“Home Automation through Internet of Things(IoT)”

Project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Technology

In

Computer Science and Engineering/Information Technology

By

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To

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Candidate's Declaration

I hereby declare that the work presented in this report entitled "**Home Automation through Internet of Things(IoT)"** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/ Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2015 to June 2016 under the supervision of Dr. Vivek Sehgal (Associate Professor, Computer science and Engineering)**.**The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Himanshi Wadhwani (121267) ....
Ridhima Gupta (121282) ....

This is to certify that the above statement made by the candidates is true to the best of my knowledge.

Dr. Vivek Sehgal
Associate Professor
Computer Science & Engineering
Dated:

ACKNOWLEDGEMENT

We would like to express our special thanks of gratitude to our project guide Dr. Vivek Sehgal who helped us in conceptualizing the project and actual building of procedures used to complete the project. We would also like to thank our Head of department for providing us this golden opportunity to work on a project like this, which helped us in doing a lot of research and we came to know about so many things.

Secondly we would like to thank our family and friends who guided us throughout the project so as to complete our project on time.

Thanking you,

Himanshi Wadhwani (121267)

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LIST OF ABBREVIATIONS

S No.	Abbreviations	Description
1	IDE	Integrated Development Environment
2	ADT	Android Development Tools
3	D2D	Device to Device
4	D2S	Device to Server
5	MQTT	Message Queue Telemetry Transport
6	XMPP	Extensible Messaging and Presence Protocol
7	DDS	Data Distribution Service
8	AMQP	Advanced Message Queuing Protocol
9	IR	Infrared
10	LED	Light Emitting Diode
11	LDR	Light Dependent Resistor
13	CMOS	Complementary metal-oxide semiconductor
14	DTR	Data Transmission Rate
15	SPI	Serial Peripheral Interface
16	EEPROM	Electrically Erasable Programmable Read-Only Memory
17	RFID	Radio-frequency identification Radio-frequency identification

ABSTRACT

Today, the use of home automation is increasing day by day. Home automation is an emerging field in information technology. Home automation is simply controlling different activities of home with the advanced technologies. In this project we are developing a prototype to demonstrate various aspects of Home Automation, like controlling electronic devices, using only when needed according to the external conditions, switching on/off electrical appliances with cellular devices from a different location. It also aims at saving the environment through efficient water use, fire detection, etc. It allows the user to perform different action of home from a remote place. Home security is a field of home automation. It concentrates on the security aspects of homes and offices. This can be achieved by local networking or by remote control. These systems safeguard homes from intruders and burglars. Home security begins with home safety. Home safety begins with homeowners taking steps to protect their home and its residents. The popularity of home security automation has been increased in greatly in recent years due to much higher affordability and simplicity. Thus, this project.

1. INTRODUCTION

From flicking a light switch to opening your garage door with a remote control; our homes have been automated for decades. The concept goes as far back as the 1934 World's Fair in Chicago where the "home of the future" was unveiled. In the last 80 years, however, the automated home has morphed into the smart home, courtesy of the Internet, sensors and connectivity. The modern automated home can do more than turn on our heating and our lights—it can actually think for us.

Security and technology are rushing to offer home automation solutions and build out the Smart Home of connected devices and applications. As cameras, alarms, as well as, thermostats and other appliances become controllable and programmable using Internet-enabled smart phones, they are becoming part of a vast web called the Internet of Things (IoT). As products and devices become connected to the internet, they join others on a two-way street. Just as commands can be sent to them, information about their activities can also be collected and downloaded. This process opens up massive potential for data collection and analysis for not just home owners, but companies as well.

When we do market research surveys we query people using mail, phone, or personal surveys. In the era of the internet of things, why call on people who have limited memory when we can query directly the washing machine or the dish washer to ask them what happened now that we will have all kinds of sensors to get the information?"

A security installer can also check the status of systems they installed. Is there something wrong with the alarm system or the thermostat? Instead of sending a technician out after making an appointment with the home owner, a technician in a distant central station can run the same kind of diagnostics and often correct problems. Thus IOT has become the essential need.

1.1 Smart Home

The terms “Home Automation,” “Connected Devices” and “Internet of Things” are often used interchangeably, but they are distinct parts of the Smart Home concept:

- **Home automation:** This is where a home’s electrical devices are connected to a central system that automates those devices based on user input. For example, you push a button and your shades go up, or you give a voice command and your lights turn on.

- **Connected devices:** These are electrical devices that are intelligent, courtesy of a connection to the Internet and sensors. These devices know or are able to anticipate what a user needs. At first, this intelligence comes from user programming, but with time the device can learn and adapt to patterns and interact with its users.

- **Internet of Things:** IoT is the magic dust that turns the automated home into the smart home. With a combination of sensors, smarts and systems, IoT connects everyday objects to a network, enabling those objects to complete tasks and communicate with each other, with no user input.

When you combine home automation, connected devices and IoT you get a Smart Home. And a modern smart home can be easily controlled through a Smartphone, tablet or computer.

- **Why do we need Smart homes?**

  - **Savings:** Connected devices such as learning thermostats, smart sprinklers, Wi-Fi enabled lights, electricity monitoring outlets and water heater modules cut down on energy and water use.

Figure 1: Smart home[15]

- **Control:** Many things inside the home, from ovens and fridges to deadbolts and garage doors, can be controlled remotely via apps on smart phones and tablets. In most cases, this control also works when you are out of the home, meaning you can close the garage door from the airport, check on the cat from Costa Rica, or confirm that you switched off your stove from the grocery store.

- **Convenience:** Having your living room lights turn on as you arrive home, the stereo playing your favourite song and the door opening as you approach with a bagful of groceries is perhaps the ultimate luxury of the smart home. But convenience isn't all about luxury. Smart locks can allow you to grant access to certain individuals at certain times, so you don’t have to stay home or give out a key. Likewise, a sensor can tell you when your fridge is out of milk, and a Wi-Fi enabled doorbell can let you “answer” your door from anywhere in the world.

- **Security:** There are many simple, connected security solutions for the smart home that are inexpensive alternatives to 24/7 monitored security systems. Wi-Fi-enabled cameras, connected motion sensors and smart smoke alarms can all be monitored from inside or outside a home via live video feed, email and text alerts.

- **Safety:** Smart sensors that can detect water leaks, humidity levels, carbon monoxide, motion, heat and every environmental concern imaginable help prevent accidents from turning into disasters because they can communicate with you directly, wherever you are.

- **Senior independence:** Automated audible reminders and voice activated alert systems are just a few of the features of home automation that can help seniors’ lead independent lives for longer. Additionally, Wi-Fi connected cameras with two-way communication can help loved ones keep an eye on the elderly when they can’t physically check on them.

1.2 Internet of things

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Various applications of IoT are:

- Environmental monitoring
- Infrastructure management
- Manufacturing
- Energy management
- Medical and healthcare systems
- Building and home automation
- Transportation

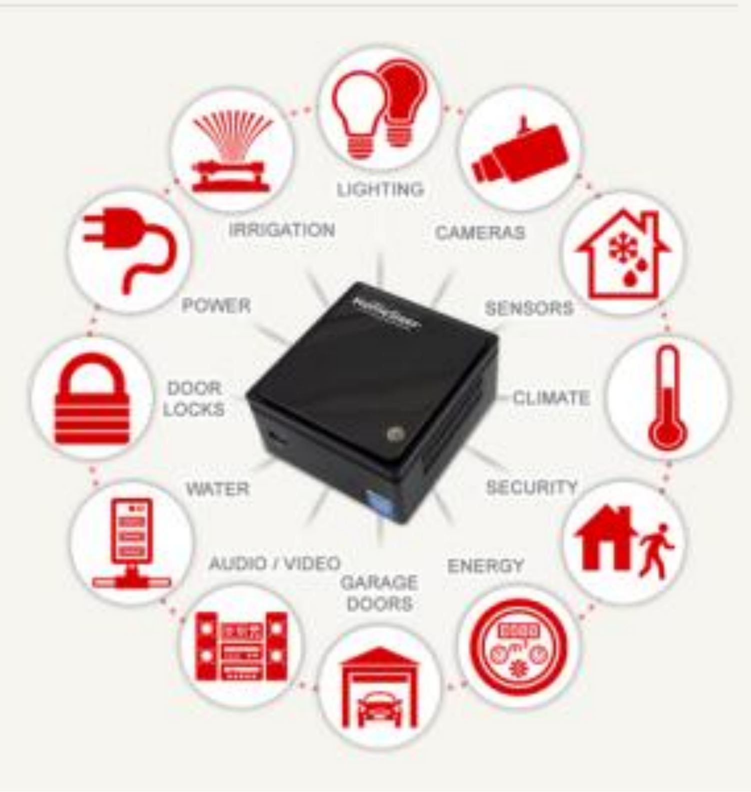


Figure 2: Iot Applications[15]

- **Benefits of IOT:**

- **Ubiquitous networks** – personal Wi-Fi on your mobile phone and on every other device. Everyone (and everything) wants and needs to be connected.

- **Connected computing** – we want all of our devices, phones, televisions, music players, vehicles, etc. to keep track of what we are doing, viewing, reading, and listening to as we move through our day, from place to place – the handoffs from device to device are already happening.

- **Intelligence at the periphery of the network** – Jim Gray, the visionary database guru from Microsoft, envisioned smart sensors acting as a mini-database with embedded machine learning algorithms. Here is how he said it (10 years ago): "Intelligence is moving to the periphery of the network. Each disk and each sensor will be a competent database machine."

- **Analytics-as-a-Service** – the API and App economies are already vast and growing – this enables any "thing" to "do something interesting" as long as it can connect to an API or invoke an App that performs a network-based service. The "thing" is a data generator and/or collector that also learns from, makes predictions, and maybe even takes data-driven actions in response to the data that are collected (through the versatility and convenience of an App or API call).

- **Marketing automation** – mobile customer engagement, geolocation, Apple's iBeacon, etc. are all creating a network of knowledge about customers' locations, intentions, preferences, and buying patterns. Of course, this degree of location-based knowledge needs to strike the right balance between user privacy and the timely delivery of useful products and services to that user.

- **Supply Chain Analytics** – delivering just-in-time products at the point of need (including the use of RFID-based tracking). Essentially, everything is a customer (including machines, automobiles, manufacturing plants, ATM machines, etc.), and the IoT is monitoring, watching, and waiting for a product need to arise.

1.3 Objective

- To develop a prototype for an automated home controlled through sensors.
- The aim is to both save electricity and provide its full use to the owner.
- To provide services such as water level sensing, fire detection, etc
- To develop a prototype for monitoring the user geographical area that will help the user in securing the domestic or industrial area.
- To provide real time monitoring of the area.
- To provide the real time information of the trespassing in the area/home and update the user by any source of notification.

1.4 Methodology

Smart home, a home that can detect and identify you, automatically adjust the lighting to your predefined taste, open doors automatically, play your favourite music, water your flowers in the morning, switch on the security lights at night and switch them off in the morning, heat water for bathe and tea, stream to you anywhere in the world via the internet a live video of what is happening in and around your house. It makes it possible to link lighting, entertainment, security, telecommunications, heating, and air conditioning into one centrally controlled system. This allows you to make your house an active partner in managing your busy life.

