REPORT

ON

"FAN SPEED REGULATION USING IR SENSOR"

Submitted in partial fulfillment of the requirements for the partial completion of

DIGITAL ELECTRONICS AND CIRCUITS [15ES3GCDEC]

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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CERTIFICATE

This is to certify that the self-study work entitled **"Fan Regulator"** is carried out by **Akshay S Rao** (USN: 1BM17EC007)**, Ankit Kumar** (USN: 1BM17EC011)**, Chongtham Gilbert** (USN: 1BM17EC026) in partial fulfillment of the requirements for the partial completion of DIGITAL ELECTRONICS AND CIRCUITS [15ES3GCDEC] during the academic year 2018-2019.

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Rubrics : DEC - Self-study assessment [2016-17] - Practical / Simulation						
Rubrics		Points	4	3	2	1
R1.	50%	Demonstration/ Experiment	Excellent with complete flow and complete output	Excellent with complete flow and partial output	In-complete flow and partial output	Random flow and minimal output
R2.	25%	Procedure/ Approach	Followed universal / standard approach	Specific approach	Specific approach but, in complete	Random approach
R3.	25%	Report / Writing	Followed exactly format specified by department.	Followed exactly format specified by department with small modification.	Followed exactly format specified by department many modification.	Followed exactly format specified by department complete modification.

Rubrics : DEC - Self-study assessment [2016-17] - Oral Presentation						
Rubrics		Points	4	3	2	1
R1.	25%	Information	Gathered from Global information resources and mentioned	Gathered from preferred texts and reference books in syllabus and mentioned	Gathered from preferred texts books in syllabus and mentioned	Gathered from preferred texts books in syllabus and not mentioned
R3.	50%	Presentation	Excellent with complete flow	Excellent with small discontinuities	Average Presentation	Average Presentation with discontinuities
R4.	25%	Report/Writing	Followed exactly format specified by department.	Followed exactly format specified by department with small modification.	Followed exactly format specified by department many modification.	Followed exactly format specified by department complete modification.

ABSTRACT

Regulators are used in fans to control the speed of its rotation. Conventional way to change the speed of fan is by connecting a regulating circuit provided with a manual knob. With the ease in designing digital circuits, here a fan speed regulation using IR sensor circuit is designed to control remotely the speed of the fan.

