UTM

UNIVERSITI TEKNOLOGI MALAYSIA

SECR1013-09

PROJECT DIGITAL LOGIC

Title : A Real System Electronic Controller Simulation

GROUP 3

NO.	NAME	MATRIC NO.
1	KHAIROL 'IZZUL FIRDAUS BIN KHAIROL HISAM	A21EC0036
2	MUHAMMAD RIDZUAN BIN BAKAR	A21EC0091
3	YEO CHUN TECK	A21EC0148
4	AMALIA SYAZANA BINTI MOHD MAZLIMIN	A21EC0014
5	MUHAMMAD AKASHAH BIN BAHAR	A21EC0066

Lecturer Name : Dr. Nur Haliza

1.0 TABLE OF CONTENTS

2.0 Dedication and Acknowledgement

This project is dedicated to God Almighty, my creator, the source of my inspiration, wisdom, knowledge, and understanding. She has been a source of strength for us during this journey. Dr. Nur Haliza, we thank you for sticking with us as our adviser throughout the time it took us to finish this research and write the report. She has been a strong supporter of our group throughout the process, ensuring that we give it our all to complete the task at hand. She's also been quite helpful with our lab and test. Thank you so much for everything. Our love for you all is indescribable. God's best wishes to you.

We must also thank all of our colleagues, students, teachers, and lecturers who have helped, advised, and supported us throughout our study and report writing. We especially need to convey our gratitude and heartfelt appreciation to all of our friends who have supported, enlightened, and entertained us throughout the years by their friendship, hospitality, knowledge, and wisdom. They have continually assisted us in maintaining perspective on what is important in life and have demonstrated to the majority of us how to deal with reality.

Finally, we like to express our gratitude to everyone in this group. Khairol, Ridzuan, Teck, Amalia, and Akashah are the main characters. Thank you for the contribution given to this project, we managed to complete the task given to us. Each of the group members has generously given their time and expertise to assist all of us in improving our work. Without one of us, the work will not be completed as it is today.

3.0 Project Background

The majority of built infrastructure is made up of buildings, which are crucial to a country's socioeconomic development. The majority of the structures are designed to last several decades and provide housing and functional services to a significant number of people over the course of their anticipated lifespan. However, buildings can be damaged by natural catastrophes like earthquakes, hurricanes, and tsunamis, as well as man-made disasters like fire and explosions and each of these disasters has the potential to wreak massive harm, mostly to infrastructure and people.

The key point we want to highlight in our project is the one of the man-made disasters, which is a fire. Accidents involving fire are uncommon. However, when they occur, they generate widespread panic, destruction, and, in some cases, death. The majority of fires are caused by human carelessness. Every year, several fires occur, resulting in significant property and human damage. When a fire has spread, the majority of persons who have been harmed by it usually have no time or a limited amount of time to escape. However, many of these can be easily prevented if we are more cautious and follow specific rules and regulations. That is why, in order to avoid a fire tragedy, we must be cautious and take preventative steps , such as those concerning fire safety or employ technology to assist humans in alerting them when there is a fire. This type of technology could aid an individual in having a quick reaction time in order to escape a fire disaster.

Fire safety is described as a set of processes for avoiding or averting fires as well as controlling the spread and impact of unintentional or intentional fires while minimising losses. Currently, the recommendations of building codes of practice are used to guarantee fire safety in structures. While the standards and strategies for guaranteeing building fire safety vary from one code of practice to the next, the most are prescriptive in character and are based on similar fire safety ideas. Prescriptive based systems provide building fire safety by combining active and passive fire prevention equipment.

