



# DA326A, Software Engineering 2

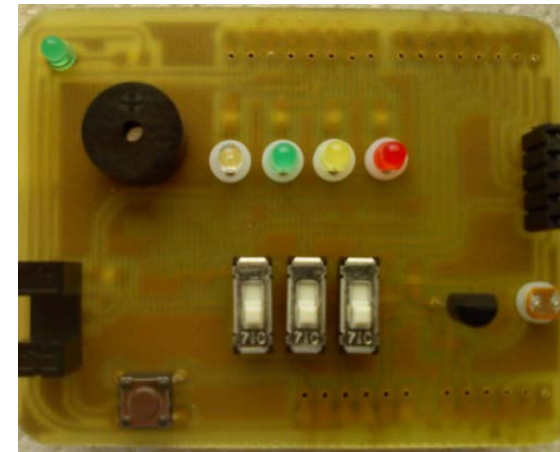
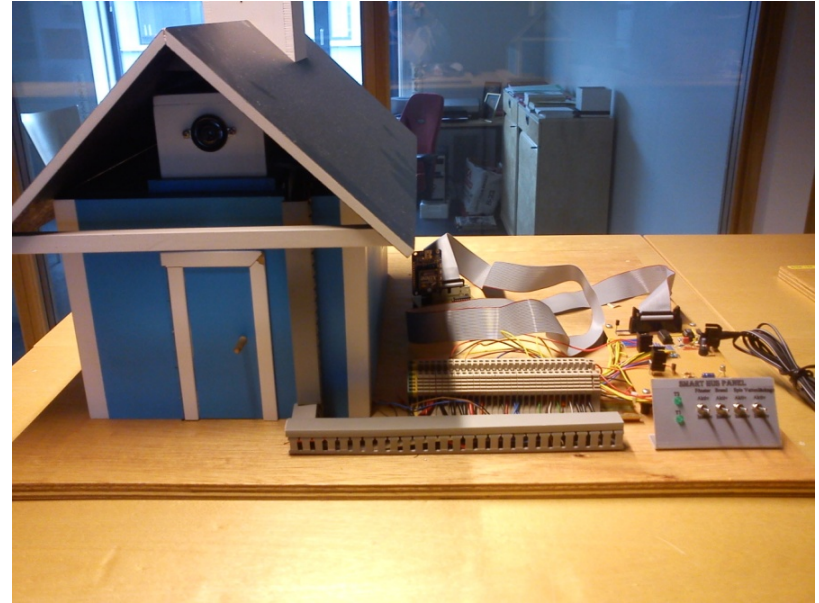
*Home, Smart Home* 😊

Introduction  
Working with the Smart House



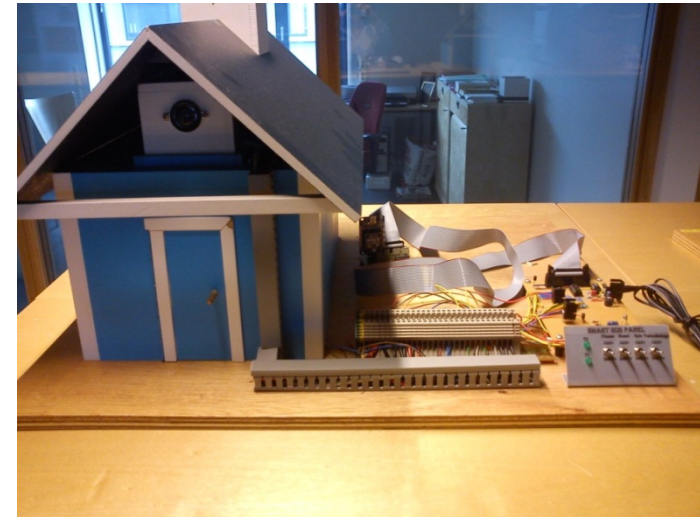
## *Hardware* – Smart House

- There are 3 houses (A,B,C)
- There are 10 prototypes:



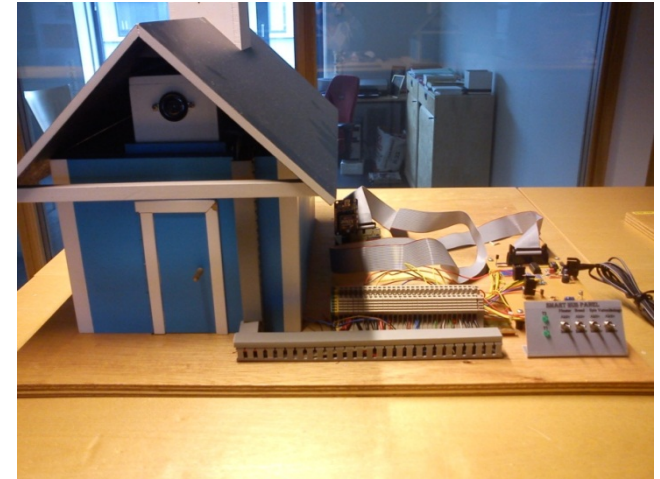
# Functionalities

- |                             |                      |
|-----------------------------|----------------------|
| • <i>Brandvarnare</i>       | Automatic fire alarm |
| • <i>Inbrottslarm</i>       | Housebreaking alarm  |
| • <i>Vattenläckage</i>      | Water leakage        |
| • <i>Temperatur inomhus</i> | Temperature indoors  |
| • <i>Temperatur utomhus</i> | Temperature outdoors |
| • <i>Spisen ON</i>          | Stove ON             |
| • <i>Fönster öppet</i>      | Window open          |
| • <i>Timer T1</i>           | Timer T1             |
| • <i>Timer T2</i>           | Timer T2             |
| • <i>Inomhusbelysning</i>   | Lighting indoors     |
| • <i>Utomhusbelysning</i>   | Lighting outdoors    |
| • <i>Elavbrott</i>          | Power cut            |



# Functionalities – cont.

- *Indikering inbrottslarm, sirén*
  - Indicating housebreaking alarm, siren
- *Indikering inbrottslarm, "saftblandare"*
  - Indicating housebreaking alarm, "juice mixer"
- *Elförbrukning*
  - Electricity consumption
- *Skymningautomatik*
  - Twilight automatic system
- *Fläkt på vinden (endast i hus A och B)*
  - Fan (only in houses A and B)
- *Värmeelement*
  - Radiator



# Input signals

- *Brandvarnare* Automatic fire alarm;
  - This signal is simulated with a switch on the front panel.
- *Inbrottslarm* Housebreaking alarm
  - This input is realized by using a magnetic switch mounted at the house door.
- *Vattenläckage* Water leakage
  - This signal is simulated with a switch on the front panel.
- *Temperatur inomhus* Temperature indoors
  - This signal is realized using an analog temperature sensor mounted inside the house (on the first and the second floor)
- *Temperatur utomhus* Temperature outdoors
  - This signal is realized using a digital temperature sensor mounted outside the house





# Input signals – cont.

- *Spisen ON* Stove ON
  - This signal is simulated with a switch on the front panel
- *Fönster öppet* Window open
  - This signal is simulated with a switch on the front panel
- *Elförbrukning* Electricity consumption
  - This input is realized by measuring the supply voltage deliver to the house (an analog signal)
- *Skymningautomatik* Twilight automatic system
  - This input is realized by Light-to-Voltage sensor (outdoors)
- *Elavbrott* Power cut
  - This input is realized by controlling the presence of supply voltage



# Output signals



- *Timer T1*
  - This output signal is simulated with an LED lamp on the front panel
- *Timer T2*
  - This output signal is simulated with an LED lamp on the front panel
- *Inomhusbelysning* Lighting indoors
  - This function is realized with a lamp mounted inside the house
- *Indikering inbrottslarm, sirén* Indicating housebreaking alarm, siren
  - This function is realized by using a loudspeaker mounted on the house gable
- *Indikering inbrottslarm, "saftblandare"* Indicating housebreaking alarm, "juice mixer"
  - This function is realized with an LED lamp mounted on the roof

