

Technical Design Document for:

Donkey Kong

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Written by Nintendo

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1.0 Revision History

Version	Description
1.0	Initial document template
1.1	<ul style="list-style-type: none">- Minor formatting fixes- Greyed out instructions for easier deletion later- Various sections started, nothing finished
1.2	<ul style="list-style-type: none">- Added to 12.0 Asset List, 3.2 Game Objects and Logic
1.3	<ul style="list-style-type: none">- 12.0 Asset List, 11.0 Audio, 7.0 Items done
1.4	<ul style="list-style-type: none">- 2.0 Development Environment, 3.0 Game Overview, 4.0 Mechanics, 5.0 Graphics, 6.0 A.I., 8.0 Game Flow, 9.0 Levels, 10.0 Interface done- Removed Scripts, Technical Risks, File Formats, Physics sections for either being irrelevant or impossible to find info on

2.0 Development Environment

CPU

Zilog Z80 microprocessor running at 3.072 MHz

Sound

MB8884 microcontroller (clone of the i8035), 64 bytes of RAM

Display

Raster monitor, vertical, 224×256 resolution, 256 out of 768 colors

3.0 Game Overview

3.1 Technical Goals

Needs to be made so that *Radar Scope* cabinets can be easily converted to play *Donkey Kong*.

3.2 Game Objects and Logic

Characters

Jumpman

- The player character
- If *Jumpman* falls a distance higher than x1.5 his own height, he will die

Lady

- Represents the player's main objective
- Calls out "help!" occasionally

Hazards

- All hazards kill *Jumpman* on collision

Donkey Kong

- The main antagonist
- Throws *Orange Barrels* and *Blue Barrels* in mostly random directions
- If there are the maximum amount of *Fire* enemies on-screen (5), *Donkey Kong* will stop throwing *Blue Barrels*
- Can affect a stage by beating his chest

Barrel

- Appear in the stage 25m
- Thrown by *Donkey Kong*
- Either roll down the slopes of the stage and occasionally *Ladders*, or is thrown in a zigzag pattern downward

Fire

- Appear in every stage
- In 25m, they spawn when *Blue Barrels* fall into the *Oil Drum*
- Max of 5 on-screen at any time
- Can climb *Ladders* (broken and unbroken), but can't change direction once climbing
- Chases *Jumpman* when within a certain distance to him
- Bigger in the final stage (100m)
- Turns blue while *Jumpman* has the *Hammer* power-up

Cement Tub

- Move along *Conveyor Belts*

Spring

- Appear on stage 75m
- Spawn continuously one after the other, bounces across the stage, then falls in a straight line off the screen

Power-ups

Hammer

- Gives player *Hammer Power-up* when collected (detailed in **7.0 Items**)

Items

Parasol, Hat, Bag

- Collectables placed in specific spots in stages *50m*, *75m*, and *100m* for the purpose of bonus points
- Each give an amount of points when collected; 300 points in level 1, 500 points in level 2, 800 points in level 3 and onwards

Environment

Ladders

- Climbable (up and down) by *Jumpman* and *Fire*
- Climbable (down only) by *Barrels*

Broken Ladders

- Climbable (up and down) by *Fire*
- Climbable (down only) by *Barrels*

Retractable Ladders

- Can only be climbed all the way by *Jumpman* when fully extended
- Randomly extend and retract

Oil Drum

- Appears in stage *25m* and *50m*
- In stage *25m*, they will spawn *Fire* if a *Blue Barrel* has fallen into it
- In stage *50m*, they spawn *Fire* based on a timer
- The top part of the *Oil Drum* will kill *Jumpman* if it is emitting fire

Conveyor Belts

- Ground that moves *Jumpman*, *Donkey Kong*, and *Cement Tubs* left or right when they are standing/placed on it, depending on current rotation direction
- Changes rotation direction randomly

Lifts

- Platforms that move up or down continuously

Rivets

- When the *Jumpman* crosses completely over one (regardless of whether he is jumping or walking), it is removed and the player is given 100 points
- Gaps left by removed *Rivets* can be jumped over by *Jumpman*, but cannot be crossed by *Fire*

3.3 Game Flow

From when the machine is turned on, until a coin is inserted, the game will cycle through 3 different screens (*Attract Mode*):

- a screen showing high scores, credits needed to play, and credits inserted
- a short demo of gameplay
- the title screen

Once a coin has been inserted, only the first screen will be displayed, instructing the player to press the *1-PLAYER button* for 1-player mode, or the *2-PLAYER button* for 2-player mode (if correct amount of coins have been inserted). 2-player mode is mostly identical to 1-player mode, except once the first player has lost a life, the second player's game will begin. The games will continue like this, back and forth until both players have lost all their lives.

