

Wi-Fi Based Economic CNC Monitoring System

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Abstract

This paper discusses a novel approach to monitor activities by using a range of remote monitoring technologies and expanding the communication potential of the main monitoring system. Information about the status of the device can be accessed anytime and anywhere, which is very useful in an emergency or when expensive devices or products are damaged, or for preventing unexpected breakdowns in a system which could be expensive or dangerous. Usually, maintenance of a CNC machine is done manually whereas this paper addresses the maintenance and analysis of the machine automatically with the help of a few circuits. The proposed model consists of Arduino Mega to measure the voltage and current from the supply to the machine. It also measures the phase difference as the input is an AC signal. These parameters are used to analyze the power consumption and state of the machine. A WIFI module is used to transmit the data to the computer. The data is then processed through Lab VIEW and then sent to the mobile app through the Wi-Fi module. The mobile app gives periodical information about the current condition of the machine. Also, when a critical condition is detected, the alert is sent through an SMS to the receiver mobile.

Keywords: *CNC machine, Arduino Mega, WIFI module, Arduino IDE, LabVIEW, TELNET*

INTRODUCTION

In the pre independence era, generation of electricity was very low and confined to a few areas in the country. After

Independence India has made huge investments in the energy sector since 1950-1951. A number of multipurpose projects came into being and with the setting up of

thermal, hydro and nuclear power stations, power generation started increasing significantly. But in the current scenario, the power available is not sufficient to provide for the country's huge demand. Hence, we need to use it in a controlled manner. In large scale industries, power consumption is measured with the highly equipped devices, whereas in small scale industries, power consumption of a machine is not monitored continuously. Therefore, there may be wastage of power leading to power crisis. In order to avoid this, we need to design a system which will continuously monitor the machine. In this approach, energy parameters of a CNC machine are monitored and then data transmitted, received using WIFI modules by assigned various conditions based on the values obtained in monitoring energy parameters. It defines the state of machine and energy consumption in that state which is represented in the mobile app that can be periodically monitored. It continuously monitors the machine through the mobile App. Data can be seen by all the officials and technical persons with the support of the android app. It predicts abnormal condition of machine tools before its failure and reduces the extent of failure. We can

plan maintenance and spares in advance by continuously monitoring the machine. It produces results of low investment, less inventory, ease of operation, etc.

LITERATURE SURVEY

The demand for power has increased exponentially over the last century. One avenue through which today's energy problems can be addressed is through the reduction of energy usage in households. This has increased the emphasis on the need for accurate and economic methods of power measurement. The goal of providing such data is to optimize and reduce power consumption. It explains the process of a condensed design which includes the energy measurement of the given load and its advantages. It uses the commercial data acquisition board (DAQ) connected to a common personal computer for high accuracy power measurements. The power digitally measured using Arduino is displayed graphically by using Processing and Mega Uno Link software.

POWER AND ENERGY MEASUREMENT

Power:

Power is defined as the rate of expending

energy. Watt is the unit for power (joule per second (J/s)). The difference in potentials between two points is equal to the energy per unit charge and this is required to move electric charge between the points. Electric current measures the charge per unit time (in coulombs/second). The electric power p is given by the product of the current I and the voltage V (in joules/second = watts).

$$P = \text{work done per unit time} = qV/t = IV$$

Where: q is electric charge in coulombs, t is time in seconds, I is electric current in amperes, V is electric potential or voltage in volts

Energy:

The amount of energy used (or supplied) depends on the power and the time for which it is used. Energy is defined by work done per unit time. This energy is found in different forms, such as light, heat, sound, and motion. There are many forms of energy, but they can all be put into two categories: potential and kinetic.

$$E = P \cdot t$$

Where: E = energy in watt hrs, P = power in watts, t = time taken in seconds

DC Circuits:

DC circuits mainly consists of resistive (Ohmic, or linear) loads. Joule's law can be combined with Ohm's law ($V = I \cdot R$) to produce alternative expressions for the dissipated power.

$$P = I^2 R = V^2 / R$$

where R is the electrical resistance.

