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DEVELOPMENT OF SMART WIRELESS SENSOR NETWORK FOR HOME AUTOMATION USING RASPBERRY PI

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Abstract- This Project incorporates the design and development of a prototype of Smart Wireless Sensor Network for home automation. Monitoring different factors like home safety, LPG gas leakage, fire detection, temperature and humidity of home, vacant parking slot in parking zones can be of significance. A traditional approach for measuring these factors required participation of individuals for measuring and checking the above mentioned factors, which could have been time taking and costly. So main objective of this system is to design and implement it in such a way so that it's efficient and cost effective. In this project one node is designed as master node and all other nodes as transmitting nodes, after collecting and processing data transmitting nodes send data wirelessly to master node. All the nodes are connected with Wi-Fi. At master node database has been created, where all the data is being stored, displayed and can be analyzed as per requirement.

Keywords- Smart wireless sensor network, Home automation, Raspberry pi3, Sensors, Wi-Fi, Database.

I. INTRODUCTION

The modern development of communication and sensor technology evolves in the growth of a new fascinating and demanding area - wireless sensor networks (WSNs) [12], [15], [25]. Wireless sensor networks are network systems consisting of a number of sensor nodes connected to each other through a wireless environment. "Facilitated with the ability of wireless communication and intelligent computation, these nodes become smart sensors which do not only perceive ambient physical parameters but also be able to process information, cooperate with each other and self-organize into the network" [5].

In wireless sensor network, sensor nodes sense data with specified potential, process the data and transmit the data to a base station via other sensor nodes. The sensor nodes and the network are facilitated by these new features to function more systematically, effectively and efficiently in terms of both data acquisition and power consumption. In WSN, sensors have different roles with some of them are responsible to process raw data coming from other sensors and save them temporarily in their built-in memories which can be used whenever needed. Some other sensors detect analog data in the environment and transmit to the other sensors. Wireless sensor networks can be used for so many applications like in home applications, in industrial environment, in physical environment, in military field, hospitals, etc. Moreover, they can also be used in unreachable places such as high mountains and danger zones.

1.1 Smart Wireless Sensor Network

The major challenges in network design are limited resources of wireless sensor networks such as memory, computational ability, and communication bandwidth and energy source. "A smart wireless sensor network will be capable to deal with these constraints as well as guarantee the connectivity, coverage, reliability and security of network's operation for a maximized lifetime" [5]. So a smart wireless sensor network is very effective and efficient and operation oriented. It can reduce effort and time required for monitoring different parameters related to home automation.

II. LITERATURE REVIEW

Ahmed et al. [1] have proposed a system which deals to minimize the wastage of energy by using raspberry pi and We MOSDI mini as the master operators along with sensors like PIR sensor and gas sensor etc. PIR sensor detects the absence or presence of human accordingly raspberry pi operate different appliances like fan, tube-light and appliances. Moreover, if there is detection of gas leakage by gas sensor then it will inform We MOS about it, then it forwards the information to raspberry pi.GSM is used to inform the user.

Arun et al. [2] have discussed security concerns in the existing home automation system and developed logic based security algorithm to enhance home security. Combination of sensors, microcontrollers, and raspberry pi and zigbee communication has been used to distinguish user conducts at various access points and logical sensing algorithm has been implemented. Home Automation system [3], [14], [18], [22] using raspberry has been developed.

Gokula et al. [4] have developed a system in which MQ5 sensor senses the gas leakage and informs the user through SMS and a phone call with the use of GSM. The system also informs the user when the gas

level is below specified margin (20%) and automatically booking is performed and information related to booking and level of gas usage is updated in webpage.

In this paper [6]-[7] base station is raspberry pi which connects the WSN and other network. Sensor nodes sense data transmit them to base station with the help of way of multi-hop and then forwards the data to end user or clients through internet. IEEE802.25.4 standard defines the physical and medium access control layer for less data rate wireless network.

Environmental Monitoring system using raspberry [8],[9], [13],[19],[21] and weather forecasting system based on IOT [10],[11], has been developed.

