MOBILE OPERATED REMOTE CONTROL OF PLC BASED INDUCTION DRIVE USING DTMF

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Abstract

Since the machine has used in the production of the goods, the control and speed of the machine always got the upper hand in it. Initially the control was manual and gradually changed [1] to automatic and now it is turn of remote control. Now days almost all the advanced applications are controlled through remote controller and has wide applicability in the advanced future generation processes. For various complicated applications it is necessary to control the drive from the desired remote place [2]. In the designed system it is possible to keep the system running with any one of fourteen different speeds along with the on/off. The proposed control system design will help to control system over a mobile using DTMF technique with microcontroller [3]. It is possible to change the control in real time using the algorithms. This will help to reduce the cost, size and human efforts helping the increase the efficiency and productivity of the system [4].

The proposed system also measures the speed and voltage. Initially the system is simulated and the results are noted. Then the hardware along with the software is designed and developed. The system parameters are measured in real time application with the remote GSM modem using DTMF decoder and compared with the simulated results. The remote application is helpful in hazardous and abnormal conditions for controlling the drive operation. It has wide applicability in the industrial and the communication areas. The control signals will be in the radio frequency range and can cover long distance without interference. The signal strength is also strong and possible to operate in the mobile operated cells.

Keywords- *remote speed control, DTMF, data acquisition system, microcontroller*

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1. INTRODUCTION

There are various ways of control of drives [5, 6] in which power semiconductor is one of the main control component [7]. To produce the reliable output, the harmonic reduction [8] is used in efficient manner. For this the mathematical algorithms and modeling was used in control of the drive [9,10]. Use of DTMF technique in the remote switching is gaining the importance in the industrial and communication applications. Some of the applications like lathe machine, process in industry, which needs to operate the drive at different speeds. So for such applications speed change is possible from the remote place. The system can operate in hazardous and repeated conditions. The advantages of remote control are time and effort avoiding along with flexibility for the geographical location and distance [11]. DTMF is general communication used for special touch-tone which is immune to the interface radio waves. So free from interference communications is possible with DTMF. The control commands are generated from the microcontroller which is a central control device that adds and boosts the advance techniques for management. 2G and 3G service Internet modems are used for receiving call or signal from the mobile [11], so with the help of DTMF decoder these signals are decoded. The use of PLC helps to minimize the hardware components and software through the MicroC-5 software which also boosts the capability of the control system. The PLC is the main control component of the industrial process in the modern atomization.

2. BLOCK DIAGRAM OF THE SYSTEM DESIGN

The block diagram of the system consists of microcontroller, DTMF decoder, display, receiver GSM modem, control circuit and switching system. The signals from the remote mobile are received by the GSM modem operated in the frequency range 900MHz, The GSM will receive these signal from the transmitter within the cell or MTSO. These signals are decoded by the DTMF decoder and fed to the microcontroller. The microcontroller will generate the necessary control signals through ports 1 and 3. These signals will help switch to start of drive, stop and to switch to respective speed. The speed of the drive can be controlled by switching one of the 14 different states that exists and each state is assigned with certain different speed.

