

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The *extent* to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Research-informed Literature Extent of research and/or own reading; selection of credible sources; application of appropriate referencing conventions.	10	6
VERY GOOD		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	25	22
EXCEPTIONAL		
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence.	25	20
EXCEPTIONAL		
4. Practical Application and Deployment Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems.	30	28
EXCEPTIONAL		
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.	10	7
EXCELLENT		

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)	
	Up to four weeks late	☒
	First Attempt?	☒
		83 %

FdSc & HN COMMON ASSESSMENT AND MARKING CRITERIA

Assessment Criteria	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
	REFER (equivalent to 0-29%)	REFER (equivalent to 30-39%)	PASS (equivalent to 40-49%)	PASS (equivalent to 50-59%)	MERIT (equivalent to 60-69%)	DISTINCTION (equivalent to 70-79%)	DISTINCTION (equivalent to 80-100%)
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research-informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	Unsubstantiated generalisations, made without use of any credible evidence. Lack of logic, leading to unsupportable/missing conclusions. Lack of any attempt to analyse, synthesise or evaluate.	Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.	Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Some evidence to support findings/views, but evidence not consistently interpreted. Some relevant conclusions and recommendations, where relevant.	Evidence of some logical, analytical thinking and synthesis. Can analyse new and/or abstract data and situations without guidance. An emerging awareness of different stances and ability to use evidence to support the argument. Valid conclusions and recommendations, where relevant.	Sound, logical, analytical thinking; synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.	Thoroughly logical work, supported by evaluated evidence. High quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Strong, persuasive, conclusions, justifiable recommendations.	Exceptional work; judiciously selected and evaluated evidence. Very high quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Highly persuasive conclusions.
4. Practical Application and Deployment Effective deployment of appropriate methods, materials, tools and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and/or contexts; formulation of innovative and creative solutions to solve problems.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application.	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.	An adequate awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques. Basic appreciation of the context of the application.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation and creativity.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation and creativity evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of cutting edge processes and techniques.
5. Skills for Professional Practice Demonstrates attributes expected in professional practice including: individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work lacks structure, organisation, and/or coherence.	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable format, but may have minor errors. Can work effectively as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, confidently and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.

Assignment name: PLC Program Design Using Ladder Logic

Module code: PDSE4005

Assignment number: 2 of 3

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Introduction

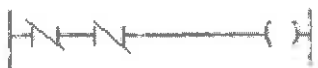
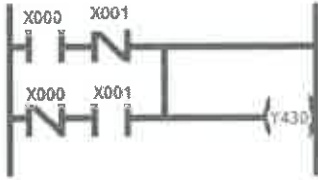
Widely across program PLCs, ladder logic is used where sequential control of a process or manufacturing operation is required. Ladder logic is useful for simple or complex systems. As Bolton (2006) says *'a ladder logic diagram has two vertical lines that represent the power rails and then the circuit is constructed on horizontal lines'*. *'On these lines the circuit is constructed, with each horizontal line made shows one operation in the control process,'* according to Bolton (2006).

With Ladder logic there is a special Program Logic Controller. For this assignment the PLC used will be a Mitsubishi FX1S, which has 6 inputs and 4 Outputs. A PLC is a device that can run machinery by taking the programs that are developed and transferring the data inputted into it. ✓

During the assignment it will show the research and practical used to investigate the ladder logic that needs to be produced for a PLC program(s). The first section of the assignment will consist of research. However, this will show the simple ladder diagrams, instruction list and block diagrams that have been 'converted' into one another. This is to ensure that the practical which happens later in the assignment will run smoothly due to the guidelines made to begin with.

All diagrams, Ladder logic and Block Diagrams, in this assignment are created in Paint. According to Wray.R (2018) Ladder Logic programs are meant to be *'easier to understand and also easier to spot mistakes, but they do take a lot of space. With List Programming it has the advantage of not taking a lot of space. An example is if a ladder program takes up several pages, it can be condensed down to a single page with list programming'*. ✓

Part A - Task 1 (Section a and b)

<u>Logic Gates</u>	<u>Ladder Diagrams</u>	<u>Instruction list</u>
AND		LD X400 ✓ AND X401 ✓ OUT Y430 ✓
OR		LD X400 ✓ OR X401 ✓ OUT Y430 ✓
NAND		LDI X400 ✓ ORI X401 ✓ OUT Y430 ✓
NOR		LDI X400 ✓ ANI X401 ✓ OUT Y430 ✓
XOR		LD X400 ✓ ANI X401 ✓ LDI X400 ✓ AND X401 ✓ OUT Y430 ✓

The table above shows the ladder diagrams and the instruction list of each of the gates that are provided. When a gate shows Normally Open it means it's a 0 and when it shows normally closed it represents a 1. This is due to the 'power' going through if its 0 it means it cannot get through if it's a 1 then it can.

With an AND gate to make a ladder diagram it requires 2 normally open (NO) switches connected in series, this only allows an output when all the switches in series are closed. To allow the power flow through the branch.

