Dice Roller

Final Report

Jeff Shannon

12/23/2001

Introduction

Our project in "Engineering in Community Service" was to create an electronic dice roller for severely handicapped children at the Hattie Larlham foundation. Hattie Larlham had wanted such a toy for a long time because their children love to play board games, but many lack the physical ability to roll the dice.

Before actual work began, it was decided that a trip to Hattie Larlham was in order to see first hand what kind of kids we would be designing for: their handicaps but also their personalities and smiles. Seeing these kids would transform the dice roller from a class project to a labor of love.

When we arrived at Hattie Larlham, we saw many severely handicapped children. Most in powered wheelchairs and most requiring the constant assistance of a caretaker or volunteer. These kids had other people making their crafts for them at arts and crafts time and hardly said a word to anyone. However, just about every kid looked at us as we walked from room to room, letting us know that even though they were handicapped, they were curious and alert. We saw several smiles and big bright eyes that provided more than enough motivation for the finishing the project this semester.

Design Requirements

After our trip to Hattie Larlham, we had a much better idea of what we needed to build in order to give the children a great dice roller. First, the dice roller had to run entirely off of batteries. This was necessary because most of the children are confined to wheelchairs and therefore the toys must "go to them" instead of them going to the toys.

Second, we learned the importance of sensory stimulation. Of course every child wants a toy that makes lots of noise and blinks vibrant colors. But stimulating the senses is very important with these children, because almost all of the children at Hattie Larlham lack the ability to "stimulate themselves" with the physical activities we take for granted. Thus, the dice roller we created had to have plenty of eye candy and make a lot of noise.

We also discovered that our toy must incorporate the paddle switches so readily used by Hattie Larlham as the source for activating our dice roller. Finally, we had to deliver a dice roller that was durable because after all, this is a toy. Toys get dropped and slapped and even get a little messy sometimes, so our dice roller had to stand up to the rigorous use that it would see at Hattie Larlham.

Operation of the Dice Roller

Early on, it was decided that the dice roller would incorporate some sort of "popping" motion. Because its activation needed to be controlled by the paddle switches, we decided that electronic circuitry would perform the task of transforming the slap of a switch into the pop of the dice. We also decided to incorporate some sort of flashing LED's into our design to provide even more eye candy.

The Popping Mechanism

We wanted the dice to pop. Naturally, a spring-loaded platform would provide this sort of motion. We quickly keyed in on another toy called a "corn popper." The corn popper is a toddler toy that motivates them to walk by "popping" small, colored balls inside a clear plastic dome as the child pushed the toy along the floor.

The corn popper toy had a very basic "popping mechanism:" the wheel axle had a slight indentation that, when turned, would catch a small, spring-loaded platform at the center of the clear dome. The base of the dome had a slight slant to it so that the balls, once popped, would roll back to the platform to be popped again. It was decided that we could attach a dc can motor onto the axle so that when we powered the motor, it would turn the axle much like the wheels did when the child pushed it.

The Electronic Interface

We decided to design simple logic to interface with the paddle switches and control the popping mechanism and the flashing LED's. We wanted a design that would allow for multiple players. We also wanted a design that would allow the popping to continue for a few seconds even if the children lost contact with the switch.[1]

We decided to implement a simple OR operation of all switch inputs so that an activation of any switch would pop the dice. This took care of the multi player feature. We also decided to implement a "one-shot" multivibrator that would continue the operation of the dice roller for 4 seconds if the children lost contact with the switch, allowing for a guaranteed minimum run time of the toy and a successful "roll of the dice" every time.

Because we wanted to incorporate flashing LED's into the toy, we needed some way of making the LED's turn on and off. We decided to use a shift register to cycle the LED's successively. The shift register we decided upon had eight parallel outputs and thus we would have eight points in a complete cycle. It was decided that each point in the cycle would briefly light four multicolored LED's. This gave us a total of 32 LED's cycling around popping mechanism during operation.

In order to keep our design modular, we decided that we would need two boards: a logic board and a driver board for the LED's. We could connect the two boards with standard solderless connections. The logic board would contain the gate logic, the shift register, the one-shot and the clock generator. The logic board would also contain the power transistor needed to drive the dc can motor, a voltage regulator to power the logic chips and all interconnects to the led driver board.

The led driver board would contain the open collector drivers and all resistors needed to power all 32 LED's. It too would contain a voltage regulator and interconnections to the logic board.

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[1] We weren't sure how long the children would be able to hold the switch down

Because the electronics and motor would require a lot of power, we decided to use a 9.6V battery pack instead of multiple smaller batteries. This rechargeable solution would greatly reduce the hookup time and clutter as well as simplify the electronics themselves.

The Structure

We needed a durable package in which to put our electronics and motor. We decided that the best solution was a rather large "Tupperware" bowl and lid. We decided to mount the popping mechanism and LED's in the lid and any electronics and the battery in the bowl.

Because we wanted to provide a way to easily access the battery and electronics, we decided to create a third board that would move the led resistors to the lid as well. In doing so, we used a standard IDE cable to provide a power connection from the led driver board to the LED's. IDE headers were pulled from old CD-ROM drives. By doing so, we maintained an easily opened lid (to access the battery and electronic boards) and a neat appearance.

Because Tupperware makes a tight seal when closed, we knew our electronics and popping mechanism would be safe in case the toy was accidentally dropped or got the occasional drool on it.

Problems with the Motor

As we finished mounting the LED's, our attention turned to installing the dc can motor the would be used to turn the axle and "pop the dice." Once the axle was modified to accept the motor and the motor was mounted to the popping mechanism, it was discovered that the dc can motor didn't have enough torque to compress the spring inside the popping mechanism. The natural solution would have been to replace the spring with a lighter one (smaller spring force). However, the spring being used was already very light and after an extensive search, none could be found that would meet both the size and force requirements. Thus a new method of "popping the dice" was needed.

