

MICROCONTROLLER BASED GAME TIME CLOCK

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Abstract

Microcontroller based game time clock was constructed for three games. The first one is chess game, the second one is crossword game and the last one is stopwatch (game of go). There are two types in chess game. The first chess game time clock is a “sudden-death” contest with five minutes for each side. The second chess game time clock is a dual counter mode. In dual counter mode, the chess game time intervals can be chosen by the player. In crossword mode, game time clock shows the over time condition by blanking on the appropriate players LED. In the stopwatch mode, the exact time of event especially sports event can be measured. In game time clock the main controlled device is PIC16F887 microcontroller and its software is written in assembly language. The other devices are 7-segment LED, transistor and counter.

Keywords-Microcontroller, preset time control, assembly language

Introduction

Game time clock can be applied in chess game, crossword game and game of go. There are two modes in chess game, speed chess game and dual counter mode. The time in speed chess game is 5 minutes for each side. This time control is officially called “Game in 5 minutes”. The time interval for each side in dual counter mode is set by the player.

A chess game consists of two adjacent clocks with buttons to stop one clock while starting the other, so that the two clocks never run simultaneously. Chess game clocks are used in chess and other two-player games where the players move in turn. The purpose is to keep track of the total time each player takes for their own moves, and ensure that neither player delays the game.

The players may take more or less time over any individual move. The opening moves in chess are often played quickly due to their familiarity, which leaves the players more time to consider more complex and unfamiliar positions later. The time of game may be unlimited. Therefore chess clock is used to limit the time of game.

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In crossword game mode, the time interval for each player is 25 minutes. The game time clock shows the over time condition by blanking on the LED. In go time mode, it records the exact time of events whose spends the game.

In this paper, PIC16F887 microcontroller based game time clock is construed. In this game time clock, the display unit is 7-segments LEDs and ULN2803APG Darlington transistor array is used as current sink driver. PIC 16F887 microcontroller is used as control device. The block diagram of game time clock is shown in Figure 1.

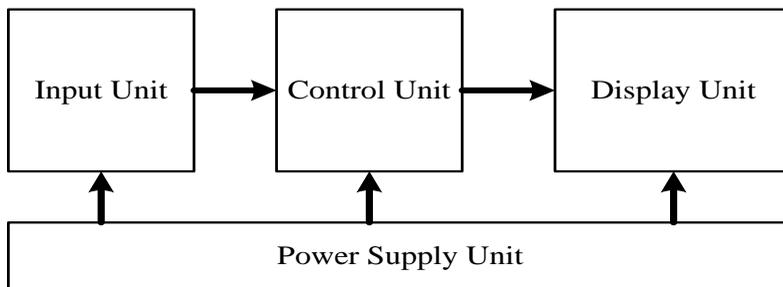


Figure 1: Block diagram of game time clock.

Hardware Design

The constructed system is divided into three units, the input unit, the control unit and the display unit.

The Input Unit

The input unit is a keypad with four buttons namely ‘SELECT/RESET’, ‘START/PAUSE’, ‘LEFT’ and ‘RIGHT’ key. In order to determine the state of each button either as a HIGH (pulled to the V_{CC}) or a LOW (pulled to the ground) on the microcontroller, pull-down resistors connected to the input pin of microcontroller or else the input pin will be in a floating state. With a pull-down resistor, the input pin will read a LOW state when the button is not pressed. When the button is pressed, it connects V_{CC} to both the input pin and through the resistor to the ground; thus the input pin reads close to V_{CC} .

Display Unit

The visual display has four digits for each side of game time clock, two digits for minutes and two digits for seconds. Each digit is made up of 7-segments whose configuration is common cathode. These segments are turned on by applying logic '1' to the required segment LEDs via current limiting resistors.

Each 7-segments LED is connected to the microcontroller via a Darlington transistor array driver in current draining mode. ULN2803 APG Darlington transistor array was chosen as the LED segment driver.

Control Unit

The main device of this system is control unit, PIC 16F887 microcontroller. It receives the input data of the keypad and scanning the corresponding pattern on the 7-segments LEDs display. The input method of PIC 16F887 microcontroller is portB change interrupt. Therefore, if two keys are pressed simultaneously microcontroller determines which key is first press. PIC 16F887 microcontroller is scanning the 7-segments LEDs display according to the input key.

