

An IOT based Intelligent Home and Security System

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ABSTRACT: Nowadays advancement in embedded system is growing rapidly, Hence IOT (Internet Of Things) is a new latest technology that is used for the advancement in home automation and home security system. IOT technology makes the user to control the things automatically or manually from anywhere in the world. In this paper we will use IOT technology for the automatic and manual control of home appliances like bulb, fan, water tank level, cameras, etc., and also maintaining the power consumed by these appliances and uploading all the images and videos and data to the cloud which is permanently stored in cloud. This paper mainly aims at the efficient monitoring and actuating the power for the appliances based on the need. The advantage of IOT technology compared to other technologies is that the data is stored in the internet cloud and can be accessed anytime from anywhere in the world.

KEYWORDS: IOT, Intelligent home, Security, LPC2148, Cloud

I. INTRODUCTION

The current tendency to embed the computational system in the quotidian objects makes them smarter. Hence this technique is used in this IOT based Intelligent Home and Security System, where the ARM LPC2148 microcontroller controls the home environment based on the sensor values, and provides images and video for the security purposes. The IOT technology is a technology where many devices are connected in a network and functions for the given specific task. IOT (internet of things) involves different devices to perform the operation. In this paper we are maintaining the home environment and security in automatic and manual mode using the IOT technique. The sensor values are recorded in the internet cloud so that the energy consumed by the devices is recorded in the internet at any time.

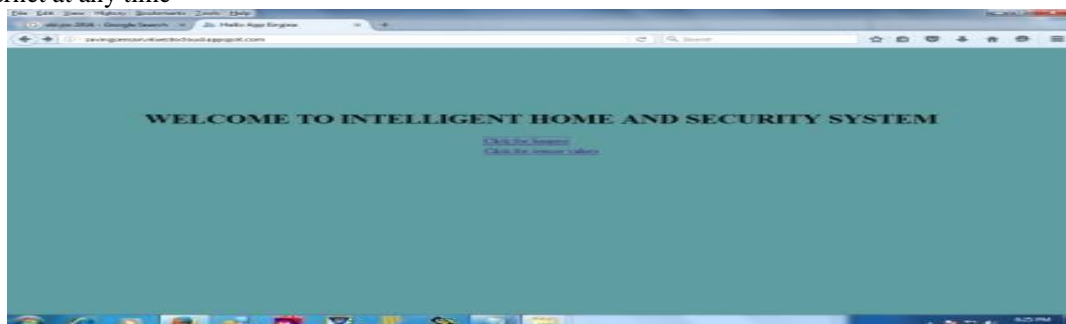


Figure1: Welcome page in cloud

The above figure shows the welcome page in the cloud, it has two options on it: one is click for images and videos and the other is click for sensor values. By clicking on the click for images and videos we can access the images and videos, and by clicking on the click for sensor values we can access the sensor values and power consumption.

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The previous many technologies for home automation like GPRS, Zigbee has some limitations like storing and the distance problems , , This IOT technique will eliminates all those eliminations present in previous technologies. Many technologies are used some of which are IOT is using for home power monitoring and actuating[1] , and the IOT technology is done by combining two sophisticated communication networks: power line communication (PLC) and 3G networks. This combination is motivated by scalability advantages of (PLC) and 3G networks, and then the IP is extended to wireless personal area networks (LoWPANs) was once considered impractical because these networks are highly constrained but then 6LoWPAN radically alters the calculation by introducing an adaptation layer that enables efficient IPv6 communication over IEEE 802.15.4 LoWPAN links, and then the smart grid applications are achieved using the power line communication (PLC).

In this we are using IOT technology for home maintaining and for security of home.

II. RELATED WORK

Previously many technologies are used for this system like GPRS, Zigbee, GSM , but they are limited by some limitations like storing and the distance limitations ,By surveying some of the previous papers it is seen that home automation can be achieved in many ways but the IOT is the latest best technology for that, some are the papers that are surveyed are.

[1]] Luís M. L. Oliveira , João Reis , Joel J. P. C. Rodrigues, Amaro F. de Sousa , IOT based Solution for Home Power Energy Monitoring and Actuating , IEEE , 978-1-4799-6649-3/15,pg 998-992, 2015.

