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SMOKE DETECTION AND FIRE SAFETY SYSTEM USING IOT

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Abstract: The available fire alarm system in the market unable to inform occupant that their house is on fire. The occupant remains unknown especially when they are away from their house. Most of the time, the house or building almost destroyed by fire when fire-fighter comes to the scene due to late inform to Fire and Rescue Department. To this aim, automatic smoke detection system using Internet of Things (IoT) is proposed. The proposed system not only able to monitor the smoke condition of a room but also able to alert user and Fire and Rescue Department. When certain level of smoke is detected by a gas sensor via Favourite platform. Arduino Uno is used in this work to control all the devices and Wi-Fi shield acts as a medium to interconnect devices with the network so that the data from the smoke sensor can be read in the Favourite platform. In this experiment, the condition of room is tested under several burning materials and the smoke levels are recorded. It is found that when the smoke level more than 100 ppm, it may cause to sore eyes, cough and hard breathing that can bring to death. Therefore, the best threshold level of the automatic smoke detection system is at 80 ppm. By using this system, the user able to take preliminary rescue action to save people and prevent fire breakout.

Keyword: *Arduino UNO, IoT, Flame Sensor, Wi-Fi, BC547, LED, DHT22, IR sensor*

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I INTRODUCTION

Fire Detectors play a very important role in Industries, Shops, Malls, Residential complexes, parking areas, etc. They help in detecting fire or smoke at an early stage and can help in saving lives. Commercial Fire detecting systems usually have an alarm signaling,with the help of a buzzer or Siren. We have designed an IOT based Fire Alerting System using Temperature and a smoke sensor which would not only signal the presence of fire in a particular premise but will also send related information through IOT .Internet of Things (IoT) is basically the network of 'things' by which physical things can exchange data with the help of sensors, electronics, software, and connectivity. These systems do not require any human interaction. In this Arduino fire alarm system using temperature and smoke sensor using the IOT project, we can send LIVE information like Temperature, Smoke Value detected by a particular device to the Fire Department.

II OBJECTIVE

The objective of this project is to show all the steps followed to perform the design, research and development of an optimized Wireless multi sensor Network to detect and protect the environment / system / building from the fire. The complete monitoring is based on IOT.

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III LITERATURE SURVEY

Several technological solutions based on wireless networks have been proposed to detect and monitor a fire. The related literature shows systems based on satellites, infrared cameras, wireless cameras and sensor networks. Some of these wireless systems are implemented alone, but there are some that mix several technologies. Moreover, there are other types of technologies, such as a GPS system, which can be added to improve their performance. There is an important system for forest fire detection based on satellite imagery: MODIS. It studies the images taken from satellites. But, weather conditions are an important problem in these systems. Clouds and rain absorb parts of the frequency spectrum and reduce spectral resolution of satellite imagery. So, the performance of this system changes very much. Satellites can monitor a large area, but the resolutionof satellite imagery is low. A fire is detected when it has grown quite a lot, so real time detection cannot be provided. Moreover, these systems are very expensive. Li et al. presented an algorithm based on satellite remote sensing to detect fire across the Canadian boreal forest zone the authors use images provided by the Advanced Very High Resolution Radiometer (AVHRR). The paper shows the analysis and how their algorithm works in order to detect a fireby using several graphics. The system presents several advantages: automatic operation, consistent data quality, cost-effective use, and rapid response, but not in real-time. Thierry Antoine-Santoni et al. designed asystem, called Fire sensor sock, to protect every sensor node (mote) of a wireless sensor network in order to avoid these devices being damaged or destroyed when they are sending data, detecting or controlling a fire. Fire sensor sock is a special protection dedicated to the thermal insulation of the sensors that leave intact their ability to sense thermal data. Thus, the objective of this work is to have a wireless sensor network that is able to resist being burnt. The sensors will continue transmitting data flow to the final user. Results show a significant change of the temperature and humidity inside the protection, which determines the presence of a fire. Besides, the authors point out that a WSN protected with Fire sensor sock is capable of sensing thermal data in the open air. They are able to detect a fire and track the fire spread during its spatial and temporal evolution. Nowadays, wireless sensor networks arewidely used to monitor and to detect a fire, and thereis a fair amount of literature on it. An example is the Fire Bug system. In, the authors present a systembased on a wireless sensor network for forest fire monitoring. The design is performed with MICA motes using GPS attached. Its objective is to gather environment parameters like temperature, relative humidity and barometric pressure when there is an active fire. Motes communicate with a base stationand data are stored in a database server. In order to access to this server, a web browser based on a web application, or any other application capable ofcommunicating with the database server, is necessary

