TRANSMISSION OF VIBRATION SIGNALS OF A MOTOR USING TRANSMITTER AND RECEIVER

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***Abstract*—This project presents a long distance communication by using radio frequency that transmit and receive data. In this, the use of transceiver module has enabled the process industry to collect the vast amount of unknown vibration data by making physically monitoring of the underlying processes and equipment practically and economically possible. This system applies transceiver NRF24L01+LNA+PA module for communication and it's based on IEEE 802.15.4 standard for the 2.4 GHz ISM band. It has high data rates and flexible structure and accurate measurement. In this project we are communicating vibration signals of bearing of a motor.**

ATmega16 microcontroller is the core of the wireless system. Accelerometer sensor is used to collect the data then the processed data is transmitted through nRF24L01 wireless transceiver module. Finally, the results of communication are display on laptop. It is a kind of environmental conditions monitoring project which consumes low power, has low cost, works in real time and at remote places.

Keywords—NRF24L01+LNA+PA module.

I. INTRODUCTION

Wireless Communication is the fastest growing and most vibrant technological areas in the communication field. The recent developments in technology which permit the use of radio frequency(RF) technology such as Bluetooth, and radio spectrum have enabled different devices to have capabilities of communicating with each other. Wireless Communication is a method of transmitting information from one point to other, without using any connection like wires, cables or any physical medium.

Radio frequency (RF) is a new technology in which it can eliminate wired communication among electronic devices. Instead of connecting with wires, it has small RF transmitters and receivers. RF module systems are used to transmit data in remote monitoring system. Modern construction sites are increasingly flooded with high tech equipment that tries to tackle the problems

There should be an effective data communication for any project site and decision making office for the construction of any project. But the project sites which are located in rural or underdeveloped areas where networking infrastructure is not available in such areas we can use RF module for long range transmission and reception of the signals. The purpose of wireless technology is to exchange data in a fast and efficient manner and it interact and share knowledge and data with the office staff.

. RF module is a small electronic device which is used to transmit and receive signals between two devices and it can communicate with other devices wirelessly. In this NRF24L01 module are being used for long distance communication which are going to transmit and receive vibration signals of a motor.

II. HARDWARE DESCRIPTION

According to the design requirements of this paper, a signal transmission device needs to be implemented through wireless communication signal at a long distance. It is divided into two parts: one wireless data transceiver system are connected on a transmitter side and the other wireless transceiver system is connected to the receiver side.

In this ATmega16 microcontroller is used which collects the data through the accelerometer and temperature sensor. The vibration signal which are getting through NRF24L01+PA+LNA module at a transmitter side are displayed on a laptop , that signal will be transfer to the laptop from MCU(microcontroller unit) through SPI interface.

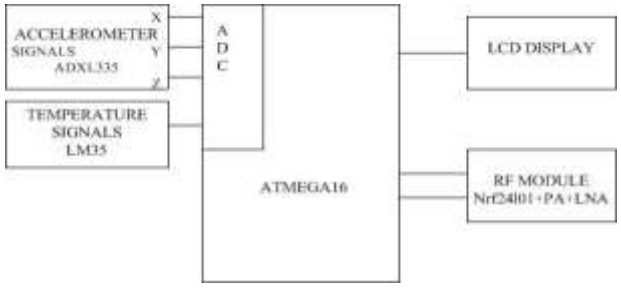

Figure1: Block Diagram Of Transmitter

Figure2:- Block Diagram of Receiver

The microcontroller collects the data from the wireless nRF24L01+PA+LNA transceiver module and it interfaces the received signal to a microcontroller to prepare for processing of the data. Then the signal which is getting at the receiver side can be checked on laptop.

2.1) MICROCONTROLLER

The ATmega16 microcontroller is responsible for executing the IEEE802.15.4 protocol. It is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. ATmeaga16 features have a 512 Bytes EEPROM, 16 Kbytes on-chip in-system reprogrammable flash memory for program storage and 1Kbyte SRAM.

By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 Mbps per MHz allowing the system designed to optimize power consumption
versus processing speed.

2.2) RF MODULE

The nRF24L01+PA+LNA is a single chip 2.4GHz transceiver module which is suitable for ultra low power wireless application, its ISM frequency band is 2.400-2.4835 GHz. In this SMA connector is used for maximum RF range, and there is the PA and LNA circuit on board, with the external antenna which can reach long distance. It can operate and configure through a serial peripheral interface (SPI). The radio front end uses GFSK modulation. The range of this module is 800-1km communication distance on open air.

2.3)ACCELEROMETER

The AADXL335 is a micro-electro-mechanical system(MEMS). It is an three axis accelerometer which has been chosen to measure the vibration of a motor. It is a small, thin, low power, 3-axis accelerometer with signal conditioned voltage outputs. The full-scale range of adxl335 is ±3 *g*. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The ADXL335 uses a single structure for sensing the X, Y, and Z axes. As a result, the three axes' sense directions are highly orthogonal and have little cross-axis sensitivity.

