



Research on Interrupt Recovery Method of Mobile Micro-Application

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Abstract. Mobile micro-application has the advantages of small volume, rapid response to business demand changes, rapid update iteration, installation-free, and high security. With the widespread use of mobile applications, the types of services that need to be handled in a mobile application increase rapidly, and the mode of “mobile portal (basic application)+mobile micro-application” gradually rises. In mobile Internet applications, WeChat+applet is the most typical. In the process of enterprise mobile informationization, More and more mobile information construction mode of “portal APP+ micro-Application” is adopted. Each business Application is developed into a micro-Application, and then this micro-application is integrated into a portal app to centrally carry business applications, which effectively solves the problems of complicated authentication and inconvenient operation caused by multi-service and multi-app. However, in the process of mobile micro-application, the problem of application interruption often leads to data loss, which affects the normal operation of business logic and user experience. This paper summarizes and refines three interruption scenarios of mobile micro-applications, and puts forward a recovery paradigm of mobile micro-applications, which can cover a wider range of interruption scenarios, avoid data loss and business logic execution caused by interruption, and improve the fluency, fault tolerance and user experience of micro-applications.

Keywords: mobile micro-application, mobile portal, interrupt recovery.

1 Introduction

1.1 Main Problems

With the widespread use of mobile applications, the types of services that need to be handled in the same mobile application are rapidly increasing, and the mode of “mobile portal (basic application)+mobile micro-application” is gradually emerging^[1-6]. Taking WeChat as an example, WeChat ontology and applet use this mode, which effectively solves the problem that WeChat carries a large number of services. This

mode is widely used in both Internet mobile applications and enterprise portal apps. However, micro-applications running in this mode often encounter business interruption scenarios during use, which will affect business processing and user experience. In order to avoid information loss caused by interruption, we should first analyze the reasons for micro-applications interruption and then deal with them. After analysis, when the mobile micro-application runs based on the mobile portal (basic application), there will be multiple situations that lead to the interruption of the application^[7], such as the user's active shutdown, the active shutdown of the operating system caused by various situations, the flash back of the mobile application, and the interruption of the mobile application caused by various abnormalities such as sudden battery failure of the mobile phone and incoming calls. After summarizing these scenarios, they can be classified into the following three categories:

- Case 1: The user takes the initiative to shut down. Users cut out the micro-application voluntarily after the phased business is processed, or cut out the mobile portal APP due to misoperation such as accidental touch during the processing, which leads to the interruption of the mobile micro-application.
- Case 2: The operating system actively shuts down. When the user is performing operations such as screen extinction and Application switching to the background, the operating system optimizes the system resource allocation and improves the device performance according to its intelligent scheduling mechanism (considering factors including memory occupancy, device temperature, background application residence time, etc.), and automatically and forcibly terminates the operation of the portal app, resulting in the interruption of the mobile application.
- Case 3: Flash back of mobile application and other abnormal situations. Incompatibility between the versions of internal components of mobile applications and the current mobile phone operating system, insufficient resource allocation caused by memory overflow when the application is running, and potential programming errors (bugs) inside the application, etc., lead to unexpected exit and interruption of micro-applications caused by instability of portal apps or micro-applications.

Once the mobile micro-application is interrupted, it will lose some input unsaved or submitted data or some completed business process links, so it is necessary to realize interruption recovery. Mobile applications such as WeChat realize the scheme that applets (mobile micro-applications of WeChat) are suspended, that is, when users click the close button of applets, they don't actually close them, but only let applets enter the background. When users cut out and handle other businesses, when they open applets again, applets enter the foreground from the background, which preserves the main operating environment before users cut out. The main disadvantage of that prior art is that it can only solve the interrupt scene correspond to the first situation, and when the second and third interrupt scenes appear, the applet is not enter the background any more, but is directly killed, so it cannot be recovered when it is opened again.

1.2 Related Foundations

In the mode of “mobile portal (basic application)+mobile micro-application”, the mobile micro-application runs on the mobile portal (basic application), so the mobile portal (basic application) can perceive some mobile application states and perform some mobile application operations, which provides the basic mobile portal (basic application) with perceivable states for realizing the interruption recovery of the mobile micro-application. The operations performed include:

- The routing information perception ability of mobile micro-applications. That is, it can perceive the switching situation of mobile application pages, and confirm which page the mobile micro-application enters from, which page it passes through, and which page it finally stops at;
- The mobile micro-application interrupts the ability to perceive environmental information. That is, it can sense that the interruption is background retreat, flash back, etc., and provide a basis for subsequent execution of different operations.
- Persistent storage capability of mobile micro-application data. That is, it can store the data related to mobile micro-applications permanently, and provide a storage method for the state information needed for the recovery of mobile micro-applications.
- Mobile micro-application routing execution ability. That is, the mobile portal (basic application) can actively make the upper mobile micro-application switch pages.
- Ability to execute mobile micro-application scripts. That is, the mobile portal (basic application) can inject script code into the mobile micro-application, so that the mobile micro-application can execute some programs that do not exist in the original code of the mobile micro-application, and then control the mobile application to perform some more complicated recovery actions.

