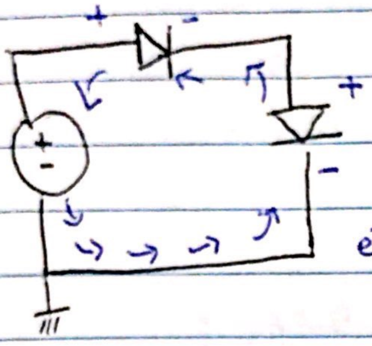
DIODE EXAMPLE OF ELECTRON FLOW



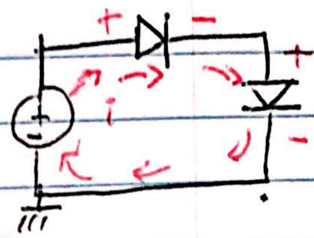
Electrons exit the negative terminal of the battery to go to the Positive terminal in search of balancing their negative charge distribution, they go from the side where they are all chunked up to where there are less electrons.

This is what really happens but we never use this Convention since we had an earlier Convention, which is the conventional Current Flow

SUMMARY: In reality Since Electrons are negative in charge, They move from the negative terminal of the battery to Positive side in search of Equilibrium.

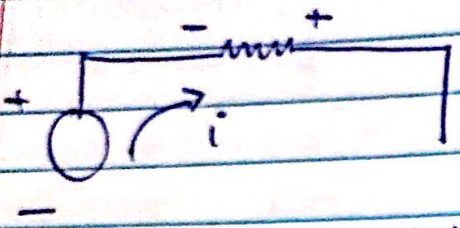
DIODE EXAMPLE OF CONVENTIONAL CURRENT FLOW

we assume the current is Positively charged



This is the Convention that had been adapted from principle, So since the current is positively charged it exits the Positive terminal in search of balance & equilibrium so it exits the Positive Terminal of the generator and Enters through the ~~bipolar~~ Positive terminal of the bipolar Passive Components. Since the flow is all a Search of equilibrium, the Positive Current flow is going from a Positively charged chunked up Place to the negative Pole to find equilibrium. So if the current didn't enter the bipolar Passive components in the Positive Pole but rather in the negative Pole, it means it found an equilibrium so there would be no current flow

Conventional current flow. Pt 2.



⇒ no current would flow through the resistor because it find equlibrium in the negative pole of the resistor

So we would need to neccesarily correct ourselves ~~b~~ or by saying the current is negative or by inverting the poles of the Resistor

DIODES

It's a semi conductor that allows current flow only in one direction

I → The current i only flows in the direction of the arrow versed diode

but let's keep in mind that the real electron flow is in the opposite direction

→ I ⇝ conventional current flow

\+ −

where the current is positive

but the electrons flow the opposite way:

ANODE  CATODE

\+ −

← e^-

p-type
⇓
positively dropped silicon
⇓
dropped with ~~two~~ 3 electrons
⇓
it has holes to host electron

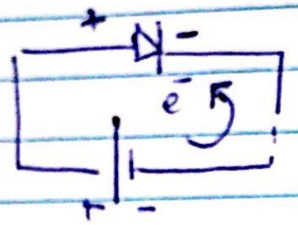
⇝ n type ⇝ negative dropped silicon
⇓
has electrons in extra to give away in search of equilibrium!
⇓
it's dropped with 5 e^- more

ex)

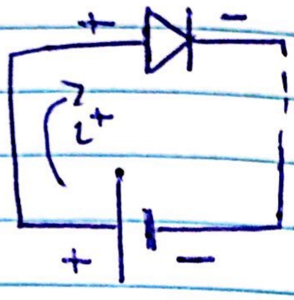
silicon has 4 electrons, to complete the set of set it needs 4 more

In Reality electrons flow from the Cathode to the anode but by convention we say the current flows the opposite direction as I is positive.

In reality



In Practice : i as positive current

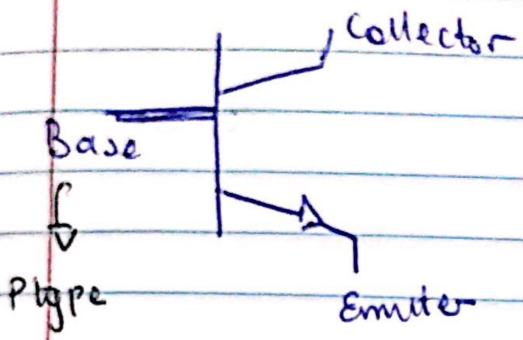


In Practice we assume that the positive current in search of equilibrium flows from the positive terminal of battery to the negative side.

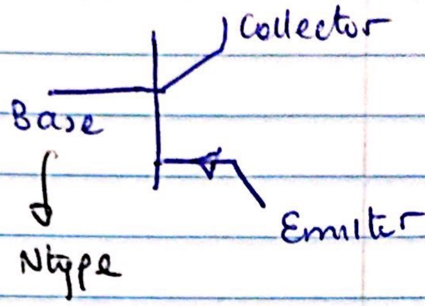
So now we understand why diodes are unidirectional because the N types ~~are~~ has the extra electrons to give away and the P type has holes to collect, so that's why the electrons would flow from N to P only, meaning from

Transistors . Could be of NPN or PNP Type !!

NPN Transistor



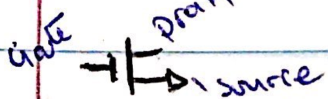
PNP Transistor



Transistors work as switch => a current will flow through the emitter only if a certain condition met so we can control the current flow intelligently therefore create a switch.

Transistors are also used as signal amplifiers !! which is the zone of saturation of the Transistor

Current flows from base to emitter !! (that gate and source)



M

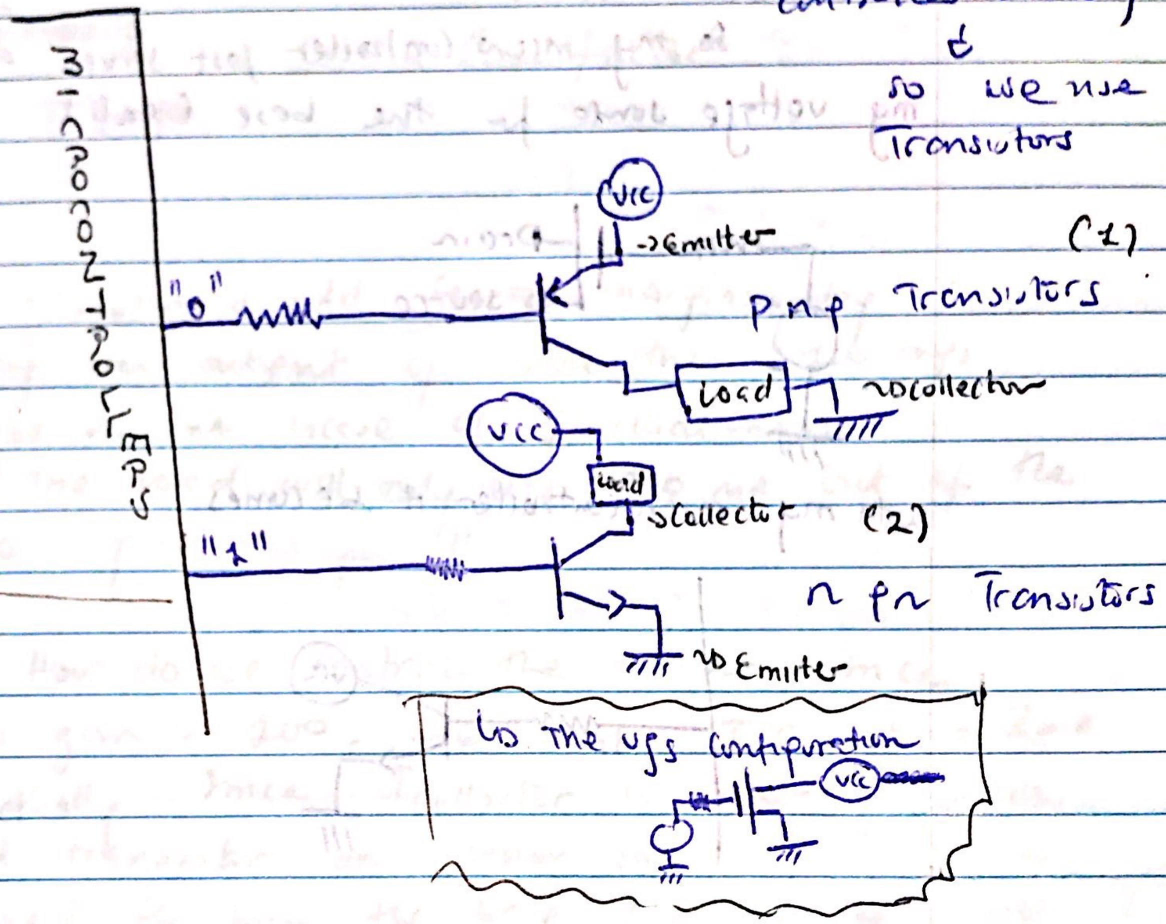
For the NPN Transistor The base is
set to the same voltage as the Collector
so no current flows through the load
to make current go through the load
make Base voltage active Low or
zero !! Then current flows through the load

For amplification ! watch out the load connected to the Emitter is a ~~Resistor~~ control
while the real load is connected to Emitter
when the transistor acts as a closed ~~[illegible]~~ Switch
switches The current received is the Emitter is amplified

Lecture 1 Embedded Systems & Design

Microcontrollers normally give out up to a maximum of 10-20 amps what if I had heavy loads with high current consumption? ⇒ I can't connect them to the controller directly

& so we use Transistors



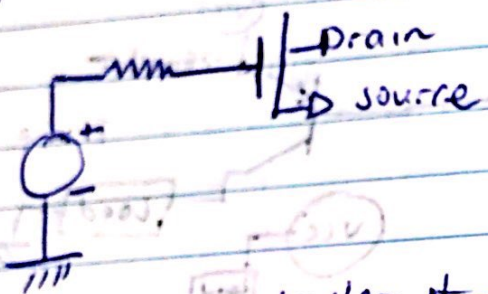
(1) PNP Transistors:- the current flows from the Emitter to the Collector, to use the Transistor as a switch correctly ⇒ the micro controller has to be a active Low because I need to turn the Transistor on by making current go trough the base from vcc !! so if the upper end is vcc, the lower end has to be active low !! Then the transistor works as a switch

When micro is active high → No current flow cause vcc is high and micro is high + + no current flow !!

