Exploding Alarm Clock

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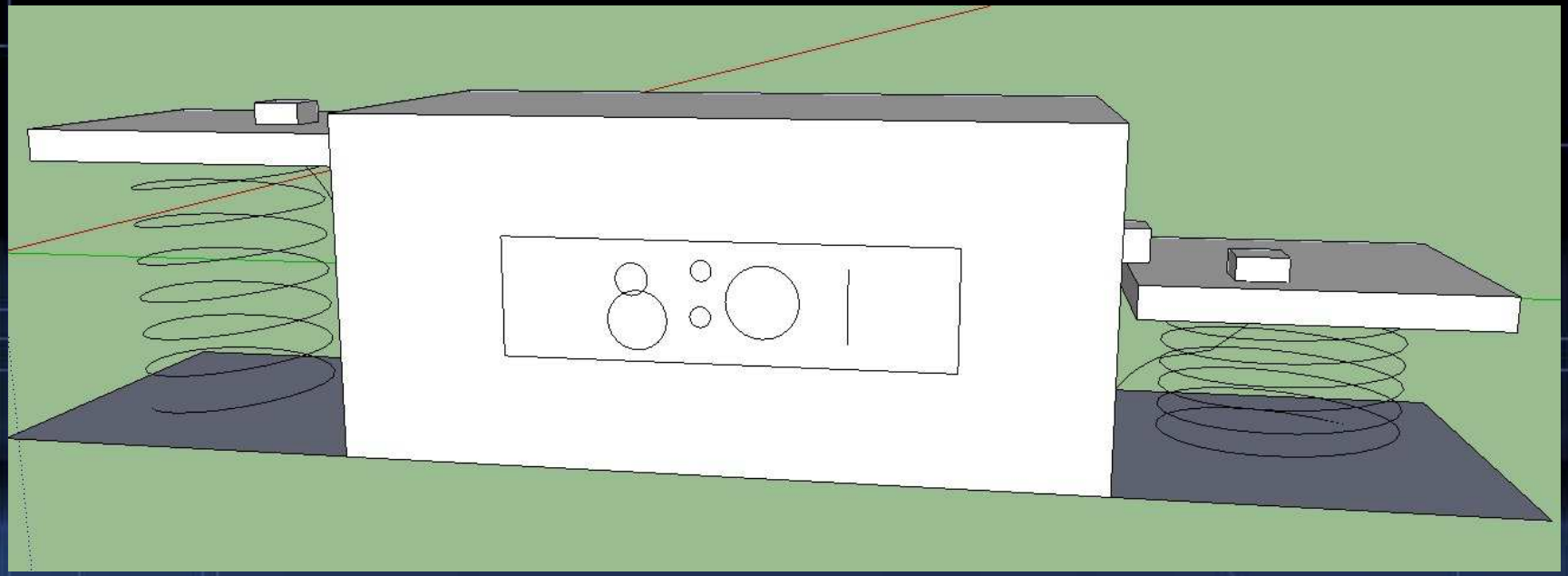
Motivations

- We wanted to create an alarm clock that would force the user to get out of bed
- We also wanted to create a product that would have more functionality than a regular alarm clock

Overview

- The Exploding Alarm Clock is an alarm clock that launches it's speakers into the air when the alarm goes off.
- The alarm clock also functions as a audio player through the use of USB/SD connections
- The launched speakers continue to make sounds (either an alarm tone or a song), even after they are disconnected.
- The speakers can also be manually disconnected and used for casual listening.

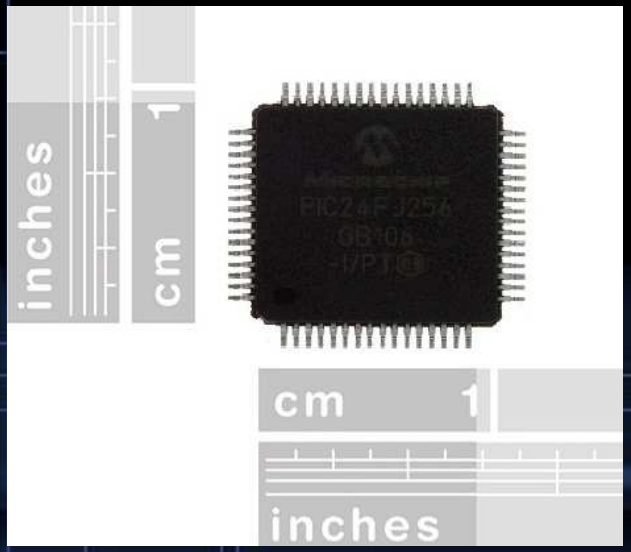


Microcontroller Requirements

- We needed a microcontroller that runs on 3.3V to coincide with our other peripherals.
- We wanted a microcontroller that has a built-in real time clock.
- We wanted to go with a MCU that had an established software repository
- We needed a microcontroller with enough GPIO and Serial Communication ports

