

# E-Frog Game



Group 6

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# Introduction E-Frog Game

- This game exists in a traditional wood version.
- Box table with open mouth bronze frog
- 20 holes & 10 metal coins.
- A player 15 ft. from table, throws coins to the target (frog's mouth)
- Each hole has a corresponding value of points (30-200pts) based on location.
- The maximum score is 400 points (frog's mouth)



# Motivation

- Have fun during Senior Design
- Today biggest cause of sickness and problems is the stress,
- People enrolled in bad habits or addictions trying to find a solution for such problem.
- IDEA: Why don't we implement and create an electronic version of this fun game, easy to use, more attractive to reduce stress?

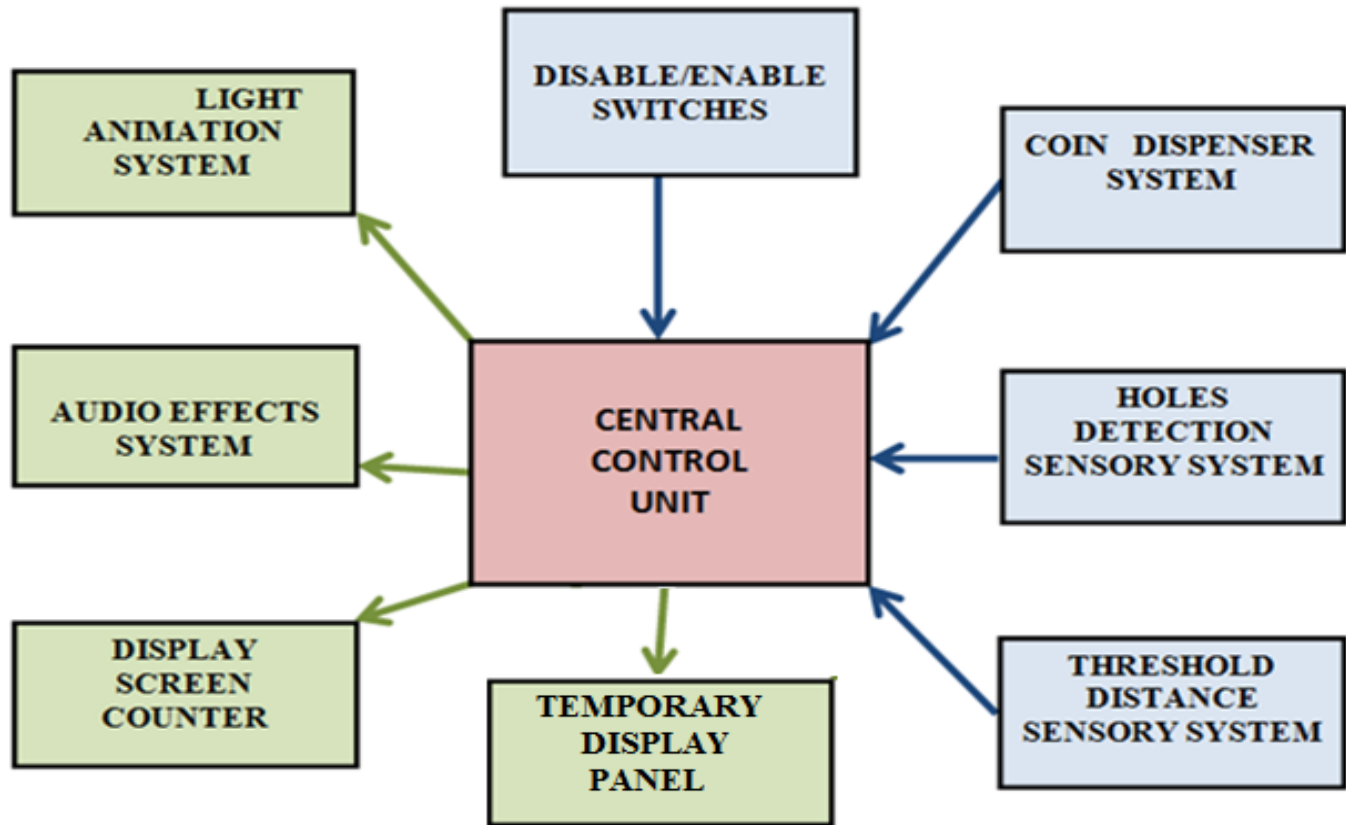
# Goals

- The main purpose: improve the traditional game with an electronic version.
- Apply: knowledge, hard work, and skills to be able to create, design, and build a new fun product with simple and attractive design
- Keep game score.
- Detection of coins through infrared technology.
- Smooth interaction of multiple inputs and outputs.

# Innovation

- It is the first time this game is modified in an electronic way.
- Introduction to sounds, light systems, lasers, display, and customized inputs to modify the operation of the game.
- Microcontroller takes care of :counting points, control lights, sound modulation, and data transfer of different sensors.

# E-Frog Game Block Diagram



# Objectives

## MCU objectives:

- Responsible for receiving and interpreting the data from the sensor units.
- Transfer of data to / from MCU & subsystems.
- Be the interface media for the programmer to configure it to the desired specifications and functions of the game.
- Control the interaction and developing of the game at all times.
- Communication with sub-systems.

# ATMEGA 2560

## Specifications:

- General purpose Input / Output pins: 86 (45 used)
- 4KB EEPROM, 8KB internal SRAM.
- 32 general purpose registers
- Clock Speed: 0 - 16MHz @ 4.5V - 5.5V.
- High performance /Low pwr
- Easy to use and has rich online library.



# Objectives

## Display:



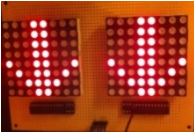
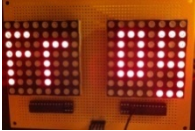
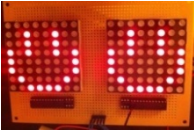
- Show updated points in screen.
- Reflect total points player-each round.

## Sensors:

- Laser array with infrared NPN phototransistor.
- Detect a coin passes through the sensor array.
- Detect hole coordinates by which the coin passes.
- Infrared Barrier in the coin dispenser.
- Sets minimum distance allowed for a player to throw a coin in the threshold sensor.
- Message & lights alert a player when the line is crossed.

# Objectives

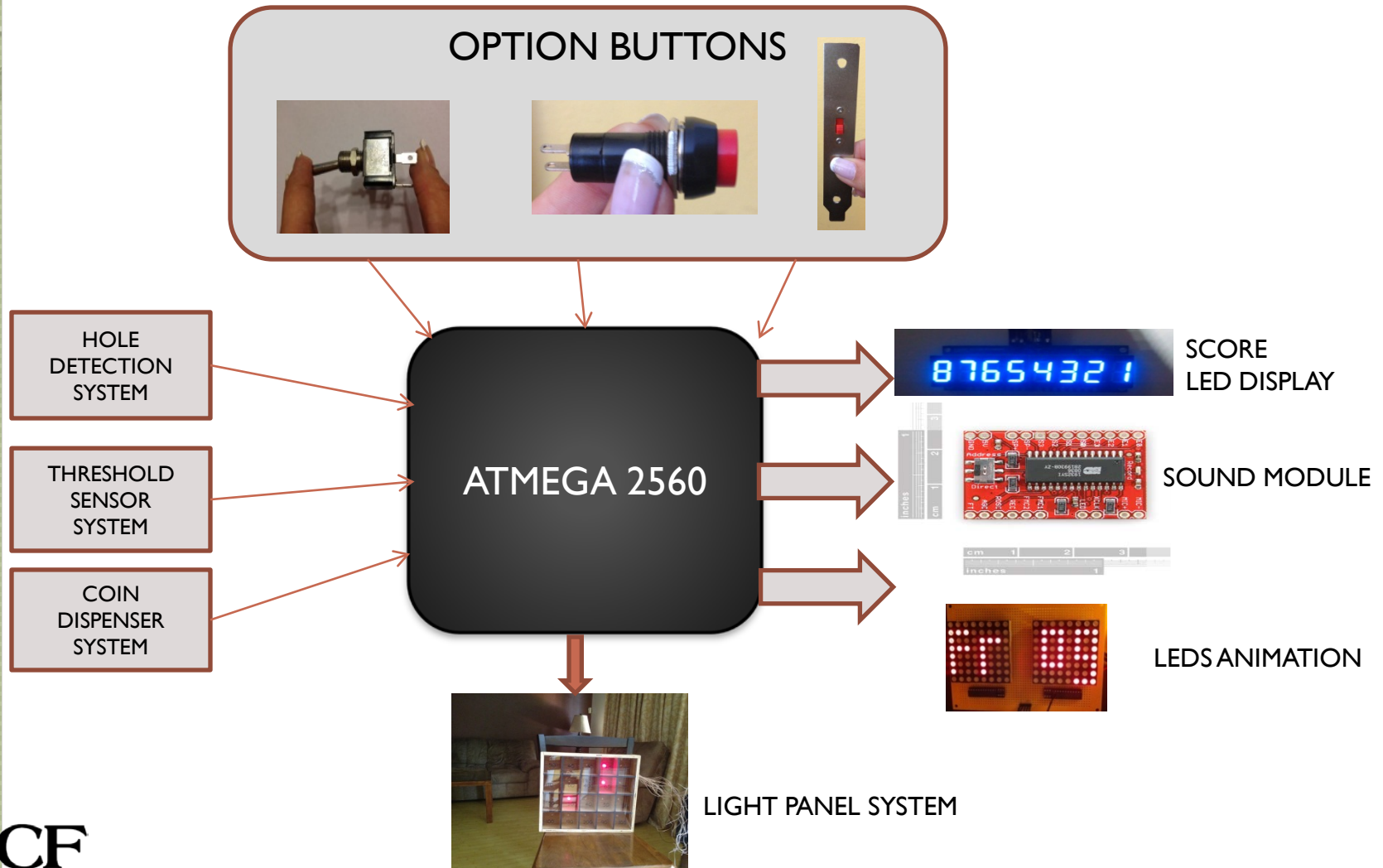
## LED Animation System:

