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***Review Paper***

# Innovative monitoring and analysis of oxygen concentration for boiler safety using advanced instrumentation

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## Abstract

*The Advanced Instrumentation Technique is designed to measure high limits of oxygen in a combustion processes. In this project tried to prepare observation of oxygen in furnace and boiler system or for the limitation of oxygen in furnace. Due to increasing of pressure in furnace along the failure of valves, dampers, interlocking etc. emergency situation arises and reduction of oxygen pressure. A small implementation to monitor this all system through wireless monitoring advanced technologies and provide safety to all boiler and furnace system through operation of induced draft fan and forced draft fan. By measuring various gases through different type of gas sensors and their percentage we provide safety to furnace and Boiler system.*

**Keywords:** GSM, SMS, Automation, Telemetry, Temperature, Zr-$O_2$ Analyzer, MFSMM, ZOD, ZOA.

## Introduction

Now in advanced technology we adopting new idea and thinking to proposed safety of an environment, society and humanity in this approach I just improving research field in field of advancement of industrial automation by using some various embedded technology including global system of mobile communication for controlling of plant operation added with zirconium oxygen analyzer that are and combustion processes observation of oxygen in furnace and boiler system in control functionality in whole process applications, also develop a hardware technology which is sense the condition of temperature in the furnace and generate a high alert signal which is transmitted to authorized mobile no. which is remotely placed[1]. After receiving that high alert signal operator simply sending a control message to stop or start the force draft fan (dc motor). Another application of wireless GSM based system is to sense the concentration combustion processes observation of oxygen in furnace and boiler system whenever it reaches to peak value it stop the force draft fan. If the authorized remote user required the status of oxygen analyzer simply he make a miss call and then designed circuit sense that signal and send a status of oxygen analyzer concentration of furnace and force draft fan status[2]. Then the operator monitoring status of field remotely and decided which step performing next. This paper describes the hardware and keil software for programming used in this project. The main aim of project is to design a program which is remotely monitors the oxygen analyzer concentration of oxygen in furnace and temperature of furnace and command the force draft fan (dc motor fan) from remote places by using GSM based wireless technology. The features which added[3]: i. Flexibility/modularity limitation by microcontroller circuitry, ii. Global coverage through GSM Technology, iii. Cost effective.

By using subscriber unit of application report describes the implement of controlling devices using simple and cheaper method through wireless technology. It is very beneficial for all automated/self operated industries to protection of environment and humanities when we monitor all parameter through a distance or remotely operated parameters we have developed combined wireless multivariable control and signal manipulation system for monitoring and flexible for field operated equipments parameters such as temperature, zirconium oxide oxygen analyzers[4]. For this we are using present mobile PSTN and BTS station for transmitting and receiving signals and enables along with multivariable control and signal manipulation system.

In this paper we propose multivariable field signal monitoring and manipulation system (MFSMM) of oxygen percentage in furnace by using the combination of a $O_2$ analyzer microcontroller circuit and a Global Service of mobile communication connected through serial port, and all the process shown in a hardware system and output analysis and control through user mobile.

**Circuit Diagram and Description:** Input and output modules functionality in some time: i. Monitoring process, ii. Physical parameter reading or secure and safe operation, iii. Control output over various aspects of a process. By using ARM Microcontroller various control and sensory devices are connected all information shares with GSM technology[5].

