PIR based Wireless Communication System for Energy Saving

Puneet Singh Chauhan[1], Aman Kumar[2], Sanjay Kumar Sahu[3],
Pushpendra Jha[4], G Palai[5]
Lovely Professional University,
Punjab

Abstract: **This research paper is aimed to replace Kit Kat type switching system to a smart automated system for energy saving, leisure, and for physically disabled people. We have made a complete room fully automated. A PIR (Passive Infrared) sensor is used to detect the presence of human beings in the room. This sensor works on two modes i.e. in repetitive and non-repetitive mode. Here we have chosen repetitive mode to make the system more efficient and versatile. Firstly the sensors are placed in appropriate positions and their signals are captured and further encoded using an encoder which are ultimately transmitted through a radio transmitter. The data received is of 4 bit that is processed by a microcontroller (Atmega 328p) for decoding purpose. The microcontroller sends signal to relay drivers for controlling various home appliance such as fans, tube lights etc.**

I.INTRODUCTION

This research paper is an approach to save electricity. Many countries around the world are continuously working on this area. This research paper (project) provides a way to save the electrical energy which is being wasted because of negligence of humans. This system is going to bring paranormal shift in the mission of providing electricity to all. Statistics shows that 67% of developing world still goes without household electricity, which is one of the basic requirement of day to day life.

Angel Deborah Suseelan claimed in her paper which is using a GSM module to receive a text message, the system gets commands via messages and with the help of relay it is controlling home appliances accordingly [1]. Francis Kwabena Oduro presented a paper on June 2018, where he has used RasberryPi (System on Chip) to obtain same result using webpage and cameras for capturing pictures [2]. Wibowo Harry Sugiharto used database replication method to control things remotely, the system uses the fixed IP and it was accessing appliances of home [3]. Kevin Naik in his paper published on Nov 2018 used IOT platform and accessed appliances remotely with the help of a webpage [4]. V. Ram Kumar presented a paper on Voice Operated Home Automation for Senior Citizens on Nov-Dec 2018, with the help of a microphone in a hand held device user can give input and can control devices without actually going to the switch board [5]. Amrutha S Et al. developed a system with Voice recognition and then sending commands via SMS with the help of GSM module [6]. Mukesh Kumar developed a system for paralyzed people in which they can elevate their bed inclination with the help of voice commands, it worked using voice recognition system along with Arduino and relay circuit [7]. Sirisilla Manohar Et al. made E-mail interactive home automation system [8]. Vidya G Et al. developed a brain controlled home automation system on April 2018, it worked on brain waves captured using electrodes and then signals are filtered followed by amplification are fed to switching circuit [9]. Harshada Rajput Et al. made a voice based home automation system using Raspberry Pi. In her approach, with the help of phone's microphone, voice commands are converted into numeric commands and sent to Raspberry Pi using Wi-Fi communication [10]. Priti Kumbhar Et al. made a research paper on smart home automation, in this Bluetooth module was used for indoor communication and GSM module for outdoor communication, user sends text commands to receiving system and switching was done with the help of relays [11]. ML Sharma Et al. presented a research paper on smart home system using IOT, using android phone with Arduino and Wi-Fi module (ESP8266), commands were send to microcontroller with the help of Wi-Fi and relays were controlled by the system [12].

In order to provide electricity to all (which is only possible by saving) we have made a fully automated room so that it can save energy and that energy can be transferred to the electricity deficient places. This automated system senses the presence of human in the room and accordingly it will turn on and off the lights fans automatically. There will be no manual switches. The system has capability of taking decisions. The smart system will check the presence of any human being for 3 minutes (repeatedly) and when it senses no motion it will turn off everything by itself. It will also be helpful for the physically challenged people as it is difficult for them to turn on and off switches every time. So just by adding some sensors and control circuit we can save a lot of energy for current and future generations. And also we can make life of physically challenged people a bit easier.

