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Home Automation System Using Internet of Things (IOT)

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Abstract: ***The main aim behind this research paper was to create a home automation system that performs all basic functions of a virtual assistant like telling the time, date, temperature and also controlling the electrical appliances that it is connected to. This system will be voice operated so that there is no need to type anything at all and reduce the user's work. Apart from the voice operated commands, the system will also take the help from sensors to provide automation to certain appliances. The main objective that must to be kept in mind for this idea is that it is developed for making the everyday life of a user easy. Getting things done without actually having to make an effort to do it is the main motto. Apart from this, the system could also be seen to provide an efficient utilization of electricity. This is achieved by the use of IOT technology and appliances like lights turning off without any explicit command by the user.***

I. INTRODUCTION

Home Automation:

Home automation is designing a system for the home that controls numerous number of appliances automatically. It involves the control and automation of anything and everything that runs on electricity and can be connected and controlled by a third party system. More accurately, it describes homes in which almost everything like Lights, appliances, electrical outlets, heating and cooling systems are connected up to a user controllable network.

Home automation has greatly increased in popularity over the past several years. One of the greatest advantages of an automated home is the ease with which functionality can be managed by using a vast array of devices like desktop, laptop, tablet or Smartphone which is based entirely on the user's discretion. Home automation systems are composed of hardware, communication and electronic interfaces. Each of these devices work to integrate electrical devices with one another. Domestic activities can be synchronized by pressing the button even from a remote location which means users can controls the system from remote locations like change the room temperatures, control the TV/Audio/Video entertainment systems and can limit the amount of sunlight. Since the 20th Century Home automation become practical with advancement of information technology. It is basically an application of computer and information technology to automate the home, household activity, Offices, classrooms and housework etc. It provides centralized and complete control to the user on Appliances, control of Temperature, Light, and appliances with other systems, to provide better convenience. Comfort, energy efficiency and security are also a part of it. For elderly and disabled users, it can provide a quality of life for persons who might otherwise require caregivers or institutional care. Demand for Home automation has been increasing rapidly due to much higher affordability and simplicity through Smartphone and tablet connectivity. The concept of the "Internet of Things" increased the popularity of home automation.

The incorporation of information technologies with the home surroundings, systems and appliances are able to communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits. We will create a system that has been implemented using Arduino Uno, which is a popular open source single board microcontroller, descendant of the open source Wiring platform, designed to make the process of using electronics in multidisciplinary projects more accessible

Internet of Things (IoT):

IoT is the inter-network of physical devices, vehicles, other items embedded with electronics, software, sensors, actuators, and network connectivity which enable them to collect and exchange data. The Global Standards Initiative (2013) on Internet of Things (IoT-GSI) defined it as "a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies" and for these purposes a "thing" is "an object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communication networks".

Objects to be sensed/controlled remotely across the existing networks infrastructure through IoT create opportunities for direct integration of computer-based systems with the physical world. This leads in improved accuracy, efficiency and economic benefit. This also reduced the human intervention. When IoT is used with sensors and actuators, then it becomes an example of cyber-physical systems, which can also includes technologies like smart homes, intelligent transportation, virtual power plants, smart cities and smart grids. Each thing in the system is uniquely identified /accessible through its computing system which can embedded in the existing internet infrastructure. Experts estimate that the IoT will consist of 30 billion objects by 2020.

IoT can offer advanced connectivity of devices, systems, and services which goes beyond machine-to-machine (M2M) communications and cover various protocols, domains, and applications. The interconnection of these devices (including smart objects), is expected to guide in automation in all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities.

Applications of IoT technology which are used in real world include smart cities, precision agriculture, building management, healthcare, energy and transportation. It can also be used as Connectivity options for electronics engineers and application developers who are working on products and systems for the Internet of Things.

This concept wasn't named until 1999,it has been in development for years. The first internet appliance, was a Coke machine at Carnegie Melon University. The programmers can connect to the machine through the internet, check the status of the machine and determine whether or not there would be a cold drink awaiting them, should they decide to make the trip down to the machine.

The Internet of things (IoT) is the concept of connecting any device like cell phones, Internet TVs, sensors and actuators to the Internet where the devices are linked together which enable new forms of communication between things and people, and things between themselves. IoT has become an increasingly growing topic of conversation in the last couple of years as it has added new dimension to the world of information and communication technologies. It is expected that the number of devices connected to the internet will increase from 100 million to 2 billion in the following years. In 2011, 80% machine to machine (M2M)[9] connections were made over mobile networks such as 2G and 3G and it is expected to increase in future as the cost related with M2M over mobile networks are much cheaper than fixed networks.