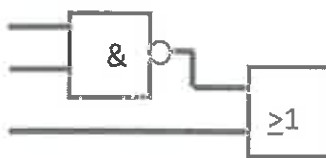
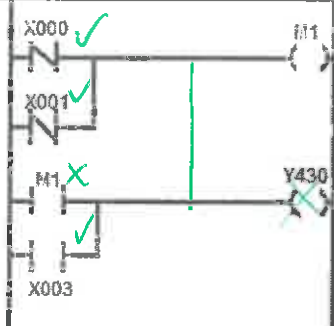
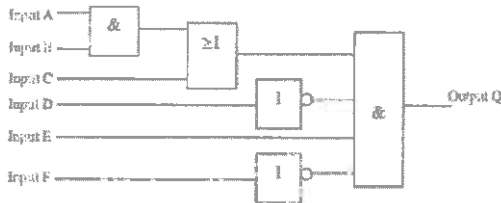
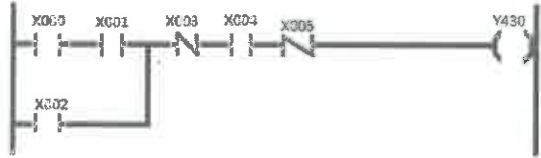
The OR gate also uses NO switches however these are connected in parallel to each other. This allows an output when any of the switches or all the switches are closed.

With a NAND or a NOR gate they both use normally closed (NC) switches. NAND is connected in parallel to each other and allows an output except for when all the switches have been opened. A NOR gate consists of NC switches that are connected in series and due to this it only allows an output when all the switches are closed.

Constructing the XOR is very complicated to explain. It has 2 NO switches and 2 NC switches, however, when connecting the gates a NO and NC switch go in series and then in parallel a NC and a NO switch are linked together. The order is very important to ensure the gate works as it should.

Task 2

a)

Function Block Diagram	Ladder Logic	Instruction List
		<pre> LDI X000 ✓ ORI X001 ✓ OUT M1 ✗ LD M1 ✗ OR X003 OUT Y430 </pre>
		<pre> LD X000 ✓ AND X001 ✓ OR X002 ✓ ANI X003 ✓ AND X004 ✓ ANI X005 ✓ OUT Y430 ✓ </pre>

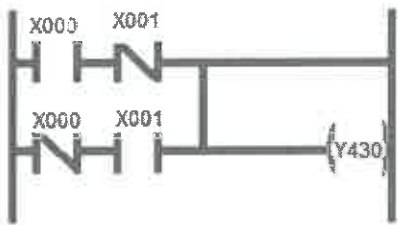
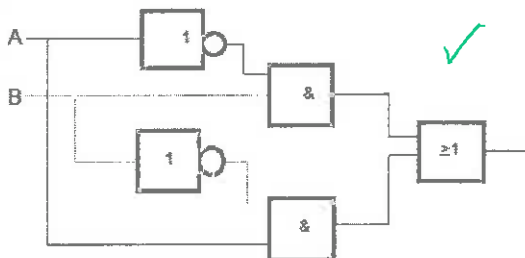
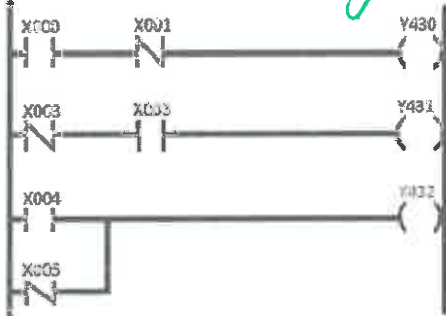
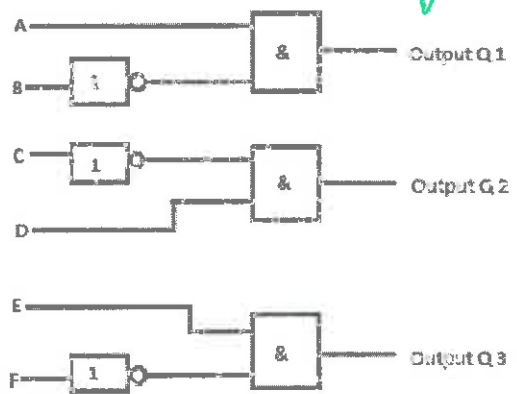
Block diagrams are blocks that have the symbol inside that show which gate they represent.

However, if there is a small circle on the outside of the block then it is the inverted gate, so an AND turns to a NAND and a OR changes to a NOR. Also, there is a NOT gate available which is a NC switch which gives an output but when the switch changes to NO then there is no output.

Creating the ladder diagrams from the block diagrams wasn't too difficult, although figuring out how to create the gates and connecting them to each other were difficult. With having the logic gates converted to ladder logic above in task 1 helped. After working out the ladder logic it was simple to convert into an instruction list by using the table provided below (table 1).

Inputs	List	Device
N/O contacts	LD	LD X400
N/C contacts	LDI	LDI X400
Series N/O contacts	LD (AND)	AND X401
Series N/C contacts	LDI (ANI)	ANI X401
Parallel contacts N/O	LD ... OR ...	OR X401
Parallel contacts N/C	LDI ... ORI ...	ORI X401
Standard Outputs	OUT	OUT Y430

b)

Instruction List	Ladder Logic	Function Block diagram
LD X400 ANI X401 LDI X400 AND X401 OUT Y430		
LD X000 ANI X001 OUT Y430 LDI X002 AND X003 OUT Y431 LD X004 ORI X005 OUT Y432		

With creating the ladder logic and block diagram from the instruction list it was very difficult. The reason for this is down to the fact that when the instruction list states OUT for an output it might be linked to another gate in a function block diagram or it could represent the output Q. This was the section that was the most difficult, but while doing some research it became clear on how to draw the diagrams.