AC Circuits:

Energy storage elements such as inductance and capacitance results in periodic reversals of the direction of energy flow which are alternating in nature.

HARDWARE COMPONENTS

Current sensor:

ACS712-05B is a *Hall Effect-Based Linear Current Sensor* for AC or DC current sensing. Applied current flowing through copper conduction path generates a magnetic field which the Hall IC converts into a proportional voltage. The ACS712 outputs an analog signal, VOUT that varies linearly with the AC or DC primary sampled current. Typical applications include motor control, load detection and management, switched-mode power supplies, and overcurrent fault protection.

Step down transformer:

Step down transformers reduce voltage. It has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

Signal Conditioning Circuit:

Signal conditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. It is necessary to bring the current level up to that required by the ADC. Here differential amplifier is used between acs712 and Arduino board.

Arduino:

Arduino is a common term for a software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, and produced by several vendors using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface various expansion

boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++. The first Arduino was introduced in 2005, aiming to provide a low-cost easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino Mega 2560:

The Arduino Mega 2560 is a microcontroller board based on the AT mega 2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), 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; you need to simply connect

it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

ESP8266:

ESP8266 WIFI Module is a WIFI serial transceiver module, based on ESP8266 SoC. This chip implements a full TCP/IP protocol stack and a very interesting feature is that it also has a great computational power onboard. That means that you can use this board as a simple WIFI connection board, offloading the main processor of your controller from the WIFI communication management. Or you can exploit its full power by implementing the logic inside the board itself. Thus, you can manage sensors and autonomously elaborate their signals and measurements. Hosting simple applications onboard can let you make a very compact IOT solution.

SOFTWARE COMPONENTS

ARDUINO 1.6.8 IDE:

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for

their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the language's processing and wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch". The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consists of two functions that are compiled and linked with a program stub `main ()` into an executable cyclic executive program:

setup(): a function that runs once at the start of a program and can initialize settings.

loop (): a function called repeatedly until the board powers off.

LABVIEW (Laboratory Virtual Instrumentation Engineering Workbench):

LabVIEW ties the creation of user interfaces (called front panels) into the development cycle. LabVIEW programs/subroutines are called virtual instruments (VIs). Each VI has three components: a block diagram, a front panel and a connector panel. The last is used to represent the VI in the block diagrams of other, calling VIs. The front panel is built using controls and indicators. Controls are inputs – they allow a user to supply information to the VI. Indicators are outputs – they indicate, or display the results based on the inputs given to the VI. The back panel, which is a block diagram, contains the graphical source code. All of the objects placed on the front panel will appear on the back panel as terminals. The back panel also contains structures and functions which perform operations on controls and supply data to indicators. The structures and functions are found on the Functions palette

and can be placed on the back panel. Collectively, the controls, indicators, structures and functions are referred to as nodes. Nodes are connected to one another using wires – e.g. two controls and an indicator can be wired to the addition function so that the indicator displays the sum of the two controls. Thus, a virtual instrument can either be run as a program, with the front panel serving as a user interface, or, when dropped as a node onto the block diagram, the front panel defines the inputs and outputs for the node through the connector pane. This implies each VI can be easily tested before being embedded as a subroutine into a larger program.

Data Dashboard:

Data Dashboard allows you to create custom, portable views of National Instruments LabVIEW applications. Using this application, you can create dashboards to display the values of network-published shared variables and deployed LabVIEW Web services on indicators, such as charts, gauges, textboxes, and LEDs .Creates a custom dashboard to control and monitor your LabVIEW application remotely. Access data using secure LabVIEW web services, read and write to network

published shared variables, and share dashboards with others from your iPad and Android tablets. Some features are also available on Android phones and Windows 8 devices.

METHODOLOGY AND DESIGN

In this approach, electrical parameters of a CNC machine are monitored by programming using Arduino mega board.

Initially, the current from the current sensor is very low. So, using signal conditioning circuit the current is brought up and given to analog pin of Arduino board. The voltage, power, energy parameters are calculated with the help of formulas as shown in section II. The data through the sensor and other calculations can be seen with the help of serial monitor in Arduino IDE.