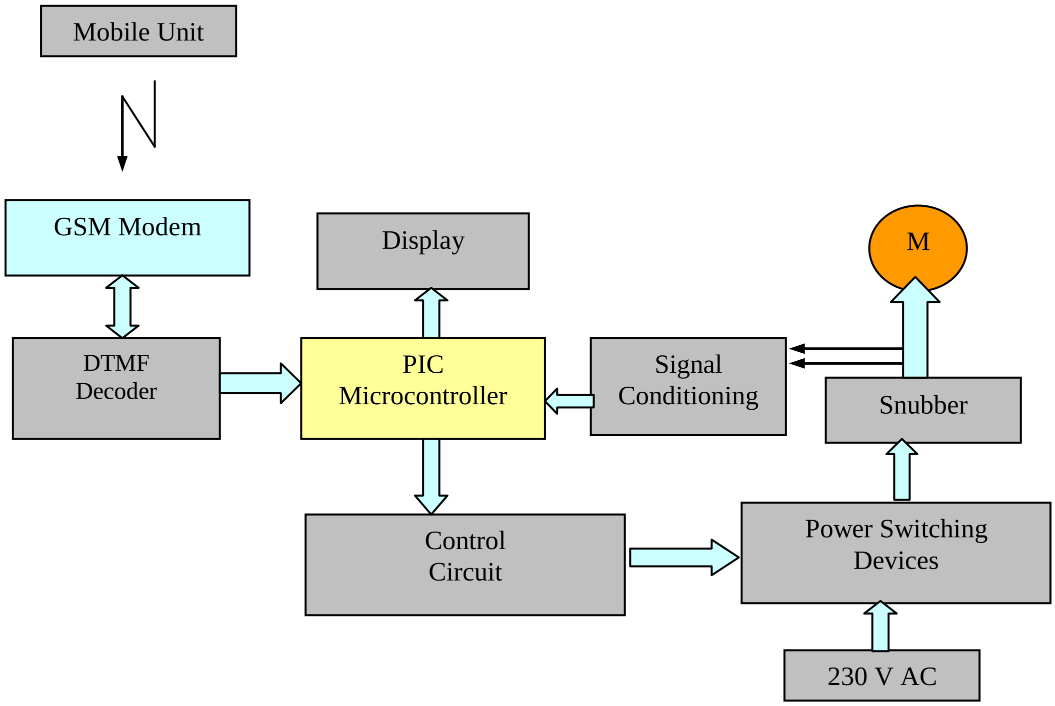


Fig.-1: Block diagram of the Microcontroller based remote operation of drive

3. CONTROL AND SWITCHING SYSTEM

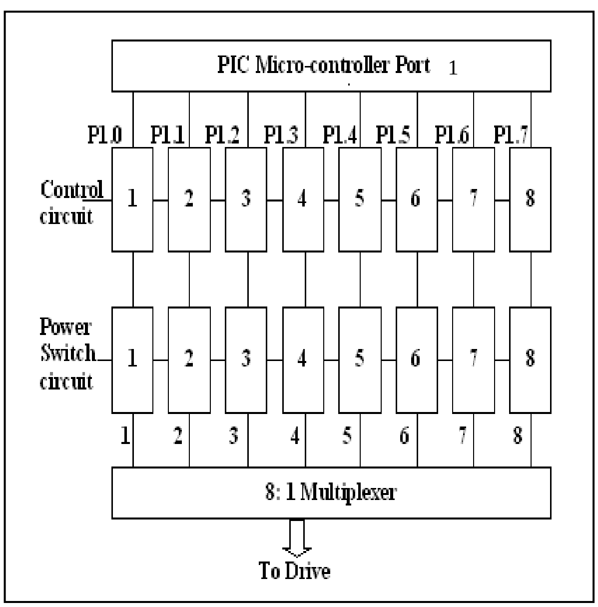


Fig.-2: Control & switching system block diagram for port 1

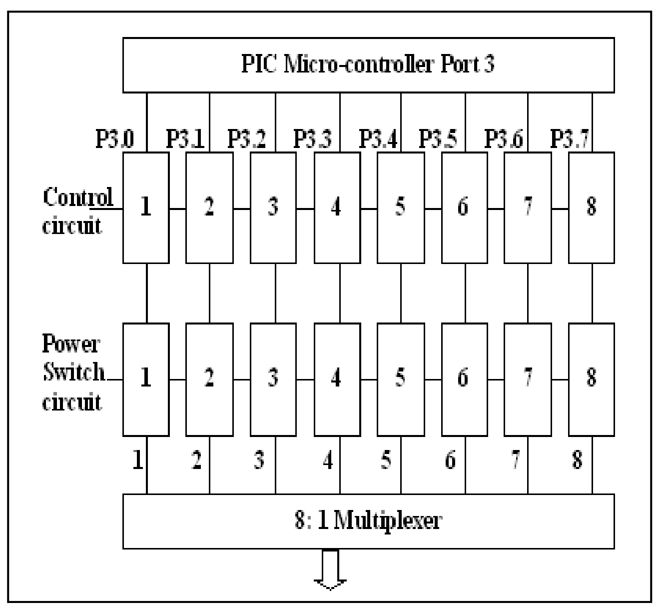


Fig.-3: Control & switching system block diagram for port 3

The control circuit consists of the amplifier in which the signal strength is increased sufficiently to drive the switching. The Darlington pair transistor is used to increase the gain of the signal. Whenever the microcontroller gives the high signal through the port 1 or 3 pins, the respective control circuit amplifies the signal; to drive the switching logic circuit. Suppose the P1.0 pin is high then the control circuit corresponding to the p1.0 is active and drives the power switch which supplies the desired power to the drive. As the power supplied to each switch is not the same but as per the speed requirement it is deliberately supplied different. It is taken from the taping of the power transformer and it depends upon the turn's ratio. P1,0 port pin is used for making start of the drive and other 14 pins of port 1 and port 3 are used to control the 14 different speeds. The 8: 1 multiplexer is used to connect the switching system to the drive depending upon the control provided by the microcontroller. The port 1 and port 3 pins combined used for the controlling the drive. The isolator is also used for separating the control circuit from the power circuit.