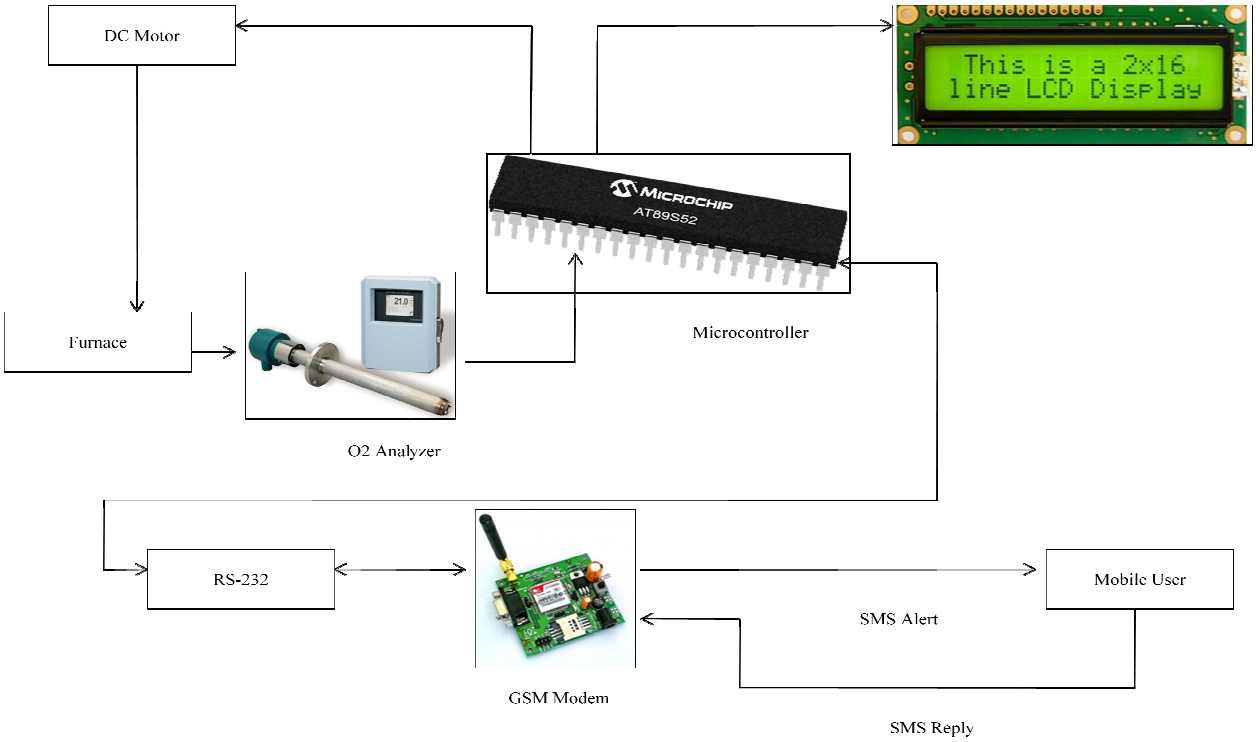


**Figure-1:** System Physical Interface Design.

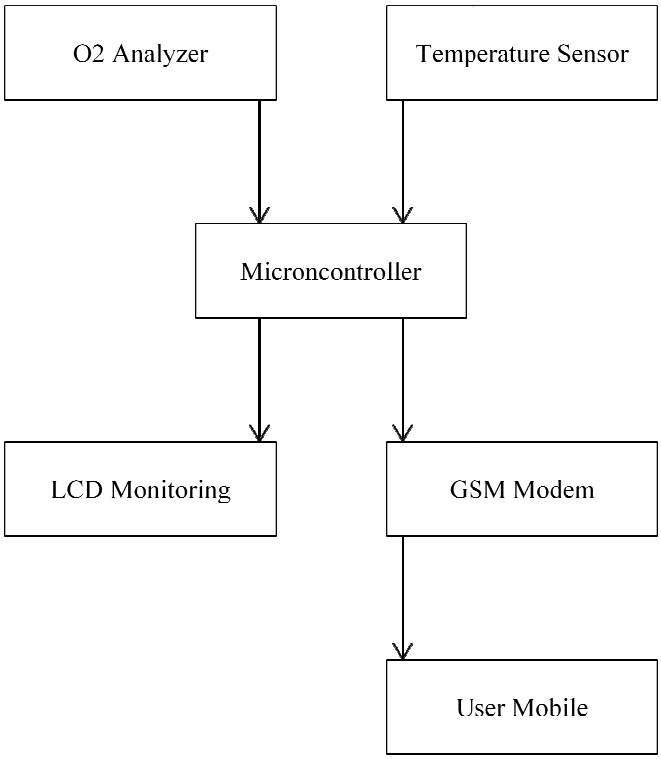


**Figure-2:** Flow Chart of Input Monitoring System.

O2 Analyzer and Temperature sensor send information to arm microcontroller then information flows to User mobile through GSM modem and display devices. Modem will issue a command by SMS technique. User will responds to control devices through Modem and control final control elements.