Software Implementation

There are five programs in the software implementation. They are main program, PortB change interrupt subroutine, speed chess program, dual counter mode chess program, crossword mode program and game of go program.

The main program selects the types of game and counting the time of the game. The flowchart of main program is shown in Figure 2.

In PortB change interrupt subroutine, it selects which switch of PortB is pressed. Figure 3 shows the flowchart of PortB change interrupt.

In speed chess program mode, the time of game is already set 5 minutes for each side. When the 'LEFT' key button is pressed the right side of the time of 7-segment will decrease. Also the 'RIGHT' key button is pressed the left side of the time of 7-segments will decrease. If the

‘STOP/PAUSE’ key button is pressed the time of every side will pause. The flowchart of speed chess game is shown in Figure 4.

In dual counter chess program mode, the time of game can be set by using ‘LEFT’ and ‘RIGHT’ key button. The ‘SELECT/RESET’ key button is pressed to start the game. When the ‘LEFT’ key button is pressed the right side of the time of 7-segment will decrease. Also the ‘RIGHT’ key button is pressed the left side of the time of 7-segments will decrease. If the ‘START/PAUSE’ key button is pressed the time of every side will pause. The flowchart of dual counter chess program mode is shown in Figure 5.

In crossword game mode, the time of game is already set 25 minutes for each player. Before switch ‘SELECT/RESET’ is pressed, the time of player is reduced. When switch ‘START/PAUSE’ is pressed, the time of game is set 25 minutes for the next player. Figure 6 shows the flowchart of crossword game mode.

In game of go mode, the time is reset. When the ‘RIGHT’ key button is pressed, it counts the time of game. When the ‘START/PAUSE’ key button is pressed the time of game will be paused. When the ‘SELECT/RESET’ key button is pressed, the time is ready for the next game. The flowchart of game of go is shown in Figure 7.

