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Energy Conservation Technique for Air Conditioner and Fan in Residential Applications

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Abstract: ***The air conditioner system plays a very essential role in our everyday lives. But air condition systems consume a lot of power. In this project, fan and AC are clubbed together and will work at different interval of time. This project is based on time variant i.e. if we set the delay time of say(1 hour) the AC will operate for 1 hour while the Fan is OFF and after 1 hour the AC will turn OFF and the Fan will operate and this operation will keep on repeating till the supply is turn OFF. The delay time for the operation of AC and Fan can be set according to our requirement through the program given to the arduino Different case studies was discussed for different Air conditioner companies for different capacities and their energy saving was analyzed for different cases.***

Index Terms: Air conditioner, Arduino, fan, Energy saving

I. INTRODUCTION

The Air Conditioner plays an important role in our home and industrial applications. During summer season, due to hot whether it is necessary for customers to have Air Conditioner. The Load will not be same every time but it will vary every time. While we take one location, the load will not be constant for 24 hours. The load in residential, industrial and commercial appliances will vary every period of time.

Now days, residential, industrial and commercial appliances using Air Conditioner for maximum number of hours. The Industrial load is comparatively more while comparing the residential load. For operating IT industries, the Air Conditioner is essential to work for the employees. During summer season, the load in residential appliances also increased due to hot environment. The commercial appliances like Mall are operating only on Air Conditioner.

During some time, the Air Conditioner will operate in a place but nobody present in that place for a hours. Energy Conservation is required to reduce the consumption of energy [4]. Due to more energy utilized, the cost of the energy utilized increased. It is necessary to take action to conserve the energy [2,8-12]. There are many steps there to conserve energy like switch OFF fan and Air Conditioner when not in use, automatic sensing control. During night time, after we sleep it is difficult to ON fan when Air Conditioner become OFF by setting time delay [3]. The existing Air Conditioner has remote control to set the temperature. But this cannot be done automatically. The room temperature will not be same at every time but it will always changes depends on the climate. So the user will set the temperature low when there is solar radiation but when rains they need to reduce the temperature or to switch ON the fan. By using AC and fan controller circuit, it is possible to overcome this problem.

The Load calculation is necessary to know the performance of air Conditioner [5-7]. To have a Air Conditioner to operate at good performance, then it is necessary to estimate the air Conditioner load. The room size, ventilation, location of windows, lights and appliances are required to estimate the Air Conditioning load. The solar radiation will differ from every location. The solar radiation will not be constant for every time and every location. The solar radiation directly passes through the windows and the efficiency will be reduced during day time. By conduction, the heat normally transferred to the room. When the heat gain produced it will affects the performance of the Air Conditioner. The heat gain normally occurs due to dust in the air. The heat gain can be calculated as

Heat Gain= Multiplying factor × Solar gain × Area of glass

So the heat gain depends on the area, solar gain and multiplying factor. The heat gain can be reduced when there is less solar gain.

The capacity of the Air Conditioner is very important to install in a room. Normally every person gives up heat every hour. The heat also normally present in the room by other things like Incandesce lamp, other lights etc. Based on the capacity of Air Conditioner it will remove Kcal of heat in a room for every hour. If the size of the room is large then there will be more heat inside the room, so the capacity of Air Conditioner is necessary to increased. When the size of the room is small then small capacity of Air Conditioner is enough to install.

II. BLOCK DIAGRAM & CIRCUIT DESCRIPTION

The power consumption of fan is 75 watts and Air conditioner will depends on different companies and capacity of the Air conditioner. The power supply of 5volt given to Aruino Uno to operate. The Air conditioner and fan was connected to relay circuit to operate feasible operation. The operation done through Ardino Uno When fan is needed to switch ON when Air Conditioner switched OFF.

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The programming of Arduino Uno done in order to operate Fan and AC controller operation.

