AGRID

Farm yard automation,
brought to the masses

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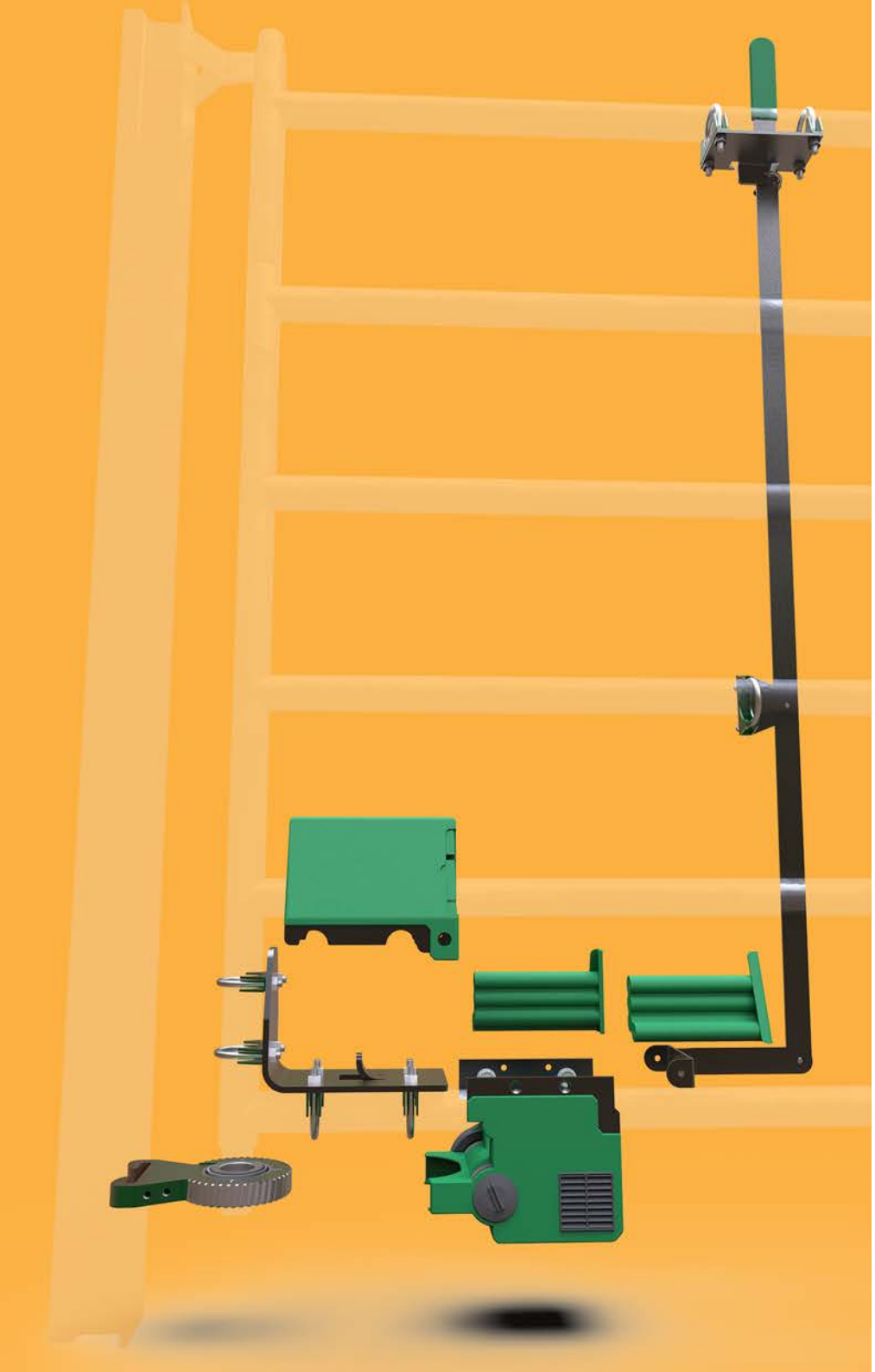


Contents

Coming from a strong agricultural background, I focused my design oppertunity investigation on identifying a design oppertunity that could allow farms to be operated with a lower time or financial commitment from the farmer. The reasoning behind that decission is rooted in a nationwide problem all farmers are becoming increasingly aware of, the fact that small family run farms are becoming less and less viable. Farmers are being forced to increase herd size every year in an attempt to chase a basic living wage. This is causing a consolidation effect on small and medium sized irish farms, pointing the irish farming sector on a course towards large industrial farms and away from the rural institution that is family run farms,damaging the rural economy in the process.

To counteract this effect, I believe that family farms will have to take a position of suplimentary income instead of primary income, this can be achieved by reducing the farmers comitment to the farm with no effect to the output. Long story short farms need to become more effort and time efficent so that farmers can explore other career oppertunities while keeping their passion for agriculture alive. The knock on effects of this will be, improved the quality of life for irish farmers, less stress for farmers, promotion of farming as an apealing option for younger generations and will maintain the practice of family run farms.

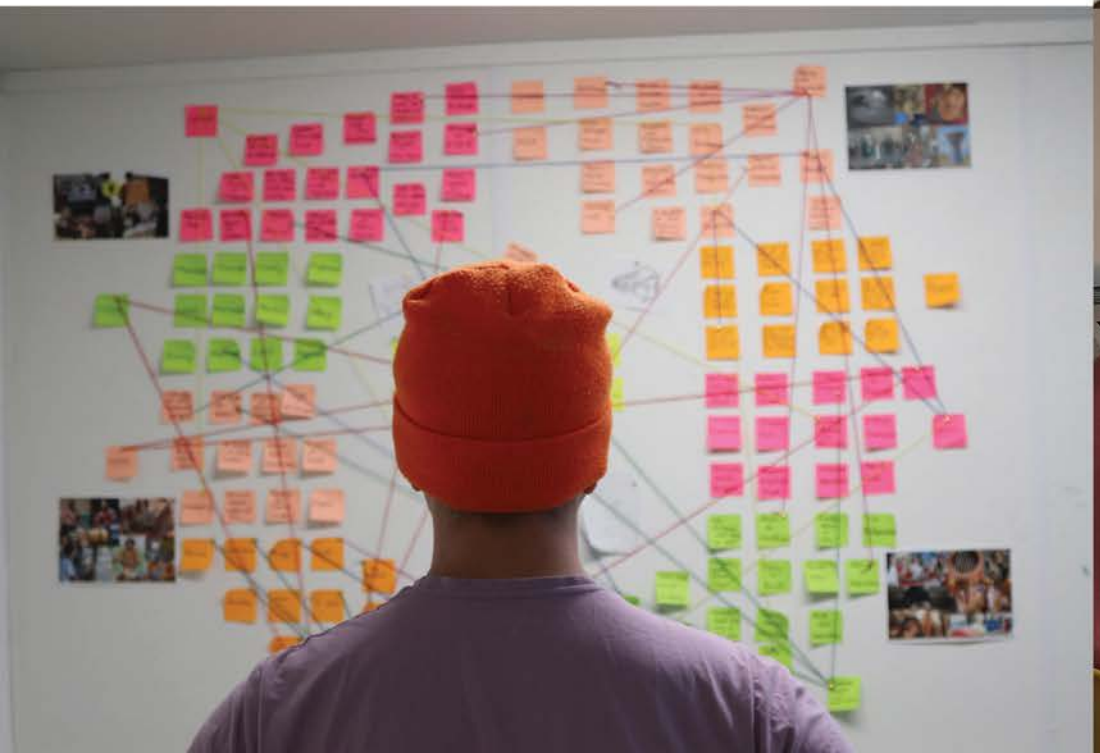
The first farming process I put under the microscope was my most hated chores of my childhood, bulkfeeding which in my case was silage bales. While it wasnt hard work it always felt like a very slow and tedious job. Driving to the feeder, closing all the gates behing me on the way, trudging through the mucky ground around feeder to open the bale and eventually driving home. It was apparent that there was a good design oppertunity some where in the process.

With my indepth knowledge of the process, my research and design skills and my experience in process automation I felt I was uniquely positioned to tackel streamlining the process. To pin point the design oppertunity I launched an in depth user investigation.

To get a broader perspective on the pinch points identified in my field research I conducted a survey across a handful of cattle marts in the midlands.

From these surveys I gaind a large library of statistical data. However, I didnt want to base my design decisions on statistics alone. To empathise more with the farmers I leveraged the contact list I'd been building during the surveys phase to set up some follow up interviews.

I then coded the interviews using my knowledge of ethnographic research to give me a clear view at the biggest problem bein encountered from the farmers perspective



Investigation

I started off my search by doing time trials of the process across multiple farms, noting down the time spent on each step of the process.

The process took on average 36 minutes to complete, this could be divided into two sub processes, journying to & from the feeder and opening & placing the bale.

