Final Project Report

E3390 Electronic Circuit Design Lab

Automatic Phone-Alert Home Security System

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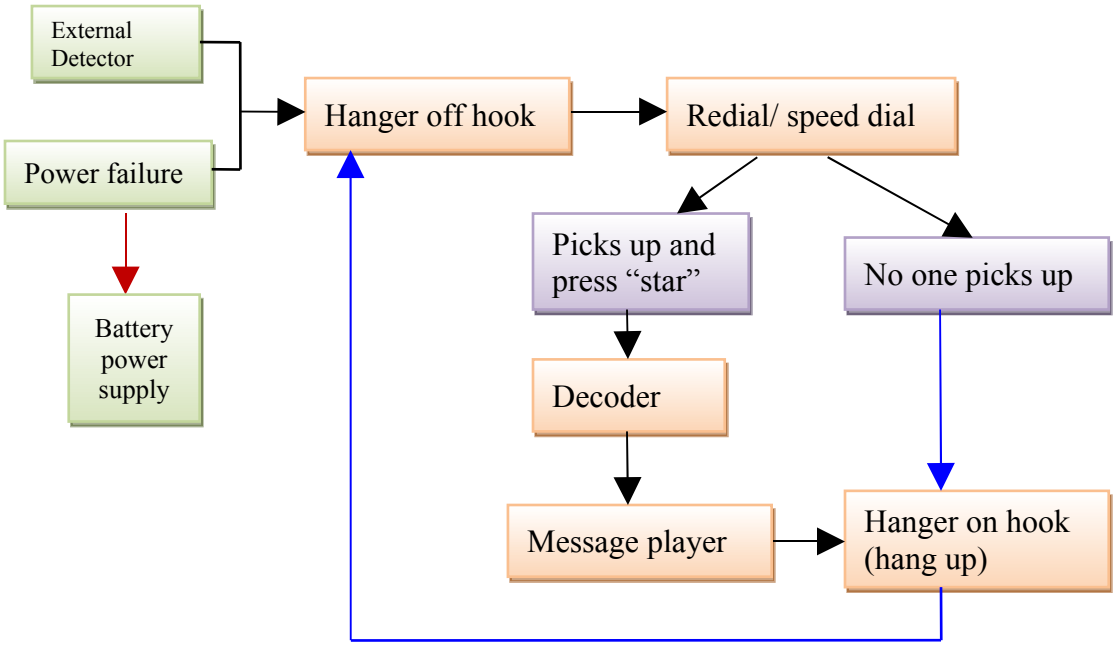
Executive Summary

Our device is an automated phone system that, when trigger by an electronic sensor, initiates a phone call and plays a notification message. It was created to give owners the ability to integrate all their security devices into a single automated system. The device offers you a cheap and flexibility way to manage your home security and to keep your family safe and aware at all times.

