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To Design a Smart Home Security System Using Android and Wi-Fi

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***Abstract*—**Technological advances have made itpossible to implement embedded systems in homeappliances. This has led to new capabilities and functions.In most cases, however, these are proprietary implementations and networking is not always possible. However, there is a growing demand for smart homes, where appliances can automatically respond to changing environmental conditions and be easily controlled from a common device. This project work presents a possible solution where the user monitors the home security witha cell phone through its Wi-Fi interface. The result is a simple, low-cost, and flexible system that is ideal forfuture smart home solutions. The system is also equippedwith a gas leak detector, which is very useful for residential and industrial kitchens in the commercial sector. A gas detector is a device that detects the presenceof various gases in an area, usually as part of a system to warn of gases that could be harmful to humans. Gas detectors can be used to detect combustible, toxic (poisonous) and CO2 gases. Here, the MQ2 is used as a gas sensor capable of detecting a gas leak, and with the help of the control circuit, an automatic warning messageis sent to the Android phone via the Wi-Fi modem. And the Android device can also be used to control the exhaustfan through the same Wi-Fi modem.The System alsoincludes the Temperature and Humidity sensor detect thetemperature and humidity in the home and rain sensor todetect the rainfall and finally the MEMS(micro electric and mechanical system) device to detect the earthquake. The demo module is designed to control three individual electrical appliances, such as light, fan, cooling unit, etc., through the Android cell phone via Wi-Fi. The status of the devices (ON /OFF) is also displayed on the LCD.

KEYWORDS -

Arduino UNO controller/Atemga328pcontroller, DHT11, Gas sensor, MEMS, Water sensor, Relay, Power supply, Wi-fi, Smart phone.

I. INTRODUCTION

With the progress of technology and the development of information home appliances, such as televisions, airconditioners, sound and stereo systems, wireless telephones,etc., the remote controls that dazzle our eyes have still not

reached a unified model or style. In view of this, we proposean environmental control system that combines wi-fi technology. Together with wi-fi wireless transmission, we can break the spatial barriers that exist in our living structure,which includes several separating objects. The system isconstructed as follows: Microcontroller and Wi-fi module.

Wi-Fi is a wireless technology composed of hardware, software and interoperability requirements. It is "a specification for short-range wireless connections between mobile computers, cell phones, digital cameras, and other portable devices" It has been adopted not only by all the major players in the telecommunications, computing, and entertainment industries, but also in fields as diverse as the automotive, healthcare, automation, and toy industries

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The Wi-Fi communication pattern is characterized byrobust (strong) digital communication. This allows a variablebit rate for desired purposes such as voice or data. 802.11n operates on both the 2.4 GHz band and the less-used 5 GHz band. Support for the 5 GHz bands is optional. It operates at a maximum net data rate of 54 Mbit/s to 600 Mbit/s.

There have been significant advances in consumer electronics over the past decade. Various 'smart' devices such as cell phones, air conditioners, home security systems, hometheaters, etc. are designed to realize the concept of the " smart home." They have led to a Personal Area Network in the home environment, where all these devices can be connectedand monitored through a single controller. Busy families and people with physical limitations represent an attractive market for home automation and networking. A wireless home network that does not add wiring costs would be desirable. Wi-Fi technology is an ideal solution for this purpose. This paper describes an application of Wi-Fi technology in the home automation and networking environment. A network is

II . LITERATURE REVIEW

In the IoT platform-based home security system, the main emphasis on protecting our loved ones and ourbelongings at home. Today numbers of IoT based home security systems are available in market. According tothe literature and marketsurvey, the common parameters of IoT enabled home security system are 24 hours monitoring and detection of the intruder,real time, cost effective and precise notification system suggested by various researchers. Following are the contributions of various researcher done in IoT domain [6].Rani et al. (2018) explains the IoT based home security using Raspberry Pi which give SMS alert to authorize personthrough WAY2SMS and image of the unauthorized person via g-mail. Dinakar et al. (2018) proposed IoT based automated home security system using Raspberry Pi which gives intruder detection alarm and notification to the owner.

