

# Industrial Process Monitoring System Using Esp32

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**ABSTRACT:** Abstract- Today's world is internet world, Internet of Things (IoT) is expanding at rapid rate increasing technology. A network of connected computers hidden in every corner of our life monitoring and controlling things with minimal IOT supports to connect hard ware devices to the internet to process the data for monitoring and security. This system uses ESP32 and sensors helps to monitor the different parameters like temperature, humidity, smoke etc. are accessed and monitored from remote area by cloud computing the data using Blynk and automatically controls the motor or system operation by computer or smartphone. This system is very useful for small scale industry for to achieve maximum throughput and to avoid from accidents by SMS alerts and email, it is a simple, smart monitoring and security system and also tells the importance of IoT in industrial applications. Proposed method very well suitable for small scale industries monitoring and controlling.

**Index Terms—** IOT, Wi-Fi, ESP32, BLYNK, SCADA, Zigbee, Bluetooth;

## I. INTRODUCTION

Now a day's intelligent monitoring system playing a major role in present day to day life. IoT playing a vital role in designing smart and intelligent system in industrial and information technology applications. IoT is a combination of embedded and communications system which interconnects hardware devices to the internet. Industrial monitoring is used to know dynamic condition of industrial devices or machines

In this paper IoT application was implemented to monitor several common parameters used in industries applications such as Smoke, Gas, Fire, Humidity and machine control using IoT. In this proposed system ESP32 Wi-Fi module is used for collecting data from equipment's and transfer it into a wireless internet, parameters are uploaded in the cloud and continuously monitored by the user either mobile using mobile application tool kits or inter net using data clouds. ESP32 is the most advanced integrated circuit with Wi-Fi module in the industry, it consists of inbuilt microcontroller and antenna with less expense. Hence this helps to transfer of data, statistics, logs and various other parameters information among various devices to improve performance, of the system. Industrial process Monitoring system consists of 5 applications, these are Machine Control, Harmful gases level

monitoring, Humidity measuring, Fire and Gas alert detection can be controlled from remote place.

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Trends driving IoT:

1. Moore's law
2. Connectivity
3. Sensors and Actuators

1. Moore's law: Exponential increasing power consumption because of number of transistors in a chip doubled and tripled for every 18-24 months due to evolution in VLSI technology. The Moore's theory predicts that processors and electronic devices used in the IoT applications will become powerful, cheaper and smaller. Sinking of Integrated circuits

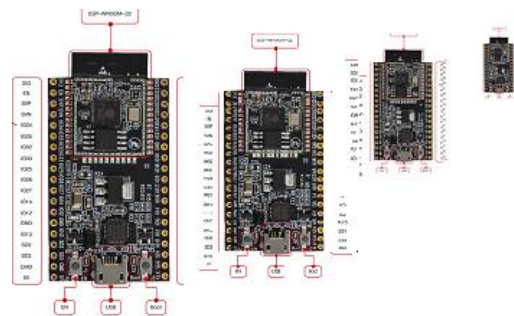


Fig 1: shows Moore's law.

2. Connectivity: By 2020-20 it is expected there will be 30-50 billion connected devices in worldwide,

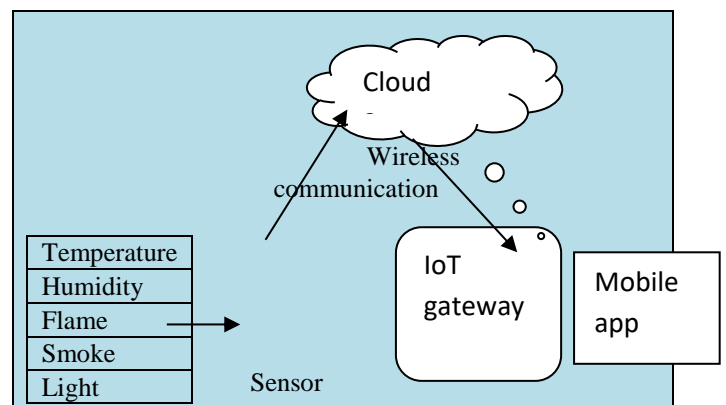


Fig 2: Shows IoT connectivity.

processing can be done by the device itself and part of the processing service on the cloud and utilization of bandwidth and protocol used left the challenge for researchers.

Connectivity controlled from cloud will become simple to operate.

3. Sensors and Actuators: Due to the availability of number of compatible sensors activators. Sensors allow

processors to aware of this environment. Activators are counter parts of sensors allow the processor to do something about the information it has act on through digitally controlled motors, piezoelectric drivers etc.



Fig 3: Shows function of Sensors and Actuators.

Sensors: Detects what happening in the world

Processor: Analyze and process digital data, and sends commands to the actuators.

