Compsys 305 Project(Group APA)

*Abstract*

—Layout titles, Mouse , VGA Sync, FSM,Block Diagram.Design,Display, Pipes/LSFR, Ball , Characters/text, Equations/Appendix. Acknowledgements ,Switch 0 pause, Button 2 selects game mode, Button 1 training mode, Button 0 back to the main screen, Max level=4 , Counts 7.5 seconds level increase, Lives = 3. Every 10th pipe extra life. Vertical sync = 699 \*524/25Mhz.

In this report it will cover the block diagram and game design of our project. The goal of our project is to design a game which is based off the game flappy bird using a DE0 board displayed on a VGA board. The design of our game is created in key components such as the pipes which generate the obstacles in the game and the mouse allows the user to control the bird. The user is able to choose from two modes, training mode and regular mode. As the player progresses through the game the level will increase, and the bird will move faster. There will be special gifts created which allow the user to pass through objects. The controls are the mouse and the DE0 board allowing the user to operate the game.

# Introduction

The goal of this mini project is to design and implement the game Flappy Bird on the DE0 board in VHDL. Users will control and play the game using a PS/2 mouse, DIP switches and push buttons on the DE0 board. The game will be displayed on a VGA board with a resolution of 640 x 480 pixels.The game is a side-scroller where the player controls the vertical movement of a bird to avoid obstacles by flying between the gaps of oncoming rows of pipes. The left click on the mouse raises the bird and the bird falls when there's no user input. The player's score increases whenever a gap between pipes is passed. The aim of the game is to achieve a high score.Our implementation of the game will have two modes: training and regular. In training mode the speed of the oncoming rows of pipes is constant at the lowest speed available in the game. In this mode the bird will have an infinite number of lives. Falling to the bottom of the screen will still prompt the game over screen in which the user can use a push button (PB0) to return to the main menu or restart the run (PB1). The user can pause (prompting a pause screen) and resume the game at any time using DIP switch 0 on the DE0 board.In regular mode the speed of the pipes will increase after ~7.5 seconds, and then increase again after another ~7.5 seconds. The increase in speed increases the difficulty of the game as the player has less time to react to the obstacles. In regular mode, the bird has a finite number of lives which begins at 3 and only increases if the user passes 10 pipes or collects “gifts” which fly across the screen in straight lines. The amount of lives decreases whenever the bird collides with a pipe. When the bird runs out of lives or falls to the bottom of the screen, the game over screen is prompted and the user can either quit to the main menu or restart the run. If the player achieves a score of 100 (passes through 100 pipes), a victory screen will appear. Like the training mode, the user can also pause the game at any time. The gift system that allows the user to gain additional lives is a unique feature to our implementation that wasn’t present in the original game. Additional lives allow the user to reach higher scores and adds another dimension to the gameplay as users won’t only focus on avoiding obstacles but also try to collect the oncoming gifts.

# System Block Diagram

This game is created by key components such as the display, mouse and vga sync. Our entire system hierarchy is shown below in figure 1 and in figure 2.

Our game is comprised of 5 components, the “altpll0” (which is the clock divider from 50MHz to 25 MHz), the “mouse” which controls the mouse, “game\_fsm” which is the FSM for our game, “game” component which contains the logic for bouncy ball, pipes and the gift, and the VGA\_SYNC component which outputs the RGB signal to the monitor. These connections can be seen in figure 1.

For the game component, we have used structural modelling to create the component. As shown in the hierarchy model of the game, from the top level underneath the game component, there are 5 components, and the 4 components menu, gameover, pause\_screen and winner represents the different screens that are shown in the VGA monitor depending on the 3-bit signal from the FSM (eg. the menu screen would be shown if the FSM sends “000”). The bouncy ball component and its sub-components are used to implement the elements of the game (bird/ball, pipes and the gift). The game component determines what RGB signals are sent to the VGA sync component, and we’ve made it so depending on the selected mode from the game FSM. If it is the menu screen or winner screen it will be a green background with white text. If it is the game over screen it will be a red background with white text. If it is the pause screen, it will be a blue background with white text and lastly if it is the training or game mode it will be a blue background with white text, yellow bird, and green pipes.

# Game FSM

Our overall FSM diagram of our system is shown in figure 3. The initial state that the user starts is the menu state. From here, depending on the input, the next state will either be the regular or training mode. This is determined by either push button 1 or push button 2. From the training or regular state, the next state will either be the pause, win or game over state. The pause state is determined if switch 0 is enabled. The win is enabled if the user reaches a score of 100 and the game over state is determined if the life count reaches 0. The next state for the win and gameover state is the initial menu state. This is enabled when the reset signal is on. For the pause state, the next state will be the regular or training state depending on the previous state when the switch is off.

# Game Design/ Components

## FSM

A key component of our design is the game FSM. The FSM determines the transitions from one state to another.

As shown in figure 4, the FSM takes in 7 input signals, clk, reset, PB1, PB2, SW\_pause, dead and win. Depending on the input, the FSM sends the output signals game\_reset, game\_pause and selected\_mode. The reset, PB1, PB2 and SW\_pause are connected to the buttons/switch on the altera DE0 board, which are PIN\_H2, G3, F1 and J6.For the fsm, there are 6 different states, menu, regular, training, gameover, pause and win. Depending on the input to the fsm, the fsm sends a 3-bit signal out called “selected mode” which is inputted to the “game” component. If the player switches up SW0 (SW\_pause) then the game FSM sends the game\_pause signal, which is used to display the “paused” screen. If the player presses the reset button, the game FSM sends the game\_reset signal, which is used to show the main menu. The outputs of the FSM component that are sent to the game component depending on the state which is shown in figure 5.

## Main Menu

The design for the Main menu screen can be found under the menu.vhd. The main menu is shown below in figure 4.

The main menu has a green background with white text. It displays the Team name with the controls.

## Bouncy Ball

The bouncy ball component encompasses the logic for the “bird” or the character of our game. The implementation is simple, with the ball being an 8x8 pixel cube with a fixed x-position of 250 (only moves up and down). To control the ball, during every vertical sync, if the user is pressing the left mouse button, the ball\_y\_motion would be increased and added onto the y-position of the ball and decreased if the user is not pressing the button to emulate the element of falling down due to gravity. To detect the collision with the pipes, we would compare the x,y position of the ball and the x,y position of the pipes, and have a flag called “ball\_collision”. If the position of the ball is within the size/position of the pipes, and if ball\_collision is 0, then we would set ball\_collision to 1. This was to avoid the ball from colliding with the pipes multiple times. The variable life would be reduced by one and the ball\_collision flag would be reset back to 0. To detect collision with the gift, the same logic was used with a different flag called “touch\_ball” and the life would be increased by 1 with a cap of 9 max. If the life is equal to 0, signal “dead” would be set to 1, and would send the user to the gameover screen. We have also created a variable called “score” and allowed the user to win the game if the user achieves 99 points. Through a conditional statement, if the score goes to 99, the user would be sent to the winner screen, where they are greeted with a “You Win!” message.

## Pipes

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

Number equations consecutively. Equation numbers, within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

*a**b* 

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## Ball

## Pause Screen

## Display

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
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* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
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* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

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Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named “Heading 1”, “Heading 2”, “Heading 3”, and “Heading 4” are prescribed.

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1. Table Type Styles

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Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

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1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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