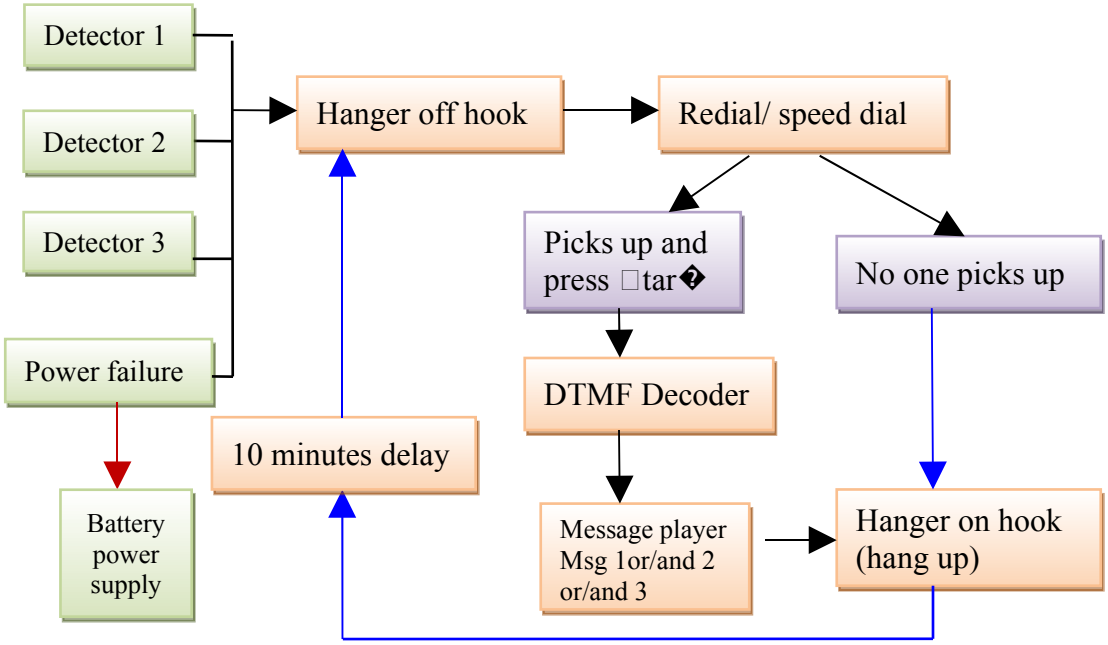
The device is compatible with any electronic sensing detector, such as an infra-red detector, motion sensor or an ultrasound detector, and is adaptable to your existing telephone line at home. As the selected sensor is trigger, a pre-stored number is dialed and voice message played, notifying which detector has been activated. The owner or designated contact dials a verification code, in this case the star button, and the message is played. If the call is unanswered or the verification is incorrect, the system will continue to make further attempts to call until the message is played.

Block Diagram, Design Targets

Design stage 1:



Design stage 2:



Individual Block Descriptions

Hook Switch and Dial:

The sensor input was feed into an XOR. The XOR was used as a buffer, with a minimum threshold input at 2V.

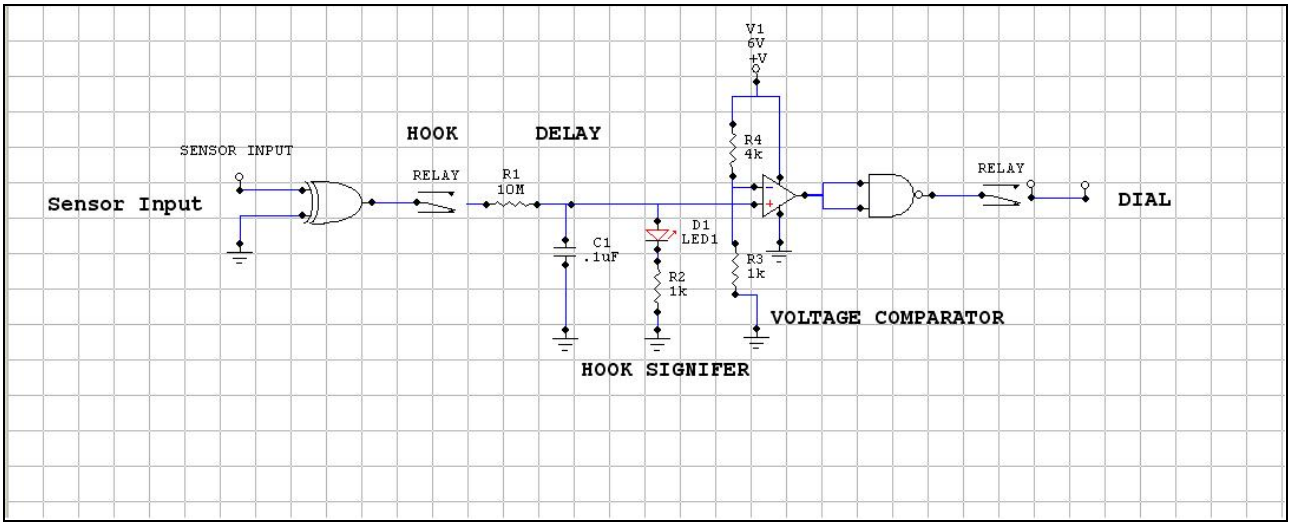
The hook switch was simulated by a relay in order to hold the state on or off. A voltage between 5-6V was needed to switch states of the relay (i.e. pick-up the phone).

