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Wireless Motor Control Using GSM and Wifi Technology for Industrial Application

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Abstract— In modern world, wireless technologies such as GSM, WiFi have been of great use in various sectors including industries which are dealing with the energy automation products. The wireless technologies give great flexibility in the operation and control of devices across a certain range depending on the technology that is being used. Addition of wireless technologies can help in serviceability and maintainability of the devices when installed in remote stations. It is significant to evaluate the GSM and WiFi technology and to recommend its applicability with respect to the Industrial Applications.

Keywords— Motor control, Switchgear, Wifi and GSM technology

I. INTRODUCTION

A motor controller might include a manual or automatic means for starting and stopping the motor, forward or reverse direction, selecting and regulating the speed, regulating or limiting the torque, and protect against overloads and faults. Small motors may have built-in overload devices to automate open circuit on overload. Larger motors have a protective overload relay or temperature sensing relay including in the controller and fuses or circuit breaker for over current protection. A motor controller is connected to a power source such as a battery(dc) or power supply, and control circuitry in the form of analog or digital input signals. Switchgears are important electronic components that perform a wide range of functions. They distribute the power, provide protection and monitor, control and regulate, make connections for communication processes . Switchgear is also used to enhance system availability by allowing more than one source to feed a load. Switchgear incorporates switches, circuit breakers, disconnects and fuses used to route the power and in the case of a fault, isolate parts of an electric circuit. The switchgear unit of the motor starter has three functions for protecting the motor. The first function is switching of the motor during operation, and is performed by dedicated standard unit, usually a called contactor. The contactor is designed to repeatedly switch high currents on-off, during the operation. Furthermore, in a switchgear unit, the functions of short circuit protection and the overload protection are integrated in one standard unit referred to power breaker. The power breaker seperates the load from the power supply system when a short circuit happens and also when the currents are too high. The two standard units are arranged next to one another on a common carrier and form the switchgear unit. The project deals with replacing the contactor used for switching by a wireless electronic circuit called the motor control unit.

II. GSM TECHNOLOGY

GSM (Global Sysyem for Mobile) is a digital mobile telephone system that is widely used all over. GSM uses the variation of Time Division Multiple Access (TDMA). GSM digitizes and compresses the data, then sends it to the channel with two other stream of user data each in the own time slot. It operates at either 900MHz or 1800MHz frequency Band.

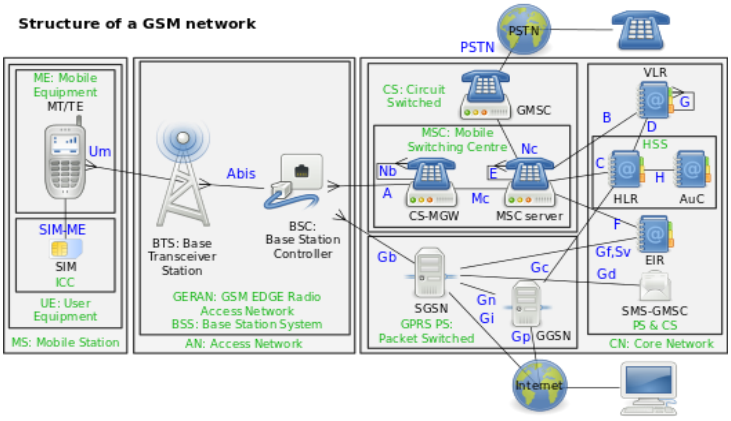


Fig.1: Structure og GSM network

The two parts of the mobile state allow a distinct difference between the actual equipment and the subscriber who will be using it. The IMSI identifies the subscriber within the GSM network while the MS ISDN is the actual telephone number a caller (possibly in another network) uses to reach that person.

III. WIFI TECHNOLOGY

Wi-Fi (/ WiFi) is a local area wireless technology that allows electronic devices to participate in computer network using 2.4 GHz UHF and 5 GHz SHF ISM radio bands.

Fig.2: Structure of Wifi network

The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network" (WLAN) product based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". However, the term "Wi-Fi" is used in general English as "WLAN" since most modern WLANs are based on the same standards. "Wi-Fi" is a trademark of the Wi-Fi Alliance. Many devices can use Wi-Fi, e.g. personal computers, video-game consoles, smart-phones, tablet computers and digital audio players. As the global market trend is growing with the need of fast data transfer and fast real time responses, it is significant to evaluate and develop Wi-Fi with most optimization and which can sustain a good life span grow day by day, it is significant to evaluate Wi-Fi for controlling of appliances specially in industrial domain along with other protocols of Wi-Fi.The speed and Wi-Fi network difference factors like freq, bandwidth. Generally Wi-Fi is designed for the medium ranges data transfers i.e. 100 to 300 feet in indoor.

