

# A game of TicTacToe

Displaying digital content in windows of a building

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# Agenda

- Introduction
- "Window" client
- Central unit
- Mobile phone App
- Demo clip
- Future work

# Project background

- Practical projects in Electronics Engineering
  - Laboratories as part of taught modules
  - Semester project (15CP, 1 Semester)
  - Placement (10 weeks, industry)
  - Thesis (12 weeks, industry)
- Embedded Systems / Internet of Things AG
  - Four hours laboratory work per week
  - Project teams of 1 – 2 students
  - Individual projects
  - Semester 3+
  - Different hardware
- Project work
- 2 students, one Semester (5CP)

# Introduction

- Objective
  - visualise digital content within the windows of a building
  - cheap, scalable, wireless (Wifi) access via mobile phone, easy to use, easy to install (wireless between windows)
- First application
  - the game "TicTacToe" for two players, shown within nine LED-lighted windows
- Hard- and software
  - ESP8266 SoC [C/C++]
  - LED-Stripes
  - Smartphones [Android]

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# Tasks

- "Window" clients
  - publish themselves in the network (Wifi: FH IoT network)
  - wait for colour code from the central unit
  - send colour code to LED
- Central unit
  - initialise and run the game
  - wait for the players
  - communicate with the player apps (game matrix, player state)
  - control the "Window" clients
- Mobile phone App
  - give possibility to choose a game
  - connect to central unit
  - receive and display game matrix from central unit
  - send player input to central unit

# "Window" clients: Hardware

- Node MCU 1.0 (ESP8266, 32-bit, up to 160MHz)
- Open source [IoT](#) platform.
- Includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems.
- Arduino-like hardware IO
  - GPIO, PWM, IIC, 1-Wire and ADC
- USB port and bootloader
- Low cost
- 5V power supply

Pinbelegung NodeMCU -Board

TOUT ADC0 A0  
Reserve  
Reserve  
SDD3 GPIO10 D12  
SDD2 GPIO9 D11  
SDD1 INT  
SDCMD MOSI  
SDD0 MISO  
SDCLK SCLK  
GND  
3,3V  
EN  
RESET  
GND  
POWER 5,0V



USB

Programmierung und Spannungsversorgung

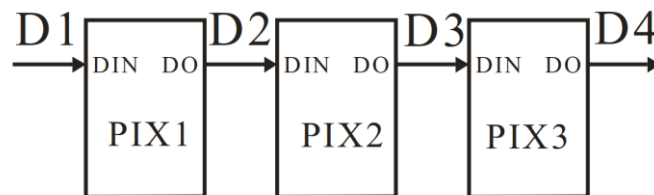
D0 GPIO16 - USER - WAKE  
D1 GPIO5  
D2 GPIO4  
D3 GPIO0 - FLASH  
D4 GPIO2 - TXD1  
3,3V  
GND  
D5 GPIO14 - HSPICLK  
D6 GPIO12 - HSPICQ  
D7 GPIO13 - RXD2 - HSPID  
D8 GPIO15 - TXD2 - HSPID  
D9 GPIO3 - RXD0  
D10 GPIO1 - TXD0  
GND  
3,3V

Mikrocontroller -  
Elektronik.de  
Der Elektronik Shop für Bastler & Tüftler

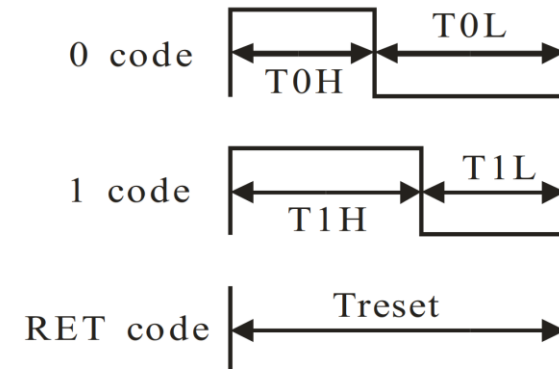
# "Window" clients: Hardware

- WS2812B (register-LED)
  - Intelligent control LED integrated light source
  - Integrated RGB LED and control circuit
  - 256 levels of brightness for each pixel of the three primary colours: total of 16777216 colours
  - 24-bit serial transmission (GRB) for each LED
  - Cascading port transmission signal by single line:  
30fps → 1024 RGB LEDs

