DISTANCE MEASUREMENT

A SDC (IoT) mini project report submitted in partial fulfillment of therequirement for the Award of the Degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

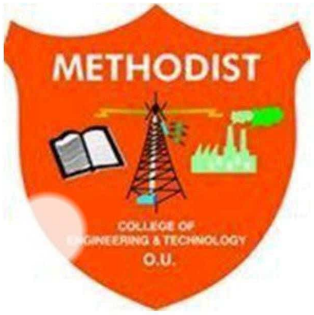
K.SATISH NAIK(160721733098),

T.VIGNESH KUMAR(160721733117),

A.KOUSHIK(160721733102)

under the Guidance of

Dr.S. Khaleel Ahmed Associate Professor, Dept. of CSE



Department of Computer Science and Engineering

Methodist College of Engineering and Technology,

King Koti, Abids, Hyderabad-500001.

2022-2023

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College of Engineering & Technology
(Approved by AICTE, New-Delhi & Affiliated to Osmania University)
College Code : 1607

Dr. Prabhu G Benakop
B.E., M.E., Ph.D.
SM., IEEE, LMISTE, LMISOI
Principal

VISION

To produce ethical, socially conscious and innovative professionals who would contribute to sustainable technological development of the society.

MISSION

- To impart quality engineering education with latest technological developments and interdisciplinary skills to make students succeed in professional practice.
- To encourage research culture among faculty and students by establishing state of art laboratories and exposing them to modern industrial and organizational practices.
- To inculcate humane qualities like environmental consciousness, leadership, social values, professional ethics and engage in independent and lifelong learning for sustainable contribution to the society.

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Department of Computer Science & Engineering

VISION

To become a leader in providing Computer Science & Engineering education with emphasis on knowledge and innovation.

MISSION

- To offer flexible programs of study with collaborations to suit industry needs
- To provide quality education and training through novel pedagogical practices
- To expedite high performance of excellence in teaching, research and innovations.
- To impart moral, ethical valued education with social responsibility.

Head of the Department
Department of CSE
Methodist College of Engg & Tech
Abids, Hyderabad.

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Department of Computer Science & Engineering

PROGRAM OUTCOMES

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in

Program Specific Outcomes

At the end of 4 years, Compute Science and Engineering graduates at MCET will be able to:

PSO1: Apply the knowledge of Computer Science and Engineering in various domains like networking and data mining to manage projects in multidisciplinary environments.

PSO2: Develop software applications with open-ended programming environments.

PSO3: Design and develop solutions by following standard software engineering principles and implement by using suitable programming languages and platforms

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Department of Computer Science & Engineering

Program Educational Objectives

Graduates of Compute Science and Engineering at Methodist College of Engineering and Technology will be able to:

PEO1: Apply technical concepts, Analyze, Synthesize data to Design and create novel products and solutions for the real life problems.

PEO2: Apply the knowledge of Computer Science Engineering to pursue higher education with due consideration to environment and society.

PEO3: Promote collaborative learning and spirit of team work through multidisciplinary projects

PEO4: Engage in life-long learning and develop entrepreneurial skills.

Head of the Department
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Abids, Hyderabad.

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Department of Computer Science and Engineering

Skill Development Course IoT MINI PROJECT

(3PW354CS)

A.Y 2022-2023

This is to certify that this SDC (IoT) Mini project report entitled " **DISTANCE MEASUREMENT SENSOR** ", being submitted *by K.SATISHNAIK (160721733098).T.VIGNESHKUMAR (160721733117).A.KOUSHIK(160721733102) submitted in partial fulfillment of the requirements for the degree of Bachelor of Engineering in Computer Science and Engineering, during the academic year 2022-2023, is a bonafide record of work carried out by them.*

INTERNAL **EXTERNAL** **HOD**

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Department of Computer Science and Engineering

DECLARATION BY THE CANDIDATES

We , **K .SATISHNAIK (160721733098), T .VIGNESHKUMAR (160721733117), A. KOUSHIK (160721733102)** students of Methodist College of Engineering and Technology , pursuing Bachelor's degree in Computer Science and Engineering, hereby declare that SDC(IoT) Mini project report entitled "DISTANCEMEASUREMENT", carried out under the guidance of **Er . Sandeep Ravikanti** submitted in partial fulfillment of the requirements for the degree of Bachelor of Engineering in Computer Science . This work is carried out by us and the references have been taking from various digital resources for report preparation.

K.SATISHNAIK(160721733098),
T.VIGNESHKUMAR(160721733117),
A.KOUSHIK(160721733102)

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Department of Computer Science and Engineering

CERTIFICATE BY THE SDC(IOT) LAB INCHARGE

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Dr.S.Khaleel Ahmed
Associate professor
Dept of CSE

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King Koti, Abids, Hyderabad-500001,

Department of Computer Science and Engineering

CERTIFICATE BY THE HEAD OF THE DEPARTMENT

This is to certify that this SDC(IoT) Mini project report entitled "**DISTANCE MEASURING** " *by* **K.SATISHNAIK(160721733098),T.VIGNESHKUMAR(160721733117),A.KOUSHIK(160721733102)**, submitted in partial fulfillment of the requirements for the degree of Bachelor of Engineering in Computer Science and Engineering of the Osmania University, Hyderabad, during the academic year 2022-2023, is a bonafide record of work carried out by them.

Dr. P. Lavanya,
Professor &
Head of the Department

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our project guide **Dr.S.Khaleel Associate professor Dept of CSE**for giving us the opportunity to work on this topic. It would never be possible for us to take this project to this level without his innovative ideas and his relentless support and encouragement. Who helped us by being an example of high vision and pushing towards greater limits of achievement.

Our sincere thanks to **Dr. P. Lavanya, Professor** and **Head of the Department of Computer Science and Engineering,** for her valuable guidance and encouragement which has played a major role in the completion of the project and for helping us by being an example of high vision and pushing towards greater limits of achievement.

We would like to express a deep sense of gratitude towards the **Dr. Prabhu G Benakop, Principal, Methodist College of Engineering and Technology,** for always being an inspiration and for always encouraging us in every possible way.

We would like to express a deep sense of gratitude towards the **Dr. Lakshmipathi Rao, Director, Methodist College of Engineering and Technology,** for always being an inspiration and for always encouraging us in every possible way.

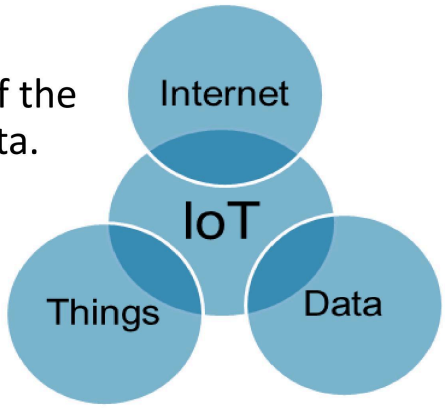
We are indebted to the Department of Computer Science & Engineering and Methodist College of Engineering and Technology for providing us with all the required facility to carry our work in a congenial environment. We extend our gratitude to the CSE Department staff for providing us to the needful time to time whenever requested.

We would like to thank our parents for allowing us to realize our potential, all the support they have provided us over the years was the greatest gift anyone has ever given us and also for teaching us the value of hard work and education. Our parents have offered us with tremendous support and encouragement, thanks to our parents for all the moral support and the amazing opportunities they have given us over the years.

What is the Internet of Things (IoT)?

- IoT is a **network** of interconnected objects (**things**) that are embedded with **sensors**, **actuators**, software, and other technologies for the purpose of connecting and exchanging **data** with other devices and systems over the **internet**.

- IoT is the intersection of the Internet, Things and Data.



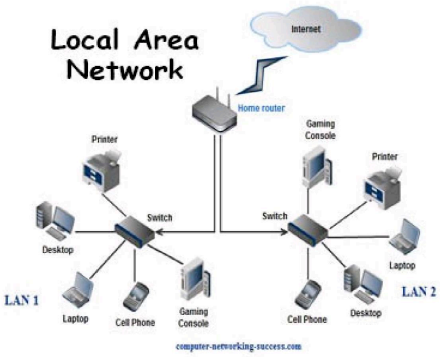
What is the Internet of Things (IoT)?

- After excluding computers and handheld devices (e.g., cellphones and tablets), there are 16.5 billion connected things in 2020 worldwide
- IoT collects that data from millions of sensors embedded in everything from cars, to refrigerators, to space capsules

IoT - Historical Perspective

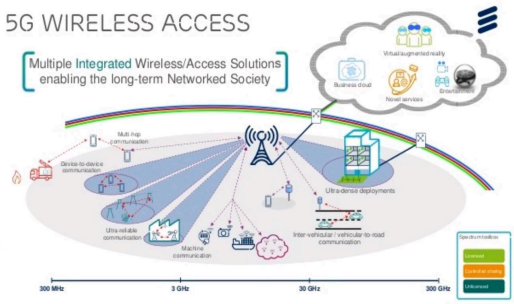
Yesterday

local Area Networks (LAN), Static services (email, web)



