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Industrial Monitoring and Control Using Internet of Things

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ABSTRACT

The advent of low-power processors, intelligent wireless networks, and low-power sensors coupled with "Big Data" analytics has led to what's become a booming interest in the industrial Internet of Things (IIoT). Put simply, this combination of technologies enables a multitude of sensors to be put anywhere: not just where communications and power infrastructure exists, but anywhere valuable information is gleaned regarding the how, where, or what of a given "thing." In On World's global survey of industrial WSN users, reliability and security are the two most important concerns cited. In this paper the industrial monitoring and control of a coal mine is discussed, where lot of sensors are needed for this industry. In this consideration, the wireless sensor nodes are playing a major role. In this concern the low power compact nodes with enabled Wi-Fi ESP8266 SoC is taken. With this the continuous monitoring and control of these sensor nodes can be done with real time data, attained with good reliability and security.

KEYWORDS: *(IIOT) Industrial Internet of things, ESP8266, Espressif Systems, System on Chip (SoC), Wireless Sensor Network (WSN)*

I. INTRODUCTION

Coal mine Industrial monitoring and control with reliability and security is the major aspect of this paper. Mining Industry requires lot of safety in order to avoid the accidents. It occupies many sensors right from obtaining the coal to the power generation. In order to avoid accidents and to maintain safety the wireless sensor networks are playing major role. Here the sensors are already the power constrained and it has the functions of sensing, processing and communicating to control dashboard. In this paper, IIOT the low power ESP8266 is interfaced with the sensor and it has the on-chip WIFI, so it can be communicated to the network.

The sensed real time data is send to the cloud and it can be accessed through a system or by a mobile phone. This is through Thing speak; it is an online platform to build Internet of Things. It has inbuilt channels and API to build Internet of Things. Each and every sensor is having an IP that means the each sensor is connected to an individual ESP8266. This gives an individual IP to each sensor and that is been shared to cloud. Then, it can be accessed through the any smart phone or a system using the thing speak channel link.

A prototype of Industrial monitoring and control system is implemented with two sensors and with cloud framework. Through this the cost of low power sensor node is reduced and the safety in coal mine is ensured by avoiding accident and through the complete monitoring control of sensors in anywhere, any time by mobile phones

II. RELATED WORK

Manan Mehta [1] tells about the features and uses of ESP8266 WIFI serial module. It shows the opportunities of the projects in Internet and gives

ideas to research and development of this technology. The importance between WSN and the IOT is shown briefly in this paper.

Zhengguo Sheng [2] and his teams in IEEE members provide us the impact of efficient management towards IOT in Industrial wireless sensor networks. It gives the overview of Industrial ecosystem, technical architecture and managing the WSN in an infrastructure.

Cheng Bo [3] described about the safety in coal mining. It is explained with the WoT monitoring platform that achieves timely monitoring and system which operates in REST based framework.

Vaibhav Pandit [4] gives the different environmental parameters of underground mine. The system explained with ARM7 and ZigBee to monitor the deadly gasses in the atmosphere along with temperature and humidity.

N.Krithika and R. Seethalakshmi [5] explains about the safety schemes in coal mining industry. The system is to track and alert via voice command that forms a complete protective system for underground labors. It involves with various sensors.

Shanzhi Chen [6] and his team explain the applications, challenges and opportunities with china perspective. They discussed the opportunities and prospect of IoT.

III. Proposed Solution

This section describes about the coal mine monitoring and control system and all the requirements both software and hardware is described briefly in this section. It consists of three parts. First one is coal dumping yard data gathering through sensors. Second one is position of the conveyer's data gathering through sensors. Third one is real time data collected and monitored in mobile phone through Internet.

The proposed solution block diagram is shown below:

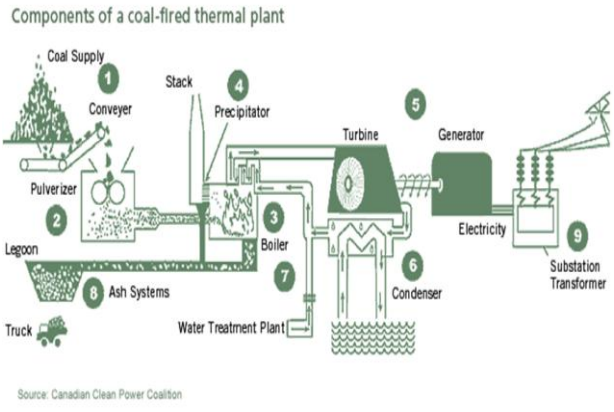

Figure1: Overall System Architecture

A. Architecture of coal dumping yard section:

As shown in figure 1 the coal supply is the dumping yard section. In this coal is collected and is supplied as per the demand. The coal can withstand the temperature of 45 degree Celsius. If it exceeds the coal will automatically burns and the raw material will get wasted. And also the industrial safety is taken in to an account, the temperature of the coal dumping yard needs to be get sensed, if it exceeds the temperature, automatically the water spreader is activated and the temperature is reduced. For this sensor implementation the temperature sensor is interfaced to ESP8266 and with the help of Think speak the continuous monitoring and control can be done by anywhere, anytime.

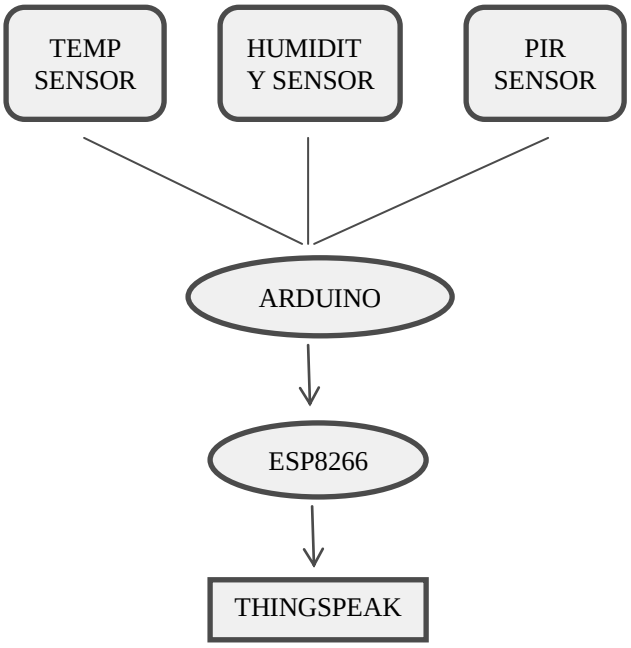

Figure 2: Proposed System Architecture

B. Conveyors section:

Second the position of the conveyors is considered as most important issues, where in the coal industry the raw material is generated in an area and the power is generated in another area. In this case the coal moved through conveyors to the power plant. If its position got changed, then it causes in production delay. In order to avoid this PIR sensor is placed and it is connected to ESP8266.

C. Controlling Section:

Each sensor in the industry is connected to the ESP8266. As a prototype three sensors are taken

and it is connected to ESP8266. Through this the IP is generated and this is shared to Thing speak. Thing speak is the online tool to develop the IOT. Here the IP is shared and channels are created in thing speak and also templates can be created as user defined. Then it can be accessed via smart phone through internet. Through this the continuous monitoring and controlling can be done.

IV. Proto Type

The prototype is designed via Arduino. The sensors named DHT22 Digital sensor, PIR sensor are connected to Arduino since it has more GPIO pins. Then the ESP8266 is connected to the Arduino to get single IP for all the sensors.

Although the ESP8266 is capable of connecting the sensors and it requires a dedicated 3.3v. This can be done by FD232 serial converter. But as a prototype the Arduino is consider being more comfortable to connect the dedicated voltage.ESP8266 has many versions with different firmware. In this project ESP-01 is used and it has totally 8 pins. The pin ESP-01 is shown below in figure 3.

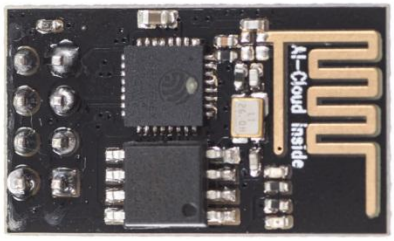

Figure 3: ESP-01

The connection between ESP-01 and Arduino is shown below in figure 4. Arduino is an open source microcontroller board. Here it used to read sensors and that data is communicated through ESP to Thing speak. By sharing the API of Thing speak, the sensed data can be monitored and controlled through smart phones.

ESP8266 ESP-01	Arduino UNO
TX	Pin 1
RX	Pin 0
CH_PD	3.3V
RST	Unwired
VCC	3.3V
GND	GND
GPIO2	Unwired
GPIO0	Unwired

Coming to the sensors, the DHT 22 has four pins, Vcc, Data, NC, GND. It is a digital temperature and humidity sensor with good accuracy. PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. PIRs are basically made of a pyro electric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted.

