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IOT BASED STREET LIGHT INTENSITY OPTIMIZATION AND AIR POLLUTION MONITORING SYSTEM

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ABSTRACT

The project is to develop a smart street lightening system based on the intensity of the traffic and also monitoring the environment to control the air pollution. By calculating the number of vehicles, we will come to know in which side the density is and the brightness of the street lights are adjusted according to that traffic density. Arduino UNO is used as a microcontroller which provides the signal timing based on the traffic density. The temperature and the humidity level of the air are monitored periodically for the environmental sustainability. The data are stored in cloud which are accessible through the web.

Keywords: Air Pollution, Sensor & Moister absorber

1. INTRODUCTION

The 21st century is striving hard to save electrical energy. Street lights are essential but expensive, therefore there is a need to optimize the system in a way that it is affordable and efficiently conserves energy. Manually controlling the street lights is a time taking and tedious process. Working in such a manner could sometimes result in large disasters and destruction. The main problem that manual controls on the street lights face is that there would be a lot of time talking during evening times when they are to be switched ON and a significant waste of energy is done in the morning at all could not be turned OFF together at once. Another way in which the wastage is done is that at midnights lights glow at full intensity although there is not much traffic. Therefore, there is a need to come up with a system that overcomes the problems of existing systems.

A system that reduces manual control and saves the energy efficiently. This could be done by using low power, robust and efficient components. Nowadays, the highest percentage of air pollution comes directly from road traffic and not anymore from large industries, currently placed outside metropolitan & urban areas. Road traffic is considered to be responsible for 25% of all emissions in Europe, rising up to 31% only in Spain. Moreover, 90% of all transport emissions are due to road traffic. Loss of environmental quality is one of the biggest threats of our century to health and human well-being, together with environmental impacts. Recently, natural disasters and extremely abnormal climate situations happen frequently and globally, the culprit of which is the exacerbation of global warming. One of the measure reasons behind global warming is Air Pollution. A human can live or survive without water and food for a few days but when it comes to air then surviving for 2 to 3 minutes may seem to be impossible. Air Pollution has a significant influence on the concentration of constituents in the atmosphere leading to effects like global warming and acid rains. Air pollutants are added in the atmosphere from a variety of sources that change the composition of the atmosphere and affect the biotic environment. The concentration of air pollutants depends not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions. Transport has a significant impact on the environment in which we live. In general, these impacts can be divided into four broad headings: local air quality, climate change, noise, and watercourse pollution, while clean air is vital to human health. High levels of fine particulate (PM10) air pollution in 2005 were estimated to have caused 1,031 accelerated deaths and 1,088 respiratory hospital admissions in London. By considering all these issues and facts we will go to design a system which will help to overcome these issues.

The system is all about detecting air pollution, monitoring the traffic density which is measure cause for air pollution also managing the Lamps brightness dynamically.

This system is designed based on IoT. Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet. The IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices such as, for instance, home appliances, surveillance cameras, monitoring sensors, actuators, displays, vehicles, and so on. This paradigm indeed finds application in many Air pollution monitoring is extremely important as air pollution has a direct impact on human health and the environment. Here, we introduce IoT system for participatory air pollution monitoring. The traditional air quality monitoring system, controlled by the Pollution Control Department, is extremely expensive. In contrast to traditional air pollution monitoring stations, we present the design, implementation, and evaluation of low power, low-cost IOT Based Air Pollution Monitoring System which provides real-time monitoring. And finally we designed a dash board to view the air pollution monitoring and automatic control for lights to adjust its brightness using vehicles count. This system is more efficient and energy saving one.

2. LITERATURE SURVEY

2.1.AN INNOVATION IN THE FIELD OF STREET LIGHTING SYSTEM WITH COST AND ENERGY EFFICIENCY - Akshay Balachandran, Murali Siva, V. Parthasarathi, Surya and Shriram K. Vasudevan, Indian Journal of Science and Technology