With the first Block diagram due to the inputs over lapping each other the 'paths' are colour coordinated to help demonstrate and will not look too complicated. However, it was simple to do due to the instruction list representing a XOR gate.

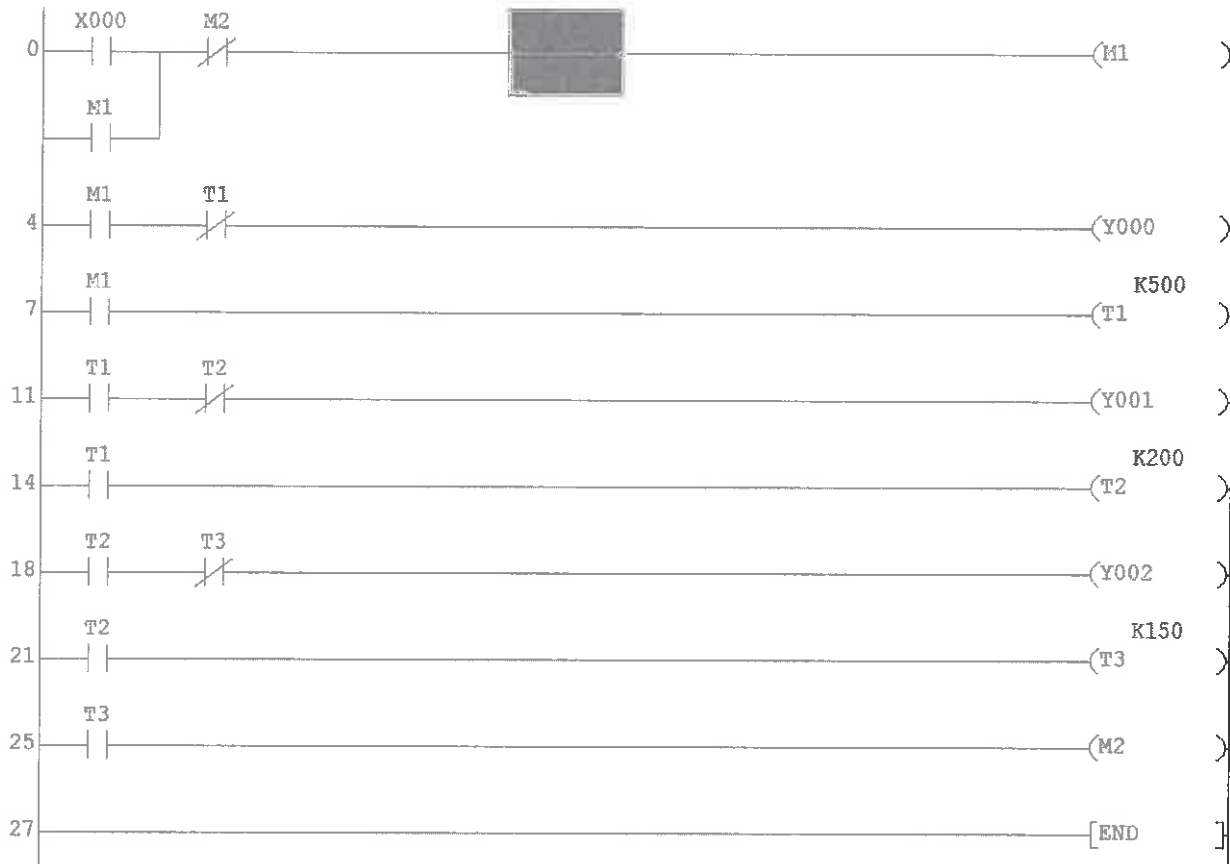
✓

/dd

Part B - Task 3

For the following ladder logic in task 3, all flow chart will be presented in the appendix labelled and an explanation of how the flow chart helps with the design aspect.

