PHYSICS RESEARCH AND TECHNOLOGY

PROCEEDINGS OF THE 2017 INTERNATIONAL CONFERENCE ON "PHYSICS, MECHANICS OF NEW MATERIALS AND THEIR APPLICATIONS"

Ivan A. Parinov ⌘ Shun-Hsyung Chang
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PREFACE

Advanced materials and composites play very important role in prospective directions of modern science and technology, defining quick development of technique and industry. The developed a new generation of materials and composites (ferro-piezoelectrics and ferromagnetics, nanomaterials and nanostructures, functional materials and polymeric composites etc.) introduces the main contribution to modern sciences, technologies, techniques and industry. With purposes to improving their properties, numerous chemical, physical and mechanical studies are necessary, accompanied by modern numerical approaches and methods of mathematical and physical modeling. Different applications define continuous and tremendous interest to these investigations. Constant growing investigations and obtained achievements allow one to understand deeper and estimate correctly very fine phemomena, nano-, micro- and macro-transformations, occurring during processing, loading and operation of modern materials and devices under intense internal and external influences of different nature. Quick development of theoretical, experimental and numerical methods require improvement of experimental facilities, computer hard- and software of higher level. Results of these researches define further movement to new scientific knowledge. They allow understanding and evaluation of numerous and fascinating physical-mechanical processes and phenomena, taking place in fabrication of advanced materials, composites and devices, developed on their base.

This collection presents reports of the 2017 International Conference on "Physics, Mechanics of New Materials and Their Applications" (PHENMA-2017), which has been taken place in Jabalpur, India, 14-16 October, 2017 (http://phenma2017.math.sfedu.ru; http://phenma2017.iiitdmj.ac.in) The conference was sponsored by the Council of Scientific and Industrial Research (India), Ministry of Education and Science of Russian Federation, South Scientific Center of Russian Academy of Science, Russian Foundation for Basic Research, Ministry of Science and Technology of Taiwan, New Century Education Foundation (Taiwan), Ocean & Underwater Technology Association (Taiwan), Unity Opto Technology Co. (Taiwan), Fair Well Fishery Co. (Taiwan), Woen Jinn Harbor Engineering Co. (Taiwan), Lorom Group (Taiwan), Longwell Co. (Taiwan), University of 45, Surabaya (Indonesia), University of Islam Kadiri (Indonesia), Khon Kaen University (Thailand), Don State Technical University (Russia), South Russian Regional Centre for Preparation and Implementation of International Projects.

The thematic of the PHENMA-2017 continued ideas of previous international symposia and conferences: PMNM-2012 (http://pmnm.math.rsu.ru), PHENMA-2013 (http://phenma.math.sfedu.ru), PHENMA-2014 (http://phenma2014.math.sfedu.ru), PHENMA-2015 (http://phenma2015.math.sfedu.ru) and PHENMA-2016 (http://phenma2016.math.sfedu.ru), whose results have been published in the following edited books "Physics and Mechanics of New Materials and Their Applications", Ivan A. Parinov, Shun Hsyung-Chang (Eds.), Nova Science Publishers, New York, 2013, 444 p. ISBN: 978-1-62618-535-7; "Advanced Materials – Physics, Mechanics and Applications", Springer Proceedings in Physics. Vol. 152. Shun-Hsyung Chang, Ivan A. Parinov, Vitaly Yu. Topolov (Eds.), Springer, Heidelberg, New York, Dordrecht, London, 2014, 380 p. ISBN: 978-3319037486; "Advanced Materials – Studies and Applications", Ivan A. Parinov, Shun-Hsyung Chang, Somnuk Theerakulpisut (Eds.), Nova Science Publishers, New York, 2015, 527 p. ISBN: 978-1-63463-749-7; Proceedings of the 2015 International Conference on Physics and Mechanics of New Materials and Their Applications, devoted to 100-th Anniversary of the Southern Federal University, Ivan A. Parinov, Shun-Hsyung Chang, Vitaly Yu. Topolov (Eds.). Nova Science Publishers, New York, 2016, 582 p. ISBN: 978-1-63484-577-9 and Proceedings of the 2016 International Conference on Physics and Mechanics of New Materials and Their Applications, Ivan A. Parinov, Shun-Hsyung Chang, Muaffaq A. Jani (Eds.). Nova Science Publishers, New York. 2017, 794 p. ISBN: 978-1-53611-033-3, respectively.

