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# GSM Based Remote monitoring of Variable Frequency Drives

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**Abstract -** For manufacturers, cost of commissioning and maintaining the Drive performance growing increasingly is more important. In industrial application most of this Drives are connected in hazardous region or in distant non reachable work sites. Service engineer needs to be monitor the performance of drives in this locations will be impossible, so analyzing the performance and taking correct decisions in this cases will be difficult .The service engineers and installers will focus on new technologies which make it convenient for customers take correct decisions without overwhelming them with unnecessary complexity.

This paper intended to propose a low cost remote monitoring system technology for variable frequency drives which is connected in hazardous areas or non reachable remote sites using a GSM modem and cloud server which will speed and ease the work of engineers commissioning drives at an industry where they won't needs to enter difficult-to-reach work or hazardous areas to analyze the drive operation. To verify the operation, results and observations from monitoring portal is cross checked.

***Key Words***: GSM Modem, Remote monitoring, Modbus RTU, Parameter configuration, cloud storing, monitoring portal, Drive performance

## 1. INTRODUCTION

The first A.C. drive was commissioned by F.E. Alexanderson of General Electric in the Logan Power Station of Pacific Gas and Electric Company in 1932.Which was based on a thyratron cycloconverter fed wound rotor induction motor drive. From then industrial drives technology grown rapidly. As a result of strong effort of scientists and engineers leaded to development of highly advanced technology named Variable Frequency Drive**.** Variable frequency drive is a power electronics principled device which provides variable frequency, variable output voltage used to control speed of induction motor from constant voltage sine wave power and a constant frequency, It varies the speeds of a three phase induction motor by controlling the frequency and voltage of the input supply of induction motor. Variable frequency drives has unavoidable importance in industrial applications, primary function of variable frequency Drive is to provide smooth control of induction motors speed with energy savings,comparing to traditional mechanical systems variable speed drives are more reliable, beyond this optimal speed control,powerfactor improvement, soft starting and extended machine life are the benefits of variable frequency Drives. In industrial atmosphere it is necessary to monitor the operation of variable frequency drives for ensuring better performance, but in most applications the Drive is installed in hazardous areas or out of work reach areas which will prevents the engineers from continuous monitoring of the drive performance. Recently some Bluetooth based applications are available with VFDs to monitoring the drives without entering to restricted areas. Which will helps engineers to troubleshooting and improve drive performance. Which will make Drive engineers work more ease and save time. But Bluetooth has many limitations in case of transfer speed, distance of communication, connectivity issue etc. GSM based remote monitoring is proposed, which will works along with Modbus communication protocol and serial port communication. Which will provide a very efficient monitoring of VFD's performance which is connected in remote site.This technology will fast fetching of drive data and will store in cloud server. Which can be monitored through a remote monitoring portal.

### 1.1 System Architecture and Communication Protocol

Fig-1 shows the Block diagram of remote monitoring of Variable frequency drives using a GSM modem. A 3g based GSM modem is the heart of proposed remote monitoring system. The Variable frequency Drive connected at remote customer site or hazardous region is connected with GSM modem. Using either an embedded fieldbus interface or a fieldbus adapter,VFD can be connected through a communication channel to an external control system. The embedded fieldbus interface will supports protocol called Modbus RTU.Modbus RTU is serial (RS-232 or RS-485) and open protocol derived from the Master/Slave architecture concept.