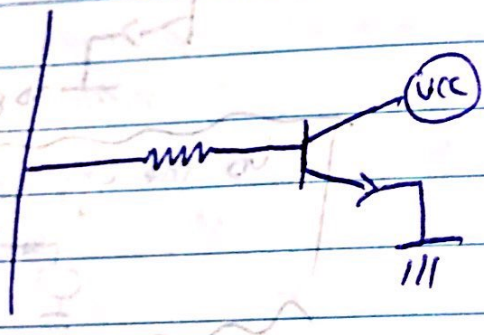
(2) NPN Transistors

we need to be in the setup configuration where the base (drain) is at a higher voltage than the Emitter (source) and Vcc is providing the current to the drain or collector !!

So my micro controller just serves as my voltage source for the base (gate)



with my microcontroller it becomes



So how do we choose our values ?

If our load needs a current of 200mA we should ~~support~~ get a Transistor with more current support

Every Transistor also has a gain factor !! which amplifies the current from the collector !!

So if my load needs 100 mA and my load is connected to the Emitter i should give the collector 1 mA since the Emitter current gets amplified a 100 !!

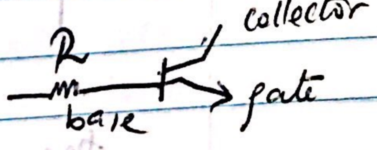
$$\frac{I_{collector}}{I_{Emitter}} = 100 = \text{Gain factor}$$

But we should add safety margins by giving an output of more than 100 amps maybe 200 mA incase of fluctuations !!
The load will only use 100 mA out of the 200 given though !

So How do we control the current since the gain is 100, we make I collector = 2 mA
Actually since I collector is meant to switch the transistor on, when the transistor is on current ~~for~~ from the base flows to the Emitter !!

So → I collector → Triggers base to emit current to Emitter

So at the end i have to control the base current



⇓

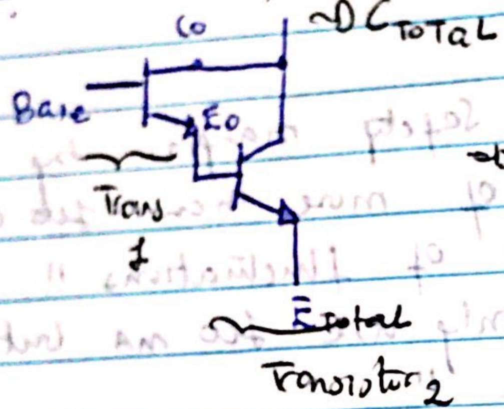
i control the base through varying the Resistance R !!

What happens to extra heavy loads that consume thousands of mA ?

⇓

we cascade Transistors !!

Darlington ~~stage~~ Transistors just gives us the cascade of Transistors in just one Transistor.



→ this is how we couple the gains !!

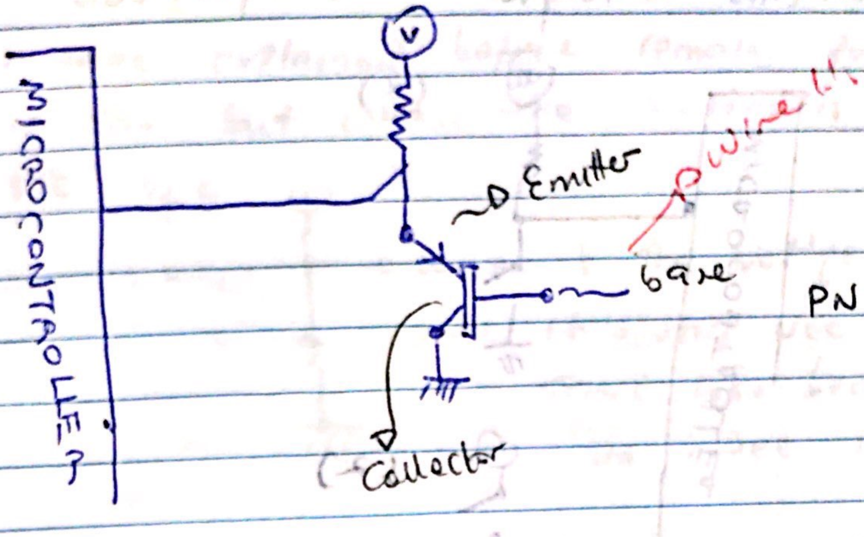
by connecting the emitter of Trans 1 to the base of Transmitter 2

They are really high-gain ⇒ Gain of 10^4

Their major application is if the input signal is very small, very very small → They are used to amplify the signals !

⇓

This ~~explain~~ explains why even though they have high gains but they support a max of not so much high current !!

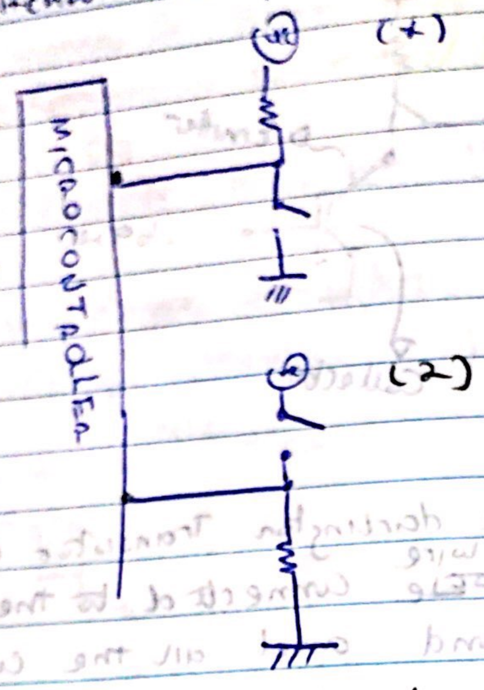


PNP Darlyton Transistor

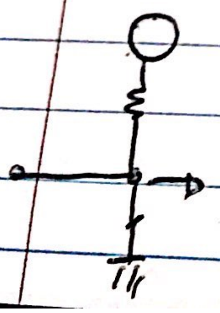
In this case, the darlington Transistor acts as a Switch if I touch the ~~base~~ wire connected to the base, my body acts as ground and all the current flows through my body, so what happens? ⟹ The transistor is triggered and it seems like no current flows through the Emitter so that pin sees ground and therefore Logic "0".

If i remove my finger my controller sees Logic high, it sees the V volts.

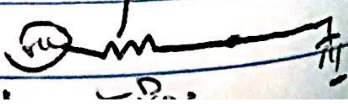
Switches through Active high & Low



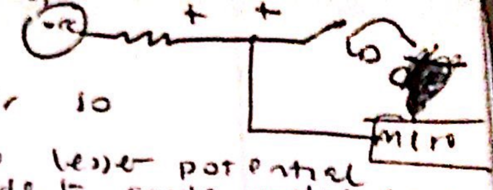
(1) when the switch is closed → active Low
The microcontroller sees 0 or ground in that pin of the microcontroller
if it's open what does the microcontroller see in that pin?
it sees a floating wire which would be anything active high, or active low
floating wire are sensible to noise around.
so how do i tie the pin to a state
when i disconnect the switch?
I use a Pull up Resistor by ~~keep~~ tieing the Pin to Vcc through a resistor.
and the pin sees an active high



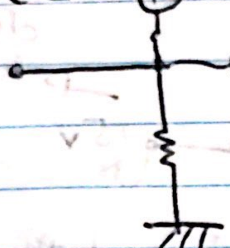
i see ground because of voltage drop caused by resistor



4 the switch is open though i see no voltage through the resistor so point c is still in vcc => so lesser potential node to cause voltage drop

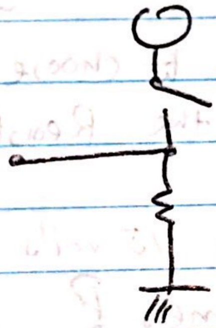


(2) The same explained before remains for this case too. But when the switch is closed i see Vcc



what is the voltage here?
It's still vcc because there has been no drop so i see Vcc

but what happens when i open the switch

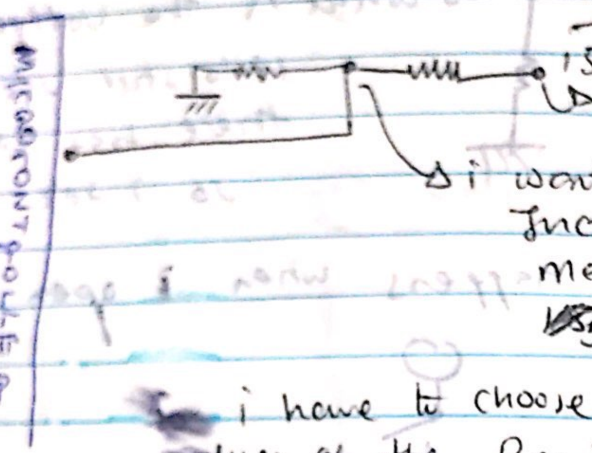


i see the closed loop
[illegible]

i see ground so active low !!

Lecture 2 SIGNALS CONTROL

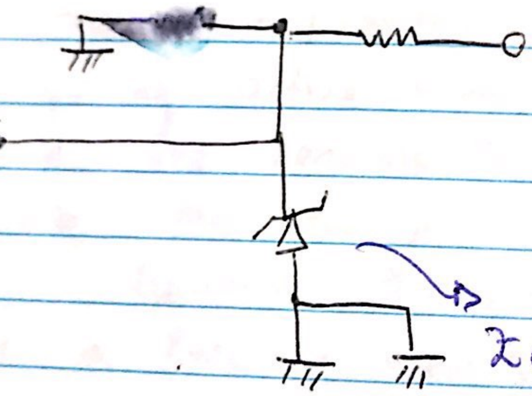
how do we measure signals in the micro controller that are greater than 5 volts ? → VOLTAGE DIVIDER



→ i want this Junction to measure max ~~15~~ 5 volts

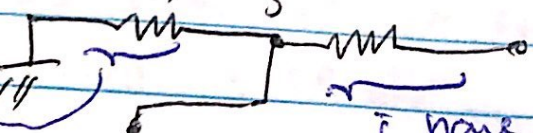
i have to choose the values of the Resistors

So what if the value of 15 volts isn't actually 15 volts and it fluctuates sometimes ?!
use the Zener diode !!



→ Zener diode !!