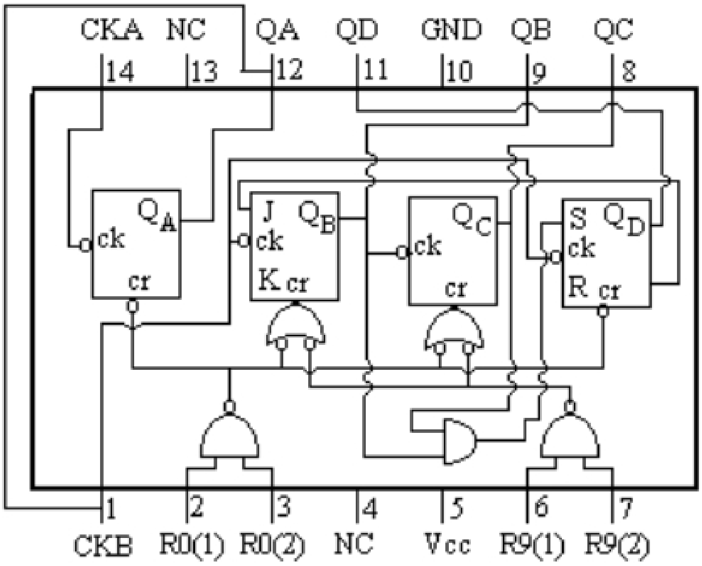
CONTENTS

CHAPTER 1: INTRODUCTION

1.1 LITERATURE SURVEY

1.1.1 IC 7490 DECADE AND BINARY COUNTER

PIN DIAGRAM



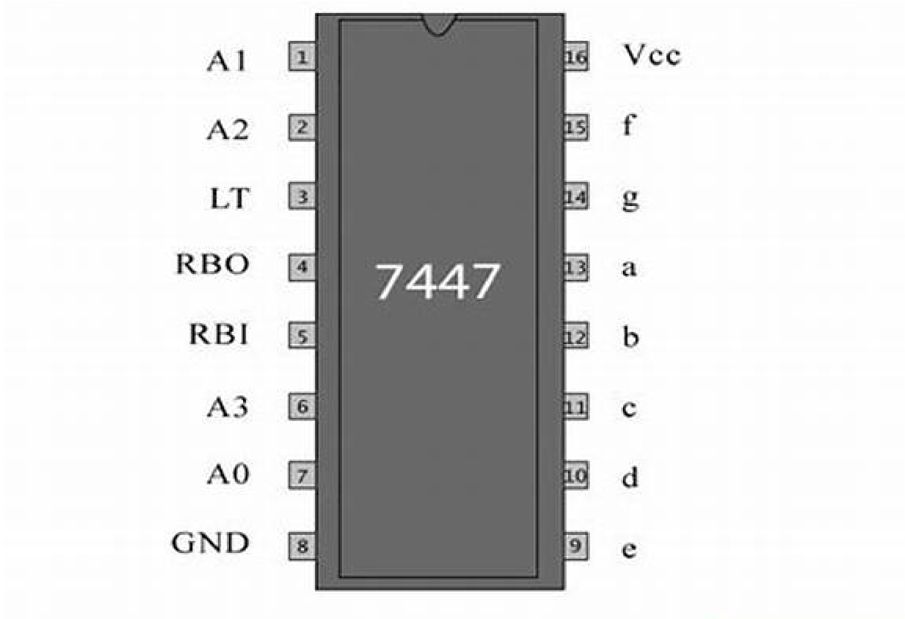
TRUTH TABLE

Decimal Count	BCD Output			
	D	*C*	*B*	*A*
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	0	0	0	0

It is a BCD asynchronous counter. 4 flip flop internally connected so as to provide mod 2 & mod 5 counter function. The IC comes with set & reset pins. When reset pins are connected to logic 1 the flip flop is reset . When set pin are connected to logic 1 the output at the counter is 1001. For normal operation set & reset are connected to logic zero.

1.1.2 IC 7447 BCD TO 7 SEGMENT DECODER

PIN DIAGRAM



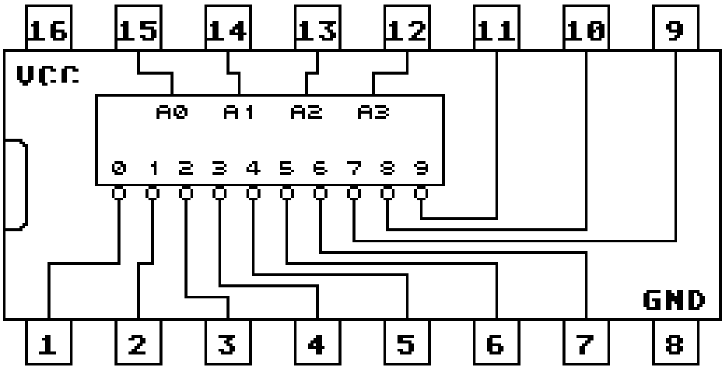
TRUTH TABLE

Decimal digit	Input				Output						
	D	C	B	A	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$
0	0	0	0	0	0	0	0	0	0	0	1
1	0	0	0	1	1	0	0	1	1	1	1
2	0	0	1	0	0	0	1	0	0	1	0
3	0	0	1	1	0	0	0	0	1	1	0
4	0	1	0	0	1	0	0	1	1	0	0
5	0	1	0	1	0	1	0	0	1	0	0
6	0	1	1	0	1	1	0	0	0	0	0
7	0	1	1	1	0	0	0	1	1	1	1
8	1	0	0	0	0	0	0	0	0	0	0
9	1	0	0	1	0	0	0	0	1	0	0

IC7447 is a BCD to 7-segment decoder/driver IC. It accepts a binary coded decimal as input and converts it into a pattern to drive a seven-segment for displaying digits 0 to 9. Binary coded decimal (BCD) is an encoding in which each digit of a number is represented by its own binary sequence of four bits.

1.1.3 IC 7442 BCD TO DECIMAL DECODER

PIN DIAGRAM



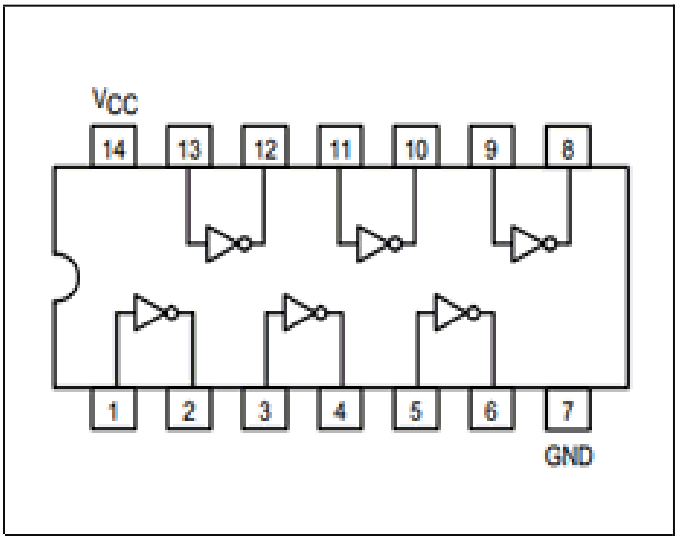
TRUTH TABLE

BCD Input				Decimal Output									
A	*B*	*C*	*D*	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	1	1	1	1	1	1	1	1	1
0	0	0	1	1	0	1	1	1	1	1	1	1	1
0	0	1	0	1	1	0	1	1	1	1	1	1	1
0	0	1	1	1	1	1	0	1	1	1	1	1	1
0	1	0	0	1	1	1	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1	0	1	1	1	1
0	1	1	0	1	1	1	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1	1	1	1	0	1	1
1	0	0	0	1	1	1	1	1	1	1	1	0	1
1	0	0	1	1	1	1	1	1	1	1	1	1	0
1	0	1	0	1	1	1	1	1	1	1	1	1	1

IC 7442 is a BCD-to-decimal decoder which consist of eight inverters and ten, four-input NAND gates. The inverters are connected in pairs to make BCD input data available for decoding by the NAND gates. Full decoding of input logic ensures that all outputs remain off for all invalid (10–15) input conditions.