Today

Wireless Mobile, ubiqitous Internet access, Cloud Mobile Services & Resources



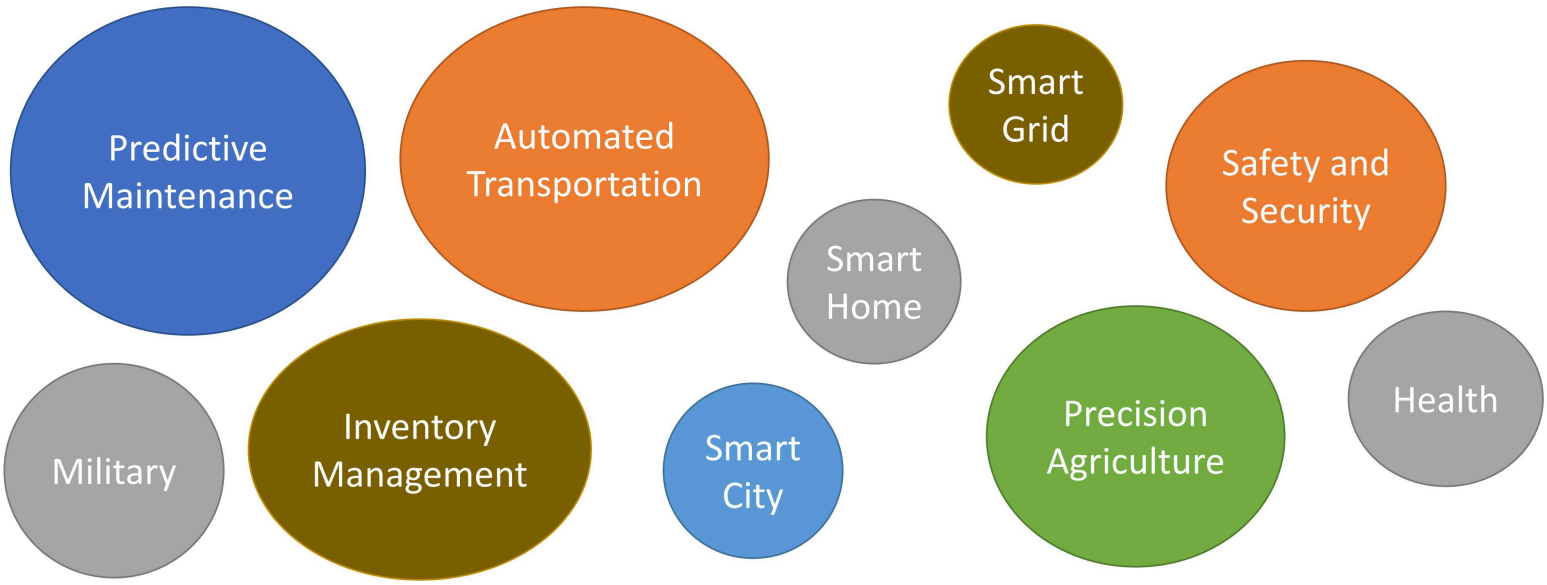
Today/Tomorrow

Machine to machine (M2M), Internet of Things (IoT), Smart World services

Evolution

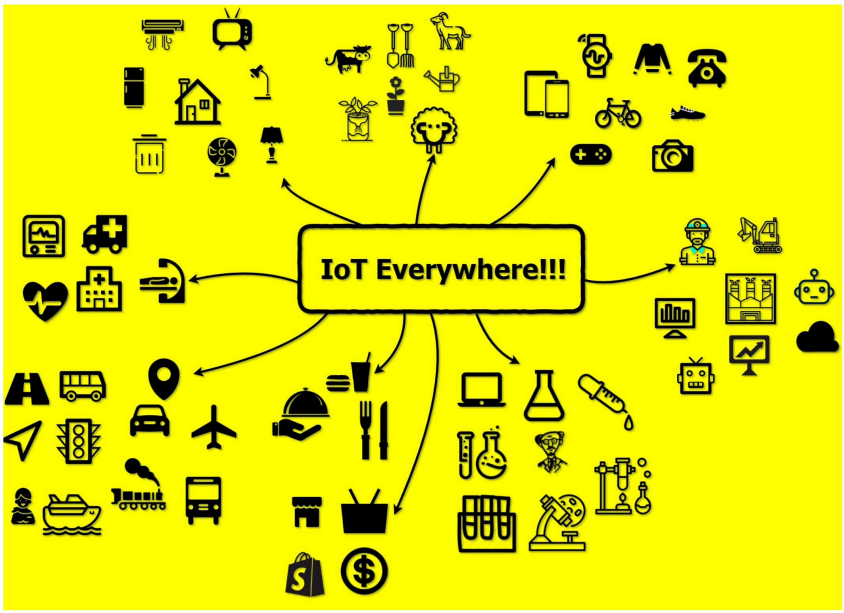
IoT Domains

- With sensors becoming increasingly ubiquitous, there is tremendous potential for innovative IoT applications across a wide variety of domains



IoT is Everywhere: From Home to Work

- Automated Transportation
- Smart Farming
- Smart Surveillance Cameras
- Thermostats
- Baby Monitors
- Smart TVs
- Refrigerators
- Children’s Toys
- Automatic Light Bulbs

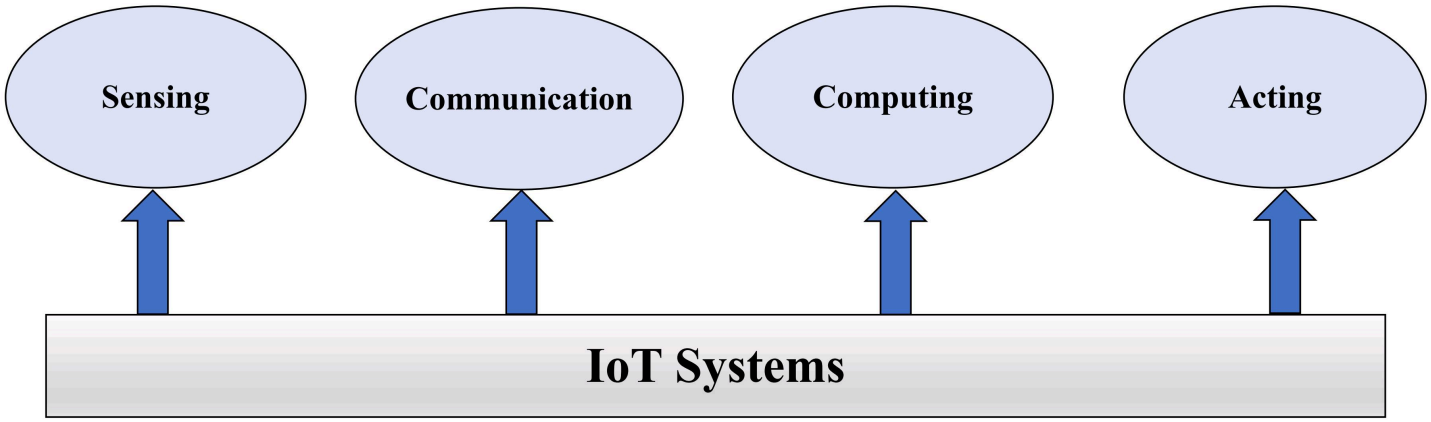


IoT sensing: more sensors than ever

- Pervasiveness of Sensing devices (digital data)
  - E.g. current smartphones are equipped with a number of embedded sensors

- A Mobile Smartphone can provide a lot of context information about you and your activities:
  - your mobility (even wthout GPS)
  - your movement between floors in a building
  - Your speech
  - Your contacts
  - Your interaction with other objects

Four Main Components of IoT Systems



IoT sensors and Actuators

- **Sensor:** a connected device enabling the sensing of physical parameters of the scenario or controlled environment, whose values are transformed into digital data.
- **Actuator:** a connected device enabling the activation of actions on the controlled environment.
- **Controller:** a connected device implementing an algorithm to transform input data in actions.
- **Smart things:** digital devices providing service functions realized by the synergy between sensors, actuators and controllers (possibly implemented by local/distributed execution platforms and M2M/Internet communications).

A Smart Home Example

- One typical evening planning next working day…

How is IoT Shaping Agriculture?

Smart Agriculture Sensors

- E.g. weather conditions, soil quality, crop's growth progress or cattle's health.
- Data can be used to track the state of the agriculture field as well as equipment efficiency.

Cost Management and Waste Reduction

- Monitor anomalies in the crop growth or livestock
- Mitigate the risks of losing the yield
- Lead to higher revenue.

Process Automation

- Increase business efficiency through process automation
- By using smart devices, farmers can automate multiple processes across your production cycle
- E.g. irrigation, fertilizing, or pest control.

Enhanced Product Quality and Volumes

- Achieve better control over the production process
- Maintain higher standards of crop quality and growth capacity through automation.

Monitoring Climate Conditions

- Weather stations combine various smart farming sensors
- Weather stations collect various data from the environment and send it to the cloud
- These measurements can be used to map the climate conditions
- It can be also used to choose the appropriate crops, and take the required measures to improve their capacity (i.e. precision farming)

Greenhouse Automation

- The use of IoT sensors enables farmer to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.
- Weather stations can automatically adjust the conditions inside the greenhouse to match the given parameters.

Crop Management

- Crop management devices, just like weather stations, can be placed in the field to collect data specific to crop farming such as temperature, leaf water potential, overall crop health, etc.

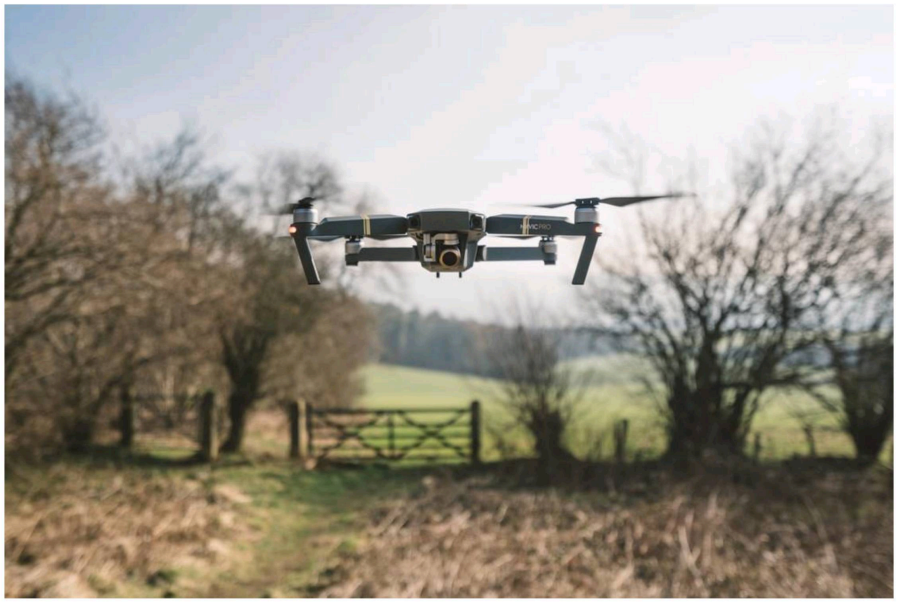
- Farmers can monitor their crop growth and any anomalies to effectively prevent any diseases or infestations that can harm the yield

Cattle Monitoring and Management

- IoT agriculture sensors that can be attached to animals on a farm to monitor their health and log performance.
- Livestock tracking and monitoring help collect data on stock health, well-being, and physical location.
- Such sensors can identify sick animals so that farmers can separate them from the herd and avoid contamination.
- Using drones for real-time cattle tracking also helps farmers reduce staffing expenses.

Agricultural Drones

- Also known as UAVs (unmanned aerial vehicles), drones are better equipped than airplanes and satellites to collect agricultural data.
- Drones can also perform a vast number of tasks that previously required human labor such as planting crops, fighting pests and infections, agriculture spraying, crop monitoring, etc.



