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IoT Based Smart Security and Home Automation System

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Abstract—**Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real world objects (things) through the Internet [1]. When it comes to our house, this concept can be aptly incorporated to make it smarter, safer and automated. This IoT project focuses on building a smart wireless home security system which sends alerts to the owner by using Internet in case of any trespass and raises an alarm optionally. Besides, the same can also be utilized for home automation by making use of the same set of sensors . The leverage obtained by prefering this system over the similar kinds of existing systems is that the alerts and the status sent by the wifi connected microcontroller managed system can be received by the user on his phone from any distance irrespective of whether his mobile phone is connected to the internet . The microcontroller used in the current prototype is the TI-CC3200 Launchpad board which comes with an embedded micro-controller and an onboard Wi-Fi shield making use of which all the elctrical appliances inside the home can be controlled and managed.**

Keywords—IoT, TI Wi-Fi CC3200 Launchpad, Internet.

I. INTRODUCTION

Wireless Home security and Home automation are the dual aspects of this project. The currently built prototype of the system sends alerts to the owner over voice calls using the Internet if any sort of human movement is sensed near the entrance of his house and raises an alarm optionally upon the user's discretion. The provision for sending alert messages to concerned security personnel in case of critical situation is also built into the system. On the other hand if the owner identifies that the person entering his house is not an intruder but an unexpected guest of his then instead of triggering the security alarm, the user/owner can make arrangements such as opening the door, switching on various appliances inside the house, which are also connected and controlled by the micro-controller in the system to welcome his guest. The same can be done when the user himself enters the room and by virtue of the system he can make arrangements from his doorstep such that as soon as he enters his house he can make himself at full comfort without manually having to switch on the electrical appliances or his favourite T.V. channel for an example. Thus using the same set of sensors the dual problems of home security and home automation can be solved on a complementary basis.

The alerts and the status of the IoT system can be accessed by the user from anywhere even where Internet connectivity may not be readily available (since it is not necessary for the mobile phone to be connected to internet only board is required to have an access to Wi-Fi).

The existing infra-red (IR) or Blue-tooth remote controls present in the market are in general appliance specific and the same cannot be used interchangeably. Electrical appliances connected through Bluetooth making use of Blue-tooth enabled smart phones cannot be managed from a distant location [2]. Thus functions such as being able to turn on an air-conditioner while returning home cannot be done with such systems. In contrast, this work gives a cost effective and simple solution for wireless home automation and home security systems [3] [4]. The difficulty faced by current home security/surveillance systems in providing information pertaining to the situation to users while being away from home is tried to overcome in this project. The subsequent sections of the paper have been organized as follows: a comparative analysis between the proposed system and the existing solutions has been provided in section II featuring the benefits of the proposed system over the existing ones. Section III illustrates how the system has been implemented, while sections IV and V goes into greater detail about working of the individual components present in the system and the overall functioning. Section VI presents a flowchart relating to the working of the system. Some further modifications which can be done to increase the fidelity and user friendliness of the current prototype have been discussed in section VII.

II. ADVANTAGES

- This low cost system with minimum requirements takes care of both home security as well as home automation

- This home security system does not use any smart-phone application or any type of user interface instead uses digits from the keypad on the phone, the system is platform independent and hence can be accessed from a wide range of phones with different operating systems.

- To operate home security system the user need not have data connection enabled in his phone. The system runs fine with the launchpad connected to wifi at home/office.

- The optional smart phone application takes care of the fact that the user may also wish to control his home appliances without sensors being triggered.

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- The optional smart phone application takes care of the fact that the user may also wish to control his home appliances without sensors being triggered [5].

- Since the launchpad sends a voice call to only a particular number which is present in the web API there is no need to worry about security leakage as the system cannot be accessed by any other unauthenticated user. This in turn increases the fidelity of the security system.

- The use of wifi enabled launchpad in the system enables the system to be controlled from any part of the globe contrary to Blue-tooth controlled or IR remote controlled existing home automation solutions that too without any net connectivity in the phone.

- Since the same set of motion sensors can be deployed for home automation as well as security system the system is simple and inexpensive.

- This system does not require the user to manually trigger an alarm but still it provides the user with the advantage of analyzing the situation and then triggering the security alarm remotely from his phone. This idea overcomes the common fault in many existing home security systems which causes unnecessary embarrassment by triggering security alarm due to the systems inability to judge a special situation in which it should not have triggered the alarm.