The answer came in a pinball machine. Pinball machines made use of electric solenoids to throw, flip and launch steel balls up and down the playing field. Surely, a solenoid could be adapted to gently roll some dice.

The solenoids used in a pinball machine operate on 30-50V but our dice roller operated on 9.6V max. It turned out that while 30V was needed to launch heavy steel balls 5 feet up a board, 9.6V would make the same solenoid gently tumble the dice and plastic balls (more eye candy) inside the plastic dome. Thus, the solenoid replaced the dc can motor in our original design. Luckily, no other modifications were necessary to either the Tupperware or electronic circuitry.

Problems with the One-Shot

Because our design incorporated a negative-edge triggered one-shot multivibrator, we had to make sure that the inputs would never trigger the one-shot unexpectedly. This would not have been a problem when all switch inputs were connected. In this situation, a negative edge would only be seen when a child pressed the switch. However, if any of

Dice Roller
Design Notebook
Jeff Shannon
Dec 23,2001

Introduction

This design notebook is supposed to be a daily saga of my trials and tribulations as my group built the dice roller throughout the semester. However, due to hectic schedules and inadequate meetings and skills, building the dice roller really didn't even "begin" until early December. By that time, everyone was worried about finals and presentations and thus, I took it upon myself to finish the dice roller and fulfill the "deliverable" promise. What follows is a brief description of everything I went through over the last 3 weeks in my efforts to finish the dice roller. Attached is a collection of rather important email correspondence between Professor Merat and myself during that same period as well as some drawings and schematics for reference.

Unless otherwise noted, all parts were purchased from the local Radio Shack store or through Jameco.

The Popper

We wanted a clear plastic dome to pop dice in and we wanted to flash some LED's around when the dice were popping. Tim came up with using a "corn popper"—a kid's toy that pops plastic balls in a clear dome when the kid pushes it along the floor. We could use the plastic dome and mount the rest of the circuitry in Tupperware to make it safe and "droppable."

The Logic

The initial design of the logic was decided upon in October. We decided to have 4 inputs for 4 players. We would OR the inputs together and run the output to a "32-bit shift register." Each stage of the register would power one led giving us a total of 32 LED's. The original logic called to OR all 32 bits of the SR together and use that to drive a DC can motor which could be used to pop the dice.

Well, needless to say, OR-ing 32 inputs would have been a bit insane. Not only would we have needed around 20 7432 OR gate chips, but the power consumption and physical size of such a circuit would have rivaled that of a P4 motherboard.

So I redesigned the logic to use one 8-bit shift register (where 4 LED's are on at a time). This wouldn't change the concept at all, but would allow the same OR-ing logic to take place on only 2 7432 chips. I also added a "74121 one shot that would allow the dice roller to operate for 4 seconds even if the input switch was released. This 4-second operation would guarantee a successful roll of the dice (a changed value).

Initially, my redesign used a 74164 8-bit parallel output shift register and a 74ls163 counter to perform the led lighting, a 555 timer to control the clock and another 555 to perfor5m power up reset. However, after close inspection, it was discovered that neither

the 74ls163 nor the power up reset 555 were needed. Thus, the required logic was greatly reduced even after the initial redesign. The final "logic board" takes up one 4.5X6.5 perf board and draws around 60ma of current. All logic was powered through 5V voltage regulators.

The LED Drivers

We knew that the LED's would require a lot of current and that standard TTL gates could not reliably drive them. Thus, we knew that we would need to buffer the logic output with high current drivers. The chip we chose was the 7407 hex buffer. In order to drive 32 LED's we needed 6 hex buffers.

After I had the first generation led driver board completed, I noticed that the 7407s were not driving the LED's. The inputs to the chips were correct, but the output was always low. After review of more datasheets, I discovered that the 7407s require pull-up resistors at their open collectors. Thus, I had to redesign the led driver board to include these resistors.

When the second generation of the LED driver board was complete, I had 100 ohm pull up resistors at each open collector output. The resistors run from the OC outputs to VCC.

A third board was needed to allow the Tupperware lid to easily separate from the bowl. An IDE cable was used to connect between the driver board and the lid-mounted led connection board. The led connection board consisted of an IDE socket and current limiting resistors for the LED's. Resistance was set to 70 ohms to allow the LED's to attain a nice glow even in a brightly lit room.

Popping the Dice

The initial design called for a dc can motor to turn the axle of the corn popper and pop the dice. The turning motor would mimic the wheels turning the axle as the child pushed the toy along the floor.

We knew that the dc can motor would require lots of current, so we opted to drive the motor with a Darlington power transistor capable of providing 3 Amps. Unfortunately, the transistor was damaged because of large voltage spiking. We then decided to use a 2n3055 power transistor from Radio Shack to power the motor. This transistor could handle 15 Amps if necessary. We also used a diode to short any large voltage spikes out.

Unfortunately, the dc can motor could not compress the popper spring that came with the toy. Although the spring was very light and easily compressed, the small motor just didn't have enough torque to perform the compressing and the spring was about as weak as possible. So another way of rolling the dice was needed.

We briefly considered other means of popping the dice such. I tried a CPU fan (what a horribly desperate move) and also thought about fish tank air pumps. If we could have gotten the "air" idea to work, we could have made the dice roller even cooler by drilling

holes in the dome so that the kids could put their hands over the dome and feel the air. Unfortunately, the air ideas just never flew.

Then I got a great idea...pinball. Pinball uses small solenoids to launch heavy steel balls 4 feet up the board. Surely, I could use one to pop the dice a few inches. But where could I get a solenoid from a pinball machine? Then I remembered having seen a pinball/jukebox shop in Lancaster, OH. So I went down to see what the shop had.

I paid 10 bucks for a used 30V solenoid. The man assured me that it would never run off of 9V. I decided to try anyway. I got it home and mounted it up vertically to the popper. I gave it 9.6V (ill talk about that next) and it moved. After some minor adjustments and a better mounting system, the solenoid worked fine to "pop the dice." Problem solved.