MCU Options

- AT32UC3B
- Offers a software package that included an interface to USB/SD for an MP3 player
- Operates on 3.3V
- Has enough GPIOs for our needs
- Was not chosen because we found a MP3 Decoder that interfaced better with another MCU



PIC24FJ256GA106

- Has lots of examples online
- Operates on 3.3V
- Has enough GPIOs for our needs
- Built in RTCC and Alarm Interrupt Handler

Microchip PIC24FJ256GA106

- 53 Input/Output Pins, with 31 Remappable Pins
- Serial Communications Pins (4 UART, 3 SPI)
- Able to be programmed in C
- More than enough program memory to handle our needs (256KB).
- 66 Built-in Interrupt Sources

PIC24FJ256GA106: PicKit3

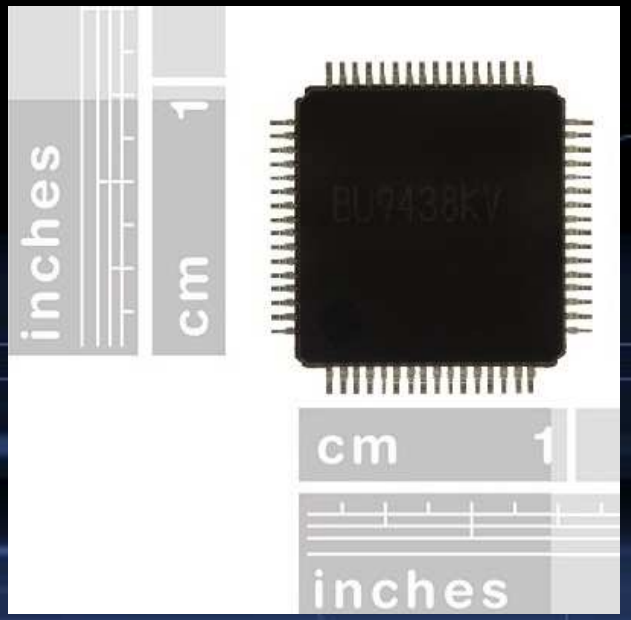
- Programmer & Debugger
- Allows for step through debugging of code
- Connects through header pins to the microcontroller
- Allows for breakpoint
- debugging

MP3 Decoder: Requirements

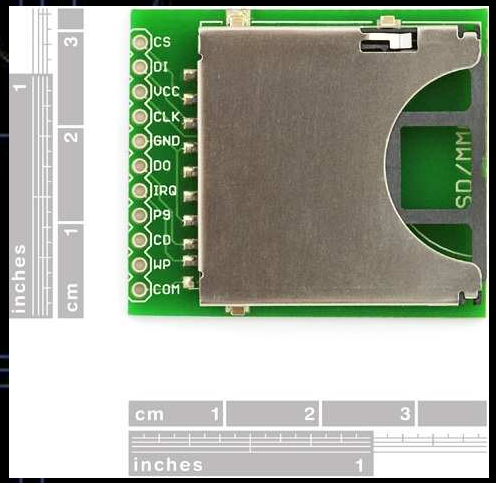
- We need a MP3 Decoder that is affordable
- We want a MP3 Decoder that can handle USB and SD inputs
- We want a decoder with ID3TAG ability
- We want to run it off 3.3V
- We want a MP3 Decoder that is simple to interface with

ROHM BU9438KV

- Is a AAC, WMA, and MP3 Decoder IC which contains USB host and SD card input function
- Has built-in audio DAC
- Has sound effect function
- Pin controllable
- File name and folder name sorting for FAT filesystems
- ID3TAG, WMATAG,
- AACTAG compatible
- KEY matrix Controller
- contained



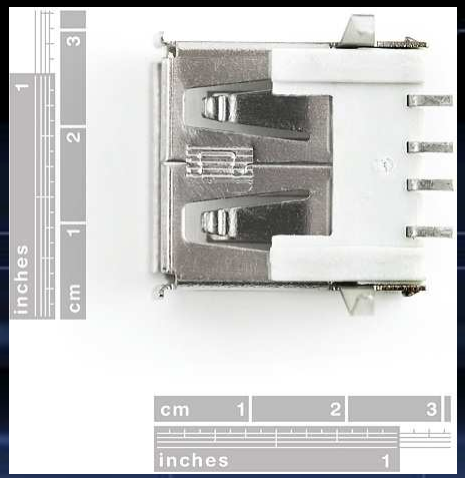
Data Reading



- SD
- Going to be using a SD
  - card reader breakout board
- Will interface directly to
- the MP3 decoder

