# Water-volume measurement of plants by using itplanter

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**Abstract:** The itplanter is an indoor cultivation device which has LED light and pump controlled by PIC(Peripheral IC). The aero hydroponics cultivation method is adopted for the sake of foolproof, dirt-free, and easy control cultivation condition. Both the pump and the LED light of the itplanter can be controlled by PC through USB interface, and can be accessed to any sensors. When the itplanter connected to the Internet PC, this itplanter can be monitored and controlled through the Internet from another PC or smart-phone device. Since a lot of itplanter will construct a huge cloud-computing garden, researchers can get several information about plants growing, and they can get cultivation program for any plants, efficiently. Furthermore, the itplanter has some sensors, such as thermo sensor, photo sensor and water level sensor; change of environment can be measured and recorded automatically. Especially, water level sensor is non-contact type sensor and it can be used for measuring water-pump characteristics of plants through water-volume measurement of plants. We found that plants absorb water in short time period and decrease gradually in long time. In this paper, the itplanter is introduced and some water-volume measurement experiment results are reported.

**Keywords:** itplanter, water-pumping, indoor cultivation, LED.
**Presentation style**: Oral

## 1. INTRODUCTION

We developed the itplanter[1] that is an indoor cultivation device which can be controlled from PC and connected to the Internet. In this paper, we introduce the itplanter system. Furthermore, we describe some experimental results of water-volume measurement of plants by using itplanter.

## 2. ABOUT INDOOR CULTIVATION DEVICE

Recently, the indoor plant cultivation has become possible by the LED light because white LED became low-priced and high power. In the plant factory, a large amount of vegetables are produced by a large-scale production facility. In this paper, we describe a small and space-saving size indoor cultivation device that can be used in the ordinary family as contrasted with the plant factory. The developed device is called "itplanter". It is possible to help plants grow automatically since this device execute plant cultivation program which can be changed according to each plant by communicate with PC.

As the ordinary similar device, the AeroGarden[2] is proposed. However, this device doesn't have the connecting ability with PC. Recently, the Click and Grow's device[3] which can be connected with PC is proposed. However, this device is not considered about the artificial light source.

Our itplanter system enables the observation of the growth of the plant easily by supplying mutritious liquid under various conditions and controlling the LED light source. Therefore, by using our system, to develop the cultivation program according to any seeding will become easy.

## 3. ITPLANTER SYSTEM

### 3.1 Hardware components

Figure 1 shows the itplanter system. To use in indoors, this device is designed to the size of 290×300×290mm. This device can be used by piling it up and down because this system is a strong structure. In this device, 96 pieces of white LED are used, and to use it all over the world, the AC adaptor is adopted for the power supply. Furthermore, this system supplies a nutritious liquid to the plant with the pump. In this system, the water cultivation method quickly drained is adopted. Because the amount of the oxygen in the air is larger than that of oxygen from among water, the growth of plants becomes early in the soil cultivation method. Moreover, in this method, feature of plant's roots is that becoming not hydroids root aquatically but also thin netlike root.



**Fig. 1 The itplanter connected with PC.**

### 3.2 System components

As shown in Figure 2, many sensors such as a room temperature sensor, a water temperature sensor, an

luminance sensor, a water level sensor and a color sensor, etc are used in our system. The LED light is controlled by the Plus With Modulation(PWM). Because the Internet use becomes possible if the itplanter is connected with PC, our system can compose the cultivation system of the Cloud-computer type. Moreover, because the real time clock is built in, the itplanter operates by the standalone even if it separates from PC after the cultivation program is set.
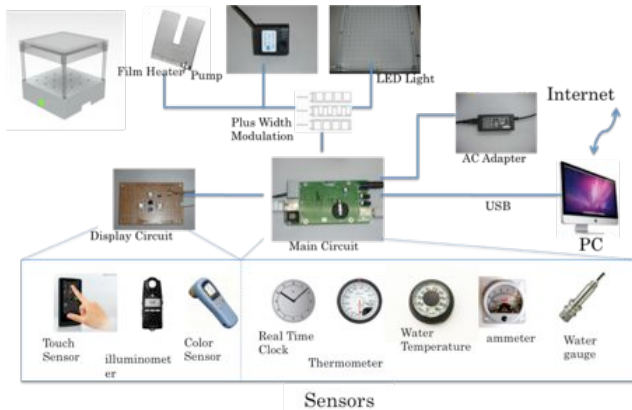


