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IMITATION & DEPICTION OF WIRELESS ELECTRICAL MECHANISMS CONTROL SYSTEM USING IR ELUCIDATION

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ABSTRACT

Today's modern world, science has made life much more comfortable for mankind. The wonders which science has done to lives every day in homes, office etc, to add another amenity to today life to control electronics devices in household like tube light fans etc. With any normal remote, electric equipments of homes is possible with just pressing a button.

This paper reports the development of an IR remote learning which when attached to an occupancy sensor can switch off/on the electrical equipments during unoccupied duration and thereby save energy. This IR learning remote act as an interface between occupancy sensor and AC by transmitting the control signal of occupancy sensor to the AC, by sending appropriate IR command. Generally, small equipments cannot be connected to regular occupancies sensor with relay design for smaller load. Such AC's can controlled by occupancy sensor with the help of IR remote develop in this work. As this system does not need any wiring and uses IR signal to control AC. This paper describes the development of the IR remote and the energy saving observed during experiment. Thus the energy saving is considerable when using the IR sensors.

Keywords: IR Sensor ,AC controller , wireless communication, remote control.

I. INTRODUCTION

Remote sensing is the science of acquiring information about the Earth's surface actually being in contact with it. This is done by sensing and recording reflection of emitted energy and processing, analyzing and applying that information.[1]

A remote works on wireless communication, sending coded bits of information modulated with an infrared signal of particular frequency. The coded information varies with the button press. Decode this information with the help of giving supply from microcontroller to the particular device on the press particular button.

Remote sensing can be broadly defined as the collection and interpretation about an object, area or event without being in physical contact with the object. The remote sensing technology has enabled the acquisition of information at other wavelength including near infrared, thermal infrared and microwaves. The capacity of remote sensing to identify the monitor land surfaces and environment condition has expanded greatly over the last few years and remotely sensed data will be an essential tool in natural resource management.[2]

II. ROLE OF IR SENSORS-

The infrared remote sensing for controlling the equipments has more advantage other than manual operation. Futuristic home automation, cutting edge entertainment service and spectacular lighting systems are now an affordable reality that can be easily combined within any home.

Using a small control panel, light security, air conditioning and even watering the garden have all been customize to suit the particular needs of house.

1. ***Total control from anywhere:-*** At home, conveniently located keypads turn lights on/off or dim to preset levels. Any security lights switch on automatically by detectors.
2. ***Automatic gardening:-*** The watering system can be as sophisticated. Use a simple on and off switch or use an automatic timer that is programmed to water at the time required.

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3. ***Automatic lighting for all occasions:-*** architectural, consulting, specifying, industrial, retail, commercial and government organizations lightings. It has exclusively agreement with a number of prestigious international lighting companies as well.
4. ***Easy installation:-*** Because of PIC wiring uses less space to accommodate so many functions, the effort needed to install the system was dramatically reduced resulting labor and cost savings.

PIC including the addition of multipoint switches. A master off switch can be added too. It turns everything off at once (light, iron etc.) to give peace of mind whether leaving the home or just going to bed. The some software also enables changes to be made for new demands like an extension of home.So the IR remote sensor is completely future proof.

Features
*The IR sensors gives the control of :-
A) Security cameras
B) TV's, VCR and DVD players
C) Irrigation
D) Roller door control
E) Electric curtain control
F) Aid conditioning
G) Automatic light control etc.

A remote works on wireless communication, sending coded bits of information modulated with an infrared signal of particular frequency. The coded information varies with the button pressed. Decoded this information with the help of giving supply from microcontroller to the particular device on the press of particular button.

III. METHODOLOGY

3.1 Power supply
For operating electrical equipments like light, fans etc with the power supply of 12V, 6V and 5V, step down transformer to be used with the ampere rating 2amp and step downing capacity 220 V AC.

After the step down process the ac voltage is converted to dc with the help of bridge rectification to extract +ve and –ve dc 12V. This is than shunt with the help of a capacitor 2.2 microfarad to boost up the loss current occurred on step down process that is when the magnetic flux is produced in the transformer. The amp rating gets loss while diminishing the voltage to 220V ac to 12V ac. The capacitor also reduces the ripple factor occurred in the dc making process. Then a fixed regulator is connected to the +ve and –ve dc 12V that is 7805 for extraction of 5 volt to operate microcontroller and switching IC which is wired in the circuit for further operation. In the same way 7805 is used and wired in such a way that it extracts 6 volt dc for the operation of IR receiver kit. The 12 volt is directly used through auto couplers for the operation of loads like fans etc.

