Industrial Data Logging System Based on Internet of Things

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ABSTRACT

IoT is the network of physical objects or things embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.IoT has given us a promising way to build powerful industrial systems and applications by using wireless devices, Android, and sensors. This model is proposed for developing a data logger system which will automatically monitor the industrial applications and generate Alerts/Alarms or take intelligent decisions using concept of IoT and it enables to monitor the data of all industrial applications in a centralized location rather than monitoring individual systems in an industry, Thus reducing the time and cost in monitoring the industrial applications. It monitors the parameters concerning the correct operation and the efficiency of the systems in industries.

1. INTRODUCTION

The Internet of Things (IoT) provides a promising way to develop industrial applications.Integrates with embedded systems to make use of sensors and actuators. Industrial platforms have been under increased pressure due to loss of productivity and increase in workforce. IoT applications can be introduced to further enhance industrial platforms and helps to improve productivity and reduce workforces by centralizing the data.

1.1 EMBEDDED SYSTEMS

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today.

Modern embedded systems are often based on microcontrollers (i.e. CPUs with integrated memory or peripheral interfaces),but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more-complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP).

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations

like traffic lights, factory controllers, and largely complex systems like hybrid vehicles, MRI, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

1.2 CHARACTERISTICS

Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

Embedded systems are not always standalone devices. Many embedded systems consist of small parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.[1] The program instructions written for embedded systems are referred to as firmware, and are stored in read-only memory or Flash memory chips.

1.3 USER INTERFACE

Embedded systems range from no user interface at all, in systems dedicated only to one task, to complex graphical user interfaces that resemble modern computer desktop operating systems. Simple embedded devices use buttons, LEDs, graphic or character LCDs (HD44780 LCD for example) with a simple menu system.

More sophisticated devices which use a graphical screen with touch sensing or screen-edge buttons provide flexibility while minimizing space used: the meaning of the buttons can change with the screen, and selection involves the natural behaviour of pointing at what's desired. Handheld systems often have a screen with a "joystick button" for a pointing device.

Some systems provide user interface remotely with the help of a serial (e.g. RS-232, USB, I²C, etc.) or network (e.g. Ethernet) connection. This approach gives several advantages: extends the capabilities of embedded system, avoids the cost of a display, simplifies BSP and allows one to build a rich user interface on the PC. A good example of this is the combination of an embedded web server running on an embedded device (such as anIP camera) or a network router. The user interface is displayed in a web browser on a PC connected to the device, therefore needing no software to be installed.

1.4 ELEMENTS OF EMBEDDED SYSTEMS

1.4.1 Hardware

Core element of an embedded system is the processor or a computational unit. Processors can act as brain of the system. They can be programmed to do perform a task. This can be designed using variety of options.

1.4.2 General Purpose Microprocessors

General purpose microprocessors are single chip semiconductor device which is a computer on chip, but not a complete computer. Its CPU contains an Arithmetic & Logic Unit (ALU), a Program Counter (PC), a Stack Pointer (SP), registers, a clock and interrupts circuit on a single chip. To make complete microcomputer, one must add memory usually ROM and RAM, memory decoder, an oscillator, a number of serial and parallel ports

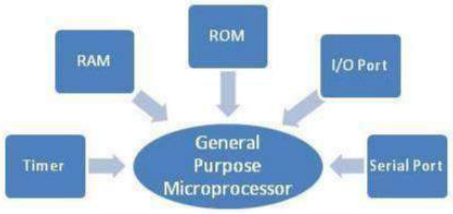


Figure 1 General purpose microprocessor

A general-purpose processor is designed to cater for large amount of applications and hence is produced in bulk. Using it in an embedded system offers various benefits. Design time is low as only software is to be developed, no digital design is involved. Typical characteristics of a general purpose processors are relatively high cost, high speeds, higher Power consumption, large architecture, large memory size, onboard flash and cache, an external bus interface for greater memory usage.

