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IoT based Smart Home automation with security surveillance

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Abstract— The home automation systems have seen large scale transformation in recent years, beginning from panic switches to send fixed messages to specified recipients during emergency, remote controlled switches for machines, systems based on GSM networked devices to comprehensive home server for monitoring and control of domestic environment. The proposed system is an Internet of Things (popularly known as IoT) based home automation and security system which aims to develop a reliable system to provide a reliable solution for the home automation.

Keywords— Home automation, IoT, ubiquitous sensors, Webiopi, Raspberry-pi

I. INTRODUCTION

The area of home automation systems has seen a substantial growth in past few years, starting with panic switches connected to police stations to ultra-vigilant CCTV monitoring systems. These systems required extensive human efforts for its success. Then came certain semi-autonomous systems based on Wireless networks such as GSM based home automation systems, though these are able to provide automation they helped little in the security aspect.

The home automation systems have seen large scale transformation in recent years, beginning with panic switches to send fixed messages to specified recipients during emergency, remote controlled switches for appliances, systems based on GSM networked devices to full-fledged home server for monitoring and control of domestic environment. Making a broader classification we can classify home automation systems as non-networked standalone systems and networked systems. The first type typically provide automation in a smaller geographical area where as latter can extend its range up to anywhere in the extremities of the globe; provided the network connection exist for control. Because of this the latter becomes the obvious choice for designers as the network costs had been on falling streak in recent times.

Cost is an important metric of home automation systems, every household cannot afford a huge initial investment or maintenance costs for home automation system, thus the ideal solution must be very cost effective; easy to install and maintain. The solution proposed in this paper qualifies these specifications. It is cost effective and pretty simple to manage.

II. LITERATURE SURVEY

Mark Weiser [1], defined a smart environment as “the physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network.”

The advancements in the field of micro-electro-mechanical systems (MEMS) technology, wireless communications, and digital electronics has given rise to the development of miniature devices which have the ability to sense, to compute, and to communicate wirelessly in short distances. These tiny devices called nodes that interconnect to form a wireless sensor networks (WSN). WSN find wide range of applications in environmental monitoring, traffic monitoring, infrastructure monitoring, retail, etc. [2]. This has the capacity to provide ubiquitous sensing ability which is critical in realizing the vision of ubicomp as outlined by Weiser [1].

Video based IoT [3], which combines the techniques of image processing, networking frameworks and computer vision, will helping to develop a new challenging scientific research area at the intersection of video, infrared, microphone and network technologies. Surveillance is the most widely used camera network application, which helps to track targets, identify wary activities, detect theft and monitor unauthorized persons access to certain areas. Automatic behavior analysis and event detection is in its early stages and is expected to emerge in the next decade.

Smart homes automates the various day to day appliances such as lights, fans, television, heaters and fridge etc. Bilal Ghazal and Khaled Al-Khatib [4], proposed such a system where elderly people can be made self-reliant as a reality we have a growing segment of population that is growing old. This paper proposed to use a WSN throughout the inhabitant’s premises and a Xbee based remote control to turn on and off the appliances. While a remote control offers a great amount of flexibility to the inhabitants, it cannot be used when the inhabitant is at a considerable distance from his home.

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R.A.Ramlee and others [5], proposed a Bluetooth based system for home automation. This paper used a PIC microcontroller and two custom GUIs each for windows and Android. This system automated the appliances and added temperature sensors to it. This system also suffers with a range problem, with the control restricted to a small range of about 10m.

Ahmed ElShafee, Karim Alaa Hamed [6], proposed a home automation system which used Wi-Fi connection for the control of appliances such as lights, HVAC, doors etc. This system automates the home environment while overcoming the range issues as said in earlier case. But this system does not provide any means of surveillance which could be a critical aspect of any household.

III. PROPOSED SYSTEM

The proposed system is an Internet of Things (popularly known as IoT) based home automation and security system which aims to develop a reliable system to provide a reliable solution for the home automation.

The system includes two major components; the user device acting as a client, and a raspberry pi board acting as a server. Here the users have facility to control the home appliances through his devices connected to internet. The commands from the user will be communicated through the internet. The raspberry pi board is set up such that it will enable the relay circuit as per user request. The relay circuit can control the home appliances.

