Grenze International Journal of Engineering and Technology, June Issue

A Novel Approach to Operate Appliances: Remotely Enabled Communication System

Sarang Krishnakumar Mishra[1], Karan Krishna Dahiwale[2], Vinay Sanjay Shende[3] and Swati Hira[4]
[1,4]Department of Computer Science and Engineering Shri Ramdeobaba College of Engineering and Management, Nagpur, India
[2]Department of Computer Science and Engineering S.B Jain Institute of Technology, Management and Research Nagpur, India
[3]Department of Computer Science and Engineering Rajiv Gandhi College of Engineering and Research Nagpur, India
Email: mishrask@rknec.edu, karand.cse@sbjit.edu.in, vinayshende79@gmail.com, hiras@rknec.edu

***Abstract*— In recent years, a lot of research work has been proposed on routing scheme in WSN. Remote Accessing is one of the most promising techniques due to its simplicity, scalability and efficiency. Under many research and development cell, it has been noted that establishing the wireless sensor nodes and let them work as a cluster, but the major problem with the wireless technology has limitation of range. The solution of this issue is to use Radio frequency as a way to communicate in a cluster. As REMS mainly focuses on the Agricultural sector, where the lands are present remotely with issues of Internet connectivity which is the main requirement for the present IOT devices. That is why we aim to develop a system which entirely runs on its own private network without any need of Internet connectivity. The system is easy to use and has a long range. The system also doesn't require a smart phone as it is interface free, it can be controlled with a simple keypad phone. The cost effectiveness and the mentioned features makes REMS a system, which can independently survive in remote agricultural lands. Thus, the creation of this system will help farmers for controlling the devices which run on electricity (e.g Irrigation Motors) as the system is cost effective, has long range and a internet free technology.**

***Index Terms*— DTMF, WSN, RF, AT commands, Cluster, GSM, Arduino UNO, Arduino NANO, HC12**

I. INTRODUCTION

Recently, Automation is one of the most growing terms in India. Day by day automation can be seen in various fields. Households, Offices, Industries are the prime areas where automation is contributing a lot. When we talk about agricultural Automation, it has still not reached many parts of India which leads to inconsistency in production and many more problems. Most of the land in India is occupied by agriculture, and as India is making progress continuously in IT and Automation, its needed to bring some reliable system of automation. This Project aims to provide farmers a better, cost-effective and reliable electrical equipment automation system.

The system actually works in a cluster and has a master and a slave node. The master controls the entire cluster, commands andacknowledges all nodes in a cluster and communicates with the user which includes task like accepting the commands from theuser with the help of DTMF, broadcasting the received command by the user into the cluster with the help of WSN and also sending a status message to the user. The nodes also process the signals or commands sent by the master with the help of theirlogic and serves the commands intended to them and

Grenze ID: 01.GIJET.9.2.329_1

acknowledge to the master accordingly. Figure 1 provides a basic block diagram of the REMS and Figure 2 provides a detailed block diagram which can facilitate in interpreting the architecture and communication inside the cluster.