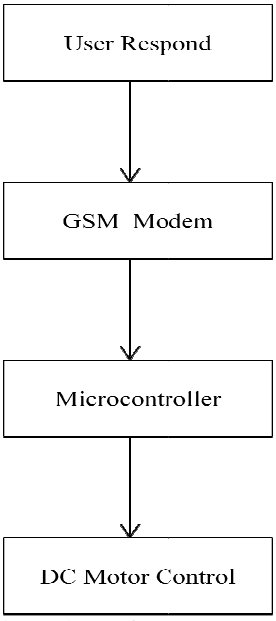


**Figure-3:** Flow Chart of Output Control Process.

## $O_2$ Analyzer

The zirconium based oxygen monitoring device has been designed to measure higher values oxygen in combustion processes. It is a kind of device for monitoring oxygen

parameter in combustion gas for boiler and furnace and control excess oxygen.
Zirconia $O_2$ equipment converter combined with microcontroller based device incorporate with latest technology. When added output with Zr-O2 detector, the user receives an exact and perfect value of oxygen quantity measurement needed for control and monitoring capabilities.

**Fundamental of $O_2$ Analyzer: Requirement of O2 analysis:** The fuel and air ratio is requiring maintaining for safe, efficient, combustion process for protection and safety of all consideration. All physical parameters are changing time to time for that it is needed to require analysis of oxygen.

**Boiler/Furnace Protection:** As per working in plant operation in boiler malfunction perform as time to time by which a explosive situation of furnace. The situation will arises input flow will block nozzle failure and effected to loss of ID and FD Fan motor burnt such dangerous explosion will perform in furnace system. This situation will be preventing by using such Oxygen monitoring and controlling equipment[5].

**Energy and Fuel Saving:** In fuel saving system we are using a burner system in linear scale of equipment where we are using maximum fuel. If air crosses their limits then optimization will occur. If ignition started below region, fuel is lost and converted in the form of CO and other small amount of oxidized HC. If air ratio is high in furnace or boiler then amount of ash stack is increases. So that oxygen analysis device is prevent such condition and balancing fuel and air ratio through controllable parameter[5].

## Zr-$O_2$ Cell

Inside of boiler oxygen content is sensed by a zirconium oxide, fuel cell type sensor. Flow of electron in that device is directly proportional to pressure difference of oxygen in air and fuel pressure.

**Reduction of Nitrogen oxide:** Oxides are formed during the combustion process. During excess air oxides of nitrogen generated in the form of solid the oxide of nitrogen can be limits by using lower concentration of air along with burner, generation of nitrogen oxide are causing industry to seek the most economical method to reduce this pollutant. Various processes are used today; combustion methods are used for nitrogen oxide reduction. The method selected is depends upon waste heat recovery systems presently used. Controlling of over limited air to minimize the generation of nitrogen oxide.

