

Textual Explanation

Class Diagram – The elevator class will contain 1 AudioSystem object, 1 Display object, 1 Door object, 1 Display object, 5 or more Button objects (an open, close, help, fire, and floor buttons for each floor). Each simple class like Door will have their own functions as their actions like open() and close(). Some parts that would only have one function such as the bell is inside the elevator class as a single function ringbell(). The elevator and the parts classes have member variables that help identify itself and what state they're in currently as well as data they would need to hold. Same with Passenger just has simple actions as functions like walk() or press() and its own data like weight, name is probably not needed. The floor contains its own data and buttons as well for an up and down. The up/down, and floor buttons inside the elevator illuminate. The ECS will be the interface that contains everything such as however many floors it should have and elevators (can be synonymous as building). It has a default allocation strategy as timebased as a function to be simple, so when adding multiple strategies just need to add the code as a function. The currstrat is used to keep track of which strat function to use for allocating elevators. Further detail as to what each function does is provided as comments in the headers or self explanatory because of the naming convention.

Basic Use case Diagrams:

Basic use case Sequence Diagram – The main use case starts with the Passenger press(direction) a floor button either up or down, which it'll illuminate(on) itself then notify(direction) its floor the direction the passenger wants to go. The floor sends a flrrequest(direction, serveflrnum) to ECS to let it know which floor to serve. The ECS will use timestrat() as the default to figure out which elevator to send to the floor to apply a Time dependent strategy when allocating elevators, after an elevator is found. The ECS orders an elevator to move(direction) depending if the elevator is above or below the floor to serve. As the floor sensor detectflr(flrmum) a floor upon the elevator arriving to it. The sensor tells its elevator with atnewfloor(flrmum), and the elevator updatecurrflr(flrmum) its display, the sensors notification gets relayed to ECS from the elevator with atnewflr(flrmum, elevnum). The movement of the elevator gets repeated while the elevators flrmum/currflrmum != the serveflrmum so keeps moving in the direction towards the floor to serve the passenger is reached. Once the elevator reaches the serveflrmum, the ECS tells the elevator to stop(), the elevator notifies the floor it arrived(direction) to turn off its button with illuminate(off) and the elevator make its bell ring() and open() its doors. The Passenger walk(in, elevnum) into the elevator. They have the option to hold(numsecs) the open doorbtn to hold the doors open() and to press() the close doorbtn, or to not do any and let the doors close by themselves (after 10 seconds). Which the elevator make its bell ring() and close() its doors. The Passenger then press(destflrmum) a floor btn they'd like to go to, which that btn will illuminate(on, destflrmum) itself and notify(destflrmum) the elevator. The elevator sends a elevrequest to ECS(destflrmum, elevnum) of which elevator the passenger is in and which floor they want to travel to. The ECS would commands that elevator to

move(direction) depending which floor they're on towards the destination floor. As the floor sensor detectflr(fltnum) a floor upon the elevator arriving to it. The sensor tells its elevator with atnewflr(fltnum) , and the elevator updatecurrflr(fltnum) its display, the sensor's notification gets relayed to ECS from the elevator with atnewflr(fltnum,elevnum). The movement of the elevator gets repeated while the elevator's fltnum/currfltnum != destfltnum so keeps moving in the direction towards the destination floor until it has reached it. Once the elevator reaches the destination floor. The ECS will tell the elevator to stop(), the destbtn will illuminate(off,destfltnum) turn the destbtn off, the elevator will ring() its bell and open() its doors which the Passenger can now walk(out,elevnum) of the elevator. Lastly the elevator will ring() its bell once more and close() its door.

Safety features Sequence Diagrams:

Help – As the Passenger presses() the helpBtn, the elevator is notified as an alarm(help) will be raised as the safety issue. Then the elevator tells the ECS with a request(helpalarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is. Which the ECS notify(helpalarm, elevnum) the Building Safety Service and tell them the safety issue and which elevator to connect to. The elevator is connected to the Building Safety Service via voice with BSSconnection() as it waitsresponse() from a Passenger. Which either the Passenger gives back a response or none. If the Building Safety Service receives a null/none instead of a response from the passenger then call911().

