IAgrE Student Awards

NOMINATION SUMMARY

Student Project Award*
Safety Award*
***please delete as appropriate:**

PROPOSER: (usually Course Director/Head of Department)

Name: Rhys James

Position: Level 3 Course Director

University/College:
ColegSirGar
Gelli Aur Camps,
Home Farm
Golden Grove
Camarthen
SA32 8NJ

Contact details:	**Tel:01554748583**	**Email: rhys.james@colegsirgar.ac.uk**

DETAILS OF NOMINATION:

Name of Student/Group of Students: Dylan Vaughan

Personal contact details (i.e not college) to enable us to contact the student(s) once their course has ended:

Bwysfa Fach, Trecastle,Brecon	07939259188	**Email:** Dylanwv24@outlook.com

Name of course studied: Level 3 City and Guilds Extended Diploma in Land based Technology

Period studied	**From: September 2024**	**To: July 2026**

Qualification to be gained:
180 Credit Extended diploma

Project Title: Electronic Trailer Braking Safety System

Details of material submitted with nomination: (Project/Exec Summary/videos etc)

PowerPoint presentation

SIGNED BY PROPOSER: DR James	**DATE SUBMITTED:** 18/09/26

If you wish to provide any additional information to support this nomination, please do so in a covering letter. When complete, return this form, together with the supporting documents, to

The Secretariat, IAgrE, The Bullock Building (Bldg 53), University Way, Cranfield, Bedford MK43 0GH
secretary@iagre.org

NB All work submitted is treated with complete Confidentiality; no part of the paper will be published by IAgrE except for the Title and Name of the winner in each category.

Land based technology level 3 year 2 2025/26 Project

By Dylan Vaughan

Background

My name is Dylan Vaughan

Im 18 years old and I'm from Trecastle where I live on a family run beef and sheep farm.

I studied at Ysgol Gyfun Ystalyfera where I did my GCSEs that lead me to study at Gelli Aur college L3 Agri engineering.

In my free time I work for other farms and also we repair machinery at home.



Aims and objectives

The Aim for this project is to either create something new within the industry or to improve the design and incorporate health and safety Also environmental issues.

We must come up with 4 concepts and score them to come up with the best concept that we are able to manufacture in the workshop and present it to a panel of judges.



Research



Having experienced an issue with a machine at home first hand and began thinking of a way to improve.

I also researched while attending big agricultural shows such as Royal Welsh 2025, Lamma 2025 and Agritechnica in 2025. These shows gave me a good insight and a range of different perspectives.

I also discussed with Family, friends, work colleagues and tutors having experience in the industry in order to gain good advice.

Lastly, I have looked online to have a broader perspective on things and also reading agricultural magazines etc.

Previous concepts

My first idea was a cage transporter that attaches to a tractor or telehandler. It has four sections for carrying ewes and lambs or one larger space for calves. It is easier to use in sheds than a quad trailer and can also be used in fields to move animals. The cage has gates for easy access and a drop-down floor for simple cleaning. It can also carry feed, fencing materials, and other items, making it useful all year round.



My second Idea is to fit wireless cameras to tractor front loaders. Large tractors often have poor visibility, making it difficult to line up and attach implements. The cameras would display a live view on a screen inside the cab, reducing the need to get in and out of the tractor. They could also help when using a bucket or levelling work. This design would be especially useful for older farmers by making jobs easier, safer, and more efficient.



Pwysau / Weighting

The highest score will get chosen.

Concept	Production cost	Operator hazard reduction	Development / Production time	Complexity	Quantity of usage	Average score
Wireless camera	6	4	6	4	5	5
Cage transporter	2	3	2	3	4	2.8
Electric Trailer brakes	5	5	8	5	9	6.4

Chosen concept (Electric trailer brakes)

Electric Trailer brakes.

Can be retrofitted to all current manual systems.

Brake light activated.

Current system remains in place.

Can be removed easily in 5 minutes.

Improves safety as gives braking in all directions of travel and all terrains.

Accelerometer activated too as backup for sudden slowing down ect.

Advantages



Can be fitted to any trailer without modifying.

Works alongside current system meaning there's always a backup.