Furthermore video recorded by the system provide more trustworthy surveillance to the user and the user can login to his dedicated account to watch a live stream of video of critical sites of his choice, more security is provided by assigning a different login name and password for the video stream to ensure the privacy of the user. User may also check the current status of the appliances by logging in into his account.

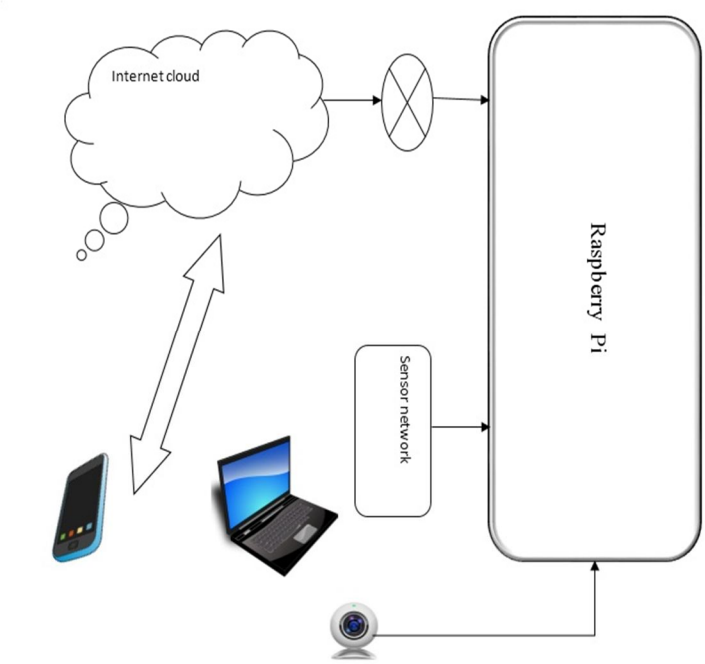

Fig1: Block diagram of proposed system

The Raspberry pi will be hosting a webserver on port 8000; for this purpose webiopi [7] webserver framework is to be used. This page is then added to Weaved IoT [8] as an html service, by logging in into Weaved IoT the user can check and alter the status of the various loads. User can also watch the live stream captured by the camera module on port 8081 of the server, for this purpose a dedicated service is added on weaved IoT service list.

IV. IMPLEMENTATION

Implementation of this paper includes of two levels, designing the hardware part and developing the required web API. The hardware part consists of a central processor, sensors and a camera module. For implanting this paper Raspberry Pi is chosen for the central processor, a DS18B20 temperature sensor and PIR sensors are used for sensor network. While for developing web API webiopi framework was used. Weaved-IoT was used to host the web API dynamically over internet.

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A. Hardware implementation

1) Raspberry Pi: Raspberry pi [9] is the heart of this home automation system, it is a credit card sized inexpensive computer with attractive features such as a RAM size of 1GB, it contains a SoC ARM11 family micro controller, in addition it also consist of a GPU for video processing, an USB controller and so on.The Raspberry Pi is available in various models, depending on the system requirements one can choose the appropriate model. This work is implanted on Raspberry Pi model B, the features of the same are as given in table1.

2) DS18B20 temperature sensor: The DS18B20 digital thermometer provides temperature measurements with a resolution of 9-bit to 12-bit in Celsius degrees and has an alarm function with static user-programmable upper and lower threshold points. The DS18B20 communicates over a 1-Wire bus that requires only one data line (and ground) for communicating with a central microprocessor. In addition, the DS18B20 can stem power directly from the data line, eliminating the requirement for an external power supply.

Each DS18B20 has a unique 64-bit serial code, which allows number of DS18B20s to function on the common 1-Wire bus. Thus, it is simple to use one microprocessor to control numerous DS18B20s spread over a large area. Thus this sensor is very useful in applications like HVAC environmental controls, process monitoring and control, temperature monitoring systems inside buildings, and equipment, or machinery.