If 2-player mode is selected, a screen showing whose turn it is will be displayed briefly, otherwise, it will be skipped. The *Opening Cinematic* will then play, before and then gameplay begins.

The player is then able to control *Jumpman* with the *Joystick* and the *Jump Button* (detailed in **10.2 Controls**). The player will then try to complete each stage's objectives (detailed in **8.2 Objectives**) as the game cycles through said stages (detailed in **8.1 'Mission' / 'Level' Structure**).

If *Jumpman* is killed by a hazard, the game checks if the player has any lives left. If there are lives remaining, one is subtracted and the stage is reset. If not, the game either enters its *Game Over* state, or goes to the other players' game (in 2-player mode, if player is still playing).

If either player's scores place in the high score table, they are prompted to enter their initials, and the score is saved. The game then returns to its attract mode.

4.0 Mechanics

4.1 Extra Lives

Once a certain number of points have been reached, the player will be given an extra life. These numbers are 7000, 10000, 15000 and 20000.

4.2 Points

Points are gained whenever:

- *Jumpman* jumps over *Barrels*, *Fire*, *Cement Tubs* or *Springs*
- *Jumpman* destroys something with a *Hammer*
- *Jumpman* removes a *Rivet*
- *Jumpman* collects a *Hat*, *Bag*, or *Parasol*

The number of points gained are:

- Jumping over X amount of enemies in one jump
 - 1 enemy = 100 points
 - 2 enemies = 300 points
 - 3 enemies = 500 points

- Destroying a *Barrel* with a *Hammer* = 300 points
- Destroying other enemies with a *Hammer*
 - *Fire* = 300 points
 - *Cement Tub* = 800 points
- Removing a *Rivet* = 100 points
- Collecting *Hat/Bag/Parasol* in Level #
 - Level 1 = 300 points
 - Level 2 = 500 points
 - Level 3 and onward = 800 points

Points are also gained on completion of a stage, depending on the number displayed in the BONUS box at the top-right of the screen. This number counts down as the stage is played. The amount of bonus points is determined by the level number.

Level 1 - 5000 points

Level 2 - 6000 points

Level 3 - 7000 points

Level 4 - 8000 points

Level 5 and onward - 9000 points

4.3 High Score Table

When the game is over, the player's score is compared with the scores on the High Score Table. If it is higher than any of them, the player is able to enter their initials, which are saved along with their score, and displayed on said table.

4.4 Difficulty

Difficulty increases with the level number. This is achieved by the game speed getting slightly faster.

5.0 Graphics

The arcade monitor is 256x224, oriented vertically, with colours inverted. The hardware has the capability of displaying 128 foreground sprites (16x16 pixels each) and 256 background tiles (8x8 pixels each). Each sprite and tile contains 3 colours, plus transparency.

6.0 Artificial Intelligence

Donkey Kong

- Decides whether to throw or roll *Barrels*
- Decides whether to pick red or blue *Barrels*

Barrel

- Decides whether to roll down a *Ladder* or not

Fire

- Moves randomly until *Jumpman* is within a certain range
- Chases *Jumpman* until he exits that range