This paper focus on the necessity of automated street light system and the peculiar way of implementation with embedded system tools. As automation booming in the industry with a fast pace, the requirement of replacing the primitive operation of street lights with quite intelligence is necessary. Methods/Statistical Analysis: The previous systems were implemented with LDR and IR sensors, here the presence of movement in the roads are sensed by IR sensors and LDR powers the street lights only after evening. The excess use of IR sensors and energy involved in the above operation are reduced in our prototype. Here we use piezo electric sensors to detect the movement in the roads instead of IR sensors. The microcontroller MSP430 as the brain to control the processes involved. The results are found to be very encouraging and the sample results are presented in the results section of the paper. LEDs are going to be vital lighting option in near future due to its peculiar low power consumption and cost effective nature. Our prototype will help in eliminating the current sodium vapour street lamps with better LED comprised lamps operated smartly using LDR, and piezo knock sensor. Discover the world's research

2.2 MONITORING VEHICLES AND POLLUTION ON ROAD USING VEHICULAR CLOUD ENVIRONMENT - Sumit A. Khandelwal, Dept. of Computer Engineering MIT Academy of Engineering, AlandiPune, India, Ashwini B. Abhale, Dept. of Information Technology, D. Y. Patil, College of Engineering, AkurdiPune, India

India is having numerous amounts of vehicle's owner and more than that 50% of vehicles are continuously running on a road. As a contrast, most of the vehicles are meeting with an accident, it causes human fatalities and generated a large amount of toxic gases are emitted out during vehicle running as well as meet into an accident. Hence, various technologies have deployed to preserve and encourage Intelligent Transportation Systems (ITS). A numerous results were suggested the related challenges and current issues of vehicular networks as well as limitation related to the cost and accessibility of a resource. Vehicular Cloud Environments (VCE) is unitary of the results. Vehicular Cloud Environments is a novel technology that point to impact on handing traffic condition and providing road safety using various vehicular resources, such as computing units, storage devices and internet facility for correct decision-making. In this paper, we focus on the vehicular cloud environments can be the future technological changing model that offers economically feasible solutions by using intelligent vehicular networks with autonomous traffic condition information, self vehicle control on road and develop opinion systems to prevent an accident as well as analysis amount of toxic gases emitted from a vehicle on a road.

2.3 OPTIMAL DEPLOYMENT OF WIRELESS SENSOR NETWORKS FOR AIR POLLUTION MONITORING - Ahmed Boubrima, FrédéricMatigot∗, WalidBechkit∗, HervéRivano∗ and Anne RuasUniversité de Lyon, INRIA, INSA-Lyon, CITI-INRIA, F-69621, Villeurbanne, France, ÉcolenationaleSupérieured'Informatique, LMCS Lab, Algiers, Algeria, IFSTTAR, Paris, France

The paper proposes, two integer linear programming formulations based on real pollutants dispersion modelling to deal with the minimum cost WSN deployment for air pollution monitoring. We depicted the concept by applying our models on real world data, namely the Nottingham City street lights. We compare the two models

in terms of execution time and show that the second one based formulation is much better. We addressed in this work the optimal deployment of wireless sensor networks for air pollution monitoring. To this end, the careful study of the dispersion modelling is something that should not be overlooked. We therefore studied a known model of diffusion of atmospheric pollution. We proposed two ILP optimization models that ensures both pollution coverage and network connectivity. We implemented and compared the two models in terms of execution time; the results showed that the second flow-based formulation is much better. We also conducted extensive simulations and derived some results to guide the choice towards an optimal deployment. As a future work, we plan to consider the impact of other parameters such as wind direction, the nature of pollutants, urban topography, etc. Moreover, we are also working on the design of specific heuristics to solve the addressed problem.

2.4 DEVELOPMENT OF IOT BASED VEHICULAR POLLUTION MONITORING SYSTEM - Ramagiri Rushikesh, M. Tech, Department of ECE, JNTUA College of Engineering, Chandra Mohan Reddy Sivappagari, Assistant Professor and Head, Department of ECE, JNTUA College of Engineering,

The main objective of the paper is to introduce vehicular pollution monitoring system using Internet of Things (IoT) which is capable of detecting vehicles causing pollution on the city roads and measures various types of pollutants, and its level in air. The measured data is also shared. This system is a low cost and provides good results in controlling the air pollution especially in the urban areas. At monitor location, the RFID reader, wireless gas sensors are integrated along with microcontroller. This entire system is placed in either of the road. Whenever the vehicles equipped with RFID tags passed through the sensor
Node, RFID reader presented in the monitoring system detects the vehicles and the sensors measures quality of their produced by that vehicle. The sensed continuous data assent to the microcontroller for verification of the pollution. Level of the vehicle. The microcontroller verifies the levels of the pollutants of the air produced by the vehicle.

