

# **A Comprehensive Study on a Power System of a Leading Telecommunication System to Propose New Strategies for Reducing the Operational Cost**

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## **ABSTRACT**

The ultimate aim of this project was to reduce the huge power consumption of the air conditioning system established in the main exchange of the telecommunication company. This huge power consumption of the organization due to the air conditioning system makes a considerable effect to increase the operational cost of all the communication. After performing a questioner survey among the employees of the organisation, it was decided to use automatically switching fan system with existing air conditioning system to reduce the power consumption of the AC system. The proposed electric fan system performs more cost effectively during the period of 8.00 p.m. to 8.00 a.m. The control system for the above proposed system was specially designed to automatically switch to the AC system and fan system according to temperature level which is decided by its electronics circuits. A PIC programme was written to activate the control system according to the requirements. BTS, Transmission and Power sections in the organisation were mainly focused when the research was performed. Finally the power section was mainly considered as it can provide a major solution to reduce the operational cost of the leading mobile multimedia telecommunication services provider

**KEYWORDS:** Air Conditioning System, Power Consumption, Operational Cost for the Mobile/Multimedia Communication

## **INTRODUCTION**

Mobitel Private Limited is indeed a well-recognized Mobile/Multimedia communication services provider in Sri Lanka. As the fastest growing mobile network in the South Asia, the organization has earned a great pride to the country. The organization consists of four main divisions or departments called Engineering Division, Administrative Division, Financial Division and Marketing Division. Base Transceiver Station (BTS), Switching Section, Radio Network Designing Section, Value Added Services Section, Transmission Section and Power Section are main sections in the Engineering Division.

The organization's vision is to be the clear leader in wireless communication and content in terms of Coverage, Clarity and Customer Care. (mobitellanka, 2009 )

There is an enormous competition in telecommunication industry at present when compared with the past. The service providers have to provide their services at a lower rate as much as possible. Otherwise they will be losing the customer and out of the path from the other. On the other hand, they have to increase their profit as much as possible to have safe future. Therefore, they have to reduce their operational cost as low as possible to achieve the goal. When the problem of operation cost is considered, power consumption is one of the major factors to increase the operational cost. By lowering the power consumption, the cost for operation can be effectively minimized by providing high quality services. It was found that the air conditioning system consume considerable amount of power compared to the other functioning systems of the organization.

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On the other hand, the air conditioning system of the organization plays a major role in protecting the most expensive and important devices of the telecommunication systems. The above considered facts were caused to perform a research system on the reduction of power consumption of the air conditioning system.

### RESEARCH OBJECTIVES

The main objectives of the research study was to reduce the power consumption of the air conditioning system, by keeping the battery lifetime at high position, and by developing a automated system which perform according to the inside temperature. The above objective was chosen to give a solution for the current major problems in the company. The ultimate scope of the research study can be mentioned as to reduce the working hours of the air conditioning machines, while maintaining the room temperature below 25°C. Also it was assigned to give special attention to reduce the temperature of the battery unit, while allowing the air conditioning system to operate simultaneously with a fan system for reducing the load on the air conditioning system.

### LITERATURE REVIEW

Air conditioning is the term commonly used for reducing the temperature and the relative humidity in a selected area of concerned. But, in the broader senses the term refers to condition the air in a selected area by cooling, heating, ventilating, humidifying, dehumidifying or by removing the impurities. The main component of a common air conditioning system is cooling coil. The evaporator of a refrigeration system is used as the cooling devices of an air conditioning system (Wikipedia, 2010).

The temperature of the conditioning space can be electronically sensed by using a thermostat which sets a temperature range

making small deviations for the pre set value. When the temperature of the space reaches the lower limit of the temperature range, the compressor supply is cutoff by the thermostat. When the temperature of the space reaches the upper limit of the temperature range due to heat gain and heat flow into the space, the compressor supply is connected again by the thermostat. This function is taken place continuously to condition the required space.

