Centralised Status Alert System for Industrial Machines

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Abstract: *Automation has become the vital practice in the maintaining and monitoring the industrial machine. Monitoring is split up with two units such as master unit and slave unit, multiple slave units are controlled by a one master unit. Several parameters has been added in the each slave unit according to the need of the industrial machine design. Where several sensor units were implemented in the slave unit for maintenance purpose. The project focus on monitoring and maintaining industrial machine. One slave unit installed in each machine which monitors the performance and gives the report to the master unit through wireless Transceiver. Slave unit automatically monitors the oil level, temperature and raw materials needed. If any problem occurs the slave unit send the alert to the master unit then it passes the SMS to control department. The slave has the ability to stop the machine if there is any fault. Thus in this project communication between the master unit and the slave unit is done through the NRF24I01 transceiver connected in each unit and GSM in master unit we are using this in our proposed system.*

Index terms – Arduino mega 2560, Ardunio uno r3, SIM900A GSM/GPRS, NRF24L01 transceiver, OLED 64x128, Buzzer, IR sensor, Oil sensor.

1. INTRODUCTION

This project focus on monitoring and maintaining industrial machine. One slave unit installed in each machine which monitors the performance and gives the report to the master unit through wireless Transceiver. Slave unit automatically monitors the oil level, power fluctuation and raw materials needed. If any problem occurs the slave unit send the alert to the master unit then it passes the SMS to control department. The slave has the ability to stop the machine if there is any fault.

1.1 Embedded System:

An embedded system is a computer system designed for specific control functions within a large system, often with real time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts.

1.2 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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 a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes. Stronger RESET circuit. Atmega 16U2 replace the 8U2. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

1.3 GSM SIM 900A

The Sim900 is complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer in the customer applications, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design. This is a GSM/GPRS- compatible Quad-band cell phone, which can be used not only to access the

Fig-1: GSM SIM 900A

Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMS's. Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR92EJ-S processor, which controls phone communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself.

2. PROPOSED SYSTEM

The proposed system deals with the monitoring the vibration, air pressure, voltage and temperature of a machine with the help of nodemcu- esp8266 12e microcontroller and displaying the values in an LCD and sending to the user using GSM module. Using IOT the measured parameters are uploaded to the could directly from the microcontroller through the wifi modem.

3. HARDWARE REQUIREMENT

3.1 GSM MODEM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a Pan-European mobile cellular radio system operating at 900 MHz. Unlike mobile phones, a GSM modem doesn't have a keypad and display to interact with. It just accepts certain commands through a serial interface and acknowledges for those. These commands are called AT commands.

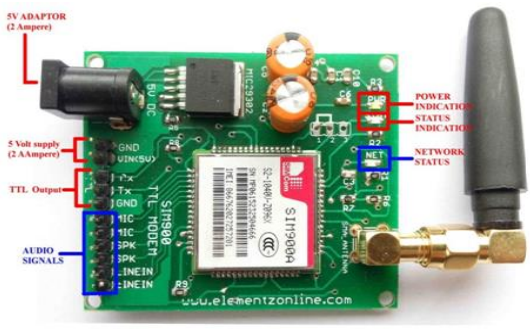

Fig-2: GSM/GPRS MODULE

There is a list of AT commands to instruct the modem to perform its functions. Every command starts with "AT". That's why they are called as AT commands. AT Stands for attention. In our simple project, the program waits for the mobile number to be entered through the keyboard. When a ten-digit mobile number is provided, the program instructs the modem to send the text message using a sequence of AT commands. GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS). The basic GSM network elements are shown in below.