Conveyor Belts

- Decides whether to rotate left or right

Retractable Ladders

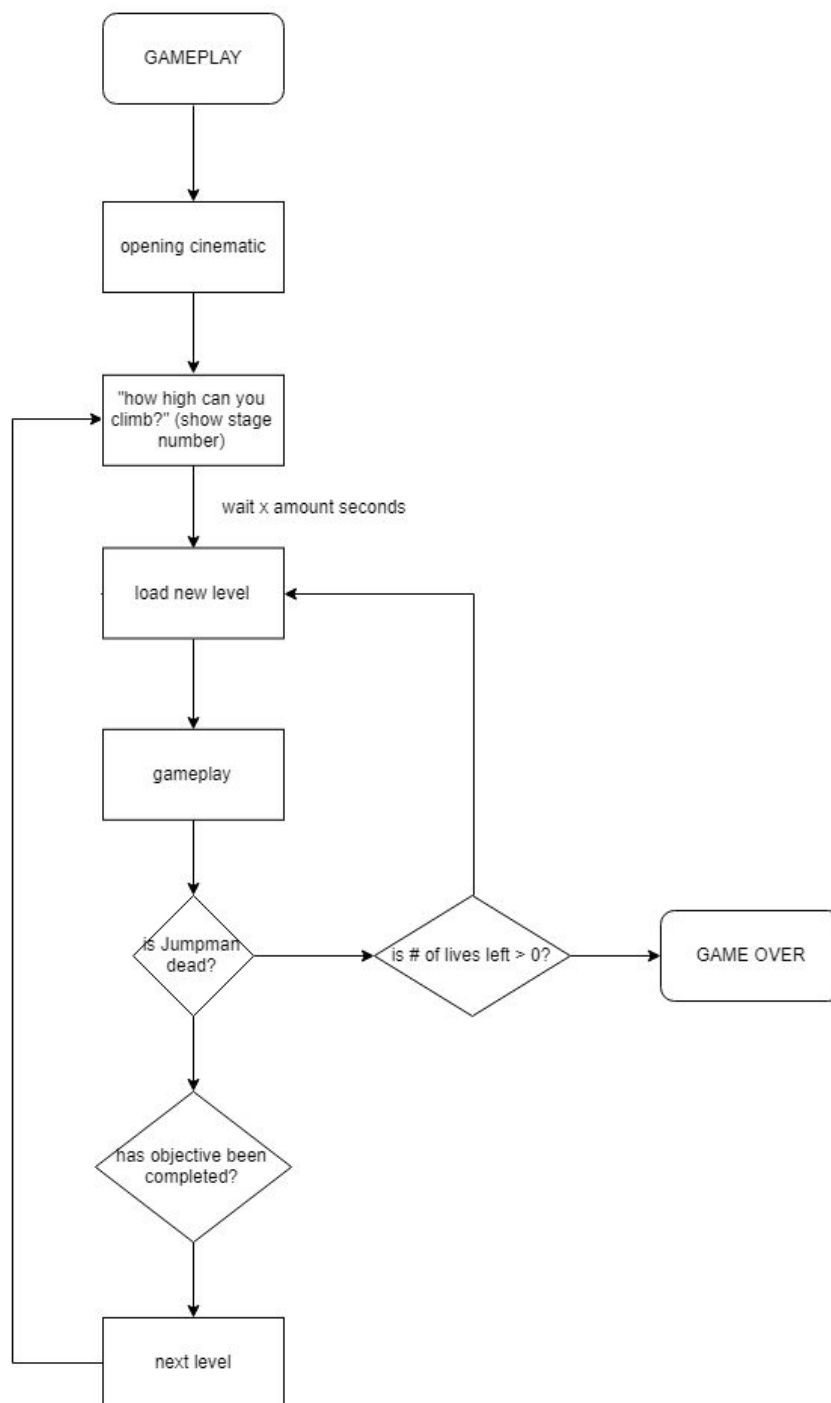
- Decides whether to extend or retract

7.0 Items

Hammer

Picking up the *Hammer* gives *Jumpman* the *Hammer Power-up*. *Jumpman* will swing the *Hammer* up and down for a total of 32 swings. During this time, if the *Hammer* hits *Fire*, a *Barrel*, or a *Cement Tub*, it will be destroyed. *Jumpman* is still vulnerable to hazards if they hit a part of his body. *Jumpman* cannot jump or climb ladders while using the *Hammer*.

8.0 Game Flow



8.1 'Mission' / 'Level' structure

Each level (represented as a tower) is made up of multiple single-screen stages, each representing a 25 metre section of said tower. At the start of each stage, the game displays the height the player needs to reach, which increments by 25m each time. Order of stages in each level will be different for Japanese and American audiences. (Note: although the stages have names that represent heights, these don't always

match up to the player's height, eg. in Level 1, the *100m* stage is used at the 50m height mark.)