IV. APPLICATION WORKING/METHOD USED

Generally switchgears are designed to operate the switch manually. However in order to achieve automated operation locally or through remote, motorised mechanism is implemented.

One of the methods to implement motorised mechanism of three position switch is by using motor control unit.

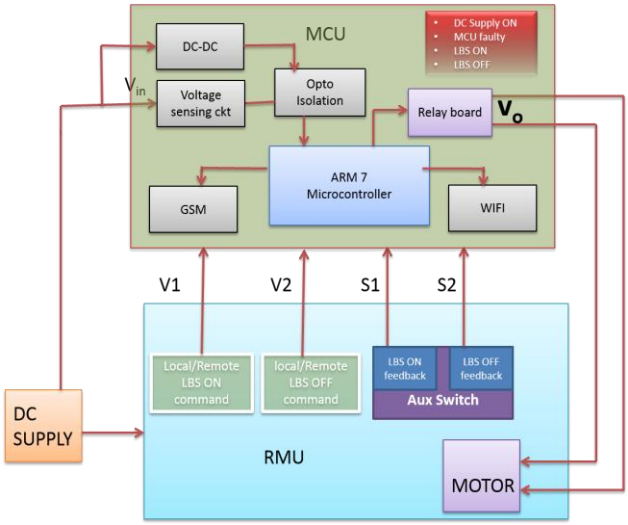


Fig.3: Block diagram of the entire unit

Where V1 and V2 are the load break switch on and off commands respectively, S1 and S2 are the feedback commands from the auxillary switch in the ring main unit of the power distribution panel in the industry. The motorised mechanism depends on the inputs v1 ,v2,s1,s2 and power. These signals are given to the gsm module and the wifi module on the motor control unit. And the energy required by both is calculated and compared.

GSM: GSM measurements quantify the: 1) Ramp energy: energy required to switch to the high-power state, 2) Transmission energy, and 3) Tail energy: energy spent in high-power state after the completion of the transfer. We conduct measurements for data transfers of different sizes (1 to 1000 KB) with varying intervals (1 to 20 seconds) between successive transfers.

WiFi : WiFi measurements quantify the energy : 1) to scan and associate to an access point and 2) to transfer data.

V. GRAPHS AND SIMULATION

The performance of motor with respect to current, voltage, power,torque, efficiency and power transfer characteristics are as follows

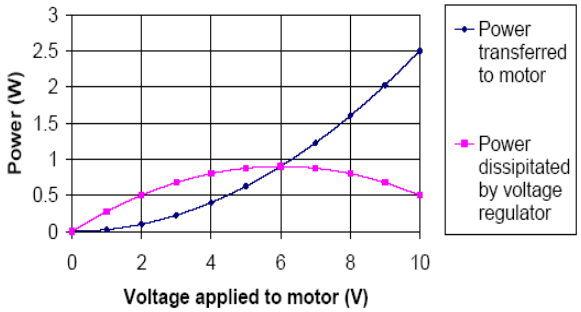


Fig 4 : Power transfer characteristics of voltage contolled motor controller.

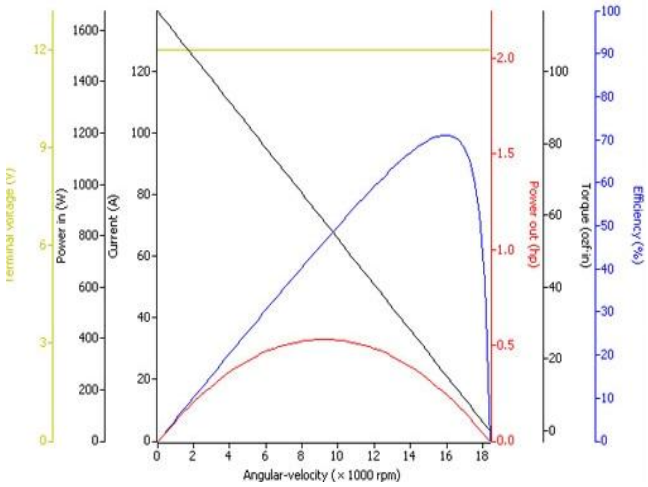
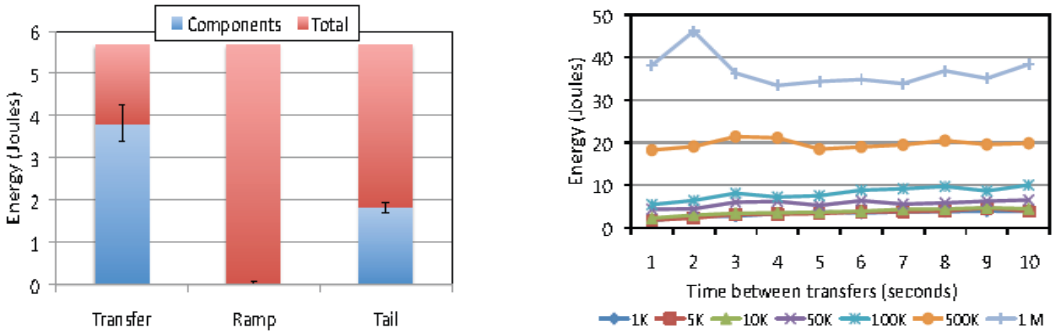


Fig 5:Motor performance graph –voltage ,power, current Torque efficiency.

