

Current state of KaiOS in Emerging market and roadblocks

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In this paper I am going to review and discuss the recent status of KaiOS. Also focus on the history of it. What are the reasons and how it became one of the best operating systems for feature phones. I also will focus on KaiOS's present market condition and also future scope of improvement. Also figure out the fundamental idea of this OS. This OS is also a open source and I want to discuss the basic programming language and development process of this OS. In future a lots of opportunities are waiting for this platform's development. Not just because It is a open platform but also it creates a great opportunity for small budget phone with world class features.

CCS Concepts: • **Human-centered computing** → **Graphical user interfaces**.

Additional Key Words and Phrases: KaiOS's features, operating system, mobileoperating system, open-source, affordable phones,HCI,KaiOS's challenges]

ACM Reference Format:

Md. Jubaer Khan ID:1721616042. 2020. Current state of KaiOS in Emerging market and roadblocks. In *Proceedings of HOME '20: MobileHCI KaiOS in Emerging market and roadblocks (HOME '20)*. ACM, New York, NY, USA, 8 pages. <https://doi.org/00000/0000000>

1 INTRODUCTION

In this section I would like to discuss the history of this KaiOS. This os was founded in 2016 after the innovation it just released over one year on the feature phone [2]. After innovating the android the feature phone market was downing day by day. Because of the open source software development android is becoming more popular on the other hand with a limited source and use the feature phone's market is not seen any ups for a decade. But with the kaiOS there is a hope and future for this small budget phone. It opens many opportunities of new applications with updated features and also a good development environment for the feature phones.

For their unique selection of devices it creates an opportunity for both the device and also the OS. They also name this operating system based on the basic idea of it means making an open source OS. In chinese Kai means "open sourced" [16]. It is only three years old but it has already proven itself. We all know after Android and iOs is introduced other mobile based operating systems lost their market and those two became the marked denominator. But the idea of KaiOS started giving those two market giants a competition. This mobile os got the idea from Linux. A non-touch screen phone can have state of the art features and is only be possible for KaiOS. This OS is first introduced in large platform by Jio[Reliance Communications] in India. They called that feature phone their jiophone with that a new era of highly advanced feature phone is started. Jiophone is the first of it kind with the feature of google assistant and other feature that previously only seen in the touchscreen phones.

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Manuscript submitted to ACM

2 LITERATURE REVIEW

In this part I will discuss the journey and research scope. After releasing KaiOS they promote and target under developed or developing countries such as India, Brazil, Zimbabwe, Bangladesh. It also became popular in Mexico. In [17] Jeffrey James mentioned how this technology brings some important features and also improved the internet to the middle and lower income peoples. These alternative touchscreen devices are becoming popular day by day. Within three years KaiOS has more than 150 million users all over the world. This mobile OS is developed by KaiOS Technologies which is a Hongkong based company [3]. The largest shareholder of this company is TCL. KaiOS is also made based on the Linux kernel. Linux is a very popular computer user for its open source development environment. The availability of the library functions for Linux makes it more developer friendly. Same idea is picked for the KaiOS

This OS is first founded in 2016 and it was launched in 2017 [4]. For the keypad device with largest shareholder being Chinese multinational electronics conglomerate TCL corporation. TCL is a multinational electronic company. It is basically a Chinese company. From designing to selling of any kind of electronic devices, the company does everything. Newly Google has invested 22 Million dollar for the development purpose of KaiOS. Additional 7 million dollar has been invested by Reliance Jio. Which is an India-based telecom operator. And the progress of the OS is going so well that it has beat Apple's iOS and secured the second position [3]. Recently in March 2020 Mozilla and KaiOS have announced their partnership. The company of KaiOS has gained many awards including the "Changing lives awards".

