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# Plc And Mobile Application Based Lab Automation

***Noman Ashraf, Dr.V.Sujatha and Dr.M.Subba***
*Department of Instrumentation and Control Engineering,*
*Sri Manakula Vinayagar Engineering College, Puducherry*

***Abstract***

*In order to save energy and time, to ensure safety as well as to reduce the human intervention, automation plays a vital role in today's human life. Though there has been significant development, individual's routine task has to be automated. Here in this work smart phones are used for automation as they are used throughout the day. In addition to above PLC and Microcontroller are also used for automation. Lab automation (Industrial automation lab) allows us to control lab appliances such as computers, Programmable logic controllers, Pump, Lights and Fans. In Lab, fire accidents due to short circuits can be prevented; sensing the usage of high power handling equipment or hazardous equipment in the absence of lab in charge and automatic ON/OFF can be detected and tested using this technology. The result of this research work is the implementation of a remote lab automation application in mobile which can help users in order to control the lab. With low cost, one can achieve automation system that can monitor and control lab equipment remotely using the smart phone. The most famous and efficient technology for short range wireless communication-IR blaster is used here to automate the system. So if the lab in charge forgot to switch OFF the lights or other equipment, it helps him to turn OFF the equipment with the smart phone.*

***Keywords*****:** *Automation, Mobile App, IR Blaster, Embedded System, Assembly Language Programming, Programmable Logic controller.*

## INTRODUCTION

Automation plays a vital role in today's world. Each and every sector is automated according to the human needs in order to reduce the labor cost. Automation not only reduces human effort but also saves time and energy. Time is money; most of the industry needs increased production with good quality in a short period of time. This is possible only through automation. In addition to above, automation also ensures safety. The safety aspects are limited in a manual process. Human cannot completely concentrate on safety all time but a machine can do it through automation.

This work contains three controllers such as 2 Microcontrollers (AT89C51) and 1 Programmable Logic Controller (PLC). One Microcontroller is used for controlling the ON and OFF of the Lab Equipment (PC, PLC, Pump, Lights) through the Mobile App with the help of IR Blaster and IR Receiver (TSOP- Thin Small Outline Package). PLC is used for detection and indication of Smoke and touch. It is also used for switching the ON/OFF of fan based on piezoelectric effect. That is it makes the fan ON when somebody sits on the chair and it makes the Fan OFF when nobody is on the chair. It also prevents switching the fan ON when the climate is too chill. Another microcontroller is used for temperature detection. That is it continuously monitor the room temperature inside the lab using LM 35 Temperature sensor and gives output when the temperature falls to a minimum value (cold climate). This output is applied to PLC for making the Fan OFF. In this work, a smoke detector and touch sensor are used in order to ensure safety of lab, lab equipment, students and staffs in the

laboratory. If there is any fault in the laboratory due to short circuit of electronics components, the smoke detector continuously monitors the quality of air inside the laboratory and it will be indicated suddenly, i.e., when any gas coming out of burning will be sensed by the smoke detector and indicated by annunciator system. Annunciator system contains lamp indications in different color which stands for different indications and buzzer or alarm. Next, the touch sensors are mounted on the high power handling equipment and hazardous equipment or the equipment which should be operated only under the supervision of a staff or lab technician. If any student in the lab touches such type of equipment, it will be indicated by annunciator system. There is a provision for a lab assistant or staff to deactivate or take out the latch through software or hardware when the equipment is operated on their supervision. Both the smoke detection and touch sensing is done by Programmable Logic Controller through ladder logic diagram. In this modern world, everything is smart examples: smart phones, smart shop, smart home, smart city, etc. The name smart refers to automation. Likewise this project makes the laboratory as smart laboratory with more automation.

## LITERATURE SURVEY

The existing systems for making ON/OFF of the appliances are based on Bluetooth, GSM and Remote. Mobile App is introduced by replacing the existing systems. In the present times, we can find most of the people clinging to their mobile phones and smart devices throughout the day. So this becomes more convenient.

Safety is an important measure in anywhere. Without safety no work can be done. Safety aspect has to be monitored and this can be done using Programmable Logic Controller (PLC). Currently, system at cheaper rates are not available according to our survey. Most of the systems are hard to install and the maintance is also difficult. Proprietary and closed systems are currently available and they are not very customizable by the end user.