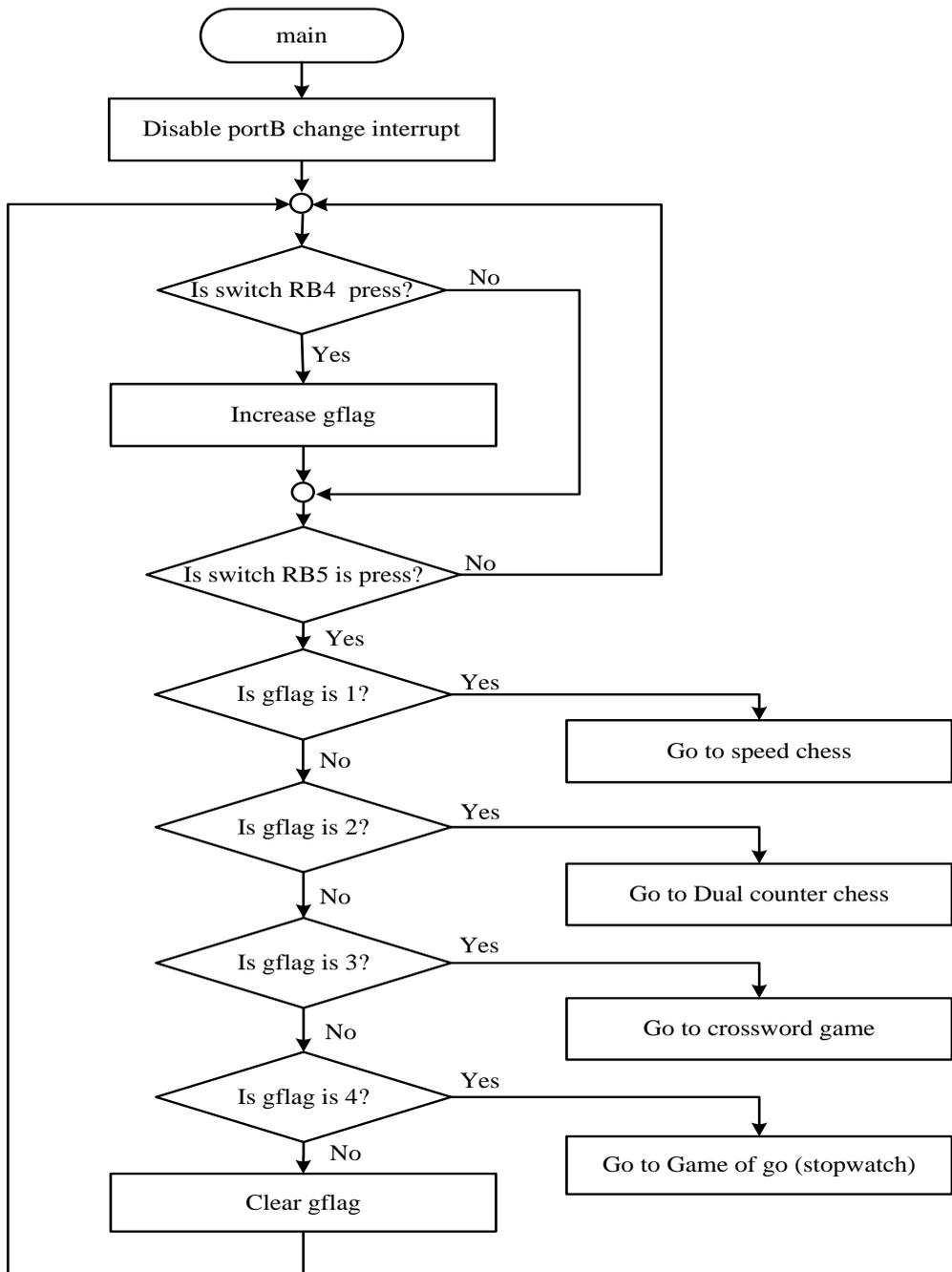


Figure 2: Flowchart of main program.

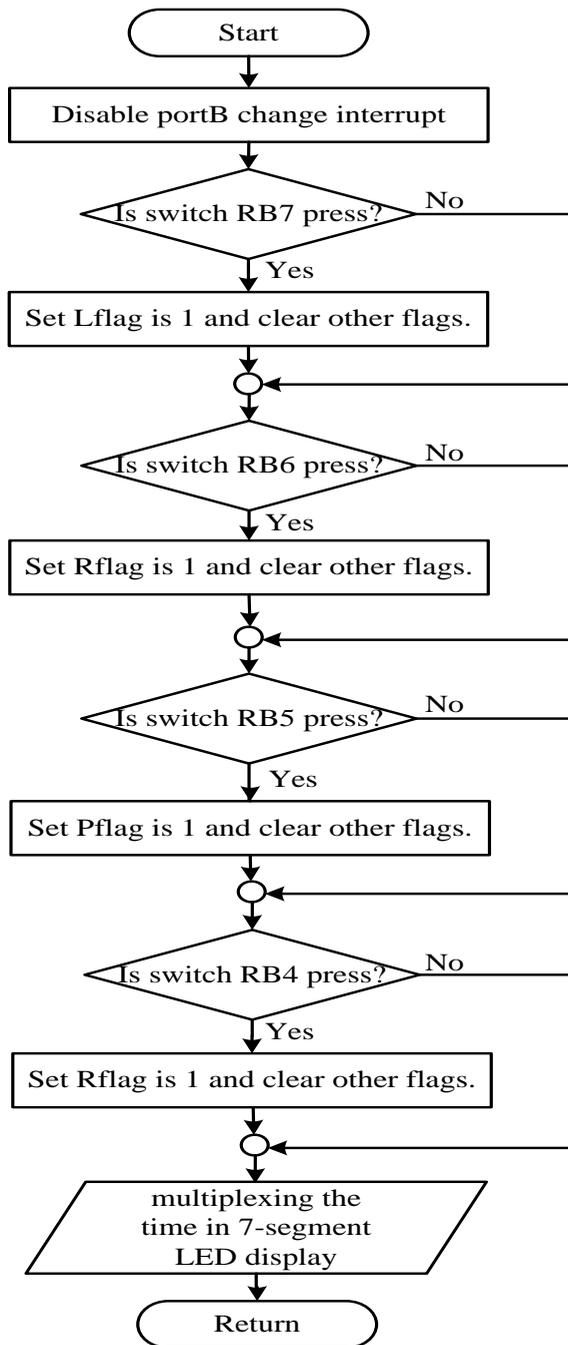


Figure 3: Flowchart of PortB change interrupt subroutine.