III. PROPOSED SYSTEM

The proposed system is a Smart home security system using android and Wifi module, consists of server, sensors. Server controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). The Arduino UNO , which is been in contact withWi-Fi module port to which the card is inserted, acts as web server. Security System can be accessed from the web browser of any local PC in the same LAN using server IP, orremotely from any PC or mobile handheld device connected to the internet with appropriate web browser through server real IP (internet). Wi-Fi technology is selected to be the network infrastructure that connects *server and the* sensors. Wi-Fi is chosen to improve system security (by using secure Wi-Fi connection) and to increase system mobility and scalability. It has many sensors to detect the senses like earthquake detection, rainfall detection, harmful gases detection (like gas leakage), Temperature and Humidity detection. In this way the system provides the information about the earthquake , rainfall, presence of harmful Gases, temperature and humidity detection and finally gives the output in the form of messages in the application named “Serial Wifi Terminal”.

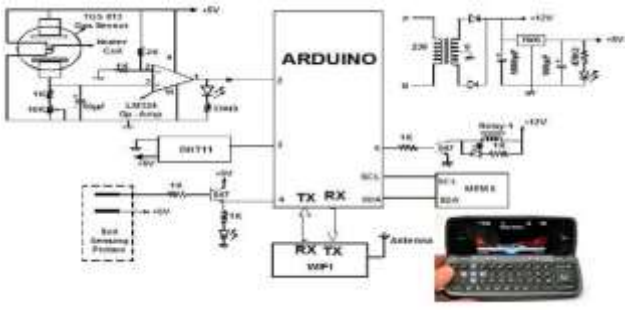

Figure: Circuit Diagram Of The System

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DESCRIPTION OF THE CIRCUIT DIAGRAM:WI-FI MODULE (esp8266):

The specification IEEE 802.11 (ISO /IEC 8802-11)is an international standard that describes the characteristics of a wireless local area network (WLAN). The name Wi-Fi (short for "Wireless Fidelity," sometimes incorrectly abbreviated to Wi-Fi) corresponds to the name of the certification by the Wi-Fi Alliance, formerly WECA (Wireless Ethernet Compatibility Alliance), the group that ensures compatibility between hardware devices that use the

802.11 standard. Because of the misuse of terms (and formarketing purposes), the name of the standard is now often confused with the name of the certification. A Wi-Fi networkis actually a network that complies with the 802.11 standard.

With Wi-Fi, it is possible to build high-speed wireless local area networks, provided that the computer to be connected is not too far from the access point. In practice,Wi-Fi can be used to establish high-speed connections (11 Mbps or more) to laptops, desktop computers, PDAs (personal digital assistants), and other devices located withina few dozen meters indoors (generally 20 m to 50 m away) orwithin several hundred meters outdoors.

RS 232 CONNECTOR (MAX 232):

The RS -232, generally used in computers for serialcommunication, is a very popular device. Here this chip is used to communicate with the wifi modem. This device is connected between the microcontroller and the Wifi modem,the main function of this device is to convert the CMOS logicto TTL logic because the Wifi modem only accepts TTL logic signals.

RS-232 was designed for a single purpose: as an interfacebetween data terminal equipment (DTE) and datacommunication equipment (DCE) using serial binary data exchange. As mentioned earlier, the DTE is the terminal or computer and the DCE is the modem or othercommunications device. This converter chip is needed to convert the TTL logic from a microcontroller (TxD and RxDpins) to a standard serial interface for PC (RS232).

According to the commands given by the microcontroller to the Wi-Fi modem, the control signal is extracted by the Android app and used to control the output supply of the energy meter and to transmit the information about the consumed units through the Wi-Fi modem. We need to convert the 'septet' of the phone into 'octet' because the microcontroller needs bytes with a length of 8 bits (the 'septet'is a byte with a length of 7 bits and the 'octet' is a byte with a length of 8 bits). All these operations are necessary to decodethe message from the WLAN.