a) Washing Machine

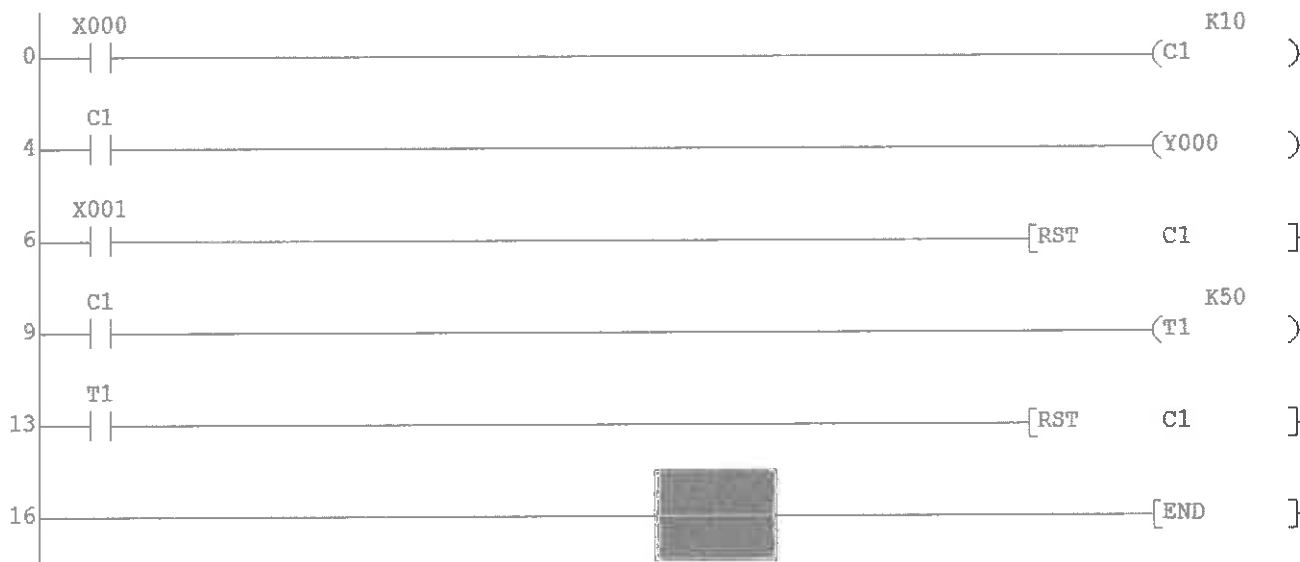


Above is a screen shot of a ladder logic that is designed to act a part of a washing machine cycle. In the cycle the water pump runs for 50 seconds and is then switched off followed by a heater switch to be run for 20 seconds. After the 20 seconds are up the heater will turn off and a drain pump runs for 15 seconds to remove the water.

With this ladder logic it was difficult to work out how to have the stop/start button to hold out an input to keep the program running. However with some guldens the solution was to connect the output to latch and override the initial input.

By using the flow chart in appendix 1, it has helped with the timings and the layout that was required for the washing machine ladder logic diagram. Although figuring out the 'decisions' that are on the flowchart was difficult. With some additional research it became easy to work out and finding a solution. The solution ended up being M which acts as a switch that hold the inputs in one area. This is useful when M needs to be used in any other branch instead of rewriting the same sequence again and again.

b) Photocell sensor



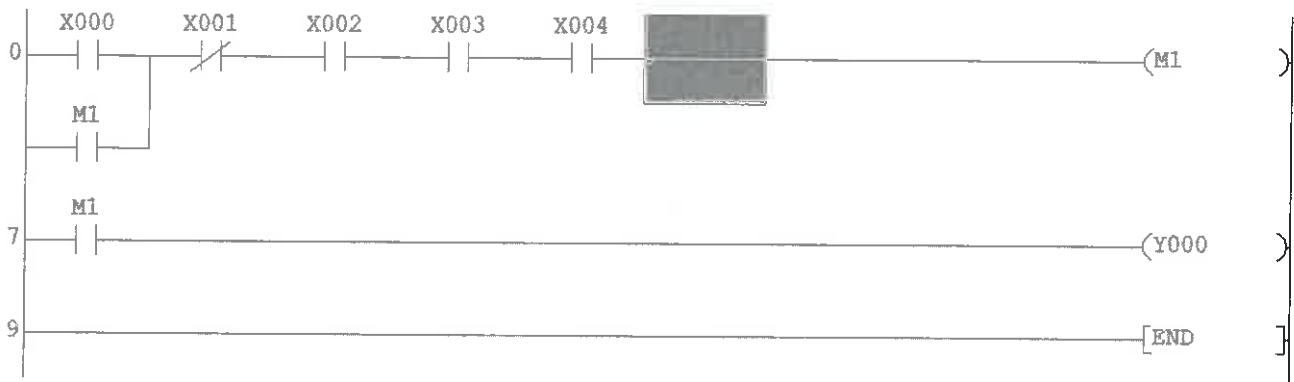
Here is a screenshot of a photocell sensor. This is a program that is designed to detect object moving along a conveyor belt. With the system design it requires to be able to count 10 objects that passes the sensor. Also for this program it specifies that the system should have a manual and automatic counter reset.

As seen in the screenshot there is a NO switch that is labelled X000 this represents the ON manual switch and X001 is also a NO switch which represents the Manual OFF switch. The ON switch is connected to a counter. When the counter has reached the count of 10 it gives an output. Also the counter starts a timer to allow the objects to go to the end of the conveyor belt. After the timer has completed the required time it also resets the counter which is the automatic reset that is part of the specification. When the OFF switch gets pressed it resets the counter due to the switch being connected to a reset counter.

Creating this program wasn't difficult but needed time to break down the specification so that when putting the program together it would be simpler than was expected. Using appendix 2 helped a lot as well to be able to follow the sequence visually.

✓

c) Pneumatic Power Press



This is a screen shot of the program that is designed for a pneumatic power press. This design requires a momentary switch button for on and off. Also it requires a safety system so that the motor will not start if any of the switches are not interlocked together.

Due to the specifications of this program it was difficult to understand but with guidance and some understanding of the task it became easy to do.

