



INTRODUCTION TO ARDUINO PROTOTYPING PLATFORM

Rahul Shrivastava

OVERVIEW

Background

- Microcontroller defined/Why Arduino's?
- Types of Arduino

What To Get (Hardware and Software)

Arduino C

Electronic Circuits

Projects

- Blinking light(s)
- Reading inputs (variable resistors)

MICROCONTROLLERS — ONE DEFINITION

- Programmers work in the virtual world.
- Machinery works in the physical world.
- How does one connect the virtual world to the physical world?
- Enter the microcontroller.
- A microcontroller is basically a small-scale computer with generalized (and programmable) inputs and outputs.
- The inputs and outputs can be manipulated by and can manipulate the physical world.

WHAT IS A MICROCONTROLLER

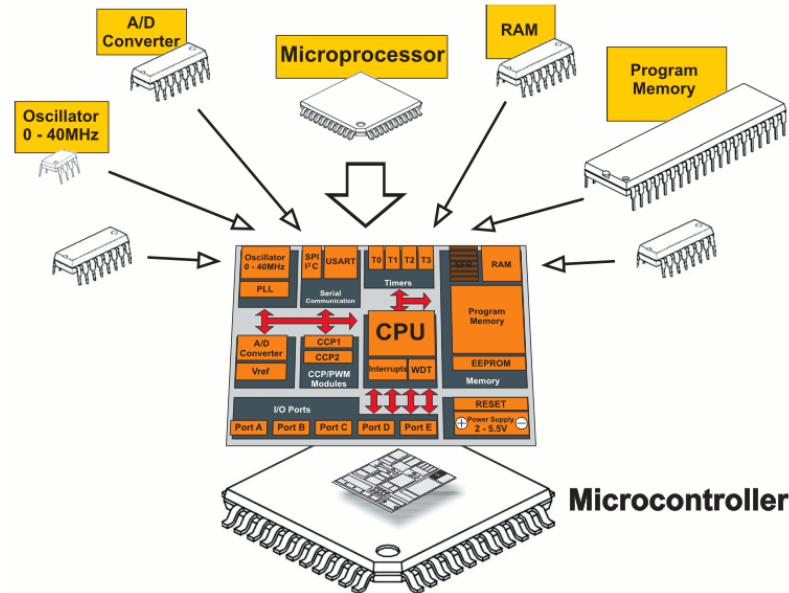
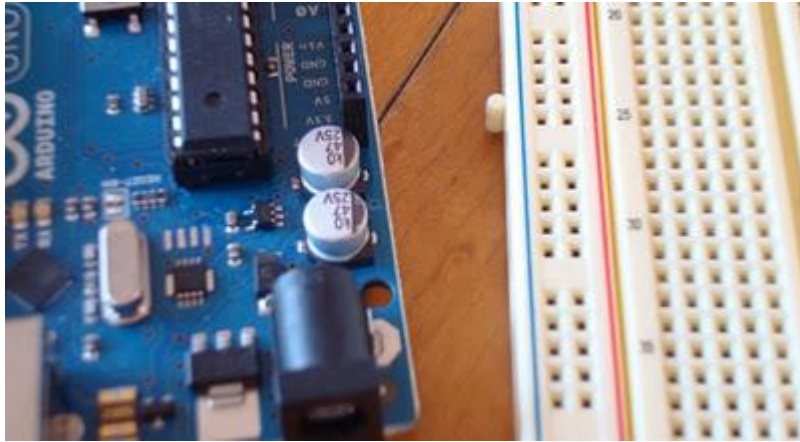


Fig. 0-1 Microcontroller versus Microprocessor

- A small computer on a single chip
 - containing a processor, memory, and input/output
- Typically "**embedded**" inside some device that they control
- A microcontroller is often small and low cost