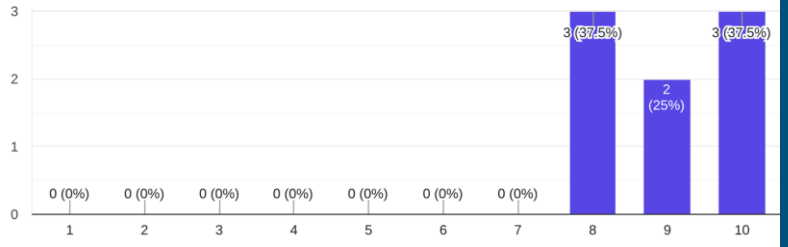
If the lights were to unplug unexpectedly (trailer disconnect) the brakes are activated.

If there's lost brake light signal it still works off the accelerometer.

Electronic actuator has safety feature meaning it works on for 5 and off for 1 this is to ensure the motor doesn't burn out.

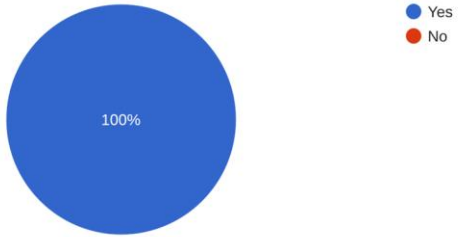
How likely would you be to install this system on your trailer?

8 responses



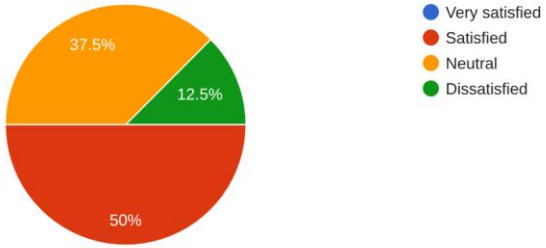
Do you think electronic trailer brakes would improve overall road safety?

8 responses



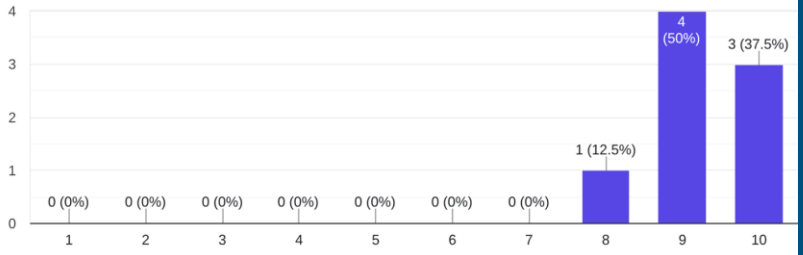
How satisfied are you with the braking performance of your current trailer?

8 responses



How useful do you think this braking system would be?

8 responses



Issue to overcome/ Justification of the idea

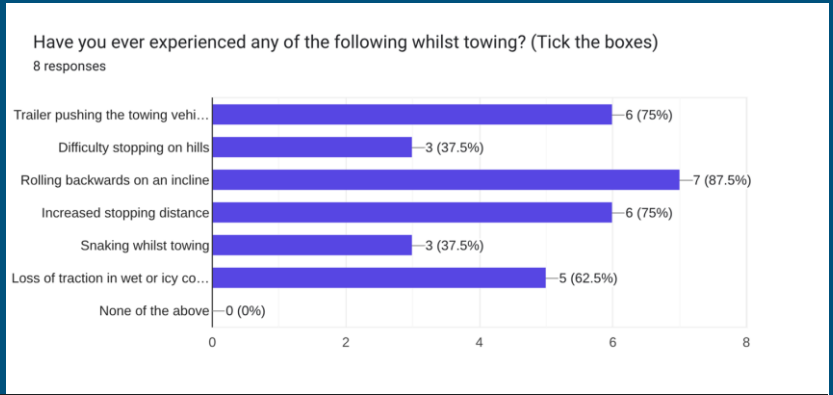
From personal first hand experience at home when getting pulled backwards down a hill with no trailer brakes due to the manual system.

This idea Targets agricultural, construction and caravans. Any trailer

An average of 4000 incidents including trailers happen every year.

This graph from my questionnaire shows the percentage of trailer users that have experienced issues.

https://www.motor1.com/news/351308/trailer-accidents-safety-uk-motorways/?utm_



Figures from Highways England, the government-run company in charge of the country's motorways and major A-roads, said around 4,000 accidents a year involved trailers of one description or another. That's an average of just under 11 per day.

