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HOME AUTOMATION USING RASPBERRY PI

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Abstract - Home automation systems or smart home technologies are systems and devices that can control elements of home environments such as lights, fans, water pumps, general purpose sockets, etc. Home automation focuses more on conservation. There are many different types of different purposes like comfort and luxury. In fact, one of the major problems of these systems is that these are neither inter-operable nor inter-connected. House hold appliances can be controlled from a centralised control unit in a typical home automation system. For the most commercially available home automation systems, these appliances usually have to be specially designed to be compatible with each other and with each other and with the control unit.

This automation system uses Raspberry Pi 2 (Model B) as its brain. The controller used in system is Arduino Uno. The size of system is also small which makes it compact. As the system is interconnected the appliances can be controlled from on single center. This system is designed to be flexible and generally programmable, extensively such that adding additional features is relatively simple and modular and forward compatible, so that new components can be added without redesigning the entire system. Our Automation is mainly based on Energy Conservation by avoiding wastage of energy.

The Core concept of the system is to make it flexible so adding or reducing number of equipment and similarly number of rooms. The Raspberry pi has 40 GPIO pins hence adding new sensors are simple from hardware point of view. The software used are open source and available for free. Hence the system is easily editable and expandable.

Keywords- Raspberry PI, Arduino, GUI (Graphical user interface.

I. INTRODUCTION

A home automation system integrates electrical devices in a house with each other. The techniques employed in home automation include those in building automation as well as the control of the domestic activities. A typical home automation system allows one to control household appliances from a centralized control unit. These appliances include lights, fans, air conditioners, television sets, security cameras, electronic doors, computer systems, audio/visual equipment, etc. These appliances usually have to be specially designed to be compatible with each other and with the control unit for most commercially available home automation systems.

The project "Home Automation using Raspberry Pi", demonstrates a system that can be integrated into a building's electrical system and allows one to control lights, fans, and turn on or of any appliance that is plugged into a wall outlet with speech commands or automatically by environmental conditions and requirements with help of the sensors used in system. The core concept of system is to make automation simple, understandable, flexible and easily upgradable, thus the control of room and whole house is kept different by using two different controllers for room and house. The Automation System uses Various sensors like PIR (i.e. Passive infrared Sensor), Moisture sensor, Smoke sensor, LDR (i.e. Light dependent resistor), etc. to acknowledge the environment of room and to decide the requirement of electrical appliances. The system mainly uses conditional programming to make these decisions. The Sensor data is fed to Raspberry Pi through Arduino. But the Arduino is programmed separately to control the electrical appliances. The flow of data is the system is from sensor to Arduino and then from Arduino to Raspberry Pi. This data can be used to make the usage statistic of a typical house which will include the amount of time the energy equipment is in running condition without requirement by comparing the data prior to system installation.

In The proposed system there is provision for voice interface which eases user to change state of any household apparatus by his speech. Speech interface not only makes it easy but also it reduces the chances of keeping unwanted equipment on due to laziness of the user.

II. LITERATURE SURVEY

The internet of things (IOT) is the network of physical object devices, vehicle, building and other items embedded with electronics, software, sensors and network connectivity that enables these object to collect and exchange data. The IOT allow object to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit; when IOT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its

embedded computing system but is able to interoperate within the existing infrastructure.

There are many different type of home automation system available currently. These systems mostly have control of household equipment based on time profile that is on the time most of The Lights Are Off at fans of our conditioner work on requirement corresponding to temperature some of the system work on hand gestures some work with the help of Android system provider on touch screen interface device the system are typically design and purchase for different purposes in fact one of the major problem of the system is that this neither impossible are interconnected household appliances can be control from a centralised control unit in a typical home automation system for the most commercially available home automation system this applicable usually had to be specially designed to be completely with each other and with the container most commercially available home automation system are all in the situation which require that all controllable appliances are from the same company or must be approved as compatible with said company system over the system normally come with proprietary dedicated device which act as a control Centre to control the system from multiple properties dedicated device which sector has the control Centre to control the system from multiple location additional control devices multipurpose Complex system usually need to integrated when the building is constructed and must be planned in the device that they are also difficult to upgrade or replace once installed. The overall investment adds up considerably and is financially infeasible in most cases. These drawbacks hinder the popularity of such system there are some home automation system has been implemented some of which use internet to control home appliances service mobile phones some use parallel ports but all of these are costly and hard to implement the objects of the propose system is to of a low-cost solution for home automation system that overcomes the above the bike the system provides basic control of appliances satisfaction of the first commercially available system the basic and most important disadvantage of our available automation system is that the system is not flexible meaning new components are not easily install able adding the components can be odd and even impossible at certain points there is also know the problem with the system which is 11 sir sensor is damage due to again replacement is not possible for the use of the use user needs to call the technicians or related expert to change a simple sensor which is major disadvantage considering the complexity of problem always disadvantage Rider modified 2 it is completely removed in the propose system the simplicity of the system is one major aspect that inter interest in in the user interface with the system and makes the system easy to use and also easy to upgrade with the changing condition of user environment according to requirements.

