BUPTIS

Project Report

Robox

Group 1

2011/9/12

This project report is the final report for the year 2’s short semester project of BUPTIS, written by group 1.

Contents

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1. Electronic Clock

1.1. Planning

The project was launched in late June 2011. In the beginning of the project, the members of group 1 took a meeting to map out a schedule for the whole project.
Here is our schedule:

Phase5: By the end of the first week in September the project report and video commecial should be finished.
Phase4: By the end of the summer vacation the entire clock with user manual and website should be finished.
Phase3: By middle of August the Clock should be assembled and tested.
Phase2: By July 6th the primary functions of both products should be developed.
Phase1: By July 3rd the circuit design should be finished, the work allocation should be arranged
Phase0: By 30th the concept design should be finished.

1.2. Design

1.2.1. Function & features

The clock will have 2 primary functions: normal clock function and alarm function. There will be only 3 buttons for control and adjustment: 1 to alter mode, 1 to shift digit, the 1 left to increase the number. The digit being modified shall flash during the modification procedure. The alarm can be shut down manually or it shall shut itself after a specific period of time.

1.2.2. Overview

Robox is mainly built up with 74HC series, 74LS series and CD4000 series logic ICs. The whole logic system works in a circumstance where VCC equals to 5 volt.

According to the features described in the previous section, there is only one set of display panel on Robox which requires that both information of alarm time and current time will be transmitted to the same set of input terminals of the display system in different time. This reminds us of a concept in communication science, TDM (Time Division Multiplex). So a simple TDM model is then designed to allow two counter arrays sharing one set of display cables under the control of a control unit formed by several state machines.

A brief design of electronic clock system is then figured out as a whole.

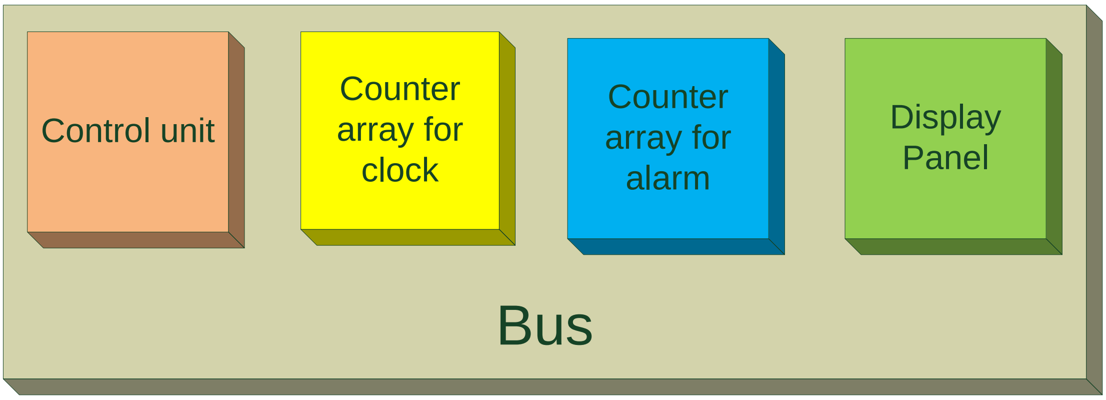

Figure 1 Overall structure

There are 4 modules in the clock including a Control unit, a Counter array for clock, a Counter array for alarm, and a Display panel. All the modules share a unified interface design to guarantee successful information exchange with each other through the bus.

1.2.3. Detailed design

1.2.3.1. Bus

1.2.3.1.1. Bus Interface

A unified bus interface provides not only the possibility for multiple information sources but also a flexibility of adding new part into the system. In order to fulfill the basic need of display function, we need at least 24 terminals (4 for each BCD number, 6 numbers for hh: mm: SS format). What's more, adding other signals to this bus cable can reduce the risk of wrong connections during the development or assembling procedures since all the connections are under the same standard. Furthermore, if more functions are added into the system in the future development, the new modules can still use this bus which will be typically convenient for the development for new devices adding to it. Therefore, we decided to use the 40 pins IDE cable which is very common in the computer markets. To control the use of bus, signals are input to 74ls245(octal bus transceivers with 3-state-output) before they enter the bus.

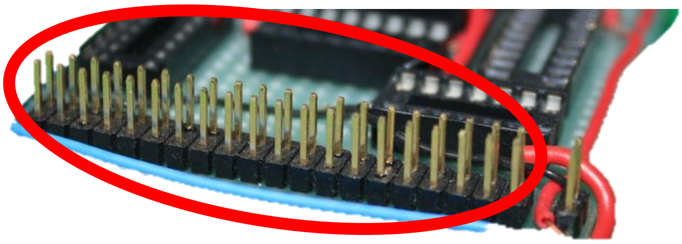

Figure 2 The bus cable and socket

Name for each pin is arranged as follows.

