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SMS based Home Automation using CAN Protocol

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Abstract— In this paper a SMS Based Home Automation System using CAN Protocol is presented. To save the much of the electrical energy, implemented this design. By sitting at the same he/ she can control the lights and other devices without putting much effort. The concept is implemented by making use CAN protocol, LPC 2129 etc. The experimental results show that this network system has high safety, stability with practical significance, market value and it is affordable to a common people.

Keywords*-CAN Protocol, LPC 2129, Automation system.*

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I. INTRODUCTION

SMS based home automation is a efficient way of saving energy. The model is using as simple as calculator. The efficient way of using the things in home could be done with the help of CAN protocol, LPC 2129 etc.

A. Problem statement[12]

Technology has advanced so much in the last decade or two that it has made life more efficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. Therefore there arises a need to do so in a systematic manner which we have tried to implement with our system. The system we have proposed is an extended approach to automating a control system. With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before. With the adoption of our system, we can gain control over certain things that required constant attention. The application of our system comes in handy when people who forget to do simple things such as turn ON or OFF devices at their home or in their office, they can now do so without their presence by the transmission of a simple text message from their mobile phone. This development, we believe, will ultimately save a lot of time especially when people don’t have to come back for simple things such as to turn ON/OFF switches at their home or at their office once they set out for their respective work. The objective of this project is to develop a device that allows for a user to remotely control and monitor multiple home/office appliances using a cellular phone. This system will be a powerful and flexible tool that will offer this service at any time, and from anywhere with the constraints of the technologies being applied. Possible target appliances include (but are not limited to) Light 1, Light 2, Pump, T.V, Fan anything with an electrical interface. The proposed approach for designing this system is to implement an ARM-7 control module that receives its instructions and command from a cellular phone over the GSM network based on CAN protocol. The ARM-7 then will carry out the issued commands and then communicate with the given appliance. For security purposes, a means of identification and user authentication will be implemented, and will combine caller identification.

II. BLOCK DIAGRAM

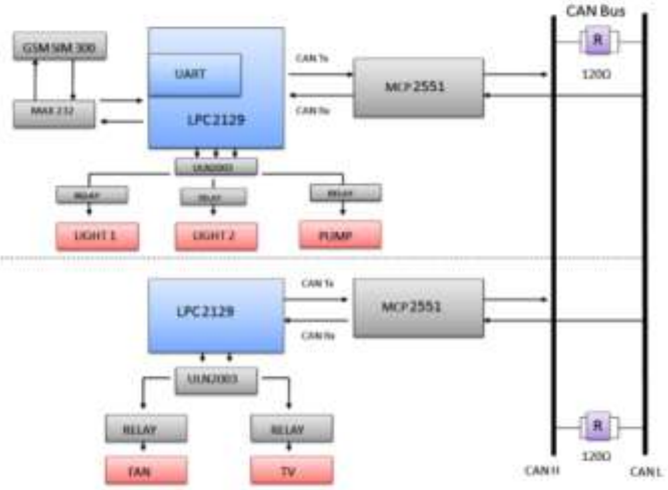


Figure1: System Block Diagram

The figure1 is the simple block diagram. It is a simple illustration of how we have implemented our idea and the various parts involved in it. From the above representation, the first GSM SIM 300 is used as a receiving section to which the user sends text messages that contain commands and instructions from the mobile station The LPC 2129 indicated in the block diagram is an ARM-7 microprocessor. On receiving SMS message microprocessor processes accordingly to carry out specific operations. The relay driver (BUFFER ULN2003) is used to drive the relay circuits which switches the different appliances connected to the interface. The LCD is used to indicate the status of the operation performed by the microprocessor and also its inclusion makes the overall system user-friendly.

Assuming that the control unit is powered and operating properly, the process of controlling a device connected to the interface will proceed through the following steps:

- The remote user sends text messages including commands to the GSM SIM 300.

• GSM receiver receives messages sent from the user cell phone.

• GSM receiver decodes the sent message and sends the commands to the microprocessor.

• Microprocessor issues commands to the appliances and the devices connected will switch ON/OFF.

