POLITEKNIK MALAYSIA
Sultan Salahuddin Abdul Aziz

FINAL PROPOSAL

TITLE:

"UV Kitchen Cleanser"

BY:

MUHAMMAD AMMAR BAHRI BIN AZHAR
(08DEP20F1048)

PROJECT SUPERVISORS:

Puan Nadiah Binti Din

DECLARATION

I hereby declare the final year project book is authentic record on my own work carried out for one-year final year project for the award of the Diploma of Electronic Engineering Communication with honours, under the guidance of Puan Nadiah Bt. Din from the week 1 until week 15.

SIGNATURE : _____

NAME : Muhammad Ammar Bahri Bin Azhar

REGISTRATION NO. : 08DEP20F1048

DATE : 18/06/2022

ENDORSEMENT

I hereby acknowledge that I have read this report and I find that its contents meet the requirements in terms of scope and quality for the award of the Diploma in Electronic Engineering (Communication).

SIGNATURE : _____

NAME : Puan Nadiah Binti Din

POSITION : Project Supervisor

DATE :

ACKNOWLEDGMENT

In this section, I'd want to express my gratitude and appreciation to everyone who has volunteered their time and effort to help me finish this project.

First and foremost, I dedicate this report to Allah, the Almighty God. Thank you for your direction, strength, mental power, protection, and abilities, as well as for providing us with a healthy livelihood.

Next, I'd like to thank my project supervisor, Puan Nadiah Binti Din, for supervising me and supporting me with indispensable guidance, counsel, and encouragement, along with enthusiasm, from of the beginning to the culmination of this research. This study project would not have been accomplished in a very professional and timely manner without her insightful tips and commitment on mentoring me. Her eagerness and encouragement for my project had really positively affected me in accomplishing my final year project.

Then I'd want to commend Polytechnic Sultan Salahuddin Abdul Aziz Shah for allowing me to pursue this study and accomplish my Diploma courses. I'd eventually figured out yet how to perform research and analyses data that would have been beneficial in our future inquiries. It's significant since I've learned a lot that will become beneficial and valuable in the future.

Furthermore, I would like to thank Puan Nur Ilya Binti Ismail for her help and support in accomplishing the objectives of my research. They also assisted me with inspiring advice and encouragement, as well as during project construction, specifically by provided me with ideas to help encourage my project. Working in this profession demands a high degree of productivity and expertise in order to ease the work process; as a response, they also represent as a panel that provides a significant amount of supervision and criticism in every task they undertake.

Finally, countless thanks and appreciation go to all of the persons and friends who had been directly or indirectly involved in this study. This research wouldn't be feasible without their involvement.

ABSTRACT

Acknowledging the importance of food hygiene and cleanliness of kitchen utensils and tools is a big must and most of people always overlook and didn't even notice importance of it at all. The cleanliness of the kitchen utensils always been a rare conversational topic in the community around us it is rare to happen but consequences were far too dangerous such as getting salmonella infection that could cause diarrhoea, fever and stomach cramps within 8 to 72 hours after exposure to it. In facts this is a reason why we build UV Kitchen Cleanser to develop a cleansed environment for our kitchen utensils to help raises the food safety from the bacteria and harmful microorganisms. The component was in this project consist of Arduino Nano, 4-digit display module, Piezo buzzer, Magnet sensor and UV Light. To use this simply just put any kitchen utensil like spatula in it then push the button to start the sterilizing process on the tool in the process the UV light will exterminate or deactivate 99% of the microorganism and bacteria on the spatula surfaces, the wavelength of UV Light to be germicidal is 266 to 279 Nanometres. As for safety measure for the users implementing the magnet sensors and piezo buzzers together on the door it's for user not to get exposure of UV light while it is turned on. This not only brings in the cleanliness of the environment to the people in this society but also ensures the actual hygiene of the kitchen in the restaurant in the most efficient way possible. This system uses the functionalities and the flexibility of the Arduino component. It is implemented in the circuit alongside many other components that used in.

Keyword: UV light, Food Hygiene, Kitchen utensils, Arduino, Magnet sensor

ABSTRAK

Mengakui kepentingan kebersihan makanan dan kebersihan peralatan dan alatan dapur adalah satu kemestian dan kebanyakan orang sentiasa terlepas pandang dan langsung tidak menyedari kepentingannya. Kebersihan peralatan dapur sentiasa menjadi topik perbualan yang jarang berlaku dalam masyarakat sekeliling kita jarang berlaku tetapi akibatnya terlalu berbahaya seperti mendapat jangkitan salmonella yang boleh menyebabkan cirit-birit, demam dan kekejangan perut dalam tempoh 8 hingga 72 jam selepas terdedah kepada ia. Sebenarnya ini adalah sebab mengapa kami membina Pembersih Dapur UV untuk membangunkan persekitaran yang dibersihkan untuk peralatan dapur kami untuk membantu meningkatkan keselamatan makanan daripada bakteria dan mikroorganisma berbahaya. Komponen dalam projek ini terdiri daripada Arduino Nano, modul paparan 4 digit, buzzer Piezo, sensor Magnet dan Cahaya UV. Untuk menggunakan ini hanya masukkan apa-apa peralatan dapur seperti spatula di dalamnya kemudian tekan butang untuk memulakan proses pensterilan pada alat dalam proses cahaya UV akan memusnahkan atau menyahaktifkan 99% mikroorganisma dan bakteria pada permukaan spatula, panjang gelombang Cahaya UV untuk menjadi pembunuh kuman ialah 266 hingga 279 Nanometer. Bagi langkah keselamatan bagi pengguna yang melaksanakan penderia magnet dan buzzer piezo bersama-sama di pintu, adalah untuk pengguna tidak mendapat pendedahan cahaya UV semasa ia dihidupkan. Ini bukan sahaja membawa kepada kebersihan alam sekitar kepada orang ramai dalam masyarakat ini tetapi juga memastikan kebersihan sebenar dapur di restoran dengan cara yang paling cekap yang mungkin. Sistem ini menggunakan fungsi dan fleksibiliti komponen Arduino. Ia dilaksanakan dalam litar bersama-sama banyak komponen lain yang digunakan.