The place I got the solenoid was Electronic Supply Co. Their address is 519 Hocking Street Lancaster, OH 43130. Their phone is 740-653-9344.

Power Requirements

Well, after talking with the man at Radio Shack (he does know his stuff), it became pretty clear that 9V batteries weren't going to drive the motor (later solenoid) and the circuitry very long. To handle the power requirements, we would have needed a ton of batteries that would require constant recharging. So I opted to buy a 9.6V battery pack used in RC cars. For 20 bucks, I got a battery and a charger. The 9.6V came in handy later because the solenoid didn't like anything less than 8V. The battery pack was small, light and had only one connector—all definite pluses over the 9V battery brigade.

So now that I had a power supply capable of 1000mah, I figured that the toy should be able to last a long time on such a large power supply. I was amazed when the toy lasted about 10 minutes. After measuring the current draw from the battery, I figured out why. It was drawing close to 3A!

For days, I spoke with Professor Merat to try and locate the problem. Finally, we found the culprit. The led driver board required pull-up resistors to operate. And the LED's required current limiting resistors. What I didn't realize is that these could be and should be the same resistor. I had never used 7407s before and my design showed it. Because of the two separate resistors in my design, the led circuitry was always drawing current. In essence, all 32 LED's leads were drawing current even when they weren't lit. The design called for only 4 LED's to be on at a time. One can quickly see the large difference in current requirements for 32 LED's and 4 LED's.

The design was remedied when the driver board was redesigned using the current limiting resistors as the 7407 pull up resistors. This design would allow the 7407s to perform as intended and turn off the current to the led leads that weren't supposed to be on. Current requirements dropped eight-fold and now the toy lasts much longer on the 1000mah battery.

tech discussion emails

topics

1) power up reset
2) current draw update
3) current draw solution
4) current draw
5) 7407 current draw
6) circuit drawing too much current
7) popping dice solution/ solenoid/diode/battery power
8) dc can motor cant pop dice/compress spring
9) input switch debouce and one shot
10) open collector

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power up reset, december 23, 2001

when the toy is on and just sitting there it draws around 300 ma. when the leds are flashing and no solenoid it goes up to around 500-600 ma meaning that the 4 leds are taking around 250 ma. thats at 9.6V and with around 70 ohms apiece. i could easily increase the resistance to 140 or 220 ohms by trimming out the resistors in parallel.

do you think i should trim the resistors to increase resistance and deascrease current consumption by the leds? right now, they are fairly bright and can be easily seen in a lit room. what i dont want to have happen is decrease current to much so that they are but a "twinkle". im assuming that the kids would play with the dice roller in a lit room (not the sensory room) because board games will have multiple players and the sensory room is not that big and to read the dice, youd want a fairly lit room.

That's true. You should be able to see it in a lit room.

let me know. everything is assembled except the shiny foil paper that im going to use to hide the electronics in the clear tupperware.

the reset would only be used to reset the shift register and turn off all the lights but i have never seen the lights power up on... they are always off at power up...

You could probably simply flip the power switch again.

let me know.

i will finish the toy tomorrow upon your instructions and finish the report/presentation/notebook

Sounds good. I am looking forward to see it.

also, can i give you the disbursement form to rake care of? ive spent a

lot of money and i need that to get to california...

You need to give me the disbursement form with the original receipts. Make sure that you also include your SSN, and especially where you want the check mailed to.

Merry Christmas

Dr. M.

thanks

From: Frank Merat <flm@po.cwru.edu>
To: "jeff shannon" <jks55@hotmail.com>
Subject: Re: do i need a power up reset?
Date: Sat, 22 Dec 2001 16:05:20 -0500

prof merat

do i need a power up reset? during this whole time, ive ran the toy without one (thats one of the chips i have to add to the logic board)

and its never started up in some funky position (meaning any lights on or solenoid on)

i will add one if you think its needed . the socket is already there but i will need to add one more 7404 inverter chip to make it work

let me know about this and the led resistor values

i have everything running off the battery and when the toy is just sitting there on, it consumes 300 ma when only the leds are running (no solenoid) current jumps to around 550 ma and with the lights and solenoid, current peaks at around 1.5-1.9 A instantaneously because of the solenoid.

These currents seem pretty good. What is the difference between just sitting there and with the LEDs running. Do the LEDs only run after the switch is pressed? The solenoid current seems reasonable.

i think these numbers are ok what do you think?

let me know on the reset

I think you are probably ok. Would the reset be simply a reset for the counters?

thanks

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current draw update, december 22, 2001

i can leave the toy and the tap and die and the soldering gun in your garage. i should have this thing finished by sunday for sure

i will also leave a copy of the report, notebook and presentation on disk

the way i made the 70 ohm resistance is by putting 3 220 ohms in parallel... a quick way of increasing resistance would be to just trim one or two resistors off. would you have objections to that? if so, i can make another board, just need a little more time

No problem with that. It leaves room for adjustment.

so now for the big news.... hows 600 ma for the led driver board and all 32 leds on at once?? and thats at 70 ohms resistance!!!

That's very good. It should drop even more with the LEDs flashing.

the led driver board itself takes up 200 ma . thats for 6 7407s and 2 7404 inverters. a little higher than i expected but i think its ok, right??

That sounds pretty high. 8 chips would mean about 25ma apiece. I would have expected about half of that or less.

the logic board takes up 60 ma but i need to add 3 more chips and i dont know how much the power transistor for the solenoid will add

The power transistor should add almost nothing since it is only used to turn the solenoid on.

the solenoid has instantaneous peaks of 1 A but thats only instantaneously and it will be fired about 3 or 4 times in 4 seconds

its a little better!!!!!!!!!!!!

ok, well let me know about those resistors... youre the boss so its your call, but it would be a lot easier to just trim out a resistor or 2 to make the resistance 140 or 220. it wouldnt affect the electrical reliability...