II.NEED OF THE PROJECT

Today the world is suffering due to inadequate availability of electricity. Around 67% of world is living in darkness. This is going to be a serious issue in coming future. Today we see a lot of energy is being wasted because of our negligence and sometimes because of our busy lifestyle. It has been found only few people are sitting in the room and all lights and fans are on in the room which leads to wastage of energy. In this paper we have tried to save that energy.
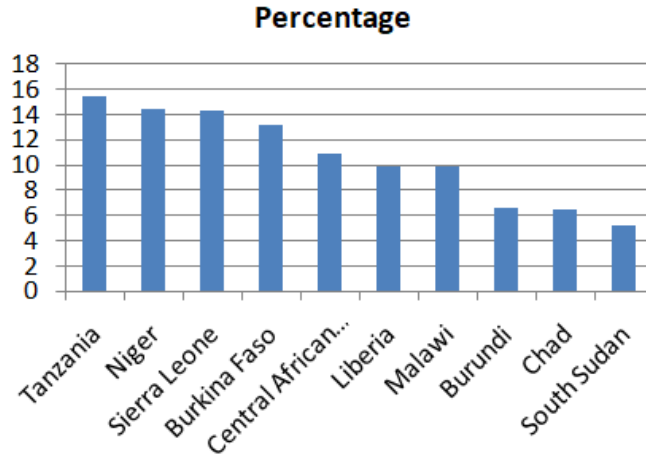

Fig.1.Energy Deficient Population

Benefits of using proposed system:
- This system is going to save a lot of energy.
- It will be very useful for physically challenged people.
- Difficulty of operating Kit-Kat switches in a dark room can be removed.

III. TECHNOLOGY USED

In this work, a pyroelectric type PIR module is used to sense very minute motion. With that passive motion, PIR sensor produces a signal of voltage 3-5 V. Signal from each sensor is encoded using HT-12E and then it is wirelessly sent through Radio Frequency transmitter of about 433MHz. The received data after passing through decoder (HT-12D) goes to microcontroller. The input is compared with preinstalled commands. All the possible conditions are pre saved in the microcontroller. The signal is then decoded and 5v data is sent to the relay drivers (ULN2003) which is connected to 15 different relays to drive the loads.

Fig.2.Main control unit

Fig.3.Transmitter of encoded data

IV. HARDWARE IMPLEMENTATION

PIR Sensor

These PIR (Passive Infra-Red) sensors are very sensitive sensors. It senses passive change in infrared rays coming from human body. Infrared rays can't pass through glass (not even from transparent glass), so if there will be any motion outside the room it is not going to sense it. It has got 2 potentiometers, one for adjusting sensitivity and other for adjusting delay. Delay indicates, till how much time it is going to give output after it senses no motion. Here delay of 3 minutes is fixed which can be varied according to the requirement. Here operation of PIR sensor is in repetitive mode so that the output signal will be constant. It checks the motion periodically. After it senses no motion for 3 minutes it will give signal 0. This sensor is very sensitive, as it even senses motion of your eyelids. Maximum range of this sensor is 7m and its view angle is 108°.

Fig.4. PIR sensor installed at a cubicle

For processing of data and advanced version chip Atmega 328p shown in fig.5 is explicitly used in this work which is quite versatile, consumes less power and moreover cost is very low. Apart from that RF (Radio Frequency) transmitter and receiver (433 MHz) is implemented to establish communication between the receiver and transmitter wirelessly for the range of 500 feet at maximum. The sensors are installed in different parts of the room and the controlling part is placed at one corner as we preferred wireless communication to avoid the complexity due to bunch of wires.

As the RF module transmits serial data and our requirement is to send 4 bit parallel data that is why we have incorporated encoder and decoder ICs, HT12E and HT12D respectively which is depicted in figure 7. An encoder IC (HT12E) which converts 4 bit parallel data into serial data which is transmitted using RF link. A decoder IC (HT12D) which converts received serial data from RF link into

Fig.5. Arduino Uno Board

original 4 bit parallel data which is fed to Arduino for further processing.

