INDUSTRIAL ENVIRONMENTAL MONITORING AND CONTROLLING WITH PASSWORD PROTECTION CIRCUIT BREAKER SYSTEM USING INTERNET OF THINGS

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Abstract: The project objective is to develop the application based on IOT [1]. At hazardous condition, the food storages, production systems etc. maintaining temperature and humidity control is very important [2]. It decides the quality of food products or the quality of industrial products manufactured. The project introduces the Humidity, Temperature monitoring system along with monitoring the load of AC in terms of voltage and current. The system maintains the temperature and humidity automatically by reading the value of temperature and humidity through the sensor. Arduino is used to interface with temperature, humidity sensor, GSM Modem and WiFi Module ESP8266. The IOT concept is implemented by connecting WiFi Module ESP8266 with the Arduino board. A mobile app is developed which enables user to see the present status of humidity, temperature, device status on or off, AC voltage and AC current. If the system load increases, the hardware turns off all devices and sends SMS to registered mobile number through GSM Modem [3]. User has to type the password received on mobile as SMS, to activate the system again and start monitoring.

Index Terms **– IoT, Internet of Things, Monitoring, Circuit Breaker, Humidity, Temperature, DHT11, GSM Modem, ESP8266, Processing IDE, Arduino**

I. INTRODUCTION

As the technology is advancing everying thing in day to day life is controlled and monitored through automization. In earlier automization phase the monitoring was done automatically but status can be monitored within the limited distance. The technology has made the device and equipments to be monitored from far geographic locations. After implementation of IPV6 (Internet Protocol Version 6) the number of IP (Internet Protocol) Address increased drastacally which made more devices to connect on Internet [4]. It has made very easy device and machines to be connected on largest network the internet [5]. A new field is born in which the everyday life and industrial monitoring systems are becoming online and can be monitored or controlled from internet using the applications developed for mobile or on websites. The technology IoT (Internet of Things) [1] is becoming popular in industries and day to day life. It facilitates the user to monitor all everyday things on its Mobile App or on website [6]. It has made man machine interface more close. Also advacing the smartphone it became very handy to monitor the device and control it on the just palm of the hand from any geographical locations.

II. OBJECTIVE

The research paper implements the automization and monitoring system using IoT. As the technology is advancing the industries are increasing their capacity of production in larger amount. During which the product quality maintainance is also important where numbers of products are manufactured everyday. The product quality is mainained by maintaining proper environmental conditions of temperature and humidity [2]. Temperature and humidity can change the product quality especially in food manufacturing industries [2].

The objective of the project is made the hardware which can give the administrator to monitor the industrial environmental condition. Also it also gives facility to control the device with safety from overloading in power supply. The hardware is made using Arduino Mega. Hardware reads the environment temperature, humidity, AC current, AC voltage in industry. Temperature is controlled by heater and humidity is controlled through fan [2]. To protect the manufacturing equipment from current overloading the overloading breaking of circuit concept is implemented. If power supply overloading is detected, the hardware turns off all devices to protect from power supply overloading. It also sends an SMS along with a password to the administrator. The system can be activated by typing the password by an authorized administrator only.