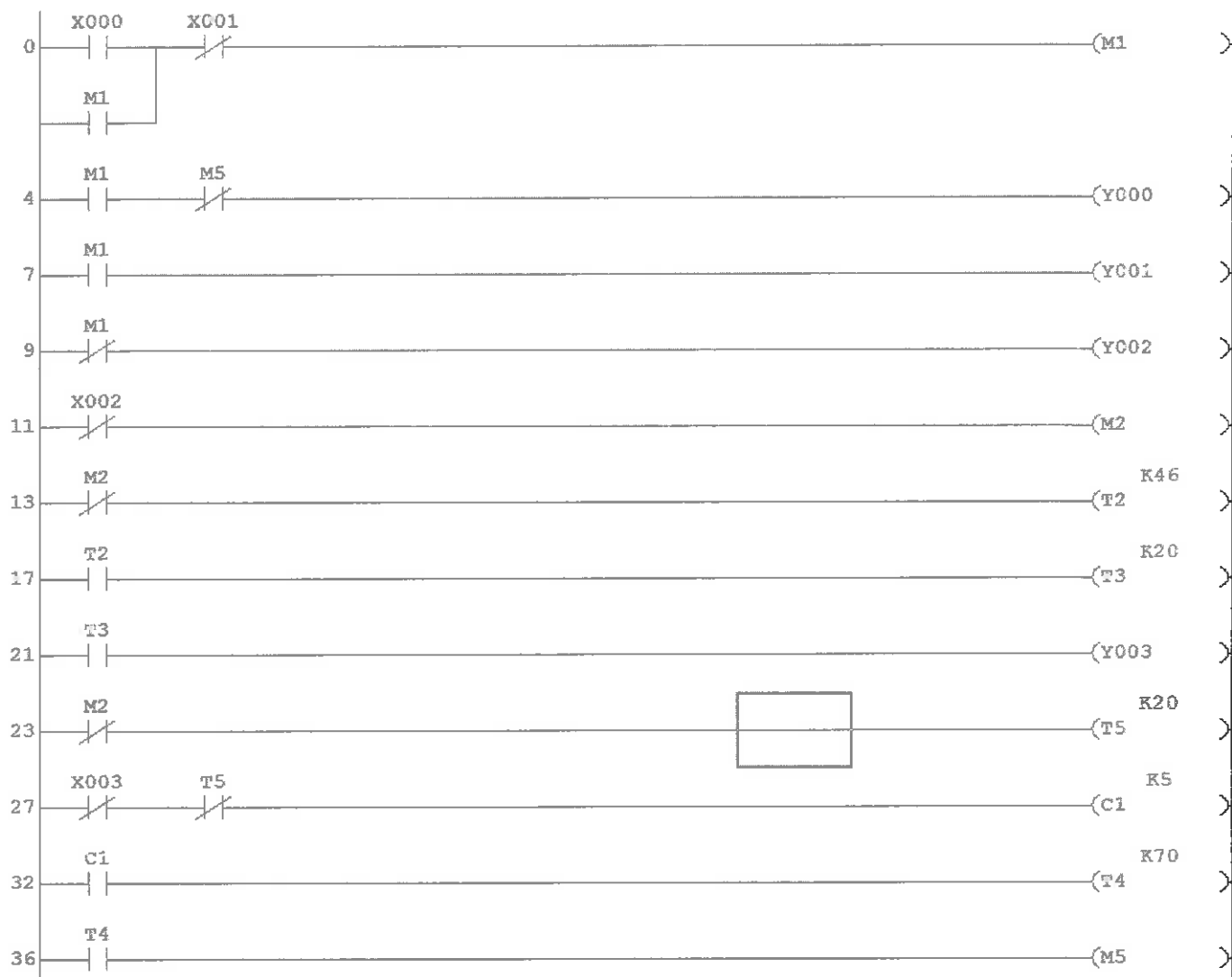
X000 is the start button, which is a normally open switch and X001 is the stop button which is normally closed. With X002, X003 and X004 they represent the three switches that are required. Those switches connect to an M1 output so that it can carry the program going to the end. If all the switches are closed the program would run but once one of the switches are open then the safety system will kick in and then there would be no output.

Appendix 3 shows the flowchart for the Pneumatic Power Press system, using this was helpful to work out how to arrange each switch. The flow chart got a bit confusing with all the looping around, when reading the programs specification again it seemed very simple and then the flow chart became easier to read.