2.5 INTELLIGENT STREET LIGHT SYSTEM USING RF TRANSMISSION - Sakshi Anand*, Dr. NeeluJainDepartment of Electronics &Comm., PEC University of Technology, Chandigarh, India

In this paper, A Street light use HID (High-Intensity Discharge) Lamp as light source. Due to global concerns regarding the amount of power consumed by HID lamps and the amount of atmospheric CO2 released because of power consumption, LED array illumination has received attention recently as an energy reducing light source. LED illumination requires about one third to one half of the electric power needed for HID lighting. The life cycle of an LED can be more than three times as long as an HID light and LED system would be comparatively maintenance free. In recent years, LED lighting can be expected to fully replace earlier used light sources. Street lights are the large consumer of energy in the cities, consuming up to fifty percent of the city's energy. In order to reduce energy consumption, an intelligent street light system based on LED lamps and wireless communication technologies can be designed. The proposed prototype of intelligent street light can detect daylight and vehicles and vary the intensity of the LED based street lamps as per the traffic flow. It can also help in monitoring of street light system and fault detection through RF wireless technology. If intelligent street light is designed and installed in the cities, then, lot of power can be saved and this will also minimize the cost of maintenance over traditional wired systems. The system is versatile, and can be extended as per user needs.

3. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

Existing system works for both indoor and outdoor lightening. On the one hand it improves efficiency of the system by sending alert signal in case of any defect and on the other hand it drastically reduces the electric energy consumption by providing central control over the lights. This system can be installed as energy efficient system to control street lamp that requires a lot of energy and needs manual intervene. traffic street lamps which grow in number in one direction. So this is different from the on premise as here we have challenge of communication range. Master Controller: It acts like brain for the whole device control and monitoring system. Micro controller receives and transmits signals to and fro slave nodes over wired connection. At the same time, it sends the feedback to a central monitoring application for visual display of the status of different electrical devices. Slave Node: Each lamp controller is connected to master controller to send and receive information about the status of the device. Based on the current sensor detector which is connected to electrical device, signal is send to the Master controller about the working status of the device. If any signal is send from the master to the slave, then the relevant action is performed based on the data received. As wireless connection range (router or Node MCU) is in meters, so it is not possible to use in cases where Wi Fi connection is require in Kilometers. Moreover, to make the system reliable wired connection is used to connect Master Controller to the street lamp device. This micro controller is turn is connected to Cloud server and web application.

3.2 PROPOSED SYSTEM:

In this project, we are going to make real time deployment of sensors to design and implement an intelligent system in which we will monitor Air quality by measuring temperature and humidity level and also designed an automatic street lighting system. We collect the temperature and humidity using dht11 sensor and collect the air quality level with help of mq135 sensor. And we used two IR Sensor to count the vehicle. Based on this count we can adjust the lamp brightness and save the energy. We used MQTT protocol to share the sensor information to Dashboard. The protocol, which uses a publish/subscribe communication pattern, is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT). It works on top of the TCP/IP protocol. It is designed for connections with remote locations where a "small code footprint" is required or the network bandwidth is limited. In this IOT project, you can monitor the pollution level from anywhere using webpage. We can install this system anywhere and get information from devices using web application by MQTT protocol.

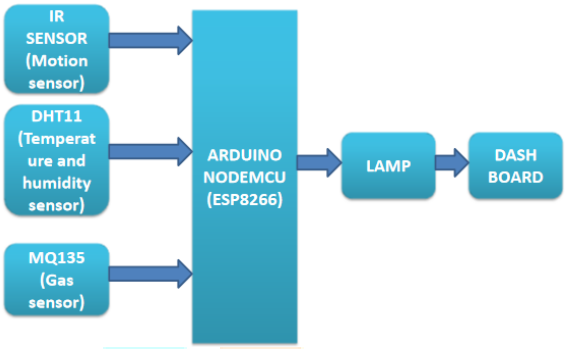


Fig: Block diagram

3.2.1 Hardware Requirements:

NodeMCU
DHT 11 (Temperature & Humidity)
IR Sensor
MQ135 sensors
LED

3.2.2 Software Requirement:

Arduino IDE
Embedded C
Adafruit IO
MQTT Protocol

3.3 Internet Of Things(IOT):

IoT is creating a giant network where all the devices are connected to each other and providing them with the capability to interact with each other. This is driving the automation to a next level where devices will communicate with each other and make decisions on their own without any human interventions.