There are various types of power saving methods supposed to use in the organization such as using battery bank, using capacity bank, using econo cool air conditioning system, using outdoor fan system and so on (Ericsson, 2009). Capacity bank is used to maintain the power factor above 0.8 which reduce the reactive power which means power loss. Econo cooler is a device which used to transmit inside heat to outside.

### METHODOLOGY

A questioner was prepared for data collection to identify the potential and means of reducing the cost of operation at the organization. Collected data was analyzed according to the hierarchical level. Weighted mode was used as the statistical analyzing method. Since ideas of engineers and technical officers should be given priority, "weighted mode" was used as the analyzing methodology. After collected data was analyzed and tabled, reduction in power consumption of AC system was identified as the most cost benefited method. Then a special electronics circuit was designed to fulfil the requirement.

There are two AC machines in existing system. Each machine is responsible for continues four hours after system is switched from one machine to the other. But this method is not effecting. There is a potential for reducing the power consumption of the system. The new designed also focuses on the safety of the AC machines.

The new electronics circuit was designed to automatically use both AC system and less power consuming fan system.

The new design used electronic components such as thermostat, resistors, transistors, oscillator, capacitors, JK flip flop and gates. A PIC program was used with these components in new design. Thermostat is a temperature sensor which produces an output according to the temperature. A transistor is a semiconductor device commonly used to amplify or switch electronic signals (wikipedia, 2010). PIC microcontrollers are small microprocessors containing RAM, ROM, and some peripherals. For this device almost no other parts are required to make a complete "embedded system". They are readily available and well supported by the manufacturer, third party developers, and most importantly, users. This has led to their immense popularity (Bobblick, 1995-2002).

**DATA COLLECTION AND ANALYSIS**

Field operational section was selected to find solution in electronically because there are lots of electronics usages. There are three main sections called BTS operation, transmission and power in field operational section. Table 1 shows number of employees who are questioned belongs to each hierarchical level. Table 2 shows their responds.

**Table 1. The questioner responded number of employees belongs to each hierarchical level**

Post	Number of members
Manager	3
Senior Engineer	7
Engineer	9
Senior TO	9
Technician Officer	10
Other	17

**Table 2. Number of preferences for each cost reduction opportunity**

Sections which are get maximum operational cost	Number of preferences
BTS operation	9
Transmission	16
Power	30

The employees suggested different kind of ways to reduce the power consumption of the operation. These responses were analyzed using weighted mode method. Percentage values were used here since number of employees from each hierarchical level was different. According to the table 2 results, it can be seen that most of employees were interested in reducing power consumption for reducing the cost of the operation.

**Table 3. Weighted values**

The Post	Weighted Values
Manager	1
Senior Engineer	5
Engineer	4
Senior Technician Officer	3
Technician Officer	2
Others	1

Table 4 indicates that the power reduction in AC system is the most preferable. Figure 1 bar chart also illustrates the data analysis clearly.

**Table 4. Weighted percentage values**

Solutions	Weighted Percentage
Solar power generating	8.16%
Proper planning for power	11.79%
Well organized PAT planning	1.25%
Don't use 3rd party constructors	2.5%
Using equipment with a low power consumption	7.97%
Divide region to small regions	2.77%
Wind mill solution for AC	7.79%
Reduce the AC using time	24.72%
Find new BTS type	8.88%
Use Mobitel E1 instead of hired E1	10.38%
Use common rectifiers	4.53%

