International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-06, Issue-10, JAN 2021

Android Application Development for GSM Motor Control

[*]S. B. Sonawane, [#]Prof. S. S. Khairnar

[*,#]Department of Electrical Engineering, K. K. Wagh Institute of Engineering Education & Research, Amrutdham, Panchavati, Nashik, India. [*]sayalison@gmail.com, [#]sskhairnar@kkwagh.edu.in

***Abstract*—Android is a software stack for mobile devices that includes an operating system, middleware and key applications. ” Android”, the world’s most popular mobile platform which is a tool for creating application that look great and take advantage of hardware capabilities. As load shedding is a common problem in villages, the three phase motor may get damaged or may give improper output due to frequent load shedding. An android application is developed which will help the farmer for ON/OFF control, protection and continuously monitoring the status of three phase parameters such as current, voltage of Induction motor using GSM technology. Communication between Quectel GSM modem and Renesas microcontroller is done using MAX-232. Android platform is being targeted since it has huge market and open source. The running motor for a brief period and the parameter control of the motor can be achieved with the Renesas microcontroller. The Renesas microcontroller used is from RL78 family. The four operation of the induction motor is best suited for industries where motors are used and as per requirement as they operate on android phones. In case of a specific operation in industrial environment, the motor needs to be stopped immediately. In such scenario, this proposed system is very apt as the operations - To Set Power on Time, To Set Auto Switch Time, To Set Under Voltage, To Set Over Voltage, To Set Motor OFF Time and many more like its integral features can be easily performed. The android application is password protected, so no other person can control the motor without password. Remote operation is achieved by any smart-phone/Tablet etc., with Android operating system, upon a GUI (Graphical User Interface) based touch screen operation.**

Keywords - Android, Induction motor, status monitoring and control, Renesas microcontroller, remote control, GSM technology.

I. INTRODUCTION

Induction motors are the most extensively used motors in most power-driven home appliances, agricultural, industrial drives control and automotive control. In the past few decades, various new technologies are emerging and some conventional ones are eradicating. Before the initiation of semiconductor devices, the DC motor were used for motor control, even though it suffers from many limitations. Due to advent of semiconductor technology and microcontroller, research and development towards AC drives has been increased rapidly. The research and development in various areas including mobile communication along with GSM technology has resulted into advancement in the field of automation. It has proved to be a great asset even in agriculture industry.

In India, more precisely in Indian villages, the load shedding timing is improper. Due to this, motor may get damaged and may not give proper output. This motor should be controlled as well as turned on/off whenever required. Most of the time it is done manually. Now it is a necessity to control motor more effectively and efficiently anytime from anywhere. The motor is to be controlled from remote place, ensure its operating conditions and get feedback from the motor itself. The aim of the project is to control the motor from distant place by mobile DTMF tone and also get feedback by SMS while it is in ON or OFF condition. The safe operation of the motor is ensured by detecting the voltage of the source and ensure feedback from system while it is over or under voltage. Again these feedbacks are received by SMS as well. It monitors and measures all three phase voltages. The controller displays the fault occurred in the system and send SMS to the registered number. Respective readings of voltage, current are sent through SMS to registered mobile number. The current status of 3ϕ motor regarding voltage and current is available using Android application. The Current of one of the phases is sensed using current transformer. Dry run sensing is provided. SMS is send for any fault occurred in the motor operation. The implemented system completely meets the demand of low cost by using

 DOI : 10.35291/2454-9150.2021.0008

Renesas microcontroller and GSM technology with the aim to reduce farmers efforts in agriculture application. This is all done using GSM technology and the developed Android application.

II. FUNCTIONAL BLOCK DIAGRAM

The proposed system works on android system and SMS as well. The user can control the motor only by entering the password and can register 3 mobile numbers. When the user presses specific key in the android application or mobile keypad, the DTMF tone is generated. This dual tone multiple frequency is decoded and given to Renesas microcontroller. Renesas microcontroller is used for monitoring the parameters and making decision. If any fault occurs to the motor, controller will send SMS to the registered numbers in the unit. This microcontroller is from RL78 family. The main advantages of this microcontroller is, it is a low power platform (as low as 66μA/MHz), 16-bit CPU core and it delivers 41 DMIPS at 32MHz. Depending on the button pressed by the user, the Renesas microcontroller takes the appropriate decision. The parameters such as under voltage, over voltage, overload, dry run sensing, phase reversal is to be sensed. 3 different PTs for each voltage with respect to neutral is used. The output of each Potential Transformer is amplified and buffered to appropriate level and then given to the Renesas controller. The ADC is interfaced with the micro-controller for calculation of respective voltages. The ADC has 8 different channels that can be selected by the Renesas -controller by giving appropriate select signal. The current can be monitored by using the Current Transformer of only one phase. For dry sensing, the simple transistorized amplifier circuit is used and logic level is given to the controller directly. The outputs of all above parameters are displayed on the LEDs display.