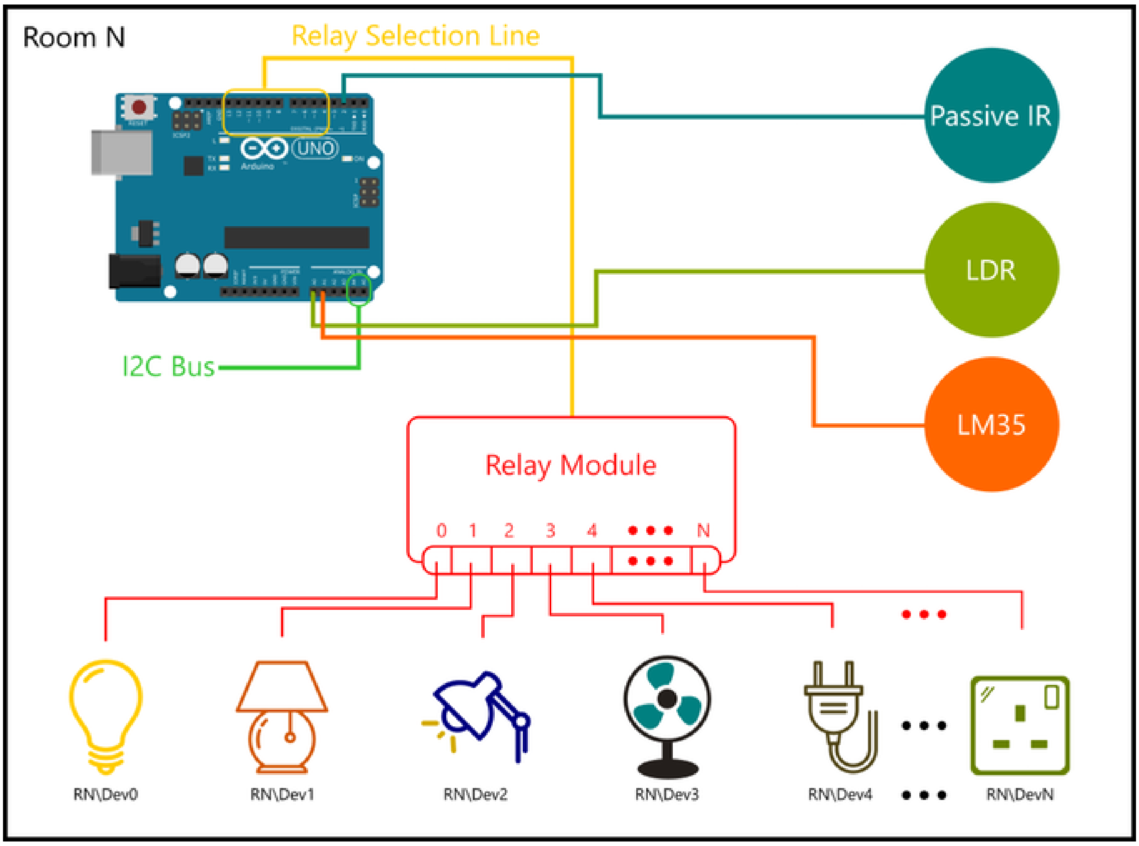


Figure 3: Methodology[8]

Ours is a simplest home automation system prototype that ranges from the burglar alarm, hi-tech security gates, water level sensing, light detection and an automated air conditioning system that maintains the temperature at a predefined value.

The Light Control Module is very useful for automation lighting system. This system switches on the lights only in darkness and switches off when there is enough light. As it works with LDR (Light Dependent Resistor) sensor, no programming of timings and battery back-up is required A double pole double throw (DPDT) relay is connected to the Arduino through a driver transistor. The relay requires 5 volts at a current of around 50 mA. The relay is used to operate the light bulb.. Normally the relay remains off. As soon as pin of the Arduino goes high, the relay operates. . The relay circuitry acts as a switch and also helps in handling the high power of AC voltage. The module helps save electricity to a great extent. This is a simple, fit and forget system. It can be further extended to commercial sign boards, advertising boards, street lights

The temperature sensor LM35 senses the temperature and converts it into an electrical signal, which is applied to the Arduino. The sensed and set values of the temperature are displayed on the serial monitor. The Arduino drives a transistor to control the fan and/or the heating element. The set temperature value can be varied from 1C to 255C.

The water level module is used to sense the water level of the tank. The output voltage changes with the emersion depth. It is low power consumption and high sensitivity. It has a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level. The Arduino pin goes high when the water level reaches a certain level and simultaneously the Buzzer pin goes high as well activating the buzzer siren.

The motion detection module senses the motion on the door and notifies the user through Bluetooth transmission. The user knows about the trespassing sitting inside the home. She/He can further send command to open the door or make it remain closed through his android app. The LCD screen provides additional feature of displaying the contents of various modules activated at the given moment.

2 LITERATURE REVIEW

1. Sanjana Prasad , P. Mahalakshmi , A. John Clement Sunder ,R.(2014) Smart Surveillance Monitoring System Using Arduino and PIR Sensor

This paper deals with the design and implementation of Smart surveillance monitoring system using Arduino and PIR sensor for mobile devices. It increases the usage of mobile technology to provide essential security to our homes and for other control applications. The proposed home security system captures information and transmits it via a Bluetooth to a Smart phone using Arduino operates and controls motion detectors and video cameras for remote sensing and surveillance, streams live video and records it for future playback. It can also find the number of persons located with the help of the Infrared sensor. For example, when motion is detected, the system automatically triggers the system and the Arduino device alerts the owner of the possible intrusion having a smart phone. Arduino is a credit- card sized computer .It functions almost as a computer. There are various surveillance systems such as camera, CCTV etc. In these types of surveillance systems, the person who is stationary and is located in that particular area can only view what is happening in that place .

2. Pyarie, R. Tyarize, R. (2014) Bluetooth based home automation system using Iot

This paper deals with the design of an intelligent home access control system. It allows the user to grant entry to any visitor to his/her house remotely after viewing the message. The design uses the Arduino Uno as the system processor. The whole system was implemented using wireless Bluetooth module through pop up message by Arduino and the Smartphone receives the message from ip Bluetooth .When the visitor arrives and wishes to enter the home, the PIR sensor continuously keeps on tracking any changes in its view . There will be a pop up message on the owner's phone asking about whether he wants to view the message or not, once he/she selects yes, it will receive the message from ip address of the Bluetooth module. Further after about 5 millisecond delay a message will be displayed to ask about owner wants to open the door or not. If owner wishes to open the door a signal will be sent to electronic lock via Arduino. If owner answers negatively the whole program will be terminated itself. In this way our system will work.

3. Vinay Sagar, KN. Kusuma, SM. (2013) Home Automation through IOT

Home automation system faces four main challenges; these are high cost of ownership, inflexibility, poor manageability, and difficulty in achieving security. The main objectives of this research is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration.

4. Chiemeziem ,E. Chukwubuikem , E. (2012) Water Level Monitoring & Control Using Arduino Microcontroller Module (Uno R3)

This project is focused on Arduino based water level monitoring and control and its impact on the technological advancement of water level control systems. The circuit is designed by programming the Arduino Uno R3 microcontroller with Arduino software and the codes are written in C++. The Arduino main board controls other unit of the system. The sensor unit acquires data from the tank and sends it to the processing unit which simultaneously displays the various levels of water on an LCD and also indicates the levels on series of LEDs. Then it controls the electric pump by switching it on when the water in the overhead tank is low and switching it off when the water level in the tank is full. This saves energy and reduces the wastage of water.

A great number of research studies have been done on the measurement of displacement is an important aspect of instrumentation. Force, torque, pressure, flow and density are just some of the measurands which are commonly measured by first being converted to a displacement. A secondary transducer then generates an electrical or pneumatic output signal proportional to that displacement. Also, displacement sensors/ transducer can be classified as contacting and non-contacting transducers, or between transducers that measure linear displacement and rotary displacement.

There are various techniques used in the course of liquid level measurement. They include; visual methods, up thrust method, pressure measurement, float and arm method, capacitance method, and ultrasonic method.

After determining the displacement and various levels of the liquid/water in the tank, one can now be able to talk about the control of the pump. Automatic water level control system has been achieved electronically using these systems;

1. Water level monitor and control based on GSM
2. Water level controller using fuzzy logic system
3. Water level sensing and controlling based on microcontroller.

In a project on “water level monitor for bore well and water tank based on GSM”. They discovered that there is no early warning system to monitor the tank water level when it has reached the critical level. By using a GSM based system that can automatically inform the users’ mobile phone this challenge can be eliminated. The basic components used in their works includes, power supply, relay drive, sensor driver, GSM modem, AT89C51 microcontroller.

In a project on “Design of water level controller using fuzzy logic system”, this fuzzy logic controller is based on Mamdani’s type fuzzy inference system. It has two inputs, error in level and fate of change of error and one output, valve position. The behaviour of the system was implemented using Matlab and simulated using Simulink.

S.M. Khaled implemented a microcontroller based automated water level sensing and controlling in a wired and wireless environment which can indicate the amount of water in the tank that can support global water types including cellular data loggers, satellite data transmission systems for remote water monitoring system. The basic component used in the project includes water indicator (LED), level sensor (iron rod, nozzle, rubber), water pump, microcontroller (PIC 16F84A), power supply etc. In their work they thought of how to make the project to be flexible so they proposed a web based water level monitoring and controlling network ie; the system can be accessed via the internet and using different types of devices.

5. Ramani, R. Olatunbosun , A. (2010) Internet of Things (IoT)

One of the buzzwords in the Information Technology is Internet of Things (IoT). The future is Internet of Things, which will transform the real world objects into intelligent virtual objects. The IoT aims to unify everything in our world under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things. In Light of this, present study addresses IoT concepts through systematic review of scholarly research papers, corporate white papers, professional discussions with experts and online databases. Moreover this research article focuses on definitions, geneses, basic requirements, characteristics and aliases of Internet of Things. The main objective of this paper is to provide an overview of Internet of Things, architectures, and vital technologies and their usages in our daily life. However, this manuscript will give good comprehension for the new researchers, who want to do research in this field of Internet of Things (Technological GOD) and facilitate knowledge accumulation in efficiently.

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it” was Mark Weiser’s central statement in his seminal paper in Scientific American in 1991. There is a sea change in human’s daily life as well as in working conditions in organizations after the arrival of IT and ITeS technologies. This is becoming well-known concept across many horizontal and vertical markets including a common man’s everyday life in the society, as it has several applications. The development of the Internet of Things (IoT) has been primarily driven by needs of large corporations that stand to benefit greatly from the foresight and predictability afforded by the ability to follow all objects through the commodity chains in which they are embedded. The ability to code and track objects has allowed companies to become more efficient, speed up processes, reduce error, prevent theft, and incorporate complex and flexible organizational systems through IoT. The IoT is a technological revolution that represents the future of computing and communications, and its development depends on dynamic technical innovation in a number of important fields, from wireless sensors to nanotechnology.

6. Reza, K. Ahsanuzzaman, S. (2010) Advanced Research in Computer Science and Software Engineering

This paper deals with the design of an intelligent home access control system based on visual authentication. It allows the user to grant entry to any visitor to his/her house remotely after viewing the visitor’s picture. The design uses the Arduino Uno as the system processor. The whole system was implemented using wireless webcam through pop up message by Arduino and the Smartphone receives the picture from ip camera (webcam as ip camera here).When the visitor arrives and wishes to enter the home, the webcam continuously keeps on tracking any changes in its view and it takes the picture of the visitor. There will be a pop up message on the owner’s phone asking about whether he wants to view the image or not, once he/she selects yes, it will receive the image from ip address of the webcam via Bluetooth pairing. Further after about 5 millisecond delay a message will be displayed to ask about owner wants to open the door or not. If owner wishes to open the door a signal will be sent to electronic lock via Arduino. If owner answers negatively the whole program will be terminated their itself. In this way our system will work.

3 SYSTEM DEVELOPMENT

3.1 Tools and Technologies used

3.1.1 Hardware Used

1. Arduino Uno

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform;

Figure 4: Arduino Uno [8]

Table 1: Technical specifications

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14
PWM Digital I/O Pins	6

Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P)
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

- **Power**

  - Vin: The input voltage to the Uno board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

  - 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

  - 3V: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- GND: Ground pins.