Kata kunci: Cahaya UV, Kebersihan Makanan, Perkakas dapur, Arduino, Sensor magnet

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Chapter 1: Literature Review

1.1 Introduction

The food contamination is described as foods that are spoiled or tainted because they either contain microorganism, such as bacteria and fungi that makes it unfit for consumption. Those contamination are a widespread public health issue and some are expensive to have the treatment with the doctors. Food contamination disease are resulted from consumption of the contaminated meals served in restaurant. At any stage, from cooking in the kitchen to serves consumption at the customer eventually produces dangerous bacteria which will cause a harmful disease. It can start from the kitchen utensils that infected with dangerous kinds of microbes which can lead to Sickness. Food contamination are increasing within the worldwide particularly in the developing countries. This happens a lot due to a lot of neglection in restaurant management.

Besides food contamination, Cross-contamination also could happen when bacteria or other microorganisms are unintentionally transferred from one object to another. The most common example is the transfer of microorganisms between raw and cooked food in the refrigerator. This is thought to be the cause of most foodborne infections. For example, when you're preparing raw chicken, bacteria can spread to your chopping board, knife and hands and could cause food poisoning to occur. Cross-contamination can also happen when bacteria is transferred in ways that are harder to see.

The hardware used are Arduino Nano, NPN Transistor, rectifier diode, LED, Resistors, 4-digit display module, Piezo buzzer, UV bulb, UV Ballast and more. This is because the Arduino that we have could set timer of what we desired. As the to start the sterilizing process press the start button. So, from coding Arduino IDE transferred into Arduino Nano will send signals to other component and start operating the sterilization selection process data that combine to easy the program to produce a good result and to make sure deactivating most microorganism in the process.

By using the software that used are Arduino IDE for write coding set up the timer for UV light to be activate and sterilize the kitchen utensils on the utensil holder. Arduino is an open-source electronics platform based on easy-to-use hardware and software you can tell through your own Arduino board what to do by sending a set of instructions within the coding you set to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Keywords: UV Lights, Cross-contamination, food contamination, Arduino, Software

1.2 Background Research

In 2014, the World Health Organization (WHO) reported that 3% of two million deaths each year, including among children, were attributed to diarrheal diseases. In Malaysia, food poisoning is a longstanding public health issue, with an incidence rate of 44.18/100,000 population in 2010, 50.42/100,000 population in 2014 and 47.2/100,000 population in 2016, and a mortality rate of 0.041/100,000 population in 2016 (MOH 2016). The school food poisoning incidence rate remained practically unchanged at 49.2% for 2013 and 49.1% for 2014, although many steps have been taken to reduce this rate (MOH 2014). According to the National Health and Morbidity Survey III (NHMS III), the overall incidence of self-reported acute diarrheal illness within two weeks among Malaysians is 5.0% (95% CI: 4.8-5.2) or 1,036,518 episodes. Among children, the highest incidence is registered by teenagers aged 15-19 years (7.7%), followed by children aged 0-4 years (4.5%) and 5-9 years (3.4%). Acute diarrhoeal is associated with 27.7% of school absenteeism among students aged 10-19 years. Among the factors restricting the activities of schoolchildren aged 8-9 years, diarrhoeal symptoms have been identified as the most significant (IPH 2008). A study by Meftahuddin (2002) showed that 66.5% of food poisoning outbreaks occur in primary and secondary schools, followed by other educational institutions, such as universities, colleges, and training centres. Also uncovered through his study is that only 0.4% of food poisoning outbreaks originate from contaminated food served at public food courts. These figures indicate that, in the context of food poisoning in Malaysia, schoolchildren are the most likely victims. Food poisoning among students usually stems from consuming food prepared in school canteens, hostel kitchens or under supplementary food programme. Food poisoning outbreaks in schools are attributed to several factors. Food handlers are the most common contamination source. They can spread harmful organisms through the faecal-oral route or skin lesions. Food contamination is also linked to unhygienic kitchen utensils and counters (Linscott 2011). The main reasons for school food poisoning outbreaks are: the overly extended period between the preparation and serving of food, the storage of cooked food under an ambient temperature before serving, and cross-contamination (Salleh et al. 2017; Soon et al. 2011). Additionally, higher temperatures in kitchens compared with those in dining areas create an ideal condition for bacterial proliferation. It has also been established that the surfaces of common kitchen items provide favourable breeding grounds for foodborne bacteria. These include the surfaces of cutting boards, wiping cloths, sinks, cleaning sponges, and knives (Abdul-Mutalib et al. 2015). While in between 2012 and 2016, Terengganu registered a rising trend in school food poisoning outbreaks. However, the evidence required for the identification of the most significant Aetiological agent, the critical control points (CCPs) and the food vehicles involved, is currently lacking. As such, we aim to determine the proportion of food poisoning outbreaks involving schoolchildren in Terengganu in 2016, and the factors contributing to these outbreaks. The results from this investigation can be used to identify significant food vehicles, aetiological agents and CCPs associated with food handling.

1.3 Problem Statement

Some kitchen utensils can be incredibly difficult to ensure all surfaces have been cleaned properly or there are certain areas that might not be regularly sanitized. Depending on what you are trying to clean, different types of sanitizers or disinfectants are recommended. It is hard to know the right cleaner for each type of situation and to follow all of the guidelines (which are sometimes up to 10 minutes of a surface remaining visible wet with certain chemical disinfectants). Meanwhile, there were many consumers are unaware that surfaces of kitchen utensils can contribute to the spread of microorganism to the foods. Therefore, just knowing that utensils may lead to cross-contamination is important. Same goes in this study, considering the influence that kitchen utensils such as knives and graters have on the transfer of pathogenic bacteria to and from produce items and acknowledge that microorganism can spread. Researchers have known that poor hygiene and improper food preparation practices in a consumer's home can lead to foodborne illnesses, but considering what practices in the kitchen are more likely to lead to contamination has not been examined extensively. Researchers also grated product that infected with dangerous microorganism such as, Escherichia coli (E. coli) into these carrots, to see how easily the microorganism spread to graters. They found that both knives and graters can cause additional cross-contamination in the kitchen and that the pathogens were spread from produce to produce if they hadn't washed the utensils and sterilize it. The study also found that certain fruits and vegetables spread microorganism to knives to different degrees such as tomatoes tended to have a higher contamination of the knives than when we cut strawberries. Besides, once a pathogen gets on the food it's difficult to removing it from there. Knives and graters aren't the only utensils in the kitchen consumers should be worried about such as example fork and spoon. Just what happened in Kota Bahru, Kelantan their cases of food poisoning rise in these few months in the news within 64 cases. State Health director Datuk Dr Zaini Hussin said “the figure was an increase compared to last year. The whole of last year, the Health Department recorded only 67 food poisoning cases state wide," as he said for the typhoid cases, the department recorded 5 cases last year and 4 cases so far this year.