# Output signals – cont.



- *Fläkt på vinden* Fan
  - This function is realized with a fan mounted on the house's loft
- *Värmeelement* Radiator
  - Four power resistors are connected in series to realize the heating of the house. The resistors are mounted in pairs, two at each long side wall
- More information in PDF file on itsLearning





## Hardware and Software - *Arduino Diecimila*

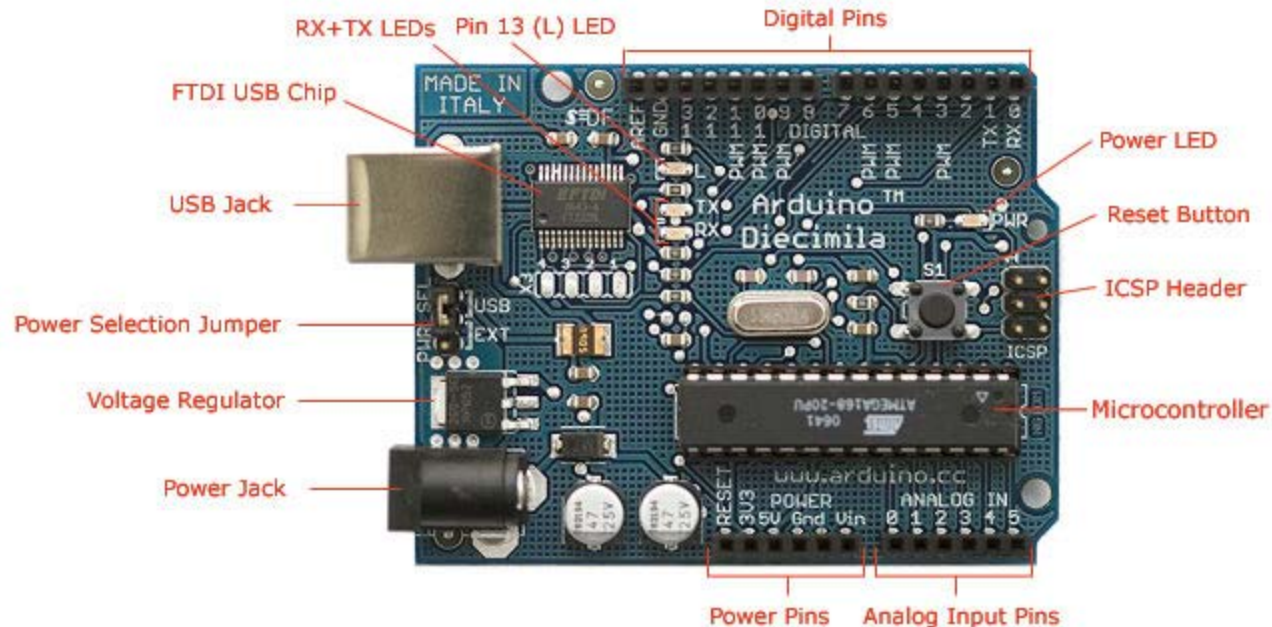
- *Arduino* is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.
- It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.
- *Arduino* can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators.
- The microcontroller on the board is programmed using the *Arduino* programming language (based on *Wiring*) and the *Arduino* development environment (based on *Processing*).
- *Arduino* projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).