Following steps are taken to characterize the vibration acquisition are: analog value is converted to a decimal value,

V= analog value *5.00/ 1023

Where analog read is the analog integer value collect by microcontroller and V is a read data in volts.

$$DEF = \sqrt{\frac{x^2+y^2+z^2}{3}}$$

Where, x, y and z are axis of accelerometer.

2.4) TEMPERATURE SENSOR

The LM35 is a precision IC temperature sensor which output is proportional to the temperature (in C°). The temperature can be measure can be more accurately with lm35, it also posses low self heating and does not cause more than 0.1°C temperature rise in still air. Its operating temperature range is from -55°C to 150°C. The output voltage varies by 10Mv in responses to every °C rise/fall in ambient temperature, i.e., its scale factor is 0.01 V/°C.

The integer data transmitted to the base station from the sensor nodes also requires an almost direct conversion:

Temperature = analog read *(500.0/1023)

III. SOFTWARE DEVELOPMENT

Firmware for the modules has been developed with the help of AVR GNU C compiler and AVR studio 6. Atmel studio 6 is integrated development environment by Atmel. The software is written in c and c## language and it uses the open source compiler AVR-GCC.

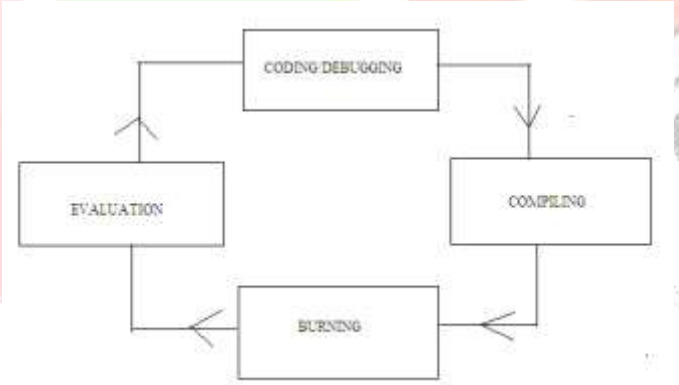

Figure 3: Steps of software development

The basic steps of software development are shown in figure.
Coding / debugging through Atmel studio 6, compiling through GCC compiler and burning through GCC programmer. Microcontroller has been programmed to test the hardware.

Visual studio is a fully featured IDE for android, web and cloud. The window form designer is used to build GUI application using windows form, it also display data like text box, list box and grid view. The user interface is link with code using an event-driven programming model. The designer generates c# code for the application. The data designer can show the graphically added data such as base schemas, including tables, foreign keys and constraints

3.1 Serial to Parallel Interface

SPI interface bus is commonly used to send the data between microcontroller and small peripherals such as shift registers, sensors and sd cards. It enables the serial exchange of data between two devices ,one called the master and the other called a slave. It

operates in full duplex mode. In serial to peripheral interface the communication takes place between the Central Processing Unit(CPU) and peripheral devices. For transferring the information in a communication channel a baud rate is used. In the serial port context, the information has been transmitted at a "9600" baud rate.