- 16,705 incidents involving towed vehicles were recorded between 2022 and 2024
- Incidents increased by 16 percent over this period
- Trailers were involved in 45.2 percent of cases, caravans in 32.3 percent and horseboxes in 21.9 percent

This concept will help provide safer towing and prevent unwanted accidents.

Especially now that anyone can tow a trailer without a trailer licence and good experience this concept is extremely helpful to them.

Nearly every farmer own a trailer let alone caravans and construction businesses ect If this concept can help save someone's life then it's done a good job.

What's on the market

I have searched online and also spoken to my local trailer centre and there are no similar products to this on the market.

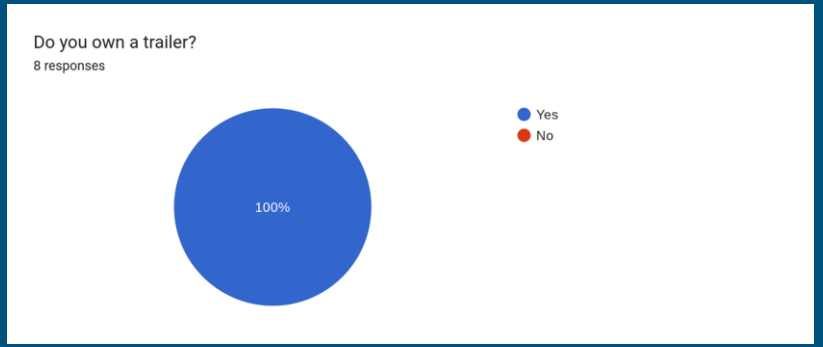
Targed Farchnad / Target market

The target market of this concept is very broad.

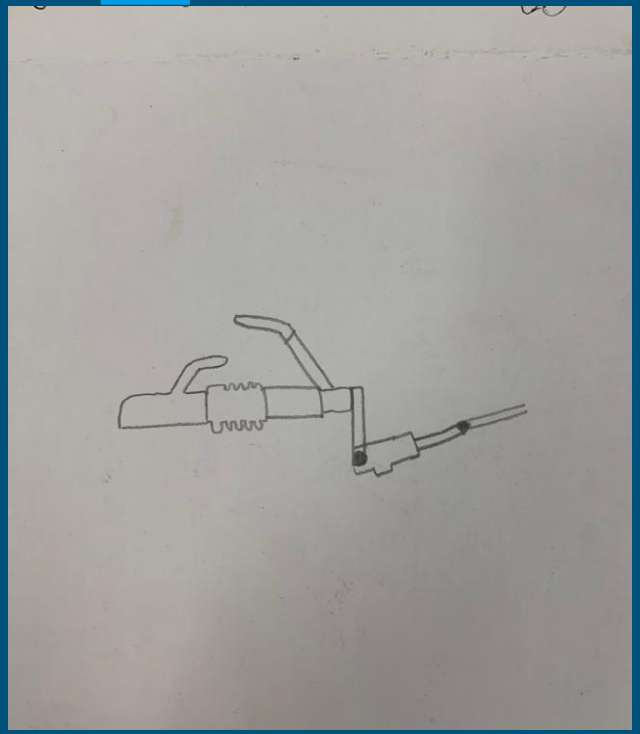
Target market includes Farmers, Construction companies, caravan owners, horsebox owners anybody that owns a trailer.

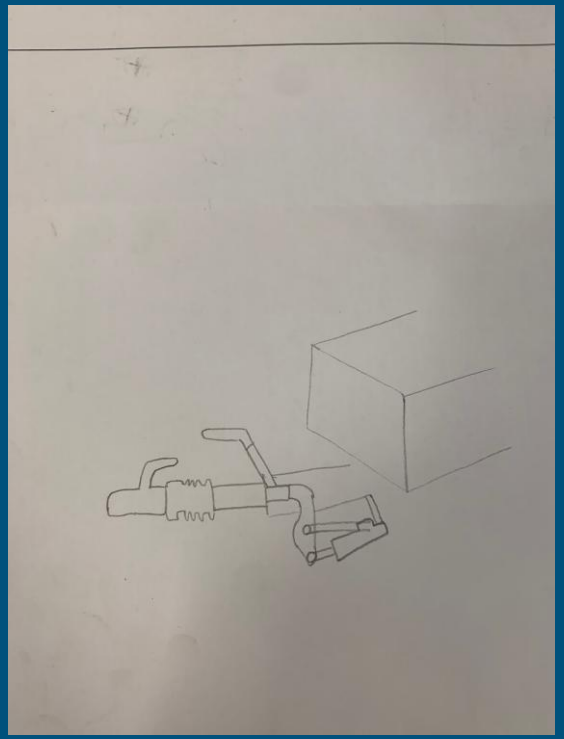
I have shown that this concept can be retrofitted to Ifor Williams trailers but it targets a much larger market.