When journying to and from the feeder I noticed that a large amount of the journey time was spent out side of the tractor opening and closing gates. It took 4 trips in/out of the tractor to open and close the gate behind the tractor. With an average of 6 gates on the way to the feeder and then same amount on the way home, it works outat 48 trips in/out of the tractor for 1 bale.

Opening and placing the bale took on average 7 minutes. The main pinch point I identified in this sub process could be atributde to the thick mud build up around the feeder. This mud is caused by land poaching as a result of the high foot traffic in the area.

Key Findings

3/10

was the average user experience score given to bulk feeding by farmers

4 Gates

was the most frequent answer when asked how many have to be used to put out 1 bale

66%

of farmers surveyed have fallen or otherwise injured themselves getting in/out of a tractor

36 Minutes

was the average total process time for feeding 1 bale of bulkfeed

3-4 Bales

was the average daily bulk feeding amount

24 Minutes

was the average total time spent outside of the tractor when putting out 1 bale

78%

say bulkfeeding negativly affects their mood

32 Trips

in/out of a tractor was the average amount needed to put out 1 bale

35-45

was the average gate per farm figure obtained through surveys

Market Analysis

At this point of the investigation I could easily identify operating gates as the the design opertunity with the highest potential, to confirm that this opertunity could be turned into a commercially viable product I researched existing solutions of the markets where I found there was no product on the market fulfilling this need. I set out to research the potential market sizes a solution like this could obtain.

The bovine population in Ireland was 7.2 million (P) as of 2018, with each animal eating 45-55kg (KgPd) of silage per day and each and each round bale weighing approximately 650kg (BKg) we can calculate the number of bales distributed to cattle in Ireland over the wintering months.

(P × KgPd) ÷ BKg = Bales Nationally per day

(7,200,000 × 50) ÷ 650 = 553,846 Bales Nationally per day

To put a monetary value on this time, we can take the number of bales distributed daily on this farm (B), the time wasted on each bale as a decimal of an hour (T), the amount of months spent wintering cattle (W) and the average hourly pay for a farm worker in Ireland (R). Multiplying these figures gives us the amount of money lost over the course of one year.

B × T × 30 × W × R= money lost over the course of one year

7 × 0.416 × 30 × 5 × 10.60 = €4,630.08 lost every year over 5 months

Using average gate per farm statistics obtained through surveys (35-45 gates per farm) I was able to calculate the total number of gates across the two largest sectors of Irish agriculture.

Number of Herds X Average Gate Per Farms = Total Gates Across Beef And Dairy Sectors

109,400 X 40 = 7,616,000

Taking this figure of 7,616,000 gates I could estimate the size of the market using the planned retail price and a modest estimate on market penetration at 10%.

(7,616,000 X €200) ÷ 100 X 10 = A Potential Market Of €152,320,000.

Farm Gate Process Optimization

S

Strengths

Reduced feeding times

Reduced fall hazards

No competition

Improving farm yard accessibility

Improved working conditions

No needless exposure to weather

W

Weaknesses

Motivation farmers who are not up to speed with the latest technology

No established brand

Challenges of educating farmers about efficency improvements

O

Opportunities

Optimise usage of farmers time

To bring new technology to the market

To improve farmer welfare

Reduce the risk of injury on irish farms

T

Threats

Farmers will not take to the idea

Competitor enters the market with more established distrobution channels

Feasibility Testing

Once I had established that this solution marketable potential, I wanted to do some preliminary feasibility testing to help me craft a more targeted brief to proceed with conceptulisationmof possible solution.

The goal of this testing was to establish a minimum torque requirement to operate a gate as this is a fundamental requirement for any concepts.

I achieved this goal by hammering a socket onto the fulcrum of the gate so that it gripped securely then attaching a torque wrench and adjusting its torqure requirement until the gate could be turned without triggering the wrench.

Brief

An electrical or mechanical device to automate standard farm gates without the need for the user to leave their vehicle.

The device must be not impeach on the gates ability to be opened manually and upmost due care should be taken to ensure that the device is as safe as possible.

The device must generate 40ft/lbs of turning force at the gates fulcrum point or otherwise reduce the torque required with a redesigned hinge mechanism.

The final solution must be affordable, standardised and intuitive to use, Possibly incorporating a guide or levelling mechanism to ensure that the gate is hung straight preventing it from swinging against gravity

Solution Vision

Every farmer could benefit from this solution, be it time, labour, mental health or working conditions most aspects of farm life could be improved.

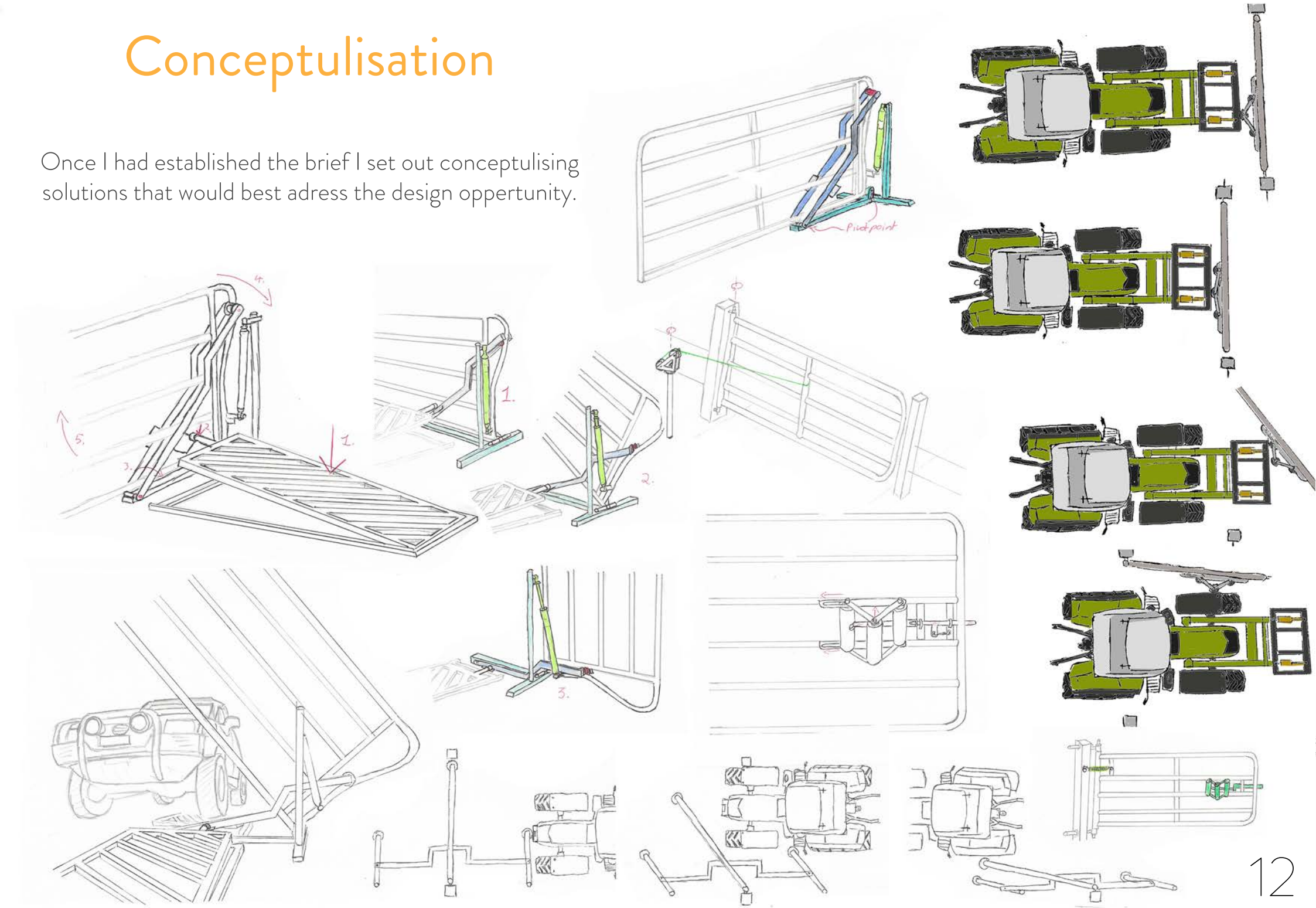
On a micro level our core use scenario are farmers who conduct regular, frequent bulk feeding as the reduction in feeding times and time spent outside of the tractor will afford them more time to pursue off farm working & activities as well as significantly reducing the potential for injury during regular farm work.

Beyond this the possibilities for use are endless as fare gates are such a common piece of infrastructure on farms. This solution can bring its benefits to all farm processes.