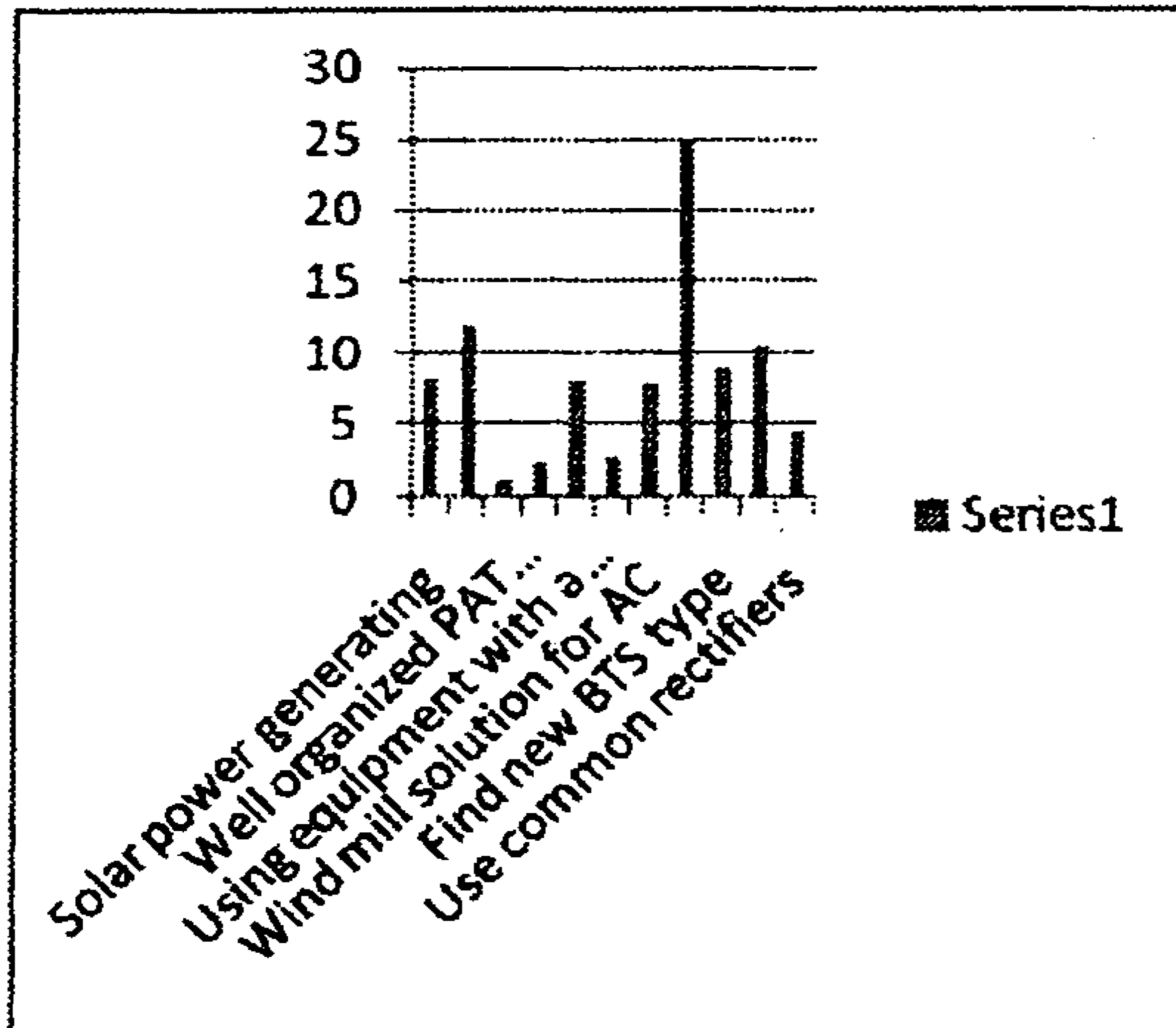


Figure 1. Bar chart of preference for solutions

### NEW DESIGN

The new electronic circuit has been designed especially for power saving. The new circuit is one of the best solutions. Since the circuit can be easily installed with the existing system with less money expenditure. The fan system was there with the air conditioning system to save the power. The newly designed system makes it to automatically switch on the fan system at the night hours. As at the night hours, from 8.00 p.m. to 8.00 a.m. the temperature of the outside atmosphere is low compared to the day time. So, air conditioning system is no longer needed for night hours to maintain the required temperature condition inside the system operational room. A fan system can be able to perform effectively during night time with low power consumption compared with air conditioning system. Then the power consumption of the HVACR (Heating Ventilation Air Conditioning Refrigeration) system gets reduced. This causes to reduce the cost of the telecommunication organization. The designed electronic control system can be used to switch on the air conditioning and fan system alternatively with the time and conform. Also this control system is able to switch on the air conditioning system during night hours if

the inside temperature of the room exceed 25°C. Block diagram of the new electronic circuit design shows in Figure 2.