The home automation model using Bluetooth via PC has explained in [1] but it cannot support mobile technology. It uses computer and computer is not portable. Even though laptop is there, if mobile was implemented, then it becomes more useful and convenient.

An electrical device control system model has designed in [2] using Web. If the server condition is currently down, they could set the server with auto restart. For controlling the devices, a telephone and PIC remote controlled device has implemented in [5]. But it was with cable network, not wireless communication.

To save lot of power and time, home automation system which uses Bluetooth has proposed in [4]. It provides a mechanism to save the preloaded list but the connection cannot be established all the time when required.

Java-based automation system was designed and implemented in [3] via World Wide Web. It had a microcontroller board integrated into a personal computer based server at home. Rather than targeting a single platform, an application in a universal XML format was developed in [6] which makes easy portability to any other mobile devices.

Home automation using PLC and SCADA was presented in [8]. But PLC and SCADA inside home is not convenient, rather it can be used inside Laboratory or Industry. PLC can
be more efficiently used in laboratory as well as in industry. Design for enabling mobile devices for home automation using zigbee was developed in [7].

Most of the literature shows different definitions for lab automation. The problems with the implementation of lab automation systems was mentioned in Paper [9]. Through various network technologies, the possible solutions are devised. Various issues which affects the lab automation systems such as lack of robustness, compatibility issue and acceptability among the old and disabled people are discussed deeply. SMS based control for monitoring systems has designed and implemented in [12]. The paper has three modules which involves sensing unit for monitoring the complex applications. The processing unit is a microcontroller and GPRS modem or cell phone via serial port RS-232 acts as the communication module. The status reporting is performed through SMS (eg:- power failure). The primary health-care management for the rural population has discussed in paper [10]. PHC services are provided to the rural population through mobile web technologies. The use of SMS and cell phone technology for information management, transactional exchange and personal communication are involved in the system. Remote monitoring through mobile phone which involves the use of spoken commands has developed in [13]. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller takes a decision of a particular task on the basis of SMS. Controlling of home appliances remotely and providing security when the user is away from the place has developed in [11]. The system is based on SMS and uses wireless technology to improve the standards of living. The problems faced by home owners in daily life can be solved with the help of this system. The system is more adaptable and cost effective because the system is wireless. To provide security against intrusion as well as to automate various home appliances using SMS, HACS system can be used. Since the system uses GSM technology, it provides access to the system for security and automated appliance control. The managing and controlling of home appliances using mobile phone has discussed in [15]. This system can be used by the people to do things in their home from a far place before they reach home. An appliance can be controlled by just sending a command by the user in form of SMS from his/her mobile phone to a computer which is connected to the appliance. When the message is received, the computer will send the command to a microcontroller for controlling the appliance appropriately. Remote control of different appliances through SMS messages has proposed in [14] which uses Atmel AT89S52 as a central microcontroller.