	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
A	Q_{23}	Q_{22}	Q_{21}	Q_{20}	Q_{15}	Q_{14}	Q_{13}	Q_{12}	Q_7	Q_6	Q_5	Q_4	1Hz	4Hz	C_0	C_2	C_4	C_6	C_8	I_0
B	Q_{19}	Q_{18}	Q_{17}	Q_{16}	Q_{11}	Q_{10}	Q_9	Q_8	Q_3	Q_2	Q_1	Q_0	2Hz	NC	C_1	C_3	C_5	C_7	C_9	I_1

1.2.3.1.2. Functions of each terminal

24 pins for display bits: these terminals carries 6 groups of BCD code therefore 24 pins in total （hour, minute and second take 2 BCD numbers respectively）. From Q_0 to Q_{23}, each pin carries signals from LSB to MSB.

3 pins for standard frequency signals： They are 1Hz, 2Hz and 4Hz respectively.

12 pins control signals & initial status information：Each of their function is shown in the following table:

Number	Name	Functional Description
C_0	0^{th} Flip-flop	Normal mode or setting mode（0 for normal, 1 for modification）
C_1	1^{st} Flip-flop	Set time or alarm clock（0 for current time,1 for alarm clock）
C_2	2^{nd} Flip-Flop	Set hour or minute（1 for hour,0 for minute）
C_3	3^{rd} Flip-Flop	Alarm triggered signal（1 for triggered , 0 for not triggered）
C_4	Set	Input signal from button panel, switch the setting status between hour and minute.
C_5	Mode	Input signal from button panel, switch the current mode among normal, modify current time and modify alarm clock.
C_6	Alt	Plus the digit being modified by 1 in the 2 setting modes.
C_7	Second Reset	Reset the second digits of current time to 0.
C_8	Hour flash	Signal for display, digits of hour flash.
C_9	Minute flash	Signal for display, digits of Minute flash.
I_0	0 preset	Signal change from GROUND to VCC when starting up, it keeps VCC for rest of the time.
I_1	1 preset	Signal change from VCC to GROUND when starting up, it keeps VCC for rest of the time.

1.2.3.1.3. Authority of each module

Authority of control unit： Signal producer &receiver. It produces all the control signals & initial status information except C_3, and receives signal in C_3.
Authority of display panel： Signal receiver. It produces no signal.
Authority of counter array for clock：Signal producer &receiver. It produces signals from Q_0 to Q_{23}, and receives other signals.
Authority of counter array for alarm：Signal producer &receiver. It produces signals from Q_0 to Q_{23} and Q_3, and receives other signals.

The 2 counter arrays do not transmit Display signals at the same time.
** The bus cable do not carry VCC or GROUND, there are separate power cables.

1.2.3.2. Control unit

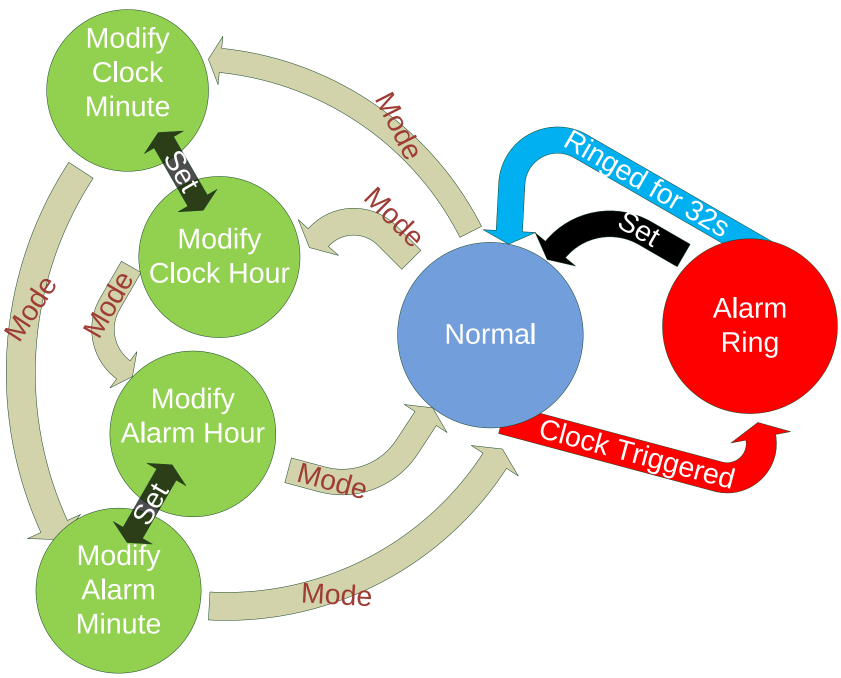

Figure 3 Status diagram

The control unit is a state machine storing the current situation receiving user's input and taking reactions. It has 4 D flip flops (74ls74) represented by C0, C1, C2, and Alarm Status.
All the other modules are under control of the control unit, it decides which signal is to be transferred to the display panel, whether to ring the alarm, light the status LEDs, or modify the number stored in the counters.
The following function table indicates the properties and actions of control unit in different situations:

Current status	Status number	0	1	2	3	4	5
	Status name	Alarm Ring	Normal	Modify Clock Minute	Modify Clock Hour	Modify Alarm Minute	Modify Alarm Hour
	C0	0	0	1	1	1	1
	C1	0	0	0	0	1	1
	C2	X	X	0	1	0	1
	Alarm Status	1	0	0	0	0	0
	C8	1	1	1	Alternating 1 and 0	1	Alternating 1 and 0
	C9	1	1	Alternating 1 and 0	1	Alternating 1 and 0	1
	Alt	disabled	disabled	enabled	enabled	enabled	enabled
The reaction of an input	Mode	No action	To 2 or 3	To 4	To 5	To 1	To 1
	Set	To 1	No action	To 3	To 2	To 5	To 4
	Alt	No action	No action	C6=VCC	C6=VCC	C6=VCC	C6=VCC
	C3(Alarm trigger)		To 0				
	Ringed for 32 second signal						

1.2.3.2.1. Control board

Control board is the main and the most important part of control unit. The flip-flops input and output logic is installed on this board.

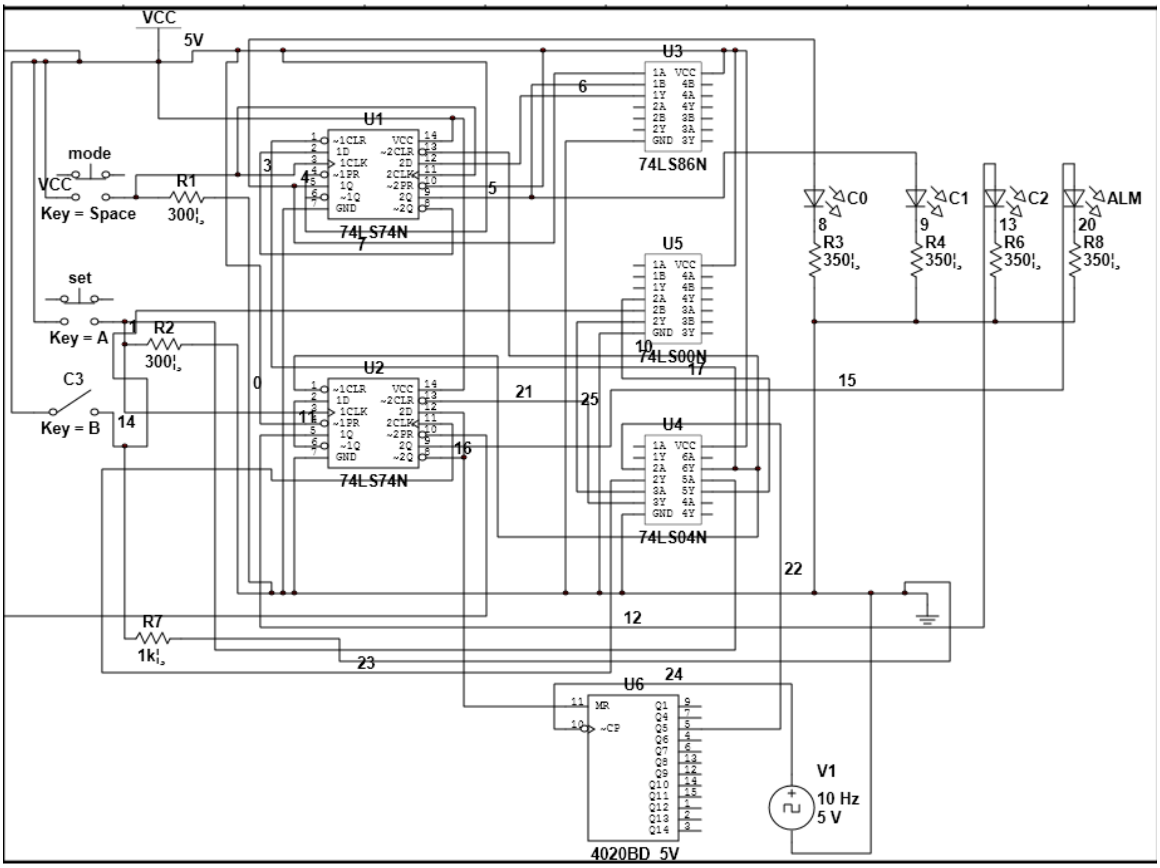

Figure 4 Control board

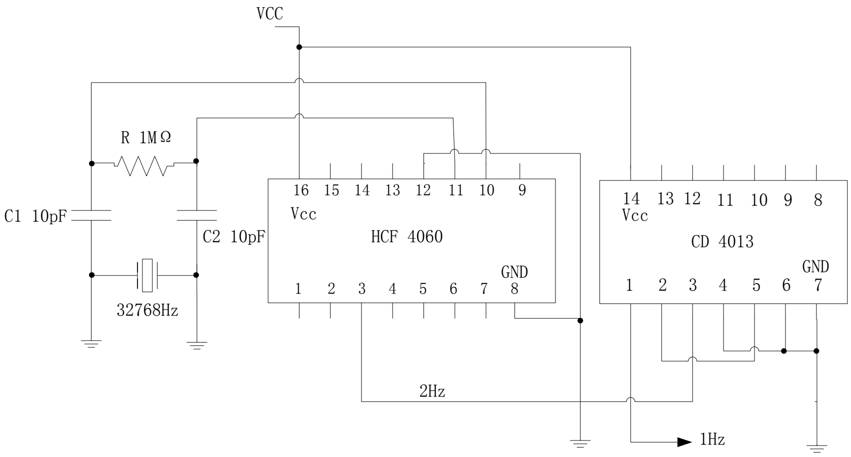

Figure 5 1Hz signal generator

1.2.3.2.2. Button panel

The function of button panel is to receive input information screening illegal input. It has 3 buttons: Mode, Set, and Alt. The mode and set buttons can produce one high signal every time pressed, the Alt button on the other hand, will activate a 2Hz signal to allow the users to keep pressing the Alt key to realize a continuous increasing on the digit being modified.

1.2.3.2.2.1. Combinational logic of buttons' input

To avoid unpredictable consequences of users' illegal operations and to add more operations with only 3 buttons, a combinational logical operator is then needed to enable or disable combination of keys (e.g. Set+ Alt means cleaning the second in our system).