- IOREF: This pin on the Uno board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

- **Memory**

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

- **Input and Output**

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.
In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().

- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

- Communication

The Uno has a number of facilities for communicating with a computer, another Uno board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required.

The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).A Software Serial library allows serial communication on any of the Uno's digital pins.The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus;

- Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It is labelled "RESET-EN".

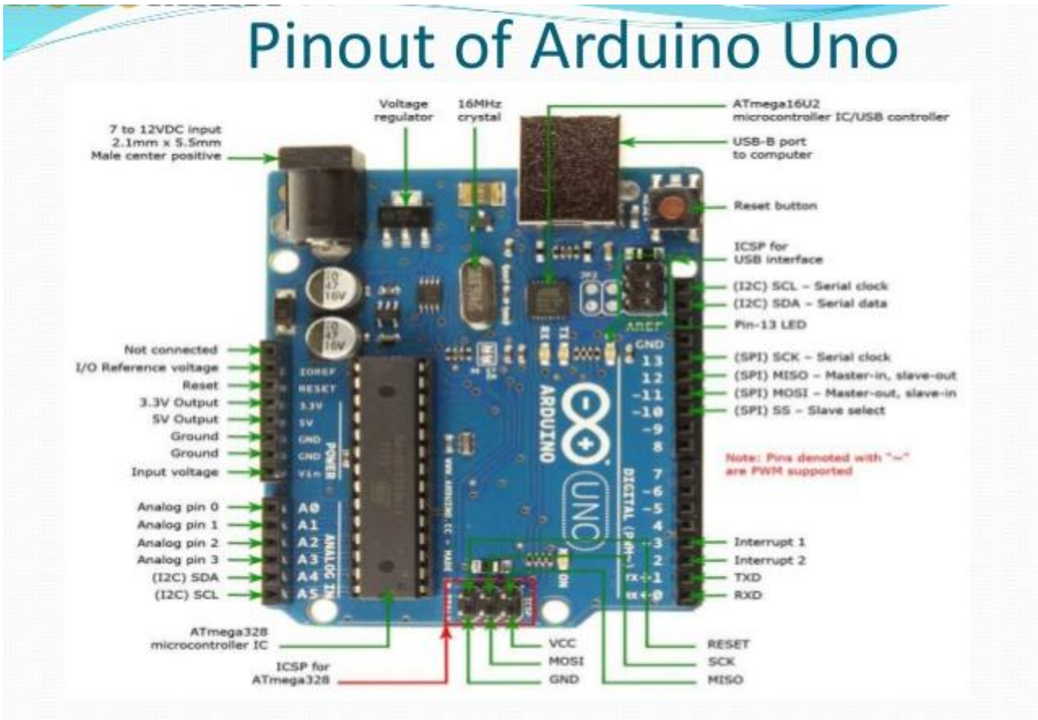


Figure 5: Arduino Pin out [8]

2. Bluetooth Module V2.0

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

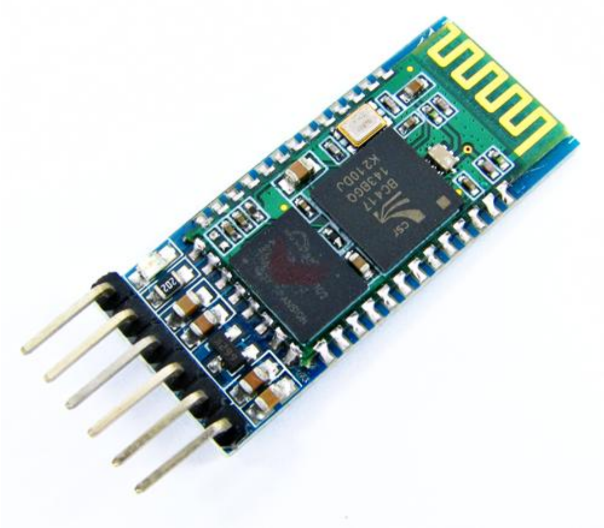


Figure 6: Bluetooth Module[9]

Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with Adaptive Frequency Hopping Feature. It has the footprint as small as 12.7mmx27mm.

Hardware Features

- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector

Software Features

- Default Baud rate: 38400, Data bits:8, Stop bit:1,Parity:No parity,
- Data control: has supported baud rate: 9600, 19200, 38400, 57600, 115200, etc.
- Given a rising pulse in PIO0, device will be disconnected.
- Status instruction port PIO1: low-disconnected, high-connected;
- PIO10 and PIO11 can be connected to red and blue led separately.
- When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2 times/s.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"0000" as default
- Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

3. Wireless Sd Shield

Bluetooth mounted on wireless shield The Wireless SD shield allows an Arduino board to communicate wirelessly using a wireless module. The module can communicate up to 100 feet indoors or 300 feet outdoors (with line-of-sight). It can be used as a serial/USB replacement or you can put it into a command mode and configure it for a variety of broadcast and mesh networking options.

4. Sensors

- **Water level sensor**

Water Sensor water level sensor is an easy-to-use, cost-effective high level/drop recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level. Easy to complete water to analog signal conversion and output analog values can be directly read by Arduino development board to achieve the level alarm effect.

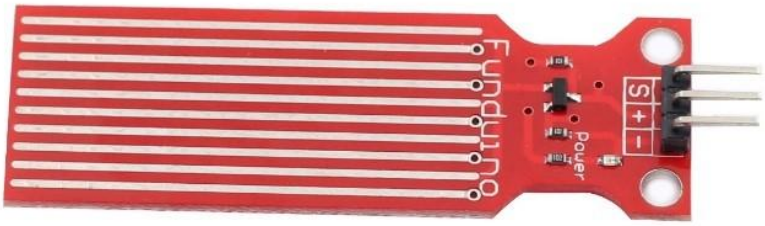


Figure 7: Water-Level Sensor [10]

Specifications:

1. Product Name: water level sensor
2. Operating voltage: DC3-5V

3. Operating current: less than 20mA
4. Sensor Type: Analog
5. Detection Area: 40mmx16mm
6. Production process: FR4 double-sided HASL
7. Operating temperature:10℃-30℃
8. Humidity: 10% -90% non-condensing
9. Product Dimensions: 62mmx20mmx8mm

- **Light Sensor(LDR)**

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band.

These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased.

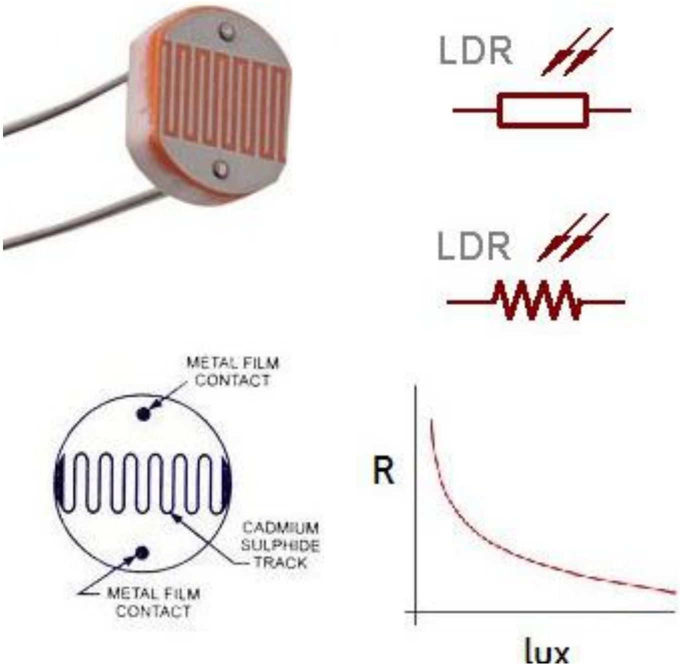


Figure 8: Light Sensor[11]

- **Temperature Sensor (LM35)**

LM35 is a basic temperature sensor that can be used for experimental purpose. It gives the readings in centigrade (degree Celsius) since its output voltage is linearly proportional to temperature.

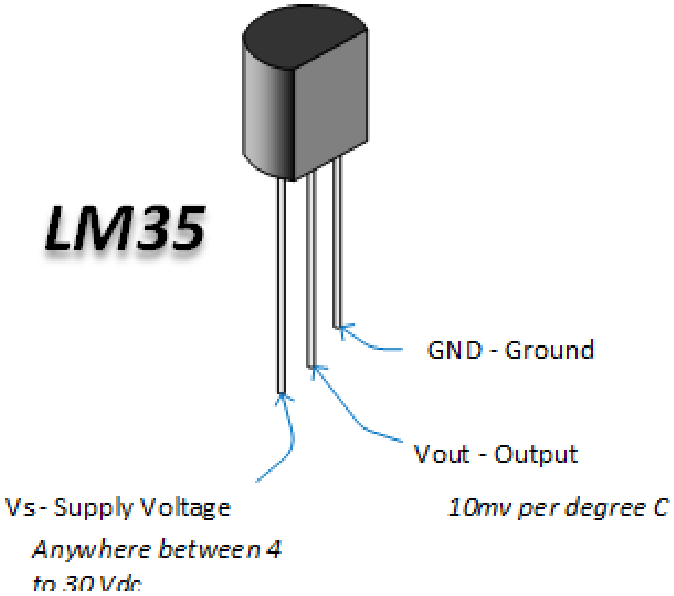


Figure 9: Temperature Sensor, LM35[12]

It uses the fact that as temperature increases, the voltage across diode increases at known rate (actually the drop across base-emitter junction of transistor). Its disadvantage is its sluggish response. It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/C or 1mV/C. Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 C temperature rises in still air. The operating temperature range is from -55°C to 150°C.

- **IR Motion Detection Sensor**

An infrared sensor is an electronic device, which emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation.

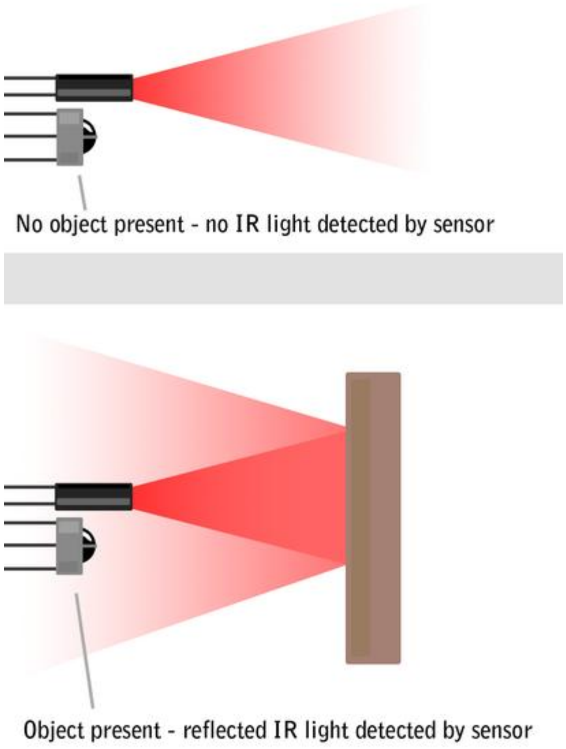

No object present - no IR light detected by sensor
Object present - reflected IR light detected by sensor

Figure 10: IR Sensor[14]

