An Innovation Method for Industrial Data Acquisition and Monitoring System Using Arduino and Cloud Service

Abi Aravinth S, Prawin Kumar.L.A[1], Raja.S[2],
[1]*Final Year ECE Students, Sri Shakthi Institute of Engg and Tech, Coimbatore.*
[2] *Assistant Professor, Dept. of ECE, Sri Shakthi Institute of Engg and Tech, Coimbatore*
(E-mail: raja.s@siet.ac.in)

Abstract— Internet of Things (IoT) is expected to play a major role in our lives through pervasive systems of sensor networks encompassing our environment. These systems are designed to monitor vital physical phenomena generating data which can be transmitted and saved at cloud from where this information can be accessed through applications and further actions can be taken. This paper presents the implementation and results of an environmental monitoring system which employs sensors for temperature and humidity of the surrounding area. This data can be used to trigger short term actions such as remotely controlling heating or cooling devices or long term statistics. The sensed data is uploaded to cloud storage and an Android application accesses the cloud and presents the results to the end users. The system employs Arduino UNO board, DHT11 sensor, ESP8266 Wi-Fi module, which transmits data to open IoT API service Thing Speak where it is analyzed and stored. An Android application is developed which accesses the cloud and displays results for end users via REST API Web service. The experimental results show the usefulness of the system.

Keywords— *Internet of Things; formatting; environmental monitoring system; Android application; Arduino; sensor.*

I. INTRODUCTION

In previous year, Industry was monitored manually, but this paper introduces Artificial Intelligent to monitor as well as control the Industry autonomously without human intervention. Now a day by using RFID readers, people can identify, track, and monitor any objects attached with RFID tags automatically. Another technology is the wireless sensor networks (WSNs), which mainly use interconnected intelligent sensors to sense and monitoring. Its applications include environmental monitoring, industrial monitoring, traffic monitoring. Both RFID and WSN are used to develop IoT (internet of things). RFID technology, which allows microchips to transmit the identification information to a reader through wireless communication.

The main control unit consist of Arduino it will receive the output signal of sensor, process it and according to that it will send the message and long ring notification to particular municipal worker in that area through GSM.

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. 98 percent of all microprocessors are manufactured as components of embedded systems. Examples of properties of typically embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with. However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functions, well beyond those available. For example, intelligent techniques can be designed to manage power consumption of embedded systems.

Modern embedded systems are often based on microcontrollers (i.e. CPUs with integrated memory or peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more-complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in certain class of computations or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP). Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, and largely complex systems like hybrid vehicles, MRI, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

II. EXISTING SYSTEM

Gas turbines become a work horse throughout the world for various industrial applications. Their reliability, operating efficiency and cost can be optimized with predictive maintenance. Proper calibration of the turbine's control system is critical to its safe operation, reliability, and minimization of operational costs. A faulty control system can quickly destroy expensive components of the gas turbine during just one improper startup cycle. In the early 1980's, as the personal computer (Pc) became available, PC based data acquisition systems migrated out of the laboratory and in to industry. The cost of installing a data acquisition system on a gas turbine control system was high. Its development was begun as a hobby, something which was fun as well as useful [1]. It eliminates costly and time consuming cable lying for new and retrofitting of existing project. This wireless conduit is an interference free link between remote devices and control room, it is ideal for a noisy industrial environment. The subject of this paper deals with monitoring, controlling, and acquiring data continuously from an industrial process using this wireless conduit. The authors plan to demonstrate the interfacing of an industrial process, transducers, and final control elements to a remotely located Computer controlled data acquisition system [2]. Data Acquisition Systems have an important role in the market today as many leading companies like National Instruments have specialized in the making of such devices. This paper deals with building a low cost system with components easily obtained in the market. It's more like a walk through tutorial of how to construct an advanced system with these components. The DAQ system itself is made up of a central processor unit connected to GUIs, memories, sensors and other I/O devices [3].

In order to monitor industrial parameters such as the temperature, pressure, and humidity more intuitively, a Multi-channel data acquisition system is designed. In the system, AT89S52 is used to control the LCD that displays different parameters with different colors. The system is composed of these components: MCU, data acquisition device, analog signal amplifier, A/D converter, and intelligent color LCD [4]. A sensor interface device is essential for sensor data collection of industrial wireless sensor networks (WSN) in IOT environments. However, the current connect number, sampling rate, and signal types of sensors are generally restricted by the device. Meanwhile, in the Internet of Things (IoT) environment, each sensor connected to the device is required to write complicated and cumbersome data collection program code. In this paper, to solve these problems, a new method is proposed to design a reconfigurable smart sensor interface for industrial WSN in IoT environment, in which complex programmable logic device (CPLD) is adopted as the core controller [5]. a portable IoT (Internet of Things) device developed based on a single-board-computer Raspberry Pi and the extend-sensor board is presented and the positional information system is presented with the data log system based on the portable IoT device and RT-Middleware. First, the potable IoT device developed based on a single board computer and various sensors for data acquisition is explained. Then, Hand loop based database system for the obtained data is presented with RT-Middleware [6]. The Concepts of Internet of Things (IoT) are applied to a number of applications ranging from home automation to industrial IoT, Where connecting physical things, from anywhere through a network. Let them take an active part in the Internet, exchanging information about themselves and their surroundings. This will give immediate access to information about the physical world and the objects in it leading to innovative services and increase in efficiency and productivity [7].