IV WORKING METHODOLOGY

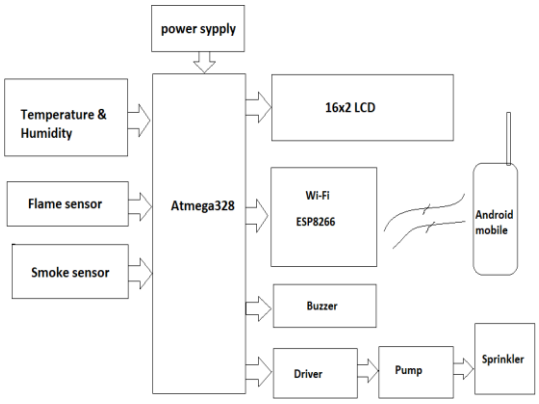

Fig: 1 Block diagram of systems

The block description of system is given below-

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1In a clear air condition, the system is used to monitor the smoke condition of a house/room. Initially, the automatic smoke detection system is in standby mode. The sensor keeps sensing the smoke level and update to Favourite platform. Once the smoke is detected and exceeds the threshold level of 80 parts per million (ppm), alarm is activated in order to give warning to the occupant.

4.1 Arduino Uno-

Arduino/Genuine Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replacethe chip for a few dollars and start over again.

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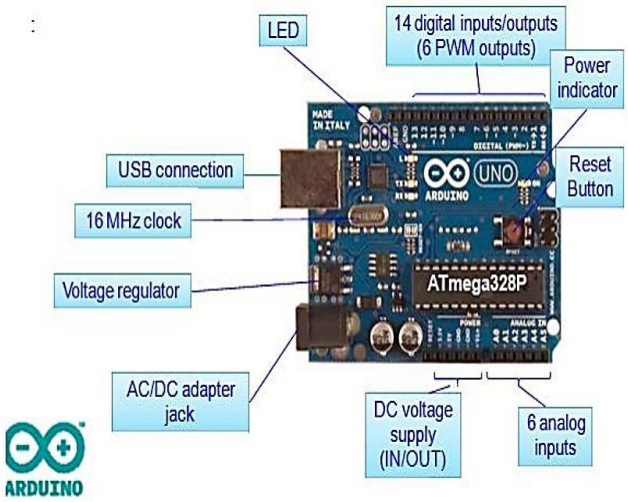

Fig.2 Arduino board Structure

- The Arduino Uno is a microcontroller board based on the ATmega328P.
- It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.
- Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

4.2 AVR (ATMEGA 328)-

- The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.
- By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