WHAT IS A DEVELOPMENT BOARD



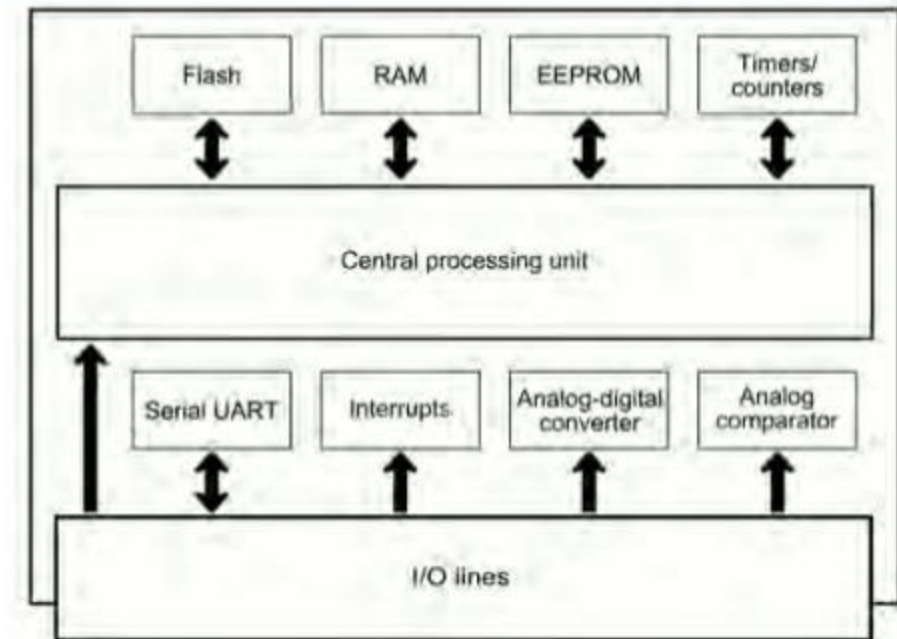
A printed circuit board designed to facilitate work with a particular microcontroller.

- Typical components include:
 - power circuit
 - programming interface
 - basic input; usually buttons and LEDs
 - I/O pins

THE ARDUINO DEVELOPMENT BOARD



THE ARDUINO MICROCONTROLLER: ATMEL AVR ATMEGA 328



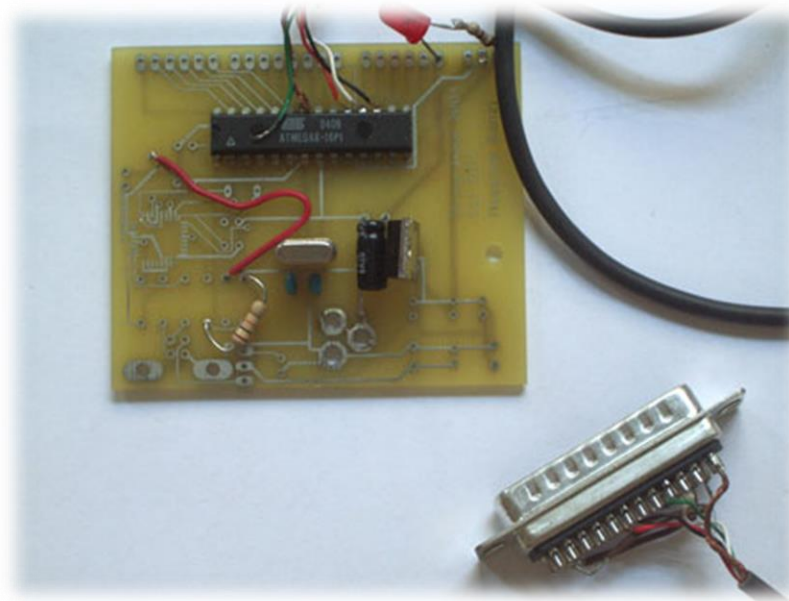
ARDUINO — OFFICIAL DEFINITION

Taken from the official web site (arduino.cc):

- Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

ARDUINO...

is the go-to gear for artists, hobbyists, students, and anyone with a gadgetry dream. rose out of another formidable challenge: how to teach students to create electronics, fast.