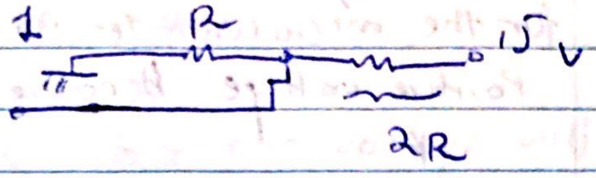
So what if 15 volts become 30 after I have chosen the value of the Resistors
Remember I designed the Resistors such a way that



I have a drop of 5 v here

I have a drop of 10 V here

So the Resistors must be Chosen In the proportion. 2 : 1



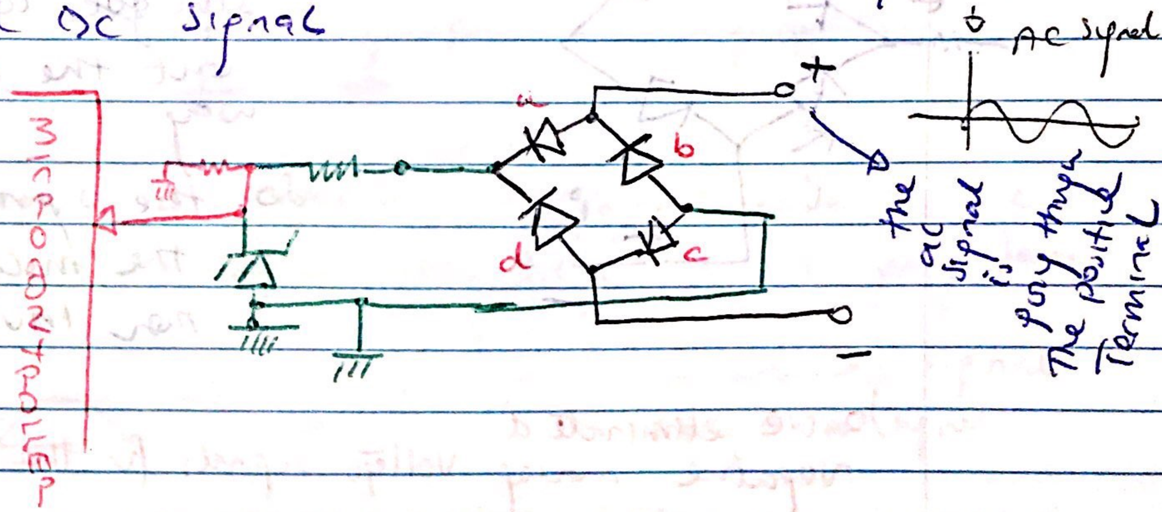
So back to our initial discussion what if 15V becomes 30 V then that junction connected to the microcontroller measures 10 Instead of a maximum of 5 volts ?

→ This is where the zener diode comes into Play

when the voltage becomes higher than 5V it clips the voltage down ~~by~~ back to 5V by turning on and Consuming the extra volts and dissipating as heat.

So now we want to build on this design other Complex structures so what if the Input Signal is an AC Signal ?

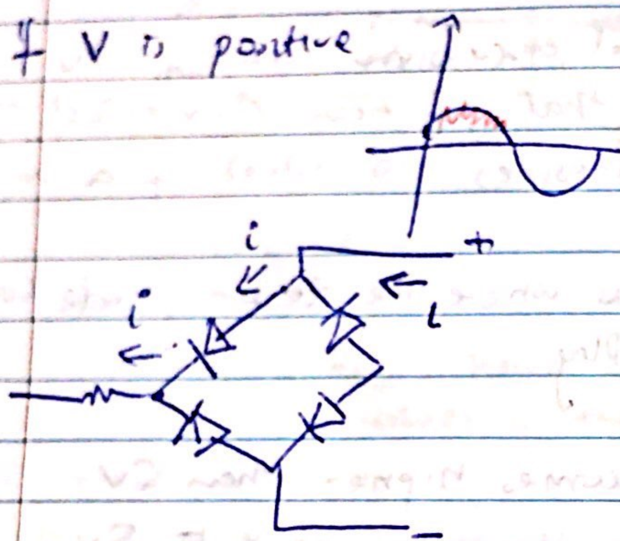
So we would like to Convert the AC signal to a DC signal



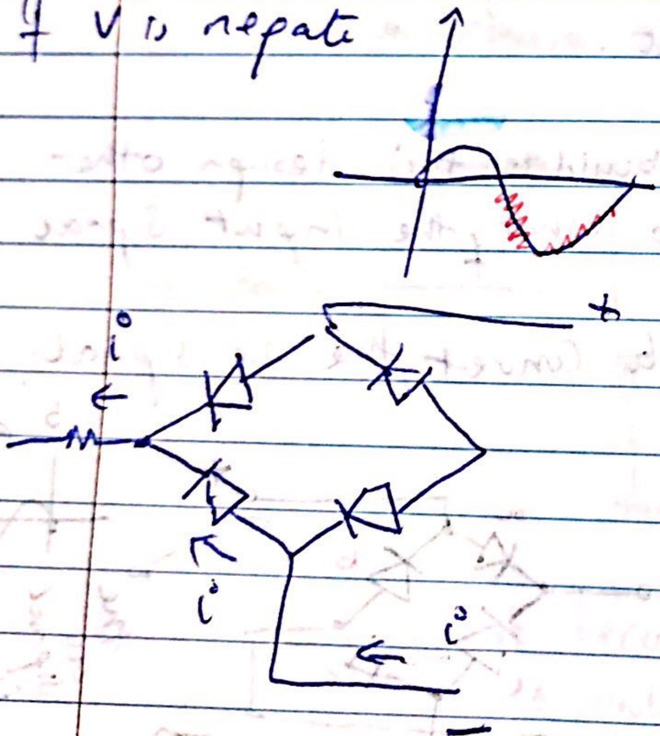
In this way we polarize the voltage signal for the microcontroller as it sees just a positive voltage because of the diode

AC

If V is positive



If V is negate



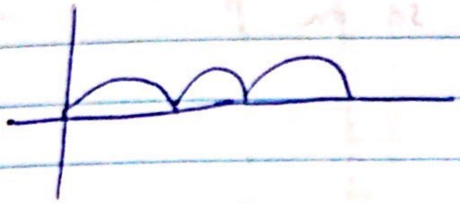
i still ~~goes~~ comes out the same way

So the signal for the microcontroller is non inverting !!

So we eliminated Negative ~~makes~~ voltage signals for the micro

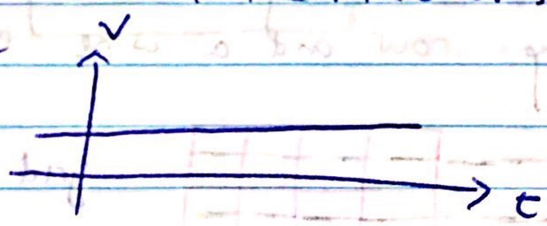
But the signal voltage is still ~~varying~~ varying

because $V = V_0(\sin \omega t + \phi)$

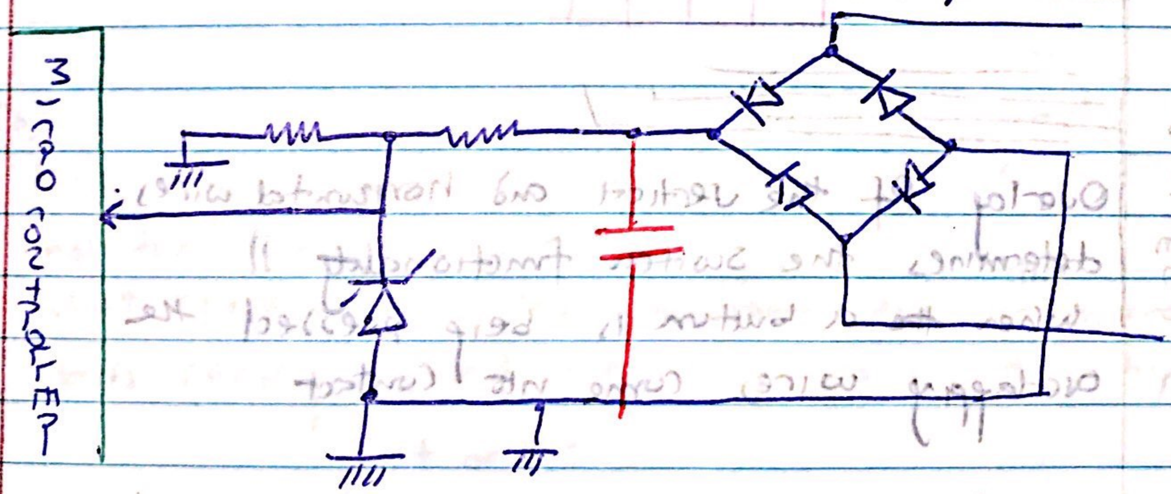


⇒ b/c the voltage will vary from 0 to V_0 then V_0 back to 0 continously so we ~~want~~ want to avoid that !!

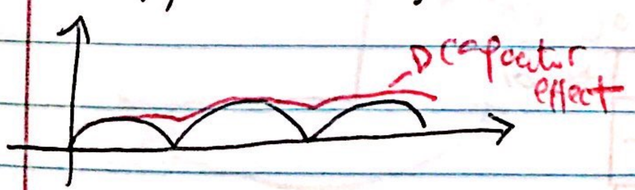
Basically what we want the micro to see is this graph



So how do we do that? ⇒ we apply a capacitor



we apply a capacitor, it's going to have to give energy to the system when the voltage is going down

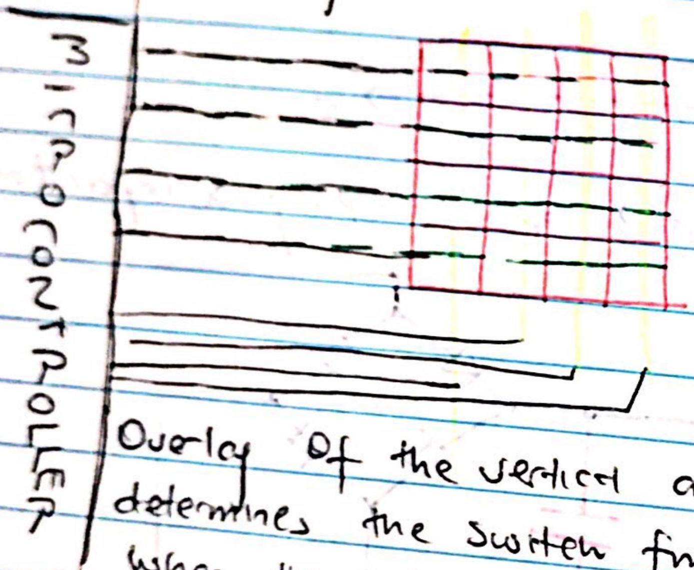


⇒ we smooth the signal to almost a signal

So instead of having the voltage going down from 5v to zero volts, we have the voltage going from 5v to 4.5 v and so on !!

