

# GUI Based Electrical Load Control Using MATLAB

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## **Abstract**

*Within the ambit of wireless technology, appearance of remote control based devices and appliances have become the order of the day. It reduces human affords and increase the efficiency. Every sector needs automation, ranging from home to industries. Automation Systems perform by allowing a number of devices to communicate with a central controller which in turn communicates all information to the user or the owner of the system as per the instructions and the structure of the system. The application of such automation systems could be in areas such as heating, lighting, defense, energy management, audio and video systems, health monitoring, and entertainment. Keeping all these facts in mind, this paper propose a system which based on GUI controlling through a PC(personal computer) or LAPTOP. This paper proposes automation of appliances like fan, bulb, motor, fire sensor. To automate these appliances, we can use the different wireless communication media like infrared, Bluetooth, Radio frequency, RFID, GSM, DTMF and GUI-MATLAB and implemented with the help of microcontroller-8051 to compare the robustness and efficiency of output. Being an emerging area of research, a review of the most recent literature and implementation has been carried out in this paper.*

**Keywords:** *Automation, Microcontroller 8051, Infrared Sensor, dual tone multiple frequency (DTMF), Bluetooth, radio frequency, GSM Module, MATLAB, GUI(Graphic User Interface).*

## **1. Introduction**

Automation is the use of control devices such as PC/PLCs/PACs etc. to control industrial processes and machinery by removing as much labour intervention as possible, and replacing dangerous assembly operations with automated ones. Automation is a broad term applied to any mechanism that moves by itself or is self dictated. The word 'automation' is derived from ancient Greek words of Auto (means 'self') Matos (means 'moving'). As compared with manual systems, automation systems provide superior performance in terms of precision, power, and speed of operation.

Due to the rapid advances in technology, all industrial processing systems, factories, machinery, test facilities, etc. turned from mechanization to automation. A mechanization system needs human intervention to operate the manual operated machinery. As new and efficient control technologies evolved, computerized automation control is being driven by the need for high accuracy, quality, precision and performance of industrial processes. Automation is a step beyond the mechanization which makes use of high control capability devices for efficient manufacturing or production processes. The application of the device control in real life is very common nowadays. There are many applications that have been developed by using device control in electronic field such as home automation, industrial automation etc [1].

The automated system needs special dedicated hardware and software products for implementing control and monitoring systems. In recent years, the number of such products has been developed from various vendors which providing their specializing software and hardware products. Some of these vendors are Siemens, ABB, AB and National Instruments.

## 2. Review of Industrial Automation

The industrial Automation can be done in different means of communication:

### (A) Industrial Automation Using IR Sensors:

This scheme uses two pair of IR sensors. IR has property that it can't penetrate the obstacle or object. In this project we exploit this property of IR. One pair of IR module is mounted at the entrance in such a way that the output of IR will be logic 1 at MCU unit if a person enters, which is indicated by an indicator LED. So, this module is used to detect the coming person and a liquid crystal display (LCD) unit is also used to display the total number of person inside the premises[1]. MCU unit is program in such manner that, if total count of person inside the defined area is greater than zero then a 12volt, 7amp relay is used to turn on the light and exhaust fan. Another pair of IR is used at the exit gate, when this sensor unit will be active the person count will be decreased by one and if total count is zero, the relay section will be activated to turn off all the appliances. Major drawback of this project is it is not efficient system because of low sensing range of infrared which is approx 10 to 20 Centimeter.

### (B) Industrial Automation Using RF (Radio Frequency):

In this method of industrial automation we use radio frequency. To implement it we need RF transmitter and receiver pair along with encoder and decoder. To give the input to RF transmitter we need input medium, thus we can use active high switch, which is first encoded with the help of encoder and then encoded signal is being transmitted with the help of RF transmitter module. The signal transmitted is being received by RF [2] receiver wirelessly and then decoded in by decoder. To automate the appliances MCU unit is programmed and compared from the received input and control the relay section to turn on and off the home

and industrial appliances. The developed system is efficient and robust and provide better range as compared to IR but not fully automatic. Its performance is good.

### **(C) Industrial Automation using dual tone multiple frequency (DTMF):**

Signal generated from keypad of mobile is basically termed as DTMF. In mobile keypad row and column frequencies are different. On pressing of any key a multiplied frequency of row and column is generated and is known as DTMF. In this scheme we use DTMF signal as an input signal has analogous nature therefore we need to decode this signal and convert it into digital signal. For this purpose we are using MT8870 IC. To transfer the signal generated by the mobile to the DTMF Decoder IC we use headphone through an earpiece. Output of MT8870 is denoted as [Q3 Q2 Q1 Q0]. To convert the output CMOS logic to TTL logic we have used 74LS04 not gate IC [6]. Output of 74LS04 is transferred to MCU unit and then MCU 89S52 is programmed in such a way that it control the relay section to turn on and off the appliances as per the Performance of this system is very good and efficient but little bit tedious in sense of circuit complexity. This received signal from the mobile. System is costlier than other because to automate the system user need to connect the call, on the other hand this system does not have any range limitation.