Rahul et al. [17] developed embedded hardware prototype for gas detection and monitoring system in android mobile platform.

Shyam et al. [20] have designed and implemented a system to specify the number of free parking slots in specified parking area. Implementation is done with the help of infrared sensors in every bay and connected them to raspberry pi, which then forwards all the data to a cloud server. Any user can access the data with the help of Mobile application.

Sudhir G. Nikhade [23] developed a wireless sensor network using raspberry pi and ZigBee. In this system base station is raspberry pi connected to sensor nodes through ZigBee protocol in WSN and gathers data from sensors and makes it available to different client services which include displaying the data. Base station can be remotely visited by the client via Ethernet or command console.

Thanh et al. [24] developed a cloud-based smart-parking system based on internet-of-things technologies.

Yashdeep et al. [26] developed a continuous monitoring system to detect the presence of trace moisture in SF6 gas insulated switchgear (GIS) employing a micro-cantilever sensor for better security purpose and also suggested an alternate method to detect trace moisture by monitoring change in Q-factor of the micro-cantilever. The system consists of Internet of Things (IoT) enabled using Raspberry Pi which enables easy local and remote accessibility of sensor data.

III. PROPOSED SOLUTION

In this paper we have proposed a prototype of smart wireless sensor for home automation. The proposed system is designed to overcome the drawbacks of traditional system, where manual collection of data can be sporadic and create variations by recording incorrect measurements. Thus smart wireless sensor can improve the efficiency of the system by providing better data acquisition.

In this system four heterogeneous nodes have been created for specific purpose, like node 1 is designed for home security, node2 is for LPG gas leakage detection and fire detection, and node 3 is for weather monitoring and node 4 for smart parking.

Node1 can be employed at the entrance of home, it detect whether a human has moved in or out of the main gate of home with the help of PIR sensor and PI camera takes the picture of the human and send it to master node as well as a mail to the owner. So it ensures the safety of home.

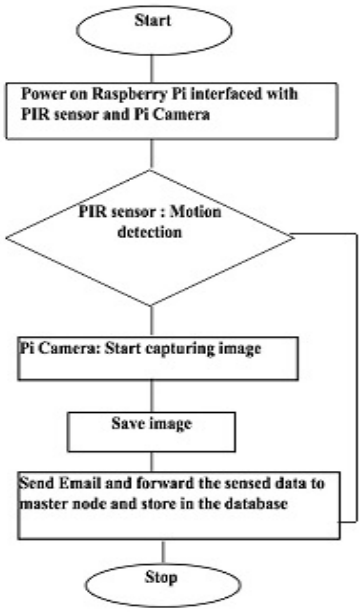
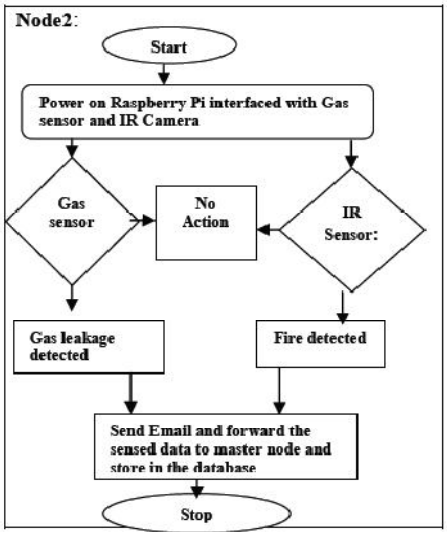


Fig.1. Flowchart of node 1

Node 2 can be employed in kitchen which remotely monitors liquid petroleum gas (LPG) leakage and fire to avoid fire accidents. The system detects the leakage of the LPG using MQ-6 gas sensor & Fire using IR flame sensor and alerts the consumer about the gas leakage or fire incident by sending email and forwarding the sensed data to master node.