III. System Architecture

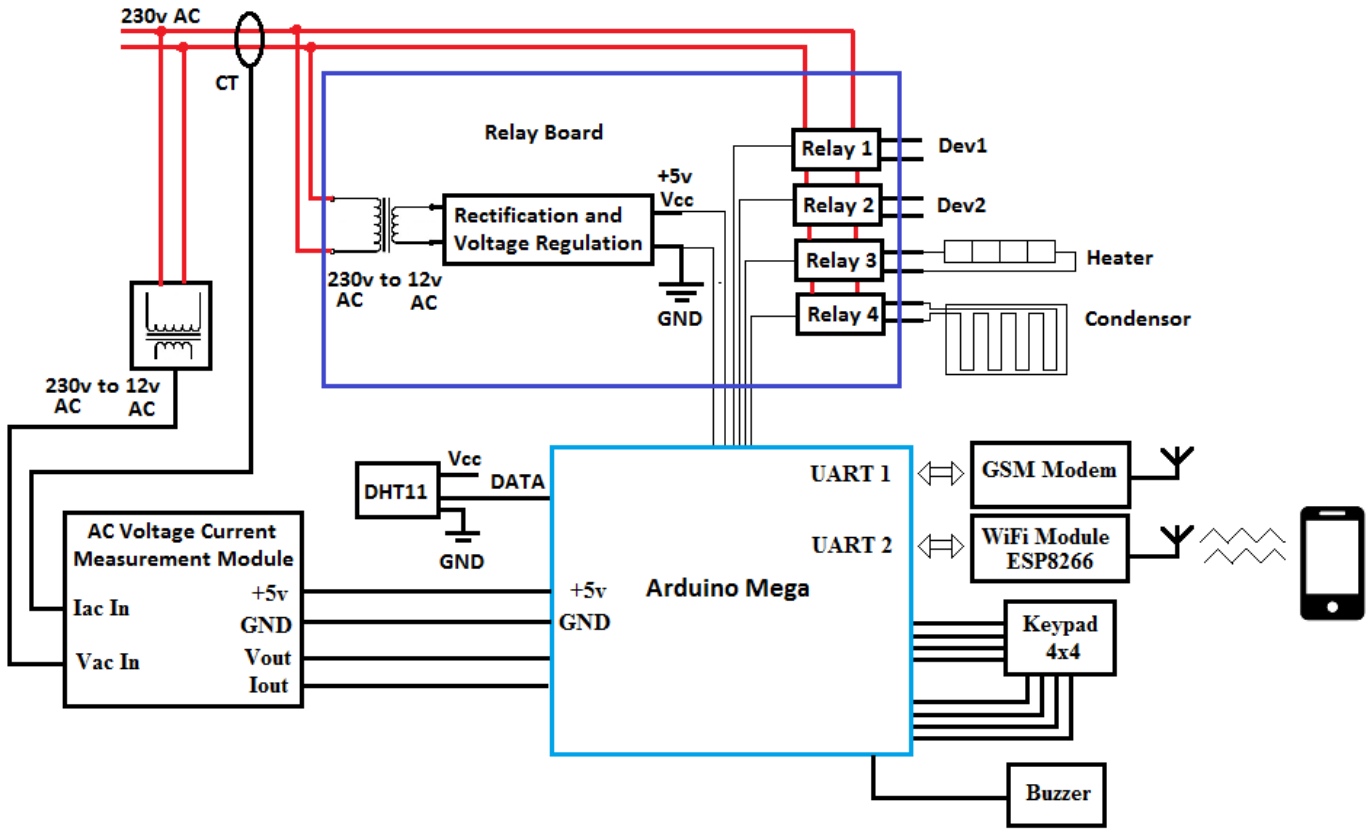

Figure 1. Block Diagram of Hardware part of project

The system is built up using Arduino Mega board [7]. Three different circuit boards are designed. The board performs different tasks.

1. Relay Board

Relay board is used for controlling the external electrical appliances. 230 volt, 50 Hz AC supply is provided to generate dc regulated +5 volt vcc output. This output is connected to Arduino board to provide the power. 4 pins of arduino are connected to relay board. These 4 pins are I/O pins of Arduino board are used to control relays through which electrical devices are controlled. These I/O pins can be controlled automatic or manually based on conditions of environment or the buttons pressed on the Mobile App buttons.

2. Arduino Mega Board

Arduino mega board is main controller of the system [7]. It controlls all I/O pins. 4 pins are used to control the operation of relay on /off. 4 I/O pins are connected to relay board. Arduino board uses 2 UART ports to communicate with GSM Modem and WiFi Module ESP8266. An I/O pin is connected to DHT11 [2]. DHT11 is temperature, humidity sensor. It sends digital data to the master device through single wire protocol.

