Table of Contents

Abstract

The 8051 microcontroller is an 8-bit microcontroller first developed by Intel in the year 1976. It was further developed in 1980 becoming the most popular microcontroller in the MCS-51 family. In this project, an 8051 microcontroller was used to create an 8-button piano with 2 modes: piano and Simon Says game. The user can select he piano mode to play the miniature piano to their own will. If they wish to challenge themselves, they can select the Simon Says mode which will play a series of notes the user must repeat. This mode has a total of 7 levels which increases the difficulty of the game as the level's increases. A binary display using 3 LEDs has been used to keep track of the score. If the user fails to complete a level, the device will signal the user of the error and clear the LED display of the score and reset the game from level 1.

Basic Discussion

The initial stage of the assembly code defines the notes and shortcuts that are used throughout the codes. The musical notes used to playback were from the 6^{th} octave '6C' (DO) till the 7^{th} octave '7C' (DO) note. To create the notes, a 12MHz crystal oscillator was used with the frequency of the notes ranging from 1046Hz to 2094Hz. The notes were assigned to the button in numeric order which is to say, the lowest frequency was assigned to button 1 and the highest frequency was assigned to button 8. Once the power supply is connected, the system will go through a loop waiting for the users input.

If the user selects piano mode, then the microcontroller will call the 'CHECK_BUTTON' and 'PIANO' functions. The 'CHECK BUTTON' function will be used to compare the user input with the notes registered in the device and playback the note the user pressed. The piano function will loop the system and keep asking the user for input until the user presses the reset button.

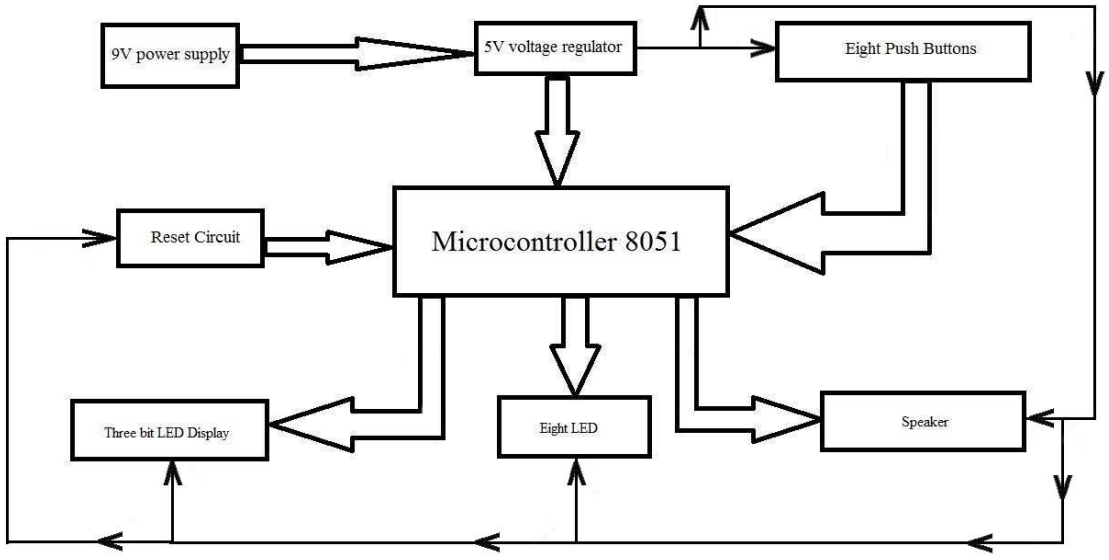
If the user selects game mode, the microcontroller will load level 1 by using DPTR. Level 1 will be played by the microcontroller and it will wait for the user input. Every time the user plays a note, the device will compare the input with the notes played using the 'START_CHECK' function. If the input is correct, then the device will increase counter and wait

for the next input. This procedure continues until a wrong note is played or the level is complete. If the level is complete, then the counter will increase by 1 and wait for the user to press the game button again to play the next level. The 3 bit binary display will show that the user passed level 1 by displaying ‘001’ using the LED’s with ‘0’ being LED off and ‘1’ being LED on. However, if the user enters a wrong note, all the LED’s will turn on and a note of 4000Hz will be played signaling that the user made a mistake. The 3 bit scoreboard will reset with all the LED’s at state ‘000’ and the flag will reset and wait for the user to select the game modes again.