<http://www.youtube.com/watch?v=pMV2isNm8JU&feature=related>



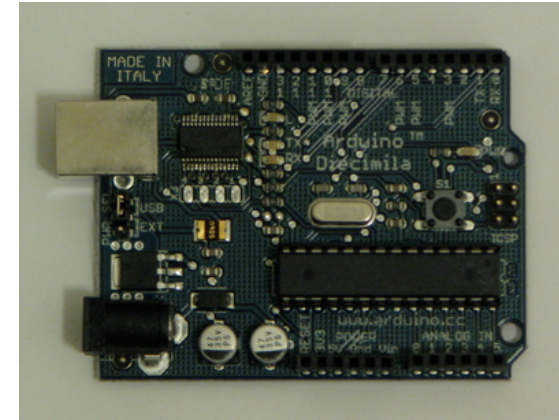
# Arduino Diecimila - Overview

- Is a **microcontroller board** based on the ATmega168
- It has
  - 14 digital input/output pins (of which 6 can be used as PWM outputs),
  - 6 analog inputs,
  - a 16 MHz crystal oscillator,
  - a USB connection,
  - a power jack,
  - an ICSP header,
  - and a reset button.





## *Arduino Diecimila* - Overview



- It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
- "*Diecimila*" means 10,000 in Italian and was named thusly to mark the fact that over 10,000 Arduino boards have been made.



# *Arduino Diecimila* - Summary

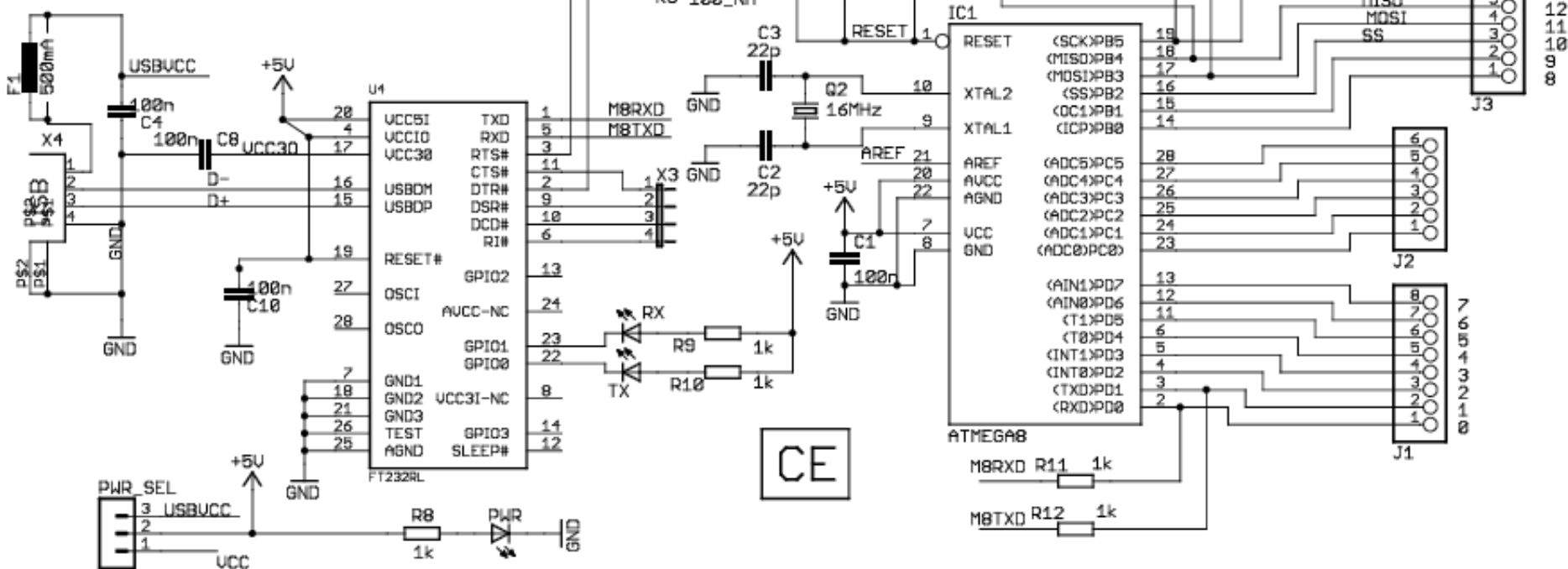
- Microcontroller: ATmega168
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 16 KB (of which 2 KB used by bootloader)
- SRAM: 1 KB
- EEPROM: 512 bytes
- Clock Speed: 16 MHz