## BLOCK DIAGRAM

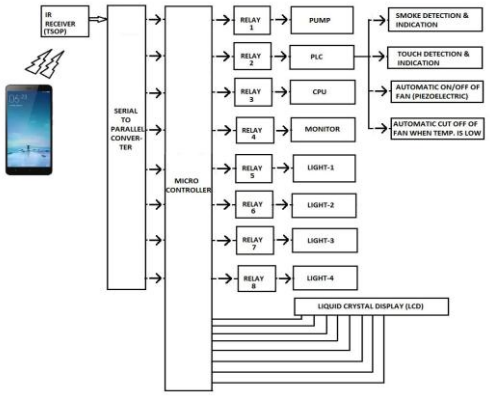
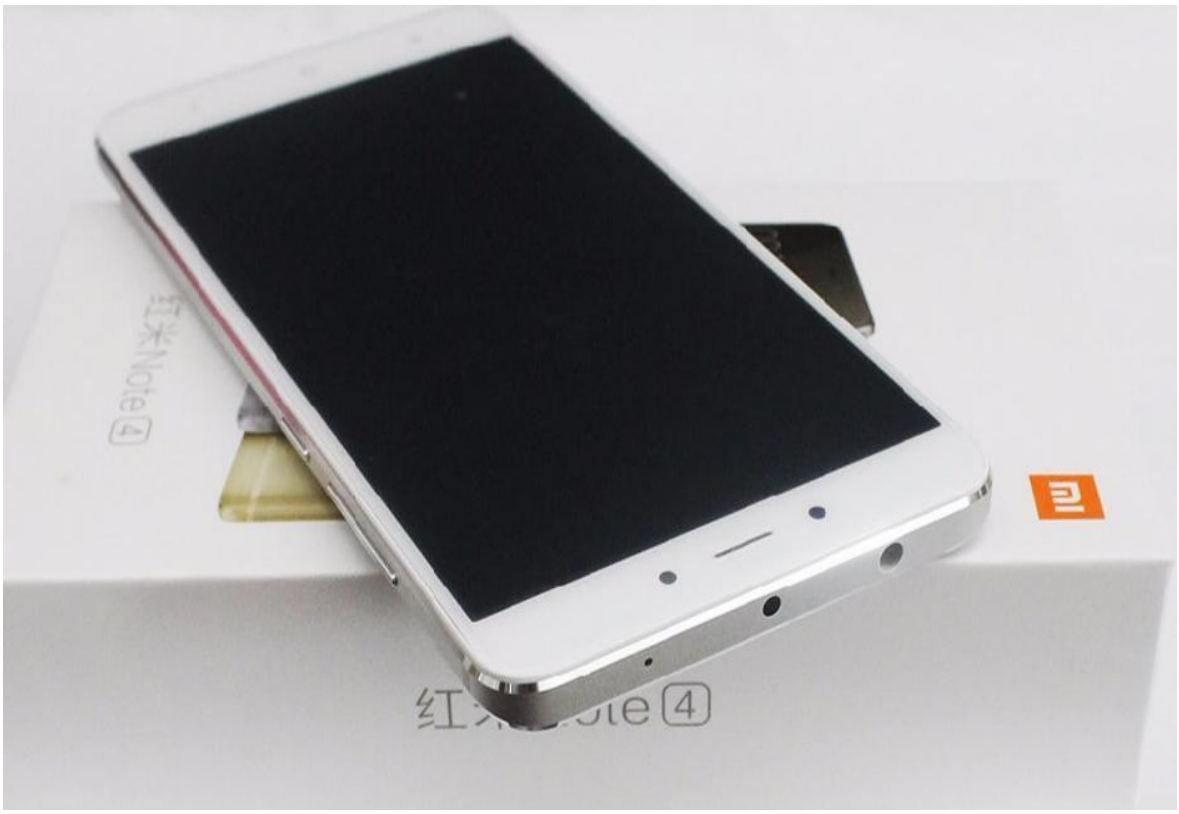



***Fig 1:*** *Block Diagram of Proposed System*

In this paper we have two parts such as Transmitter part and Receiver part. Mobile phone equipped with IR blaster is the transmitter part and the Receiver part is designed according to the requirements. The block diagram of the proposed system is shown in fig. 1.

***A.Transmitter Section***

Mobile phone equipped with IR blaster (fig. 2) with inbuilt IR Remote Application is used at the Transmitter Section.



Control circuit and Demodulator. The TSOP diagram is shown in the fig. 5.