### **(D) Industrial automation using Android Application through Bluetooth:**

This plan has limited area access that is approx. 20 meter. In this scheme generally we use Bluetooth as a communication media. MCU unit is connected through an android application via Bluetooth. As per the made application for android mobile it will transmit an ASCII character and is being received by Bluetooth module, which is connected to UART of MCU 8051. Now as per the programming of MCU8051 it will compare the received character and as per the comparison result the control signal will be transferred to relay section to perform the automation like turning on and off the appliances. Performance of this system is overall good, but the main problem of this project is limited access. It has also maintained good robustness in cheaper cost [3] [4].

### **(E) Industrial Automation through SMS:**

In this system GSM is used to transmit and receive the message over phone. Generally attention command (AT) is used to read, write and delete the message form inbox. Some basic commands are:

1. AT+CMGF=1; this command is used to take the GSM in SMS mode.
- 2.
3. AT+CMGD=1; this command is used to delete the first message from the inbox.
4. AT+CMGR=1; this command is used to read the first message from inbox.
4. AT+CMGS="9509285752"<enter>, <your message>; this command is used to is use to send the message on the given mobile number.

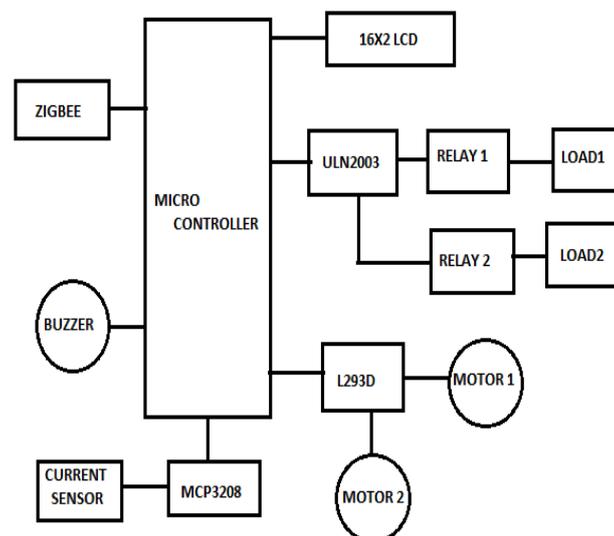
An external GSM modem is used to connect with MCU unit to receive the SMS .on receiving the message in proper format and text, MCU8051 will transfer the control signal to relay section to turn on and off the appliances [6] [7] [9].

### 2.1 The objective of the exploration outlined in this paper is to:

1. Perform the industrial automation using GUI made application in MATLAB [8].
2. Perform the industrial automation using infrared sensor, DTMF, Bluetooth, RF transmitter and receiver and GSM.
3. Compare the performance of all the systems.

### 3. Proposed work

For the objective proposed in the paper, to achieve this to a smart industrial automation system is used .The proposed offering scheme uses graphic user interface (GUI) based application designed in MATLAB-14. Purpose of this designed application is transfer the control signal to the MCU unit, so that MCU unit can compare the received data and Transfer the control signal to relay section to turn on and off the device. To perform this task instrument control toolbox of MATLAB is used to interface GUI environment and MCU 8051 in serial mode with specified baud rate (bit per signal) through communication port of pc or LAPTOP. On pressing of ON button in GUI it will transmit an ASCII code of ‘Q’ and on pressing of OFF button It will transmit an ASCII code of ‘q’ and the same is repeated for all devices. Block representation of proposed work is depicted in figure 1:

