Chess clock

Homework assignment - System modeling (FA042)

2020. február 29.

1. Overview

The student's task is to design the controller of a chess clock based on the specification below using YAKINDU.

1.1. The chess clock

The task of the chess clock is to specify the time to think for the participants. Both players (White and Black) have a given amount of time to think, wich the chess clock displays. The time of the current player constantly decreases. If the time runs out, the player loses and the clock beeps to indicate the termination of the game due to timeout. If the current player moves in time, the player should press the approriate button. As a result the decreasing stops and (depending on the game's setup) the time increases by a certain amout of reward time and the other player comes instantly. The player can use the remaining time (increased with reward time) to think in the next turn.

The expected behavior of the chess clock is discussed in section 2.

1.2. Control panel

The control panel of our chess clock consists of the following elements.

- Main text display (**Display text**), where the chess clock provides general information.
- Clock displaying the time of the White player (**White display**).
- Clock displaying the time of the Black player (**Black display**).
- Beeper that may beep when timeout or other events occur (**Beeper**).
- Buttons `MODE` and `START/RESET` for setting up and starting/stopping the game (see section 2).
- The button `♔/+` pressed after the White player's steps.
- The button `♚/-` pressed after the Black player's steps.

1.3. Yakindu binding

We start buliding the chess clock's model in YAKINDUstate modeling tool by defining the system's interfaces to the outside world. To represent them in YAKINDU we use interface events and variables (these are also used by the GUI, that will be provided later for support). Thus, our model can react to a keypress, and we can display the values of the variables on the screen. The interfaces of the system are listed below. The homework must be prepared accordingly.

- **Display.text**: interface variable representing the main display. It's text value can be read on the screen.
- **Display.whiteDisplay**: interface variable representing the White player's clock. It's non-negative integer value determines the number of seconds, which will be displayed in minutes:seconds format. If we assign a negative integer value to the variable (eg. -1) then the clock will be turned off (inactive).
- **Display.blackDisplay**: interface variable representing the Black player's clock. Similarly to the above, it's non-negative integer value determines the number of seconds, which will be displayed in minutes:seconds format. If we assign a negative integer value to the variable (eg. -1) then the clock will be turned off (inactive).
- **Beeper.beep**: output event, that beeps the beeper when triggered.
- **Buttons.modeButton**: input event representing when [MODE] is pressed.
- **Buttons.startButton**: input event representing when [START/RESET] is pressed.
- **Buttons.whiteButton**: input event representing when [♔/+] is pressed.
- **Buttons.blackButton**: input event representing when [♚/−] is pressed.

Of course, further statevariables can be defined for inner usage (that is, separated from the interfaces). There is a placeholder for this purpose in the YAKINDU model-stub issued 5th week.

2. Behavior to be implemented

2.1. Switching between setup modes

Initially `Ready to play` is displayed on the screen. Before the game begins certain setup options are available; pressing [MODE] cyclically switches between the following contents.

- `Initial time`,
- `Increment time`

– Ready to play again, and so on.

Section 2.4 discusses the detailed operation of these setup menus. The effect of the [MODE] button will be different during the game, as discussed in section 2.2.

The [START/RESET] button will start the game if Ready to play can be seen on the screen. Otherwise (when setup menus are displayed) pressing [START/RESET] will result in displaying Ready to play as if [MODE] button had been pressed the appropriate number of times.

2.2. The course of the game

During the game the clock of the White player will always show the White player's remaining time to think, and the clock of the Black player always shows the Black player's remaining time to think. The displayed text on the main display is either White moves or Black moves, depending on wich player's turn it is.

When the game begins both clocks are set to the initial time to think. The initial time to think is 90 second for both players by default, but this value can be changed (see section 2.4).

The first turn is the White player's turn.

The time of the current player is constantly decreasing (one second per second, as obvious) while the other player's time remains unchanged. If the current player presses the appropriate button (wich is [♔/+] for the White player and [♚/-] for the Black player; the other player's button is ineffective) before the time runs out, then the current players time increases and the other player's turn begins (his time start decreasing). The amount of reward time given is 30 seconds for each player by default, but this value can be changed (see section 2.4).