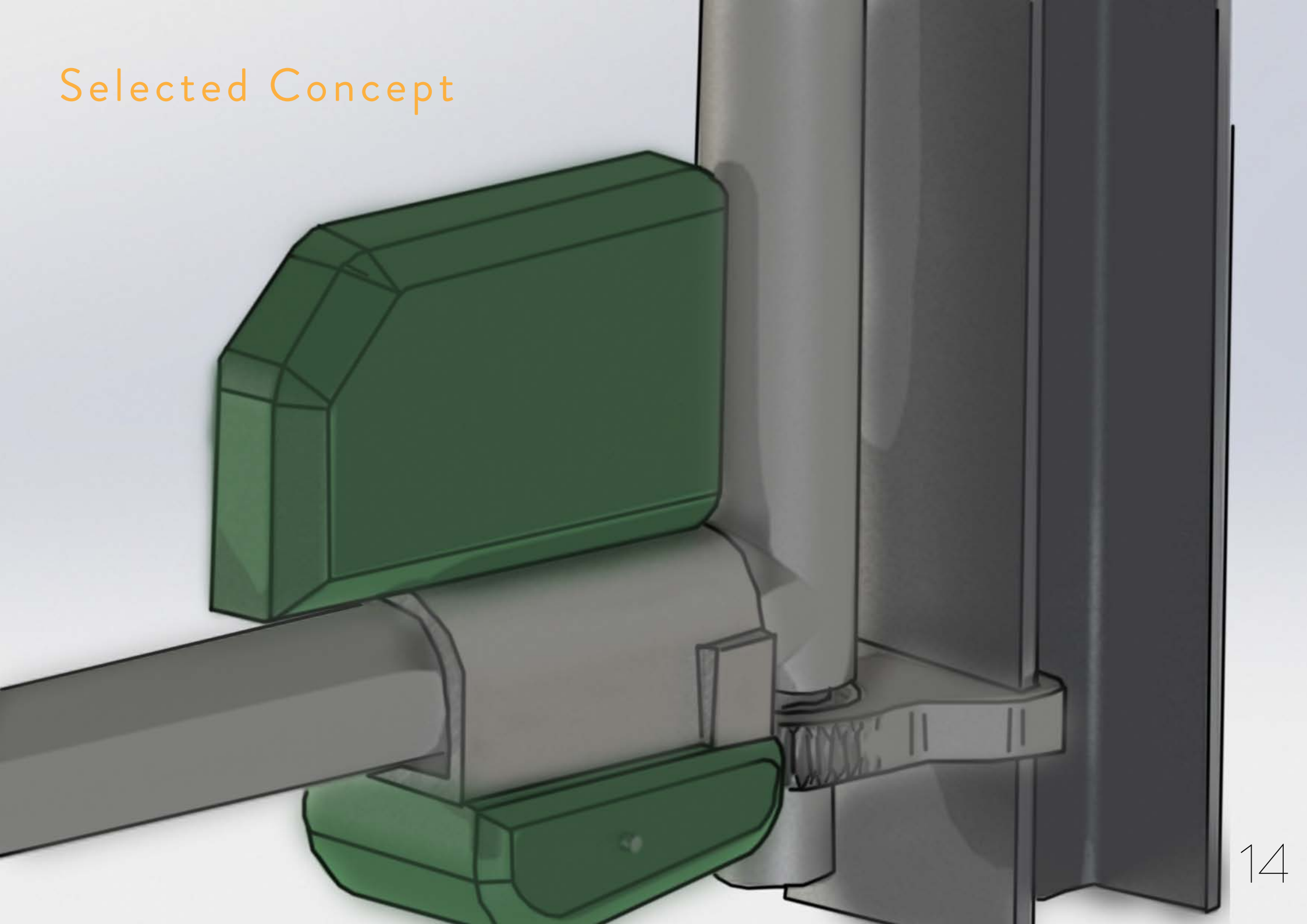
The wider impact of this solution is improved mental health, improved working conditions and improved working hours for Irish farmers which will help to preserve family run farm and promote farming to be a more sought-after profession for future generations.

Conceptulisation

Once I had established the brief I set out conceptulising solutions that would best adress the design oppertunity.

