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Remote Monitoring & Control using M2M

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ABSTRACT

Now a day due to explosion of technology number of systems get developed. These systems need help of expert for working properly. But it is highly difficult for the technical persons or experts to attend each of these systems for proper maintenance & up gradation or updating. To optimize the energy, cost & time of a manufacturing unit requires a plant wide automation strategy.

Here presenting a prototype remote monitoring system (RMS); this concept definitely helps in saving time & energy. The system also provide much more flexibility for the peoples & also help in carrying information much faster to those remote systems.

The system communicates with remote machine & takes the necessary control action within that machine. Model consists of different modules as Sensors, M2M Manager, GSM transmitter & receiver, Zigbee transmitter-receiver pair.

Key words: - AT commands, GSM, M2M, RMS, Zigbee.

1. INTRODUCTION

Connecting people, devices and systems- The aim of this study was to find ways to improve energy saving & machine to machine Communication. There are billions of machines waiting to be able to communicate with the efficient use of energy. An ice-cream vending machine wants to tell the supplier that it's running out of chocolate cones, enabling the vending operator to better schedule his onsite visits. An electricity meter wants to send consumption figures to the energy provider's billing system, thus providing more frequent meter reading. Or the other way around – using your mobile handset, you may want to activate the alarm system at your cottage remotely, check if the doors at your home are locked or tell your greenhouse to water your plants with the efficient use of energy [1].

M2M is potentially all that, and even more. The term M2M refers to systems that enable machines to communicate with companies' information systems and other machines (machine-to-machine) – or with people's mobile handsets (mobile-to-machine, machine-to-mobile) – and provide real-time data. A wireless data link is used for monitoring and control, with data transfer occurring either by request or at predetermined intervals. Ultimately, M2M solutions are created for increasing the profits, more power efficient & cost efficient and competitiveness of a company through more efficient processes, better customer service or new ways of doing things. M2M is about connecting peoples, devices and systems [1].

The vast fields of M2M communication- M2M solutions are typically developed for remote monitoring & sending indications of unusual situations, collecting information or setting parameters according to business needs. New M2M applications are continuously emerging to serve rather comprehensively all business areas – monitoring elevators in shopping centers, downloading new games into amusement machines, checking the temperature of swimming pools, locating trucks on the highways and tracking the use of office photocopiers, to name just a few [1].

1.1 Machine to Machine

Abbreviation M2M is not very strictly defined. Normally it refers to "machine to machine", man to machine" or "mobile to machine" communication. The leading idea is that at least one end of the communication is handled by a machine. This machine can be for example home appliances major electricity consuming appliances are heating & cooling. The communication & control with these appliances can be done by monitoring some parameters. Similarly the greenhouse monitoring & control can be achieved.

M2M communication can be also used to prevent damages. If machine's self diagnostics detects that some parts are worn, it can use M2M communication to order maintenance and worn parts

can be replaced before machine breaks down. If the machine breaks, it might take weeks to fix the broken part. The savings originated from this preventing maintenance can be very high and in many cases the expenses caused by the machine to machine communication are only a fraction of that [1], [2].

The remote monitoring system uses DAS & SCADA systems & remote monitoring is achieved with the help of GSM network. The M2M applications works as a remote sensing for the electrical appliances at home to check whether it is on or off, at the same time the user can control the electrical appliances at home by sending SMS (Short Messaging Service) message to the system, for example turning on the AC before returning home. [5], [6]. The existing technologies are Bluetooth, Wi-Fi, Wi-Max, wireless mobile Ad-hoc network (WMANET), UMB, wireless HART, Bluetooth and ZigBee. Wireless sensor networks are formed by communicating over wireless links without using a fixed networked infrastructure. ZigBee is the name for a short-range, low-power, low-cost, and low-data-rate wireless multi-hop networking technology standard [3] [4]. In this paper we developed the M2M remote monitoring system using Zigbee & GSM. The centralized data is stored in database. The front end form is designed in Visual Basic[7]. If star topology is used then from multiple locations we can collect the information.