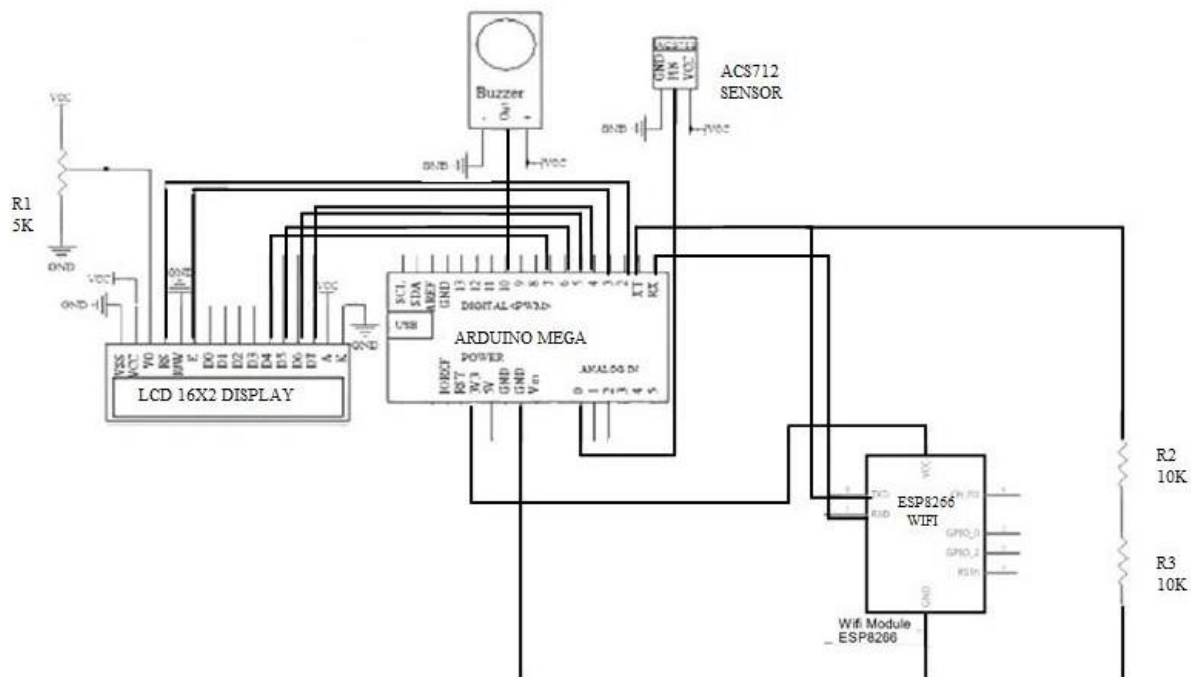


Fig 1.CONNECTION DIAGRAM

BLOCK DIAGRAM-TRANSMITTER

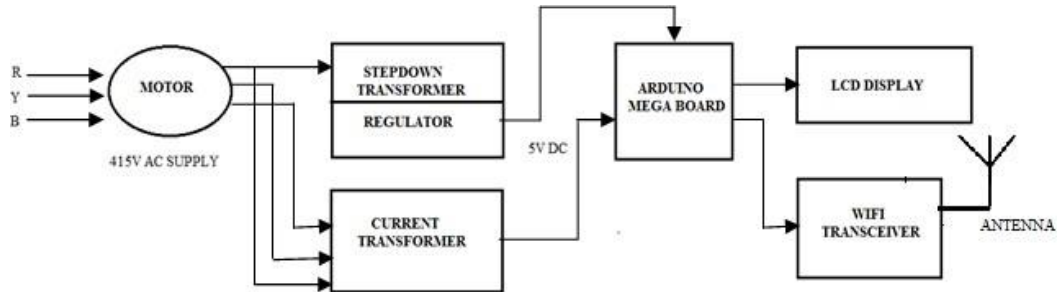


Fig 2. TRANSMITTER

BLOCK DIAGRAM-RECEIVER

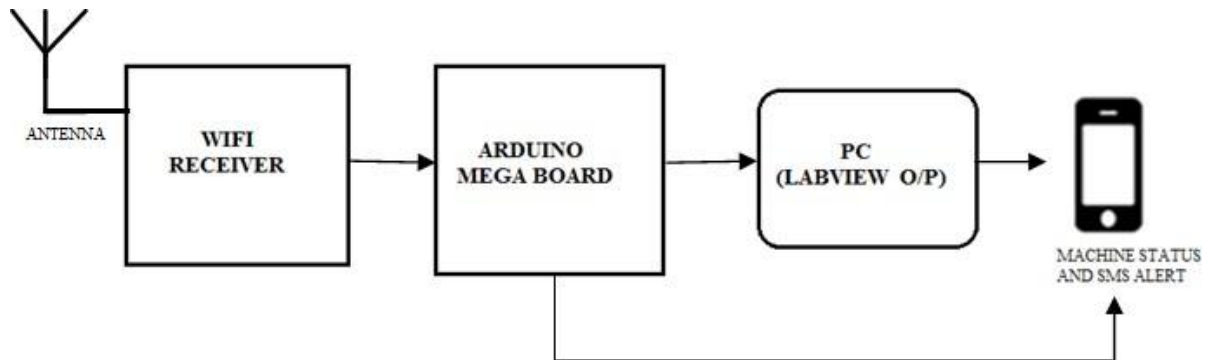


Fig3. RECEIVER

Based on the threshold values of current and voltage, the respective states of the machine are defined. The data is then transmitted to WIFI module. By using AT command set firmware, we connect to the server by interfacing mega board. The various commands are given through Arduino IDE. The transmitter is kept at the machine unit and receiver part is present in the block where the officials can remotely monitor it. Similarly, at the receiver the data received

in another WIFI module and data is sent to VISA through serial communication. For mobile app purposes, the data will be sent through TELNET by connecting to the IP address through WIFI module and data for the particular period are sent. Data taken via VISA is send to spreadsheet and data logged in the system periodically. SMS alert will be sent via visa itself. So, the officials can periodical monitor in the mobile app.