III.   IMPLEMENTATION SETUP

A. Components required

1) TI CC3200 LaunchPad
2) AccessibleWifi
3) Pir motion detector Sensor
4) Alarm
5) Relays for connecting home appliances, electromechanically controlled doors or windows,
6) Mobile phone to recieve Voice Call
7) Energia (Software)

B. TI CC3200 Launchpad

The TI CC3200 Launchpad consists of Applications Microcontroller, Wi-Fi Network Processor, and Power-Management subsystems. It uses ARM Cortex M4 Core Processor at 80 MHz. It has embedded memory including RAM (256 KB). The dedicated ARM micro-controller also has a network processing subsystem in it. Its features include:

- USB interface using FTDI USB drivers

- The board is powered through USB for the LaunchPad and external BoosterPack

- It is operated from 2 AA- batteries

- Standalone development platform provides features such as sensors, LEDs and push-buttons

- On-board antenna and U.FL connector can be selected using a capacitor re-work
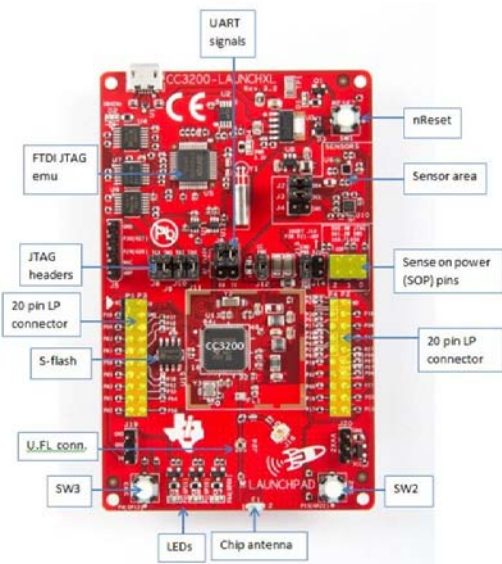
- It supports 4 wire JTAG and 2 Wire SWD

Fig. 1.   TI CC3200 Launchpad board

- GNU Debugger (GDB) supports over Open On chip debugger (OpenOCD)

- Two 20-pin connectors enable compatibility with BoosterPacks which have added functions

- Flash memory is updated through USB using SimpleLink Programmer

The board can be programmed through Energia IDE over the USB cable. The accessible Wi-Fi used by the board should be proxyless and can be of WPA or WEP type.

C. Setup

The motion sensor is connected to a digital in-out pin of Texas board. The board is powered up by external 12V battery or 12V adapter. The home appliances are connected to mains through relay which in turn is connected to another digital pin of the board. The board is programmed to have access to the local Wi-Fi. The voice call feature of the mobile phone should be enabled.

IV.   WORKING OF PIR MOTION SENSOR

Human Beings emits thermal energy of wavelength around 9-10 micro-meter everyday. Pyroelectric or Passive Infrared Sensor (PIR) [6], [7] is an electronic device which is designed to detect this IR wavelength when a human being is in its proximity. To have a wide range for detection a simple lens is used. Sensors may also be calibrated in such a way so as to ignore domestic pets by setting a higher sensitivity threshold, or by ensuring that the floor of the room remains out of focus.

V.   WORKING OF PROTOTYPE

The prototype can be used in following two ways :

