

System Requirements and Operation Guide

To use this module, the user requires a computer with Windows, Mac or LINUX based operating system. The Arduino IDE is available for download at www.arduino.com. Once the user has downloaded the required software, they can utilize this module to automate their home. They can control the different devices of their house like the light and music system wirelessly through their computer by entering simple commands. The hardware can be bought and connected as mentioned in the documents or ready to use hardware equipment can be bought from Vidur Nayyar.

If this module is connected to the server or other voice recognition unit, the user can control the different devices by just saying the command. But for now we would like to emphasize on the alternate technique of achieving home automation, that is via entering command on to the computer.

The process of using the user interface provided at the arduino level is very easy to use, all you need to do is enter a command from a list of pre defined commands and the module will take care of the rest.

Any command from the following pre-defined commands can be selected and entered to perform a certain task lined to that command:

Command	Task Performed
AA#	Turn ON the Light at 100% brightness
AB#	Turn OFF the Light
AC#	Turn ON the Light at 25% brightness
AD#	Turn ON the Light at 50% brightness
AE#	Turn ON the Light at 70% brightness
AF#	Give the feedback of the brightness of the Light
BA#	Play the Music at 100% volume
BB#	Play the Music at 0% volume
BC#	Play the Music at 25% volume
BD#	Play the Music at 50% volume
BE#	Play the Music at 75% volume
BF#	Give the feedback of the volume of the music system
BG#	Turn ON the Music System
BH#	Turn OFF the Music System

When the user enters any of these values in the serial monitoring window of the arduino IDE, which is also being used as a user interface, the command makes the module run and execute the task that needs to be executed and returns a feedback for the user to check if the task has been actually executed.

For example if the user enters the command AA#, the module will run all the related processes and protocols and turns the light ON and makes it glow at 100% intensity. Not only this, the module also provides a feedback containing the percentage of brightness at which the Light is glowing.

If the user enters the command BE#, the module will run the processes associated to realizing the task linked to the command BE#. Here the task linked to BE# is to play music at 75% volume. Hence the module will make the music system play at 75% volume and return a feedback that contains the percentage of volume at which the music is being played.

If an illegal entry is provided, the module will ignore it and take it to be error generated due to noise (as the module is made flexible to be linked to various networks, out of which some network which might be prone to noise) and will get ready to accept the next command.

Hardware, controller & Sensor Module Description

This section of the project has been developed as a flexible module which has the ability of working as a stand alone module that can realize the basic requirement of the project that is HOME AUTOMATION, or can be in-cooperated with google-voice to work as a VOICE controlled HOME AUTOMATION, or can be used with a server connected to google-voice which has been done in our project.

It is a complex module that has been developed in a way that looks very simple to the user while operating the device. This module as per the user is just a connection between them and the device. We have made the operation of the device look as simple as turning on the switch and observing the bulb to find out how brightly is it glowing. But the main challenge was to develop and program each protocol for each node and controller attached to the node.

This module has been divided into 1 hub connected to 2 Basic nodes for the time being and has the capability of adding 20 more nodes without having to change any design or protocol. Each of the Nodes has two micro-controllers which have been programmed with different codes to achieve different usability from a similar design.