“COMPETITORS” TO THE ARDUINO

PIC controller

- Microcontroller programmed with C or assembler

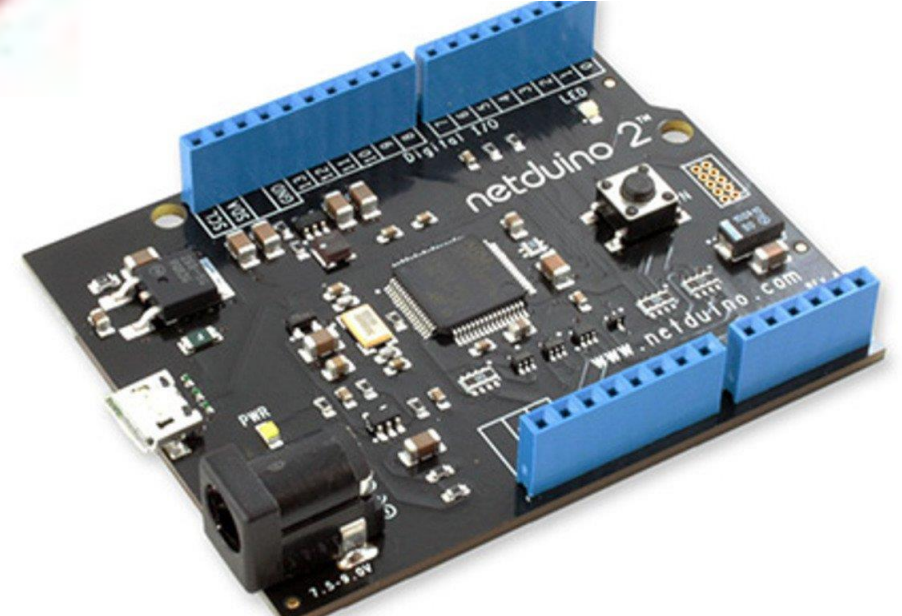
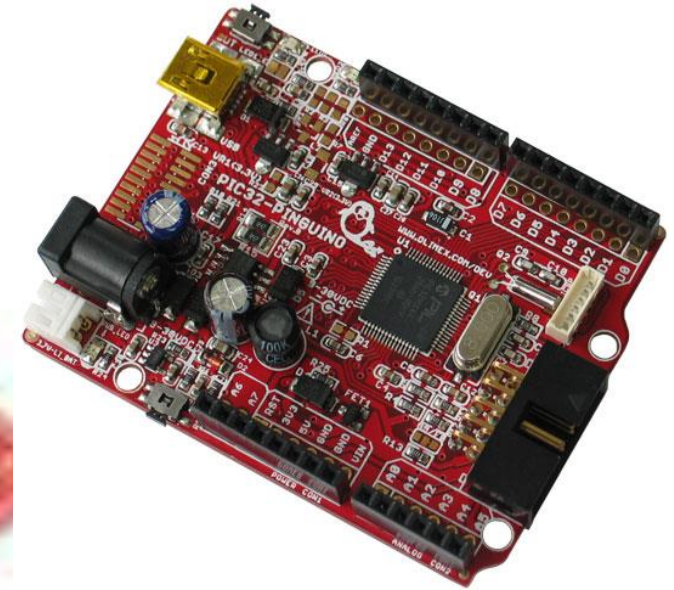
Alternatives to the Arduino line

- Pinguino – PIC controller
- MSP430 – Texas Instruments; \$4.30
- Others: customs, Teensy, etc.