III. CONTROLLER AREA NETWORK

The Controller Area Network (CAN) is a serial communications protocol which efficiently supports distributed real time control with a very high level of security. Its domain of application ranges from high speed networks to low cost multiplex wiring. In electronics, engine control units, sensors, anti-skid-systems, Home automation system etc are connected using CAN with bitrates up to 1 Mbit/s. At the same time it is cost effective to build into compact body electronics, e.g. lamp clusters electric windows etc. to replace the wiring harness otherwise required.

A.Technology:

CAN is a multi-master broadcast serial bus standard for connecting ECUs or Microcontrollers. Each node is able to send and receive messages, but not simultaneously. A message consists primarily of an ID (identifier), which represents the priority of the message, and up to eight data bytes. The improved CAN (CAN FD: FD-Flexible data rate) extends the length of the data section to up to 64 bytes per frame. It is transmitted serially onto the bus. This signal pattern is encoded in non-return-to-zero (NRZ) and is sensed by all nodes.

The devices that are connected by a CAN network are typically sensors, actuators, and other control devices. These devices are not connected directly to the bus, but through a host processor and a CAN controller.

If the bus is idle which is represented by recessive level (Logical 1), any node may begin to transmit. If two or more nodes begin sending messages at the same time, the message with the more dominant ID (which has the higher-order dominant - i.e., zero - bit) will overwrite other nodes' less dominant IDs, so that eventually (after this arbitration on the ID.) only the dominant message remains and is received by all nodes. This mechanism is referred to as priority based bus arbitration. Messages with numerically smaller values of IDs have higher priority and are transmitted first.

The CAN data link layer protocol is standardized in ISO 11898-1 (2003). This standard describes mainly the data link layer (composed of the logical link control (LLC) sublayer and the media access control (MAC sublayer) and some aspects of the physical layer of the OSI reference model.

B. Data transmission

CAN features an automatic arbitration-free transmission. A CAN message that is transmitted with highest priority will succeed and the node transmitting the lower priority message will sense this and back off and wait.

This is achieved by CAN transmitting data through a binary model of "dominant" bits and "recessive" bits where dominant is a logical 0 and recessive is a logical 1. This means open collector, or wired or physical implementation of the bus (but since dominant is 0, this is sometimes referred to as wired and). If one node transmits a dominant bit and another node transmits a recessive bit then the dominant bit "wins" (a logical AND between the two).