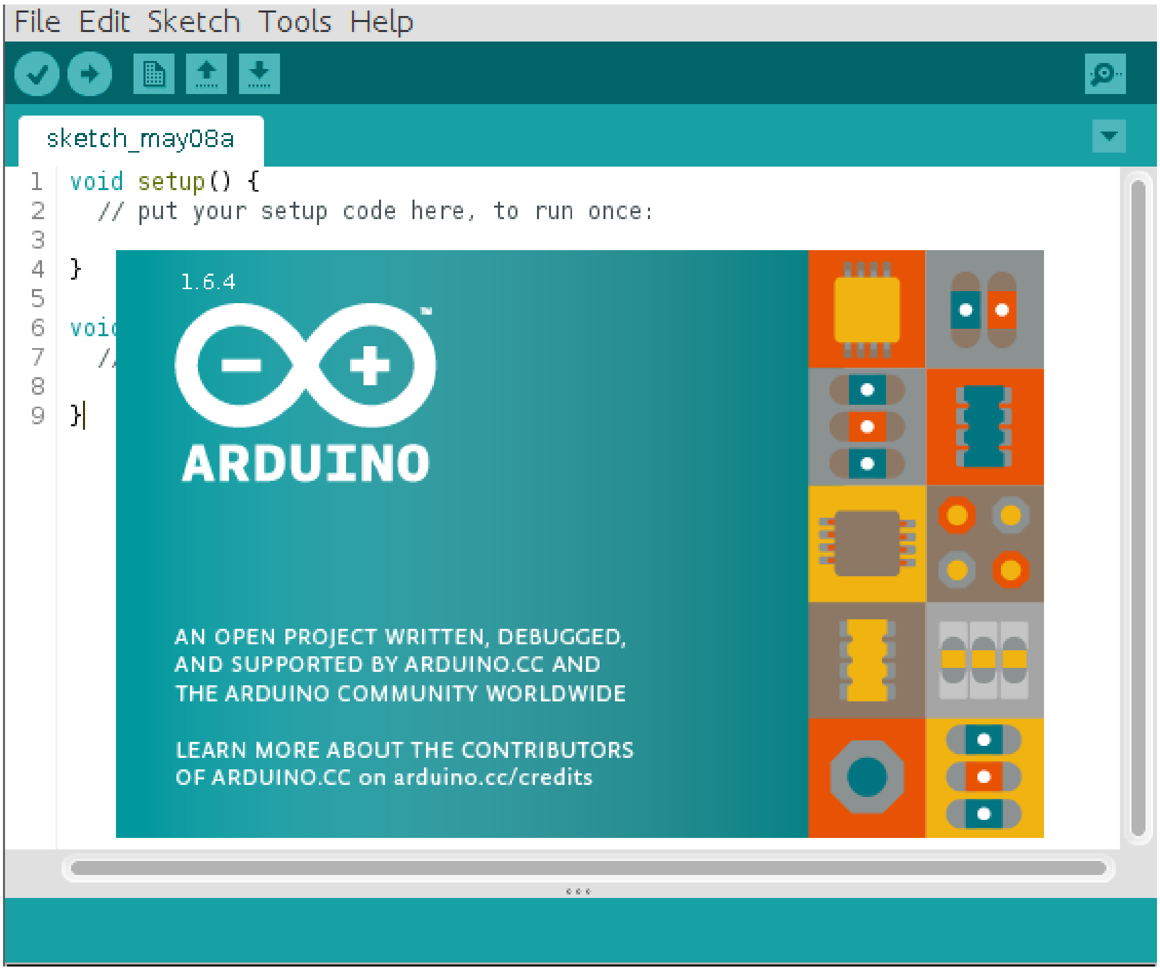
Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes but can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

3.1.2 Software Used

1. Arduino Integrated Development Environment (IDE)

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino.

The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.



```
void setup() {
  // put your setup code here, to run once:

}

voi
  /

}
```

AN OPEN PROJECT WRITTEN, DEBUGGED, AND SUPPORTED BY ARDUINO.CC AND THE ARDUINO COMMUNITY WORLDWIDE

LEARN MORE ABOUT THE CONTRIBUTORS OF ARDUINO.CC on arduino.cc/credits

Figure 11: Arduino IDE

2. Eclipse ADT (Android Development Tools)

Android is an intent based operating system. Using Android came into existence with the sure fire idea that developments are given the power and freedom to create enthralling Mobile applications while taking advantage of everything that the mobile handset has to offer. Moreover Android is an open source platform and hence can be learned and implemented easily.

Android Development Tools (ADT) is a Google-provided plug-in for the Eclipse IDE that is designed to provide an integrated environment in which to build Android applications.

ADT extends the capabilities of Eclipse to let developers set up new Android projects, create an application UI, add packages based on the Android Framework API, debug their applications using the Android SDK tools, and export signed (or unsigned) .apk files in order to distribute their applications. It is free download. It was the official IDE for Android but was replaced by Android Studio (based on IntelliJ IDEA Community Edition).We need an android application to interface with the user and device.

ArduDroid (formerly Andruino) is a simple tool to help you control your Arduino (or clone) from your Android phone. It’s both an Android app and an Arduino program. ArduDroid has a simple Android user interface to 1) control Arduino digital and PWM pins 2) send text commands to Arduino 3) and receive data from Arduino over Bluetooth serial.

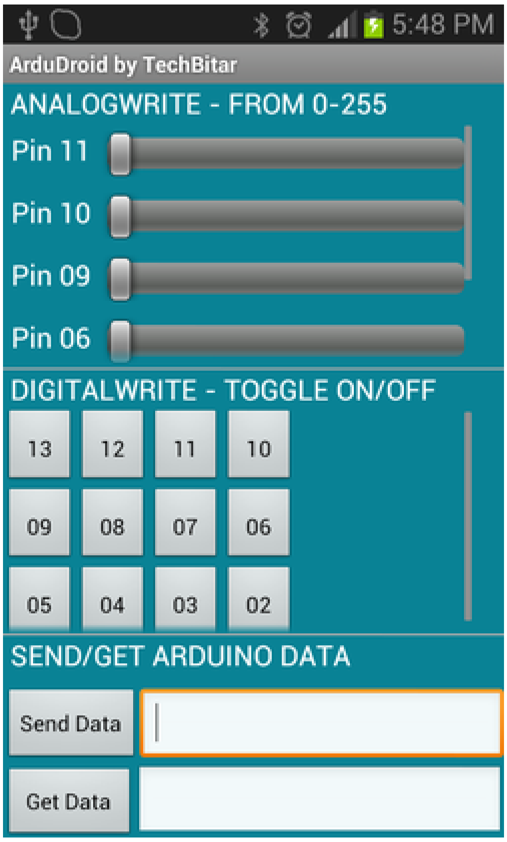


Figure 12: ArduDroid

3.1.3 Protocols

Devices must communicate with each other (D2D). Device data then must be collected and sent to the server infrastructure (D2S). That server infrastructure has to share device data (S2S), possibly providing it back to devices, to analysis programs, or to people. From 30,000 feet, the protocols can be described in this framework as:

1. MQTT

MQTT, the Message Queue Telemetry Transport, targets device data collection. As its name states, its main purpose is telemetry, or remote monitoring. Its goal is to collect data from many devices and transport that data to the IT infrastructure. It targets large networks of small devices that need to be monitored or controlled from the cloud.

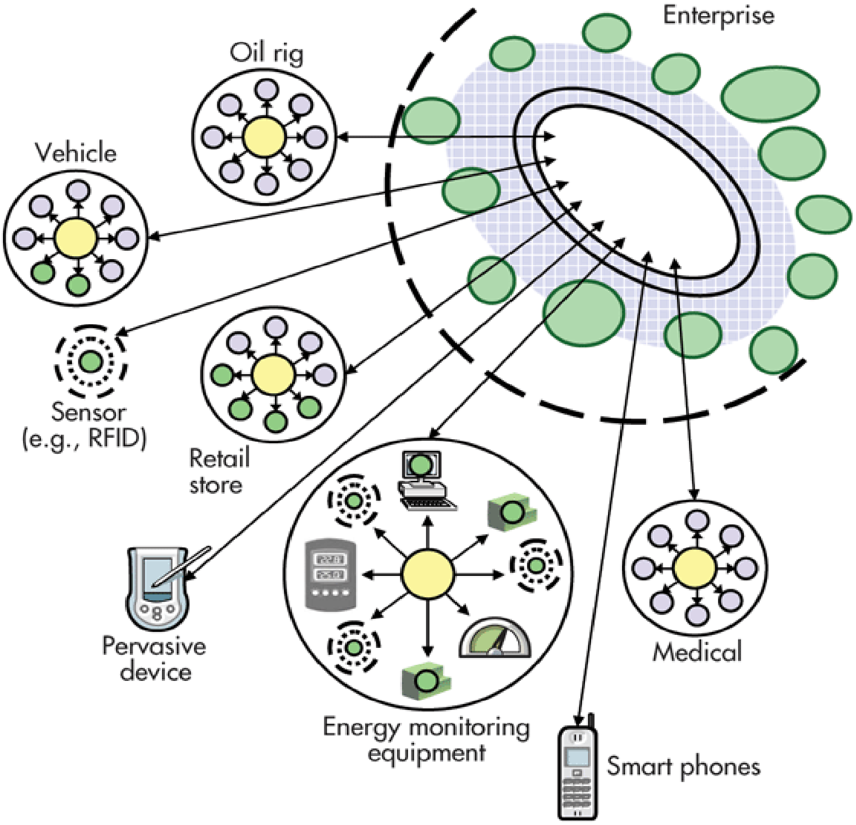


Figure 13: Message Queue Telemetry Transport[13]

Message Queue Telemetry Transport (MQTT) implements a hub-and-spoke system. MQTT makes little attempt to enable device-to-device transfer, nor to “fan out” the data to many recipients. Since it has a clear, compelling single application, MQTT is simple, offering few control options. It also doesn’t need to be particularly fast. In this context, “real time” is typically measured in seconds.

A hub-and-spoke architecture is natural for MQTT. All the devices connect to a data concentrator server, like IBM’s new Message Sight appliance. You don’t want to lose data, so the protocol works on top of TCP, which provides a simple, reliable stream.

2. XMPP

XMPP was originally called “Jabber.” It was developed for instant messaging (IM) to connect people to other people via text messages. XMPP stands for Extensible Messaging and Presence Protocol. Again, the name belies the targeted use: presence, meaning people are intimately involved. XMPP uses the XML text format as its native type, making person-to-person communications natural. Like MQTT, it runs over TCP, or perhaps over HTTP on top of TCP. Its key strength is a name@domain.com addressing scheme that helps connect the needles in the huge Internet haystack.

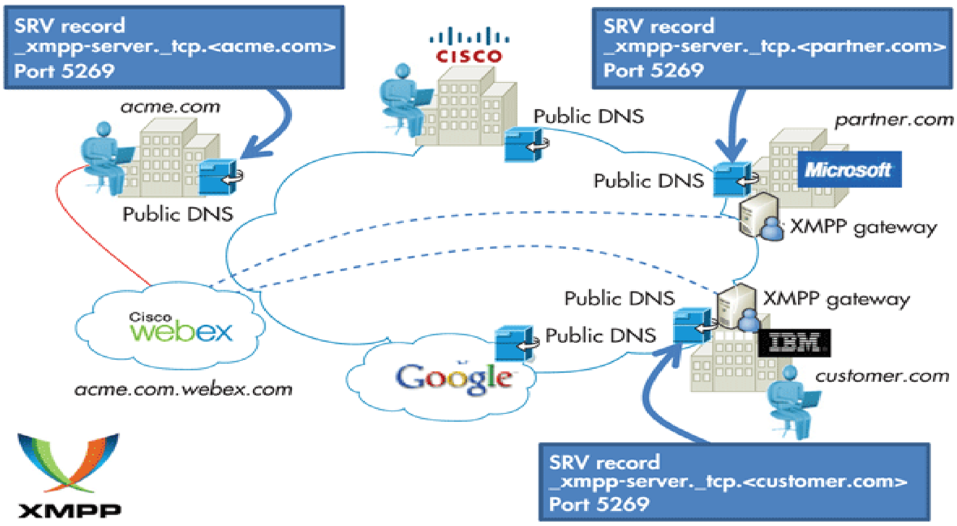


Figure 14: Extensible Messaging and Presence Protoco[13]l

3. DDS

In contrast to MQTT and XMPP, the Data Distribution Service (DDS) targets devices that directly use device data. It distributes data to other devices. While interfacing with the IT infrastructure is supported, DDS's main purpose is to connect devices to other devices. It is a data-centric middleware standard with roots in high-performance defense, industrial, and embedded applications. DDS can efficiently deliver millions of messages per second to many simultaneous receivers.

