



Faculty of Electrical and Electronic Engineering Technology



**DEVELOPMENT OF SELF-ALIGNMENT EQUIPMENT FOR A
FENCE POST INSTALLATION**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LEONG ZHAN HU

**Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)
with Honours**

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**DEVELOPMENT OF SELF-ALIGNMENT EQUIPMENT FOR A FENCE POST
INSTALLATION**

LEONG ZHAN HU

**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)
with Honours**



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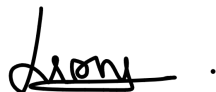
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DECLARATION

I declare that this project report entitled “Development of Self-alignment Equipment for a Fence Post Installation” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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Date : 6 FEBRUARY 2022



DEDICATION

This study is wholeheartedly dedicated to our beloved parents, who have been our source of inspiration and gave us strength when we thought of giving up, who continually provide their moral, spiritual, emotional, and financial support.

To our brothers, sister, relatives, mentor, friends and course mate who shared their words of advice and encouragement to finish this study.



ABSTRACT

In recent years, construction industry is booming and experts expect growth to continue as there are many new type of professional tool are designed and used in their field. Levelling instrument, one of the tool that is frequently used by contractor while building poles, and installing plaster ceiling to keep those installations are aligned to horizontal or vertical plane. Therefore, the purpose of the project is to develop a self-alignment equipment for a fence post installation with advance feature. The objective of this project is to develop a fence post alignment tool by using microcontroller with dual gyroscope sensor and new method of self-alignment. This tool used a microchip of Atmega328P with DIP package as a main microcontroller of the system, MPU5060 accelerometer sensor to detect the pitch and roll of the fence post, piezo buzzer for sound alert, display screen, tact button, and a power supply. The advance features for this alignment tool is to used battery as a power supply for portable purpose, provide illusion of the actual value of the tilted angle, and come along with sound and light alert to give alert while planting the fence post. Therefore, the data is collected and analyzed in different aspect, which is the zero error of measured value, alert functionality based on angle value, and battery voltage level indicator based on zener diode voltage. The result represent high accuracy with 0.5 degree tolerance, able to produce alert functionality without error, and provide battery percentage level indicator. This product is designed to use in any application and it is user-friendly as introduced a better construction tool. Thus, it given the name Advance Digital Level, (ADL) and the prototype version first is ready.

ABSTRAK

Dalam masa kebelakangan ini, industri pembinaan berkembang secara pesat dan pakar menjangkakan pertumbuhan akan berterusan kerana terdapat banyak jenis alat profesional baharu telah direka dan digunakan dalam pekerjaan mereka. Instrumen perata adalah salah satu alat yang sering digunakan oleh kontraktor semasa membina tiang dan memasang siling plaster untuk memastikan pemasangan tersebut sejajar dengan pesawat mendatar atau menegak. Oleh itu, tujuan projek ini adalah untuk merekakan alat penjajaran sendiri untuk pemasangan pilar pagar. Objektif projek ini adalah untuk merekakan alat penjajaran pilar pagar dengan menggunakan mikrokontroler dengan dua sensor giroskop dan membangunkan kaedah yang baru untuk alat penjajaran sendiri. Alat penjajaran pilar pagar ini menggunakan mikro cip Atmega328P dengan pakej DIP sebagai mikrokontroler utama, MPU5060 sensor accelerometer untuk mengesan padang dan gulungan pos pagar, piezo buzzer untuk bunyi amaran, skrin paparan untuk memaparkan nilai, tact suis untuk penukaran konfigurasi alat penjajaran ini dan bekalan kuasa. Hasil yang dijangkakan untuk alat penjajaran ini adalah dengan menggunakan bateri sebagai bekalan kuasa untuk kegunaan mudah alih, memberikan ilusi nilai sebenar sudut condong, dan datang bersama dengan bunyi dan lampu amaran untuk memberi amaran semasa menanam pilar pagar. Justeru, data telah diambil dan dianalisis dalam beberapa aspek, termasuklah bacaan ralat sifar, fungsi amaran bagi sudut yang dipilih, dan penunjuk aras bateri berdasarkan voltan diod zener. Hasilnya menunjukkan ketepatan yang tinggi dengan toleransi 0.5 darjah, dapat menghasilkan fungsi amaran tanpa alat, dan memberikan penunjuk tahap peratusan bateri. Produk ini direka untuk digunakan di mana-mana kawasan dan mesra pengguna kerana ia memperkenalkan alat pembinaan yang lebih baik. Oleh itu, alat ini dinamakan sebagai *Advance Digital Level* dan prototaip versi satu disediakan.