Stages:

- *25m*
- *50m*
- *75m*
- *100m*

Level Structure (Japan Version):

- *25m, 50m, 75m, 100m* for every level

Level Structure (American Version):

- Level 1: *25m, 100m*
- Level 2: *25m, 50m, 100m*
- Level 3: *25m, 50m, 75m, 100m*
- Level 4: *25m, 50m, 25m, 75m, 100m*
- Level 5: *25m, 50m, 25m, 75m, 25m, 100m*
- Level 6 and up: Level 5 is repeated with increasing difficulty

Information carried between game states is:

- Current stage and level
- Current score
- Current amount of lives
- Top high score

8.2 Objectives

The overall goal of the game is to achieve the highest score. There are multiple ways to gain points (defined in section **4.2 Points**).

The completion of an individual stage is determined by different objectives:

25m: reach *Lady's* platform

50m: reach *Donkey Kong's* platform

75m: reach *Lady's* platform

100m: remove all *Rivets*

The completion of a level is determined when a certain set of stages is completed (defined in section **8.1 'Mission' / 'Level' Structure**).

9.0 Levels

All levels are 28 tiles wide and 32 tiles high.

25m

- Hazards used: *Barrels, Fire*
- Items used: *Hammer (x2)*
- Environment objects: *Ladders, Broken Ladders, Oil Drum*
- Begins with *Donkey Kong* throwing a *Blue Barrel* directly into the *Oil Drum*, spawning a *Fire*
- *Barrels* are either rolled, where they follow the slope of the stage and may randomly decide to travel down *Ladders*, or thrown, where they zigzag downward rapidly
- When *Jumpman* reaches the highest platform, the stage is completed

50m

- Hazards used: *Cement Tub, Fire*
- Items used: *Hammer (x2), Hat, Bag, Parasol*
- Environment objects: *Ladders, Retractable Ladders, Conveyor Belts, Oil Drum*
- Introduces *Conveyor Belts*, which carry *Cement Tubs* and influence *Jumpman* and *Donkey Kong's* horizontal position (they do not affect *Fire*)
- *Conveyor Belts* change direction randomly, except the one *Donkey Kong* is on. This one changes direction consistently so that *Donkey Kong* travels all the way to the left and right continuously.

