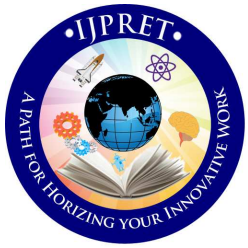
Research Article *ISSN: 2319-507X*
Shaila Kharde, IJPRET, 2013; Volume 1(8): 969-978 *IJPRET*



INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

UNDER WATER EMBEDDED BLUETOOTH DATA ACQUISITION ROBOT BASED ON ARM PROCESSOR

SHAILA P. KHARDE, P. H. BHAGAT

1. ME (Electronics), Government College of Engineering, Aurangabad.
2. Assistant Professor, Electronics and telecommunication Department, Government College of Engineering, Aurangabad.

Accepted Date:

27/02/2013

Publish Date:

01/04/2013

Keywords

ARM Processor, Pressure and Temperature sensor, Wireless Bluetooth module.

Corresponding Author

Ms. Shaila P. Kharde

Abstract

This paper presents an abstract model of underwater embedded Bluetooth data acquisition robot which has designed using the ARM processor and Bluetooth model for data transfer, which is connected to the ARM processor through a RS-232 serial port. We know that pressure and temperature under water is different from pressure and temperature above the water, so it is necessary to measure Bluetooth pressure and temperature under water. Also there are certain objects present under water, which is also necessary to display on computer. Is an open wireless technology that provides connections without wires. It is a cable replacement technology. The usage of cable in the industry field becomes more costly and any fault in the connection may leads to the total system failures. In our implementation, under water robot can move using DC motors i.e. we can start it, stop it and make it go on either in clockwise and anticlockwise direction. The ARM processor can act as central data acquisition system that acquired data from subsystem of underwater robot and transfer the data through Bluetooth module to PC for display

I. INTRODUCTION

An underwater embedded Bluetooth data acquisition robot based on ARM and Bluetooth chip called BLUELINK was constructed for completing the task without cables in industrial field and to reduce the complexity of cable, the occurrence of accident and so on. Data acquisition system is product or processor used to collect information to document or analyze some phenomenon data acquisition which is based on sensor technology, signal detection and processing. A sensor, which is a type of transducer is a device that converts a physical property into a corresponding electrical signals i.e. LM35 temp sensor and H03 pressure sensor.

Embedded system plays an irreplaceable role in industrial control and data acquisition and transmission. We know that pressure and temperature under water is different from pressure and temperature above the water, so it is necessary to measure pressure and temperature under water. Also there are certain objects present under water, which is also necessary to display on computer. Therefore, we implement this unmanned underwater vehicle, we called it as underwater robot that can move using DC motor i.e. we can start it, stop it and make it go on either in clockwise and anticlockwise direction. The pressure and temperature sensors are connected to underwater robot and ARM processor. The ARM processor can act as central data acquisition system that acquires the data from different subsystem of underwater robot and transfer the data through Bluetooth module to PC for display.

II. OVERVIEW OF PROJECT It consists of A) Data Acquisition System, B) Bluetooth Module, C) Pressure and Temperature Sensor, and D) Motor Drive.

Over view of project is shown below

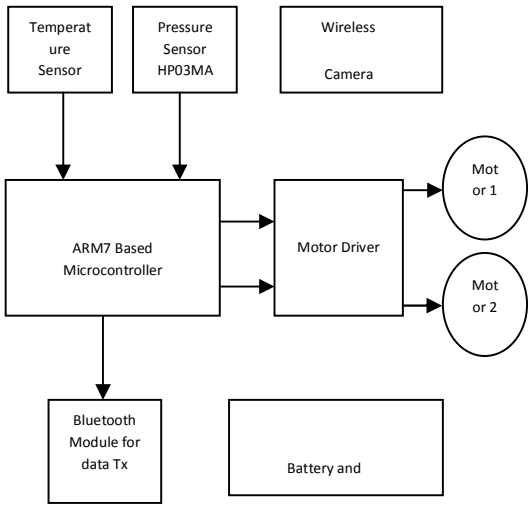


Fig.1. Overview of Project

A) Data Acquisition System:

Data Acquisition System is product or process used to collect information to document or analyze some phenomenon. The data acquisition is based on three steps sensing, signal detection and processing.

1. Sensor that converts physical parameter to electrical signals.
2. Signal conditioning circuitry to convert sensor signal into a form that can be converted to digital value.
3. Analog-to-Digital converter, which convert condition sensor signal to digital value.

Functionality:

The total Functionality of Data Acquisition System is such that it has to collect the information from the pressure and temperature sensor of the unmanned under water vehicle into central data acquisition system for further processing and storage. The CDAS send the control command to pressure and temperature sensor to send the measured pressure and temperature by them to CDAS. CDAS receives the data and process the data for transmitting it to PC for display.