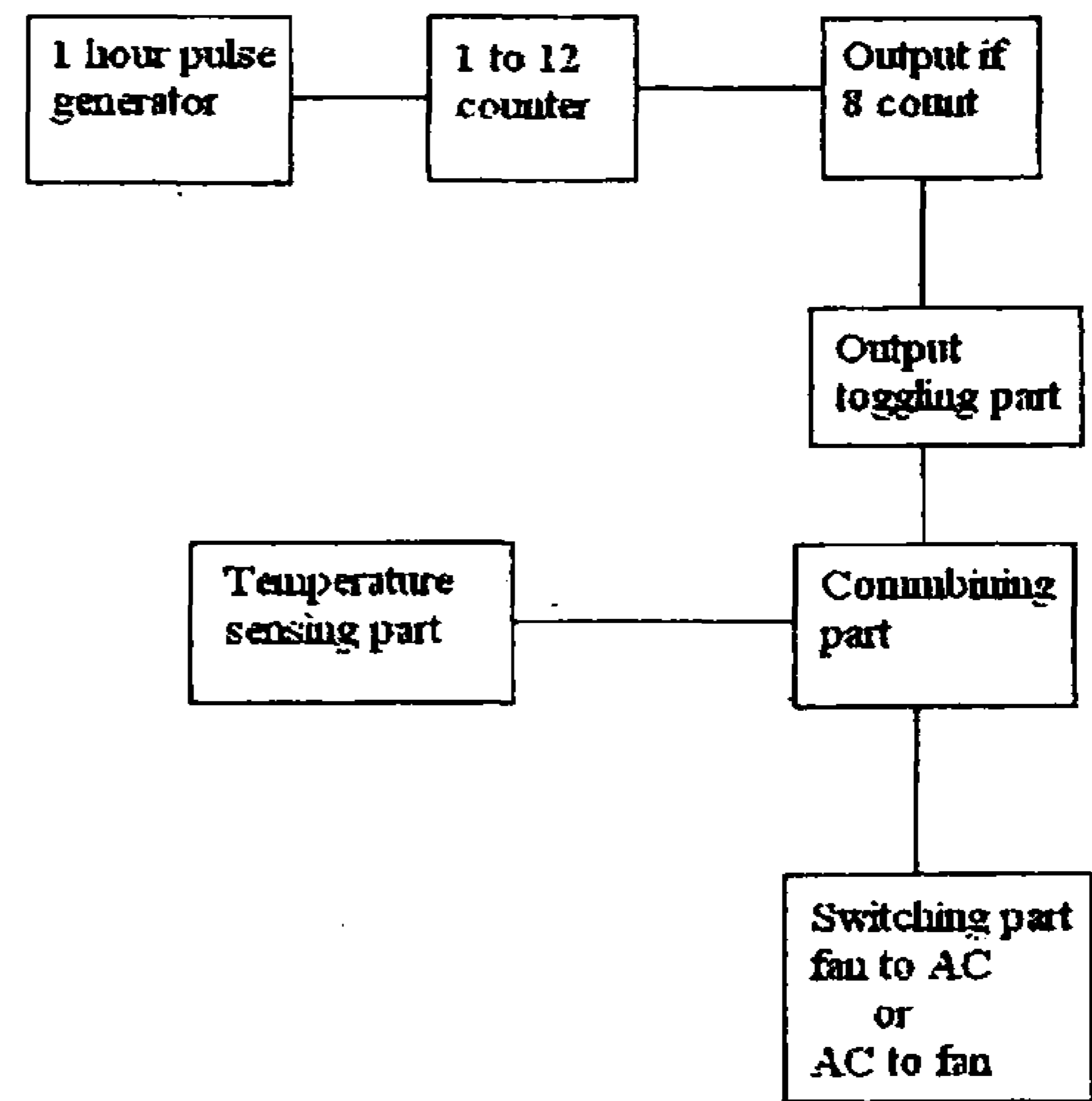


Figure 2. Block diagram of the new circuit design

One hour pulse generator is operated by a PIC (Programmable Interface Controller) program, shown below. A PIC programme was written to generate a pulse per hour by using the delay calling. Here, makes a signal is output in every one hour. The output signal is made to input for the 1 to 12 counter as a clock pulse.