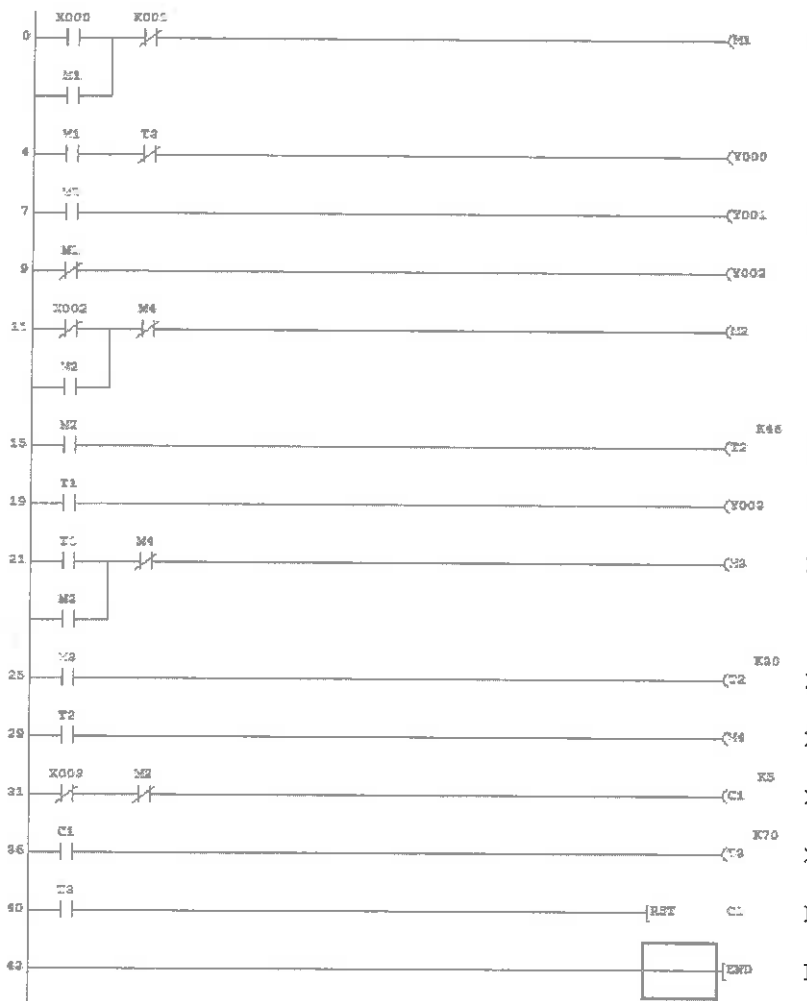
Task 4

Conveyor belt



Appendix 4 consists of the flow chart for the conveyor belt. Creating the Conveyor belt was very complex. It took a long time to get all the components in the right place and working out the timings for each timer. Even with the research and all the gates in the assignment done getting each of the outputs to work together was hard. Even the flow chart took a long time to construct because of all the elements required for the specification for the program. Luckily with having guidance and being able to use a pre made conveyor belt to test, it did not take long to adjust any imperfections that were in the program. With a lot of time and dedication the program was developed, however, the program does not follow all the specification and does have a few mistakes. The counter for the smaller objects is the section that is the most difficult to do due to the fact that all objects pass the sensor and finding a way to stop the taller objects being counted was very difficult. Even with adding a timer to make sure that the counter wouldn't count them didn't work either and when changing the switches to closed that still caused problem with counting. With this program it will only count to 1 and finding the problem became too difficult to work out. ✓

As stated on page 10 the program does not work to the desired specification, however, the program below has been modified to follow all specification.



Here it shows the completed program. As seen many more switches have been added to ensure that the program does not faultier in any way. Also, a reset for the counter is shown and been added to the program. This is due to realising when the program resets the counter dose not. So reset counter is a feature to ensure when the off switch is pressed it resets and also when the count reaches 5 it will reset as well.

✓
/SDP

Conclusion

Learning and understanding ladder logic did not take long to understand, however the instruction list was the easiest to understand. When creating the ladder logic it was very difficult to understand how each of the switches connected together and in what order as well.

Task B was very difficult to complete. Making the flowchart to go with the program to help build each one was not as difficult as thought but knowing what switches to use for each part was. The switches all indicate an input, but knowing whether if the switches are normally open or normally closed was difficult. Although understanding the ladder logic did not take long some guidance was needed due to not understanding how some functions worked, for example, how to make a momentary switch button.

Task 4 was more difficult to construct than task 3. The flow chart and the program for this task was very complex to make. Due to the PLC only consisting of 4 outputs it was difficult to ensure that no more outputs were made by mistake. With better knowledge of ladder logic and some guidance it was possible to create the desired program that was given.



Referencing

Bolton,W. (2006) Programmable Logic Controllers (4th edition) published unknown.

Table 1 - Wray.R 2018, Pembrokeshire College, Wales.

Bibliography

Tutor Wray.R 2018, Pembrokeshire College, Wales.