3.2 Infrared system
A remote works on wireless communication, sending coded bits of information modulated with an infrared signal of particular frequency. The coded information varies with the button pressed. Decoded this information with the help of a mega 16 microcontroller by giving supply from the microcontroller to the particular device on the press of a particular button.

3.3 Working
The remote sends a train of bits (0's and 1's) of some fixed length modulated with a 38 KHz infrared signal. The sequence of bits which the remote sends is decided by a particular protocol known as RC-5 protocol.

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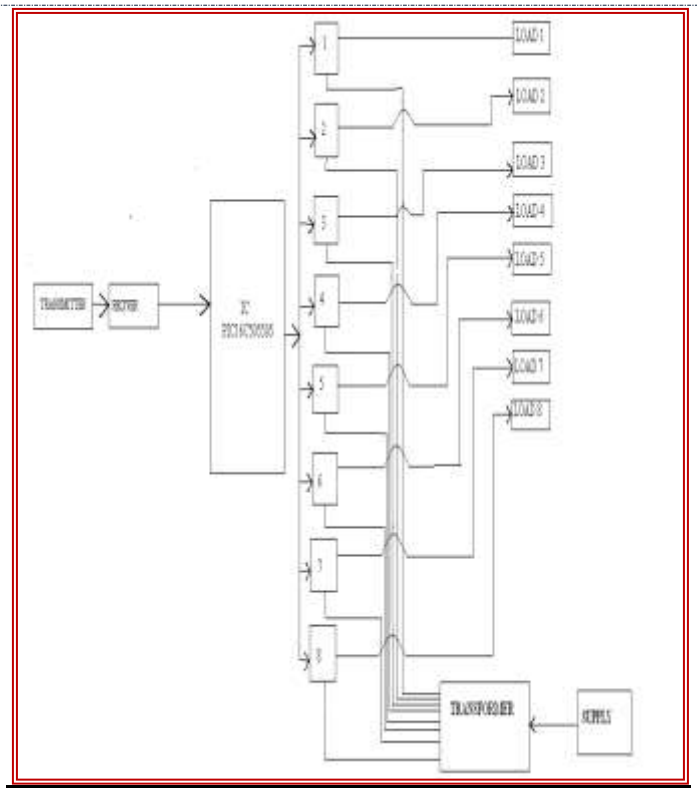

Fig.1 working sequence

3.4 RC-5 protocol

A common used standard protocol for infrared data communication is the RC5 code, originally developed by Philips. This code has an instruction set of 2048 different instructions and is divided into 32 address for different devices the remote belongs to like TV,VCR etc. with each address having 64 instructions each for different buttons on the remote.

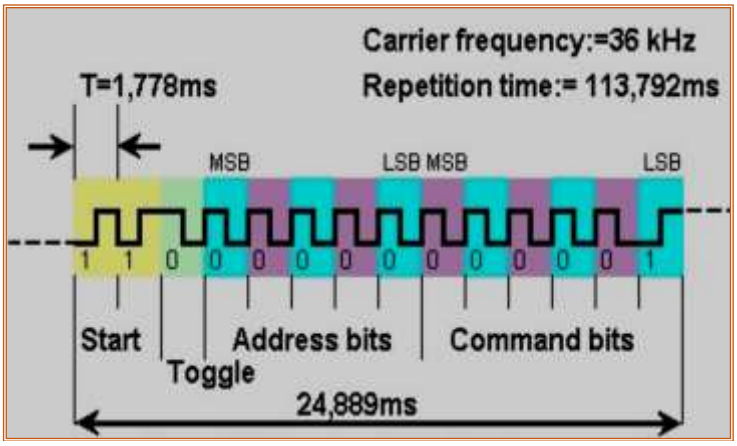

Fig.2 infrared remote protocol

Every kind of equipment uses his own address, and every button has its own unique code. So this makes it possible to change the volume of the TV without change the volume of the stereo.