IoT Wearables

Wearables' Characteristics

- Small electronic devices
- Comprised of one or more sensors
- Associated with clothing or worn accessories, such as watches, wristbands, glasses, and jewelry
- Have some sort of computational capability
- Capture and process data about the physical world
- Some presenting data in some sort of display

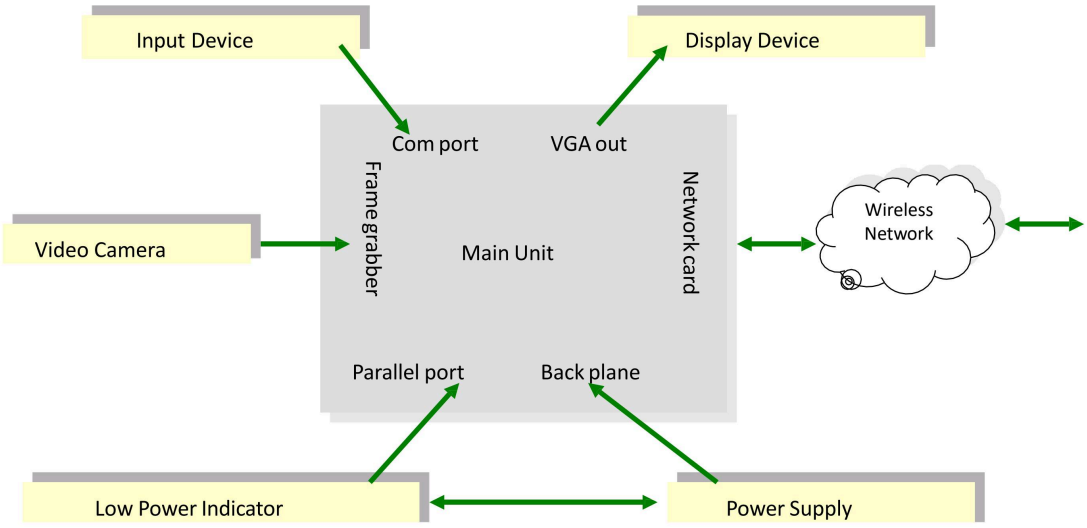
Connectivity

- Wearable devices are not always connected to the Internet
- Offer connectivity, such as Bluetooth- or NFC- (Near Field Communications) based connectivity to smartphones
- Connect to smartphone applications

IoT Wearables

- Adding information & value to wearables' capabilities
- More sensors and functionalities
- Integration with services and data provided by other devices (including other wearables)

IoT Wearable System



Wearables Input & Output Devices

Input Devices	Output Devices
• Keyboard alternative, included chording keyboards and special purpose keyboards • Mouse alternatives, including trackballs and joysticks • Tab alternatives, including buttons and dials • Eye trackers • Head trackers • Pens • Gesturing • Bar code readers • Textiles • Video capture devices, microphones, GPS locators • Speech recognition • Other devices (e.g., skin sensors)	• Head Mounted Displays (HMDs) • Flat panels, text-to-speech • Tactile output • Non-speech auditory output • Paper and olfactory output (scent)

Wearables Functionalities and Application Areas

Sensors	Consumer-oriented applications	Non-consumer-oriented applications
• Light • Sound • Speed/acceleration • Humidity • Temperature • Accelerometers	• Fitness and sports • Fashion and apparel • Home automation • Gaming	• Defense and security • Manufacturing and industry • Healthcare

Wearables Examples

Apple Watch

- Includes a heart rate sensor, GPS, and an accelerometer
- Fully integrated into the Apple ecosystem

Sensoria Fitness T-shirt

- Comprised of embedded textile sensors
- Enables tracking of heart rate

Adidas Smart Run

- Wrist device that monitors the wearer's heart rate and location data
- Blended into Adidas miCoach system

IoT Future Trends

Wearables Ecosystems	Interoperability	Novel IoT Services
• Complete programming and application development environments beyond the device level • Wearables as parts of the IoT ecosystem	• Across devices of different types and from different vendors • Across different ecosystems • Single entry point for managing personal data	• Integrated IoT wearables services combining data and services from multiple ecosystems • Driven by innovation for fitness, healthcare, industry, etc.

IoT and Manufacturing Maintenance Activities

Preventative and condition-based monitoring

- Prevent malfunctions
- Equipment that needs to operate within a certain temperature range, the company can use IoT sensors to actively monitor when it goes out of range
- Measuring vibrations to detect operations that are out of spec
- Leverages Big Data Analytics including predictive modelling

Predictive Maintenance

- Leverage multiple modalities to predict when maintenance will be required
- Examples: vibration analysis, oil analysis, thermal imaging, etc.

Asset Monitoring and Management Using IoT

Asset Management using IoT

- Monitoring assets for their status (including predictive maintenance) using IoT Technologies
- New service offerings and business models for equipment suppliers

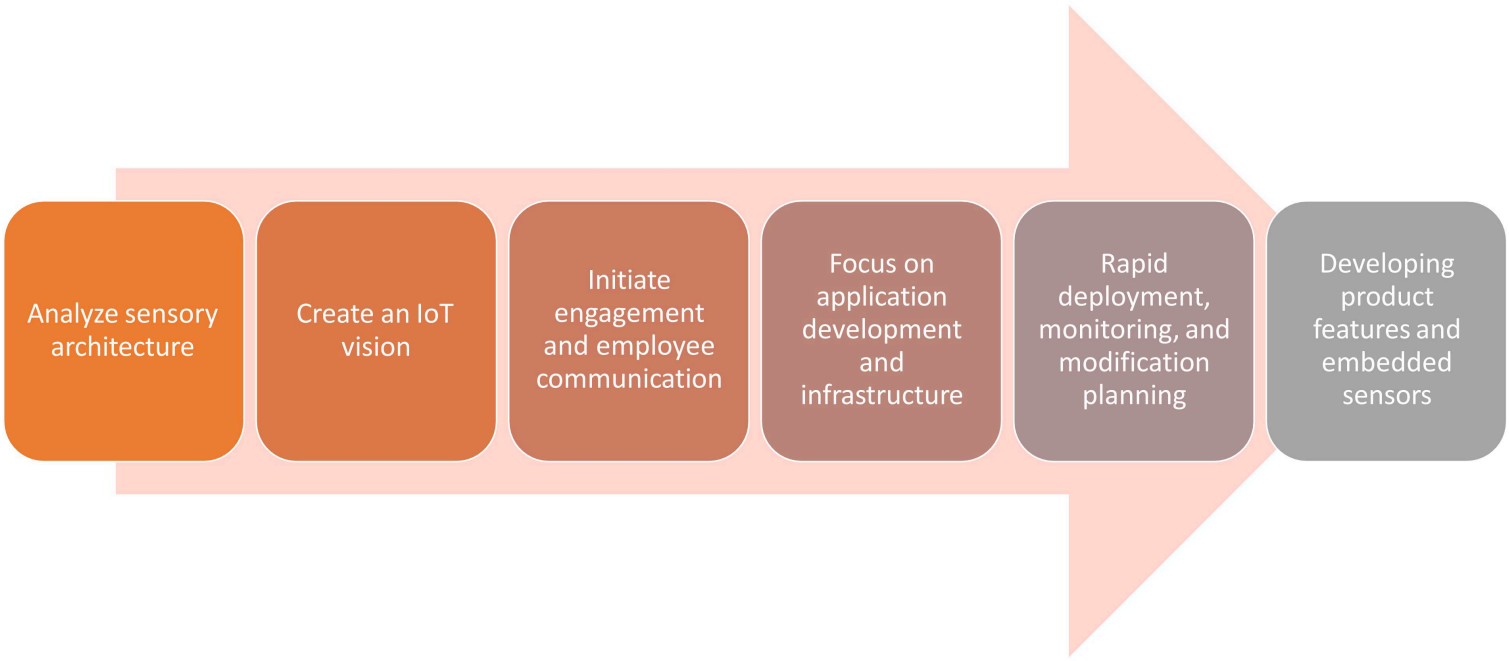
Example Business Models

- Models around hours of operation rather than equipment sale; buyers use the equipment in an “as-a-service” offering
- New and very closely linked business relationships between manufacturers and their suppliers

Industry example

- GE’s maintenance cost per (flight) hour model for its aviation business

IoT Applications Development Process



IoT Applications - Smart City

Urbanization	Demographic changes	Changing lifestyles	Climate change
• Urban population worldwide amounts currently to approximate 4.1 billion people • Expected to double by 2050 • Resource depletion; need for efficient management of resources • Exclusion, inequality, and rising insecurity challenges	• Number of seniors aged 60 or over is the fastest growing segment of the population at a rate of 3.26% • Decline in infant mortality & high fertility • Proliferation of the younger population • Need for employment opportunities	• Changes in family patterns • New habits in work and mobility, e.g., tele-working, vehicle sharing, & renting • Need for novel urban services in support of these changes	• Climate changes & global warning • Policies for efficient use of water, energy, and other resources • Measures for sustainable growth

Smart Cities and IoT

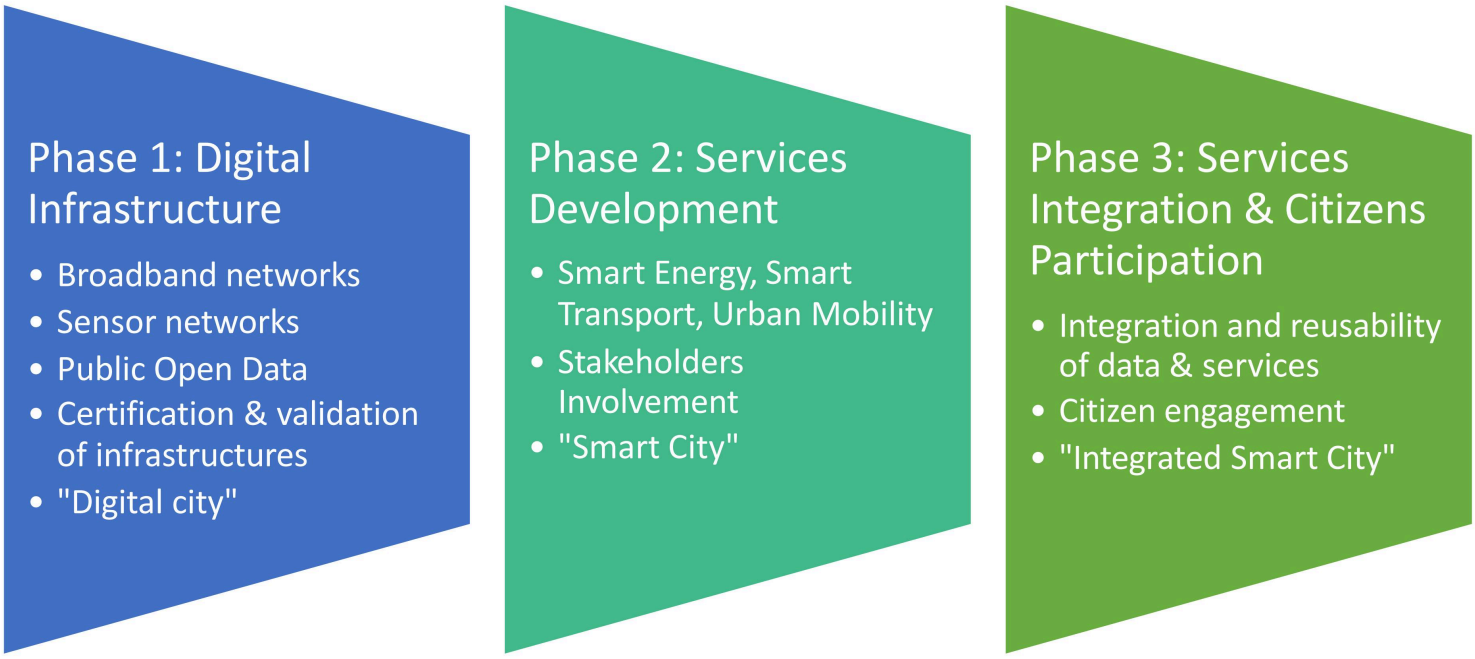
Smart Cities are empowered by IoT technologies