I agree.

thanks

jeff

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current draw solution, december 20, 2001

I think we covered a lot by phone which makes most of this irrelevant. You are turning off the leds by palcing a short across them. However, current is still flowing through the A resistors which is what is causing the huge current consumption you are seeing. If you use the attached circuit this should dramatically reduce the current consumption, by a factor of 8.

Note that you only need one resistor per led. I am not sure of the exact value but it sounds suspiciously like R = (9.6-.2-3.5)/30mA = approx. 200 ohms. The power rating would be P=I^2R=(30mA)^2*200=.175 watts. A quarter watt resistor should be enough to drop the 9.5 volts down. If worse comes to worse consider putting two 1/10 watt 390 ohm resistors in parallel. You should be able to get something close at radio shack.

Do not use the 70+10 shown in the jpeg. That was based on your other circuit. Start with a value of about 200 ohms. The closest values are probably 150, 180, 220 and 270.

I am not sure about the inversion. As we discussed it your circuit should be logically inverting the input. If worse comes to worse you may need an extra set of inverters prior to the 7407 inputs to handle the logic.

This should really make the circuit run a lot longer on its batteries.

Dr. M.

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current draw, december 20, 2001

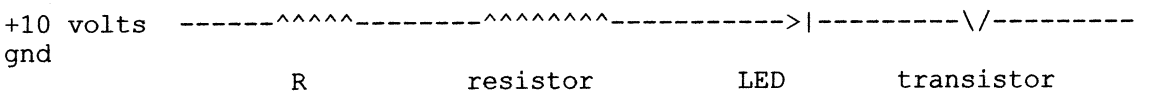
prof merat

so if i put the big voltage divider out front to drop the voltage in half will the value of the resistors i pick limit the current that i have available to drive the leds?

in other words say i have 10V coming from the battery and i want five volts
i can either use 2 1K resistors or 2 500 ohm resistors or any other pair of identical resistors (simple voltage divider) but will the 500 ohm resistors "allow more current" through the network? or will that extra current just go to ground?

If you have the following circuit

I would not use a voltage divider as you described. I would simply use a series current limiting resistor. Like this. The value of R would hae to be chosed to give the desired brightness.

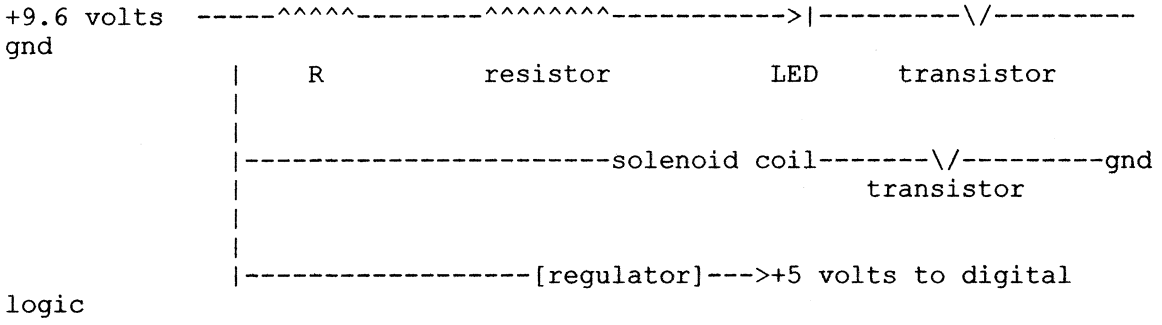


If you use a voltage divider as you described then you are wasting a tremendous amount of current through the voltage divider.

i want to drop the voltage by half but also still provide enough current for the leds/solenoid (has a peak current of an amp... but only instantaneously)

also i do need a 9.6 volt system because the solenoid doesnt like anything below 7-7.5 volts...remember, its a 30V solenoid when used in a pinball machine

I would not use a voltage divider because that will waste a lot of battery power. Here is what I would recommend.



The R controls the brightness to the LEDs. The regulator provides the proper voltage to the logic. And the solenoid coil can go to the full 9.6 volts for the "kick" you need.

As I understand it, the digital logic will be 60-100 mA, the solenoid coil will be a lot but it does not run continuously, and the LEDs will be 100-400 mA. You might need a current limiting resistor in series with the solenoid coil if the transistor controlling it stays on for too long a time period.

Hope this helps.

Dr. M.

finally, the system has 3 boards a logic board, a led driver board and a led resistor. i broke up the drivers and resistors so we could open up the lid. (ide cable)

i really think im close on this. just answer the resistor question above and i think i have a good shot at getting the thing working and drawing 600-700 amps... maybe less with the lower voltage at the leds...

let me know asap

thanks

7407 current draw, december 19, 2001

prof merat

the 7407s have been getting hot with 9.6V at their inputs (un regulated) and i think they finally gave out because now some leds stay on all the time. i have a few extra chips but not 6.

Is the regular chip voltage at 5V? If not, it should be. The chip electronics runs at 5V and should be connected to +5. Only the outputs should be connected to the 9.6V -- but only through the leds and current limiting resistors.

im kinda thinking that maybe we should put two 1 amp 5V reg on the board. 1 reg for 3 7407s and the leds it drives. that way the chips would get 5 volts and also the lower voltage would lower the current consumption by an amp...

Yes, the chips should get 5 volts which they require. For example, the chip should work with just an ohmmeter connected to the output. Note that many ohmmeters are polarity sensitive and you may need to reverse the polarity of the ohmmeter leads to see it function properly. The output is simply the open collector of a transistor. The base is driven by the internal 5 volt electronics. The emitter serves as the ground for the current which will come through the collector.

let me know but i think it would be a good idea... by the way... know anywhere to get a to-220 socket? all this soldering/desoldering of the regulators is ripping up the board...