The Switching logic simply consists of the solid state device called switching power device. When the control signal gives the sufficient signal to drive the relay. It will supply power to which it is connected. The tearing and chattering effect of the relay needs maintenance how ever the experiment is also carried using the power switching transistor and for the same a control circuit is built for drive the base is called base drive is used. In the present system two 8:1 multiplexers are used and afterwards it requires 2:1 but instead for that 16: 1 may reduce the hardware and the cost also.

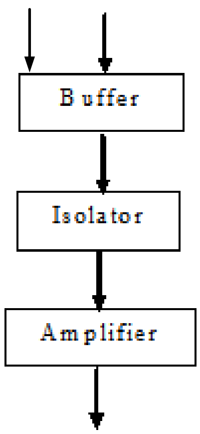


Fig.-4: Block diagram of the Driver

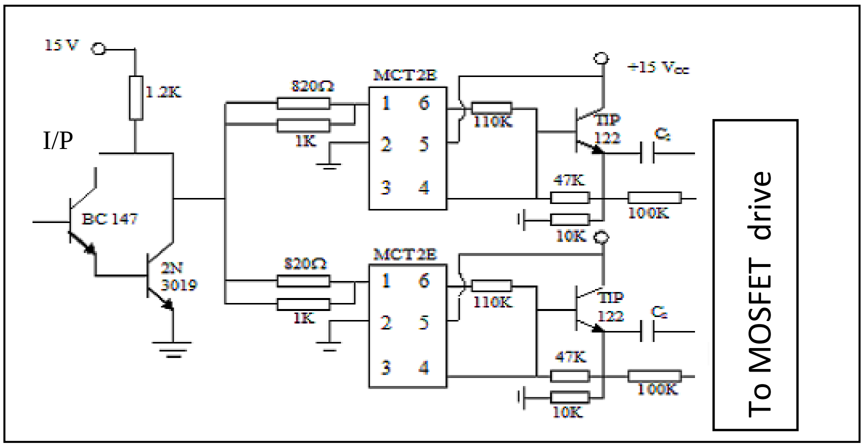


Fig.-5: Driver circuit diagram

The block diagram of the switching system has buffer, isolator and driver. The actual diagram of the driver circuit is shown in the fig.-5. Input from the controller is amplifierd by using darlington pair. The isolator will isolate the power circuit from the control circuit. The MCT 2E is the isolator IC and the TIP 122 is the amplifier. The amplifier output is quite sufficient to drive the power MOSFET. Two channel driver circuit is shown in Fig.-5.

3.1 Snubber Design for Switching System

Basically the snubber circuit is used for avoiding the sudden transients produced during the switching. These sudden changes may produce the heating leading to damage the system. This design is effective during the turn-on and turn-off of the power switching system. It consists of the transistor, capacitor and inductor connected in parallel with switching system module. This also helps in avoiding the turnoff losses with peak overshoot. The snubber circuit is placed in each stages of switching system.