However, the increased time can't exceed the maximum time enabled. If the sum of the remaining time and the reward time exceeds the maximum time to think, then the player's time will be set to the maximum time. The value of the maximum time is 1200 seconds for both players.

When a player moves and presses the appropriate button the chess clock beeps to warn the players that the other player's turn has started.

2.3. Finishing and aborting the game

In case the players finish the game (by checkmate, stalemate, surrender or draw by agreement) before te time runs out, they indicate it, by pressing the [START/RESET] button. As a result Ready to play is displayed on the screen again, and the players can press [START/RESET] to start a new game or [MODE] to access the settings.

In case the current player's remaining time is dangerously low, that is, 5 or less, then the chess clock beeps to warn the player to move quickly.

In case the current player's time runs out, the clock beeps to inform the players that the game is over and the current player lost. Then, if the White player lost `White flag fallen` can be seen on the screen, otherwise `Black flag fallen` is displayed. The players' clocks continue to display their remaining time (as obvious, the losing player's time is zero). The chess clock doesn't react to the players' buttons (♔/+, ♚/-) or MODE, but START/RESET resets the clock (`Ready to play` appears again, etc. as discussed previously).

It is possible to postpone the game. In this case the last player doesn't move on the table, but envelopes the move and the match can continue next time with the other player's turn by revealing the move. During the game pressing MODE postpones the game. In this case the game continues unchanged, it's still the same player's turn, except when the current player presses the appropriate button indicating that the move has been enveloped, and the playaer's clock stops (reward time is given), the other player's time doesn't start decreasing. If the current player in turn is the White player, `White adjourned` is displayed on the screen, and `Black adjourned` is displayed otherwise. During postponement the clocks display the players' remaining time. Postponement ends by pressing MODE again. The next player's turn begins just like without postpone. During postponement the chess clock reacts to START/RESET exactly like during the game, but the players' buttons are ineffective in this case.

2.4. Setting the parameters

When the user chosed `Initial time` menu the players' time can be set. In this case the Black player's clock is inactive while the initial time to think is displayed on the White player's clock. ♚/- decreases the time by 30 seconds while ♔/+ increases it by 30 seconds. If the value is less than 60 seconds or more than 600 seconds, the change will be unsuccesful. In this case the chess clock beeps instead of modifying the value.

When `Increment time` menu is chosen the reward time can be displayed and set. Displaying and setting the time works similarly to the above. The minimum value of reward time is 0 seconds, the maximum is 60 seconds, and the value can be increased or decreased by 5 seconds per keypress.

In each of these menus the modified value of a parameter is preserved until it is modified again, regardless of the number of games played and the other settings.

Since when displaying `Ready to play` settings can't be changed (only after pressing MODE), the buttons ♔/+ and ♚/- are ineffective and both clocks are inactive.

3. Released Test Cases

3.0.1. base1

Basic test: Pressing each button.
[♚/-] → [♔/+] → [MODE] → [START/RESET]

3.0.2. base2

Basic test: Waiting for 3 sec.
🕒+3s

3.0.3. optionCycle

By pushing the MOD button in the menu each options are available, and are set to the default values.
`Check #1>` `Ready to play` on the main display
[MODE]
`Check #2>` `*BEEP*` is NOT expected
`Check #3>` `Initial time` on the main display
`Check #4>` `01:30` on the WHITE clock
[MODE]
`Check #5>` `*BEEP*` is NOT expected
`Check #6>` `Increment time` on the main display
`Check #7>` `00:30` on the WHITE clock
[MODE]
`Check #8>` `*BEEP*` is NOT expected
`Check #9>` `Ready to play` on the main display