In telecommunications, RS -232 is a standard for serial binary data signals transmitted between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. AtRS -232, data is sent as a timed sequence of bits. Both synchronous and asynchronous transmissions are supported by the standard. In addition to the data circuits, the standard defines a number of control circuits that are used to manage the connection between the DTE and the DCE. Each data or control circuit operates in one direction only, i.e., signalling from a DTE to the connected DCE or in the reverse direction.Since transmit and receive data are separate circuits, the interface can operate full duplex and support simultaneous data flow in both directions. The standard does not define the character configuration within the data stream nor the character encoding.

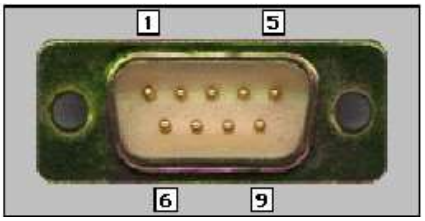

Figure: Typical RS-232Transmitted Data (TxD)

Data sent from DTE to DCE.

Received Data (RxD)

Data sent from DCE to DTE.

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Request To Send (RTS)

Asserted (set to 0) by DTE to prepare DCE to receive data. This may require action on the part of the DCE, e.g.., transmitting a carrier or reversing the direction of a half-duplex line.

Clear To Send (CTS)

Asserted by DCE to acknowledge RTS and allow DTE to transmit.

Data Terminal Ready (DTR)

Asserted by DTE to indicate that it is ready to be connected. If the DCE is a modem, it should go "off hook" when it receives this signal. If this signal is de-asserted, the modem should respond by immediately hanging up.

Data Set Ready (DSR)

Asserted by DCE to indicate an active connection. If DCE is not a modem (e.g.., a null-modem cable or other equipment), this signal should be permanently asserted (set to0), possibly by a jumper to another signal.

Carrier Detect (CD)

Asserted by DCE when a connection has been established with remote equipment.

Ring Indicator (RI)

Asserted by DCE when it detects a ringsignal from the telephone line

RTS/CTS handshaking

The standard RS -232 use of the RTS and CTS lines is asymmetrical. The DTE signals with RTS that it wants to transmit, and the DCE responds with CTS to give permission. This allows half-duplex modems to disable their transmitters when not needed and have to send a synchronization preamble to the receiver when they are re-enabled. There is no way for the DTE to indicate that it cannot accept data from the DCE. A non-standard symmetric alternative is widely used: CTS indicates the DCE's permission for the DTE to send, and RTS indicates the DTE's permission for the DCE to send. The "request to send" is implicit and continuous. The standard defines RTS/CTS as a signaling protocol for flow control of data transmitted from the DTE to the DCE. The standard does not provide for flow control in the other direction. In practice, most hardware seems to have repurposed the RTS signal for this function. A minimal "3- wire" connection RS -232 consisting only of transmit data, receive data, and ground is commonly used when the full capabilities of RS -232 are not needed. If only flow control isrequired, the RTS and CTS lines are added in a 5-wireversion. In our case it was mandatory to connect the RTS line of the microcontroller (DTE) to ground to enable the reception of bit streams from the modem.

MICROCONTROLLER:

The next important device used in this project workis the microcontroller, which plays an important role, as it will be treated as the heart of the project work. Nowadays, there is no device that works without a microcontroller. Microcontrollers have become an integral part of all devices. Many tedious tasks, from simple to specialized, are left to thecontroller to solve.

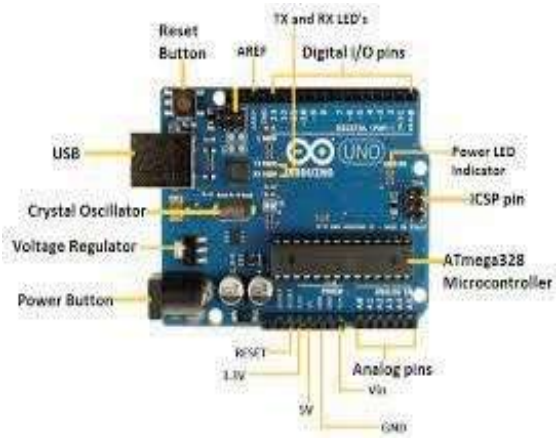

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Figure: Arduino UNO Board Description.