I have never seen one since regulators are typically not changed very much.

circuit drawing too much current, december 18, 2001

prof merat

so i went to radio shack and got a couple more voltage regulators. i replaced the one on the logic board and completely removed the one on the led driver board...circuit works fine under battery power now (havent tried the solenoid yet though)

both boards and the leds consume 2.8A. thats a lot. and with the current 9.6V 1000mah battery the toy could only be used around 15-20 minutes before the 1000mah battery would need to be recharged.

there is a 3000mah 7.2V pack but i dont think the 7.2 v would power the 5 V regulator or the solenoid very well

so my question is ... know of any 9.6V battery packs that are like 3000+ mah.... thats what they would need to play with the toy for an hour on a full charge

any other ideas? seems like this is a real power hungry toy...

let me know

thanks

The 2.8A drain is really large. It has to be the LEDs since the logic cannot consume that much current. The only kind of battery that can handle that kind of capacity is a lead-acid type or gel cell. But these are considerably larger and would probably placed on the floor.

We might consider a gel cell (something more like the batteries used in wheel chairs and the like). But this is the kind of thing that I would get at a surplus store. A new gel cell would be expensive.

Lap top batteries are even more expensive. They are things like lithium ion and might cost several hundred dollars for a large one.

Dr. M.

the circuit works fine off of the graymark 808 +5v/1A terminal. its voltage regulators are no bigger than what im using.

and the led drivers are the open collector 7407s so being digital logic chips, wouldnt i need a regulator there too...

You would need a voltage regulator on the chip power supply leads but the open collector output which would be a resistor and LED or whatever would not need one.

so heres whats going on... when i bypass the voltage regulators and power the circuit from the graymark, everything works great. but the minute i run through the regulator, the chips no longer get 5V...

If you are running a 5V regulator from the 5 volt terminal of the Graymark that explains the problem. The 5 volt voltage regulator chips require a input voltage which is 1.5 volts or more higher than the output voltage to function properly. Instead of using the Graymark regulated output you could instead go inside the Graymark and take the output from TP9. I bet that would work since the DC voltage there is probably several volts above 5V.

Dr. M

my question is, how much current do the regulators draw? enough to saturate the graymark power supply regulators?? its kinda weird to use an external regulator on the regulated power supply but i need to make sure things will work before i hook up the battery

The regulators by themselves draw very little current. They basically function as electronically controlled resistors. They get rid of the difference between the input voltage and an internal 5v voltage reference by using their VCE voltage as a variable voltage drop.

how much current can a 9.6V battery pack handle?

Depends upon the batteries.

ps: i only have like 6-8 chips per board... 15 total and the solenoid... the battery pack should handle this right??

I would say yes. However, the LEDs might be taking a lot of current. Most of these TTL chips should be only 10's of millwatts per chip. If the chips are taking even 10ma per chip and you have 15 of them that would be only 150 mA which whould be well within the battery capability.

let me know

thanks

From: Frank Merat <flm@po.cwru.edu>
To: "jeff shannon" <jks55@hotmail.com>
Subject: Re: help ... voltage regulator not powerful enough
Date: Tue, 18 Dec 2001 09:33:06 -0500

yeah the exceptionally large spikes was what i was talking about... if i dont need one then thats cool

ok so i just hooked everything up to battery power and blew the 9.6V

pack... started smoking ... so my dad ran in to exchange that... dont know what was causing that...

^^^This sounds like a short. Check things out with an ohmmeter first.

and the voltage regulators i have cannot drive the led driver board. with no leds on the current draw is 300 ma and the regulator is good to 1 amp... its like a lm317 only outputs a constant 5V...

any ideas how to get around this... without the regulator, the board runs fine. i replaced the regulator and the same problem occurs....

can i "regulate voltage" another way accurately? any chips come to mind that would be ok with a higher current?

I don't think you need voltage regulators for the LED drivers. Run them off the main supply with a simple resistor. I would only use the voltage regulator for the digital logic.

im running outta time... i know you need to see this, but little things keep happening... let me know asap

hopefully this doesnt set me back too much

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popping dice solution/ solenoid/diode/battery power, december 15, 2001

prof merat

dont know how many of my phone calls you got but heres the way things look

the whole thing is powered by a 9.6 V battery pack

and i went all the way down to lancaster (ex girlfriends town) and found a guy who sells pinball machine/parts

what i have in the dice roller now is a used but pretty heavy duty solenoid. the pinball game uses it as a ball launcher. when powered by 30V, the solenoid can shoot steel balls up 4 feet to the top of the board but i only have 9.6V to it and it does "ok" to pop dice

now my question is: do i need to have a voltage regulator on the boards to protect them from spikes from the 9.6 battery pack and/or feedback from the solenoid????

Yes. You should at a minimum put a zener diode to protect the electronics from spikes. Depending upon how you are triggering it there is also the possibility of putting a diode across the solenoid

coil to short out negative spikes.

I would certainly recommend using a regulator as well. The electronics is worth more than the solenoid.

and secondly, like i said, this solenoid is used. i replaced the diode across its terminals .... but how long can i expect this solenoid to last? the price was great...10 bucks and it is a heavy duty one...

I would think this could last for a long while. I would like to see you document as much as you can about it in the report including where you bought it. If you can say what pinball machine it was from that would be great.

and lastly, not including your 100 bucks from jameco, i think i may have spent 100+ on it myself... making this one very expensive toy... i will give you all the wire/chips/parts/ and motor that i didnt use (maybe for another project) ... i hope the 200+ price tag is ok... this thing IS awesome though... its too bad that i have to give it up, but if the kids have half the fun playing with it that i had building it, they will love it... (i really hope they do)

Let's see what it looks like. I can't wait.

ok get back to me with the answers and opinions

thanks

jeff

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dc can motor cant pop dice/compress spring, december 14,2001

prof merat

got the LED circuitry done but im working on the motor now and the spring is too pwerful for the motor ... in other words, the motor doesnt have enough torque to pull the spring down and "pop" the dice. there is very limited mounting capabilities and no room for a gear system (not that taht would help much anyway)

so my question is ... where can i get a bigger motor (more torque) or a spring with a smaller spring force?

im leaning torward a more powerful motor because if the spring is weaker, the dice wont "pop" as much.... im going to sears hardware tomorrow to look at springs though

i got the biggest DC can motor radio shack has and it runs good, but sucks at torque

any ideas?

parts ordering emails

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parts ordering, november 29, 2001

hattie lahlham has adapters to and from .25 to .125 inches so it doesnt matter but since the switch that fulter has is a .125 order me 5 of the .125 jacks... that way we dont need an adapter...

by the way, can you get the big red switch back from fulter or who ever has it? i need that for testing...

let me know asap when the parts come in...

thanks

I ordered the parts last night with overnight delivery. I am expecting them tomorrow.