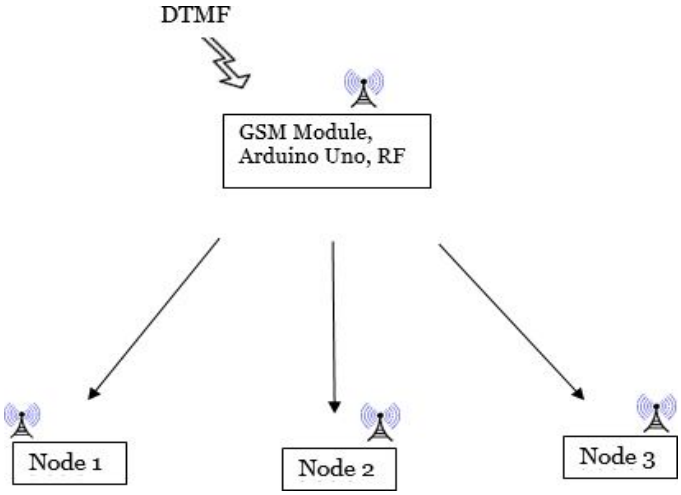

Fig 1. Block Diagram Of REMS

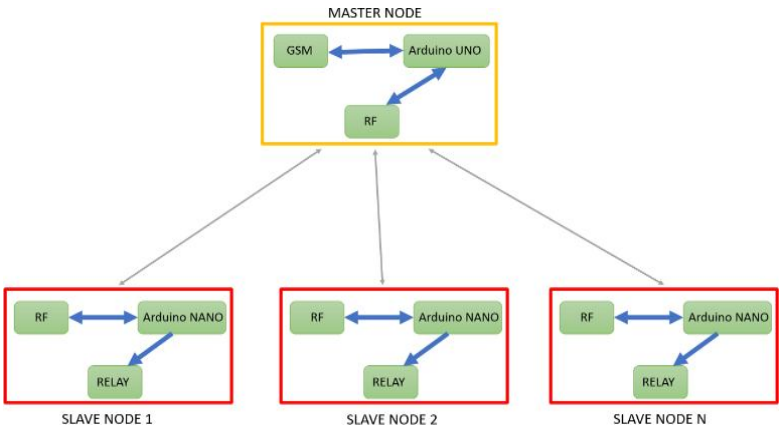

Fig 2. Detailed Implementation of REMS

The major objective of our invention is to provide farmers with automation systems, which are reliable, easy to use and has low prerequisites. Seeing the recent conditions, Automation without the intervention of internet is a need now. Our invention makes Automation system, an internet free technology, also there is no interface to control the system which makes system easy to use and because of radio frequencies there are no range limitations. Also the minor objective of the invention is to reduce the cost of Agricultural Automations.

To make a system based on Remote Device Controlling and Automation which can be used to control the electrical agriculturalequipment and also home appliances through a Radio Frequency, cluster based and an Internet free technology.

In this paper, we started with the introduction of the system, then we reviewed various literature and concluded them. After thiswe defined the methodologies which are used into the system, also we explained the detailed description of how the system works and provided the observations we noticed during the testing of the system and then finally we concluded the paper.

II. Literature Review

As various researches has been done in this field. We are discussing some of them here.

Author [1] discussed about a home appliances Control automation System using GSM. The overall design of smart Home Automation system is said to be low cost and also wireless. The system claims that the ON/OFF process of home appliances can be done remotely through GSM. Paper [2] presents a low-cost Smart Living System, which

uses Android based User Interface for controlling of home appliances via Bluetooth or internet connection. The system also integrates home security and alert system. Researcher [3] talks home automation and remote monitoring, environmental monitoring including humidity, temperature and fault tracking and management. The system is based on the Microcontroller MIKRO tiple passive and active sensors and also Internet services which is used in different monitoring and control processes. In paper [4] author talks about A low-cost home automation system based on Arduino microcontroller that works with Modbus protocol which is controlled by network communications and Modbus industrial protocol. Researcher [5] develop a home automation system that gives the user complete control over all remotely controllable aspects of his or her home. The system can be controlled through a centralhost pc and the Internet. It concludes that improvements in wireless automation solutions as well as lowering of price points asthe market can help in increasing automaton usage in larger volumes. Authors [6] also develop a home automation system usingtechnologies like WSN, Wi-Fi, Bluetooth and ZigBee to provide a user friendly and cost effective home automation system. Itconcludes that the system provides interface between various types of home and electrical appliances in a limited range and thesystem is cost manageable, flexible and energy efficient. The paper [7] describes the technology about a smart switch board. The switchboard module fits behind the existing switchboard panel, without changing any electrical wiring or interior décor and automates accordingly. It is a wired approach which can be controlled with the help of internet. Findings of author [8] presents a low cost and flexible home control and environmental monitoring system which consists of an embedded micro – web server in Arduino Mega 2560 microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely. Controlling can be done through a web application or a Bluetooth based smart phone app. The paper [9] presents Bluetooth and Arduino based smart home automation system using the Arduino ATMEGA328 processor. In this system, the temperature and fire alerts are also detected through sensors by using the Android based mobile phones. The paper explains about the automated approach of controlling the devices in a household through temperature and fire detecting sensors that
could ease the tasks of using the traditional method of the switch. The paper [10] presented with design and implementation of a low cost but yet flexible and secure internet-based home automation system. The communication between the devices is wireless with te help of RF communication. The protocol between the units in the design is enhanced to be suitable for most ofthe appliances. Authors discussed about implementation of a wireless real-time home automation system based on Arduino Uno microcontroller as main controller. This project is about building a home automation system, where the user can control the home appliances by simple phone including a GSM module, just by sending SMS through the phone.
Referring to the literature review, we can say that most of the automation or home automation technologies are based on Internet, Wi-Fi and Bluetooth modules. Using these technologies brings the constraint of range limitations and also availabilityof Internet should be present. In some cases, technologies like Radio Frequencies and GSM are also used but they are limited in scope and are able to control a single device at once. Many papers claim that the systems are cost effective but if we think about a system which can only control a single device or a set of devices with the help of Internet and android phones, we willfind out that these systems does not bring cost effectiveness to that extent. REMS uses GSM which connects the user with thesystem. The system works in a form of cluster and communicates using Radio frequency which provides REMS modularity and also the system becomes wireless and the range increases.

