Optimistic state

Contents

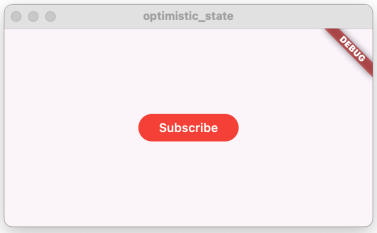
When building user experiences, the perception of performance is sometimes just as important as the actual performance of the code. In general, users don't like waiting for an action to finish to see the result, and anything that takes more than a few milliseconds could be considered "slow" or "unresponsive" from the user's perspective.

Developers can help mitigate this negative perception by presenting a successful UI state before the background task is fully completed. An example of this would be tapping a "Subscribe" button, and seeing it change to "Subscribed" instantly, even if the background call to the subscription API is still running.

This technique is known as Optimistic State, Optimistic UI or Optimistic User Experience. In this recipe, you will implement an application feature using Optimistic State and following the Flutter architecture guidelines.

Example feature: a subscribe button

This example implements a subscribe button similar to the one you could find in a video streaming application or a newsletter.

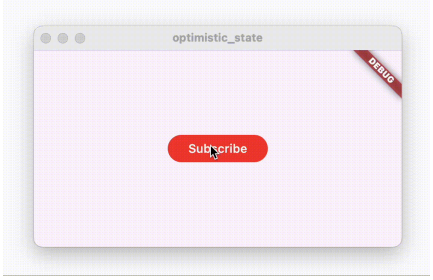


When the button is tapped, the application then calls an external API, performing a subscription action, for example recording in a database that the user is now in the subscription list. For demo purposes, you will not implement the actual backend code, instead you will replace this call with a fake action that will simulate a network request.

In the case that the call is successful, the button text will change from "Subscribe" to "Subscribed". The button background color will change as well.

On the contrary, if the call fails, the button text should revert back to "Subscribe", and the UI should show an error message to the user, for example using a Snackbar.

Following the Optimistic State idea, the button should instantly change to "Subscribed" once it is tapped, and only change back to "Subscribe" if the request failed.



Feature architecture

Start by defining the feature architecture. Following the architecture guidelines, create these Dart classes in a Flutter project:

- A `StatefulWidget` named `SubscribeButton`
- A class named `SubscribeButtonViewModel` extending `ChangeNotifier`
- A class named `SubscriptionRepository`

```dart
class SubscribeButton extends StatefulWidget {
  const SubscribeButton({
    super.key,
  });

  @override
  State<SubscribeButton> createState() => _SubscribeButtonState();
}

class _SubscribeButtonState extends State<SubscribeButton> {
  @override
  Widget build(BuildContext context) {
    return const Placeholder();
  }
}

class SubscribeButtonViewModel extends ChangeNotifier {}

class SubscriptionRepository {}
```

The `SubscribeButton` widget and the `SubscribeButtonViewModel` represent the presentation layer of this solution. The widget is going to display a button that will show the text "Subscribe" or "Subscribed" depending on the subscription state. The view model will contain the subscription state. When the button is tapped, the widget will call the view model to perform the action.

The `SubscriptionRepository` will implement a subscribe method that will throw an exception when the action fails. The view model will call this method when performing the subscription action.

Next, connect them together by adding the `SubscriptionRepository` to the `SubscribeButtonViewModel`:

```dart
class SubscribeButtonViewModel extends ChangeNotifier {
  SubscribeButtonViewModel({
    required this.subscriptionRepository,
  });

  final SubscriptionRepository subscriptionRepository;
}
```

And add the `SubscribeButtonViewModel` to the `SubscribeButton` widget:

```dart
class SubscribeButton extends StatefulWidget {
  const SubscribeButton({
    super.key,
    required this.viewModel,
  });

  /// Subscribe button view model.
  final SubscribeButtonViewModel viewModel;

  @override
  State<SubscribeButton> createState() => _SubscribeButtonState();
}
```

Now that you have created the basic solution architecture, you can create the `SubscribeButton` widget the following way:

```dart
SubscribeButton(
  viewModel: SubscribeButtonViewModel(
    subscriptionRepository: SubscriptionRepository(),
  ),
)
```

Implement the `SubscriptionRepository`

Add a new asynchronous method named `subscribe()` to the `SubscriptionRepository` with the following code:

```dart
class SubscriptionRepository {
  /// Simulates a network request and then fails.
  Future<void> subscribe() async {
    // Simulate a network request
    await Future.delayed(const Duration(seconds: 1));
    // Fail after one second
    throw Exception('Failed to subscribe');
  }
}
```

The call to `await Future.delayed()` with a duration of one second has been added to simulate a long running request. The method execution will pause for a second, and then it will continue running.

In order to simulate a request failing, the subscribe method throws an exception at the end. This will be used later on to show how to recover from a failed request when implementing Optimistic State.

Implement the `SubscribeButtonViewModel`

To represented the subscription state, as well a possible error state, add the following public members to the `SubscribeButtonViewModel`:

```dart
// Whether the user is subscribed
bool subscribed = false;

// Whether the subscription action has failed
bool error = false;
```

Both are set to `false` on start.

Following the ideas of Optimistic State, the `subscribed` state will change to `true` as soon as the user taps the subscribe button. And will only change back to `false` if the action fails.

The `error` state will change to `true` when the action fails, indicating the `SubscribeButton` widget to show an error message to the user. The variable should go back to `false` once the error has been displayed.

