

PEOPLE MOVER PROJECT (COMMUNICATION SYSTEM)

A REPORT SUBMITTED TO DR. AHMED KAMAL OF  
ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT OF  
BRAC UNIVERSITY IN FULFILLMENT OF THE REQUIREMENTS  
FOR THESIS WORK

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## **Declaration**

We hereby declare that this thesis is based on the results found by ourselves. Materials of work found by other researchers are mentioned by reference. This thesis, neither in whole nor in part, has been previously submitted for any degree.

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## **Abstract**

People-Mover is an electrical dynamic vehicle that moves people between different airport terminals, community or small length places. Normally, the train runs independently from terminals to terminals. Additionally, its speed and movement can also be controlled wirelessly by voice commands of a supervisor staying in the control tower.

Main goal of a project is to convert the theoretical knowledge into practical system. On that aspect this project is perfect, because here all features of Electrical Engineering (control system, circuit designing and implementation, wireless communication, micro electronics etc.) are being used as well as some mechanical engineering features also.

## **OBJECTIVE**

The telecommunication part of the people mover project requires the control of various parameters of the vehicle from a remote distance through IR communications system .We will be designing IR transceiver system to control the vehicle. The telecommunication system will be integrated with the control and electronics subsystem of the people mover project and tested.

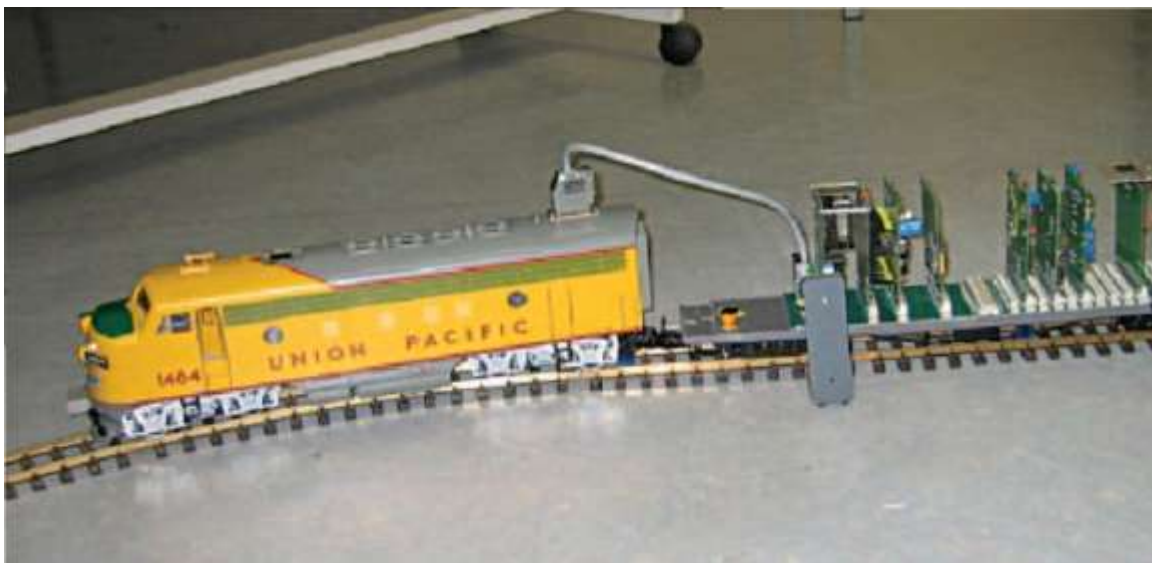
## **DESCRIPTION OF THE PROJECT**

Our PeopleMover project is inspired by the project carried out at the Katholieke Universiteit Leuven (K.U.Leuven), Belgium by the senior-level bachelor students of electrical engineering. The objective of this project is to enhance our practical skills in subjects that are traditionally taught in purely theoretical courses. The project mimics the electronic and control aspects of a people mover, an autonomous but remotely supervised train that transports passengers between airport terminals or stations. The train is to be remotely controlled, and it faces and get around different real practical problems while moving along the track, such

as speeding up at the slopes,slowing down while turning and halting at the right terminals with the help of speed control system implementation.

Our multidisciplinary design project complements traditional education, consisting of theoretical courses and exercise sessions. In such a real application,we encounter practical problems that do not arise in a simulation.

Since students must address multiple design aspects,alternative solutions can arise, resulting in an increased workload for the supervising staff and necessitating the use of nonstandard assessment techniques. In particular, performance assessment is based on presentations of progress and results, team contributions, global outcome, documentation and communication, and continuous evaluation with attention to effort, efficiency, cooperation with other team members, and innovation.This leads to better understanding of the implementation of theoretical knowledge in overcoming practical problems.



## **OUTLINE OF THE PROJECT**

The project has been divided into three parts:

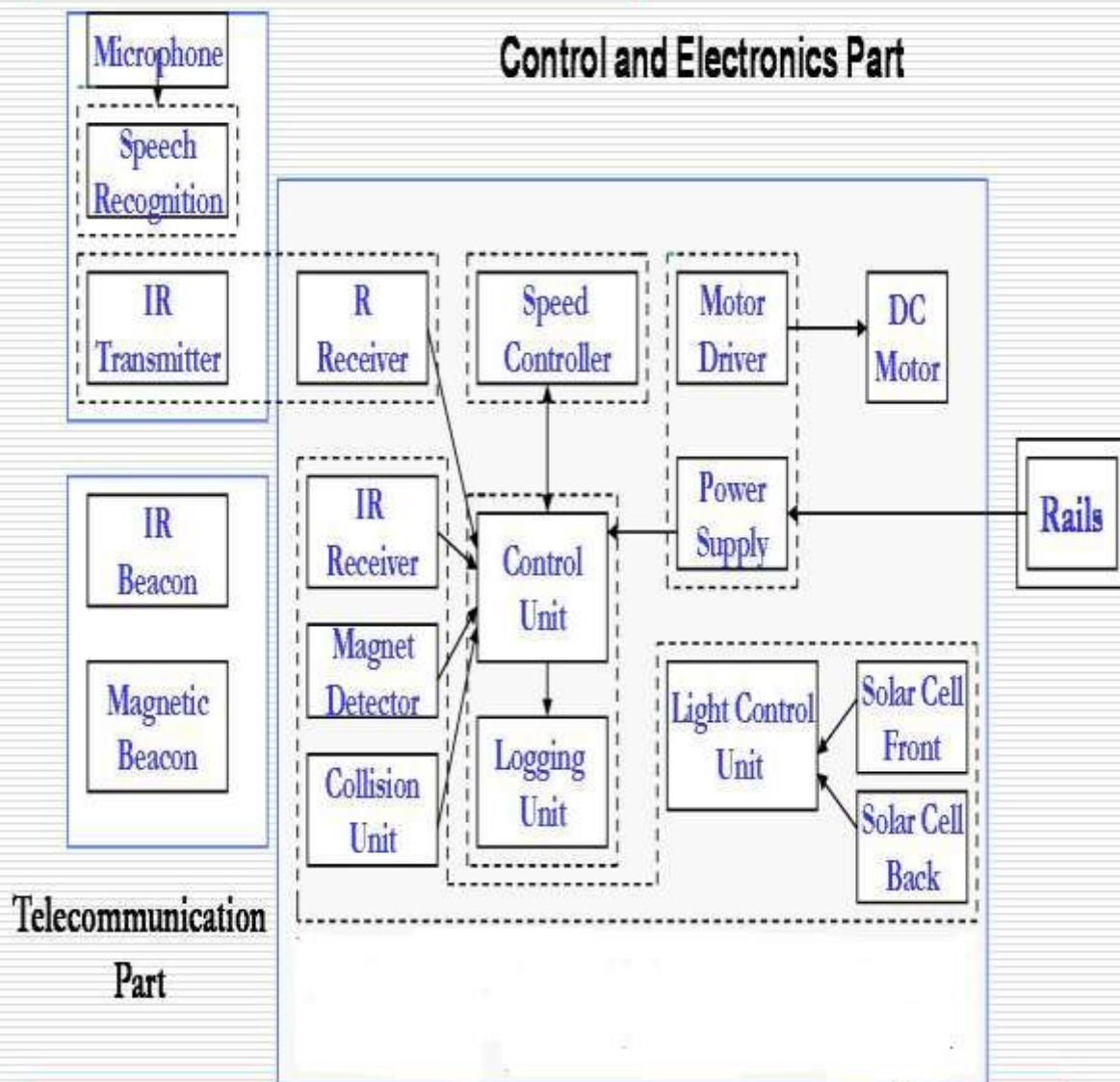
1) Electronics part

2) Control part

3) Communication part

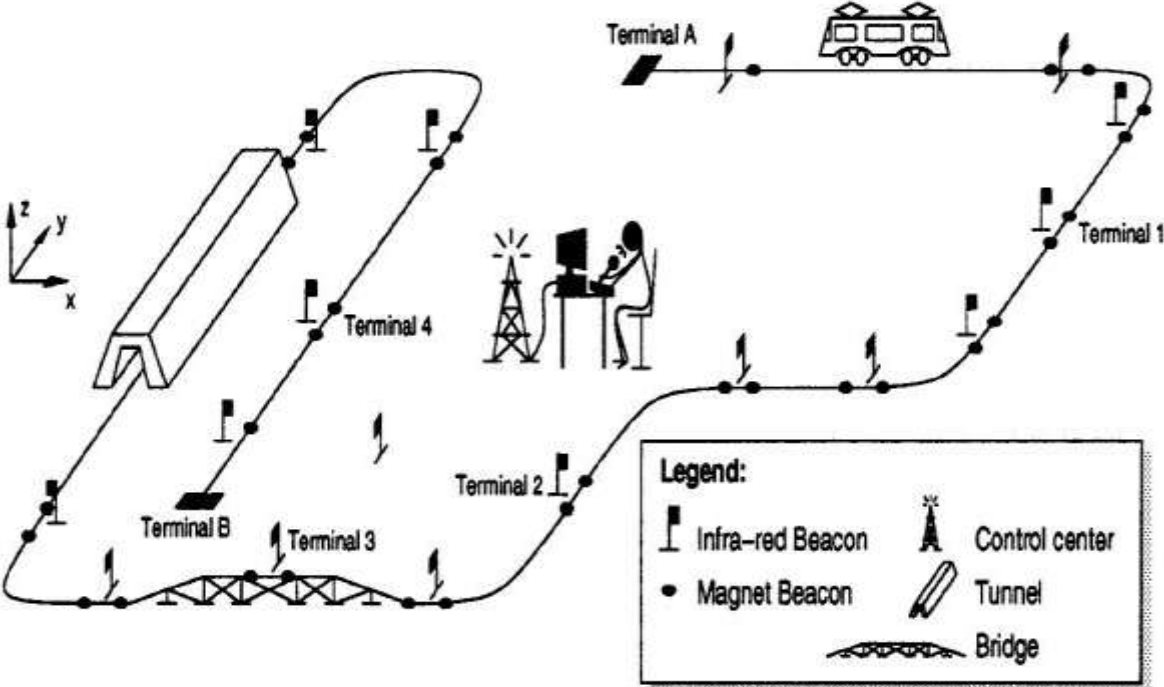
The job for the students under the communication section is to build a system through which the train can be controlled from a remote distance.

