

IoT based System for Smart City

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Abstract - Recently, population is increasing day by day, which gives in lack of public awareness of healthy environment. This has been creating a health issues all over the world .The world is increasingly getting smarter and looking for secure, perception and smart conclusion of resource optimization to increase quality of consumer life. This necessity has led to the development of smart and safe cities connecting the virtual world to the physical, bring real-time services that modify to real-time situations based on IOT technology. This system uses various sensors for monitor of infrastructural facility in a city. System sensor connected ATmega16 microcontroller using wireless communication technique. Controller collects the information from sensors transfer to the internet through Wi-Fi module, it display on monitor in the web application designed for this system.

Key Words: Arduino Board, smart city, power saving, waste management.

1. INTRODUCTION

This project is totally based on Microcontroller and on wireless module which is wi-fi module, with the help of this we are trying to implement to build up a city as a smart city. In our city many times we see that the garbage bins or dustbins placed at public places are overflowing. It creates unhygienic conditions for people. So by keeping this in mind we have built up a garbage level detection system. Also some of the most prominent problems facing the world today are wastage of power. Governments and scientists across the globe are working day and night in order to bring these problems under control. This project gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated.

The present system is like, the street lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. The Noise sensor is also used in this system to monitor the amount of noise pollution in the environment of that city. This Noise sensor provides the data to the microcontroller as per the measurement of noise. A gas sensor MQ135 is also used in the system to monitor the air pollution in the surrounding. The sensor sends all the data to the microcontroller, the microcontroller compares and sends the processed data over the internet.

2. METHODOLOGY

The block diagram and circuit diagram for that project is as follow

2.1 BLOCK-DIAGRAM

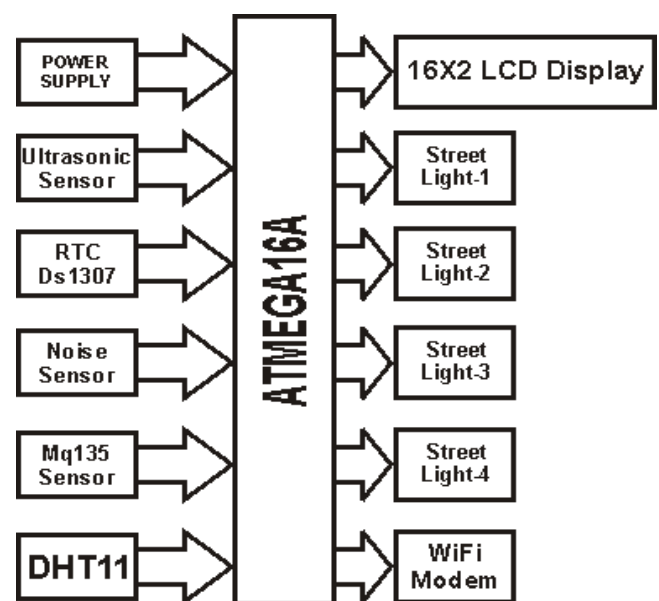


Fig.1: Block diagram of IoT based system for smart city

The above block diagram AVR based Atmega16A microcontroller is used to perform the mentioned function of the system. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. The AVR core combines rich instruction set with 32 general purpose working registers. The circuit components in the system require the power supply for their desired function. This power is supplied by the power supply unit in the system. Power supply unit provides regulated 5v and 12v DC supply as per the requirement of the component. An ultrasonic sensor is implemented on the top of the dustbin to monitor the level of the garbage in the dustbin and to check whether the dustbin is full or overflow. This sensor is interfaced with the microcontroller to provide the monitored data to it for further processing. A MQ135 sensor is used in this system and interfaced with the microcontroller as shown in the above architecture of the system. This sensor is used to detect and monitor the pollution in the environment that is to monitor air quality. This sensor detects the sound intensity. And it gives respective voltage output to the microcontroller. This sound

sensor provides the signal to the microcontroller after sensing the high intensity in the surrounding. The hardware of the system consists of a RTC which is used to set the time for the street light switching system. Here we have used DS1307 real time clock IC for the above mentioned purpose. This RTC is interfaced with the microcontroller by I2C protocol. For the demo purpose we have used 4 LED lamps as street lights and these are interfaced with the microcontroller and are controlled by the microcontroller as per the timing set by the user. The hardware of the system also consists of a DHT 11 sensor which used to monitor and sense the temperature and humidity in the surrounding area. This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. All the monitored parameters and status of the street lamps will be displayed on a LCD display. This is a 16x2 LCD display interfaced with the microcontroller for the above mentioned function. This display will show the values of the temperature, humidity, sound intensity and air quality in surrounding monitored by the sensor network in the system. All the parameters are also sent over the internet for the remote monitoring and controlling through wi-fi module interfaced with the microcontroller as shown in the architecture of the system above. Here we have used an ESP01 Wi-Fi module for this wireless data transmission.