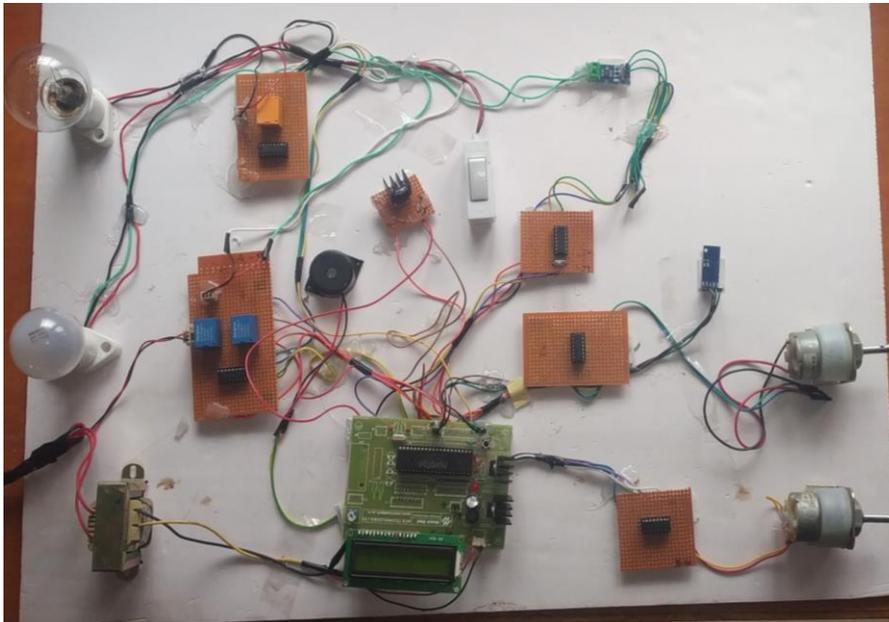


**Figure 1: Block diagram of proposed work**

**This device consists of two sections:**

**1. Transmitter side:** At transmitter side GUI based designed application as shown in figure-2 is used to transmit some predefined ASCII codes to the MCU 8051. To connect the MATLAB and MCU unit, a MATLAB code is designed for instrument control toolbox. Through MATLAB coding first of all, we transfer a byte through USB of LAPTOP. UART (universal asynchronous receiver and transmitter) Unit is used convert RS232 logic into TTL logic supported by microcontroller.

In this project the user specified program developed in c is entered into the computer and downloaded from the computer to the microcontroller using serial communication through RS232 protocol between them. Further the computer acts as a master for an interactive GUI for the user so as to control the various devices connected to the microcontroller.



**Figure2: Hardware implementation**

**2. Receiver side:** At receiver side data received at input of MCU unit is being compared the data as per the loaded code in the microcontroller and the decision to turn on and off the device connected to the relay section. A ULN2003 IC is used to activate the relays. in order to provides high current a Darlington pair of transistor is required, therefore we are using ULN2003, which consist of seven pairs of Darlington transistor and seven relays[4] at a time. One relay is used to control one device, in this project we use two relays, which connected to bulb and motor. Benefits of proposed work are it is more efficient and reliable. It is secure, reliable, power efficient and cheap as well.

## 4. Result

1. The two motors used in the project are controlled in terms of ON and OFF from remote locations using GUI

2. Speed Control of one of the two motors is programmed to run at two different speeds for variable speed drives.
3. One of two motors is programmed to run in both clock wise and anti clock wise directions.
4. Based on the user requirement, load shedding is also provided for industrial load balancing.
4. Overall controlling of loads are achieved by using Graphical User Interface shown below.



**Figure3: GUI for Load Control**

## 5. Conclusion

The GUI based device control using Matlab has been presented in this project. Here an elaborate and immaculate discussion of all our associated work pertaining to the study, that includes GUI toolbox of Matlab, programming and designing of microcontroller for controlling the various loads has been presented. The various loads used in our project demonstrate the functions that are being performed and hence the communication between the PC and the various devices associated. Here the PC is sending message to the controller

simply by serial communication that desirably controls the load connected to it. All the load devices are connected via computer network preferably to allow control by a PC, and it allows remote access through the Zigbee. With the integration of information technologies and the industrial environment, various systems and appliances are able to communicate in an efficient manner which results in convenience, energy efficiency, and safety benefits.

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### References

- [1] H. ElKamchouchi, Ahmed ElShafee, "Design and Prototype Implementation of SMS Based Home Automation System" ,IEEE International Conference on Electronics Design, Systems and Applications (ICEDSA),pp 162\_167,2012.
- [2] A. Jadhav, and P. Gadhari, "Interactive Voice Response (IVR) and GSM Based Control System". Proceedings of the National Conference "NCNTE-2012" Mumbai 2012.
- [3] I. Petrov, S. Seru, and S. Petrov, "HOME AUTOMATION SYSTEM", School of Engineering Science, 2011.
- [4] R. Piyare and M. Tazil, "BLUETOOTH BASED HOME AUTOMATION SYSTEM USING CELL PHONE", IEEE International Symposium on Consumer Electronics, Vol. 15, 2011.
- [5] Khusvinder Gill, Shuang-Hua Yang, Fang Yao, and Xin Lu, "A ZigBee-Based Home Automation System", IEEE Transactions on Consumer Electronics, Vol. 55, No. 2, pp 422\_430,MAY 2009.
- [6] M. L. Glaze, "The Design and Implementation of a GUI-Based Control Allocation Toolbox in the MATLAB® Environment", Msc. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, 85 p. 2008.
- [7] A. Delgado, R. Picking and V. Grout, "Remote- Controlled Home Automation Systems with Different", Centre for Applied Internet Research (CAIR), 2006.
- [8] S. R. D. Kalingamudali et al., "Remote Controlling and Monitoring System to Control Electric Circuitry through SMS using a Microcontroller", Industrial and Information Systems, First International Conference on Industrial and Information Systems: Peradeniya, Sri Lanka, 8-11 August, 2006. pp. 378-382.

[9] A. Alkar and U. Buhur, “An Internet Based Wireless Home Automation System for Multi functional Devices”, 2005.

[10] N. Sriskanthan, F.Tan and A. Karande, “Bluetooth based home automation system” ELSEVIER - *Microprocessors and Microsystems*, Vol. 26, pp. 281- 289, 2002.