The range for under voltage, overvoltage, dry run trip percentage and over load/current trip percentage is programmed in the Renesas microcontroller as - Under voltage trip percentage - 280V-390V. Over voltage trip percentage - 430V-500V. Dry run trip percentage - 110%-200 % .Overload trip percentage - 50%-90% .

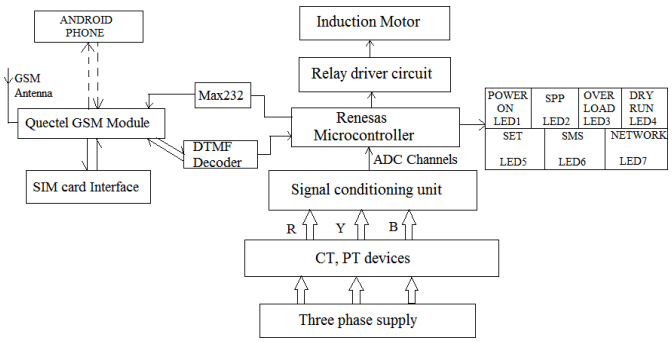


Fig. 1. BLOCK DIAGRAM

III. RENESAS MICRO CONTROLLER(RL78)

The Renesas architecture is based on the configuration known as Harvard machine structure (CISC) with 3-stage pipeline, where separate memories are used for the program and data which are accessed by separate buses. Renesas IC is developed to control peripheral devices. This device ia a 64-pin package, 16-bit microcontroller that belongs to RL78 family having a program memory and data memory. The controller operates on 1.6V to 5.5V from a single-phase supply. The micro controller delivers 41 DMIPS at maximum operating frequency of 32MHz. It executes 86 instructions. The Renesas has Data memory access controller (DMA) upto 4 fully programmable channels and its transfer unit is 8-bit or 16-bit. It has multiple communication interfaces and extended 16-bit function timers upto 16 channels. The software program is written using the instructions, compiled in a PC and then downloaded to the ROM as a machine code. To simulate and debug the code, MPLAB software tool is used. The Renesas microcontroller and microprocessor portfolio offers the most scalable MCU/MPU platforms available, offering low power, high performance, small packages and the largest range of memory sizes combined with feature-rich peripherals. Renesas family consists of H8 Value series, RL78 Family, RX MCU family, 78K Family, M32R family, M16C Family and so on.

A. POWER SUPPLY CIRCUIT

Step down transformer- The following information must be available to the designer of the transformer-

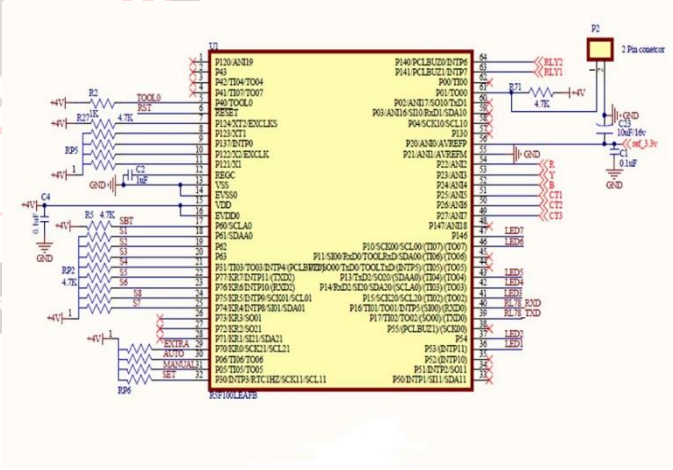


Fig. 2. CIRCUIT DIAGRAM OF RENESAS MICROCONTROLLER

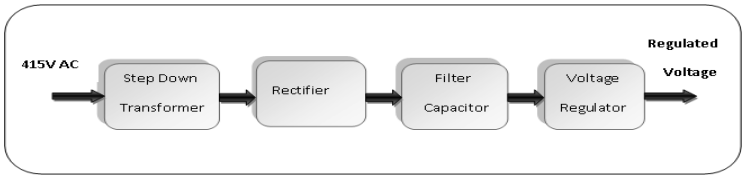


Fig. 3. POWER SUPPLY

1) Power output.
2) Operating voltage.
3) Frequency range.
4) Efficiency and regulation.

