International Journal of Smart Home
Vol. 10, No. 6 (2016), pp. 155-162
http://dx.doi.org/10.14257/ijsh.2016.10.6.16

Smart Door Lock System for Elderly, Handicapped People Living Alone

Ateev Agarwal[1], Eesh Mehandiratta[2], Rohit Sanket[3], Rohit Samkaria[4], Tanisha Gupta[5], Rajesh Singh[6], Anita Gehlot[7]

[1-7]College of Engineering Studies, University of Petroleum and Energy Studies, Dehradun, India
[1]ateevag@gmail.com ,[2]eeshmehandiratta297@gmail.com ,[3]rohitsanket@gmail.com ,[4]rohit.samkaria93@gmail.com
[5]tgupta7777@gmail.com ,[6]rsingh@ddn.upes.ac.in ,[7]anita@ddn.upes.ac.in

Abstract

The old, deaf and blind people faces problem in opening and closing of the door in their house as they have to walk to the door to do so. This paper is about the device which is made to solve the problem faced by old people of opening and closing of door again and again, by using an Arduino based remote that can control the door lock using RF module, for receiving and transmitting the data. The product consists of two devices both are based on Arduino. One of the two devices will be fitted at the door that will send the signals to indicate the old person to open the device and will receive the signal to open and close the door lock while the other device will work as a remote consists of chargeable batteries, easy to carry just like a mobile will help to indicate the person carrying it to open the door. The receiving and transferring of signals will be done using RF modules connected to the Arduino boards. The device will help to ease the problem faced by the old, blind and deaf people in controlling the door lock from any part of the house. In future, the RF module in the device to transmit and receive the data can be replaced by Internet of things technology to control the lock from any part of the world. More features like controlling of home appliances, windows etc. will also be the part of this device in future therefore, it has a good future scope also.

Keywords*: Arduino, RF modules, home automation, etc.*

1. Introduction

The Elderly people face problem in walking to the door and opening it again and again because of body pains and ageing problems, sometimes they get injured too. Aldrich et al discussed the benefit of using variability models to maximum for designing some system with strong logical base capable of performing autonomic operations at runtime. These autonomic operations are made possible by variability models which reuse the design time effort. They came up with a model for management operations which can be applied to smart homes for achieving self-heating and configuring capabilities. [1] Valtchev et al implemented an initiative to improve the quality and integration of numerous existing home networks. The enhanced quality allows Open Service Gateway Initiative to be used for real world problems like doorway management system.[2] Al-Muhtadi et al discussed a smart home programmable security mechanism. Tiny SESAME were presented to adjust according to the environment falling short of resources.These SESAME's which are Java implementation of a subset of SESAME can be attached to handheld devices. [3] Han et al discussed the use of wireless technologies like Zigbee and IEEE 802.15.4 in controlling consumer devices, smart home energy networks and automation projects. A wirelessly communicating green home system which includes home appliances and some

ISSN: 1975-4094 IJSH
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smart sensors, capable of energy management was presented. This system assigned particular home jobs to particular components. The information from these components was collected using networks based on both sensor and actuator components. A protocol for improving wireless communication network performance was developed. [4] McDaniel et al presented a smart grid power management and generation system with advanced security features. The paper also considered the present condition of smart grids deployed the world over and various factors behind them including major sources and financial losses during security collapse.[5] Hou et al discussed the working of intelligent, Zigbee and GSM/GPRS based home security system. The system included two sections– a home system and remote control system. The information regarding the unusual, unwanted activity could be received at a remote location via MMS/SMS. As a response, the remote controller can send remote instruction to monitor household appliances. Enhanced sensors and surveillance devices along with wireless communication network ensured better control and home security. [6] Hong et al introduced the solution to the problem of unreliable information from sensors due to manufacturing or operational defects. A process of fusing together the contextual information from partially unreliable sensor data was addressed. Using various data handling techniques, a consensus is achieved, which automatically recognized daily activities of inhabitants of smart homes. A framework for management of unreliability of sensors is introduced. The effects of reliability level of various sensors used on the final decision making process were demonstrated. [7] Li et al presented an IoT based application of smart homes in making smart communities. The architecture communities which are basically networked smart homes been described. Secure and robust applications of smart community techniques used and challenges therewith have been presented.[8] Edwards et al examined the technical and social challenges in the way of smart homes becoming a reality. Owing to the potential of smart homes in enhancing quality of life with increased communication and awareness, they aim at creating awareness among researchers in various fields. [9] Tang et al discussed the individual technological benefits of telecare and smart homes and then the improved security and living from the integration of the two. The telecare services brought together with smart homes would save costs such as those incurred in visits in healthcare, better cater to user's needs and decrease improper resource allocation. [10]

2. Prototype Development

The device consists of two Arduino based devices which communicate with each other and control the door. The device attached at the door consists of an Arduino board, LCD display, LED panel, microphone, speaker, door locking system, buzzer, RF modem and a button. The device with the person inside the house consists of an Arduino board, vibrator, LED panel, microphone, buzzer, speaker, RF modem and a switch.