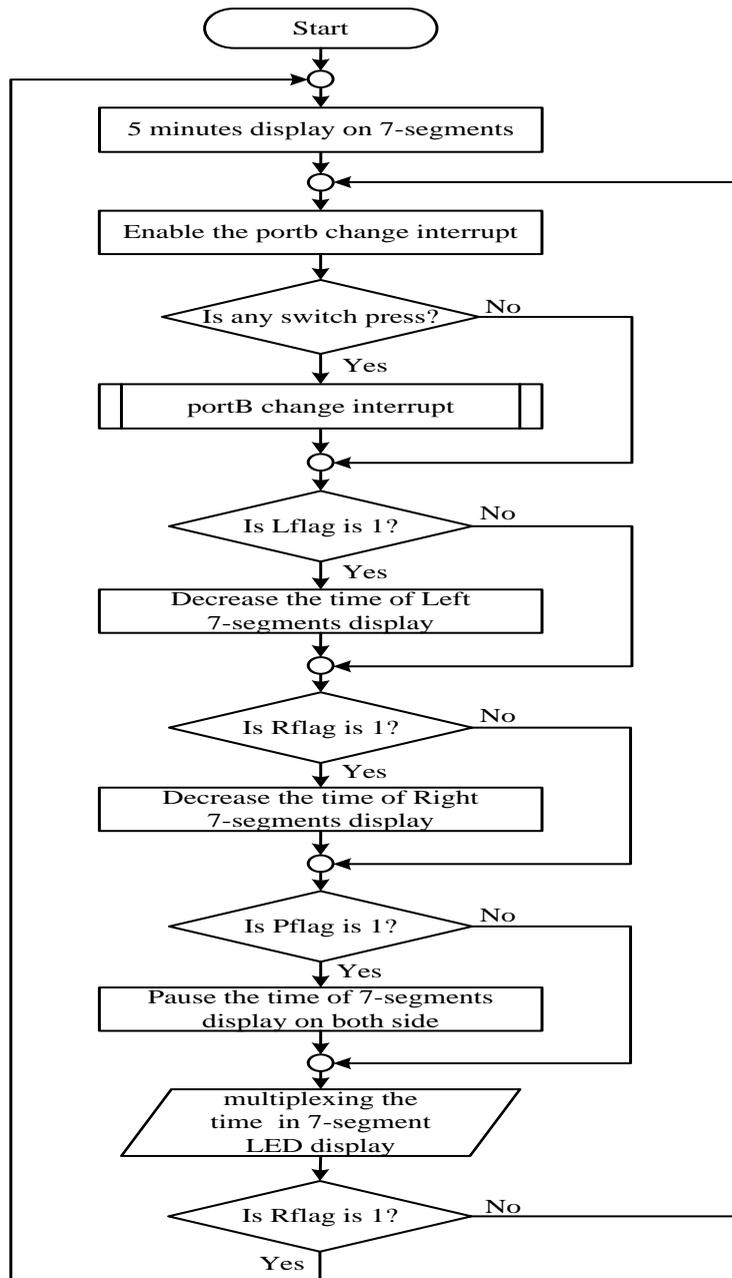


Figure 4: Flowchart of speed chess game.

