfully he/she can do this by writing the below code into the MainActivity.static { if(OpenCVLoader.initDebug()) { Log.d("Check","OpenCv configured successfully"); Log.d("Check", "OpenCv doesn't configured successfully"); } Menú Esta web usa cookies para mejorar la experiencia de usuario. Aceptar Leer másPrivacy & Cookies Policy I am new to android development, and I have been using the command line tools to create an android project. I followed all the instructions given in the tutorial at android developers. However, they are focused more on IDE users. When I tried extending my MainActivity class from Activity, it threw the following error. error: package android.support.v7.app does not exist It was complaining about this import statement. import android.support.v7.app.ActionBarActivity; I made sure to visit the SDK manager, and it says Android Support Library is installed. I am truly stumped on this one, and I would really appreciate any help you guys could give me. This might help: History of the Android beta on November 5, 2007. The first commercial version, Android 1.0, was released on September 23, 2008. Android is developed by Google in which new major released later in the year. Overview See also: Android software development The development of Android started in 2003 by Android, Inc., which was purchased by Google in 2005.[1] There were at least two internal releases of the software inside Google and the Open Handset Alliance (OHA) before the beta version was released on November 5, 2007,[4][5] while the software development kit (SDK) was released on November 12, 2007.[6] Several public beta versions of the SDK were releases were done through software emulation as physical devices did not exist to test the operating system. The first public release of Android 1.0 occurred with the release of the T-Mobile G1 (aka HTC Dream) in October 2008.[8] Android 1.0 and 1.1 were not released under specific code names "Astro Boy" and "Bender" were tagged internally on some of the early pre-1.0 milestone builds and were never used as the actual code names of the 1.0 and 1.1 releases of the OS.[10] The project manager, Ryan Gibson, conceived using a confectionerythemed naming scheme for public releases, starting with Android 1.5 Cupcake. Google announced in August 2019 they were ending the confectionery theming scheme to use numerical order format was Android 10, which was released September 2019. In 2017, Google announced that Google Play would begin to require apps to target a recent Android version. [12] The current target API level 30]. [13] New apps and app updates must target API level 31) in August 2022. App updates will be required to target API level 31 in November 2022. Name Internal codename[9] Version number(s) APIlevel Initial stablerelease date Latest security patch date[14] Latest Google Play Services version[15] (release date) Android 1.1 Petit Four Old version, no longer maintained: 1.1 2 February 9, 2009 Android Cupcake Cupcake Old nger maintained: 1.5 3 April 27, 2009 Android Donut Donut Old version, no longer maintained: 1.6 4 September 15, 2009 Android Eclair Eclair Old version, no longer maintained: 2.0 5 October 27, 2009 Old version, no longer maintained: 2.0.1 6 December 3, Froyo Froyo Old version, no longer maintained: 2.2 - 2.2.3 8 May 20, 2010 3.2.25 (October 2014) Android Gingerbread Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 - 2.3.7 10 February 9, 2011 Android Honeycomb Old version, no longer maintained: 2.3 maintained: 3.0 11 February 22, 2011 Old version, no longer maintained: 3.1 12 May 10, 2011 Old version, no longer maintained: 4.0 - 4.0.2 14 October 18, 2011 14.8.49 (February 2019) Old version, no longer maintained: 4.0.3 - 4.0.4 15 December 16, 2011 Android Jelly Bean Jelly Bean Old version, no longer maintained: 4.1 - 4.1.2 16 July 9, 2012 21.33.56 (September 2021) Old version, no longer maintained: 4.3 - 4.3.1 18 July 24, 2013 Android KitKat Key Lime Pie Old version, no longer maintained: 4.4 - 4.4.4 19 October 31, 2013 October 2017 22.26.15 (July 2022) Old version, no longer maintained: 4.4W - 4.4W.2 20 June 25, 2014 ? Android Lollipop Lemon Meringue Pie Old version, no longer maintained: 5.1 - 5.1.1 22 March 2, 2015[18] March 2018 Android Marshmallow Macadamia Nut Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 4, 2016 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 4, 2016 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 4, 2016 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 4, 2016 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 4, 2016 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Old version, no longer maintained: 7.1 - 7.1.2 25 October 2019 Android Oreo Oatmeal Cookie Oatmeal Cookie Oatmeal version, no longer maintained: 8.0 26 August 21, 2017 January 2021 Old version, no longer maintained: 9.28 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2018 January 2022 Android 10 Quince Tart[21] Older version, yet still maintained: 10.29 September 3, 2019 August 6, 2019 Augu 2022 Android 11 Red Velvet Cake[21] Older version, yet still maintained: 12 31 October 4, 2021 Android 12 Snow Cone v2 Older version, yet still maintained: 12.1[a] 32 March 7, 2022 Android 13 Tiramisu[23] Current stable version: 13 33 August 15, 2022 Legend:Old versionOlder version, still maintainedLatest versionLatest preview versionFuture release Version history The following tables show the release dates and key features of all Android 1.0 (API 1) Android 1.0, the first commercial version of the software, was released on September 23, 2008. [24] The first commercially available Android device was the HTC Dream. [25] Android 1.0 incorporated the following features: Version Release date Features 1.0 September 23, 2008 Android Market, allowing application downloads and updates through the Market application. Web browser to show, zoom and pan full HTML and XHTML web pages - multiple pages show as windows ("cards").[26][27] Camera support - however, this version lacked the option to change the camera's resolution, white balance, quality, etc.[28] Folders allowing the grouping of a number of application icons into a single folder icon on the Home screen.[29] Access to web email servers, supporting POP3, IMAP4, and SMTP.[27] Gmail synchronization with the Calendar application. Google Contacts synchronization with the People application. Google Contacts synchronization with the People application. as find local businesses and obtain driving directions using GPS.