Home Monitoring System Using RP Device

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Abstract—The wireless connected devices introduce different types of applications and require specific hardware components that integrate sensing, computing, and wireless connectivity. This paper presents Home Monitoring System (HMS), which includes sensors and Internet of Things (IOT). The HMS monitors home and gives information to a resident if any threat like leakage of gas, fire, occurs. The security status within the house can be monitored through the data collected from the sensors through the internet. The Raspberry Pi (RP) is a tiny single-board computer that is used for Home Monitoring System.

Keywords— Internet of Things (IoT), Smart Home, Raspberry Pi (RP), Near Field Communication (NFC)

I. INTRODUCTION

Internet has become the most basic necessity in human life. The recent advancement in technology has led to growth in various smart devices such as Smartphone, Smart watch and intelligent home devices. The Internet of Things (IoT) is a network of internet connected devices and their ability to transfer data over a network without requiring human to human or human to computer interaction. By the end of 2020, about 50 billion devices will be interconnected over the internet. These IoT systems will be implemented in various applications ranging from home automation, health monitoring and smart manufacturing, smart hospital and many others. Visualize a world where the lights automatically turn on when the car approaches the driveway, the coffee starts brewing when the morning alarm goes off and the front door automatically unlocks when approached by a member of the household but stays locked when a stranger arrives at the door step. That is the type of world the Internet of Things can create. The main advantage of IoT is that it allows a person to automate and control tasks that are done on a daily basis, avoiding human intervention. The Fig 1 represents various areas where IoT concept is adopted. The paper is organised into following sections, in section II-Literature Survey, section III-Research Model, section IV discusses hardware requirements. Finally section V consists of Experimental Setup and Results.

II. LITERATURE SURVEY

The Internet-of-Things is an inter-networking of physical devices, vehicles also referred to as "connected devices" and "smart devices", buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data using Raspberry Pi Computer.
Won-Jun Lee presented a paper on “Satisfiers and Dissatisfiers of Smart IoT Service and Customer Attitude”. He explained a technology based on paradox theory develops hypotheses. The Hypotheses 1 tells about the Satisfiers of IoT & Hypotheses 2 about Dissatisfiers of IoT [1]. Jaehak Byun, Sooyeop Kim, et al, proposed a paper on “Smart City Implementation Models Based on IoT Technology”. They discuss on Smart Traffic Service, Smart Education Service based on IoT [2]. Fabian Astudillo-Salinas et al. presented a paper on “Minimizing the Power Consumption in Raspberry Pi to use as a remote WSN Gateway”. They have done a comparative analysis of Raspberry Pi power consumption under multiple settings. The results show energy consumption is reduced to 20% by using IoT [3]. Pranay P. Gaikwad, Jyotsna P. Gaikwad, et al., presented a paper on “A Survey based on Smart Homes System Using Internet-of-Things”. They have given a brief introduction to IoT and described the architecture of IoT for a smart home system. The devices and appliances at home can be monitored and controlled remotely. These devices are connected over the Internet using standard protocols and network architecture and this system as a whole is referred to as a smart home system based on IoT. The problems and challenges that are faced in IoT are overcome using new technologies like CPLD controllers, Zigbee modules etc [4]. Freddy K Santos and Nicholas C. H Vun proposed a paper on “Securing IoT for Smart Home System”. They have discussed on how to deploy security in IoT for smart home system. They implemented an IoT based Smart Home System using Wi-Fi network and AllJoyn framework. It also provides authentication and communication between the IoT devices and user via an android phone [5]. Vinay Sagar K N and Kusunaa S M presented a paper on “Home Automation Using Internet of Things”. The proposed system is integrated with cloud networking and wireless communication to provide the user with remote control of various home appliances such as fans, lights, AC, etc., and stores the data in the cloud using Intel Galileo device. The system has been designed to be low cost and expandable. The sensor parameters are stored in the cloud in real time [6].

**III. RESEARCH MODEL**

The above diagram Fig 2 represents the architecture of the Home Monitoring System. It consists of Raspberry Pi and act as a centralised monitoring system which interacts with various components such as sensors, mouse, keyboard, LCD and NFC module. The Home Monitoring system (HMS) is built using IoT technology to achieve high reliability, efficiency and reduced cost compared to that of the existing system. The device will be placed in a secure location and can only be operated by the owner of the house. There is no third party involved. The system has temperature, gas, sound and infrared sensor. The Raspberry Pi monitors the security status in real-time and alerts the user in case of any event via a push notification and a text message. HMS has NFC support i.e. near field communication, to enable and disable the system. The system is always connected to internet and so the user will be notified in case of an event in real time even if he goes abroad.