The time when a person at the door will press the doorbell button the RF module attached to the arduino at node-2 will transmit the signal and the RF module connected to the arduino at node-1 will receive the data and the arduino will activate the indicators (led, buzzer & vibrator) connected to it at node-1 & at the time the person in the house will be indicated he/she can press the button to start the microphones and speakers connected to both the arduino of the two nodes to communicate with the the person at the door to verify his/her identity. After the verification the person inside the house will press the open button that will send the data to the arduino using RF module on node-1, the RF module on node-2 will receive the data , the time data is received lcd will display opening and motor will rotate to open the lock, another button on node-1 will be used to close the door lock

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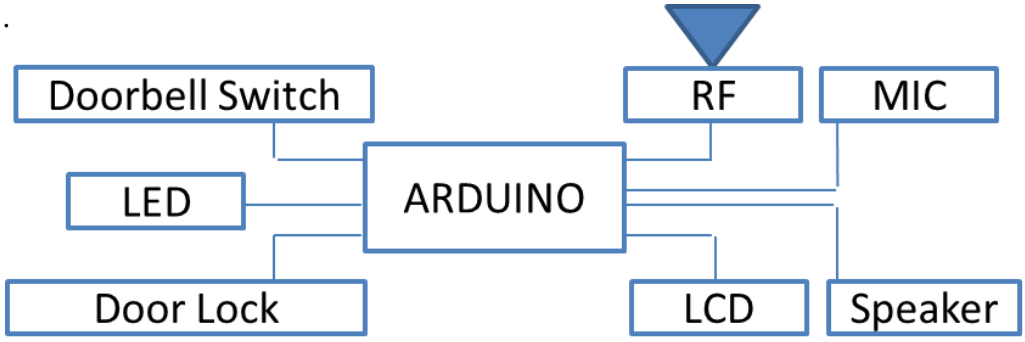

Figure 1. Block Diagram of Node-2

Figure 2. Block Diagram of Node-1

2.1. Hardware Development

2.1.1. Device at the door (Node-2): Button is connected at pin 6 of the Arduino board , lcd is connected at pin (12,11,5,4,3,2), RF module is connected at RX and TX pin of Arduino board and servo motor is connected at pin (10,9,8,7), Microphone is connected at analog pin A0 and speaker is connected at pin A1.
When a person at the door pushes the button, the RF module transmits a signal to the receiver end which turns on the vibrator, microphone and LED's of the device with Handicapped person inside the house. Thus deaf or blind person inside the house can be notified whenever anyone presses the door bell and can communicate with the person.

