Design and Implementation of Smart City using IoT

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Abstract - *This paper provides a systematic approach on how the idea of Smart city can be implemented and made cost effective.By using cameras(to monitor situation),LED with varying intensity(to reduce power loss),an emergency call system(to prevent crimes) in street lamps ; cost effective and low power consuming beacons(to push notifications) ; control devices in building,home,office and hotel to save power through app or website(which can be done by voice too) and validate it.*

Keywords: IOT, Esp8266, Node MCU, Intelligent Poles, Beacons, package tracking

1. Introduction/ Origin of Idea

Any innovation or new idea is outcome of problems or issues in our surroundings or faced by people around us or society at large. So, I always used to think about various problems and if we can do anything about it. I am a student of class 9 and learning Robotics and Arduino programming too, my mind started thinking more and gained more knowledge from internet, books and my teachers and then decided to make an implementable solution which can be used at large scale as in cities and countries. The idea of Smart City aims to conserve power and make the life of residents easy.

2. Birds eye view (block diagram)

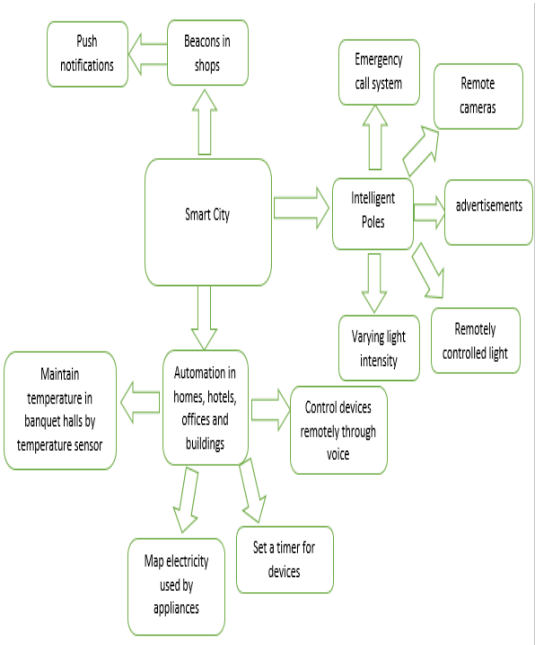

Fig 1- birds eye view

3. Problems and proposed solution

3.1 Problem

- 19 % of the total energy is used for lighting purposes.
- Production of this energy leads to cutting of 275 billion trees.
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Proposed solution

- Smart LED can be used which will change the intensity of light according to time and need.
- For this an LDR (light dependant resistance) can be used but to lower cost the time data will be directly imported from websites and traffic data will also be fetched and on basis of these data the intensity of light will be controlled. By this 76% of the energy use will be reduced than a high-pressure lamp.

3.2 Problem

- An increase in number of crimes

Proposed solution

- Remotely accessible cameras can be placed.
- Emergency call systems can be placed on poles which will send a message to police centre.

3.3 Problem

- People remain unaware of the brands and products.

Proposed solution

- Advertisements can be displayed on street poles.
- Beacons can be used. Beacons are a low-cost piece of hardware, small enough to attach to a wall. If a person is 5-6 metres away from a shop its offers or relevant content will be directly pushed in the persons mobile (He will not have to go in to know about the latest offers). These can also be used in museums where if you go near a certain artefact its history will be shown on your mobile. Its proximity can be changed. These can be made work on Bluetooth to reduce power consumption.

3.4 Problem

- Controlling devices in homes, offices, factories remotely.

Proposed solution

- Device can be controlled through Wi-Fi by an app or website; a timer can also be set to switch off the device after some time. Analysis of each device's power consumption can also be made and given to the user through mail.

3.5 Problem

- Changing temperature in banquet halls according to need.

Proposed solution

- A temperature sensor can be used to maintain the appropriate temperature.

3.6 Problem

- Tracking packages in offices or factories.

Proposed solution

- Small device accessibility can be placed on the package to track it. An app can also be made for this which can show the position of package on a map.

3.7 Ease in life

Based on the IOT platform many outputs could be achieved just by sending a mail or a message (from Face book, WhatsApp or messaging) and according to content of message things like – booking a cab for you, getting your house power usage analytics, get the weather forecast, get the picture of day taken by NASA, getting the headlines, get the hotel offers etc.

4. IoT

Internet of Things (IOT) is an ecosystem of connected physical objects that are accessible through the internet. That is, objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. These are some of the technologies support the specific networking functionality needed in an IoT system-

4.1 NFC and RFID

RFID (radio frequency identification) technology employs 2-way radio transmitter-receivers to identify and track tags associated with objects. NFC (near field communication) consists of communication protocols for electronic devices, typically a mobile device and a standard device.

