# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## DEVELOPMENT OF CONTROLLER FOR GROUND WATER WELL BY USING ARDUINO

This report is submitted in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electronic Engineering Technology (Industrial Electronic) (Hons.)

by

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# DECLARATION

I hereby, declared this report entitled "Development of Controller for Ground Water Well by using Arduino" is the results of my own research except as cited in references.

Signature      :……………………………………….

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Date        :27 JANUARY 2016

# APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (BACHELOR OF ELECTRONICS ENGINEERING TECHNOLOGY) (INDUSTRIAL ELECTRONICS.). The member of the supervisory is as follow:

…………………………………

(Cik Siti Halma Binti Johari)

# ABSTRAK

Pada tahun-tahun kebelakangan ini terdapat lebih banyak peranti mudah alih yang muncul dan menjalankan sistem operasi Android. Pada masa kini terdapat satu tren penggunaan teknologi maklumat pada bila-bila masa dan di mana sahaja. Projek ini dengan menggunakan Arduino adalah kerja gabungan bersepadu untuk membangunkan model untuk menghasilkan cara alternatif untuk mengumpul air bersih dari bawah tanah dengan menggunakan telefon pintar dikawal Arduino. Projek ini bermula apabila penduduk yang mempunyai masalah dengan air bersih di tempat tekanan rendah. Jadi projek ini digunakan untuk mengumpul air bersih dari tanah untuk pengguna. Objektif projek ini adalah untuk menyelesaikan masalah pengguna dengan menggabungkan diantara sambungan peranti android smartphone dan pengawal mikro diprogramkan berdasarkan Arduino dengan matlamat untuk mengawal pam air bawah tanah. Apabila telefon pintar dihidupkan Sim900 GSM akan menghantar isyarat amaran dalam bentuk mesej kepada telefon pintar, DC motor (pam air) akan diaktifkan, air bawah tanah akan dihisap menggunakan pam dan air dialirkan ke tangki simpanan sebelum pemindahan kepada pengguna. Apabila air diisi dalam tangki, sensor aras akan mengesan air maksimum atau minimum, jika air melebihi maksimum motor akan berhenti. Projek ini adalah untuk menyediakan satu teknologi yang diperlukan untuk mewujudkan keselesaan kepada pengguna, dan keupayaan kawalan oleh mikropemprosesan.

# ABSTRACT

In the recent years there are more and more mobile devices appearing which are running Android operating system. Nowadays there is a trend of information availability anytime and anywhere. Ground water well by using Arduino UNO R3 is the combined work integrated to developed a model for produce alternative way for collecting clean water from ground by using smartphone controlled Arduino UNO R3. The project is begin when the people having a problem with clean water in certain place. So this project used to producing clean water from ground to people. The objective of this project paper is to present the solution for interconnection of mobile device application environment and universal programmable microcontroller based on Arduino UNO R3 board with the goal of monitoring and remote control of small ground water well. Next when the smartphone turn ON the DC motors (water pump) will activate, ground water will suck by pump and the water is store at water tank before transfer to the consumer. When the water filled in tank the maximum and minimum water level sensor will sense the presence of water which is if the water exceed to maximum sensor motor will stop. The Sim900 GSM module will send the warning message to the smartphone. This project is to providing a necessary technology to create convenience, intelligence and control ability.

# DEDICATIONS

To my beloved parents

Ahmad Pisol Bin Talid and Nadziroh Binti Din

To my lecturer and supervisor, for her guidance and encouragement

Cik Siti Halma Binti Johari

To my friends, for their unconditionally support

# ACKNOWLEDGEMENT

First of all, I am really grateful to almighty Allah S.W.T because the strength that he gave me, finally I have finished my Final year project I without any delay. I am also very grateful to Almighty Allah S.W.T for granting me the wisdom and strength to face and overcome the challenges and obstacle to accomplish this Bachelor Degree Project 1 (BDP 1) and my Bachelor Degree Project 2 (BDP 2). I thank my academic supervisor Cik Siti Halma Bt. Johari, for her supervision through the period of my BDP, without him my BDP will be nothing. Her guidance and help though this period helped me to understand better on working this report. It has been truly memorable and educative being student under his supervision. Gratitude is also to FTK lab technician works for their cooperation and also for sharing their knowledge. I also would like to express my sincere to my thanks to my friends in BETE, their ideas and moral support have helped me during this project .