The presented reports are divided into five scientific directions: (i) processing techniques, (ii) physics, (iii) mechanics, (iv) applications, and (v) industry and management.

These PHENMA 2017 Proceedings present many fascinating tasks, connected with solution of the promising problems and R&D processing techniques, chemistry, physics, mechanics, and applications (including industry and management) of novel materials and composites. The suggested book gives important contribution in theoretical and experimental methods, which allow manufacture of nano-materials (including ferro-piezoelectric and environmentally-friendly), and other materials with before given and improved characteristics. The book also focuses on results of mathematical modeling and experimental studies of advanced devices (energy-harvesters, piezogenerators, piezoelectric transducers, magnetic field sensors, medical devices etc.), based on developed nano-materials, ferro-piezoelectrics and other materials with specific characteristics. The book studies very interesting modern nano- and microstructure techniques for processing various advanced materials (for instance, ZnO nanostructures) and devices, which are very important for educational and industrial applications, unification and improvement of different expertise, design and analysis. Moreover, the book presents theoretical and experimental investigations of various promising piezoelectric materials and devices by using the methods of condensed matter physics and mechanics of deformable solids. The obtained results include new improvements of numerical approaches (in particular, finite-element modeling). Many achievements are connected with novel (including nano- and microstructural) devices with higher accuracy, longevity and demonstrating extended opportunities to work under critical temperatures and pressures, aggressive media, etc. They show improved properties, determined by developed materials and structures, opening new possibilities to investigate numerous physical-mechanical processes and phenomena.

The book is addressed to students, post-graduate students, scientists and engineers, participating in investigation and development of a new generation of nanomaterials and nanostructures, piezoelectrics and magnetic materials, other promising materials, and also

various devices, fabricated on their base and intended for numerous applications in different areas of science, technique and technology. The book presents new investigations and scientific results in the Condensed Matter Physics, Materials Science, Physical and Mechanical Experiment, Processing Techniques and Engineering of Nanomaterials, Piezoelectrics, Ferromagnetics and other Advanced Materials and Composites, Numerical Methods, and also various promising applications (including industry and management) and developed devices.

Ivan A. Parinov
Shun-Hsyung Chang
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Chapter 76

IMPLEMENTING A WATER CONTROLLER SYSTEM USING MICROCONTROLLER ARDUINO AND THE APPLICATION SYSTEM (BASED ON THE VISUAL BASIC VERSION 2010) TO CONTROL THE WATER VOLUME IN ALL BOARDERS

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ABSTRACT

Today, the use of electronic systems is growing and almost all people use these electronic systems. A water controller system helps to control water volume with the purpose to decrease or reduce the water dissipation, which is not necessary. The boarders will realize how important saving clean water is. This water controller system uses the microcontroller arduino mega and a few electronic things, such as electronic series for arduino mega and a solenoid valve with voltage of 12 volts; meanwhile, for a 12 volts relay that is used as a switch to close and open a solenoid valve, a water flow meter is used to read the water debit. Meanwhile, in a part of the controller system, the application based on Visual Basic 2010 is used. With this application, we can control this water system controller, water quota, add the quota, and monitor it. As a connector between system and hardware, we use the USB cable data with the communication series UART TTL.

Keywords: microcontroller arduino, visual basic, water controller system, water flow meter

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1. INTRODUCTION

Water is essential and important to all lifeforms known to date on Earth. Water covers 1.4 trillion cubic kilometers (330 million miles) of the Earth's surface, and it is also present within clouds, rain, rivers, lakes, water vapor, and sea ice. The air in these objects moves in an air cycle, namely:

Through evaporation, rain, and airflow above the soil surface (runoff, reach of springs, rivers, estuaries, etc.) to the sea. Clean water is essential to human life.

In many places in the world, it is absent. In addition to Earth, large quantities of water are also thought to exist at the north and south poles of Mars, as well as on the moons of Europa and Enceladus. Water can be solid (ice), liquid and gas (air vapor). Water is the only substance that naturally exists on the surface of Earth in its three forms. Improper water resource management can cause air shortages, monopolization and privatization, and even trigger conflicts. Indonesia already has a law regulating resources since 2004, Undang Undang No. 7 of 2004 on Water Resources (Wikipedia.org, 2015).

Water is an inherent element of human life, and it can be argued that the development and processing of water resources is the basis of human civilization [1].

The use of water is universal or can be from all aspects of life and becomes more precious both in terms of quantity and quality [2].