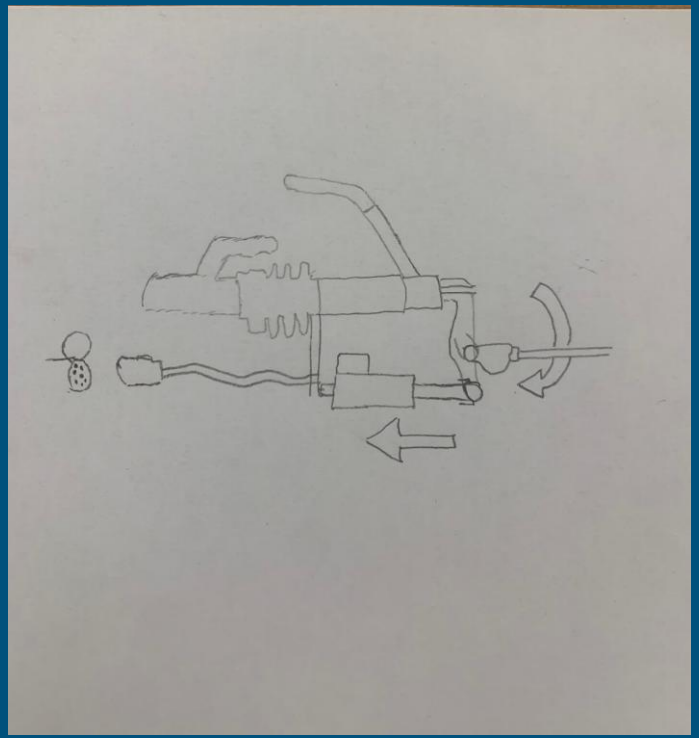
This concept can be fitted to all types of trailers such as Nugent, Brian James, Gamic and Graham Edwards.