Cascade method:



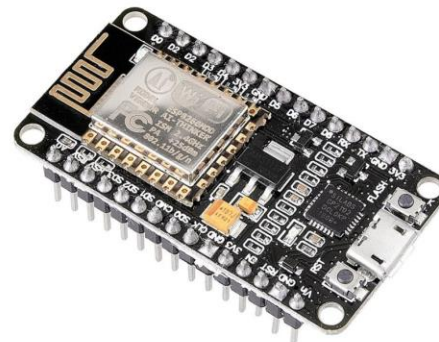
Sequence chart:





# "Window" clients: Software

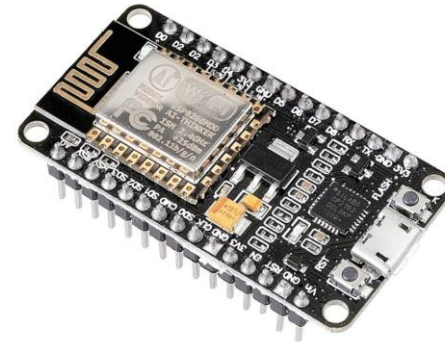
- C, Arduino IDE
- Adafruit\_NeoPixel.h
  - LED stripe communication
- mDNS (ESP8266mDNS.h)
  - IP address resolution in networks without local name server.
- Tcp ServerSocket



<https://tutorials-raspberrypi.de/wp-content/uploads/2017/05/Einf%C3%BChrung-Programmierung-des-ESP8266-NodeMCU-Boards-1024x1024.jpg>

