

Design and Control of AMF Panel using WI-FI and Gateway Controller

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Abstract – This paper focuses on the development of a Smart Auto Mains Failure (AMF) Panel meant for day to day electrical application. AMF Panel is unavoidable in Industries, Hospitals, Educational industries etc where Generator is Compulsory. It acts as a switching mechanism between the generator, load and the main power supply. It ensures consistent power supply to the load. AMF panel helps in detecting power failures, Overload condition in supply mains and to start generator set automatically hence saving of time and energy is possible. An AMF panel, using microcontroller based M2M GATEWAY controller which can be controlled from distance using WI-FI is presented here. The proposed system displays parameters such as Voltage, Current, Power Factor, Active Power etc on AMF panel as well as on Android mobile phone using MYMQTT App.

Keywords – AMF Panel, DG Set, M2M GATEWAY Controller, WI-FI, MYMQTT App.

I. INTRODUCTION

Electricity is required for domestic, industrial and commercial purposes. Thus, Electricity is very important. Failure in electricity supply or interruption in the supply has many adverse effects on control systems and electric equipment [4]. In the present world, uninterrupted power supply is inevitable. The building of additional connections to main supply unit in order to provide necessary power in case of power failures can be expensive. In such cases, electrical power generated by using Diesel Generator sets can be used [5]. When there is a fault on supply mains and there is a power failure, the DG set has to be turned on and when the power supply comes back to normal condition the DG set has to be disconnected. However frequent switching on and switching off the DG set produces discomfort and delay. Hence AMF panel are used to encounter such situation. An Auto Main Failure panel is necessary in areas where a generator is present like industries, hospitals, educational institutions etc. An AMF panel is fully automatic in nature. It ensures that there is a consistent and uninterrupted power supply to the load and also acts as a switching mechanism between the generator load and the mains power supply. When the supply is available Auto Main Failure panel connects load to the supply mains whereas when the mains supply is unavailable the AMF panel transfers the load to the Diesel Generator set [5]. Initially, AMF panel had a start/ stop switch only [5]. With the technological advancement present day AMF panel displays various electrical parameters on AMF panel but no provision of remote control of AMF panel.

These aspects of AMF panel increase the research interest in modification of existing system. The proposed system displays electrical parameters such as Voltage, Current, Power, Power factor, Frequency etc on mobile app with the help of microcontroller based M2M Gateway Controller and cloud. Detailed block diagram and circuit diagram of Smart AMF panel is presented here. Along with this comparative study of proposed system with existing system is made in order to strike out disadvantage of existing AMF panel with Smart AMF panel. Section-II deals with comparison of proposed and existing system. Section III deals with design consideration of proposed methodology. Section IV presents block diagram, methodology and algorithm used for proposed system. Section V presents Result of the proposed method and Section VI presents Conclusion and Future Scope.

II. COMPARISON OF PROPOSED AND EXISTING SYSTEM

1. Using relays and timers:

In our existing system we use a concept of implementing relays and timers for the design of an AMF panel to execute switchover. This enables automatic switching from mains power supply to a diesel generator set. Here voltage sensor, overload relay, and air circuit breakers are used. The system is continuously monitoring the voltage level from the mains. If the voltage is dropped below the allowed level, this system will switch the load to generator (Auxiliary supply) and switches back to the main supply when the voltage is back to nominal required normal level [4]. Delay is provided in the system to avoid

the transient condition falls in which the system will not have to switch.

2. Using Programmable Logic Controller:

A PLC or Programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability. In this system a PLC design is implemented for the AMF system to do its service in a highly structured and user friendly manner. Upon mains power interruption AMF panel sends command to the PLC to start the diesel generator set and the supply is maintained. PLC monitors and controls three-phase machines.