The KaiOS is forked from Boot to Gecko OS (B2G OS). This Boot to Gecko OS was a community-developed mobile operating system. This follows the Firefox OS goals. KaiOS uses the open source. The Gecko is a Mozilla developed browser engine. This OS (B2G) was discontinued by Mozilla in 2016. The KaiOS contains a rich UX [16]. So, KaiOS is a developed version of Firefox. KaiOS uses HTML5 and some other web technologies. The web-based technologies give a flexibility so that it can run well in a limited hardware [16]. The primary features include 4G LITE E, VoLTE, GPS and Wi-Fi. This OS also supports HTML5 based apps. Longer battery life is also ensured to the non-touch device. It optimizes the user interface. And new feature is added to the OS. Which is it uses less memory and energy consumption in this OS. Still, it provides a really good user experience. Again, it has the features of over-the-air updates. One important point of the over-the-air update is anyone can central over the location and it can be sent to the users, those who are unable to get any updates [5]. The OS works with chipsets of some popular manufactures like MediaTek, UNISCO, Qualcomm. KaiOS offers a full-fledged store for popular apps. That's why users will be able to install their necessary apps from there such as HTML applications, Twitter, Facebook, YouTube. More than 500 apps were launched in the KaiOS store on 1st April of this year 2020. With the help of KaiOS developer portal app developers can create content for themselves. And they can also publish them into the KaiOS store. Even the apps can be monetized with the help of KaiAds. The products of KaiOS are divided into two components. One is core and another is App Profile. The App Profile summarizes the web apps all the built-in web applications. It shows the UI functions of KaiOS. In Fig. 1 the architecture is shown. Core part is the combination of Gecko and the hardware part and some other supporting modules [6]. KaiOS simply uses the HTML, CSS and JavaScript for app. And all of them are run on the Gecko runtime [7]. Parsing HTML, CSS is done for the rendering. It uses graphic APIs for painting. And JS engine named SpiderMonkey is used here. All the JavaScripts are executed on that platform. In order to connect with C++ components, XPConnect and WebIDL binding are used. The XP connect is a bridge in-between of JS and XPCOM. The communication way of application and core process is through IPC protocols [7]. Which is defined by IPDL. And the core components like file and memory management threads, Data structure all of these are given by XPCOM component object model [1]. It is mainly a cross platform component model. Its proper use has been seen in Firefox web browser. The Web APIs play a very important role here.

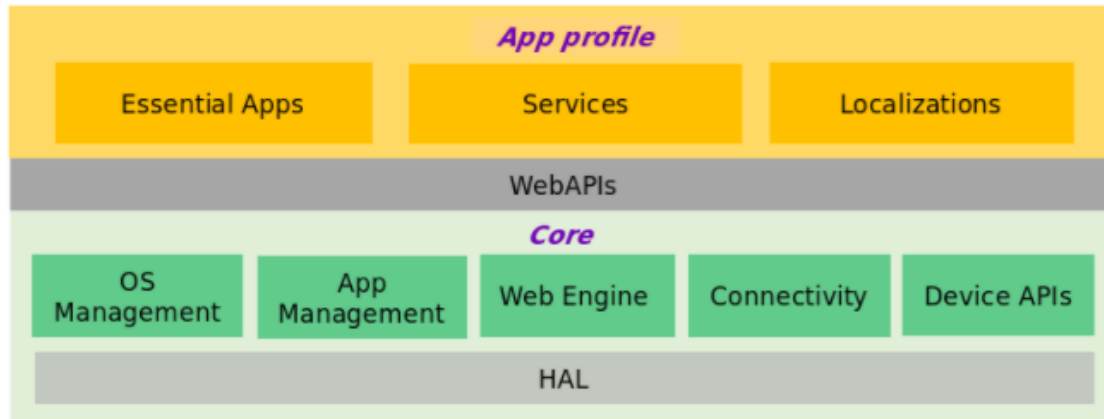


Fig. 1. Architecture: Core and App Profile combination of kaiOS. (<https://developer.kaiostech.com/introduction/architecture>).

It perform various tasks. It manipulates the DOM, Plays the audio or video files and also generates the 3D graphics. For the designing issue the OS is very light weighted on the hardware resources usages. And most importantly it can run over a device containing only 256 MB memory. It has given a new dimension to the feature phone. It has been able to reduce the gap between the feature phone and the smart phones. Now HMD Global is using this. And it is being used as the default operating system for the Nokia. This made by HMD Global. Some extra functionality is needed for the hardware support. Such as Wi-fi support, NFC payment system, apps support, web application support. KaiOS has instigated GSMA's latest KaiOS MISTT modules into Life app. It is spreading access to train digital skill. It is basically an internet skills training toolkit. Which contains 5 modules including KaiOS [8].