Fig 2: Raspberry Pi 2 Model B

Item	Description
CPU	900 MHz Quad-core ARM-v7
RAM	1GB
GPIO	40 pins
USB Ports	4 Ports
Network Port	RJ-45 Port
HDMI Port	Output HDMI Port
Combined AV Port	3.5 mm port
SD Card slot	micro SD card slot
CSI	15 pin MIPI connector
DSI	15 pin display connector
Current Rating	800mA
Size	86mm X 56mm

Table1: Features of Raspberry Pi2 Model B

Volume 4 Issue XII, December 2016
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Fig3:DS18B20 temperature sensor

3) PIR sensor: PIR sensor is an optoelectronic sensor which works on the principle of light reflection by interacting bodies. Human beings can't recognize infrared beams however transmits infrared from the body as warmth like all other warm blooded (creatures in which body temperature stays steady Mammals and Birds). This is used in Motion finders to identify the nearness of people. PIR sensors (Passive Infra-Red sensor) are utilized to actuate an alert framework utilizing the Infrared signals reflected by the body of the intruders in this particular case. PIR sensor is an electronic gadget that measures the infrared in its field of view. Development is identified by the sensor when an infrared source like human goes before the sensor with one temperature and contrasting another temperature like that of the divider in which the sensor is mounted.

The PIR sensor is mounted on a PCB with different semiconductors. The total get together is mounted for a situation with a Fresnel focal point shaped before it. Behind the focal point, there is a little window through which infrared goes into the sensor. The window is secured with a straightforward plastic which permits just IR beams to go into the sensor and preventsvisible light. The separating window restrains the IR beams to 8-14 micrometers like the IR beams from human body.

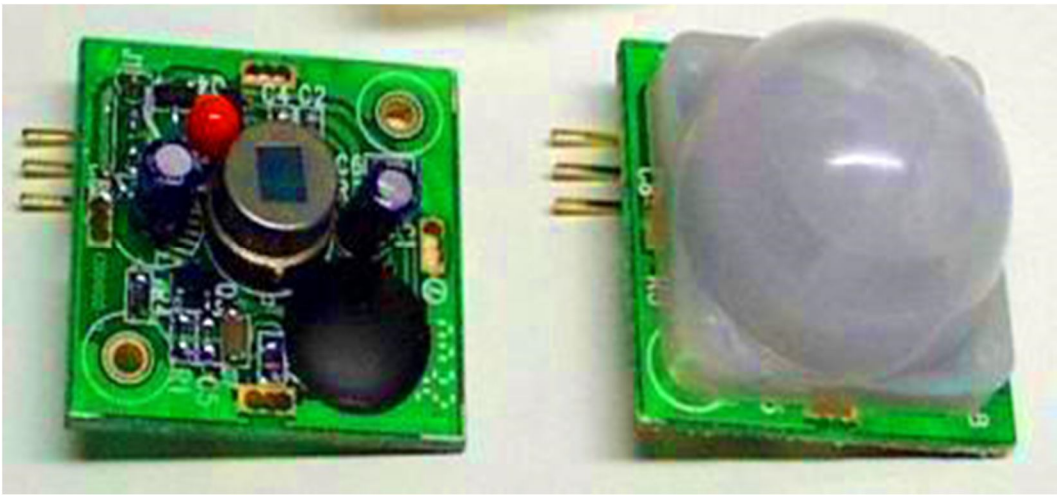

Fig 4: PIR sensor

B. Web API development

For developing web API the web frame work webiopi was used, this greatly simplifies the coding of web API. Webiopi is useful to create web APIs with a little knowledge of HTML saving a lot of time and effort, which can be utilised for designing the system rather than API. This API is accessible from port 8000 of the Raspberry Pi, thus it could be only available in local network.

To overcome this there are two options using port forwarding or having a domain name, however port forwarding is not secure and can violate the restrictions of ISP, on the other hand having a domain name is not economical. Hence this paper is implemented by using a free service called Weaved-IoT.

Weaved IoT hosts a fleet of Raspberry Pi devices which are accessible by the unique username and passwords. Weaved IoT also provides a remote ssh connection through the same account, thus increasing the flexibility of the system.