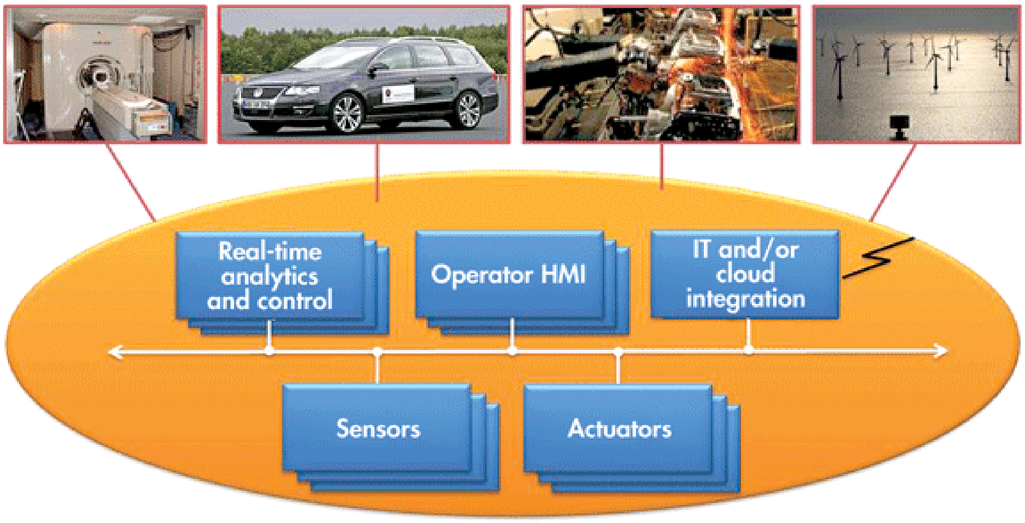


Figure 15: Data Distribution Service[13]

Devices demand data very differently than the IT infrastructure demands data. First, devices are fast. "Real time" is often measured in microseconds. Devices need to communicate with many other devices in complex ways, so TCP's simple and reliable point-to-point streams are far too restrictive. Instead, DDS offers detailed quality-of-service (QoS) control, multicast, configurable reliability, and pervasive redundancy. In addition, fan-out is a key strength. DDS offers powerful ways to filter and select exactly which data goes where, and "where" can be thousands of simultaneous destinations.

Some devices are small, so there are lightweight versions of DDS that run in constrained environments.

4. Advanced Message Queuing Protocol

Finally, the Advanced Message Queuing Protocol (AMQP) is sometimes considered an IoT protocol. AMQP is all about queues. It sends transactional messages between servers. As a message-centric middleware that arose from the banking industry, it can process thousands of reliable queued transactions. AMQP is focused on not losing messages. Communications from the publishers to exchanges and from queues to subscribers use TCP, which provides strictly reliable point-to-point connection. Further, endpoints must acknowledge acceptance of each message. The standard also describes an optional transaction mode with a formal multiphase commit sequence. True to its origins in the banking industry, AMQP middleware focuses on tracking all messages and ensuring each is delivered as intended, regardless of failures or reboots.

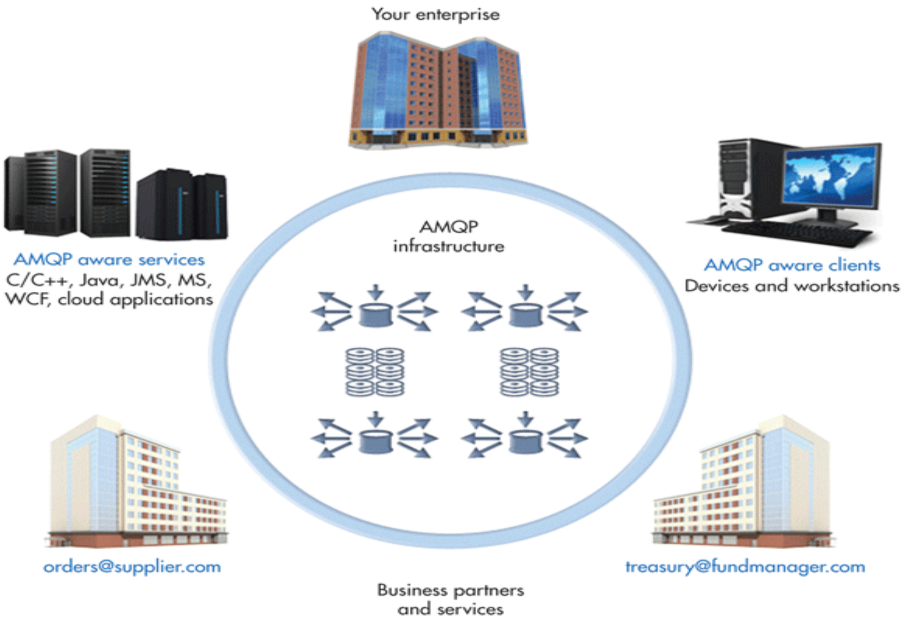


Figure 16: Advanced Message Queuing Protocol[13]