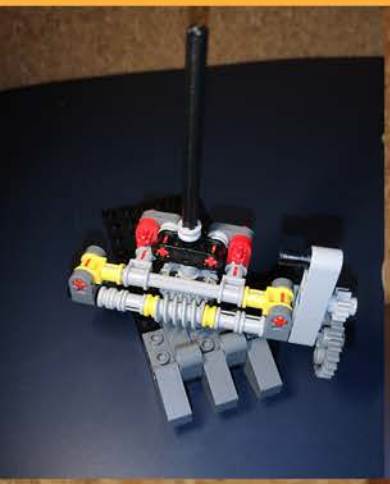


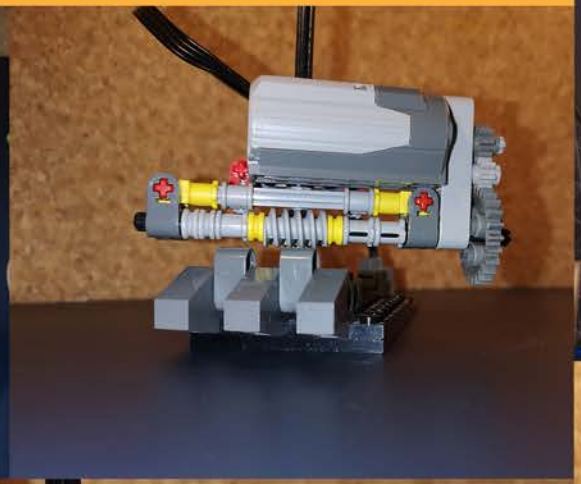
Selected Concept

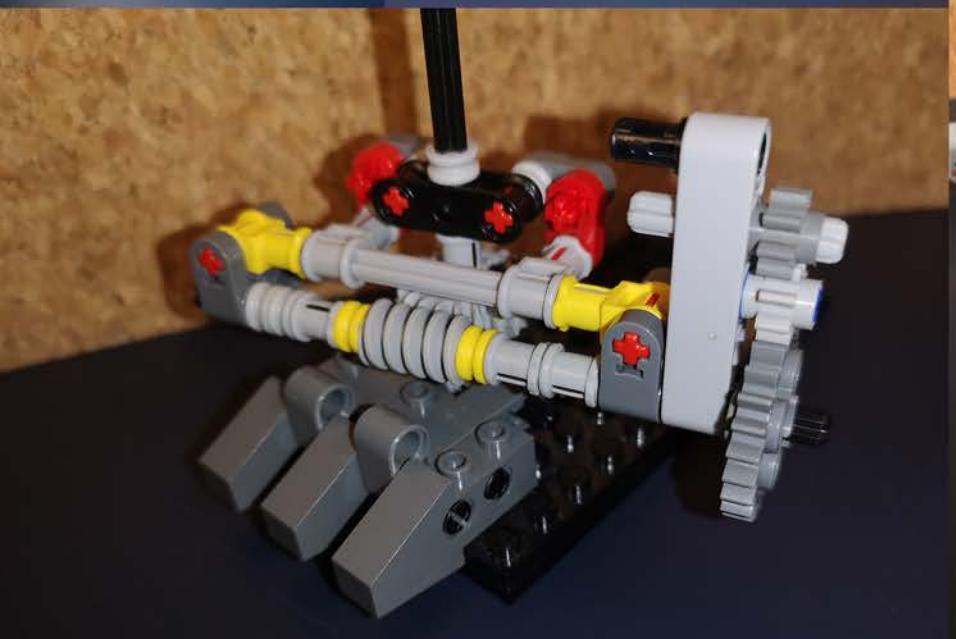


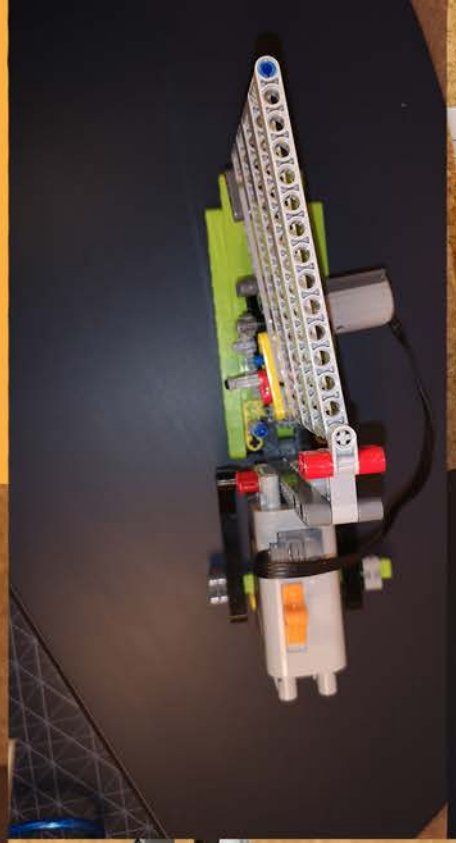
Concept Development

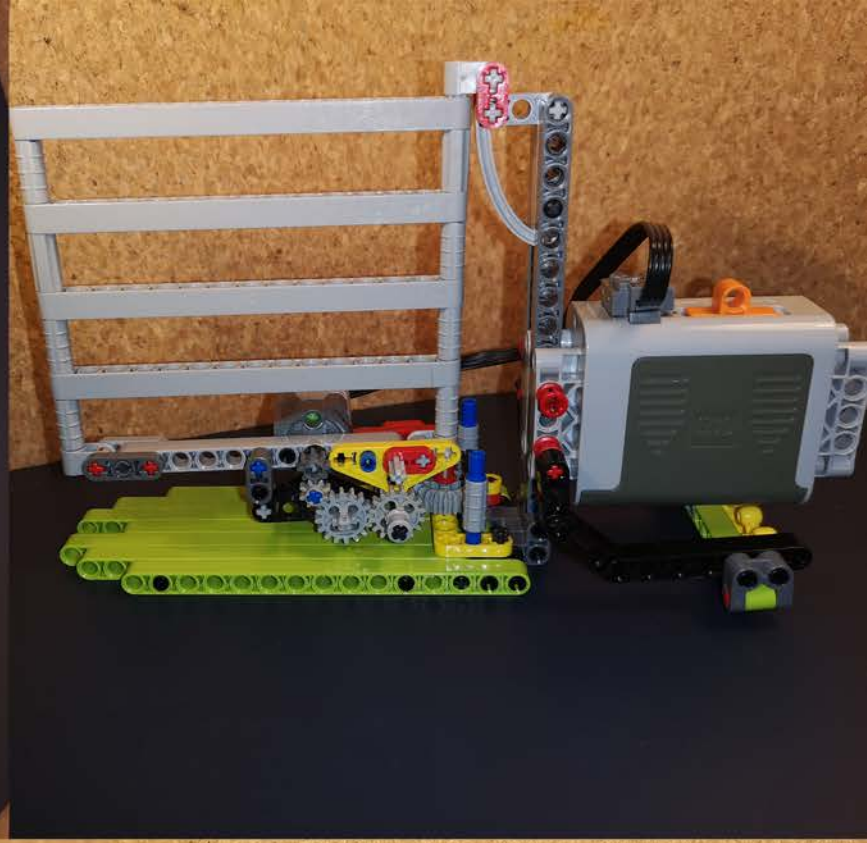
After a solution had been conceptualised I developed it further using a combination of desk research, rapid prototyping, digital prototyping and testing. The firt prototyping medium I used was lego as its modularity lent itself to rapid prototyping