# Block diagram of the Project





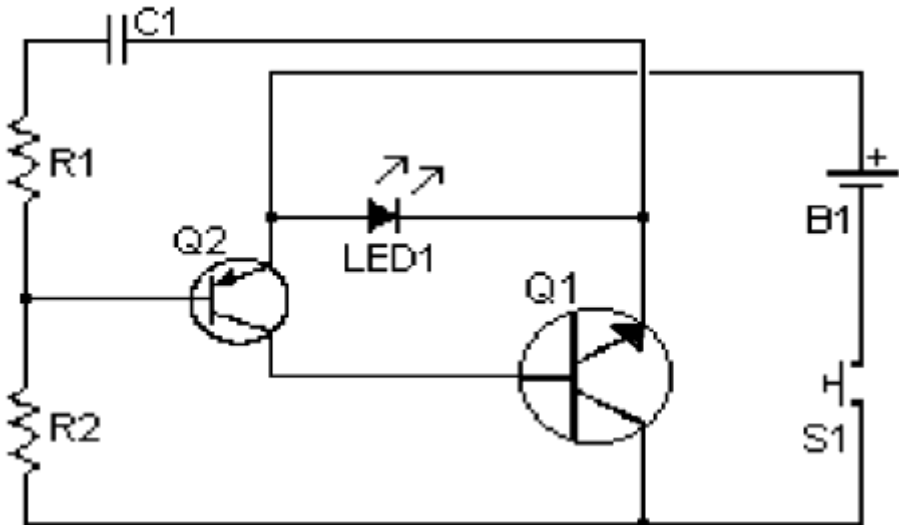
**OVERVIEW OF THE PROJECT**



# ***The first transceiver system implemented on bread board***

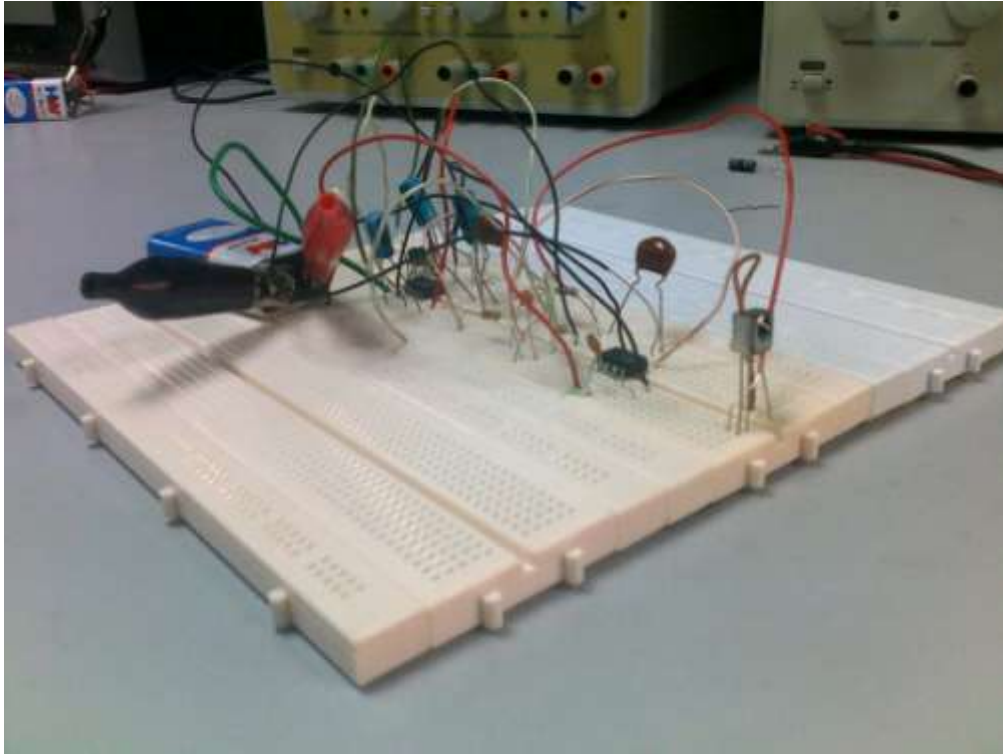
In the pre-thesis semester we developed an infrared transceiver system which was working within a short range.

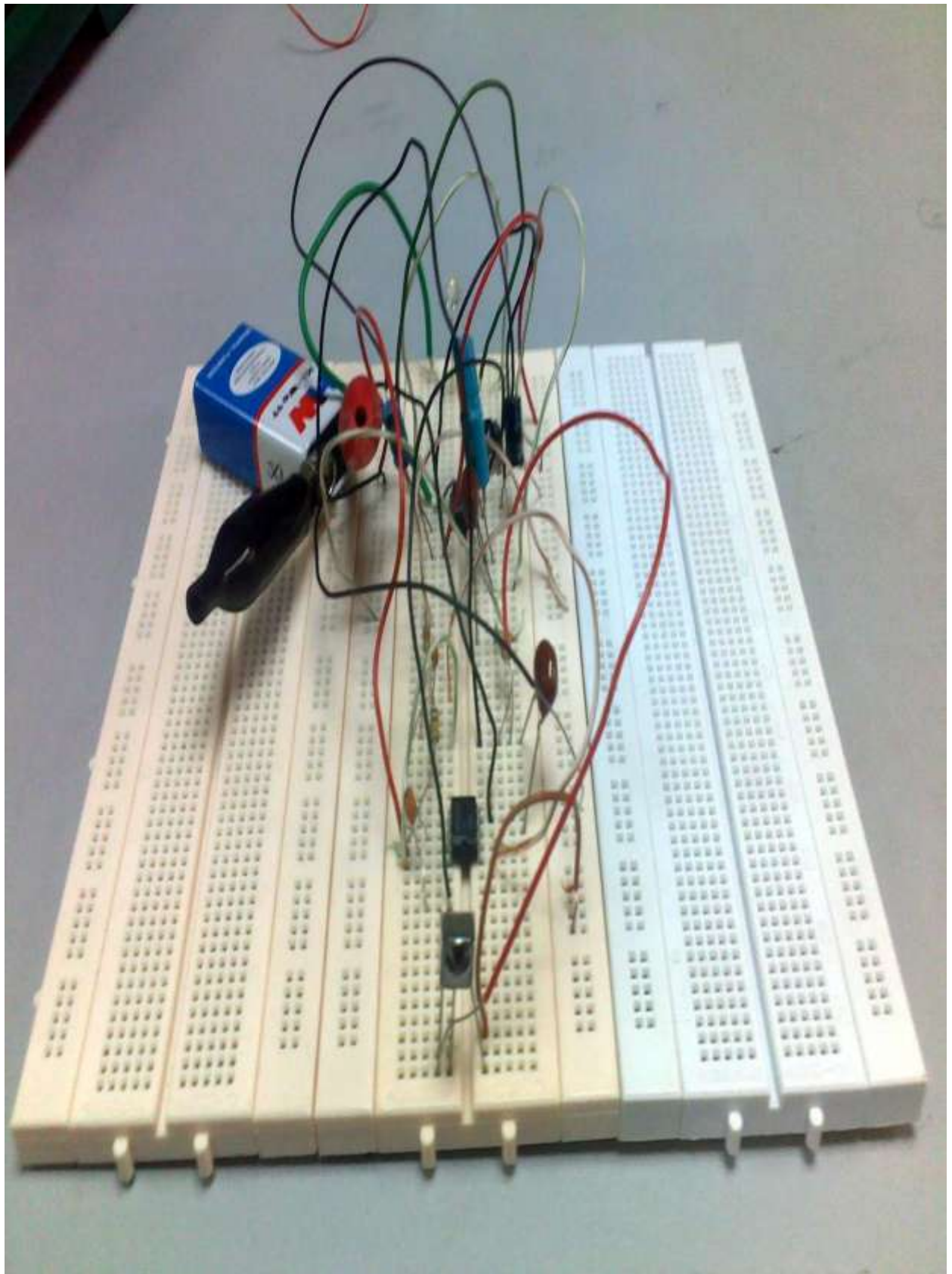
(TRANSMITTER USED IN THE PRE-THESIS)



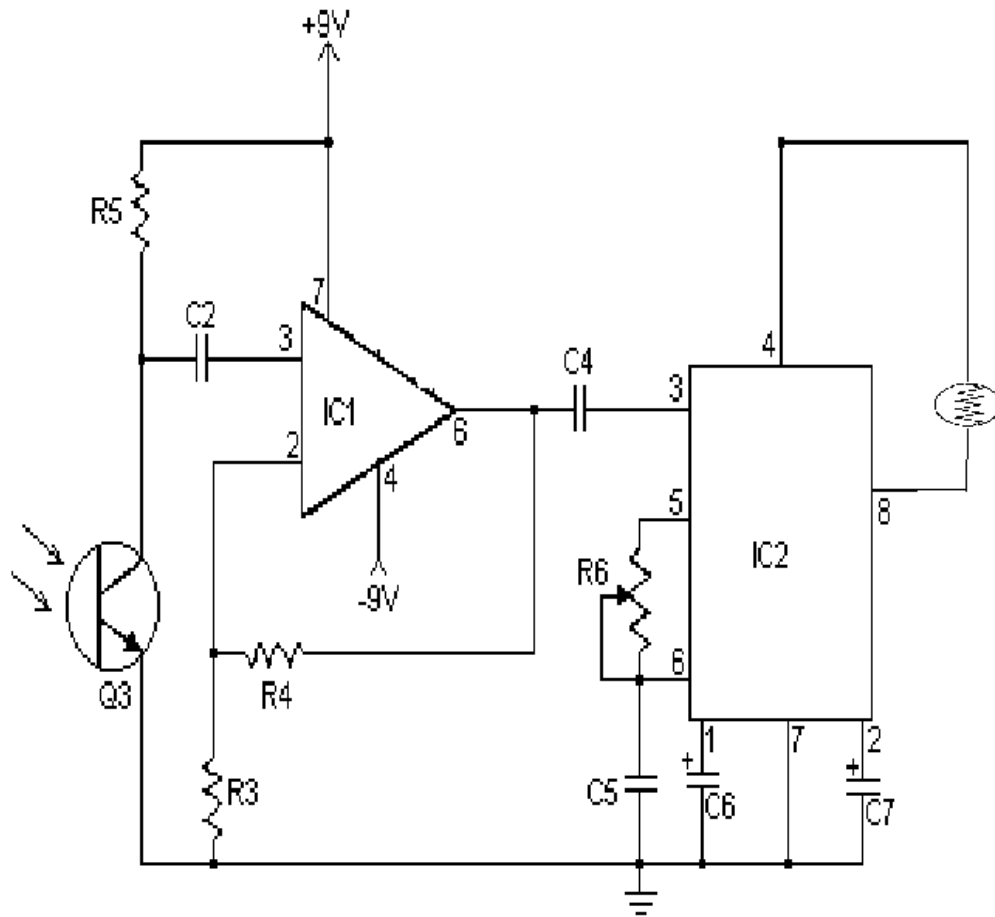
Circuit brief description: In the circuit diagram, we can see, we are using a very small dc voltage supply (2 volts). In fact the transistors are allowing us the usage of lower possible operating voltages, making transmitter suitable for small, battery-powered application. Q1 and Q2 are NPN and PNP silicon transistors respectively. Also the values of R1(1 Mohm), R2(220 kohm) and C1 (.01 microF) have been chosen as such that a current between 200 mA to 400 mA is driven across the infrared LED whenever the push-to-

make switch is closed. Anything between this range will trigger infrared light from it at 1 THz frequency.





(RECEIVER USED IN THE PRE-THESIS)



Brief Description of the circuit: In the circuit diagram, we can see the phototransistor (Q3) which has been used is a NPN phototransistor. If the PN junction is forward biased, the increased current through the junctions due to incident light will be relatively insignificant. On the other hand, if the same junction is reverse biased, the increase in current flow will be considerable and is a function of the light intensity. Therefore, reverse bias is our normal mode of operation.

When infra-red is incident on the transistor, the light-induced current effectively

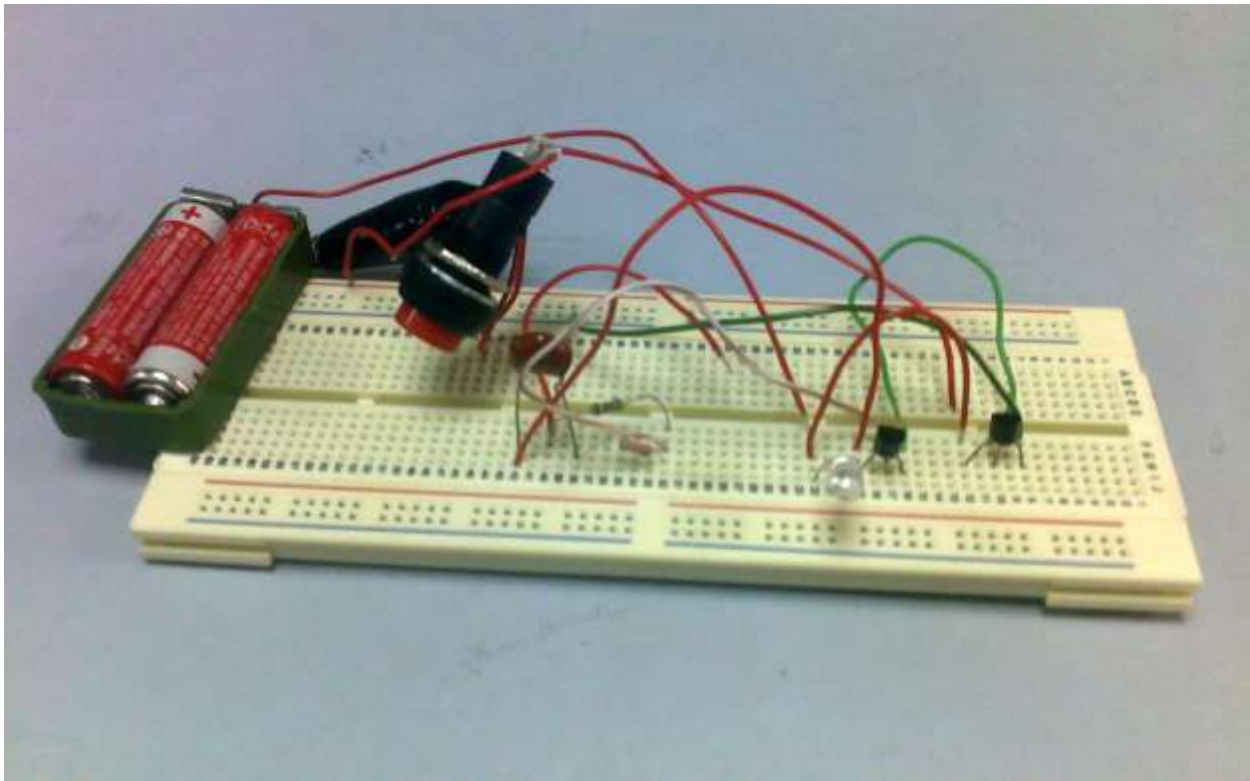
replaces the base current. The physical base lead of the transistor is left as an open terminal. It is the nature of transistors that a change in base current can cause a significant change (increase) in collector current. Thus, light stimulation causes a change in base current, which in turn causes a bigger increase in collector current and, considering the current gain, a rather large increase at that.