[28] Google Sync, allowing management of over-the-air synchronization of Gmail, People, and Calendar, etc. Google Search, allowing users to search the Internet and phone applications, contacts, calendar, etc. Google Sync, allowing users to search the Internet and phone applications, contacts, calendar, etc. Google Sync, allowing users to search the Internet and phone applications, contacts, calendar, etc. Google Sync, allowing users to search the Internet and phone applications, contacts, calendar, etc. Media Player, enabling management, importing, and playback of media files - however, this version lacked video and stereo Bluetooth support. [27][28] Notifications appear in the Status bar, with options to set ringtone, LED or vibration alerts. [26][27][30] Voice Dialer allows dialing and placing of phone calls without typing a name or number. [27] Wallpaper allows the user to set the background image or photo behind the Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and widgets. YouTube video player. [31] Other applications include: Alarm Clock, Calculator, Dialer (Phone), Home screen icons and Dialer (Phone), Home screen icons Android 1.1 update was released, initially for the HTC Dream only. Android 4PI and added a number of features:[33] Version Release date Features 1.1 February 9, 2009 Details and reviews available when a user searches for businesses on Maps. Longer in-call screen timeout by default when using the speakerphone, plus the ability to show/hide the dialpad. Ability to save attachments in messages. Support added for marguee in system layouts. Android 1.5 Cupcake (API 3) On April 27, 2009, the Android 1.5 update was released, based on Linux kernel 2.6.27.[34][35] This was the first release to officially use a codename based on a dessert item ("Cupcake"), a theme used for all releases until Android Pie, with Android 10 using a number-only system. The update included several new features and UI amendments: [36] Version Release date Features Image(s) 1.5 April 27, 2009[34] Support for third-party virtual keyboards with text prediction and a user dictionary for custom words. Support for Widgets - miniature application views that can be embedded in other applications (such as the Home screen) and receive periodic updates.[37] Video recording and playback in MPEG-4 and 3GP formats. Auto-pairing and stereo support for Bluetooth (A2DP and AVRCP profiles). Copy and paste features in web browser. User pictures shown for Favorites in Contacts. Specific date/time stamp shown for events in call log, and one-touch access to a contact card from a call log event. Animated screen transitions. Auto-rotation option. New stock boot animation. Ability to upload videos to YouTube. Ability to upload photos to Picasa. Ability to check phone usage history.[38] Android 1.6 Donut (API 4) On September 15, 2009, Features Image(s) 1.6 September 15, 2009[40] Voice and text entry search enhanced to include bookmark history, contacts, and the web. Ability for developers to include their content in search results. Multi-lingual speech synthesis engine to allow any Android application to "speak" a string of text. Easier searching and the ability to view app screenshots in Android Market. Gallery, Camera and camcorder more fully integrated, with faster camera access. Ability for users to select multiple photos for deletion. Updated technology support for CDMA/EVDO, 802.1x, VPNs, and a text-to-speech engine. Support for WVGA screen resolutions. Speed improvements in searching and camera applications. Expanded Gesture framework and a new GestureBuilder development tool. Android 2.0 Eclair (API 5) On October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 27, 2009, the Android 2.0 Eclair (API 5) October 20, the Android 2.0 E Image(s) 2.0 October 27, 2009[44] Expanded Account sync, allowing users to add multiple accounts in one page. Bluetooth 2.1 support, with a combined inbox to browse an email and contacts. Microsoft Exchange email support, with a combined inbox to browse an email and contacts. email the person. Ability to search all saved SMS and MMS messages, with the added ability to deleted when a defined limit is reached. Numerous new camera features, including flash support, digital zoom, scene mode, white balance, color effect and macro focus. Improved typing speed on a virtual keyboard, with a smarter dictionary that learns from word usage and includes contact names as suggestions. Refreshed browser UI with bookmark thumbnails, double-tap zoom and support for HTML5. Calendar agenda view enhanced, showing attending status for each invitee, and the ability to invite new guests to events. Optimized hardware speed and revamped UI. Support for more screen sizes and resolutions, with better contrast ratio. Improved Google Maps 3.1.2. MotionEvent class enhanced to track multi-touch events.[45] Pressure-sensitive touch support in API, even though no according hardware existed at that time.[46][47] Addition of live wallpapers, allowing the animation of home-screen background images to show movement. Android 2.0.1 Eclair Android 2.0.1 Eclair (API 6) Version Release date Features Image(s) 2.0.1 December 3, 2009[48] Minor API changes, bug fixes and framework behavioral changes, bug fixes and framework behavioral changes. Minor amendments to the API and bug fixes. Android 2.2 Froyo (API 8) On May 20, 2010, the SDK for Android 2.2 Froyo, short for frozen yogurt) was released, based on Linux kernel 2.6.32.[50] Version Release date Features Image(s) 2.2 May 20, 2010 Speed, memory, and performance optimizations.[51] Additional application speed improvements, implemented through JIT compilation. [52] Integration of Chrome's V8 JavaScript engine into the Browser application. Support for the Android Cloud to Device Messaging (C2DM) service, enabling push notifications. Improved Microsoft Exchange support, including security policies, auto-discovery, GAL look-up, calendar synchronization and remote wipe.[53] Improved application to disable data access over a mobile network. Updated Market application with batch and automatic update features.[51] Quick switching between multiple keyboard languages and their dictionaries. Support for file upload fields in the Browser application. [55] The browser now shows all frames of animated GIFs instead of just the first frame only. Support for installing applications to expandable memory. Adobe Flash support. [56] Support for high-PPI displays (up to 320 ppi), such as four-inch 720p screens. [57] Gallery allows users to view picture stacks using a zoom gesture. Android 2.2 home screen 2.2.1 September 27, 2010 [58] Bug fixes, security updates and performance improvements. 2.2.2 January 21, 2011 [59] Minor bug fixes, including SMS routing issues that affected the Nexus One. [60] 2.2.3 November 21, 2011[61] Two security updates. Android 2.3 Gingerbread (API 9) On December 6, 2010, the Android 2.3 Gingerbread (API 9) On December 6, 2010, 2.3 December 6, 2010[63] Updated user interface design with increased simplicity and speed. Support for extra-large screen sizes and resolutions (WXGA and higher).