III. BLOCK DIAGRAM OF THE SYSTEM

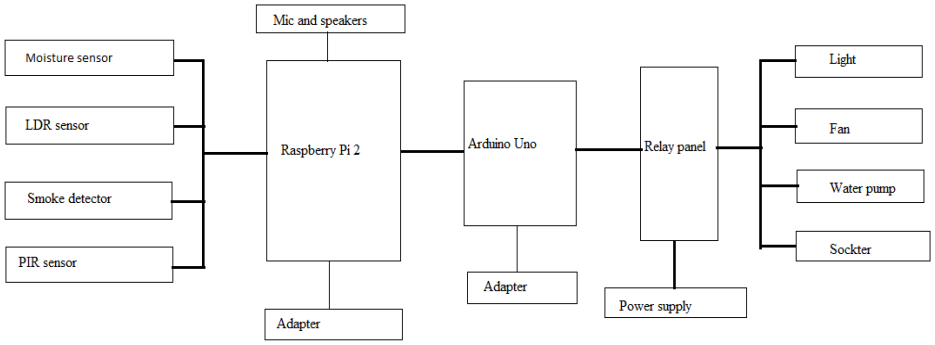

Fig: Block diagram of system.

The Block diagram contains Block representation of all hardware in the system that is interfaced together to form this project.

This block diagram gives an overview of the Home Automation System. As the block diagram suggests the sensors read the data from environment and then the data is fed to Raspberry Pi Model 2 B and Arduino Uno. The data is then processed and corresponding values are given to the Relay. Then the relay changes the state of equipment as per the input. The voice control act as second option for Automation. The voice data received form Microphone is processed in Raspberry Pi with speech-to-Text engines and then the output is given to Arduino Uno and then Arduino changes the relay states according to values.

IV. RASPBERRY PI

3.1 INTRODUCTION TO RASPBERRY PI

A Raspberry Pi is a credit-card sized computer originally designed for education, inspired by the 198I BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. In 2006, early concepts of the Raspberry Pi were based on the Atmel ATmega644 microcontroller. Its schematics and PCB layout are publicly available. Foundation trusteeEben Upton assembled a group of teachers, academics and computer enthusiasts to devise a computer to inspire children. The computer is inspired by Acorn's BBC Microof 1981. Pi's model A, model B and model B+ are references to the original models of the British educational BBC Microcomputer, developed by Acorn Computers. The first ARM prototype version of the computer was mounted in a package the same size as a USB memory stick. It had a USB port on one end and an HDMI port on the other. Several generation of Raspberry Pi's have been released. The first generation (Pi 1) was released in February 2012 in basic model A and a higher specification model B. A+ and B+ models were released a year later. Raspberry Pi 2 model B was released in February 2015 and Raspberry Pi 3 model B in February 2016. The boards are priced between ₹1400 and ₹2450.

3.2 THE BASIC HARDWARE REQUIREMENT OF RASPBERRY PI

The hardware required for basic user of raspberry pi is much same as the desktop PC. It requires a Display with HDMI Port Connectivity as display output or a touchscreen display through DSI Port (i.e. Display serial interface) where it works as both input and output. We also need a Keyboard and mouse to use as input devices. The Keyboard and Mouse should be USB as Raspberry Pi does not have any PS2 Port. Other than this two things Audio device or Internet connectivity are optional thing Audio device is important as speech recognition and audio output are added in the system. The standard Power Supply required for Raspberry Pi is 5V , 2A DC Power Supply Through a AC to DC Adapter. But the requirement of Raspberry Pi is not actually 2A. It is the maximum amount of power that requirement if all ports are consuming energy. Otherwise for the home automation system 800mA is enough.

3.3 INTREFACE ARDUINO WITH RASPBERRY PI

The Raspberry Pi and Arduino Uno were interface through serial interfacing. As the Raspberry pi has USB port and the Arduino has USB serial cable to connect it with Computer for programming using these both to connect Raspberry Pi with Arduino is not so complicated. In that way the sensor data is fed to raspberry Pi and Raspberry Pi can also control over the Arduino through this serial USB cable to control the relay by voice commands as the relays control the state of electrical equipment connected in the system. Serial interfacing methods like I2C Bus interface can cause severe damage to Arduino and Raspberry Pin by the current surges and imbalanced voltage levels.

3.4 PROGRAMMING THE ARDUINO WITH RASPBERRY PI

After connecting Raspberry Pi to Arduino, the software Arduino IDE (i.e. Integrated Development Environment) which is a free Compiler designed by the Manufacturer of Arduino. Though Arduino microcontroller board can be programmed with C. Thus the programs are written in C with the Arduino IDE. This Programs are called Sketches.