V. Implementation

We had tested our prototype with two sensors temperature and humidity and PIR sensor because thinking in mind about the cost factor. Here the Arduino is having both 5v and 3.3v.So the connecting the ESP to the Arduino is comfortable. The Prototype result of Arduino with ESP is shown in figure 5.

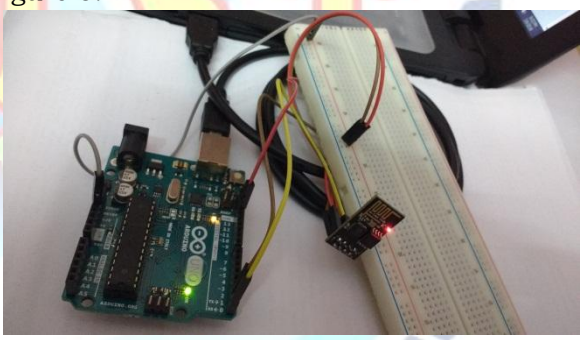

Figure 5: Arduino with ESP 01

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. Here we are using the version of Arduino 1.06 for the programming the libraries are more important. We can program ESP8266 native code or use ESP8266 Node MCU. But there is a better way. Recently there was released ESP8266 Arduino IDE. We can program ESP8266 directly in Arduino IDE. That's how we will get Arduino simplicity and power of ESP8266. The DHT 22 sensor has a high accuracy with data pin. The sensed data is send to Arduino and it is getting communicated through a SoC called ESP 01.This will have an unique IP address, and this is updated to the website that can be accessed by a smart phone. The prototype connection diagram of sensor is shown below in figure 7.

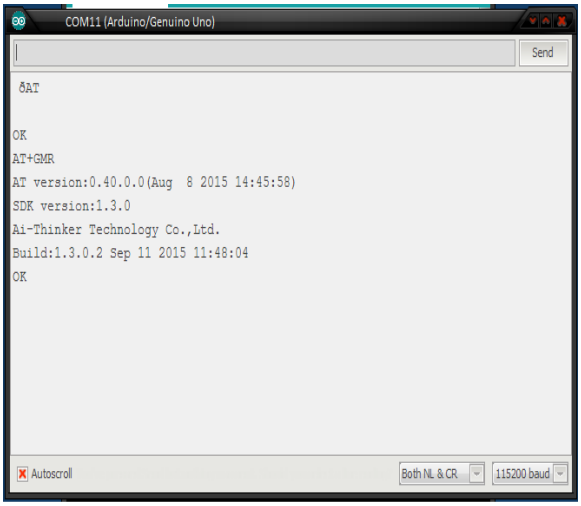

Figure 6: Firmware version

To operate with this the firmware in ESP 01 is playing a major role. There are plenty of firmwares in market, but the compatibility is important. This is shown in figure 6 Espressif released a software development kit (SDK) that allowed the chip to be programmed, removing the need for a separate microcontroller. Since then, there have been many official SDK releases from Espressif; Espressif maintains two versions of the SDK — one that is based on RTOS and the other based on callbacks.

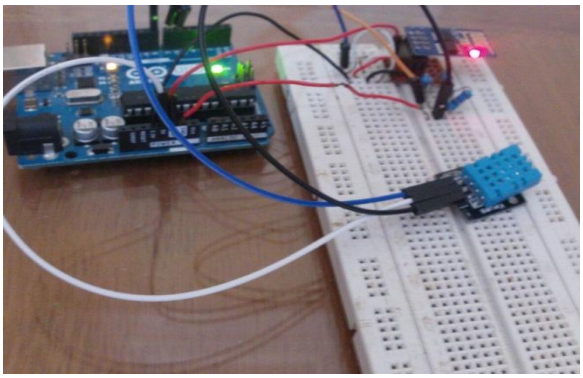

Figure 7: Sensor interfacing

By sharing the API to the code, the program will get accessed to the template. The sensed data is been shown as a simulation result in figure 8.

Figure 8: Simulation result

VI. Conclusion and Future Work

In this project we tested the prototype and the results are shown. Thus the implementations of low power wireless sensor node for coal mine is done and it is been monitored and controlled by the template created by the think speak and it can be accessed by the smart phone.

In future the security can be more ensured, but it technologies depend, since it uses internet. The light weight gateways can be designed with more effective manner.

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