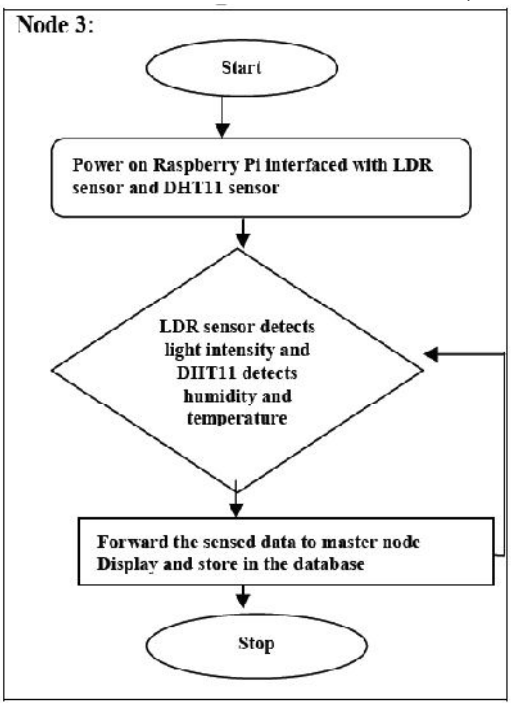


Fig.2. Flowchart of node2 and node 3

Node 3 can be employed in living area; it monitors the intensity of light, temperature and humidity with the help of LDR and DHT11.

Node 4 can be employed in the parking area, it senses the parking area and determines whether a parking slot is vacant or not with the help of IR sensor and Ultrasonic sensors.

Moreover one master node is being designed where all the four nodes transmit their data. This system uses wireless technology to provide real time data. Raspberry pi is the main block of the system it collects data from sensors, processes the data and sends the information to the master node. Sensors data from all the transmitting nodes are being sent wirelessly and stored at the database of master node and being displayed with date and time in tabular format. We have used Wi-Fi inbuilt in raspberry pi3. The system aims to reduce the cost and efforts of wiring and to elevate the mobility and flexibility of the selected sensing points.

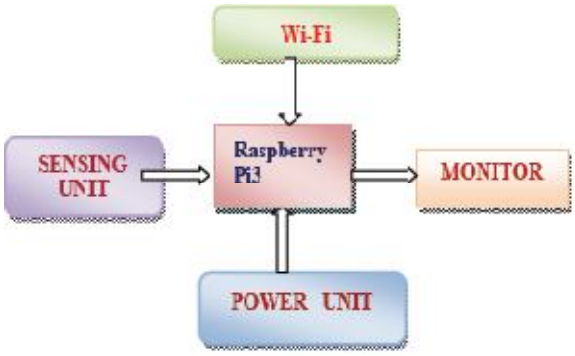


Fig.3. Block Diagram of Transmitting node

IV. RESOURCES REQUIRED

4.1 Hardwares used: The hardware is composed of the Sensor module and Raspberry Pi module.

4.1.1. Sensor Module

Wireless sensor networks are network systems consisting of a number of sensor nodes connected to each other through a wireless environment. Sensor nodes have complex functions, such as the detection, collection, calculation and routing of surrounding data. Different sensors are employed at different transmitter nodes or so called MOTES which are described as follows.

Pi Camera is used to capture photos and record videos**. PIR Sensor** is used to sense motion. **MQ6 Gas Sensor** is used for gas leakage detection. **IR Flame Sensor** is used for fire detection. LDR is used to check the intensity of light. **DHT 11sensor** detects temperature and humidity. It is used for both purposes. **Infrared Sensor** is used for sensing the light wavelength of surroundings either emitting or detecting infrared spectrum.It detects the presence or absence of device and sends message to user. **Ultrasonic Sensor** is a device that can measure distance of object by sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

4.1.2. Raspberry Pi Module:

The Raspberry Pi is a low cost,credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.