Even this OS can power some other devices just as cars, TV, wearables [14] The most important 5 feathers of the KaiOS are firstly, it supports 4G, Bluetooth, GPS, and many transfer applications. Second is it supports the most used applications, which are very popular in world wide. Third is google assistance is used in this. It can be used by using voice command and it can open any app even the navigation and typing too. Fourth is many of the low costly mobile devices have the OS. So, in order to use the KaiOS people don't have to buy a costly phone. Finally, the market share for the os is increasing day by day. By today's date (25th December) it has global market share of 0.2%. It has the presence of 100 million devices. It has additionally gained \$50nm from Cathay Innovation and the investors [9]. TLC holding and Google are included in them. There are many advantages of the KaiOS. As we know the OS is really light weighted. So, it does not require any Snaldragon 835 which comes with 8 gig Ram and 5000 Mah battery. It can run on a weak hardware. It has the browsers, google assistant and all the popular social websites. So, it has become very famous among the people. And the important part is it its popularity has increased as much that it has left behind the iOS. In India JioPhone has connect many people who are in the urban area. Not only India it has become popular in Africa too. Only in Africa there are 800 million people who are impressed by the newly introduced device. In Southeast Asia people are also supporting the OS. More than 100 million devices are running currently on KaiOS and also it has shipped over 100 countries [10] And as it supports the 4G internet. So, the internet speed will be so fast. Which is very grate to the users. This phone supports the dual-core with 1.3 GHZ UniSOC chipset. Which uses the 3G connectivity. The general display of this device is about 2.4-inch. Which is a non-touch display. The Ram of the device is 265MB which is very minimum. And the overall is 512MB and it is expandable. But for the JioPhone it is different. It comes with the 512MB RAM and

4GB of storage. It supports dual sim. And the camera is 1.2MP camera. But it does not contain dual camera. the camera will be on the one side only. I work well with the Wi-Fi support. Even the mobile hotspot is also good for it. Finally, it comes to the Bluetooth. The Bluetooth and GPS are also working best with it. There is also navigation system in the device. Though the system navigation is too simple. Like the right direction of the device will lead to the camera. And up button will give the setting menu. The center key will open the app drawer. The end call or reject call will let you to the back. And by pressing the center key you can accept anything. This easy manual is helping the people a lot. All of these makes the phone more usable. Any cheap android phone cannot have so much functionality or service. That's why they are more expensive. But this KaiOS is really useful among the low-cost phone. It is available is \$20 or less in market. Where any smartphone requires about \$50. The new addition will be 5G internet. They are trying to increase the internet user. Because the phone has an opportunity to use forge. Through this the network carriers will be able to sell data to the users who are likely to use the feature phone. And according to the calculation the percentage of the users to cell data will be 20 to 25. And it is a great contribution towards the business [11]. Slowly the KaiOS is taking the market. Already the Nokia's 8110 model has taken the place of Android in figure 2 that phones look is given. KaiOS



Fig. 2. Look of nokia 8110. (<https://images.app.goo.gl/VYtfbSLkRBs5jnmk9>).

is modern operating system. Though it contains smart-features but it is not called smartphone. Because, it doesn't contain some features that are available in smartphones. Such as touch display. And the large storage, or the high-end processors. Multitasking like smartphone cannot be done here. So, it is a lacking here. And another missing feature is copy and pasting feature. It is very much used feature in smartphones. App data cannot be shifted to another place. The goal of kaiOS is getting more smart. The OS has become more popular because of it's app support.

I would like to discuss two recent work on KaiOS. One is Climate Service Application [19] and another one is Crypto Wallet [18]. As we know previously these two applications are very much well developed and also made for solving

reallife problems. First let's discuss the "Climate Service Application". This app is for rural farmers as they can know the changes of climates and can be alert before any kind of weather disaster that can destroy their app. As they claimed this is a functional app and they tested with small budget phones and local farmers. They chose KaiOS so that any farmer can buy a device for using the application. They observe agricultural cycles and provide user necessary steps for better crops. This application also gives suggestions based on the climate so that farmers can know what is the need of their crops in the situation. First firmer will provide some basic information like what kind and which variety of crops