- Empowers internet-based connectivity across devices
- IoT will generate up to $11.1 trillion a year in economic value by 2025
- Smart cities are one of the IoT settings with the highest business value

Relevant IoT technologies

- Connectivity: WiFi, 4G/LTE, 5G
- Devices interaction: IoT middleware
- Scalable processing: Cloud computing
- Data processing: Data mining, Data analytics, BigData

Smart City Development Model



IoT & Smart Cities Services Trends

Interoperability

- Control center integrating all systems and projects in the smart city using IoT technologies

Citizen Engagement

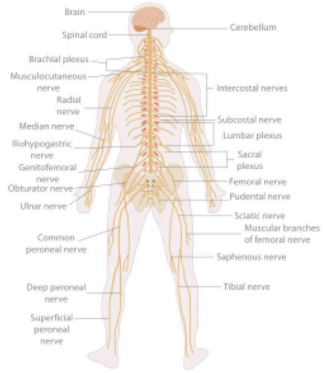
- Engagement in IoT Services design (e.g., co-creation, integration of artistic concepts)
- Citizen-centric services

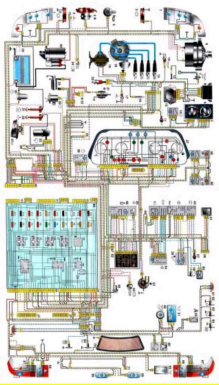
Public Private Partnerships

- Public sector deploys connectivity infrastructure (Wifi); while private sector deploys services

Connected Car and IoT Transport Sensors

- An economy cars: more than 200 sensors (brakes, belts, air bags, doors, etc.)
- A luxury car: more than 600 sensors (A/C, ABS, lights, radar, road conditions, etc.)
  - 70 sensors just in the engine of a 2005 Ford Focus (today 15X w.r.t. 15 years ago)
  - Vehicle safety and comfort has improved via sensors and actuators





The vehicle's automatic control (beyond driver) is more likely a "**nervous system**" reacting to possible problems, obstacles and contributing to comfort and safety

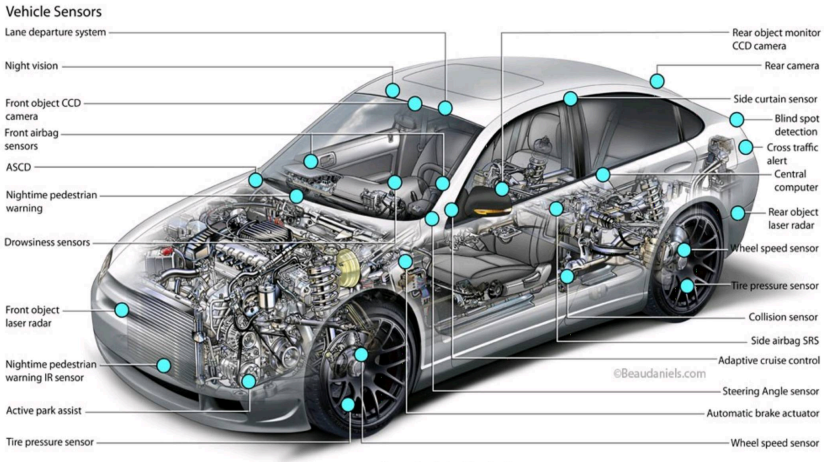


Image source: Beaudaniels-illustration.com

Connected Car and IoT Transport Sensors

- Road Condition Sensor
- Magnetic Sensor
- Vehicle Distance Sensor
- Forward Obstacle Sensor
- Blind Spot Monitoring Camera
- Drive Recorder
- Side Obstacle Sensor
- Air Pressure Sensor
- Airbag
- Road-To-Vehicle/Vehicle-to-Vehicle Communication System
- Rear View Camera
- Water Repelling Wind Shield
- Seatbelt Pretensioner
- Driver Monitoring Sensor
- Headup Display
- Steering Angle Sensor
- Electronic Control Throttle
- Electronic Control Brake
- Fire Detector Sensor
- Vehicle Speed, Acceleration Sensor
- Collision Detection Sensor
- Pedestrian Collision Injury Reduction Structure
- Electronic Control Steering
- Message Display System
- Hands-Free System
- Inside Door Lock/Unlock
- Rear Obstacle Sensor
- GPS Sensor

Source: *Application Developers Alliance, "Internet of Things: Automotive as a Microcosm of IoT", White Paper, 2019*

Connected Car: Indicative Applications

Infotainment

- Brings information functions (i.e., navigation, location-based services, rear seat web browsing, social networking, etc.) into the vehicle's entertainment system.
- E.g., CarPlay for using iTunes, watch videos, run navigation apps on the in-dash display with a touch screen interface & Apple's voice-companion Siri (vocal commands)
- Bring the entire apps ecosystem to the dashboard and present endless possibilities for an in-car experience
- Examples: Read out email & calendar reminders, order food, switch on the heater, etc.

Vehicle-to-Vehicle (V2V) Communication

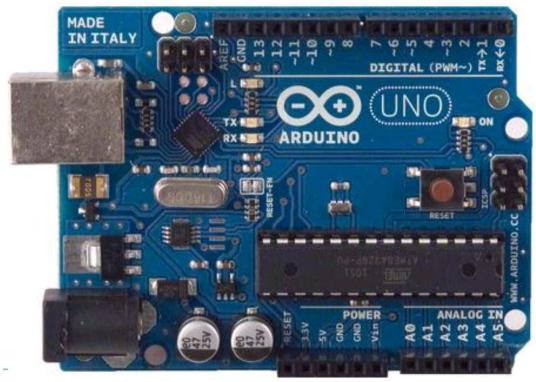
- Wireless exchange of the position, speed, and location data between nearby vehicles
- E.g., toward improving the safety of commuters

Vehicle-to-Infrastructure (V2I) Communication

- Wireless exchange of information between vehicles and roadside infrastructure
- Communicate with the roads, digital signage, traffic lights, safety, and control systems
- E.g., avoid crashes and traffic congestion

What is Arduino?

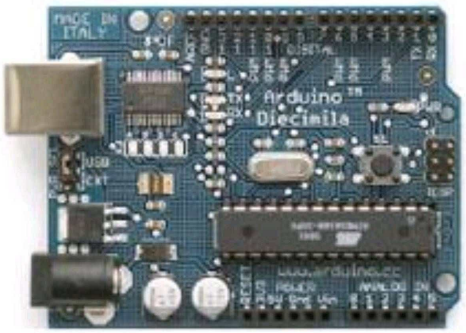
- An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits.
- It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.



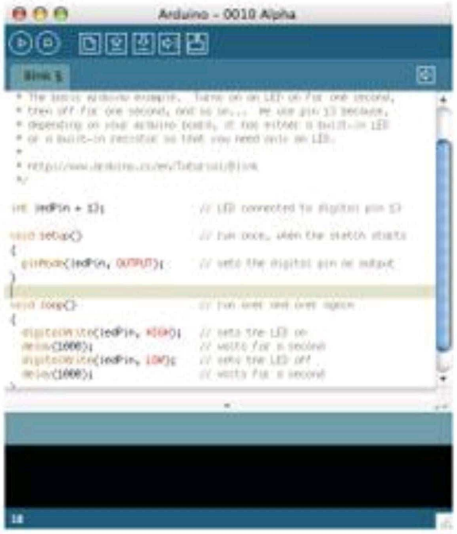
What is Arduino?

The word "Arduino" can mean 3 things

A physical piece of hardware



A programming environment



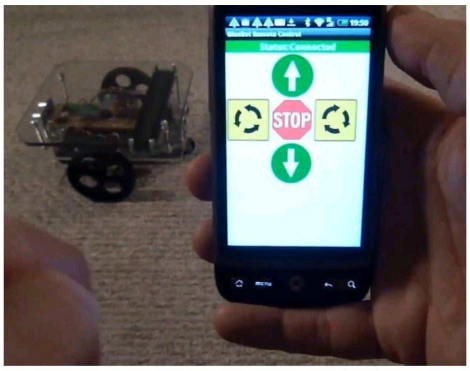
A community & philosophy

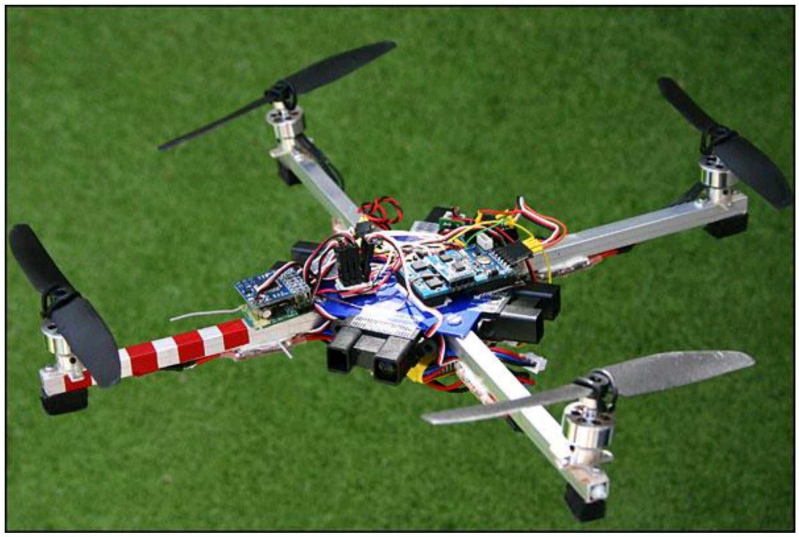
todbot.com/blog/bionicarduino

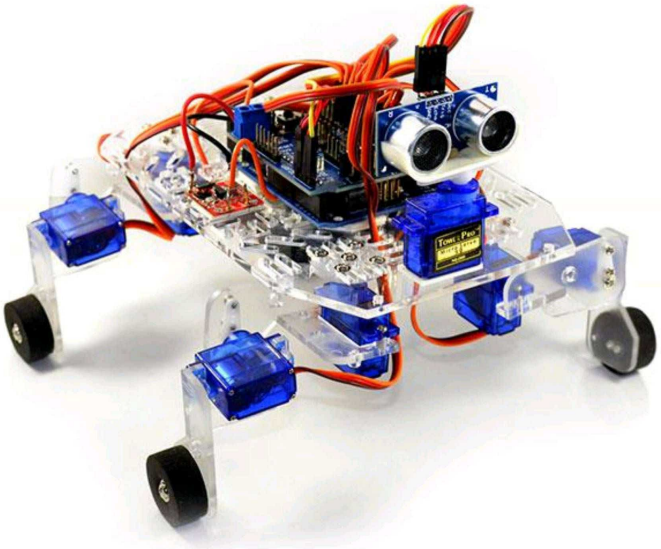
Why Arduino?