The microcontroller used in this project work is ARDUINO UNO ATMEL Coporation AT89C52, basically this IC belongs to the 8051 family. In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This controller has 256 bytes RAM, 8K bytes ROM, two timers, one serial port and four ports. This IC is called an 8-bit processor, which means that the CPU can only process 8 bits of data at a time. The 8051 has four ports and each port contains 8 input/output lines. This IC became very popular after Intel allowed other manufacturers to produce and market any variant of the 8051 on the condition that they remain code compatible with the 8051. This has resulted in many versions of the 8051 being marketed with varying speeds and amounts of on-chip ROM by many manufacturers.

ATMEL is one of the major manufacturers of these devices that are compatible with the original 8051 in terms of instructions. The original 8051 from Intel has a maximum of 64K bytes on chip ROM, while the ATMEL 89C51 has only 4K bytes on chip. The ATMEL 89C52 is equipped with 8K memory, so up to 20K bytes are available on ATMEL's French fries. Atmel Corporation has a wide selection of 8051 French fries and of these, the AT 89C51 is a popular and inexpensive chip used for many applications. It has 4K bytes of flash ROM; 'C' stands for 'CMOS' which has low power consumption.

The ATMEL AT89C52 is a low power, high performance CMOS 8-bit microcomputer with 8K bytes of flash memory (PEROM). Its high-density non-volatile memory, compatible with the standard MCS-51 instruction set, makes it a powerful controller that provides an extremely flexible and cost-effective solution for control applications.

Microcontrollers operate according to the program written in them. Most microcontrollers today are based on the Harvard architecture, which clearly defines the four basic components required for an embedded system. These include a CPU core, memory for the program (ROM or flash memory), memory for data (RAM), one or more timers (customizable timers and watchdog timers), and I/O lines for communication with external peripherals and complementary resources - all in a single integrated circuit. A microcontroller differs from a general-purpose chip (CPU) in that the former can generally be converted into a working computer fairly easily, with a minimum of external support French fries. The idea is that the microcontroller is built into the device to be controlled, connected to the power supply and given all the information it needs, and that's it.

This is not possible with a conventional microprocessor. It requires that all these tasks be done by other French fries. For example, a certain number of RAM memory French fries must be added. The amount of memory provided is more flexible with the traditional approach, but there must be at least a couple of external memory French fries, and also many connections must be made to pass the data back and forth to them.

A typical microcontroller, for example, has a built-in clock generator and a small amount of RAM and ROM (or EPROM or EEPROM), meaning that to get it running, all you need is some control software and a timing crystal (although some even have internal RC clocks). Microcontrollers also usually have a variety of input/output devices such as analog-to-digital converters, timers, UARTs, or special serial communication interfaces such as I²C, Serial Peripheral Interface, and Controller Area Network.

Often these integrated devices can be controlled by special processor commands.

Originally, microcontrollers were programmed only in assembly language or later in C code. Newer microcontrollers are equipped with on-chip debug circuitry that is accessed by an in-circuit emulator via JTAG (Joint Text Action Group), allowing a programmer to debug the software of an embedded system with a debugger.

More recently, however, some microcontrollers have begun to include a built-in interpreter for high-level languages to make them easier to use. BASIC is a common choice and is used in the popular BASIC stamp MCUs (Master Control Unit). Microcontrollers come at the expense of speed and flexibility to simplify device development and reduce cost. There is only so much space on the chip, so for every I/O device or memory expansion the microcontroller provides, another circuit must be removed. Finally, it must be mentioned that some microcontroller architectures are available from many different vendors in so many variations that they could rightfully belong in a category of their own. This includes the 8051 family in particular. The controller is connected to the Wifi module via its serial interface. By sending commands from the Android cell phone to the Wifi module, the controller decodes the data and controls the electrical devices via the relays. The status of the devices is displayed on LCD, which is also connected to the same controller and also sends feedback about the status of the devices to the Android cell phone.