**Fig. 2 Components of the itplanter.**

## 4. WATER-VOLUME MEASUREMENT

### 4.1 Settings

The water level sensor uses the character that the exchange resistance changes by the difference of the ratio of water and air. As shown in the circuit diagram of Figure 3, the pulse of 455kHz is outputted and the current value of two electrodes is measured. In a word, the current value becomes a high value if there are a lot of ratios of water. Oppositely, if the ratio of the air between sensors is high, the current value becomes a low value. By measuring this current value, the volume of water can be measured with water and non-contact measuring the water level. At this time, we try to measure the volume of water of the plant by misappropriating this water level sensor.

### 4.2 Experiments

In this section, we describe the preparation for the experiment.
1) Two wires are removed from the water level sensor of itplanter. There is no polarity in two wires.
2) The disposal electrode used to measure the electrocardiogram is installed on one line, and the aluminum foil is installed in other one.
3) The aluminum foil is wrapped around the stem of a plant.
4) The disposal electrode is installed in the other side of the leaf that exists near the wrapped aluminum foil.
5) It measures by itplanter, automatically.

The itplanter adopts the water cultivation method. The pump is operated only by one minute, gives the nutritious liquid of about two liters to plant roots, and stops. The nutritious liquid given to the root will flow

from the hole made for the bottom of the cultivation tray in about five minutes and drop. The root absorbs water quickly. Moreover, after nutritious liquid flows and it falls, it enters a wet state in nutritious liquid, and the oxygen in the air is absorbed.
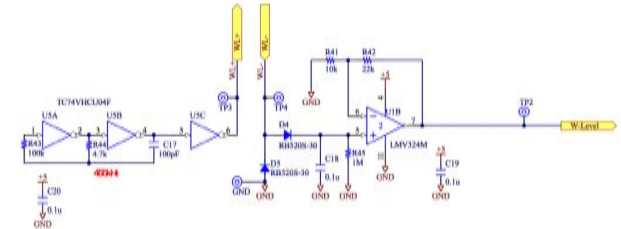


**Fig.3 Circuit diagram of water level sensor.**

### 4.3 Results

Figure 4 shows the result of a measurement. The amount of water absorption of the plant is also the maximum immediately after the water supply with the pump. Afterwards, it returns to former volume of water spending about 12 times. It is hardly supplied water as shown in Figure 5 even if nutritious liquid is given with the pump with light irradiated the other day. Perhaps, it is thought that it entered in the state that is called the catnap of the plant. This result is similar to simulation result[4].
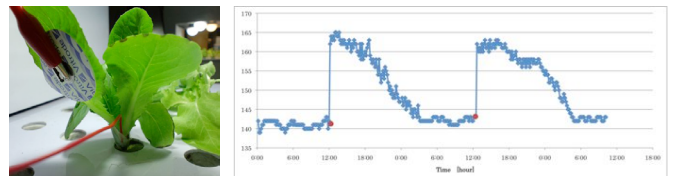


**Fig.4 Disposal electrode set on a plant, and measurement result of water-volume changes in a plant.**
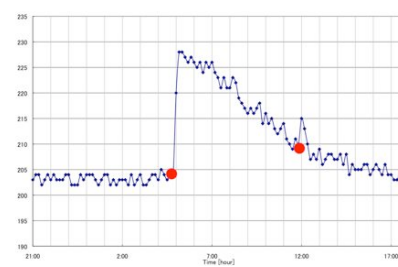


**Fig.5 Measurement result of added water supply.**

## 5. CONCLUTION

In the indoor cultivation, the catnap phenomenon of the plant was confirmed though the temperature of the leaf was constant. It thinks this cause to be the one by the difference between the photosynthesis rate and the commutation speed. The PWM ratio according to both speeds is scheduled to be tried in the future.

## REFERENCES

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