[57] Native support for SIP VoIP internet telephones. Faster, more intuitive text input on a virtual keyboard, with improved accuracy, better suggested text and voice input mode. Enhanced copy/paste functionality, allowing users to select a word by press-holding, copying, and pasting. Support for Near Field Communication, headphone virtualization, headphone virtualization, and bass boost. New Download Manager, giving users easy access to any file downloaded from the browser, email, or another application. Support for multiple cameras on the device, including a front-facing camera, if available. Support for multiple cameras on the device, including a front-facing camera, if available. Support for multiple cameras on the device, including a front-facing camera, if available. keeping the device awake for too long. Enhanced support for native code development. Switched from YAFFS to ext4 on newer devices. [64][65] Audio, graphical, and input enhancements for game development. Switched from YAFFS to ext4 on newer devices. version to feature an Easter egg. It was an image of the Bugdroid standing next to a zombie gingerbread man, with many more zombies in the background. Android 2.3 home screen 2.3.1 December 22, 2010[66] Improvements and bug fixes for the Nexus S. 2.3.2 January 21, 2011[67] Improvements and bug fixes for the Nexus S. Android 2.3.3 Gingerbread Android 2.3.3 Gingerbread (API 10) Version Release date Features Image(s) 2.3.3 February 9, 2011[68] Several improvements and API fixes. [69] 2.3.4 April 28, 2011[70] Support for voice or video chat using Google Talk. [71] Open Accessory Library support. Open Accessory was introduced in 3.1 (Honeycomb) but the Open Accessory Library support. Library grants 2.3.4 added support when connecting to a USB peripheral with compatible software and a compatible application on the device. [72] Switched the default encryption for SSL from AES256-SHA to RC4-MD5. [73] Fixed a spontaneous reboot on Samsung Galaxy S Plus. 2.3.5 July 25, 2011 [75] Improved network performance for the Nexus S 4G, among other fixes and improvements. Fixed a Bluetooth bug on Samsung Galaxy S. Fixed a Wi-Fi crash on Samsung Galaxy S Plus. Improved the Gmail application. Shadow animations for list scrolling. Camera software enhancements. [76] Improved battery efficiency. 2.3.6 September 2, 2011[77] Fixed a voice search bug. [b] 2.3.7 September 21, 2011 Google Wallet support for the Nexus S 4G. Android 3.0 Honeycomb Android 3.0 Honeycomb (API 11) On February 22, 2011, the Android 3.0 Honeycomb (AP released on February 24, 2011.[84] The update's features included:[80] Version Release date Features Image(s) 3.0 February 22, 2011[82] Optimized tablet support with a new "holographic" user interface (removed again the following year with version 4.2).[85] New Easter egg, an image of a Tron-themed bumblebee. Added System Bar, featuring quick access to notifications, status, and soft navigation buttons, available at the bottom of the screen. Simplified multitasking - tapping Recent Applications in the System Bar allows users to see snapshots of the tasks underway and quickly jump from one application to another. Redesigned the keyboard, making typing fast, efficient and accurate on larger screen sizes Simplified, more intuitive copy/paste interface. Multiple browser tabs replacing browser windows, plus form auto-fill and a new "incognito" mode allowing somewhat anonymous browsing. Quick access to camera exposure, focus, flash, zoom, front-facing camera, time-lapse, and other collections in full-screen mode in Gallery, with easy access to thumbnails for other photos. New two-pane Email UI to make viewing and organizing messages more efficient, allowing users to select one or more messages. Hardware acceleration. Support for multi-core processors. Ability to encrypt all user data. HTTPS stack improved with Server Name Indication (SNI). Filesystem in Userspace (FUSE; kernel module). Disallows applications from having to write access to secondary storage (memory cards on devices with internal primary storage) outside of designated, application-specific directories. Full access to primary internal storage is still allowed through a separate application-level permission. [86][87] Android 3.1 Honeycomb Android 3.1 Honeycomb (API 12) Version Release date Features Image(s) 3.1 May 10, 2011[88] UI refinements. Connectivity for USB accessories (USB On-The-Go). Expanded Recent Applications list. Resizable Home screen widgets. Support for FLAC audio playback. [89][90] High-performance Wi-Fi lock, maintaining high-performance Wi-Fi connections when the device screen is off. Support for HTTP proxy for each connected Wi-Fi access point. Android 3.2 Honeycomb Android 3.2 Honeycomb Android 3.2 Honeycomb (API 13) Version Release date Features Image(s) 3.2 July 15, 2011[91] Improved hardware support, including optimizations for a wider range of tablets. Increased ability of applications to access files on the SD card, e.g. for synchronization. Compatibility display mode for applications to access files on the SD card, e.g. for synchronization. Compatibility display mode for applications to access files on the SD card, e.g. for synchronization. Compatibility display mode for applications to access files on the SD card, e.g. for synchronization. Compatibility display mode for applications to access files on the SD card, e.g. for synchronization.

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and minor security, stability and Wi-Fi improvements. Update to Android Market with automatic updates and easier-to-read Terms and Conditions text. Update to Google Books. Improved Adobe Flash support in browser. Improved Chinese handwriting prediction. 3.2.2 September 30, 2011 Bug fixes and other minor improvements for the Motorola
Xoom 4G. 3.2.4 December 15, 2011 Pay As You Go for 3G and 4G tablets. 3.2.6 February 15, 2012 Fixed data connectivity issues when coming out of Airplane mode on the US 4G Motorola Xoom. Android 4.0 Ice Cream Sandwich (API 14) The SDK for Android 4.0.1 (Ice Cream Sandwich), based on Linux kernel 3.0.1
[93] was publicly released on October 19, 2011.[94] Google's Gabe Cohen stated that Android 4.0 was "theoretically compatible" with any Android 4.0 became available on November 14, 2011.[96] Ice Cream Sandwich was the last version to officially support Adobe Systems'
Flash player.[97] The update introduced numerous new features: [98][99][100] Version Release date Features Image(s) 4.0 October 18, 2011[98] Major refinements to the "Holo" interface with the new Roboto font family. Soft buttons from Android 3.x are now available for use on phones. Separation of widgets in a new tab, listed in a similar manner to
applications. Easier-to-create folders, with a drag-and-drop style. Improved visual voicemail messages. Pinch-to-zoom functionality in the Calendar. Integrated screenshot capture (accomplished by holding down the Power and Volume-Down buttons). Improved error correction on the keyboard. Ability to speed up or slow down voicemail messages.
