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# AIRCRAFT FLIGHTS DIRECTION SENSING SYSTEM– A SHORT RANGE WIRELESS APPLICATION

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**ABSTRACT**
In recent times there is development of communication technologies at immense pace, which increased development of wireless communication technologies. Short range wireless communication has found its applications in almost all fields. This paper introduces and demonstrates how to develop short range wireless communication based on AVR microcontroller. In this paper we demonstrated how the remote control system of aircraft model communication is developed which is nothing but an short range wireless communication application. This model is built at low cost and hence it can be used in our daily day to day life activities, thus providing social value and benefit both.
***Keywords -*** Accelerometer, AVR, Remote control system,RF 2.4GHz, DSSS.

## I. INTRODUCTION

Short range wireless communication provides benefits like it needs low cost, low power and also supports peer to peer communication. Low power consumption limits range of transmission distance but it exhibits wide range of communication. Short range wireless communication technology work in ISM band i.e industrial, scientific and medical band. Commonly used frequencies in ISM band are 27MHz,868MHz (Europe),902-928MHz(U.S) and 2.4 Ghz. We have used RF 2.4 GHz serial link [RKI-1197] for short range wireless communication. The AVR 40 pin rapid robot controller board acts as an heart of system as it communicates between accelerometer and RF 2.4 GHz serial link [RKI-1197]. The adxl 335 accelerometer acts as direction sensing element. The output of this sensor is analog voltage.The RF 2.4GHz serial link should be connected to any TTL/CMOS logic serial RXD and TXD lines and can support baudrate of 9600 bps,19200 bps,38400 bps and 57600 bps. It also supports 4 unique RF channel selections to reduce congestions on same channel during peer to peer communication. It provides upto 100 meters outdoor open air node to node range. This device covers wide range of applications such as wireless mouse, wireless keyboard, wireless data logging applications, swarm robotics and in wireless home networking applications. AVR 40 pin robot controller board comes with LCD HD44780 which can be used in our paper as an testing element which will show the output analog voltage. Remote control system of aircraft model is an low cost short range wireless application.

## II. IMPLEMENTATION

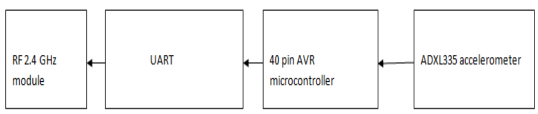
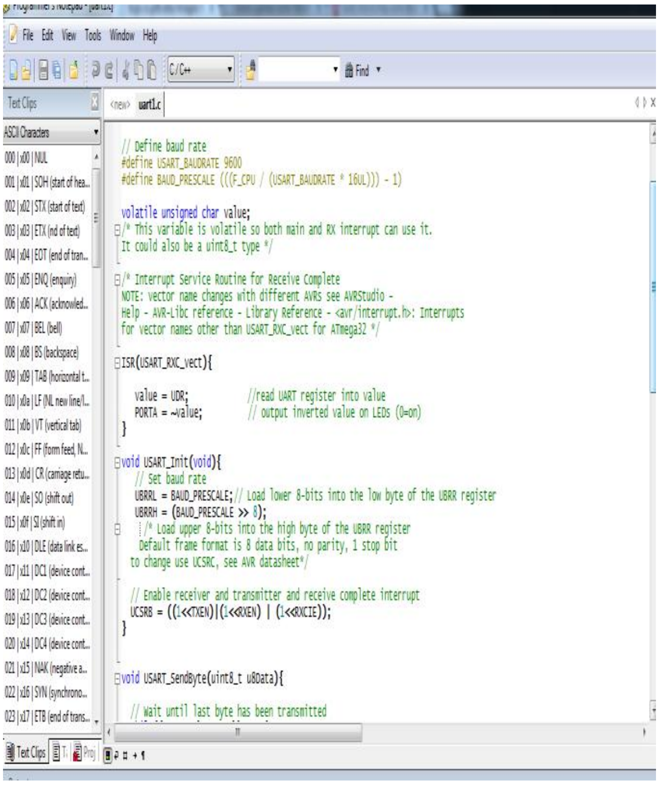
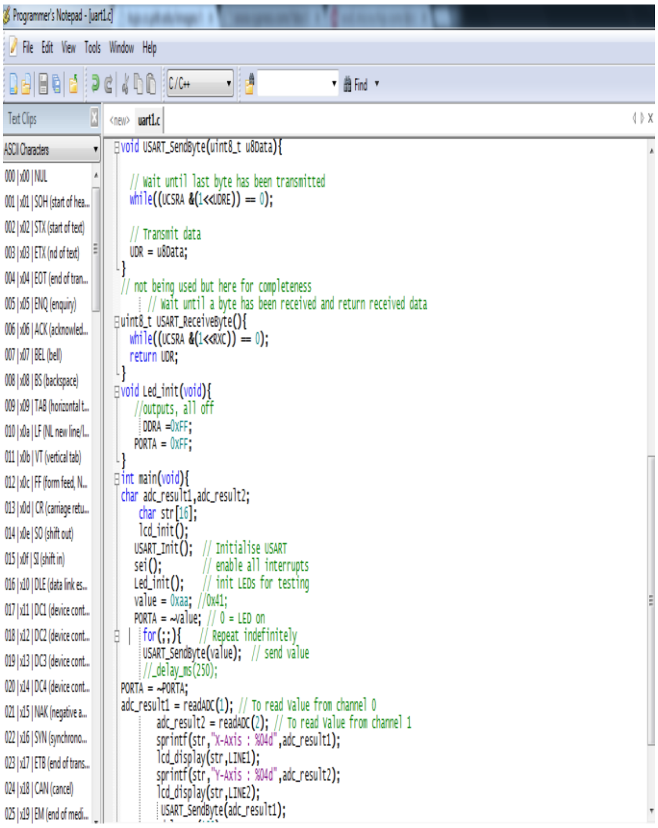