Delay was implemented to hold until dial-tone was heard: C = .1μF and R = 1K

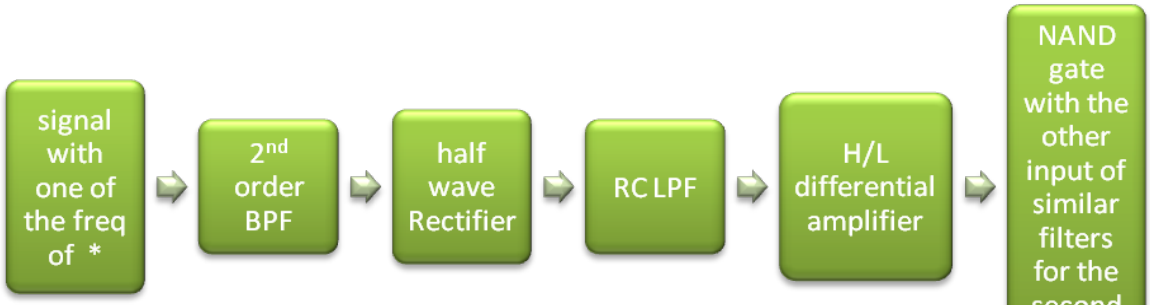
LED was placed as a hook signifier to show the picking up of the phone.

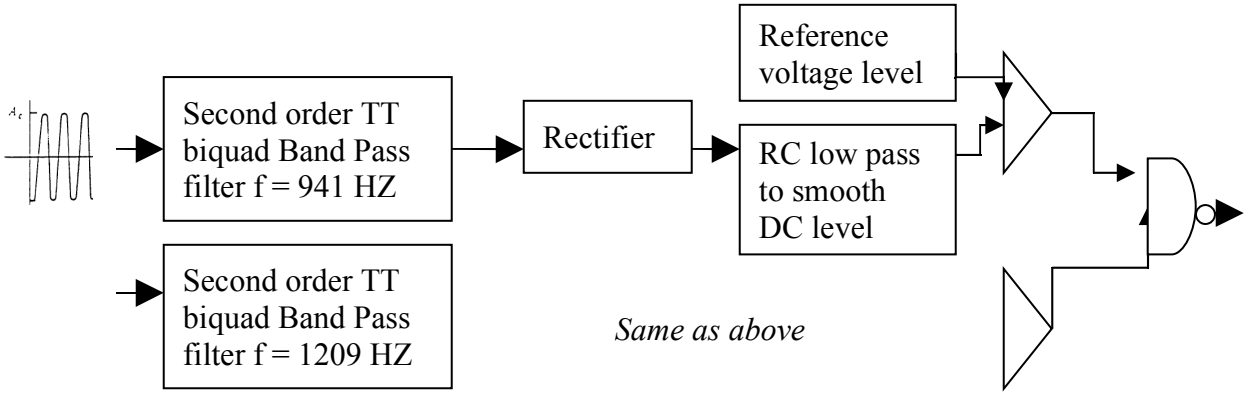
Voltage comparator implemented to step up 3V back to 6V. Voltage input from the hook, which ranged from 2-3V, compared to a 2V voltage with a 6V output.

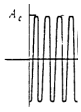
Inverter to switch state from high to low, and another relay placed to triggering to dialing.