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LIST OF SYMBOLS

| | | |
|----|---|----------------|
| A | - | Ampere |
| Ah | - | Ampere Hour |
| C | - | Discharge Rate |
| Hz | - | Frequency |
| KB | - | Kilo Byte |
| m | - | Meter |
| V | - | Voltage |



LIST OF ABBREVIATIONS

| | | |
|--------|---|---|
| DC | - | Direct Current |
| EEPROM | - | Electrically Erasable Programmable Read-only Memory |
| I2C | - | Inter-integrated Circuit |
| IO | - | Input / Output |
| LCD | - | Liquid Crystal Display |
| LED | - | Light Emitting Diode |
| MEMS | - | Micro-electromechanical System |
| OLED | - | Organic Light Emitting Diode |
| PCB | - | Printed Circuit Board |
| PID | - | Proportional-integral-derivative |
| RAM | - | Random Access Memory |
| SCL | - | Serial Clock |
| SDA | - | Serial Data |
| SRAM | - | Static Random Access Memory |
| UART | - | Universal Asynchronous Receiver /Transmitter |
| USB | - | Universal Serial Bus |
| UV | - | Ultraviolet |
| WIFI | - | Wireless Fidelity |

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CHAPTER 1

INTRODUCTION

1.1 Background

Levelling instrument is one of the most important tool and is widely used in the whole construction area as it had been proven very useful in the construction industries. Laser level beam is commonly used currently and the concept of this mechanical innovation has been around since at least the early 1970s. Contractors saved time and avoided errors by ensuring that the fence post was level. There was less danger of developing an accidental slope as the fence post drifted off level. Self-levelling, on the other hand, was not without defects. Wind had an effects on self-levelling compensators, if they were pendulum, bearing, or liquid types. After that, the Electronic self-levelling, which is a truer self-levelling instrument and more resistant to wind and vibration, was made possible by low-cost electronics. The diode lasers used inside the laser level beam also last in a long time, which roughly around 30'000 hours and they can show beam light even using in outdoor area and different type of levelling tools is shown in Figure 1.1.

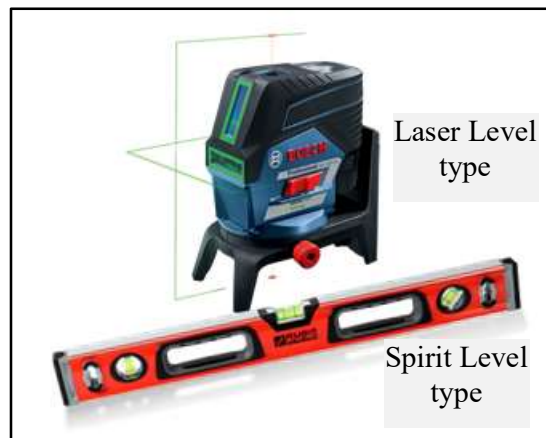


Figure 1.1 Different type of leveling tools

In this modern era, technologies had become the world's driving force, resulting in positive progress among humans. Micro-electromechanical system, (MEMS) gyroscope which has turned the world of inertial sensors with the presence of solid state non-rotating rate sensors, called as gyroscope and invented over the last twenty years. This MEMS gyroscope then convert the geometrical properties into digital signal that required microcontroller to process the raw data of MEMS gyroscope. Atmel microcontroller that will be programmed by using Arduino software to fulfil the process and create alert sounds and display the angular rotation simultaneously.

1.2 Problem Statement

Nowadays, we can find out there are several of levelling instruments that can be purchased in the marketplace, such as beam levelling or laser levelling. However, there are still lack of invention for those levelling instruments to provide alert sounds or display in different angle with exact value. The laser levelling tools that are selling in the marketplace only provide sound alert while the levelling mechanism is place on a slope that more than three degree of angle, the purpose of this sound alert just to ensure that the levelling mechanism can move freely inside the laser levelling tools.

Among the workers in the construction area, the currently available method to install the fence post is by using the laser level tool or beam level tool which required workers to keep obtain the readings frequently to avoid the fence post away from the vertical line. If the workers missed to record the readings, the fence post probably would be tilted away from the normal line while they fill back the hole with soil or concrete.

1.3 Project Objective

The objectives of this study are as follows:

- a) To design a fence post alignment tool by using microcontroller.
- b) To develop a new algorithm for post alignment testing, maintaining, and self-calibration.
- c) To develop the flexible usage of prototype alignment tool.
- d) To analyse the performance of fence post alignment tool.

1.4 Scope of Project

For construction industries that are mainly installing the fence post. This tool can help the workers to avoid the misalignment while installing the fence post by giving alert sound and also the display of the actual value of the tilt angle by using the gyroscope to detect the three axis attitude and analyses by the microcontroller. Thus, the scope of this study is as follow:

- a) The design of the system is using low cost and accurate components.
- b) The algorithm provide mode selection for different way of measurement.
- c) The prototype hold all of the components in place and the display screen can viewed clearly and it can be used in many ways.
- d) The system required high sensitivity and high precision to obtain best performance.

1.5 Report Structure and Organization

This thesis has five chapters that are outlined as follows:

Chapter 1 explained the background of alignment tool. Based on the problem statement that faced, few objectives are established as a guidance for further reference.

In Chapter 2, literature study is conducted to provide knowledge while understanding of the other researches to reduce unresolved problems and prevent repetition of project occurs. The comparison between previous researches works are done to conclude the advantages and disadvantages of their methods.

In Chapter 3, methodology is formulated into four milestones that referred to the objectives for this project. The system architecture able to be designed based on the previous research studies by selecting the right methods and the components that included in this project. Testing and troubleshooting is evaluated based on the algorithm development in this system. Furthermore, data collection and analysis are analyzed to ensure this system achieved the objectives stated in this project. Finally, the prototype of the system is developed to fit all components.

Chapter 4 shows the preliminary results that should be achieved by the system designed after the basic testing for the components. This result is used as a guidance for further works in second task of the final year project.

Lastly, Chapter 5 concludes all the efforts and works inside this project and a short summary for all the process that have been done in this project.