Advanced Features

Two new features introduced into this device is the freestyle piano mode and the 3 bit binary LED display. The piano mode has been explained in detail previously. It allows the user to play any single note at a time in any order and for any number of time. The 3 bit LED display was used to keep track of the user’s successfully completed levels. These LED’s are connected to port 0.1, port 0.2 and port 0.3 of the microcontroller.

Block Diagram

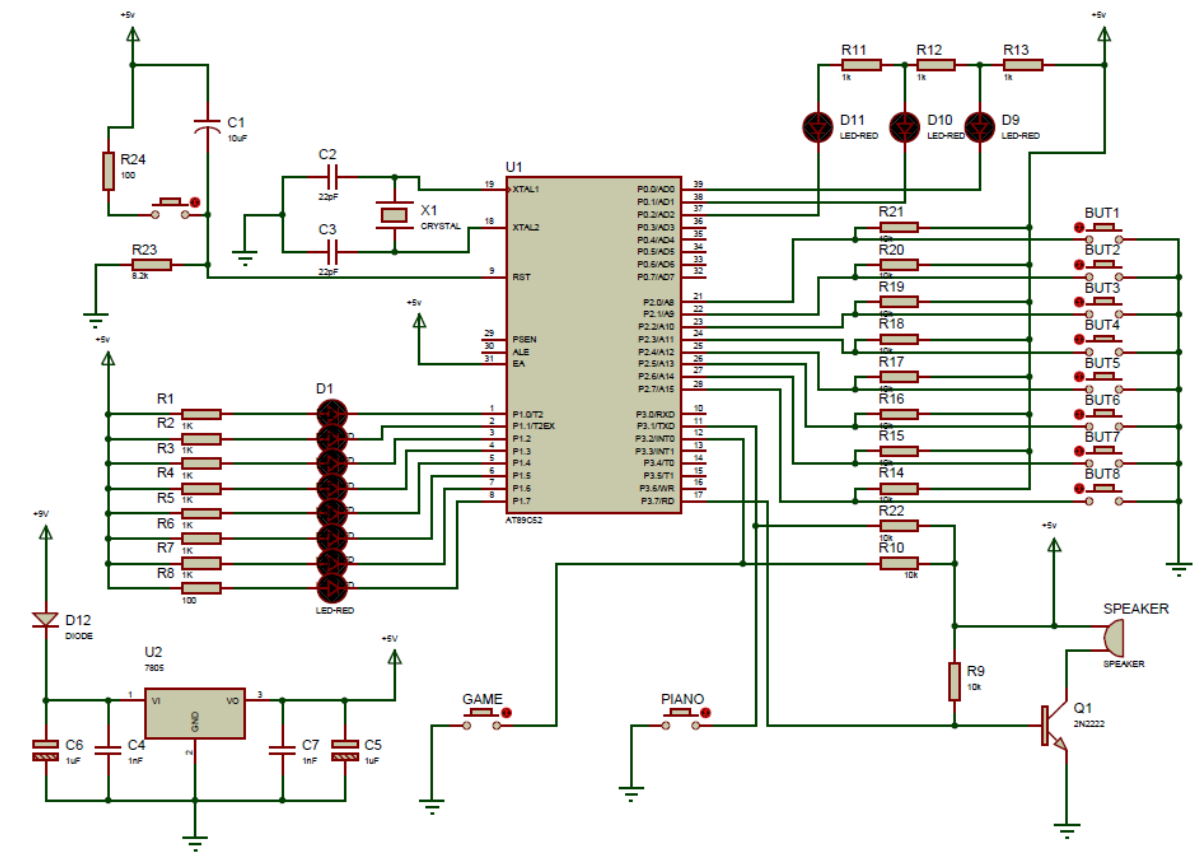


The basic components used in this circuit were transistor, resistor, capacitor, diode, pushbutton switches, LED’s, crystal frequency oscillator and the 8051 microcontroller. Each components are soldering in the circuit board using lead (Pb) soldering.