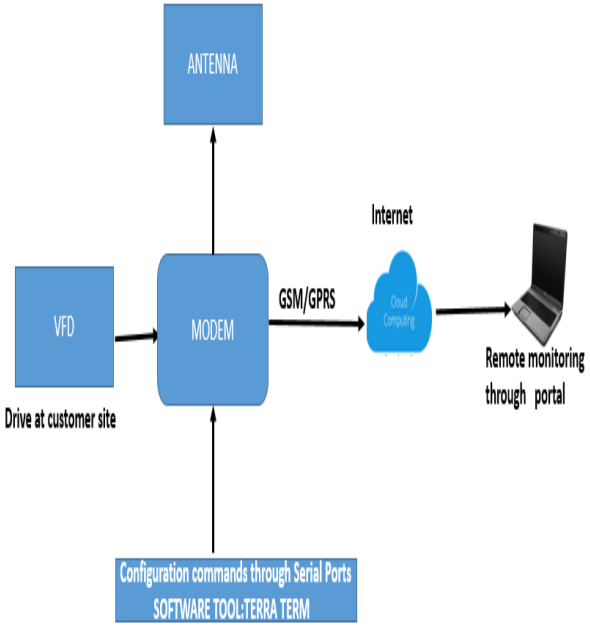



Fig-1: Block Diagram

The heart of proposed Low cost remote monitoring system is a 3G based GSM modem, for variable frequency drives applications a modem which is supporting M2M connections is used, which type modems is using in applications facing tough environmental conditions and extended lifetime requirements. Machine to machine (M2M) is a broad label used to describe any technology that allows exchange of data and react automatically. Modem operating Open AT ® Application framework will supports specific Protocol, where Modbus RTU communication protocol is enabled for data transfer. Variable frequency Drives has several parameters including statuses, according to drive operation which will show corresponding values in hexadecimal system. User can see those values either through the assistant control panel display available in drive itself or using drives operating software. The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources. Before using GSM modem remote monitoring system, it should be configured with required parameters and settings. For configuration of required parameters to the monitoring GSM device, requires establishment of a serial connection from the serial port of computer to the corresponding serial port of the device. Basic settings should be configured in both modem and Drive for the proper communication between drive and connectivity device and then to store in cloud server.

A GSM based modem operates on 3G enabled sim card, modem is operates in 5-32 VDC.Internet enabled sim network providing GPRS communication for modem to transfer the fetched data to cloud server which URL is configured during modem settings. By using communication interface connection Variable frequency Drives can be integrated into a control system. The communication interface can accessible using either RS- 232. Most VFDs support the Modbus RTU protocol, it is easy to support and using widely for industrial automation applications. The Modbus communication interface is built in messages. The physical interface used is independent of the formats used. Regardless to the connection type same protocol can be used. Without large changes in the software structure Modbus characterized with easy upgradation of the structure of an industrial network.

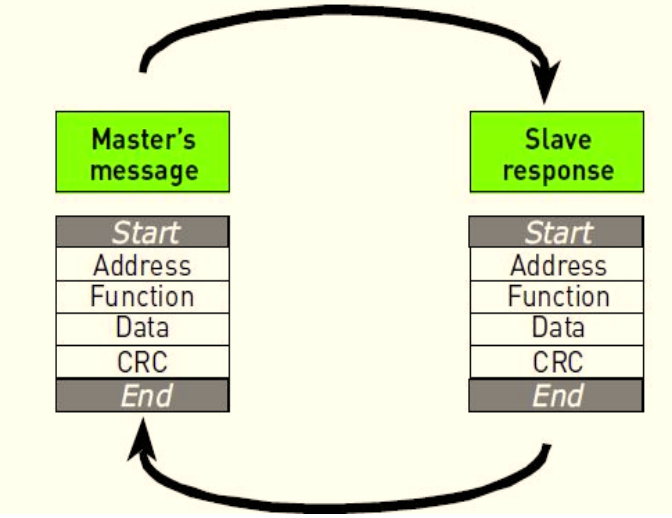



Fig-2 Basic structure of Modbus Frame

When using network systems like TCP/IP which is more versatile over Ethernet, the Modbus message will be in the form of embedded in packets with the format essential for the physical interface. In that situation Modbus can co-exist at the same physical interface at the same duration. Structure is same for each Modbus address. In each message four basic elements are present. For all messages sequence of these elements is same for easy parsing the structure content of the Modbus message. Master in the Modbus network will always starts the conversation. A Master sends a message and action is taking by slave and responds to it In a Modbus network more master is possible

## 1.2 Modbus Addressing and Software Description

By selecting the mode of communication in which device to be operated using mode select command device queries RTUs and communicates to head-end.

