

1809806

by Richard Harrison

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PROJECT FINAL REPORT AND LOG BOOK

HNC yr2 electrical and electronic engineering

Image processing SGEE4006



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Table of figures is good and appropriate for the project

Introduction

Project summary

*You must avoid
first person terms*

After careful consideration and discussion with both my workplace manager and my college tutor, I have decided to do my HNC project in the college lab (G8). The college lab needs a system that can demonstrate contactless sensing in a production environment that is why this project has been chosen. The project will address this issue through construction of a system which simulates an industrial process involving a select and separate visual system commonly used in the automotive industry. The project will involve the use of a conveyor, program, Arduino, camera and reject arm to represent and simulate the industrial process. The project will involve creating a software program using National Instruments LabView software that recognizes coloured objects on a camera based on the images RGB values on the colour spectrum. The software will recognize the colours of the objects passed under the camera by the conveyor and reject certain colours and pass others. The program will give commands to the Arduino board which will control the reject arm and possibly the conveyor speed also. Following this, the result of this project may be implemented onto the large CIM system in the college lab which is a large-scale system with multiple PLCs and stations which simulate a larger scale industrial process.

Objectives

This projects main objectives are to create a concept and possible upgrade for the CIM system or standalone system to simulate an industrial process involving colour recognition. Lastly, the program and build layout must be easy to understand and explain so it can be used effectively in the classroom for future lessons.

Background research

Solution 1 – OPC server

An OPC server or Open Platform Communications server is essentially a Client/Server based software communication and interface standard that converts hardware communication protocols that can be from either a PLC or the hardware itself into OPC communications protocol and vice-versa. Allowing a software program in a computer (for best compatibility must be Windows based) to communicate with any industrial hardware such as PLCs, HMIs etc. That the computer has access to (Represented in figure 1)

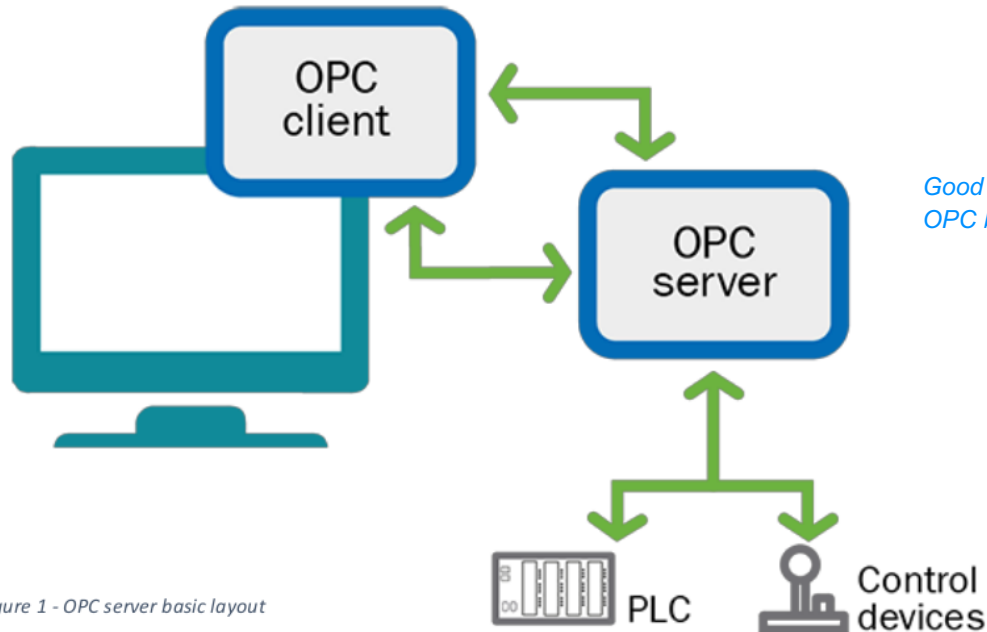


Figure 1 - OPC server basic layout

"OPC (OLE for Process Control) was first defined by a number of players in automation together with Microsoft all the way back in 1995." (Novotek, 2020)

OPC servers are now one of the best ways to set up communications in the automated industry. As it evolved and was improved upon, it went from being solely data access software, to alarms and events to historical data access to further improvements to allow it to run and control PLCs and hardware. Because of its now large flexibility and world-wide usage, manufacturers often try their best to make sure their product is OPC compatible and although Microsoft played a large part in its development, the software can be used on other platforms such as Linux and Apple.

This solution could also be used in conjunction with an Arduino board as well as a standalone method of controlling the project with LabView software.

Solution 2 – Arduino/microcontroller board

“Arduino is an open-source platform used for building electronics projects” (Sparkfun, 2020)

Microcontrollers such as Arduino boards are highly customizable and can be used for an almost endless variety of projects. Especially with all their different variations and shields which can be added to provide extra functions like extra I/O, network capabilities and motor control. All an Arduino board requires to function is power, a connection to its project and a software program to issue commands. The software and power can both be supplied by a PC via a usb cable. The Arduino board normally uses basic SCL code but computer programs such as LabView can be used to control them as well which is part of the reason these boards are considered to be so flexible.

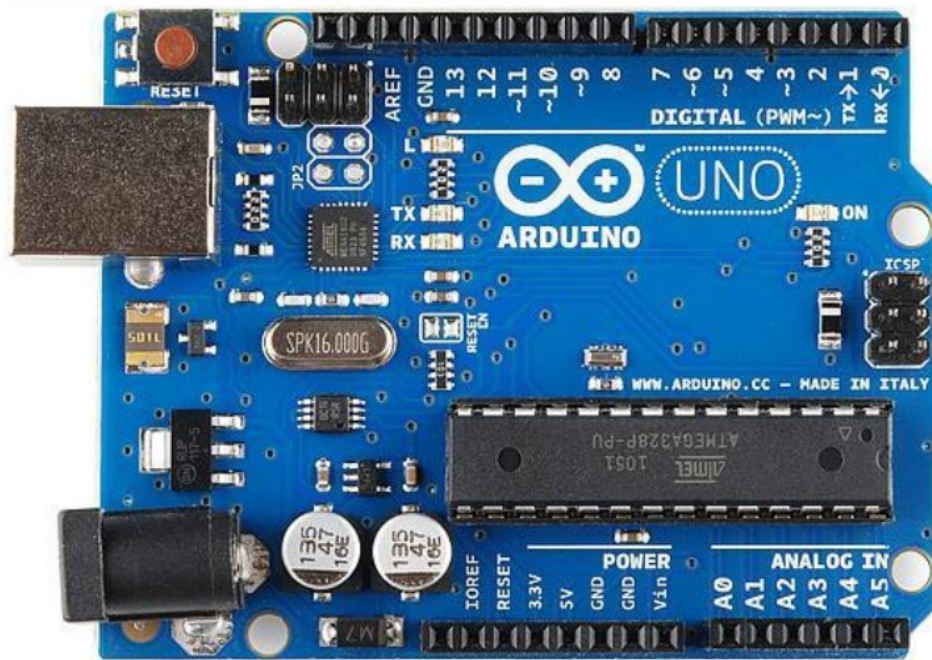


Figure 2 - Arduino UNO board

Because it is easy to use the Arduino board is often used by beginners and has a large number of tutorials and online projects for beginners including lessons on how to use the board.

If used in the project, an Arduino similar to the UNO would be used as it is a relatively new and up to date model with a wide variety of possibilities for expansion if necessary and it works with LabView software which would be used for creating a program for the camera.

Solution 3 – PLC



Figure 3 - Siemens LOGO! 8 module

A PLC or Programmable Logic Controller is a highly customizable and industrial scale controller which can be used to control a huge number of I/O devices and systems at once. In this case either an S7-1200 PLC would be used or a Siemens Logo! Logic module. This small module is specifically designed for both industry, hobbyists and home automation and can be controlled wirelessly from an app on a mobile phone. The Logo! Requires siemens software to create programs and is essentially a mini PLC. It is also very expandable with expansion options ranging from communications to more I/O to operator devices like HMI screens.

Either the S7-1200 PLC or the LOGO! Module would be suitable for this project. Both these options are essentially computers specialized for industrial use in controlling automated processes.

The research here is fine , but what are the purposes of these three solutions because none of these will do the image processing without third party equipment and software.

If used for this project either the PLC or LOGO! Would be programmed using Siemens software on a computer the program created possibly using Siemens TIA portal V15.1. This method would mean the system could be implemented onto the larger CIM system in the classroom later on if necessary.

Specification

One reason for this project is to create a system concept which could be implemented onto the existing CIM system in the G8 lab if required to upgrade the current systems product inspection station. The problem with the existing one is that it does very little except provide a visual representation on a screen of the product before and after it has gone through the process. The addition of this system would mean the product could be inspected for colour imperfections and would mean the operator would not need to ensure the correct product is being processed as the system would do that automatically. Meaning the operators could perform other tasks and act more efficiently. Also, if different products got mixed up somehow the system would be able to reject any product that is not to specifications.

Project objectives:

This project must:

1. Correctly identify the colour of the item underneath the camera
2. Reject any and all product which is the incorrect colour according to the parameters applied
3. Upon acknowledgment of an unspecified items, the system must reject the item into the reject bin by firing the reject arm.
4. The system must be able to be programmed to reject different coloured products. Not just one colour.
5. Software must be easy to explain and understand for teaching purposes

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Planning and budget layout

The planned starting point for this project is the 24/09/2019 and its due to be completed by the 05/05/2020. In order to keep track of time a Gannt chart shall be used to track progress and log entries will be produced each time work is done on the project. As objectives are met and time goes by the Gannt chart will be filled out. This will show how the project played out, if all aims were met in their timeframes, what took longer than expected and how events effected the project's completion date. The budget for this project is £200 but can be increased if necessary. **Figure 5 (Page 8) shows the Gannt chart on the page below.**

For testing, once the system is complete the functionality of the system will be tested piece by piece. Camera, reject arm, conveyor and software will all be tested and inspected for faults. The full system will then be tested. Parameters will be set for different coloured objects to be passed of rejected and the system must reject the correct objects in order to pass the test.