2. ARCHITECTURE

"Remote Monitoring & Control using M2M" our paper, deals with different parameters collected at remote location using sensors & M2M Manager (ARM Processor LPC 2138). The advantages are that ARM processor uses less power & parameters are transmitted to the user with the help of GSM modem using SMS facility & same parameters are collected and stored in PC at other location by zigbee transmitter & receiver pair. The data log is maintained in the computer with the date & time. The set point values of the parameters can be changed from the computer.

This system is more user friendly cost efficient & also it consumes low power.

2.1 SPECIFICATIONS

Input Voltage :- 5V Battery
Input to System :- SMS / Computer
Number of Sensors :- 3
Number of Relays :- 3
GSM Module : - Wavecom
Zigbee Modem :- Xbee Pro
Clock Mode :- 24 Hour Mode
SMS Billing :- At Low Cost
Security :-Authentication by Login & Password.

3. BLOCK DIAGRAM

The block diagram of the system is as shown below

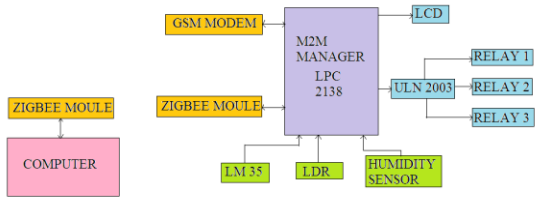


Fig. 3.1 Block Diagram

M2M (Machine to Machine Communication) is the ability of the machines or devices to exchange information with people or an enterprise. Regardless of the type of machine or data, information is conveyed in the same general way- from a machine to a network, and then through a gateway to another machine.

There are many different choices to have how machines connected to each other, what type of communication being used, how data is used. There are four resembling basis stages for any M2M process

1. Collecting data
2. Transmitting collected data through a Communication network
3. Receiving data
4. Processing data.

As shown in Fig. 3.1 the physical parameter likes temperature, light intensity & humidity values are collected by different sensors. Then these values are processed by M2M Manager (ARM Processor). It compares the current parameter values with the threshold value or the already set values, if any of the parameter value is exceeded above the set point, then the corresponding message is send to the user & corrective action is taken to control the parameter value. So the unwanted working of the machine is prevented. Also the machine working condition is also stated to the user, if the damage or anything wrong occurs with the machine a message will be sent to the user, so user can take necessary action. So M2M is about letting your machines talk to user.

4. AT COMMANDS

Some of the AT commands used to communicates with the GSM modem & M2M Manager are as follows

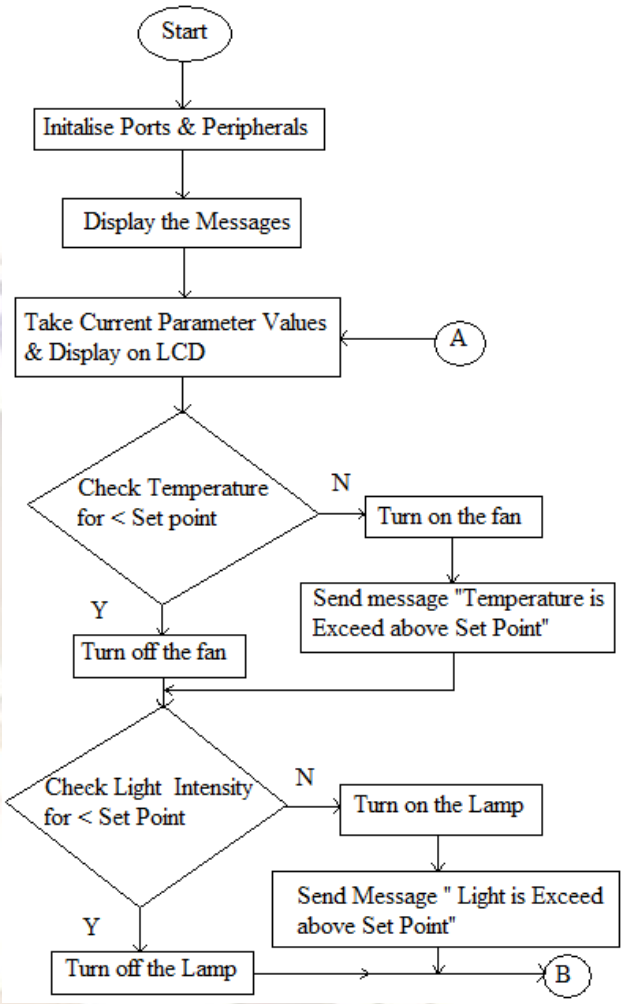
1. AT + CPMS Preferred Message Storage
2. AT + CMGF Message Format
3. AT + CSMP Set Text Mode Parameters
4. AT + CMGS Send Message
5. AT + CMGW Write Message to Memory
6. AT + CMGC Send Command
7. AT + CMGD Delete Message
8. AT + CMGR Read Message
9. AT + CNMI New Message Indications to TE. [9] [10]

