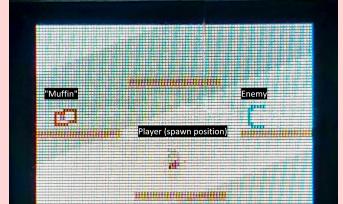
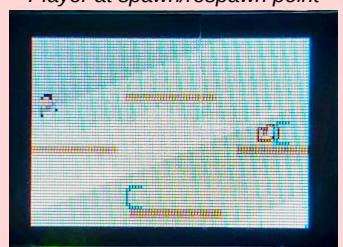
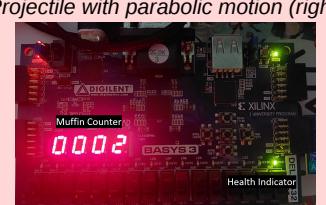
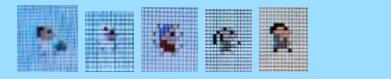
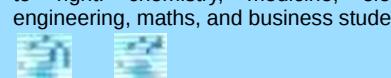


PERSONAL AND TEAM IMPROVEMENTS

Student and Improvement Name	Improvement Description	Images/Photos
Team: "Student Knight"	<p>The group has created a platformer similar to that of the game "Muffin Knight", but with a student-themed design instead. Playing as a student, the goal of the game is to collect as many "muffins" as possible, while avoiding enemies in the form of letter grades. "Muffin" sprites are displayed as certificates to fit in with the overall theme.</p> <p><u>Overall system features include:</u></p> <ul style="list-style-type: none"> - Main menu, pause menu, character descriptions and credit screens - LED and 7-seg display to show number of lives left and muffins collected. <p><u>Gameplay features:</u></p> <ul style="list-style-type: none"> - Player collecting a muffin (by running into it) randomly switches them to one of 5 different characters, and increments the 7-segment display - Contact with enemy causes player to lose a life (shown via LEDs) - Each character has a unique ability/projectile to attack enemies (more damage for certain abilities) - Player loses life when they fall into the pit (bottom of the screen) - Enemies become angry when they fall in the pit (+2 health and move faster) - Enemies have max 5 health, and are displayed as A/B/C/D/E (health 1 to 5) - Muffin and enemy spawn locations are randomised 	 <p>Student Knight at Main Menu</p>
Group Member 1: Kashfy "Player movements, interactions with user and game environment, Projectile motion Muffin logic"	<p>Player Logic: The user will be able to control the character's left/right movements (by pressing btnL(btnR)) and jumping (by pressing btnU). By timing the jumps accurately, the player is able to "double jump" while in mid-air. Otherwise, the player falls downwards with increasing velocity until it hits a platform/bottom of the map. If the player attempts to move into the edge of the map while it is falling, the player will cling to the "wall" of the map, resulting in a much slower fall.</p> <p>Led[2:0] serves as a health indicator of the player, with full health reflecting all 3 LEDs being lit. Each time the player loses a "life", the number of lit LEDs decreases by 1 ($\text{led}[2:0] = \text{led}[2:0] \gg 1$).</p> <p>The player is allowed to move anywhere within the map, confined to the boundaries of the screen. Upon falling through the "pit", the player loses a life and respawns in the middle of the map. While the player is allowed to jump through platforms, it is unable to fall through platforms or phase through them from the left or right.</p> <p>Upon contact with an enemy, the player loses a life.</p> <p>Projectile Motion: The player is able to do damage to the enemies using its abilities/projectiles by pressing btnD alongside btnL(btnR). The mechanics are as follows:</p> <ul style="list-style-type: none"> • Projectiles with linear motion (for medicine student and maths student) Outputs: x-y coordinates of projectile(s) (linearly changing x, constant y) • Projectiles with parabolic motion (for business student) Outputs: x-y coordinates of projectile (linearly changing x, changing y) • Laser projectile (for electrical engineering student) Outputs: x-y coordinates of laser position(constant x, constant y), width • Mine projectile (for chemistry student) Outputs: x-y coordinates of projectile (constant x, changing y) <p>Muffin Logic: A "muffin" to be collected by the player will spawn at a random location on the map at the start of the game. Upon being collected, the muffin will respawn at another random location to be collected again by the player. The 7 segment display serves as a muffin counter for the number of "muffins" collected by the player. Upon collecting a "muffin", the player switches to a different character, with a different ability.</p>	 <p>Player at spawn/respawn point</p>  <p>Player clinging to wall</p>  <p>Projectiles with linear motion (left) Projectile with parabolic motion (right)</p>  <p>Muffin Counter and Health Indicator</p>
Group Member 2: Timothy "Game graphics designer (excluding projectiles)"	<p>This section of improvements focuses on student, enemy and muffin sprites, and the overall map (background). Student sprites are 8 pixels by 8 pixels, the muffin sprite is 6 pixels by 8 pixels, and enemy sprites are 8 pixels by 6 pixels. All sprites were designed using a pixel art creator tool, PixilArt, then downloaded as .png files and written into code by hand. Only for student sprites, the open-source Picture2Pixel Python library was additionally utilised for initial conversion from .png to Verilog code, following which some output colours and pixels were manually edited and refined.</p>	 <p>S1 versions of all character sprites. From left to right: chemistry, medicine, electrical engineering, maths, and business students</p> 

