

DESIGN AN ELECTRONIC GAME⁶

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Abstract: *This paper presents the process of design an electronic game, as well as writing a software for embedded microcontroller. Using a variety of entertainment devices, especially from young people, takes up a significant part of our lives. Many electronic devices are created and used for this purpose. So, designing a device which will be used from kids to adults is not an easy task. Electronic devices have to be safe, easy to use, handy, attractive and last but not the least entertaining. This paper aims to create an electronic game which will cover all of these requirements.*

Keywords: *electronic game, embedded system, microcontroller.*

INTRODUCTION

Nowadays, electronic devices and computer games take a lot of time from the human life, especially for children and young people. In order one game to be interesting for the users and to attract their attention, it must meet the following requirements and to be:

- Attractive;
- Easy to play;
- Safe;
- Portable.

To develop such a game the complex logic and control with microcontroller is necessary. These days the control module (microcontroller) is an essential part of the system hardware. It begins from a basic relay operation ON/OFF time-controlled buttons to automated AI systems. One of the important points in using an electronic system in our life is to be as simple as possible and accurate. In most of the situations ensuring both requirements is hard to achieve. All parts are selected from one trader (Digi-Key, 2019), so everything is available in the market.

Nowadays most of teenagers and young people prefer to play computer games instead of going outside or playing boardgames with friends or family. Most of the game industries works hard to achieve good PR to attract all of these people to play their games and spent their family or own moneys. The software programmers is mostly preferable job positions but most of the students are skipping that hardware is also important. For developing such a game and provide its functionality it is not needed a serious microprocessor. For this reason, this electronic game is created on base of analog and digital electronics which works independently and they are not controlled of such a system. This requirement makes much harder the design of a hardware engineer.

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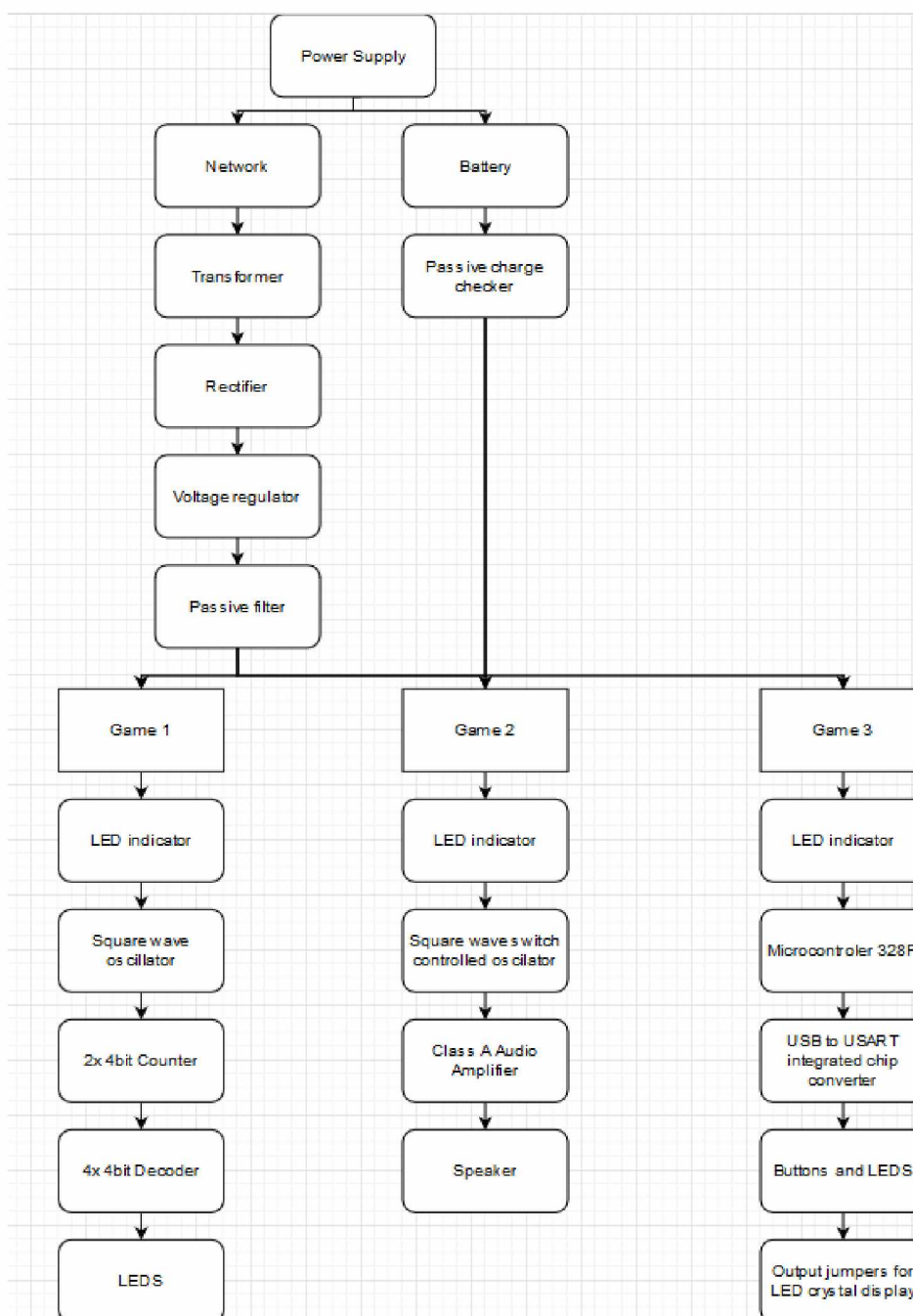