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V. RESULTS

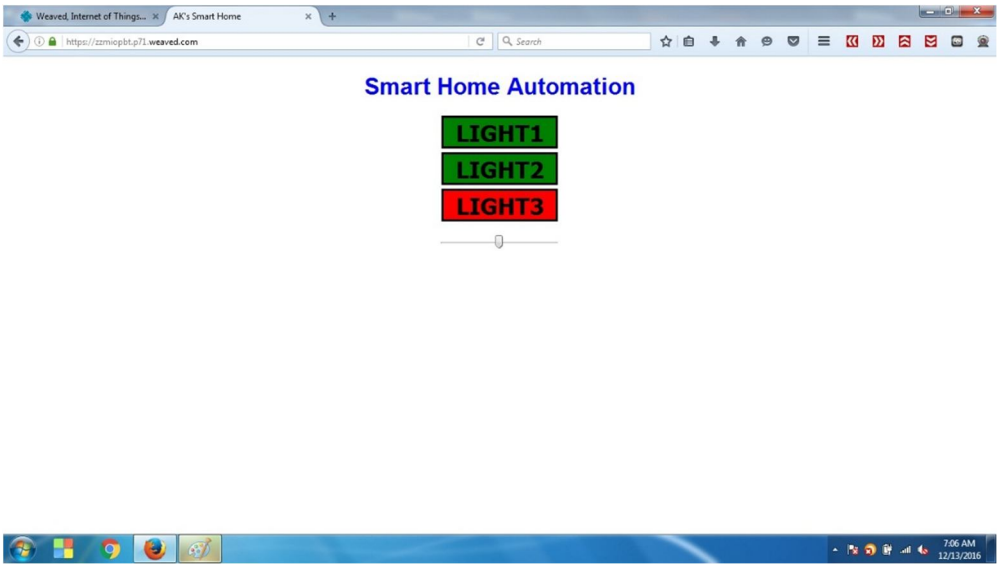

Fig 5: Web API served by Weaved IoT

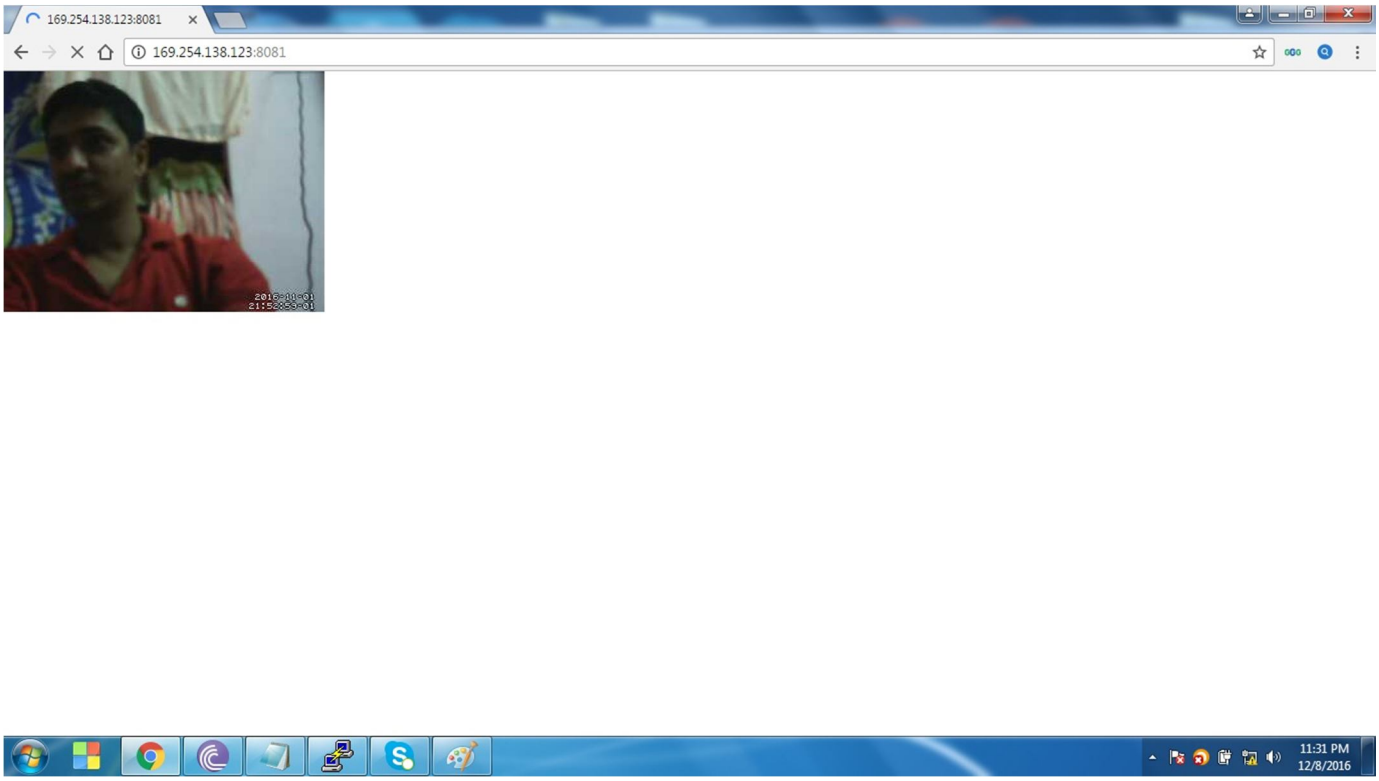