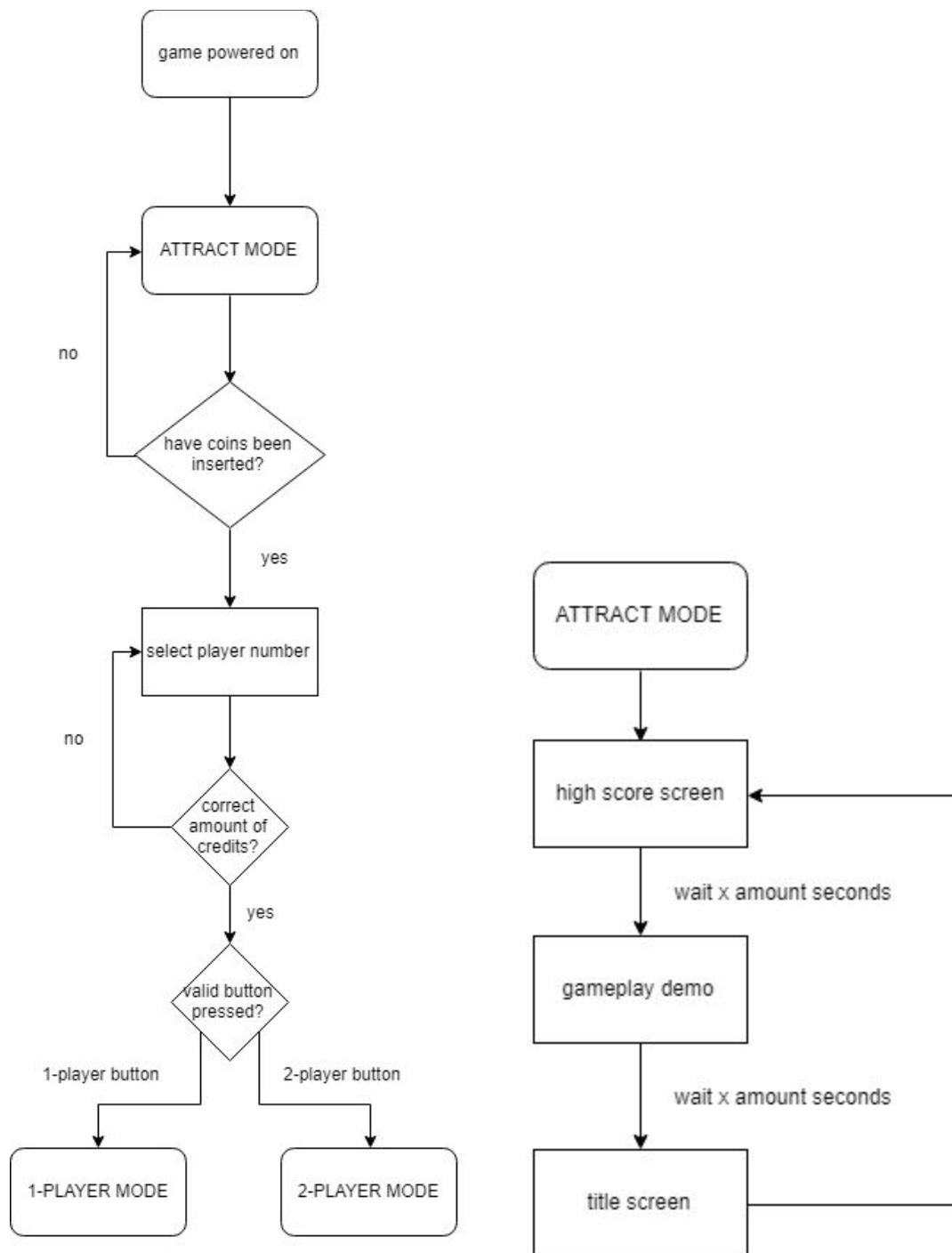
75m

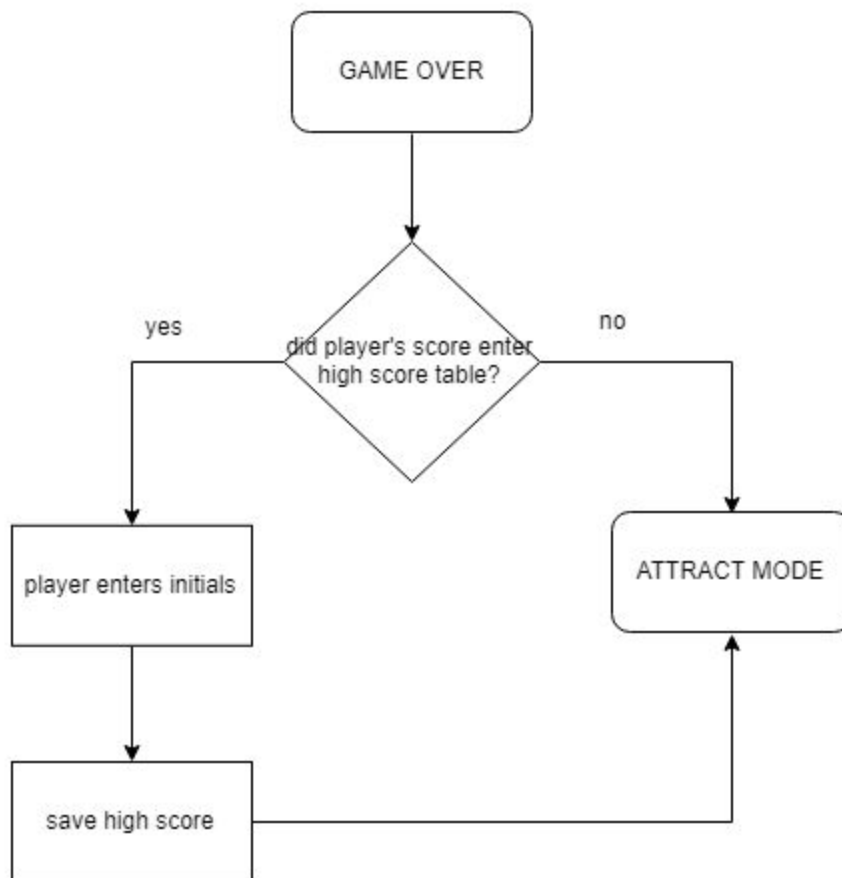
- Hazards used: *Springs, Fire*
- Items used: *Hat, Bag, Parasol*
- Environment objects: *Lifts, Ladders*
- Introduces *Lifts*, one of which moves down continuously, the other moves upward