1.2.3.2.2.2. De-bounce Switch

Contact bounce (also called chatter) is a common problem with mechanical switches and relays. ……The result is a rapidly pulsed electric current instead of a clean transition from zero to full current.

--Wikipedia-Switch-Switch Bounce [*]

To eliminate the influence of switch bounce, we designed a switch filter. It is a D-flip-flop that takes in switch input with its clock frequency set to 16Hz. Therefore, any input signal beyond this frequency is ignored.

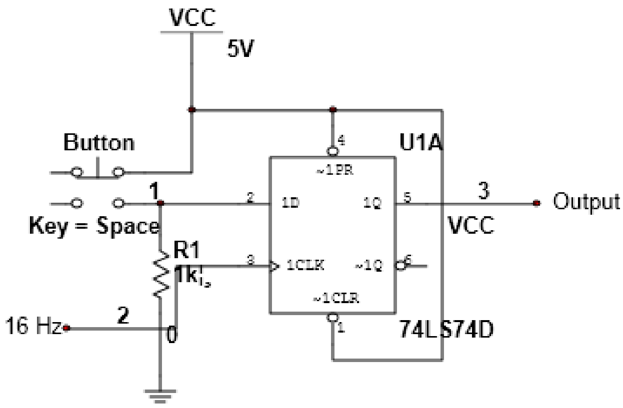

Figure 6 De-bounce switch

1.2.3.3. Counters

There're 2 groups of counters in our electronic clock, clock counter array and alarm counter array. The former is for current time, while the latter is for storing the alarm time. 74LS90 are chosen to build these counters for they are capable for BCD number and can be easily found in electronic market.

1.2.3.3.1. Clock counter array

In this counter group, there are 6 4-bit BCD counters representing each digit in hour, minute and second. Each group of dual counters receives carry signal from a smaller counter group. Several

*Wikipedia-Switch http://en.wikipedia.org/wiki/Switch feedback circuits control the counters' clear terminals to implement base 60 carry system and base 24 carry system. On the other hand, each group of 2 counters can also be modified by user's input.