Dr. M.

P.S. I could not get the jacks from Jameco. I think our best bet is either Electronic Stores or Radio Shack for the jacks -- I think both would have them.

From: Frank Merat <flm@po.cwru.edu>
To: "jeff shannon" <jks55@hotmail.com>
Subject: Re: jameco order
Date: Wed, 28 Nov 2001 20:23:18 -0500

prof merat

this order is fairly large but ive included ever thing that i can think of... a few things may be excessive, but i figure you can use them for the next class.

also i need 5 headphone jacks for the "big red switches" but i could not find them in jameco... take a look or maybe try somewhere else ? (let me know)

are these 1/4" diameter or 1/8" diameter?

what did bob say on the soldering iron???

No word yet.

ok well here it is.. feel free to make adjustments and additions but i think this will cover most of it.... if you subtract from the order let me know too

thanks

jeff

Get your FREE download of MSN Explorer at
http://explorer.msn.com/intl.asp

Attachment converted: Macintosh HD Ti:dice roller order.xls
(XLS4/XCEL) (000339E0)

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parts ordering, november 27, 2001

prof merat

nope never got it... but heres my take

id really like to do the ide cable thing... it will be so much easier and neater looking... also, we are going to have 4 jacks for 4 big red switches (for up to 4 players). can you order those? if not, i will get them at radio shack...

and also, did you get the LED buffers and sockets (i think you said they were 6 on a chip)? if not, could you order them as well or i can also go to radio shack on that as well...

but just let me know cause im planning on finishing the motor / led driver board this weekend and hopefully tim will have the logic done....

thanks

jeff

Let's get together tomorrow and settle things. This is difficult to do via e-mail.

Dr. M.

From: Frank Merat <flm@po.cwru.edu>
To: "jeff shannon" <jks55@hotmail.com>
Subject: Re: dice roller
Date: Tue, 27 Nov 2001 18:13:21 -0500

prof merat

i never got an email from you about the components... i dont think anyone else did either... ill see you tomorrow...

jeff

That is very odd. Here is a copy of it.

I'll see at the electronics shop as soon as I can about the parts. If
they're not open tommorow, or it would be better to have them ordered, Rochester Electronics (rocelec.com) stocks the following parts...
CD74HCT4075E $.51 ea. (x10)

SN74LS164N $.61 ea. (x6)

Make sure that these are in DIP packages, i.e. 14 pin or whatever packages with 0.1" pins that can go into ordinary sockets.

I did not check. Do they have a minimum order? And do they take credit cards?

The only kind of boards I've ever used are the standard breadboard things we used in ECES301, so I'm not familiar with doing either PCBs or the 'prototype boards'. Do you think a PCB is feasable during the remainer of the semester? I'm assuming that the ones we can solder on will be easier. Assuming we use the "prototype board", I guess we'll need about 15 of those 14-pin circuit socket things, plus the other stuff which wasn't a problem (like the clock, etc).

I would go with a board suitable for soldering. A PCB is difficult to layout unless your circuit is finalized. Also, if you are going to solder the circuit you will want the solder-tail sockets. Are all the chips 14 pins?

I'll probably stop in the electronics store tommorow to look for those chips... I'll let you know if I get them or need to order them.

Let me know what you got and I will go ahead and order the rest.

Also, we were hoping to find IDE connectors with pins on them we could use, so that we could transfer the signals between the digital circuit and the motor/led circuits through a 40-pin IDE cable (since we need 34 wires anyway to go between the two, we figured we might as well try to be neat about it). We haven't had any luck finding a manufacturer or seller of these. Do you have any ideas?

This is an interesting problem. A cable would certainly make it look better. Jameco has a 17" IDE hard drive cable w/2 40-pin sockets for $6.95 Part Number 175492 Product NO. PFUDMAG2 in their latest catalog in case you want to take a look.

Their web page is www.jameco.com

The problem will be the pins the sockets mate to. I would guess that the spacing is 0.1" (which mates with a vectorboard for soldering a circuit together). One possibility might be somethng like Jameco Part Number 53479 which has 20 contacts in double rows in a plastic base. for $0.32 each. These parts are called male headers. I don't know that Jameco means by double row and the number of contacts. Is 20 the total number of contacts or the number of contacts per row -- that will influence what parts we order. Even if we have to also get Part Number 53532 which says 40 double row contacts, the part is only $.39. These are bare headers with the pins sticking up in the air