1.4.3 Microcontrollers / Embedded Processors

A microcontroller is a functional computer system-on-a-chip. It contains an integrated processor, memory (a small amount of RAM, program memory, or both), several peripheral devices, such as timers, analog to digital converters, and serial communication devices all on one chip resulting in compact and low-power implementations. It is not expandable as it has no external bus interface. Examples are PIC DSPIC33 / PIC24, Mot 8051.

Typical characteristics of a microcontroller are: Low cost, Low speed, Low Power, small architecture, Small memory size, Onboard Flash, Limited I/O.

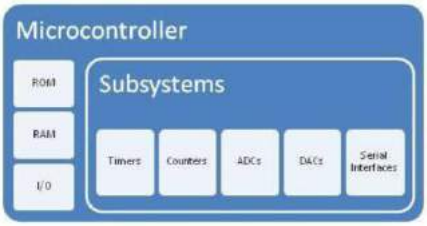


Figure 2 Microcontroller Architecture

Microcontrollers provide pin access which allows programs to easily monitor sensors, set actuators, and transfer data with other devices. Providing specialized instructions improves performance for embedded systems applications; thus, microcontrollers can be considered ASIPs to some degree. Special microcontrollers are often called embedded processors. The difference between a microcontroller and an embedded processor is not clear, but processors with large architectures with fast processing, fast context-switching & atomic ALU operations are marketed by many vendors as embedded processors. Examples of embedded processors are ARM 7, INTEL i960, AMD 29050.

2. LITERATURE REVIEW

Literature review was carried out throughout the entire project to gain knowledge and improve the skills needed to complete this project. The main sources for this project are previous related projects, research thesis, books, journals and online tutorials. This chapter focuses on the basic concepts and all fundamental theories which

related to this project and the drawbacks of the current system.

2.1 USAGE OF WIRELESS SENSOR NETWORKS

Wireless sensor networks saw its dawn when the World needed a revolution. The circuitry for each assembly proved to be quite difficult because of the lack of scalability and the inability to accommodate more wires into a single system.The Throughput in this case was high enough while considering the fact that the sensors deployed here are wireless. But the system did not match the expectations of implementation in a vehicle that is a result of some serious cost cuts. Moreover, the image sensors are globally known for its ambiguity and its lack of reliability.

Thus these were the problems that were encountered, which proved to be a mismatch for the core idea behind the proposed project. Moreover, a proper formula had to be used to detect the distance between the obstacles. So, a cost efficient technique had to be used in order to make a real time implementation to facilitate the IoT domain.

2.2 BLIND SPOT DETECTION BASED ON VISION SENSORS

Blind spots are the areas which are not visible to the driver via the rear view mirrors of a vehicle unless the driver performs a shoulder check. This may cause a huge accident while changing lanes in a highway because the driver is unaware of the action that is exactly 45 degrees from his/her shoulders. A wide range of lenses and image sensors have already been used by luxury car makers like Audi and Volvo to make the vehicle much safer in terms of blind spots.

The implementation of this system was quite complex and was touted to be unsuitable for vehicles that are on the budget end of the market. Vision sensors needed image processing techniques for the detection of the blind spots. Though the results produced are very accurate, it does not help the case of simple implementation.

2.3 WIRELESS HOME AUTOMATION USING VARIOUS SENSORS

Home automation is the process of controlling home appliances automatically using various control system techniques. The electrical and electronic appliances in the home such as fan, lights, outdoor lights, fire alarm, kitchen timer, etc., can be controlled using various control techniques. This model involves in controlling the devices over the internet using wifi module. The implementation of this system lacks in data monitoring for further enhancement in productivity and also in data centralization.

3. DESIGN METHODOLOGY

3.1PROBLEM STATEMENT

Most of the industries face the problem of losing the productivity due to the negligence of work force. Certain vital parameters are not noticed until critical situation occur. The important problem faced in the industry is that they do not have a single screen control center for overall machines.