Student Sprites: There are **20 distinct student sprites** - for **5 characters** (medicine, maths, business, electrical engineering, and chemistry students), each with **4 sprites**. The 4 sprites include 3 walking/running sprites (denoted below as S1, S2 and S3) and 1 jumping sprite. **Exactly 1 student sprite** is displayed at any given time. All student sprites face right by default, and are flipped to face left/right depending on whether btnL(btnR) is pressed respectively (**sprite flipping is done via formula logic** within each sprite module, not via hardcoded a second copy of each sprite). Student sprites utilised the open-source Picture2Pixel Python library as a base, before having the code manually edited and refined by hand. When the character is **stationary**, S1 is displayed. When the student **moves** sideways (i.e. btnR or btnL is held), as the student's coordinates change, the student goes through a **walking animation**. The displayed sprite **cycles through S1, S2 and S3** sequentially, completing roughly 2 cycles per second. When the student is in the air (i.e. not on a platform), the **jumping sprite** is displayed.

Enemy sprites: There are **5 distinct enemy sprites**, each representing a letter grade (A/B/C/D/E). Each sprite has **2 versions** of different colours determined by whether they are "angry" (see member 3's section). **Up to 6 enemy sprites** are displayed at any given time, with each sprite changing based on their health and anger states.

Others: One muffin sprite is displayed at each time.

The background is formatted as a .mem file and read directly by the drawing module to reduce LUT utilisation.

Stationary (left) vs jump (right) sprite for maths student - facing left



"Muffin" sprite (resembling certificate)



LEFT: Display of sprites of all enemies (top 2 rows - "angry" and "not angry" enemies respectively), 1 character (business student), and the "muffin" (certificate); all against the map background.

RIGHT: map background without sprites

Group Member 3: Claire

"Enemies, Projectile control and interaction"

Enemy logic: When the game starts, a set number of enemies spawn at a fixed frequency (e.g. first spawn is 3 small and 1 big enemy). After each set of enemies, there is a time delay, before the next set of enemies spawn. **As the game progresses, the time delay between sets of enemies decreases and the number of enemies in each set increases.** The number of enemies alive is **capped at 8**. Each enemy spawns with either 3 (small enemy - C) or 5 (big enemy - E) health. They **spawn randomly** at one of two spawn locations, facing a random direction. The enemies move till they reach the edge of the screen and turn around.