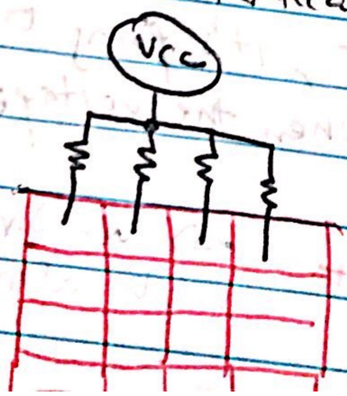
Keypad Connections !

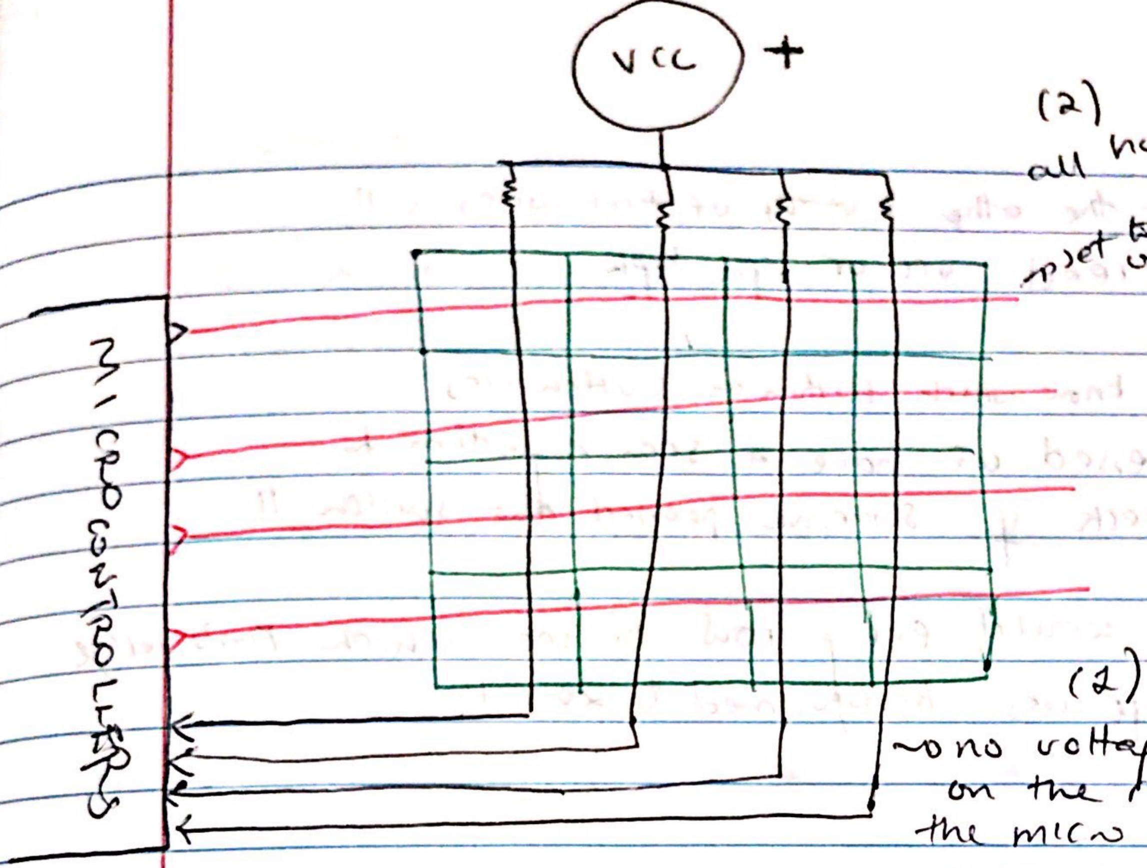
It's a grid of some switches (buttons)
The best way of connecting a keypad to the microcontroller is by dedicating a wire to every row and a wire to every column



Overlay of the vertical and horizontal wires determines the switch functionality !!
When ~~the~~ a button is being pressed the overlapping wires come into contact

we connect the vertical wires to the VCC through a...

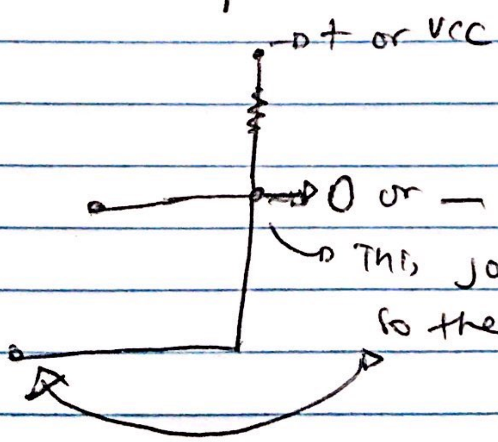




(2)
all horizond wires are set to active low or ground

(1)
→ no voltage drop on the resistor so the micro controller sees VCC on the pins, Remember current only flows from higher potential to Lower potential, here I dont have a low potential just high potential which is VCC

(3)
Now when i press a button and two overlapping wires touch what happens? ⇒ The ~~horizontal~~ vertical pins in microcontroller starts reading ground instead of vcc or active high

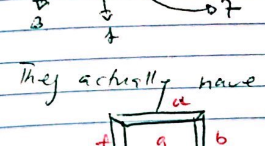


→ This joint here becomes ground so the pin sees ground but the other 3 ~~wires~~ vertical wires will still read vcc or logic high

To know which button or switch was pressed we have a scan algorithm to check if someone pressed ~~the~~ switch !!

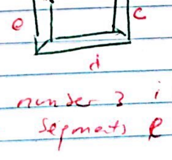
we would every row to see which Pin's voltage voltage was transformed to zero !!

SEGMENTS LED



so it has 7 segments

They actually have names



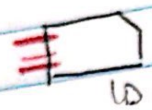
to have number 1
i have to light up segments
~~so~~ b and c

to have number 3 i have turn all segments on except segments e & f

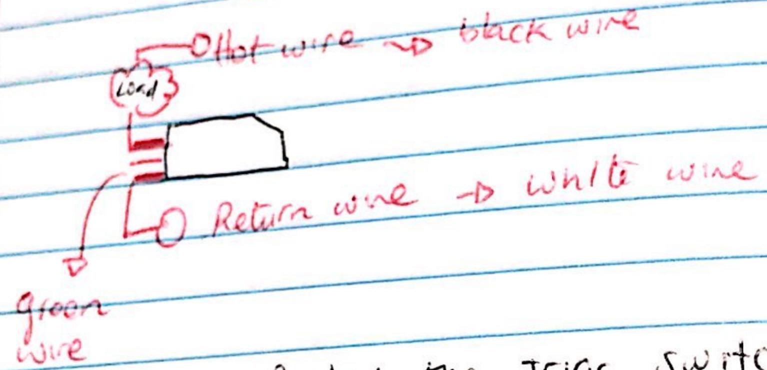
DIGIT MULTIPLEXING

How ~~to~~ we switch on/off AC and HIGH POWER LOADS ?

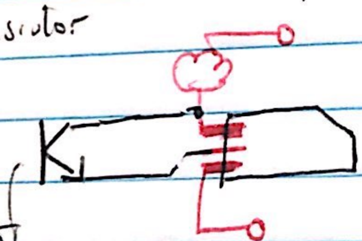
We can't use simple Transistors for light loads we have seen up till now, we use special devices called TRIACS



It has 3 wires, 2 thick ones and thin one in the middle



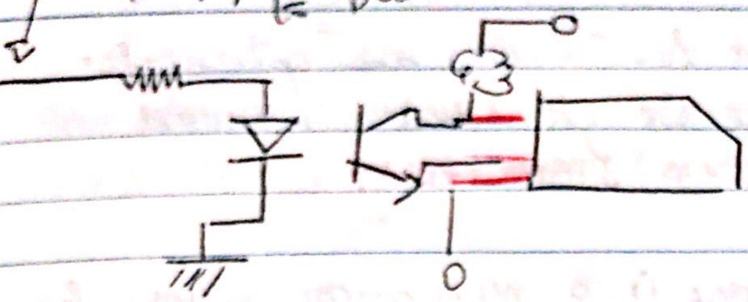
(1) So how do we control the triac switch?
It's controlled through a small signal Transistor



(α) Collector to Hot wire
(β) Emitter to the green middle wire also called the gate to the triac

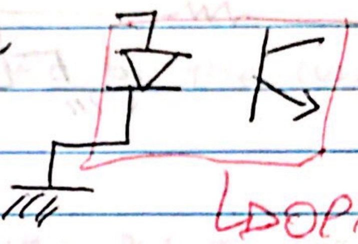
It has no gate but a photosensor to trigger the transistor i control the led by applying high or low to pud on the led

microcont.



the transistor is triggered by the Led when it's turned on, AC voltage is supplied to the Load, so the microcontroller controls the led which controls the TRIAC.

The package of the Led x Transistor is called OPTOISOLATOR

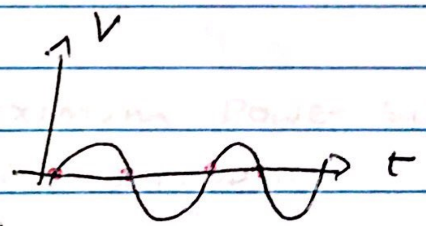


LDOPTOISOLATOR

b))

FOR AC SUPPLIANCES

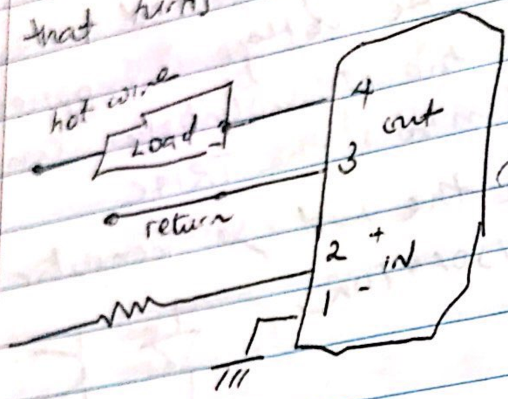
It's ideal to turn switches on at the zero crossing to avoid overshooting currents at max voltage that can damage electronic devices.



example → Light bulbs burn out because when they are turned on, they are turned ~~out~~ on at the voltage is at peak but if they were managed to be turned on at the zero crossing everytime they would last longer !!

So combining a zero crosser, an optoisolator and a TRIAC we get ~~what~~ is called an ~~OFF~~ A SOLID STATE RELAY

A solid state Relay is a mechanical switch for AC Loads that turns them on at the zero crossing!



The kyotto SSR is for AC for Loads with voltage 28 - 240 V and 2A but there are SSR with more amps!

3 n p 8

MOTORS CONTROLLING

How do we Control DC Motors ? and what needs to be Controlled ?

(1) The motor's direction

Clock or anticlock wise

(2) its Speed => which can't be Controlled by cutting voltage or amps to the motor !!