4.0 Problem Statement

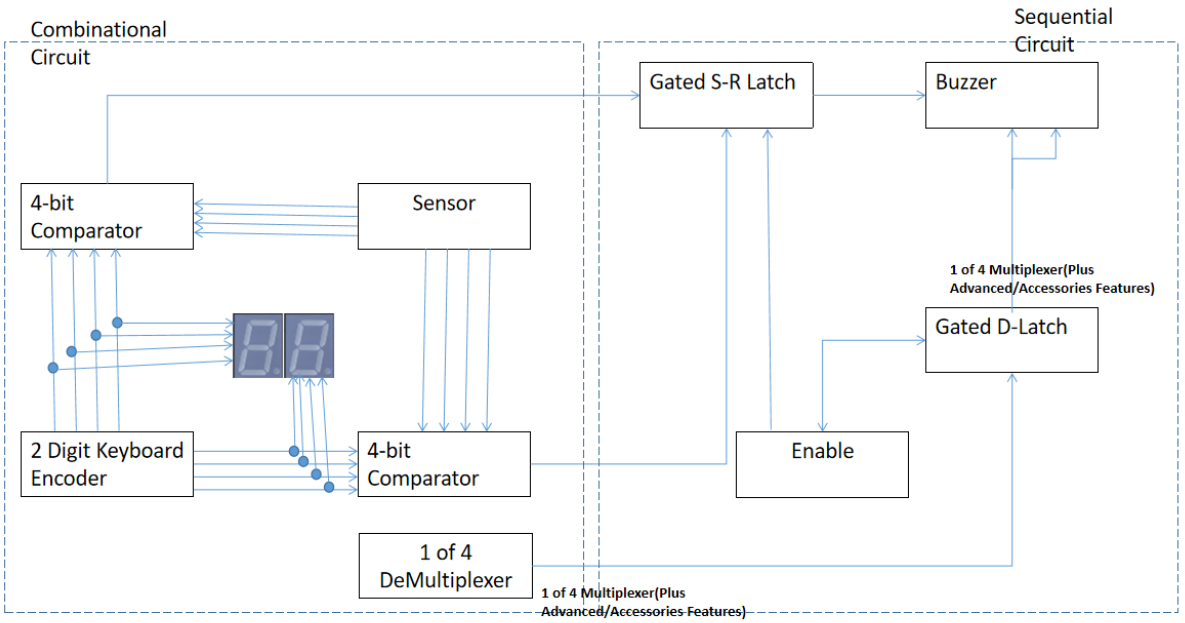
A structure caught on fire and it took the life of many people. The fire was initially mild, but due to no one noticing, the fire quickly spread and destroyed the structure completely which closed up the exit for the other people. To avoid a repeat of the incident, the owner intends to rebuild the structure and add a fire alarm system to alert the people in the building if there may be a fire. So, the fire alarm must have a detector that can detect smoke, heat or manual breakpoint that will alarm the sounder to notify people in the building that there may be a fire and to advise them to escape.

5.0 Objective

The main objective of this project is to design a solution to alert people when there is fire based on a real system electronic controller simulation. While, the other objective are:

1. To come up with a solution that can overcome the problem statement.
2. To design a logic circuit that consists of a combinational circuit, sequential circuit to simulate a system of fire alarm.
3. To implement and test the logic circuit by using a deeds software.
4. To prove the logic circuit by explanation and demo video.

6.0 Suggested Solution



In order to solve the problem and achieve the objectives we mentioned in previous parts, we decided to provide a block diagram as our solution to stimulate a fire alarm system

According to the block diagram we designed based on real system electronic controller simulation, the logic circuit will be made up of two parts:one is combinational circuit and other one is sequential circuit.Both parts will be used to perform different kinds of tasks. The combinational circuit part will be more focused on the part of detection of occurrence of fire in the building and the function of the fire alarm control panel while the sequential circuit will be more focused on the part of alarming the buzzer or fire drill.

In the part of detection of occurrence of fire , we supposed that it will have two processes:presetting and comparing. Before the fire occurs, the owner is required to set up a limit value through a 2 digit keyboard encoder in the fire alarm control panel for a certain sensor which was installed in the building. The output from the sensor will be compared with the limit value in the 4-bit comparators.

In this case , we will use a sensor to detect the temperature. When there is a fire in the building, the temperature in the area will be increased. When the temperature achieves

or exceeds the limit value, the sensor will produce output which is equal to the limit value.Otherwise, the sensor will produce output which is lower than the limit value.

Next, we come to the part of alarming the buzzer or fire drill. If the output from the sensor is found out to be higher than or equal to the limit value, the comparator will activate the set state of Gated S-R Latch to alarm the buzzer. Otherwise, the comparator will activate the reset state of Gated S-R Latch to alarm the buzzer.There is a main switch in the fire alarm control panel to perform its role as an enable to allow or not allow the Gated S-R Latch to perform its function.