## *Arduino Diecimila* – cont.

- Each of the 14 digital pins can be used as an **input** or **output**, using *pinMode()*, *digitalWrite()*, and *digitalRead()* functions.
- <http://arduino.cc/en/main/boards>
- Programming
  - Arduino software <http://arduino.cc/en/Main/Software>
  - For details, see the <http://arduino.cc/en/Reference/HomePage> and tutorials/ examples <http://arduino.cc/en/Tutorial/HomePage>
  - One of the intreresting projects with Arduino:  
<http://www.youtube.com/watch?v=2HIL3URZyAs>







Smart Hus			Arduino					Arduino	Atmega chip	On	Off	
1	GND							RX	0	PD0		
2	GND							TX	1	PD1		
3	Brandvarnare	Input digital	PD2					Brandvarnare	2	PD2	1	0
4	Inbrottslarm	Input digital	PD3					Inbrottslarm	3	PD3	0	1
5	Vattenläckage	Input digital	PD4					Vattenläckage	4	PD4	1	0
6	Temperatur inomhus rum Vout	Input analog LM350CZ	PC1					Spis ON	5	PD5	1	0
7	Temperatur inomhus vind Vout	Input analog LM350CZ	PC2					Fönster Öppet	6	PD6	1	0
8	LDR	Input analog	PC3					Elavbrott	7	PD7	1	0
9	Temperatur Utomhus Vout	Input digital	PB1									
10	Utomhusbelysning		Mux						8	PB0	output digital	
11	Spis ON	Input digital	PD5					Temp UTomhus Vout	9	PB1	input digital	
12	Fönster Öppet	Input digital	PD6					Fläkt	10	PB2	PWM	
13	Elförbrukning	Input analog	PC0						11	PB3	output digital	
14									12	PB4		
15									13	PB5	output digital	
16	5V	Arduino +5V										
17	Elavbrott	Input digital	PD7					Elförbrukning	A0	PC0	input analog	
18	Timer 1		Mux					Temp rum Vout	A1	PC1	input analog	
19	Timer 2		Mux					Temp rum Vout vind	A2	PC2	input analog	
20	Inomhusbelysning		Mux					LDR	A3	PC3	input analog	
21	Indikering inbrottslarm siren	output digital-analog	PB4						A4	PC4		
22	Indikering inbrottslarm lampa		Mux						A5	PC5		
23	Värmeelement vind		Mux									
24	Fläkt	output digital-analog PWM	PB2									
25	Värmeelement		Mux									
26	GND											



Mux				
12	13	11	8	Arduino
B4	B5	B3	B0	Atmega chip
0	0	0	0	Off --> Sound
1	0	0	0	On --> Sound
0	0	0	1	On --> Timer 2
1	0	0	1	Off --> Timer 2
0	0	1	0	On --> Indoor Lighting
1	0	1	0	Off --> Indoor Lighting
0	0	1	1	On --> Indication burglar alarm lamp
1	0	1	1	Off --> Indication burglar alarm lamp
0	1	0	0	On --> Heating element wind
1	1	0	0	Off --> Heating element wind
0	1	0	1	On --> Heating element
1	1	0	1	Off --> Heating element
0	1	1	0	On --> Timer 1
1	1	1	0	Off --> Timer 1
0	1	1	1	On --> Outdoor Lighting
1	1	1	1	Off --> Outdoor Lighting