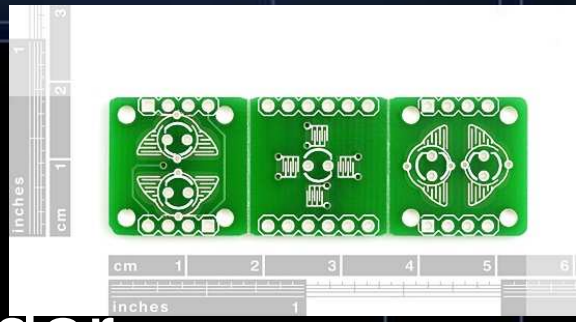
USB

- Type-A Female connector
- Will interface directly to the MP3 decoder



SD will be chosen first. If no SD card is selected, it will move to USB.

Button Control



- Buttons will be directly
- connected to the MP3 decoder
- MP3 decoder KEY matrix controller will handle all button presses for the MP3 decoder
- The buttons will be used to handle pause/play, volume control, and track selection

Alarm Clock Overview

- Software driven through built-in interrupts
- The built-in Real Time Clock uses external oscillator 32.768MHz to give accurate time
- Special assembly command to allow the oscillator to be used for calculating the time

Setting the Alarm Clock

- Setting the time and the alarm is done through exterior push buttons that are processed by the MCU
- These signals will be processed by the MCU changing the time keeping registers
- The time registers are updated automatically, but the LCD screen needs to be continually updated