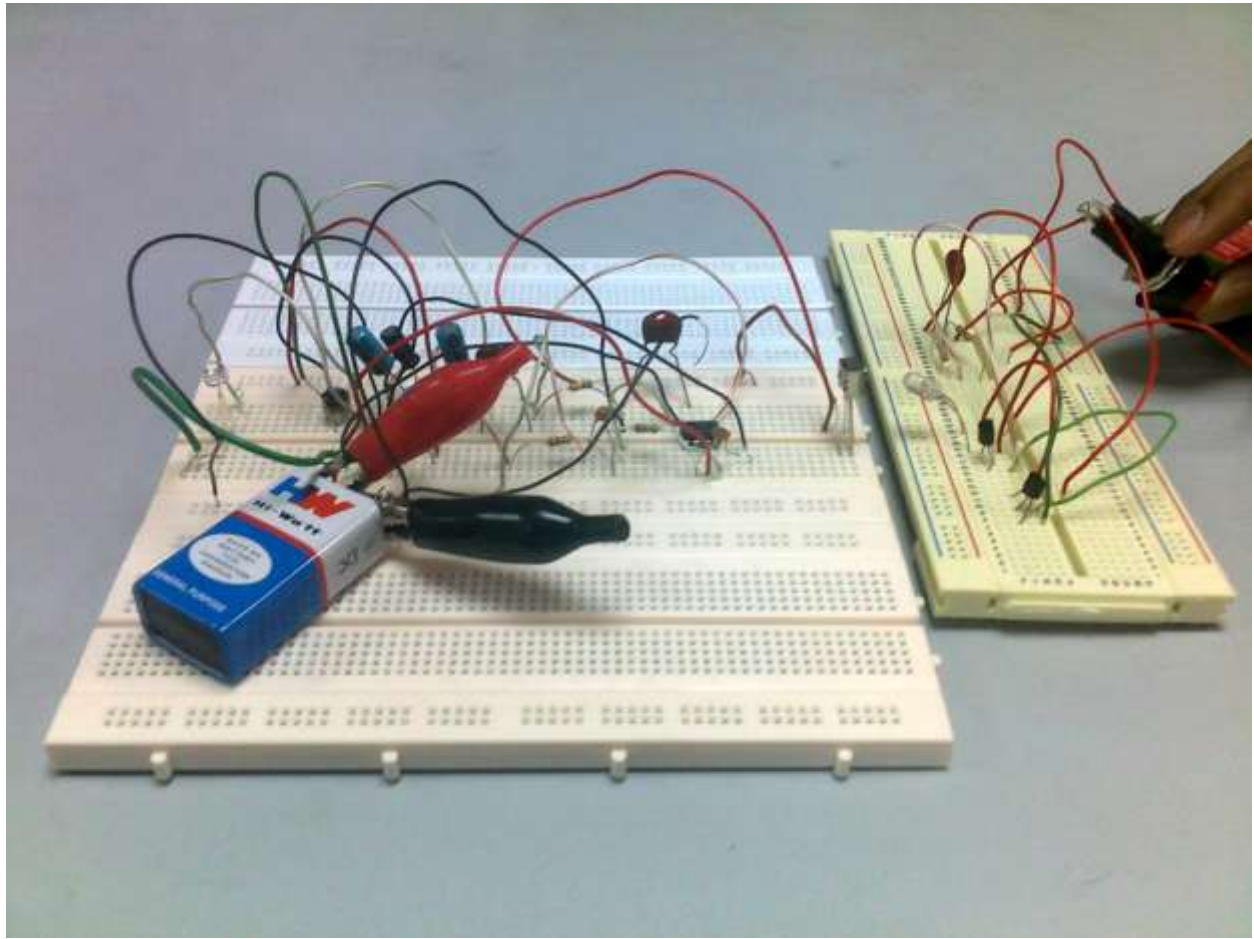
The Op Amp(IC1) is functioning both as an amplifier and a filter. This is an AC coupled op amp which is generally used to amplify a weak signal. Also the resistances and the capacitor used here (C2=.01 microFarad) determine the cut off frequency of the high pass filter.

C4 capacitor (.047 microFarad) is the coupling capacitor. This coupling capacitor is used to connect the two segments of the circuit circuits such that only the ac signal from the first circuit can pass through to the next while dc is blocked. C5(0.1 microFarad), C6(3.3 microFarad) and C7(1.5 microFarad) are the de-coupling capacitors. They are used to prevent unwanted noise from entering the input terminals of the tone decoder.

The primary function of the tone decoder is to drive a load whenever a sustained frequency within its detection band is present at the input. The bandwidth center frequency and output delay are independently determined by means of external components, i.e the resistors and capacitors.

The receiver needs to be calibrated to the Centre Frequency of the Tone Decoder. We have to make sure the center frequency matches with our desired input (36 kHz in our case) by adjusting the potentiometer to the required resistance.







## **Building more efficient transceiver systems**

The main drawback of the first infrared transceiver system we built was, it was only working within a very short range. Also, we needed our receiver to perform four functions instead of one. To get closer to our desired outputs, we built two more different infrared transceiver systems .

### **(A)Transceiver System 2:**

In this transceiver system, we used the transmitter made for remote controlling television, built a receiver circuit of our own and obtained four functions.

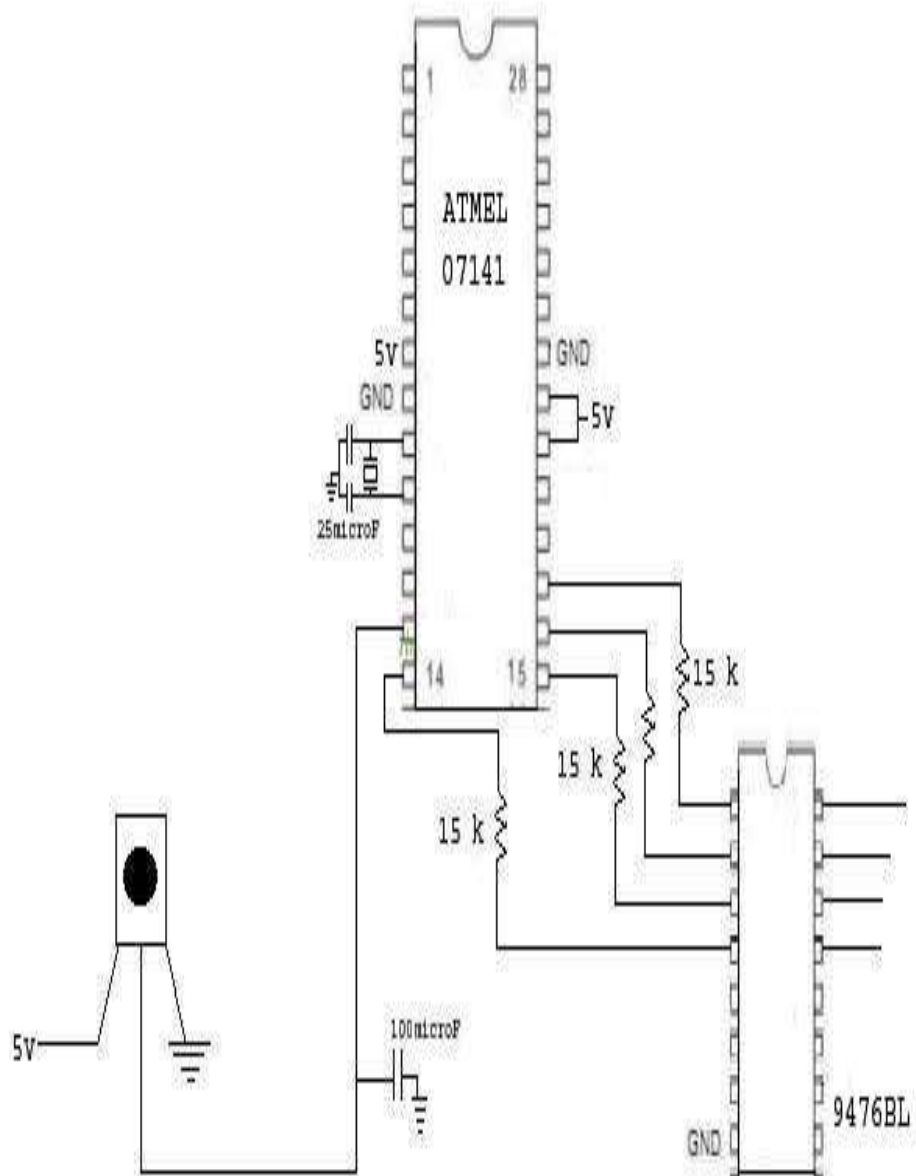
When we push on a switch on a tv remote control transmitter, it sends infrared signal containing pulses or bits. The receiver is supposed to distinguish between different bit signals and perform the corresponding function.

We used a 18 bit ASV LCD panel to find the decimal value of the bit signals sent each time we pushed switches 1 to 4.

Switches	Decimal value of the transmitted 18 bit signal
1	255
2	32,895
3	16,575
4	49,215

Our receiver circuit contained a micro controller Atmel 07141. We programmed it as such that whenever it gets an input bit string through the phototransistor, it checks if it is any of the desired four

values, and gives output (binary 1) to one of the four output pins.



Input bit string of decimal value 255 gives output binary 1 to pin number 14.

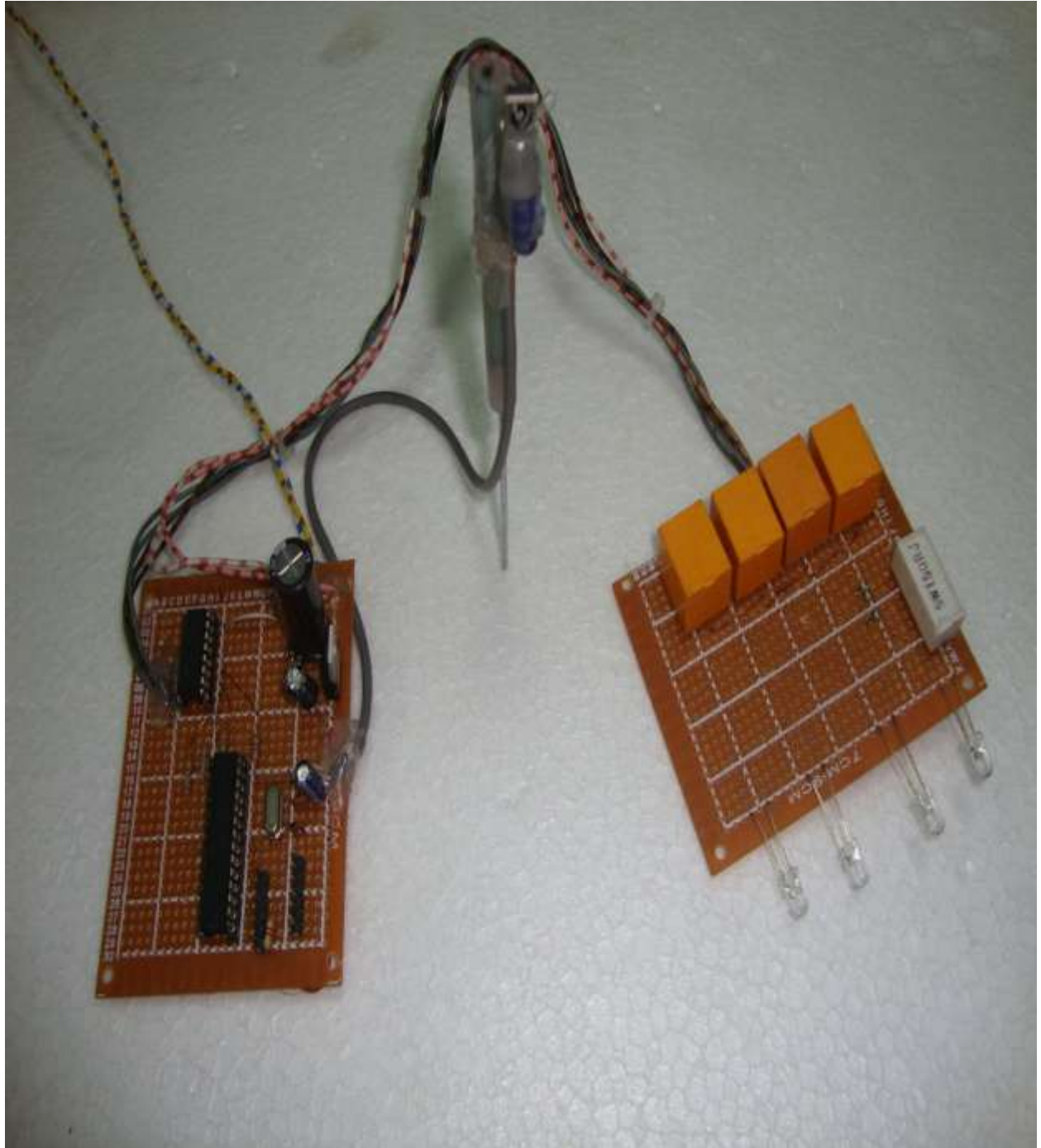
Input bit string of decimal value 32,895 gives output binary 1 to pin number 15.