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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|---|---|---|
| PC | - | Personal Computer |
| USB | - | Universal Serial Bus |
| ICSP | - | In Circuit Serial Programming |
| AC | - | Analog Circuit |
| DC | - | Digital Circuit |
| GND | - | Ground |
| LCD | - | Liquid Crystal Display |

# CHAPTER 1

## INTRODUCTION

This chapter will cover the detail explaination of the introduction of project background. Some of the discussion is about problem statement, objective project, the scope, and limitation of this project.

## 1.1   Background Project

With the fast growth of information technology, the idea of smart living has been put forward and occur and emerged as an attractive field for research and investor in past decade. The model of system can be a very practical platform for further research into making smart living to help people in daily life. The Sim900 GSM technology has been one of important technology to monitoring ground water well. It use the wireless technology to replace cable on devices like smartphone and PC. The cable replacement could create a point communication, the Sim900 GSM allow wireless device to communicate with each other within in specific range. Clean water from main inlet is pumped up to the tanks using DC water pump. Water supplies to most part of are drawn from the tanks by means of gravity. When there is power failure, no water is pumped up to fill the tanks. As a result the water level in the tank reduces gradually. The water level of the tank reduces drastically and within short period of time the water runs out. Unexpected water shortage does occur any time if the tank is not properly monitored. Hence, a monitoring system to monitor the tank water level has to be developed and eventually able to alert the person in-charge or technician on the current status of the tank. The system consists of water level detector circuitry integrated with GSM module.

Upon reaching the critical water level in the tank, an SMS is sent through GSM module to the technician incharge for further action.

## 1.2 Problem Statement

Most of people have a problem to have clean water especially after flood. Recent development of controller for ground water well in Malaysia is driven by the expansion of industries and population growth in remote areas where connection to the main water supply is not available. Alternatively the ground water becomes an alternative source of water supply that can be use in every residence.

## 1.3 Objective

The objectives of this project are as listed below:
1) To study interconnection of mobile device environment and Sim900 GSM/GPRS shield based on Arduino UNO R3 board.
2) To develop prototype of ground water well control by Arduino UNO R3.
3) To analyse the performance of ground water control by Arduino UNO R3.

## 1.4 Scope and limitation

This project involve of an Arduino UNO R3 (ATmega328). In this project the DC motor is control by Arduino UNO R3. The SIM900 GSM coverage is to send message to the smartphone which is the warning level in the water tank. When the Arduino UNO R3 is turn ON, the DC motors (water pump) will activate, ground water will suck by pump and the water is store at water tank before transfer to the consumer. The depth of pumping depend on distance of tube. When the water filled in tank the maximum and minimum water level sensor will sense the presence of water which function to trigger motor to stop when the water exceed to maximum.

## 1.5    Outline of report

Generally, this report is divided into two part which are Bachelor Degree Project (BDP I) and (BDP II). The total report contains of five chapters. These chapters generally discusses about back ground of study,  problem statement,  scope, as well as the limitation of the study and research methodology. Chapter two is the literature review which will done based on journals, books. Internet recourse and previous studies done related to this topic. Based on information gathered this chapter will discuss the bluetooth device, Arduino UNO R3 and component function. Chapter three, the all method to construct the research and phase to developing a software are explained. On the other hand, Chapter 4 is about process to developing the software to estimate the project cost. On this chapter, a detail step by step process to develop the software will be explained. In the last chapter conclusion and recommendation which summary and the conclusion for the project of developing the interactive process and also some suggestion to improve this study for the future. Finally , all the chapter are complied separately in sequence in oder to give a clear view to the readers.

# CHAPTER 2
## LITERATURE REVIEW

In this section, will discuss about any fact that might be helping to developing the ground water well. The facts can be an article, journal, book or paper review. Previous works done by other research are also explained.

## 2.1    Introduction

Smartphones are becoming more powerful with reinforced processors, larger storage capabilities, richer entertainment functions and more communication methods. Sim900 GSM, which is mainly used for data exchange, add new features to smartphones. Sim900 GSM technology shows its advantage by integrating with smartphones. It has changed how people use digital devices at home or office, and has transferred traditional wired digital devices into non wireless devices. Considering its normal working area are based on simcard coverage. The concept of Smart Living has offered better opportunity in convenience, comfort and security. With increase in smartphone users, Android smartphones have gradually turned into an all-purpose portable device and provided people for their daily use . In recent years, an open-source platform Android has been widely used in smartphones. Android has a complete software package consisting of an operating system, middleware layer, and core applications. GSM stands for Global System for Mobile Communication. The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. The featuring an industry-standard interface, and the SIM900 can delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application,

especially for slim and compact demand of design.(NJS Consultants Published on Jul 20, 2014).