Fig: 2.1 Block diagram of Aircraft Remote control system

ADXL335 is complete 3 axis acceleration measurement system. But in this paper we have used only two of total 3 axes of accelerometer. It has sensor which is nothing but polysilicon surface micromachined structure built on top of silicon wafer. Deflection of structure is measured using differential capacitor. Acceleration deflects the moving mass and differential capacitor gets unbalanced. The result is analog output voltage which is in direct proportion with acceleration. This accelerometer communicates with 40 pin AVR microcontroller. AVR has 16 pin male header LCD compatible connector, two motor drivers L293D, ISP programming connector, master slave SPI and also has port A which serves the dual purpose role. AVR has UART on it. RF 2.4 GHz serial link use a simple proprietary networking protocol for fast point to multipoint or peer to peer networking. It should be connected to any TTL/CMOS logic serial RXD and TXD lines and also support multiple baud rates. This serial link does not need any further configuration for out of box RF communication. It has standard serial communication socket for easy integration. It supports channel and frequency selections. The accelerometer senses the movement in given direction. It then produces analog voltage. The accelerometer module is interfaced with port A of microcontroller. Reading from ADC is then shown on LCD HD 44780. The same data is then sent through UART to RF module which is RF2.4GHz serial link. The data transmitted is received by receiver which is indicated by blinking of LED. In general LED glows for 3 times. The first time LED blinks is just to indicate that data is about to be transmitted. For the second time when LED glows it indicated that motion or acceleration in X axis direction has been recognized and shown in corresponding voltage form. For the third time when LED glows it indicates that motion or acceleration in Y axis direction has been recognized and shown in corresponding voltage form. This completes the short range wireless communication and as far as to what extent and how motion is converted to analog voltage reader must concentrate his focus to accelerometer adxl335 manual. By going through it one will understand how directions and patterns of flights are captured. For precise and complete understanding of whole application data collected by RF module is shown on hyperterminal of PC. Verifying this results with readings of LCD HD44780 will reveal that flights direction has been captured and also short range wireless communication has been achieved.

## III. CODE DEVELOPMENT



The code development begins with setting of baud rate. For this lower 8 bits are loaded in low byte of UBRR and upper 8 bits are loaded with high byte of UBRR register. Default frame format is 8 bits with no parity bit and one stop bit. When wireless communication is to achieved first of three parameters which is a testing or indicating parameter is send, but for same to be achieved without any flaw we need to enable receiver and transmitter and receive complete interrupt. USART send_byte and receive_byte functions are written to ensure complete and precise transmission and reception. The converted voltages of accelerometer are read from channel 1 and channel 2 respectively. The same results are then given to USART_sendbyte function. It should be noted that sufficient delay must be introduced when sending results to USART_sendbyte function.The delay introduced is revealed or it can be rechecked while observing reading on hyperterminal. This code development is done keeping in mind the standards that are been followed with respect to versioning, repository, naming convention ,commenting done easy debugging for module integration.