Decoder:

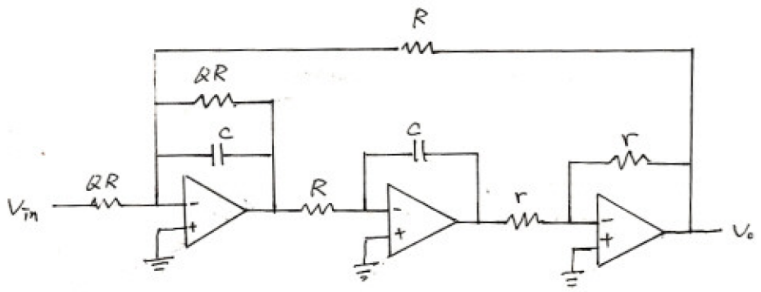






Second order band pass filter:

Tow - Thomas biquad



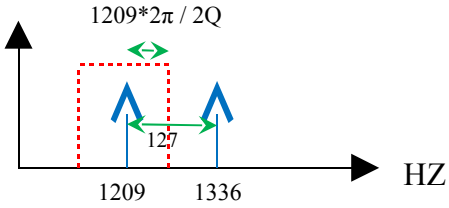
$B = \frac{f_m}{Q}$ center frequency ω_m

Choosing parameters:

Two LM324 low power quad Op-Amps were used for two filters and rectifiers.

$\omega_{01} = 2\pi * 1209$
Next frequency is at 1336 HZ, we want to filter out 127 HZ

$$\frac{2\pi * 1209}{2 * Q} < 127 * 2\pi$$, therefore Q > 4.76

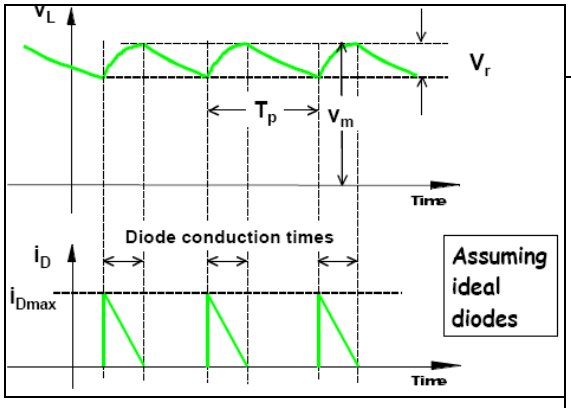


Set Q = 10, C = 10 nF, r = 20 k Ω
$R = \frac{1}{2\omega_{01} C}$ = 13.16 k Ω
QR = 131.6 k Ω

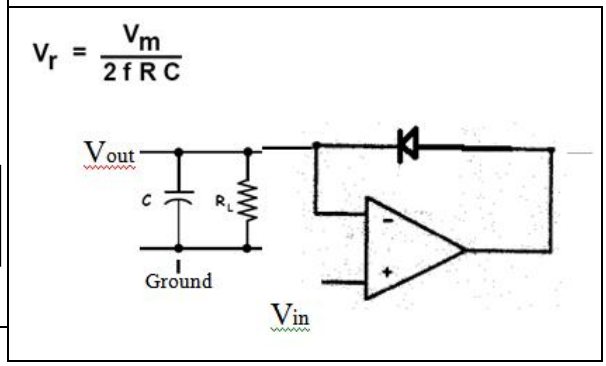
ω_{02} = 941 HZ
R = 17 kΩ
QR = 170 kΩ
Apply ±6V to low power quad Op-Amp LM324.

The output of the filter for sinusoidal waves at 6V peak to peak from the function generator (no offset) has a maximum voltage at frequencies close to the central frequency. The circuit is very sensitive so the output voltage of the next frequency targeted to be filtered out is much lower than the maxima. The results for two filters are listed in the table below:

Filters	$\omega_{01} = 2\pi$ *1209 rad/s*		$\omega_{02} = 2\pi$ *941 rad/s*	
Signal frequency	1210HZ	1339HZ	941HZ	856HZ
Output voltage	2.5 V	1.2 V	2.5 V	1.2 V



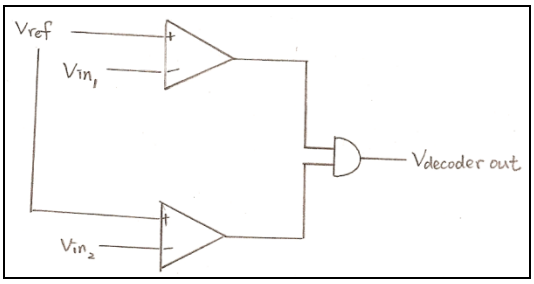
Half-wave rectifier and RC voltage regulator (AC to DC conversion):