1.4 Project Objective

The objectives of implement this project is to find out the problem facing by the residents around Malaysia with their current mailbox. After finding out the problem occur is trying to brainstorm the solution to overcome the problems and helps users to gain their productivity throughout the day. More specifically the objectives of this research are:

i. To develop a UV Kitchen Cleanser for cleansing user's kitchen utensils Ultraviolet at wavelength of the light between 266 to 279 Nm to kill microbes in the sterilization process, also display the wavelength value of the UV light.

ii. To develop a program to sterilize the kitchen utensils with the UV light within the amount of time that is set in the software.

1.5 Project Scope

This UV Kitchen Cleanser develop to clean kitchen utensils effectively and will be aiming to sterilizing the kitchen utensils at Malay restaurants within the area in Bangi. This project also aims for 30 kitchens tools and utensils such as spatula, spoon, fork, and frying pan.

1.6 Project Significance

During project implementation, every aspect of the project or process needs to be known sure to ensure the project is completed as it has been targeted. Here is the stage of the project journey outlined.

- Easy to use
- Work perfectly
- Ensured food safety
- Increases workplace hygiene

Chapter 2: Literature Review

2.1 Literature Review

Far-UVC light: A new tool to control the spread of airborne-mediated microbial diseases (David Welch, Manuela Buonanno, Veljko Grilj, Igor Shuryak, Connor Crickmore, Alan W Bigelow, Gerhard Randers-Pehrson, Gary W Johnson & David, J Brenner) for approach to prevent airborne transmission to deactivate airborne pathogens, and the airborne antimicrobial for widespread use in public settings. The method was using the far-UVC light (207–222 nm) efficiently kills bacteria without harm to exposed human skin. As result, making low cost-effective, user-friendly and capable box for decontamination.

Ultraviolet Germicidal Irradiation Handbook: UVGI for Air and Surface Disinfection (W. J. Kowalski). To acknowledge the effects of multiple kind of wavelength UV light towards the microbiological life. Method of it was using the variety kinds of UV light on each kind of when disinfecting places. Concluded to be, Various result depending on each wavelength of UV light towards the microbes in the air and surfaces.

Effciency of KrCl excilamp (222 nm) for inactivation of bacteria in suspensionLett. Appl. Microbiol,, volume 47, p. 508 – 513 (G. G. Matafonova, V. B. Batoev, S. A. Astakhova, M. Gómez, N. Christof) for examine the killing efficiency of UV KrCl excilamp against Gram-positive and Gram-negative bacteria. The method and the results, Vegetative cells of Bacillus cereus, Bacillus subtilis, Escherichia coli O157:H7, Staphylococcus aureus and Streptococcus pyogenes at initial populations from 102 to 107 colony-forming units (CFU) ml−1 were treated by KrCl Excilamp in sterile Ringer's solution with and without H2O2. The number of viable cells was determined using spread plating techniques and nutrient agar method with subsequent incubation at 28°C or 37°C for 24 h. At estimated populations of 102–105 CFU ml−1E. coli O157:H7 and Staph. aureus was the most sensitive and showed 100% disinfection within 15 s (29·2 mJ cm−2). Bacillus subtilis was more sensitive to UV treatment than B. cereus. The UV/H2O2 inactivation rate coefficients within this population range were two times higher than those observed for UV treatment alone. No effect of H2O2 was observed at 107 CFU ml−1 for Bacillus sp. and Strep. pyogenes.

2.3 Summary

To summarize in this chapter, is aim to convey the viewpoint of ultraviolet light that has been evaluated in previous research or projects, as well as to classify how closely this project is related to previous findings and concepts. This chapter will also clarify the principles and methods often used solve the issue. Theoretical considerations are crucial while doing any type of methods often used solve the issue. Theoretical considerations are critical while doing any type of study.

As to put conclusion of this chapter, we decided to disinfect the cooking utensils with UV light. They may be used in a variety of germicidal boxes to clean masks, phones, and wallets because to their capability to deactivate most microbiological life on utensil surfaces. Aside from that, UV light is environmentally beneficial since the disinfecting process is physical rather than just chemical. It could also be used on both food preparation services and non-food items. Furthermore, the nicest thing about this sensor is that it is inexpensive and easy to find in any electrical store online.

Chapter 3: Research Methodology

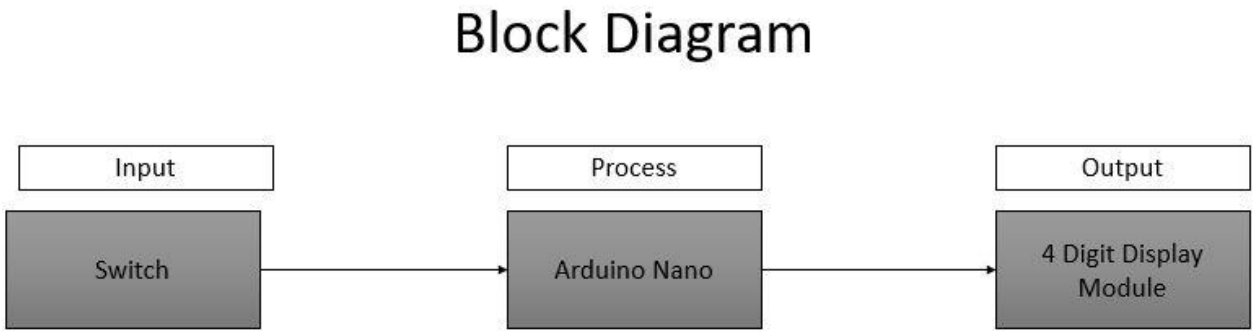
3.1 Introduction

Methodology may be used to guide a group through all of the implementation of a project. A methodology is also important to keep track of the project's progress. The methodology will make project implementation more coordinated and allowing it to be completed in a timely manner. The project supervisor will be aware of the students' contributions in finishing the project.