Different designs

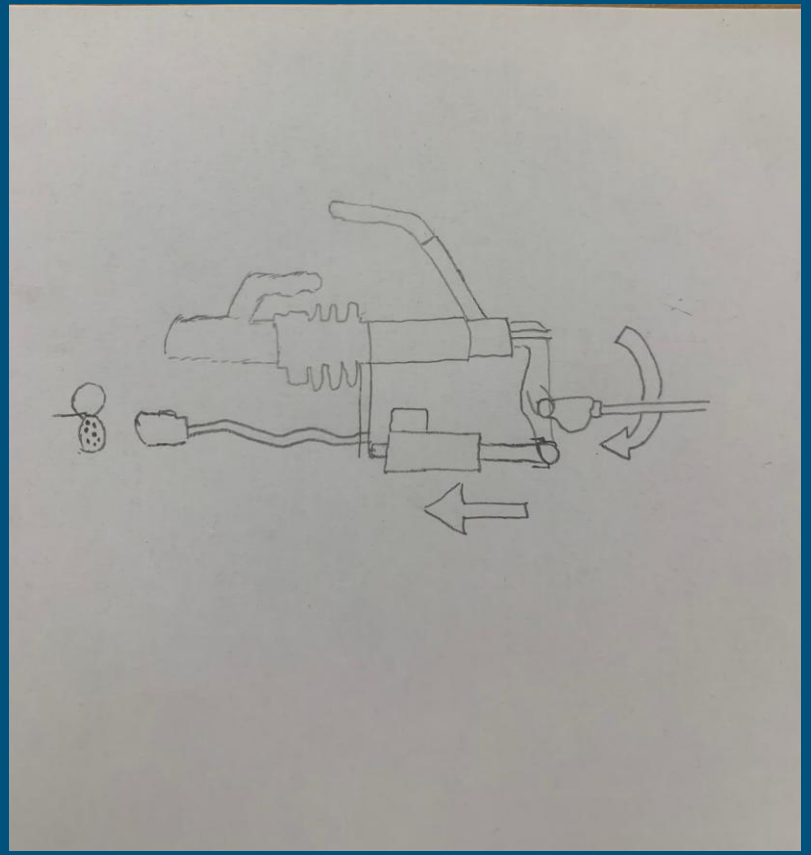






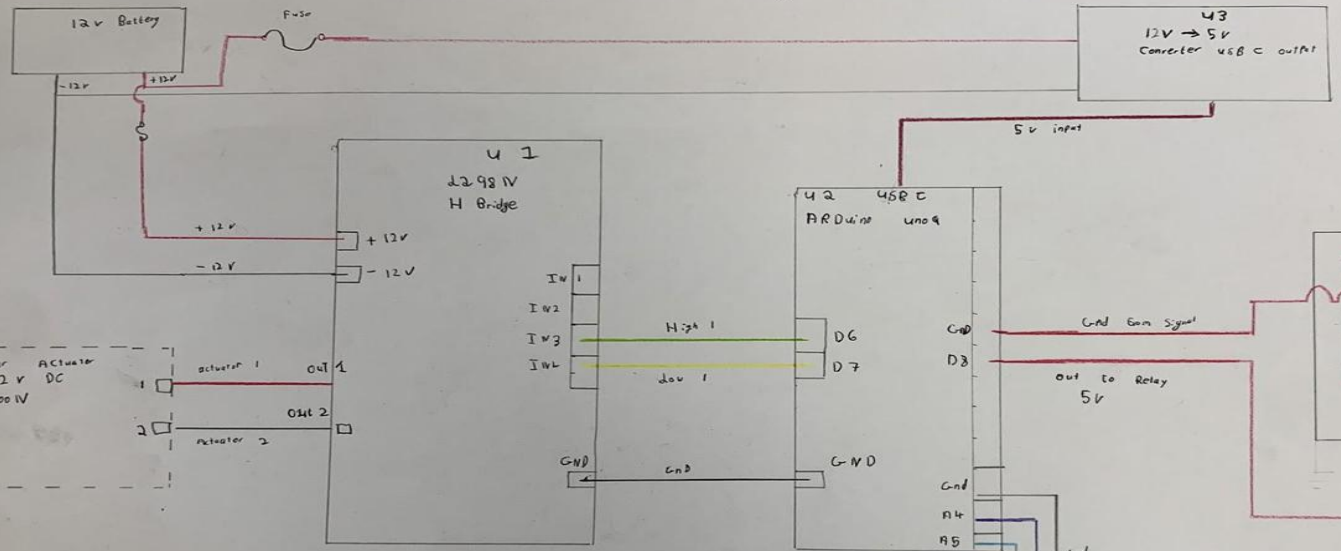
Chosen design





Trailer brake actuator Control System – Wiring Diagram.

Arduino UNO R3 + BTS7960 H-Bridge + Linear Actuator + MPU6050.



1. All grounds must be Common and connected to chassis ground
2. Use automotive grade wire and connectors.
3. Fuse rating 7.5A.
4. BTS7960 R_EN and L_EN connected to 5V to enable driver.
5. Breakaway Switch uses Arduino internal pull up.
6. Limit Switches are normally Closed. Open - triggered.
7. Maximum recommended actuator current 20A