Following steps are involved in Home Monitoring System (HMS):

1. Enable the system using NFC start tag.
2. HMS gathers the information from the environment using Motion sensor, Temperature sensor, Gas sensor and Sound sensor.
3. In case of any event like fire, gas leak, burglar intrusion the HMS sends notification to the user/owner.
4. The system can be disabled using the NFC stop tag.

**IV. COMPONENTS**

A. Raspberry Pi 3 Model-B

The Raspberry Pi is a single-board computer developed by the Raspberry Pi Foundation. The firmware is closed-source. Several generations of Raspberry Pi's have been released. They are: Raspberry Pi 1 in model A and a higher version in model B (A+ and B+ were released later), Raspberry Pi 2 model A and B, and Raspberry Pi 3 model A and B.
We are using Raspberry Pi 3 Model B as shown in Fig3 for our work. It comes with Bluetooth built into the board and it is powered by a Quad Core Broadcom BCM2837 64bit ARMv8 processor.

![Raspberry Pi 3 Model B](image)

**Fig 3: Raspberry Pi 3 Model B**

**B. Near Field Communication (NFC)**

The Fig 4 represents a Near Field Communication (NFC), a quite recent short-range, high-frequency, two-way communication technology based on the Radio Frequency Identification (RFID) principle. When two NFC-enabled devices (named Initiator and Target) are located near to each other, a peer-to-peer connection is established between them, and they both may send and receive information. Two operational modes, that is, active and passive, are possible for an NFC device. In the active mode, which is not possible in traditional RFID solutions, NFC peers may exchange messages; in the passive mode, one of the two nodes acts only as a passive tag. An NFC tag may store a given amount of information: a Universal Resource Locator (URL) addressing a specific resource on the web, the value of a specific measure etc.

![NFC module and tag](image)

**Fig 4: NFC module and tag**

**C. Temperature Sensors**

The LM35 is an integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It has very low self-heating, less than 0.1 °C in still air. The LM35 is rated to operate over a -55°C to +150 °C temperature range.

![Temperature Sensor](image)

**Fig 5: Temperature Sensor**
D. Infrared Sensor

Fig 6: IR Sensor

IR sensor is an electronic device which consists of an LED and a light sensor. The LED emits light which is of the same wavelength as the object that has to be detected, once the light emitted by the LED falls on this object it gets reflected from that object and falls onto the light sensor. This change in intensity of light is detected by the light sensor and hence it detects motion.

E. Sound Sensor(RKI-3103)

Fig 7: Sound Sensor

The RKI-3103 sound sensor can be used to sense the audio signals from the environment. The main component of the module is a simple microphone and LM393 level convertor chip. The output the sensor provides is both analog and digital. The sensor provides a digital output when the measured sound increases beyond a set threshold. The threshold level can be adjusted using an onboard potentiometer.

F. Gas Sensor(MQ-5)

The Gas sensor detects the presence of gases in an area, often as part of a safety system. It is used to detect a gas leak or other emissions and can interface with a control system. It is suitable for detecting H2, LPG, CH4, CO, Alcohol etc. We can adjust the sensitivity of the sensor using the potentiometer. It is highly sensitive and has a fast response time.
V. EXPERIMENTAL SETUP AND RESULT

Raspberry pi device is the central monitoring system onto which the sensors are connected based on the GPIO (General Purpose Input/Output) pin structure as shown in the Fig 9. The IR sensor output is connected to GPIO pin 22, Temperature sensor is given to GPIO pin 23, Gas sensor is given to GPIO pin 24 and Sound sensor is given to GPIO pin 25. Fig 10 shows the hardware connections of IR sensor. The system is powered up and ready to detect motion. When there is an intrusion the system detects motion as shown in Fig 11 and sends notification to the user. The analog signals are converted to digital output on the screen as shown Fig 12.
VI. CONCLUSION

The Home Monitoring System (HMS) using Raspberry Pi has been successfully proven to work satisfactorily using the sensors. The HMS monitors the home and informs the owner in case any threat occurs. The threat can be gas leakage, Temperature etc., Further the work will be enhanced by using an NFC module and by developing an android based mobile app to inform the owner in case of any threats. We can also add text message support where the user can receive the notification via text message.

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