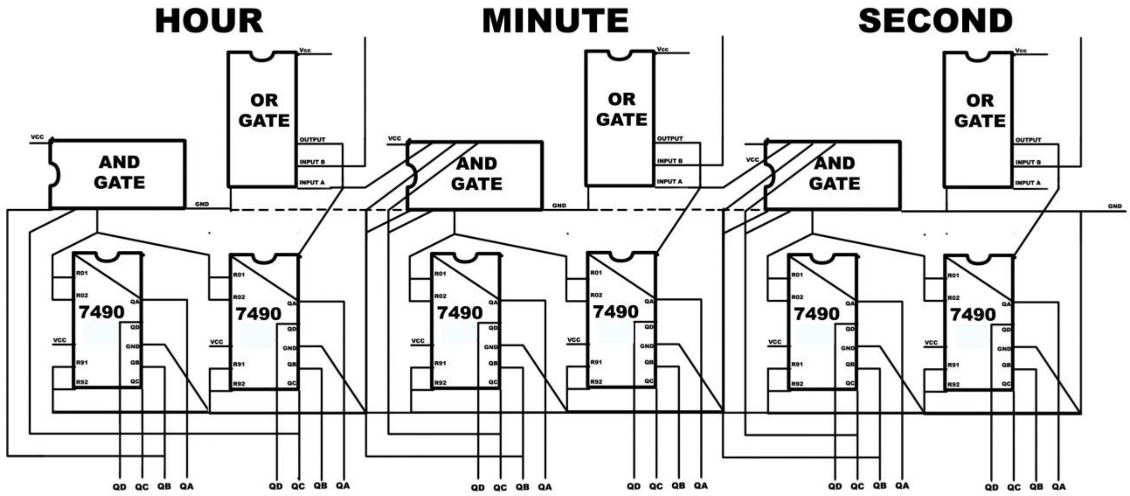

Figure 7 Clock counter array

1.2.3.3.2. Alarm counter array

Similar to the clock counter array, the alarm counter array also contains 4 BCD counters (ignore the second digits) that is the same to that of the former's, representing hour and minute. Yet it has more jobs than the clock, which requires it to judge whether the current time is the same as the alarm and send this information out. Here, we use 74ls85 8-bit comparators to finish this task.

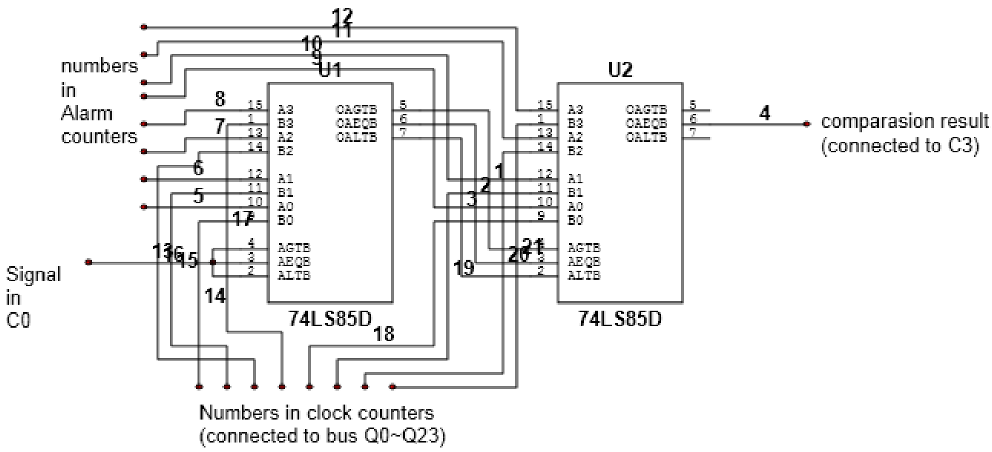

Figure 8 Comparators

1.2.3.4. Display panel

The 7-segment-display we use only accept 7 bit information, therefore, the BCD number coming from the counters should be decoded in the first place. Here we use 74ls48

BCD-to-7-segment-decoder to drive the 7 segment display. Beside, in order to implement the flashing function in time setting, the display drivers will read in the digit flashing signals on the bus therefor to decide whether to flash or to keep lighten.

