DESIGN AND DEVELOPMENT OF INDOOR PLANT WATERING SYSTEM USING PIC MICROCONTROLLER

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Abstract-- **Automatic indoor plant watering is applied for indoor plant or trees. This system principle is based on water level sensing technique. The main controller for this project is PIC16F876A. The system can be separated into three parts there are input, controller and output part. The input part is the component that detects the water level in the system. For this project, water from the watering process will act as the switch to the water level sensor to determine the water level for the plant watering. The output part is water pump. If the input part give information/ signal to the controller that the plant ground need to be watering the output device will take action, the water pump will pump the water into watering tube until the water reach the plants or trees. The controller will receive information or signal from input part and will send action information or signal to the output part to do the task needed.**

I. INTRODUCTION

Many researches showed that the indoor plant consist of several advantages or benefit for human life. Indoor plant is the important keys to achieve the 'Green Building' concept that is needed for nowadays life. From reviewed, it is showed that indoor plant provides a natural solution to cleaner indoor air. When plants transpire water vapor from their leaves, they pull air down around their roots. This supplies the roots microbes with oxygen. The root microbes also convert other substances in the air, such as toxic chemical into a source of food and energy.

Research also showed that indoor plants can reduced the heat in the building. The plants possess a natural ability to draw their system towards a light source, which can act as an indoor awning while producing a beautiful fluid effect across the space.

As we know the tree or plant is natural carbon dioxide reduction. If we plant a tree in a building it can reduce the amount of the carbon dioxide in the surrounding and it will refreshing and make the air healthier.

Respected research done by Dr. Roger S. Ulrich of Texas A&M University, Helen Russell, Surrey University, England as well as those conducted by Dr. Virginia Lohr of Washington State University verifies that plants significantly lower workspace stress and enhance workers productivity.

Planting trees are important to a healthy lifestyle. The real life office studies have proven the direct relationship clinical health complaints and plant installation. Sick Building Syndrome is serious and expensive issue and the degree to which interior plants can positively affect employees' health is an important issue today's workplace.

II. OBJECTIVE

One of the objectives of this project is to provide an easy way to water the indoor plants or tree. People nowadays were too busy with their daily life routine but still need comfortable and fresh environments by plant tree in their building or house to keep their surrounding better but still need particular time to pamper their plant. So this project can reduce the time needed.

By using this system, owner of the plant can leave the resident for a few days and do not have to worry about watering their plants because the system can take care of the plant. Nowadays, in the market there is no automatic plant watering for indoor used. So this project can fill up the needed.

This project also can be applied for outdoor and more reliable to others automatic plant watering because other were use 'Timer' technique to watering the plant and it is not effective process because it waste of water used. The physical of the plant medium (sand) also unpredicted, some time it too wet and too dry it depend on temperature surrounding. And this system can water the plant base on the medium condition. So this project can make sure the medium of the plant been watering at the suitable period.

III. METHODOLOGY

Process involved in the development of the project is very important so that the process is smooth without any difficulties. The processes involved are under constant changes due to unexpected changes or complications. Overall process covered on software and hardware development.