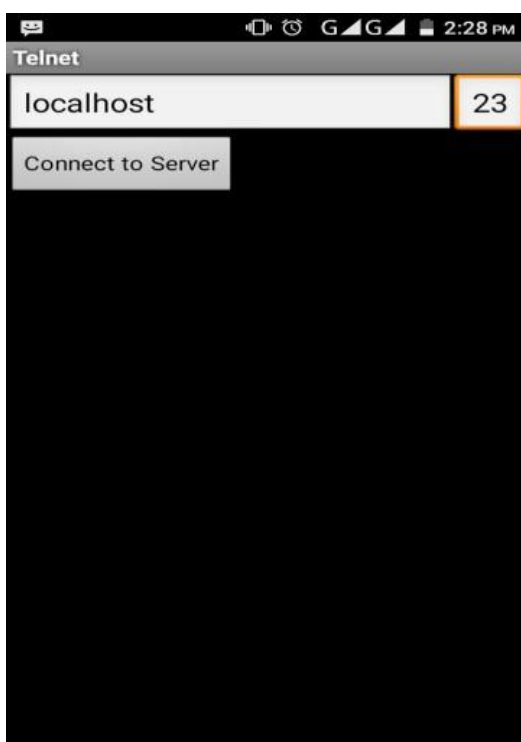


Fig.4.BEFORE CONNECTING



Fig.5.AFTER CONNECTING

CONCLUSION AND FUTURE SCOPE

Various electronic meters have been developed and are still being developed. However, the use of machine monitoring in this particular system provides numerous advantages over methods that have been previously used. The developed system is highly effective as it is able to eliminate the drawbacks of serial communication. The system also poses much less risk as it minimizes human interaction. This type of reading system is easy to install and beneficial for industries. This system provides additional features such as power disconnect due to large outstanding dues, power reconnect, power cut alert, low voltage and power factor lagging alert. Any modification can be made to the code in lesser time. The changes in tariff or unit calculation can be done very effectively.

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