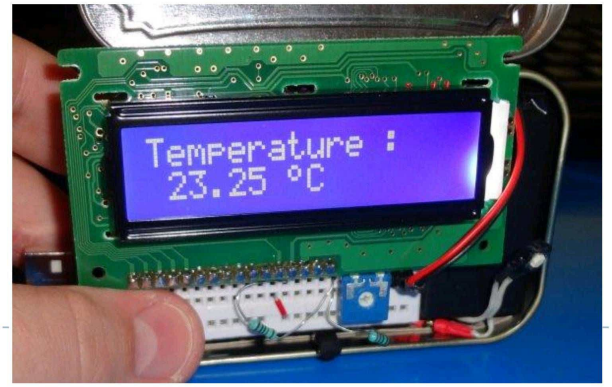
- Open source and extensible software- The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries
- Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it.
- Inexpensive
- Cross-platform
- Simple, clear programming environment

Examples of Arduino Projects

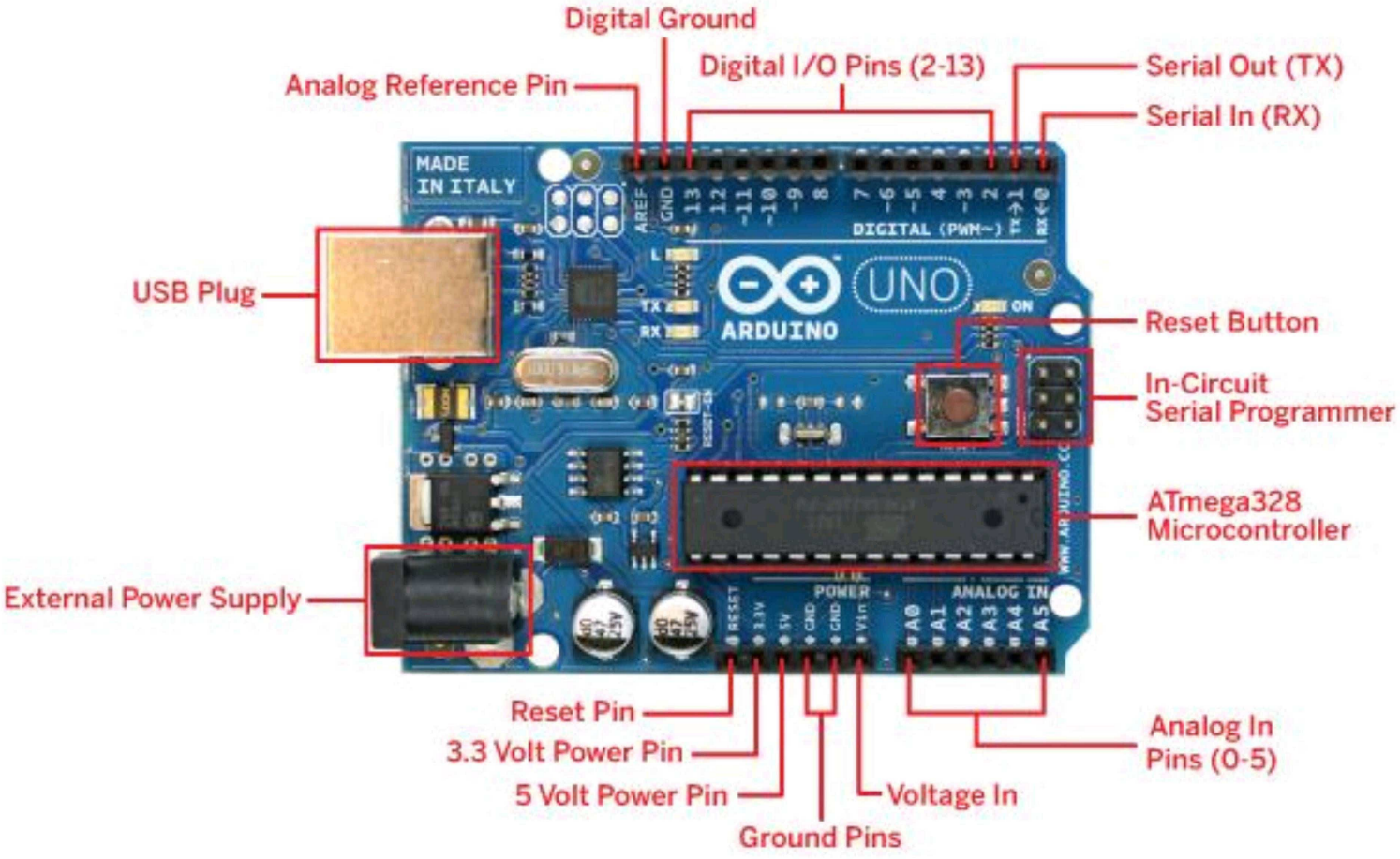








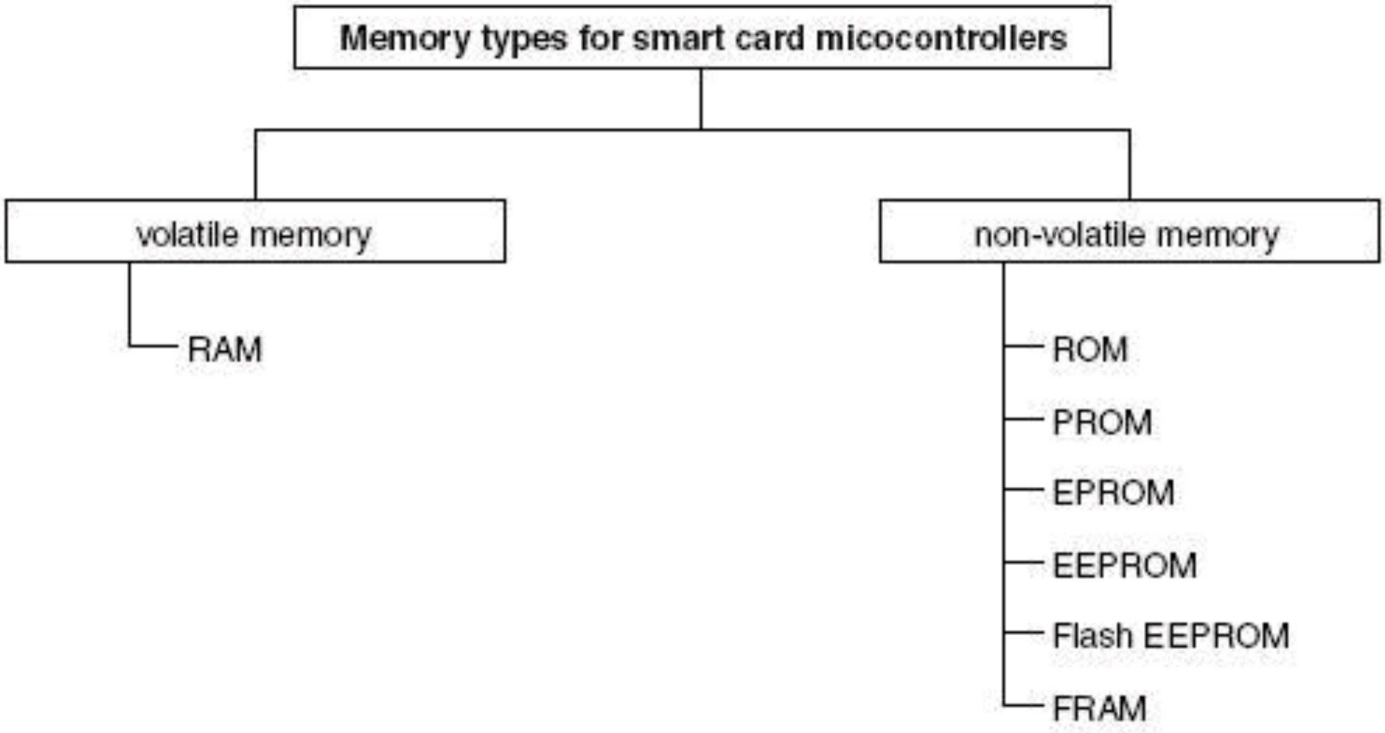
Arduino UNO board



UNO specs

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Memory Types



Arduino has:

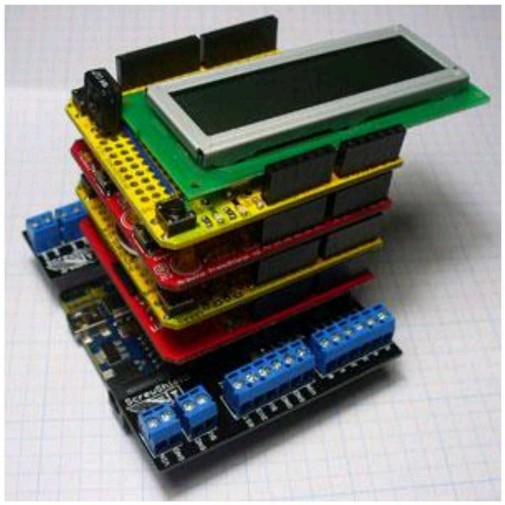
- Flash memory: it's a rewritable non-volatile memory. This means that its content will still be there if you turn off the power. It's a bit like the hard disk on the arduino board. Your program is stored here. code for writing and retrieving any data structure to EEPROM easily.
- RAM: it's like the RAM in your computer. Its content disappears when you turn off the power, but it can be read and written really fast. Every normal variable in your sketch is held in RAM while your sketch runs.
- EEPROM: it's an older technology to implement rewritable non-volatile memory. It's normally used to store settings and other parameters between resets.