3.2 Design

3.2.1 Temperature Sensing Module Design

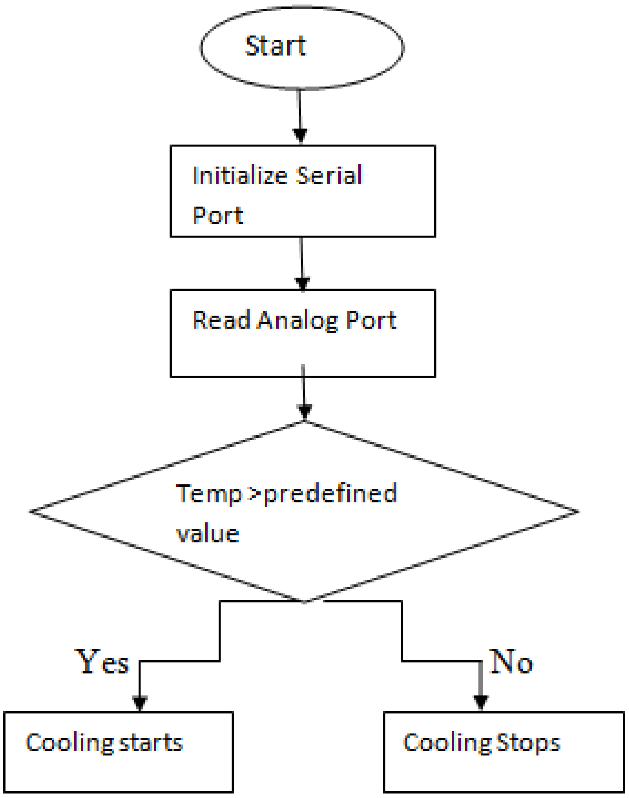


Figure 17: Temperature Sensing Module Design

3.2.2 Light Sensing Module Design

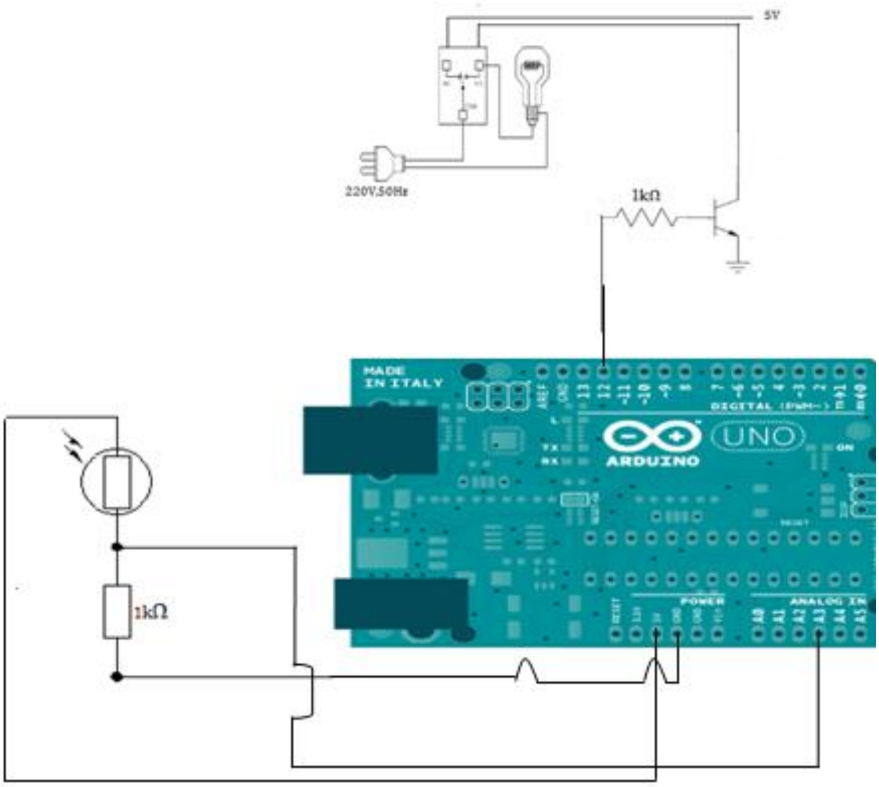


Figure 18: Light Sensing Module Circuit

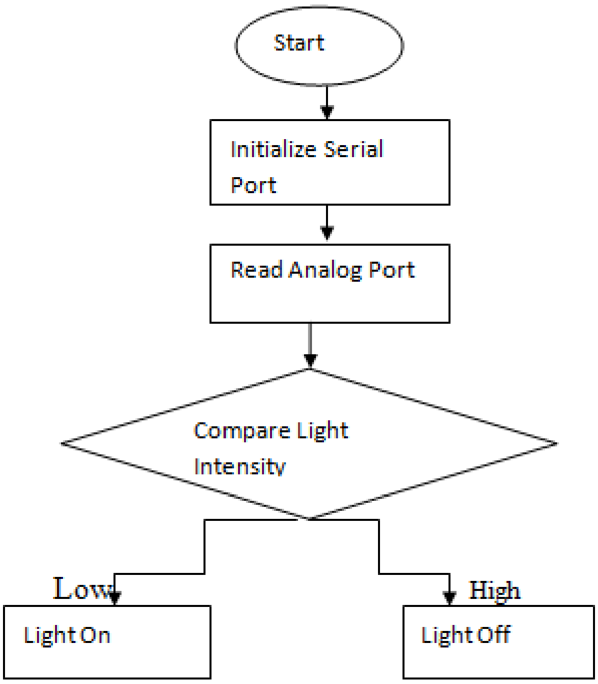


Figure 19: Light Sensing Module Design

3.2.3 Water Sensing Module Design

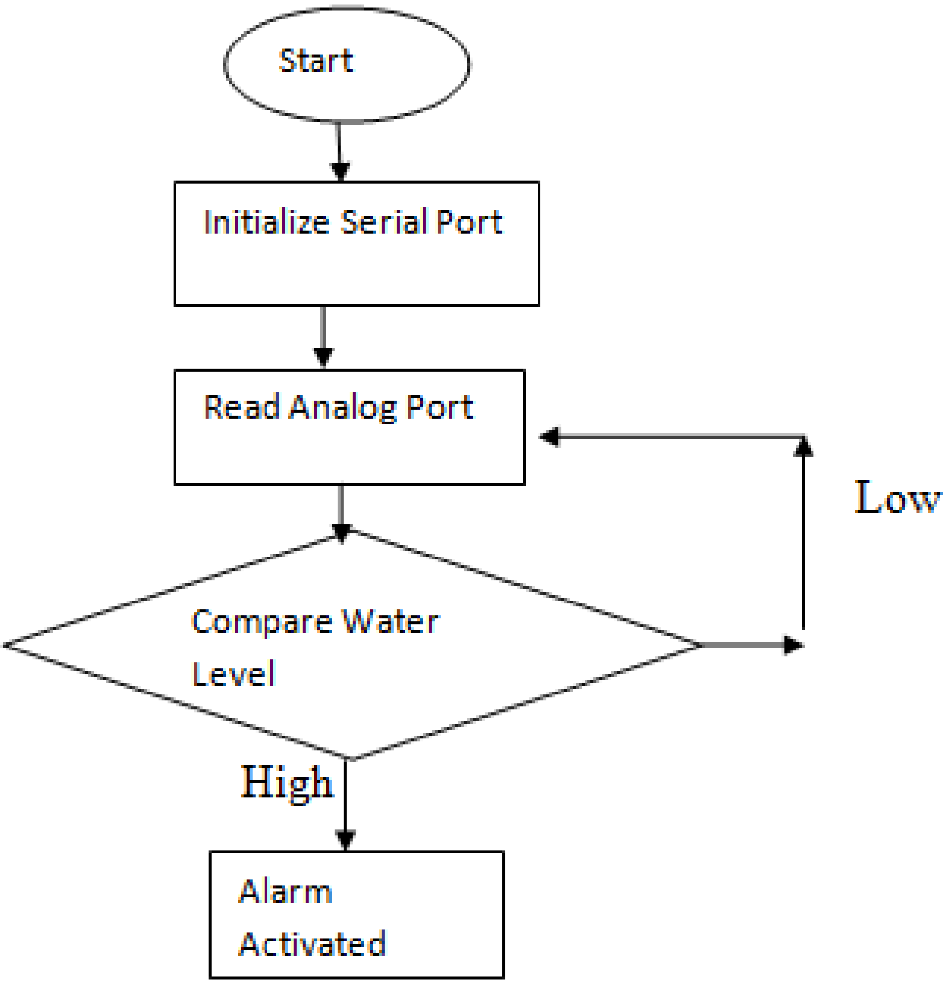


Figure 20: Water Sensing Module Design

3.2.4 Motion Detection Module Design

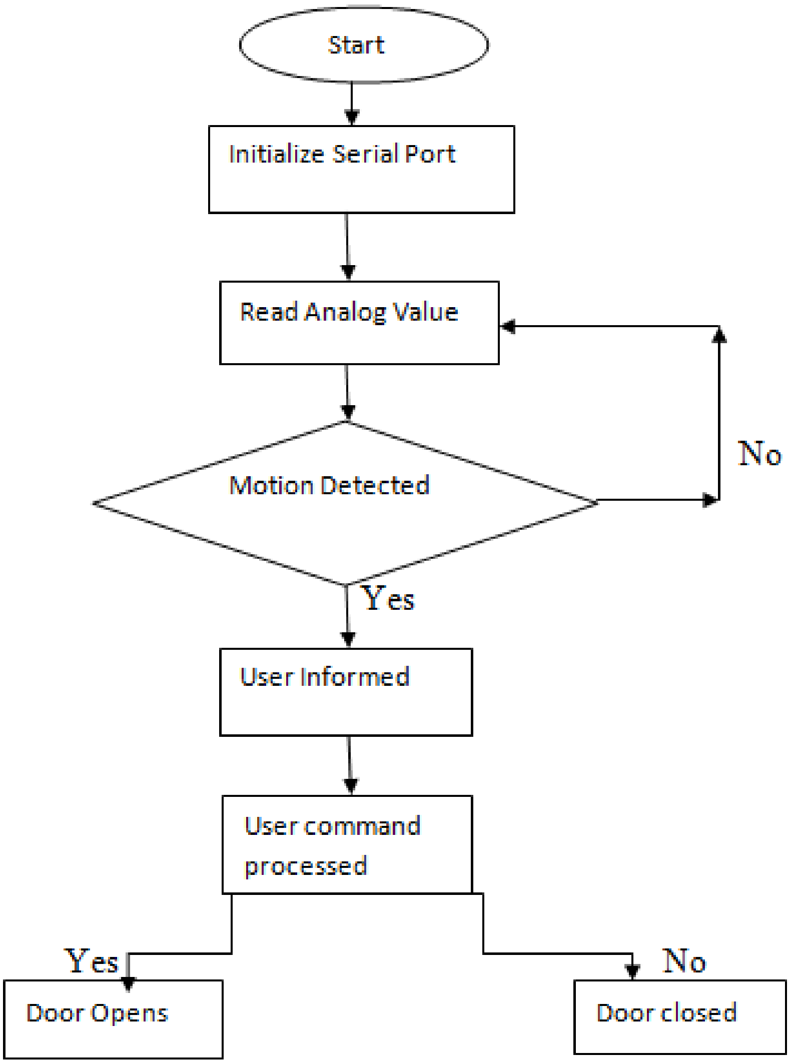


Figure 21: Motion Detection Module Design

3.3 Development:

1. Temperature Sensing Module:

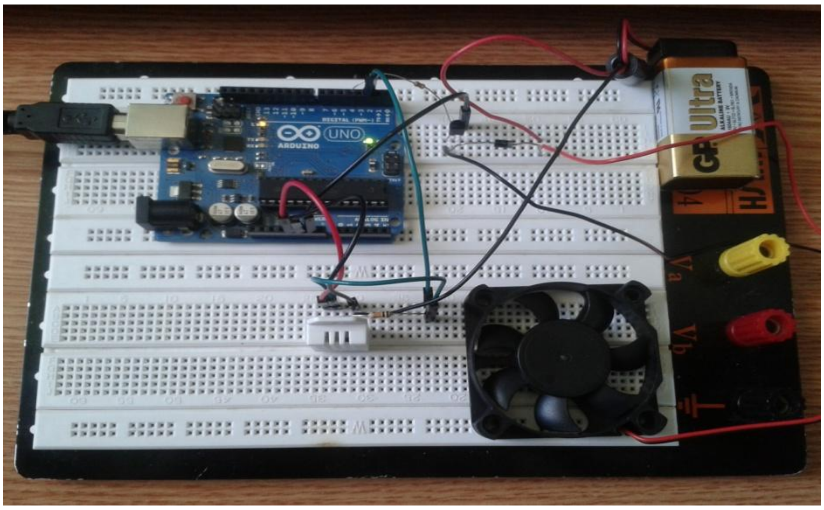


Figure 22: Temperature Sensing Circuit[9]

2. Light Sensing Module:

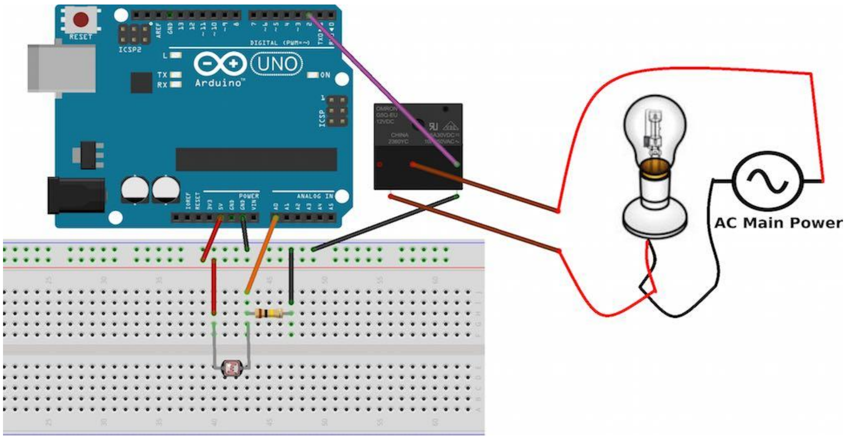


Figure 23: Light Sensing Circuit[11]

3. Water Level Sensing Module:

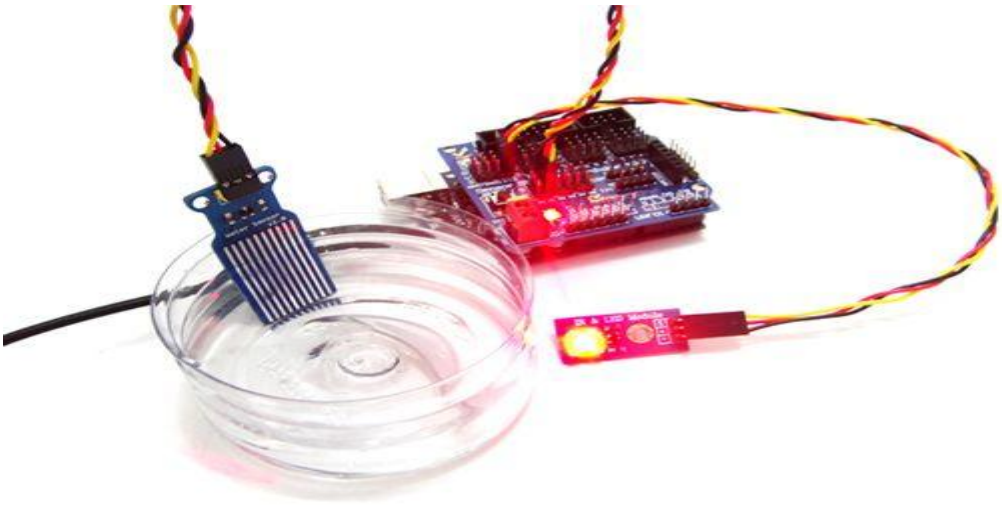


Figure 24: Water-level Sensing Circuit[10]

4. Motion Detection Bluetooth Module:

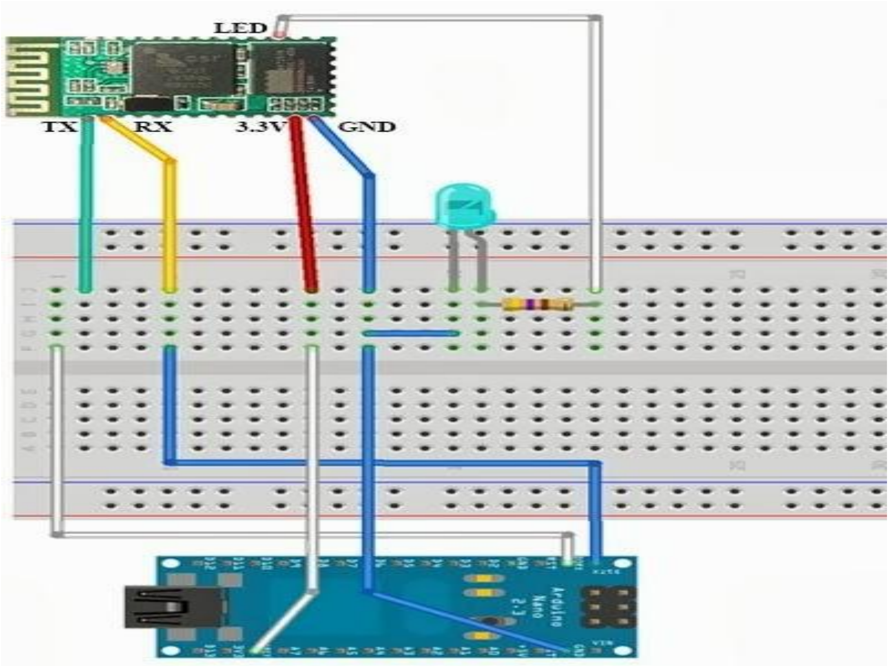


Figure 25: Motion Detection Bluetooth Sensing Circuit[14]

3.4 Algorithm:

1. Temperature sensing Module

```
 Analog Read the temppin
Convert the temperature to Celsius
If(temp==predefined value)
Start cooling
Else stop cooling
```