A. Flow Chart

(a) Project Development

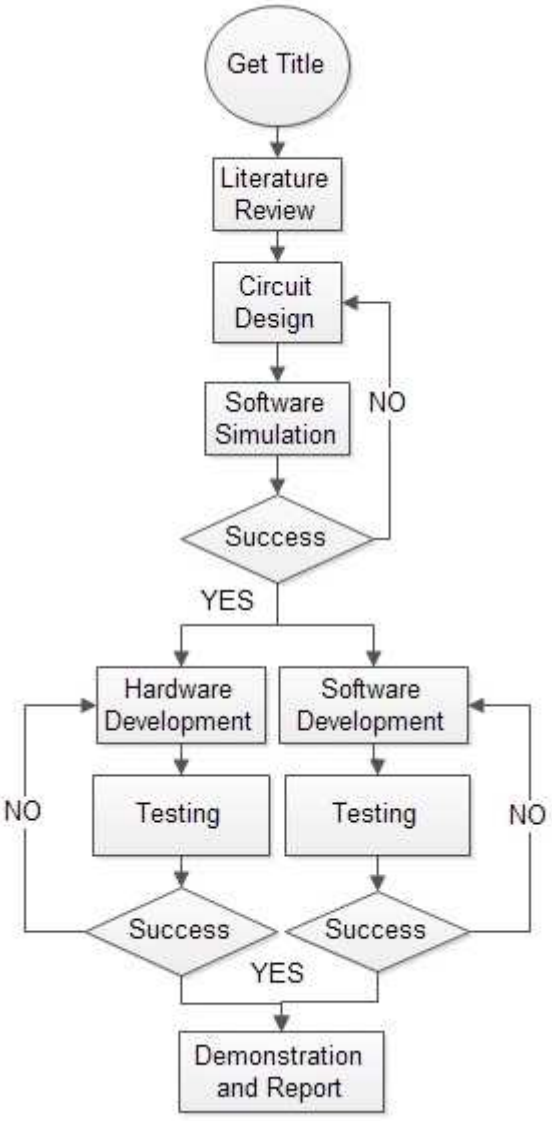

Figure 1: Flow chart for project development

The flow chart of the development of the project is shown in figure 1. A number of literatures have been reviewed to get some information and knowledge on the same research area.

A few ideas and concept design of automatic indoor plant watering have been proposed. The idea and concept designs have short listed and finalized.

Based on the literature reviews and the requirements specified in the concept design, the detail of the circuit design has been draw. Software simulation known as Multisim software was used to simulate the circuit design. Then the hardware part of the system has been developed together with the software to control the system. The whole system was tested to verify the capability of the system.

After the completing in software and hardware operation the system been showed to supervisor for demonstration and come out with a complete report.

(b) Operation of The System

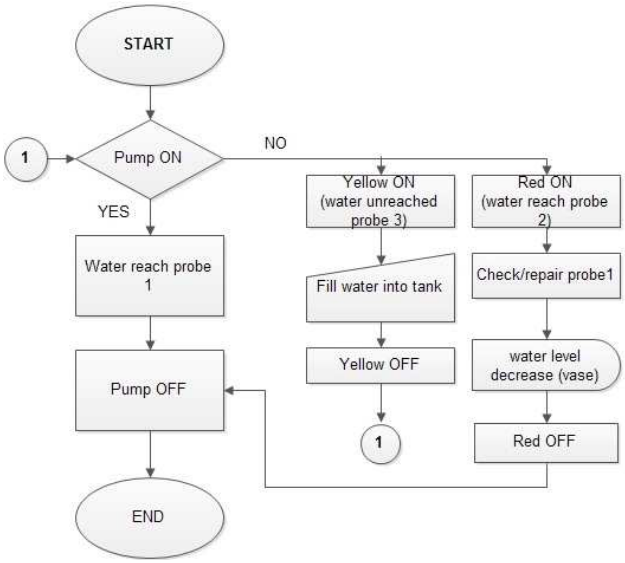

Figure 2: Flow chart for operation of the system

The operation of the automatic indoor plant watering system is shown in figure 2. Firstly, the water been filled with water and make sure the probe 1 and 2 been placed correctly in the plant vase. The purpose to make sure the probe was in the vase to make sure water not spill out of the vase when the system been turn ON.

After the system been turn ON, the pump will turn ON automatically and if the pump doesn't turn ON, please refer to the lamp indicator to know the system condition and what steps need to be taken.

If the yellow light indicator turns ON that mean the water in the tank is empty and need to be filling it manually. After the tank had been filled with water the yellow indicator will turn OFF and automatically turn ON the pump.