to access applications directly from the lock screen. Improved copy-and-paste functionality. Better voice integration and continuous, real-time speech-to-text dictation. Face Unlock, a feature that allows users to unlock handsets using facial recognition software.[85] Automatic syncing of browser with users' Chrome bookmarks. Data Usage section in
settings that lets users set warnings when they approach a certain usage limit, and disable data use when the limit is exceeded. Ability to shut down applications from the recent apps list with a swipe.[101] Improved camera application with zero shutter lag, time lapse settings, panorama mode, and the ability to zoom while recording. Built-in photo
editor. New gallery layout, organized by location and person. Refreshed the "People" application with social network integration, status updates and hi-res images. Android Beam, a near-field communication feature allowing the rapid short-range exchange of web bookmarks, contact info, directions, YouTube videos and other data.[85] Support for the
WebP image format.[89] Hardware acceleration of the UI.[102] Wi-Fi Direct.[103] 1080p video recording for stock Android devices. Android devices. Android device. Android devices. Android device
Galaxy Nexus. 4.0.2 November 28, 2011 Fixed minor bugs on the Verizon Galaxy Nexus, the US launch of which was later delayed until December 2011.[c] Android 4.0.3 Ice Cream Sandwich (API 15) Version Release date Features Image(s) 4.0.3 December 16, 2011[106] Numerous bug fixes and optimizations.
Improvements to graphics, databases, spell-checking and Bluetooth functionality. New APIs for developers, including a social stream API in the Contacts provider enhancements such as improved content access for screen
readers. [107] 4.0.4 March 28, 2012 Stability improvements. Better camera performance. Smoother screen rotation. [108] Android 4.1 [elly Bean Android 4.1 [elly Bean (API 16) Google announced Android 4.1 [elly Bean (API 16) Google ann
an incremental update with the primary aim of improving the functionality and performance of the user interface. The performance improvement involved "Project Butter", which uses touch anticipation, triple buffering, extended vsync timing and a fixed frame rate of 60 fps to create a fluid and "buttery-smooth" UI.[109] Android 4.1 Jelly Bean was
released to the Android Open Source Project on July 9, 2012,[110] and the Nexus 7 tablet, the first device to run Jelly Bean, was released on July 13, 2012. Version Release date Features Image(s) 4.1 July 9, 2012 Smoother user interface: Vsync timing across all drawing and animation done by the Android framework, including application rendering,
touch events, screen composition and display refresh. Triple buffering in the graphics pipeline. CPU input boost. Synchronizing touch to vsync timing. Enhanced accessibility. Bi-directional text and other language support added. Ability to turn off notifications on an
application-specific basis. Shortcuts and widgets can automatically be re-arranged or re-sized to allow new items to fit on home screens. Bluetooth data transfer for Android Beam. Tablets with smaller screens now use an expanded version of the interface layout and home screen used by phones.[111] Improved camera application. Multichannel audio
[109] The Fraunhofer FDK AAC codec becomes standard in Android, adding AAC 5.1 channel encoding/decoding. USB audio (for external sound DACs).[109] Audio chaining (also known as gapless playback).[109] [112][113] Ability for other launchers to add widgets from the application drawer without requiring root access. Android 4.1 home screen
4.1.1 July 9, 2012[114] Fixed a bug on the Nexus 7 regarding the inability to change screen orientation in any applications. [117] Bug fixes and performance enhancements. Android 4.2 Jelly Bean Android 4.2 Jelly Bean (API 17)
Google was expected to announce Jelly Bean 4.2 at an event in New York City on October 29, 2012, but the event was cancelled due to Hurricane Sandy.[118] Instead of rescheduling the live event, Google announced the new version with a press release, under the slogan "A new flavor of Jelly Bean 4.2 was based on Linux kernel 3.4.0, and
debuted on Google's Nexus 4 and Nexus 10, which were released on November 13, 2012.[119][120] Version Release date Features 4.2 November 13, 2012.[121] Lock screen improvements, including widget support (removed again in 2014)[85] and the ability to swipe directly to the camera.[122] Notification power controls ("Quick Settings")
 "Daydream" screensavers, showing information when idle or docked (later renamed to "screen saver" following the launch of the unrelated Google Daydream VR platform in 2016).[85] Multiple user accounts (tablets only). Rewritten Bluetooth stack, switching from Bluez to Broadcom open source BlueDroid,[123] allowing improved support for
multiple displays and wireless display (Miracast). Native right-to-left, always-on VPN and application for blind users. New clock
application with a built-in world clock, stop watch and timer. All devices now use the same interface layout, previously adapted from phones on 4.1 for smaller tablets (with centered application menu), regardless of screen size. Increased number of
extended notifications and Actionable Notifications for more applications, allowing users to respond to certain notifications within the notifications within the notifications within the application bar and without launching the application bar and without launching the applications within the notifications within the notifications within the notifications within the notification bar and without launching the application bar and without launching
where December was not displayed on the date selector when adding an event to a contact. [128] Added Bluetooth gamepads and joysticks as supported HIDs (Human interface devices). 4.2.2 February 11, 2013 [129] Fixed Bluetooth audio streaming bugs. [130] Long-pressing the Wi-Fi and Bluetooth icons in Quick Settings now toggles the on/off state
New download notifications, which now show the percentage and estimated time remaining for active application animation allows faster loading. USB debug whitelist. Bug fixes and performance enhancements. Android 4.3 Jelly Bean Android 4.3 Jelly Bean (API
18) Google released Jelly Bean 4.3 under the slogan "An even sweeter Jelly Bean" on July 24, 2013, during an event in San Francisco called "Breakfast with Sundar Pichai". Most Nexus device to officially ship with it.[131] A minor bug fix update was
