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Smart Hospitals Using Internet of Things (IoT)

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Abstract: Most of the time, due to negligence of hospital staff, excessive number of patients or inattentiveness of relatives it may happen that saline bottle is not monitored properly and it may lead to cause heart attack due to "AIR EMBOLISM". In a hospital, number of electrical equipments (fan, lights) is more so energy is more. Thus, it is important to use electricity as per the requirement. Thus, in this paper we have proposed a system which include combination of sensor technology and Internet of Things (IoT).Using this system one can control switch of the electricity and monitor level of the saline bottle from distant position.

I. INTRODUCTION

The project is based on the Internet of Things by which we can solve the problems related to hospitals. In a hospital, there is excessive use of electricity used by light, fans and various medical appliances. One of the biggest causes of excessive energy use in hospitals comes from amount of electrical equipment, lighting, and electronics and how often it is left ON when not needed.

The primary environmental effect of energy overuse is an increase in carbon footprint, but there are simple changes we can make to avoid this. For example, if the devices are kept running when they're not in use, the result is an increase in electrical use and, consequently, a bump in the amount of greenhouse gases that enter the atmosphere. This module helps to control consumption of electricity

One more important problem related to hospital is nurse or hospital staff needs to constantly monitor the level of saline bottle. So ,it may happen that due to the negligence of the hospital staff or due to more number of patients and inattentiveness, saline bottle may not monitored properly which can lead to the death of the patient. This can happen when saline bottle is fed completely to the patient and when it is not removed then due to the pressure difference between the patient's blood flow and empty saline bottle; blood can causes outward flow of blood into saline bottle.

In this system using IoT, one can control switch of the electricity and continuously monitored the level of the saline bottle from the distant position.

II. BLOCK DIAGRAM

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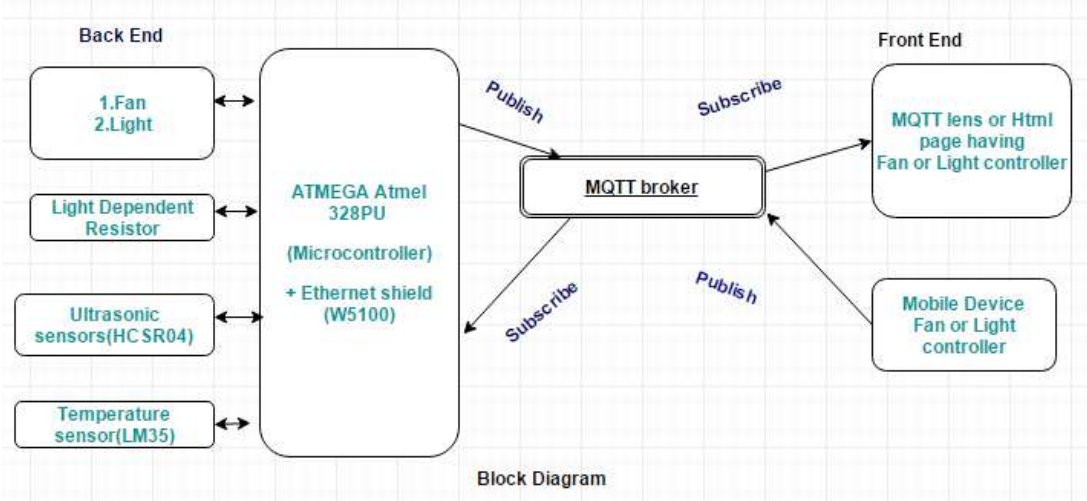


Block Diagram

In the above block diagram, there are three parts which as follows:

1. Back End which includes fan, light, ultrasonic sensor etc.
2. Arduino mega (ATMEGA Atmel328PU) +Ethernet shield (W5100)
3. MQTT broker as a cloud server
4. Front end which includes html page or mobile device having MQTT lens application which includes switch controller for fan and light.

In this system, ultrasonic sensor, light dependent resistor and temperature sensor is interfaced with arduino mega board (AT mega Atmel 328PU). This Arduino mega board is connected to MQTT server via Ethernet cable. This will provide connectivity to the server to transmit the data on to the internet. This data then monitored arbitrarily using mobile device or by using MQTT lens application

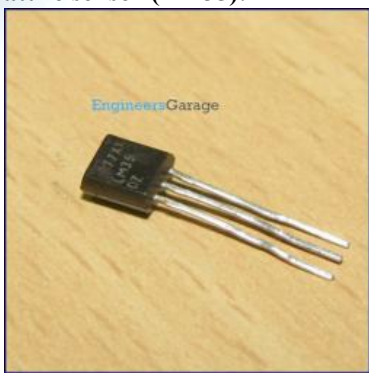
III. Working Methodology

In the above system sensor will acquire the data from the surrounding that is temperature sensor will constantly monitor the temperature of the patient's room, ultrasonic sensor will monitor the level of saline bottle and LDR (Light Dependent Resistor) will monitor the illumination of a light on it in terms of resistance value. Data acquire by all of the sensors will be transmitted by USB (Universal Serial Bus) which is used for the data transfer to the Arduino mega board. This data is then publishing to the MQTT broker server via Ethernet cable. Whenever one wants to acquire this data then that person has to subscribe to the MQTT server and then hospital staff he/she can monitor the data received. MQTT platform is used to control to the switch which will ultimately control electrical appliances (fan, light etc.).