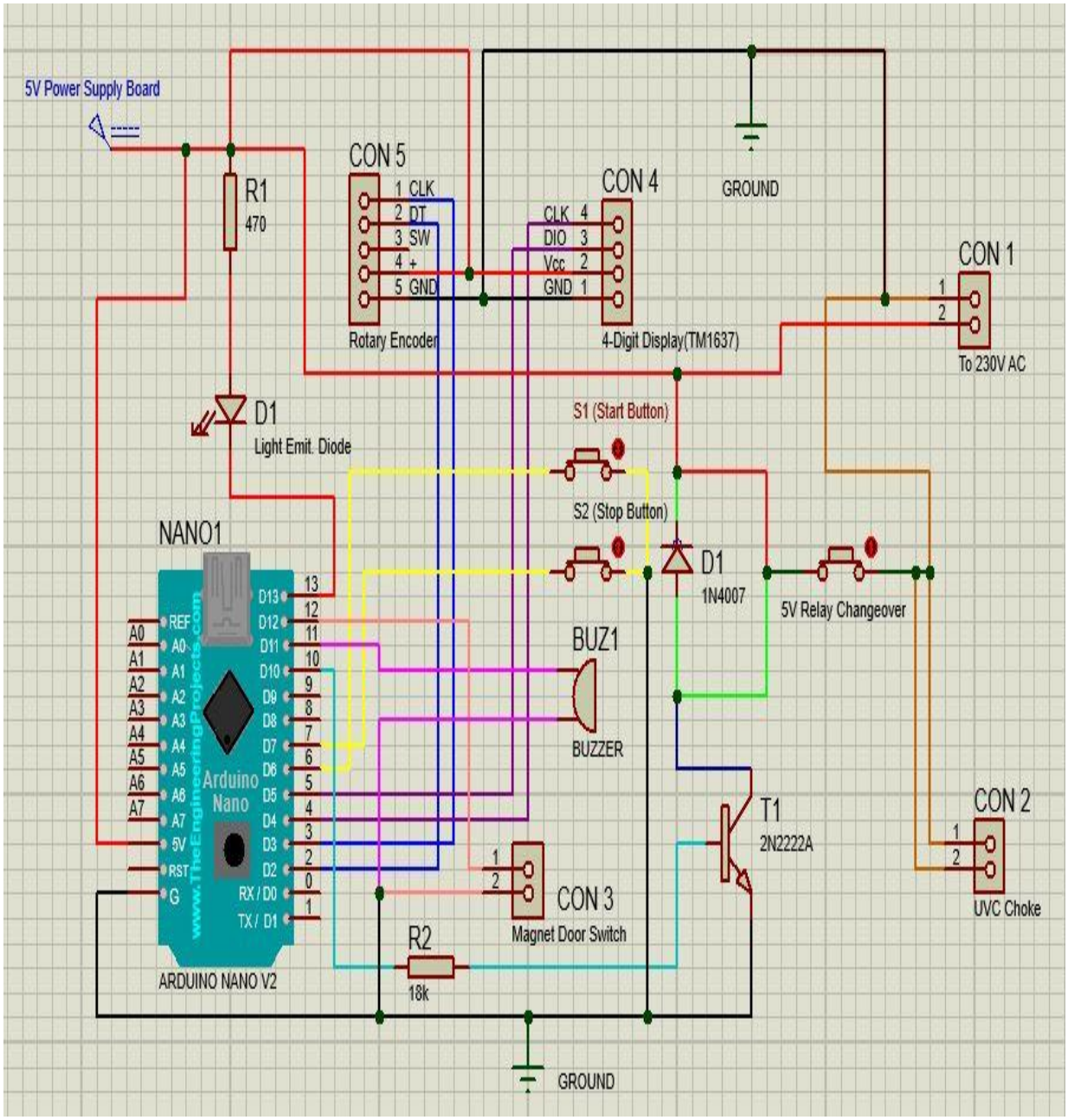
It is also a method and course of action for designing, acquiring, and data analysis in order to determine the significance to support a research project. Methodology describes how the best method could be used to confront an issue undergoing investigation also it is also to assist you in effectively using the technique by explaining the research process.

This technique includes a more detailed overview of the resources used to complete the job. The work's standard operating procedures and the processes used to finish the project are also included. This methodology is essential for the implementation of every project or the improvement of an existing project in the market.