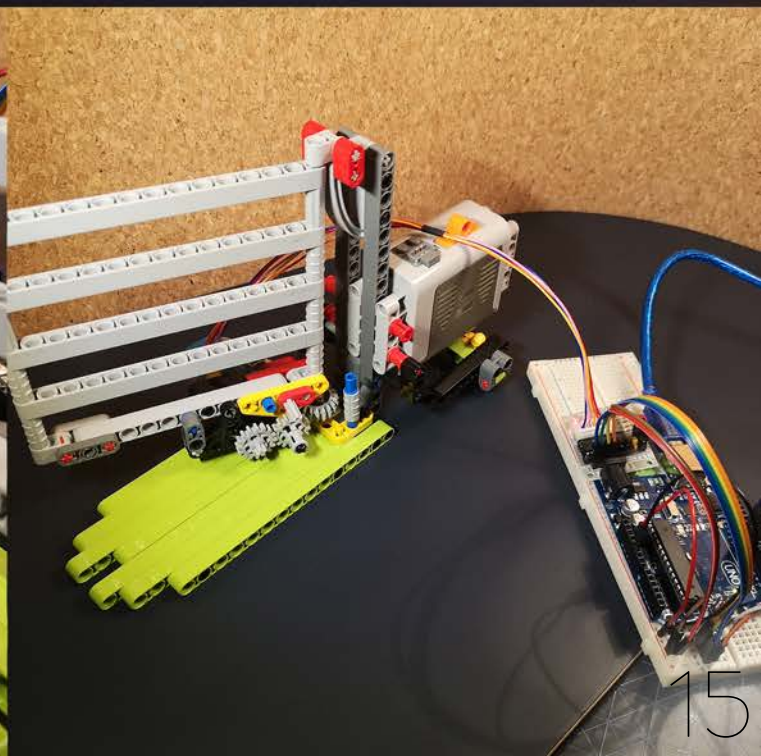




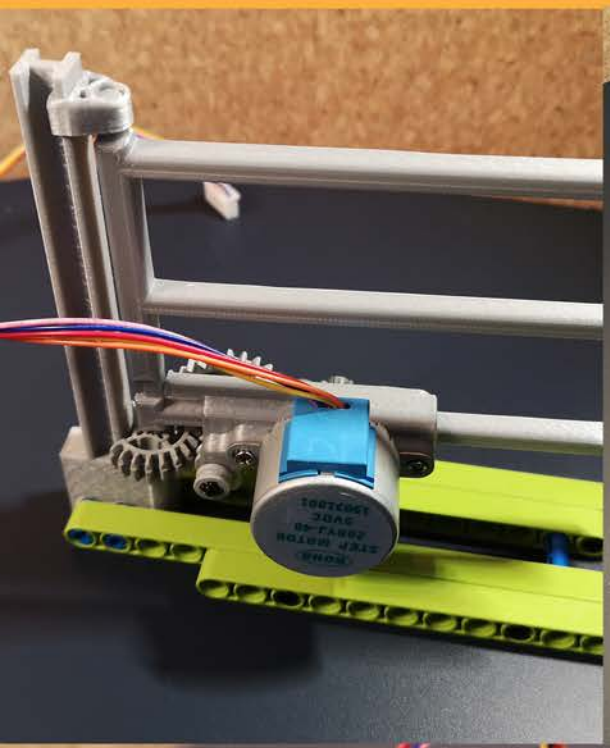


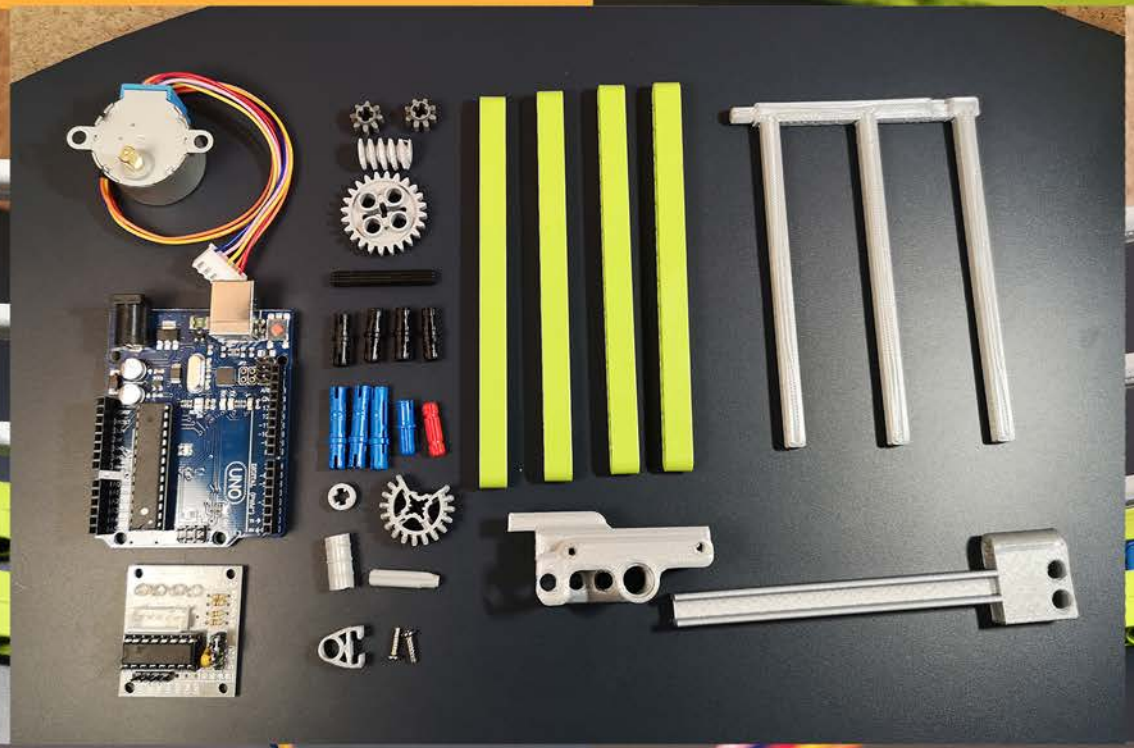


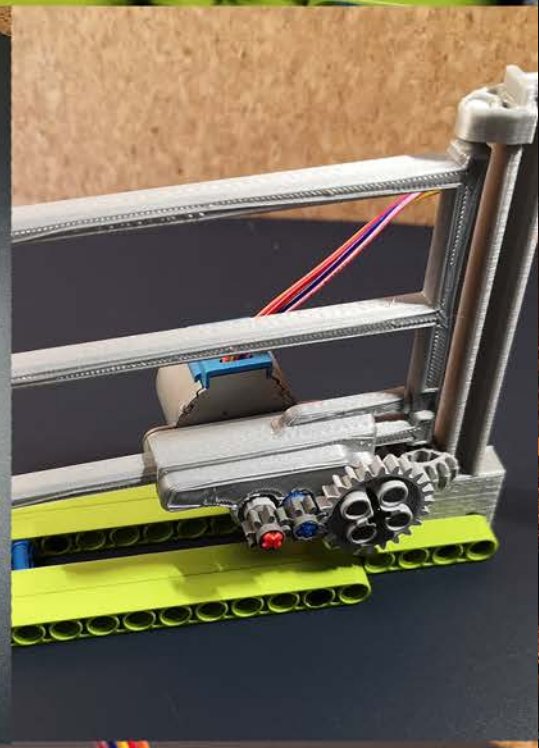


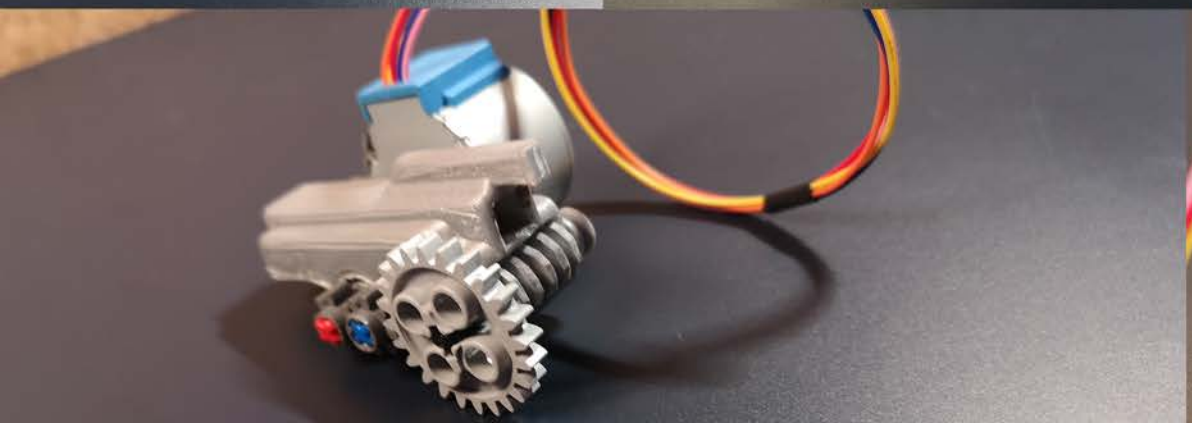


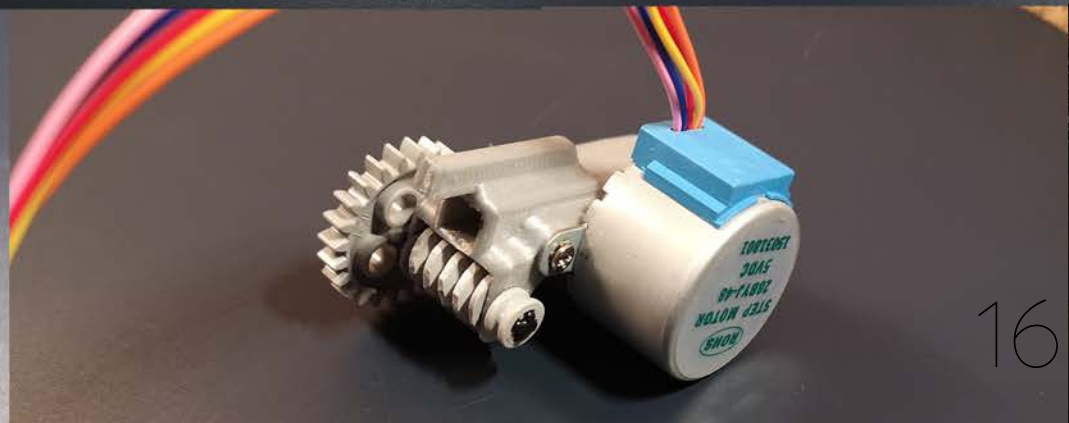
I then moved to 3D Printing once I had established the fundimentals of my design



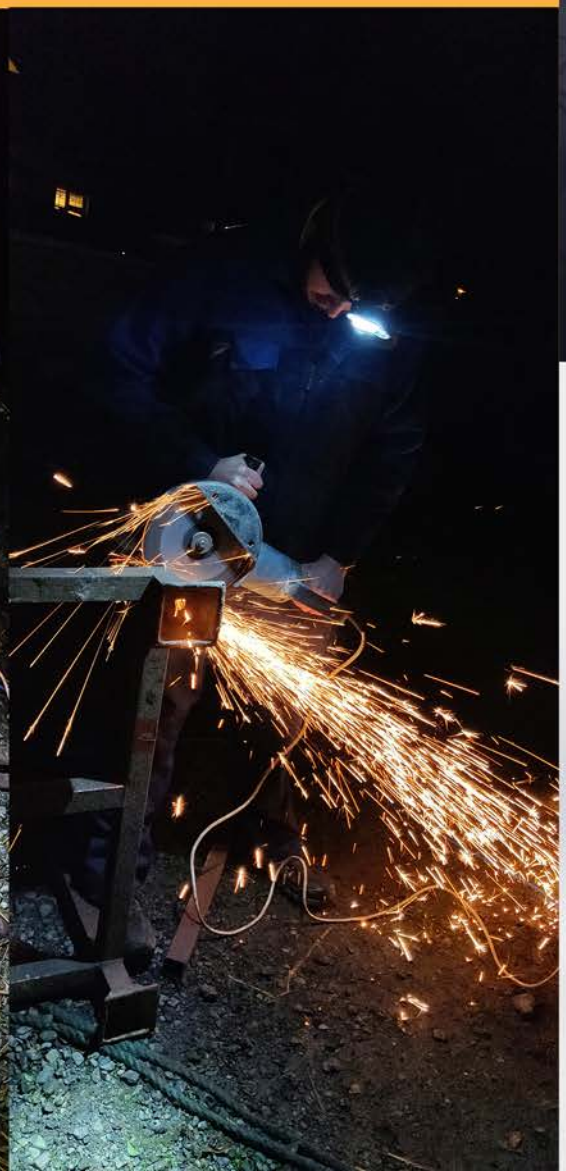


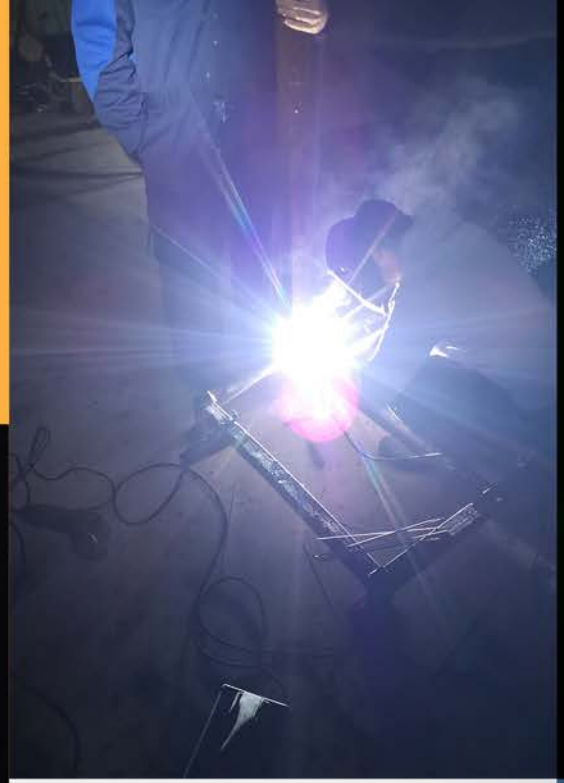




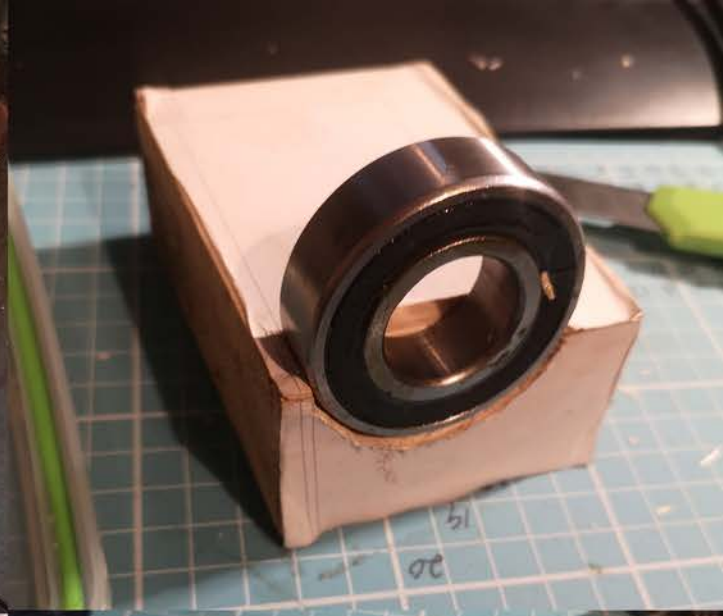


The next step was a full scale rapid prototype to test the feasibility of my mechanism. To achieve this I needed to make a toothed gate hinge with a bearing that would carry the gate, a housing that could be mounted to the gate and could house the worm in two bearings and a test rig to get repeatable results.