Fig 6: Live video streaming

VI. ACKNOWLEDGMENT

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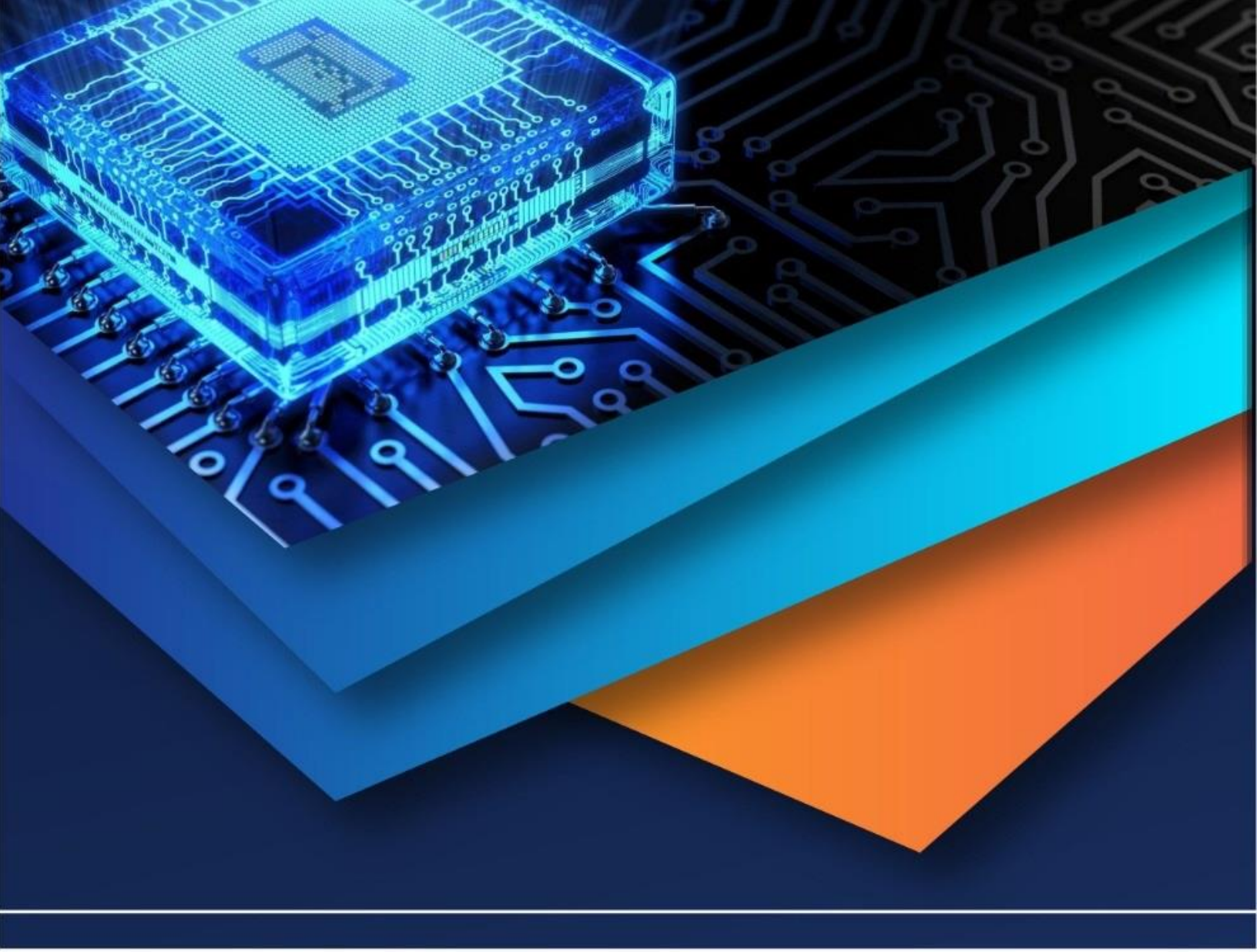

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