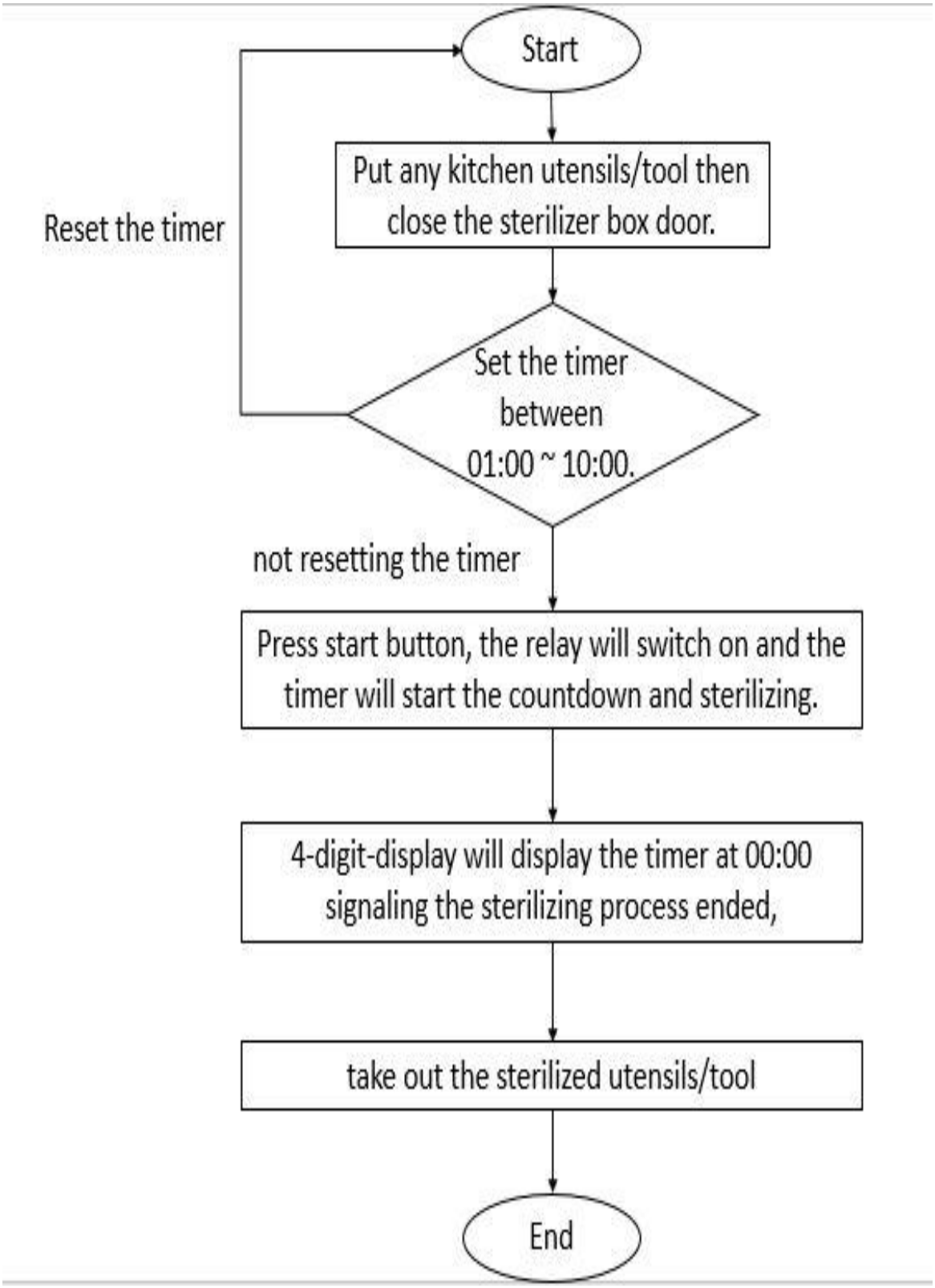
3.2 Block Diagram



3.3 Schematic Diagram



3.4 Flowchart



3.5 Project Main Components

- **Arduino Nano**

The Arduino Nano is Arduino's classic breadboard friendly designed board with the smallest dimensions. The Arduino Nano comes with pin headers that allow for an easy attachment onto a breadboard and features a Mini-B USB connector.

- **Germicidal Ultraviolet Bulb**

A germicidal lamp is an electric light that produces ultraviolet light. This short-wave ultraviolet light disrupts DNA base pairing, causing formation of pyrimidine dimers, and leads to the inactivation of bacteria, viruses, and protozoans.

3.6 Project Software

- **Arduino IDE**

The Arduino IDE is a software application that allows users to build and upload program to Arduino boards, as well as many other vendor development boards with the assistance of third-party cores. The Arduino Software (IDE) contains a text editor for writing code, a message field, a console, a toolbar with buttons for common functions, and a series of menus. It interacts with the Arduino hardware via transferring code and also interacting with it.

- **Proteus Professional 8.6 SP2**

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. Proteus 8 Professional is a software which can be used to draw schematics, PCB layout, code and even simulate the schematic. It is developed by Labcenter Electronic Ltd.

Chapter 4: Result & Discussions

4.1 Introduction

Regarding the successful completion of the project, fourth chapter will go through the analyses and outcomes of the ongoing project. To put it in simple terms, the project consists two main sections which need to be accomplished.

4.2 Result & Analysis

Analysis

- Upload coding from Arduino into the circuit board & fully wired

Objective

- To test function the rotary encoder, TM1637, door magnet sensor & UV light

Procedure

1. Connect USB to the Arduino Nano
2. Select the time between 1-10 minute using rotary encoder
3. Start the sterilize process with the start button

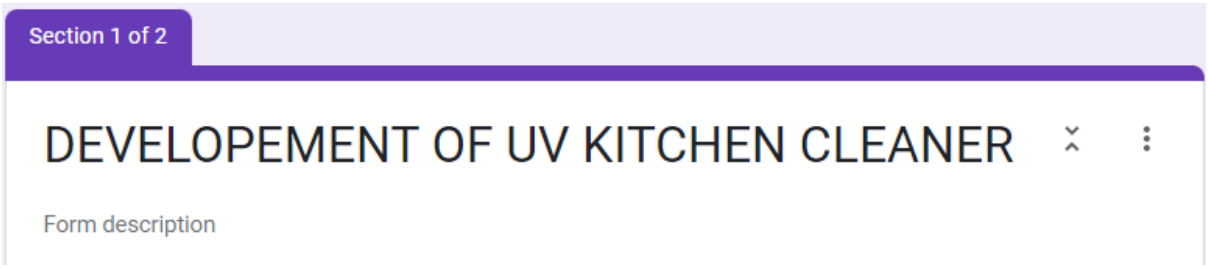
Results:

USERS	**DOOR MAGNET SENSOR DETECTION (Close/Open)**	**INPUT (Rotary Encoder Set Timer)**	**TM1637 OUTPUT**	**OUTPUT (UV Light Sterilizing Process)**	
				ON	**OFF**
Ferhad	Closed	2 Minutes	00:00	/	
Zulhariz	Closed	4 Minutes	00:00	/	
Nazrul	Opened	6 Minutes	Door		/
Wafri	Opened	8 Minutes	Door		/
Syameer	Closed	10 Minutes	00:00	/	