This circuit works on a 9V power source. The 9V power given in the VCC is stepdown to 5V by the transistor (voltage regulator). The type of voltage regulator used in this device is 7805 series integrated circuit. The output generated by the voltage regulator is identified as positive voltage, as the charge of the voltage is positive related the conjoint ground. The 7805 series voltage regulator has a build in safely feature, it which aids diminishing overheating and short-circuiting.

The 5V current is connected to the reset button, the 3 bit LED display, the eight pushbuttons and the speaker. Each pushbutton switches are connected to individual 10K resistors as a safety precaution, this works as a pull up resister. The input in the microcontroller are specified through the pushbuttons and according to the input the speaker will generate different frequency analogue output; as well as the LED for that designated key will light up. The output score is displayed in the 3 bit LED scoreboard. This device contains two different features. It can be used in both piano and game mode. Every time the mode is changed the reset button needs to be pressed.

Schematic



- **IN PORT 1 in micro controller**

Pin 1 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 2 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 3 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 4 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 5 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 6 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 7 is connected to 1 LED which and to a 1 K **Ω** resistor then 5v power supply.

Pin 8 is connected to 1 LED which and to a 1k **Ω** resistor then 5v power supply.

- **RST** is connected to 8.2k **Ω** which is connected to ground and a 10uF Capacitor which is connected 5v power supply and a 100 **Ω** resistor .
- **XTAL 1** is connected to crystal oscillator and a 22pF capacitor connected to ground.
- **XTAL 2** 1 is connected to crystal oscillator and a 22pF capacitor connected to ground.
- **PSEN** and ALE are not used .
- **EA** is connected 5v power supply.
- **IN PORT 2 in micro controller**

Pin 21 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 1 is connected to ground.

Pin 22 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 2 is connected to ground.

Pin 23 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 3 is connected to ground.

Pin 24 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 4 is connected to ground.

Pin 25 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 5 is connected to ground.

Pin 26 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 6 is connected to ground.

Pin 27 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 7 is connected to ground.

Pin 28 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 8 is connected to ground.

Pin 21 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 1 is connected to ground.

Pin 21 is connected 10k **Ω** connected to 5v power supply. At the same pin switch 1 is connected to ground.

- **In port 3 in microcontroller**

Pin 10 is not used.

Pin 11 is connected to a switch for the PIANO button controller, and to two 10 k **Ω** resistors connected to the speaker and one 1 k **Ω** resistor connected to a npn transistor connected to ground.

Pin 12 is connected to the GAME button, and two 10 k **Ω** resistors connected to speaker and npn transistor.

Pin 13 , 14 , 15 , 16 are not used.

Pin 17 is connected to 10k **Ω** resistors connected to the npn transistor and speaker.