4.2 Low-Energy Bluetooth

This technology supports the low-power, long-use need of IoT function while exploiting a standard technology with native support across systems.

4.3 Low-Energy Wireless

This technology replaces the most power consuming aspect of an IoT system. Though sensors and other elements can power down over long periods, communication links must remain in listening mode. Low-energy wireless not only reduces consumption, but also extends the life of the device through less use.

4.4 Radio Protocols

ZigBee, Z-Wave, and Thread are radio protocols for creating low-rate private area networks. These technologies are low-power, but offer high throughput unlike many similar options. This increases the power of small local device networks without the typical costs.

4.5 LTE-A

LTE(Long-Term Evolution) is a standard for high speed wireless communication for mobile devices and data terminals, based on the GSM(global system for mobile),EDGE(enhanced data rates for GSM evolution),UMTS(universal mobile telecommunication system),HSPA(high speed packet access) technologies. LTE-A (LTE Advanced) delivers an important upgrade to LTE technology by increasing not only its coverage, but also raising its throughput. It gives IoT a tremendous power through expanding its range

4.6 Wi-Fi-Direct

Wi-Fi-Direct eliminates the need for an access point. It allows P2P (peer-to-peer) connections with the speed of Wi-Fi. Wi-Fi-Direct eliminates an element of a network that often bogs it down, and it does not compromise on speed or throughput.

This diagram explains data flow in IOT devices-

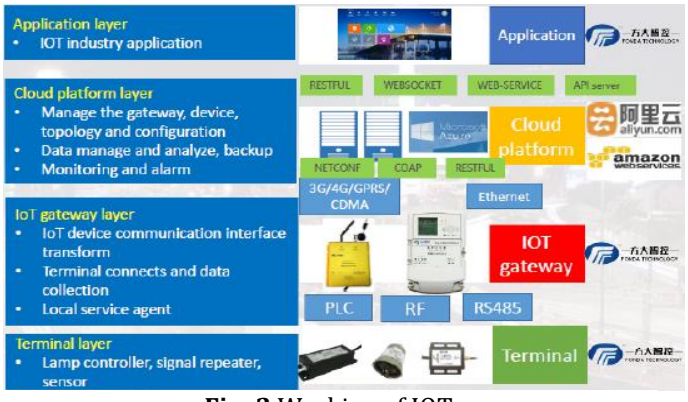


Fig -2 Working of IOT

4.7 ESP8266

Features-

- 3 SPI (serial peripheral interfaces) - general Slave/Master SPI, Slave SDIO (secure digital input output)/SPI, general Slave/Master HSPI.
- Two UART (universal asynchronous receiver transmitter) interfaces UART0 and UART.
- It has 16 general GPIO's (general purpose input output).
- It is a Wi-Fi 2.4 GHz module and supports WPA/WPA2.
- It has integrated TCP/IP protocols.
- It has a power down leakage current of < 10uA.

5. Bluetooth (HC-05)

- HC-05 Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

Features-

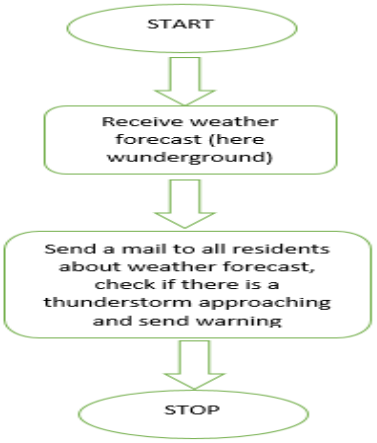
- V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.
- It uses CSR Blue core 04-External single chip Bluetooth system with CMOS (complementary metal oxide semiconductor) technology and with AFH (Adaptive Frequency Hopping Feature).
- Low Power 1.8V Operation.
- It has PIO (programmed input output) control