Power

- The Arduino Uno 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 center-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 of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

Arduino Shields

- Shields are boards that can be plugged on top of the Arduino PCB extending its capabilities. The different shields follow the same philosophy as the original toolkit: they are easy to mount, and cheap to produce.



Examples Arduino Shields

- Arduino Wi-Fi Shield - This is the Arduino Ethernet Shield sans wires. This shield can get your Arduino connected to a WiFi router, so it can host webpages and scour the Internet.
- Cellular Shield w/ SM5100B - Turn your Arduino into a cellular phone! Send SMS text messages, or hook up a microphone and speaker and use it to replace your iPhone.
- GPS Shield - GPS isn't as complicated as you might think. With a GPS Shield, your Arduino will always know where it is.

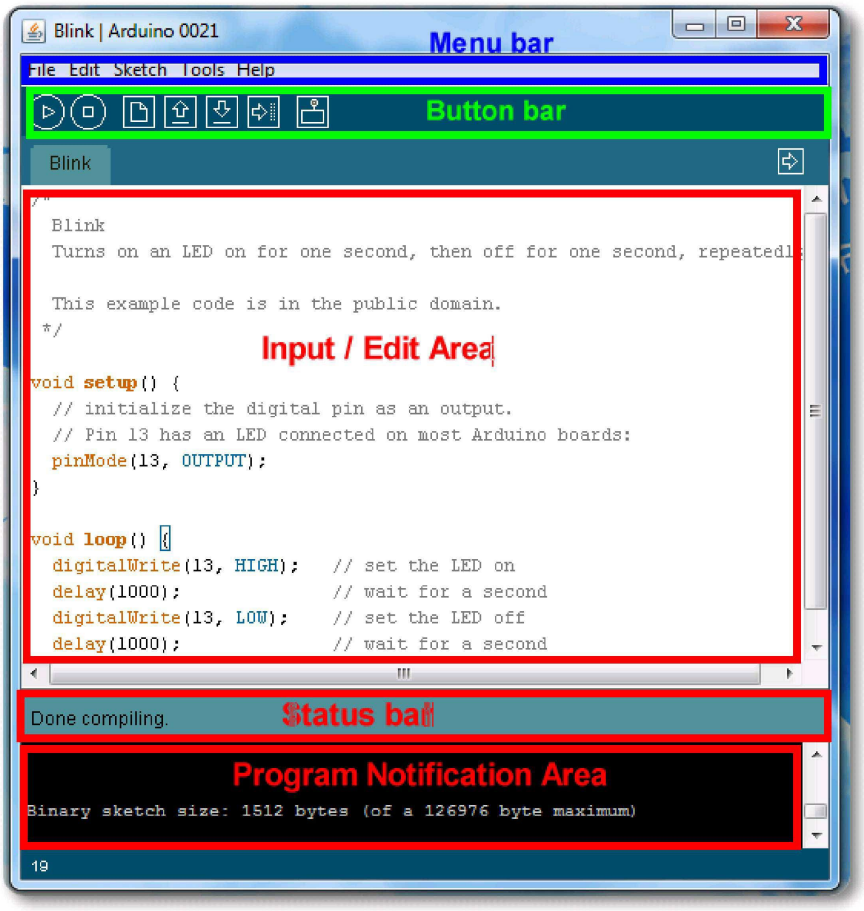
Getting Started !

- Visit: http://arduino.cc/en/Main/Software
- Download & install the Arduino environment (IDE) for Windows, Mac, or Linux. (Latest version: 1.6)
- Extract the ZIP file. (The extracted folder will contain both the Arduino program itself and also the drivers that allow the Arduino to be connected to your computer by a USB cable.
- Connect the board to your computer via the UBS cable.
- The power light on the LED will light up and you may get a 'Found New Hardware‘ message from Windows.
- Ignore this message and cancel any attempts that Windows makes to try and install drivers automatically for you.

Getting Started (cont.)

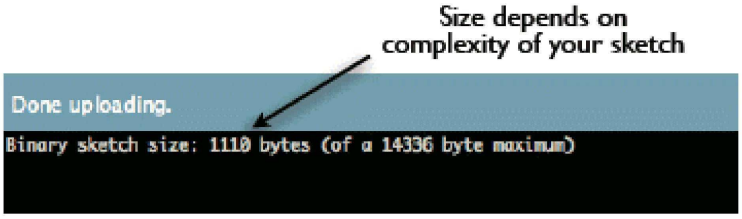
- Open Device Manager
- Under the section "Other devices" you should see an icon for "unknown device", write click on it and press update driver software.
- Select the option: "Browse my computer for driver software".
- Navigate to:
- arduino-1.0.2-windows\arduino1.0.2\drivers, in the extracted folder.
- You should be done by successfully installing the Arduino driver.

Arduino IDE


Blink | Arduino 0021
Menu bar
File Edit Sketch Tools Help
Button bar
Blink
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
This example code is in the public domain.
*/
Input / Edit Area
void setup() {
// initialize the digital pin as an output.
// Pin 13 has an LED connected on most Arduino boards:
pinMode(13, OUTPUT);
}
void loop() {
digitalWrite(13, HIGH); // set the LED on
delay(1000); // wait for a second
digitalWrite(13, LOW); // set the LED off
delay(1000); // wait for a second
Done compiling.
Status bar
Program Notification Area
Binary sketch size: 1512 bytes (of a 126976 byte maximum)
19

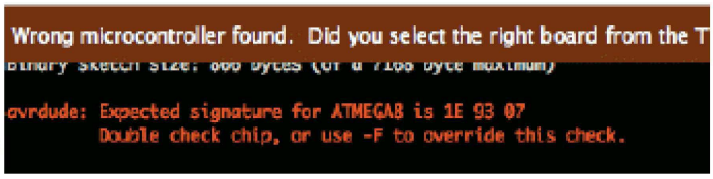
Status messages

Uploading worked



Wrong serial port selected

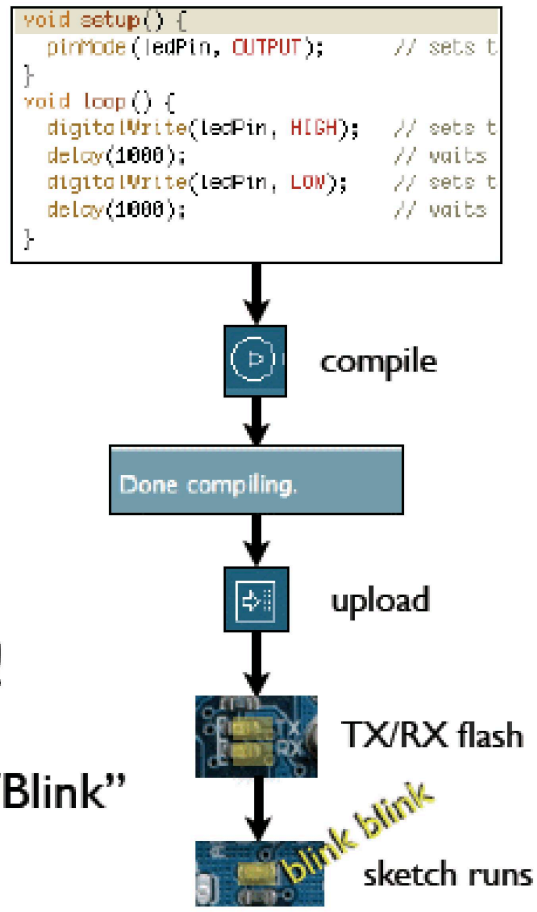
Wrong board selected



nerdy cryptic error messages

Using Arduino

- Write your sketch
- Press Compile button (to check for errors)
- Press Upload button to program Arduino board with your sketch

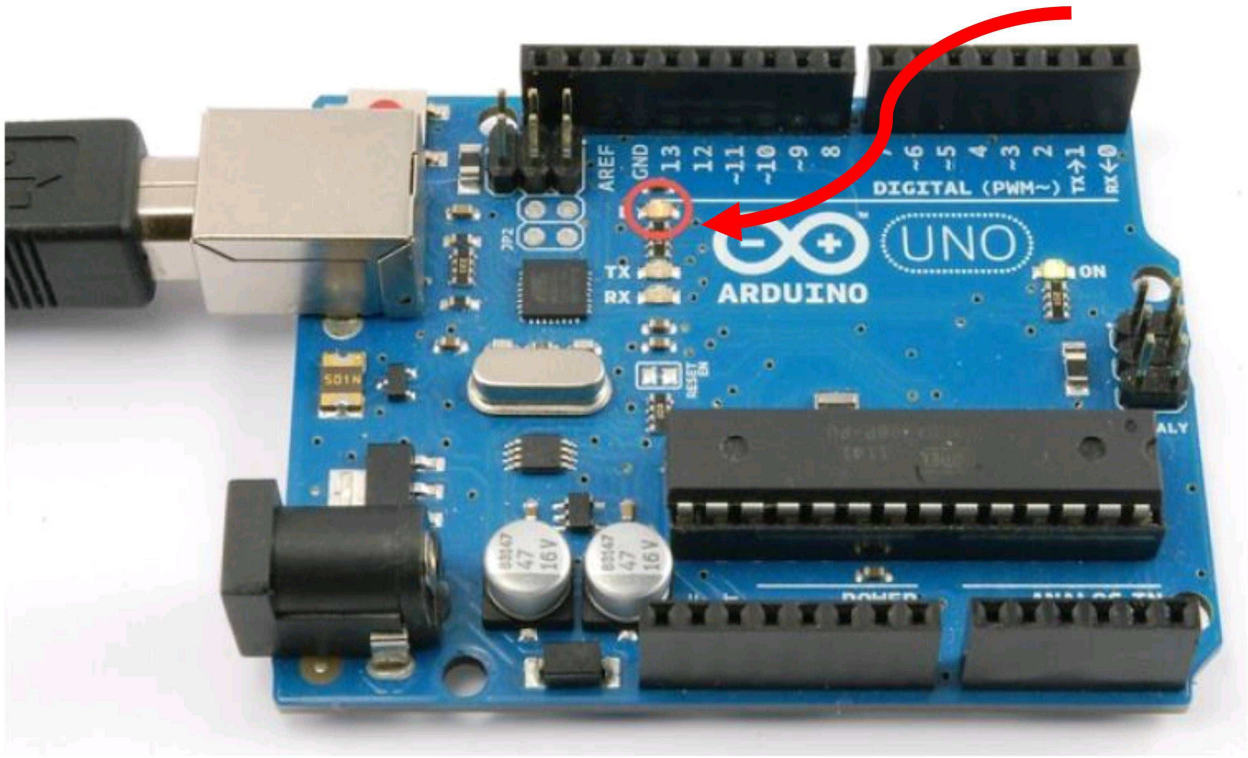


Try it out with the "Blink" sketch!