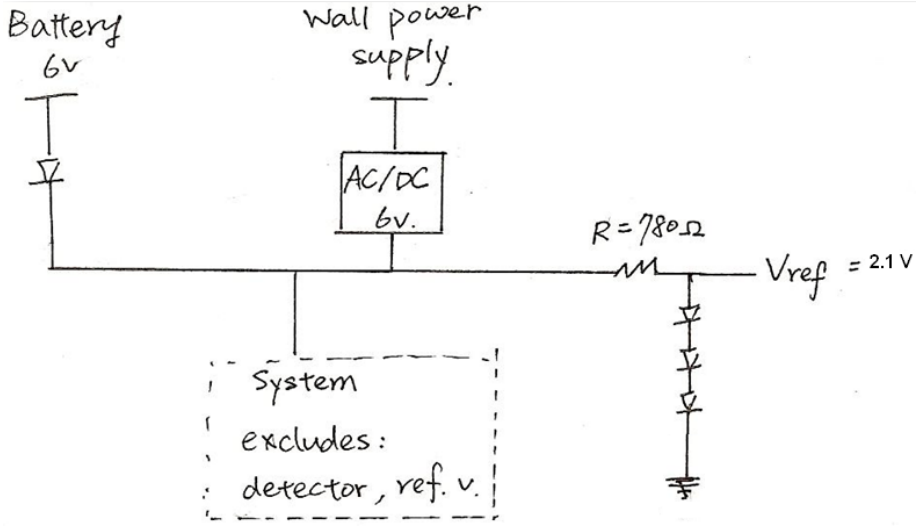
Output DC voltage values with corresponding frequencies are as below:

Filters	$\omega_{01} = 2\pi$ *1209 rad/s*		$\omega_{01} = 2\pi$ *941 rad/s*	
Signal frequency	1216 HZ	1338 HZ	947 HZ	862 HZ
Vin	2.79	1.27	2.76	1.43
Vo	4.74	-5.9	4.74	-5.9

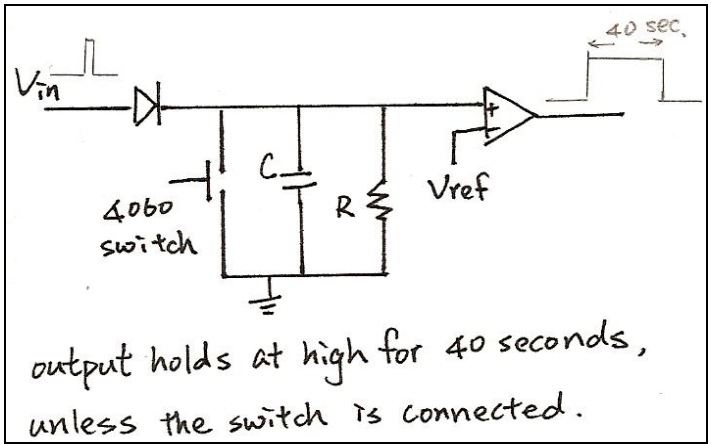
The outputs from both regulators are each fed to a voltage comparator with a 2.1 V reference voltage. A 4011 NAND gate is used for AND gate. (Originally a low was thought to be a necessary output to trigger the hook, but it was realized that an AND is more appropriate.)



Reference Voltage and Power Supply:



Reference voltage is a constant 2.1 V.
The diode prevents current to flow back to the battery since the wall power adapter will always have a higher voltage than the battery. When the wall power is off, current from the battery will pass the diode with around 0.7 V drop to support the system. In the future design, when battery is supplying the power to the system the system will also initiate a call to the owner notifying a failure of power in the residence.