The PIC program can be given as,

```

#include <16F84A.h>
#FUSES NOWDT, XT, NOPUT,
NOPROTECT
#use delay (clock=4000000)
int i;
void main(){
    while(true){
        output_low(PIN_A0);
        For (i=0;i<=59;++i){
            delay_ms(60000);
        }
        output_high(PIN_A0);
        delay_ms(1000);
    }
}
    
```

1 to 12 counters is designed using the method of sequential circuit design with these connections

- $J_0 = K_0 = J_1 = K_1 = J_2 = K_2 = J_3 = K_3 = 1$
- CLK1= the output of the 1 hour pulse generator
- CLK2= Q1
- CLK3= Q2
- CLK4= Q3

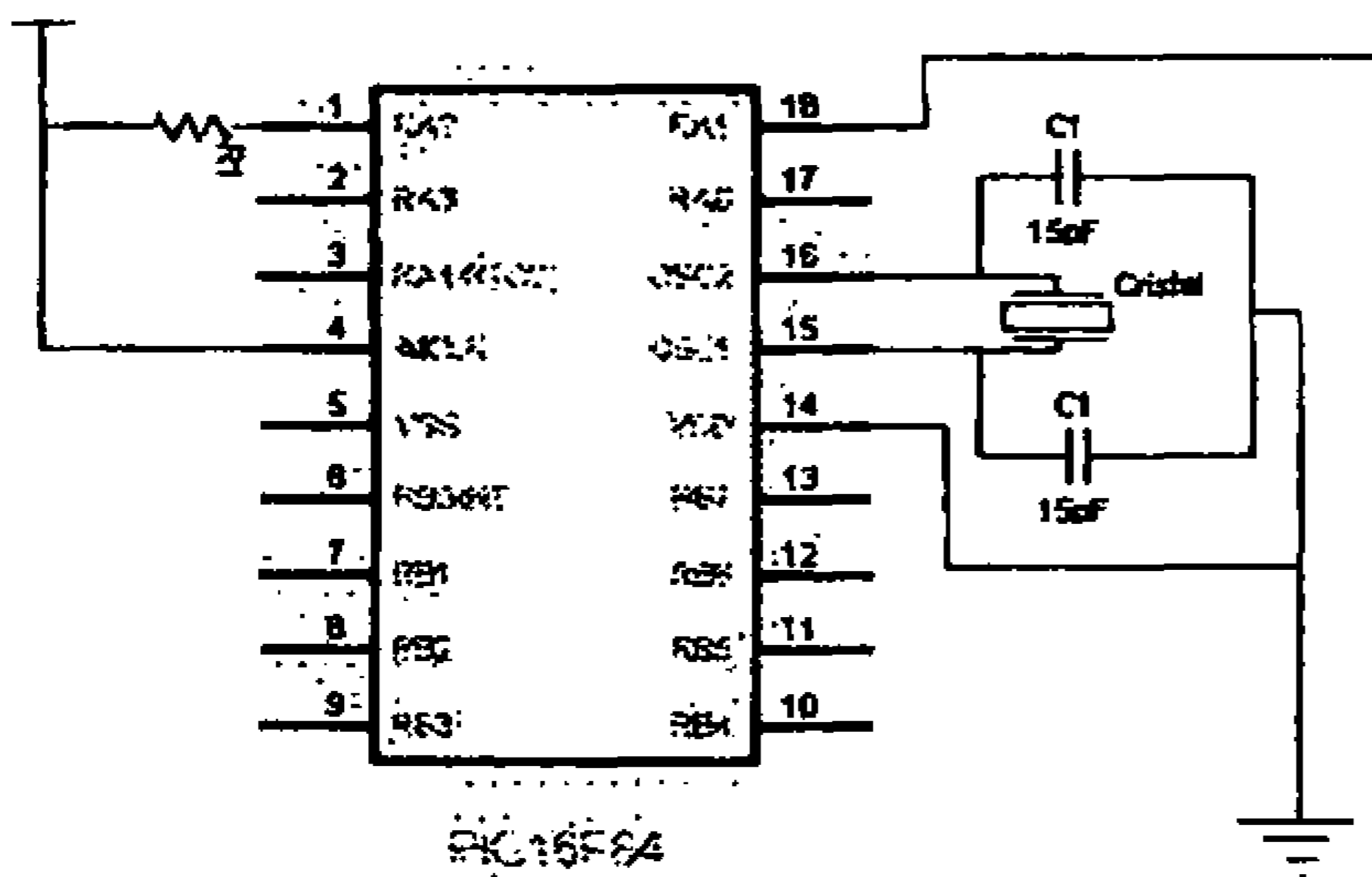


Figure 3. One hour pulse generator

The counter counts a count after receiving a clock pulse. Likewise after counting 8 times, an output is produced using AND gate and NOT gates. The produced output is directed to the toggling part as shown in Figure 4.