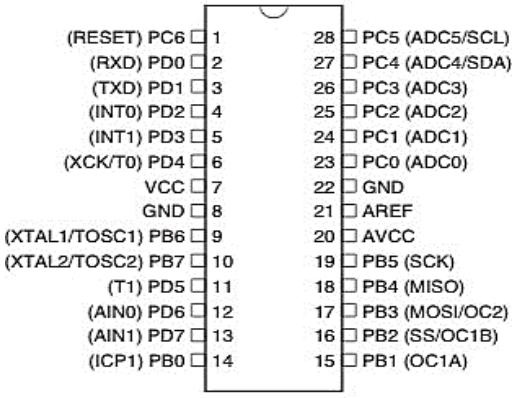

Fig. 3 Pin diagram of ATMEGA328

4.3 ESP8266 Wi-Fi Module

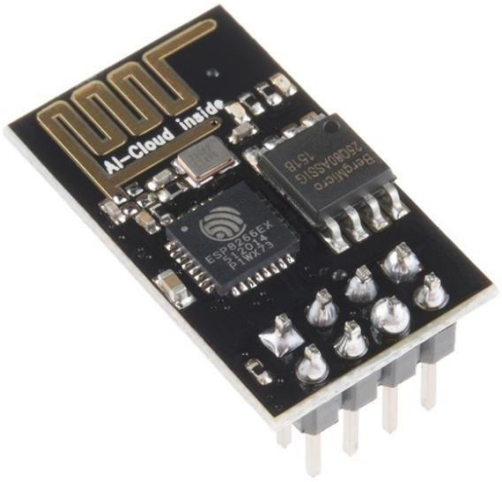

Fig.4 ESP8266 Wi-Fi

The ESP 01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application-specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, which is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the useful links section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution.

Features:

- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- It features an integrated TR switch, balun, LNA, power amplifier and matching network
- Equips integrated PLL, regulators, DCXO and power management units
- Integrated low power 32-bit CPU could be used as an application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms

4.4 BC547-

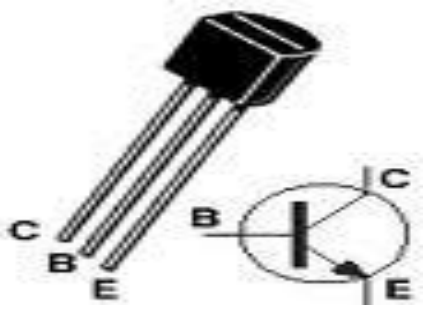

Fig. 5 BC547

- The BC547 transistor is an NPN Epitaxial Silicon Transistor.
- The BC547 transistor is a general-purpose transistor in small plastic packages.

- It is used in general-purpose switching and amplification BC847/BC547 series 45 V, 100 mA NPN general-purpose transistors.
- Whenever base is high, then current starts flowing through base and emitter and afterthat only current will pass from collector to emitter

4.5 LED-

Fig. 6 LED

LEDs are semiconductor devices are made out of silicon. When current passes through the LED, it emits photons as a by-product. Normal light bulbsproduce light by heating a metal filament until itswhite hot. LEDs present many advantages over traditional light sources including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching

4.6 7805 (3 TERMINAL VOLTAGE REGULATER)-

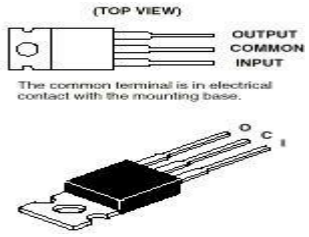

Fig. 7 Pin description of LM7805

Fig.8 View of LM7805

This is used to make the stable voltage of +5V for circuits. The LM7805 is three terminal positive regulators are available in the TO-220 - package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, more information please refer Data sheet of LM7805

4.7 DHT22

Fig.9 DHT 22 Humidity and Temperature sensor

The DHT22 Digital Temperature and Humidity Sensor Module AM2302 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the

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data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old**.** *Simply connect the first pin on the left to 3-5V power, the second pin to your data input pin and the rightmost pin to ground. Although it uses a single-wire to send data it is not Dallas One Wire compatible! If you want multiple sensors, each one must have its own data pin!*

Note: Color of connecting wire may vary. You may get any color while shipping.

Features:

- High precision
- Capacitive type
- Full range temperature compensated
- Relative humidity and temperature measurement
- Calibrated digital signal
- Outstanding long-term stability
- Extra components not needed
- Long transmission distance
- Low power consumption
- 4 pins packaged and fully interchangeable

4.8 Flame Sensor-

2**IR Receiver**

Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. The picture of a typical IR receiver or a photodiode is shown below.