Actuators: Transforms the data into useful output (visualization/action/response)

Proposed paper consists of 5 modules, II represents related work, III represents proposed method IV related to design and implementation, V and VI describes results and conclusion.

## II. RELATED WORK

Different IoT based applications are used for monitoring and control the systems parameters,

whereas the communication between module and a user is realized via wireless communication techniques such as Wi-Fi, Bluetooth, RF, and ZigBee, programs using SCADA also developed to develop user interface, SCADA are difficult to write and not adaptable to the users because of expensive and excessive libraries, the modules which are implemented using ZigBee, Rf and Bluetooth technologies are widely applicable in easy-to-use applications due to the limited range between the sender and the receiver, and useful for the low data transfer rates and these communication techniques are restricted to simple applications because of their slow communication speeds, distances and low data security because of full range of encryption techniques are not available. Nowadays, timer-controlled systems have been easily replaced with remote controlled systems after the internet became widespread. In these systems, it is known as an important issue to get information about not only the control, but also the conditions of the machines or devices through internet. In accordance with this need, there are some works about implementation of condition monitoring of system through internet and development of internet-based remote controlling or monitoring practices.

Previous implementation “Industrial monitoring system using ESP8266” explains about liquid level monitoring, DC motor speed control, color mixing and energy monitoring using PLCs [3]. “Industrial process monitoring using Raspberry” implemented to measure of light intensity, temperature, liquid level monitoring, system and user are connected by using Wi-Fi module [5].

“Industrial automation using Zigbee” Zigbee system is based on wireless sensor network used for regulating and supervising different processes in industries without distracting other processes [7].

paper on home atomization using IoT. IoT is fore part of this system to minimize human efforts. The main aspect of this system to monitor and control the home appliances

through mobiles [6]. Previous work on “IoT based Monitoring and Control System for Home Automation” explains automation of home appliances. Using mobile phones how devices are accessed using application tool kits, and electrical appliances are operated remotely with less efforts and automatically provides efficient power consumption [4].

Above mentioned work gives knowledge about industrial parameters monitoring from remote area by inter connecting modules to cloud through Wi-Fi, Bluetooth or Zigbee module. Online supervising of industrial process helps to improve throughput, decreases process time and provides security.

Proposed paper was implemented using ESP32.

ESP32 is the advanced device suitable for IoT applications in terms of properties and price. ESP32 available in various versions and user-friendly even students can connect it on bread boards easily for laboratory applications. ESP32-Dev kit is perfect solution for implementation of different education application [1].

In the proposed system related work implemented in smarter way with module using ESP32- Dev module which consists of in-built Wi-Fi Blue tooth module no need to connect external board to provide Wi-Fi, and also consists of inbuilt temperature, touch and hall effect sensor industrial process parameters monitored efficiently from remote area using smartphone by downloading Blynk application program in a smartphone.

## III. PROPOSED WORK

This system is implemented with ESP32-DEV module by interconnecting DC motor and distinctive sensors like temperature, smoke, flame sensor is interfaced to cloud by enabling inbuilt Wi-Fi module of ESP32, the system is connected to the cloud as well as android mobile loaded with Blynk application tool kit. The sensor parameter variation is uploaded to the cloud. Through the Cloud all sensors in the industrial applications are monitored easily and efficiently. In this application is Cayenne project builder is used as cloud and user mobile is connected using Blynk, which is android application tool kit. Blynk can be accessed through mobile or Laptop and also used as the cloud. If the sensor parameters limit exceeds than specified limit motor or load which is connected to the load automatically triggered and informed through SMS or electronic mail to the registered users such application very uses full for small scale industry.

In this system, industrial processes like energy meter monitoring, DC speed control, Temperature, Humidity, Gas levels and Fire accidents if any are monitored through android mobiles, and parameters data can be updated periodically by using cloud.

The basic block diagram for industrial process monitoring using IoT as shown in figure:



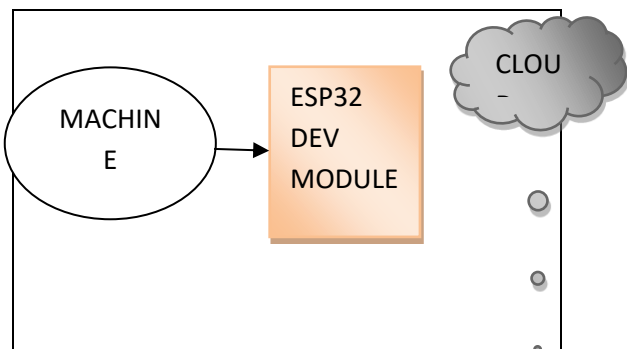


Fig 4: shows master module.

