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Internet of Things for building Smart Home System

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Abstract — Internet of Things (IOT) is an emerging technology that is making our world smarter. The idea of connected world cannot be imagined without IOT. An IOT based Smart Home is one such example. In IOT enabled Smart Home environment various things such as lighting, home appliances, computers, security camera etc. all are connected to the Internet and allowing user to check and control things regardless of time and location constraint. This paper describes Frugal Labs IOT Platform (FLIP) for building IOT enabled Smart Home. This paper discusses functions of Smart Home and its applications and introduces FLIP architecture with implementation of Smart Home services using FLIP through a proposed system. The proposed system presented in this paper is used for monitoring and controlling Smart Home environment.
Keywords — IOT platform architecture; smart home; machine to machine communication;

I. INTRODUCTION

A smart home also referred to as a connected home or home is an environment for living that has highly advanced automatic systems. A smart home appears "intelligent" because its daily activities are checked by a computer. A smart home consists of many technologies via home networking for improving quality of living. A smart home is a place that has highly advanced automatic systems for controlling and monitoring lighting and temperature, home appliances, multi-media equipment, and security systems and many other functions. IOT plays a key role in building smart home.

Through IOT almost every object of our daily life in a home can be connected to the Internet. IOT allows monitoring and controlling all these connected objects regardless of time and location

II. MOTIVATION

As a result of the digital India system, the cities of India will soon be transformed into smart cities. A city-wise city with Internet-based infrastructure and connectivity. IoT (Internet of Things) is therefore a key factor in building smart cities. The smart home plan, suggested in this paper, is part of a smart city. The purpose of this paper is to propose a smart home system that can be used in smart Indian cities.

III. FUNCTIONS OF SMART HOME

The smart home plan has applications built on IoT infrastructure. Smart home apps can have the following key functions [3] -
The smart home system can detect its location and properly send alerts to the user on a registered device or account. Alert has information related to environmental data. This information may include different gases in the area, temperature, humidity, light intensity etc. A warning can be sent to the user at any time specified. Alert can be sent via email, such as text message, tweets or any other social media platform.

- Monitor

This is the most important function of a smart home. The smart home can check the environment with various sensors and camera feeds. Monitoring is an important function as it keeps track of all the work of a smart home which is a key requirement when any further steps can be taken or a decision made. For example, checking the room temperature and sending a warning to the user to turn on the air conditioner if the temperature is above the limit.

- Control

This smart home function allows the user to manage different tasks. Tasks may include lighting / closing lights, fan, and electrical appliances, locking / opening doors, opening / closing windows and

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doors and much more. User can control items in one location or in a remote location. This function even allows the user to automatically perform tasks such as automatically turning on / off the refrigerator when the temperature is high / low.

- Intelligence

Intelligence or Home Intelligence (HI) is the most important function of a smart home and refers to the intelligent behavior of the intelligent home environment. This function is related to the automatic decision making of various events. HI is based on an Artificial Intelligence (Al) approach built on a smart home environment. HI not only provides the brain with a smart home but is also especially important in looking at home security [4]. HI creates an integrated home environment where the Al machine can find and respond appropriately depending on changing circumstances and events. By finding unusual or unexpected events HI can alert the user and supply an immediate response if needed. Some image modes automatically set up coffee as soon as the user arrives, send a warning to the user whenever a suspected employee is at the door or home, order items automatically when there is a shortage in the refrigerator, send a notice to the electrician / woodworker whenever needed repairs. etc.

IV. SMART HOME APPLICATIONS

Although the area of smart home use is limited only by human imagination, this paper shows some of them described below-

A. Smart Lighting

Smart lighting is used to save energy that can be achieved by adjusting the light and environment and by turning on / off or dimming the lights according to the user's needs thus reducing unnecessary power consumption. Energy saving also helps to reduce costs. Smart lighting can be done with Solid State lights (LEDs) or IP-enabled lights (internet or wireless controls). Intelligent lighting works with sensitivity, temperature / humidity and LUX level in the area.