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RELAY:

A relay is an electrical switch that opens and closesunder the control of another circuit. An electric current flowing through a conductor produces a magnetic field at right angles to the direction of electron flow. If this conductoris wound in the form of a coil, the magnetic field produced isaligned along the length of the coil. The greater the current, the greater the strength of the magnetic field when all other factors are equal. The purpose of a relay is generally to act asa kind of electrical magnifier, that is, it allows a comparatively weak current to bring a much stronger current into operation. It also provides complete electrical isolation between the control circuit and the controlled circuit.

Relays are widely used in electronics, electrical engineering and many other fields. A wide range of relays has been developed to meet the various requirements of the industry. There are relays that respond to voltage, current, temperature, frequency, or a combination of these conditions. The basic operation of an electromagnetic relay is easy to understand. However, selecting a relay that will perform a specific function efficiently and over a long period of time requires knowledge of the characteristics of the relay and thecircuits in which the relay will be used.

GAS SENSOR:

This circuit detects the release of toxic gasses and sends a message to the control unit, which relays the information via an optical sensor. Here is the general description of the gas sensor.

GENERAL CHARACTERISTICS OF UNIVERSALGAS SENSOR:

The Universal Gas Sensor is a general purpose sensor that has good sensitivity characteristics for a wide range of gasses. This device is designed to operate with a stabilized 5-V heating supply and a circuit voltage dependent on the design. The most suitable application for the sensor isthe detection of methane, propane, and butane, making it an excellent sensor for household gas and leak detection equipment.

The initial stabilization time of the gas sensor is very short and the relative and elapsed characteristics are very good over a long period of operation. It has very low sensitivity to 'noise' gasses, which greatly reduces the problem of false alarms. The gas sensor is most practically used in a circuit that maintains the switching voltage at a fixed value of 5V. This voltage value is very practical when determining design specifications due to the wide range of components available. This makes the use of the gas sensor aparticularly economical way to develop low-cost and highly reliable gas detection circuits. Because of its particularly highsensitivity to methane, propane and butane, the sensor is verypractical for monitoring town gas and liquefied petroleum gas. With the added features of a short initial stabilization time and highly reliable sequence characteristics, the sensor represents a new generation of gas sensors from Figaro.These sensors are encapsulated with resin.

IV. WORKING AND BLOCK DIAGRAM OFSYSTEM

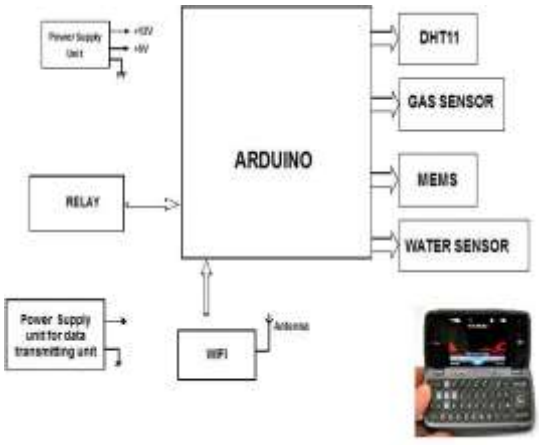

Figure: Block diagram of the system.

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WORKING:

As the system resembles that it is a Smart home security system it consists of sensors like DHT 11 Humidity and temperature sensor , Rain sensor , MEMS (micro electro mechanical system) used for earthquake detection, Gas sensor . Based on the situation each sensor reacts and provides the output accordingly. As the wifi module is used to connect all these devices together . The wifi module through Arduino UNO gathers the information from each device in the system. The wifi module esp8266 is connected to the Android mobile using an Application called " Serial Wifi Terminal" . Based on the situation in the home the system provides the information about the humidity, temperature, rainfall, Earthquake detection and Harmful gas detection .