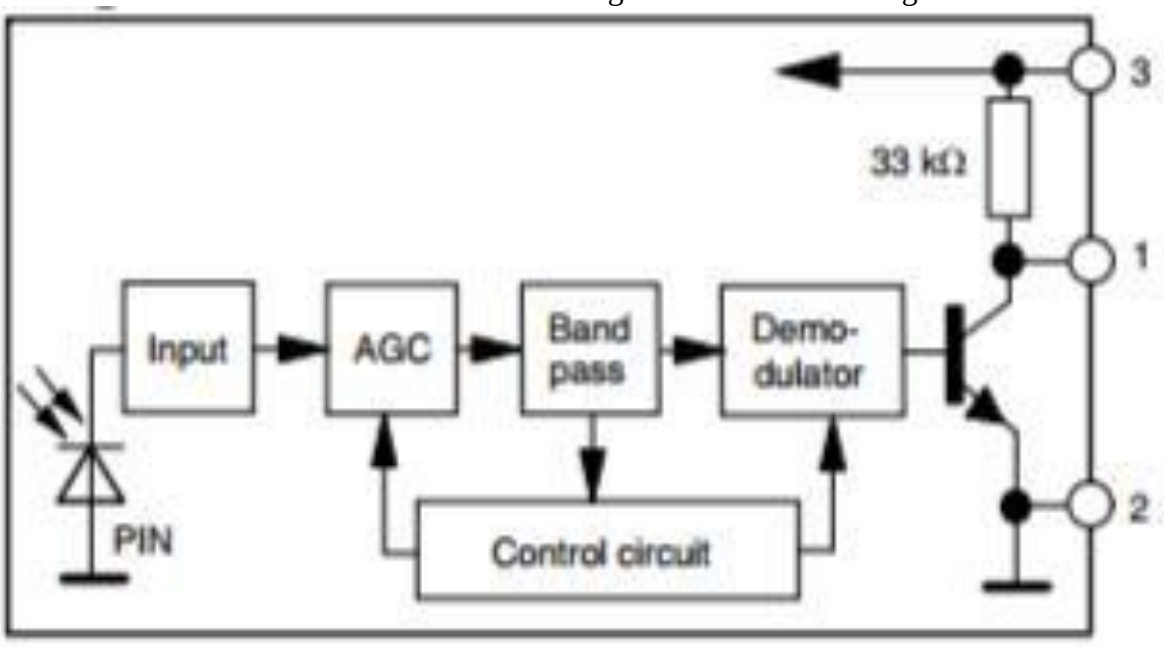



***Fig 2:*** *IR Blaster equipped Mobile Phone*

Mobile App is inbuilt in the Mobile phone which resembles the Remote with Power Button, Menu Button, Back Button, Mute Button, Input source Button, OK Button, Volume UP & Down Buttons, Channel UP & Down Buttons and Numeric Buttons ( 0 to 9 ). The remote is named as Mi Remote and it is available in the home screen itself as shown in fig. 3 and 4 respectively.


***Fig 3:*** *Mi Remote Icon in the Home Screen*

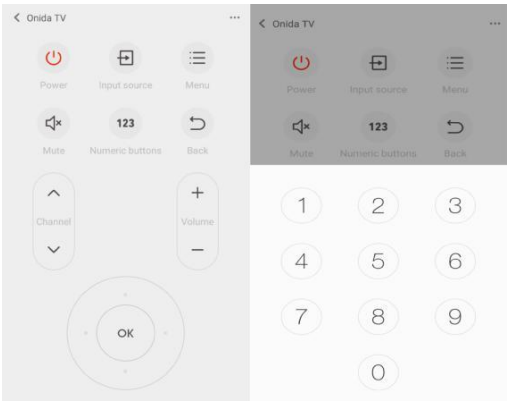



***Fig 4:*** *Screen Shot of Mobile App*

***B.Receiver Section***

Receiver section contains

1. IR sensor Section
2. Microcontroller Section
3. Relay Section

**IR Sensor Section**

The most famous IR receiver or IR sensor that is widely used in the Television is TSOP (Thin Small Outline Package). TSOP has inbuilt Automatic Gain Control (AGC), Band pass,

Fig 5: TSOP IR Sensor

TSOP has 3 terminals. They are VCC, GND and Out. Pin no 2 is GND, Pin no 3 is VCC and Pin no 1 is Out. The IR blaster emits different frequency for different key presses. Then this frequency of signal is transmitted after modulation. Modulation is the process of changing the carrier signal based on the message signal in order to transmit over a wide distance. Demodulation is in built inside the TSOP and demodulation is the process of breaking the carrier signal and retrieves back the original signal or message signal. It is the reverse process of modulation.

Typically 38 KHz TSOP 4838 IR sensing module is used to receive the IR signal. 38 KHz is the carrier frequency of the TSOP 4838. The supply voltage of TSOP 4838 varies from 2.5 V to 5.5 V. UA78M05 voltage regulator is used to regulate the supply voltage to 5V which is required by the TSOP 4838. There is a provision in this to activate all the output devices on a single key press and deactivate all the output devices on another single key press. In order to perform that, a serial to parallel converter is needed. The output of TSOP is a serial one and in order to activate all the devices at a time, we must add a serial to parallel converter. SN74LU8153 is used to convert the serial output of the IR sensor to parallel. It accepts serial input and outputs 8 bit parallel data. The conversion needs an external oscillator. Typically KDS 12.000 is used as an external oscillator in order to produce frequency of 12 Mhz. KDS is nothing but the brand name. This parallel output is applied to port 2 of the microcontroller.