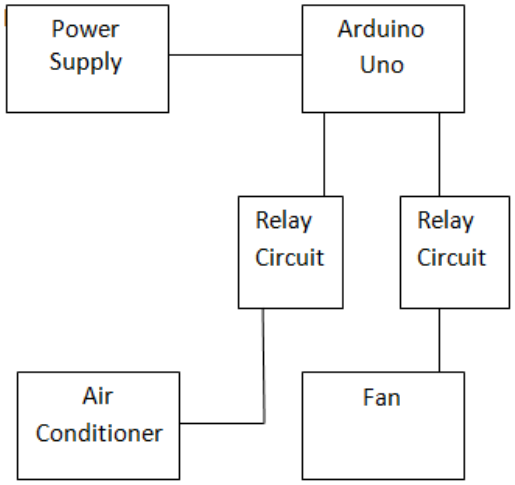

Figure.1.Block diagram for AC and Fan Controller

In this circuit the Arduino Uno is used to control the AC and fan circuit. A voltage of 12 volt DC is supplied to the ARDUINO. Here, the output pin from arduino (i.e pin 5 and pin 6) is connected to the AC and fan relay circuit respectively. The output from the one relay circuit is connected to one motor (which represented as AC) and the output of another relay is connected to another motor (which represent as fan). The circuit diagram of AC and Fan controller was shown in figure.2.

Based on the working principle, the arduino will control the timing of AC and fan operation [1,2] as shown in figure.3, depending on the delay time given to the program for the arduino. The hardware of AC and fan controller was shown in figure.3.

Many literatures have done to understand the concept of the AC and fan controllers. The Arduino based projects have increased now days. This can also be used in Fan and AC controller for better output.

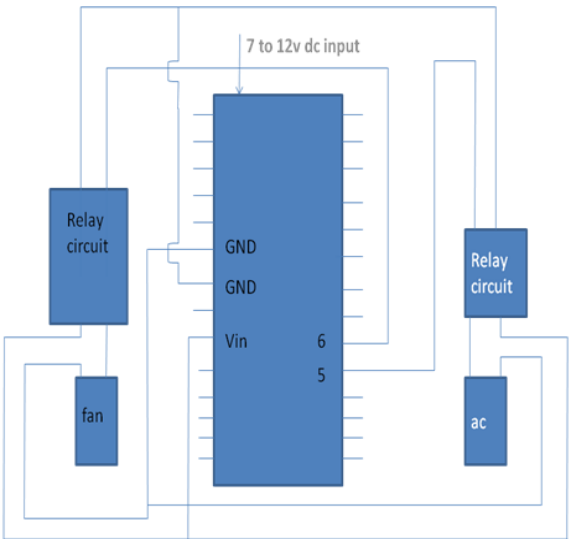

Figure.2.Schematic circuit diagram of AC and Fan controller

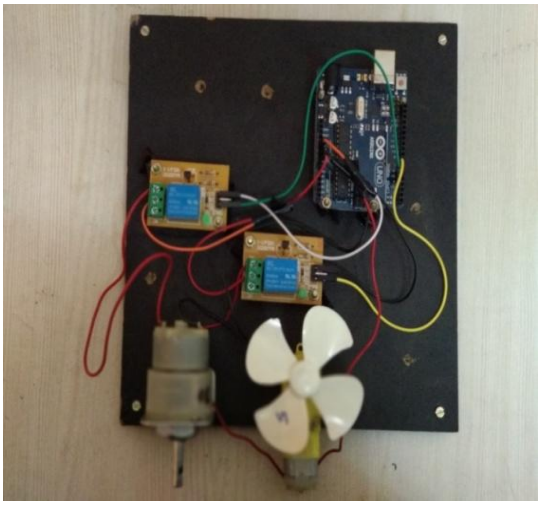

Figure.3. Hardware circuit of AC and Fan Controller

III. MATH

If you are using *Word*, use either the Microsoft Equation Editor or the *MathType* add-on (http://www.mathtype.com) for equations in your paper (Insert | Object | Create New | Microsoft Equation *or* MathType Equation). "Float over text" should *not* be selected.