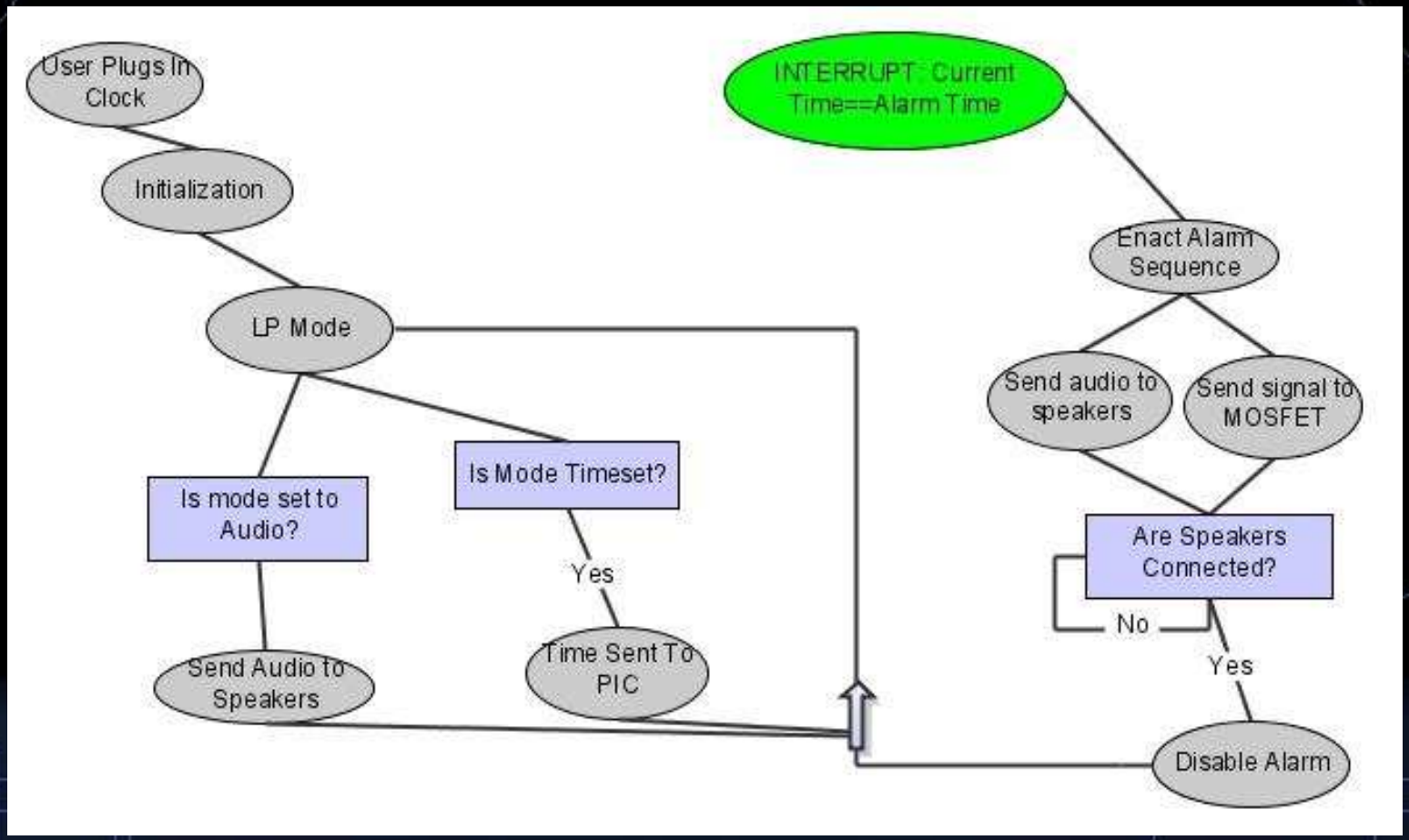
Alarm Clock Interrupt

- The interrupt will be handled by the built-in RTCC interrupt of the MCU
- Software will allow the process of the interrupt to be programmed

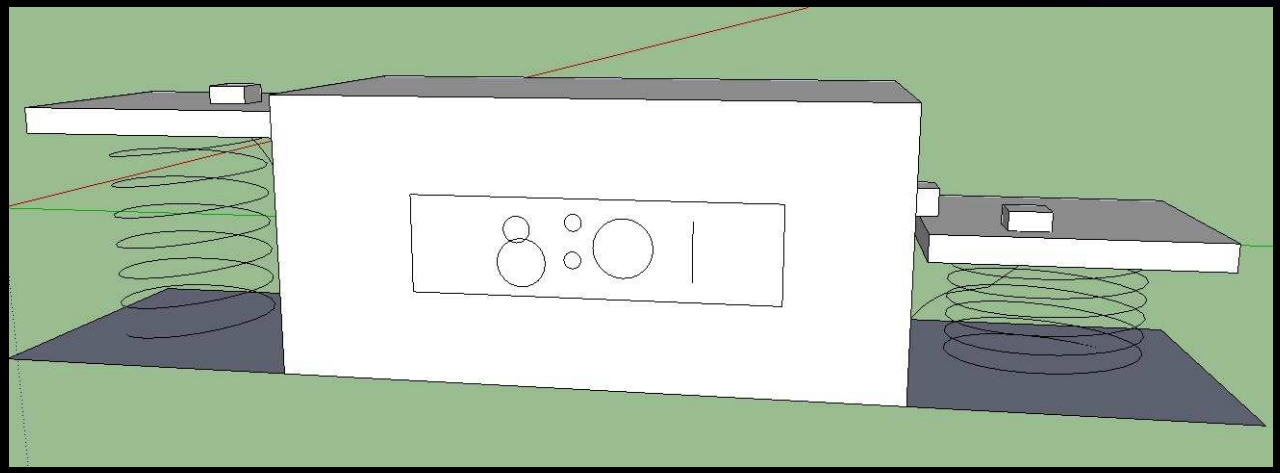
```
//Alarm Interrupt Method
void _ISR _RTCCInterrupt (void)
{
    _RTCIF = 0;     //Clear the interrupt flag

    //Insert code for Enacting the Alarm Sequence

} // RTCCInterrupt
```

- The interrupt will enact the launch sequence and play the alarm sound
- A second interrupt will be used to detect the reattachment of the speakers

Software Flowchart



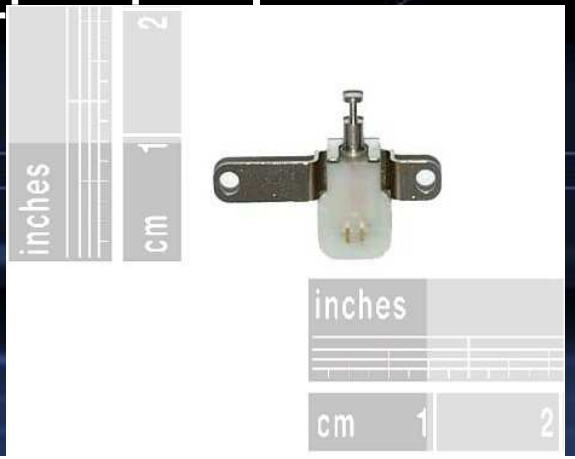
Launching System: Overview



- The base is a singular piece of Plexiglas that runs from the left speaker base to the right speaker base.
- The launching system is a combination of USB, springs, and solenoids.
- The solenoid is activated when the alarm goes off, releasing the platform. When the spring elongates, the speakers are launched. When the user goes to reattach the speakers, they reattach it to the platform via USB.