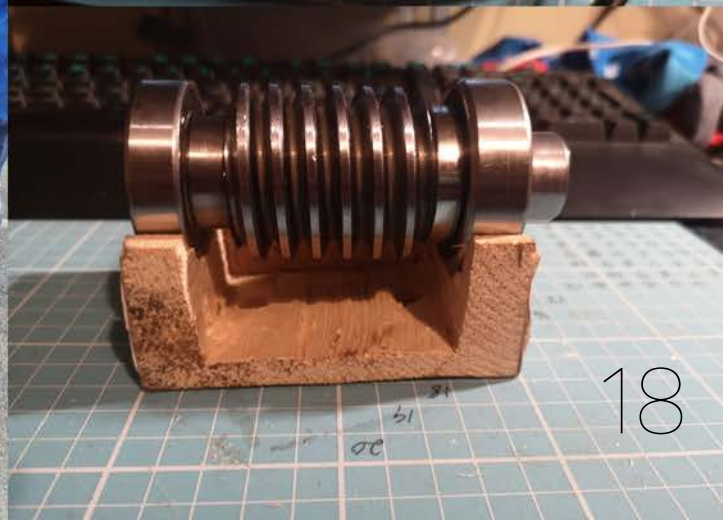




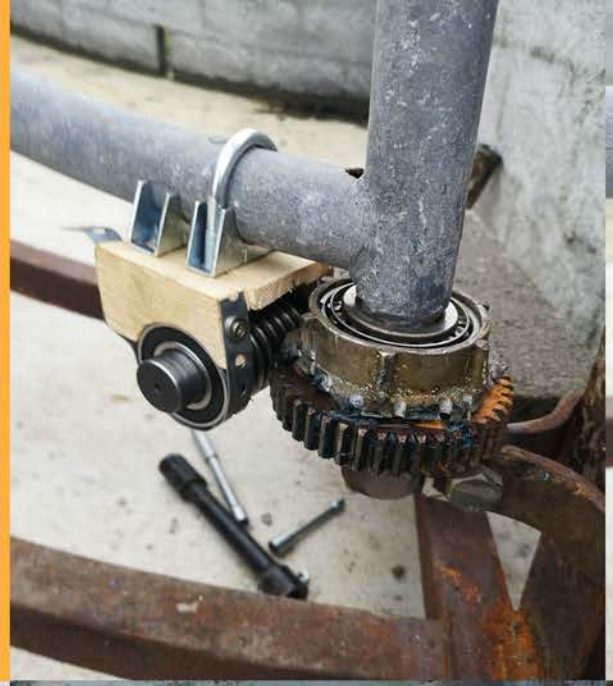




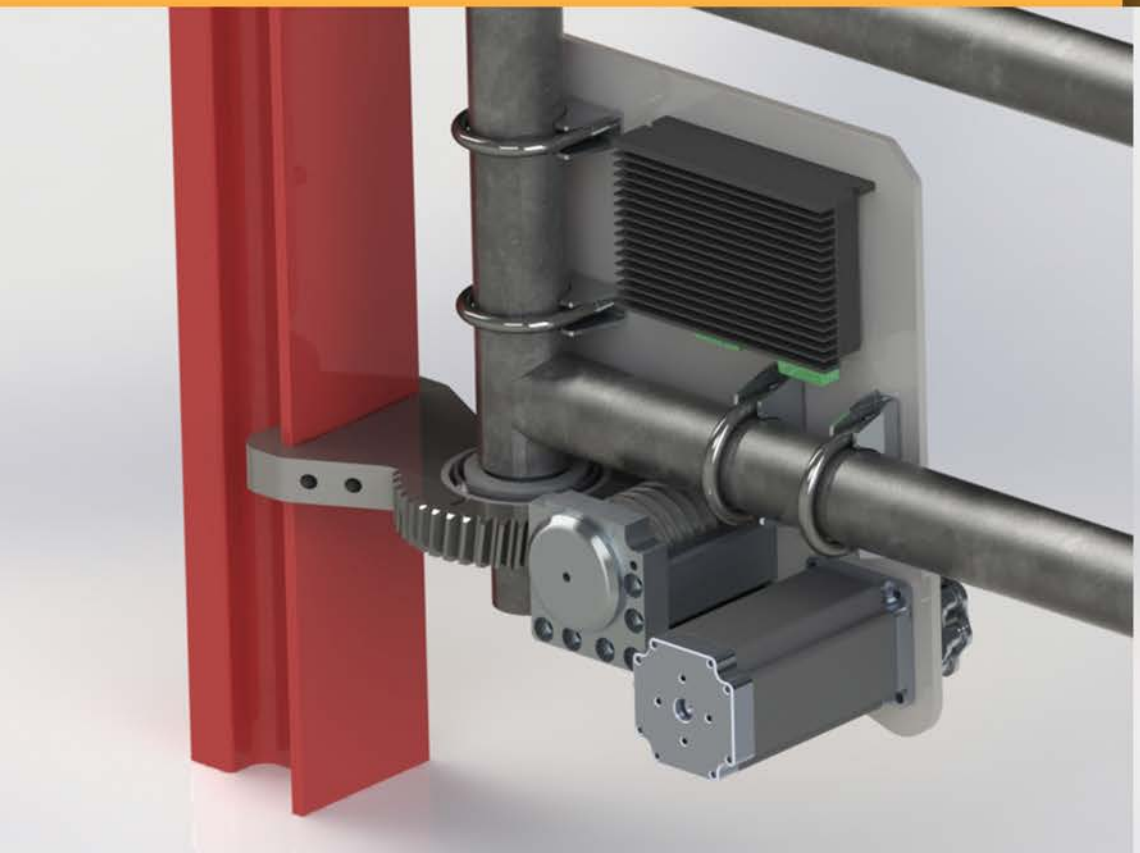


Once I had the prototype made I started testing the required torque to turn the worm. This information was vital for the next step of my development as the torque would dictate the motor size and chassi strength.



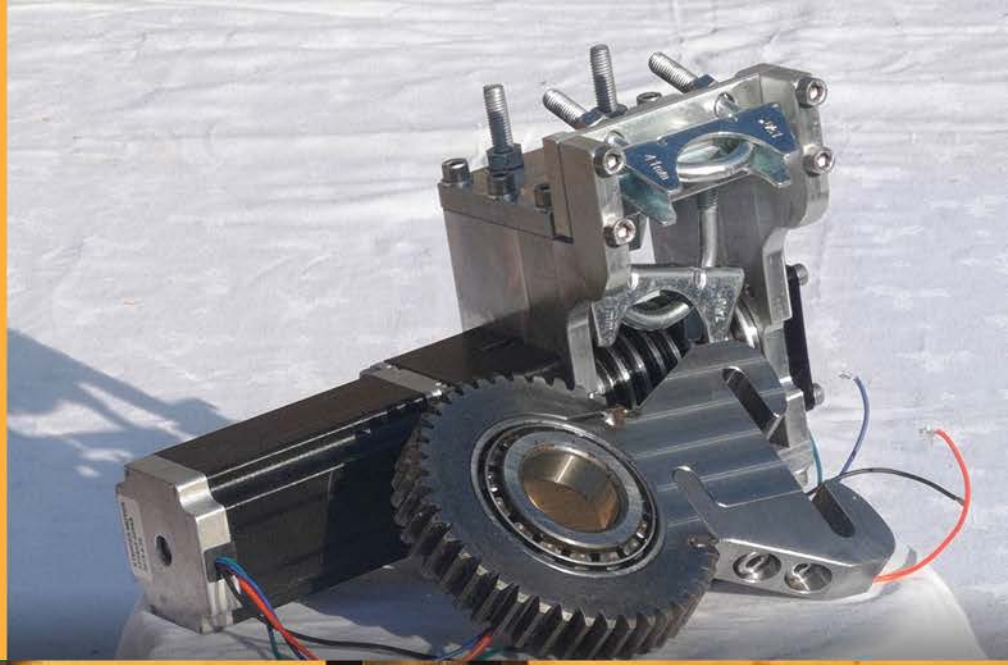
I then created a detailed digital prototype putting into practice all the design fundamentals I had discovered thus far. I then reached out to some farmers I had interview earlier in my process to get some feedback and outline some requirements for my final design.