B. Smart Machines

Smart appliances are used to collect information on the status of electrical appliances and to easily control electrical appliances inside the room or away. It is also used for scheduling activities in the pre-defined period and for the integration of working time between electrical components. Smart machines save energy and time.

C. Accessibility

Login detection is used to notify the user via email and text message. The login detection application can also send a detailed report with photos or audio / video clip to the user. The main goal of this app is to check suspicious activity in the smart home and alert user and take the necessary steps for security purposes.

D. Detection of Smoke / Gas

This app is used to feel the smart home environment for your well-being and can be used for safety. This application is used for detection, ionization, and air sampling methods. It can alert to a nearby fire station if a fire and smoke and users by email / SMS informing them of health risks.

Discussed above, there are few, but at least, smart home apps that are helpful in improving safety and quality of life. This paper describes a FLIP platform for developing such a system and discusses test results using FLIP in the next section.

V. FLIP ARCHITECTURE

FLIP developed by Frugal Labs Bangalore, India is an open source 10T platform aimed at developers, Hobbyists, and anyone interested in learning and working on 10T to turn their ideas into "Proof of Mind". FLIP is a complete IoT platform and not just a collection of devices and sensors or cloud resources to build IoT infrastructure. FLIP properties are represented in Fig. 1 [5].

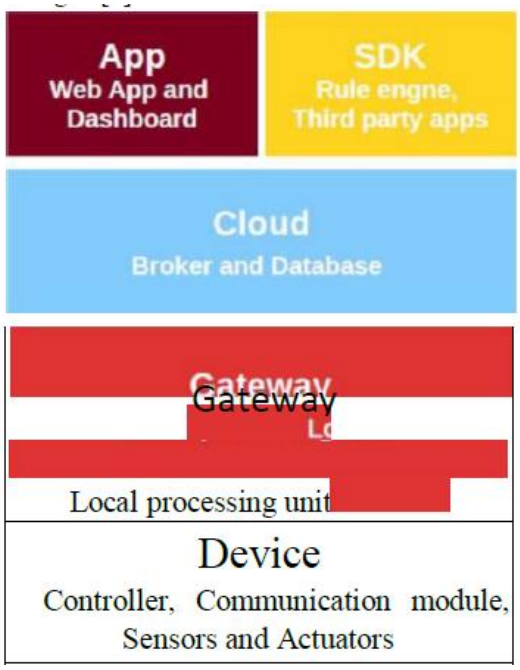

Fig. l. FLIP Architecture.

The FLIP architecture has four distinct layers device, gateway, cloud, and app & SDK.

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- Device Layer

Device cover has controller, communication module, sensors and actuators. In this case the FLIP base board layer is used as the controller. The FLIP base board is based on the Arduino Nano [6]. In the smart home app this layer also uses the smart FLIP home shield. The smart home shield is mounted on the foundation board to maximize the functionality of the foundation board. The Smart home shield has heat and humidity sensors, high light (LDR) attached to it and allows you to connect other sensors such as PIR with various gas and air sensors, sound sensors and much more. The Smart home shield also has an Alternating current (AC) relay that can be used to control anything up to 7 amps current and 250 volts current AC. Enables connecting household appliances, home lighting etc. The FLIP smart home shield is shown in Fig. 2 [5].

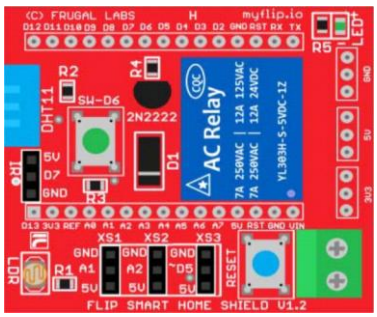

Fig. 2. FLIP Small Home Shield.