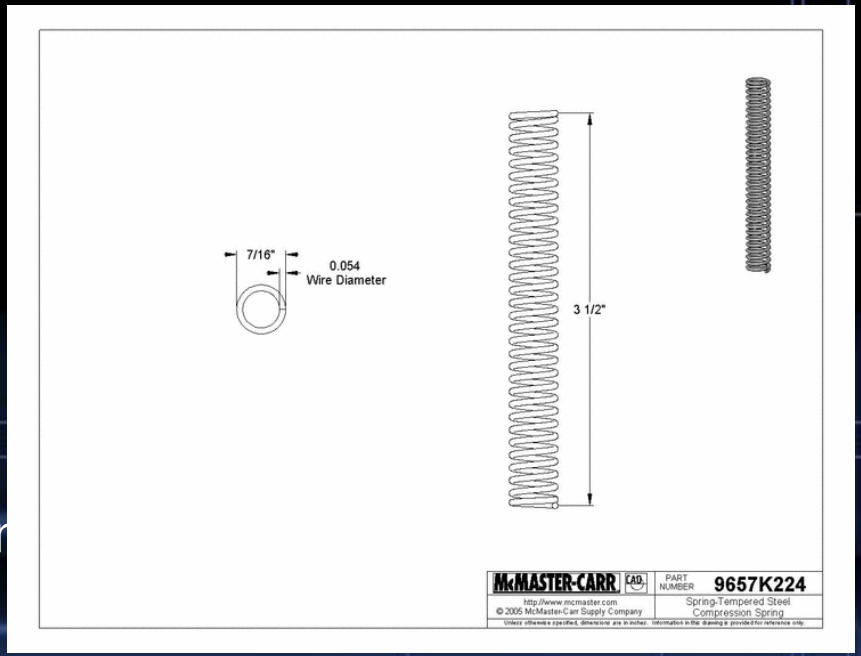
Launching System: Solenoid

- Requires 12 V and 120mA.
- Pull Type: When activated, the solenoid will “pull in”.
- The solenoid will be attached to a small wedge. The wedge is what is “on top” of the platform, holding it down. When the solenoid activates, the wedge gets pulled in. This leaves nothing to keep the spr



Launching System: Spring

- Have had some bad experiences with springs so far. Either they're not in stock, or we didn't account for the load required to compress them.
- Two total springs, one for each platform/speaker
- The springs we've chosen have a 3.5 inch uncompressed length.
- They have a 1.73 inch compressed length
- (so it compresses 1.77 inches)
- The springs will be
- permanently connected to the
- base and the platform (more
- than likely through the use of a
- chemical adhesive).
- The load is 13, meaning that
- these springs only require 13
- pounds of force to compress 1 in
- The spring rate is 8 pounds/inch.
- 8*1.77=14.16 pounds of force.



Launching System: Platform

- Made out of cheap, but stable plastic
- Spring is attached to the platform
- Hole is drilled into platform to allow a male USB cord to protrude
- USB cord will be “fixed” so that while it still connects to send data, it is loose enough that it doesn’t snag while the speaker launches

Display

- There are two main types of clock displays
  - Analog
  - Digital
- We chose digital because it is easy to read and allows the ability to display all types of information

Display Requirements

- We needed a display the was bright enough to read in a dark room
- Needed a relatively large screen area for easy visibility
- Needed multiple lines to display information for mp3 tracks
- Needed to be easy to interface with our microcontroller and to display information on.

SC2004

- We chose the SC2004 by Silicon Craft
- Features:
  - 4x16 Liquid Crystal Display
  - Powered by a standard 9 to 12V DC power supply
  - All the instructions are preset to hex values
  - Has the ability to display 4 large numbers

Bluetooth

- Chose bluetooth as means of connecting speaker to base for audio.
- Reason for choosing:
  - Good distance so the speakers can be place where ever you like when you are using the clock as just an mp3 player
  - We hope to give the speakers to pair with any bluetooth device so they can be used as portable speakers

Bluetooth Module

- Chose to use the WT32 Bluetooth Audio Module by Bluegiga
- WT32 Features
  - 30 Meter Range
  - Intergrated DSP, Stereo Codec, and Battery Charger
  - Integrated antenna
  - “Plug n’ Play” Bluetooth solution

Speakers

- Chose to use pre-made speakers instead of designing our own
- Wanted to use a speaker that was simple and light since we needed to be able to launch it when the clock explodes.
- Wanted speakers that had a built in battery and easy interface with other devices.

iHome iHM79

- We chose the iHome iHM79
- Key Features
  - Small Size
  - Robust Sound
  - Simple USB interface
  - Built in rechargeable battery