This paper illustrates that the system is based on 6LoWPAN to connect to the Internet a smart object network with two layer 2 technologies: IEEE 802.156.4 and power line communication. IPv4 to IPv6 transition mechanisms were included to provide connectivity to both IPv4 and IPv6 Internet end systems. The PCB gateway is used for controlling purpose.

[2]]H. Han-Chuan, L. Chi-Ha, "Internet of Things Architecture Based on Integrated PLC and 3G Communication Networks," 2013 International Conference on Parallel and Distributed Systems, 2011 IEEE 17th International Conference on Parallel and Distributed Systems, pp. 853-856, 2011

In this paper a new IoT architecture is purposed combining two sophisticated communication networks: power line communication (PLC) and 3G networks. This combination is motivated by scalability advantages of (PLC) and 3G networks. Further, the 3G-PLC networks test bed is constructed and analyzed to show its feasibility in supporting IoT applications.

[3]] J. Hui, D. Culler, "Extending IP to Low-Power, Wireless Personal Area Network.," IEEE Internet Computing, vol. 12, no. 4, pp,37-45. 2008

In this paper the IPv6 communication is efficiently done over the IEEE 802.15.4 LoWPAN links by introducing the adaption layer that radically alters the calculation of 6LoWPAN.

[4]] N. Kushalnagar, G. Montenegro, C. Schumacher, "IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs):.

In this paper LoWPAN is conform to the devices that work together to connect the physical environment to real-world applications, e.g., wireless sensors. LoWPANs conform to the IEEE 802.15.4-2003 standard [IEEE802.15.4].

III. SYSTEM DESIGN

The working consists of . first all the sensors are connected as shown in the block diagram, The sensors will give the reading in digital or analog form, some sensors give digital reading whereas some sensors gives analog reading. The temperature sensor gives the digital reading ,whereas the LDR,IR sensor gives the analog readings, the waterlevel sensor that is point to point sensor will gives the discrete data. The sensors which gives the digital readings are connected to the UART(Universal Asynchronous Receiver and Transmitter) and the sensors which gives the analog data is connected to the ADC (analog to digital converter) of the LPC2148.

International Journal of Innovative Research in Science, Engineering and Technology