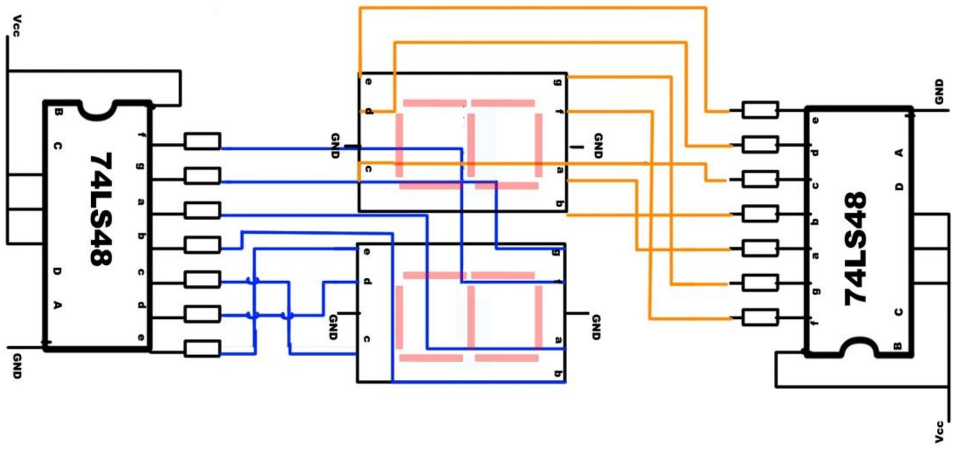

Figure 97-segment display with drivers

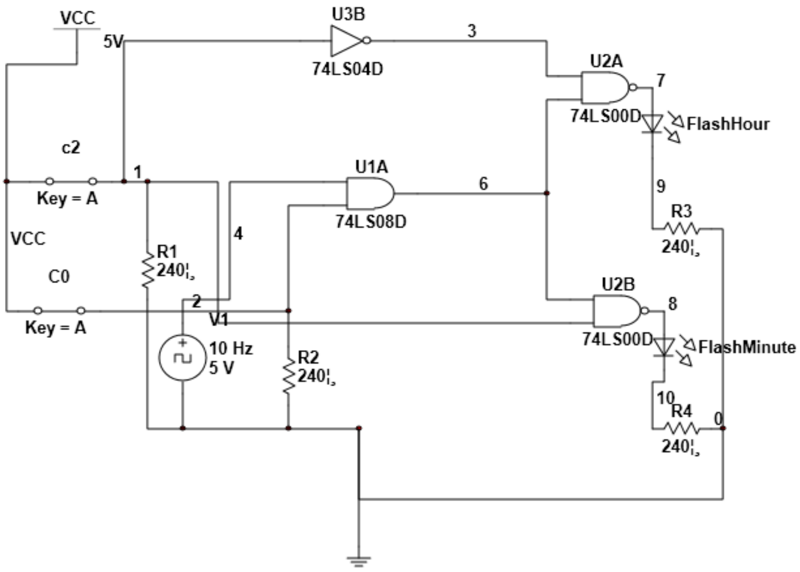

Figure 10 Flashing control circuit

1.2.3.5. Power Supply

The power supply includes a 5V-1A power adapter and a power distributer circuit.

1.2.4. Appearance design

After the circuit design, the volume that the circuit takes is basically fixed. The group member then started to find a proper shell for the clock. A Cube or rectangular solid box of an enough size would be a good choice for the clock. Then we started to seek for a box for our clock on the internet. An existing good will be better since we do not have much experience in dealing with raw materials.

A toilet paper box might be the best choice, for its sufficient inner space and regular shape. After several days' seeking and discussion, we finally decided to use a robot-shaped paper box.

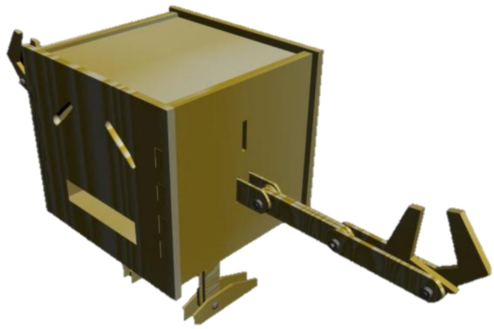

Figure 11 A 3D model of the box

1.3. Problems& Trouble Shooting

1.3.1. Switch bounce

In our early designs, we decided to use RC filter as de-bounce circuit, and several models were tested on breadboard to verify their performance. Yet the effect of these attempts is not satisfactory. Each time we clicked the button, several impulse signals were produced.

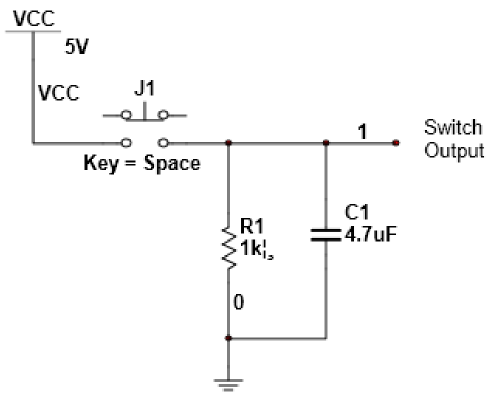

Figure 12 An early attempt to kill the switch bounce with RC circuit

Therefore we turn to digital circuit for solution. As is mentioned above, a D-flip-flop was adopted to take samples of the button's input. By using this method, the influence of switch bounce was eliminated. This method is more reliable and effective than any RC filters due to its controllable sample rate.

1.3.2. Cancel the alarm

In our concept design, the alarm will either stop beeping when user presses the Set button or it has beeped for 1 minute. But this feature is very difficult to implement with a small number of IC. We tried several designs, but most of them have flaws that will lead to error in some situation. The circuit below shows one of our early designs:

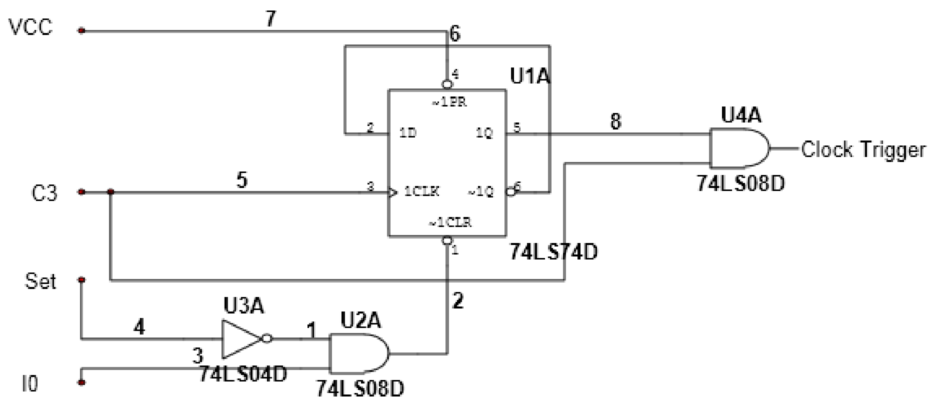

Figure 13 The first design of the alarm trigger circuit

The circuit shown above has a fatal defect that if the user does not cancel the alarm even though it will automatically shut down after 1 minute yet will not be triggered the next time.