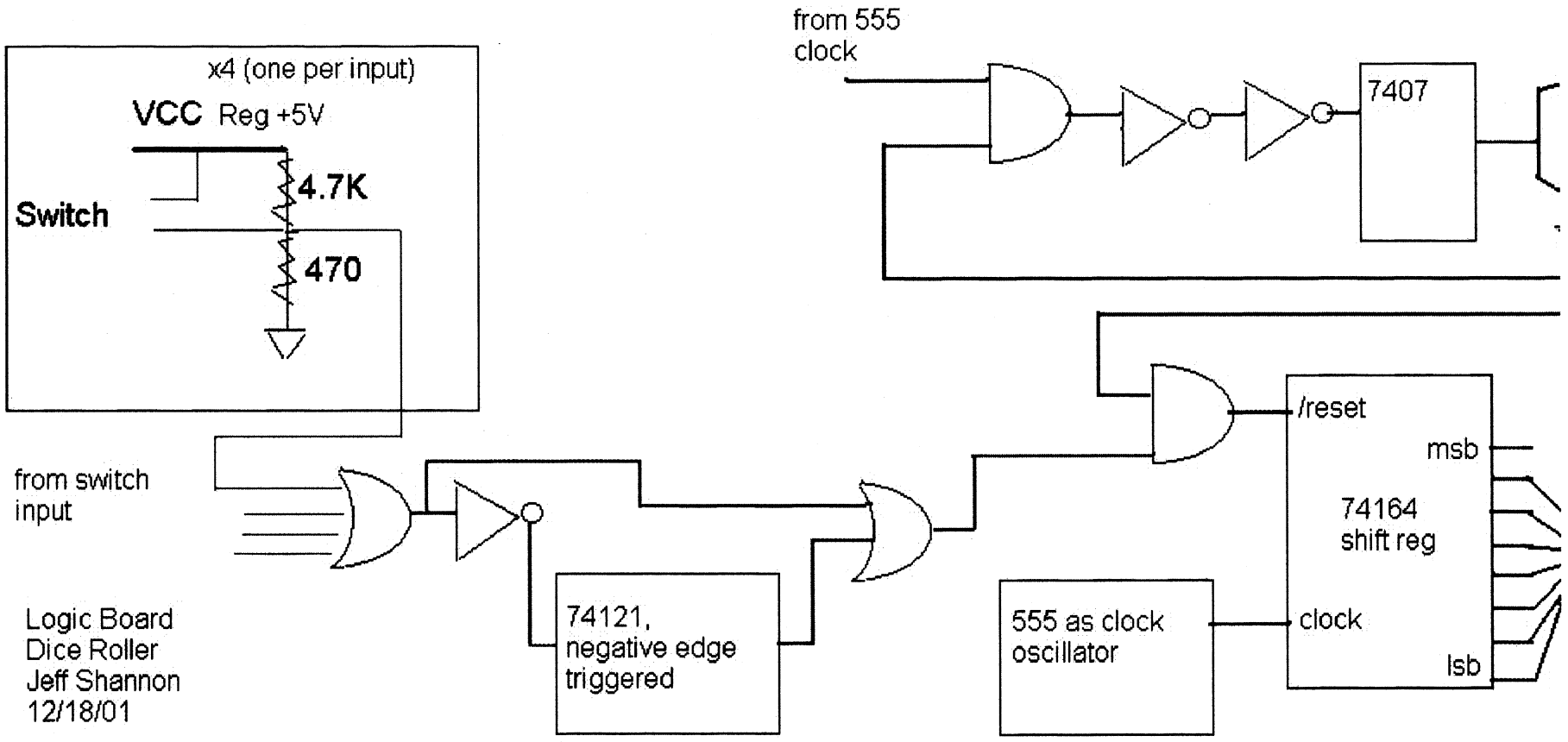
Dice Roller
Parts Inventory
Jeff Shannon
12/23/01

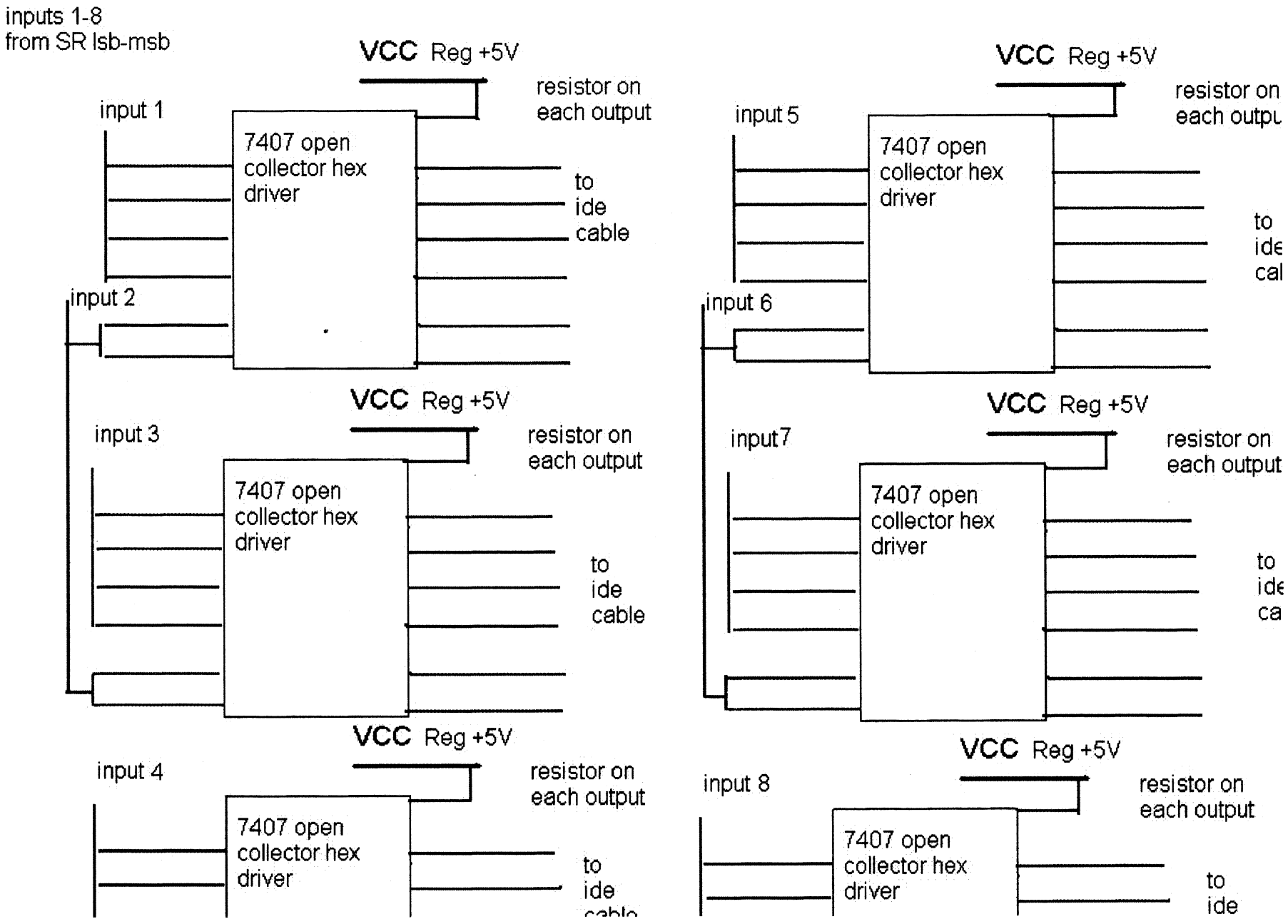
Electronics (from Radio Shack or Jameco unless otherwise stated)