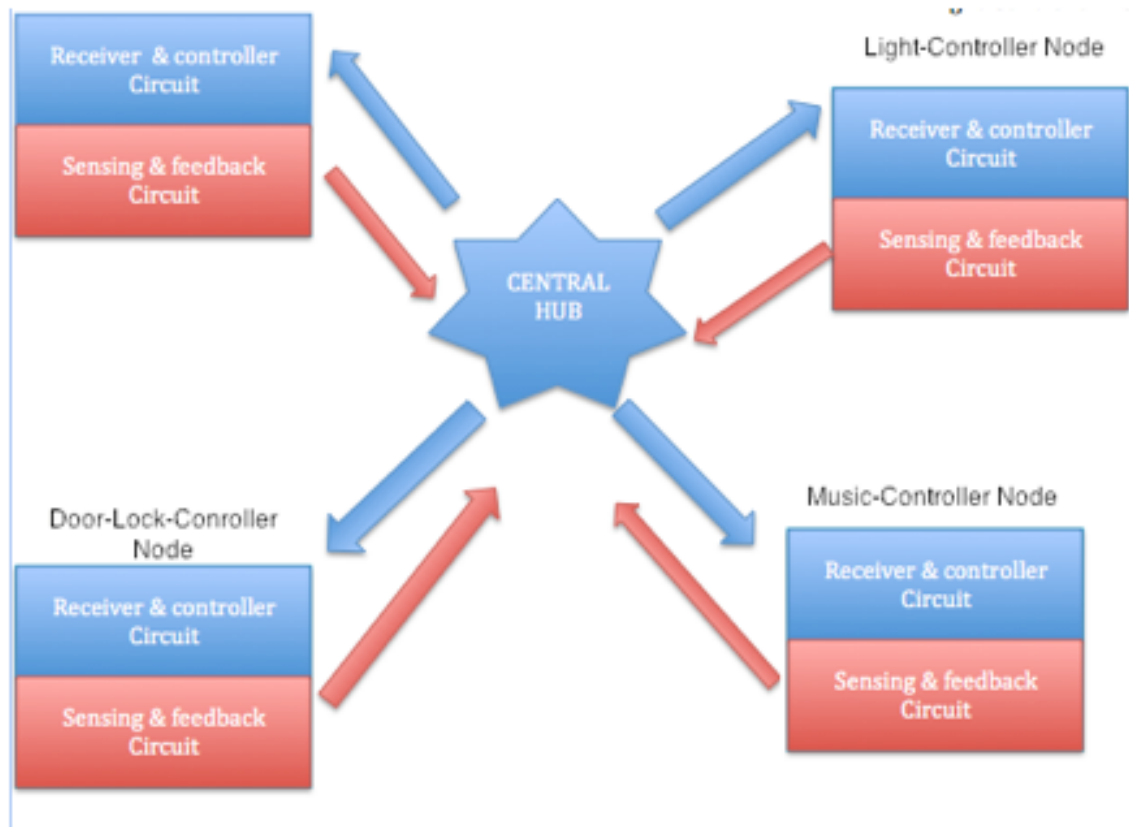
The two Basic nodes used are:

1. Light-Controller Node
2. Music-Controller Node

The other proposed nodes that will be added are:

1. Door-Lock-Controller Node
2. Temperature & Humidity-Controller Node

Temperature & Humidity- Controller Node



CENTRAL HUB

It is the main part of the star topology network formed in this module. This is the part that accepts the users command either directly inputted to this node or through the inputs provided to the server connected to it.

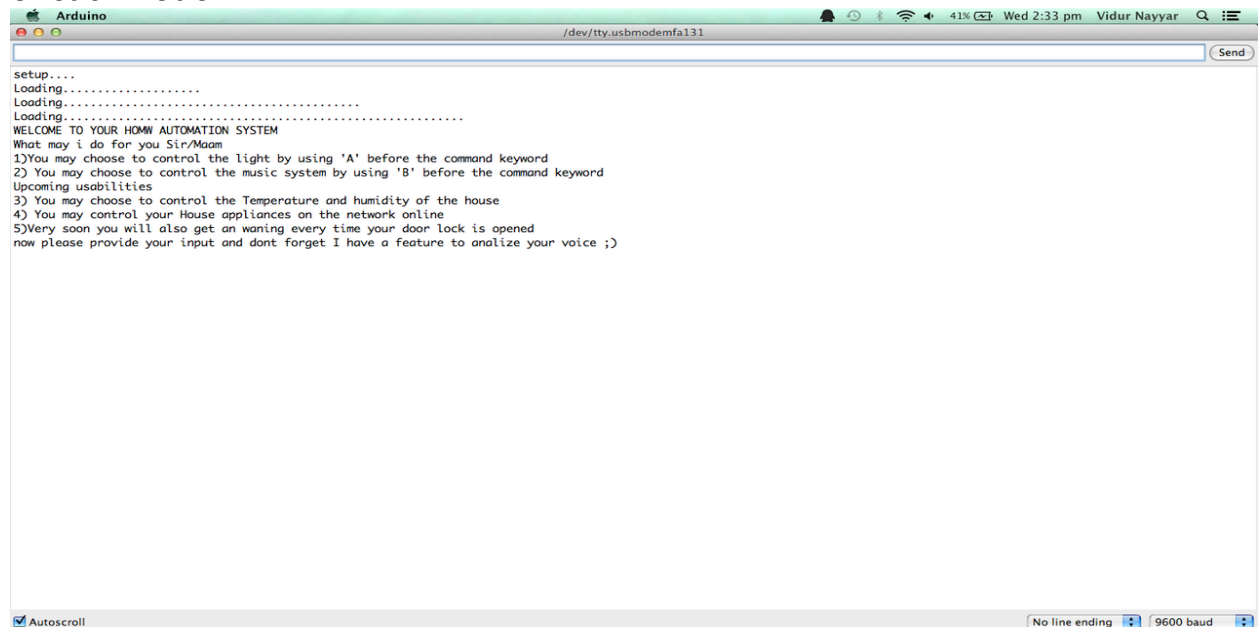
This part is connected to all the nodes in this module and forms a connection between the hardware and the software. The central Hub even provides a UMI(User machine Interface) to make module independent enough to realize the basic requirements of the project.