UART 1 connected to GSM Modem and UART 2 is connected to ESP8266 WiFi Module. UART 1 is used to interface with GSM Modem. It sends the set of AT commands. It is used to configure the GSM modem or send the SMS to programmed mobile number [3]. UART2 connected to ESP8266 is used to receive the serial command sent by any external master controlling device like Mobile or Tablet.

Buzzer is connected to microcontroller to generate audible alarm if any imbalance is found. If the temperature or humidity value goes outside of the operating range the system shuts down to protect the hardware failure and starts audible alarm. It alarms to near by human about atmospheric condition failure or overloading in system [8].

To protect the hardware from overloading, overvoltage or over current, protection is provided through measuring the AC voltage of input supply [2]. If the input current or voltage goes above safe value the system breaks the power to electrical appliaces and turns them off.

3. AC Voltage measurement module/board

To protect the microcontroller hardware and the electrical device from over loading of power supply, circuit breaker is implemented to isolate the hardware. Hardware measure AC input voltage and AC current. The current transformer is used to measure AC current flogwing through the hardware [8]. AC supply wire is passed through the Current Transformer. Output of current transformer is filtered out and dc output is generated. The output of the filtered dc output voltage is proprtional to AC current consumed in the hardware. Voltage measurement is done by a step down transformer and generating smooth dc voltage through the filtering. Thus, the dc voltage output is proportional to the power supply voltage.

The output of AC current and AC voltage is in analog quantity. The output is connected to microcontrller I/O pins which has inbuilt ADC facility. The Arduino sends internal command to convert this analog value into digital format.

IV. MOBILE APP

To develop mobile app 'Processing' development tool is used [9]. Its main advantage is that it is an Open Source development tool. It doesn't require licensing of applications and can be distributed easily over the online app stores. Processing is an open-source computer programming language and Integrated Development Environment (IDE) [9].

Using processing user can develop the mobile aps easily for interfacing with Arduino boards.

To monitor the humidity and temperature a mobile app 'iOT WiFi' is developed. Layout of the app is shown in Figure 2. 'Processing' IDE is used to develop the mobile app for Adroid Smartphones. Each component is explained below. The mobile app has two buttons shown as default red color and named '1' and '2' are used to control the external electrical devices which are connected to relay 1 and relay 2. The app displays the AC input voltage of hardware. The app displays the AC input current of hardware. This value is used to shutdown the device in over current or overload situation by Arduino. The app displays temperature value in Degree Celius. The app displays the humidity value as RH (Relative Humidity).

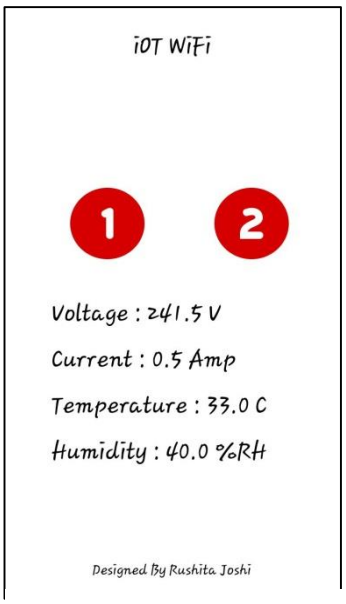

Figure 2. Mobile App 'iOT WiFi'

V. HARDWARE WORKING

DHT11 is used to sense the humidity and temperature value and pass it to Arduino. GSM SIM900 is used to send SMS to the registered mobile number ESP8266 WiFi module is used to provide WiFi connectivity to mobile. Buzzer is used to start audible alarm. Matrix keypad 4x4 is used to type the password received on mobile.

The algorithm of the hardware is as explained below.