IV. UNITS

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "3½ in disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refer to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "A·m^2."

V. CASE STUDY

For different Air Conditioner companies like Voltas, LG, O'General, Blue star, Whirlpool, the power consumption varies. For different Air Conditioner like 0.75 Ton, 1 Ton, 1.5 Ton, 2 Ton the power consumption for different companies are noted. Normally in residential applications Air Conditioners are used in night time. During summer time, the heat will be more and it was still present in the room at night also. For that purpose, it is necessary for all customers to switch ON Air Conditioner during sleep. During that time fan want to be switched OFF. The Fan switched OFF when Air Conditioner in running condition in order to increase the cooling effect. When fan get switched ON when Air Conditioner also running then the Cooling will surround to other places and the real cooling is not possible to get.

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So if the Fan switched OFF and at the same time Air Conditioner is ON means the cooling effect will be more. When both Air Conditioner and Fan ON at same time during sleep, the customers will set a timer for Air Conditioner and then sleep but the fan was still running. So in order to overcome this drawback, the Air conditioner and Fan operated at same time by using Automatic fan and Air Conditioner controller. By using fan for that time, the cost of energy increases and the electricity bill also increases.

In this case study we considered the cost of 1 KWh or 1 unit of energy as Rs.2. The number of hours the Air conditioner considered to operate as 3 hours or 4 hours. For this required hours the cost in a month, cost in a year was calculated for different Air Conditioner companies like Voltas, LG, O'General, Blue star, Whirlpool. Depending on the size of the room, the capacity of Air Conditioner was selected as 0.75 Ton, 1 Ton, 1.5 Ton, 2 Ton. The power consumption for different Air conditioner was analyzed. The Cost of using fan for daily 3 or 4 hrs in a year was calculated in order to find the saving of energy and cost. Normally one ceiling fan consumes 75 watts of power. According to that data, the total cost for using for specify hours in a year was calculated.

Case.i) For 0.75 Ton Air Conditioner When fan switched OFF:

Air Conditioner	Power consumption (Watts)	Hours per day	Price for 1KWh	Cost per month	Cost per year	Cost of using fan for daily 3 or 4 hrs in a year	Total cost when both fan and AC used	Energy Saving (KWh)
Voltas	2510	3	2	458	5497	165	5662	80
LG	2490	3	2	454	5453	165	5618	80
O'General	2500	3	2	456	5475	165	5640	80
Blue Star	2540	3	2	463	5563	165	5728	80
Whirlpool	2575	3	2	469	5639	165	5804	80
Voltas	2510	4	2	610	7330	220	7550	110
LG	2490	4	2	605	7271	220	7491	110
O'General	2500	4	2	608	7300	220	7520	110
Blue Star	2540	4	2	618	7417	220	7637	110
Whirlpool	2575	4	2	626	7519	220	7739	110