Load "File/Sketchbook/Examples/Digital/Blink"

Our First Program ! Blink

- Now, you will learn how to make the built-in LED blink.

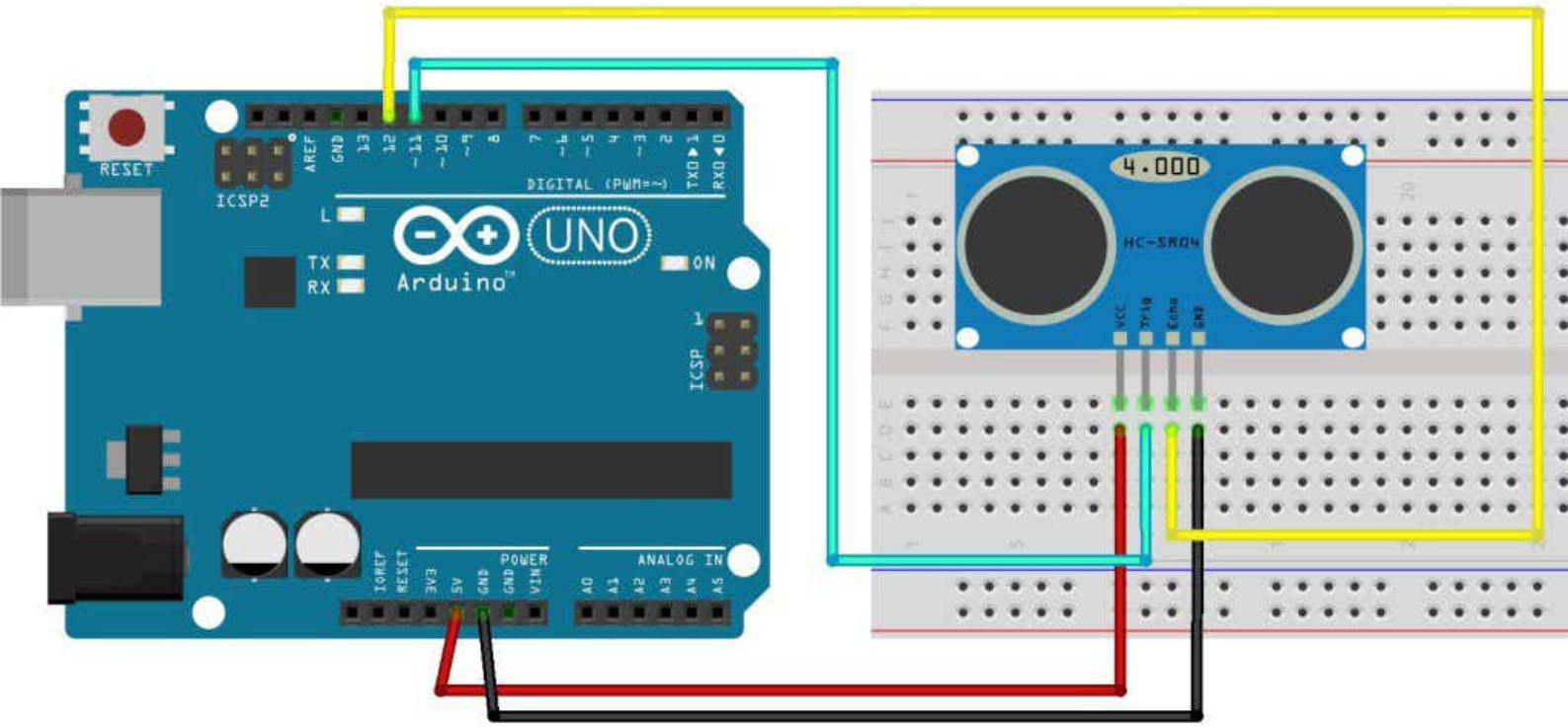


Our First Program ! Blink

- In the IDE, select: File>>Examples>>Basics>>Blink
- This is a read-only version, save it as with any other name.

MyBlink §

```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  Most Arduinos have an on-board LED you can control. On the Uno and
  Leonardo, it is attached to digital pin 13. If you're unsure what
  pin the on-board LED is connected to on your Arduino model, check
  the documentation at http://arduino.cc

  This example code is in the public domain.

  modified 8 May 2014
  by Scott Fitzgerald
 */


// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
```


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
UNO
Arduino™
ON
ICSP
POWER
IOREF
RESET
3V3
5V
GND
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5
4.000
HC-SR04
VCC
Trig
Echo
GND

METHODIST
COLLEGE OF ENGINEERING & TECHNOLOGY
[Autonomous Institution]
Accredited by NAAC with A+ and NBA
Affiliated to Osmania University & Approved by AICTE
Estd : 2008

Component Measurement Using Ultrasonic Sensor

Abstract - *The objective of this project is to design and manufacture the instrument which can measure geometrical parameters (length, width, height) of component without using traditional or current measuring techniques. This instrument has various advantages over the traditional measuring instruments.it has less moving parts and requires less physical efforts to operate it. The instrument consists of most crucial part known as ultrasonic sensor, LCD display, a circuit which is used to control the various components knows as arduino and set of wires.*

Key Words: Ultrasonic Sensor, Component Measurement, Arduino, Job Inspection, Job Analysis, Job Measurement.

1. INTRODUCTION

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object. Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound wave. Round-trip means that the sound wave travelled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object AND the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the round-trip distance in half. NOTE: The accuracy of Ultrasonic sensor can be affected by the temperature and humidity of the air it is being used in [1]. However, this change in accuracy will be negligible. It is important to understand that some objects might not be detected by ultrasonic sensors. This is because some objects are shaped or positioned in such a way that the sound wave bounces off the object, but are deflected away from the Ultrasonic sensor. It is also possible for the object to be too small to reflect enough of the sound wave back to the sensor to be detected. Other objects can absorb the sound wave all together (cloth, carpeting, etc.), which means that there is no way for the sensor to detect them accurately. These are important factors to consider when designing and programming a instrument using an ultrasonic sensor.

2. INSTRUMENTATION

In instrumentation section we are discussing the main parts used in instrumental setup. Various parts like ultrasonic sensor, Laptop display, Arduino board and each one of this part is discussed in detail below.

2.1 ULTRASONIC SENSOR

FIG 1 : ULTRASONIC SENSOR

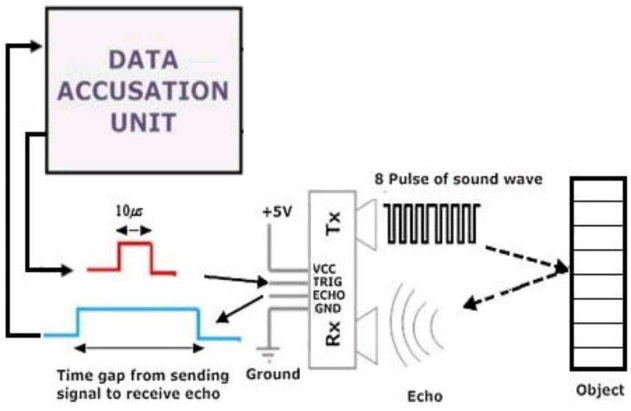


FIG 2 : WORKING PRINCIPLE

WORKING PRINCIPLE

1. Adopt IO trigger through supplying at least 10us sequence of high level signal.

2. The module automatically send eight 40 kHz square wave and automatically detect whether receive the returning pulse signal.

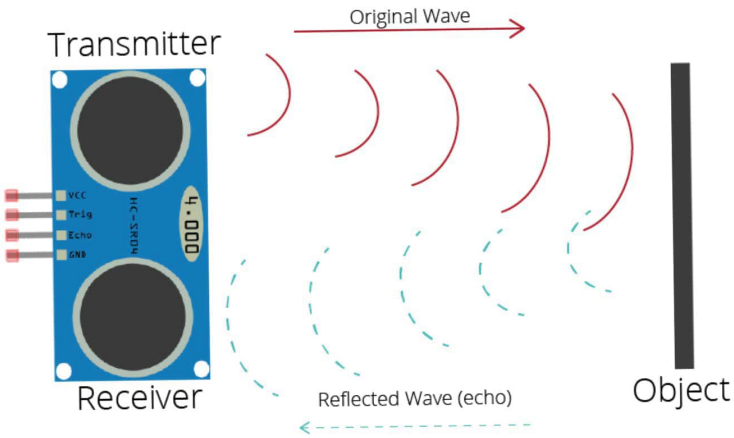
3. If there is signals returning, through outputting high level and the time of high level continuing is the time of that from the ultrasonic transmitting to receiving.

SPECIFICATIONS

1. Working Voltage: 5V (DC)
2. Static current: Less than 2mA.
3. Output signal: Electric frequency signal, high level 5V, low level 0V.
4. Sensor angle: Not more than 15 degrees.
5. Detection distance: 2cm-450cm.
6. Precision: Up to 0.3cm
7. Input trigger signal: TTL impulse
8. Echo signal: output TTL PWL signal Mode of connection

PIN CONFIGRUATION

Pin No	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.