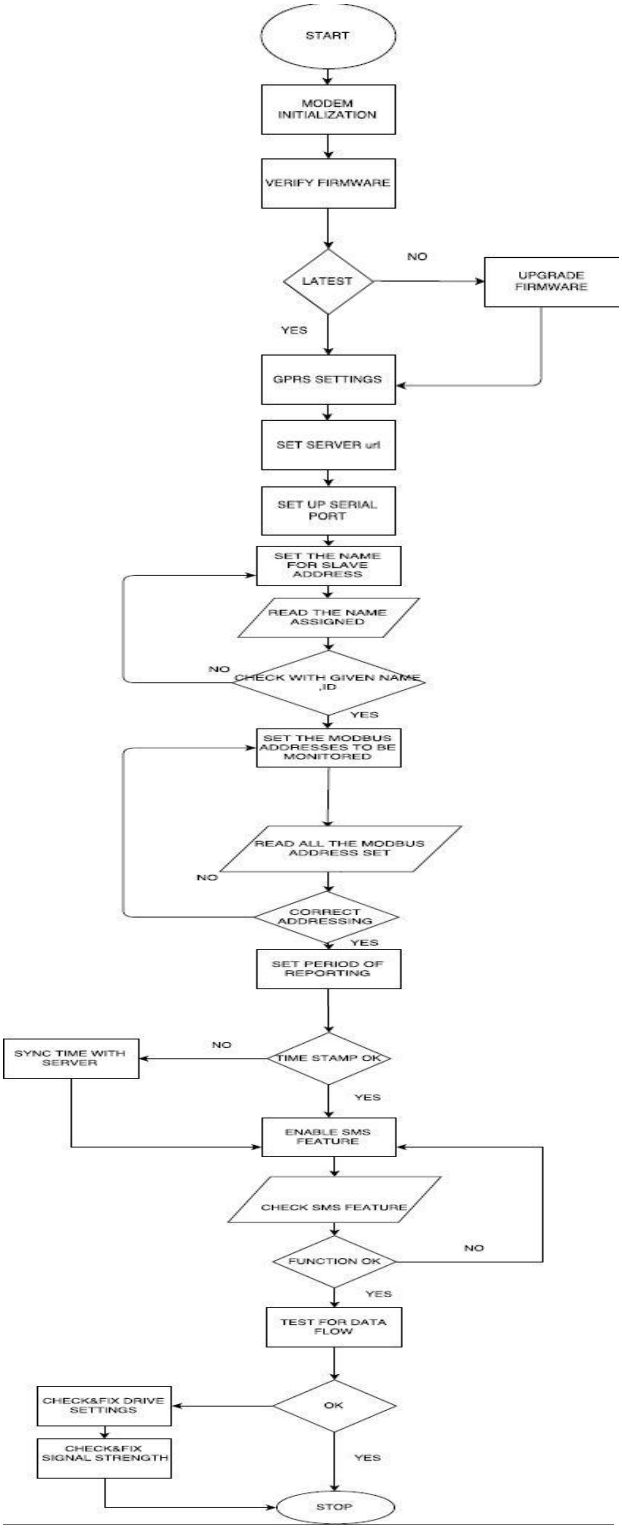


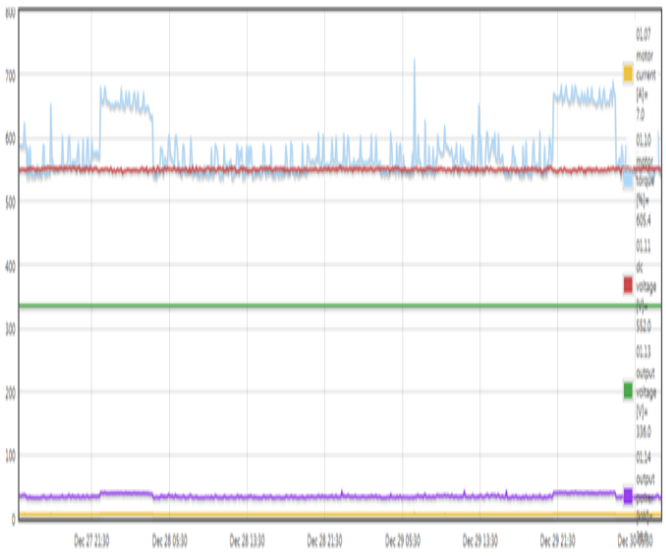

Fig-3: Flow chart

To calculate the actual Group and parameter number from the raw data we have to implement.
If raw data value is 266,
Then Group Number = Quotient of 266/256 = 1
Parameter Number= Remainder of (266/256) +1= 11.

