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GSM based Greenhouse Automation and Data Logging using CAN Bus

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Abstract

The main objective of this project work is to design an automated greenhouse system which is purely sensor based and controls the environmental conditions of greenhouse to user defined levels. The master controller can communicate with various sensors through CAN bus in real-time to control light, humidity, soil moisture, temperature efficiently inside the greenhouse by actuating lights, heater, dripper and cooler respectively according to the requirement of the crops. The data from various sensors are collected by the master controller through CAN bus and are sent as SMS through GSM for monitoring.

Keywords- *Green house, Sensors, CAN Bus, PIC Microcontroller, Actuators, GSM, UART, Environmental parameters,*

I. INTRODUCTION

Agriculture is a major contributor to Indian economy. Most of the Indian agriculture continues to be traditional, resulting in low yield compared to that in other countries. Protected cultivation is a modern concept being adapted in our agriculture. Its success depends on localization of technology so that the technology becomes affordable by the farmers. Our work is an effort to bring farm automation to the local farming community.

In this endeavor, we have attempted bringing industrial grade control technology to green house farming. Greenhouse cultivation is a form of protected agriculture wherein the environmental parameters will be under our control.

We propose a generic architecture that can be used in many other automation applications. We also propose a system that integrates analog and digital peripherals. The kit senses environment parameters of the greenhouse, collected data are sent on CAN bus to master controller. The Master receives collected data from slave node and compares with the user defined limit. If the parameters are not within the range, the actuators will turn ON/OFF using relay. The type and number of the slaves can be increased or decreased freely without affecting the operation of other nodes which facilitates data exchange and improve the flexibility of system.

All plants require optimum conditions for their healthy growth. Hence the environmental conditions of greenhouse should be periodically monitored and controlled. The data is logged for future reference. If any of the parameter crosses the optimum user defined value, a SMS is sent.

II. SYSTEM ARCHITECTURE

Figure1 shows the block diagram of the system architecture of GSM based Greenhouse Automation and Data logging using CAN Bus. The implemented system is about monitoring and controlling the greenhouse environment using CAN communication protocol. The system incorporates PIC18F458 Microcontrollers which have an inbuilt CAN module. This system saves manpower, reduces human error and improves yield.

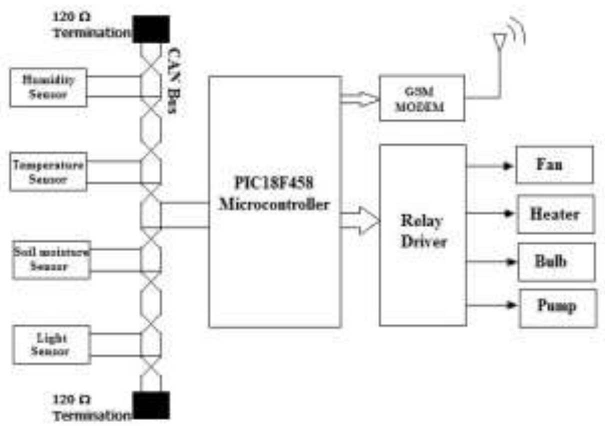

Figure 1: System Architecture

Greenhouse automation requires continuous monitoring of parameters like temperature, humidity, soil moisture and light. All these analog parameters are obtained by means of sensors. Different sensors are connected to each node. Inbuilt ADC acquires data from each sensor and converts it into digital values. These digital values are processed by microcontroller and are sent to master controller through CAN bus upon a data request. Depending on the received values of sensors from different nodes, the master controller not only generates control signals for actuators but also sends SMS for monitoring these values. The Master node compares received data values with the user defined threshold limit and sends control signals to actuators through relay whenever the threshold limit is crossed.
The system is economical, effective and easy to install. Each node consists of individual PIC microcontroller and is independent to each other. The number of nodes connected to CAN bus can be increased or decreased easily, and new node can be joined up anywhere in communication line. This provides the flexibility to the network system. The system gives an automatic, timely, on-demand precise i.e controlled environment for crops. This will not only improve the utilization of equipment, water but also contribute to a high yield and quality of crops. This system

also helps the farmers to check environmental conditions of greenhouse from any location using cell phone.