## 2.2 Previous research

"Control and monitoring system of Small Water Plant" presented by (Koval, Feci, & Jakab, 2013) in their research paper, the main goals of research in this area were:

- Versatility of the solution for remote administration and monitoring the sensor network based on Arduino Development Environmnet.
- Reliability in export readings to a central data repository.
- Price affordability of solution with respect to SOHO solutions.

Components of the monitoring system has been selected as a result of the goal analysis. The versatility of the system is the fact that any mobile device with installed Android and USB port can be connected to this system. No matter the brand, type or age of the mobile device. On other side, the universality of the presented monitoring system is assuming that it can be used in various area and therefore with smaller adjustment has versatile application in various area. Affordability which is assuming general availability of the system. Inexpensive and easy available monitoring system should be comparable with commercial system and it can be used wide range of uses from the smallest home solution to the largest stations to monitor many signals and variable. The Development of Ground Water Well by using Arduino proposed the interconnection of mobile device application (Android) and universal programmable microcontroller based on Arduino UNO R3 board. Where the board is connected to the water pump which is use to suck water from ground and store to water tank. The system is almost same but some of the application is change due to the problem to meet the population needed which is clean water.

## 2.3    System Design

In the proposed network of set Arduino UNO R3 and Sim900 GSM device, this system operates in a condition water detector which is in low level or high level water. The system is developed under GSM platform to monitor and control ground water well via Arduino UNO R3 board. The Arduino UNO R3 function as base board to received programming code from Arduino Software. The arduino controller is set as main board to receive input sensor from water level sensor. If it receives a command to instruct the arduino to change the on/off pump status, the arduino sends a command to the controller through the Sim900 GSM module. Then the Sim900 GSM board monitoring the level of water and send the warning to the smartphone. When the water level at high the Arduino UNO R3 executes the controls pump operation (off).