Netduino

Computers

- Raspberry Pi
- BeagleBones – TI; has computer and controller



ARDUINO TYPES

Many different versions

- Number of input/output channels
- Form factor
- Processor

Leonardo

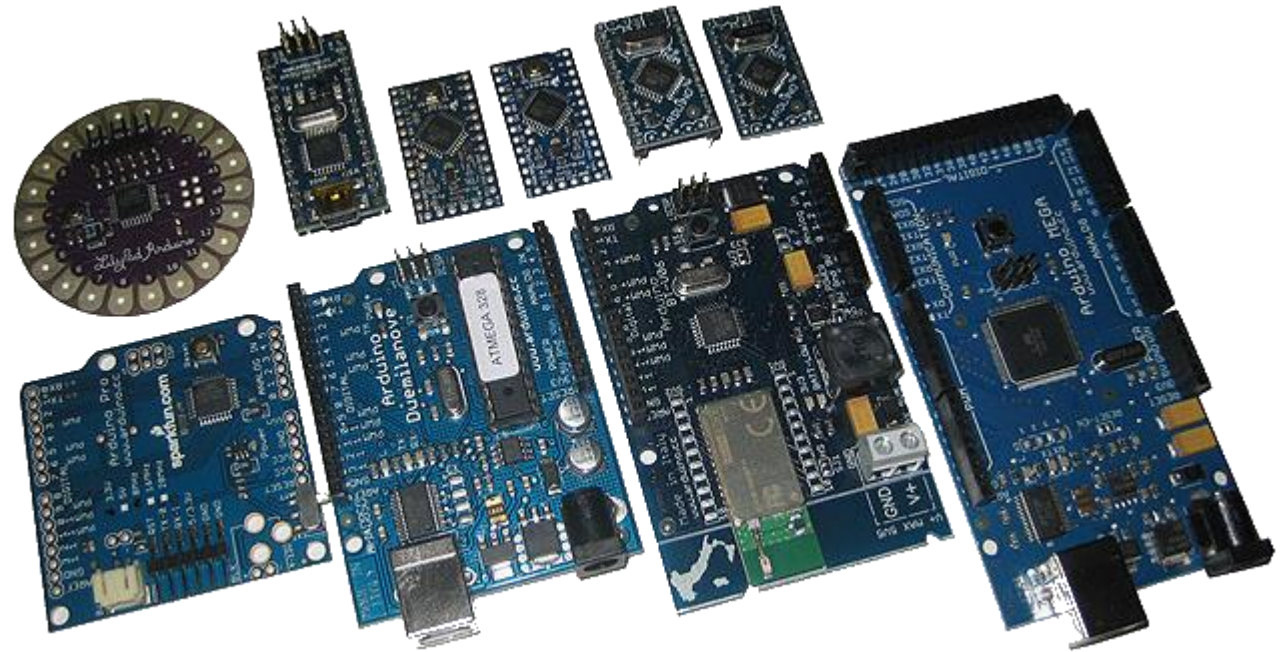
Due

Micro

LilyPad

Esplora

Uno

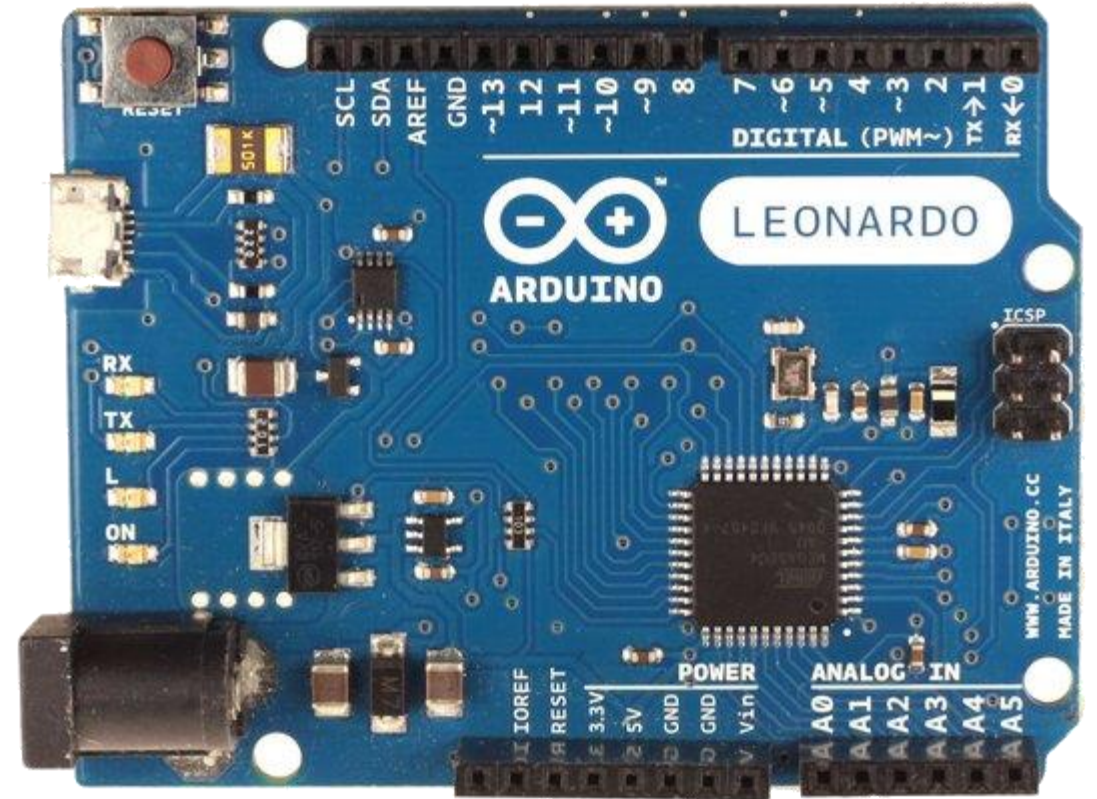


LEONARDO

Compared to the Uno, a slight upgrade.