1.1.4 IC 74LS04 HEX INVERTER

PIN DIAGRAM



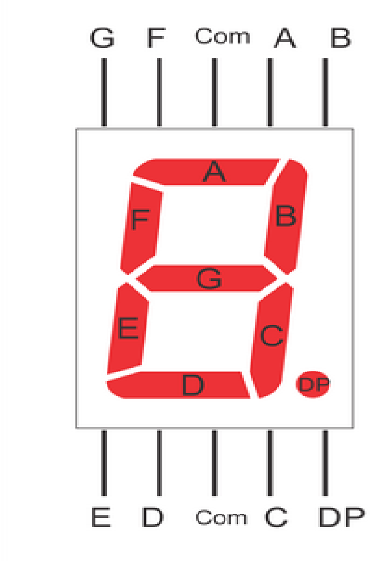
TRUTH TABLE

INPUT	OUTPUT
A	**C**
0	1
1	0

Truth Table

IC 74LS04 has six NOT gates. These NOT gates perform Inverting function. Hence the name HEX INVERTING GATES.

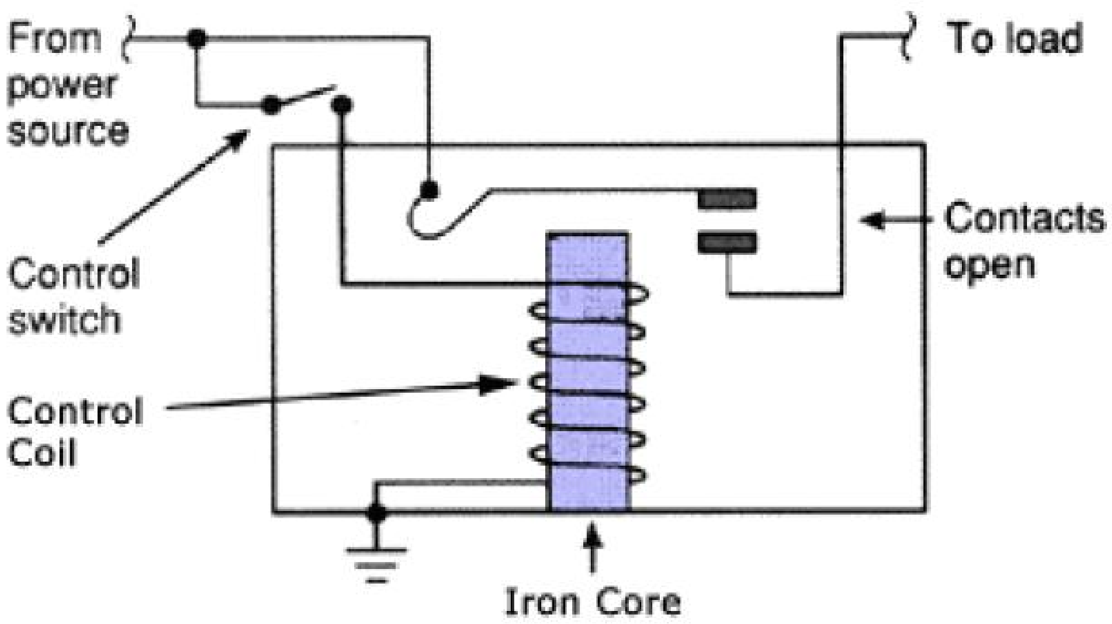
1.1.5 7 SEGMENT DISPLAY



The 7-segment display consists of seven LEDs arranged in a rectangular fashion. Each of the seven LEDs is called a segment because when illuminated, the segment forms part of a numerical digit to be displayed. An additional 8th LED is used within the same package thus allowing the indication of a decimal point when two or more 7-segment displays are connected together to display numbers greater than ten.

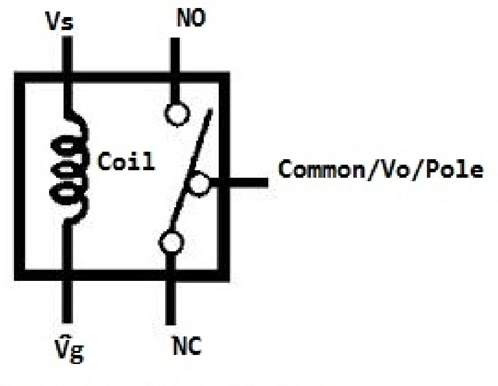
1.1.6 RELAY

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal.