III. PROPOSED SYSTEM

The block diagram of intelligent monitoring system for industry using Arduino and android app in the figure 1 and figure 2. As it requires high speed communication is intended to use Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. A GSM modem must support an “extended AT command set” for sending/receiving SMS messages, as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications. Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. This acts as a controller of our project.

For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA. The ac voltage, typically 220v RMS, is connected to transformer, which steps that ac voltage down to level of the desired dc output. A diode rectifier then provides a full wave rectified voltage that is initially filtered by simple capacitor filter to produce a dc voltage, resulting dc voltage usually has some ripples or ac voltage variation. The Parallax ultrasonic distance sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It is very easy to connect to BASIC Stamp® or Javelin Stamp microcontrollers, requiring only one I/O pin.

The gas sensor is the one type of transducer which produces the voltage signal depends on the gas level. Then the voltage signal is given to inverting input terminal of the comparator. The comparator is constructed by the operational amplifier LM 741. The serial peripheral interface (SPI) bus is a synchronous serial communication interface specification used for short distance communication, primarily in embedded systems. The interface was developed by Motorola and has become a de facto standard. Typical applications include Secure Digital cards and liquid crystal displays. SPI devices communicate in full duplex mode using a master-slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave devices are supported through selection with individual slave select (SS) lines. Sometimes SPI is called a four-wire serial bus, contrasting with three-, two-, and one-wire serial buses. The SPI may be accurately described as a synchronous serial interface, but it is different from the Synchronous Serial Interface (SSI) protocol, which is also a four-wire synchronous serial communication

protocol, but employs differential signaling and provides only a single simplex communication channel.

A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as pre-set words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

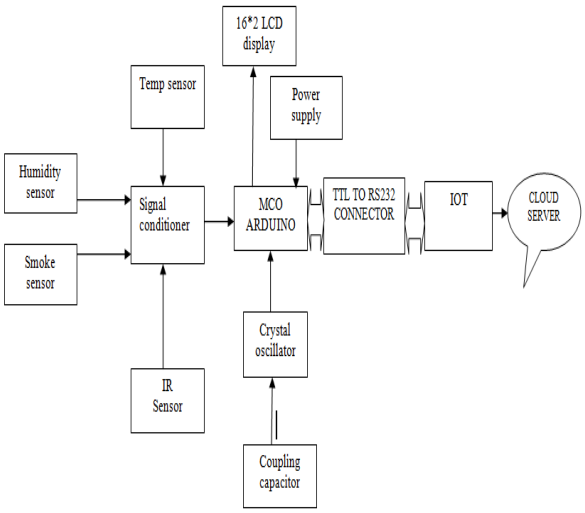

Fig 1: Transmitter block diagram

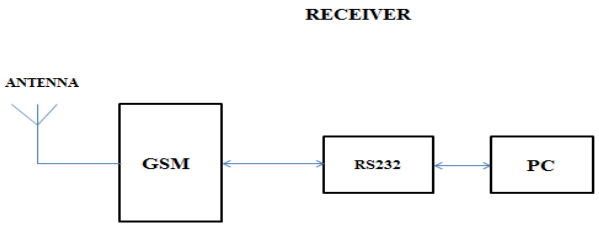

Fig 2: Receiver block diagram

A. Arduino

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

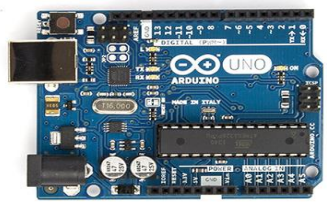

Fig 3 Arduino UNO

B. Ultrasonic Sensors

Fig 4. Ultrasonic distance sensor

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water.

C. GAS Sensors

Fig 4. Gas sensors MQ6

Ideal sensor for use to detect the presence of a dangerous gas, fire leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the gas concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane. The unit will work with a simple drive circuit and offers excellent stability with long life. This circuit is mainly designed to sense the present GAS in the atmosphere. The GAS (Propane) is sensed by the gas sensor. The gas sensor is the one type of transducer which produces the voltage signal

depends on the gas level. Then the voltage signal is given to inverting input terminal of the comparator. The comparator is constructed by the operational amplifier LM 741. The reference voltage is given to non-inverting input terminal.