For Figure 2.1 in the next page the connection in between the Arduino UNO R3 to the motor. This circuit connect the pin Analog and Digital from Arduino UNO R3 board to the breadboard connection. For Figure 2.2 is a schematic diagram for Arduino UNO R3 and For Figure 2.3 is circuit for water level schematic that consist of water level sensor that will connected to the Arduino board. Lastly Figure 2.4 Icomsat GSM/GPRS shield that for Arduino UNO R3 board that usually known as SIM900 quad-band GSM/GPRS module. That this module actually controlled by AT commands and it is fully compatible with Arduino UNO R3.
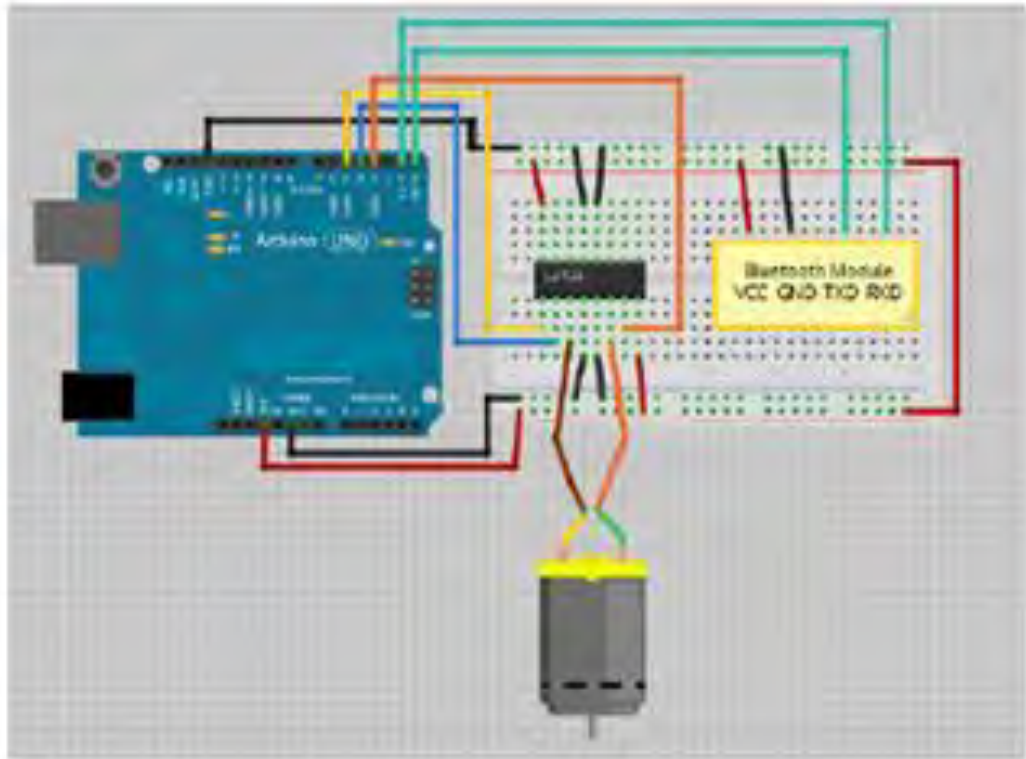
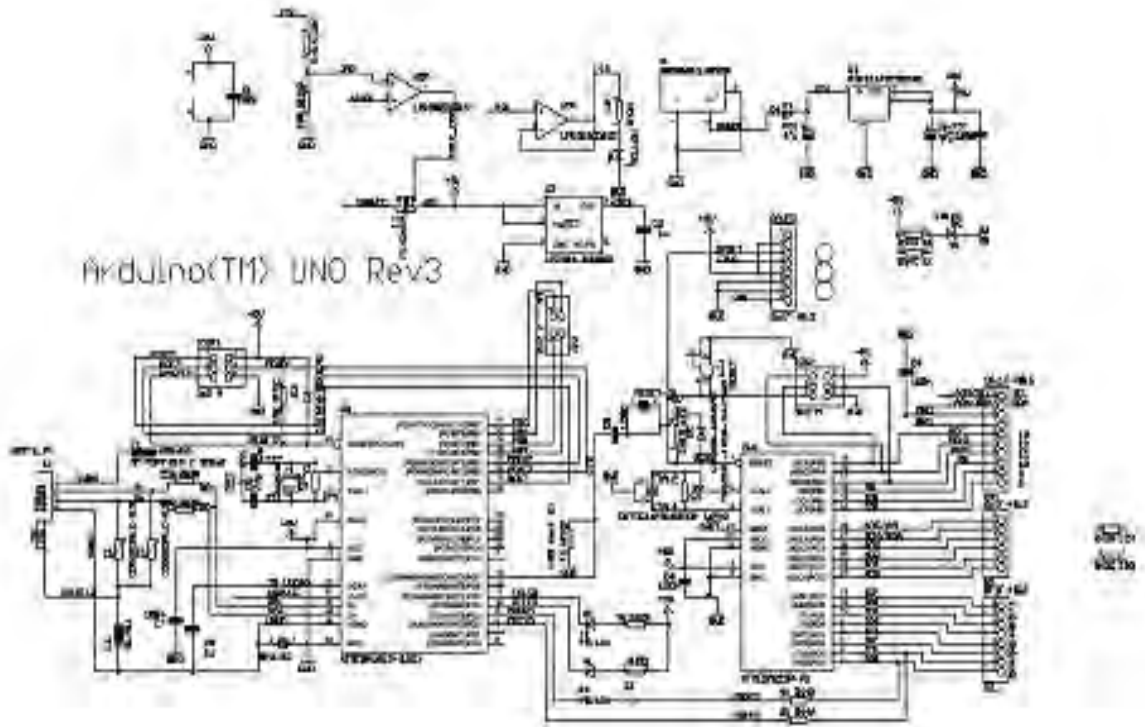Figure 2.1:  Arduino Uno circuit connection. (Santos, n.d.)



Figure 2.2:  Arduino uno schematic diagram (www.arduino.com)

Figure 2.3: Water level indicator circuit (www.Electro schematic.com)



Figure 2.4: Hardware Design (http://wiki.iteadstudio.com/IComSat)