GSM Measurements:

Figure 6(a) shows the average energy consumption in GSM networks as a proportionate of the Tail energy, Ramp energy and transfer energy for a 50 K download. The Ramp energy in GSM is less compared to the Tail energy and the transfer energy. I observed that the tail time is 6 seconds and GSM incorperates a small maintenance energy between 2-3 J/minute (not shown). Due to the small tail time in GSM, data sizes dominates energy consumption rather than the inter-transfer times.

Figure 6(b) shows the avg. energy consumed when varying the time between successive transfers in GSM networks. The average energy does not vary with increase in inter-transfer intervals. For example, for data transfers of size 100 KB, the average energy consumption is between 19 to 21 Joules even as the time between successive transfers varies accordingly.



(a) GSM: Energy components (b) GSM: Varying inter-transfer times

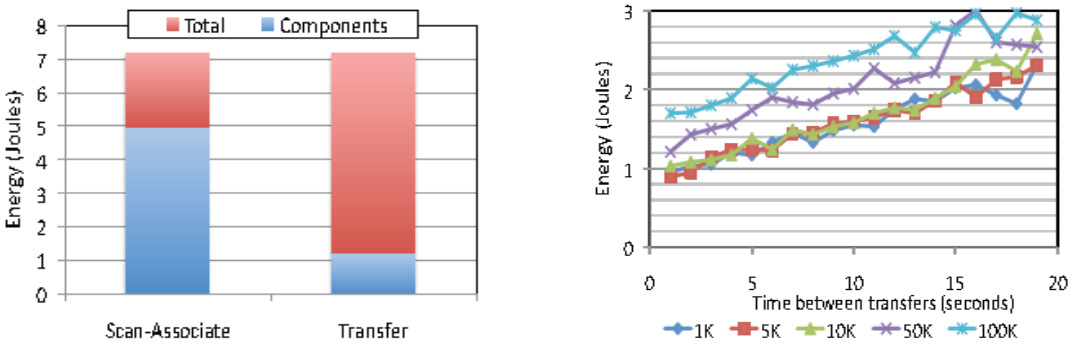
Figure 5: GSM Measurements: (a) Avg. ramp, transfer and tail energy consumed to download 50K data. The lower portion of the stacked column show the proportion of energy spent on each activity compared to the total energy .. (b) Avg energy consumed for downloading data of different sizes against the inter transfer time.

WiFi Measurements:

Figure7 (a) shows the avg. energy consumption in WiFi composed of scan, association and transfer, for a 50 K download. I observed that the scan and association energy is nearly five times more the transfer energy.

Figure7 (b) shows that the energy consumption of WiFi will increase with the time between successive transfers. The energy consumption does not plateau after threshold inter-transfer time The reason for this increase is the high maintenance energy in WiFi. When measured the maintenance overhead (not shown) for keeping the WiFi interface on to be 3-3.5 Joules per minute.

WiFi is more energy efficient than GSM networks once it is connected to an access point (AP).



(a) WiFi: Energy components (b) WiFi: Varying inter-transfer times

Figure 6: WiFi Measurements: (a) Avg scan/associate and transfer energy consumed to download 50 K data. The lower portion of the stacked columns show the proportion of energy spent on each activity compared to the total energy. (b) Avg energy consumed for downloading data of different sizes against the inter transfer time

VI. CONCLUSIONS

The paper was focused on the study of wireless motor control using GSM and Wifi to be used in industrial areas for wireless transmission of the data for the maintenance and servicing of the power distribution panels by reliable data updates with the help of spectrums and its comparison with the simulated model. The paper also proves that Gsm and wifi hence can be used specifically for replacing the wired cable transmission with wireless approach. Gsm and wifi technology helps to eliminate wired links thereby avoiding chaos in substations and helps in establishing wireless links for data transmission. All these features make the technology, market attractive and future proof which makes it inevitable for any vendor to implement the technology in its protection devices. The GSM and Wi-Fi communication between 2 devices was successfully established and both the devices were able to respond each other to the messages via its respectable wireless Links.

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