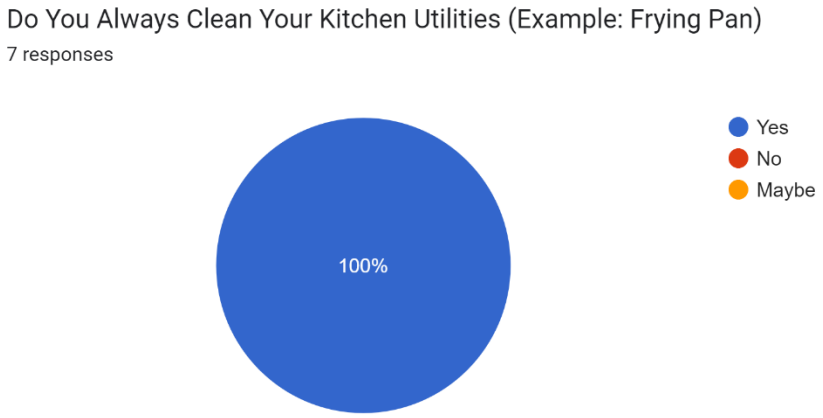
Figure 4.2.1: The UV Kitchen Cleaner Completed Project

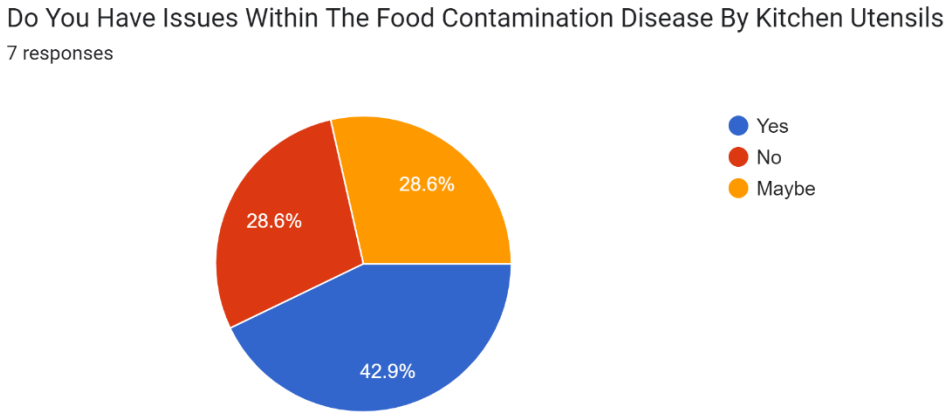
4.3 Project Google Form Survey

A survey was done using the Google Form platform to get the general response and answers for the product and its suitability and how it will perform if it were to be put in the market. This survey has questions that is closely related to the behaviours and tendencies of the ones always works at the kitchen.



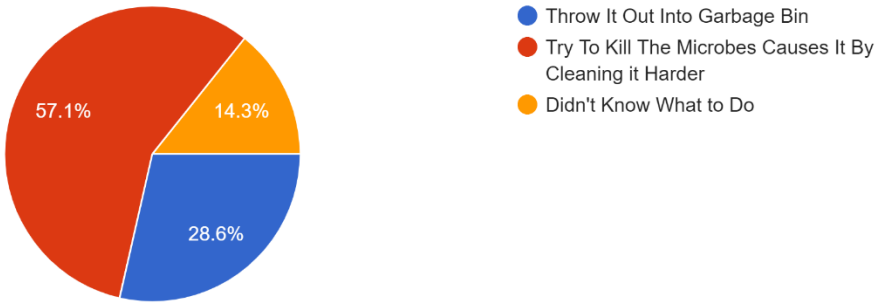
4.3.1 Data Acquired In The Google Form Pie Charts





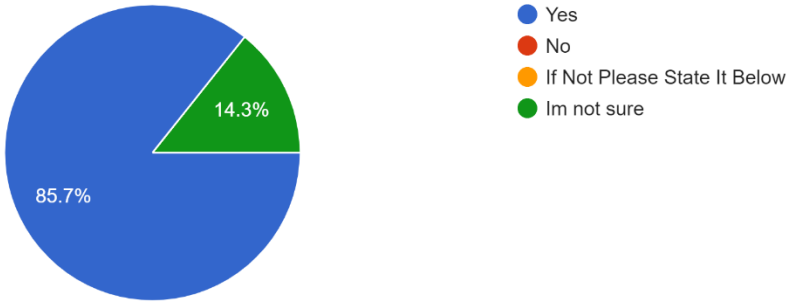
What Your Action Would Be IF The Food Contamination Spread Onto Your Whole Kitchen Utensils.

7 responses



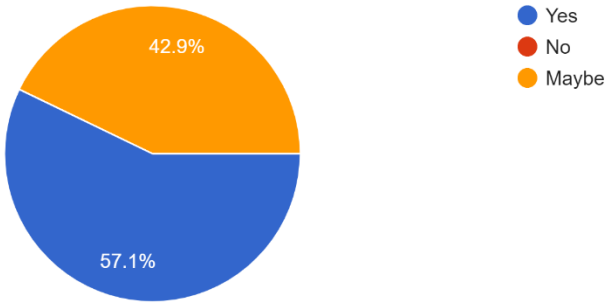
If The UV Kitchen Cleaner Device is Fully Developed, Would The Device Helps You To Improve Hygiene Of Your Kitchen Utensils?

7 responses



If this UV Kitchen Cleaner is Fully Implemented & Developed, Would You'd Be More Self-assured The Reliability Of Your Kitchen Hygiene When Using this Device?

7 responses



4.4 Discussions

In this analysis, the Arduino Nano, together with the Rotary Encoder, TM1637, Door Magnet Sensor, plus UV light, maintains the project functionality. Basically, the Rotary Encoder will be rotated into the designated turn for selecting the timer and transmitting the signal to the Arduino Nano. Arduino Nano which again will act as a processor then taken signals from the component then transmits the response signal to the specific component. When the Magnet Door recognizes that the door has been shut, it will activate the UV light within the timer.

4.5 Chapter Summary

This chapter consists of two sections: outcomes and analysis of UV Kitchen Cleaner that behaves as expected. The second portion goes on to discuss how the UV Kitchen Cleaner works in that sort of way, that used a concise and simple piece of information.

Chapter 5: Conclusion & Recommendations

5.1 Introduction

To evaluate the entire record of results, the conclusion of (UV Kitchen Cleaner) must always be verified and analysed in order to represent project successfully including all relevant of this project and to evaluate improvement of this project in order to optimize prospective.