Fig. 1. Block Diagram of the system

In this paper it has been used a practical solution of designing an electronics game module which is based on a basic principle of electronics and include almost everything that I have learned in the Faculty of Electrical Engineering, Electronics and Automation, University of Ruse.

The basic block diagram shown in the Figure 1 represents the architecture and the functionality of the developed game. The algorithm starts with power supply which can be generated from the wall network or battery. It supplies 3 games which user can choose. Each one has its own architecture and working principle described below.

DESCRIPTION OF THE ELECTRONIC GAME

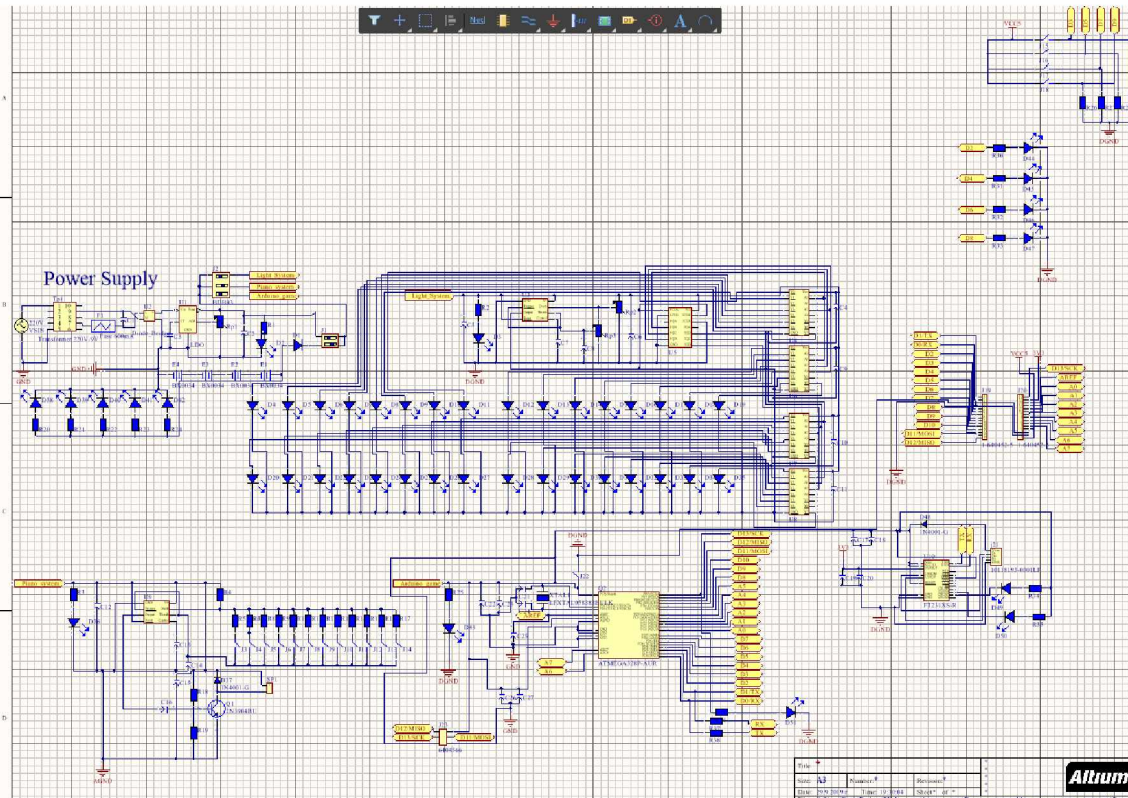


Fig. 2. Diagram of time delay relay

The Diagram shown on the Figure 2 is an electronic game which is divided into three small games. Also in the top the left corner of the diagram is the power supply needed for this board. On the left is located the first game. The second one is located under the power supply and the third one is on the bottom and top right place. First game consists just of lights which are turn on and off and they show Bulgarian flag. The second game is a frequency dependent analog circuit which is music generating game. The third game is realized by embedded microcontroller.