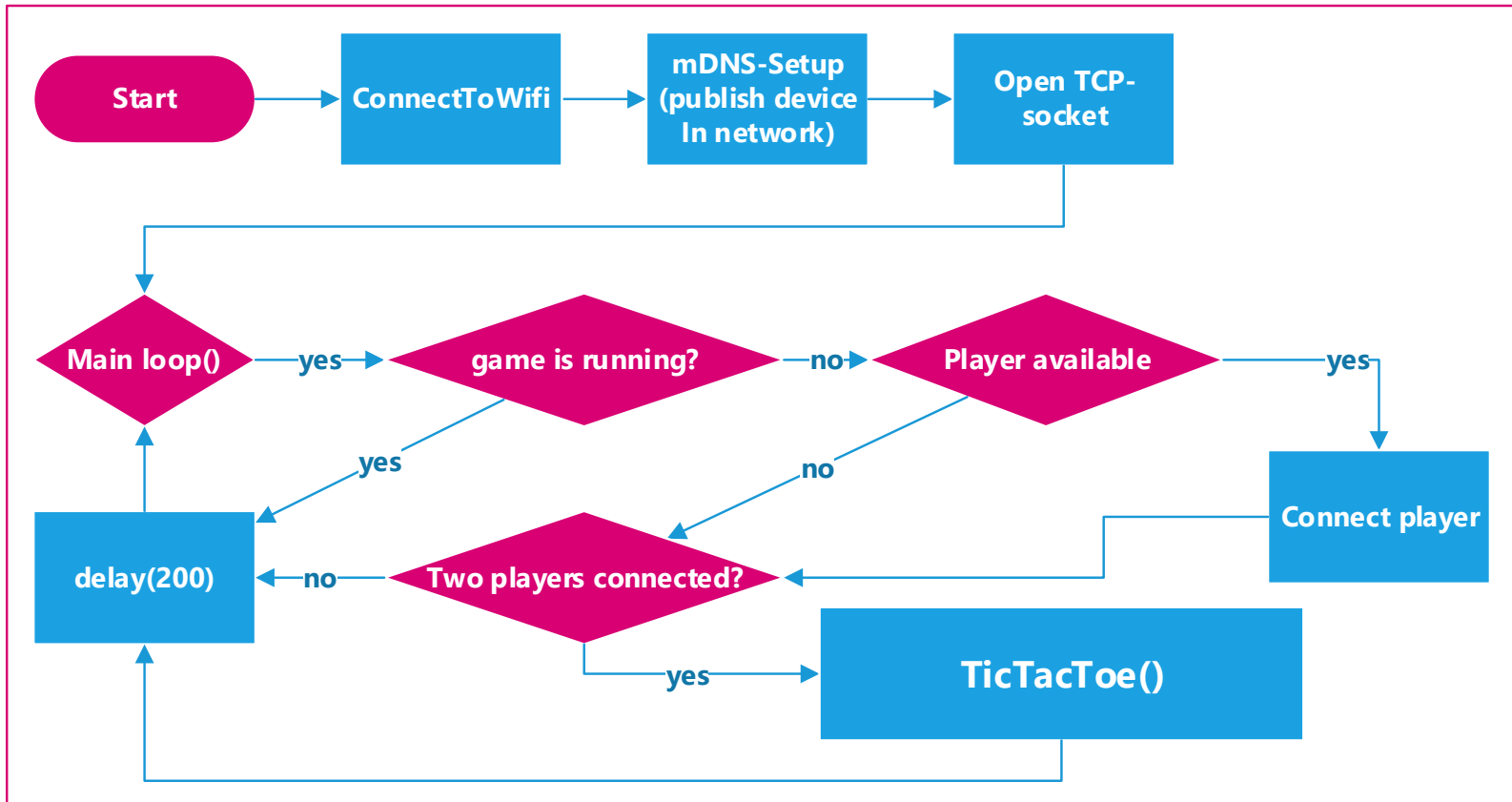
# Central unit

- Hardware
  - NodeMCU 1.0 (ESP8266)
- Software
  - C++, Arduino IDE
  - mDNS
  - communication via TCP and strings
    - to "Window" client: '0'(off), '1'(green) or '2'(yellow)
    - to App: JSON-String with multiple information
      - playerId
      - WinningPlayer
      - Player's rights
      - gameMatrix