The transmitted code is a data word which consists of 14 bits and is defined as:
2 start bits for the automatic gain control in the infrared receiver.
1 toggle bit (change every time when a new button is pressed on the IR transmitter)

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3.4.1 Operation

The microcontroller which controls the whole parameters works with the help of power supply i.e. of 12V DC, 5v DC and 6v DC which is produced with the help of transformer rectifier and regulators'. The IR instructions are adjusted by the microcontroller in the form of bits ie. each instruction is adjusted for transmission of bit form with the help of IR transmitter which is of Onida TV remote control is adjusted in such a way that the recovery can receive the instruction in the bit form. The microcontroller receives the signal of the IR transmitter by IR receivers sensor in bit form and it convert the bit forms in voltage and feed to the microcontrollers. The microcontroller receivers the signal and process the instruction and makes decision to control switching functions. The memory IC store the data which is received from the IR transmitter and the mechanical adjustment and it helps to hold the memory to microcontroller that is working. If the light may get 'off' in the memory time when it is working then after arrival of light than it works continually in the back program one doesn't has to program again & again the switching IC works as a mediator in between microcontroller and relays.

IV. COMPONENT DISCRIPTION

4.1 Microcontroller

A **microcontroller** (also microcomputer, MCU or µC) is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for small or dedicated applications. Thus, in contrast to the microprocessors used in personal computers and other high-performance or general purpose applications, simplicity is emphasized. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, and toys. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.[4] Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

A micro-controller is a single integrated circuit, commonly with the following features:

- central processing unit - ranging from small and simple 4-bit processors to complex 32- or 64-bit processors
- discrete input and output bits, allowing control or detection of the logic state of an individual package pin
- serial input/output such as serial ports (UARTs)
- other serial communications interfaces like I²C, Serial Peripheral Interface and Controller Area Network for system interconnect
- peripherals such as timers, event counters, PWM generators, and watchdog
- volatile memory (RAM) for data storage
- ROM, EPROM, EEPROM or Flash memory for program and operating parameter storage
- clock generator - often an oscillator for a quartz timing crystal, resonator or RC circuit
- many include analog-to-digital converters in-circuit programming and debugging support

4.2 Diode

4.2.1 Circuit symbol:

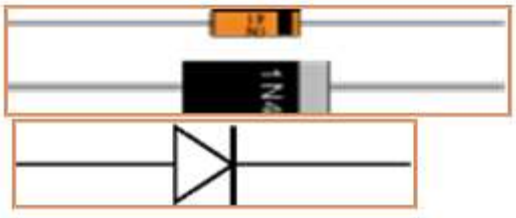

Fig.3 diode symbol

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4.2.2Function

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. Diodes are the electrical version of a valve and early diodes were actually called valves.

4.2.3 Connecting and soldering

Diodes must be connected the correct way round, the diagram may be labeled **a** or **+** for anode and **k** or **-** for cathode (yes, it really is k, not c, for cathode!). The cathode is marked by a line painted on the body. Diodes are labeled with their code in small print, you may need a magnifying glass to read this on small signal diodes!

4.3 Resistor

resistor is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current passing through it in accordance with Ohm's law:

$$V = IR$$

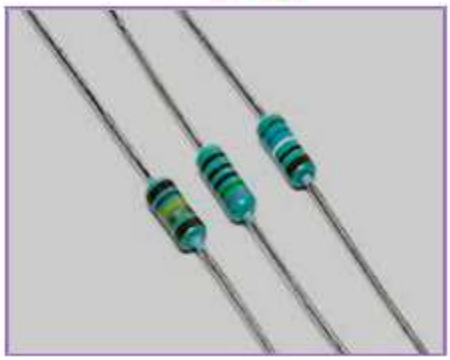

Fig. 4 resistor

For example, green-blue-yellow-red is $56\times10^4\ \Omega = 560\ k\Omega \pm 2\%$. An easier description can be as followed: the first band, green, has a value of 5 and the second band, blue, has a value of 6, and is counted as 56. The third band, yellow, has a value of 10^4, which adds four 0's to the end, creating 560,000 Ω at ±2% tolerance accuracy. 560,000 Ω changes to 560 kΩ ±2% (as a kilo- is 10^3).