- Two 8x8 LED matrix and two MAX7219 drivers as media with microcontroller gives the game more attractive look.
- There are four light animations for different situations.
- 1<sup>st</sup> animation: Coin is inserted in a hole   
(Two arrows pointing down)
- 2<sup>nd</sup> animation: Threshold Sensor has been pressed (Vertical line oscillates left-right and vice versa)  
- 3<sup>rd</sup> animation: Coin is inserted in Frog's mouth (“FROG” & happy faces)
- 4<sup>th</sup> animation: Game over laser/receiver of coin dispenser make contact through light beam (a dot moving forward from left to right and backwards)

# Requirements and Specifications

- Portable and ready to use.
- Game dimensions: 2'L by 2'W by 3.5'H.
- Maximum weight is 40 pounds.
- Number of holes 20 evenly spaced out.
- Ten bronze coins.
- Operates on main power of 120V at 60Hz.
- Coin dispenser and threshold sensor

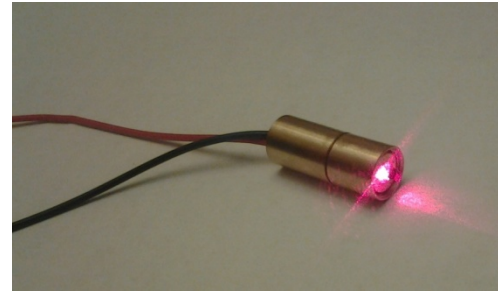
# E-Frog Subsystems- Design Diagram



# Hole Detection Sensor System

## Laser Specifications:

- 650nm wavelength.
- 3.3 V DC operating voltage.
- Operating current <40mA.
- Life Span: 5000 hours.
- Output Power < 5mW.
- Focus Distance: 10m.
- Spot Size: < 10mm.



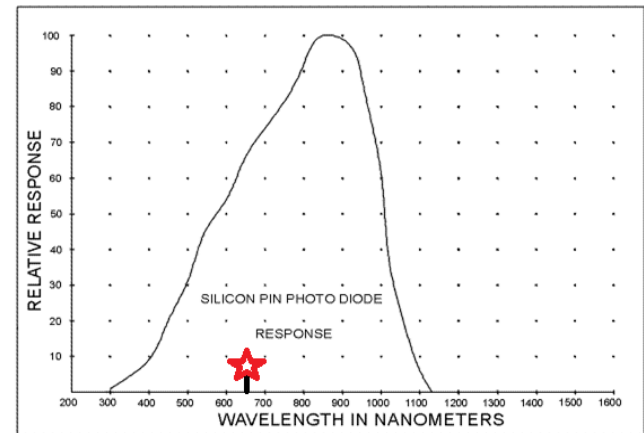
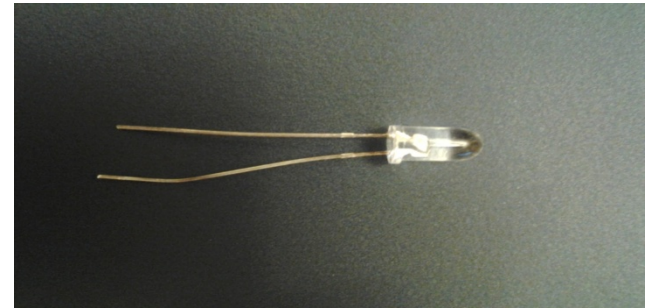
## Laser Requirements:

- Energized by a 3.3V source for steady infrared propagation.
- Voltage Regulator incorporated to the PCB to run all the lasers
- Class IIIa laser, a lot of care needs to avoid damage to retina.

# Hole Detection Sensor System

## Receiver Specifications:

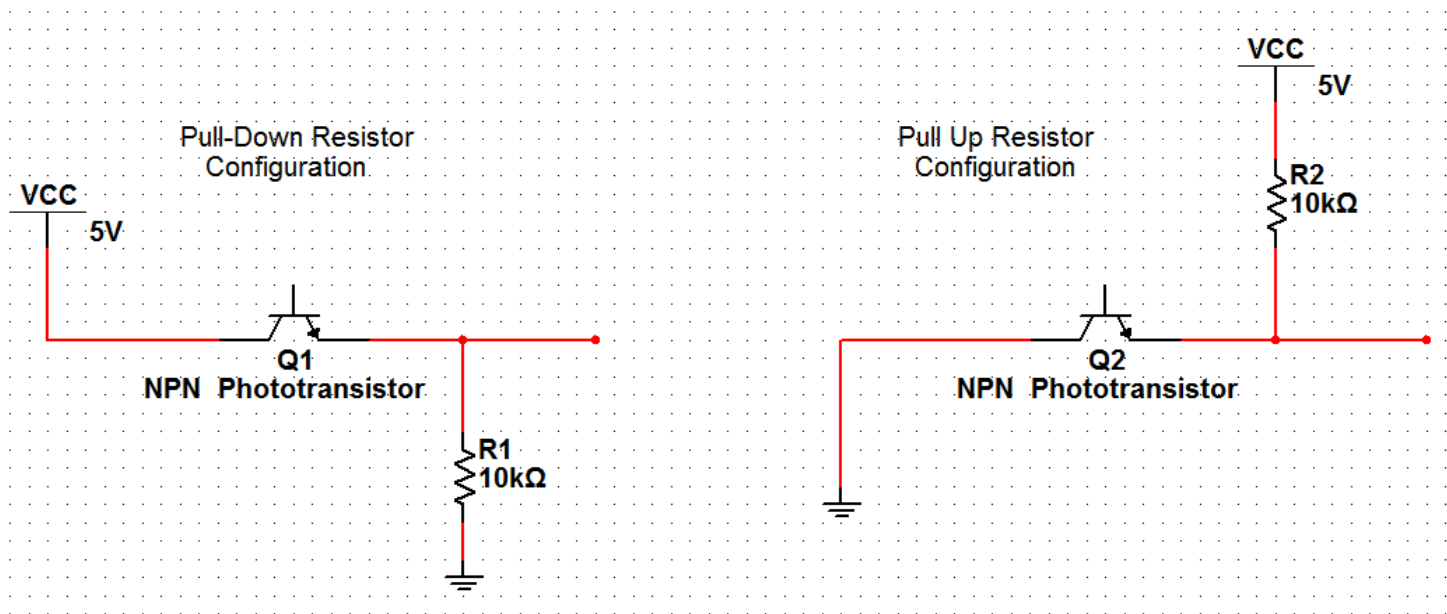
- NPN silicon type.
- Emitter-Collector V: 5V.
- Operating T°: -40<sup>0</sup>C-85<sup>0</sup>C.
- Dark Current: 100 nA.
- Light Current: 20mA.
- Rise & fall time: 5μs.
- 5mm Radial top.