# Smart house Laboration

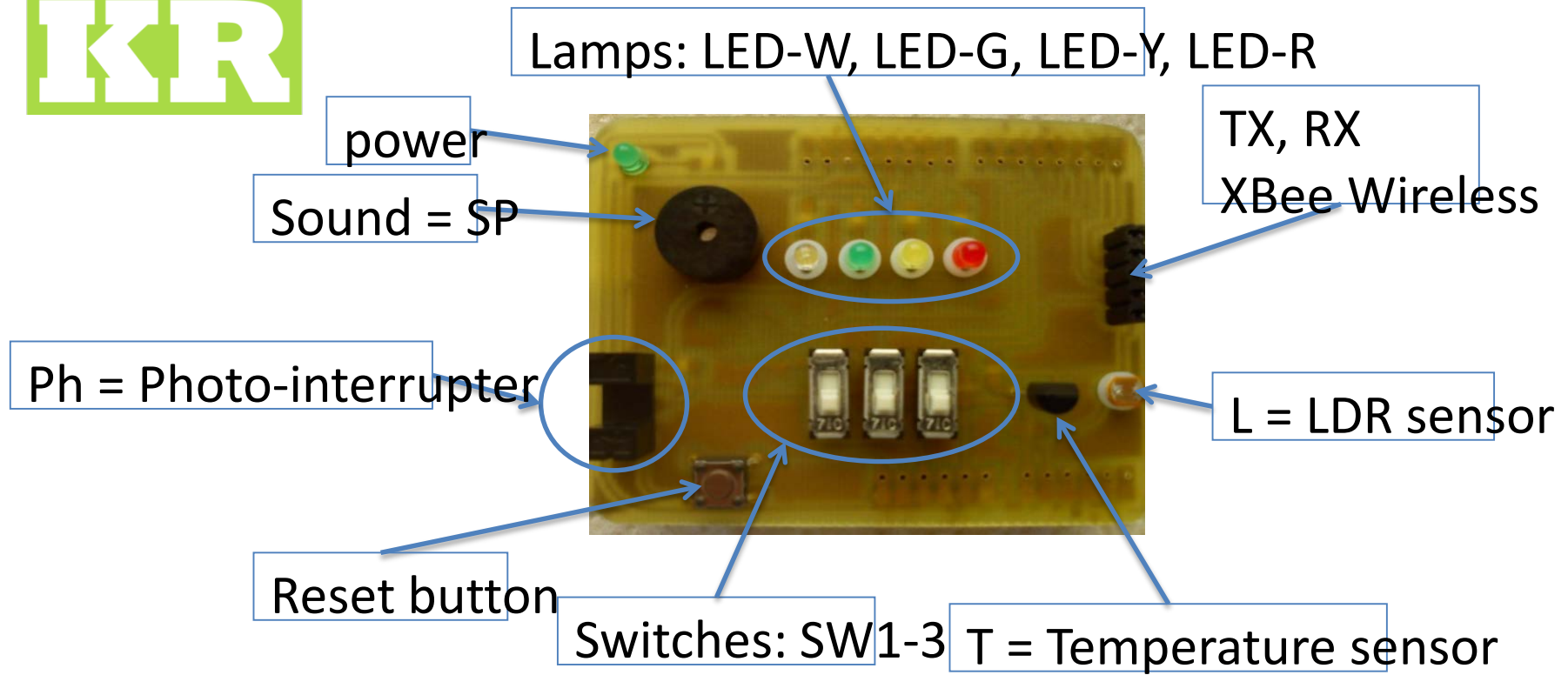
## The aim of the Lab:

- 1) Establish a connection between your computer and a smart house/prototype
- 2) Learn how to programme in Arduino environment

## Pre-lab:

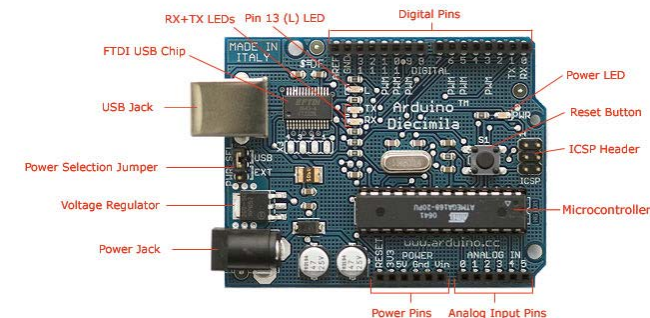
- 1) Download and install the Arduino Software:  
<http://arduino.cc/en/Main/Software> (on Windows platform)
- 2) Read description of the Language References:  
<http://arduino.cc/en/Reference/HomePage>
- 3) Read the examples: <http://arduino.cc/en/Tutorial/HomePage>  
(you can also find them in the Software)