**Microcontroller Section**

The port 2 of the microcontroller is used as the input port and port 0 is used as the output port. Microcontroller is programmed in assembly language programming in such a way that it receives 8 bit data input and produces 8 bit data output according to the requirements. If all the devices have to be activated at a time, the microcontroller receives 8 bit data through port 2 and outputs 8 bit data to port 0 and shows the corresponding changes in the LCD which is connected at port 1. Liquid crystal display is interfaced

with the microcontroller in order to display the live status of all the equipment. Live status means, the ON/OFF status of the equipment. The data lines of LCD are connected to port 1 of the microcontroller and the control lines are connected to port 3 of the microcontroller. The control line RW is not connected with the microcontroller; instead it is directly connected to ground. RW should be 0 for writing to LCD and RW should be 1 for reading. Here only writing occurs, so RW is always grounded. Enable control line of the LCD should have a high to low pulse. In order to produce high to low pulse, initially we set that pin and after a time delay it is cleared. So the LCD has been enabled. RS control line of the LCD should be zero for command word writing and it should be one for data word writing.

| | | |
|---|---|---|
| Port 2 | - | Input Port |
| Port 0 | - | Output Port |
| Port 1 | - | Data lines of LCD |
| Port 3 □ P3.4 | - | Enable (E) of the LCD |
| Port 3 □ P3.5 | - | RS of the LCD |

**Relay Section**

Relay is an electrically operated switch used for making ON/OFF of devices. ULN 2803 is used in the relay section. It is a high voltage, high current transistor array IC used especially with microcontroller where high power loads are driven using the circuit given in figure 6.

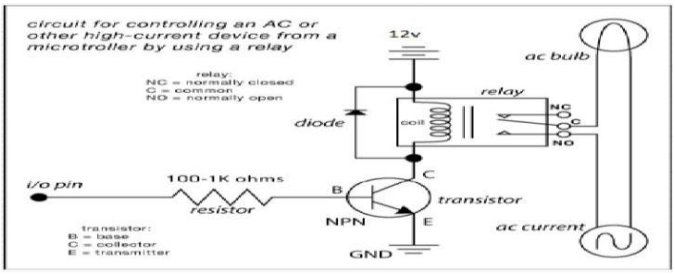



***Fig 6:*** *Relay Connection Diagram*

**RESULTS AND DISCUSSIONS**

ON/OFF control of all the equipment inside the lab has performed through the Mobile App with the help of IR Blaster and the status of the equipment is monitored in LCD. When the PLC is ON, it starts an automation system in order to performs the safety operation of the lab using Smoke detector, Touch sensor etc. Also it makes the Fan ON/OFF based on piezoelectric effect. The experimental set up is shown in figures 7,8,9 and 10 respectively.

***Fig 7:*** *Overview of Project*

***Fig 8:*** *IR Receiver*

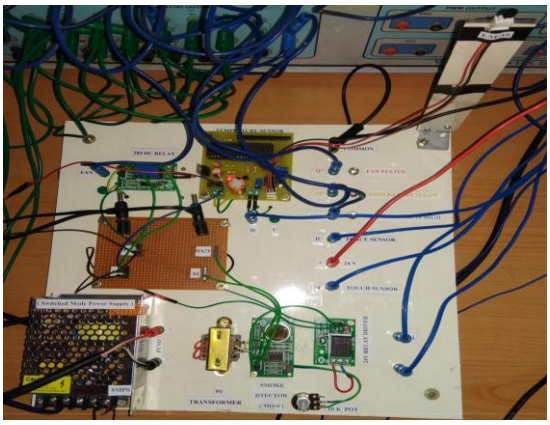


***Fig 9:*** *PLC Interfaced Board*

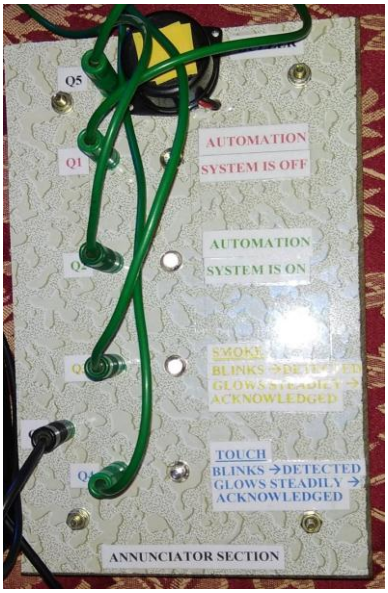



***Fig 10:*** *Annunciator*

**CONCLUSION AND FUTURE SCOPE**

The ON/OFF of lab equipment such as Personal Computer (PC), Programmable Logic Controller (PLC), PUMP, DC Motor and Lights using Microcontroller through Mobile App has been successfully done and thus performed the automation using Programmable Logic Controller with Smoke Detector, Touch sensor and Force sensor.