If the red light indicator turns ON that mean there is some problem with probe 1. The probe 1 need to be repair or be replaced because it showed the probe 1 cannot detect the presence of the water in the plant vase. After the probe 1 been replaced or be repaired, the water in the plant vase can be ignored to make sure the water be absorbed by the plant as normal. And the system can be normally operated as usual.

At normal operation, the pump will turn ON after the system is turn ON. The pump will turn ON until the water

in the plant vase reach the probe 1. The pump will automatically be turning OFF as soon as the water reaches the probe 1.

Probe 2 acts as safety probe to make sure no water spill out from the vase if the probe 1 failed to operate.

All of the process will repeated as long as the system doesn't facing any problem in the operation or the second power supply getting low.

(c) Software Programming

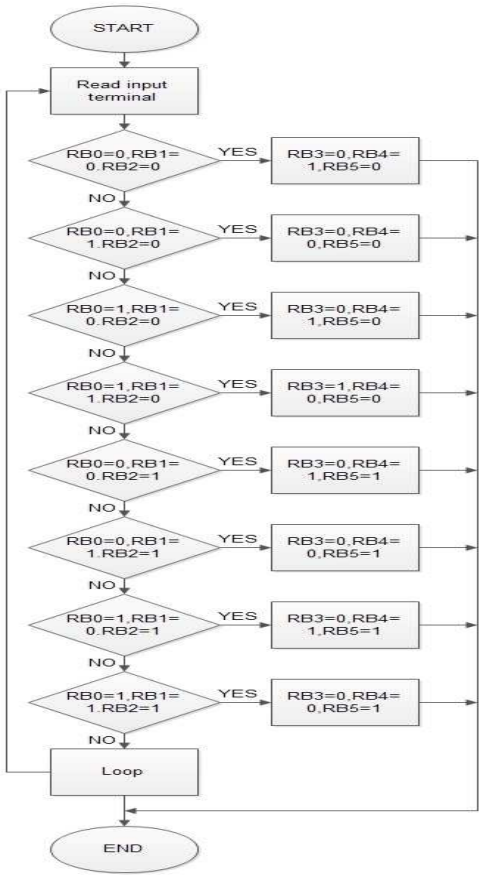

Figure 3: Flow chart for software programming

The 'automatic indoor plant watering' also consists of software part in its development. The MPLAB IDE software been used in the software development for the system operation. The C programming language been used for that purpose. The software operation been summarized into a flow chart that been showed in figure 3.

The programming involve of three input pins that represent all probes. To make sure there is no output clash in their operation, the input condition is expanded into eight conditions as been showed in the figure 3.

For every input condition it will resulted a particular output. The programming will check the input condition from one by one and it depends on the probes condition. Each probe represents its own pin.

For example if pin RB0, RB1 and RB2 are zero it will result on RB4 is one that means the red light indicator will turn ON and so on.

B. Circuit Diagram (appendix 1)

(a) Circuit Operation

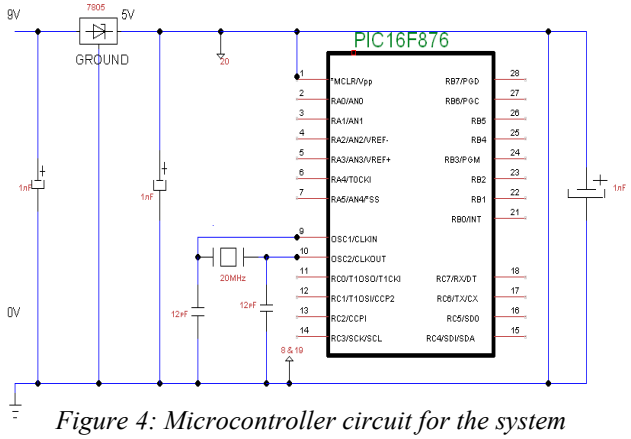

Figure 4: Microcontroller circuit for the system

The circuit diagram for the system as showed in appendix 1. The system used PIC16F876A microcontroller as it controller. System also used two separate power supply, one for the circuit and the other for the water pump. A 9V power supply been stepped down to 5V by using voltage regulator to make sure the microcontroller received suitable supply for it operation and avoid from the excess electrical supply that can damage itself. The detailed of the circuit connection as showed in figure 4.