For switching purpose we have developed a circuit board which contains 15 relays along with relay driver ICs(ULN-2003) which is connected to Atmega as reflected in fig 7.
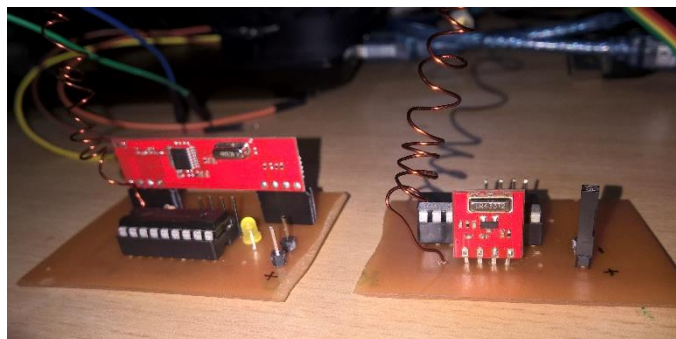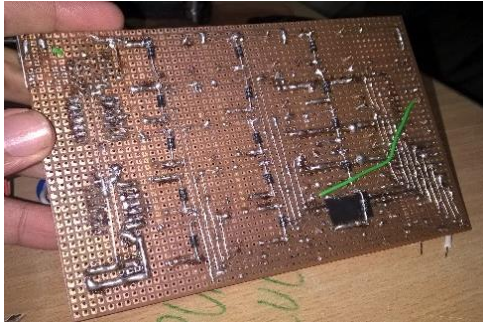

Fig.6. RF Transmitter and Receiver
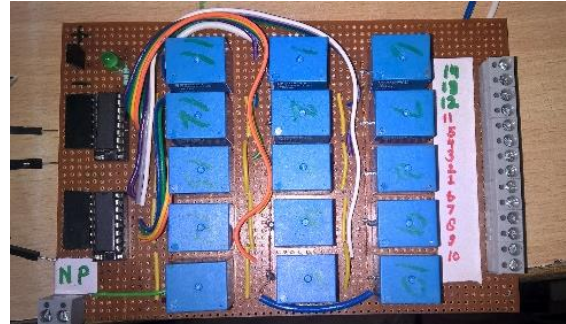
Fig.7. Relay board with Relay Driver

