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Bluetooth Based Remote Monitoring & Control System

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Abstract: **The Bluetooth is an open wireless technology which revolutionized the connectivity by providing freedom from wired connections. In this paper we mainly focus on Implementing a Bluetooth Based Remote Monitoring & Control System which is designed using the Microcontroller(ATmega16) as an embedded target and Bluetooth device which is connected to the controller along with different sensors to measure different real time parameters such as temperature, pressure & humidity, it also controls the temperature of a process. In our implementation the Microcontroller which acts as the Central Controlling System that controls the Bluetooth module connected to it and acquires the data from the different subsystems and transmits it to the control station.**

1. INTRODUCTION

The use of wireless technology in industrial automation systems offers a number of potential benefits, from the obvious cost reduction brought about by the elimination of wiring to the availability of better plant information, improved productivity and better asset management [5]. During the last 13 years, standardized radio technologies like Wireless LAN / WLAN (IEEE 802.11), IEEE 802.15.4 and Bluetooth technology (IEEE802.15.1) have become the dominating technologies for industrial applications, the comparison of different wirelesss protocols is shown in the Figure 2.As per the comparison above with all the wireless protocols as shown in Figure 1.&2.The Bluetooth technology opens up new possibilities for using wireless communication in industrial environments due to its low price and build in security.

Standard IEEE Spec	BLUETOOTH 802.15.1	UWB 802.15.3	ZigBee 802.15.4	Wi-Fi 802.11a/b/g
Max Data rate (Mbit/s)	0.72	110	0.25	54
BitTime (µsec)	1.39	0.009	4	0.0185
Max Data Payload (bytes)	339	2044	102	2312
Coding Efficiency (%)	94.41	97.94	76.52	97.18

Fig. 1. Comparison of system parameters of different Wireless Protocols

STANDARD	BLUETOOTH	UWB	ZigBee	Wi-Fi
IEEE Spec	802.15.1	802.15.3a	802.15.4	802.11a/b/g
Frequency Band	2.4GHz	3.1-10.6GHz	869/915MHz,2.4GHz	2.4GHz,5GHz
Max Signal Rate	1Mb/s	110Mb/s	250Kb/s	54Mb/s
Nominal Range	10m	10m	10-100m	100m
Nominal TX Power	0-10dbM	-41.3dbM/MHz	(-25)-0dbM	15-20dbM
No Of RF channels	79	1-15	1/10;16	14(2.4GHz)
Channel Bandwidth	1MHz	500MHz-7.5GHz	0.3/0.6MHz,2MHz	22MHz
Modulation Type	GFSK	BPSK,QPSK	BPSK(+ASK),O-QPSK	BPSK,QPSK,COFDM, M-QAM
Basic Cell	Piconet	Piconet	Star	BSS

Fig. 2. Comparison of diffferent Wireless Protocols.

2. BLOCK DIAGRAM

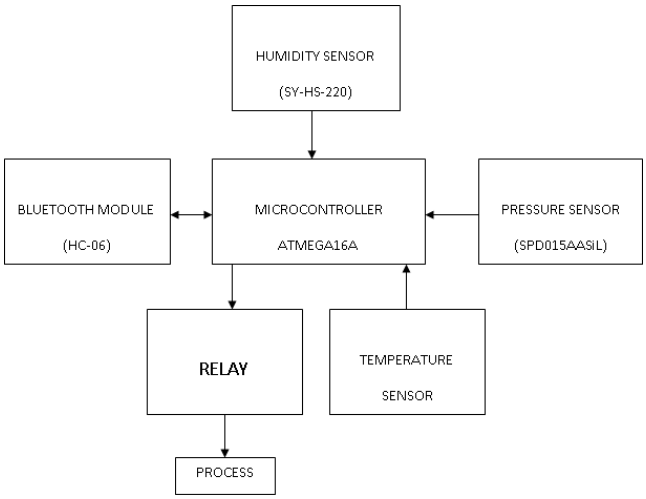

Fig. 3. Block Diagram

2.1. Bluetooth Module HC-06

This Bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly.The HC-06 module is a slave only device.This means that it can connect to most phones and computers with Bluetooth but it cannot connect to other slave only devices such as keyboards and other HC-06 modules.To connect with other slave devices a master module would be necessary such as the HC-05 version which can do both master and slave.The function of this module is to receive the data from different Sensors and transmitting the data to the Master Bluetooth module so that required parameters can be monitored and controlled [8].