2. Water level sensing Module Algorithm:

```
 Analog Read the levelpin
If(level==predefined value)
Trigger the buzzer
Else display the level to be optimum
```

3. Light sensing Module Algorithm:

```
 Analog Read the LDR pin
If(value== predefined)
 Switch the light on.
Else vary according to the light intensity
```

4. **Blutooth Control ArduDroid**

- Control Analog Pin

```
 GET analogWrite DATA From ARDUDROID
 If (ard_command==CMD_ANALOGWRITE)
 analogWrite (pin_num,pin_value);
```

- Control Analog Pin

```
GET DigitalWrite DATA From ARDUDROID
If (ard_command==CMD_DIGITALWRITE)
If (pin_value==PIN HIGH) pin_value=HIGH
Else return;
Set_digitalwrite(pin_num,pin_value);
```

- Send Text/Command to Android

```
If (Ard_command==CMD_READ_ARDUROID)
Char send_toandroid[]=”text”
Print (Send to android)
Read and Send Pin value to Arduino
```

4 PERFORMANCE ANALYSIS

3.1 Tabular and Graphical Analysis

1) Temperature Module Analysis

Table 2: Data for LM35

Temperature(ºC)	**Voltage(mV)**
16	159mV
24	240mV
28	277mV
29	290mV

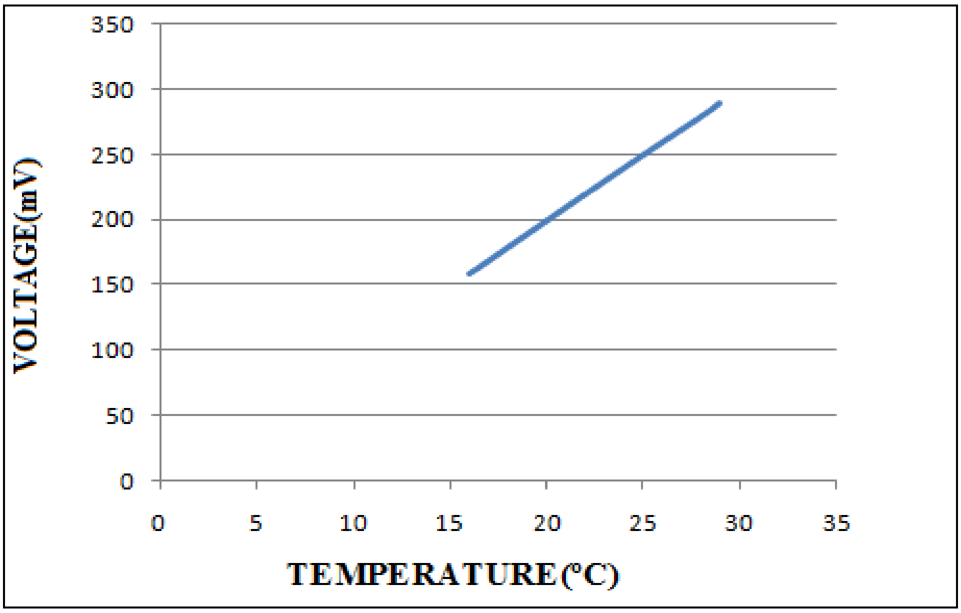


Figure 26: Temperature vs Voltage graph

Temperature sensor sensitivity factor came out to be 10mV/ºC(increase).

RESULT: When temperature conditions were set for turning ON the fan ,DC fan triggered accurately according to the set condition.

2) Water Sensing Module

For water level module following readings were observed

Table 3 : Data for water level sensor

Water level(cm)	**Voltage (V)**	**Integer value**
0	0	0
1	2.601	496
2	2.667	516
3	2.734	572
4	2.80	586

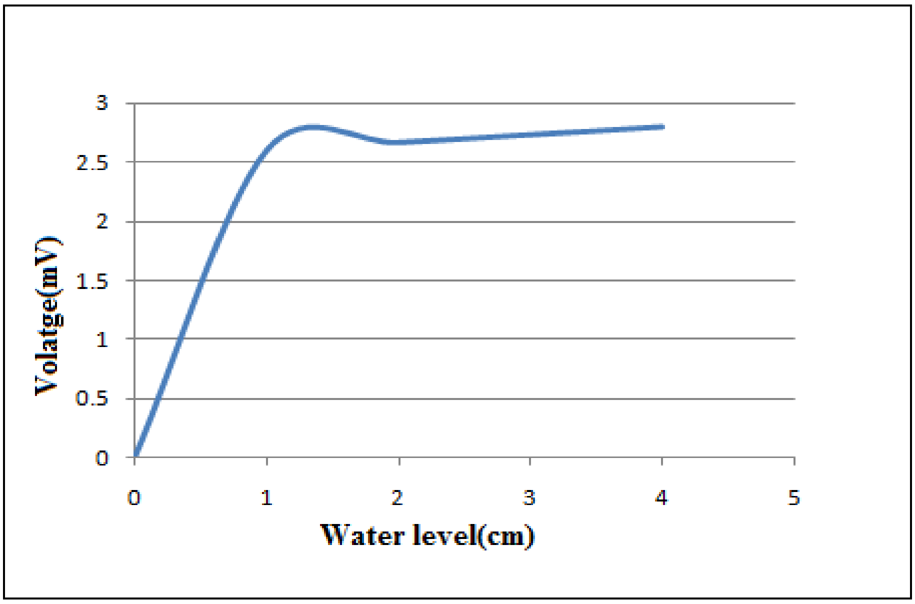


Figure 27: Water level vs Voltage graph

3) Motion Detection Module

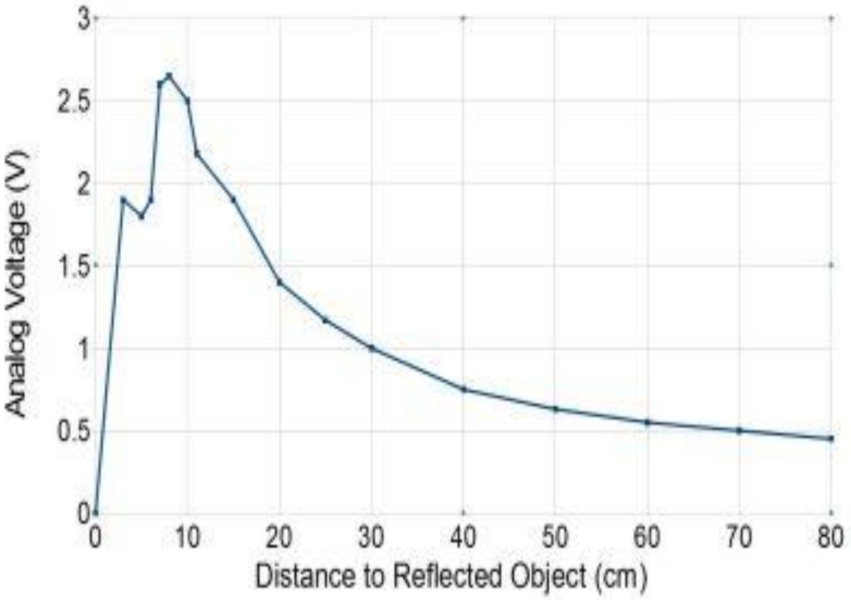


Figure 28: Distance vs Voltage graph

4) Light sensor Output

Table 4: Data for LDR

Light Intensity	Voltage(mV)	LDR Resistance
Natural light	88	343 Ω
Room light	68	364 Ω
Large light intensity	103	328 Ω
Dark	3.5	5.7kΩ
Extreme dark	1.23	12MΩ

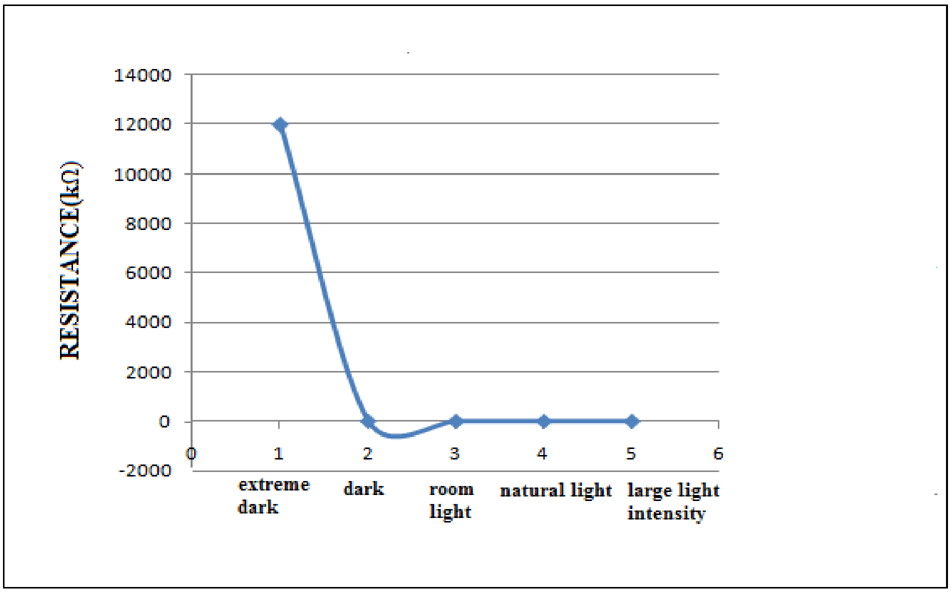


Figure 29: Light Intensity vs. Resistance graph

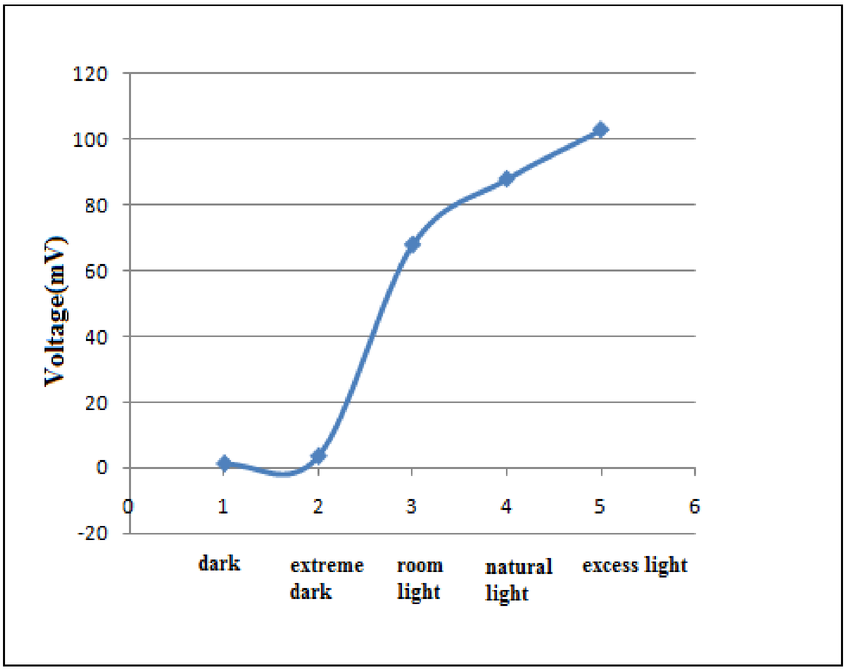
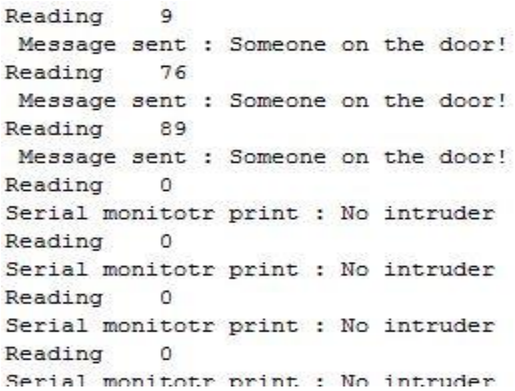


Figure 30: Light intensity vs. Voltage graph

Resistance of an LDR showed a declining trend with increasing light intensity as per the photoconductivity principle.