3.2 ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED, publishing something online by sending a set of instructions to the microcontroller on the board. To do it so by using the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

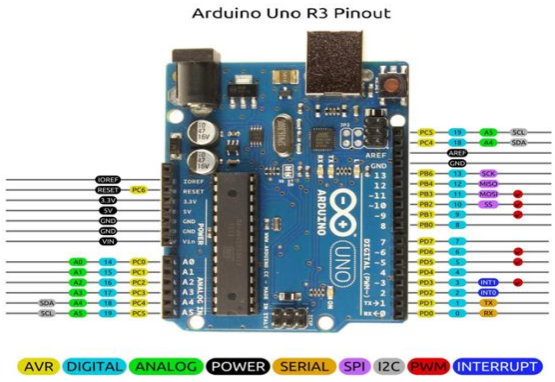

Fig-3: ARDUINO UNO PIN CONFIGURATION

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts

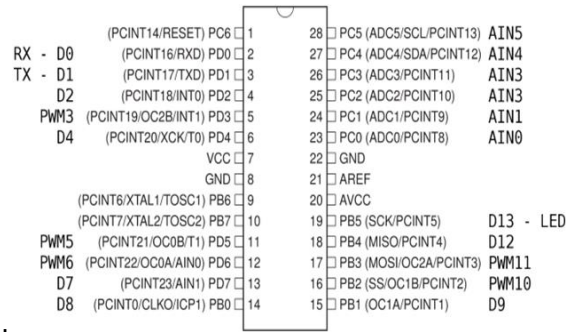

Fig-4: ARDUINO PIN DIAGRAM OF ATMEGA328P

3.3 DHT11 SENSOR

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data

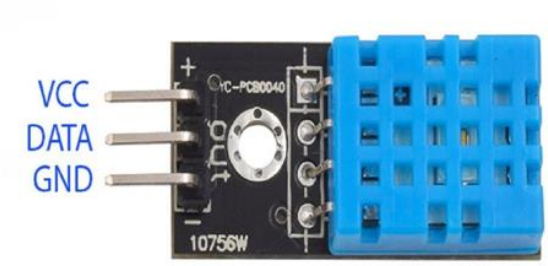

Fig-5: DHT11 SENSOR

These sensors consist of a humidity sensing component and an IC on the back side of the sensor. The DHT11 calculates relative humidity by measuring the electrical resistance between two electrodes. The humidity sensing component of the DHT11 is a moisture holding substrate with the electrodes applied to the surface.

3.4 INFRARED SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it. An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion

Fig-5: IR SENSOR

3.5 OLED DISPLAY

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive display that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). A typical OLED is composed of a layer of organic materials situated between two electrodes, the anode and cathode, all deposited on a substrate. The organic molecules are electrically conductive as a result of delocalization of pi electrons caused by conjugation over part or all of the molecule. These materials have conductivity levels ranging from insulators to conductors, and are therefore considered organic semiconductors. In a dark environment, the contrast of OLED display is higher compared to that of LCD display, and they are thinner and lighter. OLED is a monochrome graphic display module with built-in 0.96 inch, 128X64 high- resolution display. Driver chip of OLED module is SSD1306, which is compatible with IIC or SPI communication interface, therefore greatly reducing the IO port occupation. OLED module can be used in various commercial applications, such as display of mobile phones, portable digital media players, radio and digital cameras An OLED display works without a backlight because it emits visible light. Thus, it can display deep black levels and can be thinner and lighter than a liquid crystal display (LCD). They use organic molecules to produce their electrons and holes. A simple OLED is made up of six different layers. On the top and bottom there are layers of protective glass or plastic. The top layer is called the seal and the bottom layer the substrate. In between those layers, there's a negative terminal (sometimes called the cathode) and a positive terminal (called the anode). Finally, in between the anode and cathode are two layers made

from organic molecules called the emissive layer (where the light is produced, which is next to the cathode) and the conductive layer (next to the anode).

