

Arcade game "Snake" on FitKit3 platform

Project description

The aim of this project is to implement arcade "Snake" game on FitKit3 platform that utilizes **Kinetis K60** microcontroller.

The only other HW components used are two LED displays **KWM-30881AGB**. Each display has the dimensions of **8x8** but as they are arranged in a row next to each other they add up to **8x16** (8 ROWS, 16 COLUMNS). The mentioned displays are used to display the game field.

Displays and FitKit3 are connected through the **50 pins** of connector **P1** (on FitKit3 side) and connector **P3** (on display side).

Display is controlled by 8 row pins (**R0...R7**) and 4 column multiplexer pins (**A0...A3**). A row is set ON by bringing a log. 1 to the corresponding pin. A column is set ON by bringing the correct bit combination to the multiplexer pins. So to set a cell with at [3, 14] ON, the following should be done:

```
R4 <- 1;
```

```
A0 <- 1; A1 <- 1; A2 <- 1; A3 <- 0;
```

Implementation

The program is implemented in C programming language using **Kinetis Design Studio 3.0.0 IDE**.

The whole program is contained in a single source file: **main.c**. The only header files used are: **MK60D10.h**, **core_cm4.h**, **stdlib.h**, **time.h**.

First step of the program is to initialize the hardware.

The process of hardware initialization can be described by the following steps:

1. For each port in use the corresponding clock must be enabled through **SIM_SCGC5** register.
2. Every pin **n** of port **x** in use must be set for **GPIO functionality**. This is done by setting **PORTx_PCRn MUX** to **0x1**: **PORTx_PCRn = PORT_PCR_MUX(0x01);**. For the buttons interrupt detection is also enabled to detect when they are pressed: **PORTx_PCRn |= PORT_PCR_IRQC(0b1010);**.
3. Every pin **n** of port **x** in use must be set either for write(**1**) or read(**0**) functionality through **PORTx_PDDR** register.

These individual steps are repeated for **PORTA**, **PORTB** and **PORTE**.

The hardware is initialized in the following functions:

- **void init_leds(void)** - initialize LEDs.
- **void init_buttons(void)** - initialize buttons.
- **void init_display(void)** - initialize the display by setting **EN** pin of column MUX to **0** (enabled) and configuring all row and column pins to GPIO, write functionality.

- `void init_pit(void)` - initialize `PIT` (Periodic Interrupt Timer) by setting the corresponding bit in `NVIC_ISER2`, enabling the clock, turning the PIT ON etc. The trigger interval is loaded into `PIT_CHANNEL0.LDVAL` register. Knowing the desired trigger period and clock period, the value that must be loaded into LDVAL can be calculated like that: $LDVAL = (\text{period} / \text{clock_period}) - 1$. PIT clock frequency is 50MHz.
- `void init(void)` - a function that calls all the previously mentioned `init` functions.

The game logic is defined by the following functions:

- `void game_display_field(uint field[NUM_ROWS][NUM_COLS], uint dly)` - displays the 8x16 game field.
- `void game_restart(int lost)` - starts/restarts the game. Shows initial text on display, clears the field, resets global variables.
- `int game_snake_collide(pos_t head_pos)` - checks for snake collision with food and itself. In case food is touched, snake size is increased by 1 in the direction of tail.
- `void game_snake_update(void)` - updates snake position based on its current movement direction. It is done by sequentially moving the elements of the snake body array.
- `void game_spawn_food(void)` - generates a random position on field until the generated position is not occupied. The cell on generated position is assigned a value of 2, which indicates that the cell is occupied by food.
- `void game_update(void)` - calls functions like `game_snake_update` and `game_spawn_food` to update the game.

The snake direction is controller by buttons which state is tested in `irq_button_handler` function. This function is called from `PORTE_IRQHandler` which is function that gets called on each `PORTE` interrupt.

`PIT0_IRQHandler` is called when `PIT` produces interrupt. `game_update` is called from this function to update the game.

Testing

The program was manually tested by playing the game using the buttons on FitKit3 platform.

Extensions

The project task only required to implement the snake movement without any other game logic.

In my implementation the game was extended with the following functionality:

1. Food spawning.
2. Snake body length increased when picking up food.
3. Game is lost when snake collides with itself.
4. Text displayed on program start and game loss.