II. PROPOSED WORK

Proposed Model:

The proposed system is an automation system which works on the input given by the user. These input commands from the user are in the form of voice commands. The system also has 2 sensors connected to it

DHT11 Temperature sensor and PIR Motion sensor. The voice commands are defined and processed in a C# programming code. If the commands are independent of the use of any sensor, the respective output is reflected to the user in the form of speech output

The DHT11 Temperature sensor senses the temperature of the room and returns a value to a variable in the Arduino IDE. When the user gives a voice command to retrieve the temperature, the flow of control is redirected from the C# code to the Arduino IDE from where the value of temperature is received in the C# code and reflected to the user in the form of voice output.

The PIR Motion Sensor senses the motion around it and controls the respective light it has been connected to shown in Fig 3.1 and 3.2. This part has no link with the C# code.

This system works on multiple functionalities. Each functionality has its own details and specifics that need to be carefully checked before completing and using this project.

The main functions and their specifics for this system are listed below:

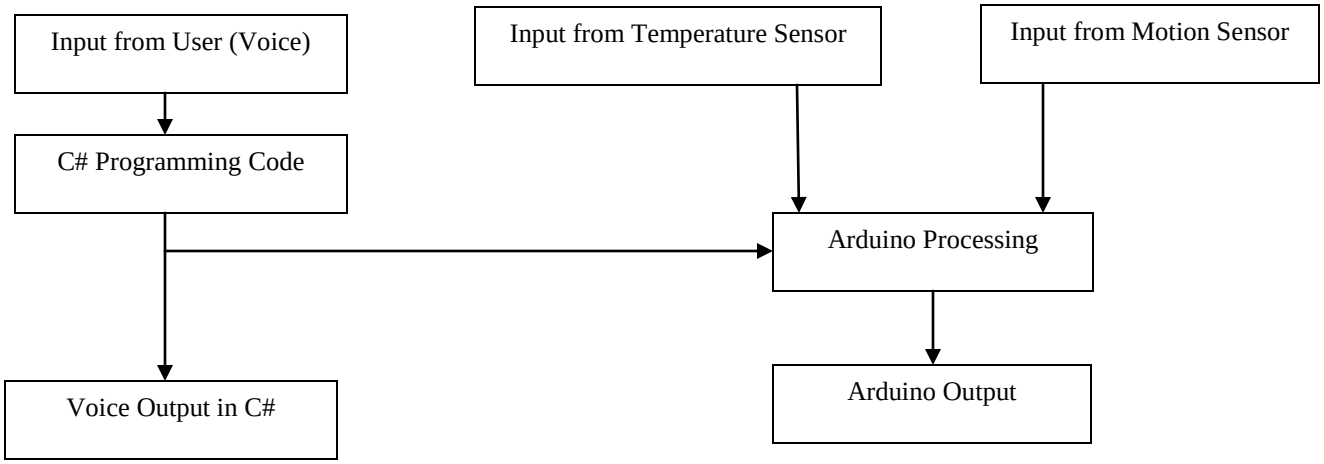

Fig. 1. Working of the Proposed System

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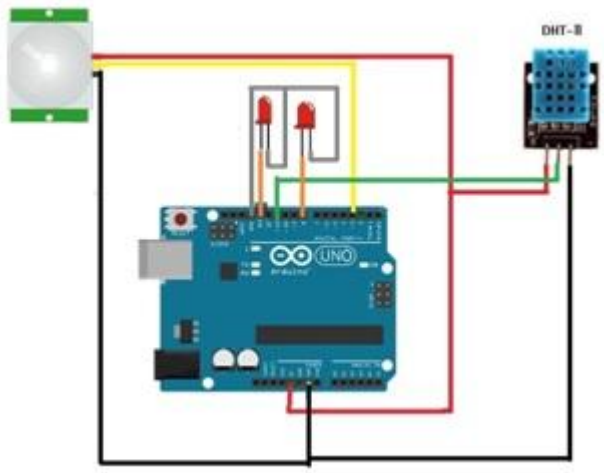


Fig. 2. Architecture of the Proposed System

Voice Operation:

This is one of the most important operation/working function of this project. This system takes input from the user in the form of voice commands and does the necessary processing and gives an output accordingly. The entire set of commands is implemented in the .NET Framework's IDE Visual Studio 2015 in C# Programming Language.