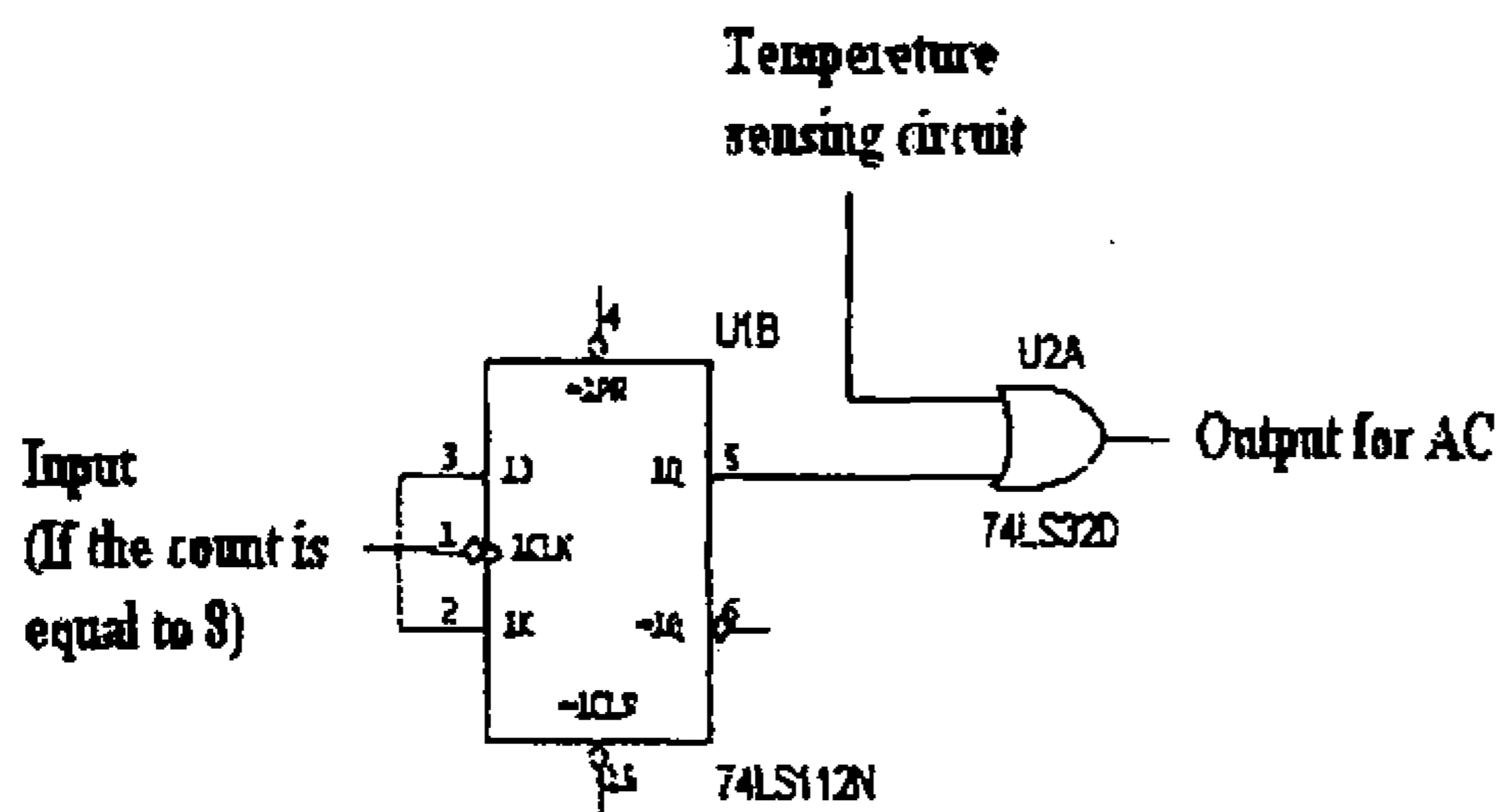


Figure 4. Toggling part

There is a flip-flop in the toggling part. Then the toggling output connect to the OR gate and also the output of the temperature sensing circuit.

The temperature sensing circuit is designed by using thermostat, resistors, and transistor as shown in Figure 5. Since the resistance of a coil is varied with the temperature, the temperature can be predicted by detecting resistance variation.

Temperature sensing device produce a signal output if room temperature exceed 25°C. The output of the temperature sensing device is also connected to the OR gate. The output of the OR gate controls the switching controller of fan and AC systems. If the OR gate signal is one, the system is switch on the air conditioning system and otherwise the fan system. Not gate is placed in between OR gate and switch of the fan system. So the air conditioning system operates day times and also if the inside temperature exceed 25°C.