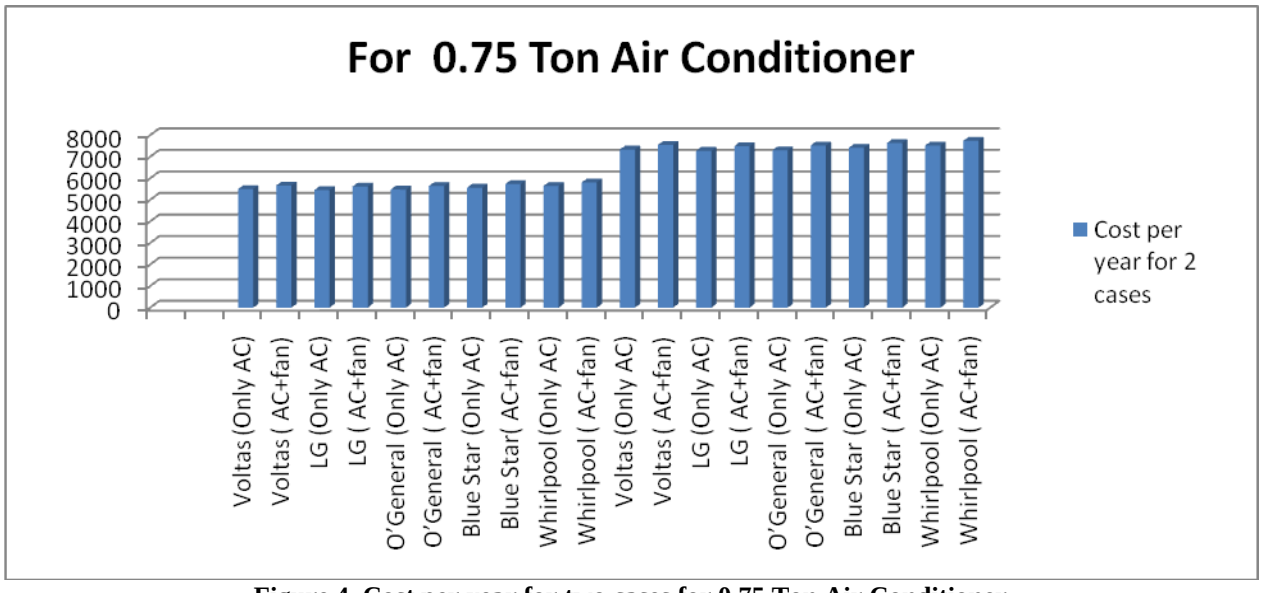

Figure.4. Cost per year for two cases for 0.75 Ton Air Conditioner

The energy saving of 80 KWh and 110 KWh obtained when using fan and AC controller for 3 hrs and 4 hrs using Arduino Uno. For 0.75 Ton Air conditioner ratings for different companies was compared. The cost per month for using 0.75 Ton Air conditioner varies from Rs.400 to Rs.600 (appr) when price for 1KWh is Rs2. The Cost of using fan for daily 3 or 4 hrs in a year of Rs.165 and Rs.220 was saved by this method. The cost comparison for AC and fan and only 0.75

Case.ii) For 1 Ton Air Conditioner When fan switched OFF:

Air Conditioner	Power consumption (Watts)	Hours per day	Price for 1KWh	Cost per month	Cost per year	Cost of using fan for daily 3 or 4 hrs in a year	Total cost when both fan and AC used	Energy Saving (KWh)
Voltas	3375	3	2	616	7392	165	7557	80
LG	3373	3	2	615	7387	165	7552	80
O'General	3510	3	2	640	7687	165	7852	80
Blue Star	3470	3	2	633	7600	165	7765	80
Whirlpool	3405	3	2	621	7457	165	7622	80
Voltas	3375	4	2	821	9856	220	10,076	110
LG	3373	4	2	820	9850	220	10,070	110
O'General	3510	4	2	854	10,250	220	10,470	110
Blue Star	3470	4	2	844	10,133	220	10,353	110
Whirlpool	3405	4	2	828	9943	220	10,163	110