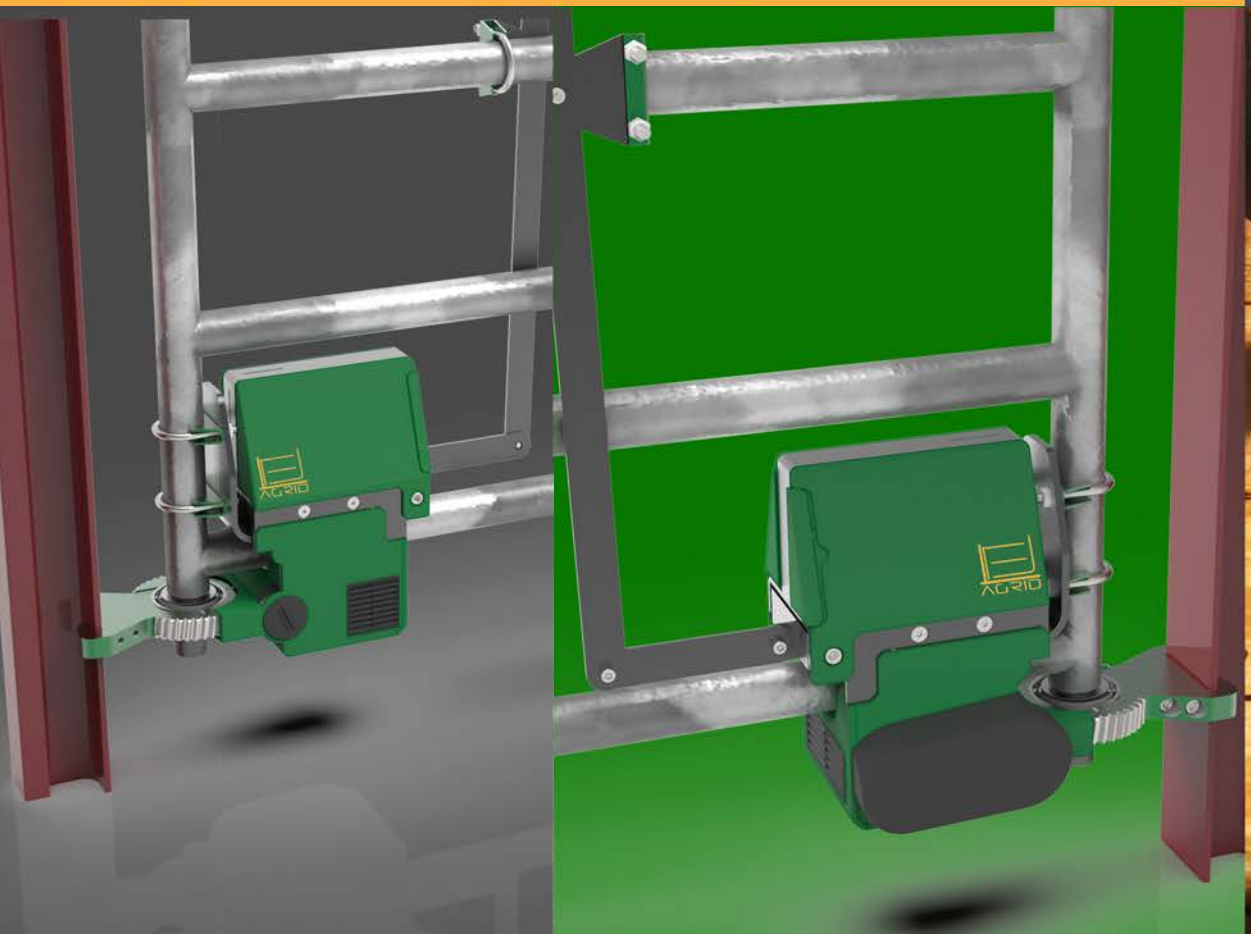


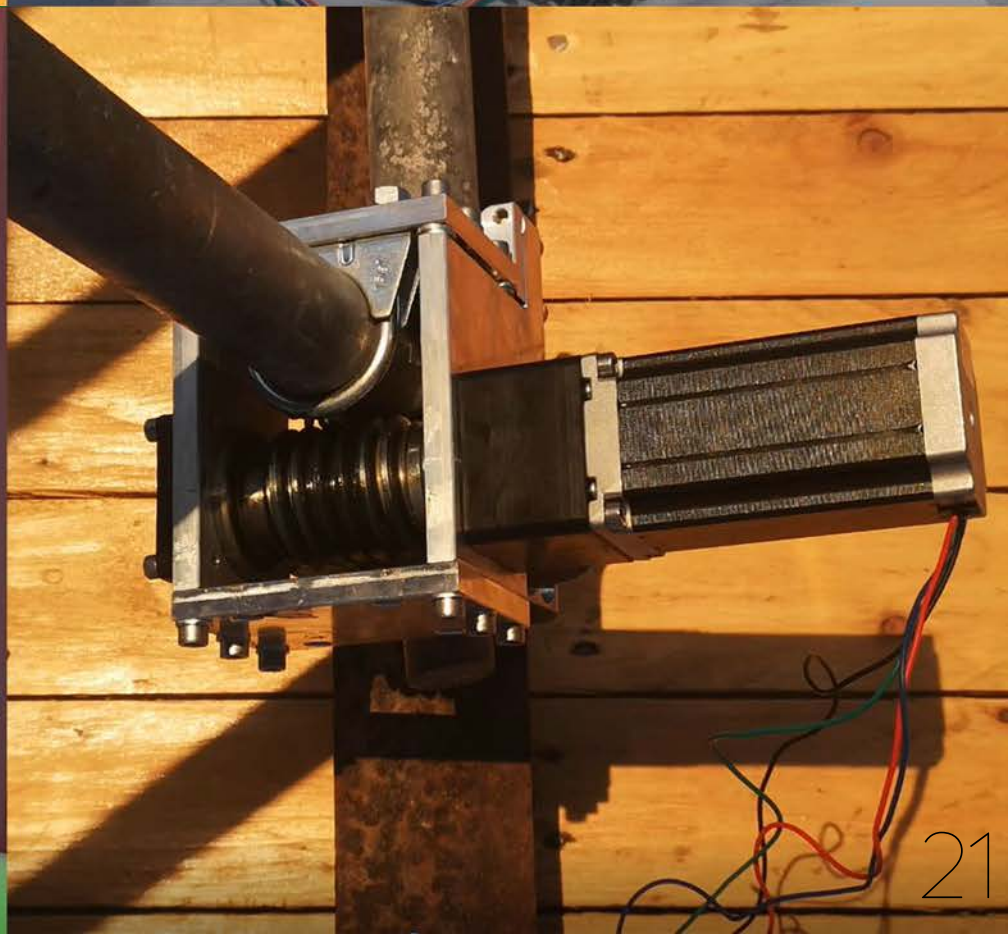
Final Prototype

Due to the lockdown of 2020 I had to adjust my final prototpype plans to be more viable for the situation at hand.

I settled on splitting my Final prototype into two parts. A detailed CAD model of my final design combined with a full scale physical prototype of my mechanism.