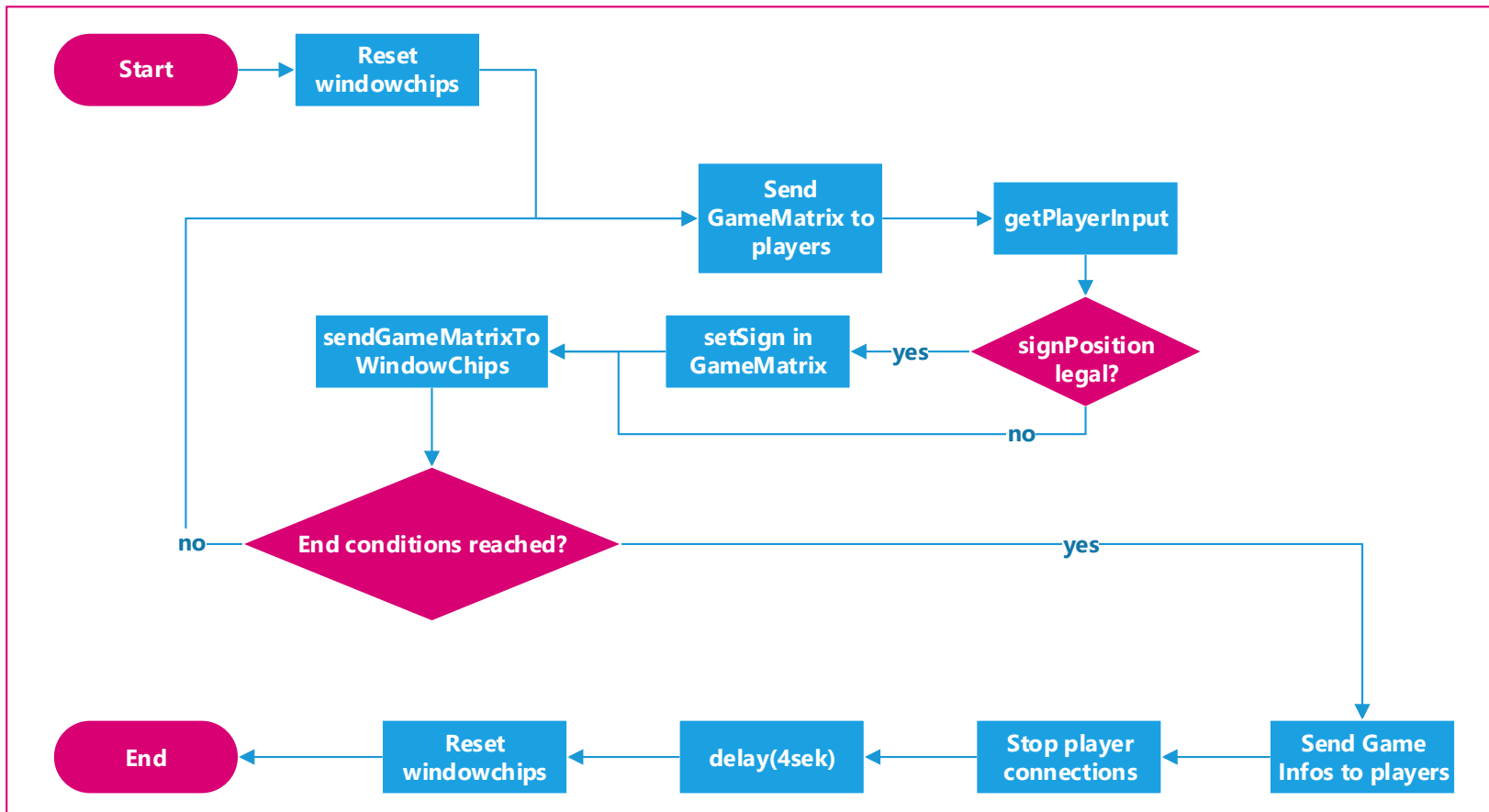


<https://tutorials-raspberrypi.de/wp-content/uploads/2017/05/Einf%C3%BChrung-Programmierung-des-ESP8266-NodeMCU-Boards-1024x1024.jpg>

# Central unit – setup



# TicTacToe

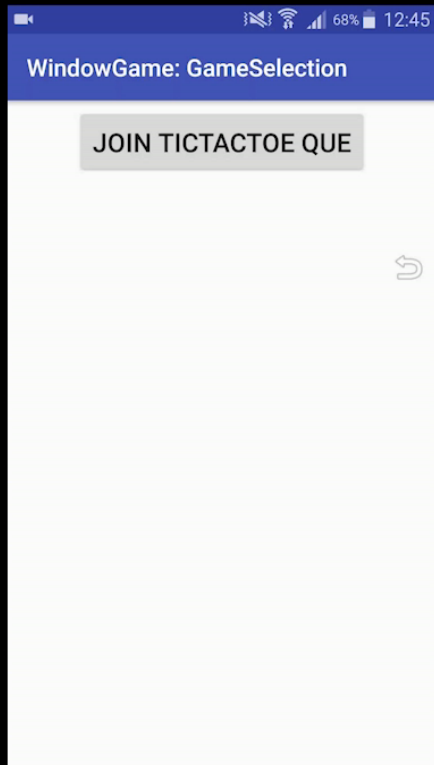


# Mobile Phone App

- Android 4.2(Jelly Bean) and higher
- Game selection
- Dynamic sized playground
- multiple threads



open in Youtube: <https://youtu.be/yIRQg43Tsd8>



# Future Work

- Change of central unit platform from esp8266 to Raspberry Pi
- Access to the central unit via web address
- Player queue management
- Physical installation at windows
- Reduction of network load
- Eecurity(encryption)