Besides that,considering that the fire alarm system may have the possibility to not ring the buzzer due to the failure of the sensor when there is a fire, we also add on an advanced feature or accessory of manual controlling in the system. With this, we will add new components into combinational circuit and sequential circuit.The new components in the combinational circuit and sequential circuit will be integrated to perform this feature so that an advanced controller system can be produced

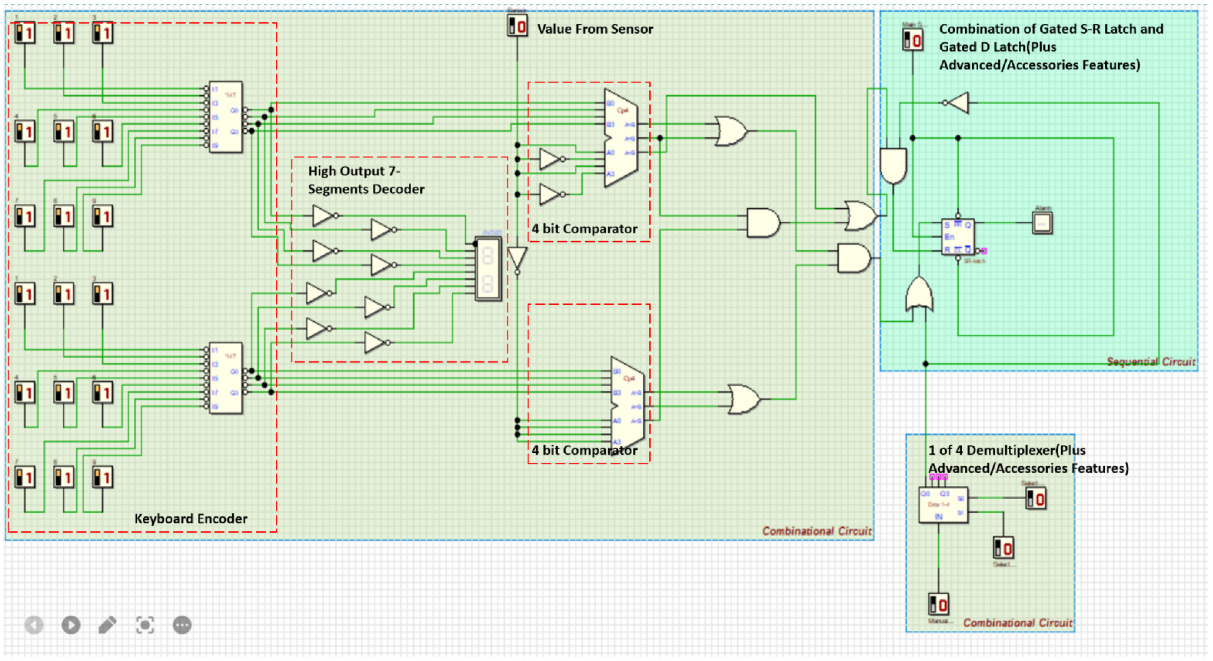
For the advanced feature , we add a 1 of 4 Demultiplexer and Gated D-Latch in combinational circuit and sequential circuit respectively.With 1 of 4 Demultiplexer in the fire alarm control panel, the owner can choose any fire drill which is installed in different areas manually to activate its alarming function manually in spite of whether there is a fire in the areas. The Gated D-Latch will be used for activating the fire drill by manual way after receiving the signal from 1 of 4 DeMultiplexer.

7.0 The Requirements

The requirements of this project are for the manual controlling part, the owner of the building is only allowed to control at most 4 alarms in different areas. The owner needs to connect the circuit from the alarms of the areas they desire to control manually to the 1 of 4 Demultiplexer which is installed in the fire alarm system control panel so that the demultiplexer could send the signal to these chosen areas. The names of the chosen areas should be the 2 bits digits which are ”00”, ”01”, ”10” and ”11” correctly according to the output pins connected. The picture seen from the CCTVs which are installed in chosen areas must also display the area name so that the owner would know which area caused the fire. It could reduce the probability they switch on the alarm in the wrong areas. The 1 of 4 Demultiplexer is only allowed to control a single alarm at the same time. However, there might be some weaknesses, which is that the owner can’t control multiple alarms manually in a time.