III. HARDWARE DESCRIPTION

1. SENSORS

Sensor is a device which converts physical quantity into electrical signal. Our system consist the following sensors:

- **Temperature Sensor (LM-35)**
  Temperature sensor converts environmental temperature into voltage proportional to the measured temperature. It is a three terminal sensor: +Vs, Vout and Gnd.
- **Humidity Sensor(SY-HS-220)**
  Humidity sensor measures the presence of water vapor in air. The amount of water vapor in air can affect the growth of plants. It is a three terminal sensor: +Vs, Vout and Gnd.
- **Soil Moisture Sensor**
  The soil moisture sensor is designed and developed in C- Quad Computers, Belagavi. This sensor measures the water content in the soil based on the conductivity between its middle electrodes by applying voltage at outer electrodes.

Figure 2: Soil Moisture Sensor

- **Light Sensor(LDR)**
  Resistance of LDR varies with light intensity that falls upon it. As light intensity increases the resistance decreases. In absolute darkness, the resistance is as high as 2MΩ and in strong light, the resistance is less than 10Ω. By connecting a resistor in series with LDR terminal, current flow can be measured in Ammeter. This acts as current limiting resistor. When no light falls on LDR, its resistance is very high and current is low. Hence voltage drop across resistor is low. And when illuminated by bright light, resistance of LDR decreases and voltage across resistor increases. This sensor provides voltage proportional to light illuminated on LDR

2. RELAY

A relay is an electrical switch. This electrical switch is operated by an electromagnet that opens and closes under the control of another electrical circuit. It is able to control an output circuit of higher power than the input circuit. Relays are used where it is necessary to control a circuit by a low-power signal and where several circuits must be controlled by one signal.

3. GSM MODEM

GSM MODEM is a device used to setup communication between computer systems and the GSM system. GSM is a standard for mobile communication used in most of the countries. GSM module consists of a GSM modem assembled together with power supply and communication interfaces for computer like UART, USB, etc. We have used VISIONTEK 81GC GSM modem in this system.

4. CAN BUS

Controller Area Network (CAN) is a serial communication protocol for real time applications. CAN bus is a differential bus terminated by 120Ω resistors at its both end. The CAN protocol is defined for physical and data-link layers. The CAN physical layer connects the CAN controller to the physical bus i.e twisted pair cable. CAN network is made by connecting individual PIC18F458 nodes to CAN bus. Each node can communicate with other nodes using predefined message format called as CAN Objects (COB) ID. In a CAN network, higher priority is given to the lower COB-ID [3]. All the nodes that want to acquire the bus will be continuously monitoring the bus. When the bus becomes free all the nodes which were requesting the bus start transmitting their messages, starting with the COB-ID. Only the device with the lower COB ID will acquire the bus for the transmission. All other nodes withdraw transmission. As a result one of the messages will be transmitted without collision.

IV. IMPLEMENTATION

CAN OBJECT ID DESIGN

In CAN protocol each node transmits data packets along with their unique CAN Object ID. The CAN message once transmitted by a node is in the bus and can be accessed by all the other nodes. If any nodes want to receive messages from specific node, the Masks and Filters should be used at the data reception. For our implementation we have used 11 bit standard Identifier. The CAN Object ID Design is as follows

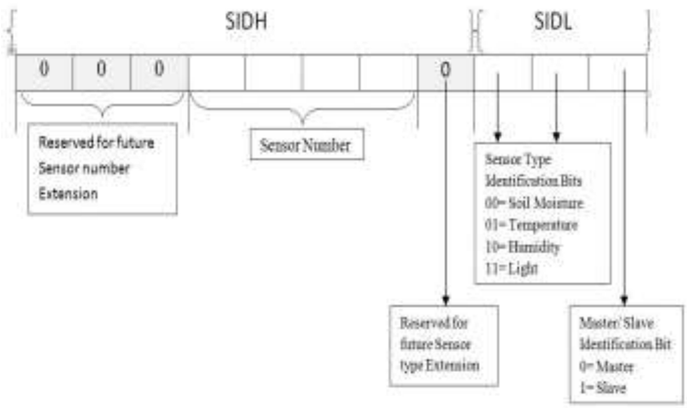

Figure 3: CAN Object ID Design

As shown in figure 2 we have partitioned the 11 bit ID into three parts. They are Master-Slave node Identification, Sensor Type Identification and Sensor Number. Bit 0 is used for Master-Slave Identification (0 for Master and 1 for Slave). Bit 1 and Bit 2 are used to define the type of sensor. We have used four types of sensors. We have reserved Bit 3 for future extension of t sensor types. (Presently set to 0). Bit 4 to Bit 7 have been assigned to address the number of sensors. In the present system we can have 64 sensors of same type. Bit 8 to Bit 10 have been reserved for future extension of number of Nodes (Presently set to 0).