Also AT commands are also used to configure the Zigbee module some of the commands are as follows
1. ATBD Serial Interfacing
2. ATDL Read Destination Address Low
3. ATDH Read Destination Address High
4. ATDB Received Signal Strength
5. ATWR Write to non-volatile memory
6. ATID Pan ID
7. ATPL Power Level [11]

5. FLOW CHART

The M2M Manager is programmed in Embedded C [8], while Front End of project is designed using Visual Basic.
The software's used:-
1. Simulation: - Keil µVision 3
2. Flash Magic
3. Front End: - Visual Basic 6.0
4. PCB Design: - Design Explorer Protel 99SE

The Flow chart is as follows



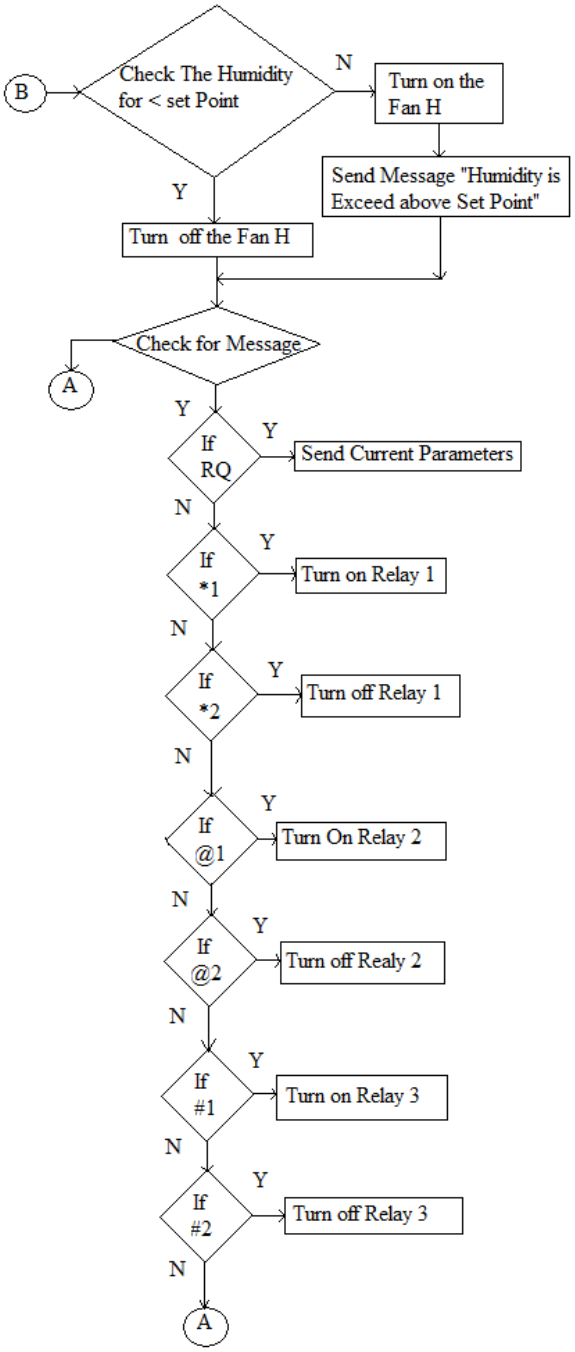


Fig. 5.1 Flow Chart (Y- indicates the true condition, N- indicates false condition)

When the user wants to know the system current status, user can send the message "RQ". The M2M manager decodes the message and sends the current parameter values to the user. Some predefined messages which send by the user to know the current status & to take action are as follows

