Low Cost Microcontroller Based TIC TAC TOE Game

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Abstract

TIC TAC TOE is a commonly traditional game in Yemen, which consists of two players. One of the player chooses a cell of the game and puts an X mark in the chosen cell while the second player chooses another cell and puts an O mark in this second cell. The purpose of the paper is to transport this commonly traditional game to modern electronic game to get along with modern electronic world. The modern electronic game is important to countryside children's, so that they can play the game safely without incurring diseases. It also aims to offer children an opportunity to deal with cheap modern techniques. The game designed in this paper is based on the microcontroller (PIC16f877A).
Keywords: Microcontroller; MCU; PIC; PIC16F877A; TIC TAC TOE; Convention on the Rights of the Child (CRC).

1.Introduction:

Traditional games have been born since thousands years ago, and the results of the ancient human culture are still condensed the values of the local wisdom. Traditional games are education tools used in the learning process of an individual, particularly children. However, games are important for children as they increase harmony between Mind (Thinking) and Muscles (Action) and enhance linguistic and mobility skills. Furthermore, Games also teach and urge children to use indirect ways of cooperative thinking and creative thinking. The environment of children must be appropriate for their health and safety. Convention on the Rights of the Child (CRC)[1] specifies the right of children to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health.It also specifies the right of the children to education and specifies the right of children to the development of their personality, talents and mental and physical abilities. As well as their fullest potential to rest and leisure, engaging in playing and

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recreational activities appropriate to the age of the children. Games achieve all subjects that specified in Convention on the Rights of the Child (CRC).

2.Problem Analysis:

Currently, electronic games are available worldwide. However in environments where emigrant people and their children live, it can be noted that these people suffer from privation of electricity, networks of communication, Internet and health care. Rural areas in Yemen suffer from the same privations that increase the emigrants suffering. This project introduces a common traditional game via modern techniques. The first purpose of the project is to introduce the game to children who can play safely without any risks. The second purpose is to bring children closer to modern techniques. The third purpose is to make the game available at a lower cost.. The game has a long history ; and scholars cannot even investigate the origin and commencement of the game . Many of the Yemeni children have forsaken traditional games, including " Tic Tac Toe ". Physical interaction with tangible game apparatus is an important aspect to keep a learner's motivation during a self-learning process.
The "TIC TAC TOE" grid has nine cells (3x3) as shown in figure(1).

Figure(1): TIC TAC TOE Game Screen

In this game, one of the player chooses a cell of the game and puts an X mark in the chosen cell while the second player chooses another cell and puts an O mark in this second cell. This operation is repeated until either player gets 3 of his mark either in horizontal, vertical or diagonal on the grid to win; otherwise the game ends.
In this project, we have two players and the microcontroller, which plays the role of a referee to determine the winner. The project uses microcontroller PIC16F877A as the core. This paper describes how to use MCU to react with what we want, by monitoring the status of switches, reading the pressing of any switch and comparing that with the information stored in memory. The game can be played via PC with

anyone around the world using the Internet. But in poor countries, the Internet service is very poor so children can't enjoy the game online.

In villages that belong to poor countries as shown in figure (2), children play TIC TAC TOE by using the following materials (sticks, small stones, and dirt).The purpose of the project is to make TIC TAC TOE electronic game getting along with modern world and provide dealing children with modern technology.

Figure(2): Child play in a poor environment [2]

3.Related Works:

Psychologists think, that the infants start to play game in their childhood and the first game; is to play with their hands. Moreover, physical interaction involves other advantages that conventional devices cannot reproduce, such as tactile sense. It was further reported tactile stimuli would activates the prefrontal cortex in a human brain and facilitate memory consolidation. This finding implies an important factor in learning system design. Digital game-based learning was composed by factors like: digital, game, and learning [3].

The advantage of above work, is the combination of digital game and digital learning. Also using of high-tech equipments to bring novel experience to learners.

While digitalization causes the loss of the aforementioned advantages, pervasive computing technologies support various aspects of traditional games. There are roughly two styles of appling the technologies to game play: creation of novel forms, and augmenting existing forms

Based on the augmented traditional games concept, the designer developed Augmented Reality Go (ARGo) game to support a beginner players self-learning process [4]. Therefore, intrinsic motivation towards self-learning would increase more

than completely digital interaction. Moreover, tactile stimuli would support knowledge acquisition and skill development by activating brain functions.

Traditional games were inaugurated thousands years ago, and the result of the ancient human culture is still condensing and reflecting the values of local wisdom. Despite very old, traditional games apparently had a very humane education role for the learning process of an individual, particularly children. It is said that, because traditional games naturally stimulate various aspects of child development, such as: motoric skill, cognitive skill, emotional, language, social, spiritual, ecological, and moral. A child is known as key actors in the preservation of the traditional game [5].