D. Can base frame format

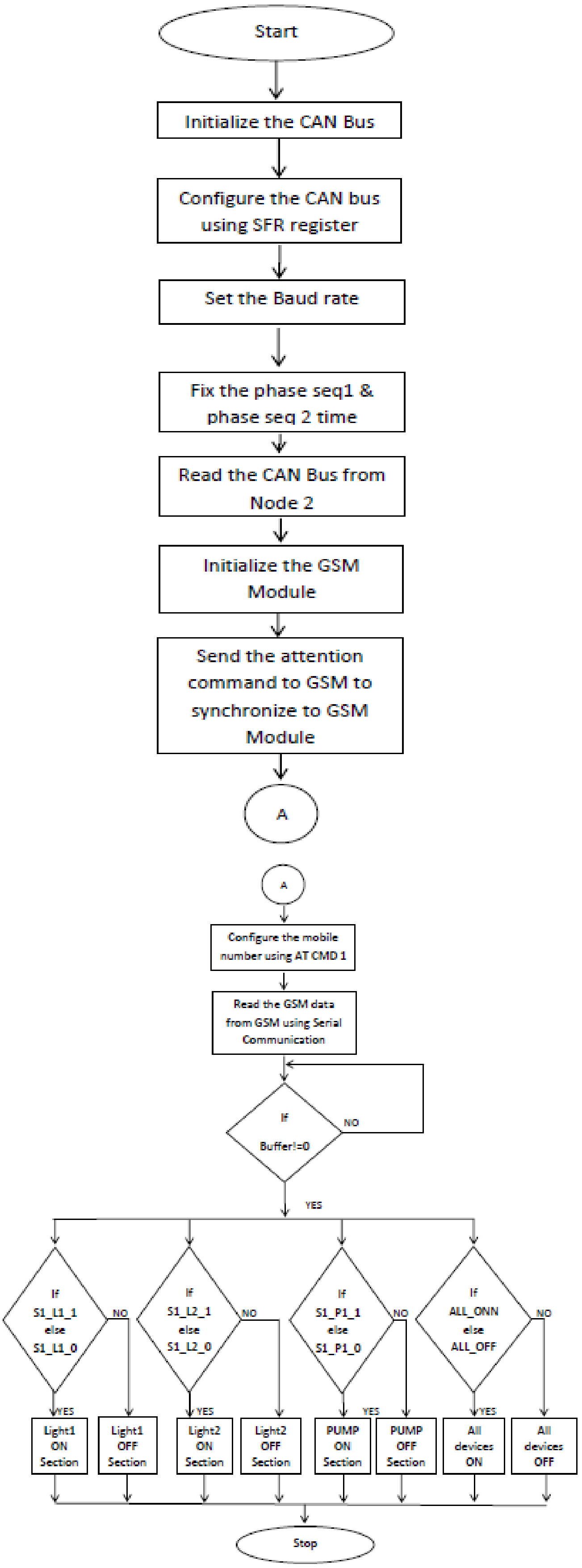
A CAN base frame message begins with the start bit called "Start of Frame (SOF)", this is followed by the "Arbitration field" which consists of the identifier and the "Remote Transmission Request (RTR)" bit used to distinguish between the data frame and the data request frame called remote frame. The following "Control field" contains the "IDentifier Extension (IDE)" bit to distinguish between the CAN base frame and the CAN extended frame, as well as the "Data Length Code (DLC)" used to indicate the number of following data bytes in the "Data field". If the message is used as a remote frame, the DLC contains the number of requested data bytes. The "Data field" that follows is able to hold up to 8 data byte. The integrity of the frame is guaranteed by the following "Cyclic Redundant Check (CRC)" sum. The "ACKnowledge (ACK) field" compromises the ACK slot and the ACK delimiter. The bit in the ACK slot is sent as a recessive bit and is overwritten as a dominant bit by those receivers, which have at this time received the data correctly. Correct messages are acknowledged by the receivers regardless of the result of the acceptance test. The end of the message is indicated by "End of Frame (EOF)". The "Intermission Frame Space (IFS)" is the minimum number of bits separating consecutive messages. Unless another station starts transmitting, the bus remains idle after this.

E. Detecting and signaling errors

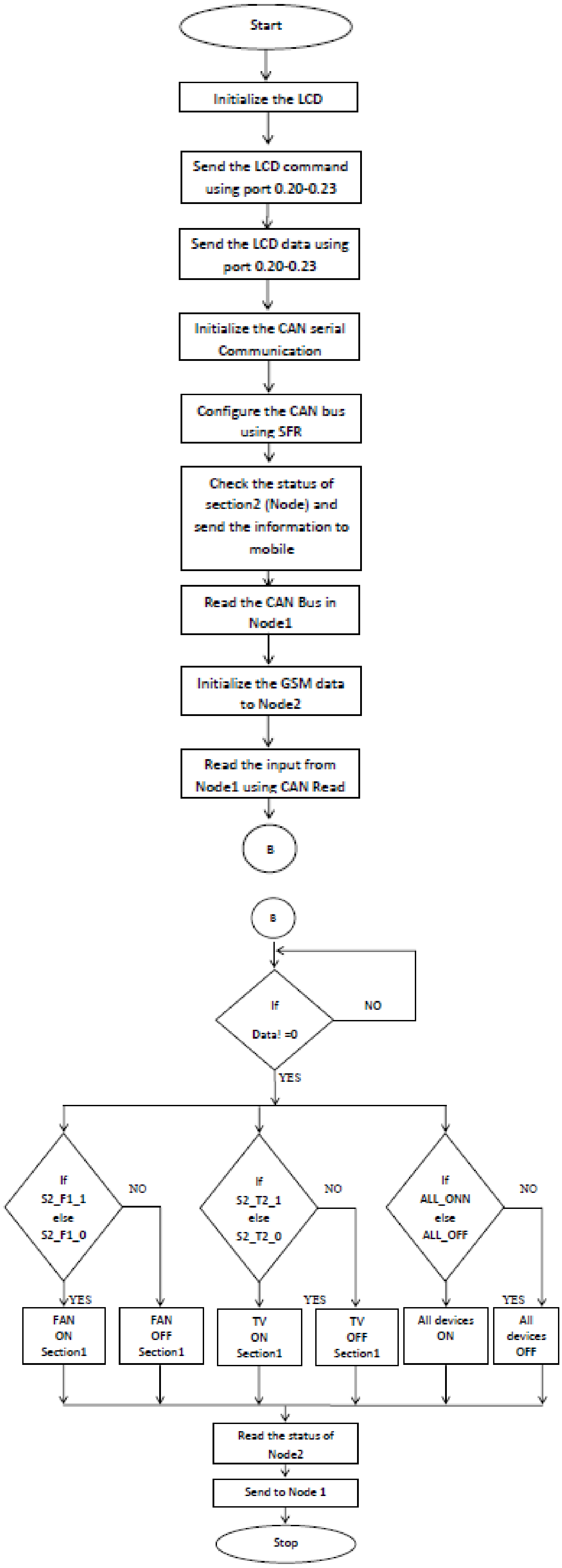
Unlike other bus systems, the CAN protocol does not use acknowledgement messages but instead signals errors immediately as they occur. For error detection the CAN protocol implements three mechanisms at the message level (data link layer: OSI layer 2).