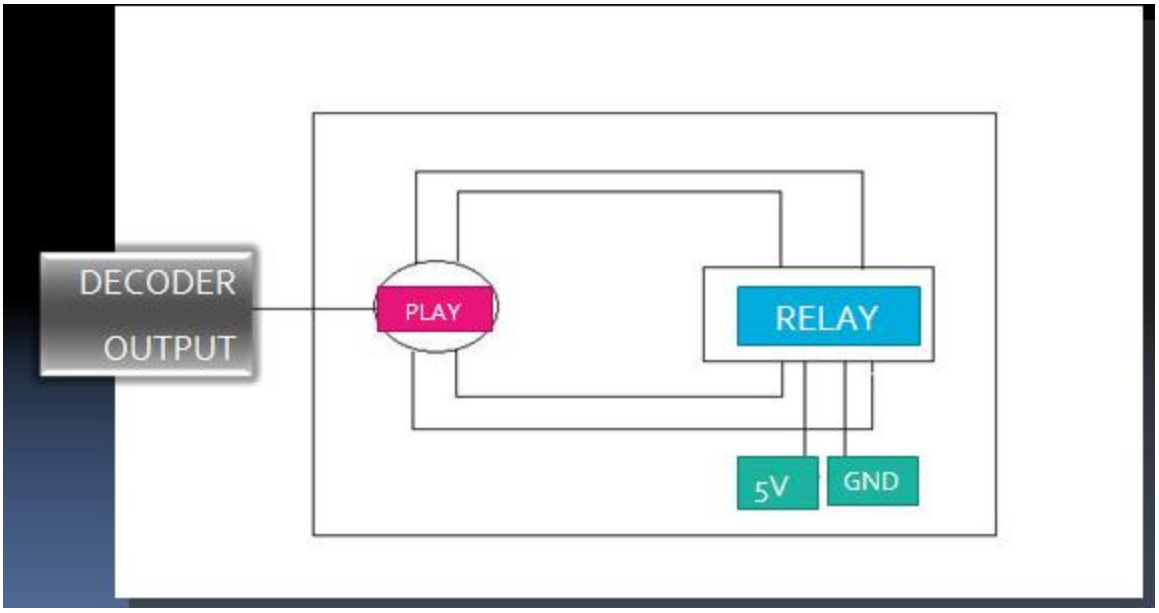
40 Second Delay:

C = 100 μF, R ≈ 40MΩ

The 4060 switch is triggered by the decoder. As the decoder sends a high pulse to 4060 the current will be pulled to ground and terminates the 40-second timer. Otherwise, the output sends out a high pulse after 40 seconds to trigger the hook to be "on" (hanging up).

Message Player:

After the verification was passed through the decoder and the signal is verified, the decoder outputs a high. The high initiates the *play* button. The *play* button is tied into a REED relay therefore any pulse generated from the decoder output would short the all contacts and play the message.