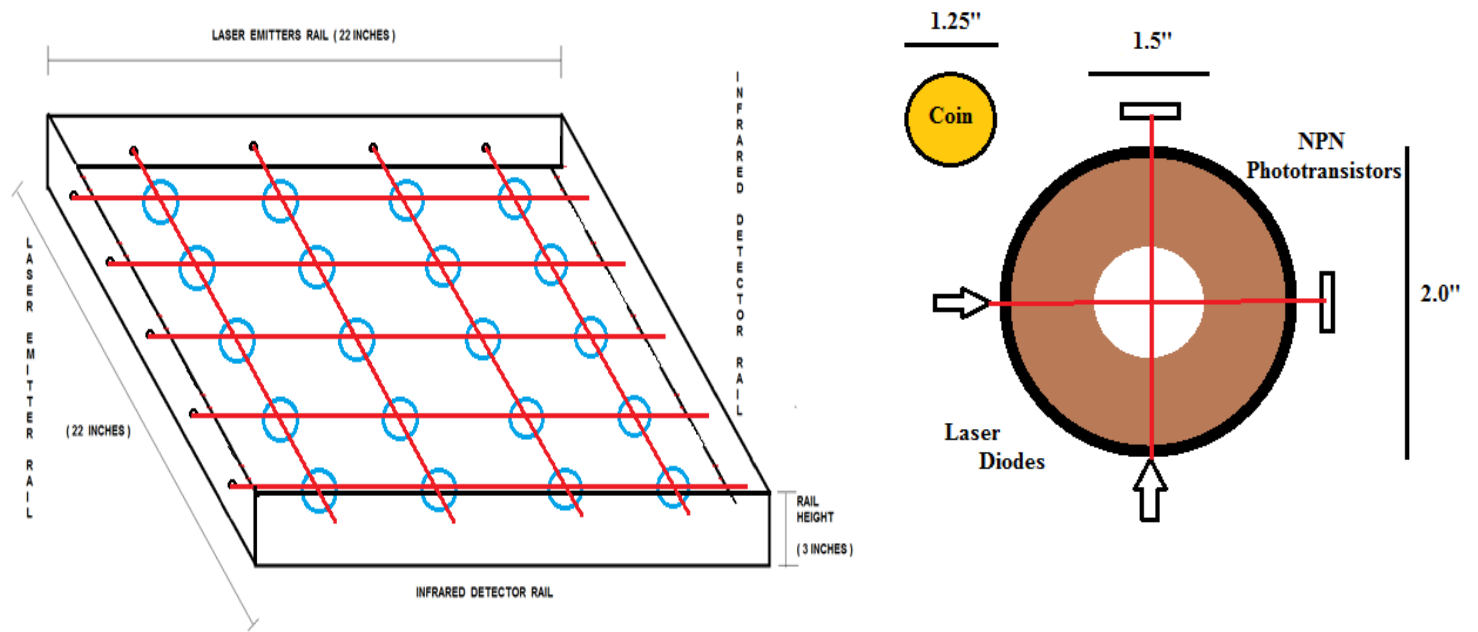
Silicon NPN photodiode response chart

# Hole Detection Sensor System

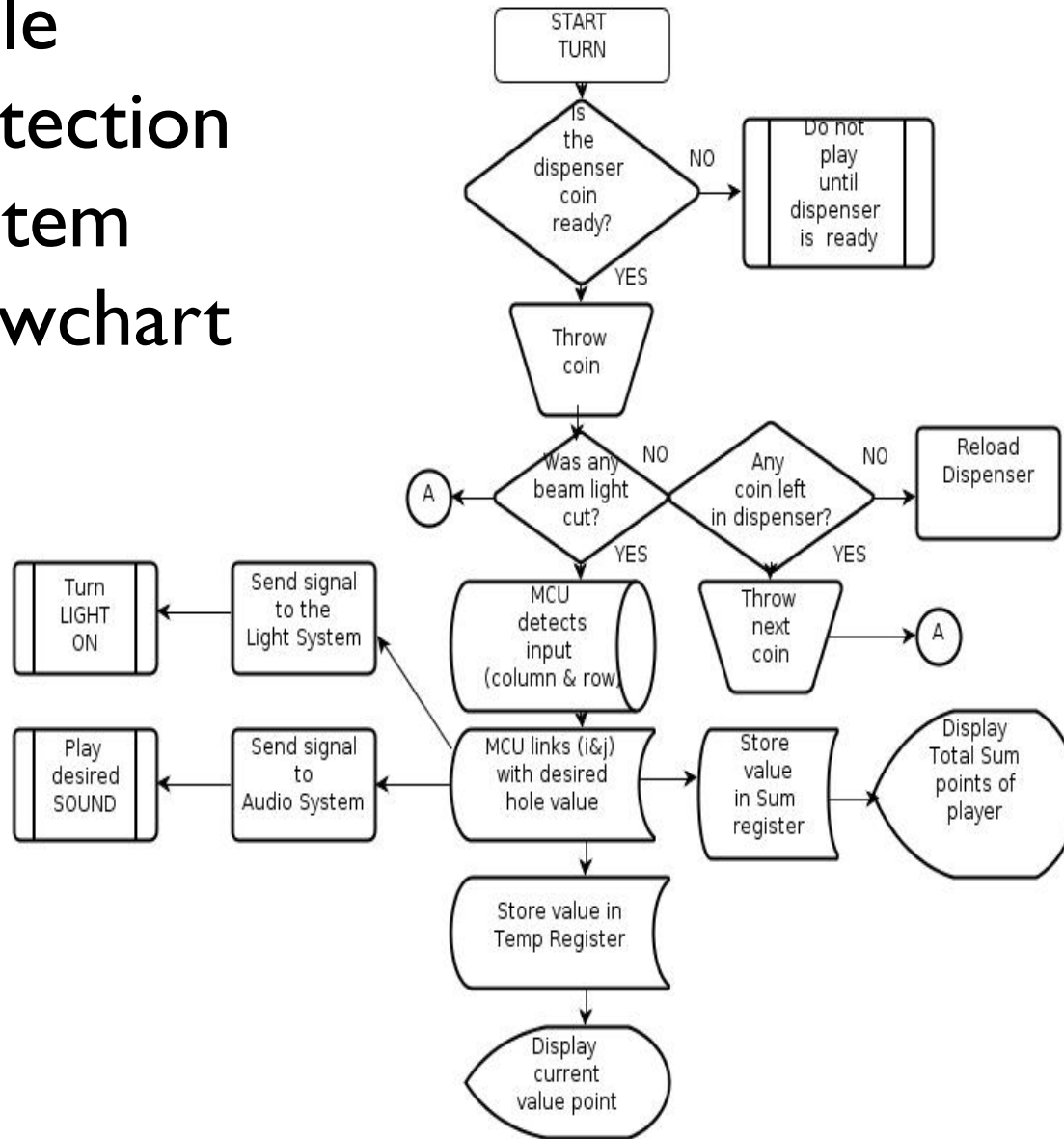
- NPN IR receiver testing worked with the MCU using the pull up resistor configuration



# Hole Detection Sensor System



# Hole Detection System Flowchart



# Coin Dispenser System

- Need to create an interrupt to start next turn.
- Add emotion activating a final counter.
- To create a way of counting coins left to throw.
- To make it easy to play and avoid holding coins.
- To create a “pausing” system to pick up coins.
- Restarts the game to the next player once all the coins are placed back into the dispenser.
- Pedestal from the floor to about 3 feet tall
- Ends with coin dispenser body composed by 1.5 in diameter pvc tube of length 8 in.

# Coin Dispenser System

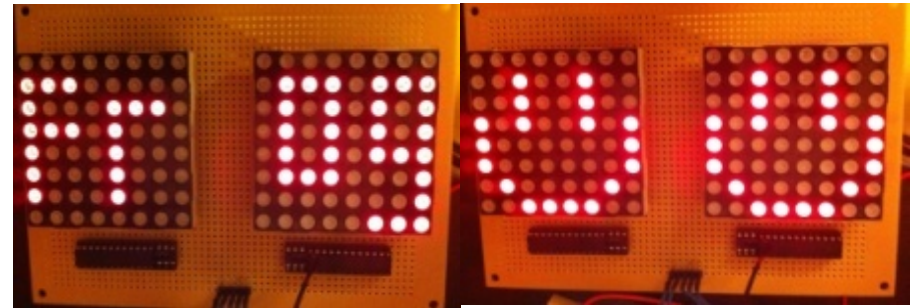
- A bigger (inclined funnel) to put in the coins for them to go down by gravity.
- At the lower end of the dispenser tube there is a semicircle slit for the player pick each coin up.
- “Sensing” part is composed by: a pair of emitter laser diode and infrared receiver.
- Pull-up connection used.
- If beam is NOT made, game continues.
- If beam is made, counter starts, the game pauses until dispenser reloaded.



# LED Lighting System

## LED Specifications:

- Current: 20 mA.
- Life Span: 50,000 hours.
- Operates at 25°C.
- 128 LED's.
- Common-Cathode LED boards suitable for MAX7219.