Door Obstacle – Assuming the case starts with the elevator closing the door. The elevator make its Bell ring() then proceed to close() its doors. If the light sensor of the elevator detects(obstacle) then the elevator is notified as an alarm(obstacle) will be raised as the safety issue. Then the elevator tells the ECS with a request(obstacle, elevnum) to let it know which elevator has a safety issue and what the safety issue is. Then the ECS will tell the elevator to interruptclose() to stop the doors from closing and command the elevator to open its doors. Which the elevator will ring() its bell and open() its doors. This can be repeated up to 5 times(or whatever times preferred)which at that point the elevator doors stays open. And the ECS will send a request(obsmsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(obsmsg) and its Display to show(obsmsg). Alternatively if the elevator didn't reach the threshold of 5 times the obstacle detection is repeated. Then the elevator ring() its bell and close() its doors.

Fire – The case starts with either the Building raises a fire alarm or the fireBtn is pressed. So if the Building raises an alarm(fire) in the elevator or a Passenger press() the fireBtn then the alarm(fire) will be raised in the elevator. The elevator tells the ECS with a request(firealarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is. Which the ECS would command all elevators to move(direction) depending which floor they're on towards the safe floor. The ECS also send a request(firemsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(firemsg) and its

Display to show(firemsg) and these messages are played/displayed the whole time till passengers leave. As the floor sensor detectflr(flrmum) a floor upon the elevator arriving to it. The sensor tells its elevator with atnewfloor(flrmum) , and the elevator updatecurrflr(flrmum) its display, the sensors notification gets relayed to ECS from the elevator with atnewflr(flrmum,elevnum). The movement of the elevator gets repeated while the elevators flrmum/currflrmum != the safeflrmum so keeps moving in the direction towards the safefloor until it has reached it. Once the elevator reaches the safe floor. The ECS will tell the elevator to stop() and elevator will ring() its bell and open() its doors which the Passenger(s) can now walk(out,elevnum) of their elevators assuming there are any.

Overload – The case starts with the passenger walk(in,elevnum) into an elevator. Which if the passengers weight + the currweight(assuming cargo + passenger weight = passenger weight) of the elevator will go over its maxweight allowed. Then the weight sensor raises an alarm(overload) in the elevator. The elevator tells the ECS with a request(overloadalarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is. The ECS sends a request(overloadmsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(overloadmsg) and its Display to show(overloadmsg) (Assuming the elevator is stationary as ECS will not command elevator to move until passenger leaves). Once the Passenger walk(out,elevnum) of the elevator. An alternative if the currweight with the passenger weight doesn't go over the max weight allowed in the elevator. After either case the bell of the elevator will ring() and the doors will close().

Power out – Assuming the Case starts with the Building cutting off the power(off) of the elevator. The power sensor raises an alarm(powerout) in the elevator. The elevator tells the ECS with a request(poweroutalarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is. Which the ECS would command all elevators to move(direction) depending which floor theyre on towards the safe floor. The ECS sends a request(poweroutmsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(poweroutmsg) and its Display to show(poweroutmsg) and these messages are played/displayed the whole time till passengers leave. As the floor sensor detectflr(flrmum) a floor upon the elevator arriving to it. The sensor tells its elevator with atnewfloor(flrmum), and the elevator updatecurrflr(flrmum) its display, the sensors notification gets relayed to ECS from the elevator with atnewflr(flrmum,elevnum). The movement of the elevator gets repeated while the elevators flrmum/currflrmum != the safeflrmum so keeps moving in the direction towards the safefloor until it has reached it. Once the elevator reaches the safe floor. The ECS will tell the elevator to stop() and elevator will ring() its bell and open() its doors which the Passenger(s) can now walk(out,elevnum) of their elevators assuming there are any.