If one or more errors are discovered by at least one station using the above mechanisms, the current transmission is aborted by sending an "error frame". This prevents other stations from accepting the message and thus ensures the consistency of data throughout the network. After transmission of an erroneous message that has been aborted, the sender automatically re-attempts transmission (automatic re-transmission). Nodes may again compete for bus access. However effective and efficient the method described may be, in the event of a defective station it might lead to all messages (including correct ones) being aborted. If no measures for self monitoring were taken, the bus system would be blocked by this. The CAN protocol therefore provides a mechanism to distinguish sporadic errors from permanent errors and local failures at the station. This is done by statistical assessment of station error situations with the aim of recognizing a station's own defects and possibly entering an operation mode in which the rest of the CAN network is not negatively affected. This may continue as far as the station switching itself off to prevent other nodes messages erroneously from being recognized as incorrect.

IV. FLOW CHART



Flowchart 1: Node 1



Flowchart 2: Node 2

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V. RESULTS

A. Software Results

Software simulation is a program that allows the user to observe an operation through simulation without actually performing that operation. Here are some of the snapshots taken during Software simulation. Before implementing it in real time, software simulation is necessary to check the functioning of the code.

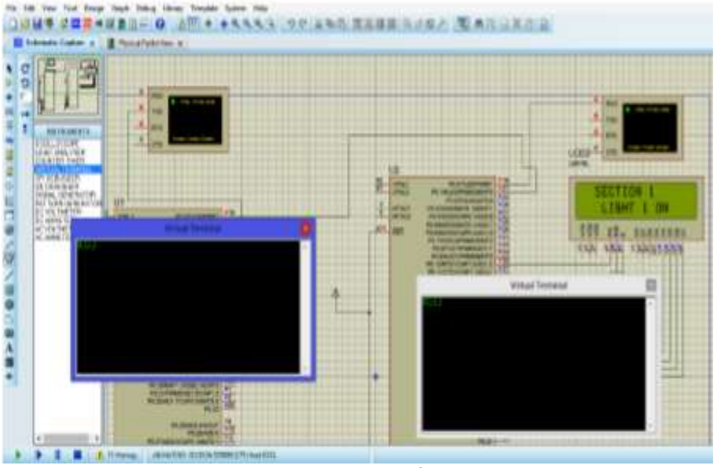

Figure6: Snapshot shows turning ON of Light 1 in Section 1

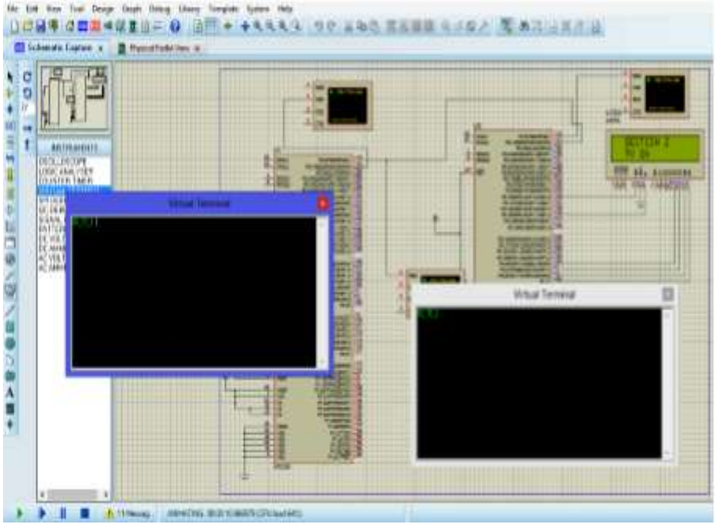

Figure7: Snapshot shows turning ON of FAN in Section 2

B. Hardware Results

Figure8: SMS ALL_ONN is send to SIM 300

Figure9: SMS ALL_ONN is send to SIM 300

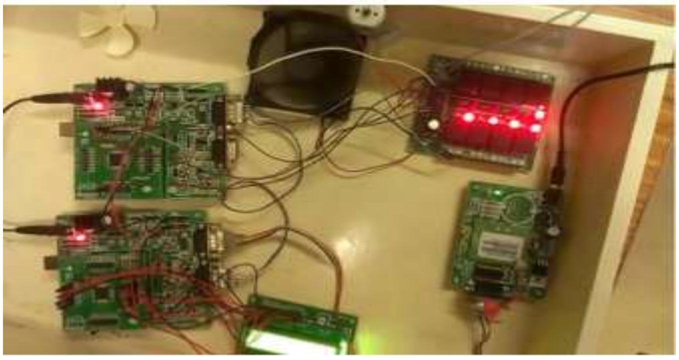

Figure10: All LEDS are turned ON in Relay Board

Here the Commands are sent via SMS to a GSM modem (GSM SIM 300); corresponding Device is turned ON/OFF depending on the command received. We consider the turning ON/OFF of the LEDs in relay board.

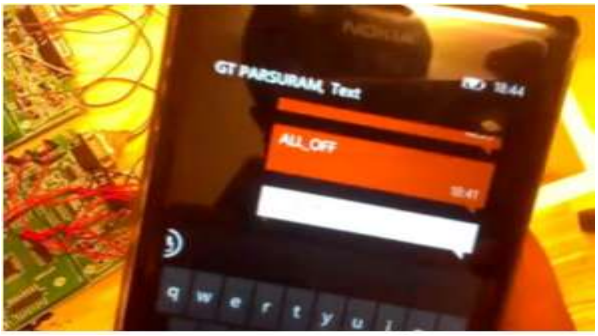

Figure11: SMS ALL_OFF is send to SIM 300

Figure12: LCD displaying command received

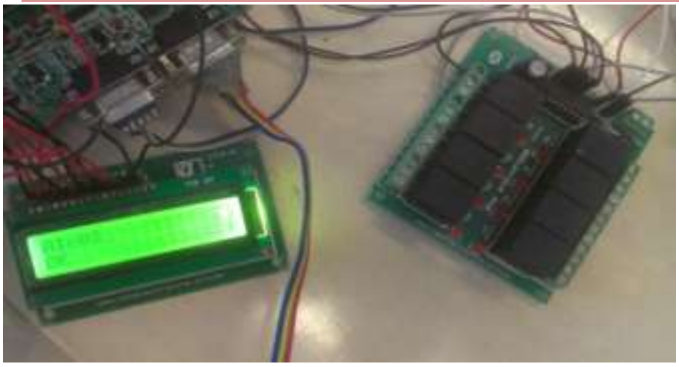

Figure13: All LEDS are turned OFF in Relay Board

Here in the above figure11 ALL_OFF command is sent to SIM 300, in figure12 LCD displays ALL_OFF command has been received and figure13 shows that all the devices connected are turned OFF. In figure13 we can observe that all LEDS are turned OFF. Similarly various outputs are obtained for different commands sent. We have 12 commands as follows