4. Digital Game Architecture

The architecture of the proposed TIC TAC TOE digital game is divided in two main parts:
   a. Hardware.
   b. Software.

4.1 HARDWARE ARCHITECTURE:

As shown in figure(3), the hardware o the game consists of four main units, power supply, PIC, LEDs Screen, and Switches. The power supply unit supplies the power to all units of the game; Switches(Keyboard) represent cells of the game; PIC is the thinking mind of game; LEDs is a dual color red and green; LEDs net is a screen which shows the game status. The child can press any switch, the PIC microcontroller detects a player to be first or the second player sends the adequate signal to LEDs screen to select adequate position and adequate color red or green.
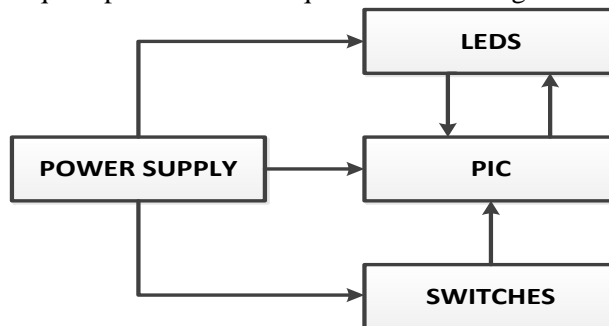
Figure(3): Game Structure

As shown in figure (4), the hardware design is simulated by simulation program (Proteus 7.7) to validate its correctness.
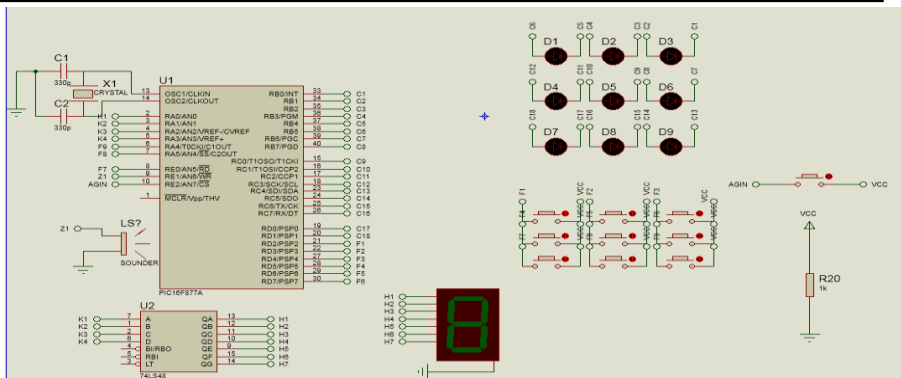
Figure(4): Simulation of The Game

4.2 PROTOTYPE AND TESTING:

The hardware components have been assembled on a PCB board, as shown in figure (5), and the code of the game has been burn to the microcontroller's memory.

Then this prototype has been tested to validate the rules of TIC TAC TOE game by pressing switches, and showing LEDs screen. Buzzer is working when one of the players is winning.

The components of the game are given in appendix (1).

Figure(5): Hardware of the project

4.3 SOFTWARE ARCHITECTURE:

As show in figure (6), the main flow chart of the digital game contains four main parts as follows:

   a. Game initialization by set a default status to all variables.

b. Input monitoring to check if any switch may be pressed
c. Acquiring the input signals to store this signal and makes the comparison with all possibilities as shown in Table (1).
d.   Making a suitable output signal according to the results after finish comparison.
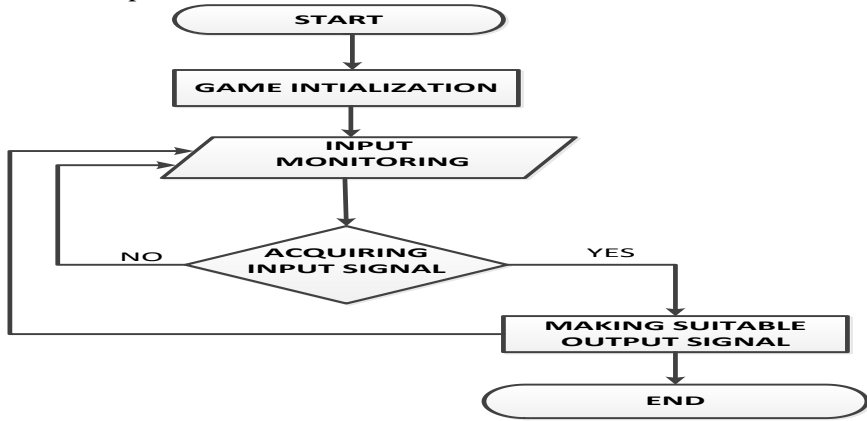
Figure(6): Flow chart of the game