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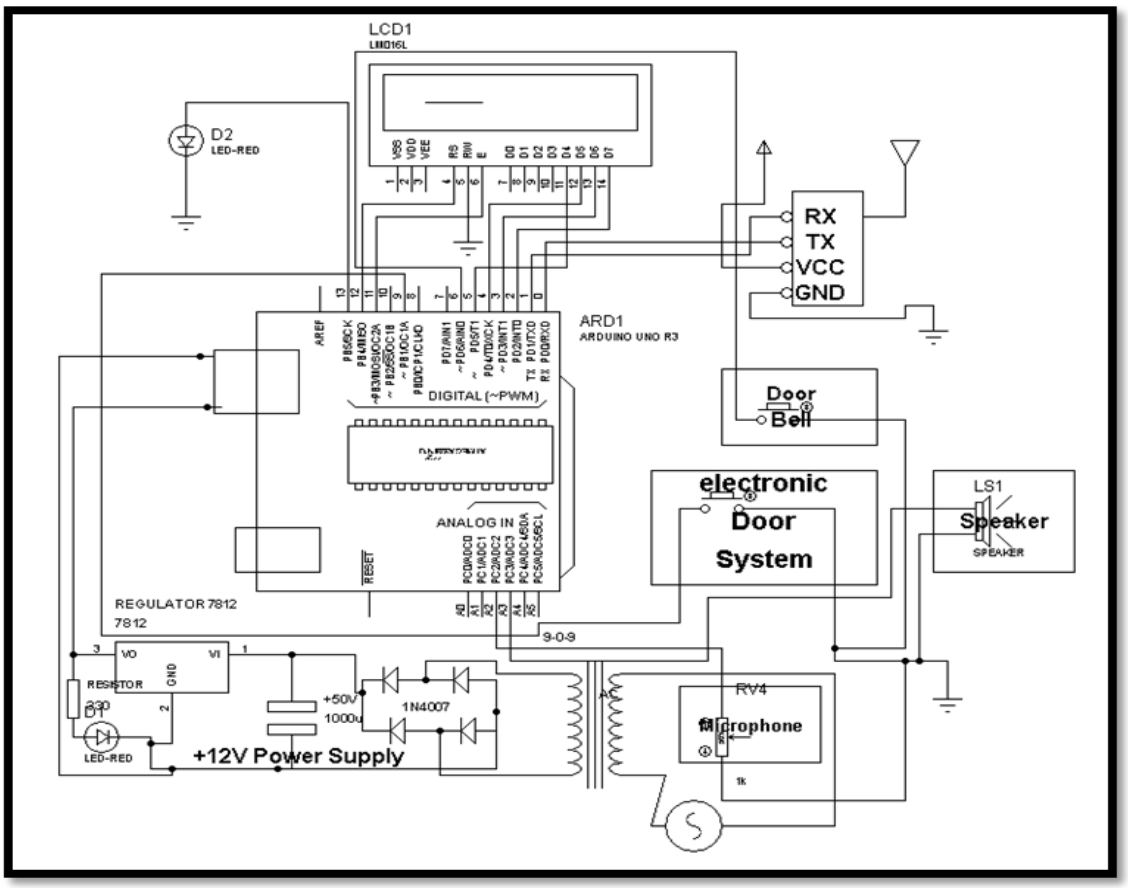

Figure 3. Circuit Diagram of Node-2

2.1.2. Device with the Person (Node-1): Button is connected at pin 6, led panel is connected at pin 12, vibrator is connected at pin 11, buzzer is connected at pin 10, Microphone is connected at analog pin A0 and speaker is connected at pin A1 of Arduino board.

The handicapped person can talk with the person at the door using his device. And when the button on the device is pressed, the door unlocks and the status of LCD display changes from door locked to door unlocked.