Each color corresponds to a certain digit, progressing from darker to lighter colors, as shown in the chart below

Table.1 resistance color coding

Color	1st band	2nd Band	3rd band (multiplier)	4th band (tolerance)	Temp. Coefficient
Black	0	0	$\times10^0$		
Brown	1	1	$\times10^1$	±1% (F)	100 ppm
Red	2	2	$\times10^2$	±2% (G)	50 ppm
Orange	3	3	$\times10^3$		15 ppm
Yellow	4	4	$\times10^4$		25 ppm
Green	5	5	$\times10^5$	±0.5% (D)	
Blue	6	6	$\times10^6$	±0.25% (C)	
Violet	7	7	$\times10^7$	±0.1% (B)	
Gray	8	8	$\times10^8$	±0.05% (A)	

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White	9	9	$\times 10^{9}$		
Gold			$\times 10^{-1}$	±5% (J)	
Silver			$\times 10^{-2}$	±10% (K)	
None				±20% (M)	

4.4 Capacitor

Capacitors are widely used in electronic circuits to block the flow of direct current while allowing alternating current to pass, to filter out interference, to smooth the output of power supplies , and for many other purposes. They are used in resonant circuits in radio frequency equipment to select particular frequencies from a signal with many frequencies.

A **capacitor** or **condenser** is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When a potential difference (voltage) exists across the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the conductors. The effect is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called plates.[5]

Fig.5 electrolytic capacitor

Fig.6 ceramic capacitor

4.4.1Capacitor markings

Most capacitors have numbers printed on their bodies to indicate their electrical characteristics. Larger capacitors like electrolytics usually display the actual capacitance together with the unit (for example, **220 µF**).

Smaller capacitors like ceramics, however, use a shorthand consisting of three numbers and a letter, where the numbers show the capacitance in pF(calculated as XY x 10^{Z} for the numbers XYZ) and the letter indicates the tolerance (J, K or M for ±5%, ±10% and ±20% respectively).

Additionally, the capacitor may show its working voltage, temperature and other relevant characteristics. A capacitor with the text **473K 330V** on its body has capacitance of 47 x 10^{3} pF = 47 nF (±10%) with a working voltage of 330 V.

4.5 Relay

It basically is a switching device. On providing a definite specified DC voltage across the induction coil, it gets magnetized and causes the switch (the middle one) to flip its position from where it was previously to the other pin, causing the device attached across it to turn on. But it had a problem, provided with only 12 volt relay (it operated on 12 V) and the microcontroller gave 5V.So it provided a BJT transistor in Common emitter mode to amplify 5V to 12 V. Finally attached device across the relay to get it working when the relay received 12 V.[6]

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Fig.7 relay structure

4.5.1 Operation

When an electric current is passed through the coil, the resulting magnetic field attracts the armature, and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

A relay will switch one or more poles, each of whose contacts can be thrown by energizing the coil in one of three ways:
A) Normally-open (**NO**) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a **Form A** contact or "make" contact.
B) Normally-closed (**NC**) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a **Form B** contact or "break" contact.
C) Change-over (**CO**), or double-throw (**DT**), contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called a **Form C** contact or "transfer" contact ("break before make"). If this type of contact utilizes a "make before break" functionality, then it is called a **Form D** contact.

4.6 Voltage regulator

A **voltage stabilizer** is an electronic device able to deliver relatively constant output voltage while input voltage and load current changes over time. A **voltage regulator** is an electrical regulator designed to automatically maintain a constant voltage level.

It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

4.6.1 AC voltage stabilizers

A voltage stabilizer is a type of household mains regulator which uses a continuously variable autotransformer to maintain an AC output that is as close to the standard or normal mains voltage as possible, under conditions of fluctuation. It uses a servomechanism (or negative feedback) to control the position of the tap (or wiper) of the autotransformer, usually with a motor. An increase in the mains voltage causes the output to increase, which in turn causes the tap (or wiper) to move in the direction that reduces the output towards the nominal voltage.

4.6.2 DC voltage stabilizers

Fig.8 voltage stabilizer

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Many simple DC power supplies regulate the voltage using a *shunt regulator* such as a zener diode, avalanche breakdown diode, or voltage regulator tube. Each of these devices begins conducting at a specified voltage and will conduct as much current as required to hold its terminal voltage to that specified voltage. The power supply is designed to only supply a maximum amount of current that is within the safe operating capability of the shunt regulating device (commonly, by using a series resistor). In shunt regulators, the voltage reference is also the regulating device.[5]

4.6.3 Simple voltage stabilizer

In the simplest case emitter follower is used, the base of the regulating transistor is directly connected to the voltage reference:

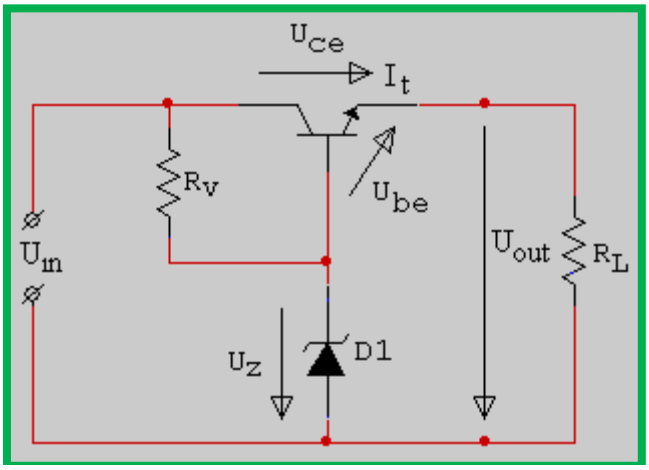

Fig.9 Voltage stabilizer circuit diagram

The stabilizer uses the power source, having voltage U_{in} that may vary over time. It delivers the relatively constant voltage U_{out}. The output load R_L can also vary over time. For such a device to work properly, the input voltage must be larger than the output voltage and Voltage drop must not exceed the limits of the transistor used.

The output voltage of the stabilizer is equal to U_Z - U_{BE} where U_{BE} is about 0.7v and depends on the load current. If the output voltage drops below that limit, this increases the voltage difference between the base and emitter (U_{be}), opening the transistor and delivering more current. Delivering more current through the same output resistor R_L increases the voltage again.

4.7 LED

Circuit symbol:

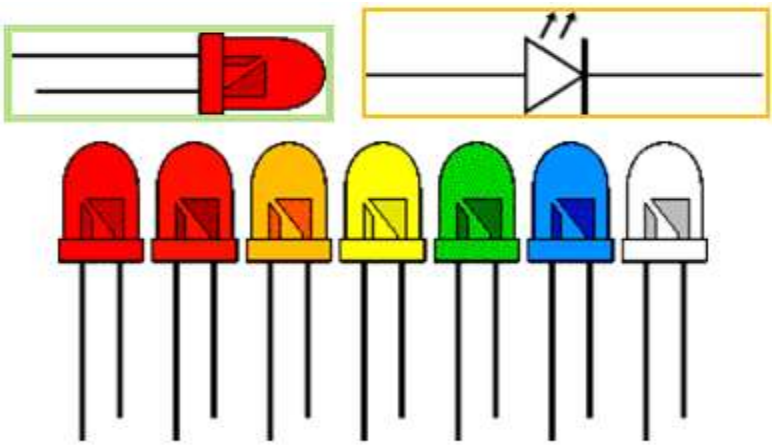

Fig.10 LED

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LEDs emit light when an electric current passes through the .LEDs must be connected the correct way round, the diagram may be labeled **a** or **+** for anode and **k** or **-** for cathode (yes, it really is k, not c, for cathode!). The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method). [6]

LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a 1kΩ resistor is suitable for most LEDs if supply voltage is 12V or less.

4.8 Transistor

Fig.11 transistor

4.8.1 Function

Transistors amplify current, for example they can be used to amplify the small output current from a logic IC so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to amplify voltage.

. Table.2 function of the transistor

Code	design	Case style	I_C max.	V_{CE} max.	h_{FE} min.	P_{tot} max.	Category (typical use)
BC 177	PNP	TO18	100 mA	45V	125	300mW	Audio, low power
BC 178	PNP	TO18	200 mA	25V	120	600mW	General purpose, low power
BC 179	PNP	TO18	200 mA	20V	180	600mW	Audio (low noise), low power
BC 477	PNP	TO18	150 mA	80V	125	360mW	Audio, low power
BC 478	PNP	TO18	150 mA	40V	125	360mW	General purpose, low power
TIP 32	PNP	TO220	3A	60V	25	40W	General

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A							purpose, high power
TIP 32 C	PNP	TO220	3A	100 V	10	40W	General purpose, high power

V. HARDWARE SECTION

5.1 PCB design

Layout of desired circuit diagram and preparation is first and most important operation in any printed circuit board manufacturing process. First at all layout of component side is to be made in accordance with available component dimensions.