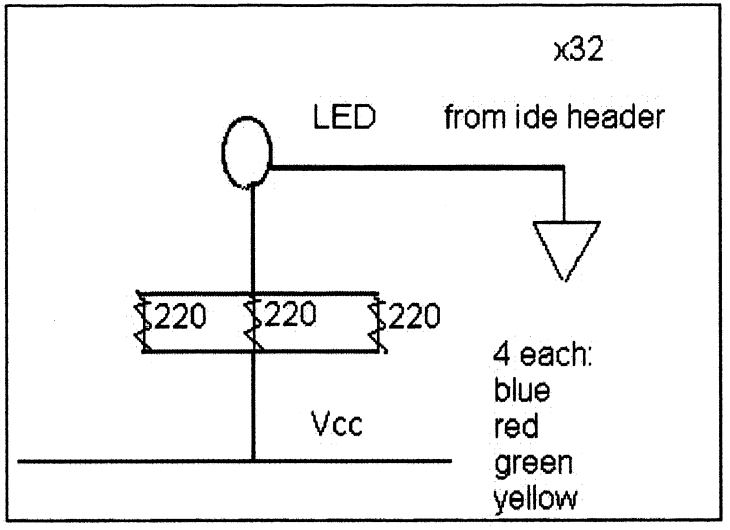
7 7407 hex buffers
1 74164 8-bit shift register
1 555 timer
1 74121 one-shot
1 7408 AND gate
3 7432 OR gates
3 7404 inverters
3 100 K resistors
4 4.7K resistors
4 470-Ohm resistors
1 15K resistor
1 10K resistor
1 470-uf capacitor
1 uf capacitor
1 .01 uf capacitor
2 7805-5V regulators
1 2N3055 power transistor
2 IDE headers
1 IDE cable
1 heavy-duty on/off switch
1 9.6V battery/charger
1 9.6V battery connector
32 multicolored LED's
1 30V pinball solenoid (from Electronic Supply Co.)
4 headphone female jacks
3 4.5X 6.5 perf boards
Misc. solderless connectors/ multicolored wire

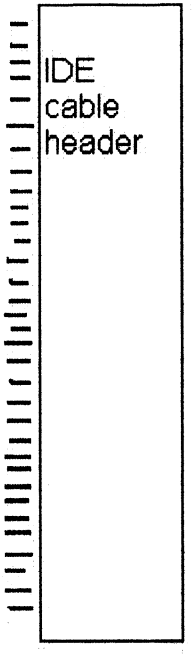
Structure

1 Tupperware bowl and lid (from Wal-Mart)
1 corn popper toy (from Amazon.com)
1 package of L brackets/bolts
4 rubber feet
1 self sticking Velcro pad
2 dice
Misc. labels


x4 (one per input)
VCC Reg +5V
4.7K
Switch
470
from 555
clock
7407
from switch
input
/reset
msb
74164
shift reg
clock
lsb
74121,
negative edge
triggered
555 as clock
oscillator
Logic Board
Dice Roller
Jeff Shannon
12/18/01
4 second pulse


inputs 1-8
from SR lsb-msb
VCC Reg +5V
resistor on each output
input 1
7407 open collector hex driver
to ide cable
input 2
VCC Reg +5V
input 3
resistor on each output
7407 open collector hex driver
to ide cable
VCC Reg +5V
input 4
resistor on each output
7407 open collector hex driver
to ide
VCC Reg +5V
resistor on each outpu
input 5
7407 open collector hex driver
to ide cal
input 6
VCC Reg +5V
input7
resistor on each output
7407 open collector hex driver
to ide ca
VCC Reg +5V
input 8
resistor on each output
7407 open collector hex driver
to ide





LED Board
Dice Roller
Jeff Shannon
12/18/01

STUDENT NAME _____
FINAL REPORT EVALUATION

(1) Technical component: Each section should be clearly identified.

Sponsor/Advisor
_____
Name of Sponsor/Advisor

Executive Summary
_____
5 points maximum; should succinctly state objective and technical approach of project suitable for a person outside the class.

Background
_____
15 points maximum; should present the basic problem to be solved and relevant background.

Technical Goals
_____
25 points maximum; should describe in detail what the project is to be designed to do. When do you know when you are done? Some of the background may be more appropriate here than the background section. Discuss with instructor.

Methodology
_____
25 points maximum; should describe in detail how the design task was accomplished. This should be the longest section and should include references as appropriate. Describe what worked and what did not work as appropriate. Include brainstorming results.

Current Status
_____
15 points maximum; should summarize the report with particular emphasis on what remains to be completed. Should describe any technical changes in the project or changes in the timetable/scope of work since the proposal was originally proposed at the beginning of the semester.

Time table/Summary
_____
15 points maximum; should describe any remaining work and the timetable for accomplishing such work. May be omitted if project is finished.

(2) Communications component

English
_____
Letter grade only; does the report read well and have few grammatical mistakes

(3) Success component

Project demonstration
_____
Yes or No; was something built and does it do something; was it convincing

Success
_____
Yes or No; does project work as specified?