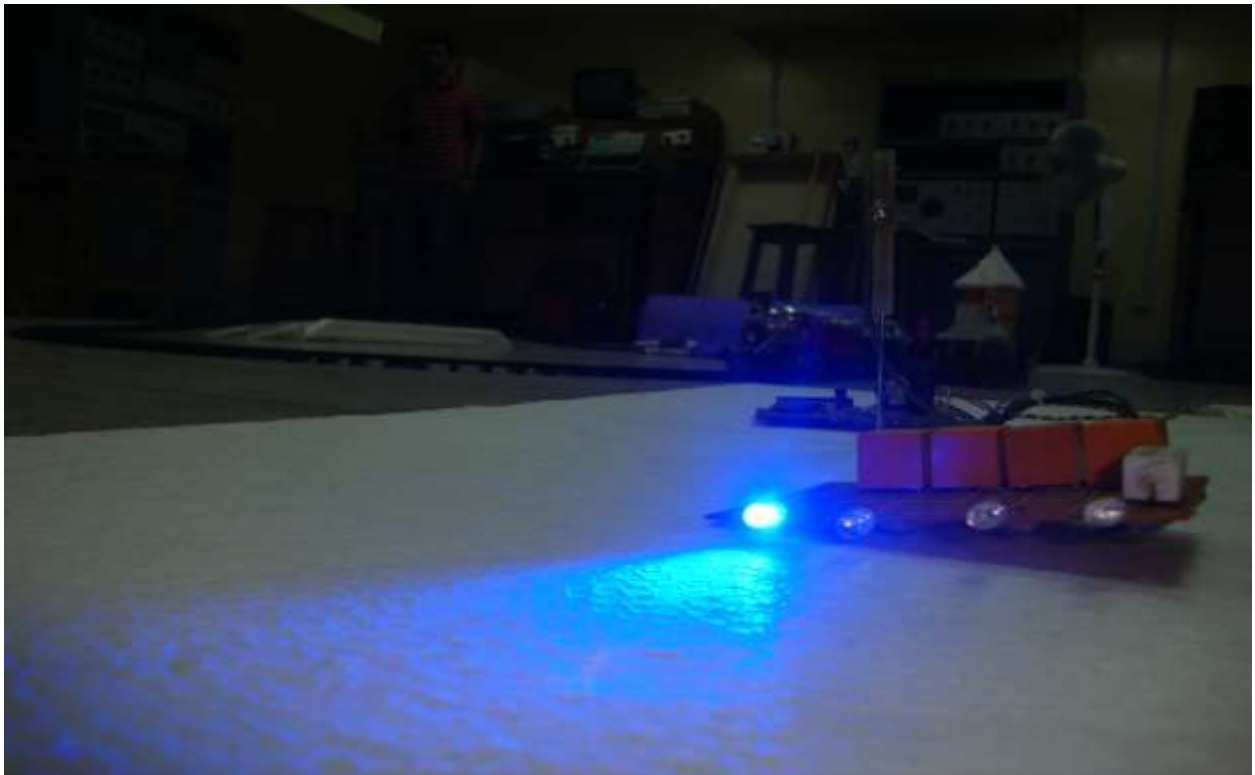
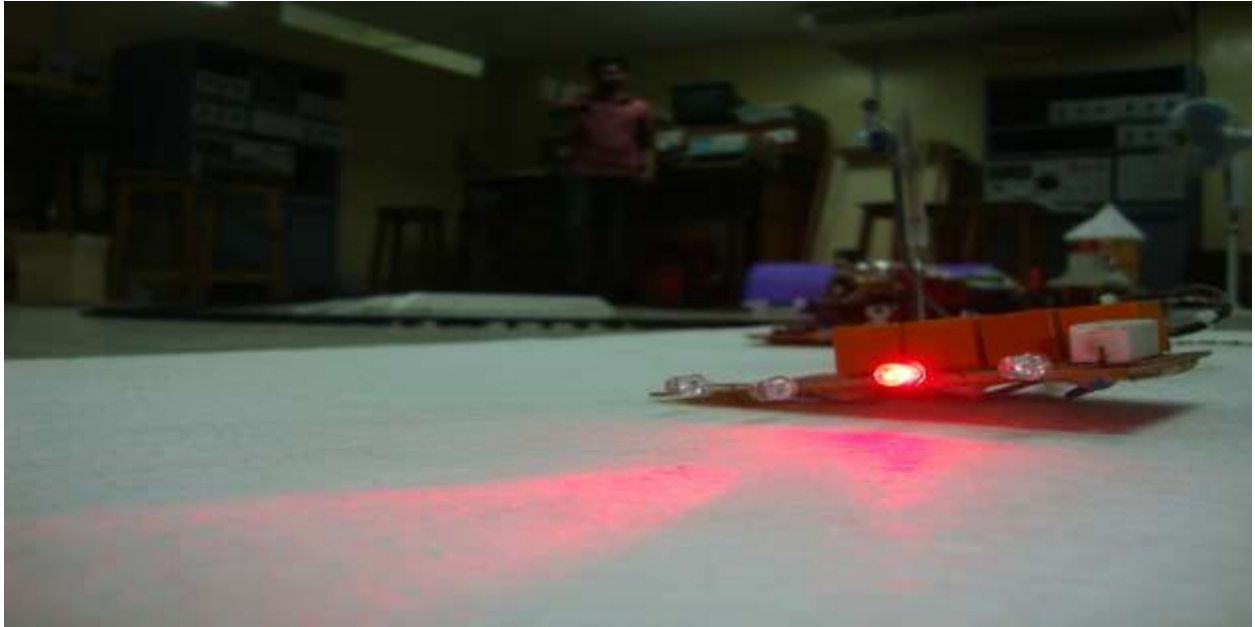
Input bit string of decimal value 16,575 gives output binary 1 to pin number 16.

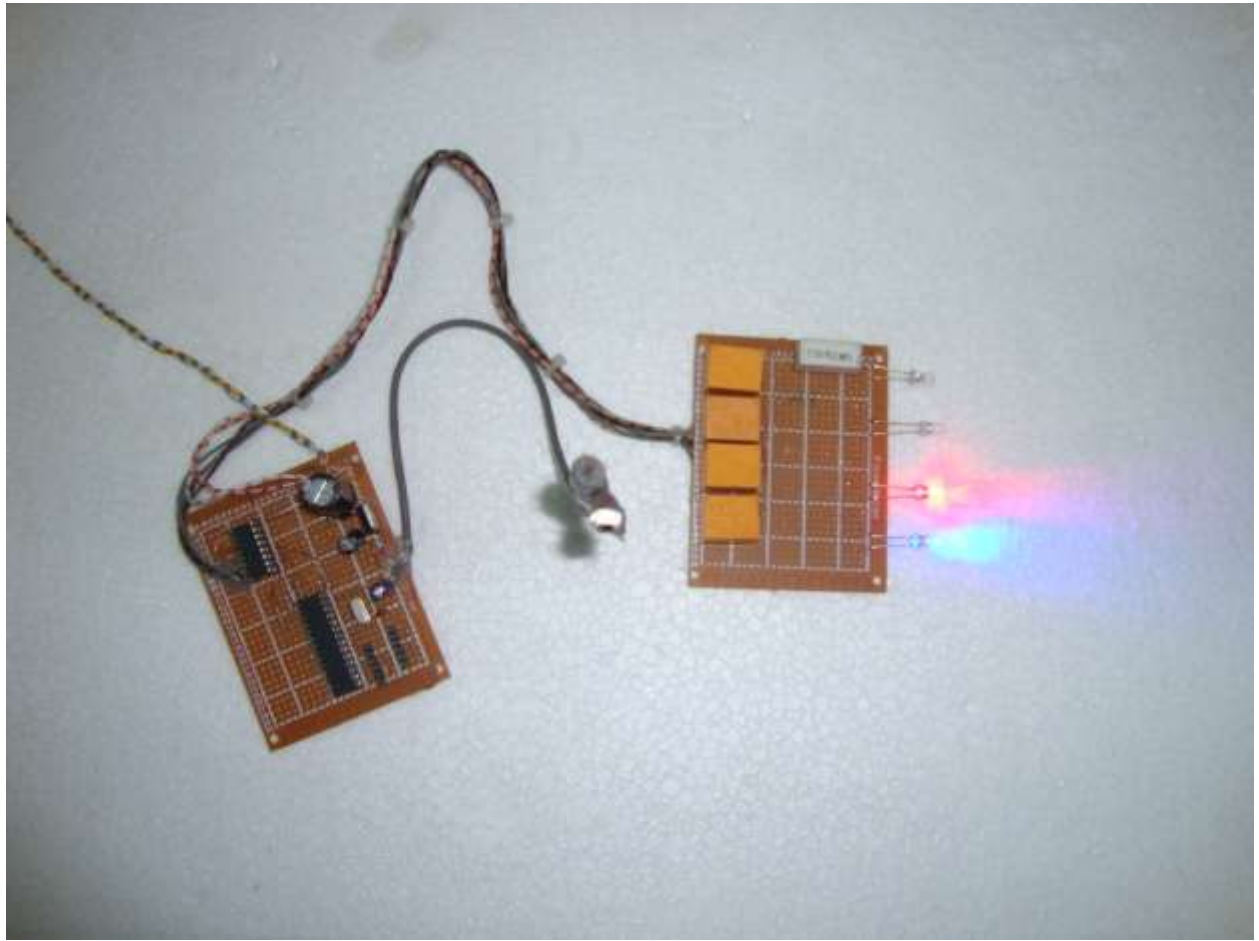
Input bit string of decimal value 49,215 gives output binary 1 to pin number 17.

We used an ic 947BL (uln2003apg).It's special feature is internal clamp diodes for switching inductive loads. This ic takes input from the output pins of the micro-controller and drives relays at its outputs. There are LEDs connected at the relays' normally open contacts. So, pressing switch 1 will energize relay 1 at output pin 13,thus LED 1 emits light. Pressing switch 2 will energize relay 2 at output pin 14,thus LED 2 emits light and so on.

So we can switch on and off four different LEDs with four different keys (1 to 4) on the transmitter.It works even from a distance of 40 feet.