Fig.7 (b). Top view of board

Season Selecting Switch

During winter requirement of fans is negligible that is why two modes of control are implemented consisting of summer and winter modes and these mode are controlled by two digital pins of the microcontroller. The advantage of this system is that an extra two way switch is connected to the microcontroller which takes care of switching from summer to winter and vice versa. The working process of entire system is explained through a flow chart which is available in fig. 8 and fig. 9.
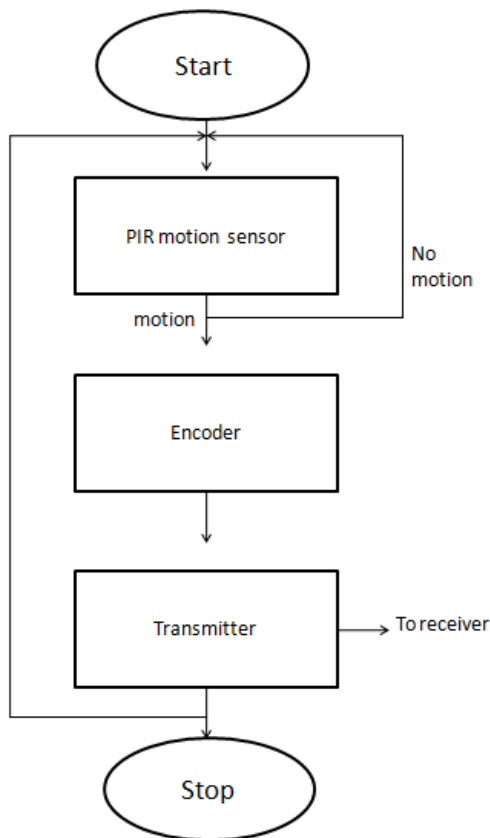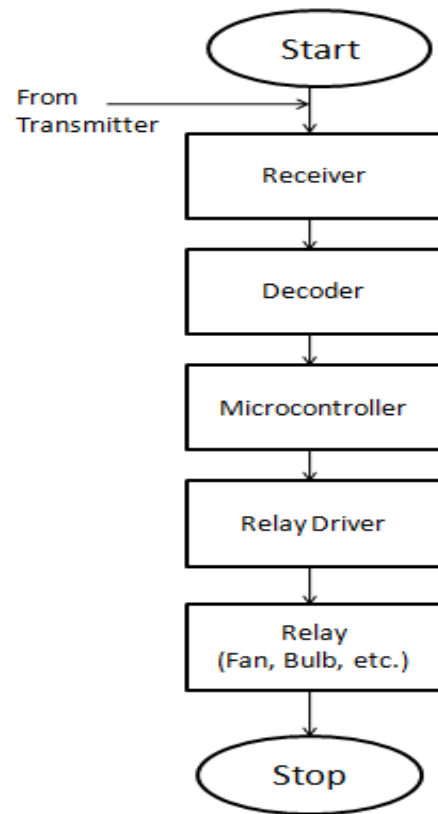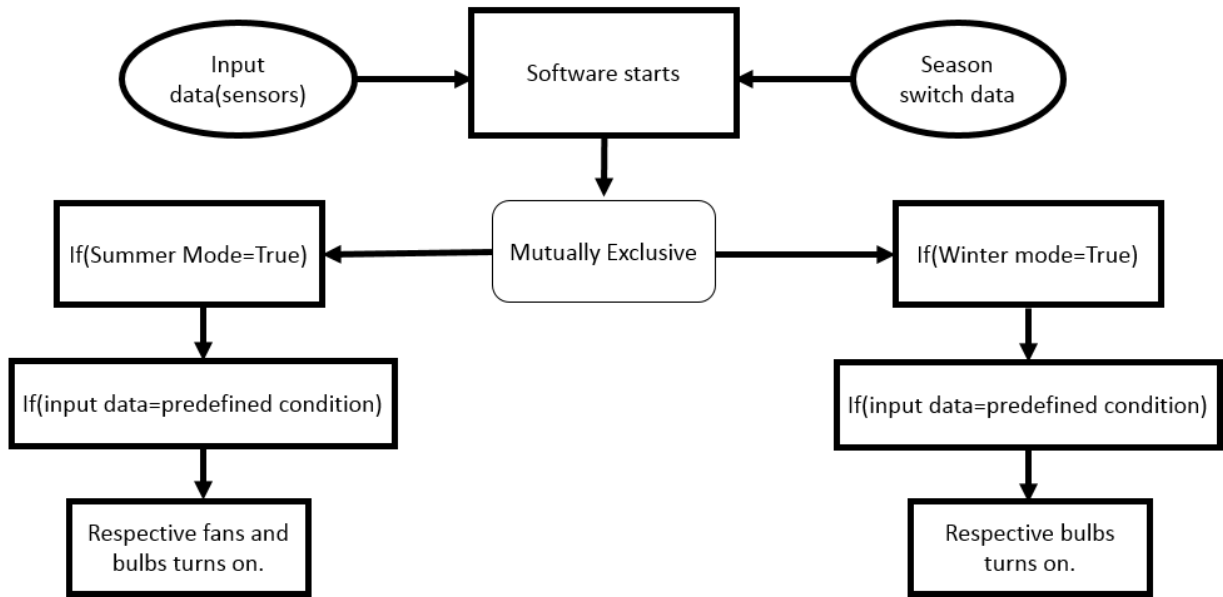