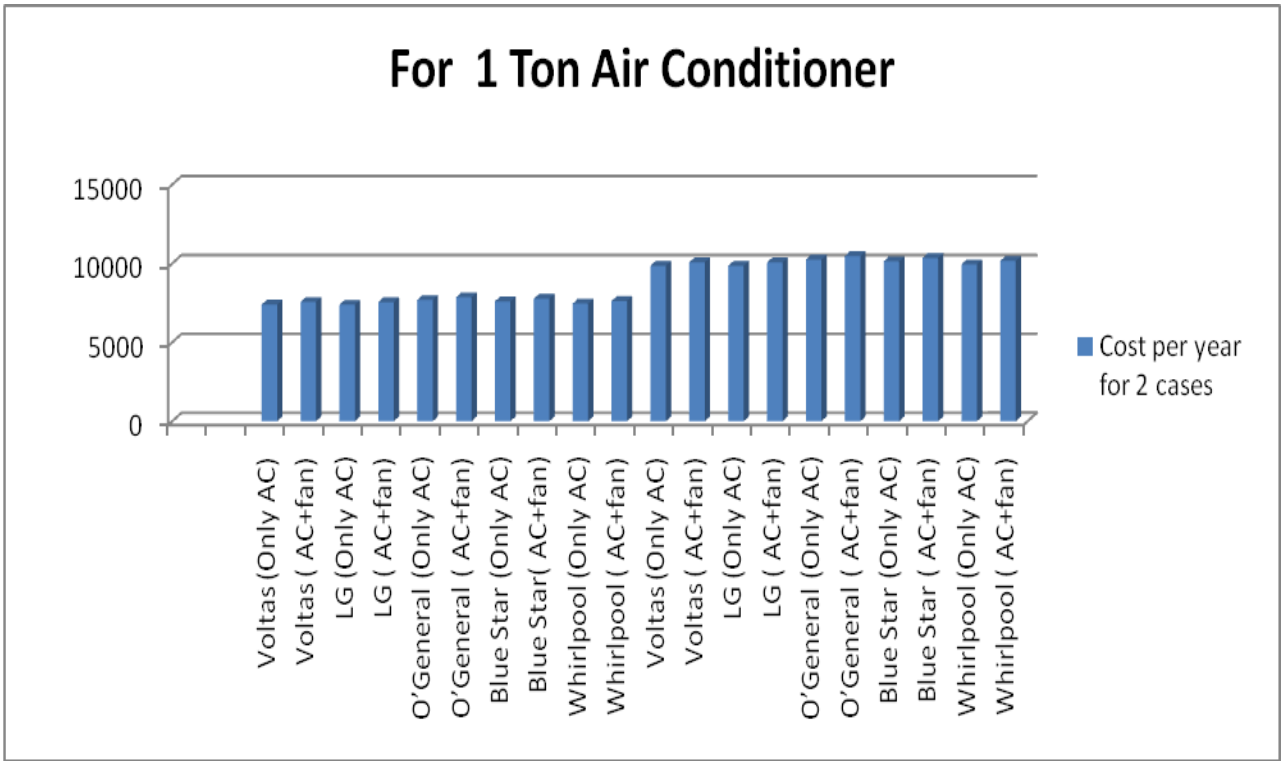

Figure.5. Cost per year for two cases for 1 Ton Air Conditioner

The energy saving of 80 KWh and 110 KWh obtained when using fan and AC controller for 3 hrs and 4 hrs using Arduino Uno. For 0.75 Ton Air conditioner ratings for different companies was compared. The cost per month for using 1 Ton Air conditioner varies from Rs.600 to Rs.800 (appr) when price for 1KWh is Rs2. The Cost of using fan for daily 3 or 4 hrs in a year of Rs.165 and Rs.220 was saved by this method. The cost comparison for AC and fan and only 1.

Case.iii) For 1.5 Ton Air Conditioner When fan switched OFF:

Air Conditioner	Power consumption (Watts)	Hours per day	Price for 1KWh	Cost per month	Cost per year	Cost of using fan for daily 3 or 4 hrs in a year	Total cost when both fan and AC used	Energy Saving (KWh)
Voltas	5100	3	2	930	11,170	165	11,335	80
LG	5045	3	2	920	11,049	165	11,214	80
O'General	5205	3	2	950	11,400	165	11,565	80
Blue Star	4765	3	2	869	10,436	165	10,601	80
Whirlpool	5195	3	2	948	11,378	165	11,543	80
Voltas	5100	4	2	1241	14,893	220	15,059	110
LG	5045	4	2	1227	14,733	220	14,953	110
O'General	5205	4	2	1266	15,200	220	15,420	110
Blue Star	4765	4	2	1159	13,915	220	14,135	110
Whirlpool	5195	4	2	1264	15,171	220	15,391	110