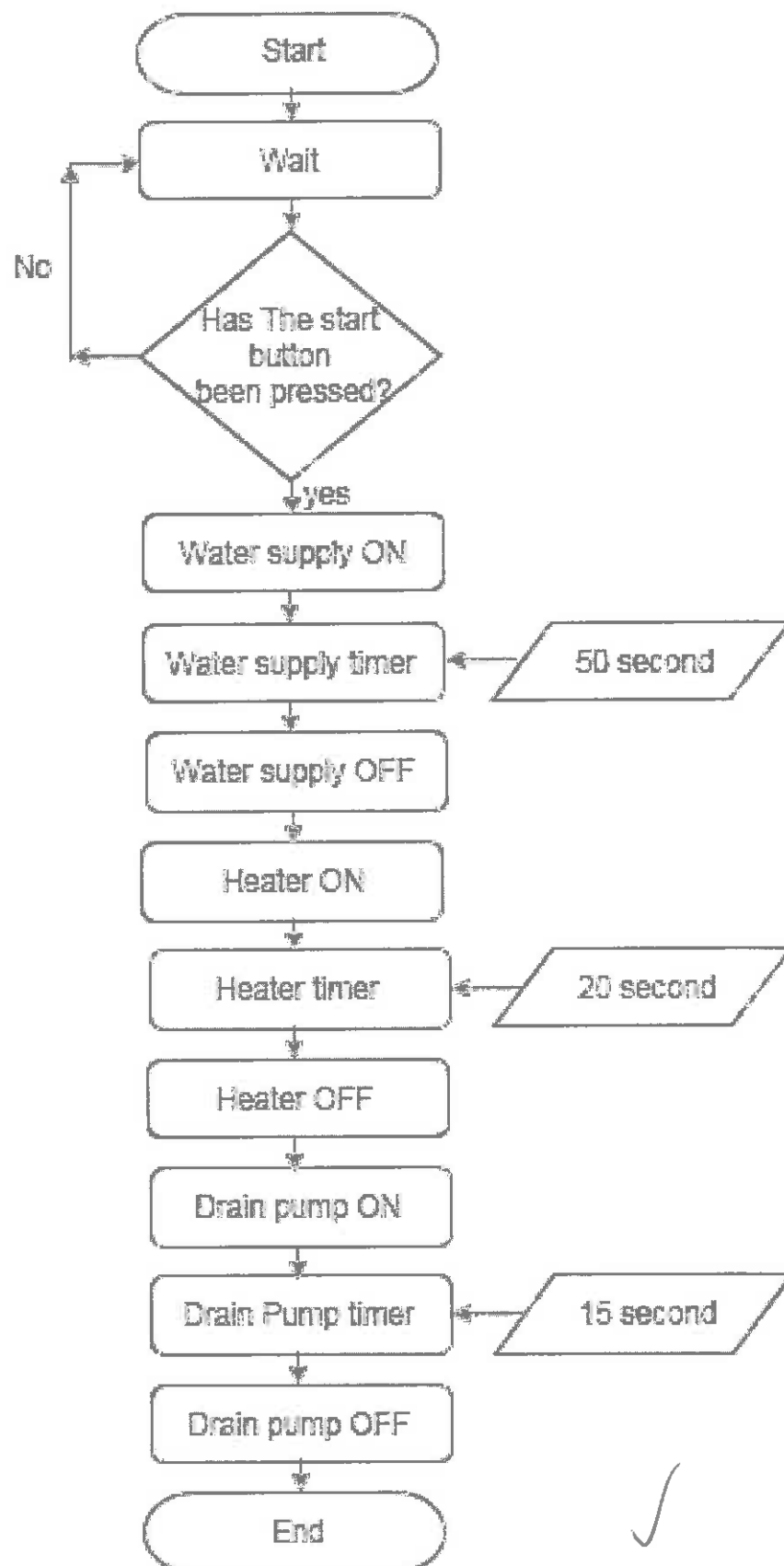
Stenerson,J. (2009) Programmable Logic Controllers with ControlLogix. Published unknown.

Green,C. (2015) Learn How to Program and Troubleshoot Ladder Logic. Published unknown.

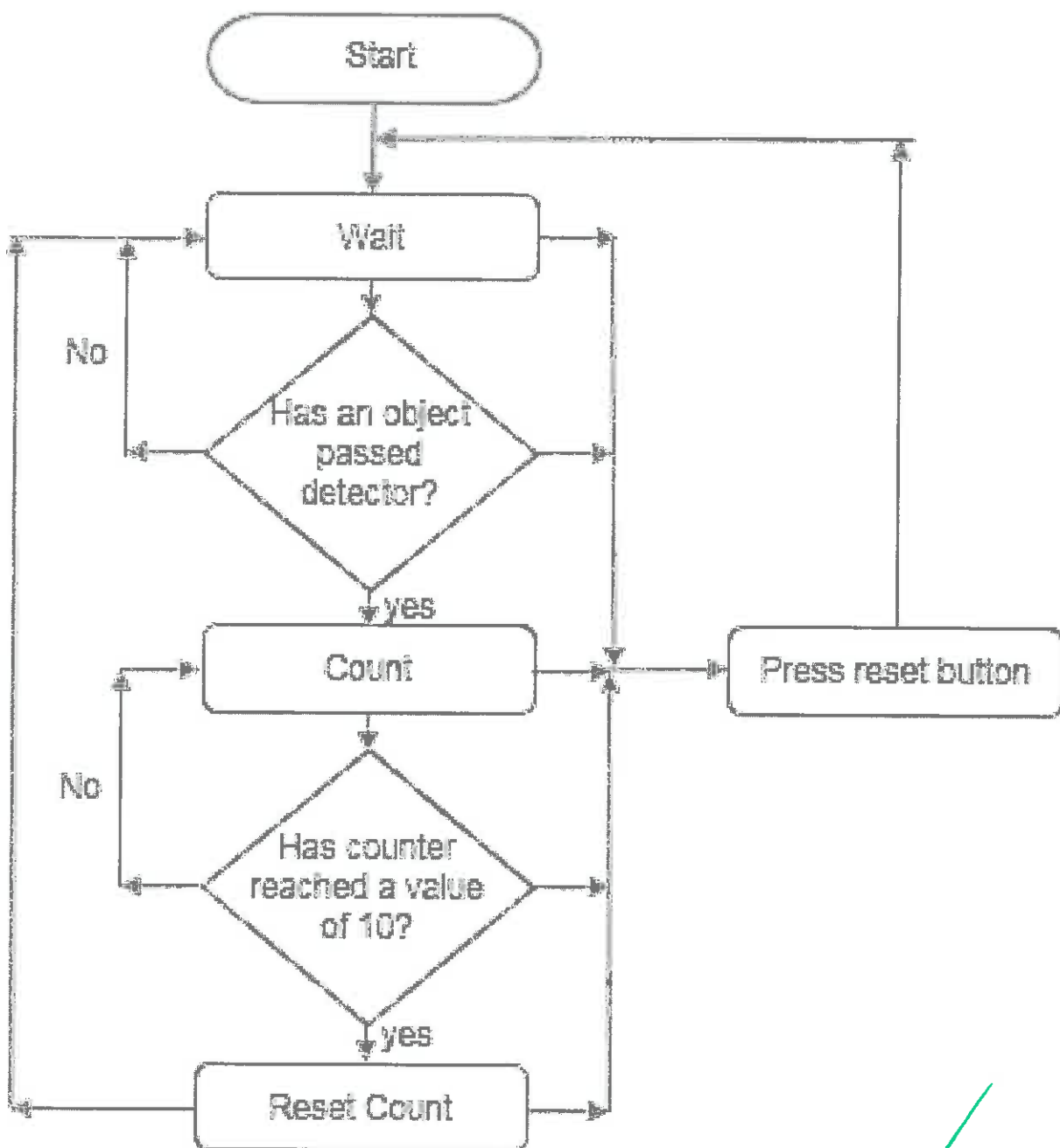
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Appendix