## IV. UART INITIALISATION

*4.1* Transmission steps in source UART

4.1.1 Host system writes data to data out register of bus interface of source UART

4.1.2 UART updates status register in bus interface to indicate transmission in progress

4.1.3 Contents of data out register is transferred to shift register in serial transmitter block

4.1.4 After all bits are transferred, UART hold the output high for one stop bit

4.1.5 After stop bits are transmitted ,UART updates STATUS register to clear transmission in progress indicator

*4.2* Receiving steps in destination UART

4.2.1 Serial receiver detects first bit of incoming message, uses this bit to synchronize clocking of receiver shift register

4.2.2 Serial receiver shifts data in bits

4.2.3 Received byte is transferred to DATA IN register of bus interface

4.2.4 Interrupt request output bit of bus interface is set(this step is optional or depending upon UART architecture)

5. Host operating system device driver accesses the DATA IN register to retrieve the byte, status register updated to clear data available bit.

## V. SYSTEM SPECIFICATIONS

5.1 ADXL335

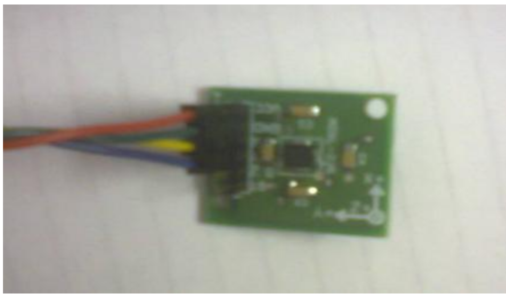


Fig: 5.1.1 Accelerometer Module

The ADXL 335 is a small,thin, low power ,complete 3 axis accelerometer with signal conditioned voltage outputs. The adxl335 is available in a small, low profile 4mm* 4mm* 1.45mm, 16 lead, plastic lead .frame chip scale package

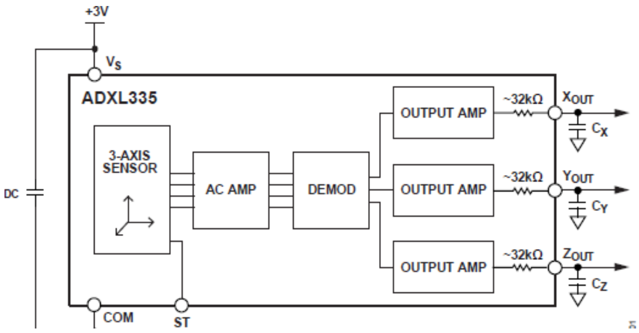



Fig: 5.1.2 Accelerometer Functional Block diagram

5.2 AVR

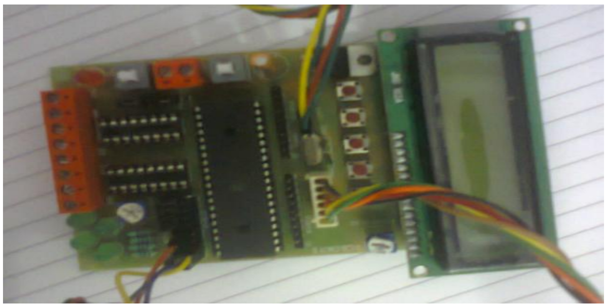


Fig: 5.2 AVR with 40 pins

It is available in small size of 93*71 mm. It has 16MHz crystal for maximum speed. Serial programmer and PC-MCU serial link is included. It has 5 switches including reset and 3 switches on interrupt pins.

5.3 LCD HD 44780

Fig: 5.3 LCD from Hitachi

It has pin 4 named as R/S register select which is 0 for instruction and 1 for data. It has pin 5 named as R/W LCD which is 1 for read and 0 for write operation.