3.0.4. checkSetStartTime

Checking the upper and lower bounds of the target option. First, the value is increased from default to maximal, plus one more time to check if it stops. Then, it decreased to minimal and checked again it it stops.
[MODE]
`Check #1>` `01:30` on the WHITE clock
[♔/+]
`Check #2>` `02:00` on the WHITE clock
[♔/+]
`Check #3>` `02:30` on the WHITE clock
[♔/+] → [♔/+] → [♔/+] → [♔/+] → [♔/+] → [♔/+] → [♔/+] → [♔/+] → [♔/+]
→ [♔/+] → [♔/+] → [♔/+] → [♔/+]
`Check #4>` `09:00` on the WHITE clock
[♔/+]
`Check #5>` `09:30` on the WHITE clock
[♔/+]

Check #6> 10:00 on the WHITE clock
♔/+
Check #7> *BEEP* is expected
Check #8> 10:00 on the WHITE clock
♚/-
Check #9> 09:30 on the WHITE clock
♚/-
Check #10> 09:00 on the WHITE clock
♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/-
Check #11> 02:00 on the WHITE clock
♚/-
Check #12> 01:30 on the WHITE clock
♚/-
Check #13> 01:00 on the WHITE clock
♚/-
Check #14> 01:00 on the WHITE clock
Check #15> *BEEP* is expected

3.0.5. checkSetBonusTime

Checking the upper and lower bounds of the target option. First, the value is increased from default to maximal, plus one more time to check if it stops. Then, it decreased to minimal and checked again it it stops.

MODE → MODE
Check #1> 00:30 on the WHITE clock
♔/+
Check #2> 00:35 on the WHITE clock
♔/+
Check #3> 00:40 on the WHITE clock
♔/+ → ♔/+
Check #4> 00:50 on the WHITE clock
♔/+
Check #5> 00:55 on the WHITE clock
♔/+
Check #6> 01:00 on the WHITE clock
♔/+
Check #7> *BEEP* is expected
Check #8> 01:00 on the WHITE clock
♚/-
Check #9> 00:55 on the WHITE clock
♚/-
Check #10> 00:50 on the WHITE clock

♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/- → ♚/-
Check #11> 00:10 on the WHITE clock
♚/-
Check #12> 00:05 on the WHITE clock
♚/-
Check #13> 00:00 on the WHITE clock
♚/-
Check #14> 00:00 on the WHITE clock
Check #15> *BEEP* is expected

3.0.6. checkEffectSetStartTime

Checks the result of changeing the initial time for player Global.
MODE
Check #1> Initial time on the main display
Check #2> 01:30 on the WHITE clock
♔/+
Check #3> Initial time on the main display
Check #4> 02:00 on the WHITE clock
MODE → MODE
Check #5> Ready to play on the main display
START/RESET
Check #6> White moves on the main display
Check #7> 02:00 on the WHITE clock
🕒+3s
Check #8> 01:57 on the WHITE clock
♔/+
Check #9> *BEEP* is expected
Check #10> Black moves on the main display
Check #11> 02:00 on the BLACK clock
🕒+3s
Check #12> 01:57 on the BLACK clock

3.0.7. checkEffectSetBonusTime

Checks the result of changeing the initial time for player Global.
MODE → MODE
Check #1> Increment time on the main display
Check #2> 00:30 on the WHITE clock
♔/+
Check #3> Increment time on the main display
Check #4> 00:35 on the WHITE clock
MODE
Check #5> Ready to play on the main display

START/RESET
Check #6> White moves on the main display
Check #7> 01:30 on the WHITE clock
Check #8> 01:30 on the BLACK clock
♔/+
Check #9> *BEEP* is expected
Check #10> Black moves on the main display
♚/-
Check #11> *BEEP* is expected
Check #12> White moves on the main display
Check #13> 02:05 on the WHITE clock
Check #14> 02:05 on the BLACK clock

3.0.8. checkResetInOptions

Checking the effect of pushing the START/RESET button in the options.
MODE
Check #1> Initial time on the main display
Check #2> 01:30 on the WHITE clock
♔/+
Check #3> Initial time on the main display
Check #4> 02:00 on the WHITE clock
START/RESET
Check #5> Ready to play on the main display

3.0.9. checkStartInGame

Checking the START/RESET button in the game
Check #1> Ready to play on the main display
Check #2> Ready to play on the main display
START/RESET
Check #3> White moves on the main display
START/RESET
Check #4> Ready to play on the main display