released on August 22, 2013.[132] Version Release date Features 4.3 July 24, 2013[133] Bluetooth Audio/Video Remote Control Profile (AVRCP) 1.3 support. [134] Restricted access mode for new user profiles.[134] Filesystem performance improvement by
running the fstrim command while a device is idle.[135] Dial pad auto-complete in the Phone application.[134] Volume for incoming calls (ringtone) and notification alerts is no longer adjustable separately. Improvements to Photo Sphere.[136] Reworked camera UI, previously introduced on Google Play edition phones.[137] Addition of "App Ops", a
fine-grained application permissions control system (hidden by default).[138] SELinux enabled by default. 4K resolution support for geofencing and Wi-Fi scanning APIs. Background Wi-Fi location still runs even when Wi-Fi is turned off. Developer
logging and analyzing enhancements. Added support for five more languages now supported. [134] Clock in the status bar disappears if it is selected as a lockscreen widget. Native emoji support. [141] 4.3.1 October 3, 2013 [142] Bug fixes and small tweaks for the Nexus 7
LTE.[143] Android 4.4 KitKat Android 4.4 KitKat Android 4.4 KitKat Android 4.4 KitKat on September 3, 2013. Although initially under the "Key Lime Pie" ("KLP") codename, the name was changed because "very few people actually know the taste of a key lime pie." [144] Some technology bloggers also expected the "Key Lime Pie" release to
be Android 5.[145] KitKat debuted on Google's Nexus 5 on October 31, 2013, and was optimized to run on a greater range of devices than earlier Android versions, having 512 MB of RAM as a recommended minimum; those improvements were known as "Project Svelte" internally at Google.[146] The required minimum amount of RAM available to
Android is 340 MB, and all devices with less than 512 MB of RAM must report themselves as "low RAM" devices.[147] Version Release date Features Image(s) 4.4 October 31, 2013[148][149] Refreshed interface with white elements instead of blue. Clock no longer shows bold hours; all digits are thin. The H, M, and S markings for the stopwatch and
timer have been removed, leaving just the numbers. Ability for applications to trigger translucency in the navigation and status bars lidden while maintaining user interaction. [151] Action overflow menu buttons are always visible, even on devices with a
"Menu" key, which was officially deprecated by Android 4.0.[152] Write access disabled for user-installed applications on external storage (i.e. MicroSD), except for their own directories inside Android/data.[153][154] Purging of app data directories in user storage (internal user storage and MicroSD) upon uninstallation[154] Optimizations for
 performance on devices with lower specifications, including zRAM support and "low RAM" device API.[146] Wireless printing capability.[146] WebViews are now based on the Chromium engine (feature parity with Chrome for Android 30). Expanded functionality for notification
  listener services.[146] Public API for developing and managing text messaging clients.[155] Storage Access Framework, an API allowing apps to retrieve files in a consistent manner. As part of the framework, a new system file picker allows users to access files from various sources (including those exposed by apps, such as online storage services).
[86] New framework for UI transitions. Sensor batching, step detector and counter APIs.[146] Built-in screen recording feature (primarily for developers, as usage of ADB is
required).[157] Native infrared blaster API. Verified boot. Enforcing SELinux. Expanded accessibility APIs and system-level closed captioning settings. Android Runtime (ART) introduced as a new experimental application runtime environment, not enabled by default, as a replacement for the Dalvik virtual machine.[158] Bluetooth Message Access
Profile (MAP) support.[159] Disabled access to battery statistics by third-party application no longer uses a multi-pane layout on devices with larger screens. Wi-Fi and mobile data activity (TX/RX) indicators are moved to quick settings.[161] Disables text wrapping in the WebView browser component.[162] Android 4.4
home screen 4.4.1 December 5, 2013[163][164] Better application compatibility for the experimental Android Runtime (ART). Camera application now loads Google+ Photos instead of Gallery when swiping away from the camera view. Miscellaneous improvements and bug fixes. 4.4.2 December 9, 2013[163][164] Better application compatibility for the experimental Android Runtime (ART).
fixes. Removal of the "App Ops" application permissions control system, introduced in Android 4.3.[166] 4.4.3 June 2, 2014[167][168] Refreshed the Dialer app's interface.[169] Updated the Chromium-based WebView to version 33 (screencasting to DevTools, HTML5 Canvas hardware acceleration performance improvements, vibration API, HTML5 Canvas hardware acceleration permissions control system, introduced in Android 4.3.[166] 4.4.3 June 2, 2014[167][168] Refreshed the Dialer app's interface.[169] Updated the Dialer app's interfac
form validation, and an HTML5 datalist).[170] Miscellaneous improvements and bug fixes. 4.4.4 June 19, 2014[171] CVE-2014-0224 fixed, eliminating an OpenSSL man-in-the-middle vulnerability.[172] Android 4.4W KitKat, with wearable extensions (API 20) On June 24, 2014, a version of Android KitKat
exclusive to Android Wear devices was released. Version Release date Features 4.4W[173] June 25, 2014[174] Initial release of the Android Wear platform for smartwatches: the same as Android 4.4 "KitKat", but with wearable extensions added. 4.4W.1 September 6, 2014[175] UI updates for Google Maps navigation and alarms. 4.4W.2 October 21
2014[176] Offline music playback. GPS support. Android 5.0 Lollipop Android 5.0 Lollipop (API 21) Android 5.0 Lollipop (api 21
by Google, including Nexus and Google Play edition devices. Its source code was made available on November 3, 2014.[177][178] Lollipop features a redesigned user interface built around a responsive design language referred to as "material design". Other changes include improvements to the notifications, which can be accessed from the
lockscreen and displayed within applications as top-of-the-screen banners. Furthermore, Google made internal changes to the platform, with the Android Runtime (ART) officially replacing Dalvik for improve and optimize battery usage, known internally as Project Volta.[179][180][181]
[182] Version Release date Features Image(s) 5.0[183] November 4, 2014[17] Android Runtime (ART) with ahead-of-time (ACT) compilation and improved garbage collection (GC), replacing Dalvik that combines bytecode interpretation with trace-based just-in-time (JIT) compilation. [183][184] Support for 64-bit CPUs. OpenGL ES 3.1 and Android