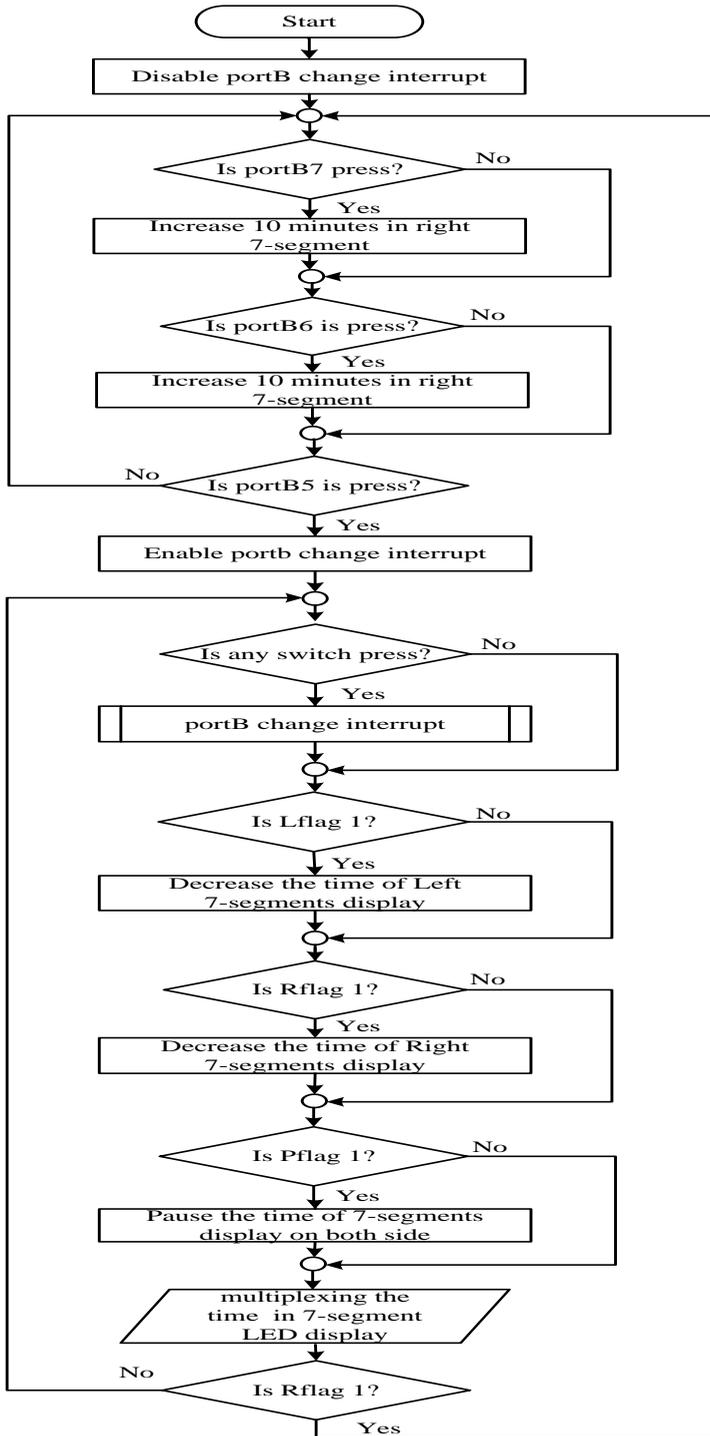


Figure 5: Flowchart of dual counter chess game.