Command	Operation
S1_L1_1	Section 1, Light 1 ON
S1_L1_0	Section 1, Light 1 OFF
S1_L2_1	Section 1, Light 2 ON
S1_L2_0	Section 1, Light 2 OFF
S1_P1_1	Section 1, Pump(Motor) ON
S1_P1_0	Section 1, Pump(Motor) OFF
S2_F1_1	Section 2, Fan 1 ON
S2_F1_0	Section 2, Fan 1 OFF
S2_T1_1	Section 2, TV 1 ON
S2_T1_0	Section 2, TV 1 OFF
ALL_ONN	All Devices ON
ALL_OFF	All Devices OFF

Table1: Command Table

Figure14: SMS S2_F1_1 is send to SIM 300 & LCD displaying command received

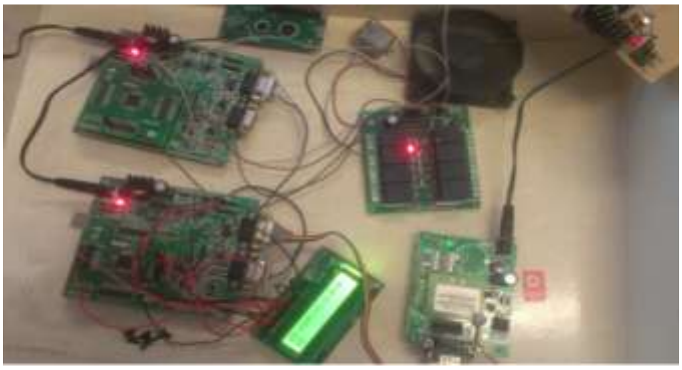

Figure15: First LED is turned ON in Relay Board

Here in the above figure14 S2_F1_1 command is sent to SIM 300 & LCD displaying command received and figure15 shows that first LED is turned ON and to which FAN is connected also turns ON.

We can compare the CAN bus with LIN as follows:

	(A) Messaging	(B) Network Synchronization	(C) Node Control	(D) Message Retransmission	(E) Error Management	(F) Bandwidth	(G) Physical	(H) Cost
LIN	Deterministic Static Message Scheduling	Global Reference Time	Master/ Slave	Limited Message Retransmission Supported	CRC Frame Field, ID Field Parity Bits, Diagnostic Frames	10 kBit/s max	1-Wire	Low
CAN	Event & Time Triggered Messages	Priority-Based Arbitration	Autonomous	Message Retransmission Supported	CRC Frame Field, Bit Monitoring Bit Stuffing, Error Frames, Overload Frame	1 Mb/s	2-Wire	Medium

Table2: Comparison between LIN and CAN

CONCLUSION

Thus an efficient Home automation system using CAN Protocol is designed and implemented. The components used in this idea are cost efficient, thus reducing the budget which can be affordable by a common man. In this concept 2048 nodes can be connected, which increases a wide range of devices that can be interfaced. The data transfer rate is 1Mb/sec which is very efficient in time. Remotely by a touch of a button status of the home can be known or monitored, meanwhile necessary actions can be taken by a single command across the globe. Since CAN bus is used as a communication of a distributed control network, CAN bus provides high safety against EMC problems, thus increasing safety. CAN gives minimized radiation and high irradiation stability. It also overcomes the problem of existing technologies like Insteon, which uses dual-band mesh home area networking topology where one node is master and other are slaves. If master node fails whole system goes down. Whereas we have used CAN bus (Bus topology), where each node acts as a master and each as a slave. Failure of any node doesn't affect other nodes keeping the system safe and stable. The system is secured for access from outside and protected by configuring the user mobile number through GT commands at the SIM 300. The users are expected to register their mobile numbers to the GSM SIM 300. This adds protection from unauthorized accesses.

FUTURE SCOPE

Since we have used Advanced ARM 7 LPC2129 Microprocessor which is of 32 bit, we can use speech signals to control the system along with the SMS. The system can be integrated with various sensors like First Alert 3120B to detect smoke and alert the user as well as Fire fighter to take further steps, PIR sensors to auto turn ON/OFF devices when the user is at home, because sending SMS is not convenient when the user is at home itself. More complex protocols and algorithms like Flex Ray can be implemented as microprocessor used is of 32 bits.

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