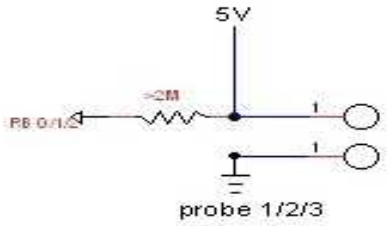

Figure 5: Probes circuit

For input probe (RB0, RB1 and RB2), the system used bypass concept for it operation. When the probe has a contact with the water, the circuit will be connected and

the low resistance of the water compare to the external resistance will make the current more interact to flow directly to the grounding by passing through the water rather than enter the microcontroller. The value for external resister used for those purpose is greater than 2MΩ because the value of the water resistance it ≈ 2MΩ. The probe circuit as showed in figure 5.

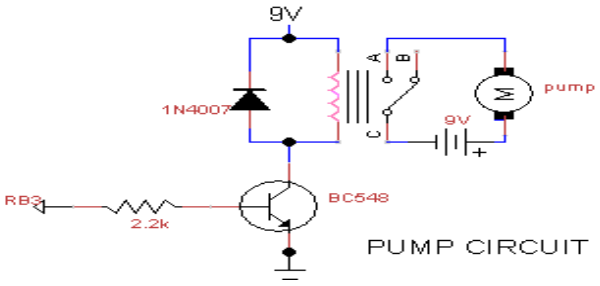

Figure 6: Pump circuit

To turn ON the water pump, a relay been used. The relay is used because the output voltage from the microcontroller cannot directly turn ON the water pump. A separate power supply need to be added for the system operation because the water pump draws too much current from the circuit and the main supply cannot handle it. To solve the problem a second supply need to be used.

C. *Block Diagram of the control system*

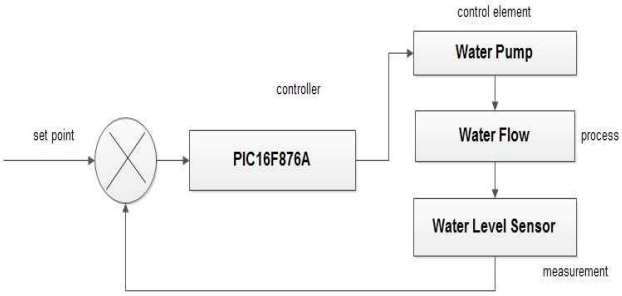

Figure 7: Block Diagram of the control system

Figure 4 showed the block diagram of the control system. In the plant vase it had been set point for water level. If the water level below the set point the water level sensor will passing the signal into the controller (PIC16F876A) and the controller will give a signal to control elements (water pump) to turn ON to make sure the water can flow from supply into the plant container or vase.

The filling process will stop when the water level in the vase reach the set point level. This closed loop system will make sure the water in the vase of the plant will always been fill with water.

D. *Project Diagram (appendix 2)*

The figure in appendix 2 showed how the system been applied in it operation. If the project was used for a vase higher than the project, it needs to be hanged to the vase as shown. The project can be hanged to the vase by it holder. If the project is higher than vase, just stand it on the floor beside of the vase.

E. *Project Dimension (appendix 3)*

The figure in appendix 3 showed the dimension of the system. The size of the project been build not too large to make sure it is suitable for indoor used.