Type	Colour	I <sub>F</sub> max.	V <sub>F</sub> typ.	V <sub>F</sub> max.	V <sub>R</sub> max.	Luminous intensity	Viewing angle	Wavelength
Standard	Red	30mA	1.7V	2.1V	5V	5mcd @ 10mA	60°	660nm



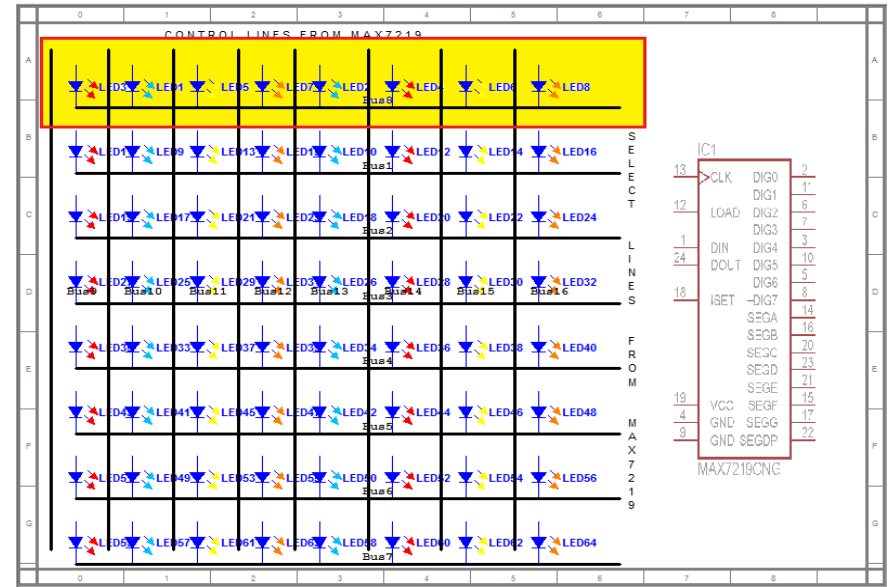
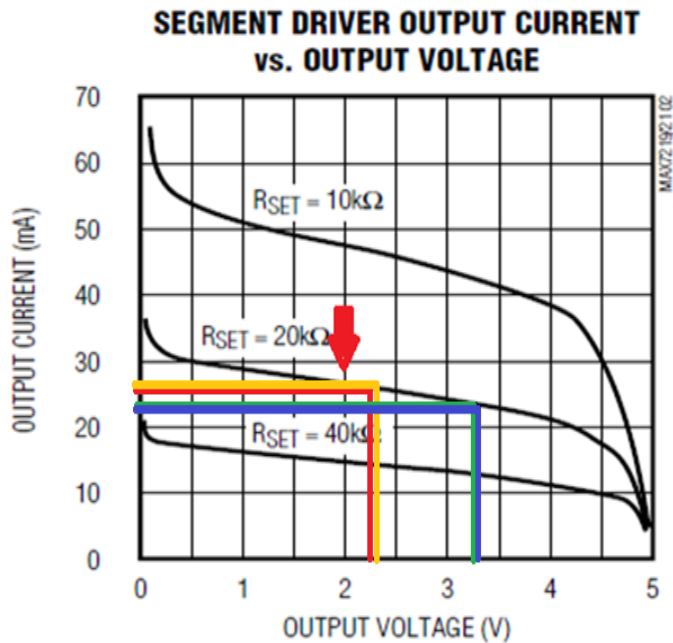
# LED Lighting System

## MAX7219:

- The MAX7219 is a compact, common cathode display driver that interface microprocessors to 7-segment numeric LED displays of up to 8 digits, or 64 individual LEDs.
- Our system would only need one resistor to set the current to all 64 LED's

# LED Lighting System

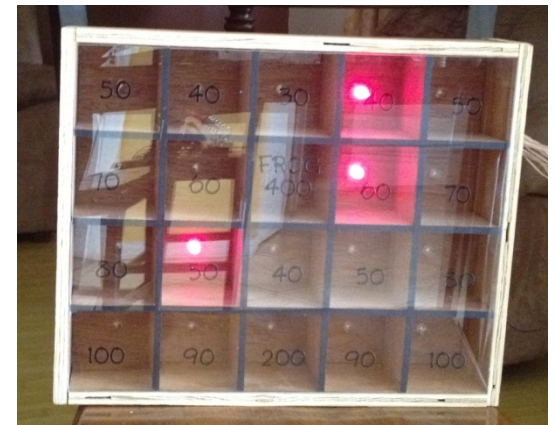
- Max7219 Output current vs. Output Voltage



Control lines from MAX7219

# Panel Lighting System

- Designed to provide a visual location for the current coin scored
- Displays the position at which the coin was inserted
- Temporary display panel
- Remains lit for 3 seconds
- Millis function was used in the code in order to manage times
- Complex code was used in this system since ATMEGA does not multi-task



# Threshold Sensor System

## Implementation in the E-Frog game:

- Minimum throwing distance: 15 ft.
- The sensor will determine if a player has crossed predetermined throwing distance.
- If player steps on sensor, the throwing does not count and no points will be awarded.

## Force Sensing Resistor:

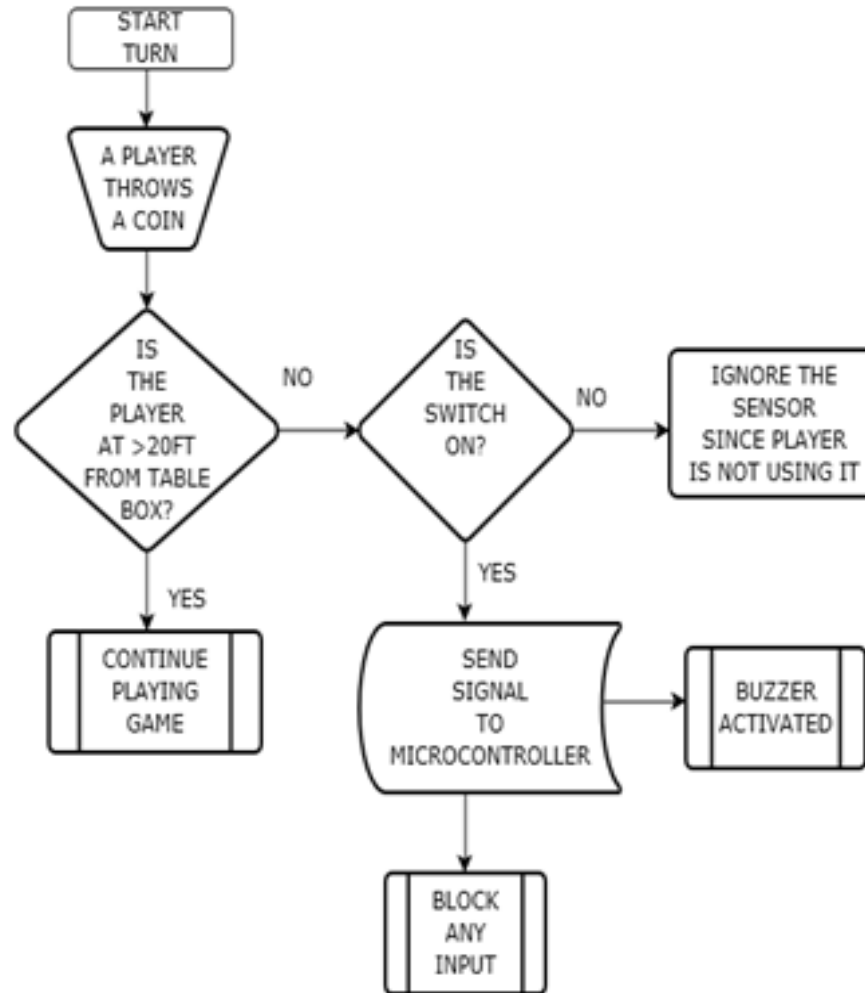
- Force Sensing Resistors (FSR) devices which exhibit a decrease in resistance with an increase in the force applied to the active surface.
- The sensor chosen is the Braun 31221A.
- Widely used in the handicap industry.

# Threshold Sensor System

## Specifications:

- Size: 2" x 24" (5.08cm x 61 cm).
- Thickness: 0.20" (5 mm).
- Force Sensitivity Range: 6 lbs. to 300 lbs.
- Rise Time 1-2 msec.
- Lifetime: 50,000 actuations.
- Temperature Range -30°C to 70°C.
- Sensitivity to Noise/not Vibration

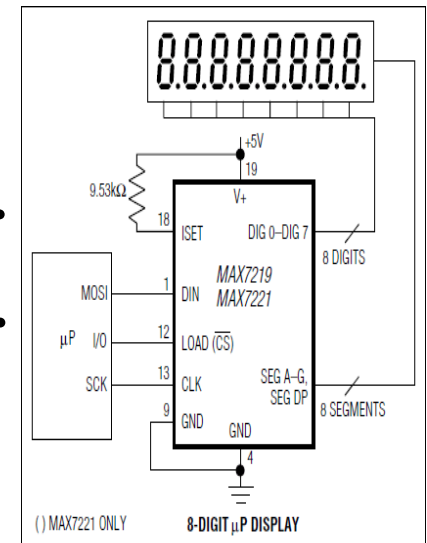
# Threshold System Flowchart





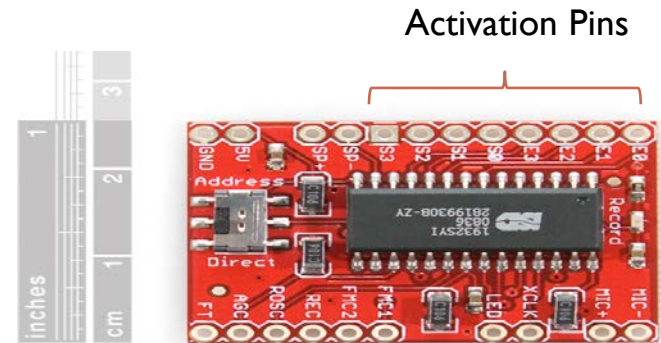
# MAX 7219 with 8-Digit LED Display Module Specifications

- 10MHz Serial Interface .
- Individual LED Seg Control.
- Decode/No-Decode Digit.
- Dig & Anal Brightness Control.
- Display Blanked on Power-Up .
- SPI, QSPI, MICROWIRE Serial Interface.
- 24-Pin DIP and SO Packages.