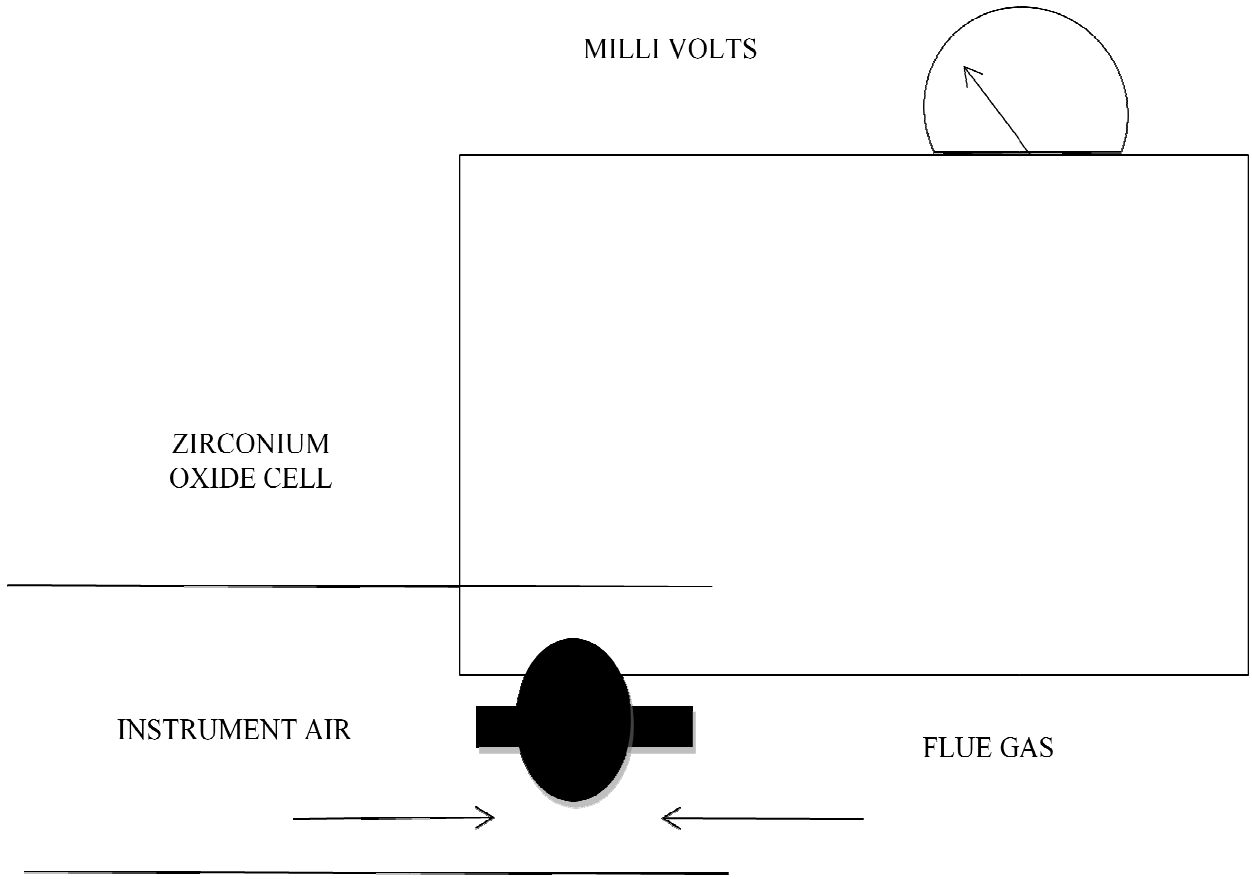


**Figure-4:** Zirconium Oxide Cell.

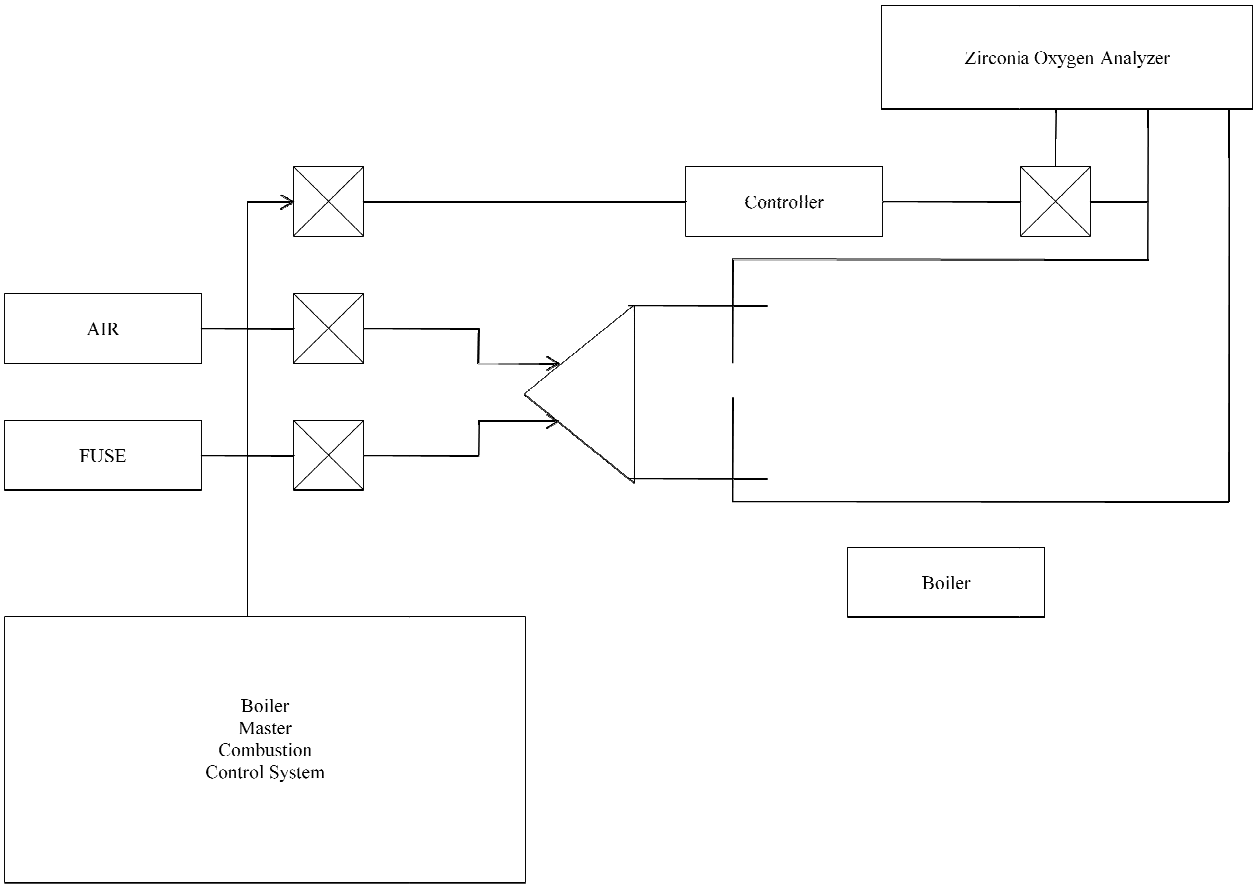


**Figure-5:** Combustion Trim Control Block.

## Application Areas

By using this system we implement all small scale/Large scale industries for safety ,security and reliable operation through this system all boiler and furnace system will protect additional pressure inside by microcontroller sensory system industries will control internal pressure through control of ID, CA and FD Fans.

Implementation of this system increase production through monitoring of such parameters such as temperature and pressure of furnace/ boiler unit or the quantity of oxygen in furnace. Specialized zirconia element used to pick up the available of oxygen in furnace. The sensors will then continuously update the field information to controller element and controller will send warning message to subscriber unit through GSM modem and again a control signal will generated by controller through message alert and control relay system all final control element.

## System Appraisals

Problem arises by using GSM control station to interfaces a very complicated network and traffic issues to user interface and plant process. By MFSMM multivariable field signal monitoring and manipulation system and forward command back to system.

Due to very less time message will be received through. As per schedule and time delay all sensor, controller and ID/FD fan data will be transferred and[6]. By RS232/485 Communication Bridge will develop between circuits. In very less duration message will be transferred various strong network will be require to operate all this operation.

Data will be transferred to a long distance without loss of original signal is a great challenge for process technology. Network load and traffic control will create a rush for transferring data will effect smooth functioning of plant operation.