IV. FLOW CHART

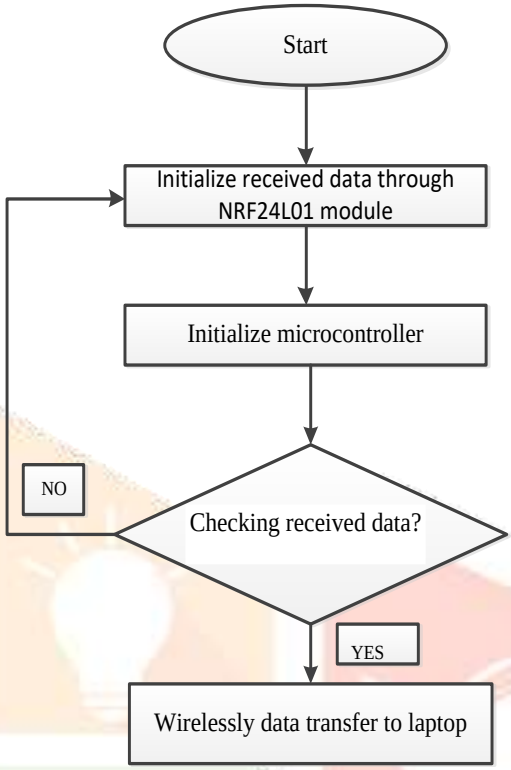

Figure 4: Flow chart of data transmission

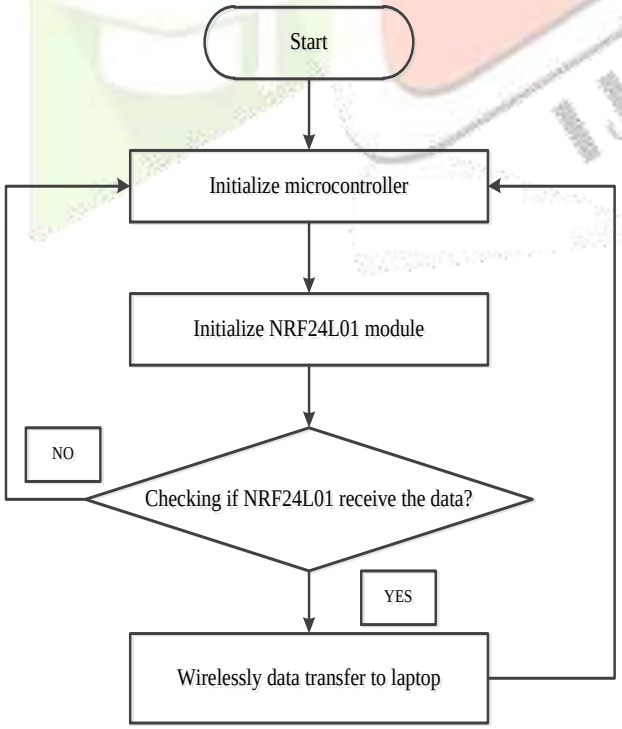

Figure 5: Flow chart of data reception

V. EXPERIMENTAL SET UP AND RESULT ANALYSIS

NRF24L01+LNA+PA connection:-

The NRF24L01 devices need to be configured before it can be used as a serial communication medium between the software and hardware and then to communicate with each other. For configuration Atmel Studio software has been used. When the data has been transmitted at 100m and it was found that transmitted values are same as that of received values. Next, the range has increased to 400m in order to check whether the NRF24L01+LNA+PA module is able to support a long distance and it was found that transmitted values are same as received values but with some delay.

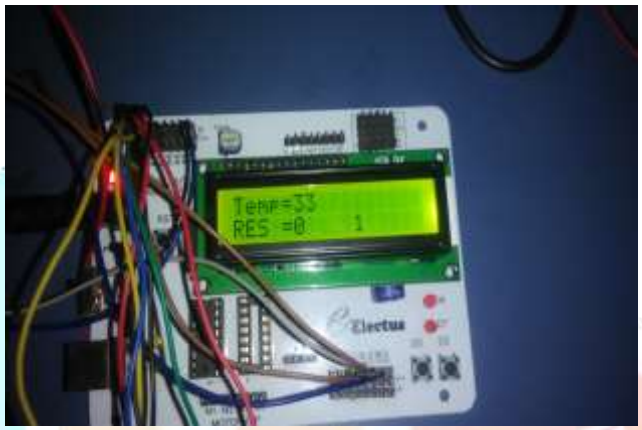

Figure 6:- Connection at transmitter

Figure 7:- Connection at receiver

Interfacing Result:-

Atmel Studio software is used to run the program to interface the sensors and the ATmega16 microcontroller. Analog to Digital converter(ADC) is used to convert the voltage from the sensor to digital system so it can be displayed on the LCD in digital form. Then the vibration signals are transmitted through NRF module and they are displayed on a laptop, that signal will be transfer to the laptop from microcontroller unit(MCU) through serial to peripheral interface.

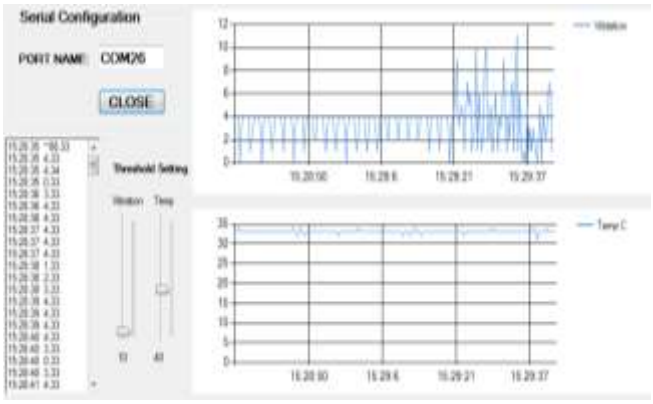

Figure 8 : Waves at a transmitter

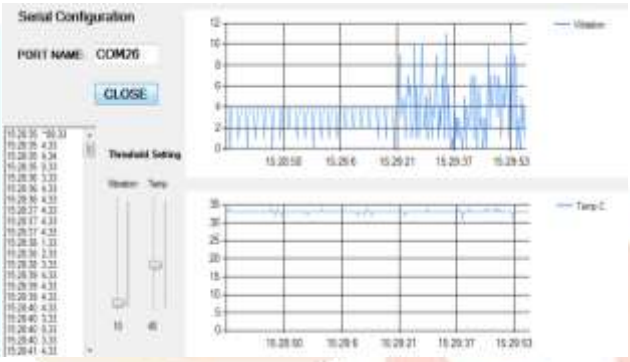

Figure 9: Waves at a receiver

Conclusion:

This project designs the plan approach and equipment choice prerequisites for transferring and receiving the vibration signals with the help of the transceiver NRF24l01+PA+LNA module which can transmit and receive the signals at a long distance.

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