V.IMPLEMENTATION AND OTHER ISSUES

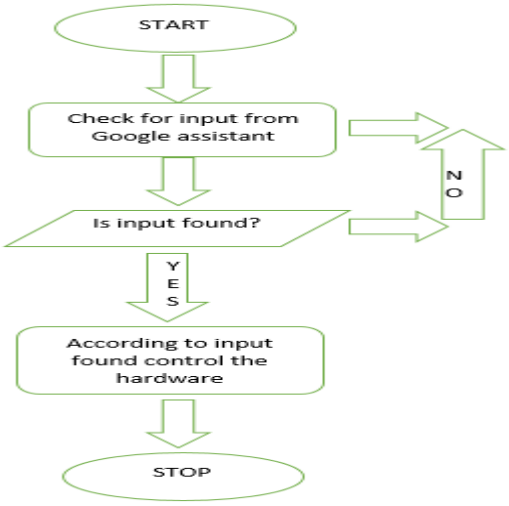
- Major issue is balancing high speed, minimum space with least power consumption
- ESP8266 consumes about than 60uA in deep sleep mode (with RTC clock still running) and less than 1.0mA or less than 0.5mA to stay connected to the access point. So, power can be managed.
- A beacon uses energy friendly Bluetooth which will also help to save power.
- A beacon can be made as small to be held in hand.
- To balance high speed a in so many devices a server with considerable processing speed will be required.
- To make the beacon and tracking device as small as possible we need to do VLSI(very large scale integration) and manufacture PCB dedicated for this purpose.

VI.LOGICAL ALGORITHMS

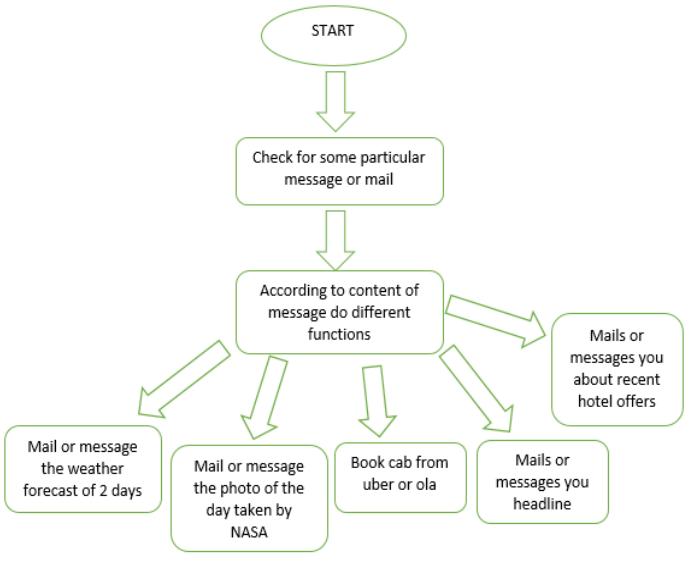
6.1 Obtaining weather forecast from websites



6.2 Controlling device via Google Assistant

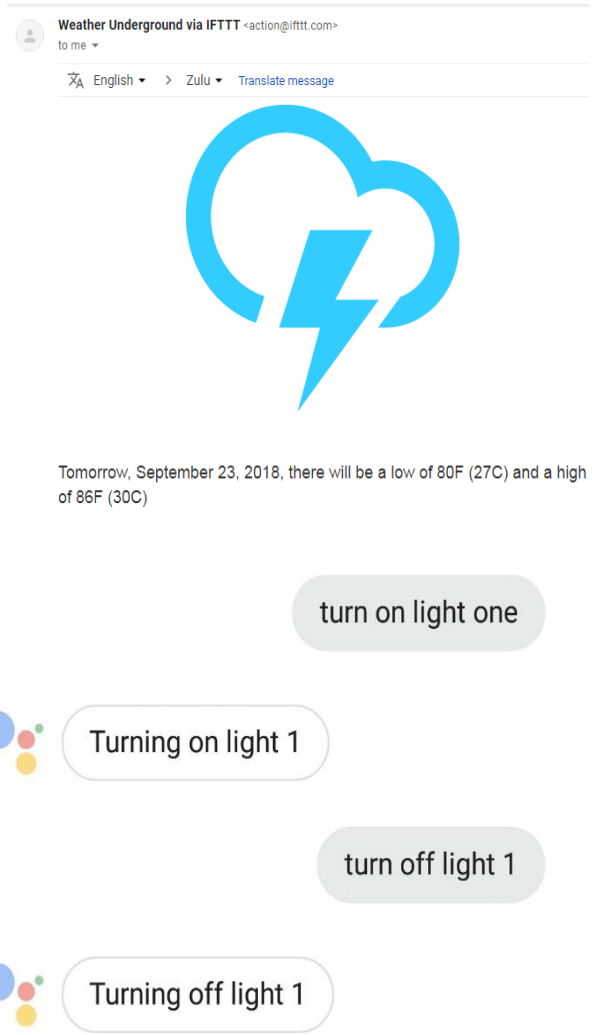


6.3 Mail and messaging



VII.RESULTS

This is the photo of mail received to me about the weather forecast. –



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