2 Recovery Method

2.1 General Idea

Focusing on the second and third reasons of interruption, this paper innovatively puts forward a method to recover the status, data and other environmental information of interrupted pages of mobile micro-applications. This method aims to cover a wide range of interruption scenarios, effectively prevent the loss of valuable information caused by interruption, and further significantly improve the fluency of business processing and the overall experience of users. Through the implementation of this scheme, it not only enhances the stability and reliability of the application, but also brings users a more coherent and seamless experience.

In the interrupt recovery mechanism of mobile micro-application, it needs to be realized by several key modules. These modules work together to ensure the effective preservation and recovery of the user's operating environment and enhance the user

experience. These modules are: application environment information module, routing module and page environment recovery module, as Fig. 1.

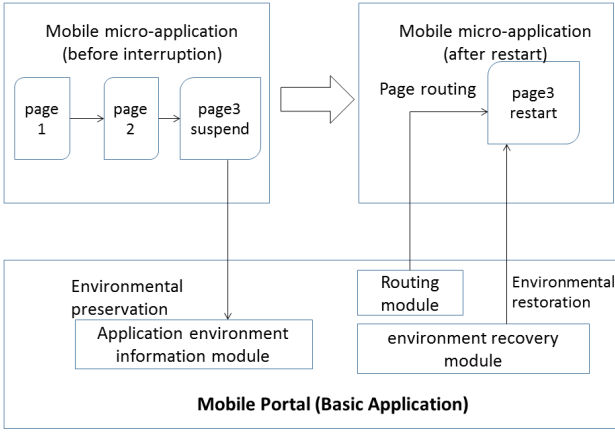


Fig. 1. Interrupt recovery principle of mobile micro-application

2.2 Design Principles

Apply the principle of minimum change: As far as possible, the mobile portal (basic application) can be used to record the information needed for interruption recovery and perform related operations in an insensitive and automatic way^[8], so as to minimize the changes of mobile micro-applications and lower the threshold for mobile micro-applications to use this method.

User transparency principle: the interruption recovery process should be transparent to users. When users reopen the application, they should be able to seamlessly return to the previous state without additional operations or configuration. In the process of recovery, if the user's confirmation is needed, clear tips and options should be provided to let the user know clearly what is happening.

Principle of data consistency: ensure the consistency and integrity of data during interruption recovery. Avoid data loss or inconsistency caused by the recovery process.

Principle of platform independence: Cross-platform compatibility should be fully considered to ensure that the scheme can work normally on different devices and frameworks and reduce the development and maintenance costs caused by platform differences.

2.3 Module Realization

(1) Application environment information module

The application environment information module is the core part of the interrupt recovery mechanism, which is responsible for capturing and saving key environment information in real time when users operate mobile micro-applications, as Fig. 2.

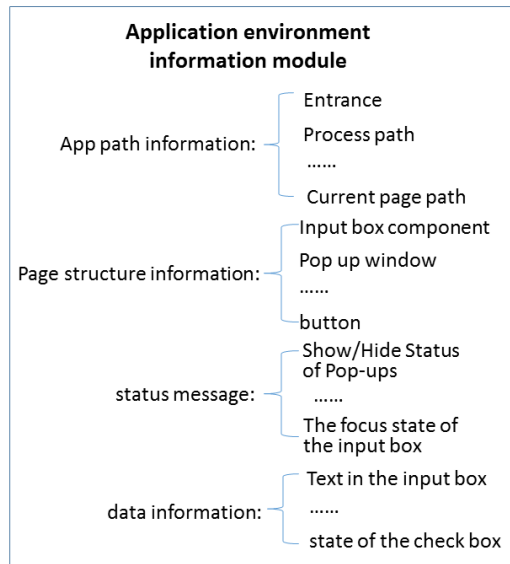


Fig. 2. Key environmental information

This information includes, but is not limited to: ① path information, that is, recording the complete path of the user from the application portal to the current operating page, so that the user can accurately navigate to the page before the interruption during recovery; (2) page structure information, which captures the current state of all components in the page that may affect the user experience, such as input boxes, pop-ups and buttons, so that the page layout can be reconstructed when the user leaves; (3) state information, which records the state changes of each component in the page in detail, such as the display/hiding state of the pop-up window, the focus state of the input box, etc., to ensure that the interactivity of the user interface can be maintained during recovery; (4) Data information, which relates and saves the data entered or selected by the user in the page structure component, such as the text in the input box and the check state of the check box, so as to restore the user's input results when restoring.