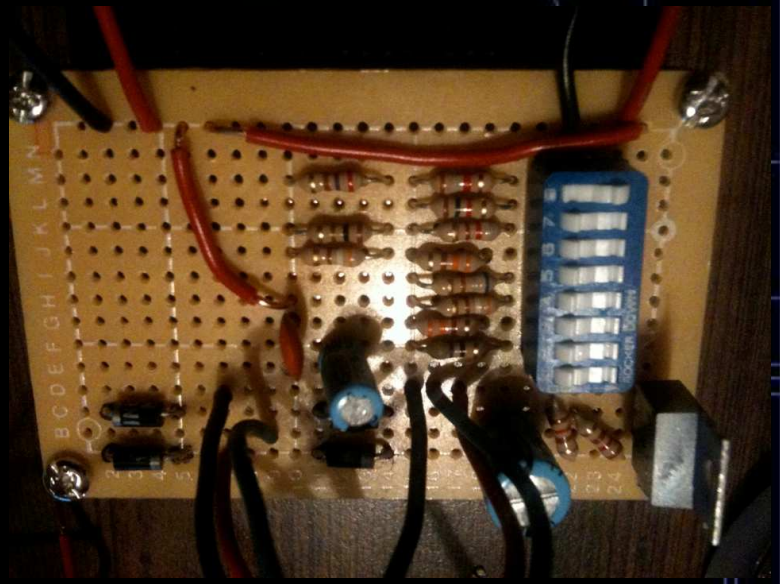
iHome iHM79 Specs

- Weight
  - 1.92 Oz
- Dimensions (H X W X D)
  - (1.42 X 2.09 X 2.09 in)
- LED Indicator Light
  - Blue - ON
  - Orange - Charging
- Uses a single mini USB port for data and power
- Built in Lithium Ion Battery
- Speaker will be inclosed in 1/2 protection
- Nerf Ball

Speaker Interfacing

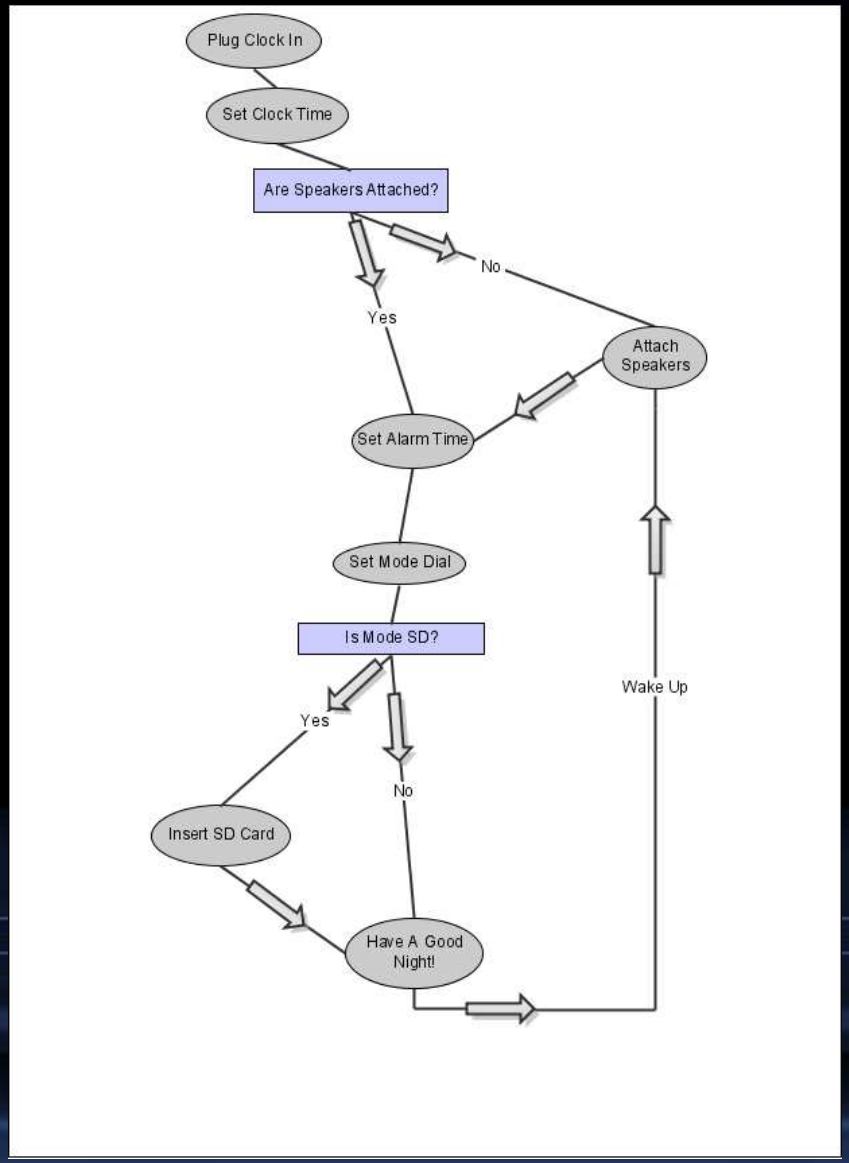
- Using the mini USB port audio received from the bluetooth receiver will be sent to the speaker
- When plugged into the base station charging will also occur.
- Each speaker will receive its own bluetooth signal one for left and one for right.