Following are a few stats that reflect the growth in the demand for IoT certification training quite accurately:

According to the Gartner report, by 2020 connected devices across all technologies will reach to 20.6 billion. As per the Cisco report, IoT will generate $14.4 trillion in value across all industries in the next decade. Unknowingly, IoT applications are becoming an important aspect of our life.

Birth of IoT
Introduction to IoT
Benefits of IoT
IoT Hardware
IoT Across Various Domains
Raspberry Pi
IoT Application – Sensing the Environment & Notifying

You may go through this recording of IOT Tutorial where our instructor has explained the topics in a detailed manner with examples that will help you to understand this concept better.

3.4 IoT Hardware

Now you would be wondering what the required hardware for preparing an IoT solution is. The answer to this question is, you'll first require sensors that will sense the environment, then you require a remote dashboard to monitor your output and display it in a clearer & conceivable form. At last, you will require a device with the capability of serving & routing. The key task of the system would be detecting specific conditions and taking actions accordingly. One thing to keep in mind is securing the communication between the devices and the dashboard. Some of the common sensors that you are surrounded by are accelerometers, temperature sensors, magnetometers, proximity sensors, gyroscopes, image sensors, acoustic sensors, light sensors, pressure sensors, gas RFID sensors, humidity sensors & micro flow sensors. Nowadays we also have many wearable devices like smart watches, shoes & 3D glasses. This is the best example of a smart solution. 3D glasses adjust television's brightness and contrast according to your eye and your smart watches keep track of your daily activities and fitness. But I feel the most important device which has tremendously contributed to IoT is the cell phones. Mobile apps have immensely contributed to revolutionizing the technology world. Cell phones are already encased with applications and sensors that reveal lots of information about its user. It has Geo-location information, it can sense and trace light condition, the orientation of your device and a lot more information. It also comes with multiple connectivity options like Wi-Fi, Bluetooth and cellular that helps them to communicate with other devices. Thus, due to these default qualities of cell phones, it is the core of the IoT ecosystem. Today, Smartphone can interact with smart watch and fitness band to further ease and enhance the user experience. IoT uses multiple technologies and protocols to communicate with devices based on the requirements. The major technologies & protocols are Bluetooth, wireless, NFC, RFID, radio protocols and WiFi-Direct. IoT applications are flourishing across all industries & market. The IoT has a multitude of expansion over various industries. It spans over all groups of users, from those who are trying to reduce & conserve energy in their home to large organizations who want to improve their business operations. IoT has not only proved it useful in optimizing critical applications in many organisations, but also have boosted the concept of advanced automation which we have imagined a decade before. Let's understand the capabilities of IoT across different industries and look how they are revolutionizing them.

3.5 IoTAcross Various Domains

Energy Applications: The energy rates have risen to a great instinct. Individuals and organisations, both are searching ways to reduce and control the consumption. IoT provides a way to not only monitor the energy usage at the appliance-level but also at the house-level, grid level or could be at the distribution level. Smart Meters & Smart Grid are used to monitor energy consumption. It also detects threats to the system performance and stability, which protect appliances from downtime and damages. Healthcare Application: Smart watches and fitness devices have changed the frequency of health monitoring. People can monitor their own health at regular intervals. Not only this, now if a patient is coming to the hospital by ambulance, by the time he or she reaches the hospital his health report is diagnosed by doctors and the hospital quickly starts the treatment. The data gathered from multiple healthcare applications are now collected and used to analyze different disease and find its cure. Education: IoT provides education aids which helps in fulfilling the gaps in the education industry. It not only improves the quality of education but also optimizes the cost and improves the management by taking into consideration student's response and performance. Government: Governments are trying to build smart cities using IoT solutions. IoT enhances armed force systems and services. It provides better security across the borders through inexpensive & high-performance devices. IoT helps government agencies to monitor data in real-time and improve their services like healthcare, transportation, education etc. Air and Water Pollution: Through various sensors, we can detect the pollution in the air and water by frequent sampling. This helps in preventing substantial contamination and related disasters. IoT allows operations to minimize the human intervention in farming analysis and monitoring. Systems automatically detect changes in crops, soil, environment, and more. Transportation: IoT has changed the transportation sector. Now, we have self-driving cars with sensors, traffic lights that can sense the traffic and switch automatically, parking assistance, giving us the location of free parking space etc. Also, various sensors in your vehicle indicate you about the current status of your vehicle, so that you don't face any issues while travelling. Marketing your product: Using IoT, organizations can better analyze& respond to customer preferences by delivering relevant content and solutions. It helps in improving business strategies in the real-time.