Whether we realize it or not, clean air is necessary for people to thrive. Clean water is usually used by residents to cook, wash clothes, and so on. However,all this time in the big city, air is filled by PDAM. However,if there is an explosion of population growth, there is a question: "Is the PDAM able to meet the needs of clean air in big cities?" [3].

Based on the article uploaded on the investor site, data tell that with a population of about 9.6 million people the need for clean water in Jakarta is estimated at 29.6 m^3/s. In 2025, the population of Jakarta should increase to 14.6 million; if this is the case, then the need for clean water at that time will reach 41.3 m^3/s [3].

2. SAMPLES AND EXPERIMENTAL METHODS

The design of an arduino-based device control system uses visual basic application. It is generally divided into mechanical design, hardware design or electronic systems that act as controllers of water volume control devices, software or software designs that control the information of remote senders. It is necessary to design the system before its creation on the base either of the hardware or software data [4].

Device creation is distinguished in several device blocks, where each block has a certain function (Figure 1). The mechanical system of the control devices of water volume is designed in such a way that the system easy operates. The design of hardware is an electronic device that plays a role in controlling the water volume. The control device consists of a microcontroller as a data processor, UART TTL series as a communication medium. The software design acts as an arduino program and visual basic.

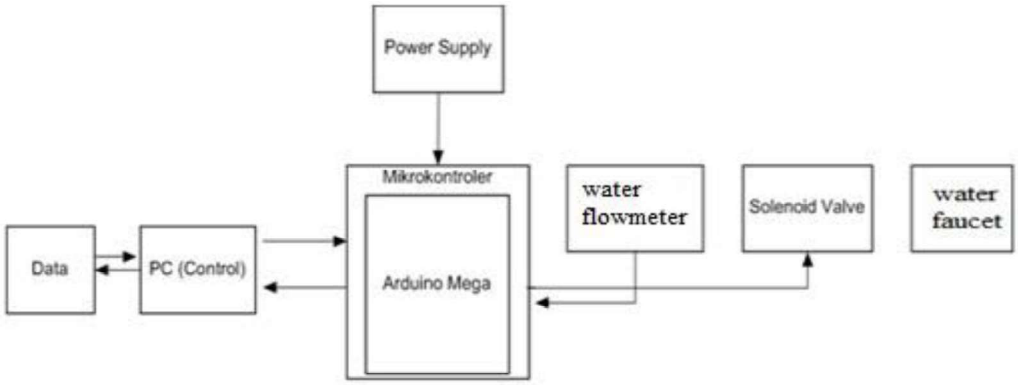

Figure 1. Block Diagram of Control System.

3. Results and Discussion

The control system uses arduino mega, which has 16 analog pins and 54 digital pins. The reason for choosing arduino mega consists in that the number of pins and memory in arduino is enough for the operation of the tool. In arduino mega for water volume controller devices, interrupted pins 2 and 3 are used. For the communication between Arduino Mega and PC/ Laptop, it is used UART TTL (5V) serial communication available on pin 0 (RX) and pin 1 (TX) on arduino mega, shown in Figure 2 [5].

The relay circuit will be connected to the arduino mega on the specified pin. The relay used in the design of this module is SPDT relay (Single Pole Double Throw). The relay will work when obtaining High logic input from the arduino as shown in Figure 3.

In the DC transformer power supply circuit, it is used Step down Transformer with 220 V on primary input, and 12 V, 6 V on secondary output. The 220 V terminal on the primary side is connected to the PLN. The 6 V and 12 V output voltages on the secondary side are connected to the bridge rectifier circuit as shown in Figure 4.

Control of real-time volume water by using control devices with timer sets or scheduling controls can be realized using RTC (Real Time Clock) Module. RTC function calculates the start time in seconds to years, and can store time data that has been set. The RTC, used for this research, is the DS1307 RTC connected to the battery then connected to the Arduino and the relay circuit as shown in Figure 5.

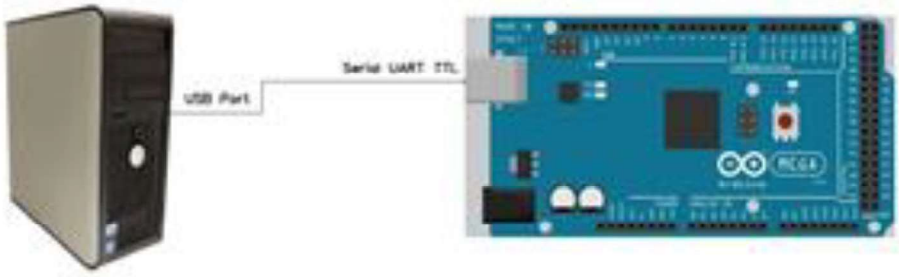

Figure 2. Connection of UART TTL Serial.