Basic Use case Traceability Matrix:

ID	Requirement	Related Use Case	Description
1	<p>On each of the N floors is a pair of buttons marked “up” and “down”.</p> <p>When a button is pressed it illuminates, and remains illuminated, until an elevator arrives to transport the customers who, at this floor, have requested an elevator going in a certain direction.</p>	Elevator Use case (section 1)	Passenger press(direction) a floor button either up or down, which itll illuminate(on) itself then notify(direction) its floor the direction the passenger wants to go. Once the elevator reaches the serveflrnum, the ECS tells the elevator to stop(), the elevator notifies the floor it arrived(direction) to turn off its button with illuminate(off)
2	<p>When the elevator arrives, it rings a bell, opens its doors (the elevator and floor doors) for a fixed time (10 seconds) allowing people to exit or board, rings the bell again, closes its doors and proceeds to another floor.</p>	Elevator Use case (section 2 - 7)	the elevator make its bell ring() and open() its doors. The Passenger walk(in,elevnum) into the elevator and let the doors close by themselves(after 10 seconds). Which the elevator make its bell ring() and close() its doors. The elevator sends a elevrequest to ECS(destflrnum,elevnum) of which elevator the passenger is in and which floor they want to travel to. The ECS would commands that elevator to move(direction) depending which floor theyre on towards the destination floor.
3	<p>Once on-board passengers select one or more destination floors using a panel of buttons; there is one button for every floor.</p>	Elevator Use case (section 6)	The Passenger then press(destflrnum) a floor btn theyd like to go to, which that btn will illuminate(on,destflrnum) itself and notify(destflrnum) the elevator.
4	<p>Each elevator has a sensor that notifies it when it arrives at a floor.</p> <p>The elevator has a display which shows passengers the current floor of the elevator.</p>	Elevator Use case (section 8)	As the floor sensor detectflr(flrrnum) a floor upon the elevator arriving to it. The sensor tells its elevator with atnewfloor(flrrnum) , and the elevator updatecurrflr(flrrnum) its display, the sensors notification gets relayed to ECS from the elevator with atnewflr(flrrnum,elevnum).
5	<p>There is also a pair of buttons on the elevator control panel marked “open door” and “close door”. These buttons can be used by a passenger to override the default timing of the doors. The door will remain open beyond its default period if the</p>	Elevator Use case (section 5)	They have the option to hold(numsecs) the open doorbtn to hold the doors open() and to press() the close doorbtn which the elevator make its bell ring() and close() its doors.

	“open door” button is held depressed; the doors can be closed prematurely by pressing the “door close” button.		
6	Inside the elevator there is also a help button linked to building safety service.	Elevator Use case (section 7c)	As the Passenger presses() the helpBtn, the elevator is notified as an alarm(help) will be raised as the safety issue. Then the elevator tells the ECS with a request(helpalarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is. Which the ECS notify(helpalarm, elevnum) the Building Safety Service and tell them the safety issue and which elevator to connect to. The elevator is connected to the Building Safety Service via voice with BSSconnection()
7	The elevator control system should ensure that the group of elevators services all (floor and on-board) requests expeditiously.	Elevator Use case	The floor sends a flrrequest(direction,serveflrnum) to ECS to let it know which floor to serve. The ECS will use timestrat() as the default to figure out which elevator to send to the floor to apply a Time dependent strategy when allocating elevators,
8	Each elevator has a display and an audio system. The display shows the current floor number and warning messages that are synced with audio warnings.	Elevator Use case	The ECS sends a request(safetymsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(safetymsg) and its Display to show(safetymsg) and these messages are played/displayed. The current floor number is always displayed, updatecurrflr(flrnum) just changes the text in the display to the current floor the elevator is on.