The voice operated commands handled by this system are basically of 2 types – simple voice commands and complex voice commands.

a. Simple Voice Commands: These are the commands that are processed and executed in the c# program itself. Basic commands to return date and time, opening websites like gmail and facebook. The system is also validated by a set of passphrase's without which neither of these commands would execute. just like the passphrase.

There are also commands for the system to go to sleep and not execute anything that it listens to, unless the passphrase is said first.

The following are the Simple Voice Commands that it can recognize and execute accordingly-:

Pass Phrase

"hey bot", "hello bot", "hi bot"

"how are you", "whats your name", "whats the time", "whats today", open google","open gmail","open youtube","open facebook

Sleep phrase

"bye","bye bye","goodbye","go to sleep"

b. Complex Voice Commands: These are the commands that require another set of instructions to be executed. All of these commands are either linked to a sensor which is in turn connected to a microcontroller or directly connected to the microcontroller. The microcontroller is the heart of these commands. The final output is given by the microcontroller itself.

We have used 2 types of sensors to facilitate with the respected voice commands. These sensors are

– PIR Motion Sensor and DHT11 Temperature Sensor.

The microcontroller used is Arduino Uno.

There are commands to manipulate lights by voice which is recognized by the Speech recognization Engine in C# and then further executed in the Arduino IDE. There are also commands that require an intermediary sensor which is then finally executed by Arduino IDE.

The following are the complex voice commands and functions that it can recognize and execute accordingly:

"light on", "light off"

"what is the temperature"

Light control by the use of motion sensor without any explicit voice command by the user.

Motion Detection:

We have used a PIR Motion Sensor which is connected to the Arduino Uno board and controls a light whenever motion is detected. The PIR motion sensor's output pin is connected to pin number 3 of the Arduino Uno which holds the output from the sesnor. The positive pin for the sensor is connected to 5V output from the Arduino UNO and negative pin connected to the Ground of the Arduino UNO.

The pin number 8 of Arduino UNO is connected to a LED bulb which is internally controlled by the motion detected by this PIR sensor.

The table that shows the delay of the motion sensor whenever it detects motion and gives output to the LED is given later in section 5.

Temperature Sensing:

We have used a DHT11 Temperature Sensor that senses the temperature of the room and returns it to the Arduino IDE.

The positive pin of the sensor in connected to 5V output pin on the Arduino UNO. The negative pin is connected

to the Ground pin of the Arduino UNO.

The output pin for the sensor is connected to pin number 11 of the Arduino UNO. This pin holds the data of the output which is sensed by the temperature sensor.

When the user gives the voice command for retrieving the temperature, the flow of command goes from the C# program to the sketch in the Arduino IDE. When the command goes to the Arduino IDE, the sensor senses the temperature of the room and stores it into a variable. This variable is then accessed by the C# program and is reflected back to the user in the form of voice response.

Voice Control:

Whenever the user gives a certain voice command to the system, it is processed by the the C# compiler. Commands like "light on" and "light off" do not require any sensor to be connected with. Whenever these commands are encountered by the Speech Recognization Engine, the flow of control goes from the C# program to the sketch in the Arduino IDE. This voice command is connected to the pin number 13 of the Arduino UNO where the LED is connected to. When the "light on" command is encountered, the pin mode of pin 13 is set to high and the LED glows. Whe the "light off" command is encountered, the pin mode of pin 13 is set to low and the LED does not glow.

III. RESULT

Implemented System:

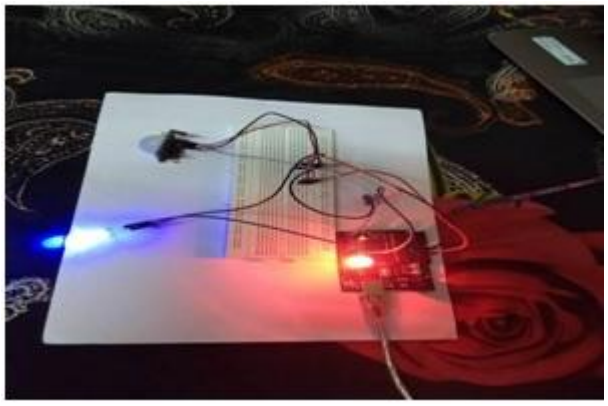
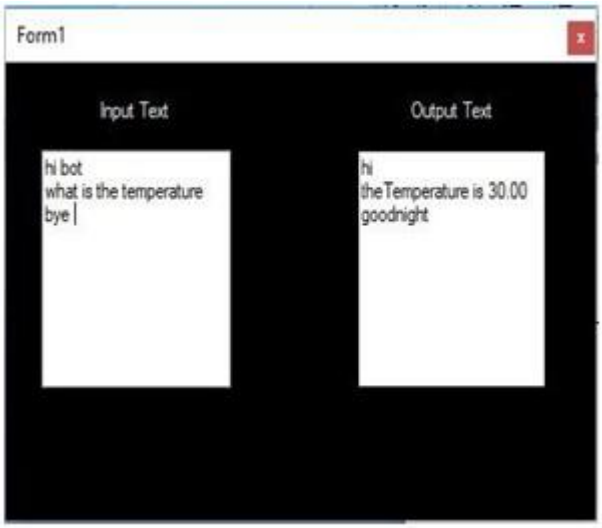