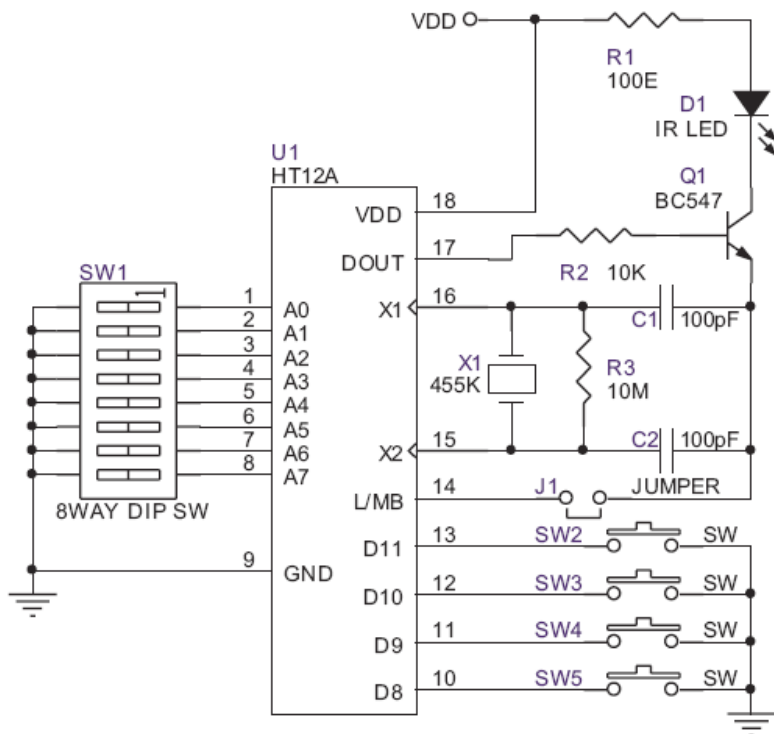




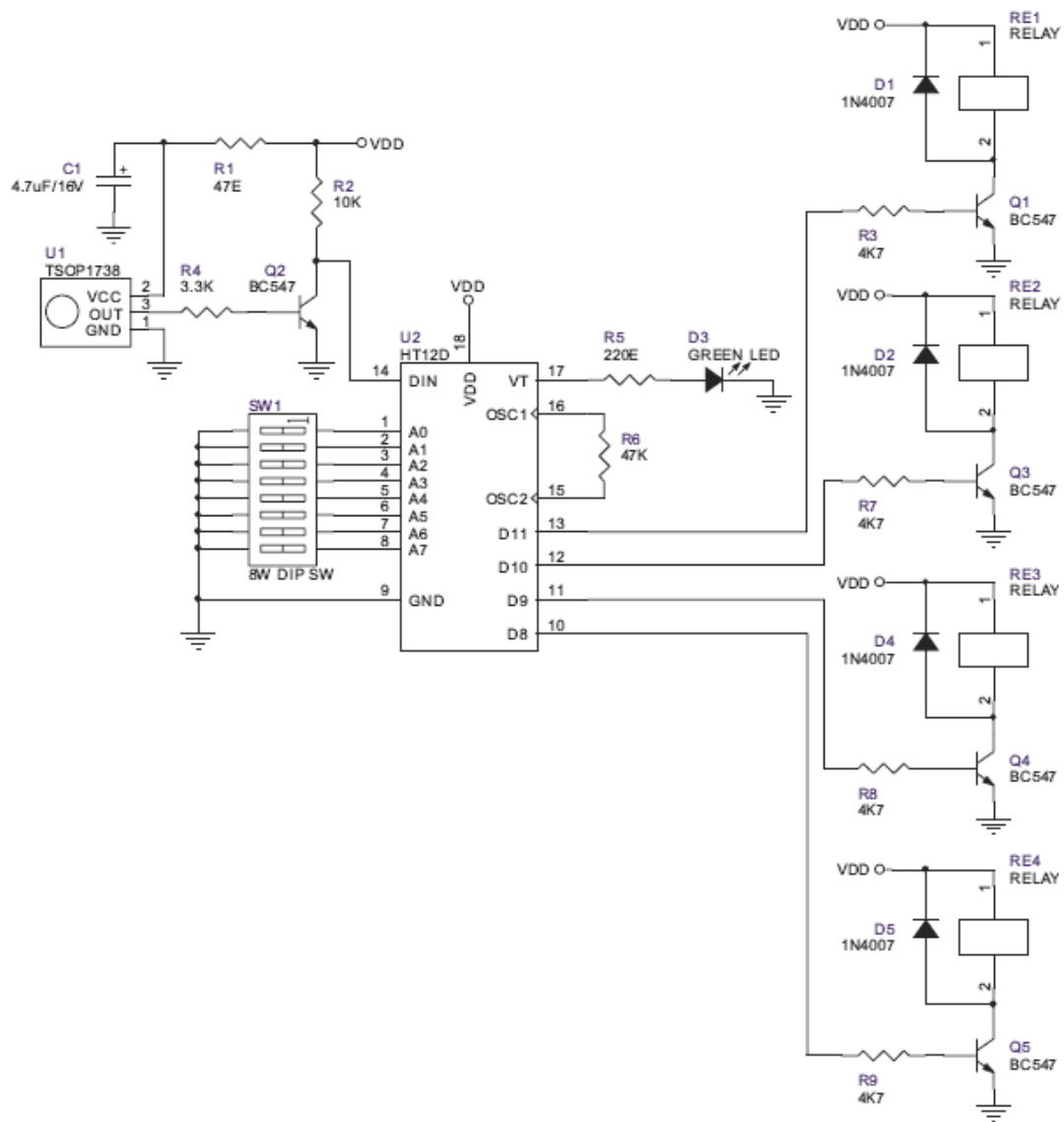


### Transceiver system 3

In the second infrared transceiver system, we made both the receiver and the transmitter circuits. We used ic HT 12A for the transmitter and HT 12 D in the receiver circuit.



**TRANSMITTER**



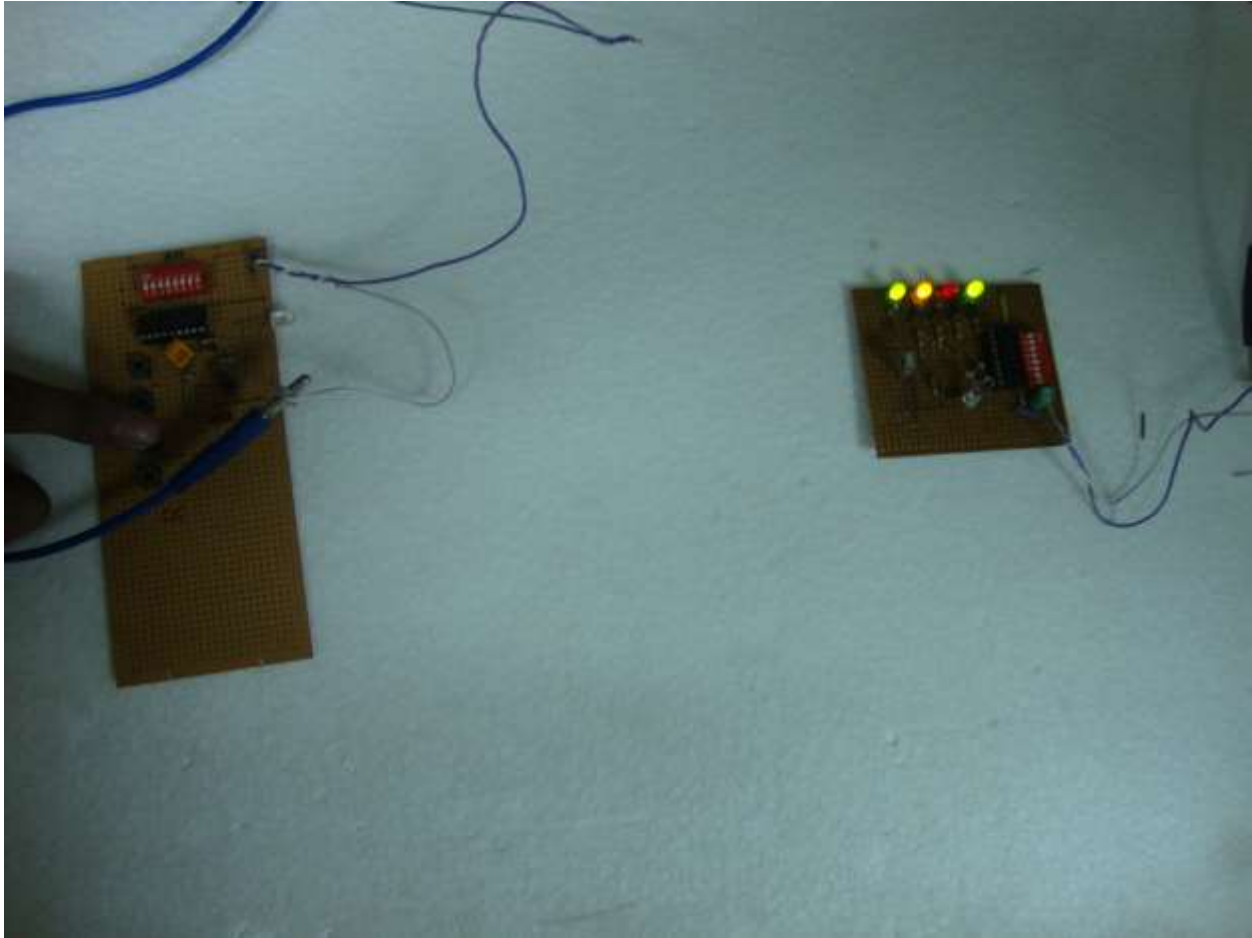
## RECEIVER



The Dip switches are used to make sure that the receiver does not operate by getting infrared signal from some other infrared source. The switch combinations of the DIP switches in the transmitter and the receiver has to be matched, the receiver will not operate otherwise.

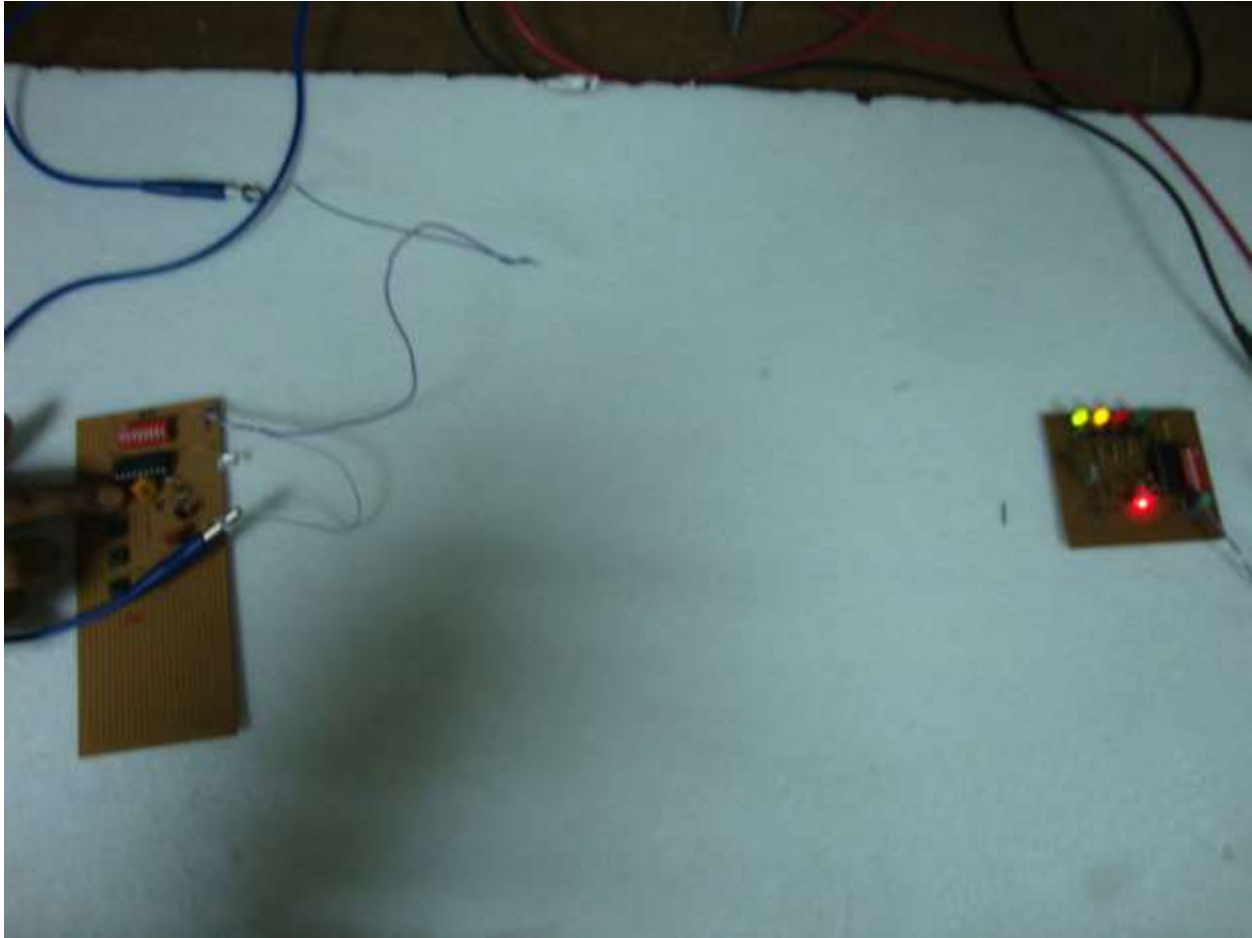
When any of the input pins is connected to the ground, the ic HT 12a sends a signal at the output pin 17 which consequences infrared emission by the infrared LED. It varies the frequency depending on which input pin was grounded. The receiver detects the signal with its phototransistor TSOP 1738, giving output to the corresponding output pin depending on the frequency.