An Embedded system using the ARM processor is programmed to control the pressure and temperature sensor. The total module can be powered up by a simple battery and power supply unit. The ARM processor module sends the commands to the pressure and temperature sensor. The respective sensors transfer the signals to the ARM processor module. This data is then send to the PC where it is displayed.

B) Bluetooth Module

Bluetooth is a wireless technology used for exchanging data over short distance, in 2.4 GHz ISM (Industrial scientific and medical) RF band. Bluetooth uses FHSS (Frequency Hopping Spread Spectrum) scheme with hoping rate of 1,600 hops per second to minimize the effects of signal interference. Bluetooth speed is up to 1Mbps. The transmission range of Bluetooth is 10 meters and by providing power amplifier Bluetooth transmission range can be extended up to 100 meters.

Blue link is the compact Bluetooth module. This module has built in voltage regulator

and 3v to 5v level converter that can be used to interface with 5v microcontroller. This module has only 5 pins Vcc, GND, Tx, Rx and RESET. The module is factory configured in transparent mode and hence there is no command required for normal operation.

For wired serial connection replacement Blue-Link is used. To established connection between MCU and GPS, PC, to the robot/project the Blue-Link is used for serial port connection replacement. Bluetooth protocol stack is shown below.

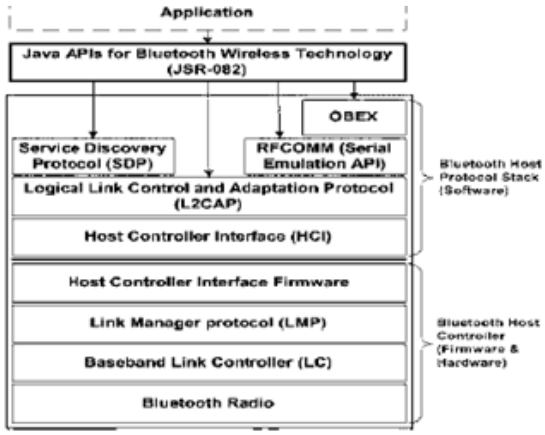


Fig.2. Bluetooth Protocol Stack

For a reliable wireless link a frequency-hopping scheme is combined with FEC (Forward Error Correction), CRC(Cyclic Redundancy Check) and Fast ARR(Automatic Repeat Request) in base based to detect and solve packet errors and to detect loss during transmission.

Radio Layer

The physical characteristics of transmitter and receiver are specified in radio layer. Radio module is provides the modulation and demodulation of signal.

Baseband Layer

This layer properly formats the data to and from the radio layer and it also provide the link between BTH devices.

Link Control Layer

Link controller carries the link manager command. It provides the establishing and configuring link between BTH devices.

Bluetooth supports two kinds of links for data and for audio/video transmission i.e. asynchronous connectionless link and synchronous connection oriented link for data and audio/ video transmission respectively.

Link Manager

It proved security function like authentication and encryption Link manager protocol provide link between BTH devices. It controls duty cycle of Bluetooth devices .It translate the host controller interface command.

Host Controller Interface

Host Controller Interface is present between lower and upper layer of the BTH stack. The BTS systems that are implemented across two separate processor are supported by host controller interface.

Logical link and Adaptation Protocol Layer (l2CAP)

The L2CAP is used for establishing connection between existing ACL link or request ACL link if it does not exist. It provides multiplexing capability, segmentation, reassemble operation and group abstraction. By using these capabilities it provide connection oriented and connectionless data services it is the upper layer protocol. ACL link has multiplexing capabilities therefore a single ACL link is sufficient for communication.

Service Discovery Protocol Layer (SDP)

SDP defines the actions for both client and server. A SDP client uses a reserved channel on a L2CAP, when communicating with SDP server. When client finds desired service it request a separate channel for service and dedicated channel is used for communication.

RFCOMM

This protocol is based on ETSI07.10 specification and is a serial line emulation protocol. It emulates data signals and RS232 control over Bluetooth base band.

OBEX Protocol

It is developed by infra rate data association and is a session protocol. it is used to exchange object. OBEX is used to browse content of folder on remote devices for it defines a folder-listing object

C) Pressure and Temperature Sensor

A Sensor is a device that converts a physical property into a corresponding electrical signal. It is a type of transducer, e.g. LM35

Temperature Sensor and HP03 Pressure Sensor.