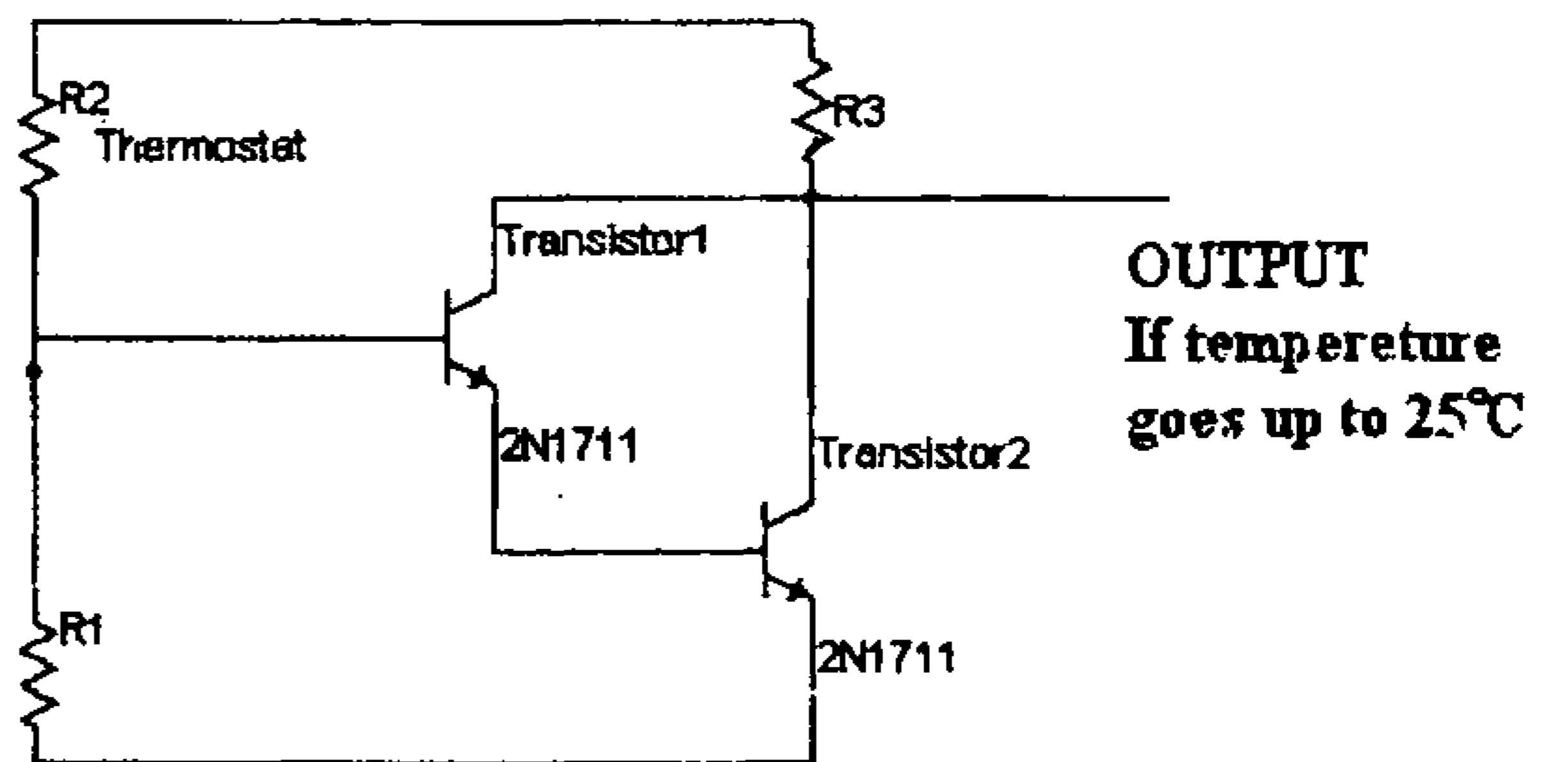


Figure 5. Temperature Sensing Circuit

## DISCUSSION

The main advantage of the new design can be mentioned as the reducing of power consumption and cost. Hence the reduction other advantages are increasing of the life time of the air conditioning system, avoiding of the generator overloading, increasing of the battery bank operation time when it is functioning.

The research study was limited to power section only. This research only focused on reducing the power consumption of the air conditioning system. Because it was founded, that the power consumption of the air conditioning system is mainly effected for considerable of increase the operation cost of the mobile/multimedia communication service provider company.

The problems encountered were finding of secondary data, and the way to design more efficient automatic switching system for the proposed AC system, fan system dual operation.

The reduction of the power consumption not only reduces the operational cost of the organization but also produces more benefits for long term error free operation. If the circuit is implemented in all the sites of the organization, they can reduce their cost considerably. On the other hand, there are many other benefits for organization as well as for Sri Lanka. Such reduction in maximum demand will increase the life time of the air conditioning machines and battery bank. Also the saved capital can be used for another profit generation operation. Other organizations also will be able make a benefit by implementing this circuit.

### CONCLUSION

The main objective of the research project was to design a electronics system for power saving of air conditioning system. An effective solution was focused. Because the maximum weighted percentage of 24.72% is given by the proposed solution of reducing the AC using time. A fan system can be used with the existing air conditioning system. Since the JK flip flops, resistors, various types of gates and other electronic components are cheap; the cost of the designed circuit is very low. The all components used are accurate enough to have acceptable result.

Since the environment temperature is low at night times, a fan system can serve acceptable manner. Then the power consumption of the system gets reduced considerably because the fan system consumes low power than the air conditioning system. Nevertheless if the temperature inside the room exceeds 25°C, the control system will be automatically switched to the air conditioning system. So the temperature inside the room will never exceed the limit if the power supply is continuously there. Since the newly designed electronics can be easily implemented without much changes the

existing system and it is another benefit for the organization.

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