4. Module Description

4.1. Module 1: To Read the Temperature and Humidity value

DHT11 Digital Temperature & Humidity Sensor is a temperature-humidity compound sensor with calibrated digital signal output. The sensor includes a resistive humidity-sensing component and a NTC temperature-sensing

component. Each DHT11 sensor is calibrated in an extremely accurate humidity-calibration chamber. The calibration coefficients are stored in the OTP memory in the form of programs, and these calibration coefficients are called during the internal signal detection process of the sensor, so that there is no need to recalibrate them. The single-wire serial interface provides easy and fast system integration. Its smart size, low power-consumption and signal transmission distance up to 20 meters makes it an ideal option in various applications.

The MQ-135 gas sensor senses the gases like ammonia nitrogen, oxygen, and alcohols, aromatic. Compounds, sulphide and smoke in the atmosphere we can find polluting gases, but the conductivity of gas sensor increases as the concentration of polluting gas increases. MQ-135 gas sensor can be implementation to detect the smoke, benzene, steam and other harmful gases. It has potential to detect different harmful gases. The MQ-135 gas sensor is low cost to purchase. To collect the Air pollution level and send it to the ESP8266P.

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received. In this module we used two IR sensors to detect the entered vehicle and exited vehicles. It sense the number of vehicles count based on this count the lamp brightness will be adjusted automatically.

4.2 Dashboard Creation in Adafruit:

In our Adafruit account which we signed in by using the same mail ID, we have to create our dashboard by giving a suitable name. Here, we have created a dashboard as “Air Pollution Monitoring”. Now the feeds are to be created. The feeds are, DHT11 Sensor (we use it for Humidity-temperature measurements), Air Quality Sensor (To read the air quality levels).

The feeds are selected and created as:

From the window “Create a new block”, we have to select a block according to the purpose we have. Like if we want to create a Temperature and Humidity blocks, we have to select the first block ‘Gauge’. After this, the block will ask us to label it by a name, to give relative change in gauge to set the minimum and maximum value and block tittle. For Air quality we select the graph to show the air quality levels.

After creating the feeds, we have to give the relative labels as temperature, Humidity etc., after creating the required feeds, our dashboard looks like:

After creation our dashboard, we have to click the key icon on the right top corner of our dashboard.it will generate a URL and a key for our account. This URL and key will be used in the program to make the Node MCU monitor the feeds in our account.

4.3 HARDWARE SPECIFICATION

4.3.1 NODE MCU

MCU stands for Microcontroller Unit - which really means it is a computer on a single chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. They are used to automate automobile engine control, implantable medical devices, remote controls, office machines, appliances, power tools, toys etc.

4.3.2 Node MCU Pin out

NodeMCU has weird pin mapping. Pin numbers written on the board itself do not correspond to ESP8266 GPIO pin numbers. We have constants defined to make using this board easier:

4.3.3 NodeMCU Circuit Diagram

Circuit diagram of NodeMCU makes clearer about connections of NodeMCU with ESP8266 GPIO. Never use GPIO0 (D3) as input pin, this pin is flash button. If it is low at power on state this will put ESP in programming mode.

4.4 KEY PARAMETERS

4.4.1 DHT11 sensor:

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-ac question technique and temperature & humidity sensing technology, it ensures high reliability y 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 micro controller, offering excel lent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 elements strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The components 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users 'request.

4.4.2 IR sensors:

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received

4.4.3 Moisture Analyzers

Moisture analyzers use wavelengths which are absorbed by the moisture in the IR region. Objects are irradiated with light having these wavelengths (1.1 µm, 1.4 µm, 1.9 µm, and 2.7µm) and also with reference wavelengths. The Lights reflected from the objects depend upon the moisture content and is detected by analyzer to measure moisture (ratio of reflected light at these wavelengths to the reflected light at reference wavelength). In GaAs PIN photodiodes, Pbs photoconductive detectors are employed in moisture analyzer circuits.