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TRANSMITTER MODULE

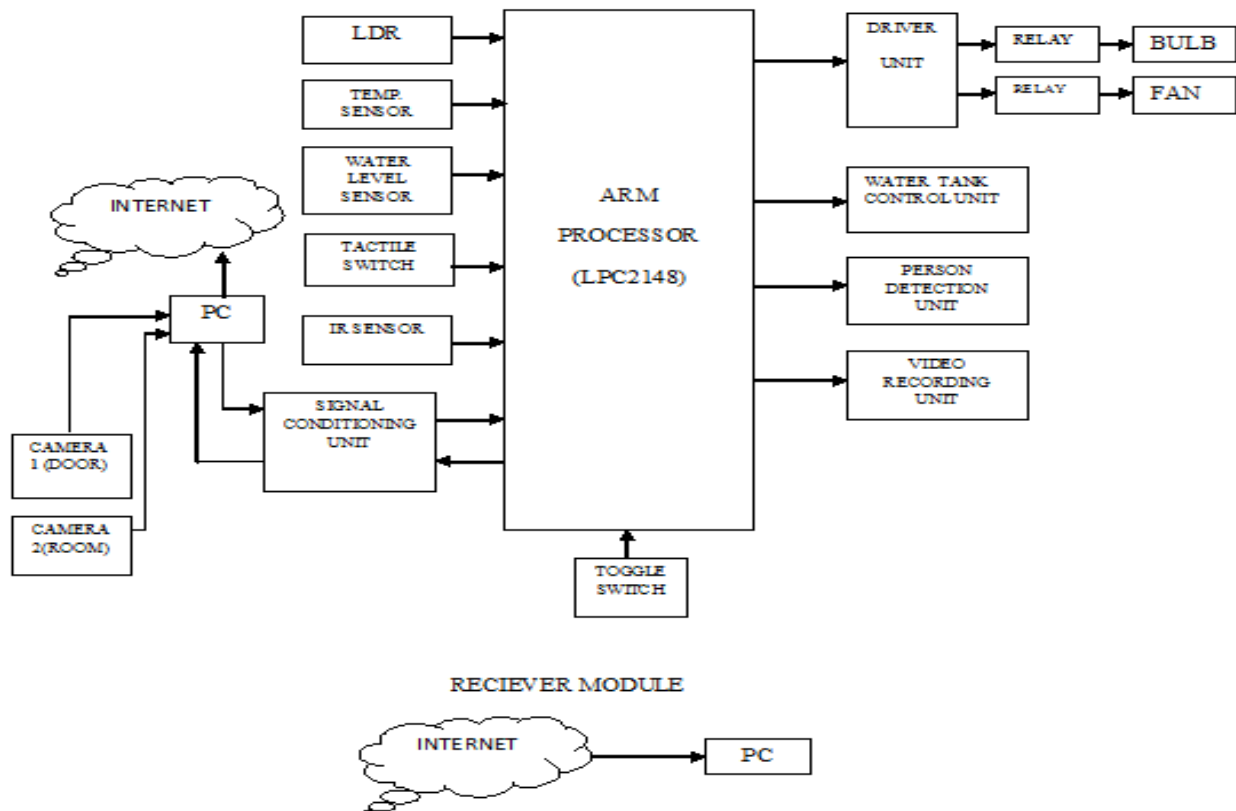


Figure2:Block diagram

The above figure shows the block diagram of the IOT based Intelligent home and security system, it is seen that all the sensors are connected to the LPC2148, and all the sensor values are fed to the LPC2148, and based on the requirement the LPC2148 controller will controls the scenario based on the requirements.

The ADC converts the analog readings to the digital readings because the microcontroller takes the digital values, Since the temperature sensor(LM35) gives the digital readings it is connected to the UART of the microcontroller, the UART gives this digital readings to the microcontroller and the sensors which gives the analog readings is connected to the ADC that converts the analog readings to digital readings and gives to the microcontroller. Now based on the sensor values the microcontroller will control the given task based on the given requirements. In this project we are controlling the home environment and its security, like automatically switching On or Off the light based on the intensity of the light, and automatically switching On or Off the Fan based on the temperature values, and automatically switching On or Off the motor based on the waterlevel, and these are done in manual by making the toggle switch to the manual mode, For security purpose of the home , in this project we are capturing the images of the person who enters in the home by pressing the door bell, and also video recording the scene in an very important room or area when the person enters that by sensing the person using IR sensor . All the sensors values are stored in the internet cloud so that it can accessible any time.

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(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

The internet cloud can be any type, there are many sources that provides the cloud for storage like amazon, google. etc., we are using googleapp engine for storing the data, the data is uploading continuously so that all data can be seen when we open the cloud, all the information is seen in the cloud.

For programming the LPC2148 we use the Embedded C language and the program dipper is FLASH UTILITY 2000, Keil is used to program the microcontroller, The microcontroller is programmed such that when the toggle switch is in automatic mode the controller will controls the devices automatically, and when the toggle switch is in manual mode the devices are controlled manually, as seen from the block diagram the ldr will gives the intensity of light in lux to the LPC 2148 and simultaneously its value is loaded to the internet cloud, and the temperature sensor LM35 gives the temperature values in degree Celsius to the LPC 2148 and simultaneously the values are loaded to the internet cloud, the point to point sensor will gives the water level in tank to the LPC2148 and simultaneously the level is loaded in the internet cloud, the two cameras used in the project will capture the images and records the video, that is one camera is used for capturing image at the door of the home and another camera is used for recording video in the room and these images and the video are uploaded to the internet cloud simultaneously. The driver unit ULN2003 is used ti boost the current or voltage coming from the controller to the bulb and fan.