2.2 CIRCUIT DIAGRAM

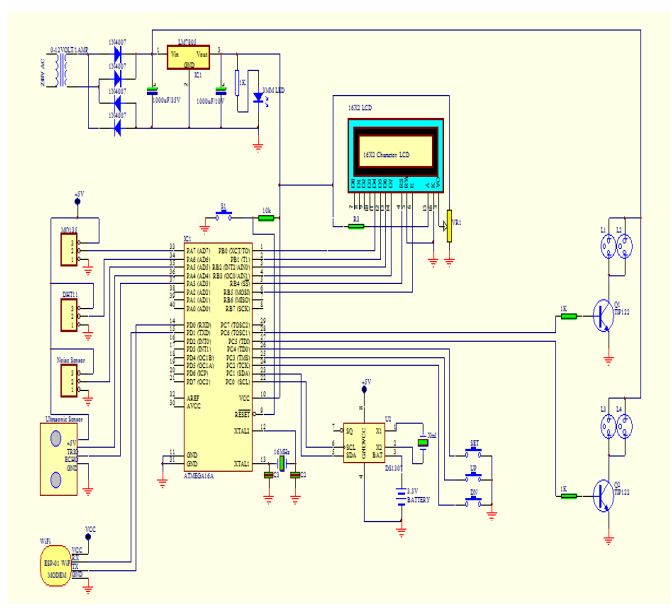


Fig. 2: Circuit diagram of IoT based system for smart city

The above diagram represents the circuit implementation of the farm automation system. In this system all the circuit components require regulated power for their working functionality. To fulfill this requirement of the circuit we have designed a power supply unit to provide regulated power supply to the circuit components. The supply is provided through mains i.e., 230v. The supply is stepped down to 12v from 230v through transformer. Hence at the secondary terminal of the transformer we get 12v AC. This AC output of the transformer is converted into DC with the help of the full bridge rectifier. The output of the rectifier is 12v DC. This 12v is provided to the regulator IC. This regulator IC used is LM7805. The input to the regulator is provided at pin no 1 of the regulator and the output is taken out at pin no 3 of the regulator IC. The ground is provided at pin no 2 of the regulator. The 5v from one IC is provided to the controller. An LED is connected in between the regulator and the controller to indicate whether the power is on or off. The capacitor at the input and the output of the regulator is used to remove the ripples in the signal i.e., this are filter capacitor. Circuit implemented consists of a microcontroller to control the complete circuit action of the unit and to collect the data from the sensor network, process the data and to transmit it to the controlling android device. To complete all these functions we have used an ATMEGA16A microcontroller in this work. This microcontroller requires regulated 5V power supply for its operation. This power supply is provided by the power supply unit in the system. Generally controller works on a stable frequency to produce machine cycles to execute the firmware stored in the memory. To obtain this frequency an external oscillator is connected to the pin number 12 and 13 i.e. OSC1 and OSC2 of the controller IC as shown in the circuit diagram of the system. This is a crystal oscillator designed using a 16MHz crystal with two parallel capacitors as shown in the circuit diagram. A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies. A reset switch is connected to the reset pin i.e. pin number 1 of the controller IC. This switch is used to reset the microcontroller during the fluctuation in the power supply or due to any malpractice during its operation. A reset input is used to reset a microcontroller. Resetting puts the microcontroller into a known state such that the program execution starts from address 0 of the program memory. In this system we have used an ultrasonic sensor HC-SR04 to measure the level of the garbage in the dustbin. In this system for demo purpose we have used a single dustbin. To measure the level of the garbage in the dustbin the ultrasonic sensor is mounted on the top of the dustbin. This ultrasonic sensor is connected to the pin number 36 and 37 in port PA of the microcontroller IC. This ultrasonic sensor provides the signal to the microcontroller based on the echo pulse obtained. On the basis of this signal the microcontroller compares and makes decision about the level of the garbage in the dustbin.