Fig.7 (a). Bottom view of developed board

Fig.9.Flowchart of processing transmitted data

VI. LAYOUT OF PROPOSED WORK

For experimental basis this work is confined within a room of size 625 sq. feet which is divided into nine cubicles of equal size. The lighting and cooling system are provided with two tube lights and four fans respectively for the same. One sensor per cubicle has been installed at the position indicated by blue triangles in fig 11. The layout of the room is given below.
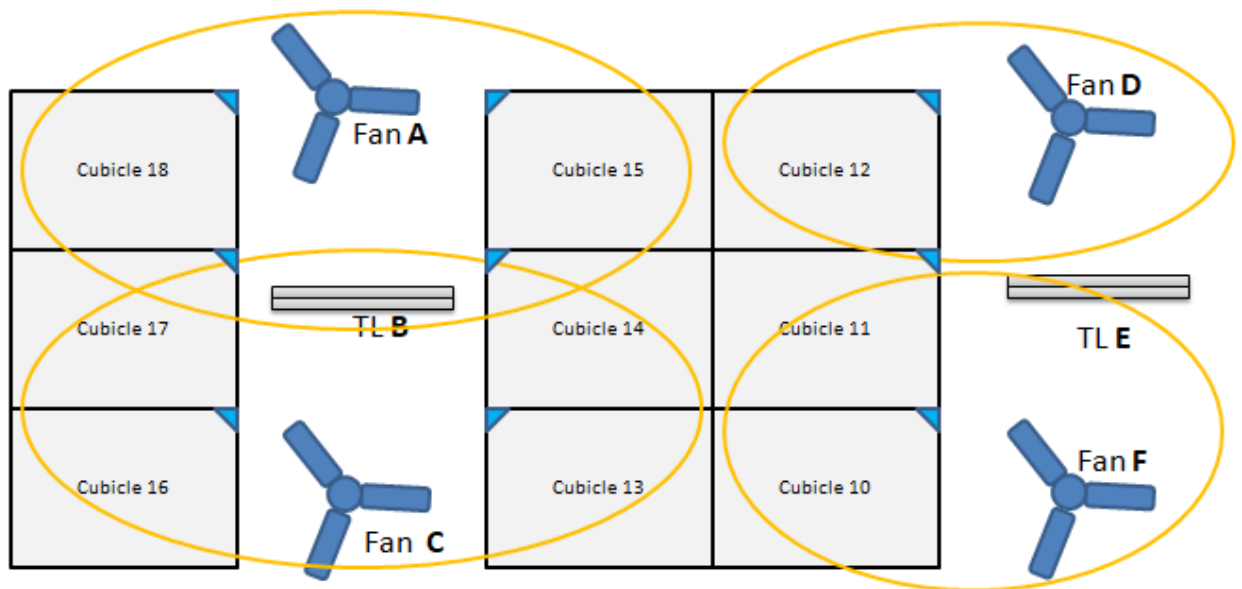

Fig.11.Layout of Room

VII. RESULT

According to figure number 11, we have categorized Fan A (G1) for cubicle 15 and 18, fan C (G2) for cubicle 13,14,16 and 17, fan D (G3) for cubicle 12 and fan F(G4) is for cubicle 10 and 11. Tube light B is meant for cubicles 13, 14,15,16,17 and 18, tube light E is for 10, 11 and 12. So we made 4 groups which are shown above in fig.11. Outputs of all sensors in each group are clubbed. 4 bit binary code for all possible combinations is shown in table 1.

S. No.	G1	G2	G3	G4	Binary code
1.	0	0	0	0	0000
2.	1	0	0	0	0001
3.	0	1	0	0	0010
4.	0	0	1	0	0011
5.	0	0	0	1	0100
6.	1	0	0	1	0101
7.	1	0	1	0	0110
8.	1	1	0	0	0111
9.	0	1	1	0	1000
10.	0	1	0	1	1001
11.	0	0	1	1	1010
12.	1	1	1	0	1011
13.	0	1	1	1	1100
14.	1	0	1	1	1101
15.	1	1	0	1	1110
16.	1	1	1	1	1111

Fig.11.Layout of Room

These binary codes were transmitted through Radio Frequency transmitter. The receiver does decoding by comparing received value with pre saved values. When the match is found, it energizes the respective relays, which turns on the respective light/fan. SPST switch is installed for selection of seasons. In summer mode it will control fans and lights both and in winter mode only lights will be controlled.

Outside interference (Presence of human beings) will not affect the working of system, because the boundary is made up of glass material which does not allow Infrared Rays to penetrate, that is why when a person enters in any of the cubicle the light/fan (with respect to season selected) near to him/her turns on automatically and if he/she leaves the cubicle for more than 3 minutes the appliances running near to the empty cubicle will be turned off automatically.

VII. CONCLUSION

In this paper, we have presented a power saving technique through an automated system. The philosophy behind this work is that it is quite distinct from other approaches like messaging, E-mail, remote controlled, brain controlled etc. It reduces significant amount of human effort by implementing various sensors. More importantly this system can provide ease to physically challenged people and makes their life a bit simple and fascinating.

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