For the limit value setting part, the owner needs to set up a value which is equal to the limit value of the sensor. The fire alarm system is only designed for this condition so that it could perform its function to activate the alarm. If the user sets up a limit value which is lower or higher than the limit value of the sensor, the system may cause some errors. This is because of the sensor design and circuit design in the fire alarm system. The sensor is only designed for producing a certain digits output which is the inverse of the limit value. Besides that, the circuit is also designed to use the inverse of limit value from keyboard encoder for comparison with the inverse of limit value from sensor. Due to that, the comparison result may be wrong in some conditions. The user also needs to be alert when setting up the limit value. They should turn one switch which represents the digit they desired in each keyboard encoder.

8.0 System Implementation



According to the block diagram that we mentioned before, we would build a circuit drawing by using Deeds and stimulate it for presenting our system implementation. In this drawing ,we would also show our design of the circuit in different parts and explain the ways of integration between different parts through connection of the circuit. In this case, the scenario will be the temperature rise when there is a fire in an area. The fire alarm system will respond to activate the buzzer if the temperature of an area exceeds or equals the temperature in the area.

First, we would explain about our keyboard encoder.We assumed that the digits which are required for the user to set up were limited to two digits. So we drew two keyboard encoders in the circuit. Each keyboard encoder will be used for setting up 1 digit. Since the digits range from 0 to 9, hence we prepared 9 switches for the user to turn on or turn off to set up the limit value based on the limit value of the sensor. Each switch represents each digit in the range from 1 to 9. The keyboard encoder would recognize active LOW input which is 0. Hence, we set up initial input to active HIGH for every switch. If the user wants to set up a certain digit, he or she is required to turn the input to active LOW from active HIGH. For example, if the switch representing 4 is turned from active HIGH to active LOW, the keyboard encoder will turn out 4-bits digits which represent 4. If no switch is active LOW,input to the encoder HIGH and its

output will be 1111(all HIGH) which is 0 as active LOW. However, this keyboard encoder is a priority encoder which will produce BCD output corresponding to the higher decimal value at the input and ignore the lower value. For example, if switch 9 and 5 LOW at the same time, only switch 9 will be recognized because it has a higher priority. With this feature, the user needs to be careful when setting the limit value. He or she needs to remember that they should not have at least 2 active LOW inputs at the same time and be advised to look at the 7-segments decoder.

Then we come to the part of High Output 7-Segments Decoder. Because of active low at the output, the 4-bits digits which arrive in this part are required to be inverted so that it could display a correct result in High Output 7-Segments Decoder. So, we draw one inverter for every bit digit. Then, the High Output 7-Segments Decoder will show the digit based on the inputs.

After that, we come to the part of 4 bits Comparator. The input of the sensor was connected to the comparators. Similar to the keyboard encoder, we also use two 4-bit comparators because we have 8 bits digit in total. Both comparators were used for leftmost digit and rightmost digit respectively. The 4-bit Comparator will be used to compare the 4 bits digit with the input from the sensor. The sensor we used in this system is assumed to produce an active LOW input when the temperature equals or exceeds the limit value. As the output from the sensor arrives the part of comparator, it will be used to produce bit digit which is equals to the active LOW digits of limit value.The outcomes from 4-bit comparators will be used for the part of Gated S-R Latch and Gated D Latch

The Gated S-R Latch consists of three input,S&R&En and one output, Q. In order to let S-R Latch to operate, the enable will be used as a switch to turn it on with active HIGH input or turn it off with active LOW input.The input S and R represents Sets and Resets respectively. The S-R Latch will run in the way according to this truth table

INPUTS		OUTPUTS		COMMENTS
S	R	Q	Q’	
0	0	NC	NC	NO change.Latch remains in present state
0	1	0	1	Latch Reset
1	0	1	0	Latch Set
1	1	0	0	Invalid condition

The buzzer or fire drill is connected to Q. In order to activate the fire drill,the output Q should be active HIGH. It will be the opposite if we want to deactivate the fire drill. Hence we will be required to use the Set state and Reset state of Gated S-R Latch to change the output Q in asynchronous mode.