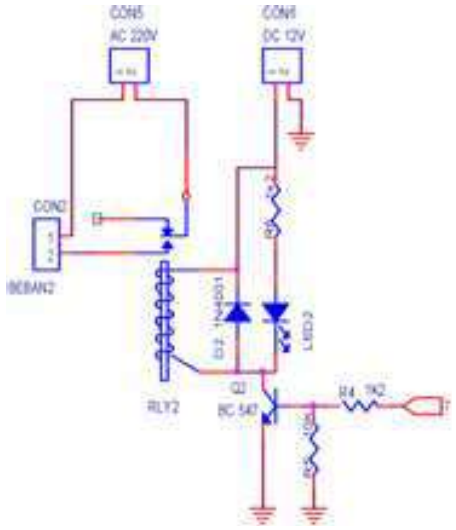

Figure 3. Relay Circuit.

Hardware circuit design is divided into four main sections, namely Relay, RTC, Arduino Mega and PC/Laptop. An overview of these hardware parts is shown in Figure 6, which describes the schematic of the whole circuit and the components and ports used.

The preparation of software consists of the next stages: arranging flow chart, context diagram, DFD (Data Flow Diagram) and table structure. These diagrams are aimed to explain the application flow in the controller. The diagrams will be referenced in the manufacture of water volume control applications. Control of circuit program and creation of program listings are based on flow charts prepared by using C language.

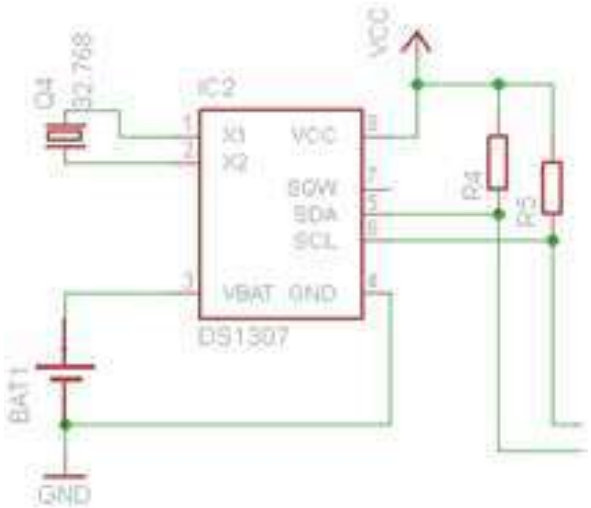

Figure 4. Power Supply Circuit.

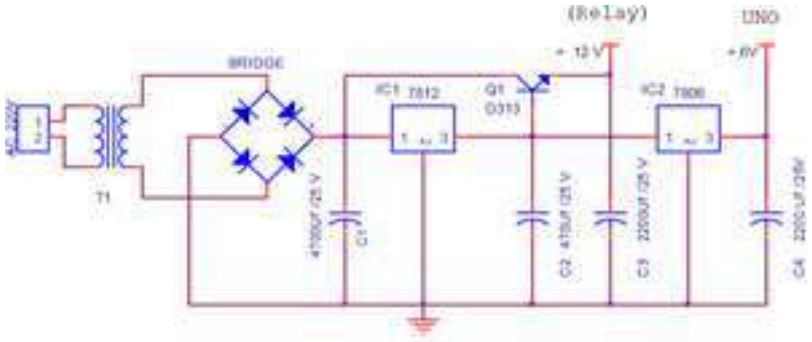

Figure 5. RTC Circuit.

This system operates by using laptop or PC with Windows 7. The first stage of software compilation is to develop a flow chart of a control circuit program, aimed to explain the application of the flow control of the water volume with control device (Figure 7). The flowchart of the control system for water volume is shown in Figure 8; this flowchart is applied on the hardware side or on the microcontroller side. From the flowchart, we can see that all inputs only come from reading data in memory and no other inputs.

Flowchart in Figure 8 explains the flow in the application: when a user opens the first application, it will immediately appear login page. In the main menu, there are some menus and reports. Users can directly control the control device of water volume through the main menu of the application.

