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Internet Based Kitchen Monitoring System and Embedded Web Server Architecture

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Abstract: The design and development of a smart monitoring and controlling system for kitchen environment in real time has been reported in this paper. The system principally monitors kitchen environment parameters such as fire detection, motion detection and LPG gas level, has been developed. The system can monitor the status of kitchen and send an email and/or an alert SMS via IOT network automatically, if the conditions get abnormal, to a concerned authorities IP address. The concerned authority can control the system through his mobile phone or systems by sending IOT Commands or by taking the necessary steps in user SMS, which is password protected. Users can monitor and control transducers on active Web pages enhanced with JavaScript and Java. This system finds a wide application in areas where physical presence is not possible all the time. The IOT device and ARDUINO microcontroller are used in the implementation of sensor module. The system offers a complete, low cost, powerful and user friendly way of real-time monitoring and remote control of kitchen. A prototype model is developed and tested with high accuracy result.

Keywords: Transmission Control Protocol/IP (TCP/IP) and User Datagram Protocol, Wireless Sensor Networks (WSN).

I. INTRODUCTION

Kitchen environment monitoring is one of the important measures to be closely monitored in realtime for safety, security and comfort of people. With the advancements in Internet technologies and Wireless Sensor Networks (WSN), a new trend in the era of ubiquity is being realized. Enormous increase in users of Internet and modifications on the Internet working technologies enable networking of everyday objects. Web-enabled systems have offered great promise to consumers. Their benefits are well known. Reduction of operating and maintenance costs due to remote monitoring, diagnostics, debugging, and upgrading firmware. Convenience and safety that comes with the ability to monitor the status of a smart house and to control Internet appliances when away from home. Remote monitoring of residential and industrial properties, notification of emergency services in case of fire, theft, and a leak of liquid or gas. Similar types of Internet-based systems, such as those in are designed to gather a bulk of data before serving them upon request. In these applications, data are compiled in a central server and are then served to the clients via the internet. Interaction with the embedded unit is also an important issue.

In an embedded PC card placed on the Internet allows limited interaction through commands sent through Transmission Control Protocol/IP (TCP/IP) and User Datagram Protocol. The paper proposes a Raspberry pi based kitchen monitoring system through webpage with WI-FI based technology. We have designed and implemented a compact wireless sensor network with internet capability. The system can monitor the status of kitchen and send email and/or an alert SMS via GSM network automatically to users. The system has the capability to control through internet, where the subject of received email is read by the developed algorithm fed into Raspberry pi and then the system responds to the corresponding instruction with high security. The user can directly log in and interact with the embedded device in real time without the need to maintain an additional server. The system is modularly built, allowing different modules to be added. In addition, it is flexible to accommodate a wide range of measurement devices with appropriate interfaces. It has a variety of features such as energy efficient, intelligence, low cost, portability and high performance.

II. LITERATURE SURVEY

Wireless Sensors Network (WSN) has wide spectrum of applications in various sectors. In these applications, it is necessary to monitor&control physical Kitchen environments remotely with great accuracy & ease. As in a wireless sensor network is a system combination of radio frequency (RF) transceivers, microcontrollers, sensors and power supply source. Wireless sensor networks with self-configuring, self-organizing, self-diagnosing and self-healing capabilities have been developed to omit problems or to enable applications that traditional technologies could not fix. Wireless sensor network consists of various sensors and an ARM controller. Wireless communication is the transfer of information over a distance without the use of electrical conductors or wires. The distances involved may be short (a few meters as in a television remote control) or very long (thousands or even millions of kilometers for radio communications). Wireless communication involves -Radio frequency communication, Microwave communication, Infrared (IR) short-range communication. Applications of this communication may involve point-to-point communication, point-to-multipoint communication, broadcasting, cellular networks and other wireless networks. In the last few years, the wireless

communications industry experienced drastic changes driven by many technology innovations. There are several systems that allow data to be remotely accessed. As a solution to wireless data collection through the Internet, GSM is a popular choice in several applications.

III. EXISTED AND PROPOSED SYSTEMS

In embedded system with the advancement in Internet technologies and Wireless Sensors Networks, such monitor the environment parameters namely; temperature, humidity, co2 concentration and light intensity in Greenhouse. In this existing system measures some of the parameters, but I can take various parameters which is important in kitchen monitoring system. The proposed system contains a Raspberry pi based kitchen monitoring system. It can monitors the parameters such as light intensity, room temperature fire and LPG gas. It also indicates the leakage of LPG gas and also inform the usage of LPG gas when it exceeds beyond certain level to the user or concerned authority. This system can monitor the status of kitchen and send an Email and an alert SMS via GSM network automatically.