Student signature:	Date:
Lecturer signature:	Date:

Customer/ Classroom needs

The customer requires that the system be designed and built in such a way that the finished product is easy to understand and explain for lesson and teaching purposes. The software especially needs to be laid out in such a way that a learner can look at it and understand how the program was created and form a basic understanding of how it works through visual representation.

Maintenance and reliability requirements

The finished system will be very low maintenance as there will be few moving parts apart from the reject arm and the conveyor. Meaning it will be highly reliable given, the system will be running in a warm, dry classroom environment with little moisture. This means the system may need weekly or monthly checkups to look at the conveyors bearings and lubricate them if necessary and check the stepper motor for the reject system. Other maintenance may include cleaning the camera lens or keeping the Arduino board coated in a non-conductive moisture repellant spray if not put inside a protective enclosure.

Health and safety aspects

Since there are only two moving parts on this project it is relatively safe as it is. However, the two parts that do move are the reject arm and the conveyor. The conveyor needs guarding to prevent fingers or clothing getting caught and the reject arm needs a guard that encloses the arm. This could be a clear plastic guard with a hole for product to travel through, pass the arm and come out the other side. However, this would not be necessary if the reject arm consisted of a flap on a stepper motor like in figure 4 shown below on page 7. As there would be nothing to get caught in.

Hazard signs need to be put in where the arm fires on the conveyor to warn operators as an addition. Then if the system is implemented onto the larger CIM system it will need to utilize the systems e-stops also.

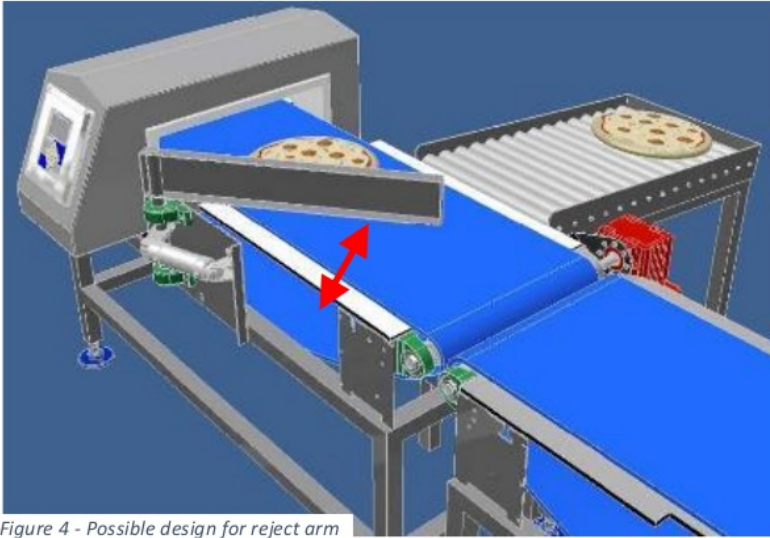


Figure 4 - Possible design for reject arm

A good diagram of reject arm on conveyor. This is the aim of the output form this system.

Environment and sustainability issues

The finished system will not require a large amount of electricity to run and will not produce any harmful bi-products. It is possible the system could be powered by an external solar panel if needed for a future upgrade or addition to promote sustainability and eco-friendliness.

A good possibility for the environment

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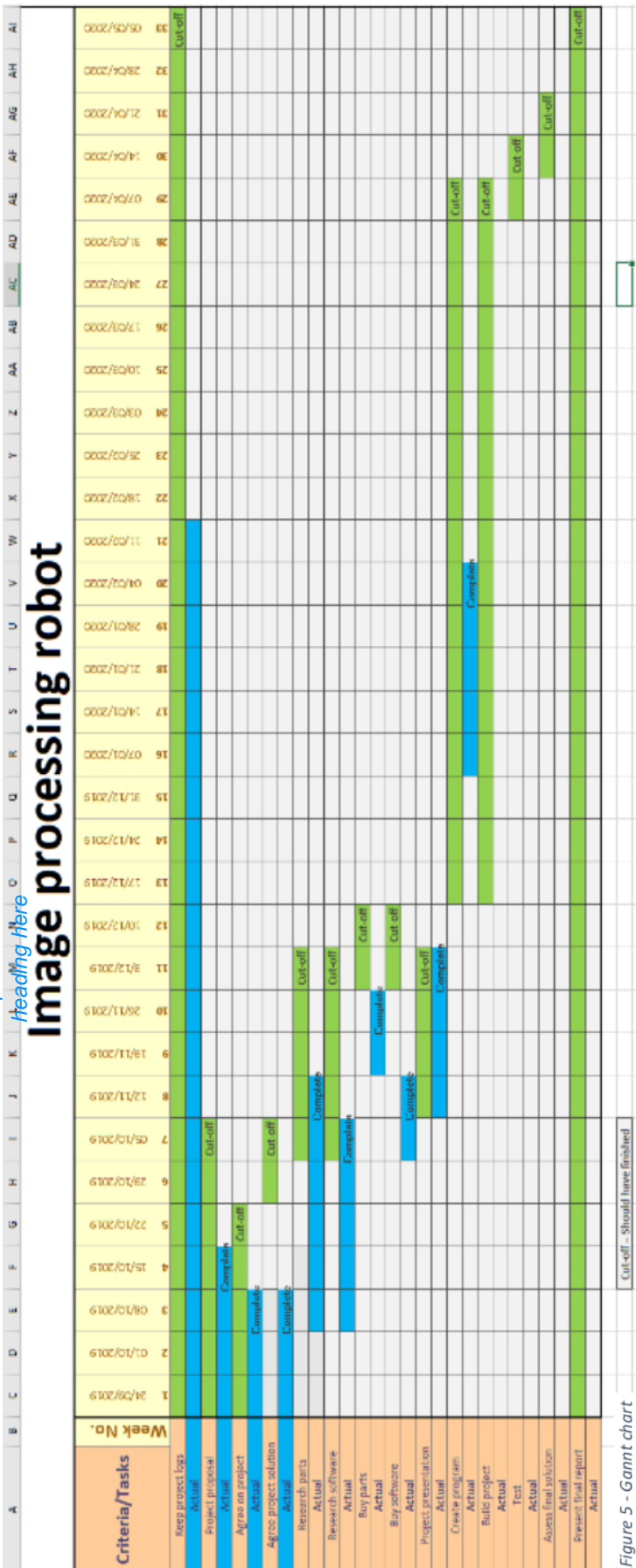


Figure 5 - Gantt chart

Good use of Gantt chart for comparison timelines.

Choosing a solution

Solution 1, OPC server:

The use of an OPC server would be highly effective given the current task as it would allow the user to make on-the-fly adjustments to the program as the machine is running meaning faults could be diagnosed and solved faster. Also, minor updates and additions to the software possibly to increase efficiency would be much faster compared to doing the equivalent task using an Arduino or a PLC. Also, it would mean that the program could talk directly to the components from the computer without a middleman such as a PLC or Arduino. However, in order to achieve this the computer used would need a specialized I/O to USB adapter so the components could be connected to it. That or the system would need to be set up to have wireless capabilities which would drastically increase costs. Additionally, I have never used OPC server software and thus, have no experience using it and for the system to function the computer will need to constantly be on with the OPC software running in order for the system to work.

The OPC server software is free to use but the WIFI adapters that would be needed if the software was to be used on its own to control the system would increase the cost dramatically. A wifi card for the system would cost in excess of £50 alone. Having the computer constantly on to power the system would mean the system would not be nearly as energy efficient and environmentally stable as it could be and would drastically increase running costs. WIFI is also not as reliable as a hardwired connection so interference from other electronic devices may be an issue which would severely impact reliability given the system needs the computer to remain connected at all times.

Solution 2, Arduino board:

Using an Arduino board would mean all the I/O for each component in the system like motor, camera, conveyor could all be connected on a board which could then connect via USB to a computer. This would mean the computer would not need an I/O adapter and if required, the Arduino board can be easily expanded using a shield to give it extra capabilities like WIFI or extra I/O or motor control. Using LabView software on the computer, the program for the Arduino can be easily created and plugins can be added to the software to allow the camera to work with it meaning the camera and the Arduino can be controlled using the same software program which will make the system far easier to create and work with and there will be no problems with getting the camera and Arduino to co-operate. Because the program is constructed and created with a drag and drop system and the wiring is represented by on-screen connections in LabView, it is very easy to understand and would be easy to teach in a classroom. This makes it perfect for achieving the aims of the project as well as meaning the program is easy to adapt and improve if future adaptations and improvements are to be done. The Arduino UNO currently costs a relatively small price of £30.

The only downside with this system is that the Arduino board would need to be mounted on the system in a safe way as it is fragile and if the system is to be implemented onto the CIM system it may prove difficult to get the Arduino to talk and communicate with the CIM systems PLCs. In terms of reliability, the program would be stored on the Arduino so a computer would not need to be constantly connected like the OPC server solution would. This means both energy efficiency and reliability are drastically improved at a much lower price compared to the PLC solution and OPC server solutions.

Solution 3, PLC:

With the use of a PLC such as the S7-1200, there would be more than enough I/O to satisfy the needs of the system and extra modules could be added to provide extra functions. The use of a PLC would mean that implementation into the CIM system would be far easier as both systems would use Siemens PLCs with the same software. So, the program could be incorporated into the program already in the CIM system stations PLC and the college already has Siemens TIA portal V15.1 on their computers so there would be more time to work on the project and less money spent on buying software. However, Siemens TIA software can be difficult to understand and learn on plus time consuming to use. This does not make it ideal as it can be difficult to understand since it is very complicated compared to LabView. Also, PLCs are very expensive to buy with the S7-1200 being £482 which would be way outside the budget that this project requires. The final issue would be with the camera. It would require a separate piece of software to work with the TIA portal program. This would complicate the system and make fault finding and creation far more difficult. The LOGO! 8 module is a toned down version of their smaller S7-1200 PLCs with a more user friendly layout. However, I have never used it, it remains far more expensive than the Arduino and is overkill for such a project.