4.4.4 MQ135 Sensor:

The MQ-135 gas sensor senses the gases like ammonia nitrogen, oxygen, alcohols, aromatic compounds, sulphide and smoke. The boost converter of the chip MQ-3 gas sensor is PT1301. The operating voltage of this gas sensor is from 2.5V to 5.0V. The MQ-3 gas sensor has a lower conductivity to clean the air as a gas sensing material. In the atmosphere we can find polluting gases, but the conductivity of gas sensor increases as the concentration of polluting gas increases. MQ-135 gas sensor can be implementation to detect the smoke, benzene, steam and other harmful gases. It has potential to detect different harmful gases. The MQ-135 gas sensor is low cost to purchase. The basic image of the MQ-135 sensor.

4.5 LED

In the simplest terms, a light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material. Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps).

Different colours

Inside the semiconductor material of the LED, the electrons and holes are contained within energy bands. The separation of the bands (i.e. the band gap) determines the energy of the photons (light particles) that are emitted by the LED. The photon energy determines the wavelength of the emitted light and hence its colour. Different semiconductor materials with different band gaps produce different colours of light. The precise wavelength (colour) can be tuned by altering the composition of the light-emitting, or active, region.

LEDs are comprised of compound semiconductor materials, which are made up of elements from group III and group V of the periodic table (these are known as III-V materials). Examples of III-V materials commonly used to make LEDs are gallium arsenide (GaAs) and gallium phosphide (GaP). Until the mid-90s LEDs had a limited range of colours, and in particular commercial blue and white LEDs did not exist. The development of LEDs based on the gallium nitride (GaN) material system completed the palette of colours and opened up many new applications.

4.5 SOFTWARE SPECIFICATION

4.5.1 ARDUINO IDE

The Uno can be programmed with the Arduino Software (IDE). Select "Arduino/Genuino Uno" from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials. The ATmega328 on the Uno comes pre-programmed with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar; see these instructions for details. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then rise in the 8U2.

On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU boot loader). See this user-contributed tutorial for more information.

4.5.2 Warnings:

The Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

4.5.3 Differences with other boards:

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.5.4 Power:

The Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm centre-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

Vin. The input voltage to the Uno board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V. This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

3V3. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND. Ground pins.

IOREF. This pin on the Uno board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

4.5.5 Memory:

The ATmega328 has 32 KB (with 0.5 KB occupied by the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

4.5.6 Input and Output:

See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8, 168, and 328 is identical. Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite () function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference () function.

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analogReference ().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.5.7 Communication:

The Uno has a number of facilities for communicating with a computer, another Uno board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed.

However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1. A Software Serial library allows serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

4.5.8 Automatic (Software) Reset:

Rather than requiring a physical press of the reset button before an upload, the Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labelled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110-ohm resistor from 5V to the reset line; see this forum thread for details.

4.5.9 Revisions:

Revision 3 of the board has the following new features:

Pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.

Stronger RESET circuit.

At mega 16U2 replace the 8U2.

4.5.10 USB Overcurrent Protection:

The Arduino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

4.5.10.1 Embedded C

Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability. Embedded Systems can not only be stand-alone devices like Washing Machines but also be a part of a much larger system. An example for this is a Car. A modern day Car has several individual embedded systems that perform their specific tasks with the aim of making a smooth and safe journey. Some of the embedded systems in a Car are Anti-lock Braking System (ABS), Temperature Monitoring System, Automatic Climate Control, Tyre Pressure Monitoring System, Engine Oil Level Monitor, etc. Before going in to the details of Embedded C Programming Language and basics of Embedded C Program, we will first talk about the C Programming Language.

The C Programming Language, developed by Dennis Ritchie in the late 60's and early 70's, is the most popular and widely used programming language. The C Programming Language provided low level memory access using an uncomplicated compiler software that converts programs to machine code) and achieved efficient mapping to machine instructions.

The C Programming Language became so popular that it is used in a wide range of applications ranging from Embedded Systems to Super Computers. Embedded C Programming Language, which is widely used in the development of Embedded Systems, is an extension of C Program Language. The Embedded C Programming Language uses the same syntax and semantics of the C Programming Language like main function, declaration of data types, defining variables, loops, functions, statements, etc. The extension in Embedded C from standard C Programming Language include I/O Hardware Addressing, fixed point arithmetic operations, accessing address spaces, etc.