Design of filter capacitor- Formula for calculating

 DOI : 10.35291/2454-9150.2021.0008

filter capacitor is,

$$C = ¼ \times \sqrt{3} \times r \times F \times R1 \quad (1)$$

Where,

r = ripple present at output of rectifier, which is maximum

for full wave rectifier. F = frequency of AC main.

R1 = input impedance of voltage regulator IC.

Specification of voltage regulator IC-

TABLE I. SPECIFICATION OF VOLTAGE REGULATOR IC

Parameters	Rating
Available o/p DC	+5V
Line Regulation	0.03
Load Regulation	0.5
Vin max	17.115V
Ripple Rejection	60-80dB

IV. QUECTEL GSM MODEM

M95 is one of the smallest Quad-band GSM/GPRS mod- ules in LCC castellation packaging with the compact size of 19.9 23.6 2.65mm, ultra low power consumption and extended temperature range. With surface mounted technology, the low profile and small size of LCC package makes M95 easily embedded into the low-volume applications and ensures the reliable connectivity with the applications. This kind of package is ideally suited for large-scale manufacturing which has the strict requirements for cost and efficiency. Built-in unique QuecFOTA^{TM} technology allows M95 to update the firmware remotely. Additional features such as integrated TCP/IP protocol stack, serial multiplexer and enhanced AT commands guarantee fast and reliable transmission of data, voice, SMS via GSM/GPRS network and extend the functionality of the application without adding cost. Its tiny size and ultra-low power consumption make M95 a very cost effective and feature-rich platform that is quite suitable for a wide range of M2M applications such as VTS, Industry PDA, Personal Tracking, Wireless POS, Smart Metering and many other M2M applications.

Key Benefits-

- One of the smallest Quad-band GSM/GPRS modules.
- easier soldering process with LCC package.
- Embedded Class-AB amplifier.
- Power consumption as low as 1.3mA.
- Embedded powerful Internet service protocols, multi- ple Sockets IP addresses.
- Jamming detection.
- DTMF decoding.

A. GSM COMMANDS FOR MOTOR CONTROL

The motor can be controlled via SMS through registered mobile number or through the Android application. The following commands execution is required for motor operation and protection. The GSM commands are specified in Table-II.

V. IMPLEMENTED ANDROID APPLICATION

Fig. 4. ANDROID APPLICATION

ALGORITHM-

1) START.
2) INITIALIZE TIMER, INTERRUPT, COUNTER, GSM MODEM.
3) READ ADC and CALCULATE R, Y, B phase VOLT AGE and CURRENT.
4) WAIT FOR COMMAND.
5) IF XXXXA<10-Digit Mobile No.># then Add Registered Mobile Number, if not go to next.
6) IF XXXXD<10-Digit Mobile No.># then Delete Registered Mobile Number, if not go to next.

TABLE II. GSM COMMANDS FOR MOTOR CONTROL

Action Needed	SMS Command Details
	Here, XXXX is the 4 digit password
Add Registered Mobile Number	*XXXXA<10-Digit Mobile No.>#
Delete Registered Mobile Number	*XXXXD<10-Digit Mobile No.>#
Get Registered Mobile Number List	*XXXXLST#
Start Motor	*XXXXON#
Stop Motor	*XXXXOFF#
Set Motor Current	*XXXXSPC#
Change Password	*XXXXCPWD<4 Digit New Password>#
Load Factory Setting	*XXXXLFS#
To Get Motor Status on Site	*XXXXSTS#
Check Parameter Settings	*XXXXPSET#
Check Measurement Values	**XXXXREAD#
Stop Outgoing SMS From Starter Unit	*XXXXDSMS#
Start Outgoing SMS From Starter Unit	*XXXXESMS#
Start Password Protection	*XXXXEPWD#