Extension Pack (AEP) on supported GPU configurations, up to a configured maximum of tasks per application, bringing a restyled user interface and "ripple effect" for buttons. Refreshed lock
screen, no longer supporting widgets.[185] Refreshed notification tray and quick settings for quicker access to particular settings. Lock screen provides shortcuts to application and notification settings. [186] Guest logins and multiple user
accounts are available on more devices, such as phones.[187] Audio input and output through USB devices. Third-party applications regain the ability to read and modify data located anywhere on external storage, such as on SD cards. However, those must be adapted to the storage access framework of Android API level 21 or higher.[188][189]
Pinning of an application's screen for restricted user activity.[186] Recently used applications are remembered even after restarting the device.[186] WebViews receive updates independently through Google Play for security reasons, instead of relying on system-wide vendor updates.[190] Addition of 15 new languages: Basque, Bengali, Burmese
Chinese (Hong Kong), Galician, Icelandic, Kannada, Kyrgyz, Macedonian, Malayalam, Marathi, Nepali, Sinhala, Tamil and Telugu.[191] Tap and Go allows users to quickly migrate to a new Android device, using NFC and Bluetooth to transfer Google Account details, configuration settings, user data and installed applications.[186] A flashlight-style
 application is included, working on supported devices with a camera flash.[186] User-customizable priorities for application notifications.[192] Smart lock feature.[193] SELinux in enforcing mode for all domains. Updated emoji.[194] Improved accessibility support (e.g. switch access support).[195] Block-based over-the-air (OTA) updates for new
devices.[196] Task listing access disabled for third-party applications. Android 5.0 home screen 5.0.1 December 2, 2014[197] A few bug fixes, including resolving issues with video playback and password failures handling. 5.0.2 December 19, 2014[22] Fixes a bug with TRIM support (introduced in Version 4.3), which prevented devices from running
on-charger cleanups of file system allocations if the device was turned off at midnight, or if it was charged only when in use. [198] Android 5.1 Lollipop Android 5.1 Lollipop (API 22) Version Release date Features Image(s) 5.1 March 2, 2015[18] Improvements
and bug fixes to the Overview screen. Ability to join Wi-Fi networks and control paired Bluetooth device is reset to factory settings. High-definition voice
calls, available between compatible 4G LTE devices running Android 5.1.[200] Improvements to the notification priority system, to more closely replicate the silent mode that was removed from Android 5.0.[201] 5.1.1 April 20, 2015[202][203] Various bug fixes[203] Native Wi-Fi calling support.[204] Android 6.0 Marshmallow Android 6.0
Marshmallow (API 23) Android 6.0 "Marshmallow" was unveiled under the build number MPZ44Q.[205] The third developer preview (MPA44G) was released on August 17, 2015 for the Nexus 5, and Nexus 9 tablet, and 
Nexus 6, Nexus 9 and Nexus Player devices, [206] and was updated to MPA44I that brought fixes related to Android for Work profiles. [207] Version Release date Features Image(s) 6.0 October 2, 2015[19][208] Precluded rudimentary file manager (package name: com.android.documentsui), accessible from storage settings. [209] Memory card
mounted to /storage/????-???/ rather than /storage/extSdCard/, with a hexadecimal volume serial number in place of the wildcard the question marks.[211] Introduction of Doze mode, which reduces CPU speed while the screen is off in order to save battery life.[212] App Standby feature.
Alphabetically accessible vertical application drawer.[213] Application search bar and favorites. Native fingerprint reader support. Direct Share feature for target-specific sharing between apps.[214] Renamed "Priority" mode to "Do Not Disturb" mode. App Linking for faster instinctive opening of links with corresponding applications.[215][216]
Larger Application folders with multiple pages. Post-install/run-time permission requests. USB-C support. Demo Mode feature for screenshot-capture usage. [217] Automatic full data backup and restore for apps. [218] 4K display mode for apps. [218] 4K disp
instruments.[222] Experimental multi-window feature.[223][224] Support for actions by third-party apps in the text selection menu.[85] App permissions now granted individually at run-time, not all-or-nothing at install time. Similar to App Ops.[225] Miracast support dropped.[85] Many new essential commands supported by Android's Linux shell
(/bin/sh). No screen rotation during touch. Android 6.0 home screen 6.0.1 December 7, 2015[226] Unicode 7.0 & 8.0 emoji support.[227] Descriptions for USB connection options. Double-press the power button to open the camera. Android 7.0 Nougat (API 24) Android "Nougat" (codenamed N in-development) is the seventh major
release of the Android operating system. It was first released as a developer preview on March 9, 2016, with factory images for supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as with the new "Android Beta Program" which allows supported Nexus devices, as well as w
2016. The final preview build was released on July 18, 2016,[228] with the build number NPD90G. Version Release date Features Image(s) 7.0 August 22, 2016[229] Support for file-based encryption.[230] Unicode 9.0 emoji and skin tone modifier support (and exposes a subset of ICU4J APIs).[231] Ability to display color calibration. Ability to zoom in
the screen. Ability to switch to the last opened app by double-tapping the overview button. Added an Emergency information part. Added the "Clear All" button to the Overview screen. Another system updates. Daydream virtual reality platform (VR interface). Improved Doze
functionality, which aims to prolong battery life. Improvements to the file browser. Ability to move files added to Storage Access Framework[232] More Quick Settings options. Multi-window support, which supports floating apps on a desktop layout. New Data Saver mode, which can force apps to reduce bandwidth usage. New JIT Compiler, making
for 75 percent faster app installations and a 50 percent reduction in compiled code size. Just in Time (JIT) compiler with code profiling to ART, which lets it constantly improve the performance of Android apps as they run. [233] Picture-in-picture support for Android TV. Redesigned notification shade, featuring instant access to certain settings.