IV. OVERVIEW OF SYTEM DESIGNED

This section presents main features and the design requirements of the system. The system consists of an embedded web server ARM11 Raspberry Pi. This ARM11 acts as main processor. A wireless sensor network containing the ARM7 as master controller along with the various sensors such asMQ2 (Gas sensor), LDR (Light Dependent Resistors), Fire Sensor, pressure sensor is also used. The ARM hardware is built on single chip module. There are various slots to the ARM11 processor for connecting the various external devices such as GSM modem. A memory card can be inserted into the one of the available slot. A regulated power supply is provided to the overall system as shown in Fig.1. All the sensors sense the respective data in the plant and send this data towards the controlling unit such as ARM7. Thus all the data is collected by the ARM7 and is maintained at this location. Here, the data is stored in the data base. At this stage signal conditioning is done and only required amount of data is sent forward. Thus a successful communication is achieved between a server and client side by using this type of system. Thus personal computer & a Smartphone will continuously monitor all the data from remote processing unit and compare with the value preloaded process structure.

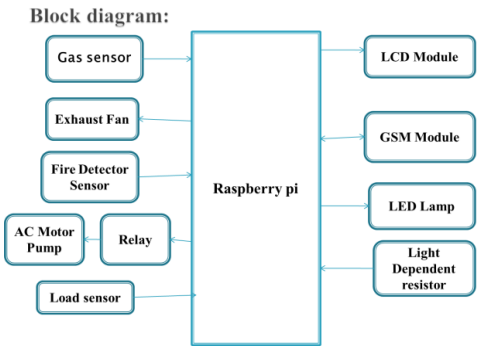

Fig.1.Block diagram of implemented system.

V. EMBEDDED WEB SERVER

The implementation of embedded internet technology is done with the help of embedded web servers. An embedded web server provides remote access to devices from a web browser. An embedded web server is integral part of embedded network which consists of an ARM processor. ARM processor contains an internet software & application code for monitoring & controlling the systems. Embedded server is a single chip implementation of the Ethernet networking standard. The client computer sends/receives data to/from the arm microcontroller using TCP/IP packets. The client has to enter IP address to access this server. The IP address of embedded devices will be available at client side to directly access the system. By using this IP address people from remote location will access the information on pc as well as on their Smartphone's. Booting of the target board is done by using the hyper terminal. After the target is successfully booted with RTOS, it is tested over the network using ping command. Now the embedded web server is responding to the clients. The operating system manages the request of the client and gives to the LAN controller of the client system. The LAN controller sends the request to the router which processes and checks for the system connected to the network with that particular IP address. If the IP address entered matches to that of the server, a request is sent to the LAN controller of the server to the client and hence a session is established between server and the client and the server starts sending the web pages to the client. There are two types of IP address i.e. static IP & dynamic IP. Dynamic IP assigned through a Dynamic Host Configuration Protocol (DHCP) server of the GSM provider for every connection established. The embedded system updates IP information on the server upon every robot, which causes an IP refresh from the GSM service provider. The dynamic IP address is of very great use as it is more flexible and it gives good secured result. Web pages are designed using HTML (Hyper Text Markup Language). HTML presents the user with a page of Information. So here we use HTML language to build embedded web pages.

VI. IMPLEMENTATION OF THE SYSTEM

The hardware design consists of various sensors, Raspberry Pi processor package, GSM modem, a far off computer & an android Smartphone. All these hardware‟ s are interfaced with each other. We're developed a coding in Python in Keil program. Additionally we're making use of RTOS to manage the whole project and to provide a outcome in actual time.

Hardware Design: To implement the overall system we used different hardwares.

A. Raspberry Pi Processor

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation. It has a Broadcom BCM2836 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU. Its GPU provides Open GL ES 2.0, hardware accelerated Open VG, and 1080p30 H.264

high profile decode which is capable of 1Gpixel/s, .5Gtexel/sor 24GFLOPs with texture filtering with 1GB RAM. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage. It can be connected to a network using an external user-supplied USB Ethernet or Wi-Fi adapter. Generic USB keyboards and mice are compatible with the Raspberry Pi. The Raspberry Pi primarily uses Linux-kernel-based operating systems. A GSM modem is directly inserted in one of the processor's slot.

B. MQ-2 Gas Sensor

Sensitive material of MQ-2 gas sensor is Sn O2, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising as shown in Fig.2. In order to make the sensor with better performance, suitable RL value is needed:

$$\text{Power of Sensitivity body } (P_s): P_s = Vc2 \times R_s / (R_s + RL)2 \quad \textbf{(1)}$$

In this system ,if gas level is exceeds the threshold value(800) Exhaust fan will be turn ON and the message and Email send to the concerned authority.

Fig.2.MQ2 Gas sensor and Exhaust Fan.