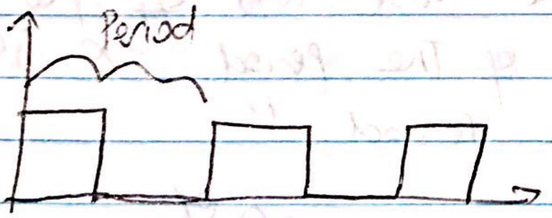
we are not decrease the voltage or current !

(1) The motor's direction is controlled by the current's polarity or direction

(2) the speed is controlled with PULSE WITH MODULATION (PWM)

so now what is PWM ?

Giving the maximum power but only for a period and repeat

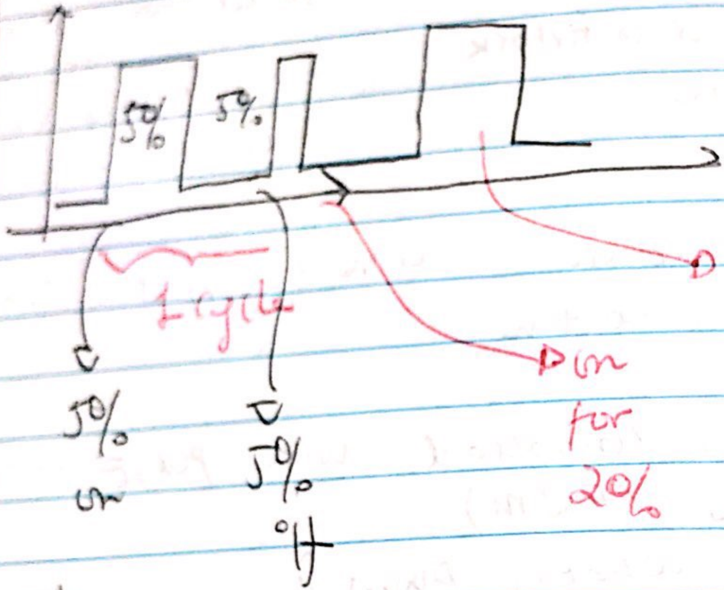


So give the motor maximum power (Voltage x Amps) for some time then ~~deer~~ cut it off from power then give it max power again.

The speed depends on the ~~duty~~ duty cycle

of the ~~we~~ pulse in one cycle which in one period, The duty cycle is the on time out of total period of time ~~of~~

time



Duty cycle is 50%

In 1st Cycle ⇒ the Pulse ~~was~~ was on for 5% of the Period & 5% off in that period

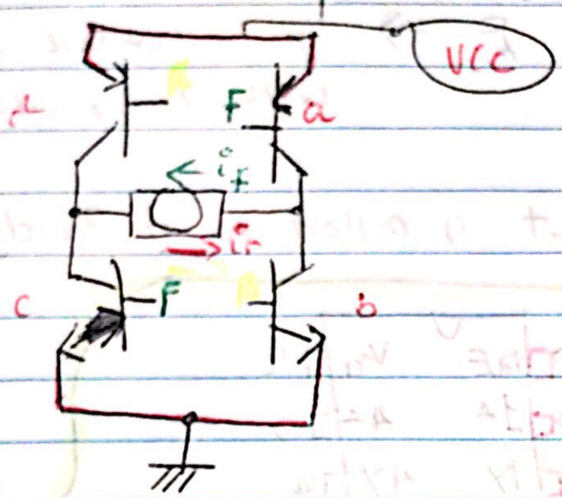
In 2nd Cycle ⇒ The Pulse was off for 20% ~~off~~ of The period & 80% off of the period !!

so the duty cycle is 20%

↳ to control the speed ⇒ we control the duty cycle ⇒ more duty cycle ⇒ more speed

↳ now lets discuss the actual control

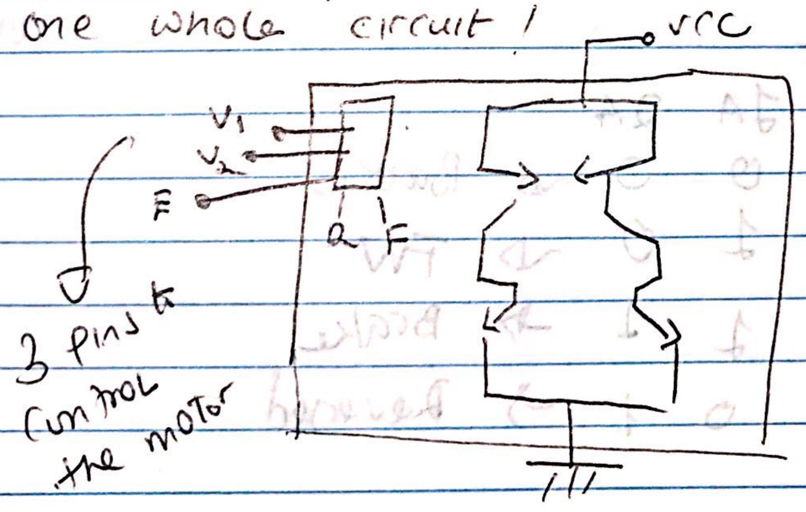
we use 4 Transistors



(1) If i turn Transistor a on current goes from transistor a to c to ground

(2) If i turn on Transistor d, current goes from Transistor d to b to ground

This quadriple set of Transistors are served as one whole circuit !



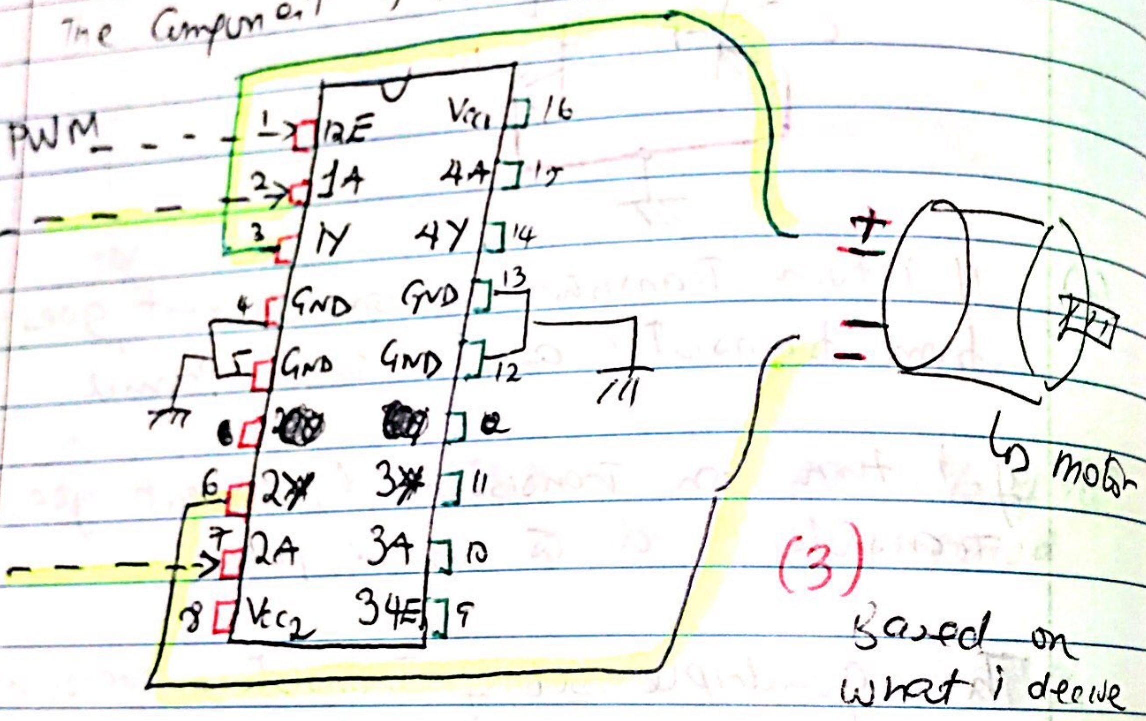
supply vcc to these pins

V_1	V_2	
0	1	→ forward
1	0	→ reverse
1	1	→ forbidden and Transformed to 0
0	0	→ no movement

Enable Pin E → is to control speed with Pulse width modulation

The Component is called an H Bridge

(1) Pins to which my controller will send signals to



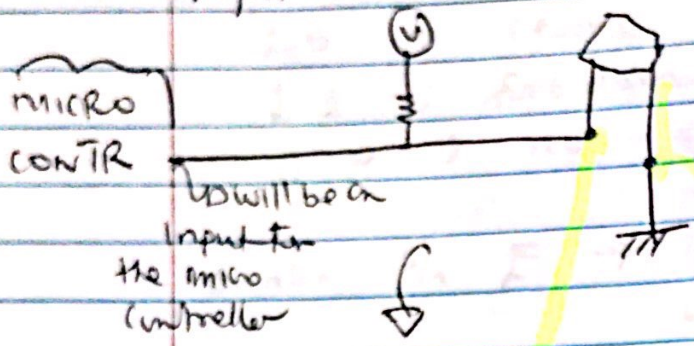
(2) direction of motor

1A	2A	
0	0	→ Brake
1	0	→ FW
1	1	→ Brake
0	1	→ Reversed

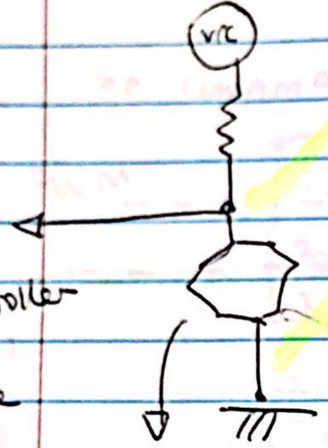
(3) Based on what i receive on my microcontroller
↓
i send the signals to the motor through slots 3 and 6

SENSORS

Light sensors



Photocell
⇓
If there is light
↓
the resistance is low
when it's dark
The resistance is high



measured by microcontroller
|
measure the voltage on the sensor respect to ground

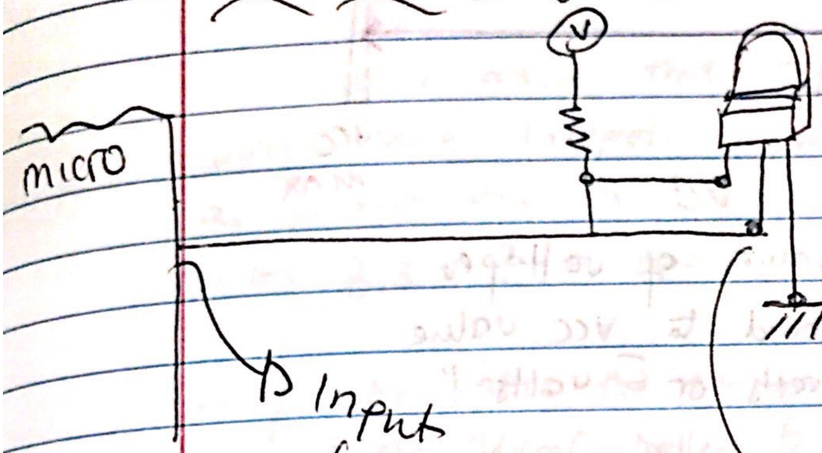
→ this can be thought as a potentiometer so a resistor

voltage divider Scenario

when it's dark the voltage ~~decrease~~ across the sensor increases so ~~current can be pushed~~ the same current can be pushed across both "resistors"

↙ sensor
↘ and series resistor

Temperature Sensor



I dont have to do anything

↓

i Just have to measure the Voltage the voltage on this Pin of the Sensor

→ Input for the micro

$10\,mV$ per $\overset{\circ}{F}$

So If $V_{out} = 0{,}85\,V \rightarrow$ Temperature $= \frac{850}{10} = 85\,F$

↓

$850\,mV$

If Temperature $= 72\,°F \rightarrow V_{out} = 972\,V$

NORMALIZATION OF INPUT SIGNALS FROM SENSORS

my micro reads values of voltages that vary from Ground to VCC value which can be 3,3 volts or 5 volts !