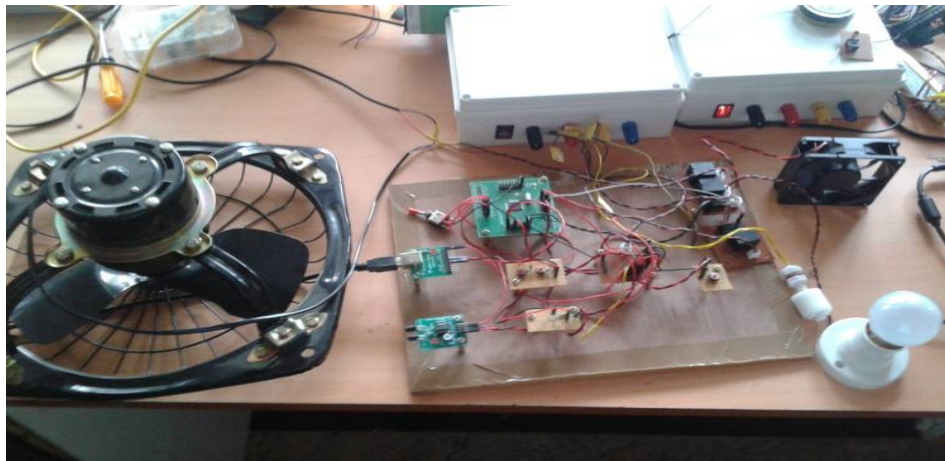


Figure3: Systematic for sensing environment

The above figure shows the systematic for the environment sensing, it is seen that the environment is controlled by the LPC 2148 controller based on the requirements. The sensors will sense the environment and feeds it value to the LPC2148 and the LPC 2148 controller will controls the environment based on the reuirements, and all the data is loaded to the internet cloud.

The relays are used for switching the correct condition, when the current or voltage comes to the relay based on the condition the relay will connects to the common connect or common open terminal so that the appliances get on or off. The power consumed by these appliances are calculated using the formula that the power is equal to the ON time duration multiplied with the given the voltage rating of the appliances will gives the power consumed by the appliances in watt-hour.

The cloud is accessed by creating an account in the googleapp engine, by creating the account in the googleapp engine, all the data can stored in that cloud space, For uploading the values to the cloud we use internet, the values that are stored in the cloud are accessible in any time .once the data is stored in the cloud it is saved, and it can be seen in any time. The on time duration saved in the cloud gives the information about the bulb and fan life span, and the power consumption saved in the cloud will gives the information about the total power consumed by appliances, so that the billing information can be known by matching with the power consumption values saved in the cloud, so that the exact billing amount can be known.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

IV. FLOW DIAGRAM

The flow diagram shows that all the sensors are setup first, then the values sensed the sensors are fed to the LPC2148, since some sensors gives the analog values and some sensors will gives the digital values, the sensors which gives the digital values are connected to the UART of the microcontroller and the sensors which gives the analog values are connected to the ADC of the microcontroller because the microcontroller receives only the digital values.