In the receiver, the circuit combination is such that the whenever  $V_{dd}$  (5 v) is applied to the circuit, the relays becomes energized. When we press a switch and send infrared signal, the corresponding relay is de-energised, hence the present contact is broken, and a new one is made.



We have used LEDs instead of relays. When  $V_{cc}$  is provided, the LEDs are switched on. We can switch off any of the LEDs using corresponding switches in the transmitter. There is an extra LED which blinks whenever a switch is pressed.

The transceiver system was working properly within a range of 30 feet.



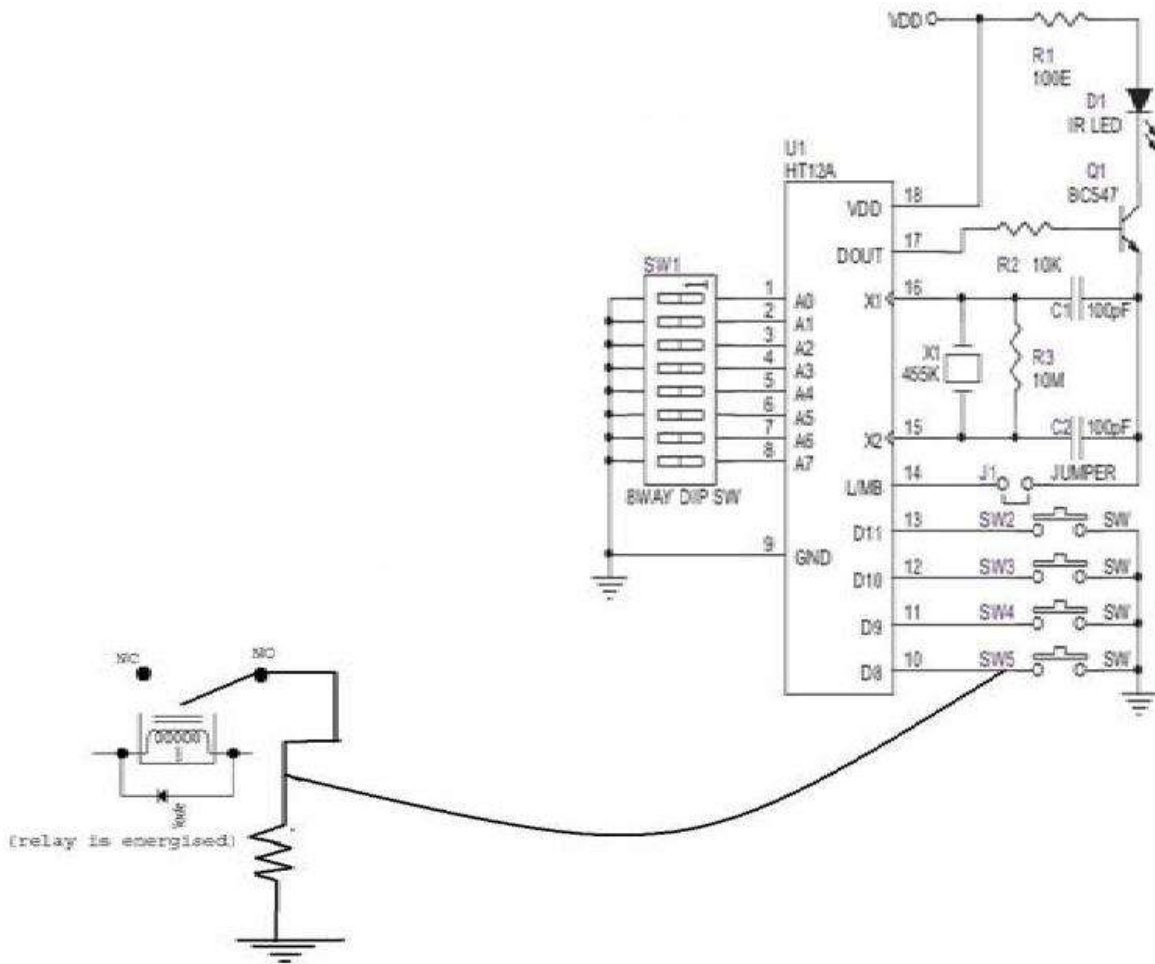
## ***REPEATER***

After having made the transceiver systems we focused on increasing the range even more.

In our TRANSCIEVER SYSTEM 3,we see that at the transmitter a switch is closed to connect the input pin to the ground. We use this feature to build a repeater.

To repeat an infrared signal,we need two sets of transmitters and receivers.

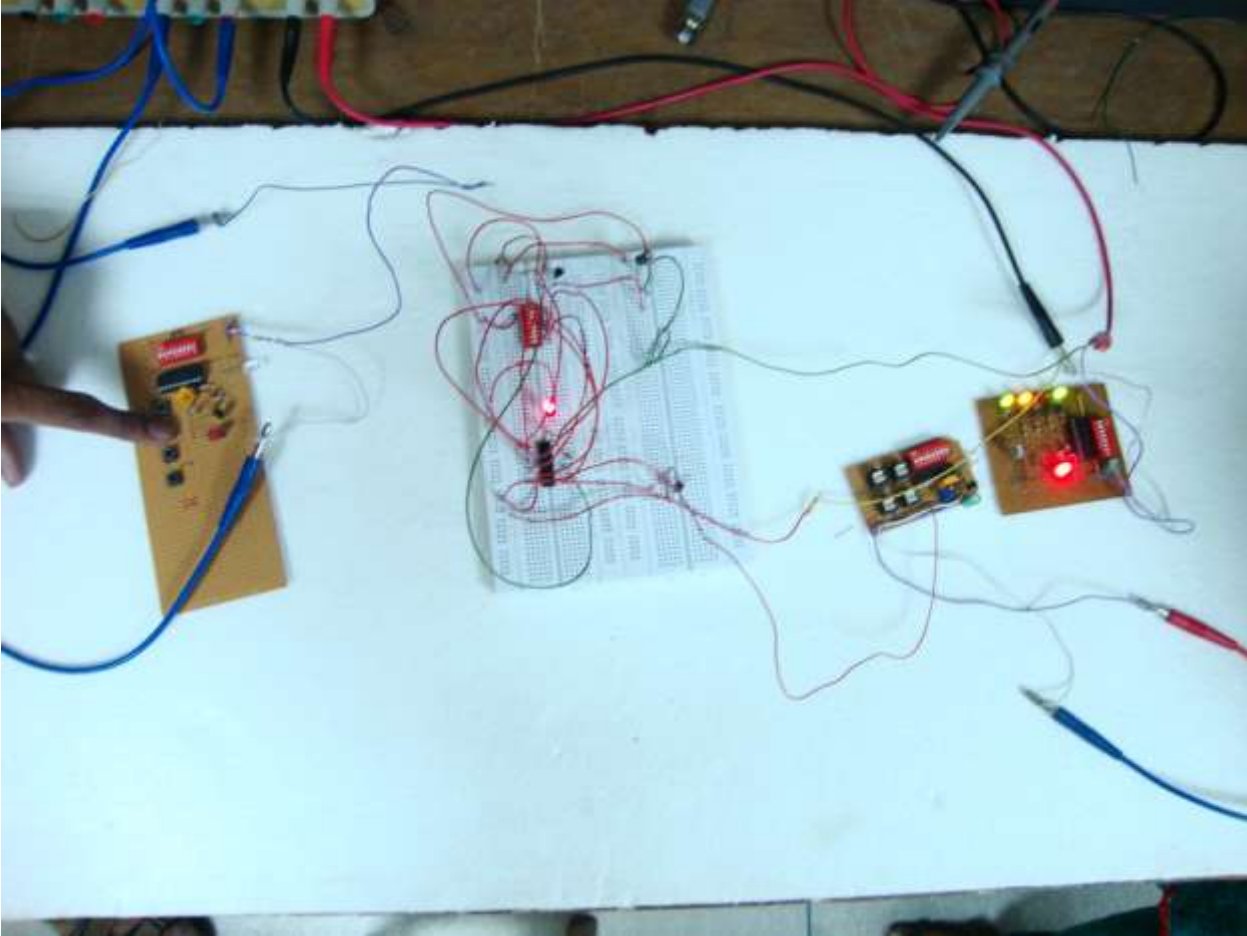
We have already seen that when the circuits are biased with  $V_{cc}$ , the relays are energized. That means the normally open contacts are closed. Now, let's have a look at the diagram below,

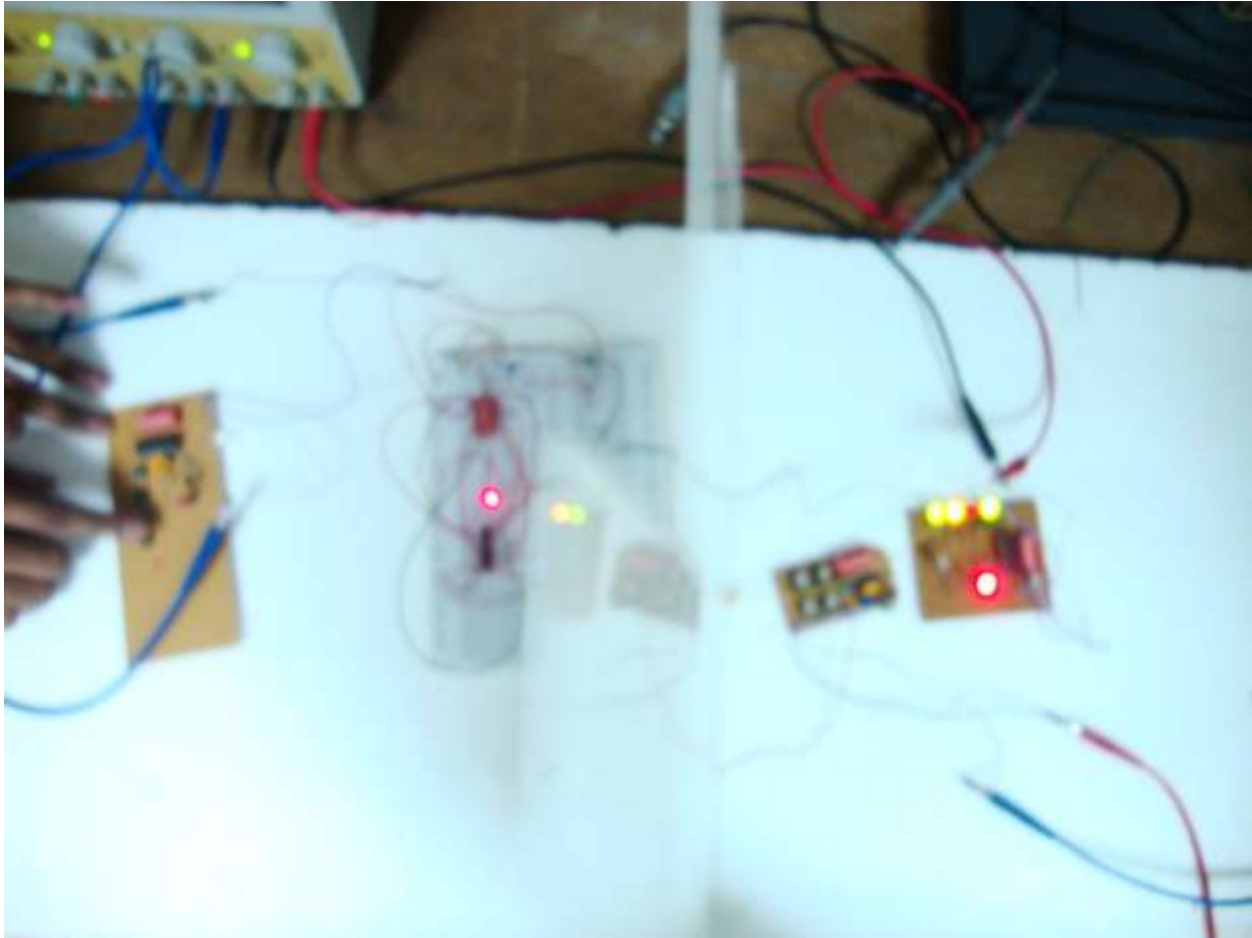


We have shorted the input pin of the transmitter 2 with the normally closed contact of a relay on receiver 1. So, whenever we press switch 1 in transmitter 1, the relay 1 is de-energized, its normally open contact is open, and thus because of the circuit combination, the switch 1 of transmitter 2 is

grounded. So, again transmitter 2 sends infrared which is directed to receiver 2. And because of switch 1 being grounded in transmitter 2, relay 1 is de-energized at receiver 2. It will work the same way for all four switches.

With the help of this combinations of 2 sets of transistors and receivers, we were able to double the working range. Thus, we can attain any desired working range using multiple number of transceivers.