To avoid severe problems due to interruption of power supply PLC is implemented to help the user monitor the three-phase machine remotely. However in the proposed system we use 1) Voltage Monitoring Relay for protection against over voltage, under voltage, and unbalanced supply 2) Load Manager for displaying various electrical parameters and for storing the data in register 3) We also use a M2M gateway controller for data acquisition. When mains supply gets interrupted the AMF panel switches over to the diesel generator set and supply is maintained. When mains supply is restored, the main contactor will get energized and load is again connected to the main supply. Data stored in the holding register of the Load Manager is accessed by M2M gateway controller through an Rs485 port and this data is sent to the cloud. Data on the cloud is accessed by an app named MYMQTT.

III. DESIGN CONSIDERATION OF PROPOSED SYSTEM

Items	Specifications
Load manager	EM6400NG
Current Transformer	20/5
MCB	10A
Power Contractor	9A 240V AC
On Delay Timer	0.3S - 30M
Glass fuse	2A

1. Load Manager

Load monitor is electronics measuring unit that performs the multiple measurement functions and offer load management facilities in a compact and rugged package device. Load manager can measure the voltage, current, frequency, real power, reactive power, apparent power, and power factor.

2. Current Transformer

The Current Transformer is a type of “instrument transformer” that is designed to reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current and also for safety purpose.

3. MCB

A miniature circuit breaker (MCB) automatically switches off electrical circuit during an abnormal condition of the network means in overload condition as well as faulty condition.

4. Power Contactor

A contactor is an electrically-controlled switch used for switching an electrical power circuit.

5. On Delay Timer

Timers are used to control the circuit for certain amount of time. Using timers, we can delay the circuit operation. on delay timer does not give the contact changeover until the preset time reached.

6. Glass Fuse

A glass fuse works by breaking the circuit when rated current passes through it. When the current passing through the fuse exceeds the rated current, the thin wire melts and breaks the circuit.

Software Used

- **M2M Gateway Controller**

Machine to machine communication, or M2M, is two machines “communicating”, or exchanging data, without human interfacing or interaction. M2M gateway controller reduces the complexity of IOT project with combination of robust and reliable remote connectivity, simple and rapid application development, and scalable cloud service. It comes with RS-485 serial ports and remote access to the Internet of things, allowing to support a wide variety of devices for monitoring and control purposes. M2M gateway is a GPRS/Wi-Fi based controller.

- **MQTT Broker**

MQTT is a simple messaging protocol, designed for constrained devices with low bandwidth which allow to send commands to control outputs, read and publish data from sensor nodes and much more. the broker is primarily responsible for receiving all messages, filtering the messages, decide who is interested in them and then publishing the message to all subscribed clients.

- **My MQTT Application**

MyMQTT is a simple Message Queue Telemetry Transport (MQTT) client for android. By Entering the IP address of the MQTT Broker the client will be able keep an eye on parameters anytime which gets updated after every 10 seconds

IV. DESCRIPTION OF DESIGN UNDER CONSIDERATION

The complete Block Diagram of proposed system is shown in figure. It consists of the main components which gives an overview of working of AMF Panel.

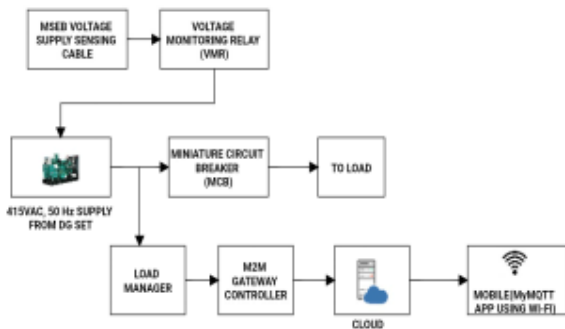


Fig.1. Block diagram.