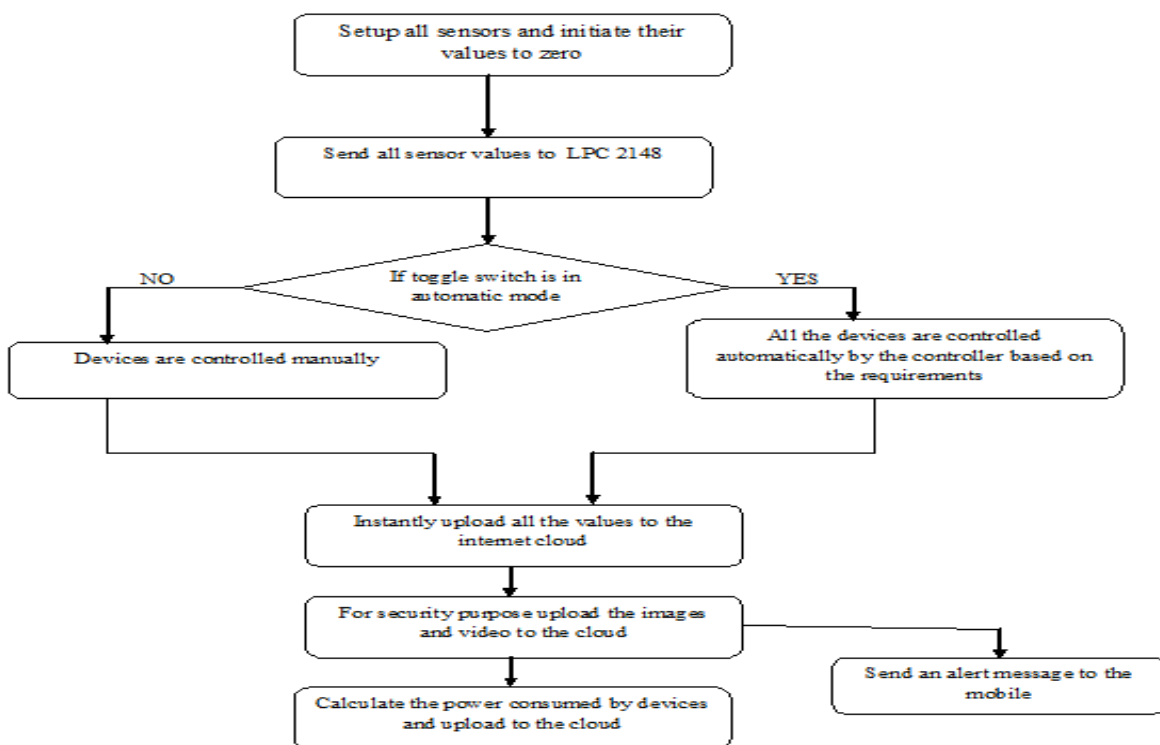


Figure4:Flow diagram

The above figure shows the flow diagram of IOT based Intelligent home and security system, it is seen that it consists of nine steps, out of which one is conditional value that is the toggle switch mode, and the controlling part is at LPS2148 controller, and all the data is uploaded to the internet cloud.

If the toggle switch is in automatic mode, then theLPC2148 will be programmed such that it should control all the devices automatically, and if the toggle switch is in manual mode then the devices are controlled manually, and then the values are instantly uploaded to the internet cloud, as for security part the images and the video captured by the cameras are uploaded to the cloud and simultaneously an alert message is sent to the mobile phone so that when an alert message comes to the mobile phone we can log in to the cloud and see the details, and finally the power consumed by the appliances are calculated as the ON time duration of the appliances multiplied by the given voltage rating of the appliance gives the power consumed in wathour and finally is uploaded to the cloud so that all the values are accessible at any time.

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Vol. 5, Issue 6, June 2016

V. HARDWARE AND SOFTWARE

LPC-2148 Micro controller

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.



Figure5:LPC2148

The LPC2148 microcontrollers are based on a 32 bit ARM7TDMI-S CPU in a tiny LQFP64 package with real-time emulation and embedded trace support, which combines the microcontroller with embedded high speed flash memory ranging from 32kB to 512kB. A 128-bit wide memory interface/ accelerator enables high speed 60 MHz operation and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. It has 8 to 40kB of on-chip static RAM ,USB 2.0 Full Speed compliant Device Controller with 2kB of endpoint RAM., Provides 8kB of on-chip RAM accessible to USB by DMA., Two 10-bit A/D converters provide a total of 6/14 analog inputs, Single 10-bit D/A converter provide variable analog output, Two 32-bit timers/external event counters, PWM unit and watchdog timer, Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 Kbit/s), SPI and SSP with buffering and variable data length capabilities, On-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and with an external oscillator up to 50 MHz, Power saving modes include idle and Power-down., Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC)

Light Dependent Resistor:

A Light Dependent Resistor (LDR) or Photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity, in other words it exhibits photoconductivity. A photo resistor can be applied in light sensitive detector circuits and light and dark activated switching circuits. 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. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

Temperature Sensor:

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature. It has an output voltage that is proportional to the Celsius temperature. Another important characteristic of the LM35 is that it draws only 60 micro amps from the supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1⁰ Celsius temperature rises in still air.