Fig.10 IR Receiver

V CIRCUIT DIAGRAM

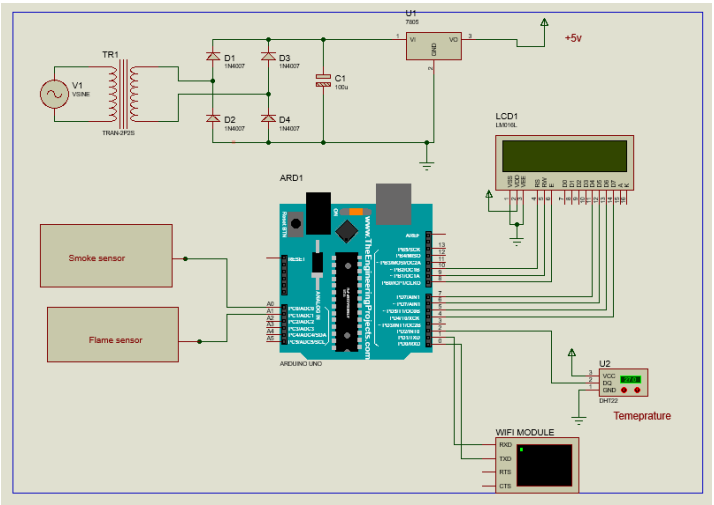

Fig. 11 Circuit Diagram of the system

In this project we have used the full wave bridge rectifier for minimum ripple. Here we have used the three sensors MQ7 for the smoke detection, IR sensor as flam detection and DHT22 for the humidity and temperature sensor. Here we have used the 16x2 LCD

displays which is connected to the Arduino board via 4 data line and 2 cmd line. We have used the serial Wi-Fi ESP8266 which is connected to the Arduino via UART on 9600 baud rate.

VI EXPECTED RESULTS

Smoke detection & Fire safety system will send notification to user and Fire Rescue Department through ESP8266 when temperature detected is greater than room temperature OR MQ2 detected smoke or combustion gases. The buzzer will sound if both sensors is triggered. It also can send signal when low battery, and control by using smartphone's apps for testing buzzer.

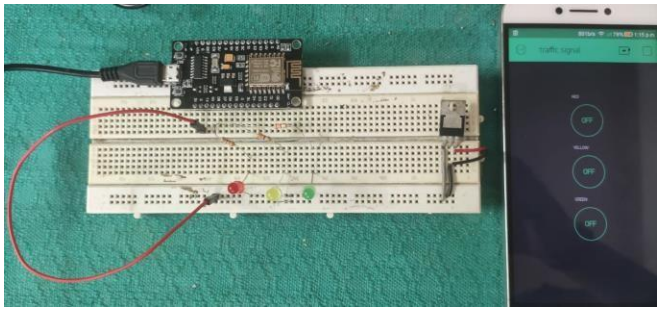

Fig. 11 Breadboard Connection 1

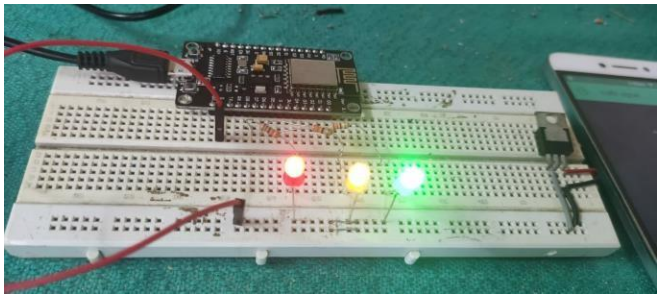

Fig. 12 Breadboard Connection 2

VII CONCLUSION

An advanced system for Fire Detection was developed which overcomes the demerits of the Existing technologies of Forest Fire Detection. It can be ensured that the system developed can be implemented on a large scale due to its promisingresults. Mechanical modelling for accessible and inaccessible areas helps in the easy implementation of the target Area modules.

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