The diagram shows an inner section diagram of a relay. An iron core is surrounded by a control coil. As shown, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus, the upper contact arm starts to be attracted to the lower fixed arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed, then the contact move oppositely and make an open circuit. As soon as the coil current is off, the movable armature will be returned by a force back to its initial position.

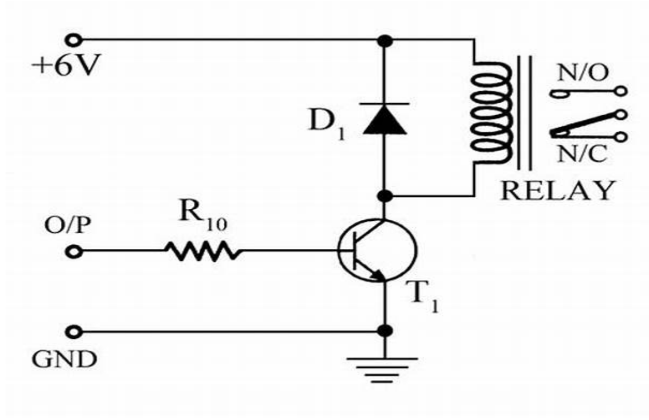
INTERNAL SCHEMATIC



- **Normally Open Contact (NO) –** NO contact is also called a make contact. It closes the circuit when the relay is activated. It disconnects the circuit when the relay is inactive.

- **Normally Closed Contact (NC) –** NC contact is also known as break contact. This is opposite to the NO contact. When the relay is activated, the circuit disconnects. When the relay is deactivated, the circuit connects.

1.1.7 RELAY DRIVER CIRCUIT



Here, the transistor base voltage depends upon the level of output pulse(logic high or low). When the Base voltage of the transistor is zero (or negative), the transistor is cut-off and acts as an open switch. In this condition no Collector current flows and the relay coil is de-energised because being current devices, if no current flows into the Base, then no current will flow through the relay coil and hence the circuit acts as an OFF state or open switch.
When the output feed to the base as logic 1 there is a large enough positive current driven into the Base to saturate the transistor, the current flowing from Base to Emitter (B to E) controls the larger relay coil current flowing through the transistor from the Collector to Emitter and hence the circuit acts as an ON state or closed switch.

1.2 PROBLEM DEFINITION

To design a circuit which can control the speed of the fan remotely and also shows the corresponding fan speed number on a 7 segment display.

CHAPTER 2: SOLUTION PROPOSED

2.1 EXPERIMENTAL SETUP

FAN SPEED REGULATION USING IR SENSOR CIRCUIT

1. The Fan Regulator circuit can be broadly divided into two part.

2. In the first part of the circuit, when the IR sensor sends a high voltage or pulse the IC 7490 records and counts it in BCD.

3. The BCD output from the counter is feed as input to the IC 7447. The decoder decodes the BCD input into 7 segment. The output is then sent to the 7 segment display and hence it displays the number count.

4.The second part of the circuit controls the speed of the fan. The BCD output of IC 7490 is given to the IC 7442.

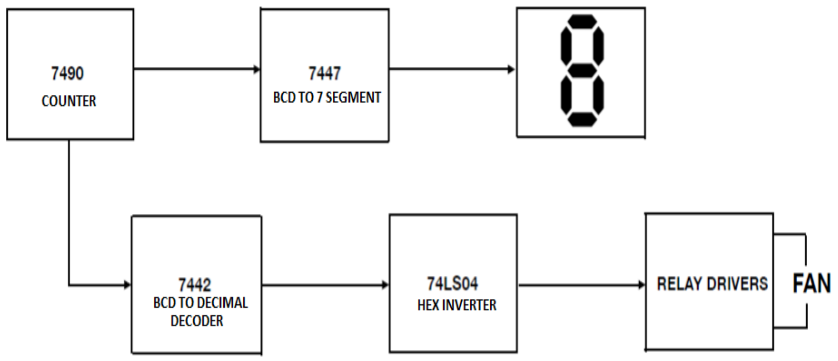
5. The output of BCD to-decimal decoder is given to hex inverter IC. The output from pin 2,4,6,9 and 11 is given to reply driver circuit through corresponding reply driver circuit. The even number output of BCD to decimal decoder is not used. Due to this the fan turns off in every even-number.

6. A switch is used to reset IC 7490. The output of IC 74LS04 is connected to base of transistor present in the relay driver through a resistor 4.7 KΩ. Similar individual circuit is built for each relay. The normal opened contact (N/O) of relay RL_1 through RL_3 are connected to regulating resistor.

2.2 OBJECTIVE/GOAL

To control the speed of fan using a digital fan regulating circuit.