Power

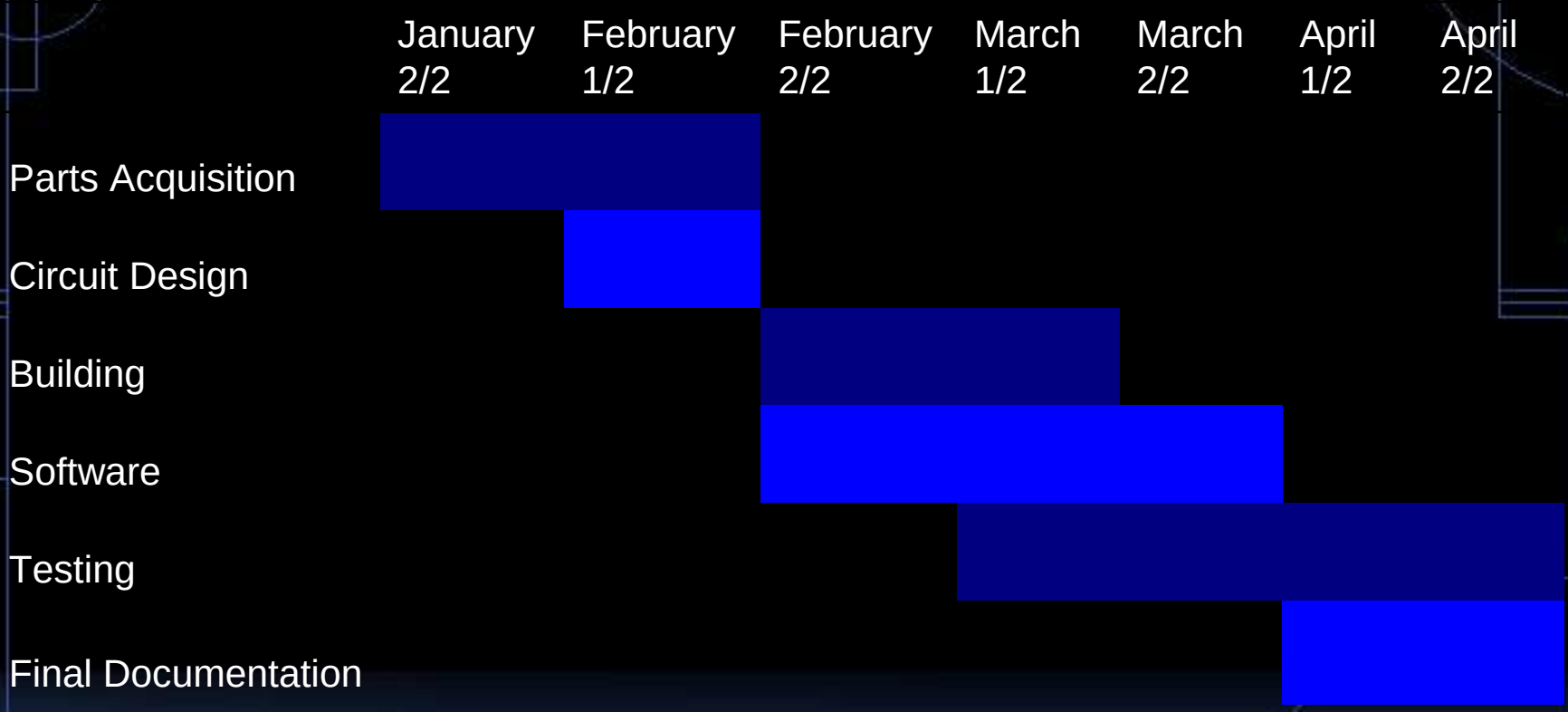


- Clock will be powered from a 12V DC power supply
- Using a LM317 voltage we created a DC adjustable power supply
- This will provide the 3.3 volts for MC, MP3 Decoder and Bluetooth Module
- Power for charging usb speakers will come from amplifying the 3.3 V to what is needed