LM35 Temperature Sensor

The LM35 series are temperature sensor. The output of LM35 temperature sensor is linearly proportional to the Celsius (centigrade) temperature. The users of LM35 temperature sensor does not required subtracting a large constant voltage from its output to obtained convenient centigrade scaling and that is advantage over linear sensor calibrated in Kelvin. To provide typical accuracies at room temperature LM35 does not required any external calibration or trimming. To make easy interfacing, the LM35 is used because it has low output impedance, linear output and precise inherent calibration, to read out or control circuitry.

HP03Pressure Sensor

HP03Pressure Sensor is used for pressure measurement and control system. The HP03Pressure Sensor includes a piezo-resistive sensor and an ADCS interface. It provides 16 bit word data for pressure and temperature related voltages. HP03 is a lower power; low voltage device with automatic power down switching IC serial interface is used for communication with microprocessor.

D) Motor Drive:

Motor give power to the MCU, power to do physical work i.e. to move robot. So it is essential to know how to control a DC motor effectively with a MCU. We can control a DC motor easily with microcontroller. We can start it, stop it, or make it go on either in clockwise and anticlockwise direction and its speed.

Control with MCU

As the MCU port are not powerful to drive DC motor directly so we need some kind of drivers. A very easy and safe to use popular L293D chips. These chips are designed to control 2DC motors. These are 2 input and 2 output pins for each motor.

Speed Control

The speed of DC motor can be controlled with MCU. To control the speed of DC motor PWM or pulse width modulation technique is used to digitally.

III] DESIGN AND IMPLEMENTATION

We can design this project using two phases, first designing the program or the code which controls the embedded system i.e. the ARM processor and also allows the ARM processor to control the pressure and temperature sensor connected to it. The second deploying the developed program into the embedded system and running it. The code for ARM7 LPC2148 is return using KEIL micro vision IDE. This code is written using embedded C language. Keil micro vision converts it to assembly language. The code is downloaded on IC using Flash-magic software. Here the Flash-magic software which convert the code in to the ARM processor understandable format.

Project Design can be shown in the following figure

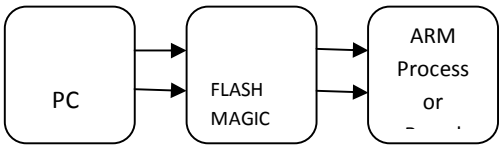


Fig.3 Project Design

Implementation

Once the code has been deployed into the ARM processor board, it runs automatically on the board. So before the deployment, the Bluetooth device must be connected to the ARM processor board through the serial port. The deployed code runs on the ARM processor board and the code will enable two timers on the ARM processor Board one for 100ms (Timer 2) and the other for 10ms (Timer 1) such that the two timers start concurrently and timer 1 repeats itself for every 10ms and the timer 2 repeats itself for every 100ms. The ACL links of the Bluetooth devices are used for establishing the data acquisition system.

IV] PERFORMANCE EVALUATION

The embedded Bluetooth data acquisition system is evaluated based on the simulation parameters which are stated below. The observed parameters and the simulation parameters are listed below:

PARAMETER	VALUE
Distance factor α	0.5 meter
Data Rate Attained	2.0 mbps
Data Rate Attained in previous model	1.1 mbps
Min data rate required	1.2 mbps

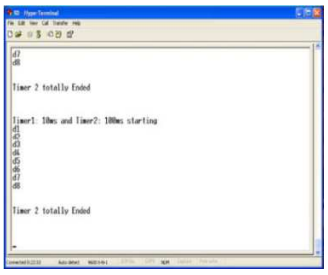
The embedded Bluetooth data acquisition system is evaluated based on the simulation parameters which are stated below. The observed parameters and the simulation parameters are listed below:

As shown in the above, for the efficient functionality of the underwater vehicle 1.2Mbps minimum amount of data rate is required. The previous model could provide a data rate nearly enough for the vehicle communications, but at the cost of complexity. The proposed model is highly secure compared to the previous model and provides much better data rates than required and also simplifies the role of data acquisition system.

V] RESULTS AND CONCLUSION

Wireless embedded systems are taking a very high pace in development and a wireless data acquisition system is perhaps the most widely used and needed system which is currently used in the industries. There are various technologies used for the development of wireless systems which include Bluetooth, Zigbee, RF Band, Wi-fi. Depending upon the range requirements, one selects the technology for its particular application.

A wide application and potential development of embedded system has become hotspots in the 21st century. This method of designing and implementing the Data Acquisition System using the Bluetooth medium achieves a maximum of 1.9Mbps of data rate against required 1.2Mbps. The controlling data sent by the ARM processor for the data acquisition cannot be shown exactly as it will be received by different subsystems but for convenience of understanding the data is represented by considering a standalone PC to be all the subsystems and the data is received in the HyperTerminal through all the Bluetooth devices.



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