Finally, we adopted this design which introduces another 14 bit counter to an automatic shut down when the alarm has beeped for a period of time. Furthermore, in the final circuit we made, we not just simply weld the wires as is shown in the circuit diagram. Instead, we put several wiring terminals on the output of the 14-bit counter making the connection with jumper pack which make the reset time period alternative.

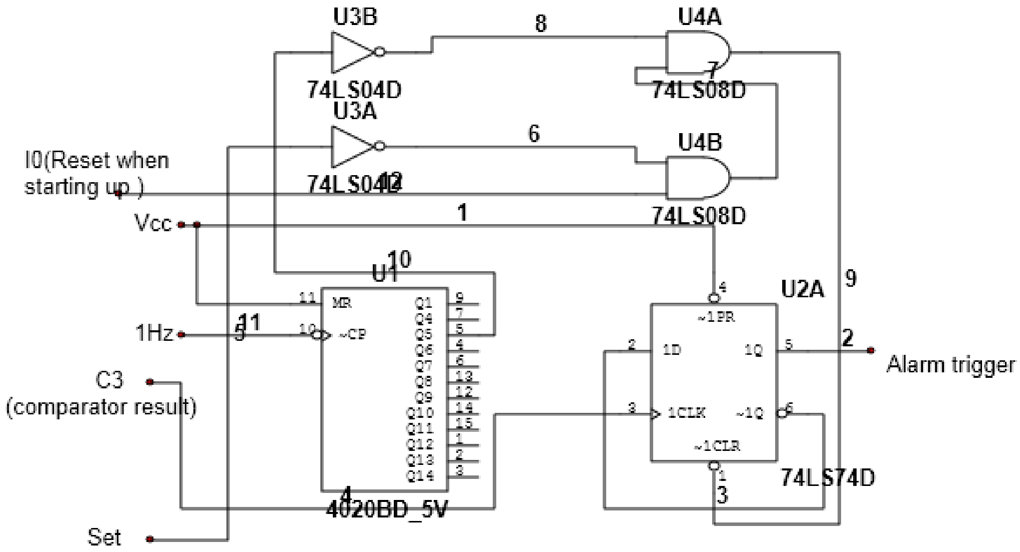

Figure 14 the final design of the alarm trigger

2. Website

2.1. Core Principle

The core principle of building up our website is trying to make the web as clear and simple as possible. Instead of a complicated appearance, a simple one can make our customer understand our products easier better. We did not want a shiny webpage design or too many functions, instead all the key points and the primary information that we want to convey to the customers are place in obvious places. By doing so, our most important new product would draw more attention and attract more customers.

As a matter of fact, the idea of building such a simple website origins from a website called snapfish.com. Unlike other webpage which are equipped with too many functions that easily make users feel confused, this website is rather simple. But the simplicity does help this website attract more users because the users do not have to spend a lot of time looking for the functions they are interested in. We believe that this feature is one of the most important idea in nowadays website developing.

2.2. Designing Procedures

By the end of June: We learnt a lot in webpage design and internet technology from the courses in the small semester, mainly focused on HTML and application of DIV+CSS. In the summer vacation after that, we learnt more detailed knowledge by ourselves.

July 15th to August 15th: We down loaded online materials and study websites to make a original design of our website.

August 20th to September 8th: Building the Website.

September 8 to September 12th: Correct the bugs and trouble shooting.

2.3. Structure:

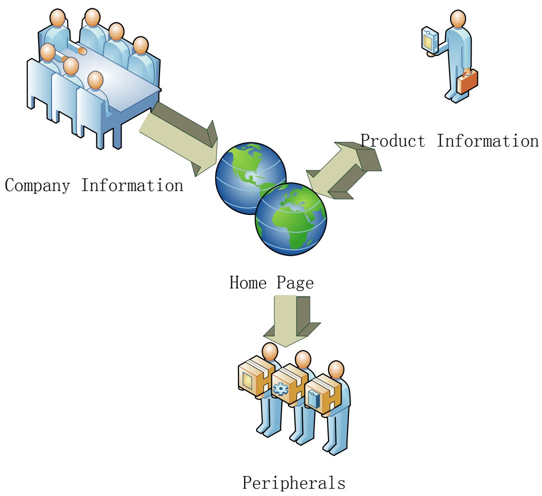

Figure 15 The structure of our website

2.4. Technologies we use

HTML

HTML is a kind of descriptive language. It can describe text, image, animation, sound, form, hyperlink, etc. The structure of HTML contains Head and Body. The Head describes the information that browsers need, and the Body contains all the content of the webpage. HTML is a series of abstract code that can be turned into visible and controllable entities.