Bill of Materials

Part	Store	Cost
AT&T Trimline Telephone	Staples	16.25

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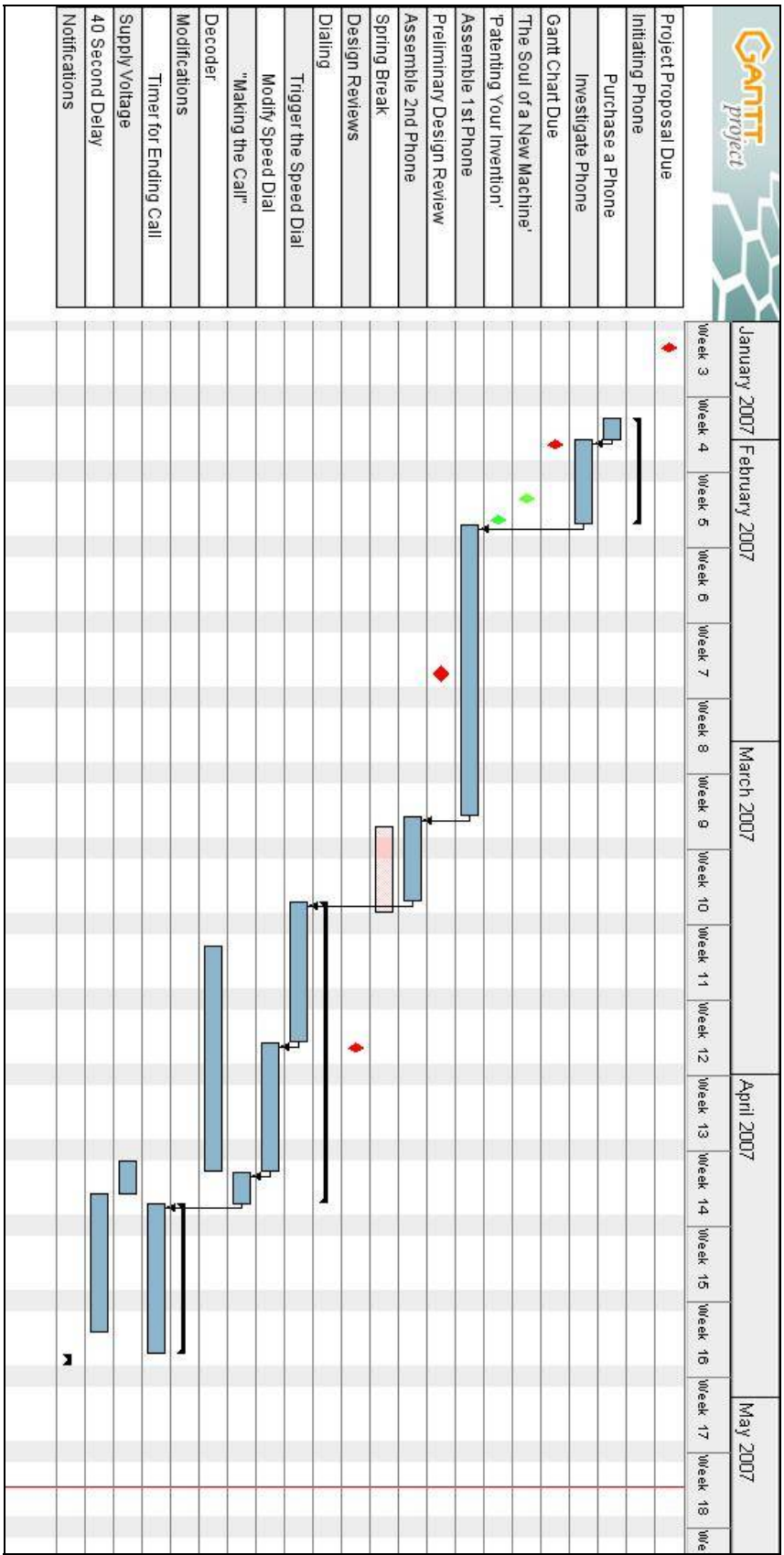
Health, Safety and Environmental Issues

a. Product Dangers: There are no known product dangers.

b. Health Hazards: There are no known health hazards.

c. Environmental Hazards: There are no known environmental hazards besides the basics of any electronic devices, such as keep out of reach of children and keep away from water.

Final Gantt Chart



Criticism of this Course:

Much of our project has changed from the original idea. In the process, much running around, from resource to resource was need. We reviewed books and online sources in order to help us get a sense for a direction to move with our project. Although much time was spent researching various topics on our phone system, we concluded to start somewhere, by building a phone.

We opened a commercial phone in the hopes of integrating it into our project, but it failed us. We thought that by building our own phone, it would give us a better understanding for our system and its functionality. To some extent it did, but mostly is took up too much of our time. At the end, we were not able to progress enough to use it.

Although the research was needed to start the project, I felt that we didn't have enough time. We spend a little more than the first half of the class deciding and playing around with the phone, and were only left with the last third to actually build the phone. At the end of the project, we were left feeling like we wanted more time and we were capable of expanding our project.

We would suggest, for the coming years, to make the Capstone a 2-semester, or one-full year course. The first semester would solely be focused on finding and creating a project, whereas the second semester would be for building. The first semester class can be a light 1-2 credit course, where Professor Vallencourt meets with the students once a week for an informal meeting, to talk about possible project and to plan through the design portion. I think the extra semester would not only produce much more successful projects, it would also leave a more fulfilling feeling with the students. The students would feel more accomplished with their projects as well as themselves.