3.2 Decoder

The Dual tone multiple frequency decoder table is shown in table-1. The keypad contains the 4 rows and 4 column frequencies and the combination of the frequency is the resultant shown as number of letter on the keypad. Two frequencies are combined and single tone is generated and for the same positions of Q1 to Q4 are indicated. After decoding the states it is given to the microcontroller. Selecting the appropriate key generate unique tone which has two frequencies.

4. FLOW DIAGRAM OF THE SYSTEM

The initialization of the controller driver takes place in the first step. Then voltage of the drive is checked if the voltage is present then it will wait for getting desired speed number. If the number 1 is entered then it will switch to control logic 1 through port P1.1 for the desired speed and the drive will continue in the desired or set speed of the respective control circuit. If number is 2 then it will switch to second control logic through port P1.2. like this it will have 14 different speed control circuits controlled through the port 1 and port 3 pins. If the number 15 is entered then it will stop the drive from operation or otherwise else other number entered even then drive will stop from working.

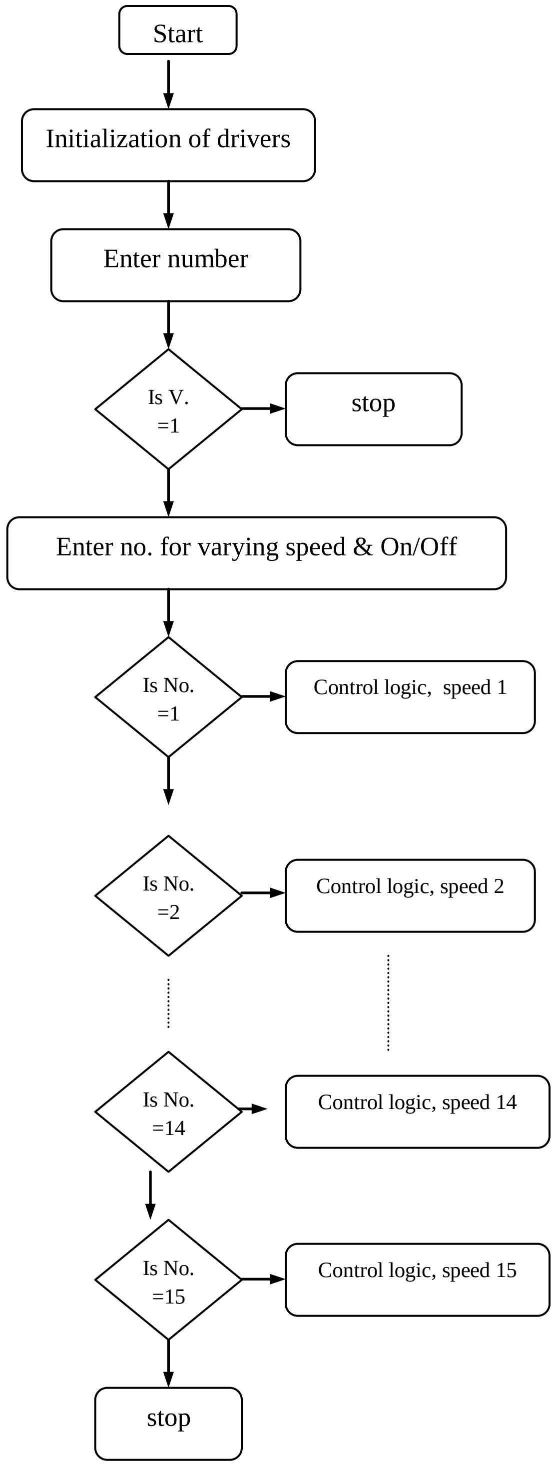


Fig.-6: Flow chart for software development of system

Table-1: DTMF Decoder Table

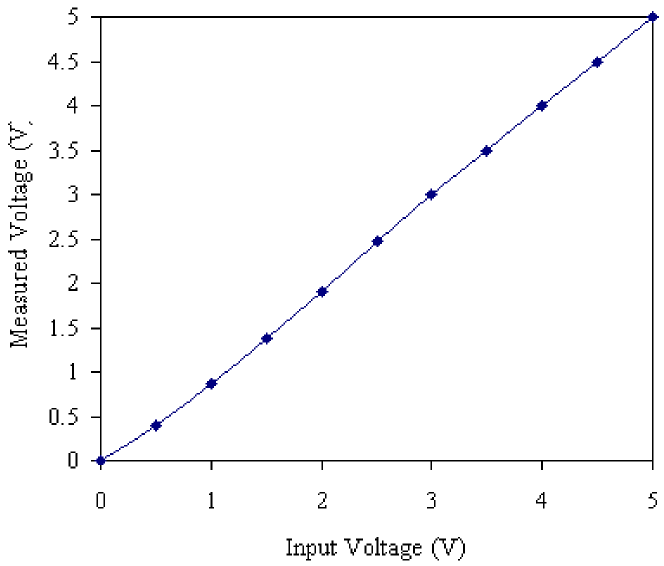