Built in USB compatibility

Presents to PC as a mouse or keyboard

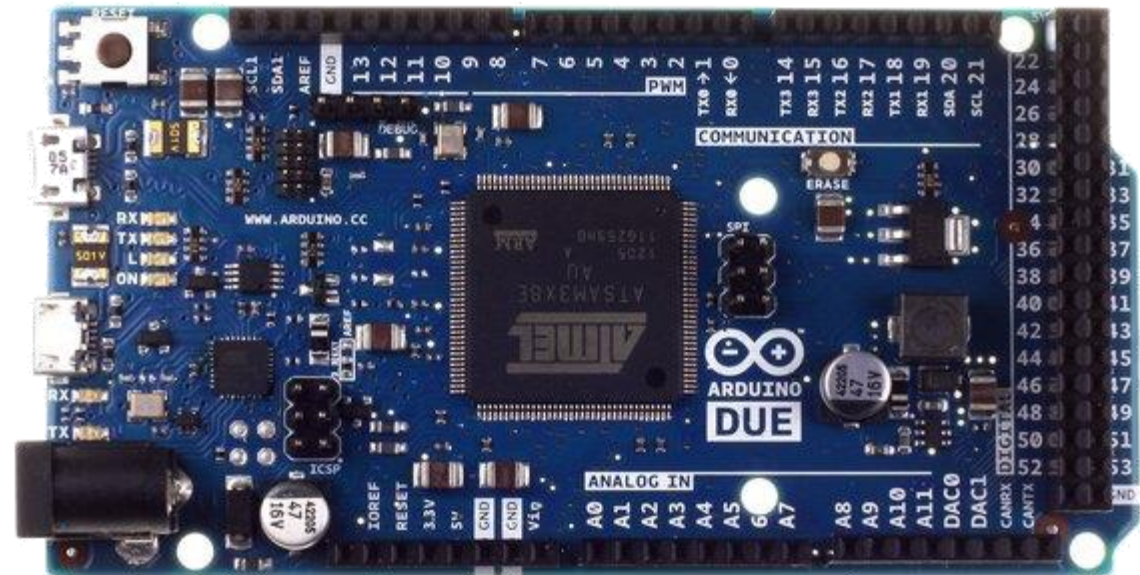


DUE

Much faster processor, many more pins

Operates on 3.3 volts

Similar to the Mega

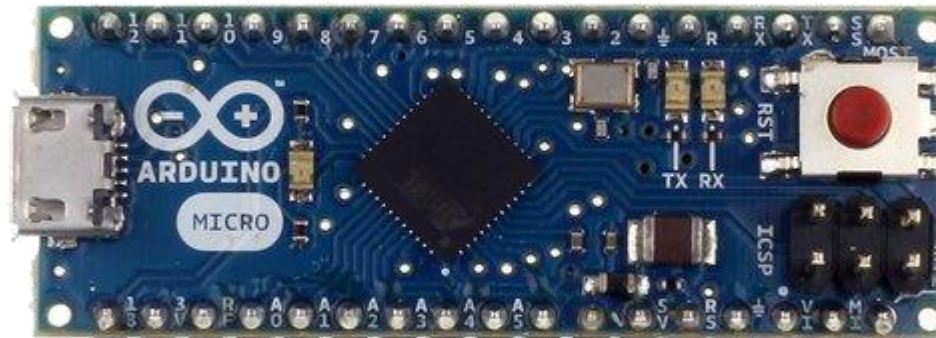


MICRO

When size matters: Micro, Nano, Mini

Includes all functionality of the Leonardo

Easily usable on a breadboard



LILYPAD

LilyPad is popular for clothing-based projects.

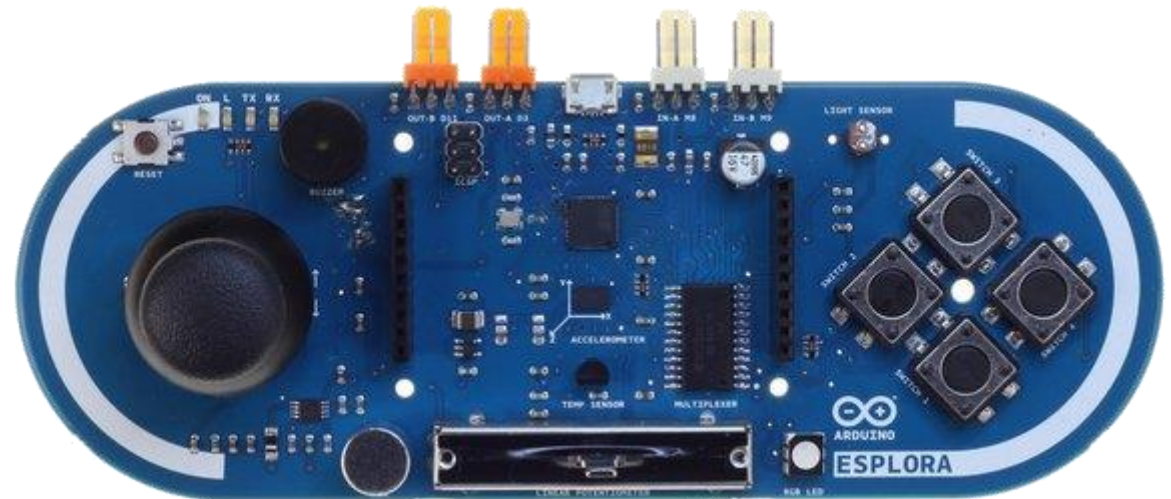


ESPLORA

Game controller

Includes joystick, four buttons, linear potentiometer (slider), microphone, light sensor, temperature sensor, three-axis accelerometer.

Not the standard set of I/O pins.