1) As a smart security system
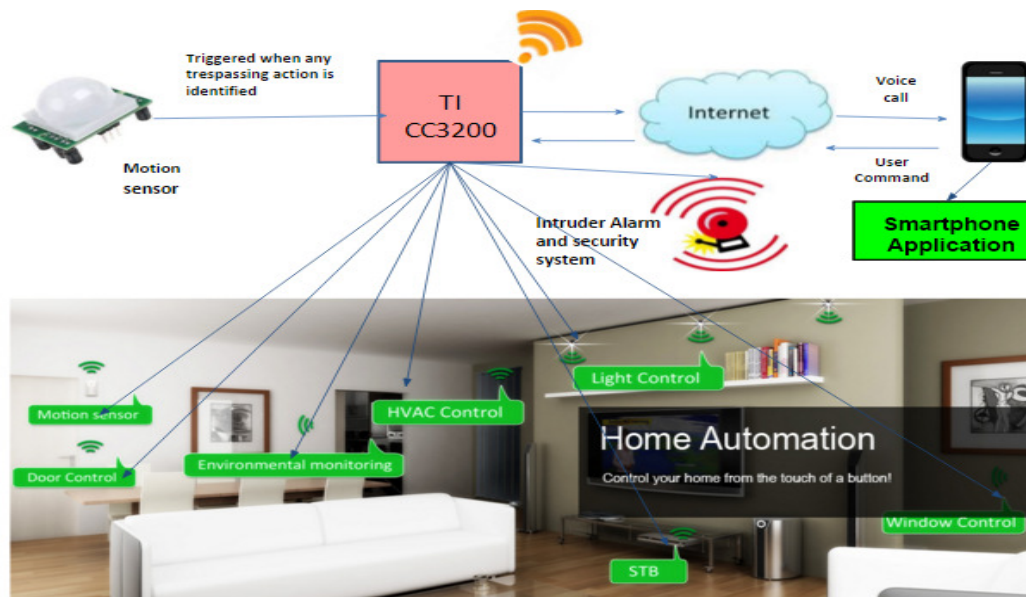2) As a smart home automation system
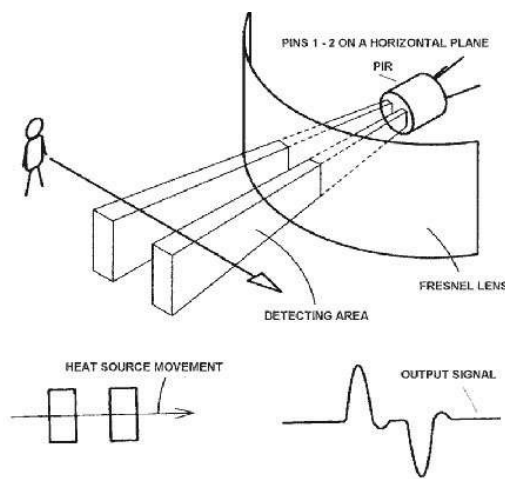
Fig. 2.   Security and Home Automation

Fig. 3.   PIR Motion Sensor working principle

A. As a smart security system

PIR motion sensors are installed at the entrances of a building. These sensors as explained earlier detect the motion of human beings. This signal which detects their presence becomes the input trigger for the micro-controller. The owner, who may or may not be present in that building, will be receiving a voice call on his mobile phone (whose number is predefined in the program) stating that 'There is an Intruder in the House'. To turn ON the lights and alarm at house so that the intruder will be warned, the owner can press '1' from his mobile keypad. Moreover if the owner finds that his building is not safe, he can send an SMS [8] to the concerned authority in police department; explaining his situation. The module will turn OFF the alarm and lights after a fixed time delay.The call will be triggered again as soon as the module detects any unexpected motion and the owner will receive the call again and the process continues so on.(To ensure the safety from

other entrances too, motion sensor should be installed at those places and will be controlled by a single micro-controller).
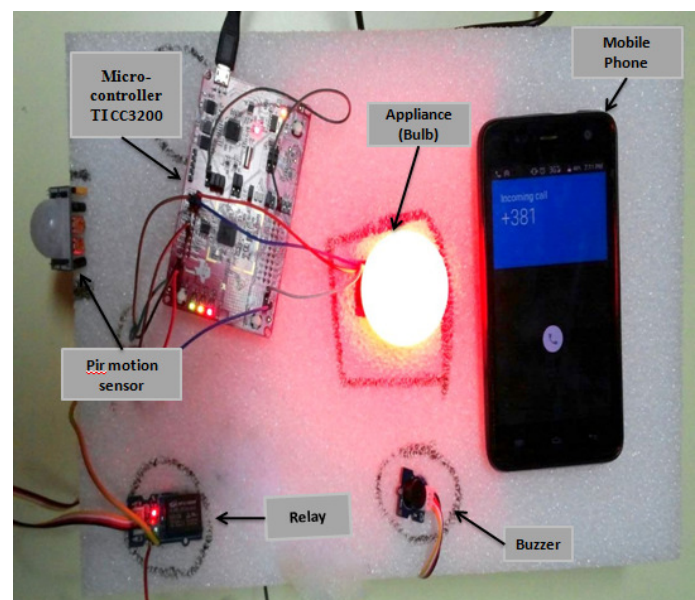
Fig. 4.   Implementation Setup