F_L	F_H	Q_4	Q_3	Q_2	Q_1	Key
697	1209	0	0	0	1	1
697	1336	0	0	1	0	2
697	1477	0	0	1	1	3
770	1209	0	1	0	0	4
770	1336	0	1	0	1	5
770	1477	0	1	1	0	6
852	1209	0	1	1	1	7
852	1336	1	0	0	0	8
852	1477	1	0	0	1	9
941	1209	1	0	1	0	0
941	1336	1	0	1	1	.
941	1477	1	1	0	0	#
697	1633	1	1	0	1	A
770	1633	1	1	1	0	B
852	1633	1	1	1	1	C
941	1633	0	0	0	0	D

5. SIGNAL CONDITIONING

5.2 AC Voltage Sensing

The peak detector is used for ac voltage sensing. The input variation is sensed and corresponding change through ADC is displayed. If required correction may be applied while indicating the correct voltage for the same the sensed results are compared with standard results and corrective action is applied through software. The limiter circuit is necessary to limit the voltage.

The voltage supplied to the drive is picked up through the step down transformer and using the signal conditioning circuit and represented in range 0-5V as shown in the Fig. 7. Actual voltage is represented using the software in the range 0-230 V. However there is sight non linearity in the initial stage as shown in the Fig. 8. The system need to be calibrated. .After applying the calibration and correction facter through the software, proportional voltage is represented in the range 0-230V as shown in the Fig, 9. It gives the linear relationship between the sensed input and the measured output.