IV. RESULT AND DISCUSSION

Table 1: Result

INPUT			OUTPUT		
PROBE1 (LOWER) (RB0)	PROBE2 (UPPER) (RB1)	PROBE3 (TANK) (RB2)	PUMP (RB3)	RED LED (RB4)	YELLOW LED (RB5)
0	0	0	0	1	0
0	1	0	0	0	0
1	0	0	0	1	0
1	1	0	1	0	0
0	0	1	0	1	1
0	1	1	0	0	1
1	0	1	0	1	1
1	1	1	0	0	1

Table 2: Result description

ITEMS	DESCRIPTION	
	1	0
PROBE1 (RB0)	Non contact with water	Contact with water(priority)
PROBE2 (RB1)	Non contact with water(priority)	Contact with water
PROBE3 (RB2)	Non contact with water	Contact with water(priority)
PUMP (RB3)	ON	OFF
RED LED (RB4)	ON	OFF
YELLOW LED (RB5)	ON	OFF

Table 1 showed the result of the system in form of truth table to make it simple and easy to understand. For the input part it consists of 3 pins of microcontroller (RB0, RB1 and RB2) that represent all of the probes respectively.

For the output part it also consist of 3pins of microcontroller (RB3, RB4 and RB5) that represent the output hardware that are water pump, red LED and yellow LED respectively.

The truth table showed the result of the output based on the input condition. For the example, what situation or

condition at the input will resulted the water pump will turn ON. From the table it showed that, the pump will only be turning ON if the probes 1 and 2 don't having a contact with water and the probe 3 showed water in the tank is available.

Table 2 showed the description of the truth table on table 1. It showed the meaning of 1or 0 at the input and output part in the truth table. It also showed what priority of the input for the system for it operation, for example the probe 3 need always been contacted with the water to make sure the system always had enough water for the watering purpose.

The knowledge on the electronic circuit has been applied in the project and the understanding on operation of several electronic components has been improved.

The project also consist of implementation of C language and can give more exposure about the operation and how the C language be implementing in electronic circuit operation.

It hopes that this project can help other who wants to plant tree in their home to respond for 'Go Green' campaign.

V. CONCLUSION

This system is one of the alternative and easy ways to watering the indoor plants. People nowadays were too busy with their daily life routine but still need particular time to pamper their plant. So this project can reduce the time needed.

By using this system, owner of the plant can leave the resident for a several days and do not have to worry about watering their plants because the system can take care of it.

This project also better from conventional automatic plant watering because it only watering the plant depends on moisture of the plant medium and it is more relevant compare with the system watering based on timing.

VI. PROJECT LIMITATION

This project need plant vase that can hold water. In other words a vase that does not having holes at their bottom.

Second power supply is by battery and cannot operate for a long term used.

The size of the water tank also influence on how long the system can watering a plant.

FUTURE DEVELOPMENT

This project can be modified for more advance in it operation. One of the modifications is to increase the water tank size. By doing so, the project can watering the plant for a long time period.

Another modification is tried to find another solution or ways how to running the system without need to use two power supply. One of the solutions is by change the water pump with one that has lower in its current operation.

VII. ACKNOWLEDGEMENT

I would like to express my appreciation and gratitude to my supervisor that is Dr. Rosidah Sam for her support, guidance and advise in making of my project. Under her supervision, I had accomplished its prescribed objectives and goals. Besides all of that, I also want to thanks our colleague that give me a lot of help in advise, guidance and facilities to me. They also take part in the making of this project. Finally, to my entire colleague and lectures, whether they are involved directly or indirectly within the accomplishment of this project. I hope that this project would be beneficial to all who concerns.