 DOI : 10.35291/2454-9150.2021.0008

Stop Password Protection	*XXXXDPWD#
Reset All Faults Occurred	*XXXXRSTF#
Set Power on Time	*XXXXPOT<3 Digit Value>#
Set Auto Switch Time	*XXXXAUT<3 Digit Value>#
Set Start to Delta Change Over Time	*XXXXSDT<2 Digit Value>#
Set Under Voltage	*XXXXUV<3 Digit Value>#
Set Over Voltage	*XXXXOV<3 Digit Value>#
Set Unbalance Voltage	*XXXXUNBAL<2 Digit Value>#
Set OL/Dry Reset Time	*XXXXODR<4 Digit HHMM>#
Set Dry Run Trip Percentage	*XXXXDRY<2 Digit Value>#
Set Over Load Current Trip Percentage	*XXXXOLC<3 Digit Value>#
Set Motor OFF Time	*XXXXSTMR<4 Digit HHMM>#
Enable Motor OFF Timer	*XXXXETMR#
Disable Motor OFF Timer	*XXXXDTMR#
Enable Dry Run Protection	*XXXXEDRY#
Disable Dry Run Protection	*XXXXDDRY#
Enable Auto Mode Operation	*XXXXEAUTO#
Disable Auto Mode Operation	*XXXXDAUTO#
Enable Over Load/Current Protection	*XXXXEOL#
Disable Over Load/Current Protection	*XXXXDOL#
Help Menu	*XXXXHELP#

5) IF XXXXLST# then to Get Registered Mobile Number List, if not go to next.
6) IF∗XXXXON# then Start Motor, if not go to next.
7) IF∗XXXXOFF# then Stop Motor, if not go to next.

VI. EXPERIMENTAL VALIDATION

The performance evaluation of system plays crucial role for determining the efficiency of the system. Especially in automation systems, control commands have to be executed within restricted time. While executing such commands, missing a single deadline may lead to catastrophic events. Hence in real time automation system, the latency of operation is a primary criterion for evaluating the performance. The hardware implementation of GSM motor controller is done for monitoring and protection purpose. An Android application is developed for the same which has made the controlling of motor more easier rather than sending text to the unit. It is possible to set over-voltage, under-voltage, overload trip percentage and dry run trip percentage using android application.

The following tests are carried out using motor specification as-

Rated voltage - 415V. Rated full-load amps- 7.5A.
Frequency - 50Hz.
Phase - 3ϕ.
Rated horsepower - 5HP.

Fig. 5. MOTOR ON

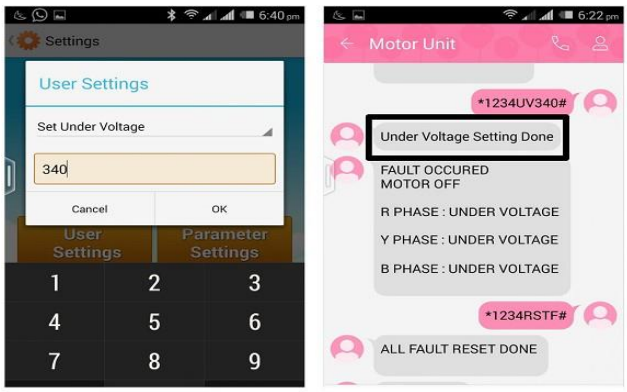
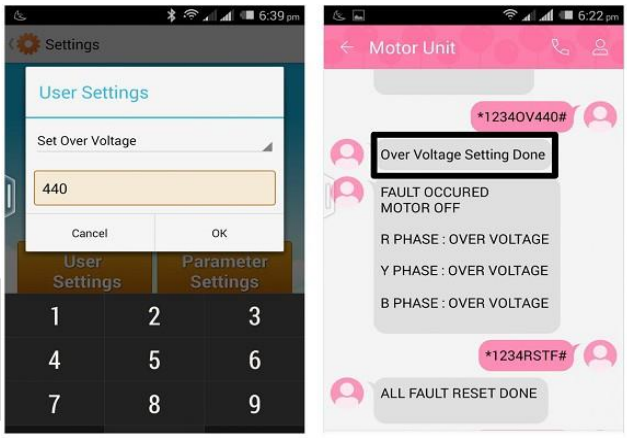