That is the parameter 1.11 will be read and send it to value the portal which URL is configured in primary configurations.By using the above formula needs to be configure all the required parameters which is to be monitored remotely.

To issue AT commands to the remote monitoring device, installer need to establish a serial connection from the serial port of the PC to the serial USB port device. Before putting the modem in use it must be configured .Configuration programming can be carried out by using standard software available on a windows PC (e.g. hyper terminal, Terra Term) to transfer serial commands to GSM modem.The primary configuration includes GPRS settings, baud rate and parity settings, mode of communication selection, period of reporting settings, creating the URL of server and sms feature settings. After modbus address is mapped to every required parameters based on formula, parameter address should be configured according to individual sets. There is limitations in maximum number of sets can be configured and it is purely depends on modem manufacturer. After configuring each modbus addresses one by one in individual sets using AT commands modem should start fetching data from drive connected and which will upload in server created in configured uploading period. Raw data are in hexadecimal values by using appropriate programming which can be shown in desired format in the remote monitoring site.

## 2. Results and Observations



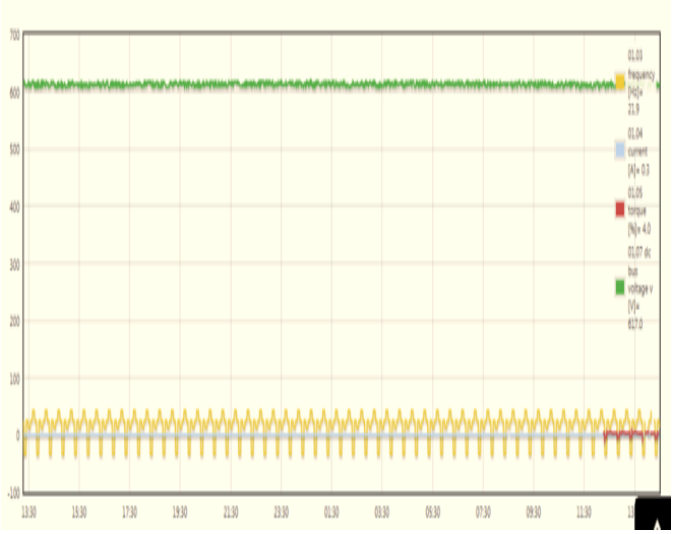


Fig 4-Remote monitoring Portal signals view

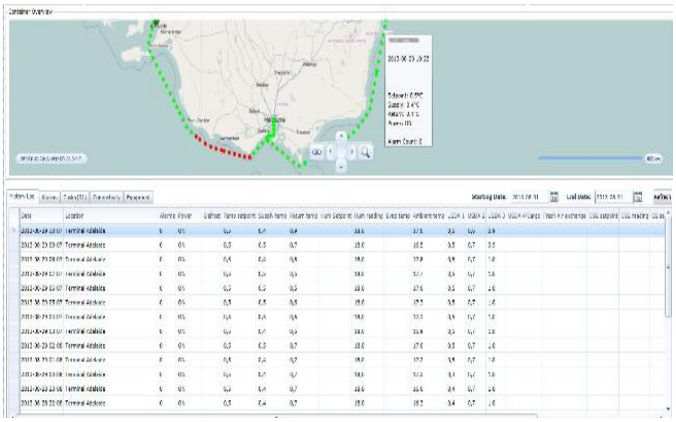


Fig 5-Monitoring portal

| 1.11 DC BUS VOLTAGE | |
|---|---|
| Value | Time stamp |
| 551 | 30/12/2016 8:08:31AM |
| 551 | 30/12/2016 8:02:40AM |
| 552 | 30/12/2016 7:55:43AM |
| 553 | 30/12/2016 7:50:03AM |
| 553 | 30/12/2016 7:44:11AM |

Fig 6-Dc bus voltage

## 3. CONCLUSIONS

Variable frequency drives are became more crucial in industrial applications because of their smooth operations and energy saving advantages. Proposed method of remote monitoring of the drives providing an efficient solutions for engineers and Installers by providing access of drives which are located in hazardous zones or non reachable work areas. Proposed Method is a low cost solution and which will overcome the slow transfer rate and distance limitation problems which are facing in Bluetooth based monitoring. From the server engineer can monitor all the data regarding drive operations there by drive performance is improved and which helps engineers to ease work and to save time.

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