User Flowchart



Milestone

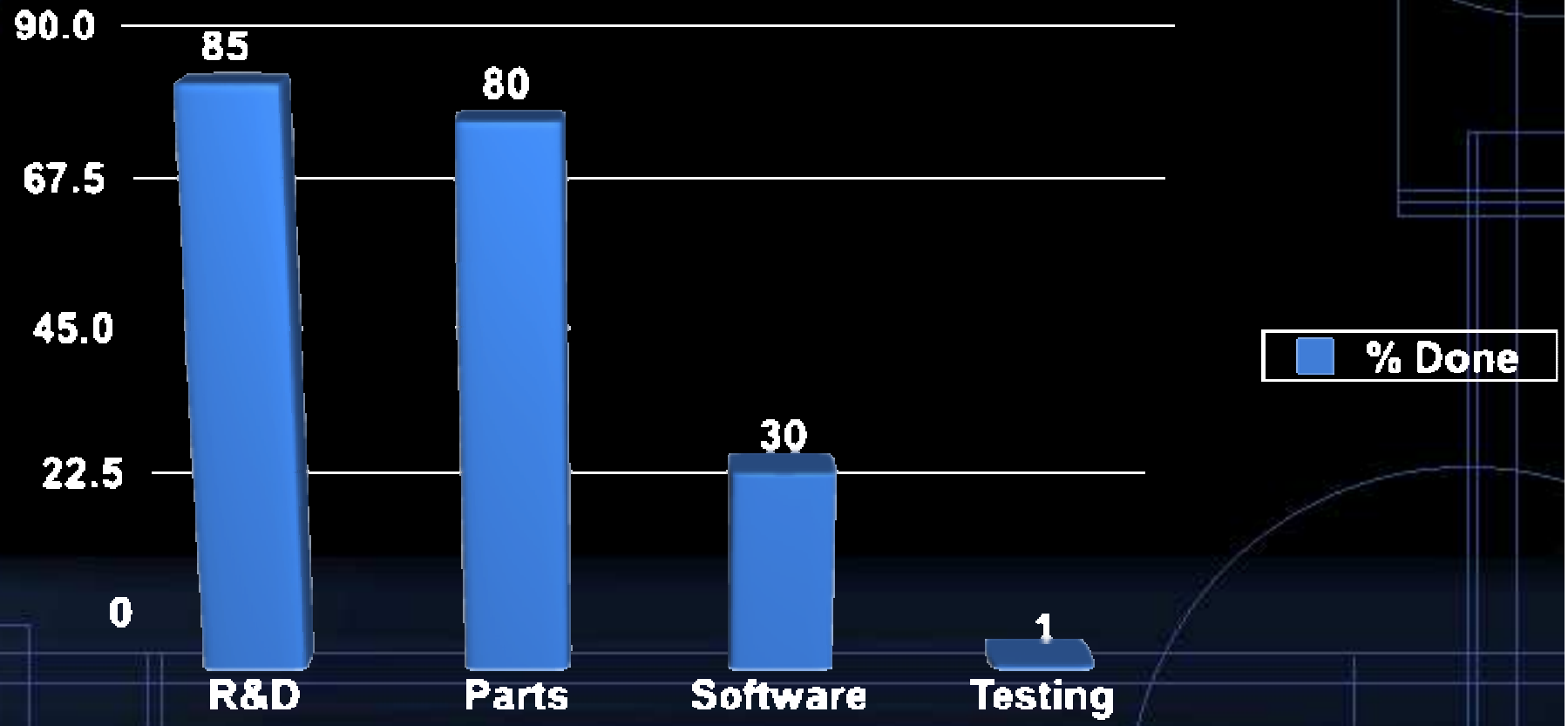


- Planned Finish Date: April 02, 2010

Budget

Final Budget				
Function	**Part**	**Price**	**Quanity**	**Cost**
Bluetooth	WT32 Bluetooth® Audio Module	$44.00	3	$132.00
Crystal Oscillator	CFS206	$4.00	1	$4.00
Launcher	Spring	$16.00	1	$16.00
Launcher	Solenoid	$1.49	2	$2.98
Demo Board	Explorer 16	$141.90	1	$141.90
Programmer	PicKit 3	$34.58	1	$34.58
Microcontroller	PIC24FJ256GA106	$6.14	1	$6.14
Power Supply	Various Parts	$71.43	1	$71.43
MP3 Decoder	BU9438KV	$30.50	1	$30.50
Push Button	COM-00097	$0.35	10	$3.50
Push Button	COM-08996	$4.95	1	$4.95
Push Button PCB	COM-08963	$1.95	1	$1.95
SD Socket	PRT-00136	$3.95	1	$3.95
Speakers	iHome iHM79	$49.95	1	$49.95
USB Cables	PC USB AA Cable	$4.95	2	$9.90
USB Connector	HWS10492	$0.57	1	$0.57
Miscellaneous	Shipping, etc.	$75.91	1	$75.91
			Total	**$590.21**

Percentage Done



Still To Purchase:
USB connecters
Springs