Compared to the other two solutions the PLC and the LOGO! 8 are very expensive and the S7-1200 especially, could be considered overkill for the task. Both would require a cabinet or DIN rail to be mounted since they are very bulky and would draw far more power compared to the Arduino. Increasing both buying and running costs in comparison. As a result, these modules would be far less energy efficient and unnecessary when an Arduino could also do the job cheaper, more efficiently and with a smaller footprint.

Final solution and implementation

After careful consideration of each solution the decision has been made to go with the Arduino solution due to its low buying and running costs and the fact it is best suited for the task. The choice was also made since the Arduino can use LabView which is perfect for achieving the aim of creating a simple and easy to explain program which learners can understand. The Arduino board is also very expandable and easily customizable so the system can be built upon easily if needed.

How it works

With the use of a conveyor belt, Arduino, computer with LabView software, reject arm with motor and a webcam, a colour recognition and sorting system will be created. The camera will be mounted above the conveyor at the start and will recognise each coloured object and determine it as a reject or pass. Further down the line there will be a reject arm that will be timed to activate once a product marked for rejection reaches it. The arm will deposit it off the side of the conveyor into a reject bin. If passed the product will pass the reject arm and drop into a container. The system will be able to run without the need for constant input from a PC as the program will be stored on the Arduino in flash memory. However, in order to alter the setup and program the PC will need to be plugged in to the board and the updated program will then be re-downloaded to the board.

Creating the program

First I made sure I had the correct LabView plugins to enable me to use the webcam with LabView. This required installing add-ons such as Vision Development and NI-IMAQ, NI-IMAQ dx and NI-IMAQ I/O.

Avoid using first person terms

Why do you require these software extensions

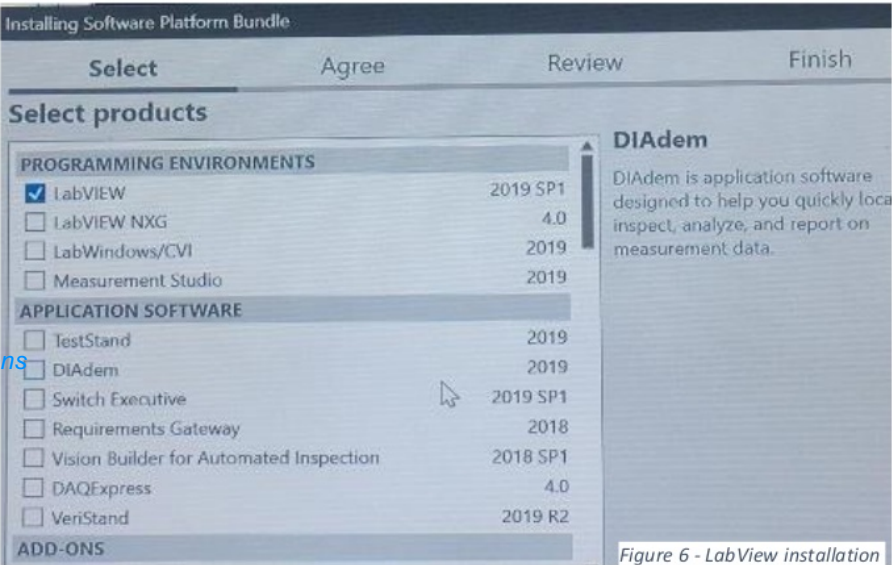


Figure 6 - LabView installation

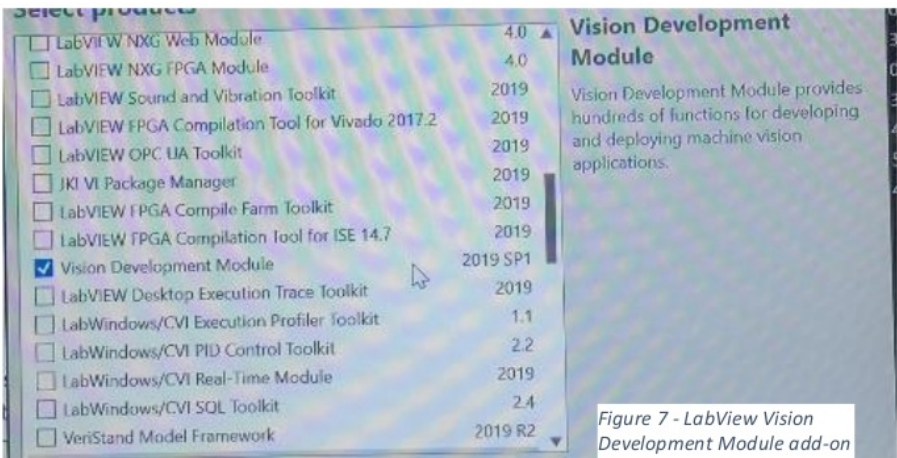


Figure 7 - LabView Vision Development Module add-on

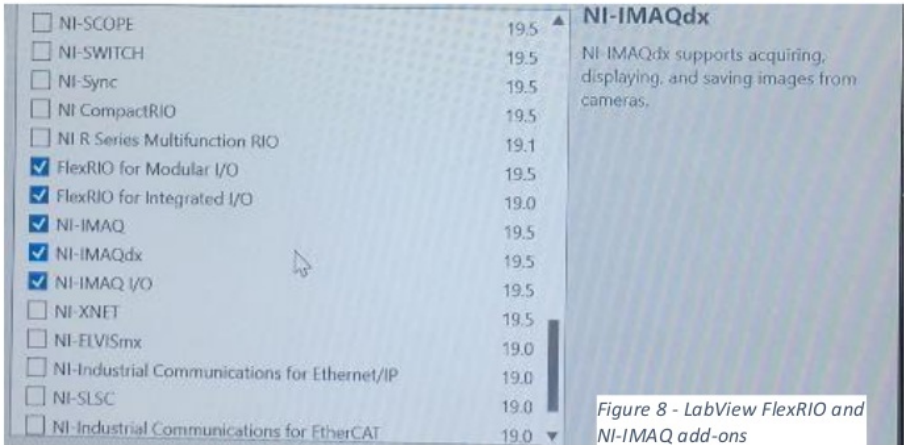


Figure 8 - LabView FlexRIO and NI-IMAQ add-ons

You should identify the need for the software.

Once installed, an on-screen window showing feed from the camera was inserted and a box as dragged onto the camera feed to determine the area in which the colour reading would be taken from. (shown in figure 9 page 12)

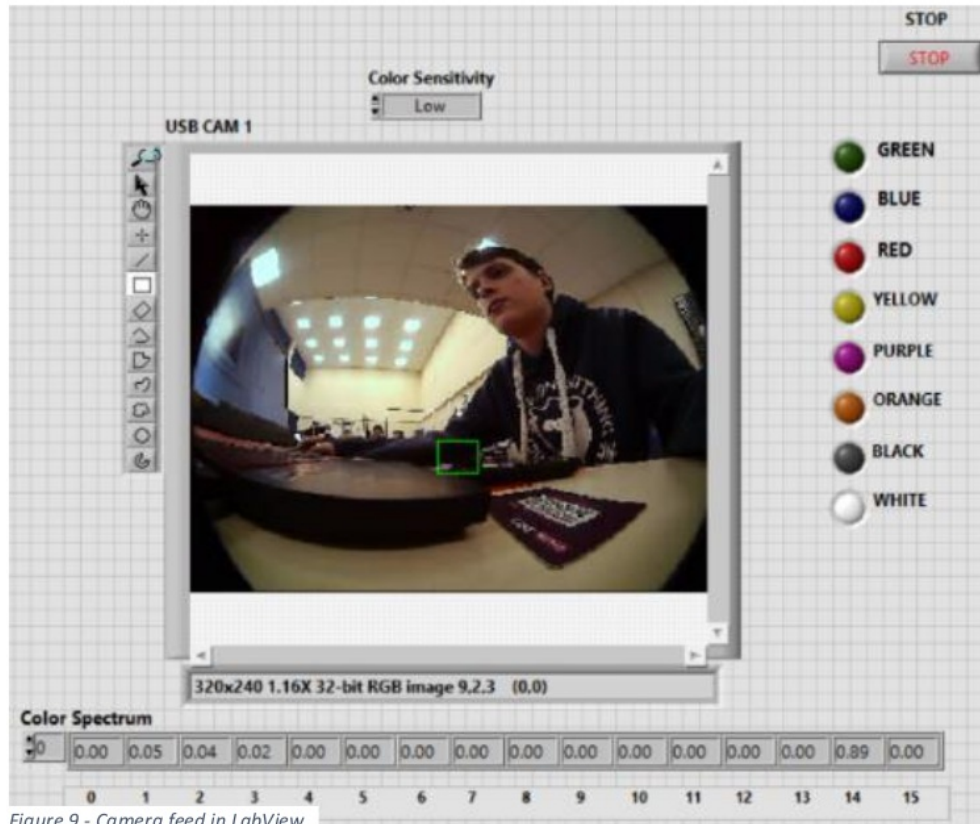


Figure 9 - Camera feed in LabView

Avoid first person terms

A colour spectrum registry was put underneath the window to show the RGB layout. This enabled me to test the recognition of each colour. In figure 9 the camera is recognising black on the camera and the on-screen indicator is lit up. (hence it appears grey) By putting different colours into the square, different parts of the colour spectrum registry would go “high” by doing this with each colour I could perform a calibration to allow each colour to activate the on-screen indicators. In order to set parameters for each colour, sensitivity and create the colour registry, the following screen (shown in figure 10 page 13) had to be created. The block diagram uses IMAQdx, USB CAM, colour spectrum, pilot light, range finder, colour sensitivity and index array blocks to create the functioning page. (shown in figure 9 page 12)

IMAQdx blocks allow the feed from the camera to be interpreted by the program. The feed then goes to the USB CAM 1 blocks which show feed on the operator page (figure 9) and set parameters for the size of the box which colour readings are taken from. The colour sensitivity and spectrum blocks allow the registry under the camera feed window to work. Finally, the index array connects all the range finder and pilot light blocks together in a network and allows parameters to be inputted so they can be calibrated.