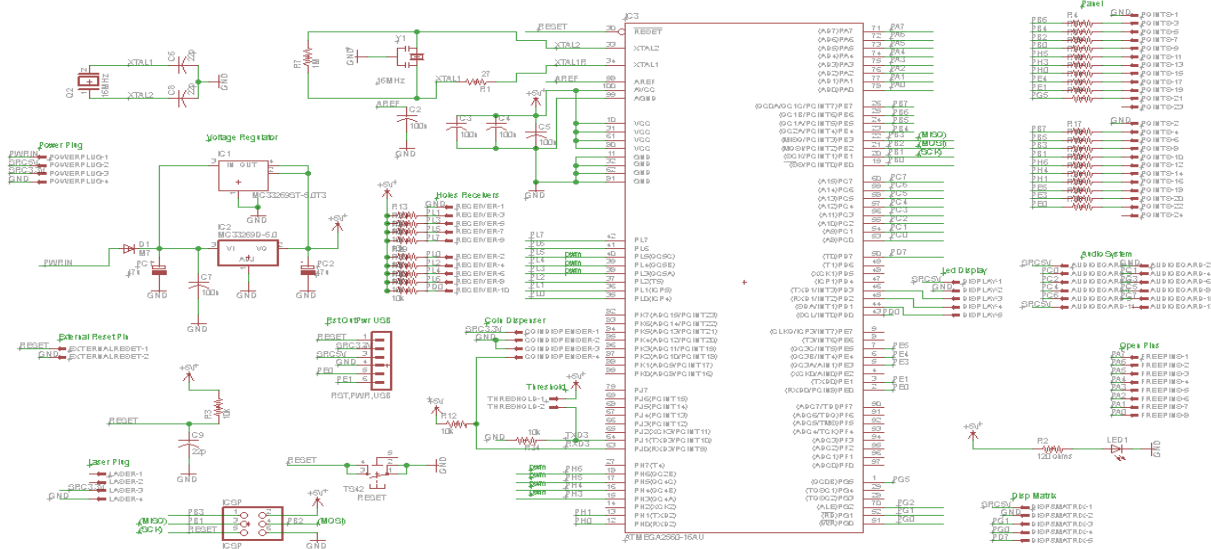
# Sound System: ISD 1932

- Supp Volt 2.4V-5.5V
- Operational mode used: Direct
- Different Sampling Frequencies and duration based on external R
- Microphone and auxiliary input included
- Automatically power down after operation cycle



Sampling Frequency	12 kHz	8 kHz	6.4 kHz	5.3 kHz	4 kHz
Rosc	53.3 K $\Omega$	80 K $\Omega$	100 K $\Omega$	120 K $\Omega$	160 K $\Omega$
ISD1932	21.3 sec	32 sec	40 sec	48 sec	64 sec

# PCB DESIGN (EAGLE)



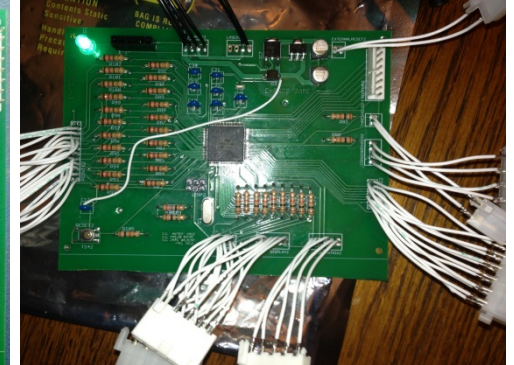
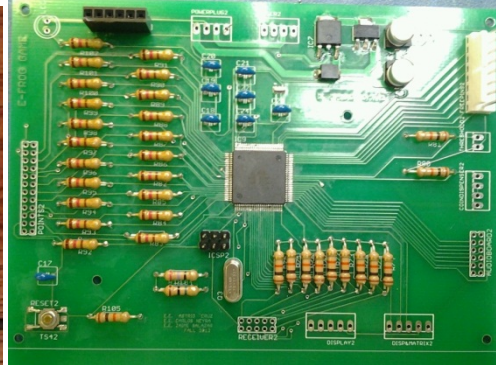
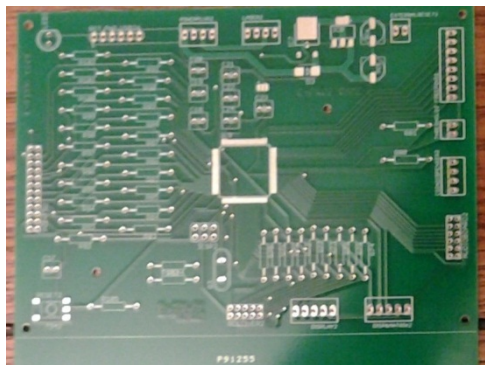
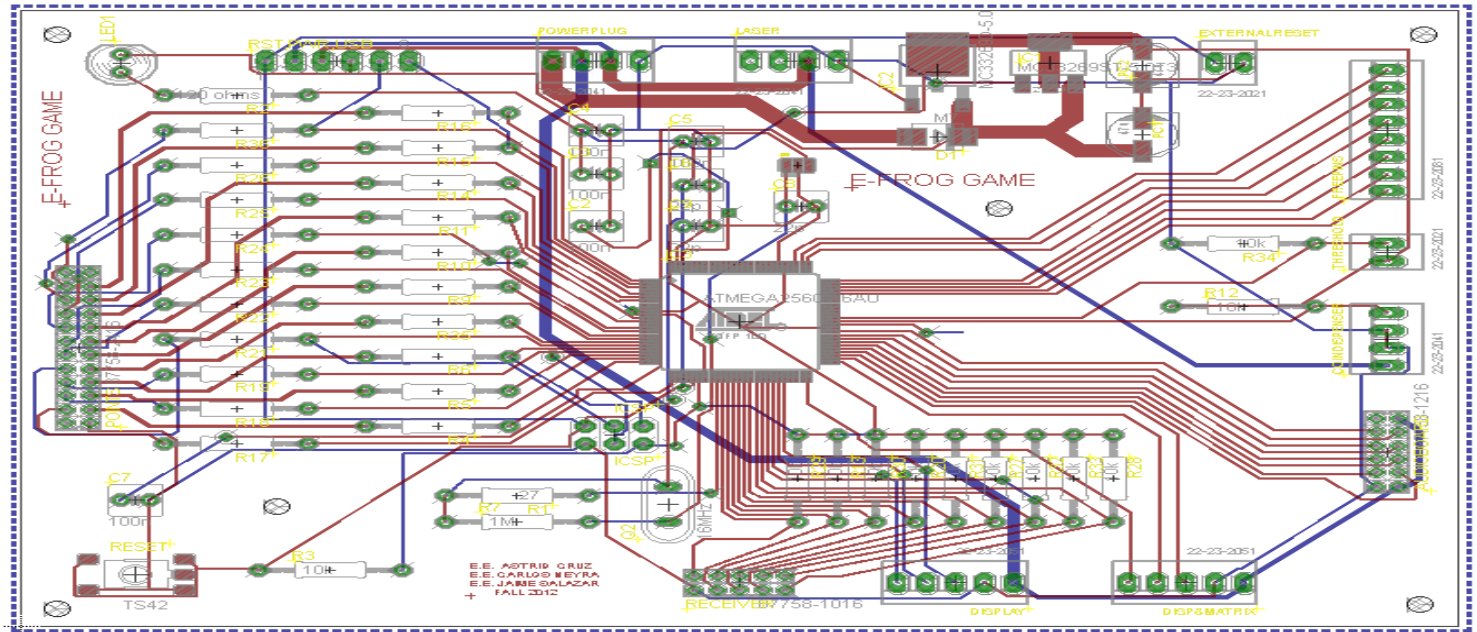
Eagle: Newark DesignLink order list for FinalSingle.sch