But my sensor emits some values of voltage that my micro will take in as input, but does my sensor minimum value correspond to the microcontroller minimum value which is ground ?
Most of the time the answer is no !!
So how can my sensor values be Normalized ?

(1) So firstly i must make sure the output of the sensor is in the microcontroller's Range of Voltage else ~~it~~ i'll damage the microcontroller !!
So for example if my sensor gives an output of 12 v → i must use a voltage divider in order to measure the voltage at a ~~Joint~~ Joint which it's reduced !!

(2) So assured that the ~~voltage~~ sensors give me output voltages within [0 , 3,3 v]
how can i normalize ~~this~~ its values ?

Scanned with CamScanner

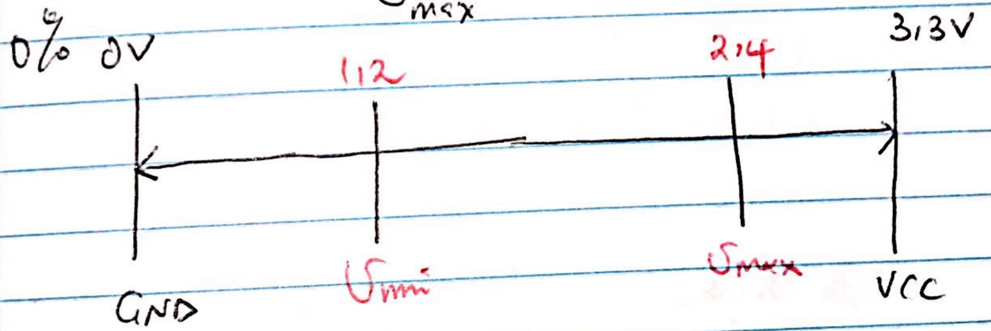
ex If my Sensor gives an output of $\xleftrightarrow{\quad}$ 1,2 ... 2,4

V_{min} ... V_{max}

how do i assure that my microcontroller intepret 1,2 volts as a min which is 0V, 2,4 volts as a max which is its 3,3 V? → There is a formule!

So if the value the sensor outputs and gives to the Microcontroller to be read is V_{in}

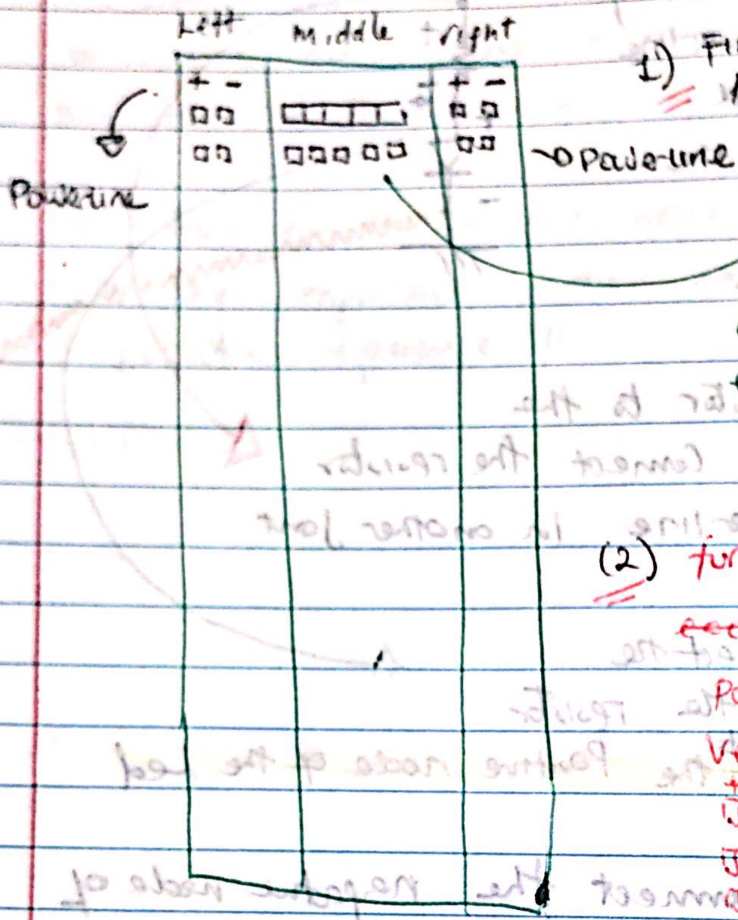
$$V_{normalized} = \frac{V_{in} - V_{min}}{V_{max} - V_{min}} \times 100$$



Power statement

1st ARDUINO HAND PROJECT

TO UNDERSTAND BREADBOARD

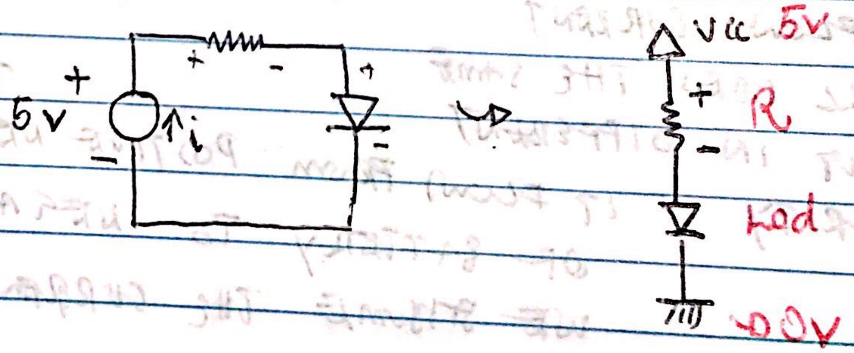


1) Firstly each row in the middle is connected → one single row is connected and each row has 5 entries or rooms

(2) for the power line, it's ~~each~~ different the powerline is connected vertically → if i connect one of them to vcc then the rest holes are also at vcc too.

So (3) basically + is always for vcc and - is for ground or the lesser voltage for there to be voltage difference.

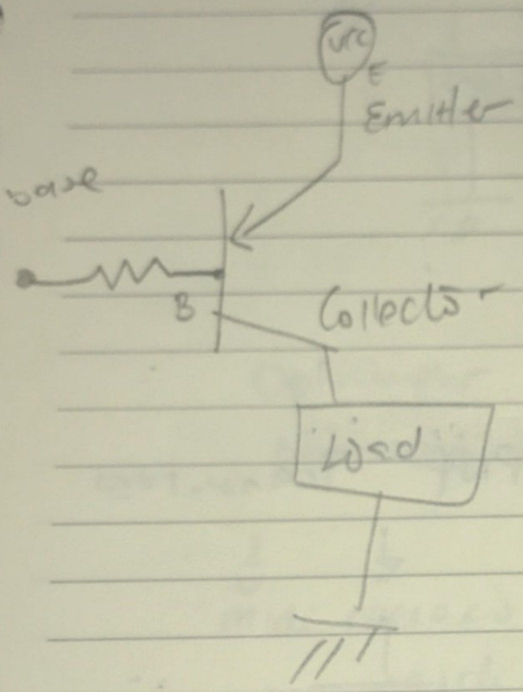
So lets build this circuit



TRANSISTOR FUNCTIONALITIES

Transistor Revision

Transistor
→ amplifier
→ switch



V_{CE} → voltage between Emitter x Collector

For current to go from Emitter to Collector, it has go through the base, so meaning i have to get current to the base !

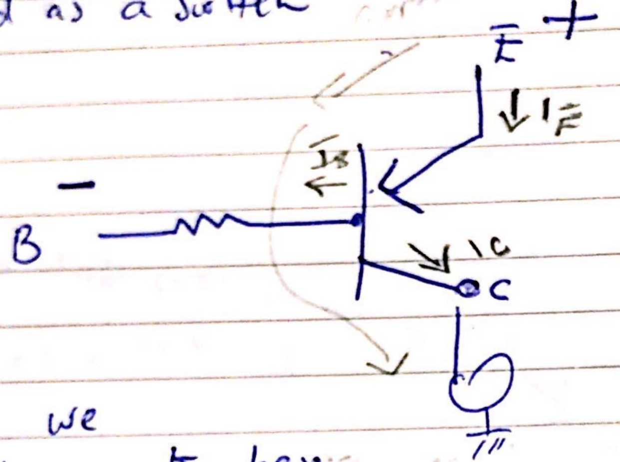
↓

How to do that? ~~Supply~~
make current go to base by giving base less potential → potential drop between Emitter x base → current flows to base and therefore to Collector ! → Transistor use as switch

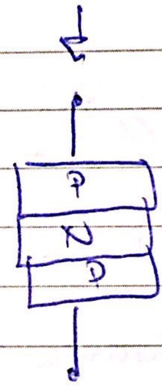
HOJA Nº

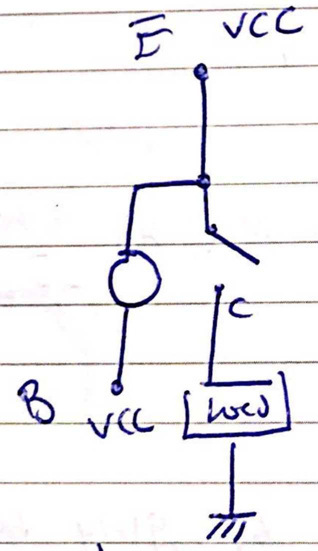
FECHA

by Controlling the Tension or voltage at base → Transistor can be used as a Switch