Trailer	Braking	Arduino	Wiring	diagram
Dylan	Vaughan			A3

Programming

The Arduino Uno has a total of 14 digital input/output pins



I used Arduino lab in order to code the arduino.

```
#include <Wire.h>
#include <MPU6050.h>

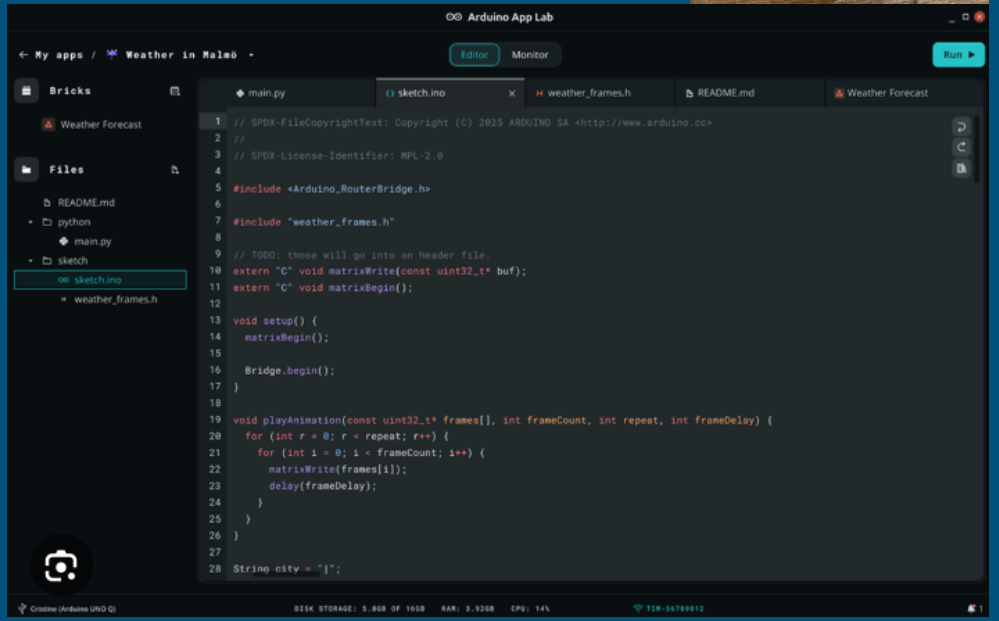
MPU6050 mpu;

// Inputs
const int brakeLightPin = 2; // Brake light signal
const int gainPotPin = A0; // Brake gain adjustment

// Output
const int brakeOutputPin = 9; // PWM output to brake driver

float previousAccel = 0;
unsigned long previousTime = 0;

void setup()
{
pinMode(brakeLightPin, INPUT_PULLUP);
pinMode(brakeOutputPin, OUTPUT);
```



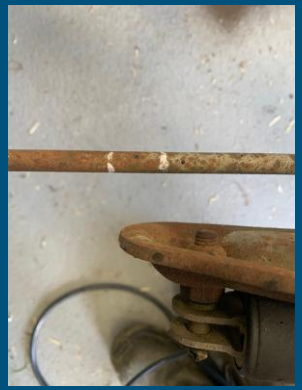
Trailer forces

Force required to activate brakes 817.17N, (83.3kg)

Brake rod travel 0.020m, (20mm)









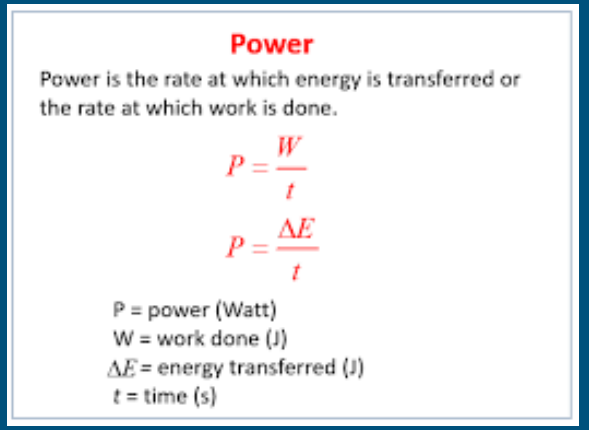
Calculations

Work= force X Distance= FS[J]

Work = (83kgX9.81)X 0.02M

W= 814.23X0.02

W= 16.343W= 16.343Joules



Power = $\frac{\text{Work Done}}{\text{Time Taken}}$

Power = $\frac{16.3}{2.5}$

P= 6.53 Watts

Wire Sizing Calculation (Resisdance)

Actuator draw load 1-2A , Stall current draw 3.3 amps

Cable length

Ltotal=2×Lone way

Ltotal=2×1.8
Ltotal=3.6m

Voltage drop calculation

R=ρL

- R = resistance (Ω)
- ρ\rhoρ = cable resistance per metre (Ω/m)
- LLL = total conductor length (m)

For 4 mm² cable:

R=0.0046×3.6
R=0.01656Ω

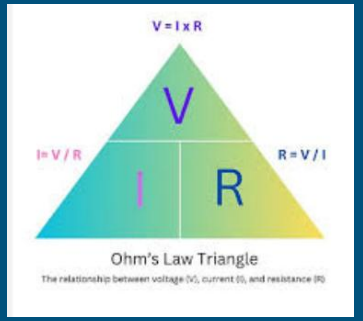
Voltage drop (Ohms law)