For connectivity at device layer FLIP board uses Wi-Fi/Bluetooth module. Both modules can be connected to FLIP base board directly via 6pin interface. Wi-Fi module, shown in Fig. 3 [5], directly connect FLIP device to the Internet and Bluetooth module, shown in Fig. 4 [5], connects FLIP device to Internet via gateway layer in the architecture.

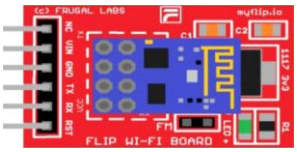

Fig. 3. FLIP Wi-Fi Module.

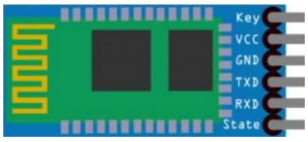

Fig. 4. FLIP Bluetooth Module.

B. Gateway Layer

The gate layer consists of a local processing unit based on the Linux operating system. The FLIP architecture uses the Raspberry PI 3 [7] as a gate device. The Gateway device has a Bluetooth connection that allows other devices to connect to it. In architecture, all devices are connected to the gate and the Internet. The gateway is connected to the Internet via Ethernet or Wi-Fi.

C. Cloud Layer

Cloud cover has vendor and website. Broker connects to all devices and the site stores data from the devices. The cloud layer consists of three main structures for MQTT vendor Mosquito [8], the Mongo DB website [9] and Node.js [10] for background processing.

- App & SDK Layer

The top layer is the App & SDK layer. The app has a web and dashboard system and is used to view data using widgets and graphs. Using dashboard devices can be checked and controlled. The SDK has a python-based control engine [11]. The Python SDK has two dimensions to explain your device's sensitivity, i.e., if the temperature is too high to turn on the fan, and secondly it can connect to social media platforms or third-party applications.

VI. PROPOSED SYSTEM

The proposed program discussed in this study is based on FLIP. The proposed system consists of four main application modules with intelligent lighting, intelligent electrical appliances, input detection, and smoke / gas detection as discussed in the earlier section. Figure 5 [5] shows a diagram for setting up a smart home lighting control device that includes temperature, humidity, light intensity and the ability to sense movement.

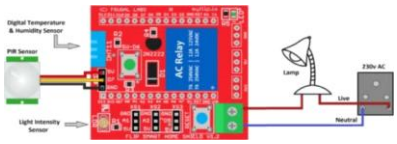

Fig. 5. Smart Home Device Setup.

The proposed smart home network structure is displayed in Fig. 6.

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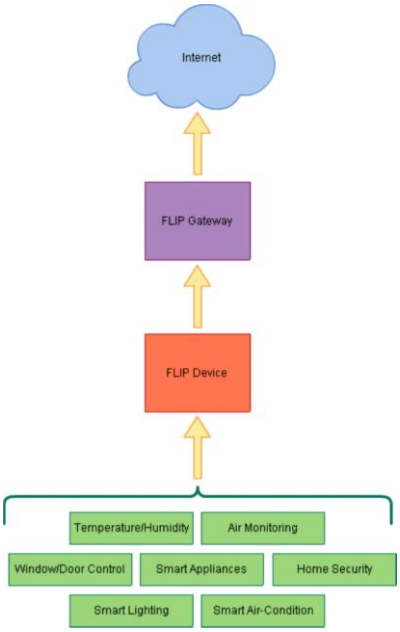

Fig. 6. Smart Home Network.