MEGA

Compared to the Uno, the Mega:

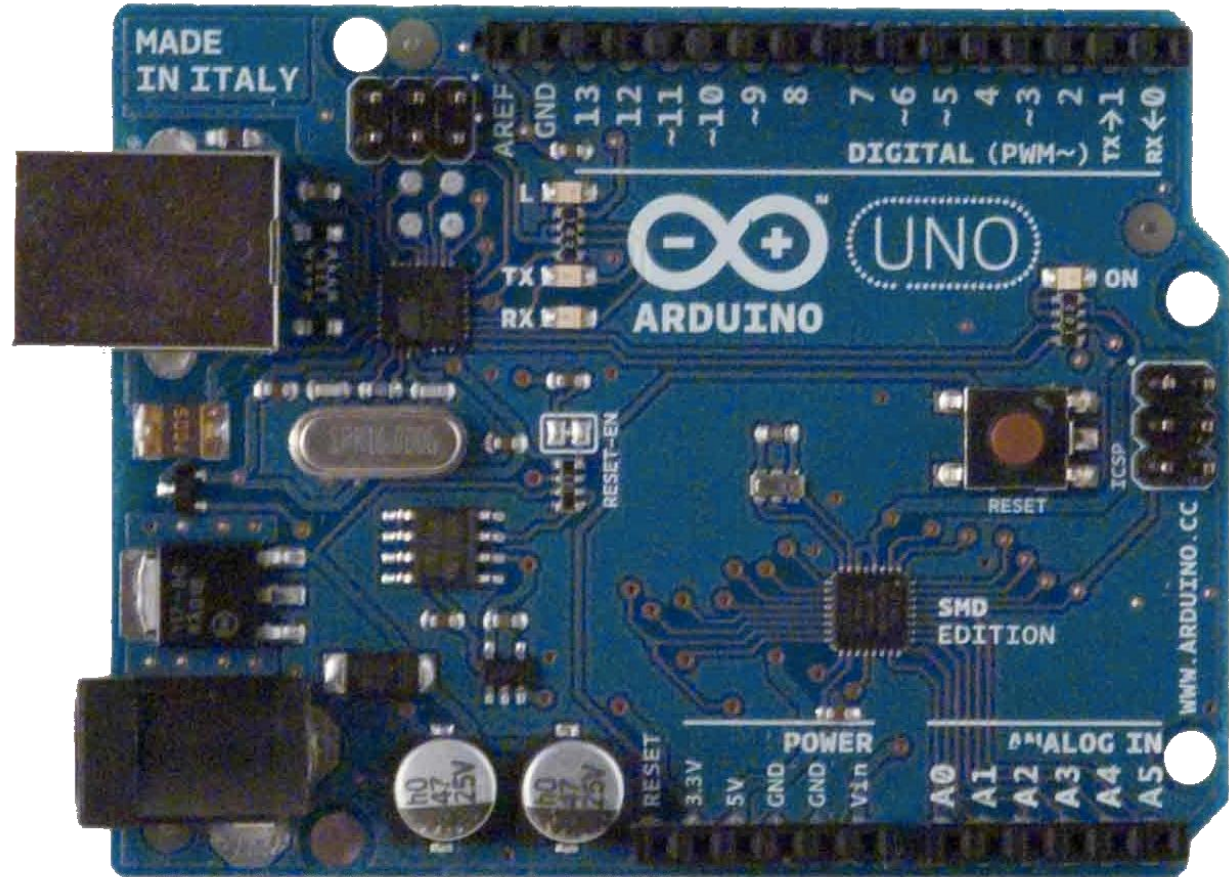
- Many more communication pins
- More memory



ARDUINO UNO CLOSE UP

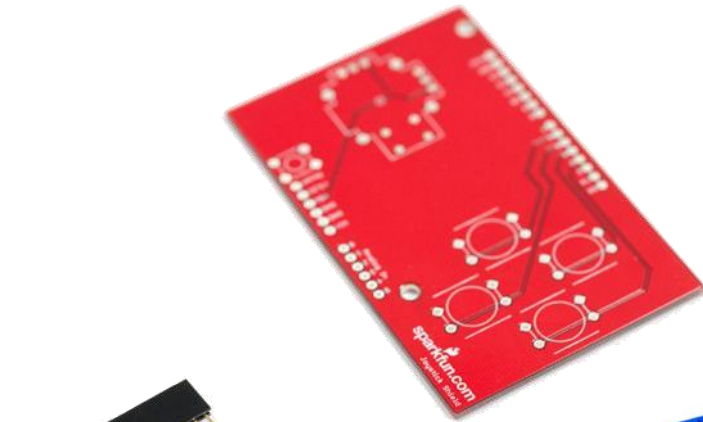
The pins are in three groups:

- Invented in 2010
- 14 digital pins
- 6 analog pins
- power



ARDUINO SHIELDS

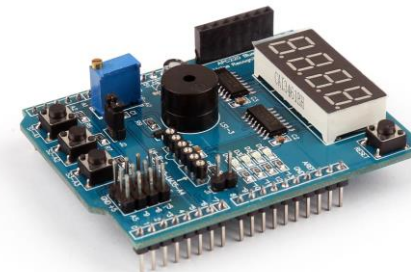
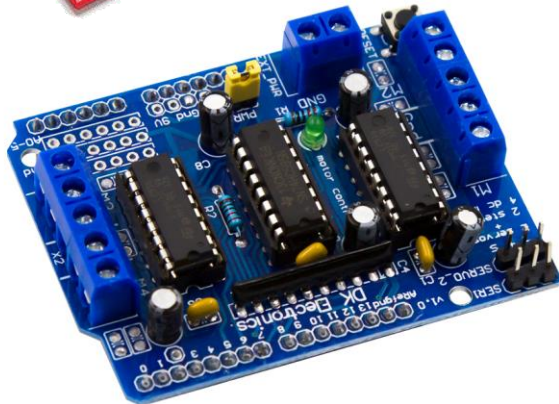
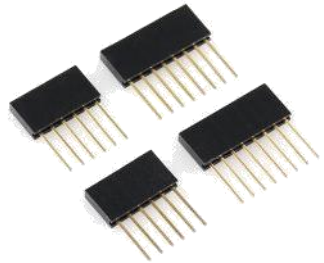
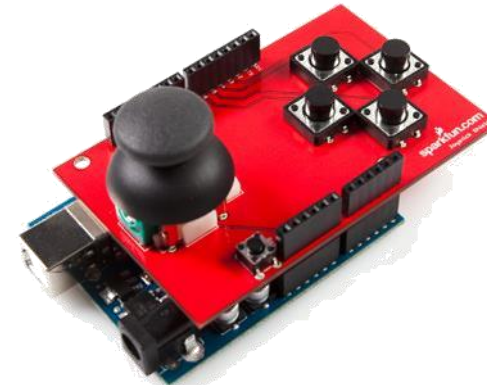
PCB



Built Shield



Inserted Shield

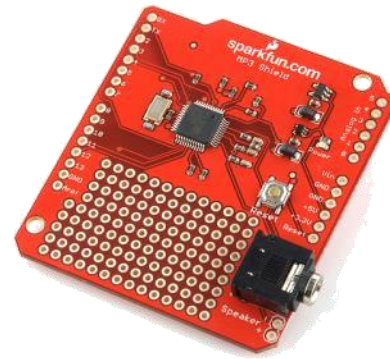


ARDUINO SHIELDS

Micro SD



MP3 Trigger



LCD





SMART CITY STREET LIGHTS CONTROL & MONITORING

By Rahul Shrivastava

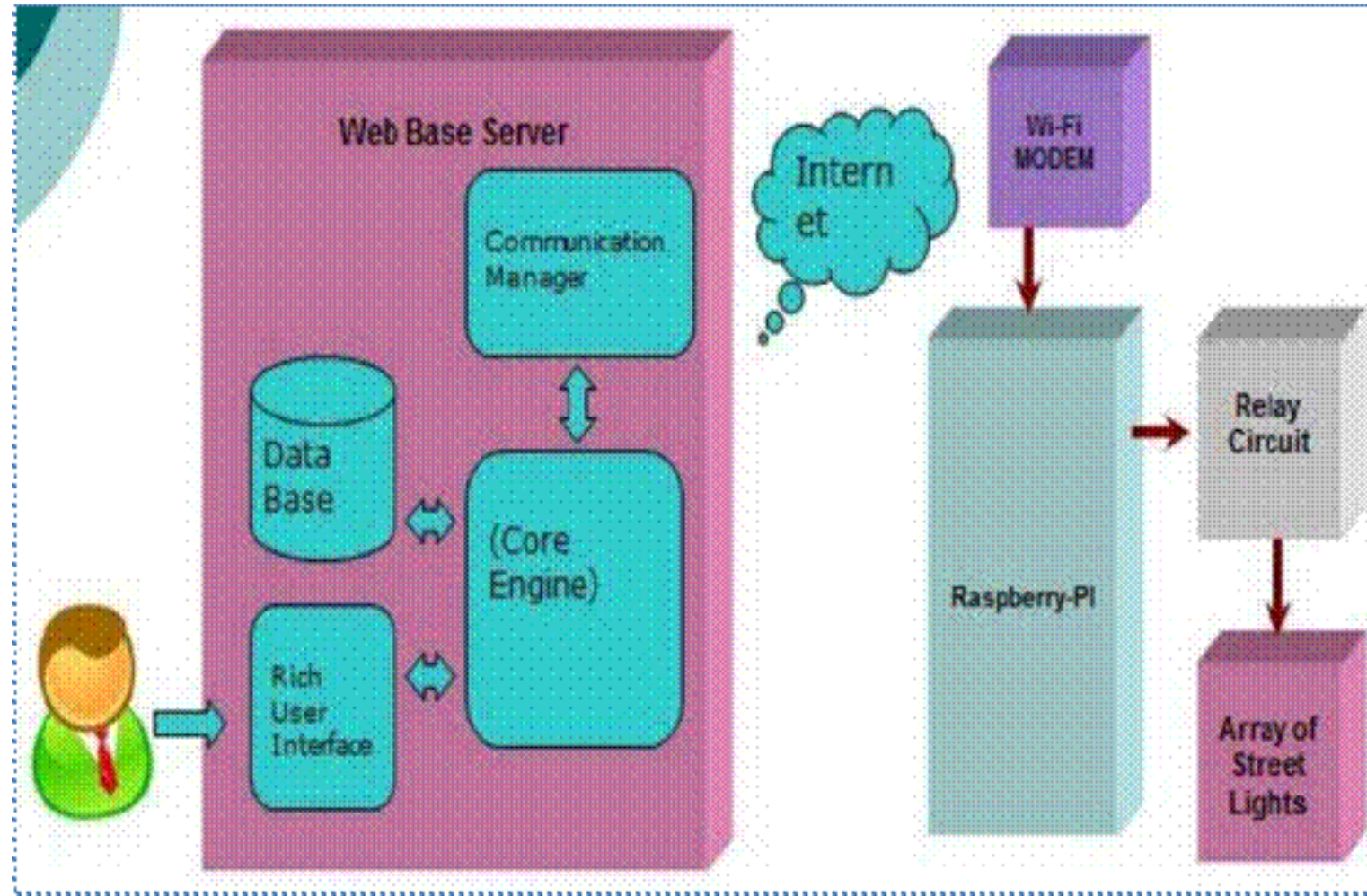
SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *INTRODUCTION*