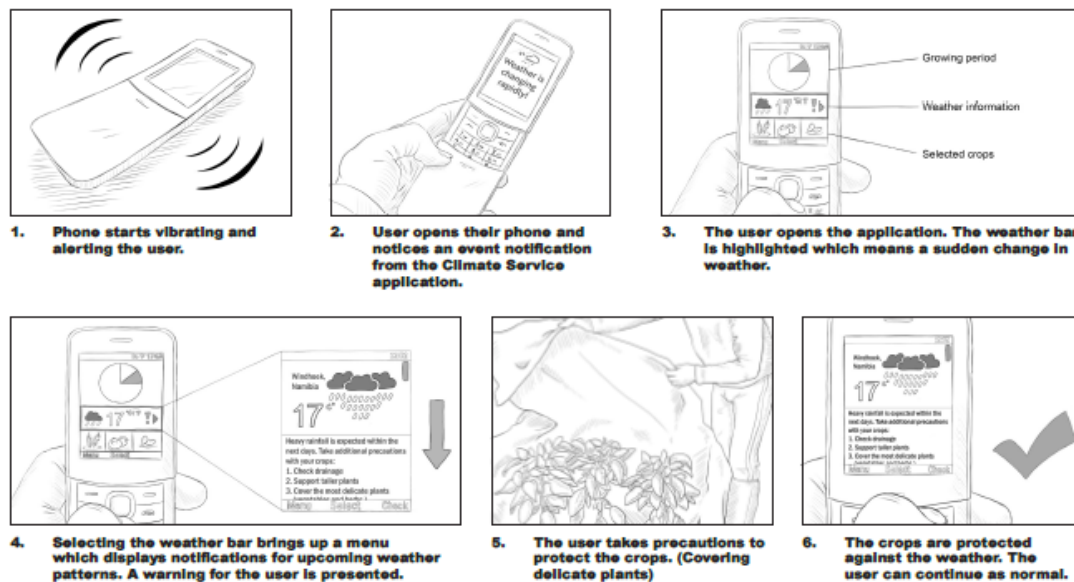


Fig. 3. Climate Service Application on KaiOS.[collector from "Holistic Model for Designing a Climate Service Application on the KaiOS Platform" Paper]

he wanted to grow then the app will collect some data and suggest crops that grow aon that environment and also give fermer a huge profit. If any kind of unusual change in climate is observed fermer will know before and take necessary steps to save their crops [19]. This app also a "todo list" type facility so that farmers can see what steps are needed for growing their crops.

This app will help rural farmers to get a good advice for their crops. And also can reduce the loss they faced when a natural disaster will come. They claimed this app is first research application with KaiOS. Figure 3 will help to understand their work. They also think this app will create a HCI field with using smart feature phone run on KaiOS.

We also find another app for low budget phones named "Crypto Wallet" [18]. This application is designed for use in crypto currency in general or low budget smartphone users. Normally for high end device user there are lots of app is already available but this app is for the people who doesn't have a smartphone but can easily buy a smart feature phone. Those people can use blockchain service so that they can easily check their crypto assets in the modern currency era. Normal crypto wallet can install the app on device and then create a account to use the services. But the app the came with can also run on a low power phones. In this app people will open their account on website then then the wallet will be generated automatically [18]. They use QRCode for transaction of "crypto currency".



Fig. 4. Comparison of use Crypto Wallet on smart phone and feature phone. And another picture is showing here how JavaScript QRCode scanner in KaiOS for currency transaction

For implementing this project they used Latest version of "WordPress" on Ubuntu Server, "WooCommerce plugin", Ethereum Wallet" plugin," Infura.io "API Key, hard coded PHP for "ERC20" token and JavaScript code of camera API for scanning QR code in feature phone. This app will run on KaiOS devices with the native web browser.

Previously no one can imagine without a smartphone(iPhone, android) crypto services can be used on such a feature phone with the progress of KaiOS and idea of implementing new things made this impossible possible. They have produces a web-based crypto wallet service for the people who doesn't have a smartphone. They tested it on Nokia 8810 which is just a 80 dollar phone. In future there are lots of opportunity to develop application like this for small budget phones. All these are became possible only for KaiOS. This app will create huge opportunity to use crypto currency with low priced phones. And shows a use of digital currency for smart feature phone. With this idea bkash and rocket can reach more people in Our country.