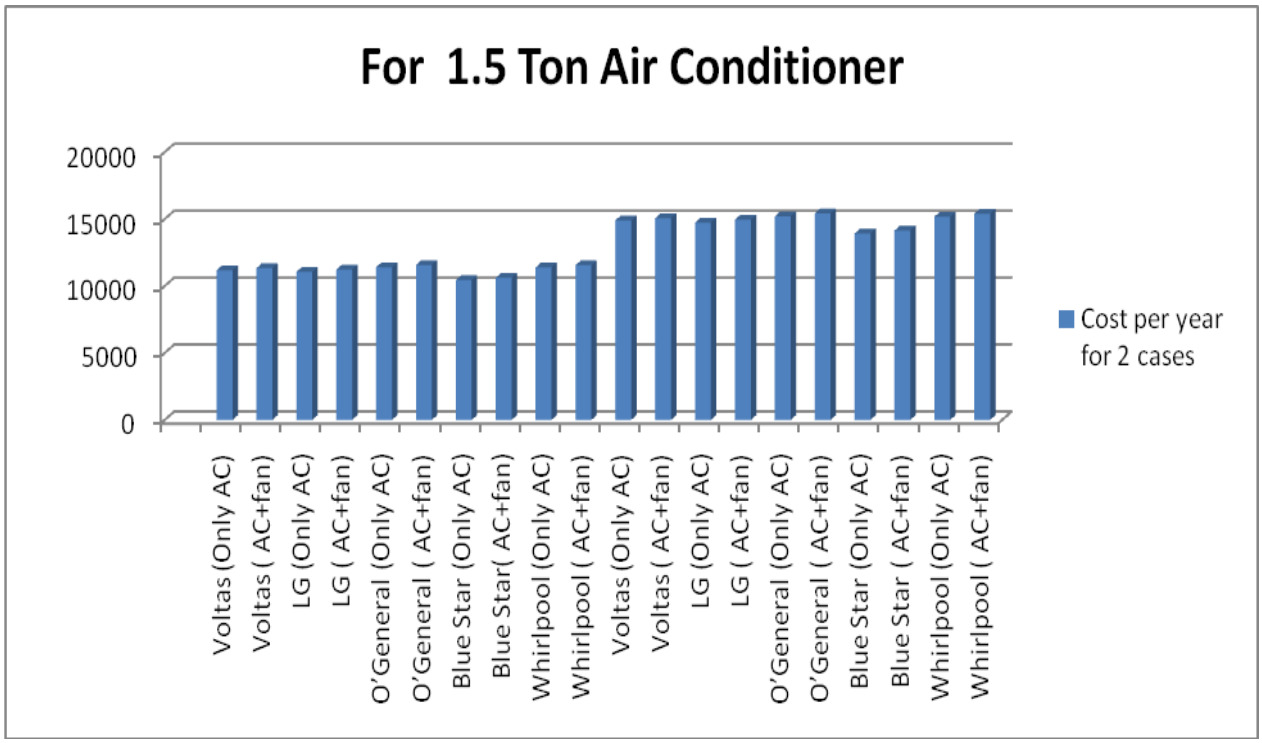

Figure.6. Cost per year for two cases for 1.5 Ton Air Conditioner

The energy saving of 80 KWh and 110 KWh obtained when using fan and AC controller for 3 hrs and 4 hrs using Arduino Uno. For 0.75 Ton Air conditioner ratings for different companies was compared. The cost per month for using 1.5 Ton Air conditioner varies from Rs.900 to Rs.1200 (appr) when price for 1KWh is Rs2. The Cost of using fan for daily 3 or 4 hrs in a year of Rs.165 and Rs.220 was saved by this method. The cost comparison for AC and fan and only 1.5 Ton AC was shown in figure.6.