2.2 Microcontroller (ATmega 16)

The Microcontroller ATmega16 acts as a central controller which controls the entire unit present in the block diagram. The main functions are to receive the data from different sensors, to convert the data from analog to digital format, to forward the data to the Bluetooth module, to generate control signal for controlling the process temperature through the relay.

2.3 Temperature Sensor LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling [9].The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to read out or control circuitry especially easy. It can be used with single power supplies, or with plus andminus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range.

2.4 Humidity Sensor SY-HS-220

This sensor module converts relative humidity(30-90%RH) to voltage and can also be used in weather monitoring application.

2.5 Pressure Sensor SPD015AASiL

This Smartec pressure sensor has an amplified analogue output. The sensor is compensated for offset, sensitivity, temperature drift and nonlinearity. The sensor has a range of 15 PSI(102 kPa) absolute and the output is ratiometric to the power supply voltage.

3. CIRCUIT DIAGRAM

The circuit diagram consist of Power supply unit in which IC 7805 & IC 16 is used to obtain 5V & 3.3V for Microcontroller, Sensors & Bluetooth Module.After switching on the power supply unit we can see that the LED of Bluetooth module starts Blinking, once the Bluetooth enabled device establishes connection or pairing of devices is done then LED stops blinking which means that data communication can be established. Once communication between Bluetooth enabled device is established then the different sensors such as Temperature Pressure & Humidity can sense the data and send it to PORT A of microcontroller ATmega16 and since the data obtained from the sensors are in analog values, this data is given to Microcontroller ATmega16 that converts received analog data in to digital form with the help of in built ADC in Microcontroller ATmega16.After conversion the digital data is send to the Bluetooth Module which is connected at PORT D of microcontroller.The Bluetooth enabled laptop or smart phone can observe the different parameter such as Temperature, Pressure & Humidity.The temperature of a process is set to 100 degree celcius if the temperature of process reaches above set point then relay is triggered to turn of the process & indicates on the display of the operator that the maximum temperature reached, once the temperature of the process is reached below or 100 degree celcius then relay is triggered to turn on the process.

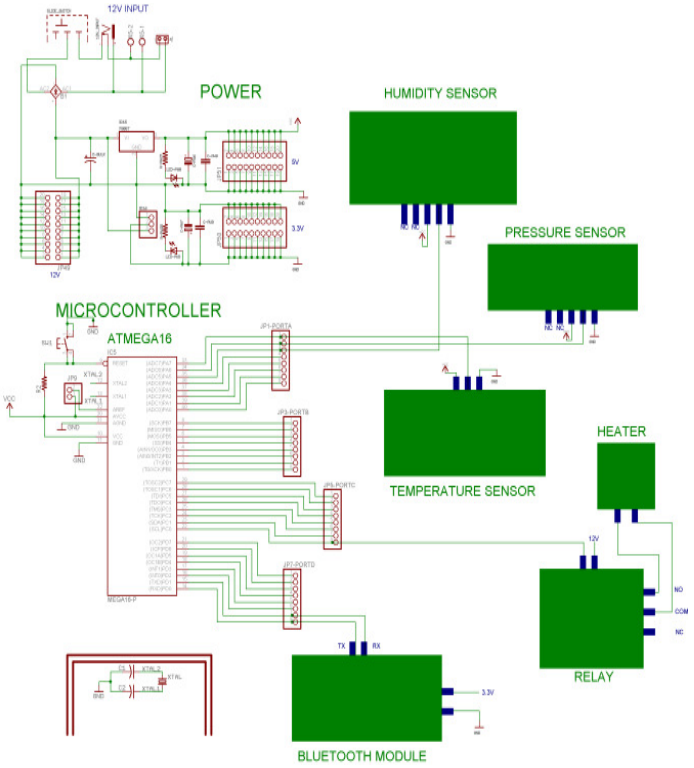

Fig. 4. Circuit Diagram

4. RESULTS

4.1Measurement of parameters & controlling the temperature On Laptop

STEP 1) Turn on the power supply of the circuit.