5.2 The Conclusion

In conclusion, the purpose and objective of the project, identified as UV Kitchen Cleaner, which is then used to enhance kitchen cleanliness and food safety security from food contamination. When a user needs to clean their kitchen utensils extensively, simply consider placing them in the UV Kitchen Cleaner box, shut the door with the magnet sensors, and the sterilization process begins with the UV light powered on throughout the timer it sets. Furthermore, once the sterilization process has been completed, the buzzer will ring to notify the user that the sterilization process has been completed and therefore it is safe to pick up the disinfected utensils without even being exposed to UV radiation.

5.3 Future Recommendations

For further recommendation improvement, this system can support further features and capabilities for potential recommendation development, for as utilizing infrared systems or IOT. Predicated on the concept, it is conceivable to establish networking utilizing wirelessly IoT to synchronize the timer and stop/start control mechanisms. Continuing this research may provide the next researcher with a fresh and distinctive proposal for constructing innovative technology incorporating new technologies and materials within the most efficient and effective manner.

Chapter 6: Project Management & Costing

6.1 Introduction

To sum it up the entire performance of accomplishments, the conclusion of (UV Kitchen Cleaner) should be validated and measured in so as to demonstrate full functionality of this project and to evaluate improvement with this project in order to achieve maximum potential.

6.2 Gantt Chart & Activities Of the Project

GANTT CHART

PROJECT TITLE : UV KITCHEN CLEANER

Course	NO	Task Name	Implementation	Duration (Days)	Cost (RM)	Date	Week 1 22.8.22 - 28.8.22	Week 2 29.8.22 - 2.9.22	Week 3 5.9.22 - 11.9.22	Week 4 12.9.22 - 18.9.22	Week 5 19.9.22 - 25.9.22	Week 6 26.9.22 - 2.10.22	Week 7 3.10.22 - 9.10.22	Week 8 10.10.22 - 16.10.22	Week 9 17.10.22 - 30.10.22	Week 10 21.10.22 - 6.11.22	Week 11 7.11.22 - 13.11.22	Week 12 14.11.22 - 20.11.22	Week 13 21.10.22 - 21.11.22	Week 14 28.11.22 - 4.12.22
DEE40082 PROJECT 1	1	PROJECT BRIEFING	Plan	1																
			Actual	1																
	2	MEETING WITH SUPERVISOR	Plan	14																
			Actual	1																
	3	PROJECT DESIGN	Plan	14																
			Actual	21																
	4	PROJECT CODING	Plan	75																
			Actual	77																
	5	COMPONENT SOLDERING	Plan	14																
			Actual	10																
	6	SOFTWARE COMPLETION	Plan	80																
			Actual	65																
	7	HARDWARE COMPLETION	Plan	65																
			Actual	63																
	8	PROJECT TESTING	Plan	14																
			Actual	12																
	9	PROJECT PRESENTATION	Plan	2																
			Actual	2																
	10	LOGBOOK WRITING	Plan	14																
			Actual	14																
	11	ISOLMS UPDATE	Plan	14																
			Actual	11																
	12	GOOGLE FORM	Plan	7																
			Actual	10																
	13	FINAL REPORT	Plan	21																
			Actual	24																
	14	ELECTRICAL & ELECTRONIC ENGINEERING INNOVATION COMPETITION	Plan	1																
			Actual	1																

6.3 Cost and Budgeting

Throughout the project's implementation, the cost of acquiring materials and components will indeed be expended. Arduino Nano, NPN Transistor, Rectifier Diode, 5mm Light Emitting Diode (LED), 470 Resistor, 18K Resistor, TM1637, Piezo buzzer, Magnetic Sensor Switch, and UV Ballast are the main components.

As indicated in Figure 6.2, the overall gross cost estimation for this project's implementation is RM213.55, with additional expenditures at RM17.50. According to the budget cost, this project is less expensive in comparison to other projects which would cost thousands of Ringgit. The project's cost is also coherent with one of the essential characteristics of a competent project developer: a reasonable cost yet high-quality project.

Figure 6.2 List of Components and Materials

No.	Component and materials	The unit price (RM)	Quantity	Total (RM)
1	Arduino Nano	75.00	1	75.00
2	1N4001 Diode	0.80	1	0.80
3	NPN Transistor 2N2222A	0.80	1	0.80
4	Light Emitting Diode (LED)	0.15	1	0.15
5	470Ω Resistor	1.00	1	1.00
6	18KΩ Resistor	1.00	1	1.00
7	4-digit display module	7.50	1	7.50
8	Piezo buzzer	3.50	1	3.50
9	UV Ballast	35.00	1	35.00
10	UV Lamp 2-Pin	24.00	1	24.00
11	Other materials	45.95	-	45.95
			Total (RM):	**196.05**
	List of other costing			
1	Transportation	-	-	-
2	Postage	3.50	5	17.50
3	Craft Work	-	-	-
4	Internet	-	-	-
5	Application	-	-	-
			Total (RM):	**17.50**
			Overall total (RM):	**213.55**

6.4 Chapter Summary

The conclusion for project costing management of UV Kitchen Cleaner is the cost is still within budget and less expensive than estimated. This resulted in projects with low costs but great quality. Although RM1000 is themaximum anticipated cost, only RM213.55 is actually required to complete this project successfully.