B. As a smart home automation system

This application of the module can be explained by an example. Suppose the owner is expecting a guest at his house but he is not available there. Now, as the guests reach at his house the owner will receive a video call. But now the owner can press digits other than 1 (such as 3 for lights, 4 for fan, 5 for A.C., and so on) or even can disable the security system. Similarly if the user or somebody leaves the house, the user will still receive a video call and this time he can switch Off the appliances or can enable the security system again by pressing

proper digits known to him. Since the appliances are connected to mains supply through a relay they can be easily controlled using micro-controller.

VI. FLOW CHART

```
            ┌──────────┐
            │  Start   │
            └──────────┘
                 │
                 ▼
            ┌──────────┐
       ┌───▶│   Idle   │◀───┐
       │    └──────────┘    │
       │         │          │
       │         ▼          │
       │    ╱─────────╲     │
       │   ╱  Motion   ╲ no │
       │   ╲ Detected? ╱────┘
       │    ╲─────────╱
       │         │ yes
       │         ▼
       │  ┌──────────────────────┐
       │  │ Voice call sent      │
       │  │ through Internet     │
       │  └──────────────────────┘
       │         │
       │         ▼
       │    ╱─────────╲    yes
       │   ╱ Intruder  ╲───────┐
       │   ╲  there?   ╱       │
       │    ╲─────────╱        │
       │         │ no          │
       │         ▼             ▼
       │  ┌─────────────┐  ┌────────┐
       │  │ Press 2 to  │  │ Press1 │
       │  │ Switch on   │  │ Alarm  │
       │  │ Lights      │  └────────┘
       │  │ Press 3 to  │
       │  │ Switch on   │
       │  │ Fan         │
       │  │ Press 4 to  │
       │  │ Switch on   │
       │  │ AC          │
       │  └─────────────┘
       └──────────┘
```
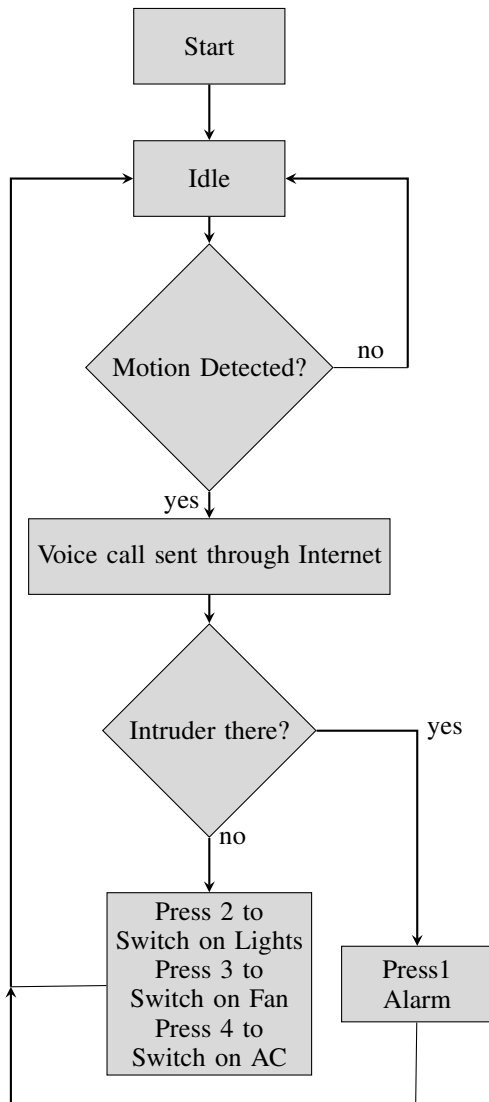
VII. FURTHER SCOPE

As the system is dependent on the user's discretion and judgeability of the situation (whether it is a guest or an intruder entering his house) the use of a camera connected to the micro-controller might help the user in taking decisions whether to activate the security system or welcome the guest [9] [10].The captured picture of the guest or intruder after face detection, can be mailed to the user. The user can further forward the same photograph to the police station if he wishes.Further the system may be made more synchronised by integrating the voice call feature within the same smart phone application through which the user can even control his home appliances without any voice call being triggered to his phone.

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