VIII. REFERENCE

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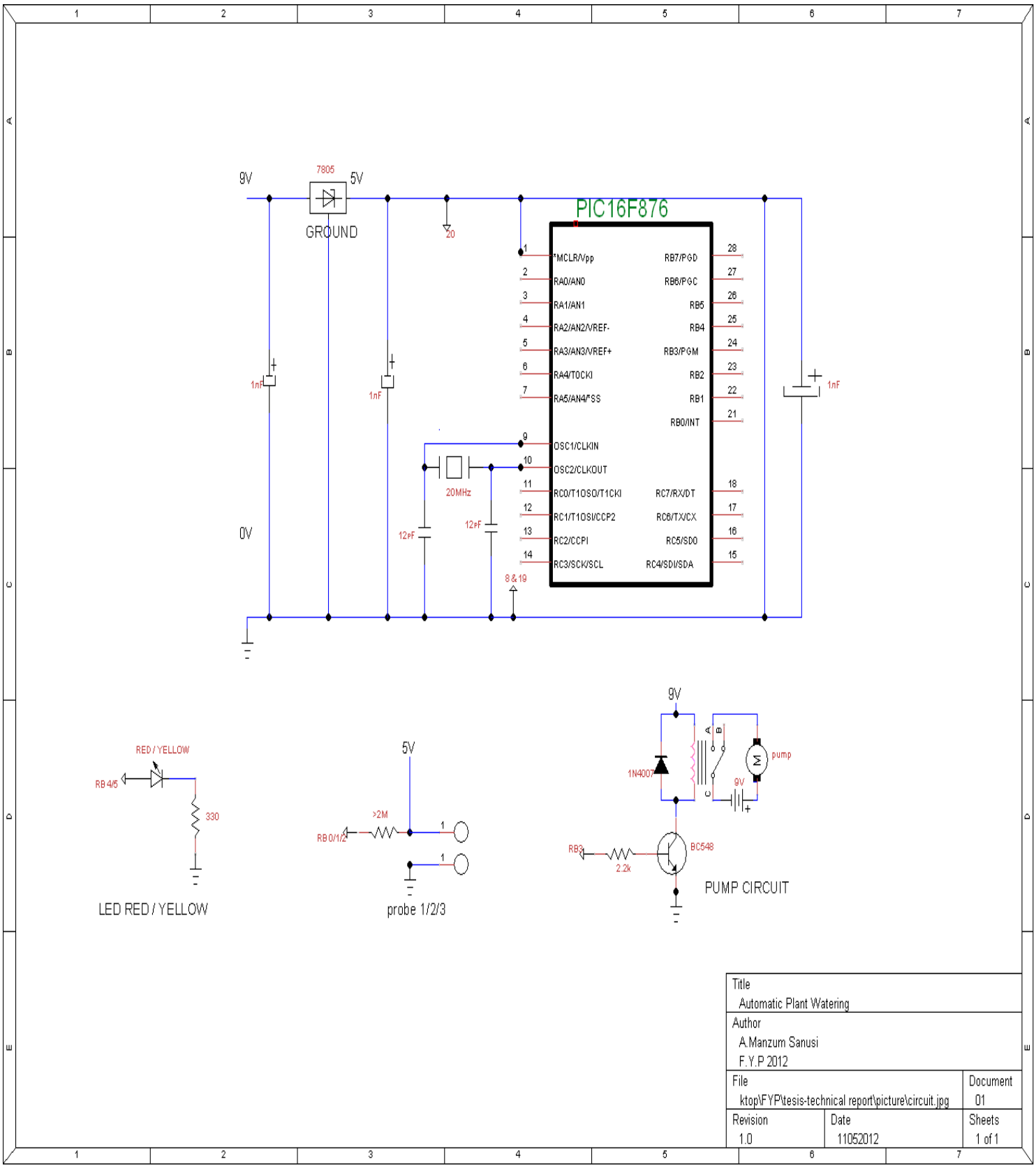
Appendix1