100m

- Hazards used: *Fire*
- Items used: *Hammer (x2), Hat, Bag, Parasol*
- Environment objects: *Rivets, Ladders*
- *Fires* are bigger in this level, but act the same way
- When all the *Rivets* are removed, a cinematic of *Donkey Kong* falling down is played and the level is finished

10.0 Interface





10.1 Camera

Camera is orthographic and doesn't move. Levels are made of multiple single-screen stages, each representing 25m of the building being climbed. The top 4 rows of the screen display the HUD, showing:

- player 1's current points
- player 2's current points (if 2-player mode is selected)
- the top high score

10.2 Controls

The *Donkey Kong* arcade cabinet has 3 buttons (*1-PLAYER*, *2-PLAYER*, and *JUMP*) and a *Joystick*.

The *Joystick* is used to move *Jumpman* left and right when on the ground, and up and down when vertically aligned with a ladder. Pressing *JUMP* makes *Jumpman* jump; either on the spot if there was no directional input upon press, or in the direction of the *Joystick* if there was. The *1-PLAYER* and *2-PLAYER* buttons are used to select number of players.

11.0 Audio

Background music is handled by a MB8884 microcontroller, a clone of the i8035, which has 64 bytes of RAM. The MB8884 has no native sound capabilities, but a DAC (digital-to-analogue converter) can be connected to one of the MB8884's output ports, enabling it to output arbitrary waveforms (triangle waves and digital samples).

12.0 Asset List

Sprites

Jumpman

jman_run

- 3 frames
- Used when *Jumpman* is moving normally
- Includes sprite used when *Jumpman* is standing still
- Flip left/right depending *Jumpman*'s direction

jman_climb

- 1 unique frame, flips left and right to animate (making 2 frames)
- Used when *Jumpman* is climbing a *Ladder*

jman_climb_top

- 3 frames
- Used when *Jumpman* is at the top of a *Ladder*

jman_hammer_stand

- 2 frames
- Used when *Jumpman* is standing still while using the *Hammer Power-up*
- Flip left/right depending on *Jumpman*'s direction
- Separate *Hammer* sprite is rendered on top

jman_hammer_run

- 4 frames
- Used when *Jumpman* is running while using the *Hammer Power-up*
- Flip left/right depending on *Jumpman*'s direction
- Separate *Hammer* sprite is rendered on top

jman_jump

- 1 frame
- Used when *Jumpman* jumps

- Flip left/right depending on *Jumpman's* direction

jman_land

- 1 frame
- Used when *Jumpman* is landing on the ground
- Flip left/right depending on *Jumpman's* direction

jman_dead

- 3 unique frames, flips the first 2 frames in animation (making 5 total frames)
- Used when *Jumpman* dies

hammer_up

- 1 unique frame (2 frames total)
- *Hammer* item being held upright by *Jumpman*
- Rendered next to certain *Jumpman* sprites to make it appear he is holding it
- Animates by changing colour

hammer_side

- 1 unique frame (2 frames total)
- *Hammer* item being held sideways by *Jumpman*
- Rendered next to certain *Jumpman* sprites to make it appear he is holding it
- Animates by changing colour

Donkey Kong

Note: Each sprite is made up of 6 individual sprites (2x3)

dk_stand

- 1 frame
- Used when standing idly

dk_grin

- 1 frame
- Used in cinematics when *Donkey Kong* growls, and when *Donkey Kong* is falling (flipped upside-down)

dk_climb

- 2 frames
- Used in cinematics when *Donkey Kong* is climbing ladders

dk_climb_lady

- 2 frames
- Used in cinematics when *Donkey Kong* is climbing ladders while holding *Lady*
- Separate *Lady* sprite is rendered on top

dk_grab

- 1 frame
- Used when *Donkey Kong* is both grabbing and rolling a *Barrel* by flipping sprite left/right

dk_throw

- 1 frame
- Used when *Donkey Kong* is throwing a *Barrel*
- Separate *Barrel* sprite is rendered on top