STEP 2) Turn on the Bluetooth module of Laptop.

STEP 3) Open Docklitght Software.

Docklight is a testing, analysis and simulation tool for serial communication protocols (RS232, RS485/422 and others).It allows you to monitor the communication between two serial devices or to test the serial communication of a single device.Docklight significantly increases productivity in a broad range of industries, including automation and control, communications, automotive, equipment manufacturers, and embedded consumer products. Docklight is easy to use and runs on almost any standard PC using Windows 8, Windows 7, Windows Vista or Windows XP operating system.

STEP 4) Go to file > New Project > Save project as test1.ptp > Start Communication.

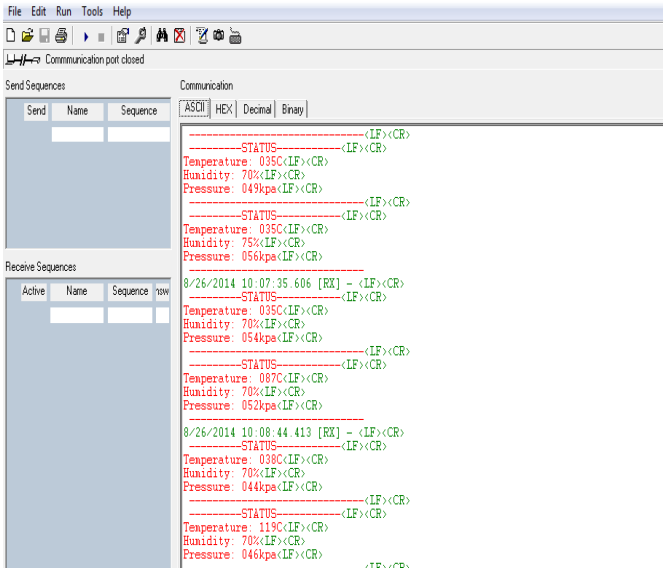

Fig. 5. Docklight Simulation Result

STEP 6) As Observed below in the screenshot that if the temperature is reaching beyond 100 degree celcius then the software indicates that maximum temperature reached.

4.2Measurement Of temperature, pressure & humidity On Android Smart Phone:

STEP 1) Turn on the power supply of the circuit.

STEP 2) Turn on the Bluetooth module of Android enable smart phone.

STEP 3) Open Sena B term application on your smart phone.

SENA BTerm is a VT-100 Terminal Emulator for Bluetooth communication. It enables the Android devices to connect to any remote Bluetooth devices supporting Serial Port Profile(SPP) and to exchange data with them. It can connect to the remote device both as Bluetooth master (similar to network client) and as Bluetooth slave (similar to network server).It provides easy ways to manage the Bluetooth adapter of the local device and to send control keys, alternate keys, function keys and other special keys.