Next, implement an asynchronous `subscribe()` method:

```dart
// Subscription action
Future<void> subscribe() async {
  // Ignore taps when subscribed
  if (subscribed) {
    return;
  }

  // Optimistic state.
  // It will be reverted if the subscription fails.
  subscribed = true;
  // Notify listeners to update the UI
  notifyListeners();

  try {
    await subscriptionRepository.subscribe();
  } catch (e) {
    print('Failed to subscribe: $e');
    // Revert to the previous state
    subscribed = false;
    // Set the error state
    error = true;
  } finally {
    notifyListeners();
  }
}
```

As described previously, first the method sets the `subscribed` state to `true` and then calls to `notifyListeners()`. This forces the UI to update and the button changes its appearance, showing the text “Subscribed” to the user.

Then the method performs the actual call to the repository. This call is wrapped by a `try-catch` in order to catch any exceptions it may throw. In case an exception is caught, the `subscribed` state is set back to `false`, and the `error` state is set to `true`. A final call to `notifyListeners()` is done to change the UI back to ‘Subscribe’.

If there is no exception, the process is complete because the UI is already reflecting the success state.

The complete `SubscribeButtonViewModel` should look like this:

```dart
/// Subscribe button View Model.
/// Handles the subscribe action and exposes the state to the subscription.
class SubscribeButtonViewModel extends ChangeNotifier {
  SubscribeButtonViewModel({
    required this.subscriptionRepository,
  });

  final SubscriptionRepository subscriptionRepository;

  // Whether the user is subscribed
  bool subscribed = false;

  // Whether the subscription action has failed
  bool error = false;

  // Subscription action
  Future<void> subscribe() async {
    // Ignore taps when subscribed
    if (subscribed) {
      return;
    }

    // Optimistic state.
    // It will be reverted if the subscription fails.
    subscribed = true;
    // Notify listeners to update the UI
    notifyListeners();

    try {
      await subscriptionRepository.subscribe();
    } catch (e) {
      print('Failed to subscribe: $e');
      // Revert to the previous state
      subscribed = false;
      // Set the error state
      error = true;
    } finally {
      notifyListeners();
    }
  }
}
```

Implement the `SubscribeButton`

In this step, you will first implement the build method of the `SubscribeButton`, and then implement the feature's error handling.

Add the following code to the build method:

```dart
@override
Widget build(BuildContext context) {
  return ListenableBuilder(
    listenable: widget.viewModel,
    builder: (context, _) {
      return FilledButton(
        onPressed: widget.viewModel.subscribe,
        style: widget.viewModel.subscribed
            ? SubscribeButtonStyle.subscribed
            : SubscribeButtonStyle.unsubscribed,
        child: widget.viewModel.subscribed
            ? const Text('Subscribed')
            : const Text('Subscribe'),
      );
    },
  );
}
```

This build method contains a `ListenableBuilder` that listens to changes from the view model. The builder then creates a `FilledButton` that will display the text "Subscribed" or "Subscribe" depending on the view model state. The button style will also change depending on this state. As well, when the button is tapped, it runs the `subscribe()` method from the view model.

The `SubscribeButtonStyle` can be found here. Add this class next to the `SubscribeButton`. Feel free to modify the `ButtonStyle`.

```dart
class SubscribeButtonStyle {
  static const unsubscribed = ButtonStyle(
    backgroundColor: WidgetStatePropertyAll(Colors.red),
  );

  static const subscribed = ButtonStyle(
    backgroundColor: WidgetStatePropertyAll(Colors.green),
  );
}
```

If you run the application now, you will see how the button changes when you press it, however it will change back to the original state without showing an error.

Handling errors

To handle errors, add the `initState()` and `dispose()` methods to the `SubscribeButtonState`, and then add the `_onViewModelChange()` method.

```dart
@override
void initState() {
  super.initState();
  widget.viewModel.addListener(_onViewModelChange);
}

@override
void dispose() {
  widget.viewModel.removeListener(_onViewModelChange);
  super.dispose();
}
```

```dart
/// Listen to ViewModel changes.
void _onViewModelChange() {
  // If the subscription action has failed
  if (widget.viewModel.error) {
    // Reset the error state
    widget.viewModel.error = false;
    // Show an error message
    ScaffoldMessenger.of(context).showSnackBar(
      const SnackBar(
        content: Text('Failed to subscribe'),
      ),
    );
  }
}
```

The `addListener()` call registers the `_onViewModelChange()` method to be called when the view model notifies listeners. It's important to call `removeListener()` when the widget is disposed of, in order to avoid errors.

The `_onViewModelChange()` method checks the `error` state, and if it is `true`, displays a `Snackbar` to the user showing an error message. As well, the `error` state is set back to `false`, to avoid displaying the error message multiple times if `notifyListeners()` is called again in the view model.

Advanced Optimistic State

In this tutorial, you've learned how to implement an Optimistic State with a single binary state, but you can use this technique to create a more advanced solution by incorporating a third temporal state that indicates that the action is still running.

For example, in a chat application when the user sends a new message, the application will display the new chat message in the chat window, but with an icon indicating that the message is still pending to be delivered. When the message is delivered, that icon would be removed.

In the subscribe button example, you could add another flag in the view model indicating that the `subscribe()` method is still running, or use the Command pattern running state, then modify the button style slightly to show that the operation is running.

Interactive example

This example shows the `SubscribeButton` widget together with the `SubscribeButtonViewModel` and `SubscriptionRepository`, which implement a subscribe tap action with Optimistic State.

When you tap the button, the button text changes from "Subscribe" to "Subscribed". After a second, the repository throws an exception, which gets captured by the view model, and the button reverts back to showing "Subscribe", while also displaying a Snackbar with an error message.