2.3 BLOCK DIAGRAM/ARCHITECTURE

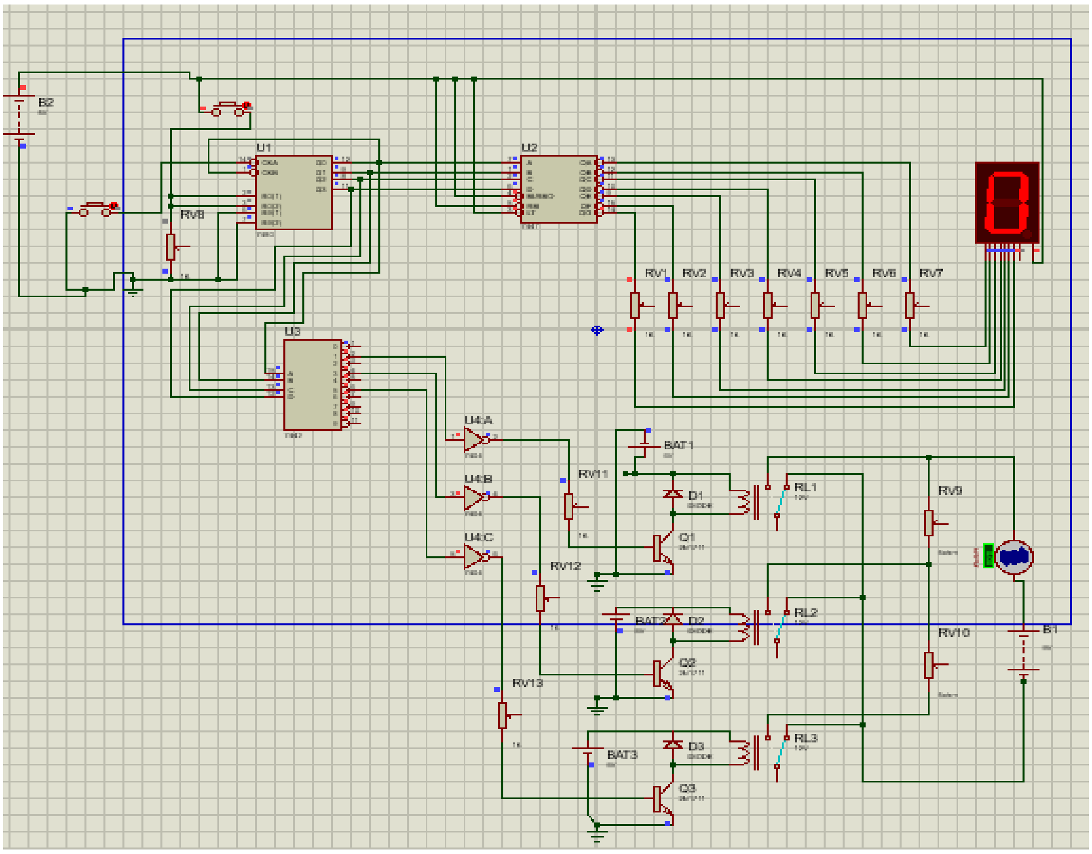


2.4 PROJECT FLOW

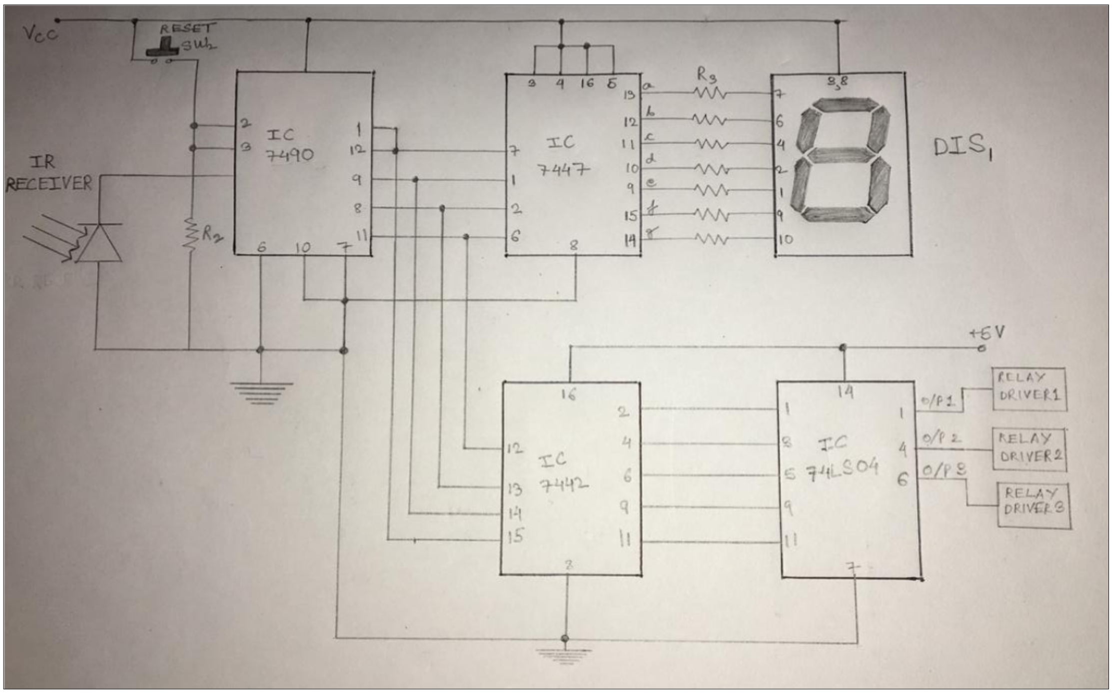
- 27th August 2018: Finalizing the topic
- 17th September 2018: Concluding the design
- 1st October 2018: Assembling and testing of components
- 6th October 2018: Oral Presentation to the class
- 20th October 2018: Construction of the circuit
- 5th November 2018: Debugging the Speed Counting Circuit
- 15th November 2018: Debugging the Fan Regulating Circuit
- 20th November 2018: Simulation
- 22th November 2018: Final report and Submission