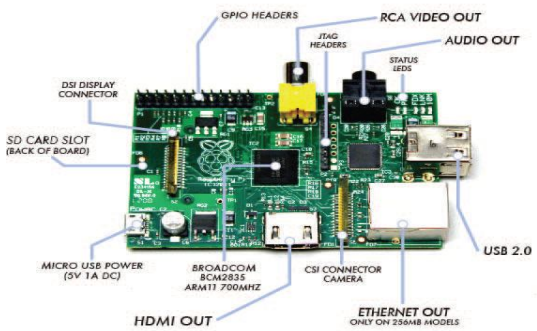


Fig.4. Raspberry Pi

4.2 Software used:

The practicality of hardware employment for all necessities is supplimented with the enforcement of the supporting software**.** The interfacing of the above mentioned hardware with each other and the Wi-Fi, and the accessing of data by the end user has been built upon a common programming platform. The

Raspberry Pi module and the sensors communicate by means of the python script run on the Raspberry Pi.

V. ARCHITECTURE DIAGRAM

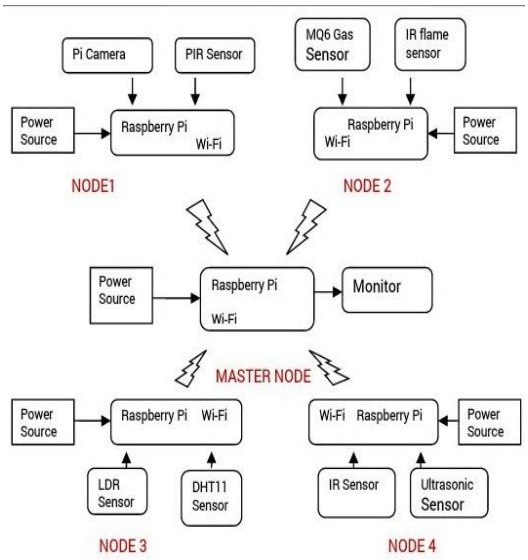


Fig.5. Architecture of smart WSN using RPi

VI. HARDWARE IMPLEMENTATION

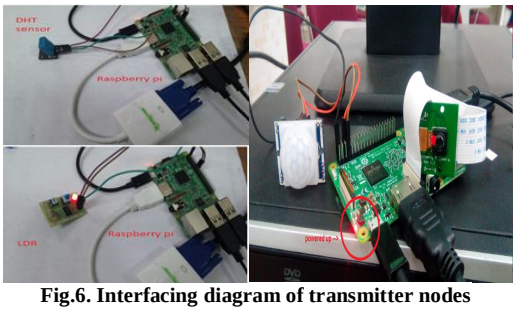


Fig.6. Interfacing diagram of transmitter nodes

VII. PROCEDURE FOLLOWED

1.) Data Acquisition: - At transmitter nodes data is being sensed by different nodes and being displayed at their respective console.

2.) Data Transmission: - Sensed data are transmitted to master node and sent as mail also.

3.) Data Storage: - The received data is being displayed as well as stored at the database of master node for further analysis.