The central HUB consists of:

1. Arduino Mega which is the main controller acting like the hub in the Star-Topology.
2. 344 MHz RF Transmitter
3. 315 MHz RF receiver

We use one frequency to transmit the data and data is received over a different frequency. This use of different frequency gives us the freedom to develop a duplex system that can communicate both ways without bothering about the interference.

We have used basic Radio Frequency transmitters and Receivers instead of xbee so that we could implement our own protocol for communication between the nodes. Not using xbee also reduces the cost of each node.



```
Arduino
/dev/tty.usbmodemfa131
Send
setup...
Loading.....
Loading.....
Loading.....
WELCOME TO YOUR HOMM AUTOMATION SYSTEM
What may i do for you Sir/Maam
1)You may choose to control the light by using 'A' before the command keyword
2) You may choose to control the music system by using 'B' before the command keyword
Upcoming usabilities
3) You may choose to control the Temperature and humidity of the house
4) You may control your House appliances on the network online
5)Very soon you will also get an waning every time your door lock is opened
now please provide your input and dont forget I have a feature to analize your voice ;)
```

Autoscroll No line ending 9600 baud

User-Machine Interface

Light-Controller Node

This is the node that actually alters the brightness of the light to which it is attached. It is connected wirelessly to the central HUB and waits for a command from it over Radio-frequency. It is in perfect synchronization with the central HUB once the signal is received. This synchronization is achieved by using handshake mechanism (explained at the end).

It further divided into two parts:

1. Receiver and Controller circuit.
2. Sensing and Feedback circuit.

The 'Receiver and Controller circuit' is the part that contains the RF receiver and waits for the command from the Central HUB. It then decodes the command and changes the brightness of the light depending on the command.

The 'Sensing and Feedback circuit' is connected to the 'Receiver and Controller' circuit as a slave and only activates when the 'Receiver and Controller circuit' send a high pulse to one of its pins. This circuit then checks the brightness of the light from the LDR (Light Dependent Resistor) connected to it and provides a feedback back to the Central HUB through the RF Transmitter connected to it.

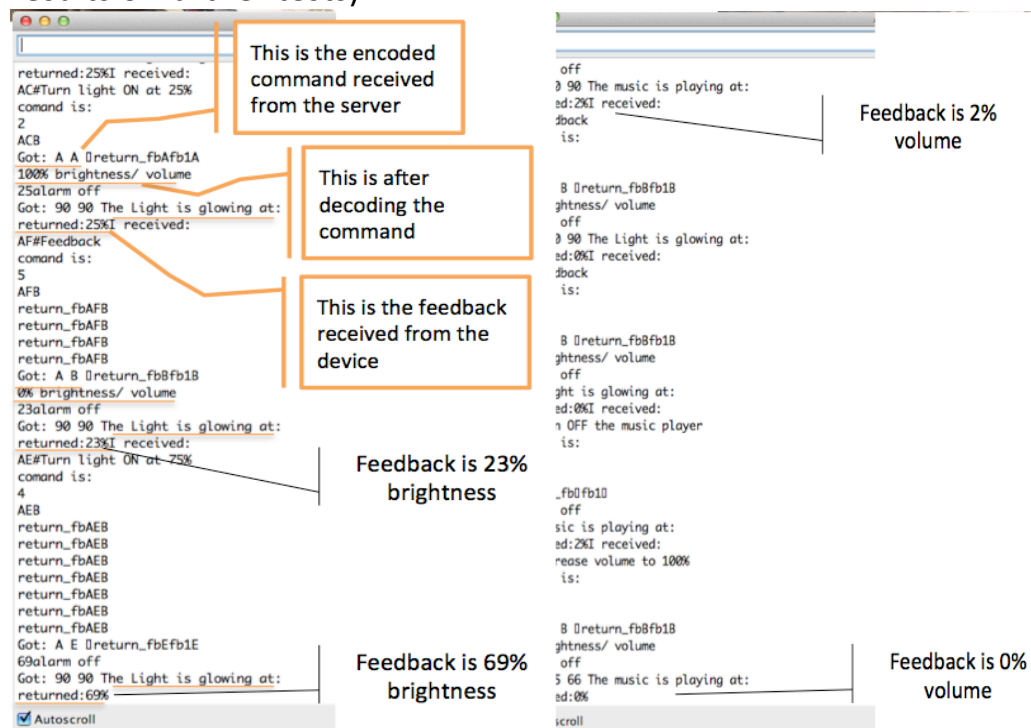
This arrangement adds a feature of letting the user know in real time if the command he/she gave has been actually been done. This feature further makes problem solving easy and to isolate the cause of any bug in the system. The Central HUB is programmed to raise an alarm in case no feedback is received after a command has been sent to a node. This alarm is reset only if a feedback is received from the same node.