Fig,-7: Input voltage versus Measured voltage of the system

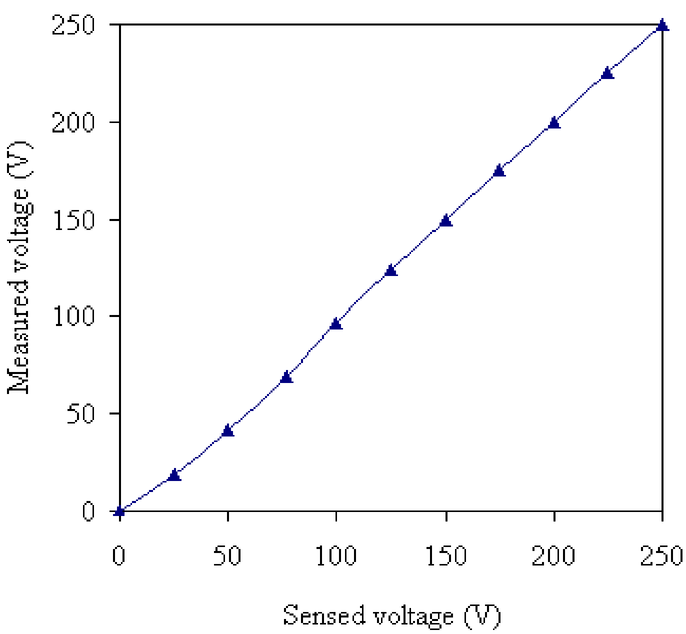


Fig.-8: Sensed voltage versus Measured voltage of the system

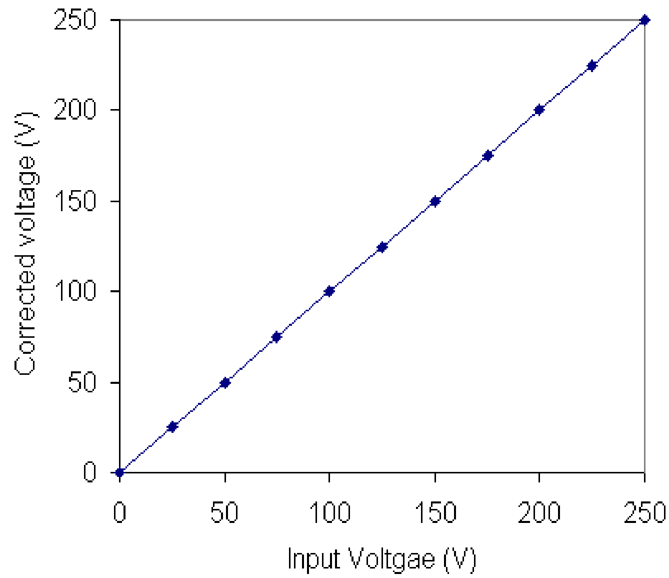


Fig.-9: Input voltage and corrected calibrated output.

5.2 Speed Sensing

Speed sensing of the drive depends on the voltage supplied to the drive. With the help of the software the sensed voltage in the range 0-5V is converted in to proportional speed in the range 0-1400 rpm and displayed. The simulation of the speed sensing is done and compared with actual speed measured while working of the drive. The simulated speed and the actual measured speed observations are comparable well within the range.

6. SYSTEM PERFORMANCE

The system is simulated for speed measurement for the various switching voltages. The actual speed is also measured using the peak detector circuit and recorded. Both observations are graphically indicted in the Fig.10. From the Fig 10, it is seen that the observed actual reading are comparatively less than the simulation. This may be due to the system components.

As the switching logic is provided different voltages increasingly with increase in switch number The speed also increases, however some change in the rpm observed with increasing switch number due to the machine losses.

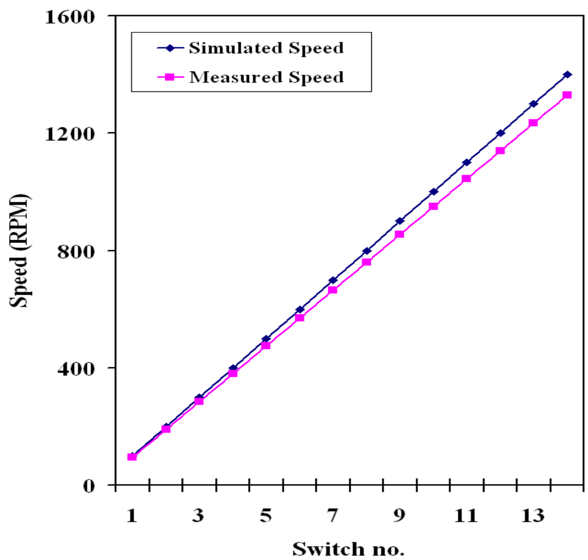


Fig.-10 shows the graph of simulated and measured speeds a at various switching positions

7. CONCLUSIONS

From the above experimental setup and the results, it can be concluded that it is possible to set speed of the drive through the switching system controlled by the microcontroller. It also possible to operate the drive from remote place through mobile device using the DTMF decoder and the GSM modem The simulation results for the various switching and the actual measured results are comparable. The speed of the drive can be modified by changing the control circuit and the power applied to the circuit of the drive. This drive system is useful in many industrial application and automation. It is tested for the lathe machine various desired speed.

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BIOGRAPHIES

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