2.3 ARDUNIO BOARD

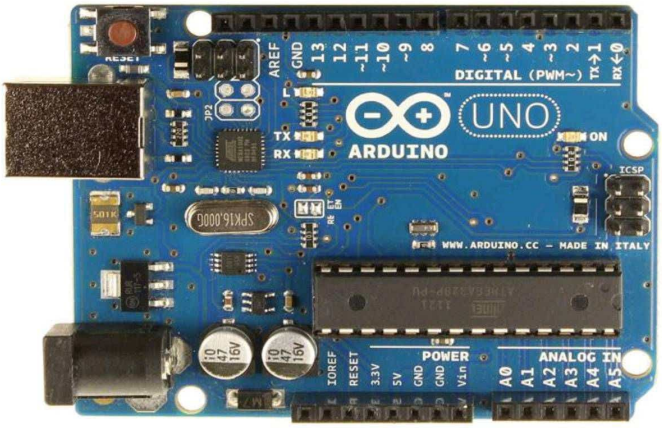


FIG 4 : ARDUNIO BOARD

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

SPECIFICATIONS

1. Microcontroller ATmega328P
2. Operating Voltage: 5V
3. Input Voltage (Recommended): 7-12V
4. Digital I/O Pins 14 (of which 6 provide PWM output)
5. Flash memory 32 KB (ATmega328) of which 0.5 KB used by boot loader SRAM 2 KB (ATmega328)

3. CALCULATIONS

Distance travelled by sound = speed of sound x time that sound travels

Speed calculations

Speed of sound C= (331.3+0.606v) m/s [2].
Where v is the temperature in degrees Celsius (°C).
At 30 °C (assumed)
C=349.48 m/s = 0.34948 mm/microsecond

Time calculations

Time that sound travels = duration (in micro seconds)

Distance calculations

The distance between the sensor and the object is one
the distance travelled by the sound wave.
Distance between object and sensor = 0.5 x Distance that sound travels

Physical constraints

Offset = 72mm

MODIFIED DISTANCE FORMULA BETWEEN OBJECT AND SENSOR

Substituting values in Distance equation, we get
Distance = (0.5 x 0.34948 x duration) -72
Distance = [(0.17474x duration) -72] mm

4. WIRING DIAGRAM

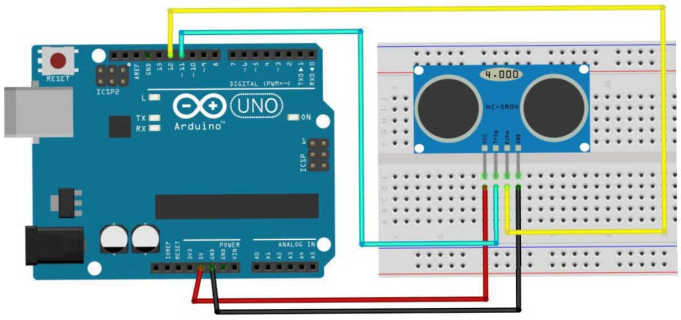
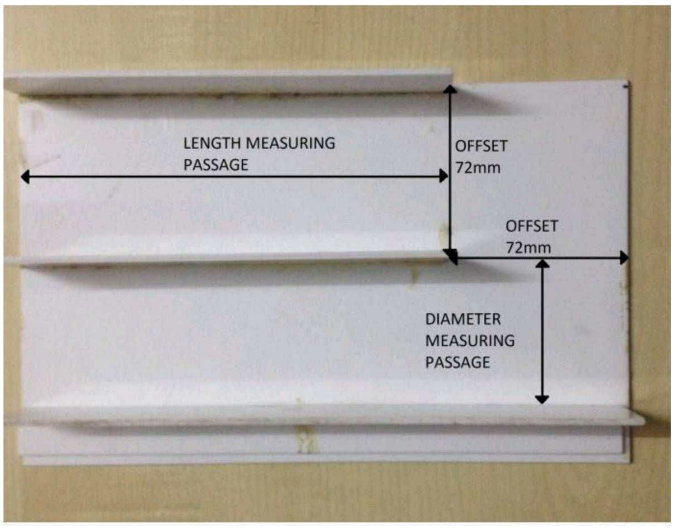


FIG 5: WIRING DIAGRAM

```
***ARDUINO CODE****

#include <Mouse.h>

const int trigpin= 8;
const int echopin= 7;
long duration;
int distance;
void setup()
{
  pinMode(trigpin,OUTPUT);
  pinMode(echopin,INPUT);
  Serial.begin(9600);

}
void loop()
{
  digitalWrite(trigpin,HIGH);
  delayMicroseconds(10);
  digitalWrite(trigpin,LOW);
  duration=pulseIn(echopin,HIGH);
  distance = duration*0.034/2;
  Serial.println(distance);
}
```

```
***PROCESSING CODE***

import processing.serial.*;
Serial myPort;
String data="" ;
PFont  myFont;
void setup()
{
size(1366,900); // size of processing window
background(0);// setting background color to black
myPort = new Serial(this, "COM3", 9600);
myPort.bufferUntil('\n');
}
void draw()
{
  background(0);
  textAlign(CENTER);
  fill(255);
  text(data,820,400);
  textSize(100);
  fill(#4B5DCE);
  text("              Distance :        cm",450,400);
   noFill();
   stroke(#4B5DCE);
}
void serialEvent(Serial myPort)
{

  data=myPort.readStringUntil('\n');
}
```



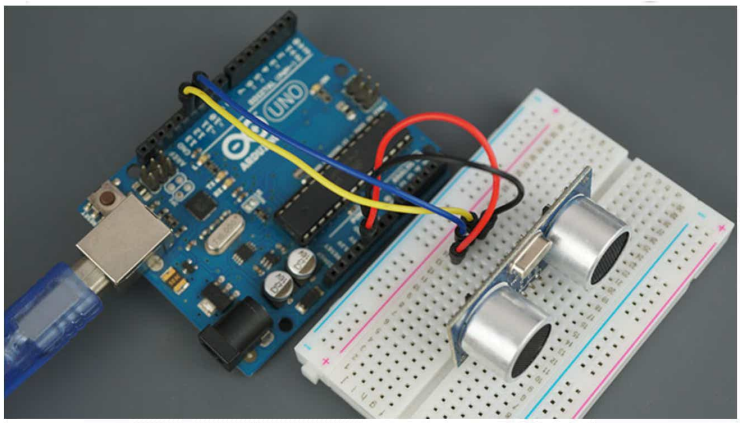


FIG 7: MEASURING MODULE

The instrument consists of two modules, first is known as main working module and second is known as measuring module. The main working module and measuring module, both are made of acrylic material. The main working module housing consists of ultrasonic sensor, arduino board, LCD display and set of wires. On measuring module two passages are made to measure diameter/width and length of component. In length measuring passage component is first kept and slider is moved till it touches top of component, then component is removed (component restricts the sound waves passing to slider) and measured value is noted down. Same procedure can be used for measuring diameter/width, but instead of placing component in length passage it is kept in diameter passage. If component have approximately same diameter/width and length, it can be kept in any passage.

7. OBSERVATIONS

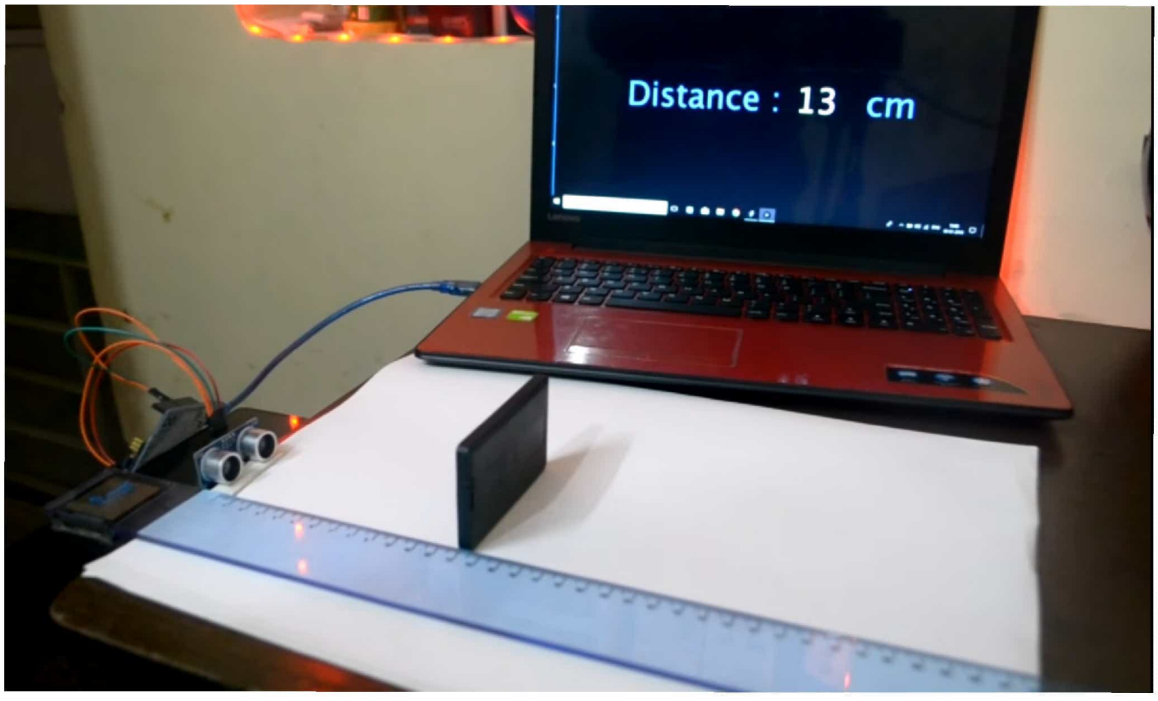


FIG 12: READING ON INSTRUMENT

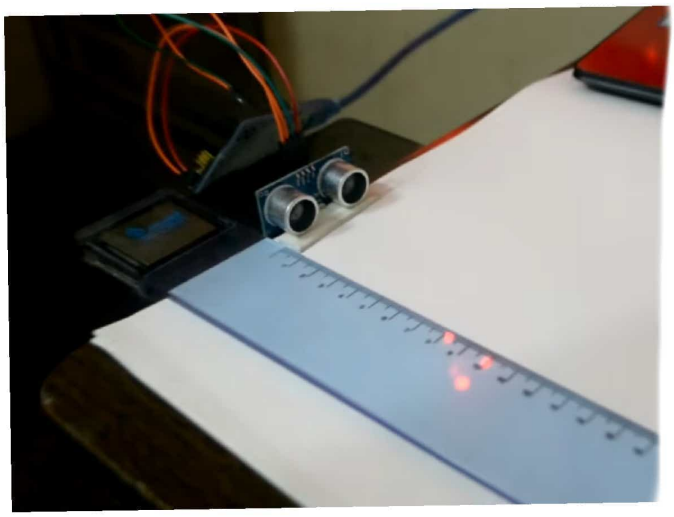


FIG 13: ACTUAL READING ON SCALE

8. RESULTS

SR NO	PARAMETER	ACTUAL VALUE	INSTRUMENT READING
		(mm)	(mm)
1.	Diameter	53	53
2.	Length	122	122

TABLE 2: RESULTS

9. ADVANTAGES

1. Various geometrical parameters can be measured on same equipment.
2. No requirement of skilled labor.
3. Time saving operation.
4. Accuracy can be increased using more accurate ultrasonic sensor.
5. Equipment is portable.

10. CONCLUSION

The instrument is portable, convenient and easy to use. From above results it is observed that the original values and measured values are approximately same. We can improve accuracy by using more accurate ultrasonic sensor.

11. REFERENCES

1. "Sound Systems: Design and Optimization: Modern Techniques and Tools for Sound System Design and Alignment" - Bob McCarthy / CRC Press, 2016 .ISBN 1317911091, 9781317911098. Pg.83.

2. "Fundamentals of Physics" - Giambattista / Tata McGraw-Hill Education, 2010.ISBN 0070648506, 9780070648500. Pg.419.