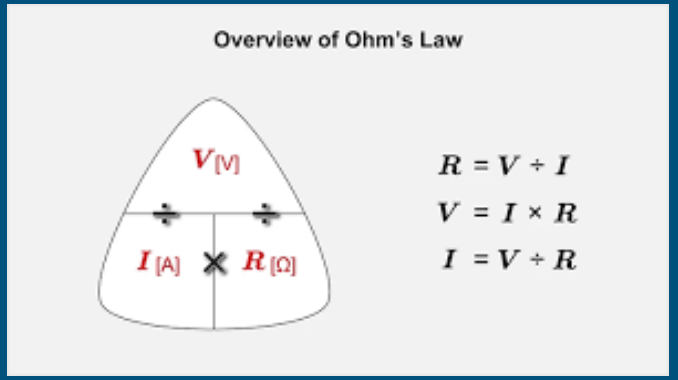
V=IXR (Voltage= Current x Resistance)

V=3.3×0.01656

V=0.054648

Voltage lost in the cable =0.054648





Percentage Voltage Drop

$$\%Vdrop = \frac{Vsupply}{Voltage} \times 100$$

$$\%Vdrop = \frac{0.054648}{12} \times 100 = 0.4554$$

%Vdrop=0.45%

Voltage Drop Calculator - A Comprehensive Guide for Electric Actuator Performance

Industry standards generally recommend limiting voltage drop to 3-5% of the supply voltage for optimal performance. For a 12V system, this means keeping voltage drop below 0.36V to 0.6V.

Fuse Calculation

Design rule

Ifuse=1.25×Inormal

Inormal=3A

Ifuse=1.25×3

Ifuse= 3.75

Nearest fuse is 5A

Condition	Current
No Load	0.8 A
Working Load	1-2 A
Heavy Load	2-3 A
Stall	3.3 A

STALL



HEAVY LOAD



WORKING LOAD



NO LOAD



Relay Sizing

Formula $I_{relay} \geq 1.5 \times I_{load}$

$I_{load} = 5A \times 1.5$

$I_{relay} = 7.5$ amp



Suggested relay inc safety factor

Final Engineering Specification

Item	Specification
Actuator Cable	4 mm^2
Battery Feed	4 mm^2
Ground Return	4 mm^2
Chassis Ground Strap	6 mm^2
Control Wiring	0.5 mm^2
Buck Converter Feed	1 mm^2
Fuse	5A
Relay	7.5 A
Voltage Drop	0.45 %
Cable Power Loss	6.6 W
Supply Voltage	12 V
Cable Run	1.8 m

Risk assessment

Completed comprehensive risk assessment before starting work.

Any task that I carry out In the workshop I ensure to create a risk assessment for.

Hazard	Person(s) at Risk	Existing Controls	Risk Rating (see matrix)			HighMed Low	Any additional control measures required.
			Likelihood	Severity	Risk Score		
*Slip, trip and falls.	*Everyone in workshop	*Workshop to be kept tidy	1	1	2	Low	*All tools and parts to be kept out of the work space.
*Falling objects/ Components	*Person working on machine	*To be aware of surroundings and wear PPE	1	2	3	Low	*Steel toe capped boots to be worn at all times in the workshop
*Sharp objects	*Person working on machine	*Careful when handling sharp objects	2	2	4	Low	*Gloves to be worn when handling sharp objects
*Oil spillages	*Everyone in workshop	*Use a tray to catch oil	3	1	4	Low	*Use granules to soak up oil
*Danger of crushing	*Person working on machine	*Always use axle stands	1	5	6	High	*Always support loads with correct size axle stands
*Electrical tool fault	*Person using tool	*Electrical tools to be PAT tested	1	5	6	High	*Keep electrical tools well maintained
*Fire hazards	*Everyone in workshop	*Flammable objects kept away from ignition sources	2	5	7	High	*Fire extinguishers made easily accessible
*Lifting heavy weights	*Person or persons lifting	*Use appropriate lifting gear for things heavier than 23kg	2	2	4	Med	*Correct lifting gear for different weights
*Oil contaminating skin	*Person in contact with oil	*Use barrier cream before touching oily parts	3	1	4	Low	*Wear latex gloves to protect hands
*Dust contamination	*Person/persons in the workshop	*Do not use compressed air to clear dust e.g. Brake dust	2	3	5	Medium	*Wear breathing apparatus when in dusty conditions
*Crushing/ machine rolling	*Everyone in workshop	*Apply handbrake and switch off engine	1	2	3	Low	*Chock the wheels to stop movement

