Staggered Animations

Contents

What you'll learn

- A staggered animation consists of sequential or overlapping animations.
- To create a staggered animation, use multiple Animation objects.
- One AnimationController controls all of the Animations.
- Each Animation object specifies the animation during an Interval.
- For each property being animated, create a Tween.

Terminology: If the concept of tweens or tweening is new to you, see the Animations in Flutter tutorial.

Staggered animations are a straightforward concept: visual changes happen as a series of operations, rather than all at once. The animation might be purely sequential, with one change occuring after the next, or it might partially or completely overlap. It might also have gaps, where no changes occur.

This guide shows how to build a staggered animation in Flutter.

Examples

This guide explains the basic_staggered_animation example. You can also refer to a more complex example, staggered_pic_selection.

basic_staggered_animation
Shows a series of sequential and overlapping animations of a single widget. Tapping the screen begins an animation that changes opacity, size, shape, color, and padding.

staggered_pic_selection
Shows deleting an image from a list of images displayed in one of three sizes. This example uses two animation controllers: one for image selection/deselection, and one for image deletion. The selection/deselection animation is staggered. (To see this effect, you might need to increase the `timeDilation` value.) Select one of the largest images—it shrinks as it displays a checkmark inside a blue circle. Next, select one of the smallest images—the large image expands as the checkmark disappears. Before the large image has finished expanding, the small image shrinks to display its checkmark. This staggered behavior is similar to what you might see in Google Photos.

The following video demonstrates the animation performed by basic_staggered_animation:

In the video, you see the following animation of a single widget, which begins as a bordered blue square with slightly rounded corners. The square runs through changes in the following order:

1. Fades in
2. Widens
3. Becomes taller while moving upwards
4. Transforms into a bordered circle
5. Changes color to orange

After running forward, the animation runs in reverse.

New to Flutter? This page assumes you know how to create a layout using Flutter's widgets. For more information, see Building Layouts in Flutter.

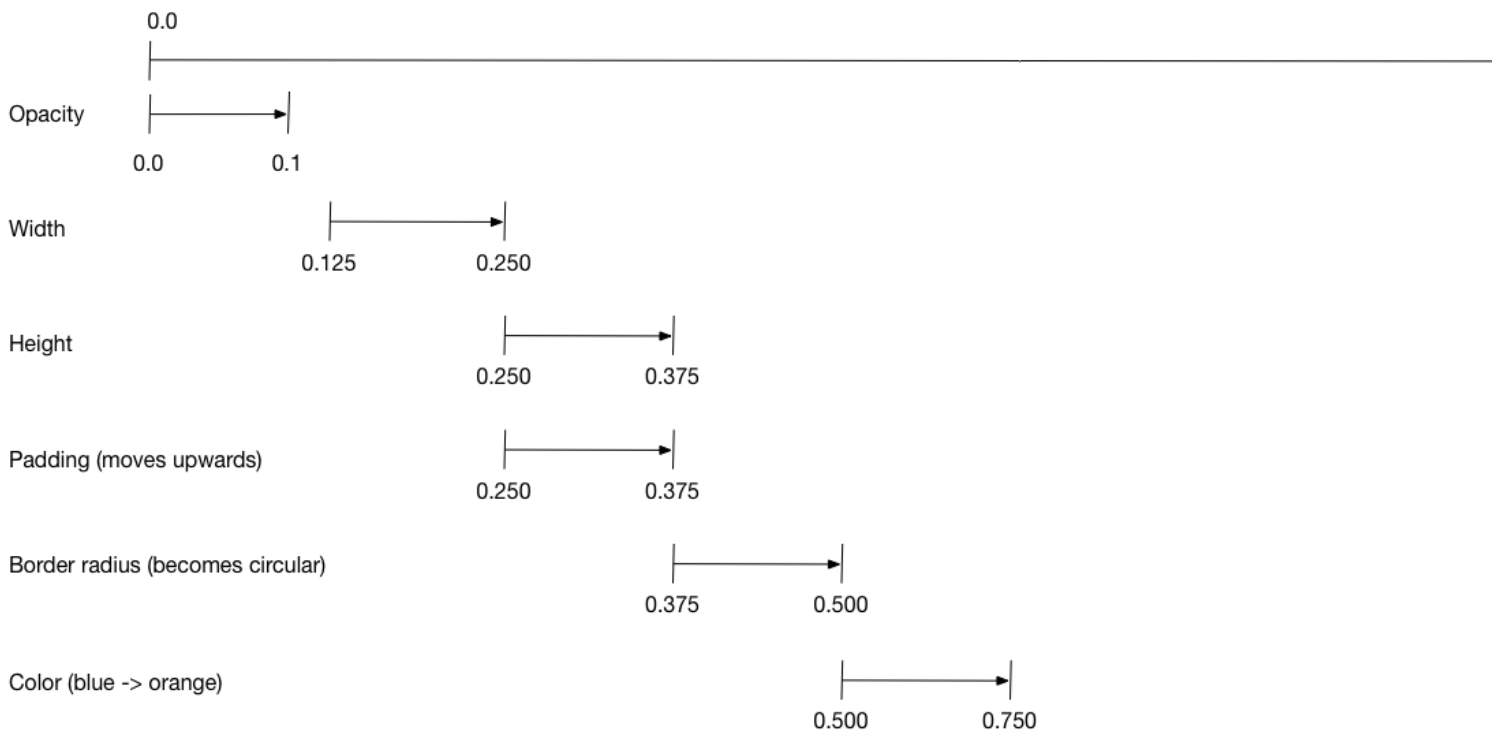
Basic structure of a staggered animation