Interfacing of sensors like temperature, smoke sensor, flame sensor, All the parameters that are connected to ESP32 are monitored by IoT, Shown in figure:

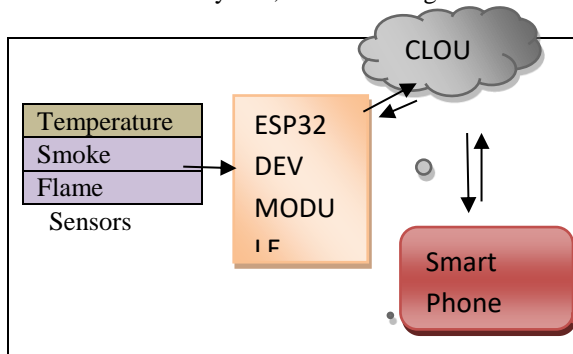


Fig 5: Shows interconnection of sensors to the ESP32 module.

#### IV. DESIGN AND IMPLEMENTATION RESULTS

Hardware and software requirement for prototype module implementation:

- i. ESP32 ii. DC motor iii. DHT11 sensor iv. Smoke sensor v. Flame sensor vi. Bazar vii.4 channel Relay. viii. Blynk Application toolkit ix Arduino 1.8.7 CC x. TuneIoT, Cayenne project builder.

ESP32: ESP32 is a series of low-power, low-cost system on chip. The microcontrollers with pack of Wi-Fi and dual-mode Bluetooth. The ESP32 series employs a microprocessor of type Tensilica Xtensa LX6 available in both single core and dual core variations and includes in-built sensors, antenna switches, RF balun, low noise, power amplifier receiver amplifier, filters and power-management modules. ESP32 is created and developed by Espressif systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40nm process. It is a successor to the ESP8266 microcontroller.

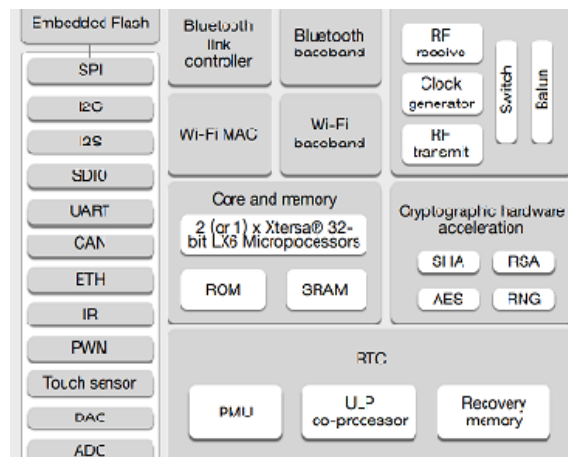


Fig.6: ESP32 module internal organization.

*Flame sensor:*

Flame sensor is sensitive to light intensity, used to identify the flame based on intensity,

in industrial applications to detect fire accidents generally flame sensor embedded with alarm purposes. This module can detect flame in 760nm to 1100nm range of light source. The detection distance is up to 100cm. The detection angle is 60 degrees. Sensor gives output as digital or analog signal.

*Smoke sensor:*

The smoke sensor is based on the free scale semiconductor MC145012DW smoke detector chip. The IC consists of infrared photoelectric chamber. It detects by sensing scattered light from minute smoke particle or it will take approximately 20seconds for relay to fire.

*Temperature sensor:*

Temperature sensors tend to measure heat or temperature in the industrial process, and often used in hazardous environment.

*Humidity sensor:*

Relative humidity in the environment is measured effectively, they measure both moisture and temperature in the air and gives relative humidity as percentage. Most of the humidity sensors are capacitive measurement sensors, moisture from the air collects on the film and causes changes in the voltage levels between the two plates, change in the voltage then converted in to digital measurement.

*Blynk:*

Blynk was specially designed for internet of things applications. It effectively works on android mobiles used to control hardware remotely and displays sensor data.

*components in the blynk platform:*

Blynkapplication tool kit: Allows you to create projects using various widgets available in the control panel.

Blynk server: Which interconnects smartphone with hardware through Wi-Fi or Bluetooth connectivity. Blynk server is an open source, and easily handles thousands of devices.

Blynk libraries: Supports all embedded system popular platforms and enables communication with the server and process all commands.

Programming ESP32:

Arduino IDE:

Arduino IDE is integrated development application written in a java programming language it is a cross platform. IDE supports C and C++ languages also. It is a best platform to develop IoT applications.



Fig 7: Shows tuniot platform.

In this present module TUNIoT is used to generate the code, Tuniot is a visual programming tool used for the ESP32 and ESP8266. ESP32 is a new board library are available under Arduino IDE. Using tuniot it is very easy to write code by using visual drag and dropping different widgets available on the flat form.

overall set of the project with different sensors connected ESP32 sensed values are updated in the cloud.