The input 1-phase supply coming from MSEB is sensed which is given to VMR Voltage Monitoring Relay (VMRD2VC21). VMR gives protection against Overvoltage, Undervoltage, Single phasing and Unbalanced Supply. The Current Transformer CT is connected to reduce the current level and then given to Load manager (EM6400NG). Load manager measures various parameters of system such as Voltage, Current, Power and stores data in Register. AMF Panel consists of contactors, one contactor will supply 1-phase main supply to load and other contactor will supply standby DG supply to load. If there is no fault then the system works on Main incoming 1-phase supply. Whenever MSEB supply fails to supply the load, at such condition DG will start. DG will take some starting time to run its rated speed hence On Delay Timer is incorporated. After set time delay AMF Panel does changeover from main supply to DG via contactor and load is connected to DG. When main supply is re-established then main contactor energize and load is again connected to main supply.

Load Manager which gives information about several electrical parameters has provision of RS485 communication. Modbus which is open source protocol is used for communication between Load Manager and RS485. The information stored in holding register of load manager is send to M2M GATEWAY Controller which is WI-FI/GPRS based controller. In proposed system WI-FI feature is used. The controller transmits this data to HIVEMQ Cloud. The HIVEMQ enterprise MQTT Broker provides fast and efficient data. The data stored in cloud is send to different clients using WI-FI. Thus, clients can get various parameters such as Voltage, Current and Power etc in MYMQTT App in Android phone.

Figure 2 shown below is used to illustrate algorithm used for data extraction from load manager to mobile app. The flow is decomposed into following main steps:

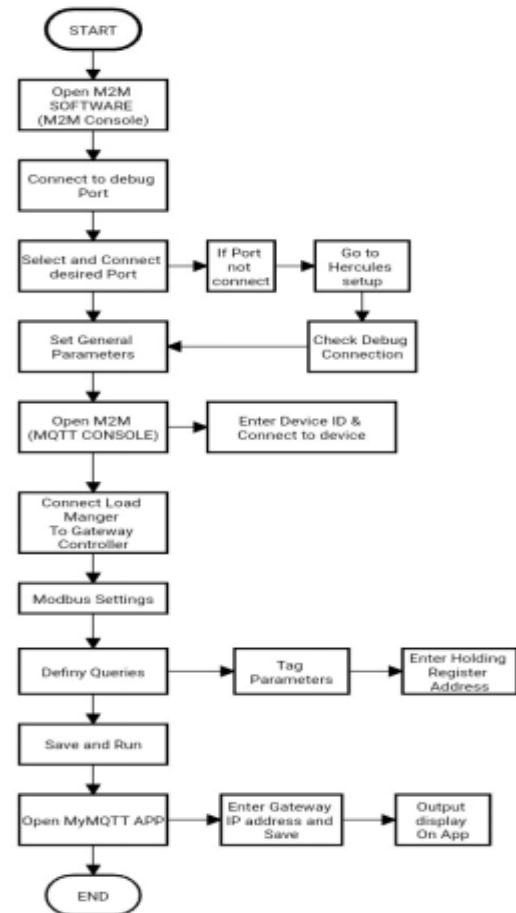


Fig.2. Algorithm.

Step 1: M2M software set up

The M2M Gateway controller come with RS-485 serial ports and 10/100 Mbps Ethernet LAN ports to provide users with a versatile communication platform. For software setting console cable should be connected to debug ports RX, TX and GRD and select appropriate port. Hercules setup is used to check proper configuration of debug connection. General parameter setting, server connection and Wi-Fi setting, RS-485 setting, firmware should be configured properly.

Step2: Configuration of load manager with M2M gateway Load manager has to be configured by assigning unique slave ID. The other parameters such as baud rate, parity, start bit, stop bit, should also be set. This can be done manually via interface of the meter using navigation button. M2M gateway controller has provision of RS-485 port which should connect to RS-485 port of load manager.

Step3: Modbus setting

According to client requirement various electrical parameters are tag with corresponding holding register

address to access data from load manager through RS-485 open source protocol. It should be ensured that register address should be configured properly.