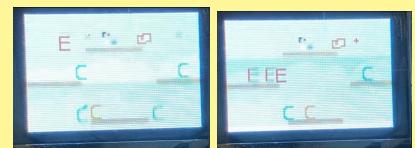
When an enemy falls into the pit (bottom of screen), they become '**angry**'. This **increases the speed** of the enemies and their **current health by 2** (capped at max health of 5). The enemies then respawn at one of the spawn locations. If they fall into the pit again, their health or speed will not increase.

Projectile Control: When the user presses btnD, the player fires a projectile corresponding to the character type. The player can fire a maximum of 6 projectiles and, between each shot, there is a set **cooldown** time based on character type.

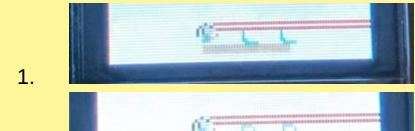
Medicine, Business & Maths students: if the projectile hits an enemy, the **enemy takes damage** corresponding to the type of projectile and the projectile deactivates. Medicine & maths students' projectiles are **unable to pass through platforms**.

Chemistry student: when btnD pressed, the player places a poison bottle down. The poison bottle instantly kills whichever enemy touches it. After the max number of poison bottles are placed down, if btnD is pressed again, the last placed poison bottle will be **repositioned** to the location of the player.

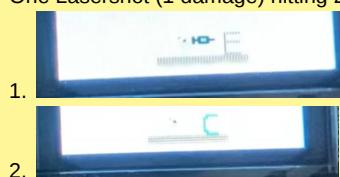
EE student: when btnD is pressed, the player will fire a laser shot for about 0.25s, and **all enemies within the range** of the laser shot will **take damage**. (Enemies only take damage once per laser shot)



Two C enemies falling into pit (left pic), becoming two angry E enemies (on the left platform in right pic)



1. One Lasershot (1 damage) hitting 2 enemies
2. One Lasershot (1 damage) hitting 2 enemies
3. One Lasershot (1 damage) hitting 2 enemies



1. Medicine shooting syringe at enemy (Syringe does 2 damage)
2. Medicine shooting syringe at enemy (Syringe does 2 damage)

Group Member 4: Sze Kang

"UI/UX designer and misc"

The player can use btnR (forward), btnL (backward), and btnD and btnU (select options) to move between the various **in-game screens**. The graphics are drawn using PixelArt and converted to .mem files to reduce memory usage and LUT utilisation.

Various Screens:

Main menu: Access options to move to other screens; includes **animations** of moving clouds and birds passing across the screen

Credits: Some words from us; can **scroll down** by pressing btnD

Pause: Displayed when player **pauses** in-game by pressing btnC in-game

Character: Select (with buttons) 1 of 5 characters to see his **description** and abilities

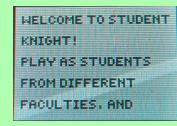
Game: The game occurs here

Other improvements:

- The **7-seg display** shows the number of muffins collected by the student.
- The game uses a **LFSR** module to produce **random numbers** to randomise character change during muffin collection, muffin spawn location and enemy spawn health
- **Design and drawing of projectiles** modules
- **Random spawning** of the muffin across the map



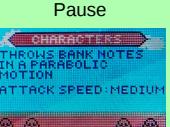
main menu



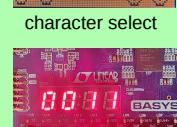
WELCOME TO STUDENT KNIGHT!
PLAY AS STUDENTS FROM DIFFERENT FACULTIES, AND
PAUSED BACK TO GAME
MAIN MENU



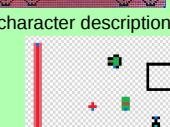
Credits



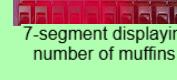
PAUSED
BACK TO GAME
MAIN MENU



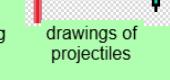
CHARACTERS



CHARACTERS
THROWS LASER SHOTS IN A PARABOLIC MOTION
ATTACK SPEED: MEDIUM



0000 BASYS: 0000



7-segment displaying number of muffins

drawings of projectiles