CAYENNE PROJECT BUILDER:

Cayenne is the world’s first drag and drop IoT project builder, using cayenne it is easy to create custom dashboard with drag and drop widgets, cayenne also used as free cloud, Monitoring can be done both from mobiles and Pc, Notifications can be sent, Various widgets are available.

Module Working:

All the components are placed and assembled accordingly. By using the cayenne cloud application, the hardware components are interfaced with cloud. By using proposed system, the changes in the industrial parameters are monitored and controlled using mobile application as well as PC application. Using the triggers in the cloud we primarily set some threshold values to every sensor, when the sensors detect the values greater than the threshold values, alarming devices will alert us by sending email or SMS to mobile devices. Thereby we turn on the Relay switch by mobile or PC application to turn on the cooling fans. The main advantage of this concept is that we can monitor the changes in the industry from anywhere and can operate them easily without requirement of human beings.

Proposed module connected to the cloud through in-built Wi-Fi module of ESP32 distinct parameters of the sensors

are computed to the cloud, updated values are monitored through smartphone using Blynk application toolkit (BLYNK APP), processed values exceeds the specified limit automatic SMS or electronic mail send to the registered users by the cloud.

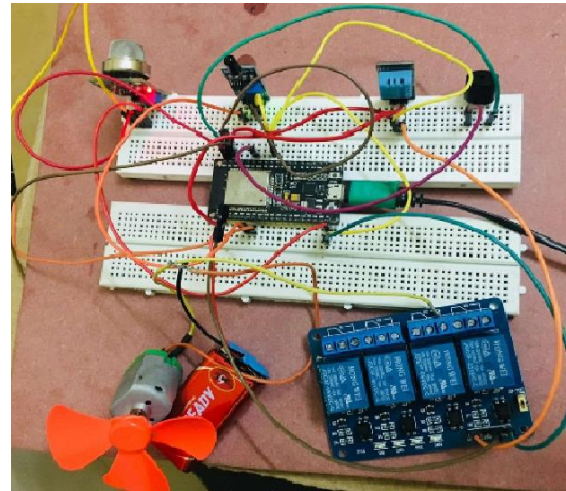


Fig 8: Shows proposed module setup.

Industrial parameters displayed in the smartphone shown in figure:



Fig 9: Shows industrial process parameters.

Timestamp	Device Name	Channel	Sensor Name	Sensor ID	Data Type	Unit	Value
579-03-09-9:54:07	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		270
579-03-09-9:54:07	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:07	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	27.0
579-03-09-9:54:07	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	32.000
579-03-09-9:54:05	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		200
579-03-09-9:54:05	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:05	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	20.000
579-03-09-9:54:05	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	20.000
579-03-09-9:54:04	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		100
579-03-09-9:54:04	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:04	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	10.000
579-03-09-9:54:04	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	10.000
579-03-09-9:54:03	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		100
579-03-09-9:54:03	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:03	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	10.000
579-03-09-9:54:03	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	10.000
579-03-09-9:54:02	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		100
579-03-09-9:54:02	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:02	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	10.000
579-03-09-9:54:02	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	10.000
579-03-09-9:54:01	Device-0227	3	Flame	4B70A8B2-A708-1768-8674-4725886F...	uint8_t		100
579-03-09-9:54:01	Device-0227	2	Smoke	4B70A8B2-A708-1768-8674-4725886F...	uint16_t		1000
579-03-09-9:54:01	Device-0227	1	Humidity	4B70A8B2-A708-1768-8674-4725886F...	float	%	10.000
579-03-09-9:54:01	Device-0227	0	Temperature	4B70A8B2-A708-1768-8674-4725886F...	float	°C	10.000

the updated values are monitored through smartphone using Blynk application toolkit (BLYNK APP) and cayenne project builder.

Proposed module implemented with DC motor and distinct sensors by connecting to the ESP32Dev at different

conditions and displayed and stored in the cloud, monitored and controlled by the industrialist even from remote areas. For example, if industry caught with any fire accident based on the updating values of the sensors (smoke, temperature values exceeds specified limit), machinery or production automatically stopped from the remote area by the responsible person of the industry. These results in the correctness working of the system at every instant of time the values are automatically updated in the cloud.

## V. CONCLUSION

The proposed system, presents the advancement of Internet technology in day to day life. The system is suitable for real time small scale industrial process monitoring and controlling applications. proposed module implemented on ESP32, one of the best solutions to implement IoT applications. The module outline was tried, actualized and the accuracy and working of the system was verified.

Benefits of use IoT in industry:

Elimination of long wiring

Web based remote monitoring

Immediate action on failures.

Ease of maintenance.

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