In this system we have interfaced a temperature and humidity sensor to monitor the temperature and humidity in the surrounding environment of the farm. To monitor these parameters we have used DHT 11 temperature and humidity sensor. This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. The microcontroller is programmed for the ON and OFF timing of the street lights. As per the program street lights will on at evening say at 7pm. The intensity of the light will be high at this time. The lights will be ON in alternate manner after 11pm to 7am in the morning. And at 7am in morning the lights will be automatically off. After 11 pm only the half street lights will be in ON condition. In this condition the street lights will be ON in alternate manner that is one ON, second OFF, third ON and so on. In the early morning 4am all street lamps will again be turned ON and at 6am all the street lights will be OFF. To turn ON and OFF the street lamps transistor is used and is interfaced in the system as shown in the circuit diagram. To set the time for switching street lamps ON and OFF a real time clock that RTC DS-1307 is used and interfaced with the microcontroller as shown in the circuit diagram of the system. Real time clock has 8 pins out of which SCL and SDA are connected to PC5 and PC4 pins respectively. SCL is serial clock while SDA is serial data. As said before, RTC is I2C compatible, where I2C means inter integrated circuit. One bit of data is transmitted on data bus for each clock cycle. I2C protocol allows one to connect 128 devices. Data can be transferred between devices, using only two bi-directional buses. Each device can act as a slave or master. The slave devices will have one address and these devices can be accessed using this address. To set the time as per the program in the RTC a keypad is interfaced in this system. This keypad consists of 3 switches which are used to increase, decrease and time format that time of day or night. The system consists of a sound sensor used to measure the sound intensity in the surrounding area. The sensor is interfaced with the microcontroller and connected to the pin number 35 in port A of the microcontroller. This sensor provides the respective voltage level to the microcontroller as per the sound intensity. The microcontroller receives the data and compares it with the threshold value and makes decision for sound pollution in area. The system is also designed to monitor the air quality in the surrounding. For this purpose we have used MQ135 sensor and interface it with the microcontroller as shown in the circuit diagram of the system. This sensor is connected to the pin number 33 in port A of the microcontroller. This sensor provides the measured data to the controller, the controller receives the data and compares it with the set value and as per the comparison result the system will intimate for the air

pollution. All the measured data will be display on the LCD display. For this a 16x2 LCD display is interfaced with the microcontroller as shown in the circuit diagram. This LCD display is interfaced in 4 bit mode with the microcontroller. In 4-bit mode, only four data pins of LCD are connected to the controller. This mode, thus, saves four pins of the controller unlike 8-bit mode. In 4-bit mode only 4 bit data is send to LCD. Since 8-bit microcontrollers contains data in 8-bit form so we divide our data in to two nibbles(1 nibble=4-bits). First higher 4-bits(nibble) are send to LCD and then the lower 4-bits(nibble). Only D4,D5,D6,D7 data pins of LCD are used in 4-bit mode. D1, D2,D3,D4 are left empty. D4 is our least significant bit and D7 is Highest significant bit. All the measured data and parameters by the system will send over the internet through wi-fi module interfaced with the microcontroller. This module sends the data over the internet with the Blynk application designed for this system. The Blynk application is designed in such a way that it will display all the data of street light status, temperature, humidity, sound intensity value and air quality for user monitoring and controlling. This sensor provides the measured data to the controller, the controller receives the data and compares it with the set value and as per the comparison result the system will intimate for the air pollution. In this system we have used ESP01 wi-fi module for this wireless data transmission over the internet to make this internet of thing system. This module is connected to the transmitter and receiver of the microcontroller as shown in the above circuit diagram of the system.

WORKING

Ultra sonic sensor is used to detect the level of garbage in the dustbin, whether the dustbin is full or empty. The sensor senses the content of the dustbin and sends the signals or the data to the microcontroller. Sensors are used to detect the garbage level in the dustbin, whether the dustbin is full or empty. The sensor senses the content of the dustbin and sends the signals or the data to the microcontroller. The microcontroller reads the data from the sensor and process the data received from sensor, and the same data wirelessly transmitted to the internet. Ultra sonic sensor is used to detect the level of garbage. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor. Ultrasonic sensors can detect movement of targets and measure the distance to them. Sensors can have an on or off digital output for detecting the movement of objects, or an analog output proportional to distance. The microcontroller is programmed for the ON and OFF timing of the street lights. As per the program street lights will on at evening say at 7pm. The intensity of the light will be high at this time. The lights will be ON in alternate manner after 11pm to 7am in the morning. And at 7am in morning the lights will be automatically off. After 11 pm only the half street lights will

be in ON condition. In this condition the street lights will be ON in alternate manner that is one ON, second OFF, third ON and so on. In the early morning 4am all street lamps will again be turned ON and at 6am all the street lights will be OFF. To turn ON and OFF the street lamps transistor is used and is interfaced in the system as shown in the circuit diagram. And at 7am in morning the lights will be automatically off. To turn ON and OFF the street lamps transistor is used and is interfaced in the system. To set the time for switching street lamps ON and OFF a real time clock that RTC DS-1307 is used and interfaced with the microcontroller. The Noise sensor or sound sensor provides the signal to the microcontroller. The microcontroller compares both the values i.e. output of the sensor and threshold value and comparison result will be send over the internet through Wi-Fi modem. This noise sensor is used to monitor the noise pollution. The MQ135 sensor is used to monitor the air pollution in the city due to several reasons. All the parameters are displayed on the LCD display connected to the system as shown in the circuit diagram. And also all the information is transmitted to the internet through Wi-Fi modem interfaced with the microcontroller as per the circuit diagram.

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BIOGRAPHIES



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