Safety Feature Traceability Matrix:

ID	Requirement	Related Use Case	Description
1	The control system receives a “Help” alarm signal from an elevator indicating that the “Help” button has been pressed.	Elevator Use case (section 7c)	As the Passenger presses() the helpBtn, the elevator is notified as an alarm(help) will be raised as the safety issue. Then the elevator tells the ECS with a request(helpalarm, elevnum) to let it know which elevator has a safety issue and what the safety issue is.
2	the passenger is connected to building safety service through a voice connection.	Elevator Use case (section 7c)	the ECS notify(helpalarm, elevnum) the Building Safety Service and tell them the safety issue and which elevator to connect to. The elevator is connected to the Building Safety Service via voice with BSSconnection()
3	If there is no response from building safety within 5 seconds or if there is no response from a passenger a 911 emergency call is placed.	Elevator Use case (section 7c)	The BSSconnection() will waitresponse() from a Passenger. Which either the Passenger gives back a response or none. If the Building Safety Service receives a null/none instead of a response from the passenger then call911().
4	If the light sensor is interrupted when the door is closing, the control system stops the door from closing and opens it.	Elevator Use case (section 5a)	If the light sensor of the elevator detects(obstacle) then the elevator is notified as an alarm(obstacle) will be raised as the safety issue. Then the elevator tells the ECS with a request(obstacle, elevnum). Then the ECS will tell the elevator to interruptclose() to stop the doors from closing and command the elevator to open its doors. Which the elevator will ring() its bell and open() its doors.
5	If this occurs repeatedly over a short period of time, a warning is sounded over the audio system and a text message is displayed.	Elevator Use case (section 5a)	This can be repeated up to 5 times(or whatever times preferred)which at that point the elevator doors stays open. And the ECS will send a request(obsmsg) to the elevator as the message to be played/displayed. Which the elevator tells its Audio System to play(obsmsg) and its Display to show(obsmsg).
6	The control system receives a “Fire” alarm signal from the building and commands all elevators to move to a safe floor. Similarly, a “Fire” alarm signal	Elevator Use case (section 7a)	the Building raises an alarm(fire) in the elevator or a Passenger press() the fireBtn then the alarm(fire) will be raised in the elevator. The elevator tells the ECS with a request(firealarm, elevnum). Which the ECS would command all elevators to

	from the elevator itself will cause that elevator to go to a safe floor.		move(direction) depending which floor they're on towards the safe floor.
7	In both cases an audio and text message are presented to passengers informing them of an emergency and asking them to disembark once the safe floor is reached.	Elevator Use case (section 7a)	The ECS sends a request(firemsg) to the elevator as the message to be played/displayed. Which the elevator tells its Audio System to play(firemsg) and its Display to show(firemsg) and these messages are played/displayed the whole time till passengers leave.
8	The control system receives an "Overload" alarm signal from an elevator if the sensors indicate that the passenger or cargo load exceeds the carrying capacity.	Elevator Use case (section 4b)	The passengers weight(assuming cargo + passenger weight = passenger weight) + the currweight of the elevator will go over its maxweight allowed. Then the weight sensor raises an alarm(overload) in the elevator. The elevator tells the ECS with a request(overloadalarm, elevnum).
9	In that case, the elevator does not move and an audio and a text messages are presented to passengers asking for the load to be reduced before attempting to move again.	Elevator Use case (section 4b)	The ECS sends a request(overloadmsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(overloadmsg) and its Display to show(overloadmsg). (Assuming the elevator is stationary as ECS will not command elevator to move until passenger leaves)
10	The control system receives a "Power Out" alarm signal.	Elevator Use case (section 7b)	The Building cutting off the power(off) of the elevator. The power sensor raises an alarm(powerout) in the elevator. The elevator tells the ECS with a request(poweroutalarm, elevnum).
11	In that case, an audio and a text messages are presented to passengers informing them of the power outage.	Elevator Use case (section 7b)	The ECS sends a request(poweroutmsg) to the elevator as the message for a safety issue to be played/displayed. Which the elevator tells its Audio System to play(poweroutmsg) and its Display to show(poweroutmsg) and these messages are played/displayed the whole time till passengers leave.
12	Each elevator is then moved to a safe floor and passengers are asked to disembark via audio and text messages.	Elevator Use case (section 7b)	Which the ECS would command all elevators to move(direction) depending which floor they're on towards the safe floor. The messages are played/displayed the whole time till passengers leave (from activation of power out mode).