Sensors and Microsystem Electronics

PROJECT{GAME}: Underwater Ruins Diamond Escape

Introduction

This project is implemented using an ATmega328P microcontroller in AVR Assembly programming language. To play the game, the switch PB0 should be high. The game will take the player on an exciting journey through submerged ruins in search of hidden diamonds within.

Screen

The screen which is a 16 bytes block display will display "Diamond pattern" if the user locates the diamond with LED on, else it displays "TRY" if he does not locate the hidden diamond.

Game Screen Logic

Initially, the game screen is off, switch it on using the switch to display the pattern "SEARCH" with a counter at initial position 0. The game automatically goes to the home page after you have exhausted the 5 attempts.

Timer

Because the screen displays independently of the game main logic loop, the screen display is put into an interrupt service routine which is set to refresh at a running time faster than the game main loop. The game with Timer0 operates at frequency of 880 Hz and overflow occurs at 256.

This is computed as.

$f\_clk=16MHz/256$

$TCNT\_init=256-(f\_clk/880) =185$

The buffer value is got from the SRAM through the Y pointer register and the corresponding address is calculated for the character then the pattern is got from the flash memory through the Z pointer.

The screen is split into 16 byte blocks, each block has 7 rows, 5 columns. Ideally, 8 bits are stored in the flash memory where the 8th byte is set to " don't care".

Keyboard Algorithm

The game keyboard uses a 4-step approach to search and detect the key that is pressed while looking for the diamond in the Underwater Ruins Diamond Escape. Whenever a key is pressed, the key is compared with the object to check if they match.

Game: Flowchart Underwater Ruins Diamond Escape

```
                          ( Start )
                             |
                             v
                    +------------------+
                    |    Boot code     |
                    |  Incude macro    |<-----------------------------+
                    | Include CharTable|                              |
                    |Constant declaration|                            |
                    +------------------+                              |
                             |                                        |
                             v                                        |
                    +------------------+                              |
                    |  Init: Switch    |                              |
                    |      LED         |<---------------+             |
                    | Interrupt Service|                |             |
                    |  Hidden Diamond  |                |             |
                    |   Home Screen    |                |             |
                    +------------------+                |             |
                             |                          |             |
                             v                          |             |
                    +------------------+                |             |
   +--------------->|      Main:       |                |             |
   |                |    Keyboard      |              YES            YES
   |                +------------------+                |             |
   |                         |                          |             |
+--------+                   v                          |             |
|Interrupt|  LOW      / Check Switch \                  |             |
|disabled |<--------- \   Position   /                  |             |
+--------+            \            /                    |             |
   |                     HIGH |                         |             |
   v                          |                         |             |
+--------+                    |                         |             |
| Blank  |------------------->|                         |             |
| Screen |                    v                         |             |
+--------+              / Keypressed ? \  YES    +------------------+  |
                   NO   \             /-------->|   Search for     |  |
+-----------+<----------                        |  diamond using   |  |
|Display home|                                  |   key pressed    |  |
| Screen    |                                   +------------------+  |
+-----------+                                            |            |
     ^       NO                                          v            |
     |    +----------+                          +------------------+  |
     |    |Lower LED |                          |     Display      |  |
     |    |  OFF     |                          |     Process      |  |
     |    +----------+                          +------------------+  |
     |         ^                                         |            |
     |    +----------+        / Diamond \    NO    / Attempt  \       |
     |    | Display  |<--NO---\ found ? /<--------\ Counter >=5/------+
     |    |  TRY     |        \        /          \    ?      /
     |    +----------+          \    /              \       /
     |                           YES|
     |                              v
     |                    +-----------------------------+     +---------+    +-------------+
     |                    | Disable the Interrupt       |     | Display |    |LED operates |
     |                    | Store the byte to the screen |--->|  Found  |--->| at 185kHz   |
     +--------------------| Select the corresponding column|  +---------+    +-------------+
     (NO)                 | bits from the chatracter buffer|
                          +-----------------------------+
                                       |
                                       v
                          +-----------------------------+
                          | Send the bits for a block   |
                          | Take the pointer to the     |
                          | correct address offset      |
                          +-----------------------------+
                                       |
                                       v
                                 / All 16 bytes \  NO
                                 \    sent?     /----+
                                   \          /      |
                                       |YES          |
                                       v             |
                          +-----------------------------+
                          | Send bits for each row      |
                          | Latch in the output         |
                          | register                    |
                          | Introduce delay             |
                          +-----------------------------+
                                       |
                                       v
                                 /  Sent  \  NO
                                 \bits from 7/---+
                                 \  rows?  /     |
                                     |YES        |
                                     v           |
                          +-----------------------------+
                          | Set row counter             |
                          | Left shift where needed     |
                          | Add carry                   |
                          | Save bits to screen buffer  |
                          +-----------------------------+
```