1. Send command to UART1 to check GSM Modem connected or not.
2. Send command to UART2 to check ESP8266 WiFi module connected or not.
3. Configure I/O pins for proper use of turn device on/off.
4. Send command to DHT11 to receive temperature and humidity value.
5. If temperature is less than Tmax, turn on the heater. Turn off the heater if temperature is more than Tmax.
6. If humidity is less than Hmax. Turn on the Fan. If humidity increases more than Hmax turn off Fan. Turn on the Fan when humidity falls below Hmin value.
7. Read the Current Analog value and convert to digital value Iac.
8. Read the voltage Analog value and convert to digital value Vac.
9. If Iac and/or Vac increase more than Imax or Vmax, generate a Random Password. Send this Random Password to registered mobile number via GSM Modem. Turn off all the electrical devices. Turn on the buzzer for audible alarm.
10. Meanwhile monitoring all these tasks transmits the Humidity, Temperature, AC Current, AC voltage value to ESP8266 WiFi module. These transmitted values will be received by the Mobile App through WiFi. And it will be displaye don the screen as shown in Figure 2.
11. The plant administrator has to type this password on the matrix keypad to reactivate the system.
12. If button is pressed to turn on device 1, the command is received by Arduino. It turns on/off the device 1 or device 2 according to command received from mobile app.

VI. SOFTWARE WORKING

The algorithm of Software is as explaiend below.

1. When application is launched it sends command to Arduino through WiFi to read the status of i/o.
2. The microcontroller sends data of temperature, humidity, AC Current, AC voltage to mobile app.
3. The mobile app receives this values and displays on its screen.
4. To turn on device 1 or 2, button 1 or 2 is pressed. The buttons has default color Red when it is in off condition. It sends command to turn on the device 1 or 2.
5. Microcontroller receives that command turns on the device and transmits back the acknowledgement.
6. Mobile app receives this acknoledgment and changes the Device 1 or Device 2 button color to Green, indicating that the device is turned on.
7. To turn off device 1 or 2, button 1 or 2 is pressed. The button has Green color if it's in on condition. It sends command to turn off the device 1 or 2.
8. Microcontroller receives that command turn off the device and transmits back the acknowledgement.
9. Mobile app receives this acknowledgement and changes the Device 1 or Device 2 button to Red, indicating that the device is turned off.

VII. CONCLUSION

The project successfully completed its objective in monitorin the humidity and temperature in the industrial environment. It also successfully implemented the circuit breaking system when the system overload is detected. The enchanced feature of GSM based password generated has increased security of device to protect unauthorised perforn from activating the devices. The app is very smoothly synchronises with the corresponding values updated in hardware. The communication between hardware and software is very fine and works very well in monitoring purpose.