On the top left corner, we start with transformer which has a fuse on a secondary coil. So, when we plug in to the network, we can transform 220V to 9V AC. The capacitor after fuse is for reducing the ripples. It has a large capacitance 1000µF. The next component on the power supply system is diode bridge, so we have only positive voltages. The voltage drop on diode bridge is 1V so we left with 8V non regulated voltage (AC). After the voltage regulator LM7805 we got 5V regulated power supply. As well as the feedback resistor on the output regulates output voltage if something goes wrong. The last thing of the power supply system is indicator that we have 5V voltage on this node. The resistor plays role for current limiting, and green led to shows that everything works well. One of the main requirement for electronics game is to be portable so it is designed a handy device. The user can choose to use battery or network for power supply. On the bottom side of the network power supply that I described above is located battery holders which is 4x1.5V. As a designer of such a system I would recommend users feel free to use any battery brand that they want, because this game is not strongly dependent on quality of power supply ripples. Most of IC inside works well with less than 5 to 1.5V. Additional future that users have here is a passive battery charge quality system. It is designed with resistor and diodes only, which helps user to identify the life of battery is good or not. The both power supply system is connected to dip switch. If the user activates both switches so the diode which is connected to battery will be off and game will use network supply. If it's not, then the battery energy can be used.

The first game starts with light indicator which has current limited diode and LED. After choosing which game to play the led indicator flashes up and the game starts. The first game is called Bulgarian running flag and it is composed by oscillator which is developed by using IC timer 555. The square wave oscillation is controlled by charging and discharging capacitor which value is 10µF. This oscillator can go to 5MHz, which is not necessary and that's why the values of the resistor and

the capacitor is in a range of human viewing. After generating square wave pulses the two timers will be activated and the countdown starts on every rising edge of a pulse. Its output is the entrance of another IC which is decoder and its output is showing running Bulgarian flag with diodes.

The second game is called electronic piano. It is built by a light indicator, which shows that this game is selected. We use the same IC to generated pulses. But this time we do not need exact value of the period. So, in this game we made it changeable with a resistor and switches. This switch are buttons which are normally opened. When the user presses a button, it generates a frequency which DC component is filtered by input capacitance of NPN transistor. The ladder of resistor with different values correspond to different musical notes. Both resistors tied to the base of transistor create a static DC operating point. The transistor works in class A amplifier so that linearity is high. The negative aspect of this transistor is draining lots of power when it is not being used by the user. We do need a heatsink to avoid this problem with the heating and it is preferable to choose a speaker with higher impedance for reducing the current flow through the transistor. The parallel connected diode is for protection the transistor after the power goes off.

The third game is called remember the sequence. This game uses Arduino nano platform (Arduino, 2019). It has also a light indicator to show that the game is selected. The main reason for choosing an embedded microcontroller is to have pseudo signal generator and easy implementation of a hardware control software (Milton Bradley Company, 2019). This microcontroller has Universal Synchronous/Asynchronous Receiver/Transmitter as a communication module so additional IC is added to convert the USB protocol (Milton Bradley Company, 2019), (Andre, 2005). To the output interface of the controller 4 buttons are added as a switch is tied up with power up resistor to power supply, to create normal closed buttons. After the user presses the switch it pulls down and the microcontroller reads zero. So in this way we can read the buttons if they are press or not. The debouncing program is used to sure that we won't read wrong value. The pressed button corresponds to the lighting one of the four LED's. So, the game starts when the user presses one of the buttons and after that the Arduino blinks the lights. The user needs to follow the same light and the microcontroller goes to another level with lighting one additional light. The game keeps running until the user forgets the sequence and presses a wrong button.

The software for the game is stored in the memory of the Arduino platform. Parts of the programme code is given on the Figure 3 and the Figure 4:

```
#define CHOICE_OFF
#define CHOICE_NONE
#define CHOICE_1 (1 << 0)
#define CHOICE_2 (1 << 1)
#define CHOICE_3 (1 << 2)
#define CHOICE_4 (1 << 3)

#define LED_1 10
#define LED_2 3
#define LED_3 13
#define LED_4 5

// Button pin definitions
#define BUTTON_1 9
#define BUTTON_2 2
#define BUTTON_3 12
#define BUTTON_4 6

// Buzzer pin definitions
#define BUZZER_1 4
```

Fig. 3 Definition of the variables

```
gameMode = MODE_MEMORY;

if (checkButton() == CHOICE_3) play_beegees();

if (checkButton() == CHOICE_2)
{
    gameMode = MODE_BATTLE;

    setLEDs(CHOICE_GREEN);
    toner(CHOICE_GREEN, 150);

    setLEDs(CHOICE_RED | CHOICE_4 | CHOICE_2);

    while(checkButton() != CHOICE_NONE) ;
}

play_winner();
}
```

Fig. 4 Part of the main structure

This is a part of the programme for the microcontroller. It starts with entering a global variables for the future work. The code is divided into different modules for easy handling and editing.

CONCLUSIONS

In this paper, we have proposed a new simple and low cost electronic game. The module can be flexibly customize by adding additional LED panels or easy replacement of the diodes with such panel. The system is robust and it is not dependent of vary clean and stable power supply. The simplicity and straightforward design produce a cost-effective, compact solution for entertainment at home.

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