Quantity	Value	Package	Order code	Manufacturer	Manuf. Code	Availability	Price (from)	Description
1	87758-1216	87758-1216	29M7970		39-29-9123	0	0.87	MOLEX - 39-29-9123 - PLUG & SOCKET CONN, HEADER, 12POS, 4.2MM
1	M7	SMB	69R6470		S2J-TP	0		MICRO COMMERCIAL COMPONENTS - S2J-TP - 2A, 600V General Rectifier, SMB / 1
1	22-23-2081	22-23-2081	01C7592	MOLEX	22-23-2081	3890	0.298	MOLEX - 22-23-2081 - WIRE-BOARD CONNECTOR HEADER 8POS, 2.54MM
1	MC33269ST-5.0T3	SOT223	71J6563	ON SEMICONDUCTOR	NCP1117S50T3G	16334	0.144	ON SEMICONDUCTOR - NCP1117S50T3G - IC, LDO VOLT REG, 5V, 1A, SOT-23-3
1	MC33269ST-5.0	DPACK	45J1183	ON SEMICONDUCTOR	MC33269DT-5.0G	1181	0.292	ON SEMICONDUCTOR - MC33269DT-5.0G - IC, LDO VOLT REG, 5V, 0.8A, D-PAK-3
1	ATMEGA2560-16AU	TQFP100	68T2776	ATMEL	ATMEGA2560-16AU	0	10.2	ATMEL - ATMEGA2560-16AU - IC, 8BIT MCU, AVR MEGA, 16MHZ, 100-TQFP
1	ICSP	2X03	82R7562		20021111-00006T4LF	2205	0.217	FCI - 20021111-00006T4LF - BOARD-BOARD CONN, HEADER, 6POS, 2ROW
1	LED5MM	unknown						
1	87758-2416	87758-2416	25M3218		39-28-8240	0	2.45	MOLEX - 39-28-8240 - PLUG & SOCKET CONN, HEADER, 24POS, 4.2MM
1	16MHz	QS	13J1628	Abracon Corporation	ABL-16.000MHZ-B2	414	0.165	ABRACON - ABL-16.000MHZ-B2 - CRYSTAL, 16MHZ, 18PF, THROUGH HOLE
1	27	0207/12	38K0259	FARNELL	MCF 0.5W 10K	6189	0.015	MULTICOMP - MCF 0.5W 10K - RESISTOR, CARBON FILM, 10KOHM, 500mW, 5%
1	120 ohms	0207/12	58K4942	Multicomp Passives	MCCFR0520121A20	4980	0.036	MULTICOMP - MCCFR0520121A20 - RESISTOR, CARBON FILM, 120 OHM, 500mW, 5%
1	1M	0207/12	38K0259	FARNELL	MCF 0.5W 10K	6189	0.015	MULTICOMP - MCF 0.5W 10K - RESISTOR, CARBON FILM, 10KOHM, 500mW, 5%
1	87758-1016	87758-1016	18M8084	WALDOM/MOLEX	39-29-9102	2032	0.675	MOLEX - 39-29-9102 - PLUG & SOCKET CONN, HEADER, 10POS, 4.2MM
1	TS42	unknown						
1	MA06-1	unknown						
1	16MHz	RESONATOR	unknown					
2	22-23-2051	22-23-2051	97C5015	MOLEX	39-30-2050	67	0.59	MOLEX - 39-30-2050 - PLUG & SOCKET CONN, HEADER, 5POS, 4.2MM
2	22-23-2021	22-23-2021	26H5401		39-29-9022	117	0.209	MOLEX - 39-29-9022 - PLUG & SOCKET CONN, HEADER, 2POS, 4.2MM
2	47u	PANASONIC_D	unknown					
3	22p	C025-050X050	unknown					
3	22-23-2041	22-23-2041	33K3781	WALDOM/MOLEX	15-24-4449	0	0.381	MOLEX - 15-24-4449 - CONNECTOR, HEADER, 4POS, 1ROW, 5.08MM
5	100n	C025-050X050	unknown					
12	10k	0207/12	38K0259	FARNELL	MCF 0.5W 10K	6189	0.015	MULTICOMP - MCF 0.5W 10K - RESISTOR, CARBON FILM, 10KOHM, 500mW, 5%
20		0207/12	58K4942	Multicomp Passives	MCCFR0520121A20	4980	0.036	MULTICOMP - MCCFR0520121A20 - RESISTOR, CARBON FILM, 120 OHM, 500mW, 5%

For detail view or new search of items please doubleclick them !

Number of PCBs:  Update Number of list items: 25 With order codes: 18 In stock: 13 [Add to shopping cart](#)  Save order codes

# PCB DESIGN & DEVELOPMENT



# Enable/disable Switches

## 1 SPDT(ON/OFF)

- Located on low back of table. (\$3.15)
- 10A for 277 VAC /20A for 125 VAC.
- Dimensions: 58.6mm by 21.5mm and 31mm.

## 1 ARCADE (Momentary buttons)

- Located on the side of the box (\$ 3.95)
- RESET (red)
- Switching currents of 10A to 21A at 250 VAC
- Dimensions: length is 2.125 in, width 0.875 in.

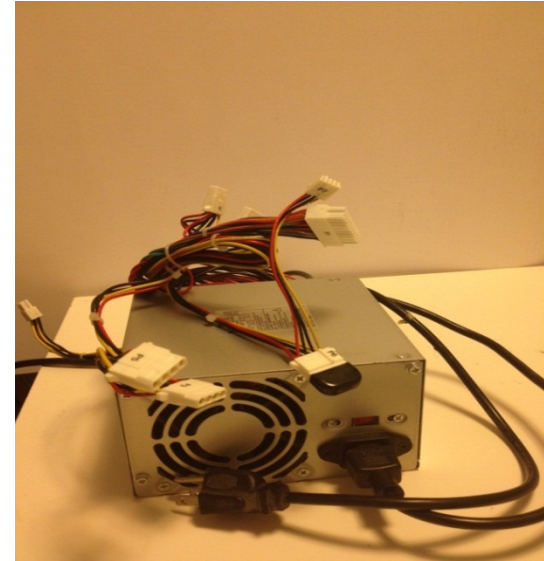
## 3 Slide Switch SPST (ON/OFF)

- Located on the right side of the table \$0.67
- Switching current of 11A EYELET at 125 VAC
- Dimensions: L 1.33 in, W 0.55 in, H 0.244 in.



# Power and its Distribution

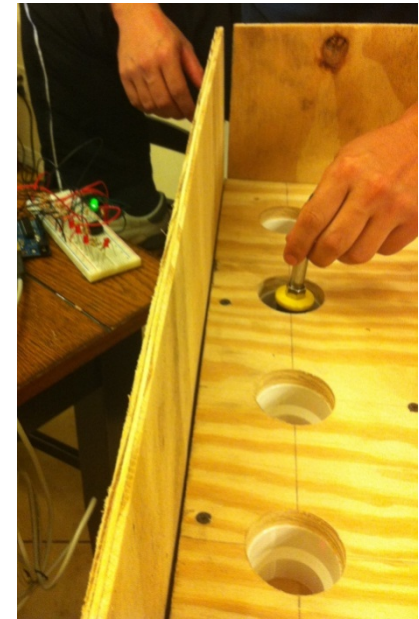
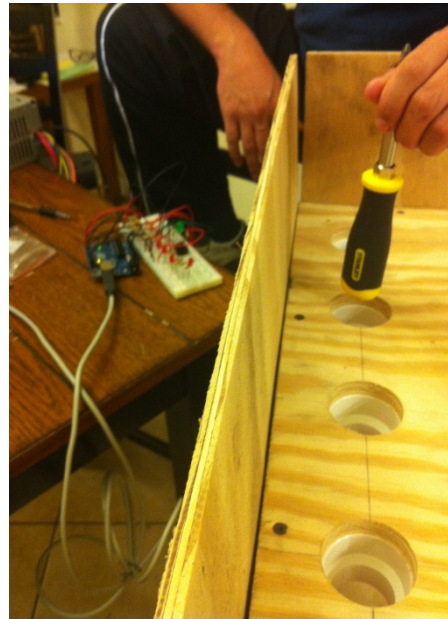
- ATX Computer PW Supply
- 350 Watts
- Reliable, Clean electricity,
- Multiple levels of power
- 12, -12, 3.3, 5v available
- No testing required
- Current protection
- Relatively low power amounts needed
- Microcontroller board powered by 12V
- NPN Phototransistors powered by 5V
- LEDs, drivers, display, and lasers: 3.3V



# TESTING E-FROG GAME

## I. HOLE DETECTION SYSTEM

- Laser Alignment & Testing



# HOLE DETECTION SYSTEM

- Each hole has been bench tested at least 20 times
- Lasers were manually adjusted for proper beam radiation
- Lasers intensity was tested for proper wavelength radiation
- Speed detection and accuracy was adjusted throughout software calibration
- Program was implemented in the way that more than one coin can be detected