Table(1): The Winning Case

1	**1**	**1**	x	x	x	x	x	x
x	x	x	1	1	1	x	x	x
x	x	x	x	x	x	**1**	**1**	**1**
1	x	x	x	**1**	x	x	x	**1**
1	x	x	x	**1**	x	x	x	**1**
1	x	x	x	**1**	x	x	x	**1**
1	x	x	x	x	**1**			
x	**1**	x	x	**1**	x			
x	x	**1**	**1**	x	x			

1 pressing, x don't care

The PIC microcontroller scans status of switches and updates status of switches in memory after pressing.PIC compares the status of switches which have been stored in memory with the status of the winning case to decide the winner.

4.4 FORMAL DESCRIPTION OF THE ALGORITHM:

We now formally describe the algorithm of the game (Pseudo code) as follows, where R represents the alignment of the players; V represents the allowing of playing:

Definition the variables. // preparation

Set MCU to ADC state. //set the MIC. to initial value of ADC state

Set ports to accurate state.

Set R=1. // for count number of repeat

Step: Set V=0 //for allowing player 1 to play.

Led Red ON // player 1 start playing

Save position of Led Red in memory (Matrix A)

Set V=1 //for allowing player 2 to play.

Led Green ON // player 2 start playing

Save position of Led Green in memory (Matrix B)

Set R=R+1

IF R=3 then // first IF

IF (Matrix A) actualize any winning case then //second IF

IF (Matrix B) actualize any winning case then //third IF

Reset LEDs Screen

End Game

ELSE //for third IF

Player 1 Win // if 3LEDs ON on the same line

Reset LEDs Screen

End Game

END IF //for third IF

ELSE //for second IF

IF (Matrix B) actualize any winning case then //fourth IF

Player 2 Win // if 3LEDs ON on the same line

Reset LEDs Screen

End Game

ELSE //for fourth IF

Reset LEDs Screen

End Game

END IF //for fourth IF

END IF //for second IF

ELSE   //for first IF

Goto Step // continue game (R less than 3)

END IF   //for first IF

The flow-chart for the above pseudo code is given in appendix (2).

5.Comparison:

The main goal of this paper is to decrease the cost of the game to become accessible to the target groups. The common TIC TAC TOE game available in markets is made by Cytron Technologies Company.

In this table we compare between our game and game is made by Cytron Technologies Company[6].

Table(2): Comparison between Cytron game and the proposed game

	Our game	Game from Cytron Technologies
Price	10 $	25$
Power Supply	Battery 5V.*	Public Power*
Game Board	Switches**	Touch Screen**
Screen	Cells of LEDs**	LCD**

*Our proposed game uses 5V battery because it is designed for an environment that hasn't Public Electricity.

**We change the components for the purpose of decreasing.

6.Conclusion:

This project attempts to allow traditional games to be played via modern techniques for common use in poor environments at a low cost.

The cost per unit goes down if the game which produce large quantities.

In the future, other features can be added to the game such as joints and playing of two persons while they are far away face to face or through the mobile communication-network. In addition, the game can be developed in terms of memory expansion and touch screen.

7.Reference

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8.Appendixes

Appendix (1): Components of The Game.

Element	count	Description
PIC16f877A	1	Microcontroller from MicroChip Company contains: • 40 pins • 10 digital transformation (ADC) 10 bits • VREF =5 V • EEPROM=256 BYTES
LEDs	9	Dual color (RED/GREEN)
CAPCETORS	2	2.2PF
CRYSTAL	1	8MHZ
SWITCHES	10	PUSH BOUTTON
BOARD	1	PCB 1 Layer
Buzzer	1	Buzzer

Appendix (2): Flow-chart of Algorithm

```
                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │    R=1      │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │    V=0      │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │   Allow     │
                    │  pressing   │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │  ON(RED)    │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │   Saving    │   A Matrix
                    │ Position of │
                    │  Red LEDs   │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │    V=1      │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │   Allow     │
                    │  pressing   │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │ ON(GREEN)   │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │   Saving    │   B Matrix
                    │ Position of │
                    │ Green LEDs  │
                    └──────┬──────┘
                           ▼
                    ┌─────────────┐
                    │   R=R+1     │
                    └──────┬──────┘
                           ▼
          NO          ◇ IF R=3 ◇        YES        ( A )
```