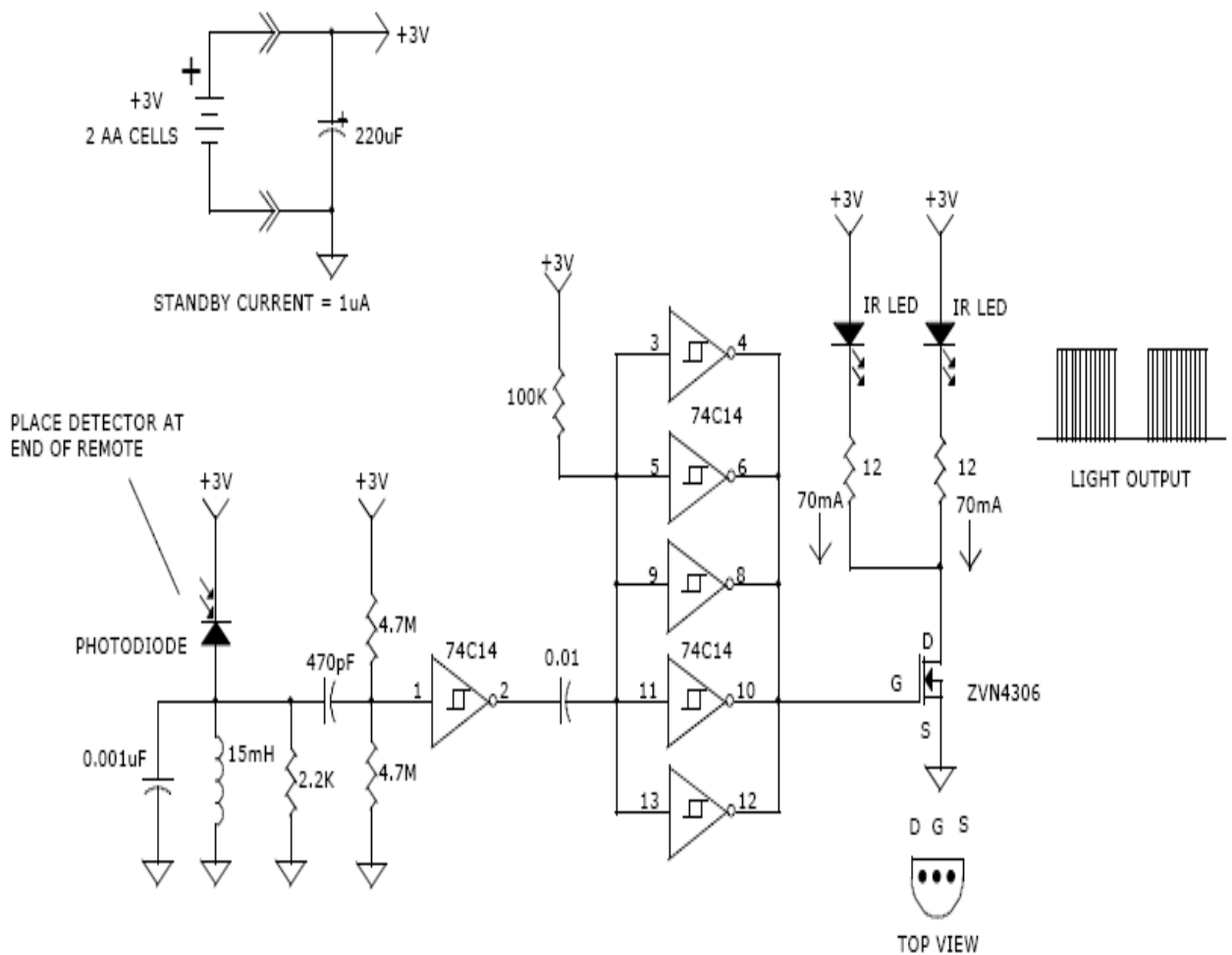




#### **40 KHz light Source Repeater:**

We also worked with the 40 KHz light source repeater .The main reason is we can increase the range by using light source repeater. In this circuit

we used a infrared receiver and transmitter. Infrared receiver receives signals from the original transmitter then transmits it by using IR transmitter. In this way we can retransmit the original signal and in this way we can increase the range.



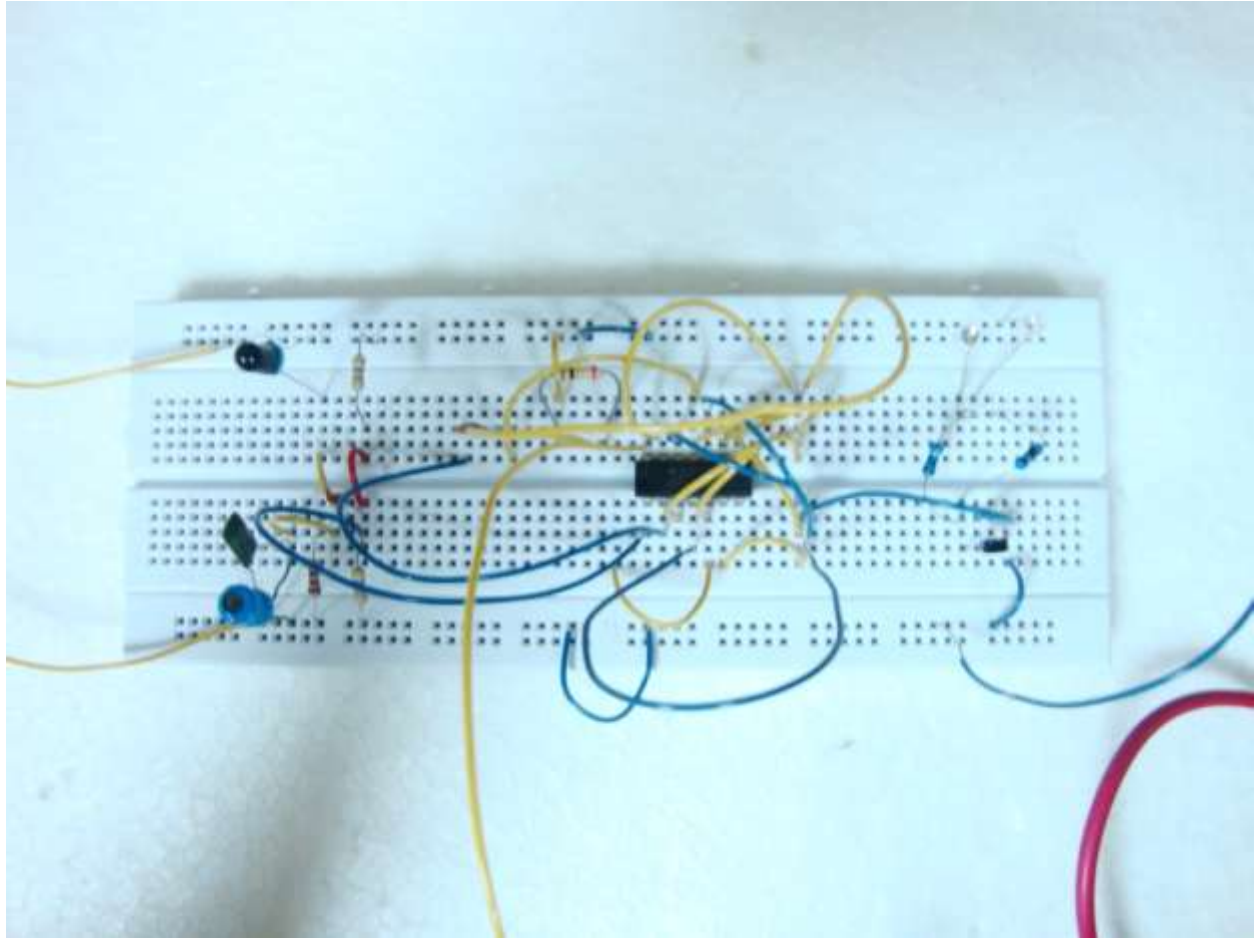
In this circuit we used a 74c14 which worked as a Schmitt trigger. The circuit is named "trigger" because the output retains its value until the input changes sufficiently to trigger a change: in the non-inverting configuration, when the input is higher than a certain chosen threshold, the output is high; when the



input is below a different (lower) chosen threshold, the output is low; when the input is between the two, the output retains its value. In this circuit we use Schmitt trigger is to increase the noise immunity in a circuit with only a single input threshold. With only one input threshold, a noisy input signal near that threshold could cause the output to switch rapidly back and forth from noise alone. A noisy Schmitt Trigger input signal near one threshold can cause only one switch in output value.

One of the main problems of this circuit is that 74c14 is unavailable in the market and there are similar 74s14 which function is different from the 74c14.

Another problem of this circuit is its influence by outer light source so to avoid the outer light source we have to use cover which protects the IR detector or receiver from the other light source.

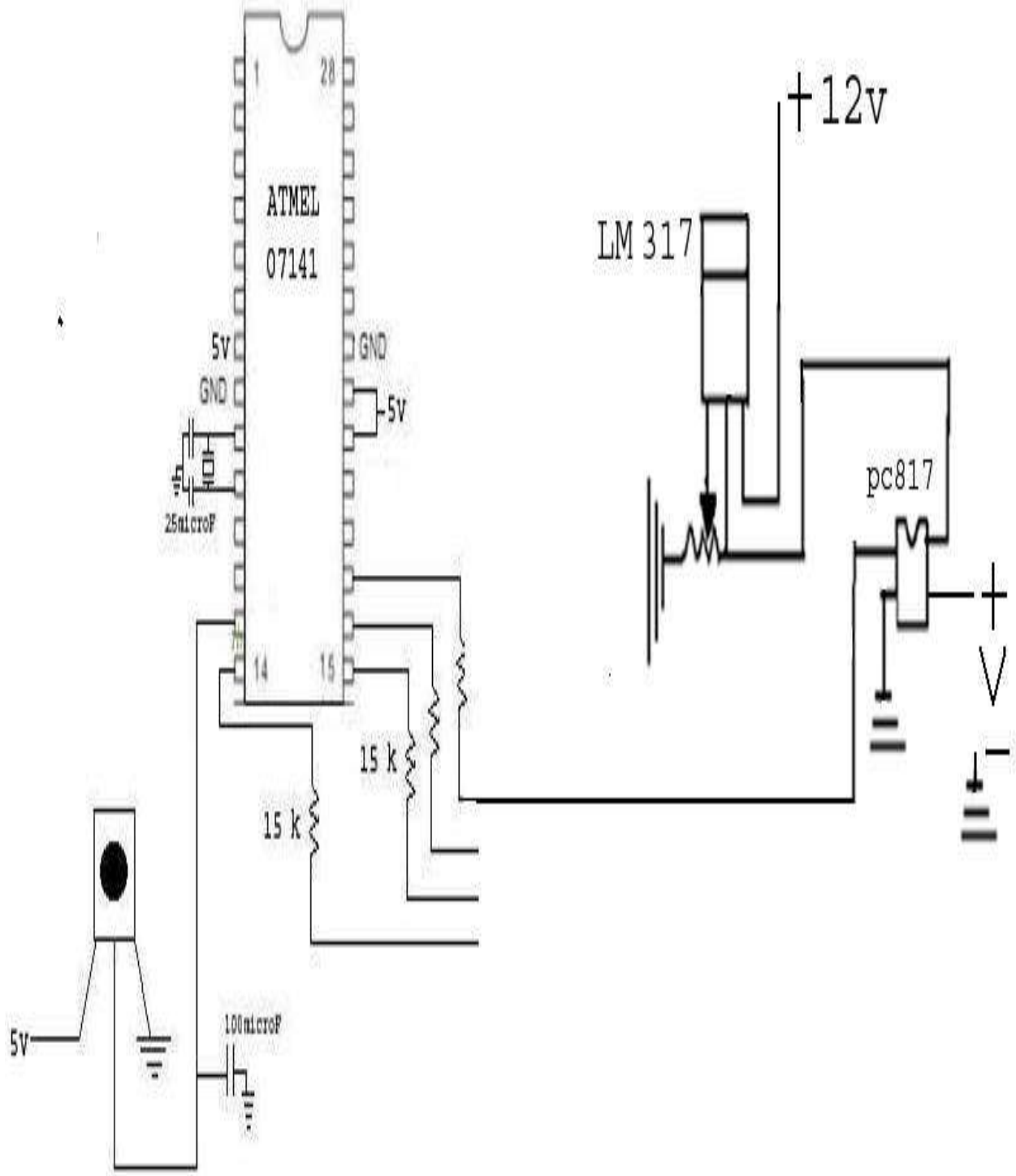


## **Achieving the principal objective:delivering different voltage levels as outputs**

We used LED-s and switched them on and off to demonstrate that the transceiver systems were working. But our main objective is to provide voltage outputs to the control group.

In the circuit where a tv remote control transmitter were used, the relay driving ic was replaced by optocouplers and voltage regulators.

