P1.

None

P2.

The use of rand() function in C will produce random integer result and to make the generation more random, srand(time()) is used. Modula 4 will ensure that the result falls in a acceptable range—we only have four types of bubbles to fire up. Plus 1 is to shift to fit in the definition of bubble colorType definition.

Using rand() will make the game fun and not that predictable

P3.

As stated in the class diagram, I restructured the “Model” part and added a new class BubbleModelsManager. This class is responsible for saving and loading of bubbles, as well as graph related part. To be more structured, this class can be broken up into two parts—one part deals with saving and loading only and another deals with graph. That is more “MVC” and flexible. But for this particular problem set/game, that is not that necessary as 1) it is not large enough. The logic can be handled without much trouble 2) Though the model is pure model as it deals with some game related logic, the game logic is pretty much not going to be changed any way

3) using one class is easier to code

As the integration started in PS4, work done for PS5 particularly is more on restructuring. But I will briefly explain the process.

The storyboard consists of multiple controllers and therefore multiple controllers are created, corresponding to each controller on the storyboard.

The game engine is re-designed as the game related logic is pulled out from the game engine—meaning that graph-related logic is not directly handled by the game engine now. This is to allow PS3 and PS4 controllers to use the same related graph logic.

Another alternative maybe that the model just handles saving and loading, graph related logic is further broken into two parts—validation of game graph goes to PS3 and graph processing logic goes to PS4. This is better than the current design in a sense that a huge BubbleModelsManager class is broken into smaller parts and the cohesion of model is very high. But that complicates the design further and is kind of like over kill for this game.

Of course my current design is not the best. In fact, among the alternatives I have listed above, I would have gone for the second one as the structure is more clear although more classes are involved. But this thought came a bit late and I do not have much for that. Anyway, the current design enables me to quickly add more bubbles types with only a few changes without having to worry about any additional bug introduced and it is highly testable now although I did not write any test of saving/loading/graph—so it is quite good in my opinion.

P4.

All the special bubbles have nothing to do with physics engine—only the way we deal with them in graph is different. Just several lines of change in BubbleModelsManger about graph-related logic will do. Testing of this is also easy as long as we ensure the understanding of special bubbles’ functions.

Particularly, the change is in

- (NSArray \*)toBeRemovedBubblesStartingFromItem(NSInteger)item

this method.

P5.

None

P6.

Please look at the class diagram.

Continue with extensions:

Integration testing:

Black-box Testing:

1. Level Design Mode

-- Testing of the loading of the main scene works fine

1) all the views are in the expected position and show up in the expected way

-- Testing pan gesture to quickly color cells/erase cells

1) observe the cell changes to the current selected color and

2) see NSLog message for the change in model data

3) change color selector and test again. Empty cells will be colored to current color and already colored cells will be set to current color

-- Testing tap gesture

1) change color to colored cells

2) nothing to uncolored cells

-- Testing longpress

1) on colored cell to erase the color

2) nothing to uncolored cells

-- just like the previous case

-- Testing save

1) the file with the correct name is created/overwritten

2) the content of the file corresponds to what is on the screen

3) invalid design—some bubbles are unattached are not allowed to be saved

-- Testing reset

1) erase all the cells

-- Testing load

1) load the screen to the state just like what is stored in the plist

2) deleting of a level will result in the deleting of the corresponding file

-- Testing play

1) invalid design cannot precede

2) properly segues to next screen and properly loaded in play mode

-- Testing back

1) return to previous screen

1. Play Mode

-- Test Bubble launching

1) current bubble and next bubble are prepared

-- Test bubble firing

1) tap on bubbleGridArea and the cannon moves to the specified direction, firing up animation and current the bubble is fired off

2) next bubble is prepared and after current round, next bubble will be moved to current position as current one and a new next bubble is produced

3) while the animation is going on, the user can specify the direction for next firing up. But only the last direction will be counted as the valid one

4) number of shots remaining is reduced by 1

-- Test Bubble Movement

1) the bubble follows the direction of firing in a constant speed.

-- Test collisions between object and the wall

1) When the firing bubble hit side walls, it will bounces off(x velocity will be inverted).