What's the point?

- All of the animations are driven by the same AnimationController.
- Regardless of how long the animation lasts in real time, the controller's values must be between 0.0 and 1.0, inclusive.
- Each animation has an Interval between 0.0 and 1.0, inclusive.
- For each property that animates in an interval, create a Tween. The `Tween` specifies the start and end values for that property.
- The `Tween` produces an Animation object that is managed by the controller.

The following diagram shows the Intervals used in the basic_staggered_animation example. You might notice the following characteristics:

- The opacity changes during the first 10% of the timeline.
- A tiny gap occurs between the change in opacity, and the change in width.
- Nothing animates during the last 25% of the timeline.
- Increasing the padding makes the widget appear to rise upward.
- Increasing the border radius to 0.5, transforms the square with rounded corners into a circle.
- The padding and border radius changes occur during the same exact interval, but they don't have to.



To set up the animation:

- Create an AnimationController that manages all of the Animations.
- Create a Tween for each property being animated.
  - The Tween defines a range of values.
  - The Tween's `animate` method requires the `parent` controller, and produces an Animation for that property.
- Specify the interval on the Animation's `curve` property.

When the controlling animation's value changes, the new animation's value changes, triggering the UI to update.

The following code creates a tween for the `width` property. It builds a CurvedAnimation, specifying an eased curve. See Curves fc other available pre-defined animation curves.

```
width = Tween<double>(
  begin: 50.0,
  end: 150.0,
).animate(
  CurvedAnimation(
    parent: controller,
    curve: Interval(
      0.125, 0.250,
      curve: Curves.ease,
    ),
  ),
),
```

The `begin` and `end` values don't have to be doubles. The following code builds the tween for the `borderRadius` property (which controls the roundness of the square's corners), using `BorderRadius.circular()`.

```
borderRadius = BorderRadiusTween(
  begin: BorderRadius.circular(4.0),
  end: BorderRadius.circular(75.0),
).animate(
  CurvedAnimation(
    parent: controller,
    curve: Interval(
      0.375, 0.500,
      curve: Curves.ease,
    ),
  ),
),
```

Complete staggered animation

Like all interactive widgets, the complete animation consists of a widget pair: a stateless and a stateful widget.

The stateless widget specifies the Tweens, defines the Animation objects, and provides a `build()` function responsible for buildi the animating portion of the widget tree.

The stateful widget creates the controller, plays the animation, and builds the non-animating portion of the widget tree. The animation begins when a tap is detected anywhere in the screen.