III. METHODOLOGY

In this section, we introduced the methodologies which are used in the implementation. We also explained the concept of the methodology, their operating parameters and how and where these technologies are used in the implementation of the system.

A. Dual Tone Multi Frequency (DTMF)

Dual-tone multi frequency signaling (DTMF) is a telecommunication signaling system using the the voice-frequency band over telephone lines between telephone equipment and other communications devices and switching centers. Here with the help of DTMF the user connects with REMS and fires AT commands which are accepted by the master node and intended action takes place.

B. Wireless Sensor Network (WSN)

Wireless Sensor Network (WSN) refers to spatially dispersed and dedicated sensors that monitor and record the physical conditions of the environment and forward the collected data to the central location. This is used by the

nodes present in the cluster. The nodes accept the command from the master node and then process it. If the command is found related to them, then they will act acordingly and will acknowledge the Masternode.

C. Cluster

Clustering is an important functionality in Internet of Things (IoT). It allows multiple devices to act as one and coordinate the work between themselves. REMS works in the form of a cluster which consists a master node and a slave node. Master node is the node which communicates with the user and also commands the nodes present in the cluster.

D. Radio Frequency (RF)

Radio Frequency (RF) refers to the rate of oscillation of electromagnetic radio waves in the range of 3 kHz to 300 GHz, as well as the alternating currents carrying the radio signals. Ths is the frequency band that is used for communications transmissions and broadcasting. In our implementation. The communication is taking place with the help of Radio frequencies. For this we have used HC12 Rf which is a LongRange RF Wireless SERIAL Module whose working frequency band is 433.4 – 473.0MHZ

E. Global System For Mobile Communication (GSM)

The Global Syatem for Mobile (GSM) network is the standard system used by most mobile phone network around the world. Whether a system uses a cellular network based around broadcast stations or satellite technology connected to signals from orbit, both types can be part of the GSM network.With the help of GSM, the user is able to connect with REMS with the help of a cellphone call.

IV. Detailed Description

This section provides the detailed description of the system and how the system communicates within the cluster and provides user with the desired results. The Master Node heading consists of how the master communicates with the user and also with the Slave nodes. The Slave Node heading consists of how the nodes receive data and process it.

A. Master Node

- SIM900 : A GSM is a module which connects the user with the entire system through a call. The GSM automatically picks up the user's call after three seconds, which opens the gateway through which user can send commands and communicate with the system. The GSM receives the command and sends it to the Arduino UNO for further processing.
- Arduino UNO : UNO takes the command as an input from the GSM which was given by the user to process according to the uploaded logic. Now, as the data is processed, it is ready for broadcasting. For broadcasting, the Arduino UNO sends the processed data to the HC12 RF module.
- HC12 RF : HC12 module broadcasts the data received by the Arduino and also receives messages sent by the receiver nodes.

Figure 3 shows the circuit diagram of the master node.