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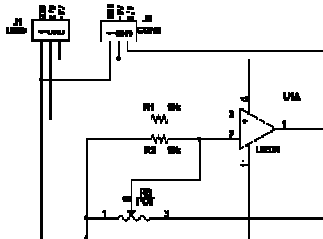


Figure 6: Temperature Sensor

The above figure shows the internal architecture of the temperature sensor(LM35) .The LM35 is a three terminal device, pin1 is connected to ground, pin2 gives the output voltage with respect to temperature and pin3 is connected to power supply (+ 5volts). The electrical signal output of LM35 is typically in order of a few milli volts and requires amplification by amplifier before it can be used.

Water level sensor(point to point level sensor)

The principle behind magnetic, mechanical, cable, and other float level sensors often involves the opening or closing of a mechanical switch, either through direct contact with the switch, or magnetic operation of a reed. In other instances, such as magnetostrictive sensors, continuous monitoring is possible using a float principle. With magnetically actuated float sensors, switching occurs when a permanent magnet sealed inside a float rises or falls to the actuation level. With a mechanically actuated float, switching occurs as a result of the movement of a float against a miniature (micro) switch. For both magnetic and mechanical float level sensors, chemical compatibility, temperature, specific gravity (density), buoyancy, and viscosity affect the selection of the stem and the float. For example, larger floats may be used with liquids with specific gravities as low as 0.5 while still maintaining buoyancy. The choice of float material is also influenced by temperature-induced changes in specific gravity and viscosity – changes that directly affect buoyancy.

IR sensor(LM358)

Dual Operational Amplifier

The LM2904,LM358/LM358A, LM258/LM258A consist of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Application areas include transducer amplifier, DC gain blocks and all the conventional OP-AMP circuits which now can be easily implemented in single power supply systems.

Relay

A relay is essentially a switch activated by a small electromagnet. The electromagnet consists of a coil wound over a magnetic core. When powered, the core gets magnetized and attracts a lever, which in turn will establish physical contact (electrical short) between two points, similar to an ordinary switch. When power is removed, the lever goes back to its initial position, disconnecting the electrical short. You will find five pins in the relay given to you. Two pins are used for powering the relay (to be connected to the transistor collector). Among the other three pins, one is common. The remaining two are identified as N/C (normally closed) and N/O (normally opened). This means that common and the N/C terminals are short when power is not applied to the coils (no connection between common and N/O pins). When powered, common pin and N/O will show a short (no connection between common and N/C pins). Play with the relay before you connect it in the circuit. You can use a 12V supply to power the relay.

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Vol. 5, Issue 6, June 2016

Driver uln 2003a

Drivers are used to amplify the current coming from the microcontroller and used to run the DC motor via relays. The ULN2003A series are high voltage, high current darlington drivers comprised of seven NPN darlington pairs. All units feature integral clamp diode for switching inductive loads.

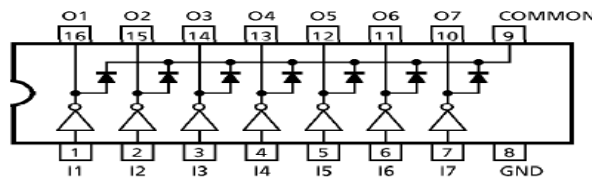


Figure8: ULN 2003 Pin diagram.

The above figure shows the pin diagram of the ULN2003 , it is an 16 pin IC, the pin 9 is common connection and the pin 8 is ground connected. All the pins use the integral clamp diode internally for switching inductive loads so that the current is amplified with the specific level.

SOFTWARES

Java

Java programming language was originally developed by Sun Microsystems which was initiated by James. Gosling and released in 1995 as core component of Sun Microsystems' Java platform (Java 1.0 [J2SE]).

Java is:

- **ECLIPSE** :Eclipse is one of the most fully featured, free, Java IDEs available. Eclipse is also very easy to use, with a minimal learning curve. This makes Eclipse a very attractive IDE for solid, open Java development. The Open Handset Alliance has released an Android plugin for Eclipse that allows you to create Android-specific projects, compile them, and use the Android Emulator to run and debug them. These tools and abilities will prove invaluable when you are creating your first Android apps. You can still create Android apps in other IDEs, but the Android plugin for Eclipse creates certain setup elements—such as files and compiler settings—for you. The help provided by the Android plugin for Eclipse saves you precious development time and greatly reduces the learning curve, which means you can spend more time creating incredible applications.