The Set state of Gated S-R Latch will be activated because the comparator will produce active High output to the S pin of Gated S-R Latch but active LOW output to the R pin of Gated S-R Latch if the temperature exceeds or equals the limit value. Hence the input S is required to be associated to the output pin of 4 bits Comparator where active LOW 4-bits digits which is produced by the output from the sensor are higher or equals the limit value.However,since the output from sensor will only be used to produce 8-bits value which is equal to active LOW input of limit values, the condition where the temperature exceeds the limit value will not occur actually. For activating the Reset state of Gated S-R Latch, the concept and the condition will be the opposite.The comparator will produce active High output to the R pin but active Low output to the S pin when the temperature is lower than the limit value. Hence, the R pin of Gated S-R Latch needs to be associated with the comparator pin where the temperature is lower than the limit value. When the temperature is lower than the limit value, the active High output from the sensor will be used to produce 8-bit digits which are lower than the active LOW input

of limit values. Some AND gate and OR gate are drawn in the circuit so that the Gated S-R Latch can operate according to the conditions.

Next,we come to the part of 1 of 4 Demultiplexers which is one of the components for advanced or Accessories features. 1 of 4 Demultiplexers will operate as a manual control of the fire drill or buzzer from the side of the fire alarm system control panel. There are 3 inputs for 1 of 4 Demultiplexers which are data inputs and two bits selector inputs. The data input will be like a switch to turn this feature on or off while two bits selector pins will be used to select which output line to have active High output to activate a certain area of fire drill . For example, there are 4 areas that had installed fire drill, if user sets up two bits selector to ‘01‘ , the first output line, Q0 will have active High output to activate an area with number ‘01’

Another component in the advanced or accessories features is Gated D Latch. The S-R Latch will run in the way according to this truth table:

INPUTS	OUTPUTS		COMMENTS
D	Q	Q’	
0	0	1	Latch Reset
1	1	0	Latch Set

Since Gated D Latch can be built up by using Gated S-R Latch and inverter. So we had combined Gated D Latch together with Gated S-R Latch. We had used AND gate and OR gate so that Gated S-R Latch and Gated D Latch can be transformed between each other according to the conditions. Gated D Latch is used to activate the drill regardless of the temperature. The output line of 1of 4 Demultiplexers will be connected to the Set pin of Gated S-R Latch. The output line with the inverter will be connected to the Reset pin of Gated S-R Latch. When the S-R Latch receives the signal from the 1 of 4 Demultiplexers , the set state will be activated. Otherwise, it will activate the Reset state if S-R Latch hasn't received the signal from the 1 of 4 Demultiplexers.

9.0 Conclusion

One of the most important components of any infrastructure is a fire alarm system. Although the usage of a fire alarm may not be able to prevent a fire disaster, it can at least alert people who are in the infrastructure to know about the presence of the fire. So, This way, they'll have enough time to escape from the infrastructure before the fire spreads. The concept behind developing a fire alarm is to employ a logic gate. There are different types of logic gates, such as the NOT gate, which can be used to create simple circuits. This type of circuit is a dependable and common device that can be used to create a fire alarm.

Moving on to the next one, every member of Group 3 has contributed to the completion of this report. There are numerous issues and challenges that must be overcome in order for this report to be successful. You can refer to the table below for the weaknesses and future plans of our project:

Weakness	Future Plan
The fire alarm system doesn't have the ability to stop the fire to spread continuously	Add on something like auto water spraying system or auto emergency calling system
Sensor is designed to produce a single fixed output only	Change to sensor which can produce outputs which is variable with the temperature
The circuit of the system is only designed for setting up a limit value which is equal to the limit value of the sensor. If the owner set up a limit value which is higher or lower than the limit value of the sensor, the comparing result may be wrong in some conditions	Change the design of the circuit so that the value from the keyboard encoders could be inverted to bits digits which will be the limit value in decimal numbers. With this, the output digit from the sensor will not be needed to inverse.
The mechanism for setting up limit value through keyboard encoder may be difficult or complex for the owner since it is a priority encoder	Maybe we could design a more easy system to key in like calculator for this part
The fire alarm system is only designed to control single alarm manually	Design a new system for manual controlling part so that the owner could control multiple alarms manually

Next, we also have issues within the group that are preventing us from completing the job. The first issue we faced was deciding on the type of logic gate circuit that this group should use to make the report. This issue has led to our main issue, which is a lack of time. This happens because we take such a long time to choose the project which leads to our time to complete it is reduced. However, we were fortunate in that the deadline for this group project was postponed. This gives us ample time to complete it without having to worry about missing the deadline. Besides that, another challenge that we face is the internet connection problem. There is one case where some of us already managed to complete our own task until the internet was cut off for unknown reasons, hence we are losing our progress because it has not been saved. Fortunately, we have taken a screenshot of our progress for the back up situation as we just need to write it back. Lastly, one of the issues is stress. We had a lot of other projects and assignments from other subjects that we needed to complete in a short period of time. Most of us are having difficulties with our own lives since we study online. In addition, some of us are even having a mental breakdown and struggle to finish a lot of work. Despite all that, we all support each other by giving motivation towards each other as well as having a positive mind.