Music-Controller Node

This is the node that actually controls all the functionality of a music player that can be realized by the remote controller associated to that music player. It is connected wirelessly to the central HUB and waits for a command from it over Radio-frequency. It is in perfect synchronization with the central HUB once the signal is received. This synchronization is achieved by using handshake mechanism (explained at the end).

It has mostly same functionality as that of the Light-Controller Node except for the fact that:

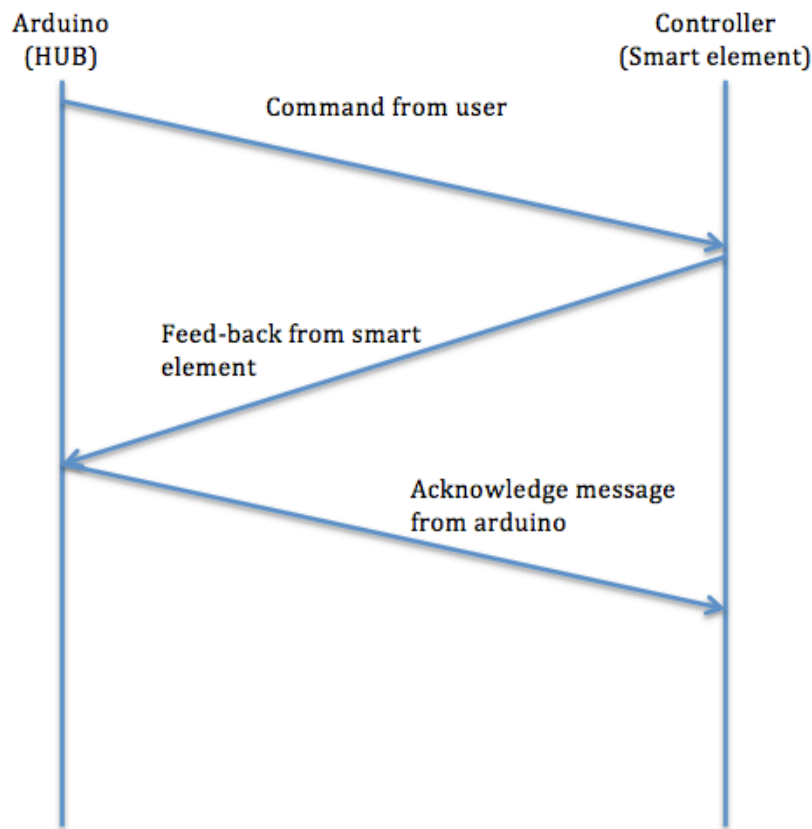
1. The Receiver and Controller circuit of this node has a Infra Red led which can convert the user's command into Infra-red signal which performs various functions on the music player.
3. The Sensing and Feedback circuit is connected to a microphone and amplifier circuit designed and programmed by me to send a feedback with just 20% error in detecting the correct volume at which the player is playing. (Results from initial analysis and tests. Awaiting results of further tests)



Handshake Mechanism

A protocol similar to the handshaking protocol is adopted for the communication between arduino and the other controllers (NODES) attached to make the elements of the house, smart elements. As-per the protocol which has been implemented. When the user sends a command message to the arduino, the arduino relays the message to the controller either via RF mode of communication, and keeps on sending the message till the controller replies with a feedback message. Once the feedback is received by the arduino, it needs to send an acknowledge message to the controller. The controller keeps on sending the feedback message till the time the arduino replies the feedback with an acknowledge message. This way the communication is reliable and in case of an error, the problem can be isolated.

A functionality of raising an alarm is developed which alerts the user if the feedback from the node has not been received. This functionality can be used to isolate the problem in case of a bug and can be also used as a security measure. In case a thief cuts the node from the door lock so that you don't get to know about it, at that point this functionality can be very useful (Door lock automation will be added in the next phase of the project).



BY: VIDUR NAYYAR
(GROUP5)