Month	Project Stage	Week 1	Week 2	Week 3	Week 4
Nov	Research and think of 4 project ideas	Research	Research	Research	Research and present 4 ideas
Dec	Score ideas and choose project	Research best product	Research how it works		
Jan	Choose project and start design		Concept presentation	Sketching	Start CAD design
Feb	Calculate costs and materials needed	Price materials		Buy materials	
March	Gather components	Buy electric ram	Buy wiring and electrical parts		
April	Begin assembly	Measuring and wiring	Assembly	Assembly	Assembly
May / June	Final touches and present project	Test system and make improvements	Reinforce wiring and connections	Testing and adjustments	Project presentation

Fabrication and Manufacturing

I first checked over the trailer.

I changed the brake shoes and cables in order to ensure the brakes were working up to standard.





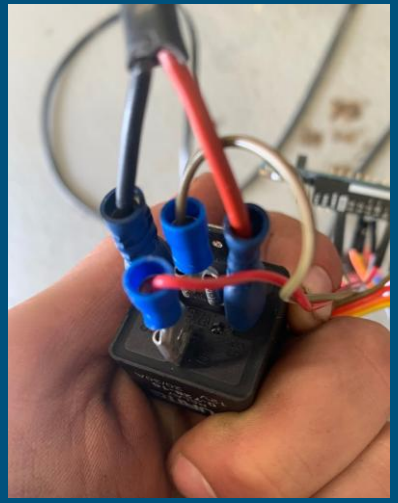


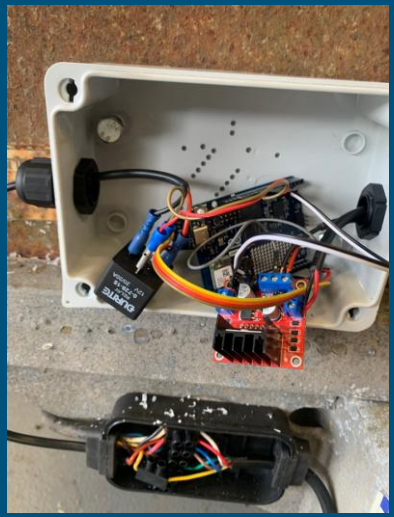


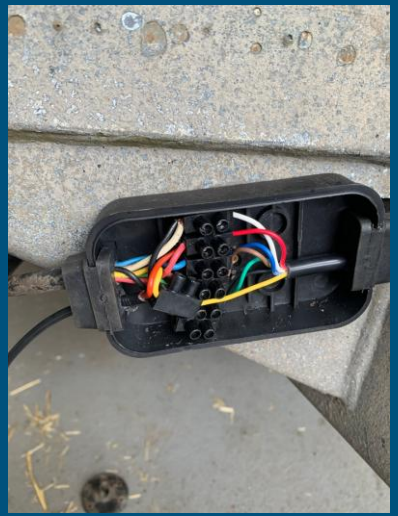



Manufacturing

I fitted a junction box to the front of the trailer and took power from the red cable (brake lights) and the earth (white cable)










Ifor Williams
Trailers

TESTING

2.45 seconds from brake pedal applied to trailer brakes applied



Costs

Arduino controller £55

Electric actuator £47.50

H-Bridge device £4

Relay £3.50

Cables £28.60

Steel £6.50

Nuts and bolts £5

Consumables (mig wire, grinding disks ect) £10

Labour 8 Hours £120 at £15 an hour

Total costings without Labour £160.10

Total costings including Labour £280.10



Possible improvements

Limit switch on actuator

This would help prevent the actuator over traveling and possibly apply the brakes quicker.

Charging the battery through side lights

This will prevent the need to remove the battery for charging meaning irregular maintenance / interference required.

Faster Actuator

This would help apply the brakes quicker for times of need such as emergency stops.

Skills learnt

I have learnt and now have a better understanding about designing and developing a project to sell.

I have also learnt alot about electrics and gained experience working with brakes.

I have developed my planning skills and my timekeeping skills.

Vote of thanks

I would like to thank all the lecturers that helped me along the way with this project Rhys James, Geraint Evans, Jordan Hill and also a big thanks to Julian Somerfield.

I would also like to thank all classmates and family members for helping and providing good feedback.



Questions

Any questions, Thank you for listening.