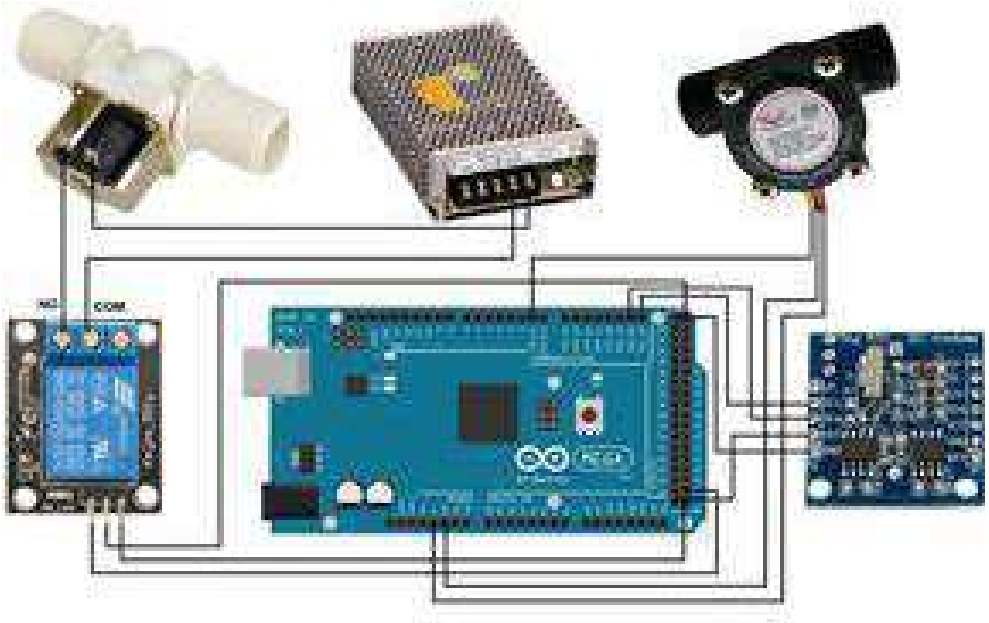

Figure 6. Schematics of all circuits connected.

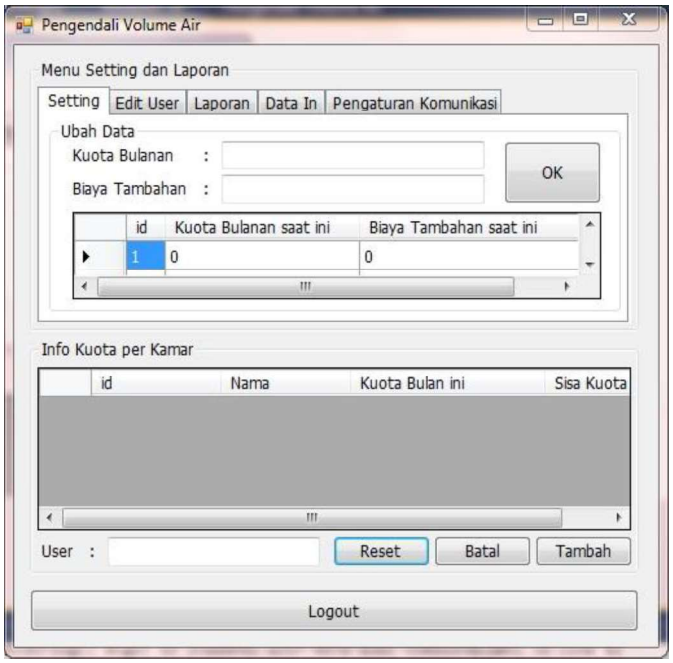

Figure 7. Volume water controller application.