3 CURRENT STATE ROADBLOCKS

Though It's a fast growing mobile operating system and also open source, It has to compete with the market dominators such as android and iOS. There are lots of issues being notified. Basically it has been developed for feature phones. Most of the featured phones are non touch-screen phones. But there are lots of phones available with a touch-screen feature phone. People are also attracted by those devices. Last year April a report was published on how KaiOS can encounter those machine related issues. Touch-screen kiosks are designed for those devices. Some significant issues that can be reveal on this OS those are stop working screen while touch, important information can be blocked during stop repeated contact and due to software issues some features may not work properly [20]. There are other types of KaiOS also available in the market. Because they are recently released the major problem they are facing to encourage the user and create more attraction for the developer. The more developer are willing to work on this environment the more it's app store will become richer.

All of the applications for this operating system are based on web apps. It has some serious limitations. Those features phones with KaiOS have a good connectivity hardware but 4G and good wi-fi internet access is not so much available. This limitation creates a huge problem because without a good Internet connection this system's features are useless for the user. This web app helps the feature phone as the budget phone also creates some more issues. Some people believe that personal data is not secure on the cloud. This KaiOS app uses cloud for it's light hardware setting. All data is processed on the cloud so phones can have minimum hardware settings. But they have ensured the security of the

data by taking several steps in the developing stages [15]. People have a small knowledge about it because they don't want to take risks with their data. If they stabilize trust among users then they will have more people as users for this operating system. There is also a problem related to the speed of the application on the operating system. Applications are a little bit slower than local hosted applications [15].

The research and also funding is more important in this field. For mobile users web apps need some more improvement. If they want to organize more and can reach more users, website developers will think about keeping a view for feature phones. The web builder needs to improve mobile optimizer. Because the user and developer are just two sides of a single coin. They need to develop more so that the launcher time of an app will reduce more. They have to improve the UX design. Android and iOS already have their well established designs [12]. The screen and its input items should be more user friendly. Their development process should be faster if they want to grab some more users for their operating system.

The most challenging part is to design applications for feature phones because they have very small amounts of memory and RAM. Because of their hardware limitation previously there is not so much work with this type of device. Challenge is to improve more apps for this kind of device [12]. Where modern day applications need more hardware resources, the idea of KaiOS is just opposite of modern application and technological development. They need to come with new ideas to overcome the limitations problems.

KaiOS needs some more marketing and also introduction for developer tools can help people to enter in the society of this environment developer through some open courses and seminars can help to encourage people to be a KaiOS developer. The debugging tools and also development environment should be more improved. Api and function related documentation should be more easy to access. KaiOS Technologies have some guidelines [13] for their developer but those instructions must be more educative so that any programmer can easily develop apps for their store.

This os is not launched all over the world. So it is facing the issue of availability. KaiOS needs to enter all kinds of mobile devices and the developer community needs to increase. Already It became the third most popular mobile OS all over the world. But the competitors are in majority. The biggest problem for this OS is going to attract iOS and android users towards it. They need to overcome the market issue and express some more attractive ideas for improvement of the KaiOS. It would be hard to catch markets like the Middle East, Africa, South America, and Southeast Asia [16]. They have to come with some good and also impactful strategy for these markets.

4 CONCLUSION

Fulfilling the market demand is also challenging for them. Recently the world and technology changes faster and creates a new market demand. To survive this their innovation needs to be more state of the art. Though the limitation of resources, kaiOS is doing well to bring high level features in the feature phones. The demand for this kind of mobile is increasing day by day. Feature phones with kaiOS have some features that makes it more useful and attractive to the user. We all dreamt about a phone which will be small and with the feature of smartphones. The price range of this kind of phone is very low so people with lower income will be happy to buy this kind of device. KaiOS have some of the most technical and commercial giants as their partners. Google, Reliance and TCL have invested their money on this mobile operating system. Already performance in markets says it has a bright future in the mobile phone industry. Already the advantage for developers and opportunity for giving some best features in an entry level phone makes the KaiOS more valuable for people. In future features phones will give some hard competition to smartphones in the market. Also can be said

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