Full code for basic_staggered_animation's main.dart

Stateless widget: StaggerAnimation

In the stateless widget, StaggerAnimation, the `build()` function instantiates an AnimatedBuilder—a general purpose widget for building animations. The AnimatedBuilder builds a widget and configures it using the Tweens' current values. The example create function named `_buildAnimation()` (which performs the actual UI updates), and assigns it to its `builder` property. AnimatedBui listens to notifications from the animation controller, marking the widget tree dirty as values change. For each tick of the animatic the values are updated, resulting in a call to `_buildAnimation()`.

```dart
class StaggerAnimation extends StatelessWidget {
  StaggerAnimation({ Key key, this.controller }) :

    // Each animation defined here transforms its value during the subset
    // of the controller's duration defined by the animation's interval.
    // For example the opacity animation transforms its value during
    // the first 10% of the controller's duration.

    opacity = Tween<double>(
      begin: 0.0,
      end: 1.0,
    ).animate(
      CurvedAnimation(
        parent: controller,
        curve: Interval(
          0.0, 0.100,
          curve: Curves.ease,
        ),
      ),
    ),

    // ... Other tween definitions ...

    super(key: key);

  final Animation<double> controller;
  final Animation<double> opacity;
  final Animation<double> width;
  final Animation<double> height;
  final Animation<EdgeInsets> padding;
  final Animation<BorderRadius> borderRadius;
  final Animation<Color> color;

  // This function is called each time the controller "ticks" a new frame.
  // When it runs, all of the animation's values will have been
  // updated to reflect the controller's current value.
  Widget _buildAnimation(BuildContext context, Widget child) {
    return Container(
      padding: padding.value,
      alignment: Alignment.bottomCenter,
      child: Opacity(
        opacity: opacity.value,
        child: Container(
          width: width.value,
          height: height.value,
          decoration: BoxDecoration(
            color: color.value,
            border: Border.all(
              color: Colors.indigo[300],
              width: 3.0,
            ),
            borderRadius: borderRadius.value,
          ),
        ),
      ),
    );
  }

  @override
  Widget build(BuildContext context) {
    return AnimatedBuilder(
      builder: _buildAnimation,
      animation: controller,
    );
  }
}
```

Stateful widget: StaggerDemo

The stateful widget, StaggerDemo, creates the AnimationController (the one who rules them all), specifying a 2000 ms duration. I plays the animation, and builds the non-animating portion of the widget tree. The animation begins when a tap is detected in the screen. The animation runs forward, then backward.

```dart
class StaggerDemo extends StatefulWidget {
  @override
  _StaggerDemoState createState() => _StaggerDemoState();
}

class _StaggerDemoState extends State<StaggerDemo> with TickerProviderStateMixin {
  AnimationController _controller;

  @override
  void initState() {
    super.initState();

    _controller = AnimationController(
      duration: const Duration(milliseconds: 2000),
      vsync: this
    );
  }

  // ...Boilerplate...

  Future<void> _playAnimation() async {
    try {
      await _controller.forward().orCancel;
      await _controller.reverse().orCancel;
    } on TickerCanceled {
      // the animation got canceled, probably because we were disposed
    }
  }

@override
Widget build(BuildContext context) {
  timeDilation = 10.0; // 1.0 is normal animation speed.
  return Scaffold(
    appBar: AppBar(
      title: const Text('Staggered Animation'),
    ),
    body: GestureDetector(
      behavior: HitTestBehavior.opaque,
      onTap: () {
        _playAnimation();
      },
      child: Center(
        child: Container(
          width: 300.0,
          height: 300.0,
          decoration: BoxDecoration(
            color: Colors.black.withOpacity(0.1),
            border: Border.all(
              color:  Colors.black.withOpacity(0.5),
            ),
          ),
          child: StaggerAnimation(
            controller: _controller.view
          ),
        ),
      ),
    ),
  );
}
```

Resources

The following resources might help when writing animations:

Animations landing page
Lists the available documentation for Flutter animations. If tweens are new to you, check out the Animations tutorial.

Flutter API documentation
Reference documentation for all of the Flutter libraries. In particular, see the animation library documentation.

Flutter Gallery
Demo app showcasing many Material Components and other Flutter features. The Shrine demo implements a hero animation.

Material motion spec
Describes motion for Material apps.