## Cell Voltage

**Cell voltage is defined by following equation**

$$E = -50.74 \log \frac{P_X}{P_A} \text{ [mV]}$$

Where, $P_X$: $O_2$ concentration in the measurement gas, $P_A$: $O_2$ concentration in the comparison gas (21 volt % $O_2$).

Oxygen concentration values obtain along with changes in percentage of $O_2$ (cell temperature 820.34º C).

## Self operation Performance

To update user for unwanted or alert information, the MFSMM is also capable while one of the roles of the MFSMM system is of automation process. Using known program sequence, the MFSMM work as program is defined.

**Table- l:** Values of Oxygen Concentration.

| Sr. No. | Percentage of $O_2$ | Voltage obtained (mV) |
|---|---|---|
| 1 | 0.5 | +22.83 |
| 2 | 1.0 | +18.42 |
| 3 | 5 | +7.65 |
| 4 | 10 | +12.44 |
| 5 | 50 | -16.31 |
| 6 | 100 | -44.69 |

## Conclusion

This paper addresses problems in outmost interest for power plants and blast furnaces of steel plants for remote measurement and controlling of oxygen percentage in combustion process. Through wireless whole process is monitored. Data logging system is based on real time data acquition and provide alert signal to flagged to the relevant personnel and allow corrective action to be taken to final end production for great and efficient quality.

By using above circuit setup oxygen values are collected and monitored in remote location With the proposed we measure percent of oxygen and their voltages by using demonstrated hardware setup of wireless MFSMM system and controlling the various applications from remote placed location For further it can be implemented in biomedical instrumentation field analytical instrumentation and other fields.

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