The DO pin of a Gas sensor is directly connected to A4 (pin-18) of the Arduino board. VCC and GND terminals are connected to VCC & GND terminals of the Arduino board. Gas sensor modules include a MQ3 sensor which senses gas. The MQ3 sensor comprises of a heater that needs a supply heat up and it takes minimum 15 minutes to detect the gas. A comparator is used to convert analog o/p to digital of MQ3. An LCD display is connected to the Arduino board in 4-bit mode, control pins RW, RS and En are connected to pin-2, pin-3 and GND terminals of the Arduino board. And data pins from D0 to D7 are connected to 4,5,6,7 pins on the Arduino board. A buzzer is connected to the pin13 of the Arduino board through a transistor BC547 having a 1K resistor at its base terminal.

D. Some Common Mistakes

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

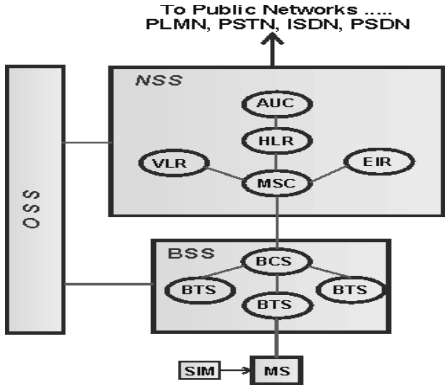

Fig 5: GSM Architecture

The GSM technical specifications define the different elements within the GSM network architecture. It defines the different elements and the ways in which they interact to enable the overall system operation to be maintained. The GSM network architecture is now well established and with the other later cellular systems now established and other new ones being deployed, the basic GSM network architecture has been updated to interface to the network elements required by these systems. Despite the developments of the newer systems, the basic GSM system architecture has been maintained, and the network elements described below perform the same functions as they did when the original GSM system was launched in the early 1990s.GSM network architecture elements.

E. GSM Modem

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

A GSM modem can also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. GSM modem is usually preferable to a GSM mobile phone. The GSM modem has wide range of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging.

Fig 6; GSM modem

F. Power Supply

Available power source is an AC voltage arrives at 230 volt. Since electronics circuits require only minimum voltage and current so there is a need of step down power transformer. It is designed in such way that the input is 230 volt and the output of 18 volt .Another thing is that electronic circuits operate in dc whereas output is ac. So rectifier circuit is used to convert dc to dc, consist of four diodes formed in bridge fashion .This dual polarity, multi voltage power supply can be built for a very small investment. The varying current in the transformers primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the secondary winding. This varying magnetic field at the secondary induces a varying electromotive force or voltage in the secondary winding.

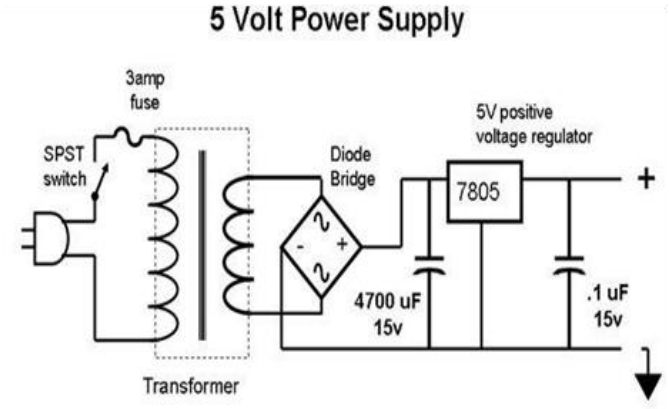

Fig 7; Power supply

A bridge rectifier is an arrangement of four or more diodes in a bridge circuit configuration which provides the same output polarity for either input polarity. It is used for converting an alternating current (AC) input into a direct current (DC) output. A bridge rectifier provides full-wave rectification from a two-wire AC input, therefore resulting in lower weight and cost when compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding. The primary application of bridge rectifiers is to transform an AC supply into DC power. Rectifiers are also used to supply polarized voltage for welding applications. Control of the output current is required in such circuits, and this may be achieved by replacing some of the diodes in a bridge rectifier with thermistors, which are diodes whose voltage output can be regulated by switching on and off with phase fired controllers.

G. LM 35 Temperature sensors

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. Low cost is assured by trimming and calibration at the wafer level. It can be used with single power supplies, or with plus and minus supplies.