(2) Routing module

The routing module is responsible for intelligently guiding the user to the page before interruption, rather than the default home page of the application, after the user reopens the mobile micro-application, as Table 1.

This module provides three flexible routing strategies to adapt to different application scenarios: ① direct routing to the final path is suitable for users who expect to return to the interrupted page quickly and don't mind losing the ability to retreat to the

superior page; (2) routing the complete path of users entering the interrupted page, keeping all the historical records of users entering the interrupted page, and allowing users to go back according to the original path after recovery; (3) No routing. For some specific pages (such as real-time data entry pages), due to the timeliness requirements of data, the interrupt status of these pages is not recorded, thus avoiding unnecessary recovery attempts and potential errors.

Table 1. Routing strategy

<i>method number</i>	<i>routing method name</i>
1	Route directly to the final path
2	Route the full path of the user to the interrupt page
3	Do not route

(3) Page environment recovery module

The page environment recovery module is the executor of the interrupt recovery mechanism, which is responsible for gradually recovering the page state and data according to the data saved by the application environment information module after the user confirms to recover the interrupted page. The module first assembles the page state, including the display of pop-up window and the setting of input box focus, so as to ensure the consistency of page vision and interactive state^[9]. Then, the page data is assembled, and the data previously input by the user is re-filled into the corresponding components, such as text boxes and check boxes, to achieve seamless data recovery.

2.4 Recovery Path

In order to achieve efficient and accurate interrupt recovery, this mechanism has designed a set of complete recovery paths and strategies, including:

(1) Interrupt on-site saving:

When the user operates the mobile micro-application or the micro-application is interrupted, it is saved on site. On-site storage of interruption mainly includes three strategies: scheduled storage, key node storage and pre-interruption storage: ① Scheduled storage, in which environmental information is saved to the application environmental information module at intervals of half a minute and one minute, and the previous information is overwritten after each storage; ② key node saving: when it is detected that the user is operating the key page structure, it is saved, for example, after the user selects the data frame and enters certain data, it is saved; ③ Save before interruption, including save before putting into the background and save before flash-back.

(2) Interrupt page recovery:

After the interruption, when the user enters the micro-application again, the interrupted page will be restored. The whole process includes: ① restoration confirmation, pop-up window or confirmation whether to perform on-site restoration through previous settings; ② page routing: through the routing module, the page is jumped from the routing transfer page to the operation page.

(3) Interrupted state recovery:

After entering the pre-interruption page, if the application environment information module has page state change information, relevant operations will be automatically performed according to the information, such as opening the pop-up window and setting the input box to the selected state.

(4) Interrupt data recovery:

After the page state is restored, if the application environment information module has data information, it will be loaded according to the components involved in the page structure information. For example, the input box will be filled with the data entered before the interruption, and the check box will be filled with the check result before the interruption.

To sum up, through the cooperative work of application environment information module, routing module and page environment recovery module, as well as the implementation of strategies such as interruption site saving, interruption page recovery and interruption state and data recovery, this mechanism provides an efficient and reliable interruption recovery solution for mobile micro-applications, which effectively improves the user experience.

2.5 Consistency Guarantee

When the interval between interruption and recovery of mobile micro-application is too long^[10], the page before interruption may not be suitable for the current situation. The related scenarios mainly include: ① In terms of program consistency, the application package of mobile micro-application may have been updated, and the application interface and logic may have changed. At this time, when the user enters the application, the interruption recovery process will not be started; ② In terms of business state consistency, the business state of the mobile micro-application may have changed. For example, the data being filled in has been filled in through other channels (such as PC), so it is necessary for the mobile micro-application to judge from the business, and then inform the mobile portal (basic application) whether it is necessary to start the interruption recovery process; ③ As for the consistency of data in the page, some data in the page to be restored may be out of date. At this time, the interruption recovery process can be carried out normally, and the user can directly modify the recovered data.

3 Conclusions

In this paper, the application interruption scenario in the usage scenario of mobile micro-application is analyzed, and the data and page recovery methods are given in two cases, namely, the user actively shuts down and the program exits abnormally, so as to ensure that the process data of mobile micro-application cannot be recovered due to special reasons. As a platform solution, the workload of mobile micro-application in dealing with the interruption situation is reduced, and the simplicity of the interruption recovery scheme for mobile micro-application is ensured.

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