Redesigned Overview screen. Replaced notification cards with notification drawer. Vulkan 3D rendering API. Multiple Device Locales[234] Discontinuation of Android 7.1 Nougat (API 25) On October 19, 2016,
Google released Android 7.1.1 as a developer preview for the Pixel C. A second preview became available on November 22, 2016, before the final version was released to the public on December 5, 2016. Version Release date Features Image(s) 7.1 October 4, 2016[237] Rearranged notification shade. "Restart" option
 added to power button menu[238] Touch/display performance improvements. Moves (Fingerprint swipe down gesture - opt-in). Opt-in with new hardware required: Seamless A/B system updates. Daydream VR mode. Developer features: Shortcut manager APIs. Circular app icons support. Keyboard image insertion. Fingerprint sensor gesture to
open/close notification shade. Manual storage manager Intent for apps. Improved VR thread scheduling. Enhanced wallpaper metadata. Multi-endpoint call support. Support for various MNO requirements. PCDMA voice privacy property. Source type support for Visual Voicemail. Carrier config options for managing telephone videos. Manual storage
 manager - identifies files and apps using storage. Android 7.1 home screen 7.1.1[239] December 1, 2016[240] New set of emojis adding different skin tones and haircuts to existing ones. Send GIFs directly from the default keyboard. App shortcuts: Launch actions on apps by long-pressing the app icon. Developer Options: Show CPU Usage feature
removed. 7.1.2[241][242] April 2, 2017[243] Battery usage alerts. Android 8.0 Oreo (API 26) Android Oreo is the eighth major release of the Android O, on March 21, 2017, with factory images for supported Nexus and Pixel devices. The final
developer preview was released on July 24, 2017, with the stable version released in August 2017. Version Release date Features Image(s) 8.0[244] August 21, 2017 Project Treble, the biggest change to the foundations of Android updates. Picture
in-picture support. Support for Unicode 10.0 emoji (5.0) and replacement of all blob-shaped emojis by round ones with gradients and outlines. Redesigned Quick Settings by regrouping sections into similar entries. Adaptive icons Notification
improvements. Notification channels. Notification shade multi-colors (for music album art, messengers, etc.). System-wide Autofill framework. Support for AAC, Sony's LDAC and Qualcomm's aptX and aptX HD codecs. [245] App-specific unknown sources. Multi-display support. 2 times faster boot time
compared to Nougat according to Google, testing on their Pixel devices. [244] Apps background execution and location limits. Google Play Protect. Downloadable fonts. Integrated printing support. Color management (deep color and wide color gamut). Wi-Fi Assistant. Android 8.1 Oreo Android 8.1 Oreo (API 27) Android 8.1
2017. Version Release date Features Image(s) 8.1[246][247] December 5, 2017[248][249] Neural networks API. Shared memory API. WallpaperColors API. Bluetooth battery level for connected devices, accessible in Quick Settings. Android Oreo Go Edition, a lightweight distribution of Android that runs better than normal Android on devices with less
than 1 GB of RAM.[250] Autofill framework updates. Programmatic Safe Browsing actions. Navigation buttons dim when not in use. Visual changes to 'Power Off' and 'Restart', including a new screen and floating toolbar. Toast messages are now white with the same existing transparency. Automatic light and dark themes. New Easter egg in the form
of an official Oreo cookie picture. [251] Android 9 Pie (API 28) And
May 8, 2018. The final beta of Android Pie (fifth preview, also considered as a "Release Candidate") was released on July 25, 2018. The first official release was released on August 6, 2018. Wersion Release date Features Image(s) 9 August 6, 2018. Wersion Release date Features Image(s) 9 August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official release was released on August 6, 2018. The first official released on August 6, 2018. The first official released on August 6, 2018. The first official released on August 6, 2018. The fir
bar.[253] The "dock" now has a semi-transparent background.[253] Battery Saver no longer shows an orange overlay on the notification and status bars.[253] A new "Lockdown" mode which disables biometric authentication once activated. Rounded corners across the UI. New
transitions for switching between apps, or activities within apps. Richer messaging notifications, where a full conversation can be seen within a notification, full-scale images, and smart replies akin to Google's new app, Reply. Support for display cutouts. Redesigned volume slider. Battery percentage now shown in Always-On Display. Lock screen
security changes include the possible return of an improved NFC Unlock. Experimental features (which are currently hidden within a menu called Feature Flags) such as a redesigned About Phone page in settings, and automatic Bluetooth enabling while driving. DNS over TLS.[254] A new optional gesture-based system interface, allowing users to
navigate the OS using swipes more often than the traditional UI. Redesigned multitask app switcher with the Google search bar and app drawer built-in. Android Dashboard, which tells the user to set time limits on apps. "Shush", an enhanced version of Do Not Disturb
mode activated by placing the phone face down, which mutes standard notifications. "Adaptive Battery" prediction, which makes use of Doze to hibernate user apps the OS determines the user will not use. Auto-Brightness feature modifies screen brightness feature modifies feature m
Do Not Disturb and turns the entire phone's interface gray to discourage further use at night. Vulkan 1.1 support. Call recording options fully disabled [255] Android 10 kndroid 10 kndroi
2019. Version Release date Features Image(s) 10 September 3, 2019 Revamped full-screen gesture navigation with new app open/close animations. [259] New permissions required to access photo, video and audio files. [260] Background apps can no longer jump into the
foreground.[260] Limited access to non-resettable device identifiers.[260] Background (idle) access to camera, microphone and sensors disabled for more privacy protection with the side effect of disabling antitheft software.[261][262][263] Sharing shortcuts, which allow sharing content with a contact directly.[260] Floating settings panel, that allows