- **IN PORT 0 in micro controller**

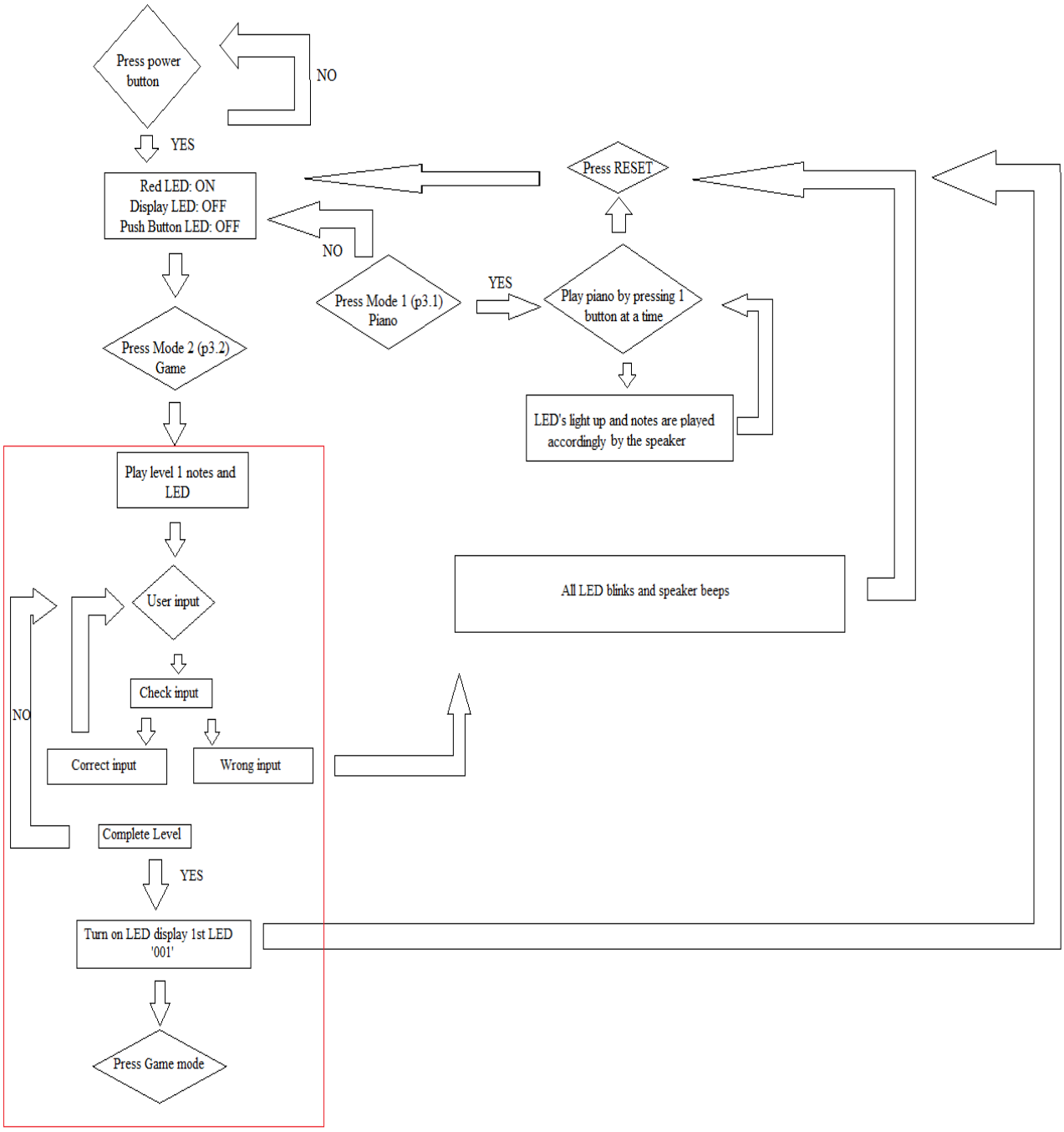
Pin 39 is connected to display Led the connected to 1 k **Ω** resistors connected to 5v power supply.

Pin 38 is connected to display Led the connected to 1 k **Ω** resistors connected to 5v power supply.

Pin 37 is connected to display Led the connected to 1 k **Ω** resistors connected to 5v power supply.

Pins 32, 33,34,35,36 are not used.