Program:

```
#include <SoftwareSerial.h>
SoftwareSerial bt = SoftwareSerial(2, 3);
int light = 0;
void setup()
{
pinMode(2, INPUT);
pinMode(3, OUTPUT);
pinMode(8, OUTPUT);  //Light
pinMode(9, OUTPUT);  // fan
pinMode(6, OUTPUT); //socket
pinMode(11, OUTPUT);  // light led
pinMode(12, OUTPUT);  // fan led
pinMode(13, OUTPUT);  // socket led
pinMode(7, OUTPUT);  // auto mode led
bt.begin(9600);
}
void loop()
{
light = analogRead(A0);
if (bt.available() > 0)
{
char data = bt.read();
if (data == 'l'){
digitalWrite(8, HIGH);
digitalWrite(13, HIGH);
}
else if (data == 'x'){
digitalWrite(8, LOW);
digitalWrite(13, LOW);
}
if (data == 'f')
{
digitalWrite(9, HIGH);
digitalWrite(12, HIGH);
}
else if (data == 'y'){
digitalWrite(9, LOW);
digitalWrite(12, LOW);
}
if (data == 's')
{
digitalWrite(10, HIGH);
digitalWrite(11, HIGH);
}
```

```
else if (data == 'z')
{
digitalWrite(10, LOW);
digitalWrite(11, LOW);
}
if (data == 'a')
{
autolights();      // auto mode
digitalWrite(7, HIGH);
}
else if (data == 'b')
{
digitalWrite(8, LOW); // kill lights manual mode
digitalWrite(7, LOW);

}
delay(50);
}

}
void autolights() {
if (light < 100) {
digitalWrite(8, HIGH);

}

}
```

IV. ARDUINO

Introduction to Arduino Uno:

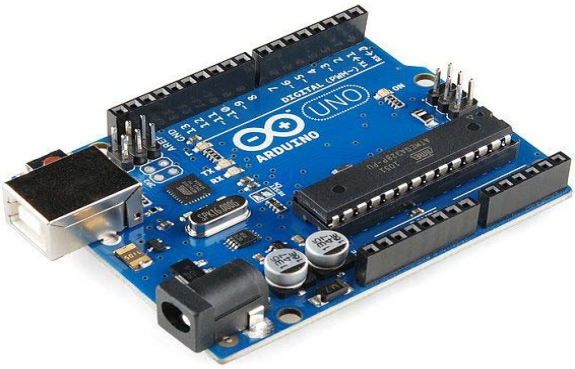

Fig: Arduino Controller

Arduino is an open-source physical computing platform based on a simple i/o broadband a development environment for writing Arduino software. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, processing, Max.MSP). The open-source IDE can be downloaded for free.

The Arduino Uno SMD R3 is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. The selected device is Arduino Uno and it is selected for various features like.

1. It is flexible, offers a variety of digital and Analog inputs, SPI and serial interface and digital and PWM outputs.
2. It is easy to use, connects to computer via USB and communicates using standard serial protocol, runs in standalone mode and as interface connected to PC/Macintosh computers.
3. It is inexpensive, around 600 RS per board and comes with free authoring software.
4. It is an open-source project, software/hardware is extremely accessible and very flexible to be customized and extended.
5. Arduino is backed up by a growing online community, lots of source code is already available and we can share and post our examples for others to use.

"UNO" means "One" in Italian and is named to mark the upcoming release of Arduino 1.0. The UNO and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

V. FUTURE MODIFICATION AND ENHANCEMENTS

1. Requirements of increment:

The home automation system is already enough for complete automation of lighting and pumping system and also the safety system is included in the form of smoke sensing capability of the anti-theft provision should be added to the system. The system is also compatible to add cameras for security. These all are areas where system can possibly evolve. Most of people have smartphone these days. Thus Bluetooth or Wi-Fi wireless controlling can be added to the system as user interface. One of the major disadvantage of the system is that it does not have any GUI (Graphical user interface). Hence the modification and upgradation are done through the Linux operation system and through Arduino IDE.

Following are possible enhancement for system:

1. Developing a GUI in the Linux.
2. Making a Linux.

3. Making an android IOS app GUI to control system through Bluetooth or Wi-Fi.
4. Making a special touch screen display to make user interface easy.

VI. CONCLUSION

Thus, From this we conclude that the project is very useful for demonstration of energy conservation, security through the automation of house using raspberry pi and the system. It is also useful for elderly and handicapped people. The system can provide a great impact in the smart-home technology. This system is also easy to upgrade hence it is a great upgrading tool for computer enthusiast. This system focuses more on conservation. These systems are typically designed and purchased for different purpose like comfort and luxury. Using this system house hold appliances can be controlled from a centralized control unit in a typical home automation system.

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