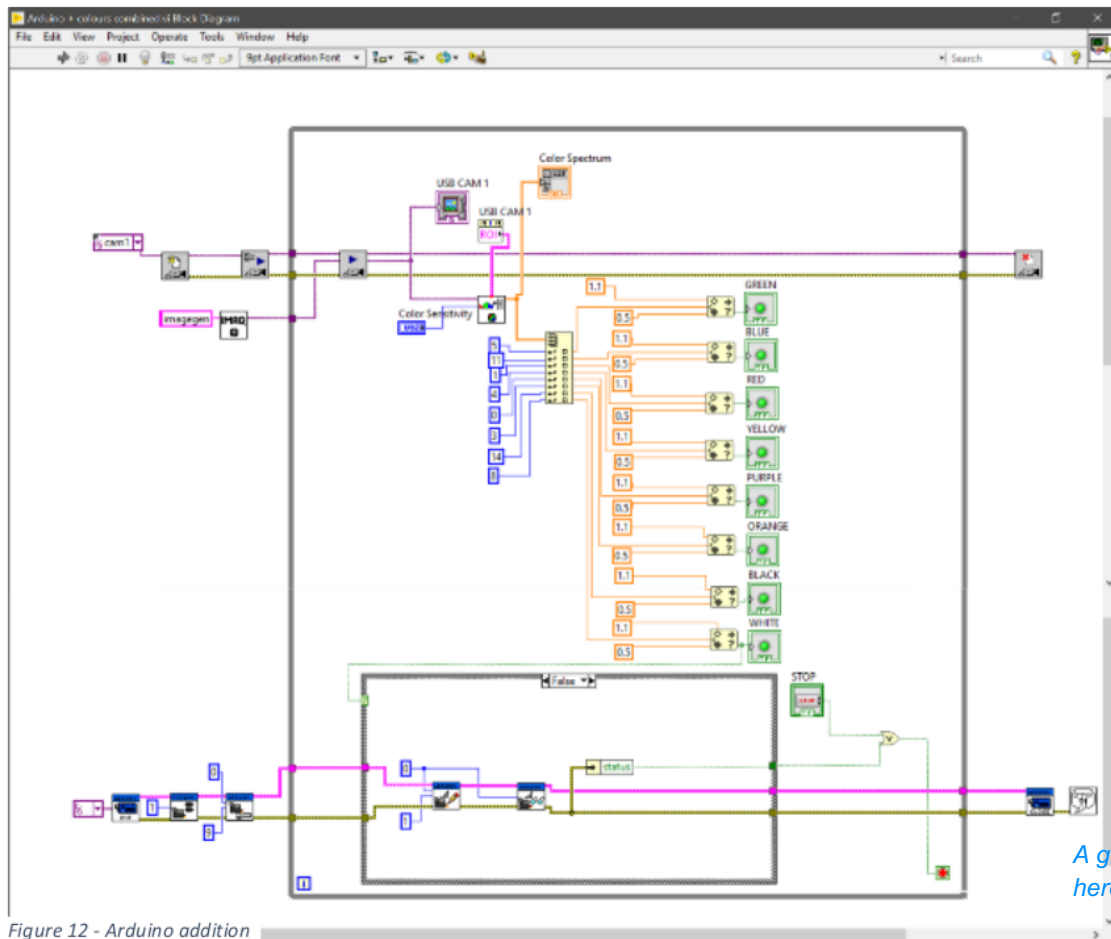


Figure 12 - Arduino addition

(figure 11 page 14) Above shows the additional case structure and Arduino blocks to enable the Arduino board to use the program and control the system functions depending on commands given by the program. The Arduino part was previously created on a different program for testing and then recreated in this one to ensure no mistakes were made and the two parts both worked correctly.

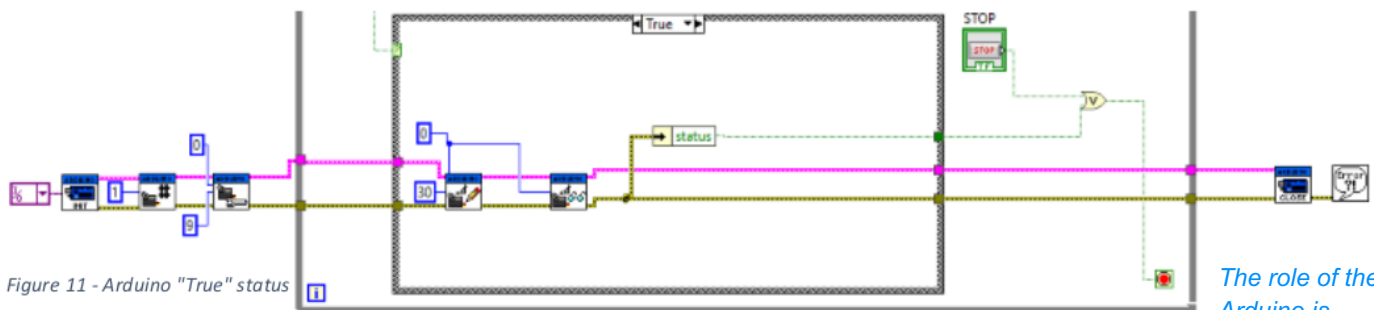
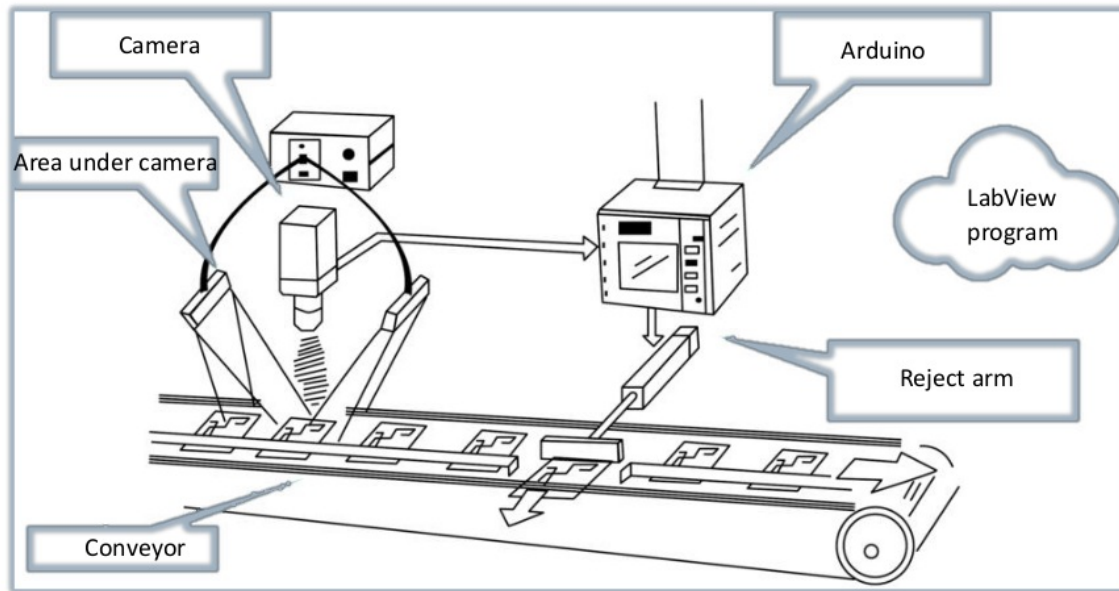


Figure 11 - Arduino "True" status

Above, (Figure 12) the true state for the Arduino is shown. In this state the camera has seen the correct colour and the product is passed. When it is false, the product is the wrong colour and it will be rejected.

Building the system



(Figure 13) Above represents the finished system and what it should look like.

A good illustration of the actual system

Recommendation

Since the project was to create a concept for a possible addition to the PLC driven CIM system in the college lab, it was decided that the PC would additionally have OPC server software installed. This would allow the PLC on the CIM system to control the project system as well and see how well the two systems

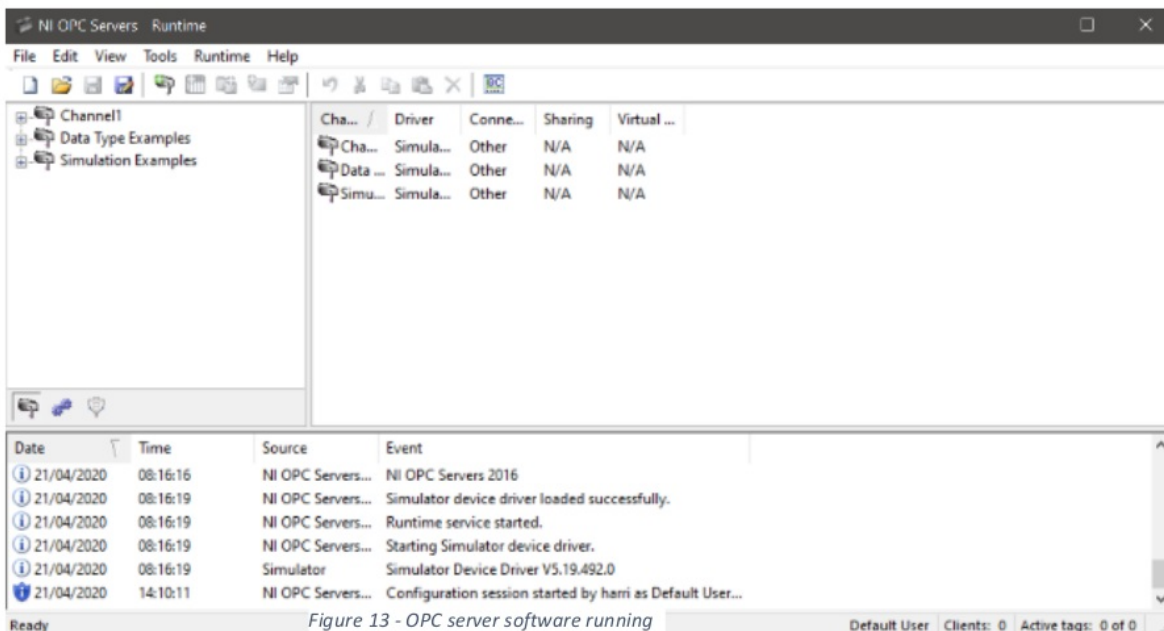


Figure 13 - OPC server software running

worked together. In order to do this the software was installed and setup on the PC ready to be tested at a later stage as it was not clear whether the Siemens PLCs on the CIM system would communicate with the Arduino board through the OPC server software. Shown in figure 13 (page 15)

Testing

Due to limitations concerning a worldwide pandemic (Covid-19), I was unable to build the system in the college. However, I was able to construct and test the program for the system which is the most important part of the project.