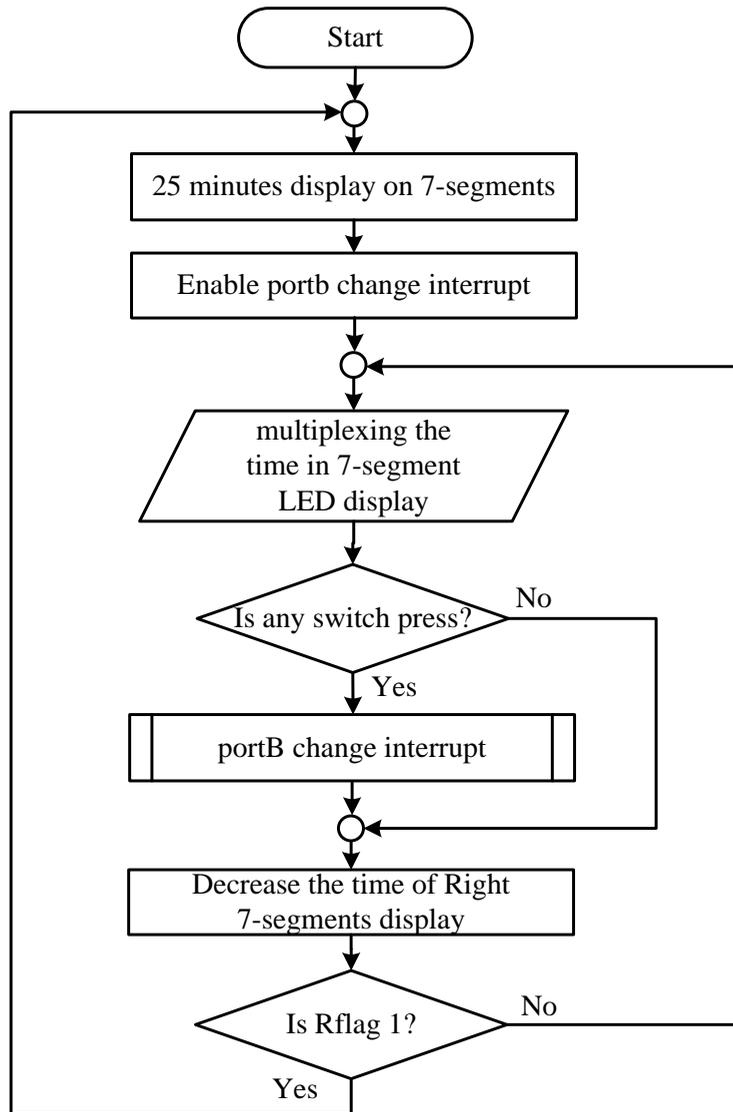


Figure 6: Flowchart of crossword game.

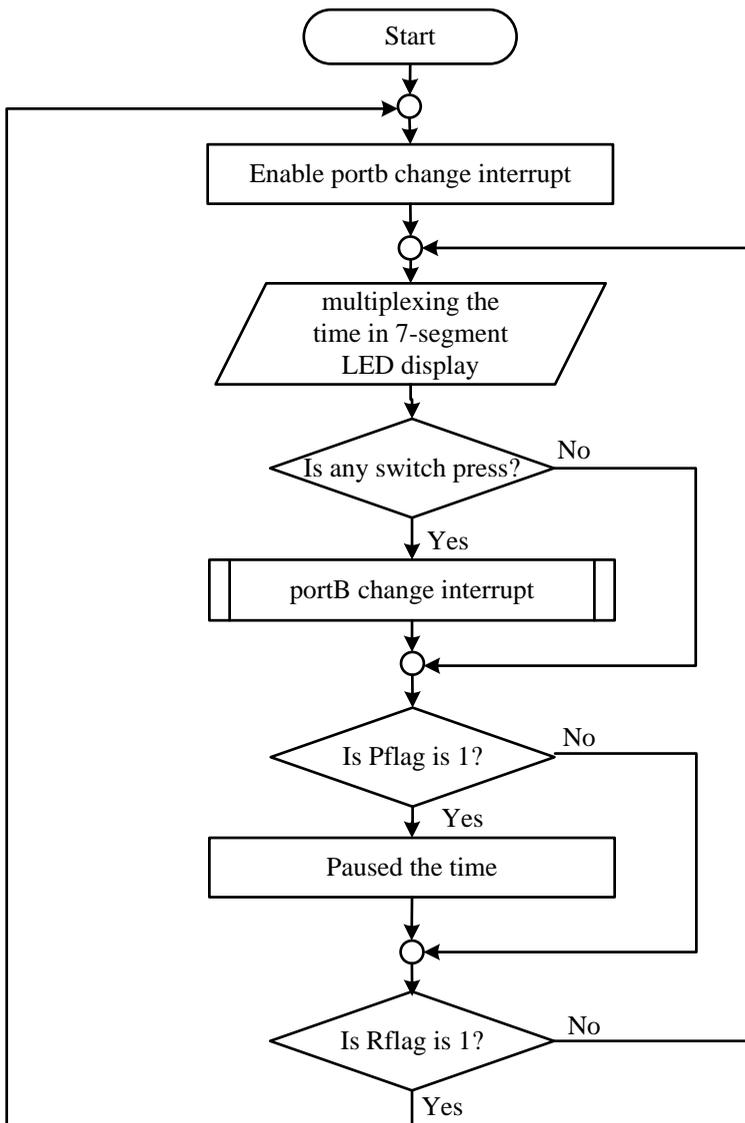
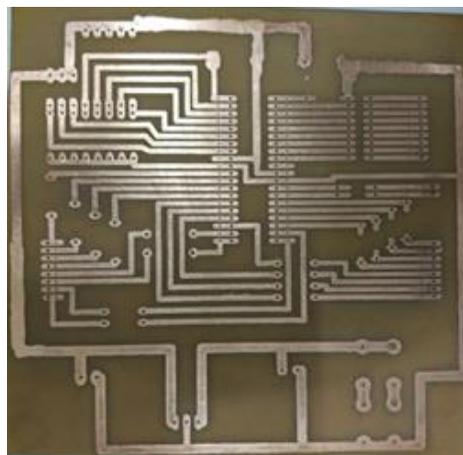