Fig-6: OLED DISPLAY

3.6 NRF24L01 WIRELESS TRANSCEIVER

NRF24L01 is a single chip radio transceiver for the worldwide 2.4 - 2.5 GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0mA at an output power of -6dBm and 12.3mA in RX mode. Built-in Power Down and Standby modes makes power saving easily realizable. NRF24L01 transceiver module uses the 2.4 GHz band and it can operate with baud rates from 250 kbps up to 2 Mbps. If used in open space and with lower baud rate its range can reach up to 100 meters. The power consumption of this module is just around 12mA during transmission, which is even lower than a single LED. The operating voltage of the module is from 1.9 to 3.6V, but the good thing is that the other pins tolerate 5V logic, so we can easily connect it to an Arduino without using any logic level converters. The module can use 125 different channels which gives a possibility to have a network of 125 independently working modems in one place. Each channel can have up to 6 addresses, or each unit can communicate with up to 6 other units at the same time.

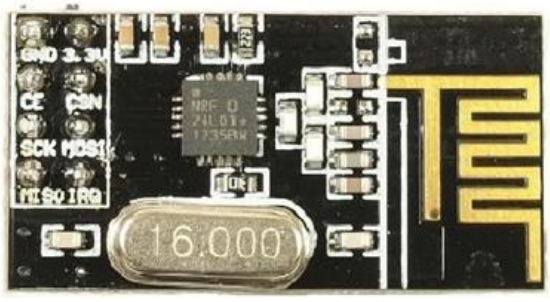

Fig-6: NRF24L01 TRANSCEIVER MODULE

3.7 BUZZER

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

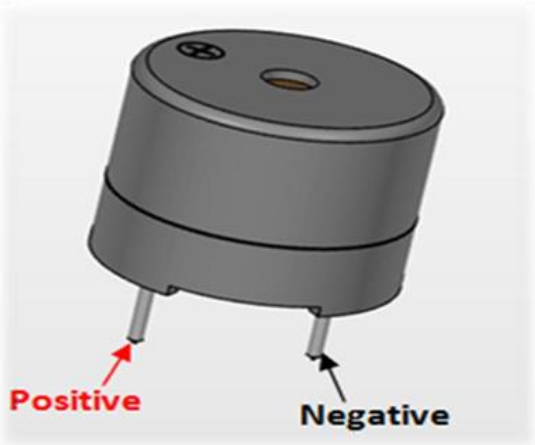

Fig-7: BUZZER

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits. The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz

4. SOFTWARE REQUIREMENT

4.1 ARDUINO

The Arduino integrated development environment (IDE**)** is a cross- platform application for Windows, macOS, Linux that is written in the programming language Java. It is used to write and upload programs to Arduino board. The Arduino Integrated Development Environment - or Arduino Software contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Arduino IDE is an open-source software program that allows users to write and upload code within a real-time work environment. As this code will thereafter be stored within the cloud, it is often utilised by those who have been searching for an extra level of redundancy. The system is fully compatible with any Arduino software board. The Arduino IDE supports the languages C and

C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

5. RESULT AND DISCUSSION

Slave unit monitors the oil level, temperature and raw materials needed through the DHT11 temperature and humidity sensor and IR sensor. The collected data are transmitted to the master unit through NRF24L01 wireless transceiver module.

Master unit receives the data transmitted by the slave unit through the NRF24L01 wireless transceiver module. The received data is processed and required message is fetched by the arduino. The received message is displayed in the 64x128 OLED display and then it is transmitted to the respective mobile phone through SIM900A GSM/GPRS module.

Fig-8: TEXT MESSAGE RECEIVED BY MOBILE PHONE

6. CONCLUSION

The monitoring and controlling system developed will be very useful and it helps in better way in enhancing the monitoring process. The IOT technique used is a modern technology and gives a good solution for monitoring which also reduces the man power. It is also helpful for continuously monitoring the machine and sends the updates to the supervisor .Here, the slave unit monitors the performance of the machine and if any problems occur the slave unit will send the alert message to the master unit and further the SMS message passes to the control department through the GSM. It's a complete automation system. Additionally the alert messages are also displayed in the LCD display. In this project, monitoring is done at each unit of the machine that reduces the faults in that machine. This monitoring system is done by using wireless RF transceiver. It's highly reliable and thus it monitors and controls the machine.

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