4.5.10.2 Message Queuing Telemetry Transfer Protocol (MQTT):

MQTT (MQ Telemetry Transport) is an ISO standard (ISO/IEC PRF 20922) light-weighted messaging protocol that provides resource - constrained network clients with a simple way to distribute telemetry information. The protocol, which uses a publish/subscribe communication pattern, is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT). It works on top of the TCP/IP protocol. It is designed for connections with remote locations where a "small code footprint" is required or the network bandwidth is limited.

4.5.10.3 Working of MQTT:

Like any other internet protocol, MQTT is based on clients and a server. Likewise, the server is the guy who is responsible for handling the client's requests of receiving or sending data between each other.

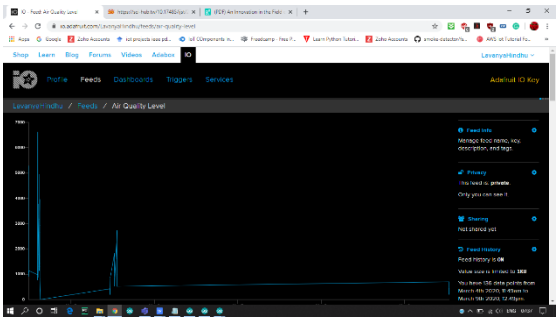
MQTT server is called a broker and the clients are simply the connected devices.

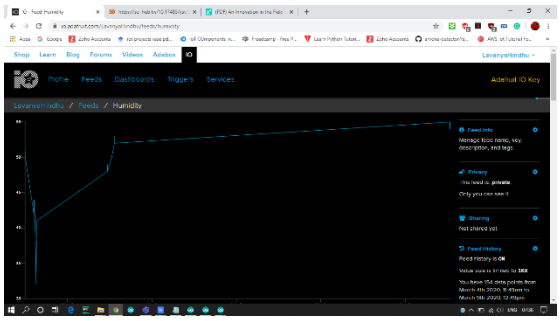
SO, When a device (a client) wants to send data to the broker, we call this operation a "publish".

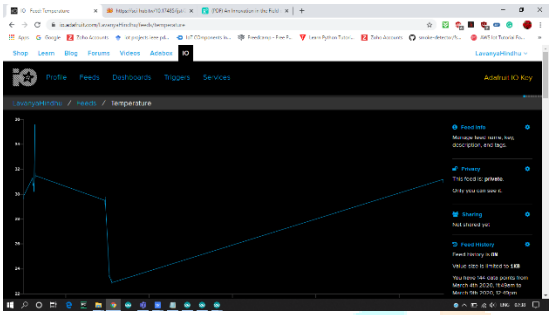
When a device (a client) wants to receive data from the broker, we call this operation a "subscribe".

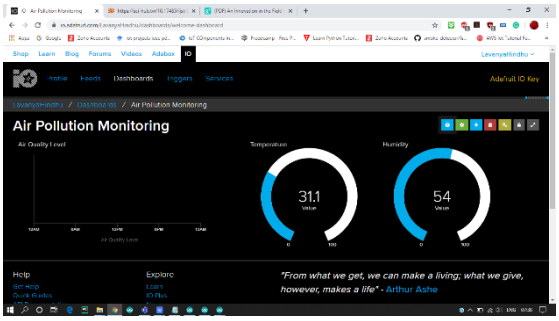
5.RESULTS

The hardware model assembled by us are given below,









6. CONCLUSION

In this project we have discussed the low cost, secure, accessible IOT based street light optimization based on the traffic and also we discussed the air pollution monitoring system. Wi-Fi module controls all the process to the internet and monitor is used to display all the web pages over the internet.The system can upload the measured temperature, Humidity and Air Qualitydata on a website based on IoT. This system could be used to integrate Lamp control based on intensity. For micro controller containing the whole system would need to be installed at the monitoring site. The device to monitor the toxicity in the air environment is designed using Node-MCU, IoT technology is implemented to control the air quality in high traffic areas. The use of MQ135 sensor senses various hazardous gases, automatic lighting system and Node-MCU is the heart of this application, which controls the whole process. Micro controllers in build Wi-Fi module controls all the process to the internet and monitor is used for displaying all the web pages over the internet.

7. REFERENCES

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