Intermediate project
Autonomous plant watering system

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Abstract

The goal of this project was to create a device which will take care of a house plant. It will monitor plant's vital parameters and water it when needed. The device will connect to a server which will decide if the watering is needed and will store the data gather by the device.

1 Introduction

Watering a plant is necessary, but people often forget about it or it is sometimes impossible, if the owner is on away. Therefor there is need to develop a system which will take care of any plant. It should by battery powered thus power efficient.

2 Sensors

To determine if the watering of the plant is needed it will have to have some information about plant's environment. To gather the data range of sensors is used:

- ambient light sensor,
- ambient temperature sensor,
- soil humidity sensor,
- ambient humidity sensor.

All used sensors are ready to use preassembled boards. It allows quick development, easy upgradeability and lowers the cost.

3 Hardware

For the microcontroller the ESP8266 (ESP-12E) was used. It has built in Wi-Fi module, all needed perphials, is cheap and widely available.

For the mesurment of the soil humidity the `Waveshare Moisture Sensor` was used it has analog output with signal proportional to soil humidity. For the ambient temperature and humidity sensor the `Adafruit Si7021` was used it connects to microcontroller with I^2C interface, for ambient light sensing `Waveshare TSL2581FN` was used, it also communicates using I^2C interface.

Using these sensors allows to limit the number of cables needed to connect sensors and makes application easier to develop.

There is also a servo which allow controlling water flow to the plant.

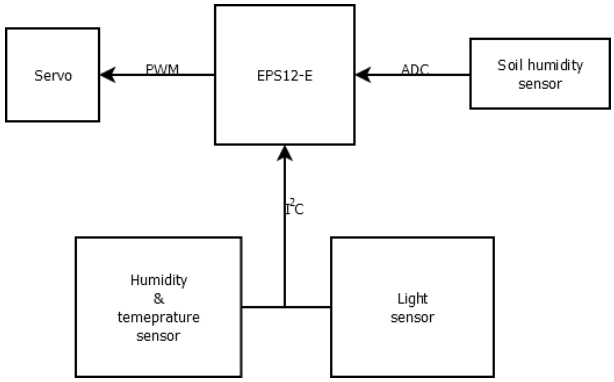


Figure 1: Block diagram of the device

4 Mainboard

The microcontroller is soldered to protoboard and all needed inrerfaces are avilable on goldpins. In this way it is easy to change the sensors if needed. The board is powered from two `AA` type batteries.

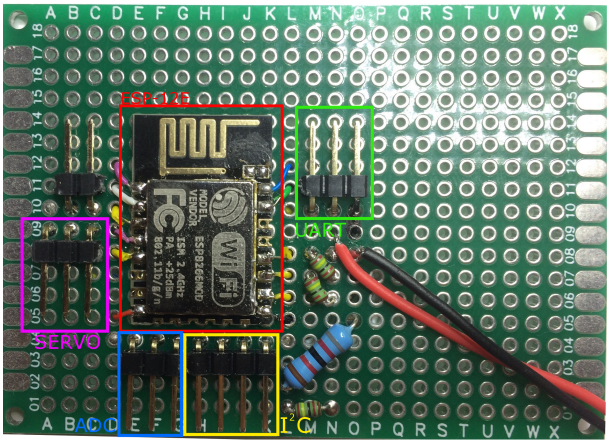
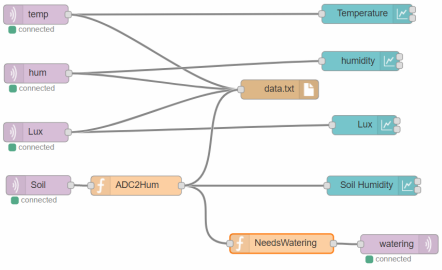


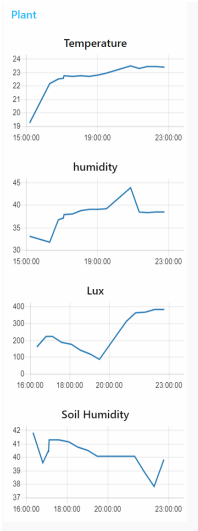
Figure 2: Photo of the main board

5 Software

The program for the EPSESP8266 is written in `C` in `Arduiono IDE`. The software implements `MQTT` client, as well as all needed interfaces for sensors. Microcontroller connects to `MQQT` broker which is run on a server. The `MQTT` broker is programed with `Node-Red`. The date from the MCU is shown on the graphs and also writen to a file. When the soil humidity is lower then defined the broker sends the request to the device to water the plant.



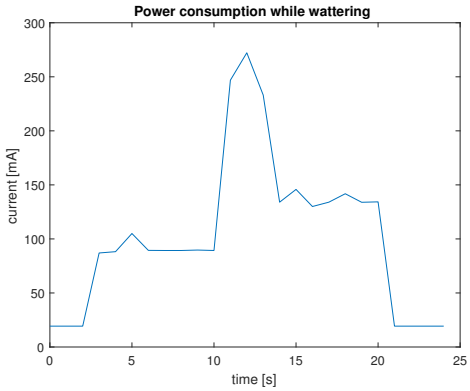
(a) Node-Red program



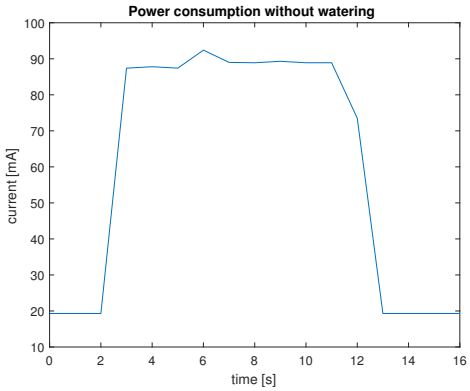
(b) Data gathered by the device

6 Power efficiency

The device was desigend to be power efficient, it has no LEDs and is in `Deep Sleep` mode for most of the time. It wakes up every 30 minutes to take mesurments and water the plant if needed. It useses two `AA` type batteries connect in series for 3 V power supply voltage. The device should work on a one battery set for 200 hours with current setup. But it can be improved by cutting off power supply for the sensors when going to `deep sleep` mode.



(c) Currentconsumption when active with watering



(d) Current consumption when active w\o watering

7 Conclusions

The main goal of the project was accomplished. The power efficiency of the device can be increased for longer life time of the batteries. The device can water the plant with no problem, but the day-to-day trials showed that in every day life the e-mail reminder would work as good if not better, as the water reservoir has to be refiled reglary, and the device with the reservoir takes up some space.

References

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[6] Batteries:
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[7] Node-Red:
`https://nodered.org/`