The two tests to be done involved a digital output drive test and a colour recognition test. To thoroughly evaluate the performance of the software.

Test 1: colour recognition

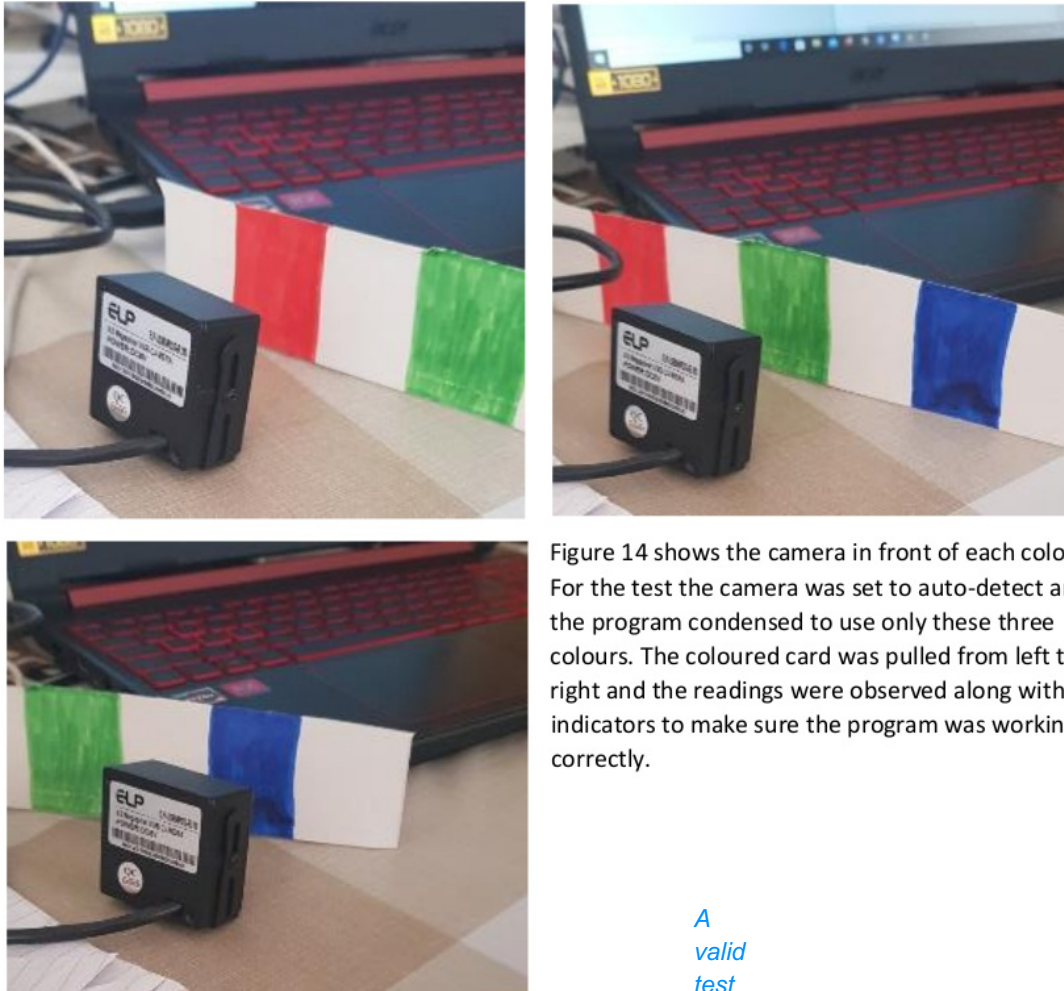


Figure 14 - Camera held in front of red, green and blue card

Figure 14 shows the camera in front of each colour. For the test the camera was set to auto-detect and the program condensed to use only these three colours. The coloured card was pulled from left to right and the readings were observed along with the indicators to make sure the program was working correctly.

*A
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the
system*

Red

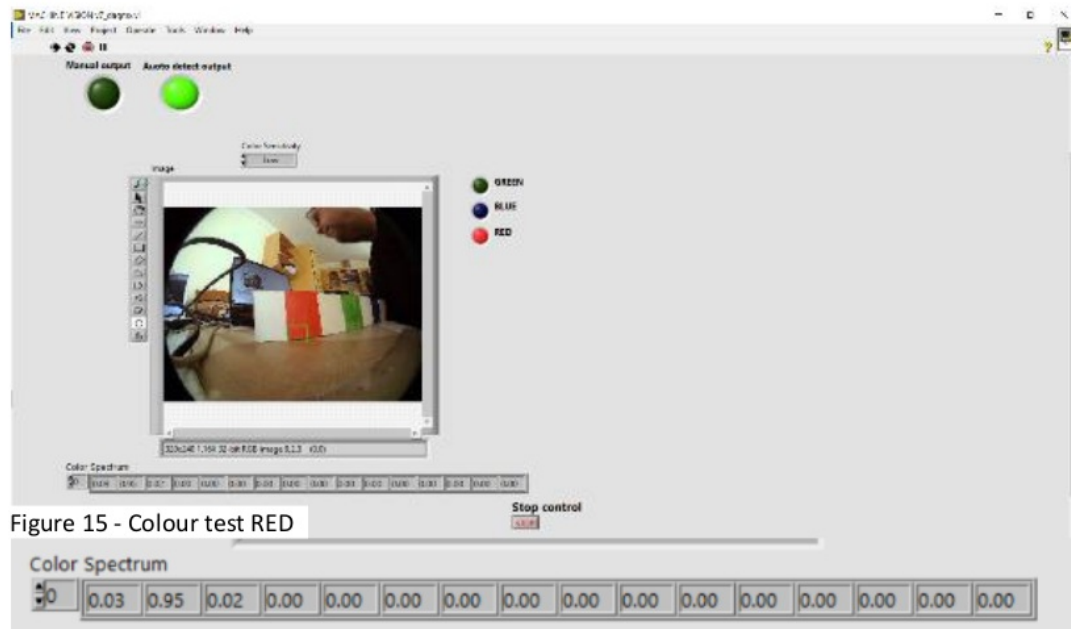


Figure 15 - Colour test RED

Once the on-screen detection box was on the red colour, the second box in the colour spectrum chart went high. This meant that the red indicator light came on, proving that the program successfully recognised the red colour.

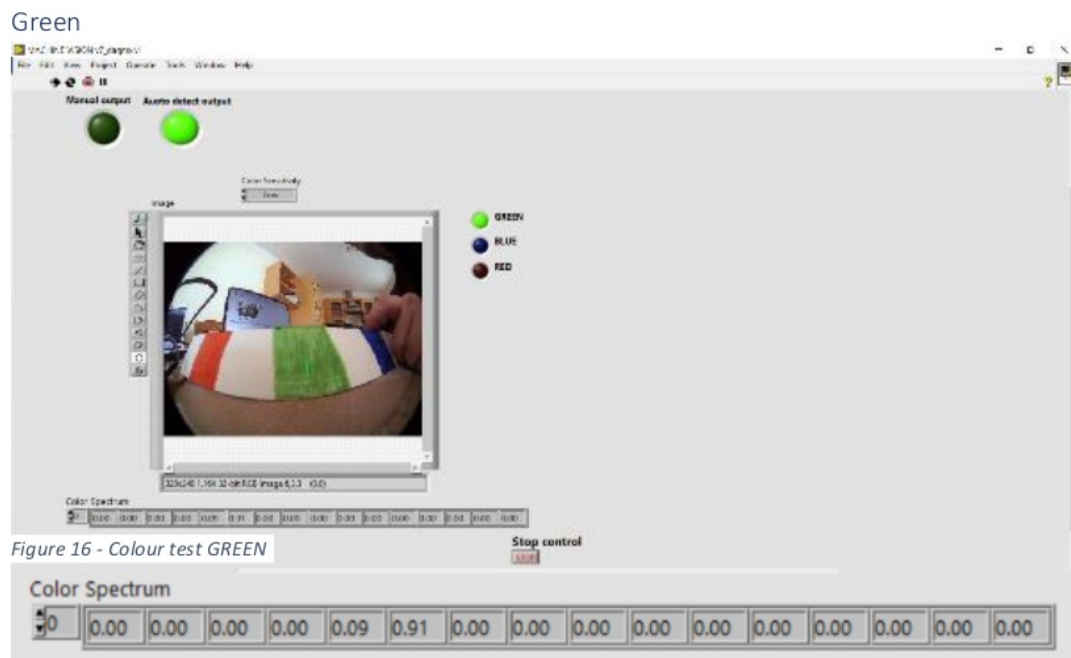
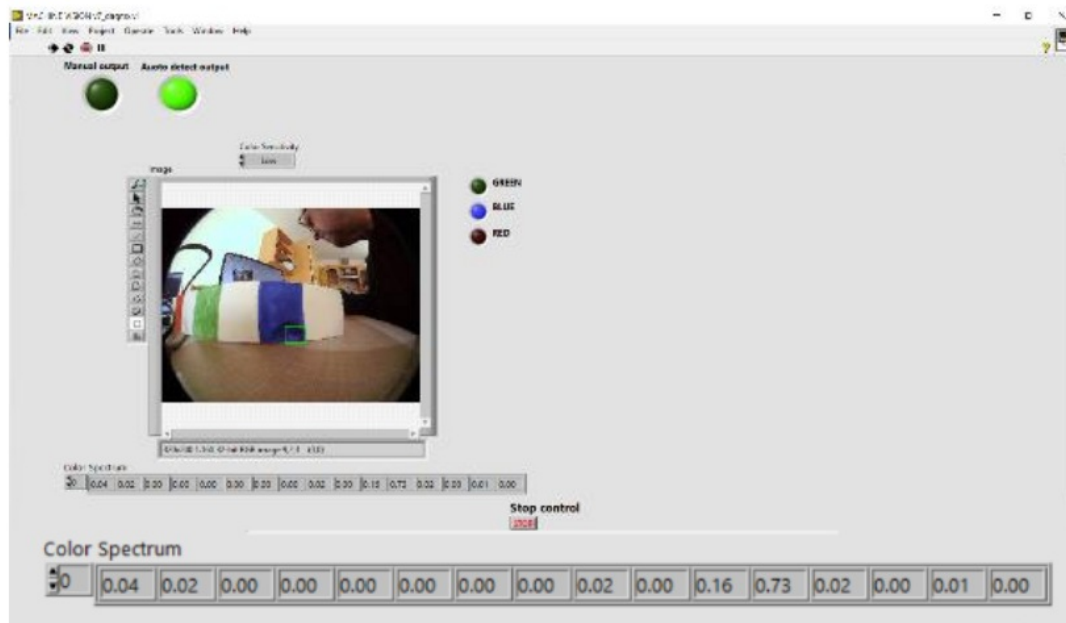