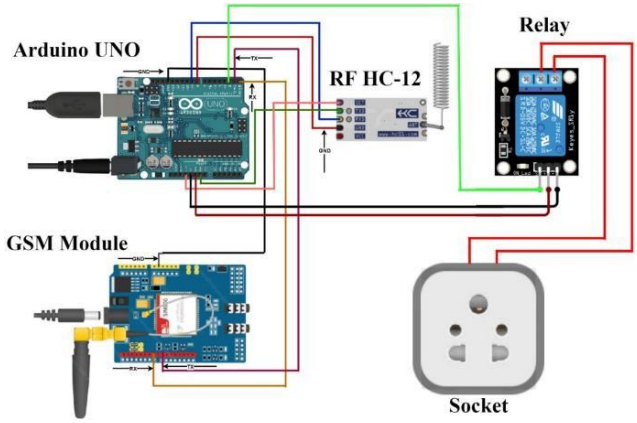

Fig 3. Circuit Design Master Node

B. Slave Node

- HC12 RF : the module receives the message sent by the Master node and provide it to the Arduino NANO for further processing.
- ARDUINO NANO : Arduino NANO takes the input from the HC12 module and processes it. After processing if the definition of the processed output is available in the uploaded logic, then the node will send signals which were intended by the user to the Relay Module.
- Relay Module : The Relay Module is connected to the Electric Socket of the node and turns it on and off, based on the signal provided by the Arduino. Figure 4 shows the circuit diagram of the slave node.

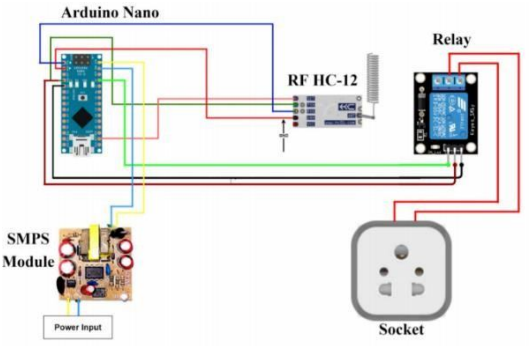

Fig 4. Circuit Diagram – Slave

V. EXPEREMINATION AND RESULTS

This section presents various readings and data we captured while using the system in the user environment. At each distance,5 tests were done, and the results are presented in a tabular format accordingly.

TABLE I: READINGS OF 5 ATTEMPTS AT 10M

Sr.No	Distance	Attempts	Attempt successful/ unsuccessful	Call Pickup	ResponseTime	Result
1	10m	1	Successful	2 rings	0.66-0.78 sec	Pass
		2	Successful			Pass
		3	Successful			Pass
		4	Successful			Pass
		5	Successful			Pass

TABLE II : READINGS OF 5 ATTEMPTS AT 50M

Sr.No	Distance	Attempts	Attempt successful/unsuccessful	Call Pickup	ResponseTime	Result
2	50m	1	Successful	2 rings	0.70-0.78 sec	Pass
		2	Successful			Pass
		3	Successful			Pass
		4	Successful			Pass
		5	Successful			Pass

TABLE III : READINGS OF 5 ATTEMPTS

Sr.No	Distance	Attempts	Attempt successful/unsuccessful	Call Pickup	ResponseTime	Result
3	100m	1	Successful	2 rings	0.50-0.62 sec	Pass
		2	Successful			Pass
		3	Successful			Pass
		4	Successful			Pass
		5	Successful			Pass

TABLE IV: READINGS OF 5 ATTEMPTS AT 200M

Sr.No	Distance	Attempts	Attempt successful/unsuccessful	Call Pickup	ResponseTime	Result
4	200m	1	Successful	2 rings	0.55-0.88 sec	Pass
		2	Successful			Pass
		3	Successful			Pass
		4	Successful			Pass
		5	Successful			Pass

TABLE V: READINGS OF 5 ATTEMPTS AT 500M

Sr.No	Distance	Attempts	Attempt successful/unsuccessful	Call Pickup	Response Time	Result
5	500m	1	Successful	2 rings	0.66-0.78 sec	Pass
		2	Unsuccessful			Fail
		3	Unsuccessful			Fail
		4	Successful			Pass
		5	Successful			Pass