Flow Chart



** Loops 7 times for seven levels

The flow chart above displays the sequence of the microcontroller at every step. First, the user will press the power button to turn on the circuit. A small red LED will light up signaling that power has been successfully supplied into the circuit. Then, the user will decide if they want to play piano, the right biggest switch, or game mode, the left most biggest switch.

If the user selects piano, then they will be able to press 1 button at a time to produce notes in the order and for as many time as they want. Once they wish to end the mode, they will press the reset button.

Once they are done playing the piano, they can select the game mode. In this mode, a series of 8 notes will be played in random order. After the notes are played, the user will have to key in the notes in the exact same pattern that it was played at. Every time the user key's in a note, the microcontroller will check if the keyed note is correct or not. If it is correct, then the user will proceed until all the notes are correctly entered in which case the 3 bit LED display will have the rightmost LED turned on displaying '001', the score of the user after level 1. However, if the user fails to input the notes in the correct order, all the LED's will light up and the speaker will play a distinct note at 4000Hz to signal that the user has made an error. The 3 bit LED display will then reset to '000'. The user can then either choose to start from level 1, or hit the reset button and then select piano mode to practice the piano.

Conclusion

In this project, we have learnt a lot of things especially about how to program the 8051 microcontroller by using assembly codes. The code is arbitrary, we can design in any kind of project that we want. We made the codes that the user can choose either piano mode or game mode. In the piano mode, the user are able to play a simple piano with 8 notes. At the other hand, in the game mode, the user can challenge themselves to play A Simon Say game. In this game, the user are required to copy the note of the song has been played by pressing the 8 buttons. This game is a good way in order to test the user's memorizing skills. It consist of 7 levels based on the difficulty levels. If the user are able to repeat the notes correctly, the LED display will be light up which means that the user got points. If the user press the buttons wrongly, that beep sound can be heard and the game will be reset to the first level.

In the hardware part, we use 8051 microcontroller and all the related components. Rather than build a mediocre project, we decided to add special features. The first feature is the LED display. Which are used to show scores for the Simon Says game. If the user are able to repeat the song correctly, the LED will be light up. The second feature is about the 2 mode button. As the user switch on the board circuit, the user can choose the mode by pressing either one of the buttons. And the third feature, is about the Vero board. We don't want to use the breadboard, because we don't want our project untidy with the abundance of jumper wires. So, we use the Vero board in order to reduce the usage of jumper wires. As a result, it looks more tidy and attractive.

In conclusion, although our project is simple, we successfully implement this thing with a correct way. We have learnt a lot of thing from this project. The most pertinent part is about the coding. The assembly language might be the way to program the 8051 microcontroller because it does not require much memory space to be stored. We are also learned on how to set up the hardware components correctly. The main thing for the hardware is about the pin of the 8051. Different pin has a different roles in terms of storing data, processing input and output code and many more. And last but not least, we have learned about a fundamental soft skill which is a teamwork. We have 8 meetings to done this project. Every members requires a determination, a sense of teamwork and the alertness of the task given. We hope that we can have opportunities to discover more about how to program an electronics devices so that we can innovate more and contribute to our country and societies.

Bill of Materials

Name	Quantity	Unite price(RM)	Price (RM)
Resistor 1k	11	0.05	0.55
Resistor 8.2k	1	0.05	0.05
Resistor 10k	10	0.05	0.05
Resistor 100	1	0.05	0.05
Capacitor 1µF	2	0.35	0.70
Capacitor 10µF	1	0.35	0.35
Capacitor 1nF	2	0.35	0.70
Capacitor 22pF	2	0.35	0.70
LED	12	0.25	3.00
Pushbuttons	11	1	11
Crystal frequency oscillator	1	3	3
Transistor 2N2222	1	0.35	0.35
Transistor 7805	1	1.20	1.20
Diode	1	0.20	0.20
Speaker	1	6	6
Microcontroller 8051	1	12.50	12.50
Power Switch	1	1.2	1.2
Circuit Board	1	7	7
Programmer	1	50	50
Total	80	-----	98.6