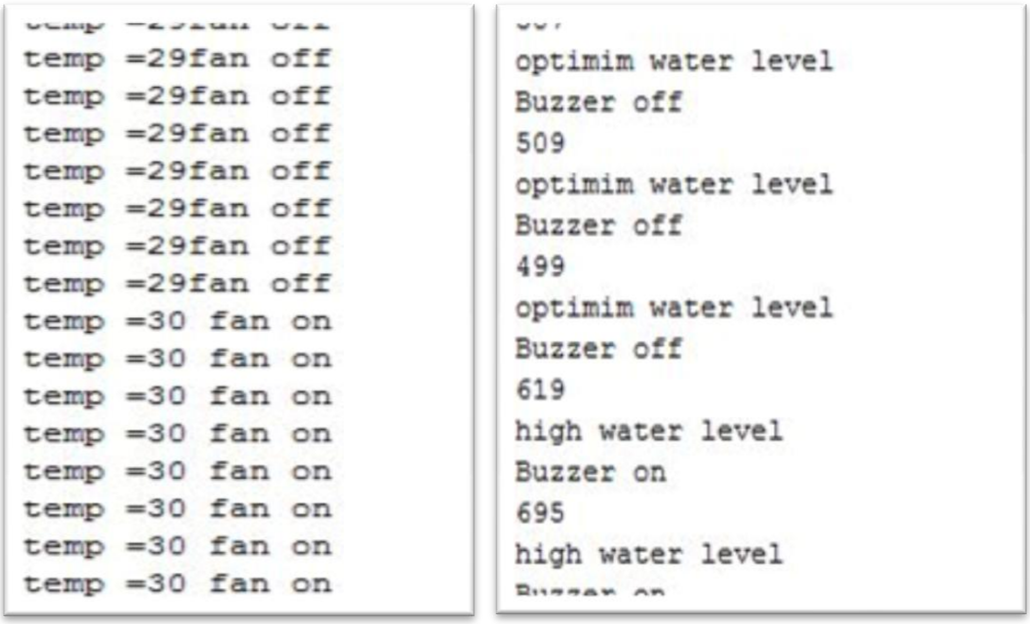
Voltage across an LDR increased with increasing light intensity.

4.2 Output Screenshots



```
Reading     9
 Message sent : Someone on the door!
Reading     76
 Message sent : Someone on the door!
Reading     89
 Message sent : Someone on the door!
Reading     0
Serial monitotr print : No intruder
Reading     0
Serial monitotr print : No intruder
Reading     0
Serial monitotr print : No intruder
Reading     0
Serial monitotr print : No intruder
```

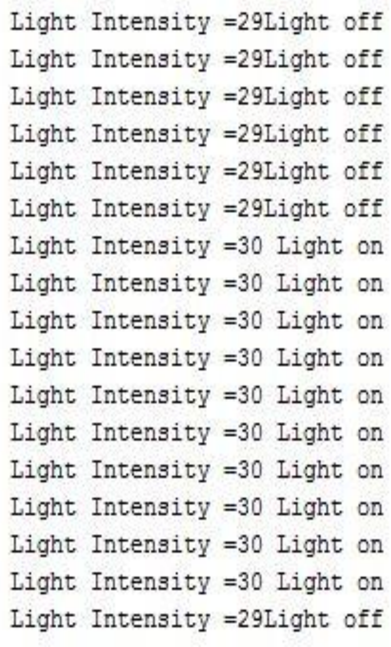
Figure 31 : Motion Detection Output



```
temp =29fan off
temp =29fan off
temp =29fan off
temp =29fan off
temp =29fan off
temp =29fan off
temp =29fan off
temp =30 fan on
temp =30 fan on
temp =30 fan on
temp =30 fan on
temp =30 fan on
temp =30 fan on
temp =30 fan on
temp =30 fan on
```

```
optimim water level
Buzzer off
509
optimim water level
Buzzer off
499
optimim water level
Buzzer off
619
high water level
Buzzer on
695
high water level
```

Figure 32 : Temperature and Water-level Sensor Output



```
Light Intensity =29Light off
Light Intensity =29Light off
Light Intensity =29Light off
Light Intensity =29Light off
Light Intensity =29Light off
Light Intensity =29Light off
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =30 Light on
Light Intensity =29Light off
```

Figure 33 : Light Sensor Ouput

5 CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled. The designed system not only monitors the sensor data, like temperature, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. This will help the user to analyze the condition of various parameters in the home anytime.

5.1 FUTURE WORK:

Using this system as framework, the system can be expanded to include various other options which could include home security feature like capturing the photo of a person entering and sending it to the owner through Whatsapp. This will increase the security and enable to keep a check on his house from anyplace. The system can be expanded for automation of various other devices at home. This kind of a system with respective changes can be implemented in the hospitals for disable people or in industries where human invasion is impossible or dangerous. Thus, resulting in a complete automated and easy to use system.

5.2 SMART HOME EXPANSIONS

- **Wireless connectivity:** A Wi-Fi enabled hub that doesn’t need to be physically connected to your router is a good bet, as this gives you more options as to where you place it in your home.

- **Expansion capability:** The higher the number of products/devices it can support, the better.

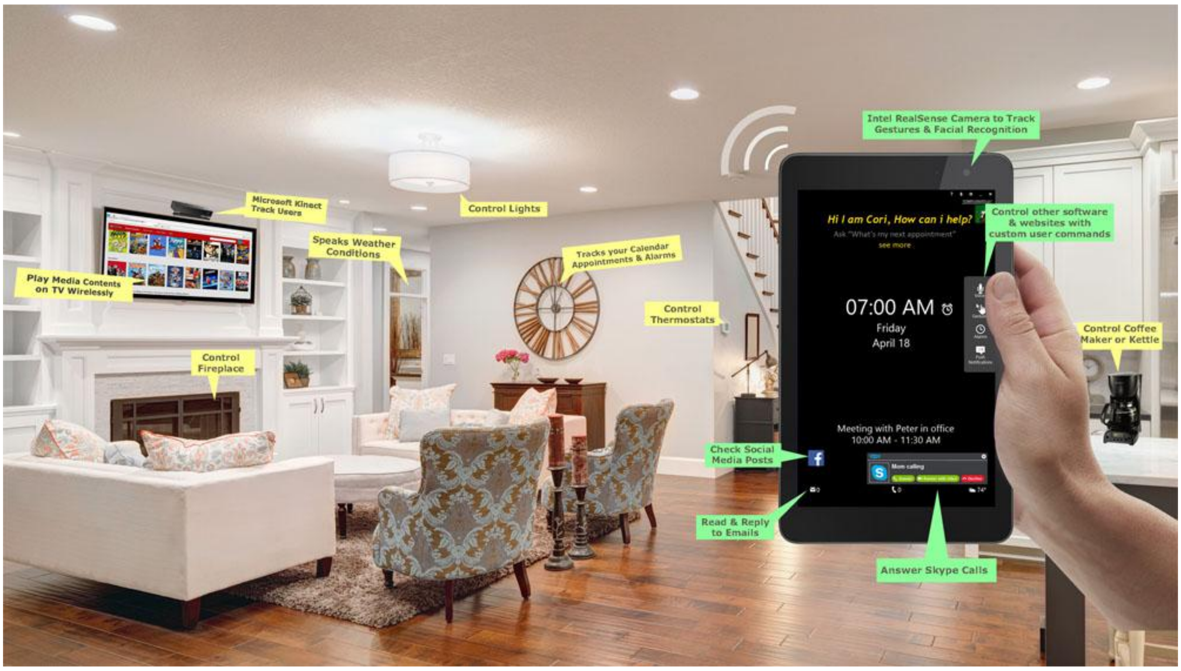

Intel RealSense Camera to Track Gestures & Facial Recognition
Microsoft Kinect Track Users
Control Lights
Speaks Weather Conditions
Tracks your Calendar Appointments & Alarms
Play Media Contents on TV Wirelessly
Control Thermostats
Control Fireplace
Hi I am Cori, How can i help?
Ask "What's my next appointment"
see more
07:00 AM
Friday
April 18
Control other software & websites with custom user commands
Control Coffee Maker or Kettle
Meeting with Peter in office
10:00 AM - 11:30 AM
Check Social Media Posts
Mom calling
Read & Reply to Emails
Answer Skype Calls

Figure 34: Smart Home[15]

- **Protocol compatibility:** A hub that can communicate with the major home automation protocols—Zigbee, Z-Wave, Wi-Fi and Bluetooth LE—is important, but what's more important is making sure it communicates with the devices you already have in your home, so check for compatibility.

- **App control:** While a website interface is nice to have, make sure your hub has an app that is compatible with your Smartphone. An automated home works far more smoothly from the palm of your hand than from behind a computer screen.

- **Scheduling /Automation System:** The hub's software should be able to set up schedules for your devices and create actions to connect different devices, such as an action that turns your lights off when you leave the house.

- **Selective Alerts/Messaging:** The software should be able to send you alerts when chosen actions are completed, such as an alert when your daughter opens your front door with her unique code.

6 REFERENCES

1. S.Praveen,"IOT and its Signifance ", 2015,Online.
Available: http://internetofthingswiki.com/internet-of-things-definition.

2. S.Prasad , P. Mahalakshmi" Smart Surveillance Monitoring System Using Arduino and PIR Sensor ",International Journal of Computer Science and Information Technologies, pp 45-65 ,Vol. 5 ,issue 1,2014.

3. Pyarie, R. Tyarize," Bluetooth based home automation system using Iot", International Journal Of Computer Science and Information Technologies, pp 103-130,Vol 2 ,issue1,2013.

4. V Sagar, KN. Kusuma," Home Automation through IOT ", International Research Journal of Engineering and Technology, pp 117-128, vol 2 ,issue 3 ,2015.

5. Chiemeziem ,E. Chukwubuikem, "Water Level Monitoring & Control Using Arduino Microcontroller Module", International Journal of Engineering Science and Technology ,pp119-122, vol 4,issue 3 ,2014.

6. Ramani, R. Olatunbosun , " Internet Of Things", International Journal Of Computer Science and Technology ,pp 120-145,vol 2 ,issue 3,2014.

7. Reza, K. Ahsanuzzaman,"Advance Research in Computer Science and Software Engineering ",pp 110-130,vol 3 ,issue 2 , 2013.

8. S.Mandeep ,"Arduino and Its Working ",2015,Online
Available : https://www.arduino.cc/en/main/arduinoBoardUno

9. M.Rawashed ,"Arduino and Bluetooth Connectivity ",2015,Online
Available: http://www.instructables.com/id/Arduino-AND-Bluetooth-HC-05

10. T.Mojidar ,"Arduino Temperature Sensor",2014,Online
Available: http://www.instructables.com/id/ARDUINO-TEMPERATURE-SENSOR-LM35/

11. Akellyirl ,"Light Sensor Arduino ",2015,Online
Available: http://www.instructables.com/id/How-to-Use-a-Light-Dependent-Resistor-LDR/

12. R.Sharma,"Water Level Sensor ",2014,Online
Available : http://www.instructables.com/id/How-to-Use-a-Light-Dependent-Resistor-LDR/

13. S.Schneider,"Various Protocols of Internet of Things ",2013,Online
Available: http://electronicdesign.com/iot/understanding-protocols-behind-internet-things

14. R.Dovina,"IR sensor with Arduino ",2013,Online
Available: http://www.instructables.com/id/Simple-IR-proximity-sensor-with-Arduino/

15. GreenPeak Technologies,2014,Online

Available : http://www.greenpeak.com/Application/SmartHome.html