TABLE VI: READINGS OF 5 ATTEMPTS AT 850M

Sr.No	Distance	Attempts	Attempt successful/unsuccessful	Call Pickup	ResponseTime	Result
6	850m	1	Successful	2 rings	0.70-0.78 sec	Pass
		2	Unsuccessful			Fail
		3	Successful			Pass
		4	Unsuccessful			Fail
		5	Successful			Pass

From observed readings we can notice that the response time is more when the distance is smaller as compared to the larger distance. The reason behind this is the internal architecture of the system which is built such a string of signal is sent so that, even if any character loses, the remaining characters will reach the node and the task will complete. So as more characters reach, while the distance is less, the processing time increases and we can observe a slight delay in communication. All the tests are done in area where many obstacles for signal loss are present. If tried in areas which are obstacle free (for. Ex. Agricultural lands), we can see an increment in accuracy as well as reach.

VI. Conclusion

In this paper we first explained that how automation is growing day by day and the need to bring it into the Agriculture sector.After this we tried to explain the system design with the help of a block diagram and defined our objective and problem statement for REMS. We also analyzed various technologies through which home automation can be achieved and also tried to describe the flaws of those systems which we overcame in REMS. The current implementation of REMS is based on a clusterapproach with only ON/OFF feature. In future, we can expand the same system, by making changes in components which canincrease the capacity as well as range. As of now, we implemented the system with three nodes and a master, but in future and according to the requirement these nodes can be increased to 9. The clustering approach and an easy customization for cross specification controlling with cost effectiveness makes REMS a more adaptive technology.

References

[1] Shubham Magar, Varsha Saste, Ashwini Lahane, Sangram Konde, Supriya Madne, Smart Home Automation By Gsm Using Android Application.

[2] Shiu Kumar, Seong Ro Lee, Android Based Smart Home System with Control via Bluetooth and Internet Connectivity

[3] Mohamed Abd El-Latif Mowad, Ahmed Fathy, Ahmed Hafez, Smart Home Automated Control System Using Android Application and Microcontroller.

[4] Vahid Hassanpour, Sedighe Rajabi, Zeinab Shayan, Zahra Hafezi, Mo hammad Mehdi Aron, Low Cost Home Automation Using Arduino and Mod bus Protocol

[5] Gaurav Panwar, Rajat Maurya, Rajesh Rawat, Rohit Kanswal and Praful Ranjan ,"Home automation using IOT application" International Journal of Smart Home. Received (May 12, 2017), Review Result (July 23, 2017), Accepted (August 18, 2017)

[6] Smart Home Automation System using Android Application Prof.H.B.Shinde1, Abhay Chaudhari2, Prafull Chaure3, Mayur Chandgude4 Pratik Waghmare5 1Assistant professor, Dept. of Computer Engineering, Keystone school of engineering, Pune, India 2345Students, Computer Engineering, Keystone school of engineering, Pune, India

[7] "IOT based Smart Switchboard using Self-Designed Programmer Device" Raashid Ansari1, Manzil Baruah2, Kamal Chauhan3, Hitesh Jethani4, Sarika Kuhikar5 1,2,3,4Student, Department of Electronics Engineering, Vivekanand Education Society Institute of Technology, Mumbai, Maharashtra, India 5Proffesor, Department of Electronics Engineering, Vivekanand Education Society Institute of Technology, Mumbai, Maharashtra, India.

[8] "Design of a Home Automation System Using Arduino" Nathan David, Abafor Chima, Aronu Ugochukwu, Edoga Obinna

[9] "Bluetooth and Arduino Based Smart Home Automation System" Srikanth.B Dept of ECE,Sri Sivani Institute of Technology, Chilakapalem Jn,AP,India. N.P.V.Bhaskar Reddy Assistant Professor, Dept of ECE,Sri Sivani Institute of Technology, Chilakapalem Jn,AP,India.

[10] A.Z. Alkar, and U. Buhur, "An Internet Based Wireless Home Automation System for Multifunctional Devices," IEEE Transactions on Consumer Electronics, vol. 51, no. 4, pp. 1169- 1174, Nov. 2005

[11] "Design and Implementation of GSM Based Home Automation System using Arduino Uno" 1Bhargav.P, 2Anjana Khadka, 3Misba Afroze Telecommunication Department, Dr. Ambedkar Institute of Technology