## 2.4 Communication protocol

Arduino UNO R3 serial is used to communicated with Arduino board and other devices. Basically the Arduino UNO R3 board actually have at least one serial port which is knows as UART or USART. The input and output pin has each 14 digital pin on the Arduino UNO R3 can be used. The Arduino basically working at 5 Volts. And every pin in Arduino can provide 20 mA operating condition. There several pin in Arduino has specialized function which is the  serial actually communicates on digital pin 0 (RX) and pin 1 (TX). For pin 2 and 3 function as the interrupt  on the low value, a rising or the falling edge, or can change the value. And for pin 3,5,6,9,10,and 11 act as PWM. It provide 8 bit PWM output with analogWrite() function. Pin 13 is built in LED driven, when the pin is HIGH the LED ON and whem pin is LOW  the LED is OFF. A0,A1,A2,A3,A4 and A5 it is Analog input is TWI communication that using wire library that provide 10 bit resolution
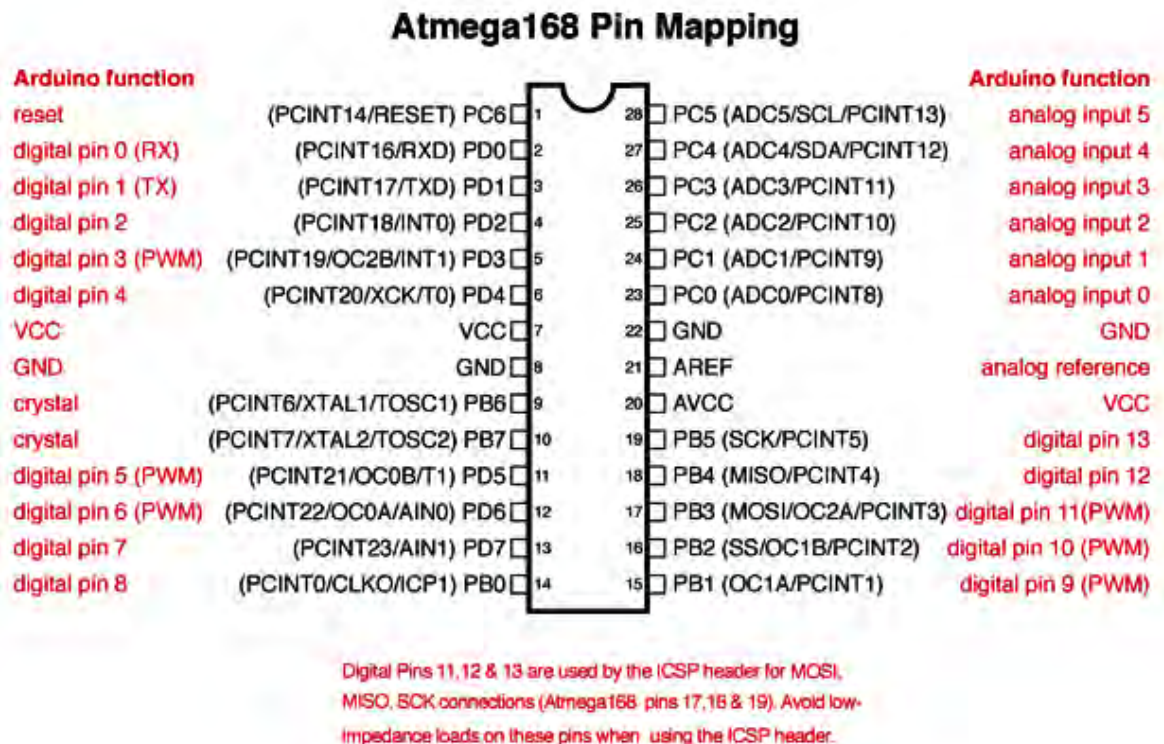


Figure 2.5: Atmega 168/328 communication Mapping

The Arduino UNO R3 provide UART TTL (5V) serial communication, the board channel for RX and TX serial communication over USB appear as virtual port to software. The Arduino Software (IDE) includes serial monitor  which allows simple textual data to sen on the board. A SoftwareSerial library allow serial communication on any Arduino digital pin.

## 2.5    Working principle

There are three functional components in this project include bluetooth devices, water level sensors and the water pump. Thus the Arduino Board is programmed using Arduino IDE software. The water level sensor is to sense present water tank. The water pump supplies water to the plants. Figure 2.5 show system block for ground water well.
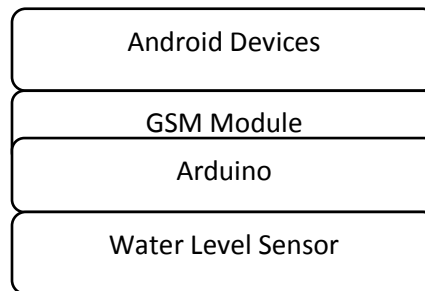


Figure 2.6: Ground water well System block

This project uses Arduino UNO R3 to control the motor. Follow the schematic to connect the Arduino to the motor driver, and the driver to the water pump. The motor can be driven by 12 Volt battery. The water level indicator will sense the present of water by using water level sensor, and measure the level of water and send the signal to Arduino Board. The motor pump will supply the water to the water tank until desired water level reached. The GSM module will send  the warning mesej to the smartphone when the water level reach to every level in water tank.

### 2.5.1 Arduino UNO R3

The Arduino UNO R3 is a microcontroller board based on the Atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM output), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC to DC adapter or battery to get started. The picture of Arduino UNO R3 is show in Figure 2.6.



Figure 2.7: Arduino Uno board (Science & Engineering, 2014)

The Uno differs from all preceding board in that it does not use the FTDI USB to serial driver chip, Instead, it features the Atmega 16U2 (Atmega8U2 up to version R2) programmed as a USB to serial converter. (Science & Engineering, 2014).

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