Fig.7. 3D diagram of node 3

VIII. EXPERIMENTAL RESULTS

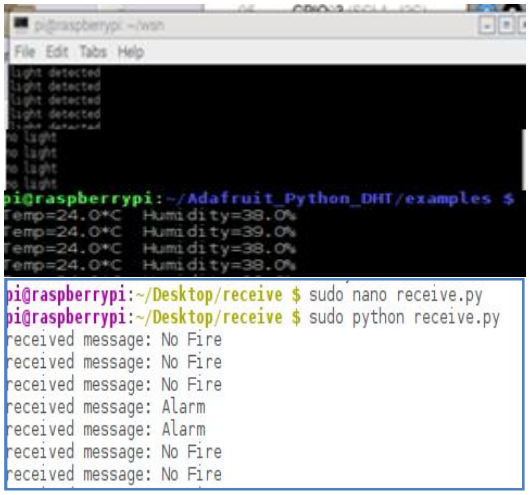


Fig.8. Console showing output of different node

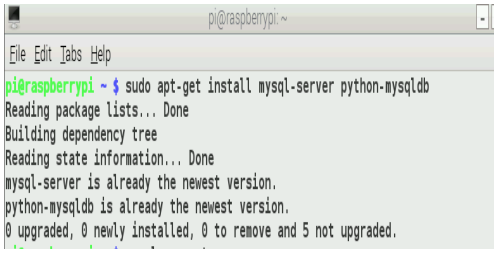


Fig.9. Installed MYSQL for database

8.1 Creating Table

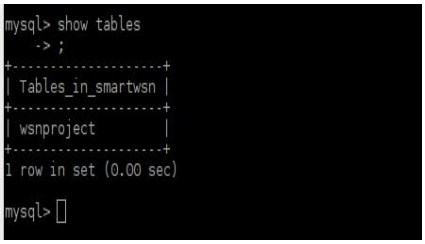


Fig.10. creation of database table

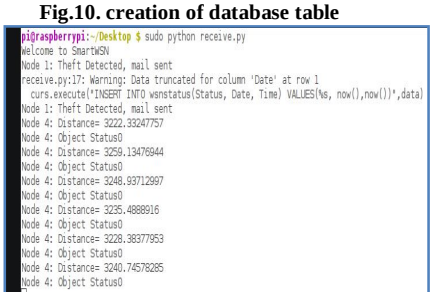
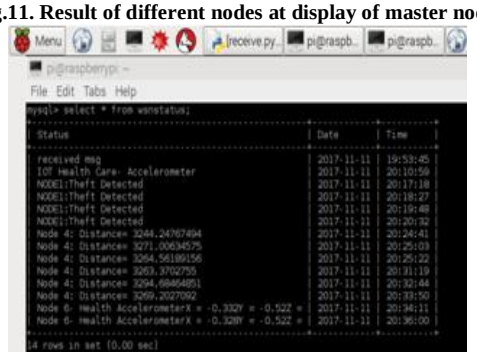


Fig.11. Result of different nodes at display of master node



Status	Date	Time
received msg	2017-11-11	19:53:45
IOT Health Care- Accelerometer	2017-11-11	20:10:59
NODE1:Theft Detected	2017-11-11	20:17:18
NODE1:Theft Detected	2017-11-11	20:18:27
NODE1:Theft Detected	2017-11-11	20:19:48
NODE1:Theft Detected	2017-11-11	20:20:32
Node 4: Distance= 3244.24767494	2017-11-11	20:24:41
Node 4: Distance= 3271.00634575	2017-11-11	20:25:03
Node 4: Distance= 3264.56189156	2017-11-11	20:25:22
Node 4: Distance= 3263.3702755	2017-11-11	20:31:19
Node 4: Distance= 3294.68464851	2017-11-11	20:32:44
Node 4: Distance= 3269.2027092	2017-11-11	20:33:50
Node 6- Health AccelerometerX = -0.332Y = -0.52Z =	2017-11-11	20:34:11
Node 6- Health AccelerometerX = -0.328Y = -0.52Z =	2017-11-11	20:36:00
Node 6- Health AccelerometerX = -0.324Y = -0.516Z	2017-11-11	20:36:29

15 rows in set (0.00 sec)

mysql>

Fig.12. All nodes result in tabular form at database of master node

CONCLUSION

Data are being sensed from different sensors at different sender nodes, those data are being sent to master node. The received data is being displayed as well as being stored in databaseat master node. The goal of the project is to design home automated system using raspberry pi where different nodes can be installed for different purposes like node 1 can be installed at the entrance of gate for security purpose, node 2 can be installed in kichen for fire detection and node 3 can be used for environment monitoring like temperature, humidity and light, and node 4 can be installed in parking zone for smart parking. Master node can be installed in living room from where one can easily operate and access the system.This project is based on raspberry pi and the language used for communication of kit is python.This is open source software.So overall implementation cost is low and easily configured.The main target of the system is to use inexpensive components and attain maximum best accurate result.

FUTURE SCOPE

In future we will work on analysis of different quality of services parameters such as sensor node measurement, deployment, coverage, number of active sensor nodes, power consumption, packet loss probability, available bandwidth, end-to-end delay, jitter and throughput. Moreover we will make it IOT based, and will develop android application for easier access.

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