Figure9: Eclipse IDE icon

The above figure shows the Eclipse icon , the eclipse software is used for writing and developing the java code , all the java programs are written and executed in the eclipse software, the eclipse software one of the most fully featured, free, Java IDEs available.

Embedded c: It is an language used for coding in the embedded systems.

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Vol. 5, Issue 6, June 2016

Googleapp engine: It is an cloud database in which we are storing all the values.

Keil microvision4 IDE :

The Keil development tools offer numerous features and advantages that helps to develop embedded applications quickly and successfully. They are easy to use and are guaranteed to help you achieve your design goals in a timely manner. When using the Keil tools, the project development cycle is similar to any other software development project.

VI. EXPERIMENTAL RESULTS AND DISCUSSIONS

The welcome page of the internet cloud where we can access the internet cloud, the specific IP address is given to this so that by using that we can open and access the page.



Figure10: Welcome page in cloud

The above figure shows the welcome page in the cloud , it has two options on it one is click for images and videos and the other is click for sensor values, by clicking on the click for images and videos we can access the images and videos, and by clicking on the click for sensor values we can access the sensor values and power consumption.

The temperature values is displayed in the degrees and the tank status is either full or empty ,and the light intensity value measured by the LDR is displayed in the lux, and the values stored in the internet cloud are stored with time and the date.

Display the sensor values

Temperature in deg Celcius	Tank status	LDR in lux	Date	time
38	FULL	1000	8/6/16	1.00PM
36	EMPTY	2000	8/6/16	2.00 PM
35	EMPTY	1500	8/6/16	2.30PM
39	EMPTY	1800	8/6/16	2.45PM
35	EMPTY	1500	8/6/16	3.00PM
40	FULL	2000	8/6/16	3.45PM
39	FULL	1800	8/6/16	3.50PM
40	FULL	1500	8/6/16	3.52PM

Table 1: Sensor values displayed in cloud

The above table shows the temperature and light intensity values and the tank status displayed in the internet cloud with date and time, and these values are accessible at any time .These values are updated instantly based on the specific requirements and settings.

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Vol. 5, Issue 6, June 2016

Bulb and Fan Time and Power display

Bulb ON duration in secs	Bulb power consumption in WattHour	Fan ON duration in secs	Fan power consumption in WattHour	Date	Time
10	20	10	23	8/6/16	1.00PM
20	22	20	24	8/6/16	1.30PM
30	23	30	25	8/6/16	1.45PM
40	24	40	26	8/6/16	1.50PM

Table 2: Power consumed by Bulb and Fan

The above table shows the bulb and fan on duration and power consumption is displayed in the cloud with the date and time, the power is the multiplication of the on duration with the voltage rating of the appliances, and the values uploaded to the cloud are updated based on the requirement and the settings.







Display the Images and Video					
Image	Date	Time	Video	Date	Time
	8/6/16	1.00PM		8/6/16	1.00PM
	8/6/16	2.00PM		8/6/16	3.00PM
	8/6/16	4.00PM		8/6/16	5.00PM

Table3: Images and Videos displayed in cloud

The above table shows the images and the videos displayed in the internet cloud with the date and time, the image and The videos are captured and recorded by the cameras based on the settings and uploaded to the internet cloud and stores the images and videos permanently in the cloud, so that these images and the videos are accessible any time.

VII. CONCLUSION AND FUTURE WORK

The IOT based intelligent home and security system not only maintains the home and security system but also stores all the specific data related to the home and security system in the internet cloud so that this data is accessible at any time at anywhere in the world. Compared to the previous technologies like GPRS and Zigbee which has storage problem and distance problem, This IOT technique has eliminated all the limitations that were occurred in previous technologies. Hence it concludes that the IOT technique is the best latest technology for intelligent home and security system, and this IOT based intelligent home and security system is best then the previous technologies.

The future works contains that the PCs are replaced by the SOCs(Silicon on Chip) so that there is no need for the PCS to be On every time and hence the power is efficiently saved.

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