In the proposed smart home system, the FLIP device is connected to sensors, lamps, air conditioners, camera, windows and door system, and various electrical appliances. The flip device is connected to the internet via gate. The gateway to the proposed smart home network plays a key role as it adds an extra layer of security to the smart home network thus making the proposed system more secure. The proposed smart home system can perform a variety of functions such as air conditioning and safety purposes, control of household appliances, locks, doors and windows from a remote location, generating alerts and notifications in set conditions, adjusting room lighting and hearing temperature. light power and temperature / humidity in the room and thus automatically control the lighting system and air-conditioner. It follows the C-language firmware code, which is uploaded to a single FLIP device, records temperature and humidity and light energy data and allows the light to turn on / off remotely. The part of the following code from the proposed smart home system sends temperature, humidity, and light energy data to the server and allows the user to control the remote power switch.

```
#include <FlipSmartHome.h>

#include <FlipMqtt.h>

FlipSmartHome          fsh;
FlipMqtt m;

char* temp_topic —"Home/temp";
char* hum_topic —"Home/hum";
char* Idr topic =" Home/light";
char*                          switch
topic="Home/switch";          char*
ssid="ssid";                   char*
pwd="password"; int temp, hum,
Idr; char* s=NULL•, void setup ()

  m.mqttSub(switch_topic);
  m.mqttBegin(ssid,pwd);
  fsh.relayOff();


void loop()

 s=m.GetSubValue(switch_topic
 ); if (strcmp(s," 1     {
 fsh.relayOn();} else {
 fsh.relayOff();}

 temp fsh.readTempC();
 m.mqttPub(temp_topic,temp);

 hum fsh.readHum();
 m.mqttPub(hum_topic,hum);

 Idr fsh.readLdr();
 m.mqttPub(ldr topic,ldr);
```

The proposed system visualizes data using widgets and graphs in a web application and supplies widgets to set alert conditions and control devices such as opening / closing doors and windows, turning on / off lights and other functionality. The system also allows users to download all tracking details in excel format and add new logic to the system using the python script whenever needed thus making the system more flexible. It is also possible to add new devices to the system. Figure 7 [12] shows the user interaction of a web application.

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Fig. 7. Web App Interface.

The user can also specify how to receive alerts and notifications. Different methods can be email, text message, and social media. The user can select any one or all of them. Tracking python text sends an email alert when light intensity is high.

```
import Flip Utilities as
Flip import FlipMQTT
as mq import time
import getpass

mqtt mq.F1ipMQTT()
mqtt.sub_topic("Home/li
ght") mqtt.infy()

service 'gmail' Flip. select
Service(service) username
"username" password
"password" to "to-email-
address" frm "from-email-
address"
Flip.emailCredentials(usemame, password)
print "Logged in successfully!"

received data [1 check

The proposed system was tested and
timestamp '0' while
True:
  received data mqtt.sub value("Home/light")
if received data None and received
        check timestamp:
prmt received data if (received data[0] "500") :
check timestamp received data[l] subject
"Sensor Values" message "Light Intensity is "+
received data[0]+" Time:"+received
data[l]+""+" Turning OFF
Room Light. "+,,,,
Flip.sendMessage(to, form, subject,
message) print "message sent!" time.
Sleep (5)
Flip.closeEmail()
```

Currently the proposed system performs tasks as described in this section but is not limited. Any new functionality in the system can be easily added thus enabling the system to expand.

VII. RESULT

The proposed system is extremely helpful in monitoring and managing a smart home environment. Using this program air quality can be checked continuously at home and alerts can be sent to the user about health risks if any. The proposed system also improves security. The user can check all activities at home and can control windows and doors. The program also ensures efficient use of energy and resources with intelligent lighting, smart appliances and an intelligent air-conditioning system. Figure 8 shows the email notification received from the user's registered email account as the maximum light received in the room, so the system automatically turned off the room lights.

VIII. FUTURE SCOPE

The proposed 10T smart home system can be used in smart Indian cities. Currently the proposed system performs a variety of functions as described in the sections above. In the future, the proposed system could be expanded to include other functions such as water management and pollution.

IX. CONCLUSION

With the rapid development of the internet and communication technology, modern homes can also calculate and communicate skills. A smart home based IOT appears as an integral part of the smart and smart cities that are proposed and developed globally. The purpose of a smart home is to improve the quality of life, safety and security as well as save energy and resources. A smart home plays a key role in the development of a community. The purpose of this paper is to promote such a FLIP-based program. The program presented in this paper is highly adaptable and extends to the needs of users with security concerns. The proposed system can be used according to the needs of each user.

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