Case.iv) For 2 Ton Air Conditioner When fan switched OFF:

Air Conditioner	Power consumption (Watts)	Hours per day	Price for 1KWh	Cost per month	Cost per year	Cost of using fan for daily 3 or 4 hrs in a year	Total cost when both fan and AC used	Energy Saving (KWh)
Voltas	6125	3	2	1117	13,415	165	13,580	80
LG	6350	3	2	1159	13,908	165	14,073	80
O'General	6750	3	2	1232	14,784	165	14,949	80
Blue Star	6025	3	2	1099	13,196	165	16,361	80
Whirlpool	6505	3	2	1187	14,247	165	14,412	80
Voltas	6125	4	2	1490	17,886	220	18,086	110
LG	6350	4	2	1545	18,544	220	18,764	110
O'General	6750	4	2	1642	19,712	220	19,932	110
Blue Star	6025	4	2	1466	17,594	220	17,814	110
Whirlpool	6505	4	2	1583	18,996	220	19,216	110

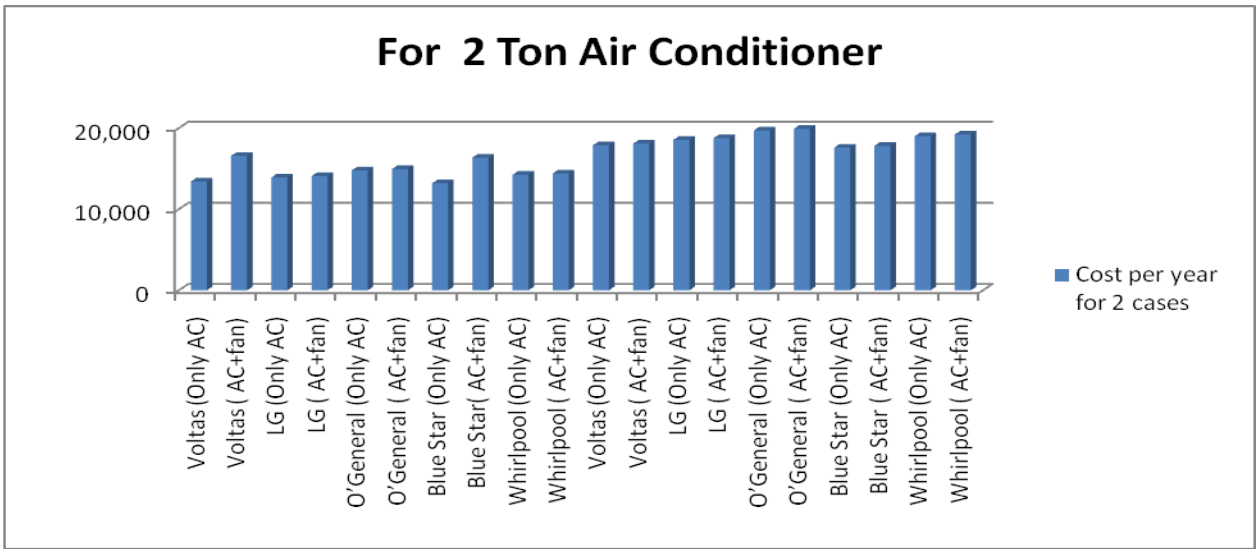

Figure.7. Cost per year for two cases for 2 Ton Air Conditioner

The energy saving of 80 KWh and 110 KWh obtained when using fan and AC controller for 3 hrs and 4 hrs using Arduino Uno. For 0.75 Ton Air conditioner ratings for different companies was compared. The cost per month for using 2 Ton Air conditioner varies from Rs.1100 to Rs.1500 (appr) when price for 1KWh is Rs2. The Cost of using fan for daily 3 or 4 hrs in a year of Rs.165 and Rs.220 was saved by this method. The cost comparison for AC and fan and only 2 Ton AC was shown in figure.7.

VI. CONCLUSION

This paper elaborates the design and construction of AC and fan controller. The delay time for the AC and Fan operation was chosen. The arduino Uno had been used to control the delay time through the program given in the arduino. The arduino was programmed using C language and was implemented for execution process. The design of AC and fan controller was performed for any time variant and can be used as Automatic control. Hence this project will reduce the amount of power consumed. This system will also reduce the running cost since AC and fan are not used simultaneously. Different case studies for AC and fan controller was used in order to understand the energy saving in residential applications.

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