Figure 16 - Colour test GREEN

The coloured card was then slid along until the green colour was in front of the camera and the on-screen detection box was on the green colour, the sixth box along in the colour spectrum chart then went high. This allowed the green on-screen indicator light to come on, proving that the program successfully recognised the green colour.

Blue



Colour recognition tests are successful and the images provide good evidence.

Finally, the coloured card was then slid along until the blue colour was in front of the camera and the on-screen detection box was blue. The twelfth box along in the colour spectrum chart then went high. As a result, the blue on-screen indicator light came on, proving that the program successfully recognised the blue marker colour.

Digital output drive testing with alternative methods

Three alternative digital output drive methods were also tested with the LabView software. For each, a separate sub-circuit was created using LIFA, DAQ and VISA program blocks instead of Arduino ones to create an on-off button. The test involved making sure the circuits activated a simulated digital output. The simulated output was an on-screen indicator on the home screen. The indicator also switched the selected digital output on or off.

However, not all the prototypes worked perfectly. The DAQ prototype performed the best as the others gave intermittent readings. This could partly be because the DAQ method is fully supported by National Instruments whereas the other two are not.

Prototype LIFA test

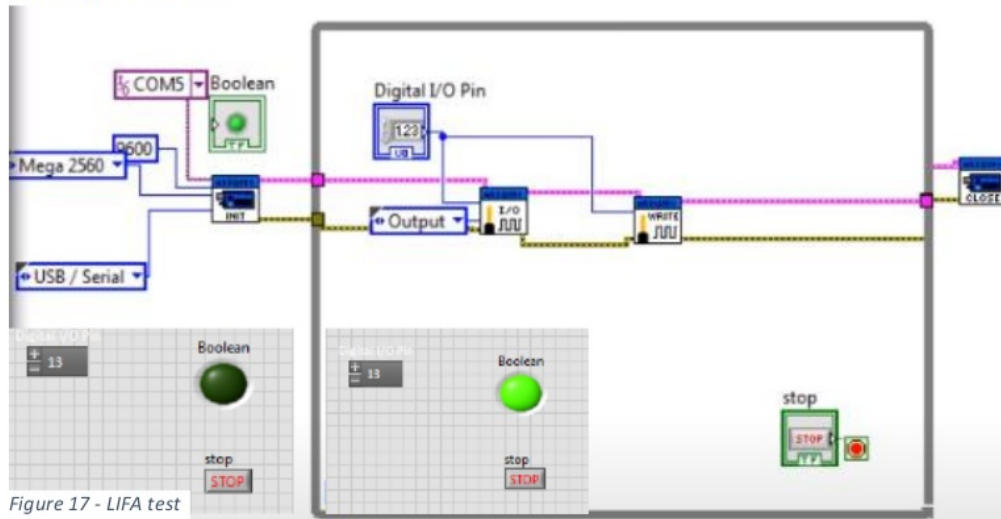
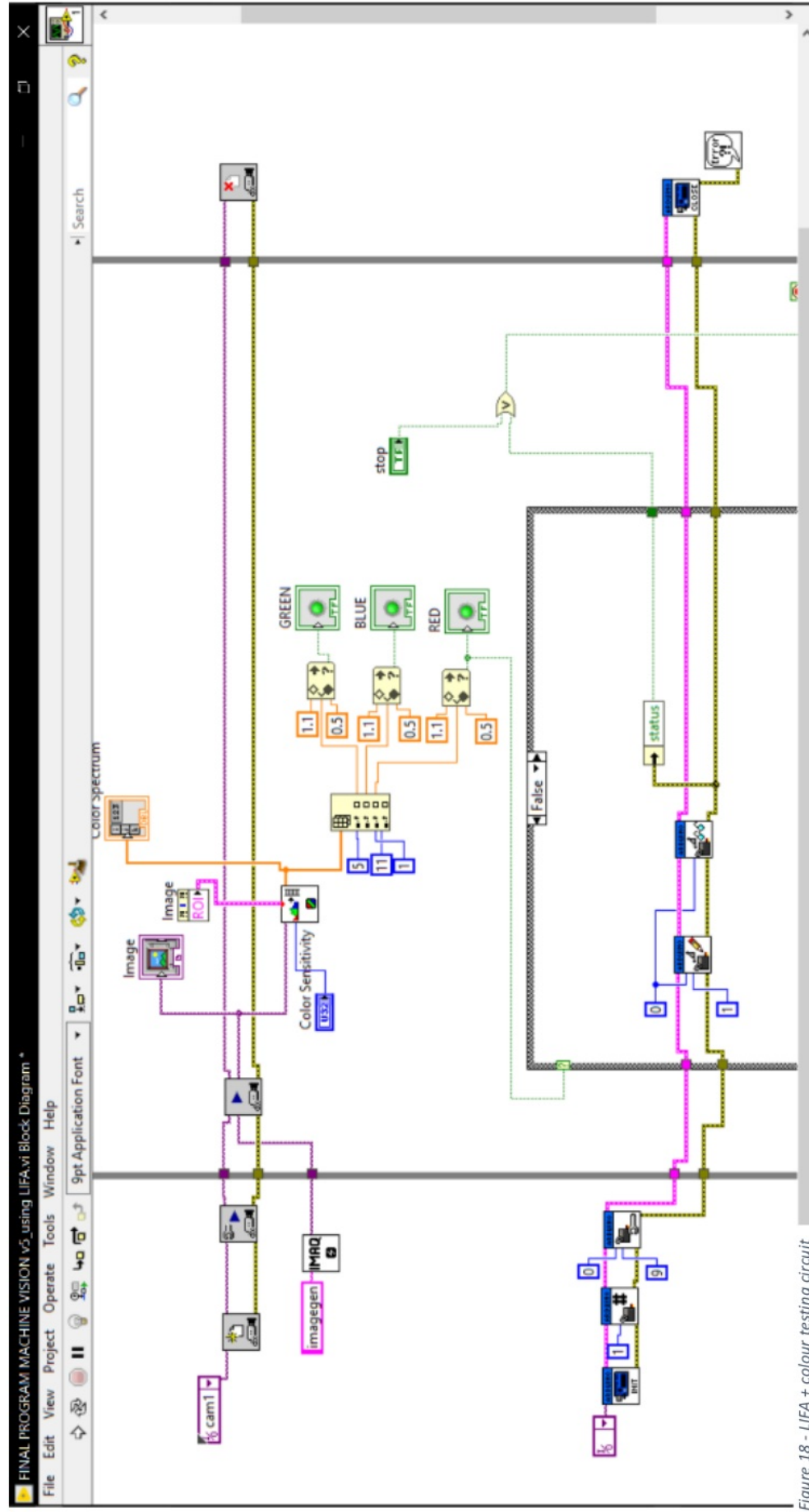


Figure 17 - LIFA test

LIFA is (Labview Interface For Arduino) and as a result, uses Arduino blocks. Figure 17 shows the sub-circuit with the indicator in the on and off state representing the digital out.

Figure 18 (page 21) shows the LIFA sub-circuit integrated into the same circuit used for testing the colour recognition.



Prototype DAQ test

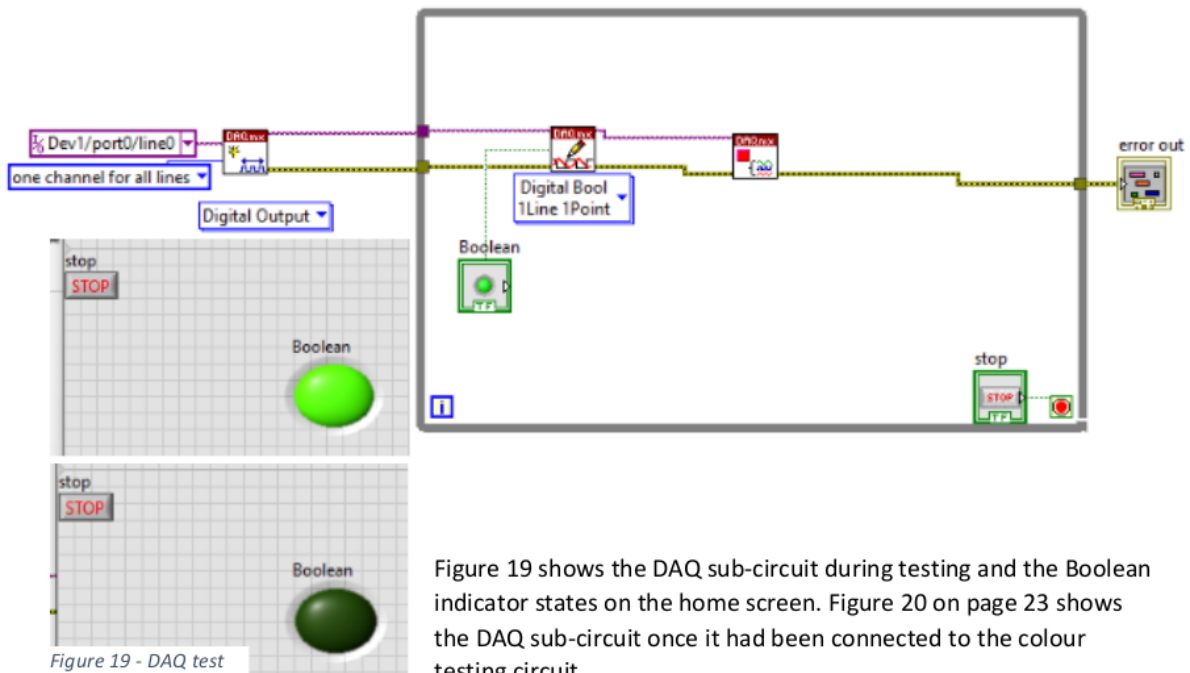


Figure 19 shows the DAQ sub-circuit during testing and the Boolean indicator states on the home screen. Figure 20 on page 23 shows the DAQ sub-circuit once it had been connected to the colour testing circuit.