Whenever temperature of the patient's room increases above predefined level, it will send the data to the page and then from the webpage or from the mobile device. In case of saline bottle, level of the saline bottle continuously sends on to the server so that hospital staff needs not to go to each and every patient's room to monitor it. As soon as the level of liquid in a saline bottle falls below predefined value then nurse can go to the patient's room and change that bottle.

IV. Components Required

4.1 Temperature sensor (LM35):



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The LM35-series devices are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The features of the LM35 make it suitable for many general temperature sensing applications.

4.2 LDR (Light Dependent Resistor):

LDR sensor has two cadmium sulphide photoconductive cells (cdS) with spectral response similar to that of the human eye. The cell resistance will fall with the increasing light intensity. Its application includes smoke detection, automatic lighting control system, and batch counting and burglar alarm systems. Light dependent resistors have property to store the lighting conditions in which they have been stored. Light storage reduces equilibrium time to reach steady state resistance values.

4.3 Ultrasonic sensor (HC-SR04):

2cm-400cm non contact measurement function. Ranging accuracy may reach 3mm.

The basic working principle of Ultrasonic sensor is as follows:

a)Using IO trigger for at least 10us high level signal.

b)The module automatically sends eight 40kHz and detect whether there is a pulse signal back.

c)If the signal back ,through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time × velocity of sound(340M/S)/ 2)

Ultrasonic sensors module includes ultrasonic transmitters, receiver and control circuit. It provides

4.4 AT mega Atmel 328PU

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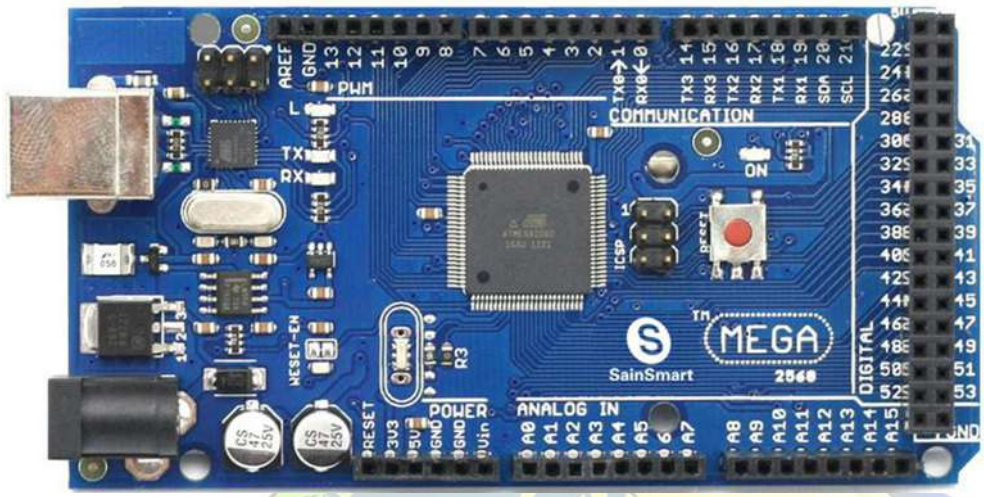

The AT mega Atmel 328PU is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle AT mega Atmel 328PU achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. Power saving is the major important factor. It is easy to do coding for the arduino board as various libraries are available to use in the code.

4.5 MQTT protocol

In this system use of MQTT protocol has been used because it has advantages over http protocol. This protocol gives faster response output. It has lower battery and bandwidth consumption. It works efficiently enterprise level applications which include transfer data to server or to mobile application. It assures data transmission and efficient distribution. It is suitable for constrained environment than http. It is a light weight publishes and subscribes protocol and runs on IP. It is open standard protocol.

V. Results and Conclusion

In this project, Smart hospital using Internet of Things (IoT) has been successfully designed. This project is highly energy efficient as it uses arduino board having microcontroller (AT mega Atmel 328PU) which having low power utilization. It also uses MQTT networking protocol which is a light weight protocol and helps in power saving. We do not need to manually turn ON or turn OFF the switch of the light. It is possible to control the switch from a webpage or from the mobile application. This system is a time consuming. It will save patient from the risk of "AIR EMBOLISM" .It is user friendly system. Maintenance of this project is not costly.

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BIOGRAPHY

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