Aside from that, we can claim that the achievement of the group was that we were able to apply the theories we learnt in class to develop a system to solve a real-life problem. We also hope that the skills and knowledge that we gain while working on the group project will be useful in the future. Moving on to the following point, the fact that our project was able to achieve its goal of alerting the people in the region so that they could notice the fire and flee the area immediately should be considered a strength for this project. When smoke, fire, or other fire-related emergencies are noticed, it also alerts people. This will enable them to flee before it's too late. So In a nutshell, we can say that our project is a success and we hope that our group project will receive good marks and can be a good example towards other students in the future, allowing them to receive an A or better in this subject as well as our project. Last but not least, we'd like to thank our lecturer, Dr. Nur Haliza, for her unwavering support throughout the process to the very end. We are very happy that we were able to complete this group assignment on time and manage to work in a group while having good memories and experiences.

10.0 Reference

[1] ADMIN. (2018, January 10). *Simple smoke detector circuit*. Making Easy Circuits. https://makingcircuits.com/blog/simple-smoke-detector-circuit/

[2] ADMIN. (2018, February 17). *LED emergency light with automatic battery cut-of circuit*. Making Easy Circuits. https://makingcircuits.com/blog/led-emergency-light-with-automatic-battery-cut-of-circuit/

[3] ADMIN. (2020, May 14). *Automatic Street light circuit*. Making Easy Circuits. https://makingcircuits.com/blog/street-light-circui/

[4] Daniel Crimmins. (2020, July 15). *What is a fire alarm system? (Fire detection system)*. PLC Programming Courses for Beginners | RealPars. https://realpars.com/fire-alarm-system/

[5] Law Yong Yi. (2020). *Digital E report 2020*. StuDocu. https://www.studocu.com/my/document/universiti-tunku-abdul-rahman/digital-electronics/digital-e-report-2020/8830604

[6] ORP Protection. (2020, October 22). *Sequence of operations: Basic & integrated systems*. ORR Protection | Fire Protection Experts. https://www.orrprotection.com/mcfp/sequence-of-operations-basic-integrated-systems

[7] Shaoxuan Kang. (2021). *Analysis on the circuit design of fire alarm*. ResearchGate. https://www.researchgate.net/publication/351964411_Analysis_on_the_Circuit_Design_of_Fire_Alarm

[8] Smith, P. (2021). *Using logic gates to make a fire alarm*. Maths/Physics Tuition Throughout London & Online Tests/Notes. https://astarmathsandphysics.com/a-level-physics-notes/electronics/2651-using-logic-gates-to-mkake-a-fire-alarm.html

[9] Smith, P. (2021). *Using logic gates to make a light activated burglar alarm*. Maths/Physics Tuition Throughout London & Online Tests/Notes. https://astarmathsandphysics.com/a-level-physics-notes/electronics/2652-using-logic-gates-to-make-a-light-activated-burglar-alarm.html

[10] Smith, P. (2021). *Using logic gates to make an Autometic watering system*. Maths/Physics Tuition Throughout London & Online Tests/Notes. https://astarmathsandphysics.com/a-level-physics-notes/electronics/2653-using-logic-gates-to-make-an-autometic-watering-system.html