## II. COIN DISPENSER SYSTEM TESTING

Loading to begin game



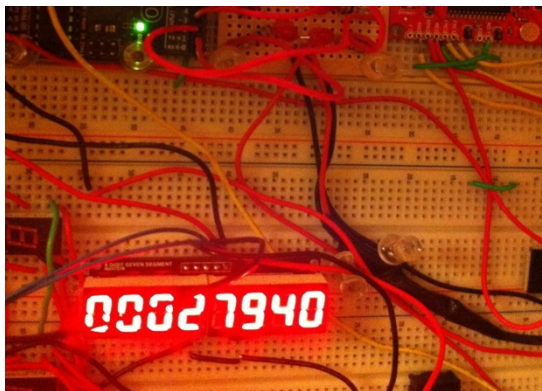
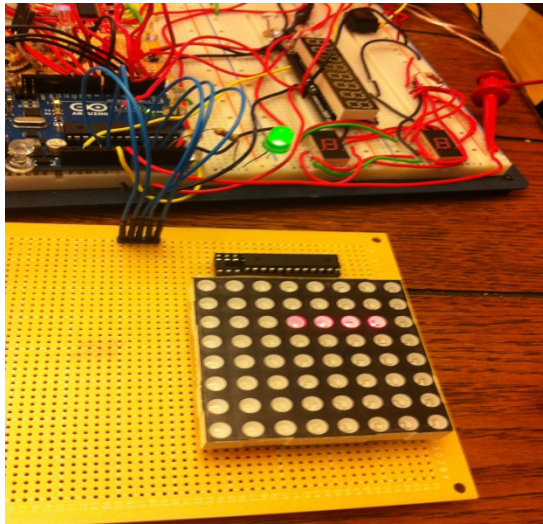
Taking last coin



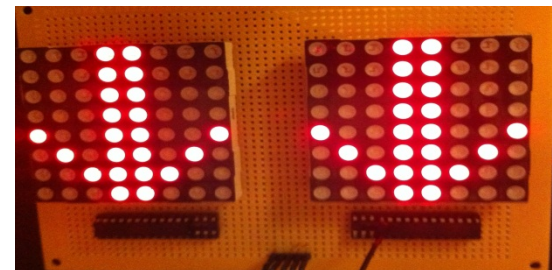
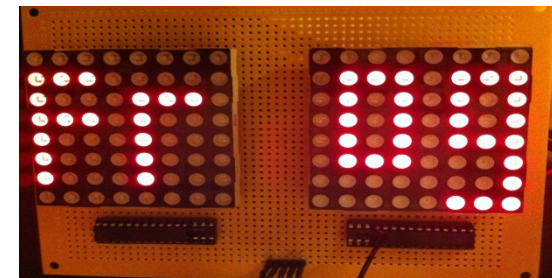
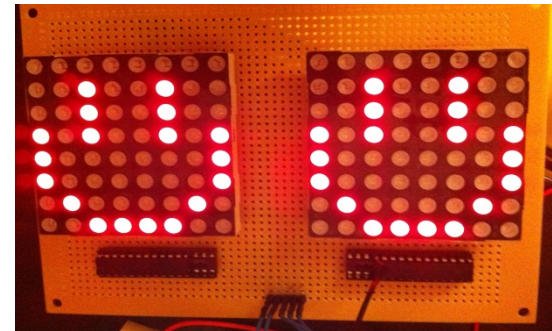
## II. COIN DISPENSER SYSTEM TESTING

- Laser/Receiver Alignment
- Taking last coin animation comes out
- Loading the dispenser with 10 coins display announces next player
- Coin dispenser empty, sound message of: Game Over
- Software takes care of timer and switching to next player after last coin taken

# III. DISPLAY AND LED LIGHTING SYSTEM TESTING



Testing and Animations



# IV. THRESHOLD SYSTEM TESTING

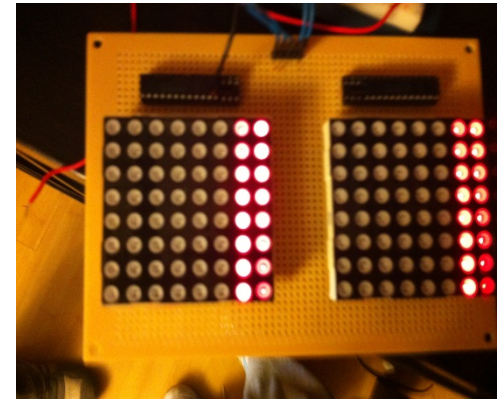
Sensor



Pressed sensor



Animation

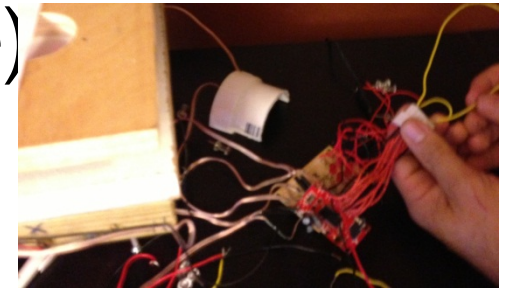


## IV. THRESHOLD SYSTEM TESTING

- Sensitivity test
- Tested on different surfaces: carpet, wood, and tile
- Effectively 100%
- Determined distance of 15ft tested
- An external function and a delay were introduced in the main code to keep the program busy and not take in any other inputs when in use.

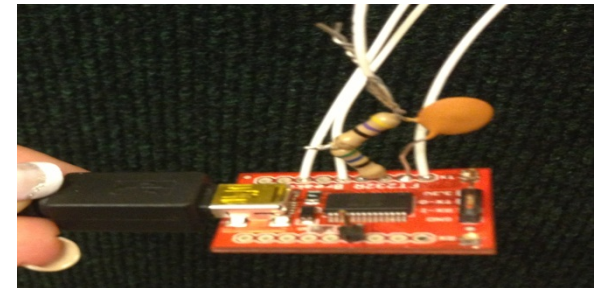
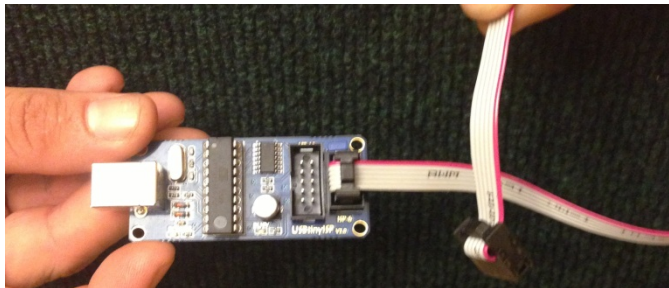
## V. SOUND CHIP SYSTEM TESTING

- This board was tested at different frequencies (8kHz was selected for length and quality)
- Direct mode used in order to have same message length total 32 seconds (8 messages/4 s each message)
- Board is activated with ground signals
- Messages were recorded (ground) and play back (5 v)

