Poster: A Notification Management System for: Sorting and Classifying Smartphone's Notifications

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Abstract
Notification plays an important part in mobile devices, which can deliver important information to people in an effective manner. However, Lin et al. [3] mentioned that users cannot organize on the current Android phone system interface of notification, which is not what they desire. Weber et al. [6] states that among a large number of notifications, not all of them are similarly important. Thus, the purpose of this study is to establish a system that can assist users to manage a large number of notifications on smartphones, so they can quickly get the information they want.

This system is mainly divided into two operation modes. The first one is Manual Control, which allows users to sort, classify, and pin notifications on their own preferences. The second one is Automated Organization, which uses machine learning models to sort notifications and classify them by their own categories. Three notification modes are designed by these two modes: Default, Manual Control, Automated Organization.

Author Keywords
Notification Management, Smartphone, Manual Control Notification, Automated Organize Notification

Introduction
In the era of information explosion, people receive a large amount of notifications and smartphone's drawer accumulates different types of notifications. In such, notifications management on smartphones is of

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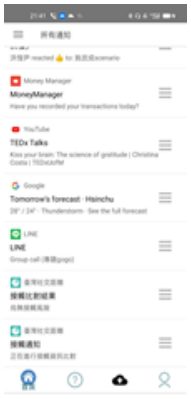

Figure 1: Our app's homepage which imitates current notification drawer

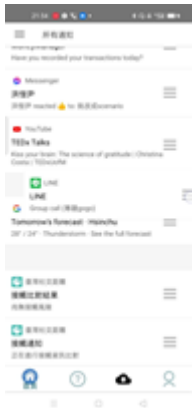

Figure 2: In "Manual Control" mode, users can sort their own notification

importance and how to make it easier for users to get information from notifications has become a vital topic.

Lee et al. [2] shows that users have different message reception degrees due to different IM pattern clusters in which the notification is located. In the meanwhile, Weber et al. [6], Shirazi et al. [5], Church et al. [1] show that types of notification affect the attractiveness toward users, and users prefer notifications related to people, such as notifications from communication apps. At the same time, Weber et al. [7] divided notifications into four levels according to their importance and urgency, so as to assist users to deal with notifications at the right time. Therefore, the appropriate classification of notifications can help users to give priority to notifications more easily. These research show differences in the way people deal with different types of notifications, which leads to the need for more customized ways to manage notifications, and help users quickly find the notifications they want.

In addition to the type of notification that affects how users perceive notifications, the sender's identity, the user scenario and other factors affect the notification order they want to see. Norrie et al. [4] pointed out that users do not like the design of managing notifications through the current notification system. They want to have more freedom in arranging the order of notifications. Lin et al. [3] mentioned that the modern notification system cannot fully present the multiple-purpose role of notifications, and users want to have control over notifications to manage the notification by themselves and place the notification in their desired location. However, there is no study developing a Notification Management System, which can help users, for example, sort and classify notifications manually or automatically. Users cannot manually manage notifications on the current system, so we want to build a system enabling users to actively manage their notifications. In the meanwhile, Manual Control requires a lot of user effort, so Automated Organization is also a way to reduce user effort which still increases the effectiveness of notification management.

As a result, we built a Notification Management System to improve the current interface of smartphones system of notifications which is sorted by merely a single condition. Our system lets users arrange their notifications and gives out multiple-purpose roles of notification presentation. This research finds a way to assist users to manage a large number of notifications in smartphones.

Method

We developed an app to imitate users' notification drawer but allow users to pin, sort, and classify notifications. Our app has two modes: Automated Organization and Manual Control.

Manual Control

We developed sorting, pinning and classifying functions for the manual control mode. In this mode, we want to focus on the users' operation. Therefore, we used Figma to make our prototype, and got feedback about our interface design from several testers.

For sorting, users can change the order of the notifications, not only by the time they received them. Users can reorder notifications by dragging them. For pinning, users can let the specific notifications stay on the top by pressing the button to pin the notifications.

Figure 3: In "Manual Control" mode, users can add category by themselves

Figure 4: In "Manual Control" mode, users can pin their notification on the top

And for classifying, users can create their own category folders and put notifications into the specific folder. In the meanwhile, those notifications would stay at the home page at the same time.

Automated Organization

The interface design was based on the interface of Manual Control. For collection of training data to build the model, we used phone data which was collected from previous work Lin et al. [3]. The dataset contained 34 users reporting a total of 1,952,369 notifications of which order the users wanted to display or check. Each notification that we collected contains app name, title, content, category, click order, content attractiveness, display attractiveness, display order, importance, post time, sender attractiveness, urgency.

For extracting features and building the model, we extracted 4 features from the collected data, and built a model of BERT with 80.1% accuracy on error within one position. While with 90.77% accuracy on error within two positions. When the notifications come, we use the model to predict the order of all notifications and then reorder the notifications for users.

For classifying notifications, the system automatically helps users to classify notifications by using a database including apps' categories. We decide the app's category by using the induction of the previous work Weber et al. [6] Lin et al. [3] Shirazi et al. [5] Zhao et al. [8]. When notification comes, we create the category folder automatically by the app's category of notifications and put each notification in the specific folder.

Current Result

We made the prototype of our app to pilot test our system's functionality in the early stage. Then, we developed a system with Manual Control and Automated Organization modes based on the prototype and feedback from the pilot testers. The former is for users to manually control their own notifications, which allows users to sort, classify, and pin their notifications. The latter will automatically organize users' notifications, which helps users sort, classify their notifications before users see them. For sorting in automated organization mode, we have also done using machine learning to build a model.

Future Work

In the future, we will combine both Automated Organization and Manual Control modes to see what the differences are compared to the original three modes (Default, Automated Organization, Manual Control). Also, we will evaluate the system including all the modes by recruiting participants for usability testing and asking our participants for an ESM questionnaire while doing the test. What we decide to evaluate and measure includes participants' subjective feelings during the test periods and system-collected data about participants' smartphones, their notifications, and the usability of our system.

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