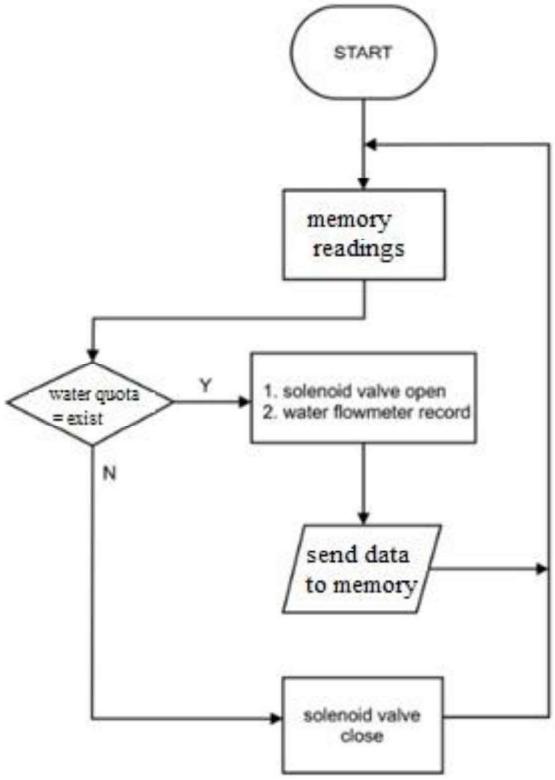

Figure 8. Flowchart of the Software.

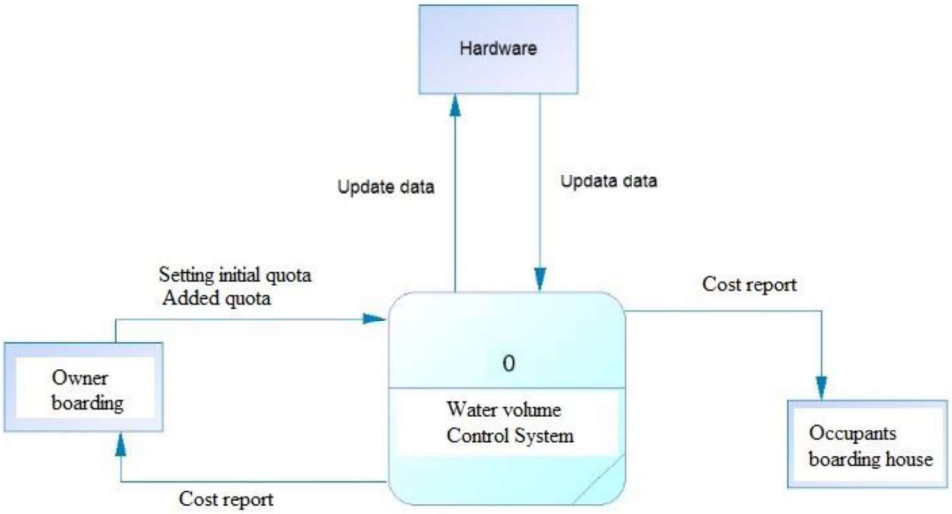

Figure 9. Context diagram.

Context diagram is a model or pattern that describes the interaction of the system with the external entity that is the board owner. The board owner has full rights on system and data management, such as inserts and updates. It is shown in Figure 9 below.

DFD (Data Flow Diagram) is a graphical representation of a system. It describes an existing or new system will be developed logically without considering the physical environment in which the data can be stored.

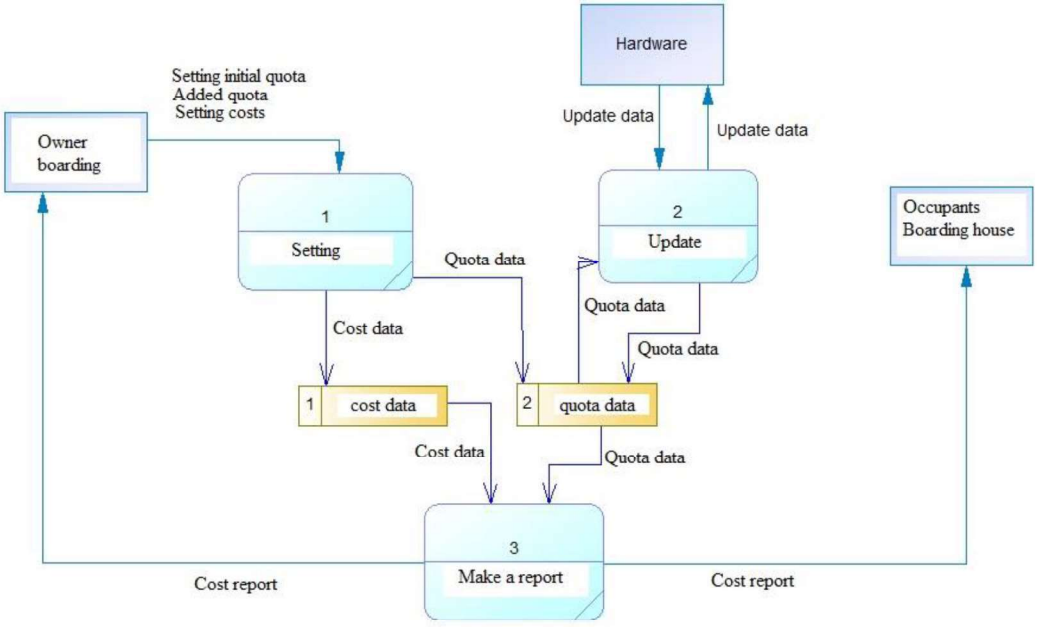

Figure 10. Data flow diagram, level 1.