5.4 Transmitter

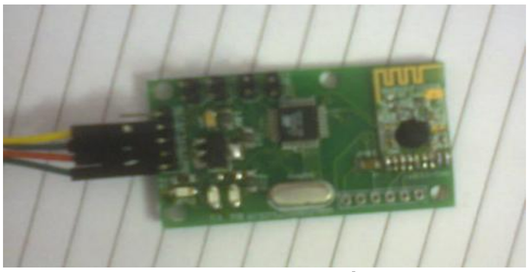


Fig: 5.4 Transmitter with antenna

Parameter specification for transmitter is given below

| Symbol | Parameter (condition) | Notes | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $P_{RF}$ | Maximum Output Power | a | | 0 | +4 | dBm |
| $P_{RFC}$ | RF Power Control Range | | 16 | 18 | 20 | dB |
| $P_{RFCR}$ | RF Power Accuracy | | | | ±4 | dB |
| $P_{BW2}$ | 20dB Bandwidth for Modulated Carrier (2Mbps) | | | 1800 | 2000 | kHz |
| $P_{BW1}$ | 20dB Bandwidth for Modulated Carrier (1Mbps) | | | 900 | 1000 | kHz |
| $P_{BW250}$ | 20dB Bandwidth for Modulated Carrier (250kbps) | | | 700 | 800 | kHz |
| $P_{RF1.2}$ | 1st Adjacent Channel Transmit Power 2MHz (2Mbps) | | | | -20 | dBc |
| $P_{RF2.2}$ | 2nd Adjacent Channel Transmit Power 4MHz (2Mbps) | | | | -50 | dBc |
| $P_{RF1.1}$ | 1st Adjacent Channel Transmit Power 1MHz (1Mbps) | | | | -20 | dBc |
| $P_{RF2.1}$ | 2nd Adjacent Channel Transmit Power 2MHz (1Mbps) | | | | -45 | dBc |
| $P_{RF1.250}$ | 1st Adjacent Channel Transmit Power 1MHz (250kbps) | | | | -30 | dBc |
| $P_{RF2.250}$ | 2nd Adjacent Channel Transmit Power 2MHz (250kbps) | | | | -45 | dBc |

5.5 RECEIVER

Fig: 5.5 Receiver with Antenna

Parameter specification for receiver is given below

| Datarate | Symbol | Parameter (condition) | Notes | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| | $RX_{max}$ | Maximum received signal at <0.1% BER | | | 0 | | dBm |
| 2Mbps | $RX_{SENS}$ | Sensitivity (0.1%BER) @2Mbps | | | -82 | | dBm |
| 1Mbps | $RX_{SENS}$ | Sensitivity (0.1%BER) @1Mbps | | | -85 | | dBm |
| 250kbps | $RX_{SENS}$ | Sensitivity (0.1%BER) @250kbps | | | -94 | | dBm |

5.6 Total system on Transmitter side

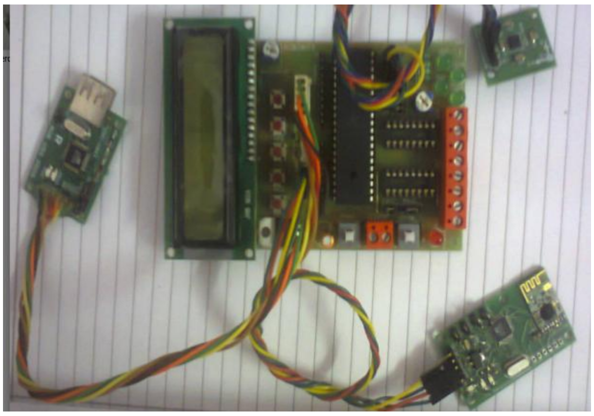


Fig: 5.6 Integrated system on transmitter side

## VI. DISCUSSION

The total system is implemented keeping in mind the features short range wireless communication offers such as low power, point to point communication, low cost etc. The coding has been done in Win AVR's programmer notepad. The AVR USB programmer was used with AVR controller and similarly programmer was also used on receiver side. The programmer is generally used to dump the converted c to hex file in our electronic kit. The final results can be verified from hyperterminal,although the results can be shown via LCD which in our paper can be considered as an intermediary reference unit. The implementation of short range can be done by various ways by zigbee , RFID,NFC etc and what we have presented in this paper is an basic idea on how short range wireless communication is implemented keeping in consideration the constraints of power and cost. Short range wireless communication finds its application in various fields like audio response systems, swarm robotics ,wireless data logging applications , wireless telemetry for transmitting sensor data, wireless home networking applications, wireless audio transmission applications, point to point and point to multipoint network topologies and many such fields are there where wireless applications forms heart of entire system.

## VII. CONCLUSION

This paper implements the model of aircraft remote control system which is nothing but a short range wireless application. The accelerometer sends the direction senses to AVR, which in turn sends the data to UART. UART finally communicates to RF2.4GHz module. This system incorporates the advantages such as low cost, low power requirement, point to point communication etc. As this sending system is working in public 2.4GHz frequency, to avoid interference with other signals of nearby wireless devices it uses DSSS baseband correlator.

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