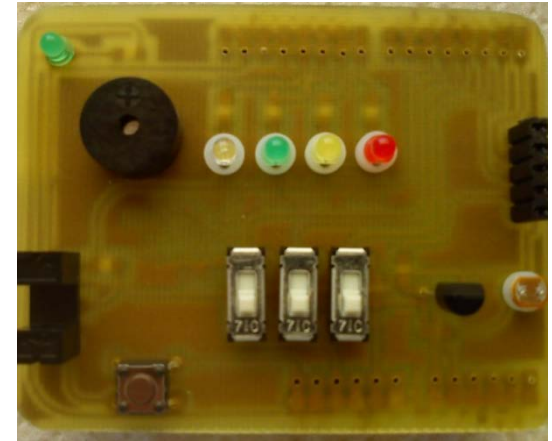


AREF	GND	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Arduino POR
		PB5	PB4	PB3	PB2	PB1	PB0	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0	Atmga168
			SP	LED-W	LED-G	LED-Y	LED-R			Ph	SW1	SW2	SW3	TX	RX	Prototyp

0	1	2	3	4	5	Arduino
PC0	PC1	PC2	PC3	PC4	PC5	Atmga168
T	L					Prototyp
T = Temperature Sensor , L = LDR sensors						



# Smart house Laboration



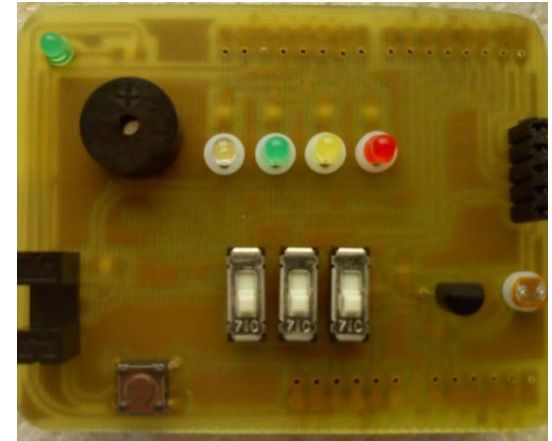
## Lab on prototype:

Connect the Arduino to the PC through USB port (after installation the Software)

- 1) Send a signal to each of LED lamp with different functionalities, i.e. the LED-W will blink, LED-G will shine, LED-Y will shine during 5 s, LED-R will blink 10 times
- 2) Activate LED-W and LED-R when switch1 is ON (both lamps will shine together)
- 3) Activate LED-G and LED-Y when switch2 is ON (both will blink)
- 4) Activate Sound when switch3 is ON
- 5) T – Temperature sensor, show the temperature on the Serial Monitor
- 6) L – LDR sensor = LED-W should shine when it is dark. Try to show the value on the Serial Monitor
- 7) Photo-interrupter: put a paper in between and activate a sensor, e.g. a sound or a lamp



# Smart house Laboration



## Lab on prototype:

Optional:

You are at home and the alarm is not active. You should activate the alarm.

Use the Photointerrupter as a door.

"Open" a door = put a piece of paper in between.

When you open a door, you activate LED-G (blink) until the door is closed.

When the door is closed, LED-Y is shining.

When you again open a door, activate the alarm and LED-R (blink).



# Smart House Project

- Project team should realize a smart house where various functionality should be implemented.
- In essence, it falls within the monitoring and control functions that may be included in a modern villa, and communication with the outside world.



## Getting Started with Arduino on Windows

1. <http://arduino.cc/en/Guide/Windows>
2. Select the Board and Serial Port  
(in the **Tools > Board** menu)
  1. Arduino Decimila
  2. Serial Port (COM\_X)