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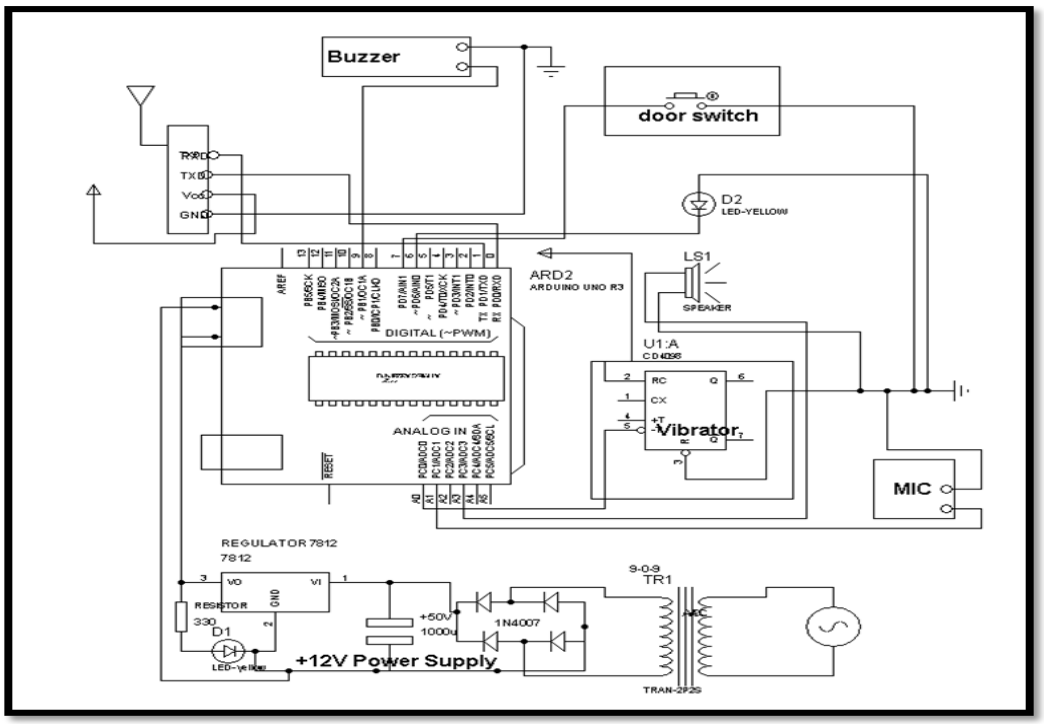
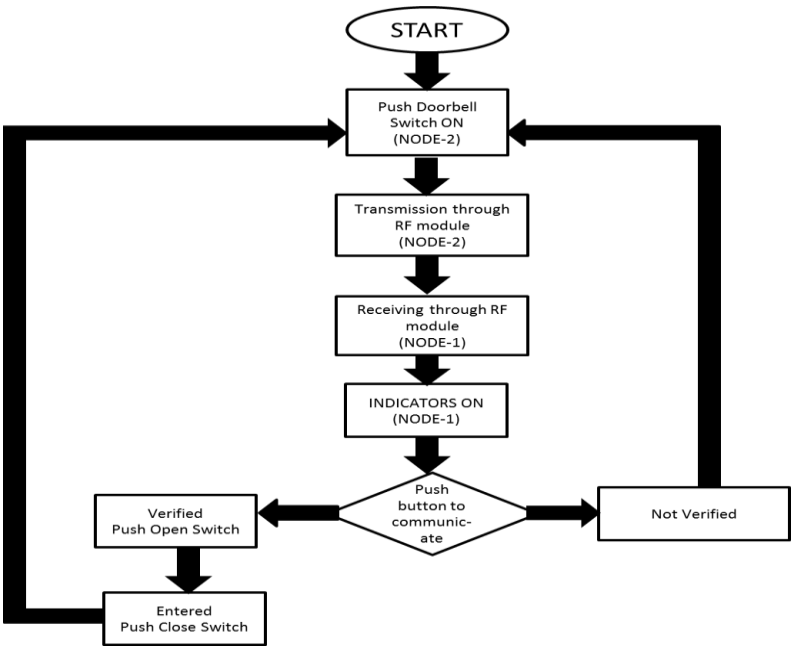


Figure 4. Circuit Diagram of Node-1

2.2. Software Development

A simulation software Proteus is used to analyze the prototype of the device. An arduino is used to control the RF module (to receive & transmit the data wirelessly), microphone, speaker, motor of the door lock system as shown in figure-5, another arduino is used to control the indicators(led, vibrator, buzzer), microphone, speaker, RF module(to receive and transmit the data wirelessly) as shown in figure-6.