Since the GE FANUC VERSAMAX 24 POINT MICRO PLC is a fixed type PLC, its input and output modules cannot be modified. It has fixed 14 inputs and 10 outputs. By using a modular PLC and by adding the input- output modules, we can further develop the project in order to perform a complete automation of the "Process Automation" Laboratory. The development such as automatic attendance system by counting the number of person entering and exiting the lab and displaying the number of person inside the lab, monitoring the atmospheric parameters such as humidity, moisture, temperature and atmospheric pressure inside the lab can be done in the future.

**REFERENCES**

1. N. Sriskanthan and Tan Karand. "Bluetooth Based Home Automation System". *Journal of Microprocessors and Microsystems*, Vol. 26, pp.281-289, 2002.
2. Muhammad IzharRamli, MohdHelmyAbdWahab, Nabihah, "TOWARDS
3. S M A R T H O M E : C O N T R O L E L E C T R I C A L D E V I C E S ONLINE" ,Nornabihah Ahmad International Conference on Science and Technology: Application in Industry and Education (2006)
4. Al-Ali, Member, IEEE & M. AL-Rousan,"Java-Based Home Automation System R." IEEE Transactions on Consumer Electronics, Vol. 50, No. 2, MAY 2004
5. Pradeep.G, B.Santhi Chandra, M.Venkateswarao, "Ad-Hoc Low Powered 802.15.1 Protocol Based Automation System for Residence using Mobile Devices", Dept.of ECE, K L University, Vijayawada, Andhra Pradesh, India IJCST Vo l. 2, SP 1, December 2011
6. E. Yavuz, B. Hasan, I. Serkan and K. Duygu. "Safe and Secure PIC Based Remote Control Application for Intelligent Home". *International Journal of Computer Science and Network Security*, Vol. 7, No. 5, May 2007.
7. AmulJadhav, S. Anand, NileshDhangare, K.S. Wagh "Universal Mobile Application Development (UMAD) On Home Automation"
8. Alexandru-CorneliuOlteanu, George-Daniel Oprina, Nicolaepuand Sven Zeisberg, 19th International Conference on Control Systems and Computer Science.
9. *Multidisciplinary Journal of Research in Engineering and Technology, Volume 1, Issue 1by* Vijay S. Deshpande, Amit S. Vibhute, Amol K. Choure and Prof Smitha P
10. Delgado, A. R., Picking, R., & Grout, V. Remote-controlled home automation systems with different network technologies. Proceedings of the 6th International Network Conference (INC), University of Plymouth.
11. Murthy, M. V. R., Mobile based primary health care system for rural India. W3C workshop on Role of Mobile Technologies in Fostering Social Development
12. Malik, S. H. K., Aihab, K. and Erum, S., SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security. Issues in Informing Science and Information Technology
13. [12] Ciubotaru-Petrescu, B., Chiciudean, D., Cioarga, R., & Stanescu, D.,Wireless Solutions for Telemetry in Civil Equipment and Infrastructure Monitoring. 3rd Romanian-Hungarian Joint Symposium on Applied Computational Intelligence (SACI)
14. [13]. Jawarkar, N. P., Ahmed, V., Ladhake, S. A. & Thakare, R. D., Micro-controller based Remote Monitoring using Mobile through

Spoken Commands. Journal of Networks, 3(2)
15. Mohamed Salman and Jayavrinda Vrindavanam, "Efficient Interactive Control System based on GSM", International Journal of Latest Trends in Engineering and Technology (IJLTET), Vol. 3 No. 2, pp. 50-56
16. Ahmad, B. I., Yakubu, F., Bagiwa, M. A and Abdullahi, U. I., Remote Home Management: An alternative for working at home while away. World of Computer Science and Information Technology Journal (WCSIT)