changing system settings directly from apps. [260] Support for the AV1 video codec, the HDR10+ video codec, the HDR10+ video codec, the HDR10+ video format and the Opus audio codec. [260] Support for aptX Adaptive, LHDC, LLAC, CELT and AAC LATM codecs [264] [265] A native MIDI API,
allowing interaction with music controllers.[260] Better support for biometric authentication in apps.[260] Support for Notification Bubbles.[260] Support for Notification Bu
components to be updated via the Google Play Store, without requiring a complete system update[270] Android 11 (API 30) Androi
[271][272] The launch of Android 11 Beta was postponed from June 3, 2020 to June 10, 2020.[273] Version Release date Features Image(s) 11 September 8, 2020 Chat bubbles. Screen recorder. Notification history. New permissions controls. API distinction between standalone 5G NR and non-standalone 5G. One-time permission[274] Permissions
 auto-reset.[274] Wireless Android Auto on devices with 5GHz Wi-Fi.[275] Increased number of updatable core OS components in Google Play from 12 to 21.[274][276] Enterprise work profile privacy protections now apply on company-owned devices.[277] Independent left and right edge sensitivity for gesture navigation.[278] Android 11 home screen
Android 12 Android 12 (API 31) Android 12 is the twelfth major version of the Android operating system. It was first announced by Google on February 18, 2021, and the first developer preview was released on the same day.[279][280] Version Release date Features Image(s) 12 October 4, 2021 Easier Wi-Fi sharing. AVIF image support. Material You
an updated design language based on Material Design. Scrolling Screenshot.[281] One Handed Mode.[282] Android Runtime (ART) module added to the updatable core OS components via Google Play, added functionality to existing modules.[283][284] Area Magnification can zoom in any content on device.[285] Extra Dim reduces brightness below
minimum level.[286] Bold Text. Greyscale. Mic and Camera indicator and toggle.[citation needed] Option to choose precise or approximate location.[287] Privacy Dashboard.[288] Gestures can work in immersive mode.[289] Performance improvements to system services to improve transitions, power efficiency, and reduce app startup times.[290]
Third party app stores now have the ability to update apps without constantly asking the user for permission. [291] Android 12L (API 32) Android 12L (api asking the user for Android 12L (api asking the user for permission. [291] Android 12L (api asking the user for Andr
system. It was announced on October 2021 alongside Beta releases with a stable version launching on March 7, 2022. Version Release date Features Image(s) 12L March 7, 2022 Improvements specific for foldable phones, tablets, desktop-sized screens and Chromebooks, and modifications to the user interface to tailor it to larger screens. [292]
Android 13 Android 13 (API 33) Android 13 (API 33) Android 13 home screen with themed icons and widgets Hardware requirements See also: Android (operating system) § Hardware The main hardware platform for Android is the 64
bit ARM architecture (i.e. ARMv8-A; previously the 32-bit ARMv7 architecture was supported and first ARMv5), with x86[e] and MIPS[f] architecture was supported in later versions of Android 1.0 through 1.5 required a 2 megapixel camera
with autofocus camera. This was relaxed to a fixed-focus camera with Android 1.6.[296] In 2012, Android devices with Intel processors began to appear, including phones[297] and tablets. While gaining support for 64-bit variants of
all platforms are supported in addition to the 32-bit variants. Requirements for the minimum amount of RAM for devices running Android 7.1 depend on screen size and density and type of CPU, ranging from 816 MB-1.8 GB for 64-bit and 512 MB-1.3 GB for 32-bit meaning in practice 1 GB for the most common type of display (while minimum for
Android watch is 416 MB).[300][g] The recommendation for Android 4.4 is to have at least 512 MB of RAM,[301] while for "low RAM" devices 340 MB is the required minimum amount that does not include memory dedicated to various hardware components such as the baseband processor.[147] Android 4.4 requires a 32-bit ARMv7, MIPS or x86
architecture processor, [302] together with an OpenGL ES 2.0 compatible graphics processing unit (GPU). [303] Android supports OpenGL ES 1.1, 2.0, 3.0, 3.2 and since Android 7.0 Vulkan (and version of the OpenGL ES, and suitable GPU hardware is
required to run such applications.[303] In 2021, Android was ported to RISC-V.[305] In 2021, Android was porte
March 2022 and subsequent updates as 12.1 for the version. [22] Note: The software information on supported devices continues to show Android version 12 with no indication of the update. ^ The 2.3.6 update had the side-effect of impairing the Wi-Fi hotspot functionality of many Canadian Nexus S phones. Google acknowledged this problem and
fixed it in late September.[78][79] ^ For Canadian consumers, 4.0.2 reportedly created a bug on the Galaxy Nexus that crashed the NFC capabilities of the Nexus phone.[104][105] ^ Released as "Android 12.1" for smartphones of the Nexus phone.
Lowest supported x86 generation is the P6 microarchitecture, also called i686.[293] ^ Disk-based memory (hard drives), solid state disk devices such as USB drives, DVD-based storage, bit rates, bus speeds, and network speeds, are specified using decimal meanings for
K (10001), M (10002), G (10003), etc. References ^ Elgin, Ben (August 17, 2005). "Google Buys Android for Its Mobile Arsenal". Bloomberg Businessweek. Bloomberg Businessweek.
Retrieved April 8, 2013. ^ "Dan Morrill". Google +. January 2, 2013. Archived from the original on September 30, 2011. ^ "Live Google's gPhone Open handset alliance
conference call" (transcript). Gizmodo. November 5, 2007. Archived from the original on February 8, 2013. ^ "SDK Archives". Android Developers. Archived from the original on August 22, 2010. Retrieved February 8, 2013. ^ "SDK Archives". Android Developers. Archived from the original on August 22, 2010. Retrieved February 8, 2013. ^ "SDK Archives".
 March 3, 2015. Retrieved March 7, 2015. ^ "The history of Android: Android 1.0—introducing Google Apps and actual hardware". Ars Technica. June 16, 2014. Archived from the original on March 10, 2015. Retrieved December 5, 2018. ^ a b "Codenames, Tags, and Build Numbers". Android Open Source Project. Google. Retrieved June 1, 2022. ^ a b
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