APPENDIX – Arduino Coding

UVTimer.ino

```
/*
    Pin 2  - Rotary Encoder A
    Pin 3  - Rotary Encoder B
    Pin 4  - Display Clock
    Pin 5  - Display Data

    Pin 6  - Start Btn
    Pin 7  - Stop Btn

    Pin 10 - UV Relay

    Pin 11 - Buzzer
    Pin 12 - Door Sensor
    Pin 13 - UV Light On Indicator

    Process:
      Set time based on size of product (2  3   5   10),
      Close door. Press Start. Press Stop, if required to cancel process. Timer will be reset.
    UV light will switch off on counter reaching zero.
    If door is opened, process will be stopped. Press Resume to restart, Stop to clear.

*/
//--------------------------------------------------------------------------------
#include "Arduino.h"
#include "NewEncoder.h"
#include <TM1637Display.h>
#include "OneButton.h"

// function Prototypes
  void displayTimeOnLED(void);
  void ckStart();
  void ckStop();
  void ckDoorOpenedSwitch();
  void ckDoorClosedSwitch();
  void displayTimeOnLED();

// Constants
  const uint8_t aPin = 2;                   // Rotary Encoder Pin A
  const uint8_t bPin = 3;                   // Rotary Encoder Pin Btn
  const uint8_t CLK = 4;                    // Display Clock pin
  const uint8_t DIO = 5;                    // Display Data pin
  const uint8_t Pin_Start = 6;              // Start Button
  const uint8_t Pin_Stop = 7;               // Stop Button
  const uint8_t Pin_Relay = 10;             // Relay module attached to this pin
  const uint8_t Pin_Buzzer = 11;            // Buzzer attached here. Active High
  const uint8_t Pin_DoorOpenedSwitch = 12;
  const uint8_t Pin_Indicator = 13;

  const int16_t minValue = 0;               // Rotary Encoder minValue
  const int16_t maxValue = 10;              // Rotary Encoder maxValue
  const int16_t initialValue = 0;           // Rotary Encoder initalValue
  const uint8_t type = FULL_PULSE;          // One Turn Rotary Encoder

  enum ProcessStage{ReadKeyboard, CountdownStarted, CountdownPaused};

```

```
// Global Variables
  int16_t UVMinutesSet = 0, UVSecondsRemaining = 0, prevSetTime = 0, currentValue = 0;
  uint8_t SEG_End[] = {0b01111001, 0b01010100, 0b01011110, 0b00000000};  // End
  uint8_t SEG_door[] = {0b01011110, 0b01011100, 0b01011100, 0b01010000}; // door
  uint8_t SEG_StoP[] = {0b01101101, 0b01111000, 0b01011100, 0b01110011}; // StoP
  int BeepCount = 0;
  unsigned long CurrentTime=0, PrevBeepTime=0, PrevTimerTime=0;

// Instantances
  NewEncoder encoder(aPin, bPin, minValue, maxValue, initialValue, FULL_PULSE);
  NewEncoder::EncoderState EnState;
  TM1637Display display(CLK, DIO);
  ProcessStage Stage;
  OneButton btStart(Pin_Start, true, true);
  OneButton btStop(Pin_Stop, true, true);

//--------------------------------------------------------------------------------
void setup()
{
  pinMode(Pin_DoorOpenedSwitch, INPUT_PULLUP);// Open - High, Closed - Low
  pinMode(Pin_Relay, OUTPUT);
  digitalWrite(Pin_Relay, LOW);      // Relay Off, Active high
  pinMode(Pin_Buzzer, OUTPUT);
  digitalWrite(Pin_Buzzer, LOW);     // Buzzer off, Active via NPN transistor
  pinMode(Pin_Indicator, OUTPUT);    // Active low
  digitalWrite(Pin_Indicator, HIGH); // LED Active Low

  display.setBrightness(0x0f, true); // Full brightness true - display on
  display.clear();

  encoder.begin();

  btStart.attachClick(ckStart);
  btStop.attachClick(ckStop);
  Stage = ReadKeyboard;                       // initial value ReadKeyboard
  displayTimeOnLED();                         // initial value 0
}

//--------------------------------------------------------------------------------
void loop()
{
  if (digitalRead(Pin_DoorOpenedSwitch) == LOW)      // Door closed
  {
    CurrentTime = millis();
    btStart.tick();                                  // Read btStart button state
    btStop.tick();

    switch (Stage)
    {
      case ReadKeyboard:
        if (encoder.getState(EnState))
        {
          currentValue = EnState.currentValue;
          if (currentValue != UVMinutesSet)
          {
            UVMinutesSet = currentValue;
```

```
            UVSecondsRemaining = UVMinutesSet * 60;  // Convert minutes to second
            displayTimeOnLED();                      // Display UVSecondsRemaining
          }
          else
          {
            BeepCount = 1;                           // upper/lower limits reached
          }
        }
        break;

      case CountdownStarted:
        if (UVSecondsRemaining > 0)
        {
          if((CurrentTime - PrevTimerTime) >= 1000)
          {
            digitalWrite(Pin_Indicator, LOW);     // LED On
            digitalWrite(Pin_Relay, HIGH);        // Relay On
            UVSecondsRemaining -= 1;
            displayTimeOnLED();
            PrevTimerTime = CurrentTime;
          }
          if (UVSecondsRemaining == 0)
          {
            digitalWrite(Pin_Indicator, HIGH);     // LED Off
            digitalWrite(Pin_Relay, LOW);          // Relay Off
            BeepCount = 5;
            display.setSegments(SEG_End);
            Stage = CountdownPaused;
          }
```

```
          }
          break;
        }
        if (BeepCount > 0)                         // Routine for beep sound
        {
          if (CurrentTime - PrevBeepTime >= 200)
          {
            bool x = digitalRead(Pin_Buzzer);
            BeepCount -= (x ? 1: 0);
            digitalWrite(Pin_Buzzer, !x);
            PrevBeepTime = CurrentTime;
          }
        }
      }
      else                                    // if door open then
      {
        display.setSegments(SEG_door);
        digitalWrite(Pin_Indicator, HIGH);     // LED Off
        digitalWrite(Pin_Relay, LOW);          // Relay Off
        encoder.newSettings(0,10, UVMinutesSet, EnState); // restore last used value
        UVSecondsRemaining = UVMinutesSet * 60;
        Stage = ReadKeyboard;

        while (digitalRead(Pin_DoorOpenedSwitch) == HIGH)           // door open
          delay(100);                                               // do nothing
        displayTimeOnLED();
      }
    }

```

```
//--------------------------------------------------------------------------------
// Display UVSecondsRemaining (global variable)
void displayTimeOnLED()
{
  int valueToDisplay = 0;

  valueToDisplay = (UVSecondsRemaining/60)*100 + UVSecondsRemaining%60;
  display.showNumberDecEx(valueToDisplay, (0x40), true);
}

//--------------------------------------------------------------------------------
void ckStart()
{
    switch (Stage)
  {
      case ReadKeyboard:
        if (UVSecondsRemaining > 0)
          Stage = CountdownStarted;
        else
          BeepCount = 1;
        break;

      case CountdownStarted:
          BeepCount = 1;
        break;

      case CountdownPaused:
        Stage = CountdownStarted;
        break;
```

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