Step 4: Data extraction from cloud to MYMQTT app
 For access all the information stored in HIVEMQ cloud, enter M2M gateway controller IP address and password in MYMQTT dashboard. Thus, clients can access data continuously according to time interval set.

V. DESIGN CONSIDERATION OF PROPOSED SYSTEM

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Load manager	EM6400NG
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VI. RESULT AND DISCUSSION

The results from no load are shown below. The parameters will vary according to the load connected.

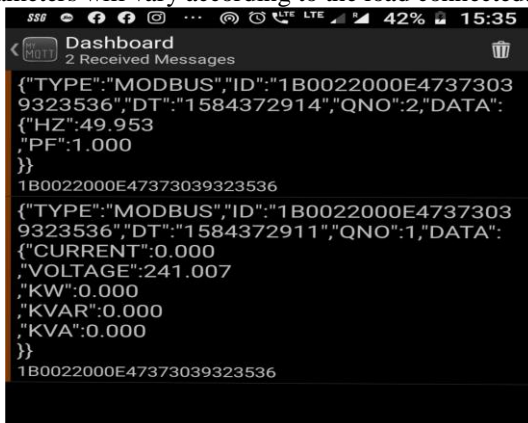


Fig.3.Result 1.

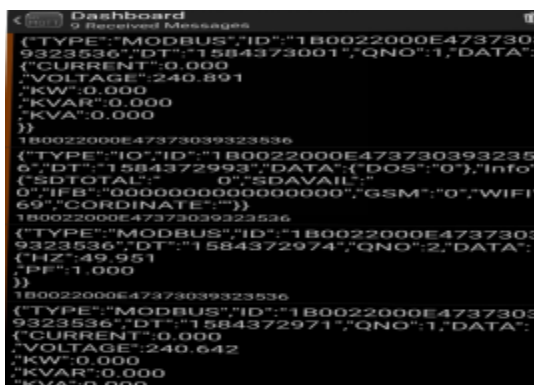


Fig.4. Result 2.

As shown in above figure the following parameters of AMF Panel are display on MYMQTT App.

Name of Parameter	Reading	Register address
Current(A)	0.000	2999
Voltage(V)	241.007	3027
Active Power (KW)	0.000	3053
Reactive Power (KVAR)	0.000	3061
Apparent Power (KVA)	0.000	3069
Frequency (HZ)	49.953	3109
Power factor	1.000	3191

Clients can access all this parameter from distance using MYMQTT App on mobile phone. These parameters are displayed on mobile according to time set in M2M software. Clients can access this parameter up to 5 km.

VII. CONCLUSION AND FUTURE SCOPE

A detailed study about the drawbacks of present-day AMF Panel is carried out and a new idea for an advanced AMF Panel is put forward. AMF Panel has been designed to reduce the stress and loss of time associated with Starting and shutting down of DG Set. It is capable of fault identification in the supply mains, conserving energy and can be controlled from a distance. The proposed idea can be modeled as hardware to carry out the demonstration. The proposed system solves the disadvantages of the present system and moreover it is an innovative concept in the field of energy conservation. The proposed project displays various parameters such as Voltage, Current, Power Factor, Frequency, Active Power etc. on Android Phone. Hence the proposed idea gives provision to clients to access various Electrical Parameters of AMF Panel from a distance.

Existing AMF panel automatically transfers the switch from mains to auxiliary during overvoltage, under voltage or blackout. However, in proposed system along with this system parameters can be seen from distance as Wi-Fi is incorporated. A gateway named M2M does the data transfer via cloud hence parameters can be seen on mobile application in fraction of seconds by different clients with unique ids. However, the development of this project surely prompts many new areas of investigation. 1. Control of the DG set remotely can be the further advancement of AMF panel. 2. It can be made to have push notifications of warnings from mobile application so as to help client to take necessary action as early as possible. 3. App can be updated to indicate Type of fault and fuel level. 4. Range of sight of data transfer can be increased, thus in future there are so many modifications, which we can make to survive the global competition.

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