The following points are to be observed while forming the layout of P.C.B.

1. Between two components, sufficient space should be maintained.
2. High wattage/max. Dissipated components should be mounted at a sufficient distance from semiconductors and electrolytic capacitors.
3. The most important point is that the components layout is making proper compromization with copper side circuit layout.

The two most popular boards are single sided boards and the double sided boards. The single sided P.C.B are widely used for general purpose application where the cost is to be low and the layout is simple.

5.2 Preparing circuit layout

First of all the actual size circuit layout is to be drawn on the copper side of the copper clad board. Then enamel paint is applied on the tracks of connection with the help of a sharp brush. It has to apply the paints surrounding the point at which the connection is to be made. It avoids the disconnection between the leg of the component and circuit track. After completion of painting work, it is allowed to dry.

5.2.1 Drilling

After completion of painting work , holes of 1/32 inch (1 mm) diameter are drilled at desired points where it have to fix the components.

5.2.2 Etching

The removal of excess of copper on the plate apart from the printed circuit is known as etching. For this process the copper clad board with printed circuit is placed in the solution of Fecl3 (Ferric chloride) with 3-4 drops of HCL in it and is kept so for about 2 hrs and is taken out when all the excess copper is removed from the P.C.B. [5]

After etching, the P.C.B is kept in clean water for about half an hour in order to get P.C.B away from dry acidic profile which may cause poor performance of the circuit. After the P.C.B has been thoroughly washed paint is removed by soft piece of cloth dipped in thinner or turpentine. Then P.C.B is checked as per the layout. Now the P.C.B is ready for use.

5.2.3 Soldering

Soldering is the process of joining two metallic conductors , the joint where the two metal conductors are to be joined of fused is heated with a device called soldering iron and then an alloy of tin and lead called solder is applied which melts and covers the joint. The solder cools and solidifies quickly to ensure a good and durable connection between the joined metals. Covering the joint with solder also prevents oxidation.[5]

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5.2.3.1 How to solder

A good soldering practice is very important for assembling for any electronic circuit. A poorly soldered joint or connection in electronic circuit is the cause of most services problems. Given below are some important steps to be followed in good and correct soldering practice.

1. Use of correct type of soldering iron and solder. Avoid the use of excessive flux.
2. Keep the soldering iron hot during the working period and let it rest on its stand when not in use.
3. All components leads and wires should be thoroughly cleaned to remove dust and rust before soldering.
4. Enough heat is applied to the joint so that the solder metal flows freely over the heat.
5. Over heating of components in P.C.B is avoided. Overheating may result in damage of components or P.C.Bs
6. Too much solder is not used to avoid short circuits between conduction paths on a P.C.B.

VI. PRECAUTIONS

1. The supply of microcontroller should be not more than +6 volt otherwise microcontroller may be damaged.
2. Microcontroller input and output pin should not be interchanged.
3. Only regulated power supply used for microcontroller.
4. It using higher rating motor than buffer IC should be using for interfacing.
5. In output section heat-sink should be mount on transistor because insufficient heat generate when run motor.
6. The component fitted on the PCB should be tightly fitted.
7. Do not touch the PCB layer with hands and for fitting component use long nose pliers only.
8. Use 25 W pencil bit soldering iron only.
9. The solder metal has 60-40 and for all soldering. A good solder joint have always shining bead like appearance.
10. IC are fitted with IC base so that heat generated at the time of soldering are avoided.

VII. ESTIMATE

Table.3 estimate

Sr. No	Name of component	quantity	Cost per product(rs)	Total (rs)
1.	Microcontroller	1	250	250
2.	Diode	10	4	40
3.	Resistor	18	3	54
4.	Capacitor	6	3×1+2×3+7×1	16
5.	Relay	8	25	200
6.	Voltage regulator	1	10	10
7.	LEDs	8	1.5	12
8.	Transistor	8	3	24
9.	PCB	1	90	90
10.	Transformer	2	40	80
11.	Motor	1	90	90
12.	Sensor	1	30	30
			total	896

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VIII. RESULT

Fig. 12 module structure

IX. CONCLUSION

The IR remote sensor has been developed to switch on/off the electrical equipments. This project provides 15% of energy saving at residential base, than manually operated systems. It provides safe and easy operation of house hold loads like lights, fans. If this system used in the place of conventional system then it will give great economical range, which can be easily afford.

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