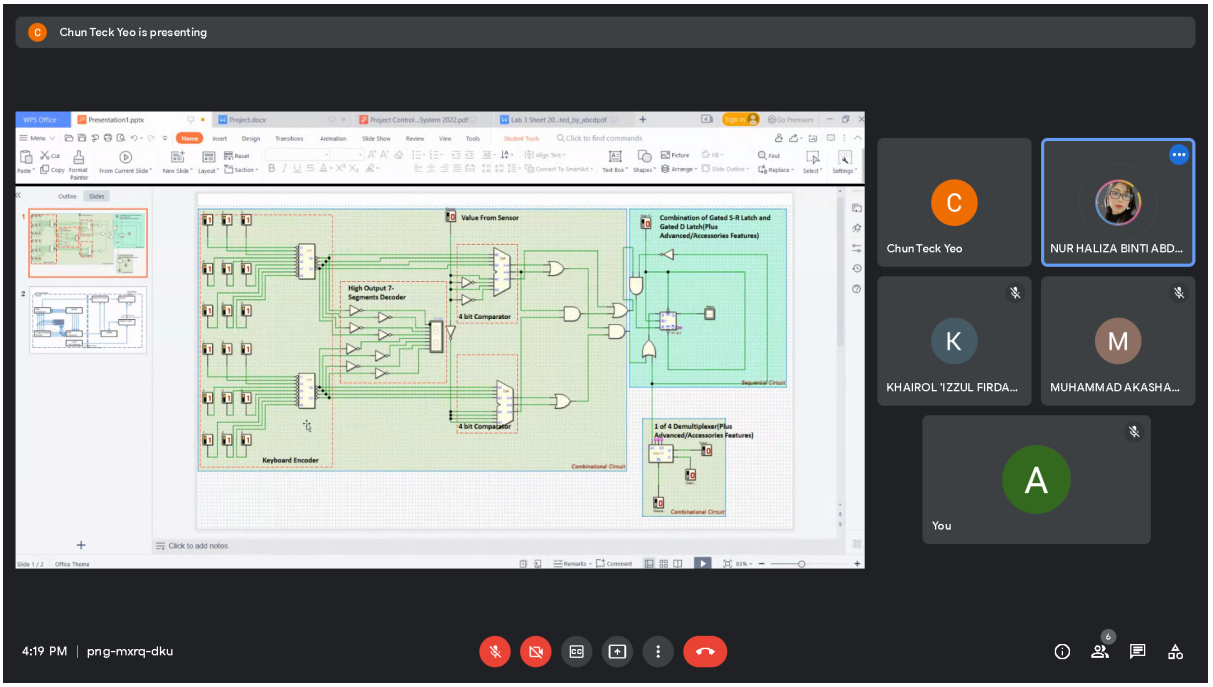
[11] Smith, P. (2021). *Using logic gates to control a washing machine*. Maths/Physics Tuition Throughout London & Online Tests/Notes. https://astarmathsandphysics.com/gcse-physics-notes/897-using-logic-gates-to-control-a-washing-machine.html

[12] Smith, P. (2021). *Using logic gates to make a push Button lock*. Maths/Physics Tuition Throughout London & Online Tests/Notes. https://astarmathsandphysics.com/a-level-physics-notes/electronics/2654-using-logic-gates-to-make-a-push-button-lock.html

[13] V. Ryan. (2017). *Example logic circuit - 1*. ENGINEERING - DESIGN AND TECHNOLOGY. https://technologystudent.com/elec1/dig5.htm

11.0 Appendices

Group Discussion's Screenshot



Appendix A: Task Distribution

Team

1. Yeo Chun Teck
2. Khairol Izzul
3. Muhammad Ridzuan
4. Amalia Syazana
5. Muhammad Akashah

Tasks

1. Searched for a problem statement.
2. Analysed the problem.
3. Developed for a project proposal.
4. Suggested the solution of the problem.
5. Developed the solution(circuit) via deeds software.
6. Tested the solution(circuit) suggested via deeds software.
7. Identified the weakness of the solution.
8. Developed the initial project report.
9. Demo Video
10. Developed the final project report.

Summary

We performed the above task together as a team. We discuss the solution of the problem such as the logic circuit and component to be used via Whatsapp group. Since we had to deal with several tasks, we divided the task up to each team member. We also arranged a meeting with our lecturer, Dr. Nur Haliza for discussion about the project. We received approvals and comments from her and did some improvements based on the comments.

Project Timelines

Date	Activity
3/1//2022	Briefing about the Project
5/1/2022	Discussion about the Project
16/1/2022	Work on Project
31/1/2022	Discussion with our lecturer, Dr. Nur Haliza for seeking approval and comments for improvement
2/2/2022	Finish the incomplete part and improve and do improvements based on the comments
7/2/2022	Make Project Video
11/2/2022	Submit Project Report, Project.pbs and Project Video