Fig. 6. UNDER VOLTAGE TEST



∗

Fig. 7. OVER VOLTAGE TEST

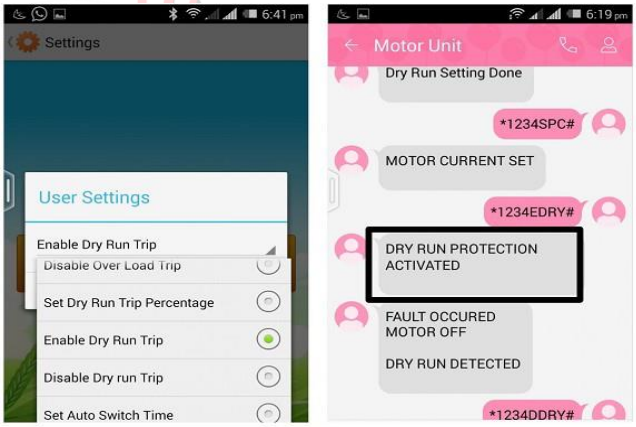


Fig. 9. DRY RUN TEST

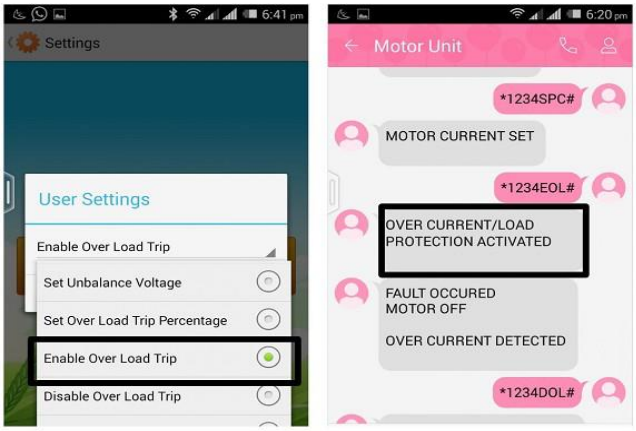


Fig 10 .OVER CURRENT TEST

 DOI : 10.35291/2454-9150.2021.0008

VII. CONCLUSION

The project has been designed to develop a parameter control system for Induction motor. It is possible to demon- strate control of a Induction motor using a microcontroller through remotely operated commands to it by touch screen based user friendly GUI on any smart phone with Android applications. This project can be enhanced by using higher power electronic devices to operate high capacity AC motors.

An android application is developed which is user friendly and has great use in the agriculture application. The GSM technology is used because of its main features which can be listed as, complete accessibility, simplicity, smaller amount of signal deterioration, large coverage area etc. The approach discussed in the paper has achieved the target to control industrial and agriculture appliances remotely using the GSM-based system satisfying user needs and requirements.

REFERENCES

[1] Trupti S Bobade, Anushri S. sastikar, Anushri S. Garud, U. W. Kaware and R. K. Dehankar, ”Induction Motor Speed Control Using Android Application”, in International Journal of Engineering Research and General Science Volume 3, Issue 2, Part 2, March-April 2015, ISSN 2091-2730.

[2] V. Bhaskar T. Gowri Manohar,” GSM Based Motor Monitoring and Speed Control”, International Journal of Mechanical and Industrial Engineering (IJMIE), ISSN No. 2231 -6477, Volume-1, Issue-2, 2011.

[3] P. Patil, A. Narkhede, A. Chalke, H. Kalaskar, and M. Rajput, Real time automation of agricultural environment, in Convergence of Technology (I2CT), 2014 International Conference for, pp. 14, April 2014.

[4] P.Nagasekhara Reddy, ”Microcontroller Based Speed Control of Induc- tion Motor using Wireless Technology”, ISSN:2319-6378, Volume-1, Issue-9, July 2103.

[5] P. M. S. Sujatha and D. V. Kumar, On-line monitoring and analysis of faults in transmission and distribution lines using gsm technique, in Journal of the- ortical and applied information technology, vol. 33, p. 258265, Nov 2011.

[6] Ms.Devjani Banerjee and Prof Dr.Mrs.N.R.Kulkarni, ”Three Phase Pa- rameter Data Loggingand Fault Detection Using GSM Technology”, International Journal of Scientific and Research Publications, Volume 3, Issue 2, February 2013, ISSN 2250-3153.

[7] A. Mulla, J. Baviskar, J. Desai, C. Beral, and A. Jadhav, Gsm based in- teractive voice response system for wireless load control and monitoring, in Communication, Information Computing Technology (ICCICT), 2015 International Conference on, pp. 16, Jan 2015.

[8] Lingyan Bi, Weining Wang, Haobin Zhong, Wenxuan Liu, ”Design and Application of Remote Control System Using Mobile Phone with JNI Interface”, The 2008 International Conference of Embedded Software and Systems Symposia (ICESS2008), 2008, pp.416-419.

[9] Microchip, AT89C2051 Data Sheet, Microchip Technology Inc., 2003.

[10] Arrick Robotics, ”Driving High-Power Loads with a Microprocessor,” 2005, http://www.robotics.com/highload.html.

[11] MM74C922, MM74C923 16-Key Encoder, General Manual, 1999.

[12] D. Neamen, Electronic Circuit Analysis and Design, New Mexico: Times Mirror Higher Education Group Inc., 1996, pp. 69.

[13] http://www.Renesas.com.

[14] http://www.Quectel.com.

[15] http://www.aplusinc.com.

[16] http://www.google.co.in.

 DOI : 10.35291/2454-9150.2021.0008