C. Fire Sensor

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire as shown in Fig.3. The module makes use of IR sensor and comparator to detect fire up to a range of 1 -2 meters depending on fire density. In this application when fire will be detected in kitchen by the fire sensor AC motor ON automatically and sprinkle the water around the kitchen and also alert SMS send to the concerned authority thorugh the GSM.

Fig.3.Fire sensor and AC motor.

D. LDR

An LDR or a photograph resistor has a resistance which changes founded on the quantity of visible mild that falls on it. An image resistor is product of an excessive resistance semiconductor LDR is discovered in many customer objects similar to, digital cam mild meters, avenue lights, Clock radios, Alarm contraptions and so forth. The sun shine falling on the zigzag strains of the sensor (more commonly made of Cadmium Sulphide), reasons the resistance of the gadget to fall. In this application when light intensity decreases LED is glow otherwise LED will be OFF.

E. Pressure Sensor

Pressure sensing using diaphragm technology measures the difference in pressure of the two sides of the diaphragm. Depending upon the relevant pressure, we use the terms ABSOLUTE, where the reference is vacuum, GAUGE, where the reference is atmospheric pressure, or DIFFERENTIAL, where the sensor has two ports for the measure of two different pressure as shown in Fig.4.

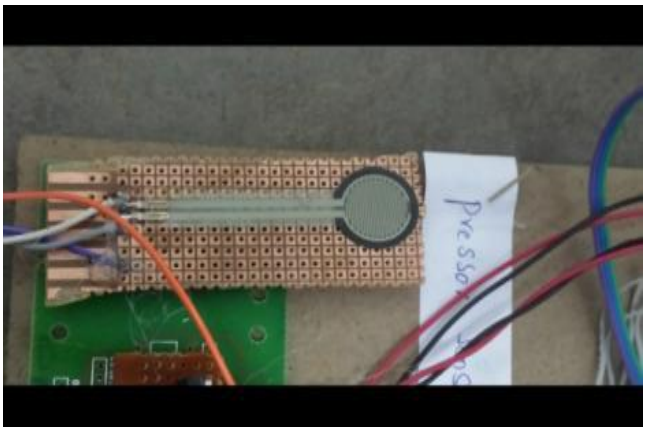

Fig.4.Pressure sensor.

F. GSM

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated as shown in Fig.5. The rarer 400 and 450 MHz frequency bands are assigned in some countries, where these frequencies were previously used for first-generation systems. GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used. In some countries the GSM-900 band has been extended to cover a larger frequency range. This 'extended GSM', E-GSM, uses 880–915 MHz (uplink) and 925–960 MHz (downlink), adding 50 channels (channel numbers 975 to 1023 and 0) to the original GSM-900 band. Time division multiplexing is used to allow eight fullrate or sixteen half-rate

speech channels per radio frequency channel. There are eight radio timeslots (giving eight burst periods) grouped into what is called a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate is 270.833kbit/s, and the frame duration is 4.615ms.

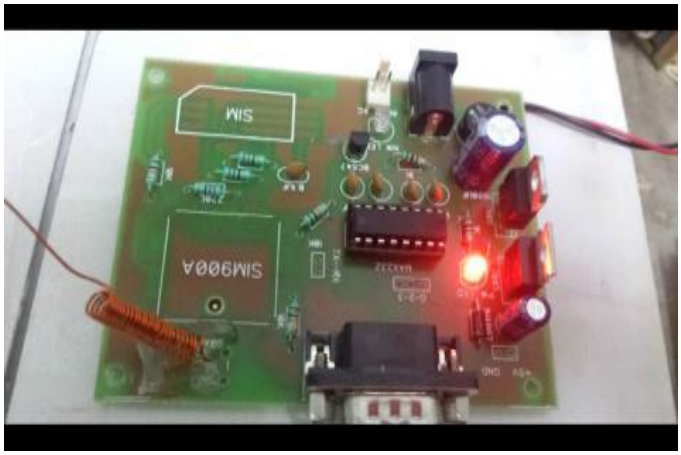

Fig.5.GSM900SIM Module.

VII. CONCLUSION

The design and the development of an interactive kitchen monitoring system with the GSM, WI-FI communication and Web-based measurement and control systems. The Web based monitor and automatic control of equipment is forming a automation field. Replacing PC with low-cost single chip processor can make administrators to get parameters of different remote sensor and send control information to kitchen parameters at any time through Internet. The GSM is an excellent choice for this due to its extensive coverage of the all parameters. Since SMS is a text based protocol, even the most basic GSM systems make changes on these states. The complete system is secured through a login E-mail and Webpage password based authentication. The design is completely integrated and wireless with the software to form a low cost, reliability and easily operable system. WI-FI communication makes the system to install easily. The GSM, E-mail and Web based communication system provides a decision making device concept for adaptation to several kitchen scenarios.

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