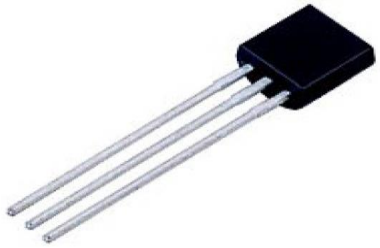

Fig 8; Temperature sensor

The LM 35 IC generates a 10mV variation to its output voltage for every degree Celsius change in temperature. The Output of the temperature sensor is analog in nature so we need an analog to digital converter for converting the analog input to its equivalent binary output. The ADC 0804 is the analog to digital converter IC used in the project. 0804 is a single channel converter which converts the analog input up to a range of 5V to an equivalent 8-bit binary output.

H. Flame Detector

A flame detector is a sensor designed to detect and respond to the presence of aflame or fire. These types of sensors are used for short range fire detection and can be used to monitor projects or as a safety precaution to cut devices off / on. The flame sensor is very sensitive to IR wavelength at 760 nm ~ 1100 nm light. Analog output (A0): Real-time output voltage signal on the thermal resistance.

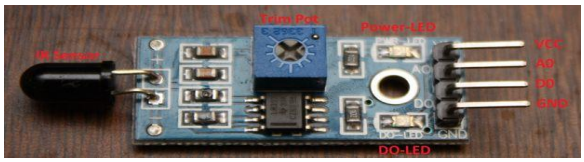

Fig 9. Flame sensor

Digital output (D0): When the temperature reaches a certain threshold, the output high and low signal threshold adjustable via potentiometer.

IV. EXPERIMENTAL RESULTS

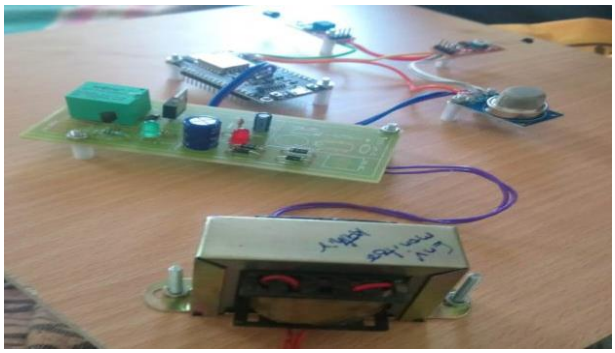

Fig 9; Hardware kit output

Fig 10; Software simulated application

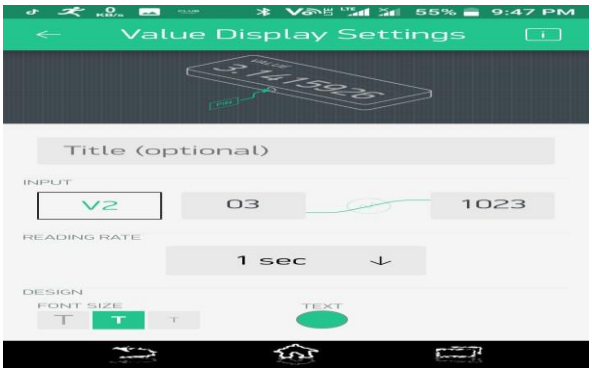

Fig 11; Value of application display 2

Fig 12; Value of application display 1

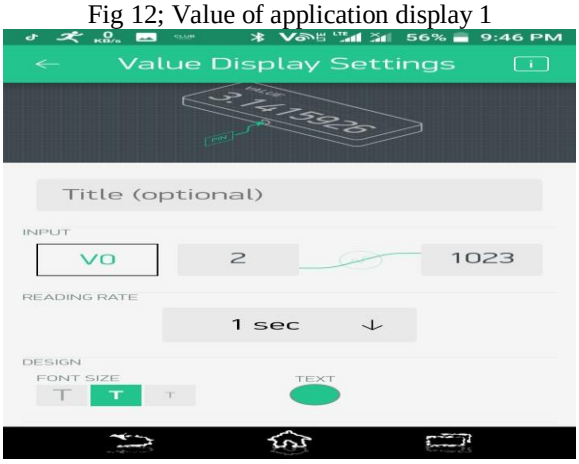

Fig 13; Value of application display 3

V. CONCLUSION AND FUTURE SCOPE

Earlier we can only monitor the situations with the help of cameras. In industries to reduce manual overhead we have implemented Internet of Things (IoT) in Industry to monitor as well as to inform the responsible person to take appropriate measures, but this will partially fulfill our requirement. As sometimes it will be late in this process and it will harm to property as well as life. For this purpose we are developing a system for IOT based industrial data acquisition system with the help of Artificial Intelligence to make system automated which will take intelligent decisions. The Future work of this project is very essential in order to make the design system more advanced. In the designed system the enhancement would be connecting more sensors to internet which measures various other industrial parameters and would be beneficial for industry monitoring i.e. connecting all the objects to internet for quick access. The data is stored in cloud server through internet. The data from the server can be monitor through personal computer or URL.

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