CSS

CSS is a kind of markup language it can be performed by browsers without compiling. In a standard web design CSS takes charge of the performance of the web content (XHTML). Because of the limitation of HTML in layout design and interface effect, we turned to CSS for help. We use CSS to decide the way that the web content shows. Some functions that should be implemented by the image transition are easily realize by the application of CSS, thus faster the loading speed

optimize the font of webpage make it easier to arrange and make the webpage more delightful.
A bathing function can renew several pages within one operation, therefore no more repetitive work is needed. All the page styles can be controlled by a single CSS file. A single modification on this file will effect on all the pages that are connected to it. HTML on the contrary, will be more difficult and takes more store space to implement the function above.

2.5. Problems and solutions

Problems	Solutions
There is always errors in the page title.	After discussion, we finally realized that HTML heading label can only be used in the title.
2. The hyperlinks always lead to wrong pages or blank page.	We checked the link code Link text, but no fault was found, soon we find that the slash in the subdirectory was missing , e.g.href="http://www.school.com.cn/html
3. Multi-forms problems when dealing with database.	After searching on the internet, we found that the inherit method can solve multi-form problem. If all the data control are put in TPanel and put these Panel into a temporary Form A, and create a new form (a template form), and set TPanel.Panal as template form, a lot of code are needed in this method. Instead, if we use inheriting, and divide them into modules, the forms in each DLL are much less.
4 When implement the searching functions, the searching result should be displayed on the webpage, but when we tried the searching function no reaction was activated.	We find out a way to access ACTION directly and then turn to the webpage. The web page is firstly turned into static page, thus avoiding accessing the database each time the user log onto the webpage.

[Appendix-1]

Financial

model number	item description	price	Total number	Spare number	Total price
74ls04	IC	1.5	8	3	12
74ls08	IC	2	6	2	12
74ls00	IC	2.5	5	2	12.5
74ls32	IC	2	7	3	14
74ls74	IC	2	5	2	10
74ls85	IC	2	6	2	12
74ls86	IC	2	1	1	2
74ls90	IC	2.5	15	5	37.5
74ls138	IC	2.5	3	1	7.5
74ls245	IC	2	9	3	18
74ls48	IC	2	10	4	20
CD4013	IC	1.5	2	1	3
CD4020	IC	2.5	2	1	5
CD4060	IC	2	2	1	4
1k ohm	resistor	0.02	100	90	2
400 ohm	resistor	0.02	100	50	2
Omron B3f 1000	switcher	1.5	6	3	9
20p	capacitor	0.1	10	8	1
222	capacitor	0.2	10	0	2
104	capacitor	0.1	10	5	1
474	capacitor	0.3	10	5	3
dip14	IC socket	0.4	25	3	10
dip16	IC socket	0.4	25	8	10
dip20	IC socket	0.4	25	15	10
15*15	dual side board	15	1	0	15
15*20	single side board	10	3	0	30
SYB-120	bread board	15	3	0	45
0.5mm-63Sn	solder	40	1	0	40
MT03611A	7-segment display	1.5	10	4	15
1mm	wire	1	30		30
	IDE Cable	10	2	1	20
Geecook	wooden box	50	1	0	50
40*2	pin header	2	4	2	8
	dupon line	10			0
5v-1000mA	power adapter	10	1	0	10

	battery holder	3	1	0	3
total expend					485.5

[Appendix-2]

Job allocation

JP number	Surname	Given name	Duty
jp092695	Wang	Haoxuan	clock system design&report
jp092742	Qi	Shibo	display panel design
jp092788	Wang	Wenxin	soldering
jp092832	Wu	Xingyu	soldering
jp092877	Chen	Pan	soldering
jp092919	Zhang	Yumiao	soldering
jp092967	Tang	Zhanghan	Counter design& trouble shooting
jp093013	Pan	Yizhou	Counter design& trouble shooting
jp093035	Wu	Kezheng	website design
jp093088	Wang	Shimeng	website design
jp093139	Wang	ChenYu	website design&report

[Appendix-3]

Video Script

The commercial video will be a 3D animation about 30 seconds' long. The video will be made by using Auto desk 3Ds max and Adobe After Effect.

Scene 1[back ground music: Sabre Dance]
Electronic components march forward in line on a wooden board. The camera focused on the shadow on the wall.

Scene 2[back ground music: Sabre Dance]
The camera now turns to the electronic components and they match fast.

Scene 3[back ground music: Sabre Dance]
Now the camera is on the edge of the board. All the electronic components jump off one by one

Scene 4[back ground music: Sabre Dance]
The electronic components fall into a paper box, the box shakes.

Scene 5[back ground music: Sabre Dance]
The paper box breaks and ROBOX appears.

Scene 6[No back ground music]
The camera is now on ROBOX
The subtitle and narrate: ROBOX, a good friend on your bedside.
In the end the clock beeps