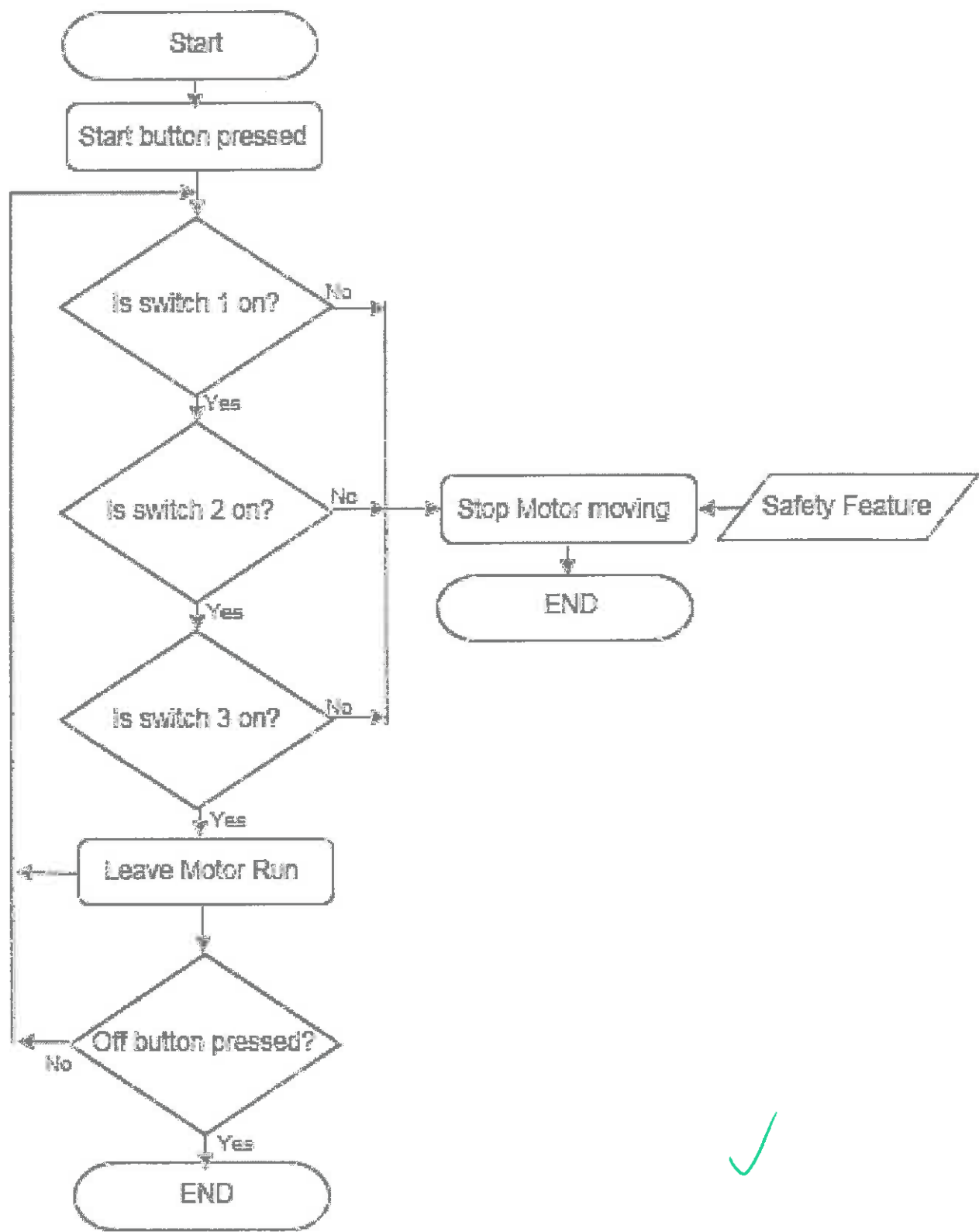
1. Flow chart washing machine



2. Flow chart of photocell sensor



3. Flow chart of Power press



4. Flow chart of a conveyor belt

With the Stop button it was very hard to be able to connect it in with the rest of the flowchart due to it needing to be connected at each point. So it has been put in a red box to represent an emergency function