1. RQ: - To get the current status of the parameters
2. *1:- Turn on the Relay 1
3. *2:- Turn off the Relay 1
4. @1:- Turn on the Relay 2
5. @2:- Turn off the Relay 2
6. #1:- Turn on the Relay 3
7. #2:- Turn off the Relay 3

6. RESULTS

Following result / data is taken from hyper terminal when the communication between GSM modem & ARM processor take place. The following sequence of AT commands & its response is observed:-

AT
OK
ATE0
OK
AT+CMGF=1
OK
AT+CPMS= "SM"
+CPMS: 1,25,1,25
OK
AT+CMNI=1,1,0,0,0
OK
+CMTI: "SM",1
AT+CMGR=1
+CMGR:"REC UNREAD","+919960282414",,"12/02/2,15:30:25+22"
P
OK
AT+CMGS="+919673253900"
> Tp:24 ^{0}C H:70% LI:60Lux
+CMGS: 135
OK
AT+CMGD=1
OK
+CMTI: "SM",1
AT+CMGR=1
+CMGR:"REC UNREAD","+919960282414",,"12/02/12,15:31:17+22"
Tp:30 ^{0}C H:75% LI:65Lux OK
AT+CMGS="+919673253900"
>OK
+CMGS: 136
OK
AT+CMGD=1
OK

Following are the Screen shots of the LCD
The current status of the parameter is displayed & is automatically updated in the given specified time:-

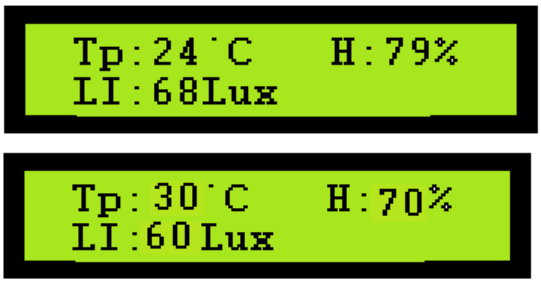


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Fig. 6.1 Screenshot (Current Status of Parameters on LCD)

The message is send to the user when one of the parameter is exceeded above the set point values:-

Fig. 6.2 Screenshot (After sending the message)

The system also updates the computer database time to time. We can set the parameters set point values by using the form designed in visual basic. The form is as follows:-

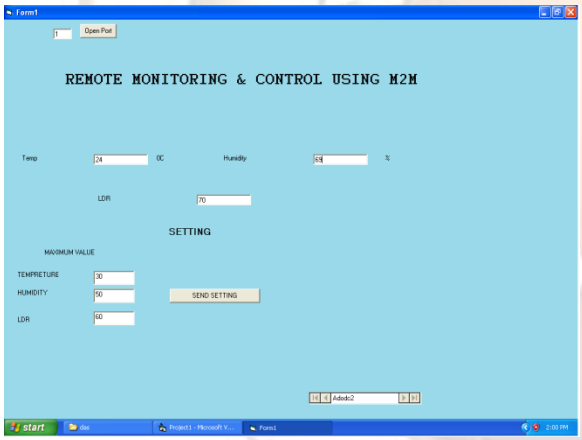

Fig. 6.3 Screenshot (V. B. Front end form)

CONCLUSION

As with the help of this we can save the energy by controlling the devices. The device can work only when it is necessary. The working in sensor networks is very dynamic, and the expectations of the applications and business potential are very high. For this purpose, we have given a perspective on state-of-the-art wireless sensor networks from the application point of view.

We have also listed several application visions. It is the task of industry and the research community to realize these visions.

It resolves communication and control problems between different in technical characteristics machines and make them part of global Internet network. This system provides flexibility to commercial people. This system can be further extended to remote factory automation. No physical presence is required at the location where you have to control the device.

Applications

M2M-based control applications require systems to make decisions based on input from multiple sensors. For example, a network of distributed temperature sensors could control a heating system or motion sensors could detect when people are moving toward a building lobby and call an elevator.

There are limitless M2M applications. However, they are categorized as following:-

1. Automation in industries.
2. In agriculture.
3. Greenhouse monitoring system
4. Home automation and security
5. Lease machine control monitoring
6. Automation in vending machine
7. To communicate with rural KIOSKS.

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