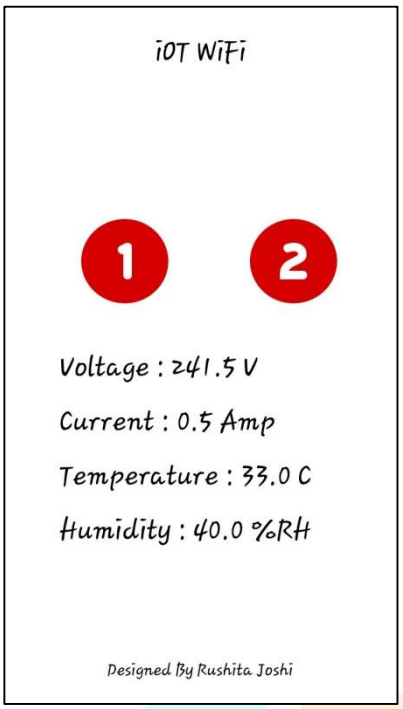

Figure 4. Heater on condition Mobile App

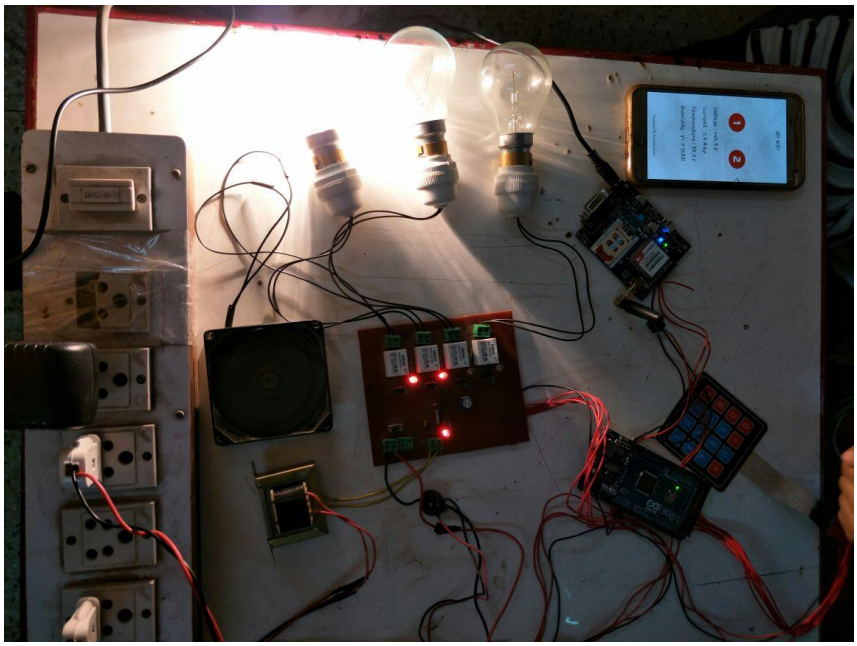

Figure 3. Heater on condition hardware

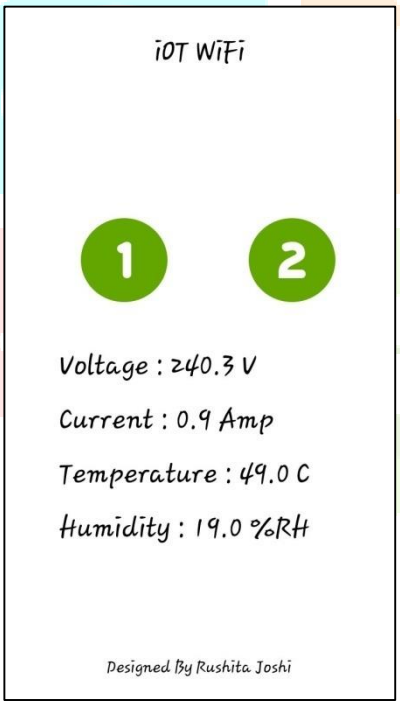

Figure 6. Fan on condition Mobile App

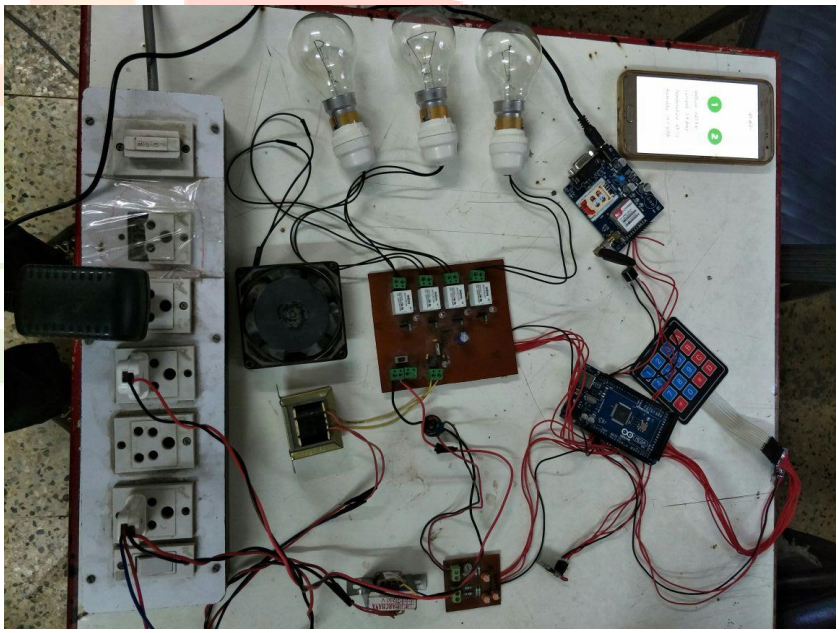

Figure 5. Fan on condition hardware

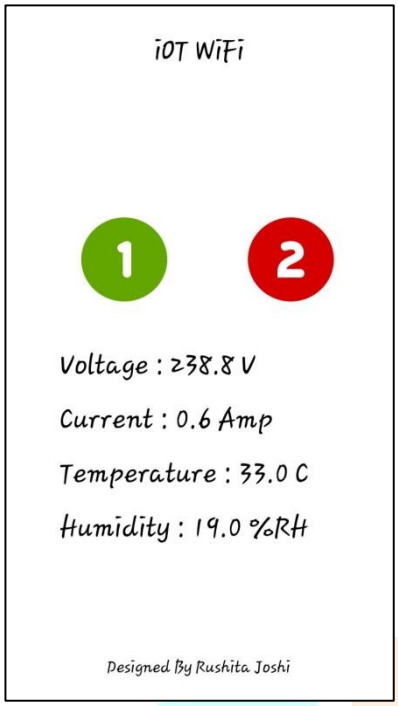

Figure 8. Device 1 on condition Mobile App

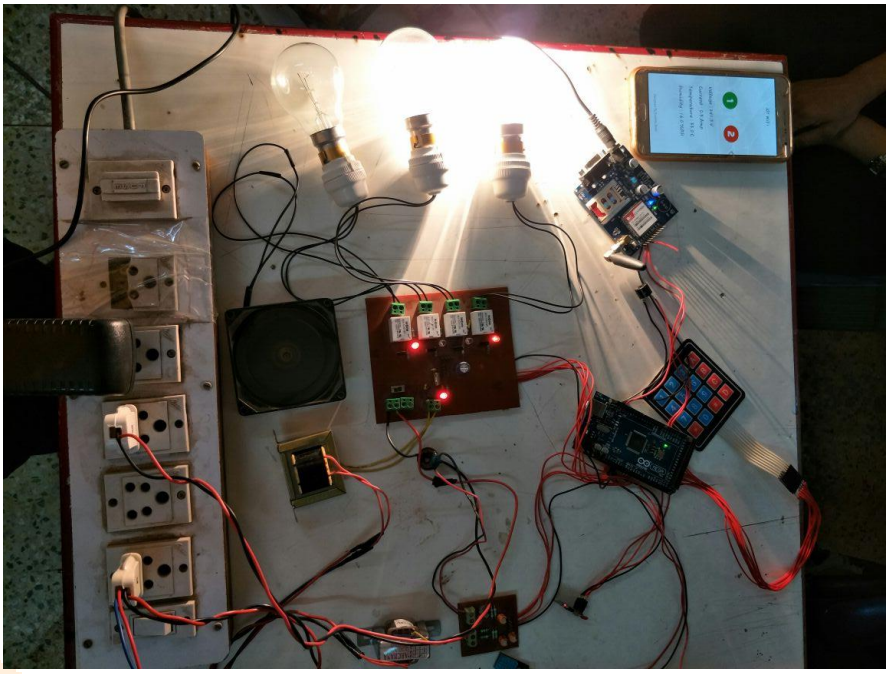

Figure 7. Device 1 on condition hardware

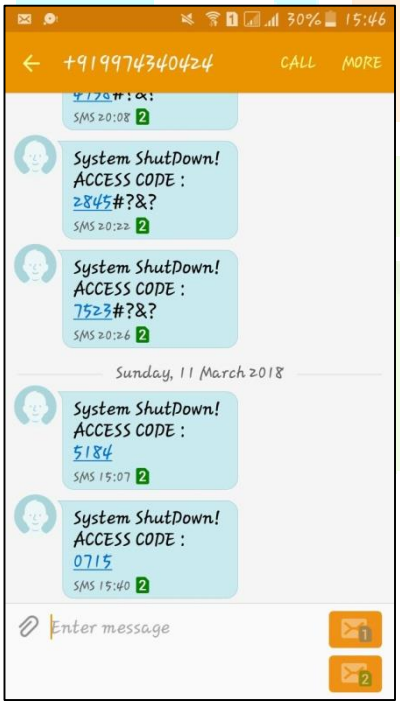

Figure 10. Mobile screenshot of SMS received

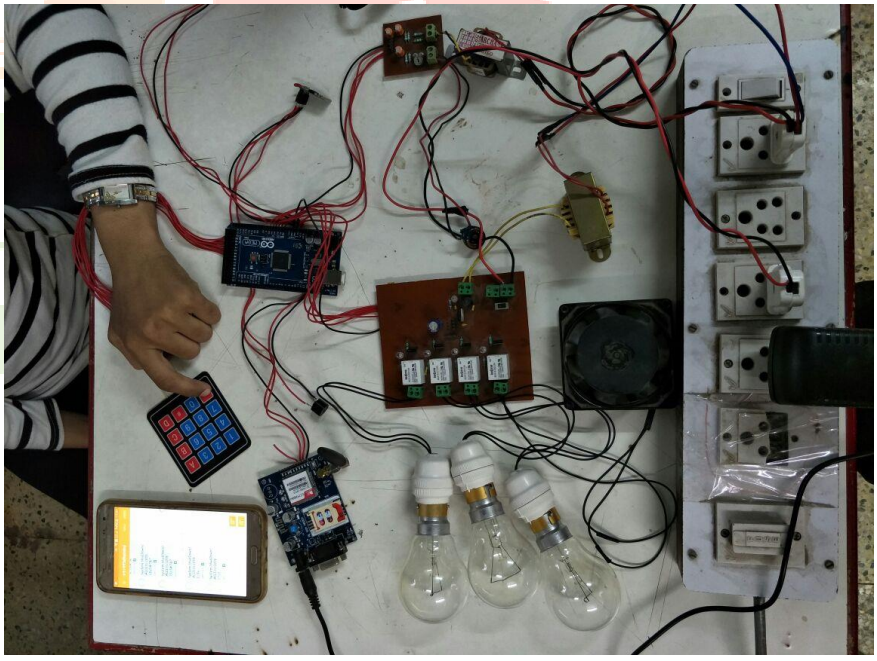

Figure 9. Typing password received through SMS to activate the monitoring system hardware

When the temperature is less than Tmax heater is turned on, this condition is shown in Figure 3. And the parametres displayed on the mobile app is shown in Figure 4. When the humidity is less than Hmin value the fan is turned on which blows air with humidity, thus humidity in environment increases this hardware conditino is shown in Figure 5. The humidity value displayed on the mobile value is shown in Figure 6. User can manually turn on or off the device via mobile app. To turn on the device 1, button 1 on the mobile app is pressed and the button 1 turns into Green when device is turned on. The device 1 on condition in mobile app is shown in Figure 8. The hardware turns on the device 1 though activating the relay 1; this condition is shown in Figure 7. When the device load goes above the Icut value, all device turns off, buzzer starts, SMS with password is sent to preconfigured mobile number. The SMS format which received in mobile is shown in Figure 10. The manufacturing plant administrator has to type the password in matrix keypad to activate the monitoring system. The typing procedure in hardware is shown in Figure 9.

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