MASK AND FILTER DESIGN

The Master and the Slave Nodes will have their own unique Transmit and Receive ID. The mask and filter for Master are designed to accept messages only from all slave (sensor) nodes and the mask and filter for all slave nodes should accept messages of only master node. Since CAN protocol supports ID based priority, in this system Master ID is designed with high priority and slaves ID priority depends on sensors types.

NODE	MASK	FILTER	COB ID RANGE
MASTER	0b11100001001	0b000xxxx0xx1	0b00000010000 to 0b00011110110
SOIL	0b11100001111	0b000xxxx0000	0b00000010001 to 0b00011110001
TEMPERATURE	0b11100001111	0b000xxxx0100	0b00000010101 to 0b00011110101
HUMIDITY	0b11100001111	0b000xxxx0010	0b00000010011 to 0b00011110011
LIGHT	0b11100001111	0b000xxxx0110	0b00000010111 to 0b00011110111

NOTE: x refers to Don't Care Bits

Table1: MASK AND FILTER DESIGN

As shown in Table 1, the Master Node mask and Filter is set such that it checks only the Master/ Slave check bit, rest of the bits are don't care. Hence it receives messages i.e data of slave nodes. At the slave side Bit 1 and Bit 2 are checked along with the Master/ Slave check bit and the slave number bits are don't care. Hence the node will accept data only from master, when addressed by that type of sensor. Each type of sensor can be of 16 in numbers. So devices connected in the network and their COB ID's are as follows:

Master: 0x010 to 0x0F6
Soil Moisture: 0x011 to 0x0F1
Temperature: 0x015 to 0x0F5
Humidity: 0x013 to 0x0F3
Light: 0x017 to 0x0F7

The wide range of COB ID gives flexibility for user to add new nodes without any modification of address or changing the COB IDs of older nodes when required.

IV. RESULTS

Figure 4: Sensor Results from CAN Bus

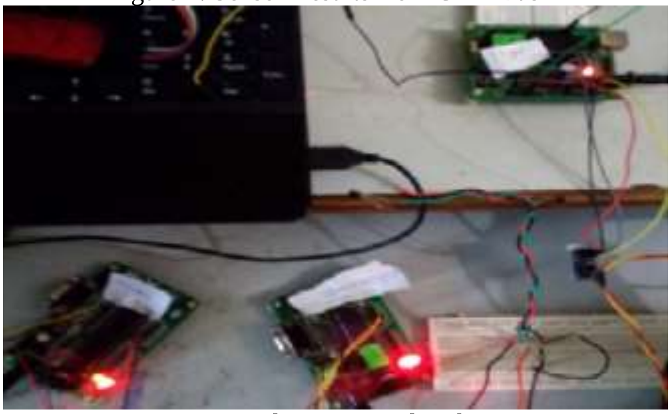

Figure 4: CAN Nodes connected with CAN Bus

V. CONCLUSION

We have studied CAN bus protocol and different types of sensors like temperature, light, humidity and soil moisture sensor. We interfaced all types of sensors with PIC microcontroller and sent collected data from slave node to master node through CAN bus. The controlling part of actuators is done through relay and the data logging is done through GSM MODEM at the master side. The code is written in embedded C using MPLAB IDE software.

REFERENCES

[1] "Green House Parameters Monitoring Using Can Bus And System On Chip", International Journal of Engineering Research & Technology, (IJERT) Vol. 2 Issue 5, May – 2013,ISSN: 2278-0181

[2] Teemu Ahonen, Virran Kask, Mohammed, "Greenhouse Monitoring with Wireless Sensor Network", 'Proceeding of IEEE International conference on Mechatronics and Embedded System Application',2008 (MESA 2008),Page 403-408

[3] Sushma Arjuna Kolha and S. A. Annadate "Implementation of Green House Automation using ARM7 Controller " *International Journal of Computer Applications (0975 – 888) Volume 47– No.20, June 2012*

[4] He,Guomi Wang, Xiaochan; Sun, Guoxiang., " Design of a Greenhouse Humiture Monitoring System Based on ZigBee Wireless SensorNetworks", Fifth International Conference on Frontier of Computer Science and Technology (FCST),2010.

[5] Pranita J. Gujarathi and Prof. Mrs. Jyoti Giri Advanced Greenhouse Control and Monitoring System on CAN BUS, *International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682 Vol.22, No.22, February201*