Chapter 3: HARDWARE/SOFTWARE DESIGN

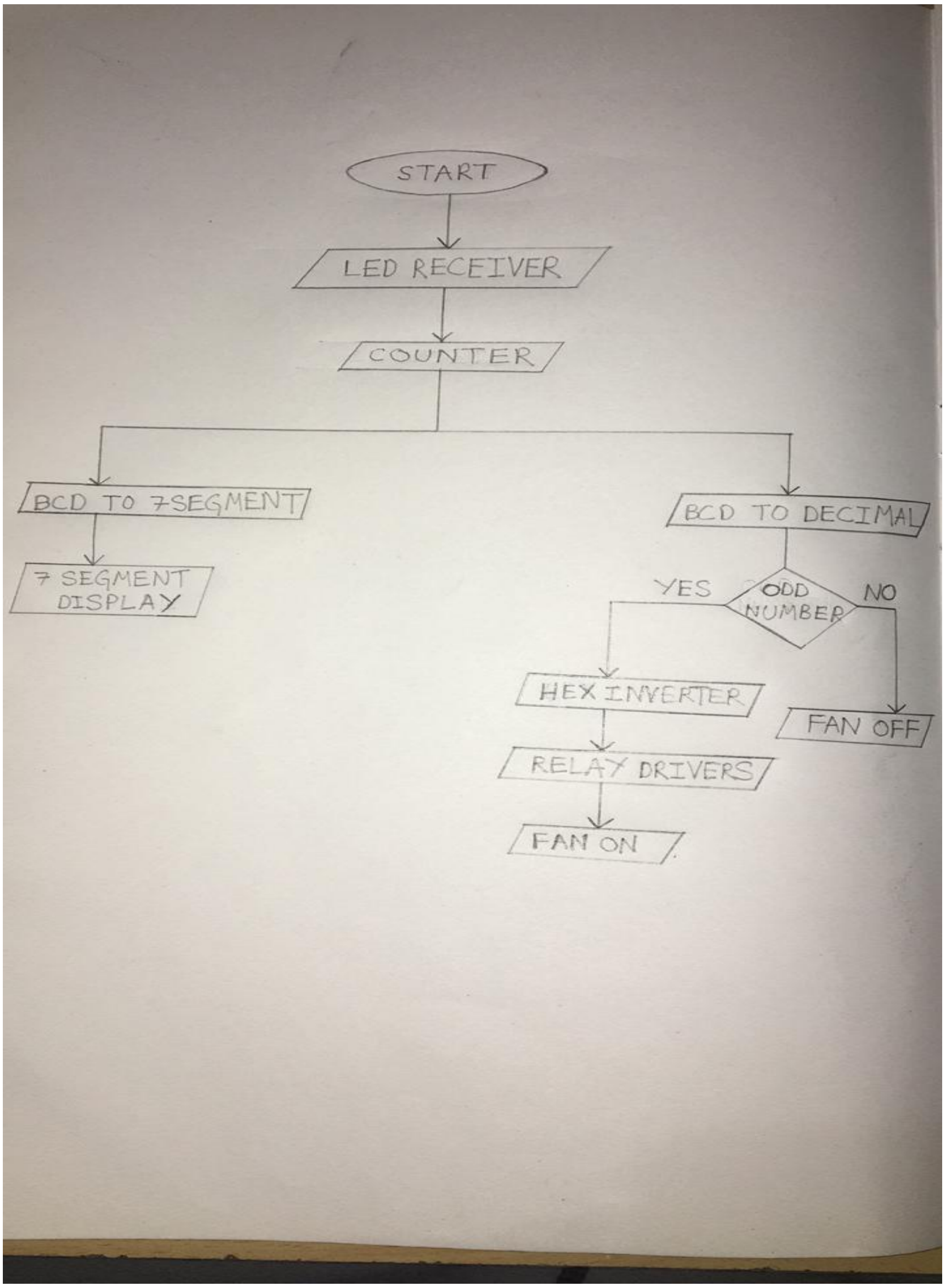
3.1 ARCHITECTURE



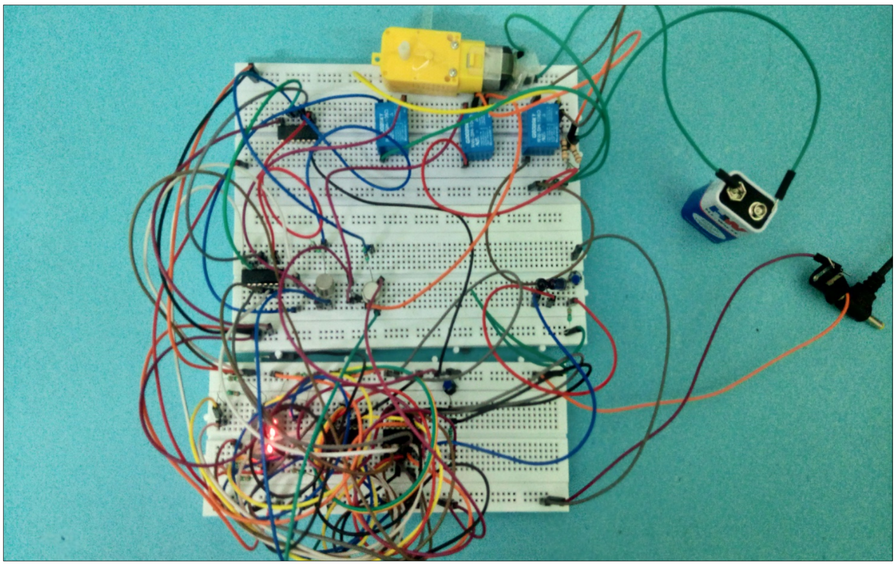
3.2



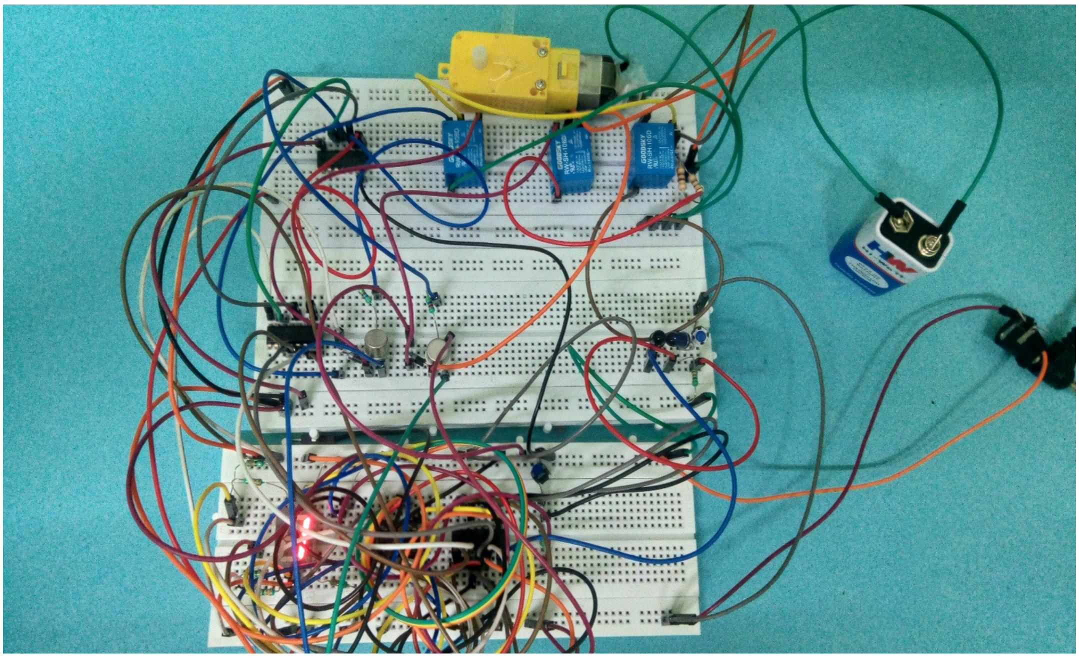
3.3 ALGORITHM/FLOW CHART



CHAPTER 4: PROJECT INTEGRATION



4.1 FINAL MODEL



4.2 LIST OF MATERIALS AND COST DETAILS

List of all Components and Cost				
Sl No.	Component	Quantity	Cost per unit	Cost
1	9V battery	2	15	30
2	IR sensor	2	12	24
3	Breadboard	3	60	180
4	Jumper wires	2 bundle	80	160
5	Common Anode 7 segment display	2	10	20
6	Push button	2	2	4
7	Resistor 1k	2	0.5	1
8	Resistor 330ohm	10	0.5	5
9	Resistor 4.7k	8	0.5	4
10	Resistor 10k	4	0.5	2
11	Resistor 100k	4	0.5	2
12	Capacitor 22uF	2	20	40
13	Capacitor 0.01uF	2	20	40
14	IC NE555	2	10	20
15	IC 7490	2	25	50
16	IC 74LS04	2	20	40
17	IC 7447	2	40	80
18	IC 7442	2	20	40
19	npn Transistor	5	3	15
20	Relay	5	30	150
21	Diode	5	2	10

TOTAL=Rs 917

CHAPTER 5: TEST AND RESULTS

5.1 TEST METHODOLOGY

Initially, IR transmitter is given power and it emits IR radiation. The IR receiver after receiving the signal completes the circuit, thus producing a pulse which triggers the counter. The counter BCD output is then sent to BCD to 7 segment decoder and followed by passing the output of BCD to 7 segment decoder to 7 segment display to display the number.