2) Collision with top wall will result in snapping to the nearest cell

-- Test collisions between objects

1) Colliding with existing cell will result in collision and snapping to the cell

-- Test snapping to grid cells

1) Collision with existing cell or top wall will result in the current firing bubble snapping to the nearest cell. Corner case is solved by taking left neighbor/right neighbor cell

-- Test for Removing bubbles

1) special bubbles will function as specified, also star/lightning/bomb will have bubble burst animation

2) connected bubbles from snapping bubble with the same color and the number is larger than 3, they will be removed

3) 1 score for normal bubble-removing and 5 score for candy green

4) bubble bursting sound

-- Test for dropping bubbles

1) after removing bubbles, unattached bubbles will also be dropped

2) 2 for normal bubbles and 5 for candy green

-- Test game-won

1) when all bubbles are clear, game won alert view

-- Test game-lost

1) bubbles are out of bound

2) no shots left

1. Level Select

-- Test loading levels

1) loading of user-defined levels as well as preloaded “Level-1”…

2) play button is not press-able

-- Test selecting level

1) the screenshot of selected level will be displayed (a glass box testing note here—the previous view is removed too)

2) the play button is press-able now

-- Test play button pressing

1) segues to next scene and level is properly loade

-- Test back button

1) when back button is pressed, return to Welcome

1. Welcome

-- Test loading

1. App Delegate

-- Test background music

1) the music will pause/stop when the app becomes inactive/runs in background

(for the reason of time, I did not implement music one/off option. In fact, I am confused about how I should do this—the music player is held by who? Who is controlling on/off and volume? How app delegate shuts the music down if it is not holding music player—so it just holds the controller that is controlling the music and shuts it off? But app delegate should be able to control all the controllers sound right? So including all of them? How? So the controller controls the music player and holds it?)

Glass-box Testing:

-- Test segues:

1) shouldPerformSegue will stop design mode from seguing to play mode if the current design is not valid

2) prepareForSegue will configure of path for the AnimateViewController

-- Test bubbles to remove/drop/add

1) look at the log msg for what bubble model is removed/dropped and sees if the msg conforms to the expectation

2) (testing strategies in PS4)

Bells & Whistles:

1. Bubble-burst animation for bubble-bomb, bubble-star and bubble-lightning only
2. Game score in label format
3. Number of shots left in UISlider format
4. More special bubble
5. Candy-red: when touched by the fired bubble, it is considered to be of the same color as fired bubble. The effect will only triggered by direct touching
6. Candy-green: when touched by the fired bubble, it will be removed and the fired bubbled will be removed too. Also it has higher score
7. Bubble shaking animation when snapping to a grid
8. End game scene in the form of plain alert view
9. Background music and sound effect for cannon and bubble bursting
10. App icon and app name definition
11. Validation of design before saving/playing
12. Screenshot for predefined and user-defined levels

As for the modification, some of them come from view controller and special bubbles come from BubbleModelsManager too. Personally I did not spent a lot time implemting them after I think of it—as I think my design overall if good ☺

Final Reflection:

I have changed a lot from the original design and I believe the current design is much better than the previous design in terms of conforming to MVC and coupling/cohesion. Now the model is quite coherent and the design of game engine is neater too. Some api change also enabled me to quickly add new features and the view controller is more flexible/powerful.

I think the part about Model is still not the best as I have discussed earlier. Due to the time limit and the scale of this project—too small so the current design is still quite handy.

As the red-font words state, I am quite curious to know how to design the music player and how to control the on/off or volume of it. I want to hear the opinion as I think my design is really not good for that part.

Bonus Problem:

1. Well, I am not sure how to answer this question. I spent about 70+ hours in total as the whole recess week is gone because of this. Probably Bells & Whistles, Integration and Crafting take a lot of time. Also, restructuring was done again at the beginning of recess week. That is tricky too.
2. A lot of restructuring happened because of bad design in the first place.
3. Thanks for the feedback. If only the clarification was better stated in the first place, everything will be great.
4. For some questions involving software design, I am not pretty sure and probably personally I need more suggestion and criticizing on my design. Or some alternatives can be communicated or something like that—I mean I think of my own design but I want to learn about others and better designs too. I spent a lot of time restructuring and improve the design every time but even now I am not pleased about what I have now. Just I am a bit too tired now and time does not permit.