Figure 7: Flow chart of Game of Go.

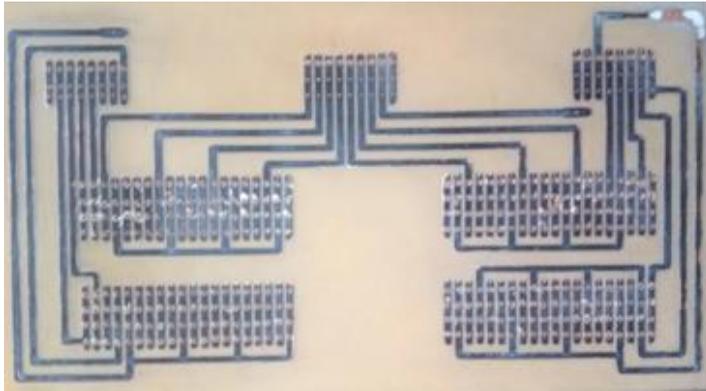
Construction and Operation

In this system, the main control device is PIC16F887 microcontroller. Common cathode 7-segments LEDs are also used to display the time. PortC of PIC microcontroller is connected to anodes of left side of 7-segments LEDs and portD is connected to anodes of right side of 7-segments LEDs. PortA and portE are connected with the input pin of ULN2803APG Darlington transistor array IC. The output pin of Darlington transistor array is connected with the common cathode pins of 7-segments LEDs. Darlington transistor array IC acts as a switch to multiplex the 7segments LEDs. The PCB layout of this system is shown in Figure 8. The complete circuit diagram of the constructed system is shown in Figure 9.

In this system, PIC16F887 microcontroller is used as a control device. There are four switches in this circuit. The photograph of initial state of game time clock is shown in Figure 10. At first, select the type of games using ‘SELECT/RESET’ key button (yellow colour). Figure 11 to Figure 14 shows types of games. If the type of games is selected, press the ‘START/PAUSE’ (green colour) button to start the game. The Figure 15 shows the photograph of speed chess game can be started.



(a)



(b)

Figure 8 (a) Photograph of control unit PCB design.
(b) Photograph of display unit PCB design.



Figure 10: Photograph of initial state of game time clock.



Figure 11: Photograph of speed chess game mode.



Figure 12: Photograph of dual chess game mode.



Figure 13: Photograph of cross word game mode.



Figure 14: Photograph of game of go mode.



Figure 15: Photograph shows speed chess game can be started.

Conclusion

Microcontroller based game time clock was constructed. In the clock display system, two groups of 7-segment LEDs are used. Microcontroller controls these two groups in separate bus. Therefore the duty cycle of on time of 7-segment LEDs is twice the same bus. The brightness of 7-segments LEDs is higher than that of the same bus. The program is written in assembly language in this system. PIC 16F887 microcontroller use internal clock of 4MHz. Thus most of the instruction is complete in 1 μ s. The input switches of the game time clock is used as portB change interrupt. There is no waste of time when the switch is pressed. Therefore the clock time of this game time clock is adequate.

In this paper, two types of chess game can be played. By modifying software program, other types of chess game can be played.

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