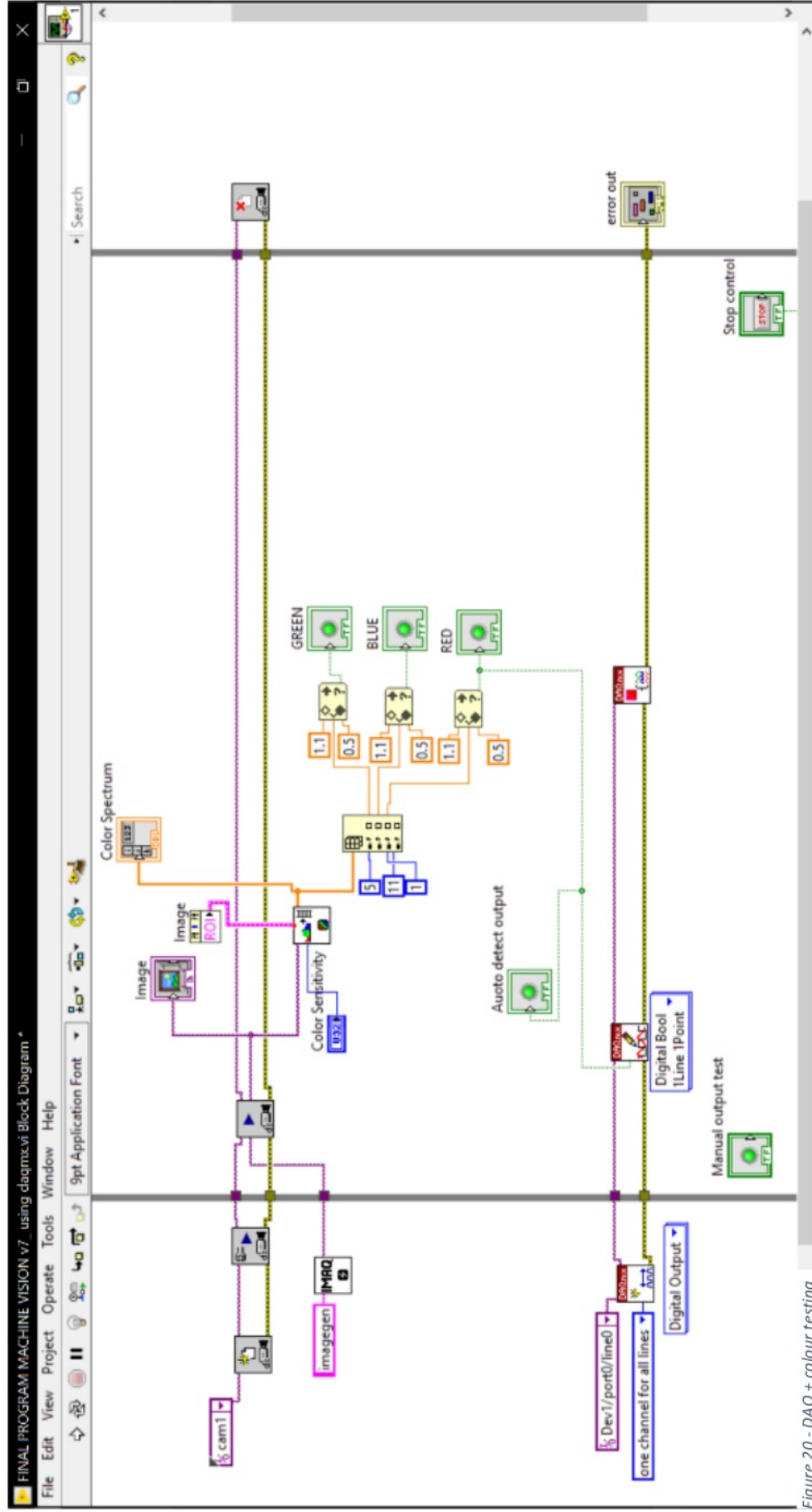


Figure 20 - DAQ + colour testing

[illegible]

Figure 21 - Visa test

Figure 21 shows the VISA sub-circuit with the Boolean indicator states which represent the digital outputs. Figure 22 (page 25) shows the VISA circuit combined with the colour testing.

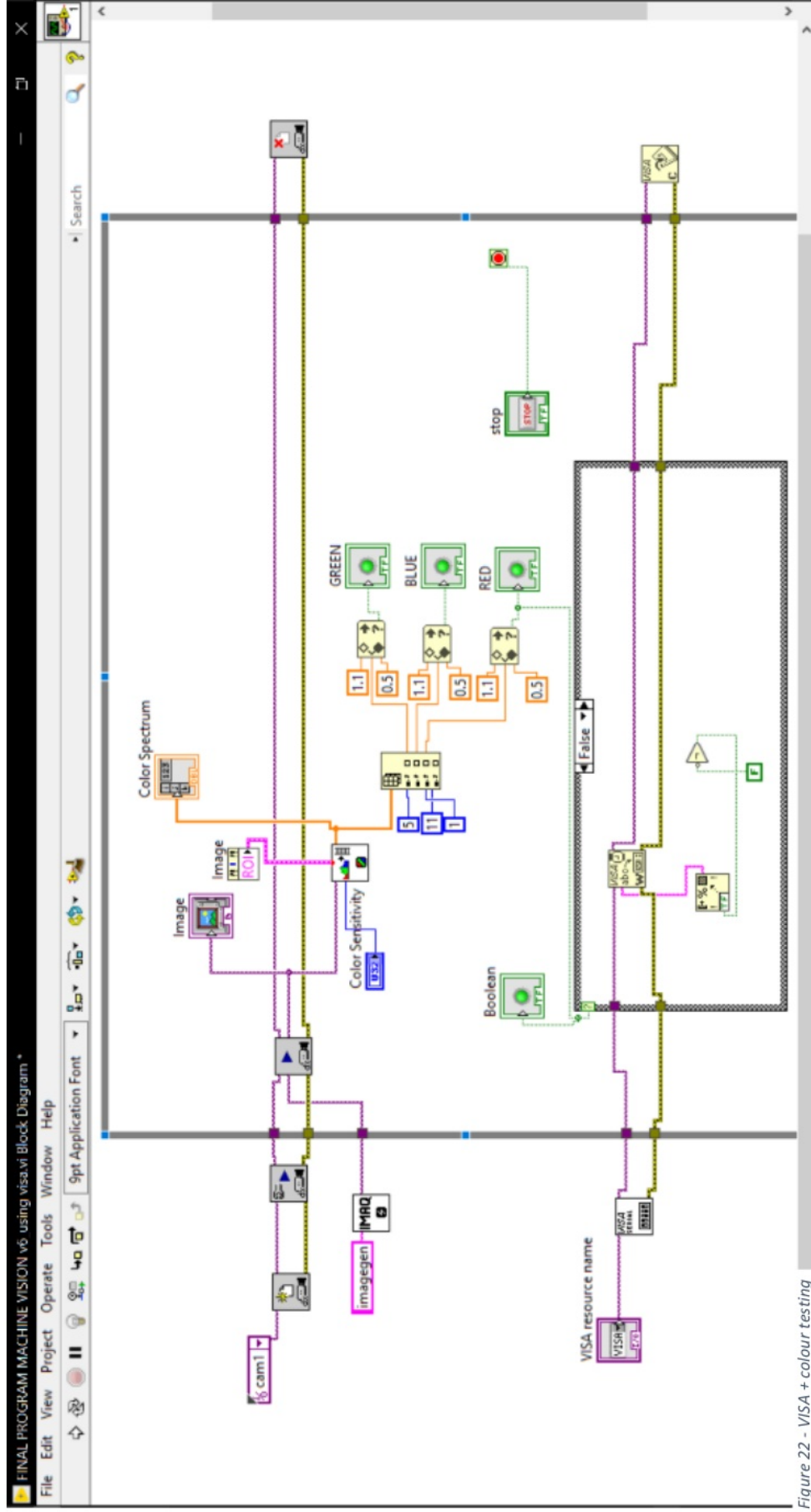


Figure 22 - VISA + colour testing

A good test to realise the best and most reliable digital output drive method from the three possibilities.

Results

Table 1 - Testing

Tests:	Expected results:	Actual results:
Colour recognition (RED)	Once camera sees the colour, the on-screen indicator for red should come on.	On-screen indicator for red lit up once the colour search box and software identified the colour in front of the camera.
Colour recognition (GREEN)	Once camera sees the colour, the on-screen indicator for green should come on.	On-screen indicator for green lit up once the colour search box and software identified the colour in front of the camera.
Colour recognition (BLUE)	Once camera sees the colour, the on-screen indicator for blue should come on.	On-screen indicator for blue lit up once the colour search box and software identified the colour in front of the camera.
LIFA prototype	When activated, the digital output simulated by the home screen indicator should come on. Signifying a digital output.	Once activated, the simulation worked but there were issues and the results were unreliable because the method is not fully supported.
DAQ prototype	When activated, the digital output simulated by the home screen indicator should come on. Signifying a digital output.	Once activated, the home screen indicator lit up and went off again once the circuit was deactivated.
VISA prototype	When activated, the digital output simulated by the home screen indicator should come on. Signifying a digital output.	Once activated, the simulation worked but there were issues and the results were unreliable because the method is not fully supported.