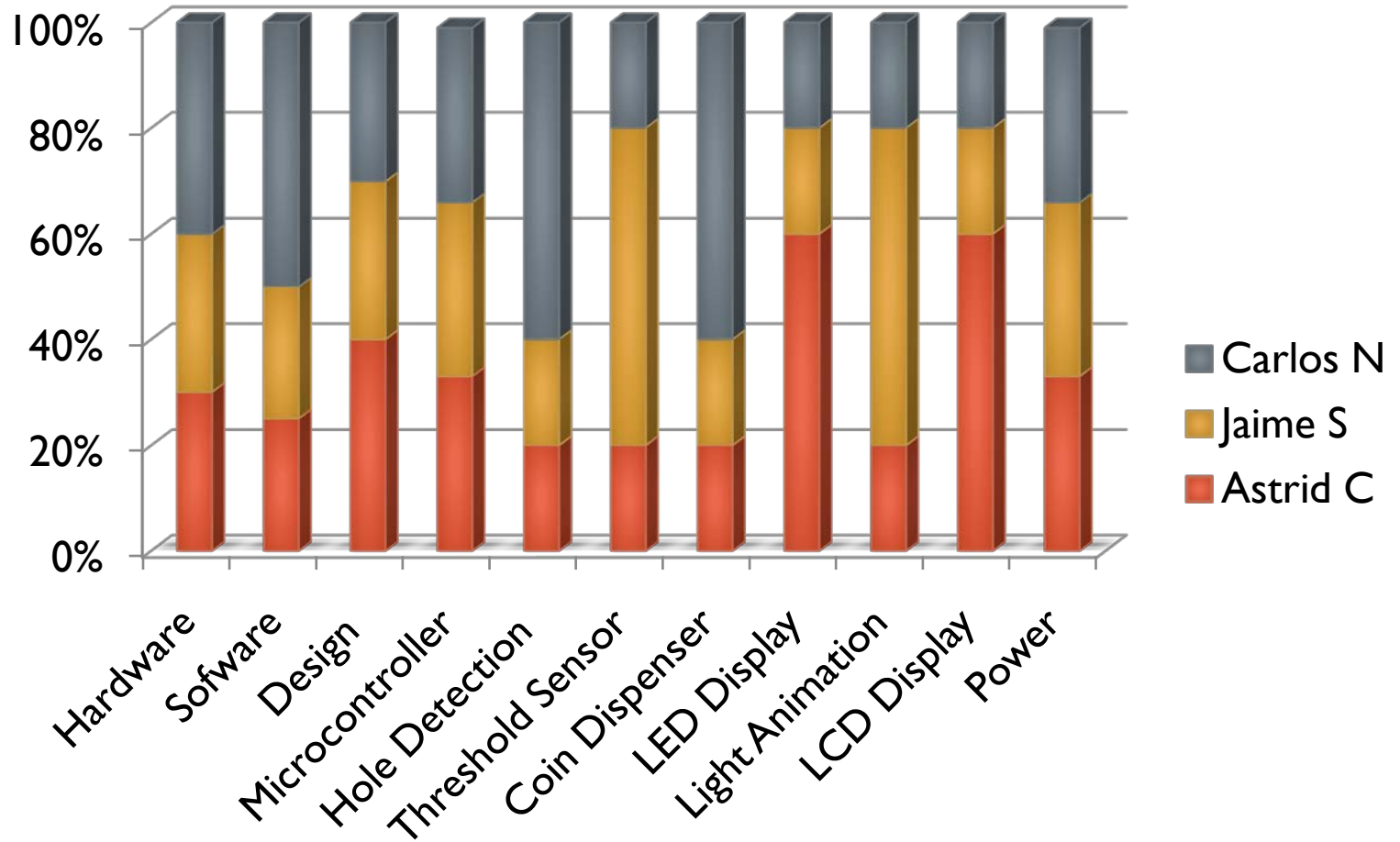


# External Devices Used

- **USB Tiny Serial Programmer:** Used to boot load the Atmega2560 with the proper AVR software platform.
- **FT232R USB UART Board:** Used to input the E-Frog software program to the already bootloaded MCU.



# Work Distribution



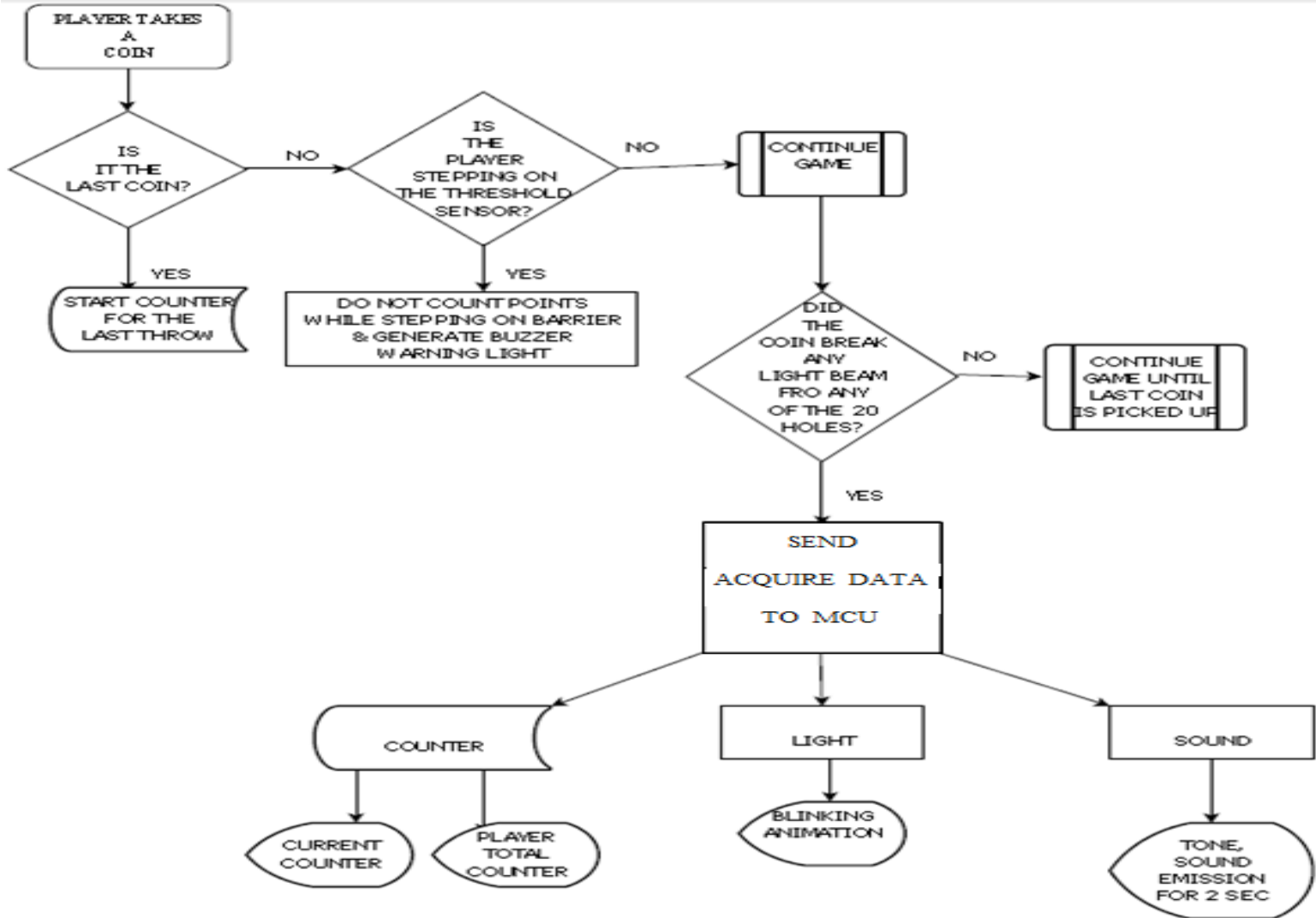
# Budget and Financing

DATE	NAME	DEVICE	QTY	COST	TOTAL
Jun 7	CARLOS NEYRA	MSP430, LASERS	2,10	\$33.60	33.60
July17	JAIME SALAZAR	LEDS, 7SEGLED DISP	6,6	\$3.21	36.81
July17	ASTRID CRUZ	EMMITER-RECEIVER, transistor	1,1	\$5.20	42.01
July27	ASTRID CRUZ	ARCADE BUTTON,SOLDER IRON	1,1	\$19.67	61.68
Aug23	CARLOS NEYRA	SOUND CHIP, WOOD, PVC	1	\$28.62	90.30
Aug23	ASTRID CRUZ	ARDUINO UNO & RECEIVERS	1,3	\$39.90	130.20
Aug26	JAIME SALAZAR	CABLE DOUBLE CORD,RECEIVERS	1,1,4	\$22.54	152.74
Aug27	CARLOS NEYRA	RECEIVERS & BREADBOARD	3,1	\$6.39	159.13
Aug30	JAIME SALAZAR	RECEIVERS, LASERS & DISPLAY	10,1	\$43.46	202.59
Sep5	CARLOS NEYRA	MAX 7219, LEDES, RED LIGHTS	2,25,200	\$20.57	223.16
Sep27	JAIME SALZAR	WOOD AND TOOLS	1,1	\$58.00	281.16
Sep30	ASTRID CRUZ	LABELS, TAPE, SCORING KNIFE	1,1,1	13.50	294.66
Oct14	ASTRID CRUZ	SPEAKER, PC BOARD,NPN	1,2,3	\$21.99	316.65
Oct18	CARLOS NEYRA	MAX7219 LED DISPLAY & DRIVER	1,1	\$20.19	336.84
Oct18	CARLOS NEYRA	NEW 1X8X8 Dot Matrix 5mm	2	\$13.85	350.69
Oct25	JAIME SALAZAR	7 SEGMENT LED DISPLAY, SOCKET	2,1	\$5.72	356.41
Oct26	ASTRID CRUZ	Breakout Board FT232RL USB-Serial	1	\$18.59	375.00
Oct26	CARLOS NEYRA	USB Tiny ISP programmer	1	\$10.99	385.99
Nov1	ASTRID CRUZ	PCB EAGLE & Extra for 3 designs	1	\$70.00	455.99
Nov1	CARLOS NEYRA	PCB EAGLE (part of it)	1	\$31.53	487.52
Nov1	ASTRID CRUZ	DIGI KEY (PCB components)	+100	\$100.0	587.52
Nov1	CARLOS NEYRA	ATMEL-ATMEGA 2560	1	\$45.00	632.52
Nov3	CARLOS NEYRA	PC BOARD, PIN IC SKT, SOLID UL	1,1,1	16.50	649.02
Nov3	JAIME SALAZAR	JUMPER, GREEN CARPET, PVC	1,1,1	\$28.84	677.86
Nov14	CARLOS NEYRA	GREEN CARPET, PC BOARD	1,1	\$19.89	<b>\$697.75</b>

TOTAL SPENT: **\$697.75**

SELF-FUNDED: **\$232.58** per member

# Complete Game Flow Chart



# THANK YOU!



## QUESTIONS??

Let the Game Begin!