Fig. 3. Actual Layout of Implemented System

Working of Temperature Sensor with Voice Commands: The command "What is the Temperature" is given to the system via voice. The Arduino senses the room temperature from the DHT 11 Sensor and sends the result to the c# code. The result is presented in speech form to the user.

Command to Activate and Deactivate the System:



Output Table for the Motion Sensor:

The Table 1 shows the readings taken by 2 users by the motion sensor.

Readings 1-20 are taken by user 1.

Readings 21-40 are taken by user 2.

Start Time tells at what time the motion has been performed.

Delay Time refers to the time after which the led start to glow

End Time refers to the time after which led stops to glow.

Output for voice operated LED:

Light On Command: The command "Light On" is given to the system via voice.

Start Time indicates the time when the command is given.

Light On Time indicates the time after which the led starts to glow.

Table 2.1 and 2.2 shows readings taken by 2 users.

Light Off Command: The command "Light Off" is given to the system via voice.

Start Time indicates the time when the command is given.

Light Off Time indicates the time after which the led stops to glow.

Table 3.1 and 3.2 shows readings taken by 2 users.

IV. CONCLUSION AND FUTURE SCOPE

The final system created is capable of recognizing the voice commands and gives an appropriate response to the user. The form page created displays the input command

as well as the response. IO commands like light on and light off work perfectly The PIR motion sensor senses motion and controls the light properly. The DHT11 sensor retrieves perfect temperature data of the room and this data is sent as a response back to the user via voice speech output.

V. DIFFERENCE BETWEEN EXISTING SYSTEM AND OUR PROJECT

Existing Systems	Proposed Project
Their cost is more than Rs.3000	Our Project cost occurred to be Rs.1500
These can implemented using non dedicated system	Our project is implemented using only dedicated system
These are implemented only with help of sensors	Our project is working with sensors as well as voice commands
These are easy to install	Compared to existing project our project is not as easy to install
Most of these project require a micro controller along with Bluetooth or wifi module	Only a micro controller required along with a dedicated computer system

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Table 1. Different Values of Motion Sensor

S. No	Start	Delay	End Time
1	0	0.2	10.2
2	0	0.13	9.87
3	0	0.08	9.92
4	0	0.08	9.92
5	0	0.12	10.12
6	0	0.1	9.9
7	0	0.5	10.5
8	0	0.26	10.26
9	0	0.27	9.73
10	0	0.24	10.24
11	0	0.19	9.81
12	0	0.3	9.7
13	0	0.18	9.82
14	0	0.21	10.21
15	0	0.07	9.93
16	0	0.26	9.74
17	0	0.19	10.19
18	0	0.21	10.21
19	0	0.13	9.87
20	0	0.08	9.92
21	0	0.13	10.13
22	0	0.27	10.27
23	0	0.18	9.82
24	0	0.04	9.96

25	0	0.1	10.1
26	0	0.13	9.87
27	0	0.05	9.95
28	0	0.2	10.2
29	0	0.15	10.15
30	0	0.11	10.11
31	0	0.03	9.97
32	0	0.13	9.87
33	0	0.15	10.15
34	0	0.16	10.16
35	0	0.05	9.95
36	0	0.06	9.94
37	0	0.01	10.01
38	0	0.05	10.05
39	0	0.01	9.99
40	0	0.26	9.74

Table 2.1. Readings of Light On Command (User 1)

Start Time	Light On Time
0	6.8
0	9.7
0	4
0	2.3
0	1.8

Table 2.2. Readings of Light On Command (User 2)

Start Time	Light On Time
0	2.97
0	1.5
0	3.7
0	11.34
0	3.18

Table 3.1. Readings of Light Off Command (User 1)

Start Time	Light On Time
0	3.5
0	7
0	2.8
0	1.8
0	8

Table 3.2. Readings of Light Off Command (User 2)

Start Time	Light On Time
0	2.94
0	4.54
0	4

0	7.3
0	3.83