3.2 METHODOLOGY

The key methodology is to provide an improved productivity to monitor the workforce and to regularize the machinery

management and check errors. Reduction in workforce cost cutting and centralized data management, reduction in maintenance cost

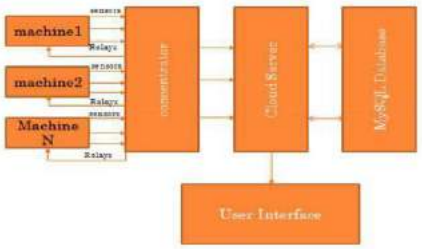


Figure 3 Model architecture

3.3 MERITS OF PROPOSED EMBEDDED SYSTEM

Unlike conventional method, it provides a mechanism to terminate the system in case of emergencies prior to the happening of any damage with the help of relays. It provides data centralization which reduces the time to monitor the system rather than monitoring individual systems. It makes use of various sensors to study the overall functioning of the industrial systems and provides the accurate and reliable data to the user.

4. HARDWARE SYSTEM DESIGN

4.1. PCB- PRINTED CIRCUIT BOARD

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer (outer and inner layers). Multi-layer PCBs allow for much higher component density. Conductors on different layers are connected with plated-through holes called vias. Advanced PCBs may contain components - capacitors, resistors or active devices - embedded in the substrate.

Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require the additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part. Furthermore, operator wiring errors are eliminated.

4.2 DESIGN:

Initially PCBs were designed manually by creating a photo mask on a clear mylarsheet, usually at two or four times the true size. Starting from the schematic diagram the component pin pads were laid out on the mylar and then traces were routed to connect the pads. Rub-on dry transfers of common component footprints increased efficiency. Traces were made with self-adhesive tape. Pre-printed non-reproducing grids on the mylar assisted in layout. To fabricate the board, the finished photomask was photolitho graphically reproduced onto a photoresist coating on the blank copper-clad boards.

Modern PCBs are designed with dedicated layout software, generally in the following steps Schematic capture through an electronic design automation (EDA) tool. Card dimensions and template are decided based on required circuitry and case of the PCB. The positions of the components and heat sinks are determined. Layer stack of the PCB is decided, with one to tens of layers depending on complexity.

Ground and power planes are decided. A power plane is the counterpart to a ground plane and behaves as an AC signal ground while providing DC power to the circuits mounted on the PCB. Signal planes can be on the outer as well as inner layers. For optimal EMI performance high frequency signals are routed in internal layers between power or ground planes.

Line impedance is determined using dielectric layer thickness, routing copper thickness and trace-width. Trace separation is also taken into account in case of differential signals. Microstrip, stripline or dual stripline can be used to route signals. Components are placed. Thermal considerations and geometry are taken into account. Vias and lands are marked. Signal traces are routed. Electronic design automation tools usually create clearances and connections in power and ground planes automatically.

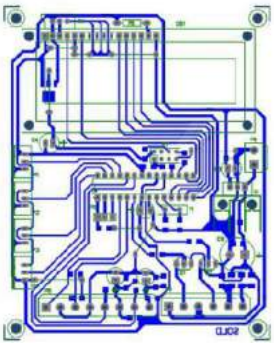


Figure 4 PCB top layer with bottom overlay

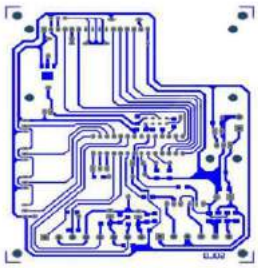


Figure 4.1 PCB bottom layer with overlay

5.Wi-Fi MODULE:

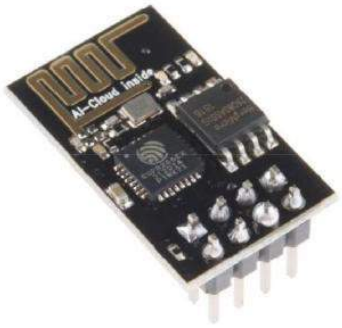


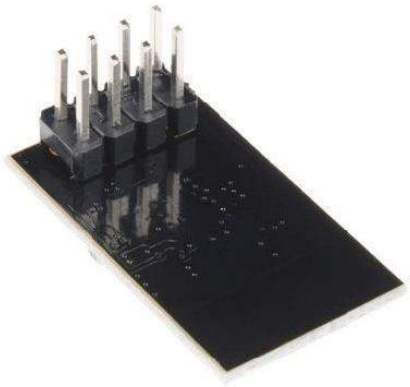
Figure 5 WiFi module side view

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi 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 WiFi- just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

5.1 Wifi module top view

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, 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.