Simultaneously, the output from counter is sent to BCD to Decimal Decoder. The IC 7442 BCD to Decimal Decoder is active low enabled. The output of BCD to-decimal decoder is given to hex inverter IC. The output of hex inverter from pin 1,4 and 6 is given to corresponding relay driver circuit. Since the BCD to decimal decoder is active low enabled. Logic 0 is passed from it to the hex inverter and eventually logic 1 from hex inverter is passed to corresponding relay driver circuit. The even number output of BCD to decimal decoder is not used. Due to this the fan turns off in every even-number. The speed increases with every odd number.

5.2 RESULTS

The expected result of controlling the speed of the fan using fan regulator circuit is accomplished.

CHAPTER 6: CONCLUSION

6.1 CONCLUSION

The fan regulating circuit which can control the speed of the fan remotely is presented. This design with modification can control the speed of fifteen fans with single switch. This design would be cheaper than the normal electrical regulator and more effective and convenient to the user. The overall idea behind this design could also be used to control intensity of light bulb/switching action for light bulb or the combination of lights and fans with a single switch.

REFERENCES

http://www.futurlec.com/74/IC7490.shtml

http://www.futurlec.com/74/IC7404.shtml

http://www.futurlec.com/74/IC7447.shtml

http://www.futurlec.com/74/IC7442.shtml

ANNEXURE

IC7490

DM74LS90

Absolute Maximum Ratings (Note 4)

Supply Voltage	7V
Input Voltage (Reset)	7V
Input Voltage (A or B)	5.5V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 4: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter		Min	Nom	Max	Units
V_{CC}	Supply Voltage		4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage		2			V
V_{IL}	LOW Level Input Voltage				0.8	V
I_{OH}	HIGH Level Output Current				−0.4	mA
I_{OL}	LOW Level Output Current				8	mA
f_{CLK}	Clock Frequency (Note 5)	A to Q_A	0		32	MHz
		B to Q_B	0		16	
f_{CLK}	Clock Frequency (Note 6)	A to Q_A	0		20	MHz
		B to Q_B	0		10	
t_W	Pulse Width (Note 5)	A	15			ns
		B	30			
		Reset	15			
t_W	Pulse Width (Note 6)	A	25			ns
		B	50			
		Reset	25			
t_{REL}	Reset Release Time (Note 5)		25			ns
t_{REL}	Reset Release Time (Note 6)		35			ns
T_A	Free Air Operating Temperature		0		70	°C

Note 5: C_L = 15 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 6: C_L = 50 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 7)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min		2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IL} = Max, V_{IH} = Min	(Note 8)		0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min			0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V	Reset			0.1	mA
		V_{CC} = Max	A			0.2	
		V_I = 5.5V	B			0.4	
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V	Reset			20	µA
			A			40	
			B			80	
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V	Reset			−0.4	mA
			A			−2.4	
			B			−3.2	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 9)		−20		−100	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 7)			9	15	mA

Note 7: All typicals are at V_{CC} = 5V, T_A = 25°C.

IC 74LS04

DM74LS04

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−0.4	mA
I_{OL}	LOW Level Output Current			8	mA
T_A	Free Air Operating Temperature	0		70	°C

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max	2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min		0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min		0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V			0.1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			20	µA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−0.36	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)	−20		−100	mA
I_{CCH}	Supply Current with Outputs HIGH	V_{CC} = Max		1.2	2.4	mA
I_{CCL}	Supply Current with Outputs LOW	V_{CC} = Max		3.6	6.6	mA

Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	R_L = 2 kΩ			
		C_L = 15 pF		C_L = 50 pF	
		Min	Max	Min	Max
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	3	10	4	15

'47A Switching Characteristics

at V_{CC} = 5V and T_A = 25°C (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	Conditions	Min	Max	Units
t_{PLH}	Propagation Delay Time Low to High Level Output	C_L = 15 pF R_L = 120Ω		100	ns
t_{PHL}	Propagation Delay Time High to Low Level Output			100	ns

IC 7442

DM7442A

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−0.8	mA
I_{OL}	LOW Level Output Current			16	mA
T_A	Free Air Operating Temperature	0		70	°C

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −12 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min	2.4	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IH} = Min, V_{IL} = Max		0.2	0.4	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V			1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.4V			40	μA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−1.6	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)	−18		−55	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 4)		28	56	mA

Note 2: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 3: Not more than one output should be shorted at a time.

Note 4: I_{CC} is measured with all outputs open and all inputs grounded.

Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	Conditions	Min	Max	Units
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output from A, B, C or D through 2 Levels of Logic	C_L = 15 pF R_L = 400Ω		25	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output from A, B, C or D through 3 Levels of Logic			30	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output from A, B, C or D through 2 Levels of Logic			25	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output from A, B, C or D through 3 Levels of Logic			30	ns