We used voltage regulators LM 317. DC supply +12 was given as input. With the help of a variable resistor, any voltage level between 1-8 volts could be fixed as LM317's output. This output went as input to the optocoupler PC817. Another input for the optocoupler is coming from our microcontroller.



So, the optocoupler receives an input of a fixed voltage level from the voltage regulator. Whether it passes this input as its output depends on what signal is coming from the microcontroller. If the microcontroller gives 1, then the optocoupler gives the same voltage it gets from the voltage regulator as its output. If the microcontroller gives 0, it gives no voltage as its output.

We used four groups of LM317 and optocoupler PC817. Outputs of three of the four optocouplers were paralleled.

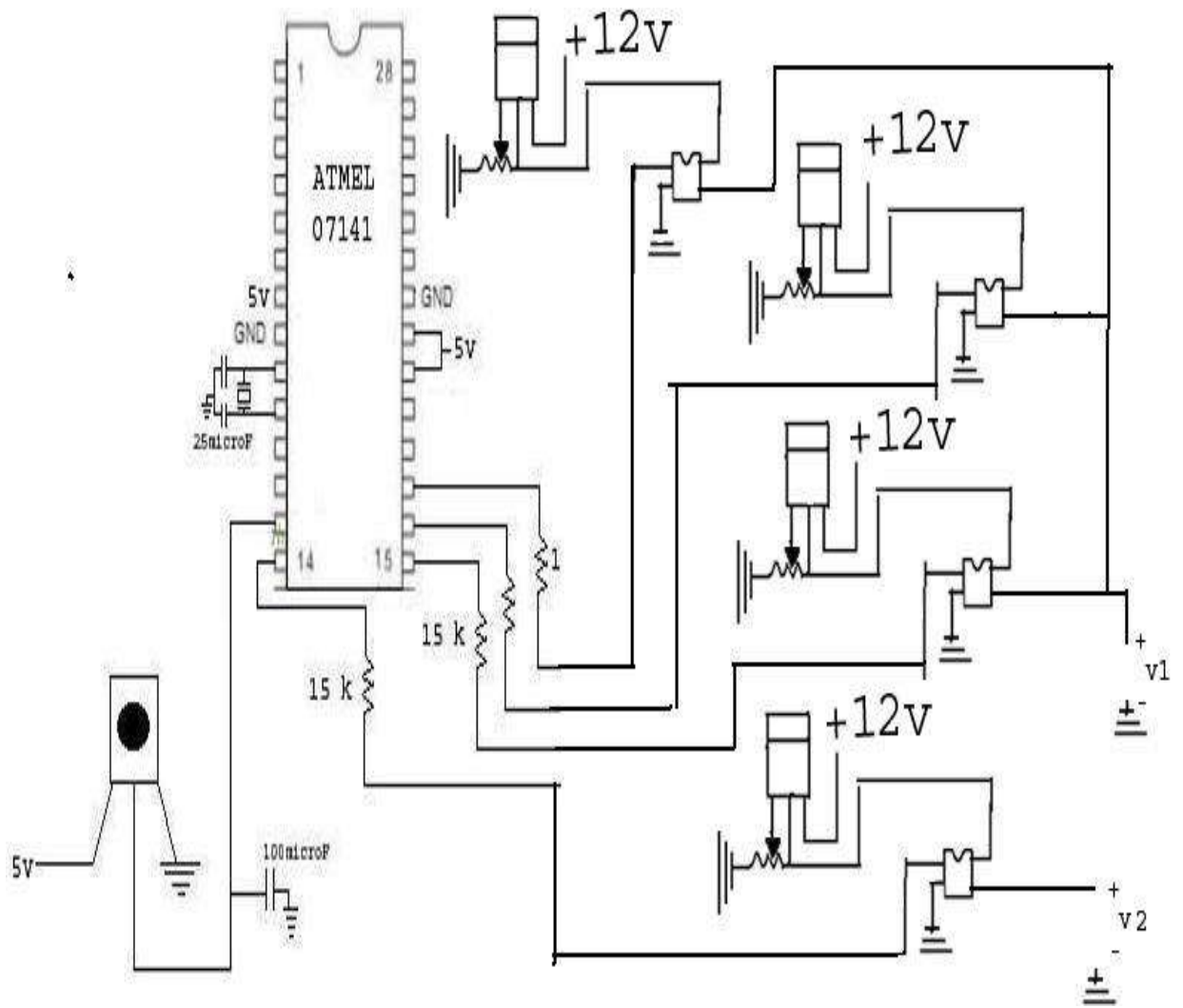
Now, by pressing switches on the transmitter, we got different voltage levels as output from our receiver.

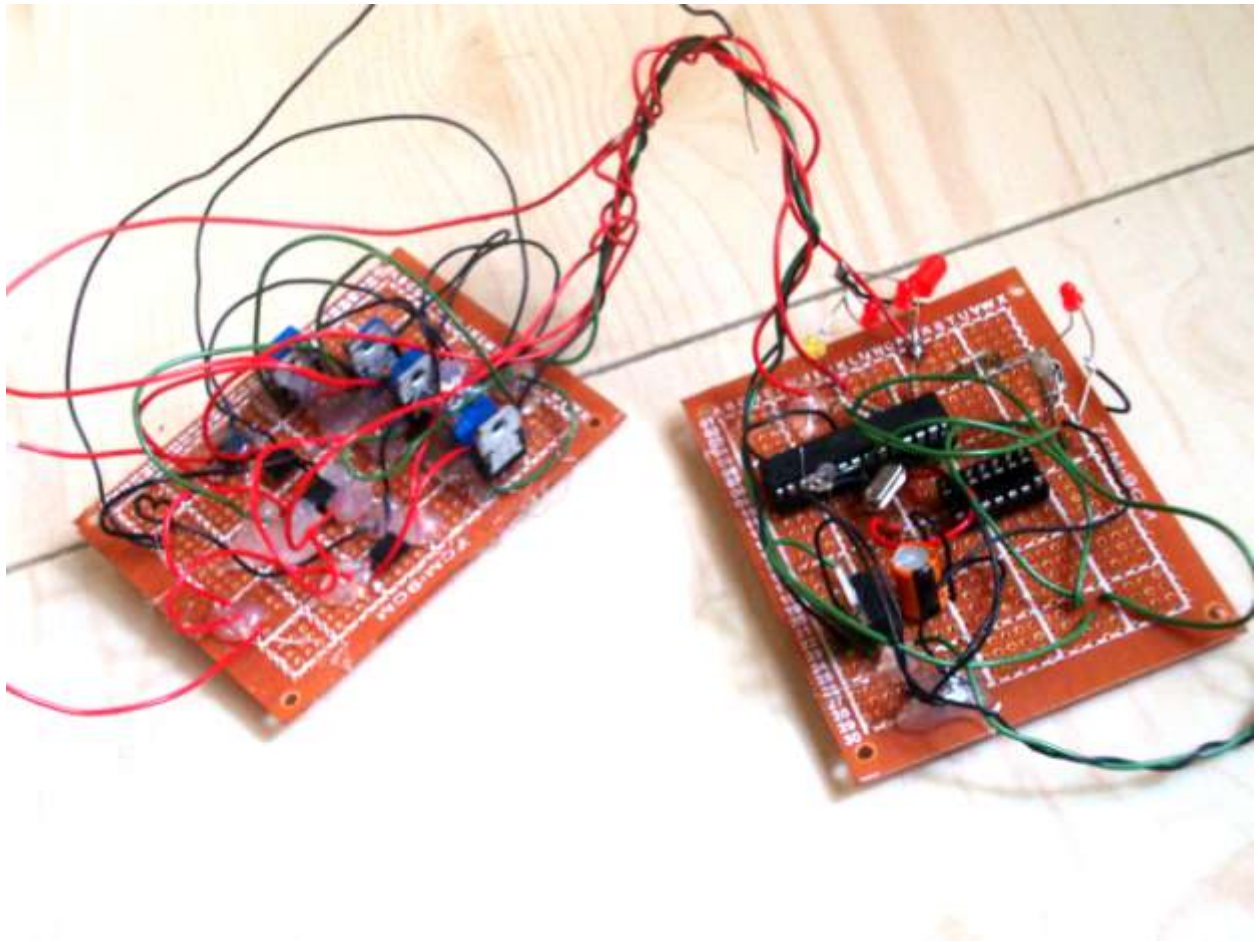
Switches	outputs
1	1.3 volts
2	2.7 volts
3	4.7 volts
4	5 volts

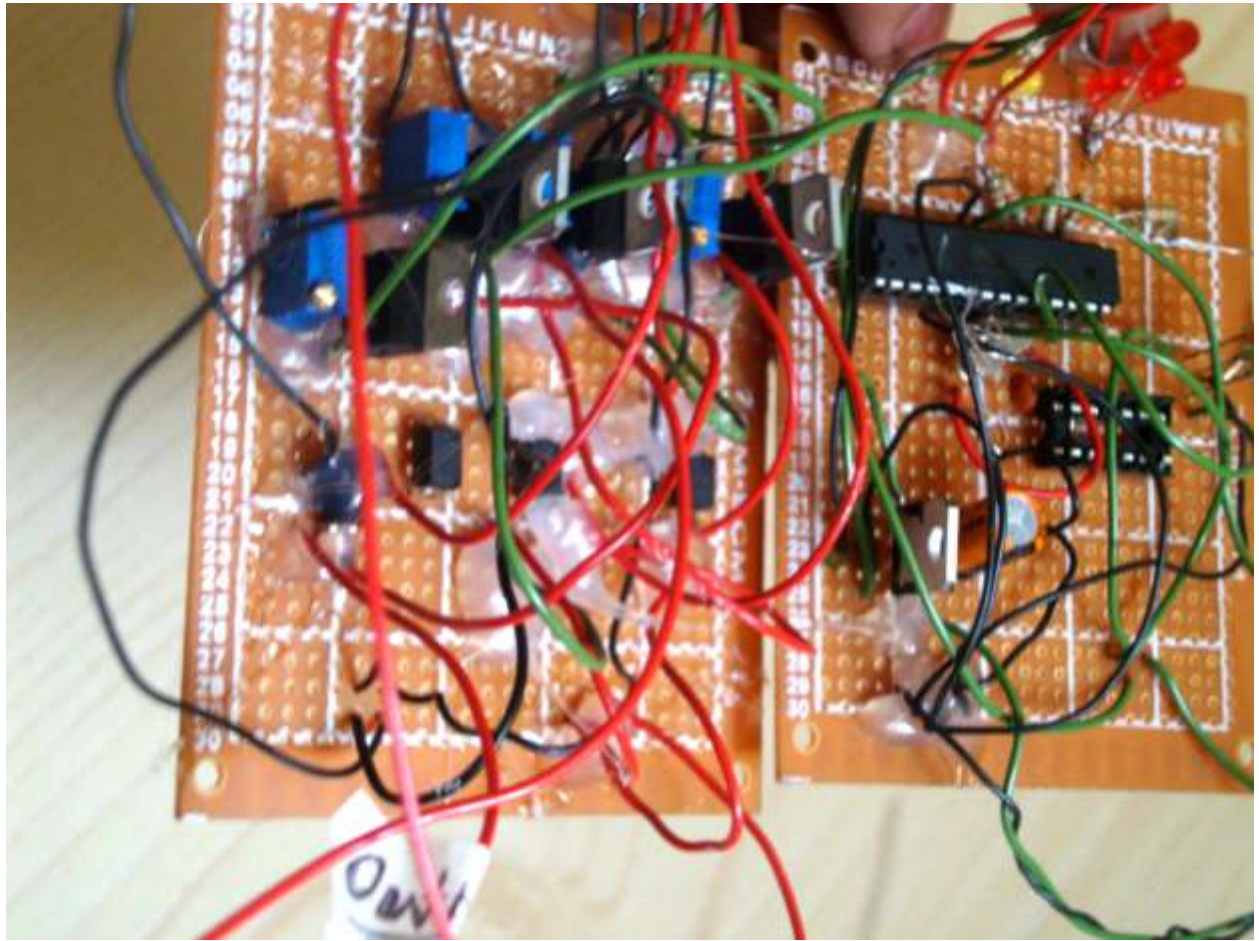
The first three outputs were paralleled, so we got any of the three voltage levels from the same node. Also, the microcontroller was programmed as such that among these three, no 2 outputs will be given simultaneously. When we press any switch, the output given by the previous switch pressed is first brought to zero, then it provides its own voltage level.

The first three levels of voltage define three speed levels for the train.

The fourth switch is for defining the direction mode for the train. When it gives 5 volts, the train moves forward, when 0, the direction is reversed.









## **Conclusion:**

Many extensions to this work can be made With extended time we could implement position and collision detection system. We can set a couple of camera so the supervisor can easily monitor.

Using these technologies can prevent train accidents in our country.

.At last we want to say this project helped us to increase our practical knowledge.

## REFERENCES

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