5.2 Wifi bottom view

5.2 DATABASE SCHEMA DESIGN

5.2.1 MySQL:

MySQL is an open-source relational database management system (RDBMS) in July 2013, it was the world's second most widely used RDBMS, and the most widely used open-source client server model RDBMS. It is named after co-founder Michael Widenius's daughter, My. The SQL abbreviation stands for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. the Swedish company MySQL AB, now owned by Oracle Corporation. For proprietary use, several paid editions are available, and offer additional functionality. MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open-source web application software stack (and other "AMP" stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python". MySQL is also used in many high-profile, large-scale websites, including Google (though not for searches), Facebook, Twitter, Flickr, and YouTube. On all platforms except Windows, MySQL ships with no GUI tools to administer MySQL databases or manage data contained within the databases. Users may use the included command line tools, or install MySQLWorkbench via a separate download. Many third party GUI tools are also available. This model creates the following types of table for various purposes

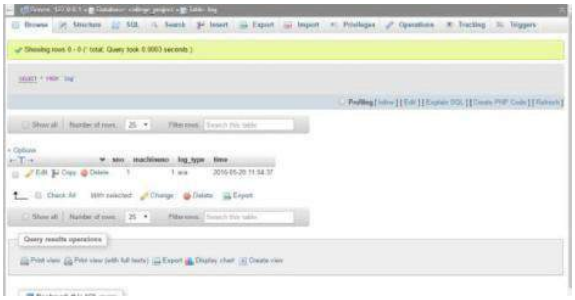


Figure 5.3 Event log table

Fig 5.3 depict the logs created during the occurrence of an event.It provides the entire events happened on the system

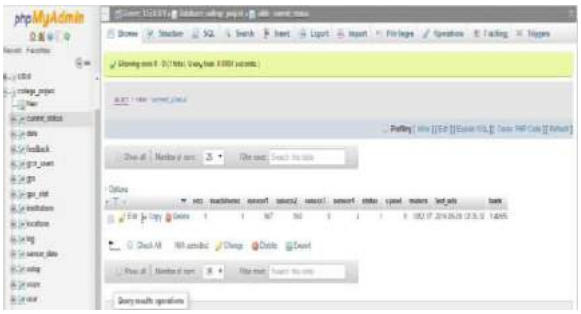


Figure 5.4 live information table

Figure 5.4 depicts the usage of live information table to display the current details of all the sensors. It provides all the necessary parameters of the sensors.

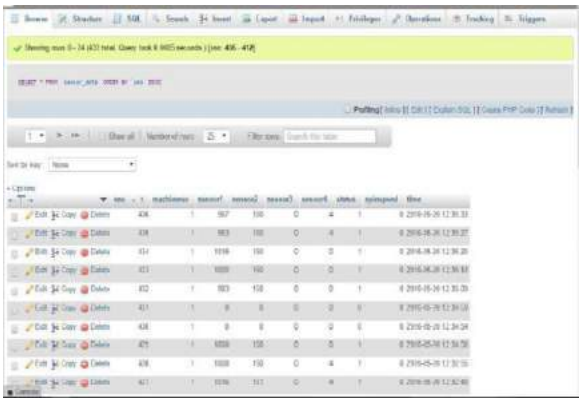


Figure 5.5 analytical data table

Figure 5.5 depicts the usage of analytical data table. It provides the historical data of all the sensors. This gives the clear view of the entire status of all the sensors from the beginning

6. CONCLUSION AND FUTURE SCOPE

The Industrial data logging system fetches the data from the machine using sensors and centralize it. Future enhancement involves in integrating into android platform with the help of cloud access and also for providing a detail productivity analysis. This report depicts the productivity of the industry in a convenient manner

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