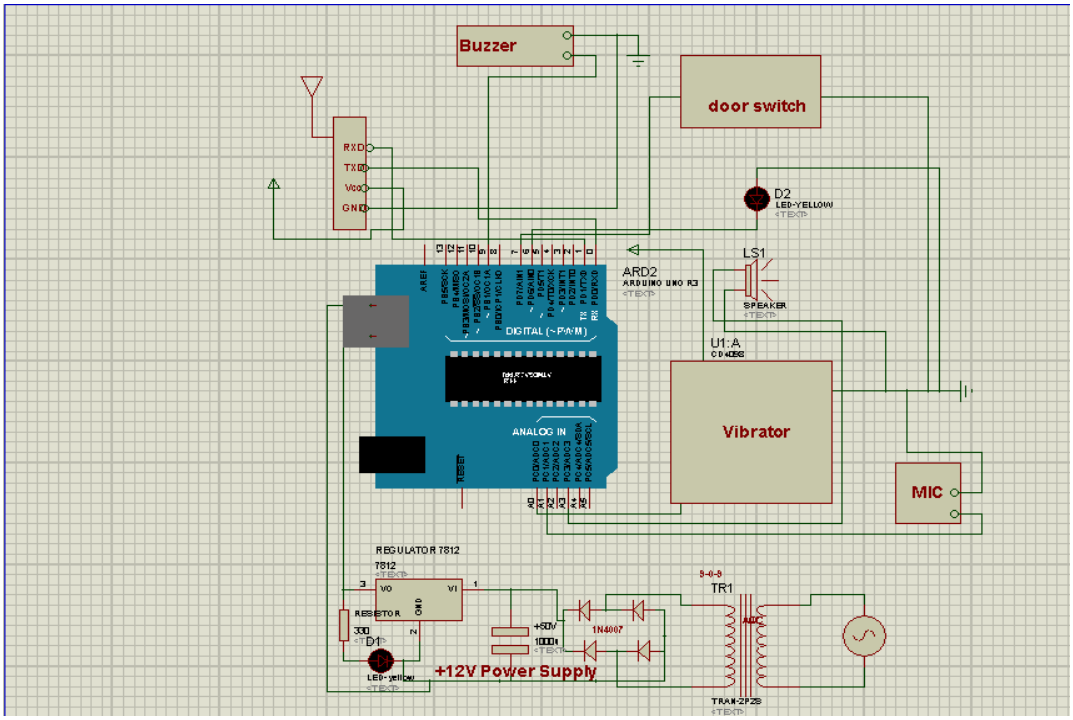


Figure 5. Proteus Model of Node-1

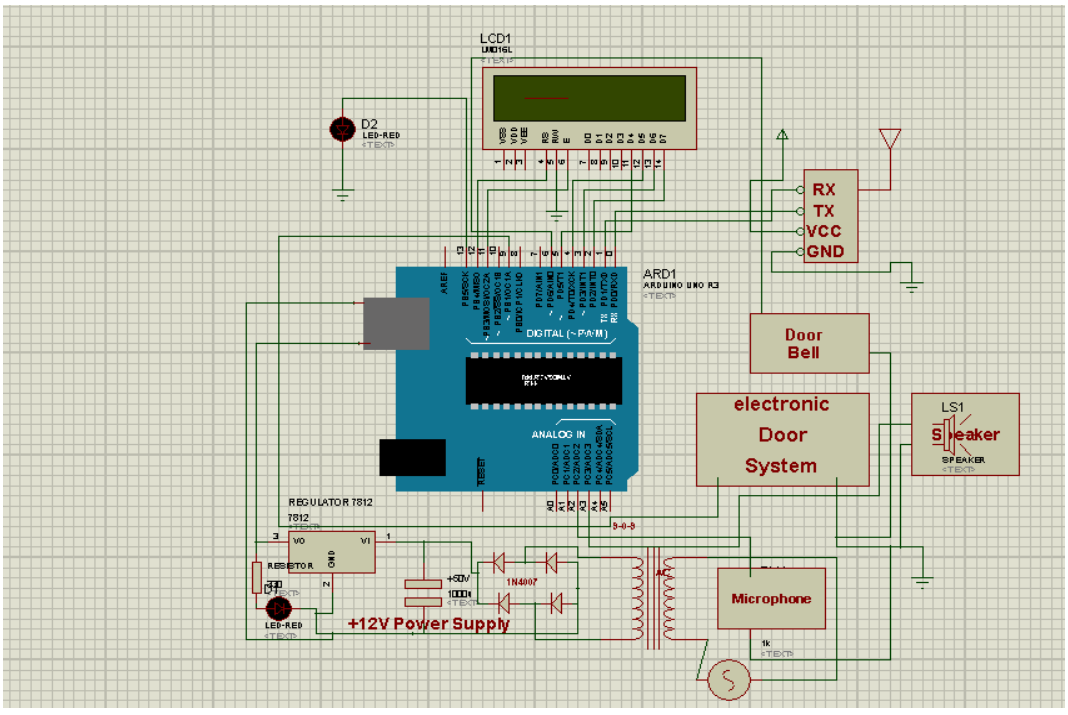


Figure 6. Proteus Model of Node-2

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3. Result

The prototype of the device based on the concept of Home Automation to help the elderly and disabled people to overcome the problem of opening and closing of the door lock has been successfully developed. Both the nodes one at the door and other with the person inside the house has been simulated using Proteus Professional Software. The controlling of door lock using RF modules has also been checked. The transmission and receiving through RF modules has been checked using Virtual Serial Port Emulator (VSPE), and Virtual Terminal.

Figure 7. Node-1

Figure 8.Node-2

4. Conclusion and Future Scope

The proper working of the prototype concludes that idea is a successful innovation to help the elderly and disabled people to overcome the problem. This will help to easily control the door lock from anywhere inside the house using a remote size wireless device. In future, the main purpose will be on replacing the RF module with the concept of Internet of Things (IoT) so that the door can be controlled from any part of the world. The other field of focus will be on the idea of home automation in which controlling of home appliances and windows will be added on the same device. Therefore, we can conclude a good future for this prototype.

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