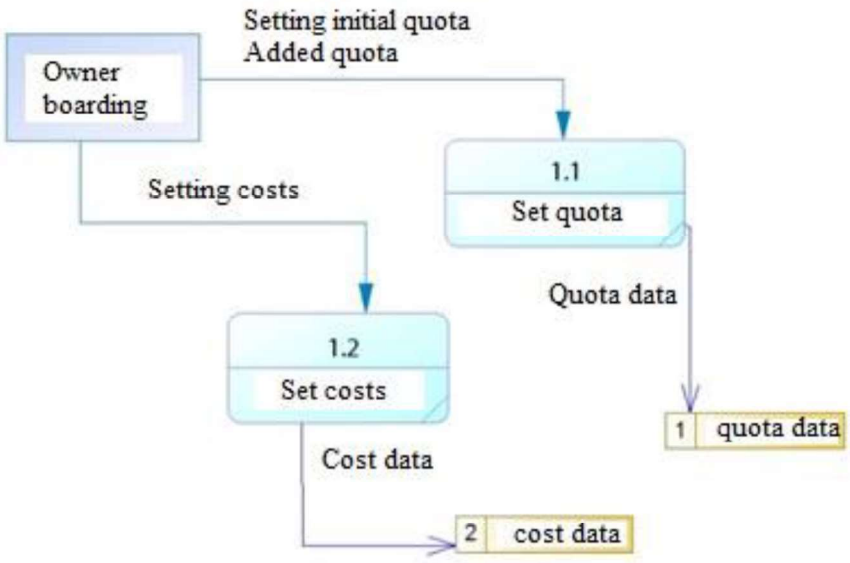

Figure 11. DFD level 2 of "Setting" Process.

The board owner sets the quota setting input and adds quota, then the data goes to "Quota data". The board owner also inputs the cost setting then the data goes to "Cost data".

The database file that will be used in system planning and management of controlling water volume is presented on Tables 1-3.

The results of the using hardware can be seen in the result table and accuracy of compiling and calculating the water discharge by using two different flow meters. The results are shown in Tables 4 and 5.

Table 1. tb_user

Field	Type	Key	Comment
id	varchar (100)	Primary key	
name	varchar (100)		
quota_this month	int (100)		
the rest of the quota	int (100)		
added quota	int (100)		
added cost	int (100)		
added quota	varchar (100)		

Table 2. tb_setting

Field	Type	Key	Comment
id	int (100)	Primary key	
monthly quota	int (100)		
added quota	int (100)		

Table 3. tb_admin

Field	Type	Key	Commet
user	varchar (50)		
password	varchar (50)		
id	int (50)	Primary	

Table 4. Results of test water flow meter 1

Trial No.	*Recorded water discharge with 1 liter reference*
1	*1,2*
2	*1,1*
3	*1,3*
4	*1,1*
5	*1,1*

Table 5. Results of test water flow meter 2

Trial No.	*Recorded water discharge with 1 liter reference*
1	*0,9*
2	*0,7*
3	*0,8*
4	*0,8*
5	*0,9*

For testing tools the following software will show the performance view of the water volume control application, and which will be explained, based on the menus available on the application. This test is the same as the previous test, where the input data from water flow meter there are 2 pieces, therefore from the following simulation there are 2 users from room 1 and room 2.

To test the software is performed the login process, menu settings, user edit menu, communication settings menu, data menu in/monitoring, report menu and quota additional testing.

CONCLUSION

i. From the results of the observation and testing, the circuit looks to work well in accordance with the design, so that controlling the volume of water is easier for users;
ii. arduino control with the application, using data cable, is still limited;

iii. the application of the software water volume controller with Microsoft Visual Basic 2010 is easier and suitable for a control system;
iv. a testing tool with two water flow meters gets different results for each tool; and
v. a monthly quota will increase automatically when entering the new month.

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