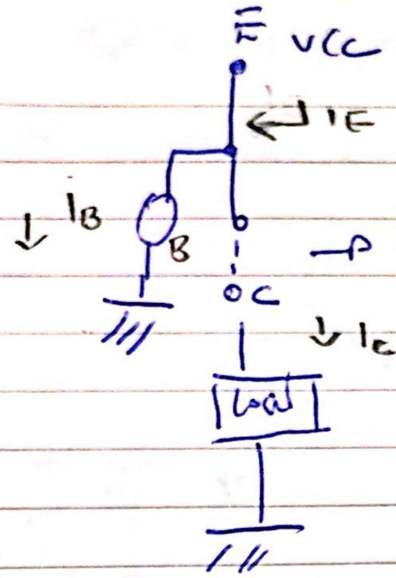
when we supply − to base
↓
Transistor Turns on ⟹ PNP Transistors





IF Emitter & Base are both at same voltage ⟹ there is a switch between Emitter and Collector

NOTA



→ Switch closes

E at Vcc

base at 0v

Optocoupler voltage isolation between input & output

↓

midi received between port 4 & port 5 on midi din → This lights up internal led in opto

↓

sensed by photosensor in opto

Brainstorm

8 → base 1 and Collector 1

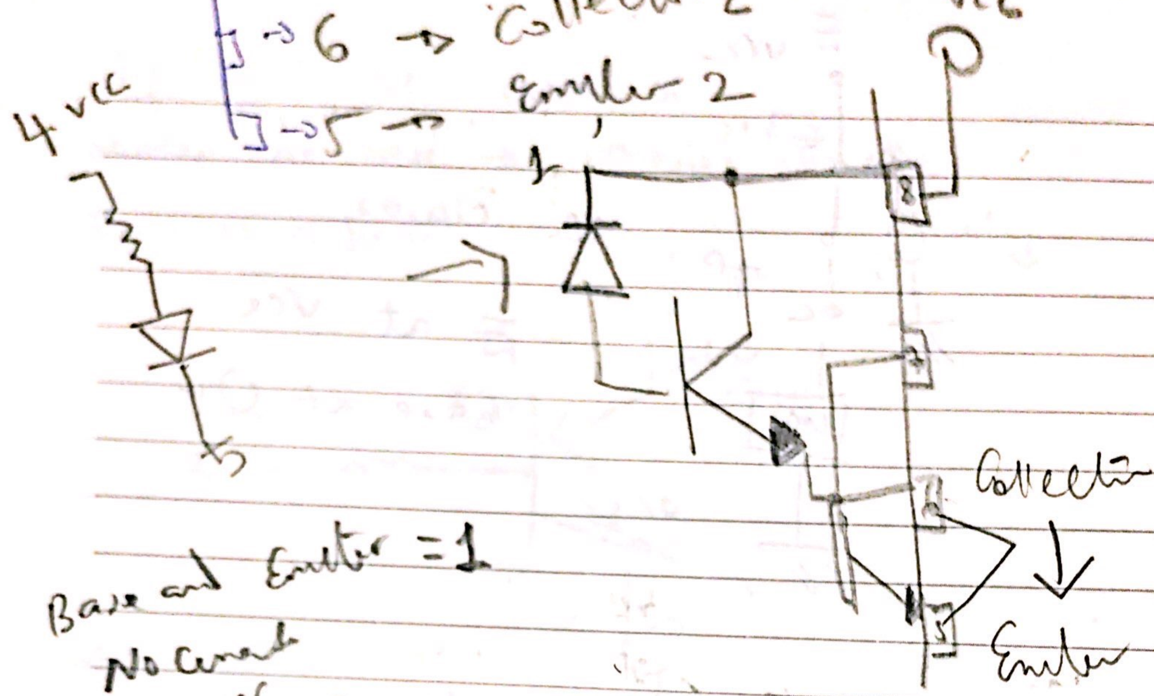
HOJA N°

7 → base 2

FECHA

6 → Collector 2

5 → Emitter 2



Base and Emitter = 1

No Current

XTRANS ZND

TIE PIN 4 TO HIGH

Tx to PIN 5

⇓

MID MORE ZERO HAT no does XOR operation!!

NOTA

AND

5	4	
1	1	→ 1
0	1	→ 0

Pin 4 → always tied 5

Midi data travels through Midi 5

bas Midi Signal

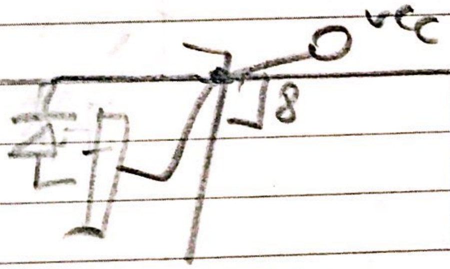
5	4	
1	1	0
0	1	1

The Mididata can be seen as an XOR operation between Pin4 x Pin 5

Reading w

Midi cable ties Pin 4 to high

Midi 5 → High or Low based on data received



Initial schematic by ... tied to 5V

No current flow → light sensor → Current Flow

breaks base to 0V

from Emitter to base 2

Question on ~~at~~ how
Rx recieves
date sent from
pin 5 of
mich

how does collector 2
go to gnd?
if tied to 5V initially?

trans 1 activate ~~trans~~ 2

trans 2 → activated means
i allow current to go
from ~~collector to~~
emitter to collector

switched closed between
emitter 2 & collector 2

means emitter
has ~~be~~ to be at
gnd since ~~coll~~ ~~Emit~~ //
the circuit is
seen closed
between
emitter & collector

HORA
FECHA
NOTA

HOJA N°

FECHA

Pin 5 Recieves data

Pin 4 Receive data

~~tied to high~~ voltage

cable ties Pin 4 to VCC

base on the data transmitted ~~on~~ the cable → Pin 5 voltage varies

~~The Arduino data is~~ XOR

Operation between Pin 5 × Pin 4 is applied to optocoupler

If 4 is high
5 is high → ~~bit~~ 0 Led is OFF

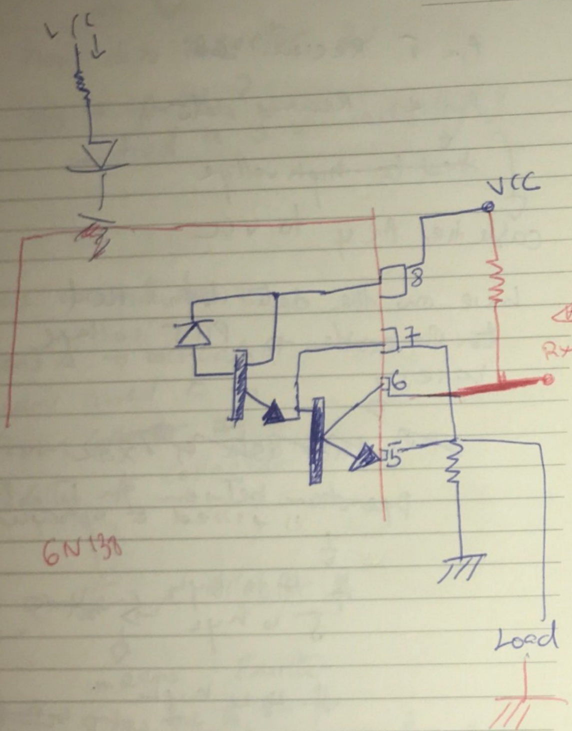
~~If~~ 4 is high
5 is low → ~~bit 1~~ led is on

bit 0 is at received side the arduino

NOTA

HOJA Nº

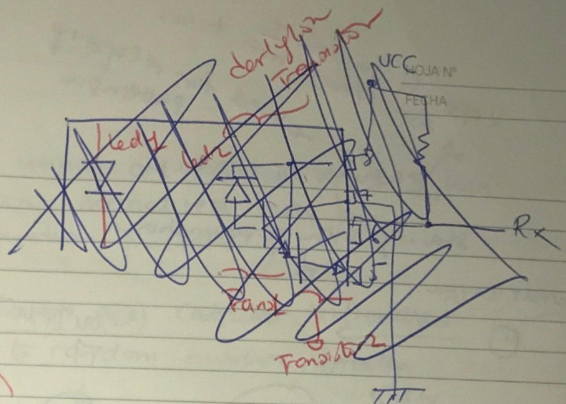
FECHA



NOTA

HOJA Nº

FECHA



(1) Base 1 connected to VCC (3) Emitter 1 connected to Base 2

(2) Collector 1 " " " ",

(4) Base 2 connected to Port 7 to ground

(5) Collector 2 connected to Port 6 to Rx

(6) Emitter 2 connected to Port 5 to wall or ground to any Power

when Led 1 switches on, base 1 goes to zero V?

↓

transistor 1 activates !! Current flows from collector 1 to base, then to Emitter 1

NOTA

MICRO PINS

Midi In → Pin Rx (Pin 0)

Midi out → Pin Tx (Pin 1)