These all information is been provided in the Application called Serial wifi terminal. The application is been developed based on the Serial connection of wifi module in the system. So finally using wifi module the system protects the home and detects if there is any unusual activity arises and provides with alerts to the serial wifi terminal application in the Android mobile to which the system is been connected.

Figure: Hardware Circuit Of the System

V. APPLICATION DESCIPTION

Serial WiFi Terminal' is a line-oriented terminal / console app for devices connected over WiFi. In Addition to the usual ssh and telnet protocols, it also supports raw-sockets making it an ideal terminal for devices such as ESP8266 configured as WiFi to Serial bridge.

Supported protocols:
- ssh
- telnet
- raw sockets

For raw sockets these ESP8266 'WiFi to Serial' firmwares have been tested:
- Arduino -> Examples -> Esp8266WiFi ->TelnetToSerial
- GitHub -> jeelabs/esp-link

This app can also be used as Linux terminal, but is not a full full-blown terminal emulator as it is line-oriented and only supports a subset of escape sequences.

VI . RESULT

Finally the system provides the information about the situations in the home like presence of harmful gases , temperature and humidity in the house, earthquake detection in the house and rainfall detection at the house. As the Wi-Fi module is connected to the Android mobile it sends all the notifications to the Android mobile continuously through the application named " Serial Wi-Fi Terminal". And accordingly the home is been secured with this smart system.

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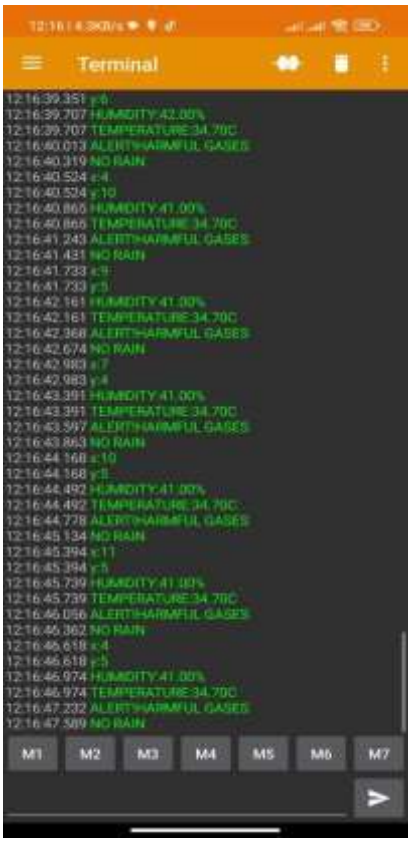

Figure: Output Displayed in Application in Android Mobile to which the Wi-Fi module is been connected.

VII . CONCLUSION

Smart Home Security has taken us too far from traditional ways and increased advancement has led us to use our homes and devices to the optimum level. If the Gas leakage detectedthen exhaust fan will be started automatically to exhaust the harmful gases to outside . The rainfall detection, temperature and humidity values are been given continuously as a value in the mobile application “Serial Wi-Fi Terminal”. The protection given by the system is completely appreciable as the system cost is less and complexity remains low as the system requires less number of components it is easier to install anywhere in the home .

VIII. FUTURE SCOPE

Future homes will most likely offer practical and advanced security to its owners and revolution in smart homes is made possible through IOT Digital code lock security is provided as an advanced feature. Nearly all Smart

Home Security Systems will offer Apps for your smart phone,smart tablet or even PC. A few taps on the screen is all it takes to make changes to your security - for example enabling and disabling security "Zones" to suit which parts of your home are occupied or not. Any voice assistant such as Alexa, Google,Siri or Cortana can control your Smart Home Security System. So you won't even need to reach for your smart phone, you can simply bark orders at your Smart Speaker or Smart Screen. With natural language recognition and machine learning, youcan even make inferences rather than direct commands. Tell Alexa or Siri that you're going out and they'll automatically start the exit timer ahnd set the alarm after you've left the building.

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