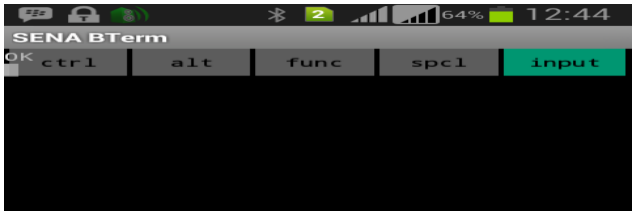

Fig. 6. Sena Bterm home page

STEP 4) Go to Bluetooth Management > Connect to

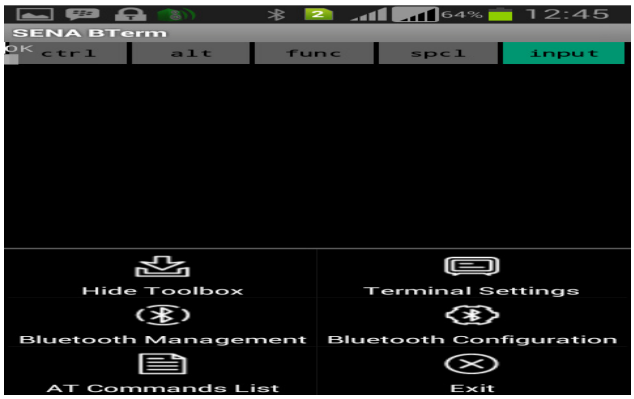

Fig. 7. Bluetooth management

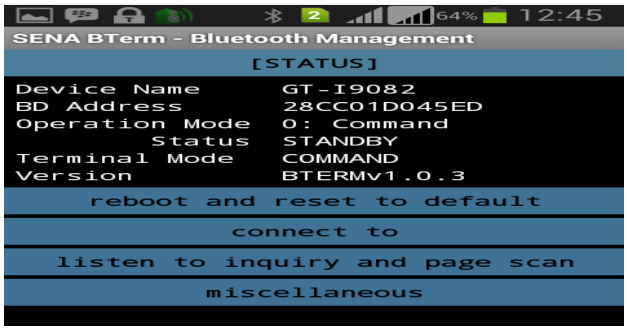

Fig. 8. Bluetooth Configuration

STEP 5) Go to listen inquiry & page scan

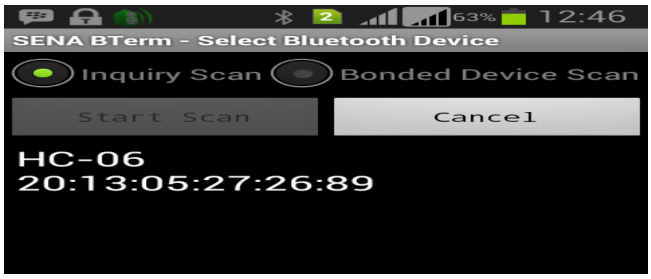

Fig. 9. Scanning Devices

STEP 6) Connect to HC-06 Bluetooth module >after establishing Connection > to Observe the status Type S

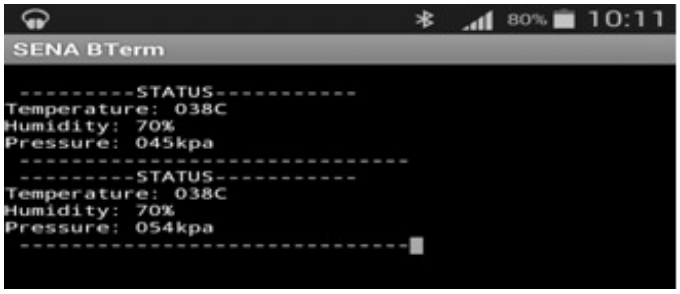

Fig. 10. Real time Parameter Status

As Observed below in the screenshot that if the temperature is reaching beyond 100 degree celcius then the software indicates that maximum temperature reached.

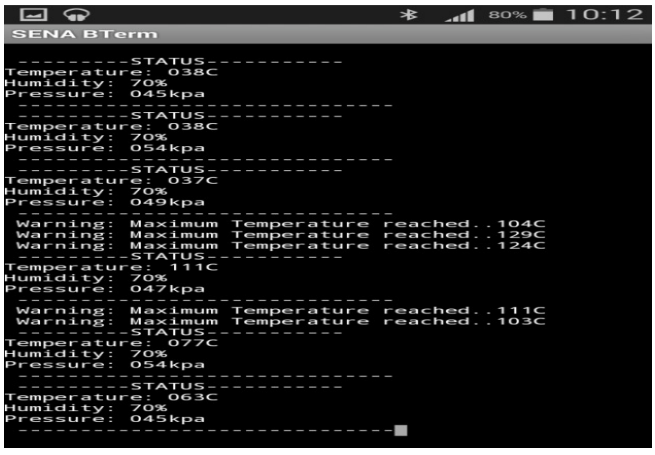

Fig. 11. Simulation Result

5. CONCLUSION

The work presented here gives implementation of Bluetooth based remote monitoring and control system in which we measure the real time parameters of temperature, pressure& humidity as shown in the results.The status of all the parameters is transmitted automatically within 10 seconds which gives flexibility to the operator to monitor the parameters from control room & as mention earlier it also helps us to control the temperature of the Process which is set at 100 degree celcius.This system developed has virtues such as high reliability, robustness, low power consumption etc.

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