Led For Mode choice → Pin 3

Led For start Button → Pin 2

Pin 4 } Pins For button

Pin 5

Pin 6

Pin 7

Led For octave choice → Pin 8

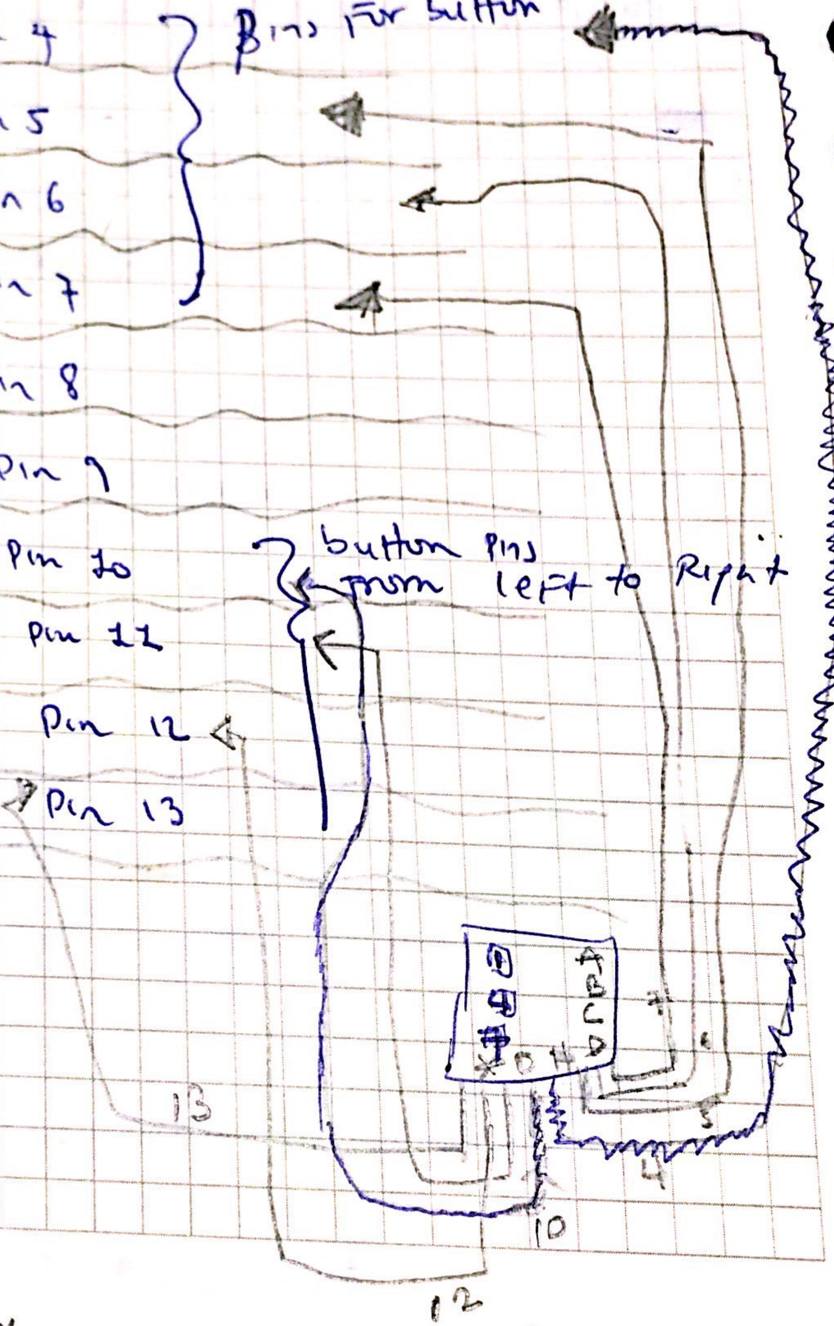
Led for confirmation of Sent bass note → Pin 9

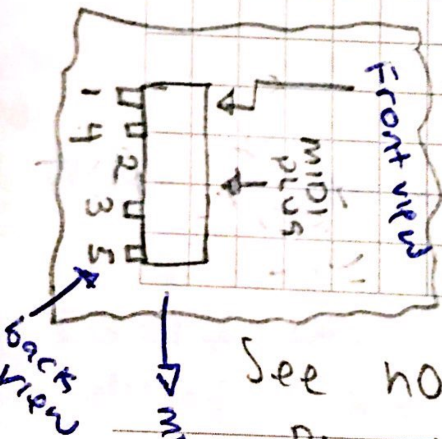
~~Led for [illegible] Tx Pin~~ → Pin 10 } button pins from left to Right

Pin 11

Pin 12

Pin 13

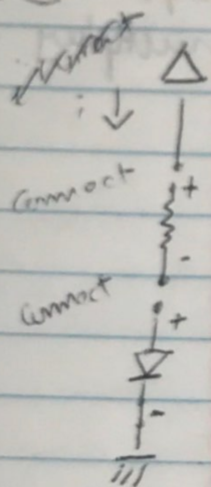




See how Tx Pin works by connecting Led to Tx Pin too

If we use the realistic Perception, It's still the same, but current flow from negative to Positive but negative in sense of high-potential Packed with Negative sign !!

So ~~From~~ for the Micro Controller, VCC & GROUND ~~GND~~ are very Important, there needs to be a potential difference !!



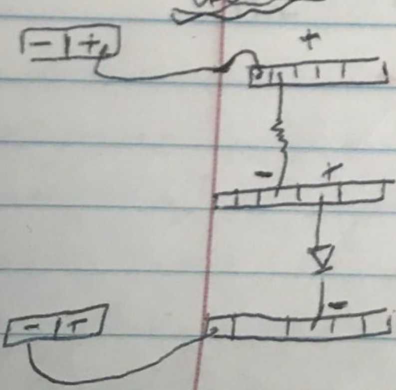
or ~~The terminals~~ ~~of bipolar to be linked to~~ VCC or Ground state

drop in voltage so current flows through resistor

→ ~~DOD~~

1) Connect VCC to ~~negative~~ Positive pole of Resistor, The other pole becomes the negative one
2) Connect Positive Pole of diode to negative Pole of Resistor
3) Connect negative Pole of diode to GROUND

ON BREAD BOARD



→ The current Flows through resistor

~~BREAD BOARD~~ & to let the current flow through the LED, ~~DOD~~ connect it through ~~this~~ it positive terminal

ARDUINO IDE STYLE

define variables →
setup function
Loop function

→ water Hacker's guide to programming an arduino !!

* define variables (define pin) → look at pin chart
  ex pin 1.7 → number 15
  1.6 → number 3 etc.

* setup function {
  pinMode (variable holds pin number , INPUT/OUTPUT)
  }

define which pins are for input & output

* Loop() {
  code logic on what to make pins do
  digitalWrite (Pin 1, HIGH)
  }
  ↓
  pin 1 emits 3.3 V !!

TRADITIONAL C STYLE (CCS IDE)

```
#include <msp430.h>
unsigned int ....

void main ( ){
```

(*) WDTCL = WDTPW + WDTHOLD; => disables watch dog timer => meant to reset the controller after some time

(*) Configure input X output pins !!

how do i do so? Port 1 has 8 pins from 1.0 to 1.7

So there is a register called P1DIR of 8 bits or a byte

P1DIR = <pin7><pin6><pin5><pin4><pin3><pin2><pin1.1><pin1.0>

1 → output

0 → input

if the first bit of P1DIR is 1 -> then pin 1.7 will be an output pin, if the second bit of P1DIR is 0 -> pin 1.6 will be an ~~I/p~~ input pin and so on !!

* So lets say i want to use pin 1.0 as an output -> P1DIR has to be -> 00000001

P1DIR = 00000001 in hex it's 0x01

So i just do the or operation by saying

P1DIR = P1DIR | 00000001
↳ OR

So i get

00000000
OR
00000001

00000001

So P1DIR Register Value = 00000001 ~ 1 in binary

↓

in Code P1DIR |= 0x01
~ 1 in hexadecimal

So let say i want to use Pin 4, 5, 6 as outputs
P1DIR will have to be 01110000

to Convert in hexadecimal
Just group in 4s ⟹ 0111 0000
then Convert each group of 4 bits to decimal
then reconvert to hexadecimal

$\underbrace{0111}_{7 \text{ in decimal}}$ $\underbrace{0000}_{0 \text{ in decimal}}$

7 in decimal ↓ 7 in hexadecimal

0 in decimal ↓ 0 in hexadecimal

So just write in
C code ⟹ P1 DIR |= 0x70

⟹ P1DIR = 00000000
OR 01110000

So P1DIR has these bits ⟵ 01110000

and in these way ~~Po~~ Pins 1.6 1.5 1.4 become output Pins

There is a simpler way of doing all this though, to set Pin 1.4, 1.5, 1.6 as outputs just write

P1DIR |= (BIT4 | BIT5 | BIT6)

or operator

P1DIR becomes 01110000

to set just Pin 1.2 as output
Just do → 00000100

The code is → P1DIR |= BIT2

It ors the bit in position 2 with 1

16+32+64
32

Problem

i have transistor that is always Constantly
hang ~~3~~ volts on the ~~Emitter~~ base
&
when i touch the base => i ground the
base to 0 V

now ~~if~~ i have to Code the Micro Controller
such that at every touch of the base (grounding of the same)
two Leds toggles

green red

(1) at initial state -> no touch yet -> Red Led on
touch(1) base -> Switch to green Led on & Red led off

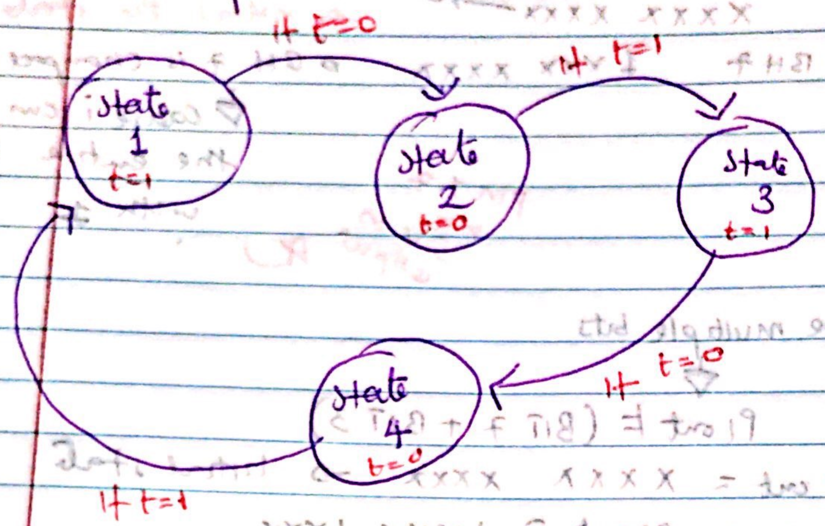
while touching(1) base -> green led on & after touching base
green led still on

nex touch or touch(2) of base -> green led off and
Red led on !!

$t = 1 \rightarrow$ no touch on base

$t = 0 \rightarrow$ touch on base

Model of Problem



State 1 → Initial Circuit State → red on no touch on base
State 2 → during touch → green on
State 3 → after touch → green still on
State 4 → during touch → red on
→ State 1 → after touch → red on

Solution Code

* if t==1 → { State 1 = 1 }

* if (State == 1 & t==0) → { State 2 = 1; State 1=0 }

If I was in state 1 — and I am touching — switch green on — switch red off

* if (State 2==1 & t==1) { State 3 = 1 }

* if (State 3 ==1 & t==0) { State 4=1; State 2 & 3 = 0 ; }

* if (State 4 =1 & t==1) { State 1= 1; }

Useful table

$$\begin{array}{cccccccc} 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\ x & x & x & x & x & x & x & x \end{array}$$

P1out XXXX XXXX → Initial pin state

1) P1out |= BIT7 1XXX XXXX → BIT 7 is changed to 1

cause i can or-ing the entire Register with 1

pin 1.7 has 5V in output

~~to change~~

To change multiple bits

P1out |= (BIT 7 + BIT 3)

So P1 out = XXXX XXXX → Initial state

now P1out = 1XXX 1XXX

1) If i wanted to turn a bit to → all of this apply but instead use P1 out &= ~BIT

and operation with it's opposite so i will always have zero

3) P1out ^= BIT7 → XOR operation

P1out = 1XXX XXXX

P1out ^= BIT7 → 0XXX XXXX

MEMORY BRAIN REFRESHER