- Street lights are one of the main city's assets which provide safe roads, inviting public areas, and enhanced security in homes, businesses, and city centers
- The goal is to automate street lighting, as current system is facing many problems.
- A user has to deal with numerous problems like
 - maintenance problem,
 - timer problem,
 - connectivity problem,
 - display problem.
- The solution to these problems is IoT Based Street Lights.

SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *ISSUES*

- Timer Problem-Contractors need to manage timer settings manually. As timer requires twelve hours of continuous electricity supply, and if in case it is not available, it will delay further timer settings.
- Maintenance problem-If any of the street lights gets failed or any problem occurs
- Incorrect Readings-Sometimes exact readings are not shown on the display. So we cannot conclude how much energy is being consumed which gives rise to high billing.

SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *COMPONENTS*



SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *COMPONENTS*

- **Energy efficiency using SSL (smart street light system)**
- The SSL system, a framework for fast, reliable, and power efficient street lamp switching based on pedestrians' location and personal desires of safety .
- In the developed prototype user location, detection as well as safety zone definition and announcement of other configuration information is accomplished using standard Smartphone capabilities.
- An application on the phone is periodically sending location and other information to the SSL server.
- For street lamp control, each and every lamppost is extended with a ZigBee-based radio device, receiving control information from the SSL server via multi-hop routing.

SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *COMPONENTS*

- **Embedded Platform for IoT applications**
- For embedded platforms, CoAP (Constraint Application protocol) is used for IOT applications.
- The main idea of this protocol is to provide a lightweight protocol for resource-oriented applications run on constrained networks.

SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *COMPONENTS*

- **Electrical power saving using VANET**

- The huge amount of electrical power of many countries is consumed in lighting the streets.
- However, vehicles pass with very low rate in specific periods of time and parts of the streets are not occupied by vehicles over time.
- An efficient autonomous street lighting control and monitoring system based on the innovative technology named as Vehicular Ad-Hoc Networks (VANET) is proposed.
- The system can be integrated with VANET to reduce the cost and use the rich services and communication features of VANET.
- Huge energy can be saved without affecting the visibility and the safety of the drivers.
- It can extend the lifetime of the lamps. It can automatically monitor the street lighting equipment's and warn the maintenance traffic authority upon failure detection in any place of the streets.

SMART CITY: STREET LIGHTS CONTROL AND MONITORING: *COMPONENTS*

- **System**

- Raspberry-Pi is used to provide interface between user and system.
- This system includes two admin: System admin and Operational admin.
- System admin handles log messages and operational admin.
- System admin can add, delete and view operational admin.
- Once the operational admin added to the system by the system admin then operational admin can log in to the system.
- For example, operational admin choose the city and area from database to ON or OFF the street lights.
- And if any fault occurs in the functioning of street lights then relay circuit will send the faulty street light's IP address to the operational admin then operation admin will resolve the problem.