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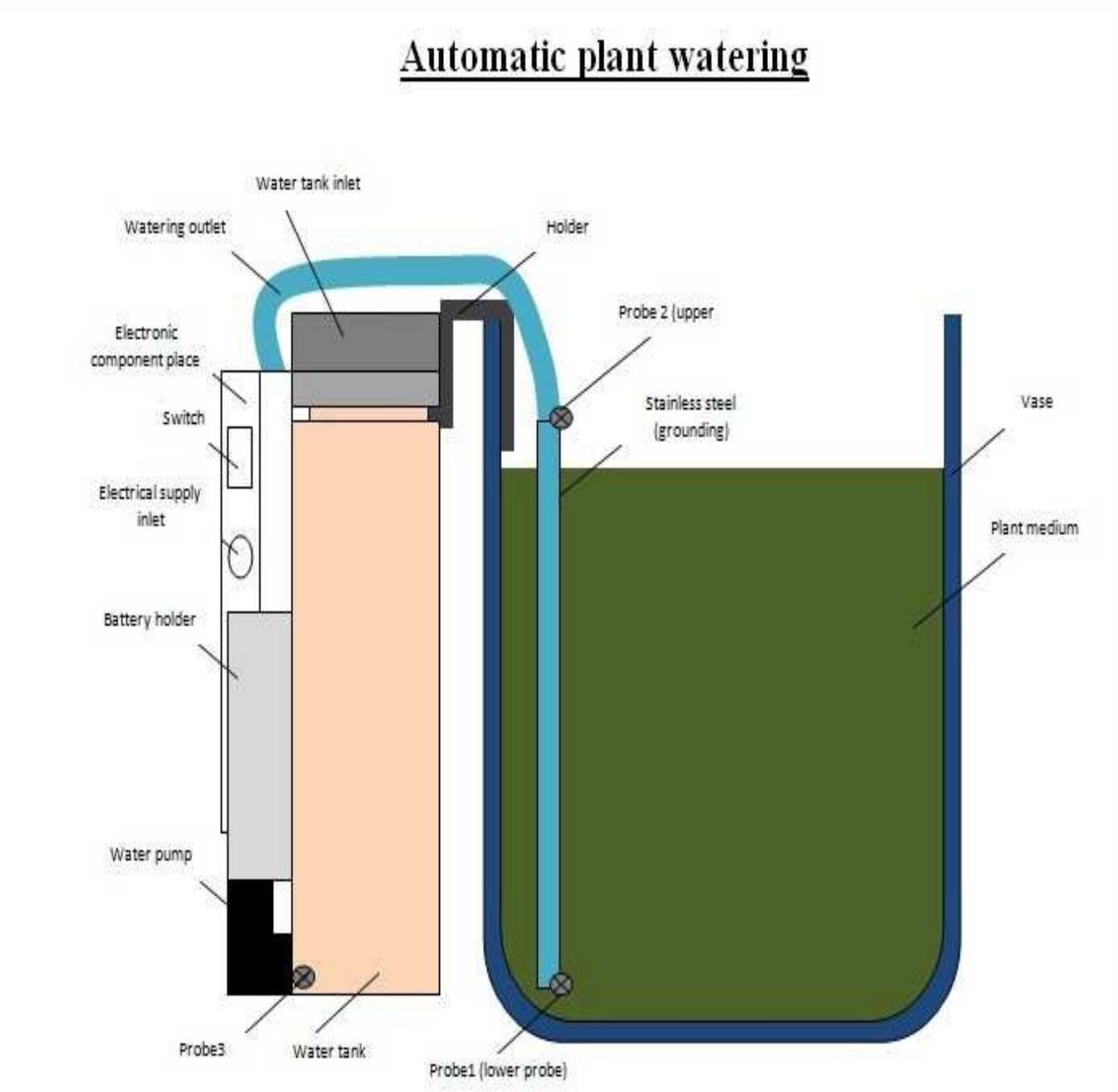
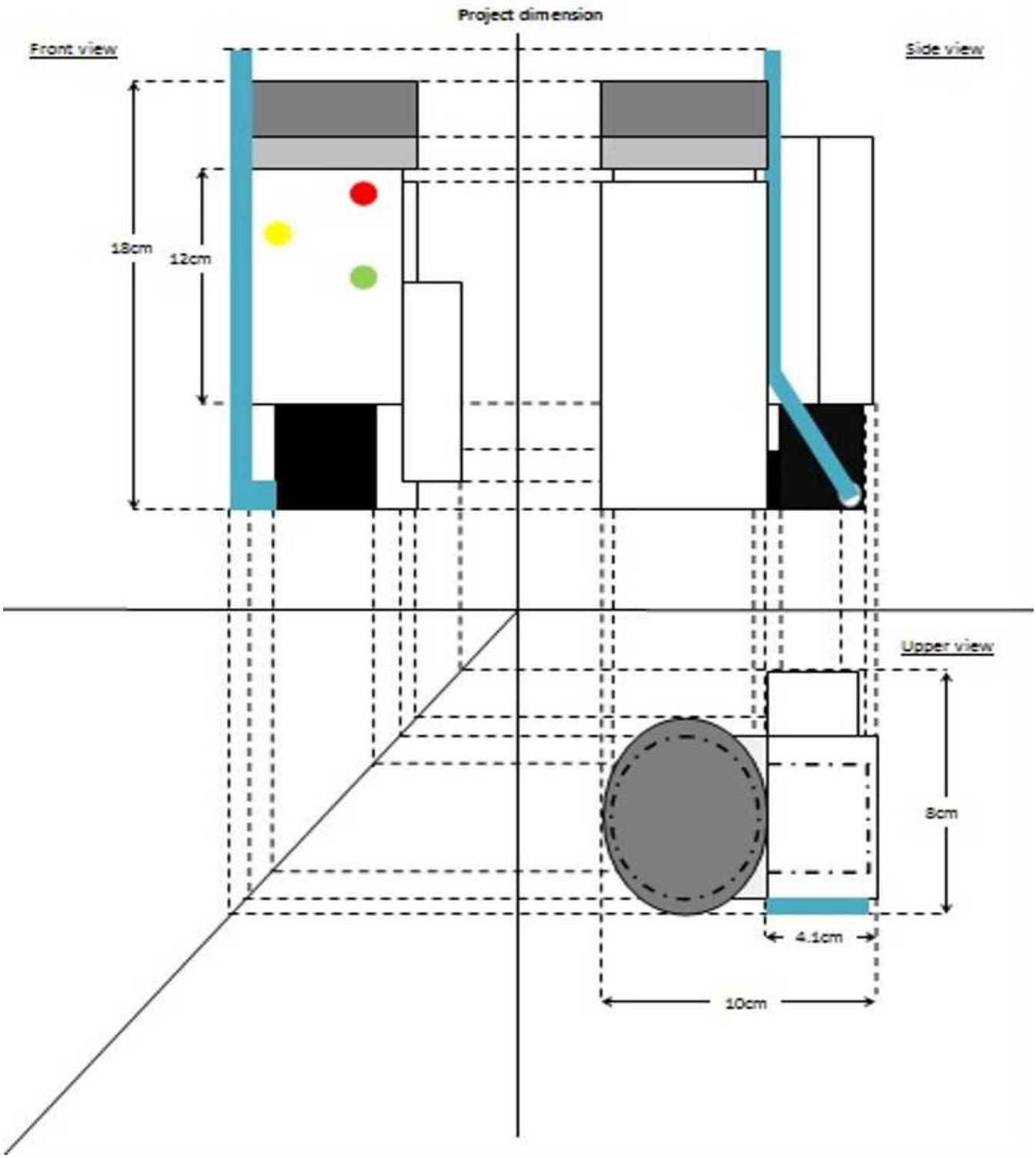
Appendix2


Automatic plant watering
Water tank inlet
Watering outlet
Holder
Probe 2 (upper
Electronic component place
Switch
Stainless steel (grounding)
Vase
Electrical supply inlet
Plant medium
Battery holder
Water pump
Probe3
Water tank
Probe1 (lower probe)

Appendix3


Project dimension
Front view
Side view
18cm
12cm
Upper view
8cm
4.1cm
10cm