Conclusions

Avoid the use of first person terms

Once the project was successfully completed, I notified my tutor (since the project was based in college). However, due to the Covid-19 outbreak I was unable to build and fully test the project. Therefore, only the program could be built and tested since the college was closed and I was told to do as much as I could from home. This turned out to be the biggest problem in the project.

To conclude, this project was as successful as it could have been given the current situation. The biggest part of the project was always going to be constructing and testing the program, so it was a relief that I was still able to do this from home. After the initial research was done it was clear to me which of the three options would prove to be the best. I believe that despite the setback created by the college having to be closed this project can still be a success. The program works and is ready to be loaded into a system and the specification has been met as far as the software is concerned. Throughout the project despite the setbacks I have persevered and completed it to the best of my ability and the outcome is as good as it can be.

This is more of a personal opinion than a conclusion

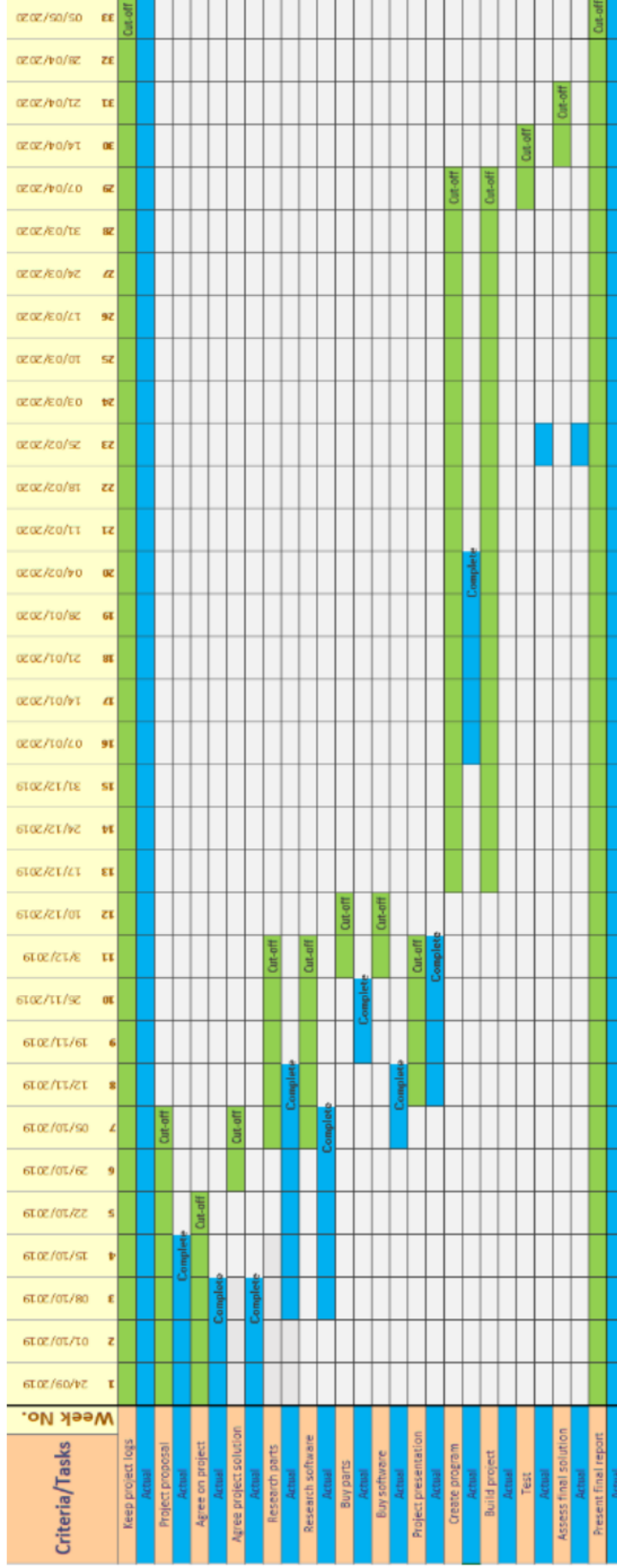


Figure 23 - Completed Gantt chart

Works Cited

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<https://opcdatahub.com/WhatIsOPC.html>
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<https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo.html>
- Sparkfun. (2020, 04 16). *What is an Arduino?* Retrieved from SparkFun:
<https://learn.sparkfun.com/tutorials/what-is-an-arduino/all>

*Good sources
used.*

Extra images

<https://www.bing.com/images/search?view=detailV2&id=46E523B87861073076333EB10E20DBC7174B914A&thid=OIP.632QVMUmdtw3yko32APbrAHaFc&mediaurl=https%3A%2F%2Fcdn.sparkfun.com%2Fassets%2F9%2F1%2Ffe%2F4%2F8%2F515b4656ce395f8a38000000.png&exph=405&expw=551&q=arduino&selectedindex=40&ajaxhist=0&vt=0&eim=0>

https://www.bing.com/images/search?view=detailV2&ccid=MBWZ8Yn0&id=34C7AC5A38F42187E348572B310D628D4C0FC7D6&thid=OIP.MBWZ8Yn0FdkWqaowTqYqxAHaID&mediaurl=http%3a%2f%2fmedia.rs-online.com%2ft_large%2ff8251644-01.jpg&exph=444&expw=408&q=siemens+logo+8&simid=608010404891853698&selectedIndex=4&ajaxhist=0

https://www.bing.com/images/search?view=detailV2&ccid=exM813c5&id=CDDA6AC0DB8E33D01436ED85475F03657CC8C673&thid=OIP.exM813c5fj4m1FcHm0IA2gHaEK&mediaurl=https%3a%2f%2fi.ytimg.com%2fvi%2fn2ra_aA89iQ%2fmaxresdefault.jpg&exph=720&expw=1280&q=conveyor+reject+arm+cov er&simid=607986048144311152&selectedIndex=10&ajaxhist=0

Appendix

FINAL GRADE

GENERAL COMMENTS

Instructor**50**/100

PAGE 1

PAGE 2

PAGE 3

Text Comment. Table of contents is good and gives details of the contents

Text Comment. Table of figures is good and appropriate for the project

PAGE 4

Text Comment. You must avoid first person terms

PAGE 5

Text Comment. This section needs a heading such as output driver for system. These are possible system solutions for the digital output to the image system.

Text Comment. Good diagram of the OPC based system

PAGE 6

PAGE 7

Text Comment. The research here is fine , but what are the purposes of these three solutions because none of these will do the image processing without third party equipment and software.

Text Comment. The specification is mainly about the image process and an output driver integrated into the image system. This needs to be clearly identified. Your explanation is a little vague.

Text Comment. A good diagram of reject arm on conveyor. This is the aim of the output form this system.

Text Comment. A good possibility for the environment

Text Comment. There should be an explanation and heading here

Text Comment. Good use of Gantt chart for comparison timelines.

Text Comment. The camera would have to be a Smart Camera which would drive up the costs considerably.

Text Comment. These explanations here are far to long. The point of the solution has become vague . Far fewer word need to be made to get the point across.

Text Comment. You must be clear in what the purpose of the Arduino is here.

Text Comment. This should be a test in a table form or flow chart. There are too many words used and is confusing the point.

Text Comment. Avoid using first person terms

Text Comment. Why do you require these software extensions

Text Comment. You should identify the need for the software.

Text Comment. Avoid first person terms

Text Comment. The LabVIEW program is good and you have extended the colour rage index array.

PAGE 16

Text Comment. A good explanation here

Text Comment. The role of the Arduino is identified here

PAGE 17

Text Comment. A good illustration of the actual system

PAGE 18

Text Comment. A valid test for the system

PAGE 19

PAGE 20

PAGE 21

Text Comment. Colour recognition tests are successful and the images provide good evidence.

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

Text Comment. A good test to realise the best and most reliable digital output drive method from the three possibilities.

PAGE 28

Text Comment. Avoid the use of first person terms

Text Comment. This is more of a personal opinion than a conclusion

Text Comment. Good sources used.

GRADING FORM: CSG-RUBIC

**RICHARD
HARRISON**

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RESEARCH-INFORMED LITERATURE



The research carried out is appropriate and there are some good points. 6.5/10 Good relevant sources used 6.5/10

13/20

KNOWLEDGE AND UNDERSTANDING



Specification could be clearer but you have included costs in the options only for the output driver. There is no costing for the smart camera or LabVIEW. 5/10 The solutions considered are mainly for the output driver. There is not much about the smart camera needed for the PLC option. Your explanations are vague in parts. You seem to have missed the fact that the LabVIEW is an option for the image process and a smart camera would be other option. Therefore only the minor part of the project bis

9/20

considered for alternatives. 4/10

ANALYSIS



Testing and results are good and clearly explained. There is sufficient detail in this section. However you have left out the part where the RGB needs to be converted to HSL spectrum. 6/10 Conclusion and recommendations are more of an opinion rather than points about this method of testing. 3/10

9/20

PRACTICAL APPLICATION AND DEP.



Planning with the use of a Gantt chart and a comparison chart is clear and the project seems to have run to the plan. However you have not explained the chart and should at least give a heading for the planning part. 3/5 Final solution considered should have explained the LabVIEW relevance and the alternative to this. This should have been the main focus on choosing solutions for the project. 4/10 Implementation is explained but you have not explained the software. 5/10

12/25

SKILLS FOR PROFESSIONAL PRAC.



There are parts of the project missing in the report and some of the report is in disarray. Part of the report gives the impression that your focus was lost. There are many grammatical errors and overuse of first person terms. 7/15

7/15