dk_pound

- 1 unique frame (2 frames total)
- Used when *Donkey Kong* beats his chest
- Flip sprite left/right to animate

dk_fallen

- 6 frames
- Used after *Donkey Kong* has fallen down

dk_how_high

- 1 frame
- Used on the *How high can you climb?* screen

Lady

Note: Each sprite is made up of 2 individual sprites (1x2) (except *lady_carry*)

lady_stand

- 1 frame
- Used when *Lady* is standing still

lady_panic

- 2 frames
- Main animation for *Lady*

lady_carry

- 1 unique frame (2 frames total)
- Used when *Lady* is being carried by *Donkey Kong*
- Flip left/right to animate

help1

- 1 unique frame (2 frames total)
- Animated by switching between blue and white, or blue and darker blue
- "help!" text displayed next to *Lady*

help2

- 1 frame

- Alternately angled “help!” text

heart

- 2 frames
- Full and broken hearts displayed next to *Lady*

Other Animated Objects

fire_small

- 2 frames
- Main animation for small *Fire* enemy
- Red and blue palettes
- Flips left/right depending on direction

fire_big

- 2 frames
- Main animation for big *Fire* enemy
- Red and blue palettes
- Flips left/right depending on direction

barrel_stand

- 1 frame
- Used for *Barrels* sitting next to *Donkey Kong*

barrel_sideways

- 1 frame
- Used for *Barrels* being thrown by *Donkey Kong*
- Red and blue palettes

barrel_roll

- 4 frames
- Used for *Barrels* rolling on the ground
- Red and blue palettes

cement

- 1 frame
- Standard static *Cement Tub* sprite

cement_fall

- 1 frame
- Used for falling *Cement Tubs*

spring

- 2 frames
- Standard *Spring* animation

oilbarrel

- 1 frame
- Standard static *Oil Barrel* sprite

oilbarrel_fire

- 4 frames
- Used for fire erupting from the *Oil Barrel*

conveyor_edge

- 3 frames
- Used on the edges of *Conveyor Belts*
- Flipped left/right accordingly

explode

- 4 frames
- Effect played when an object is destroyed by the *Hammer*

Other Non-Animated Objects

hammer - *Hammer* item

hat - *Hat* item

bag - *Bag* item

parasol - *Parasol* item

ladder - *Ladder* object

ladder_retract - Slightly wider *Ladder* for depicting retracting *Ladders*

lift - decoration on the tops lifts, and flipped upside for bottom of lifts

100 - 100 point sprite

200 - 200 point sprite

300 - 300 point sprite

500 - 500 point sprite

800 - 800 point sprite

Tiles

text (x36 individual tiles) - characters A-Z, numbers 0-9

bonus (x12 individual tiles) - a box where the amount of bonus points the player will earn on completing the stage is displayed

jumpman - used to represent amount of lives a player has

floor1 - used to make up the ground

floor2 - alternate design used to make up the ground

conveyor_belt - makes up conveyor belts

mesh - a crosshatch pattern used in level *50m*

vertical_bar - used to represent elevator pulleys in *75m* and to hold up *Lady's* platform in *100m*

rivet - used for *Rivet* object

blank - a completely black tile used to crop *Donkey Kong* cleanly when he moves offscreen

Audio**Music**

intro - Played when *Donkey Kong* climbs the *Ladder* at the start of the game

how_high - Played on the *How high can you get?* screen

dk_roar - *Donkey Kong*'s roar played at the beginning of a stage

dk_fall - Played when *Donkey Kong* falls in *100m*

25m - Music for the *25m* stage

50m - Music for the *50m* stage

100m - Music for the *100m* stage

hammer - *Hammer Power-up* music

hammer_hit - Fanfare played on defeating an enemy with the *Hammer Power-up*

rivet - Played when the player removes a *Rivet*

timer - Played when player is running out of time

ending1 - Played after beating any stage that isn't *100m*

ending2 - Played after beating *100m* on an even-numbered level

ending3 - Played after beating *100m* on an odd-numbered level

SFX

walk - Played when *Jumpman* is walking

jump - Played when *Jumpman* jumps

boom - Played when *Donkey Kong* pounds the ground or a *Barrel* hits *Jumpman*

bounce - Played when a *Spring* jumps across the stage

fall - Played when a *Spring* falls off the stage

points - Played when player earns points