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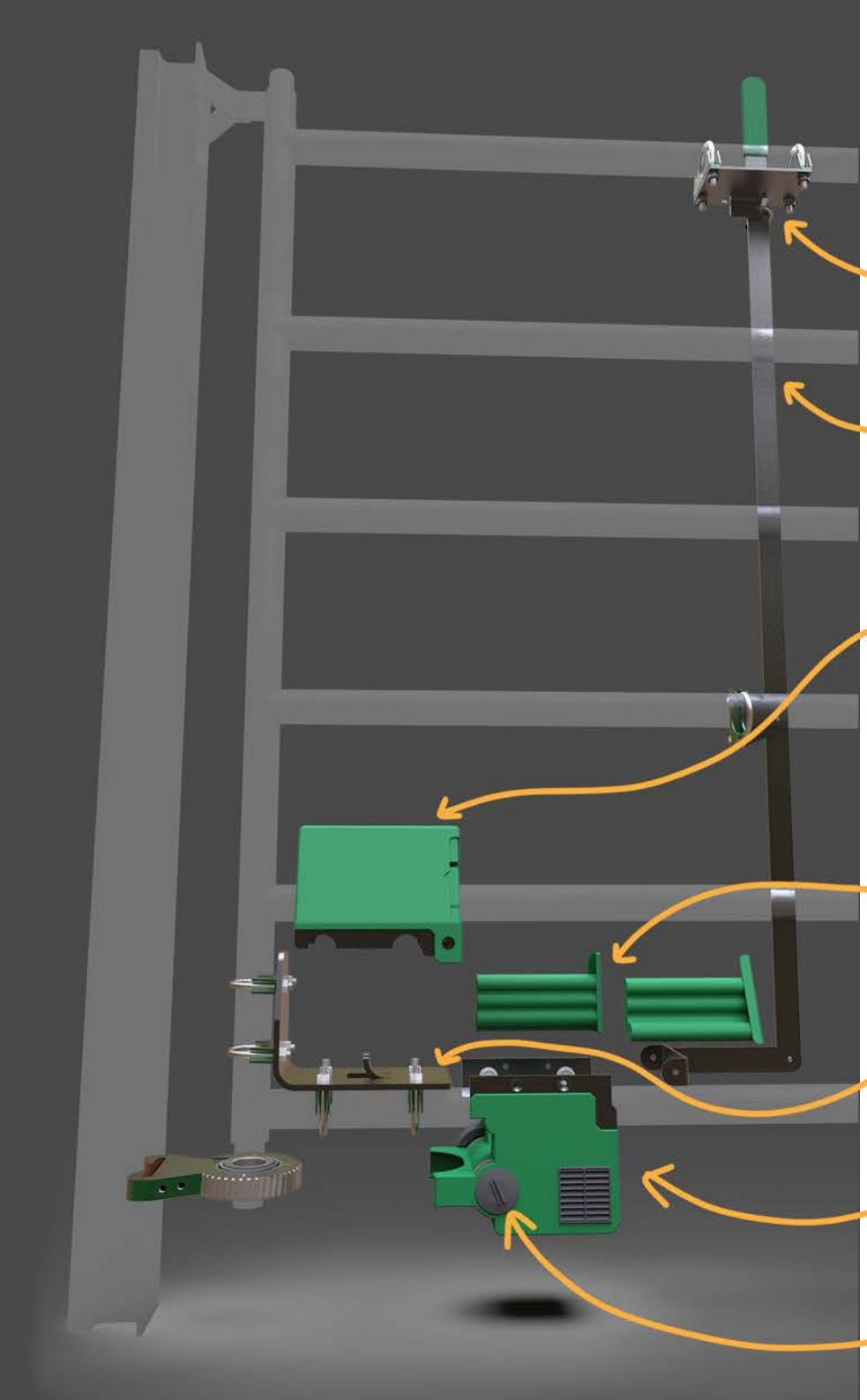


Product Features

Manual override is secures with a standard padlock for easy access

Ergonomic positioning of manual override.

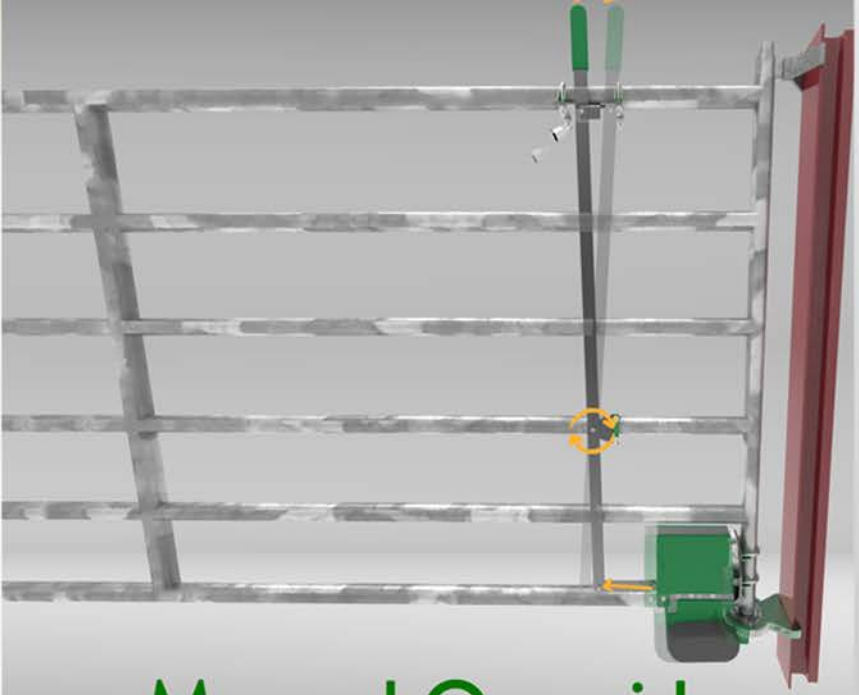
Anti-step design minimising and reinforcing horizontal surfaces

Hot swapable batteries alowing product be used when a battery pack is being charged

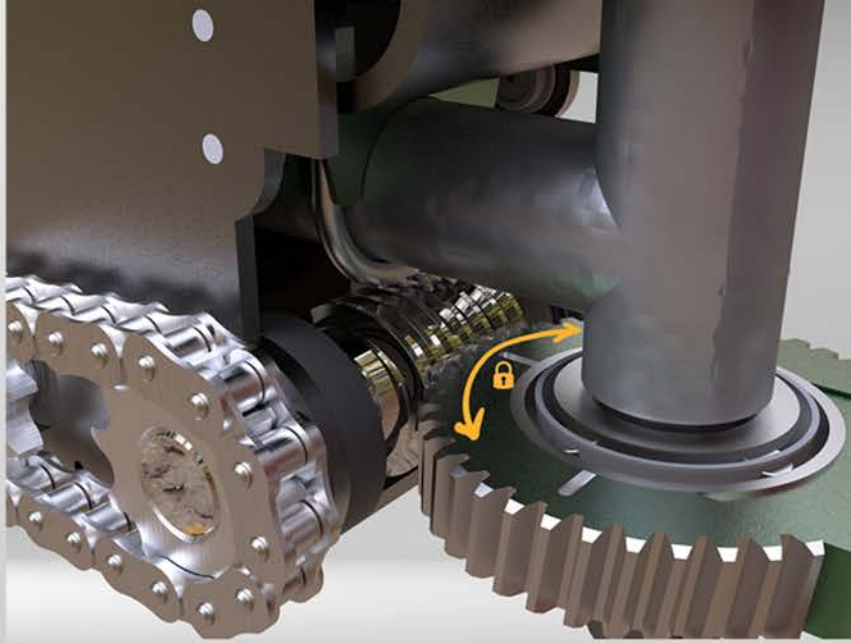
Centralised support to reduce leverage on mointing points if product is climbed on

Modular design

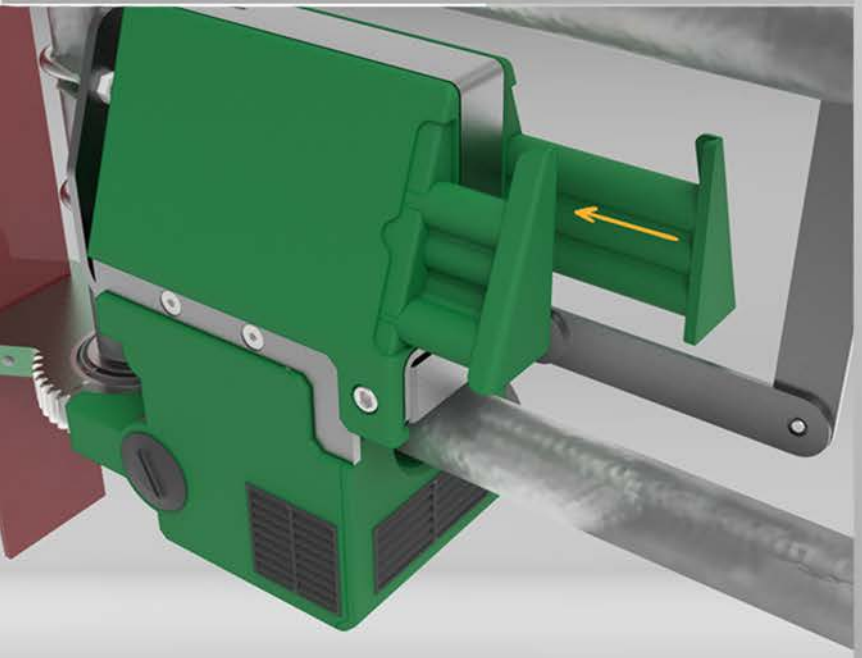
Removable service pannels



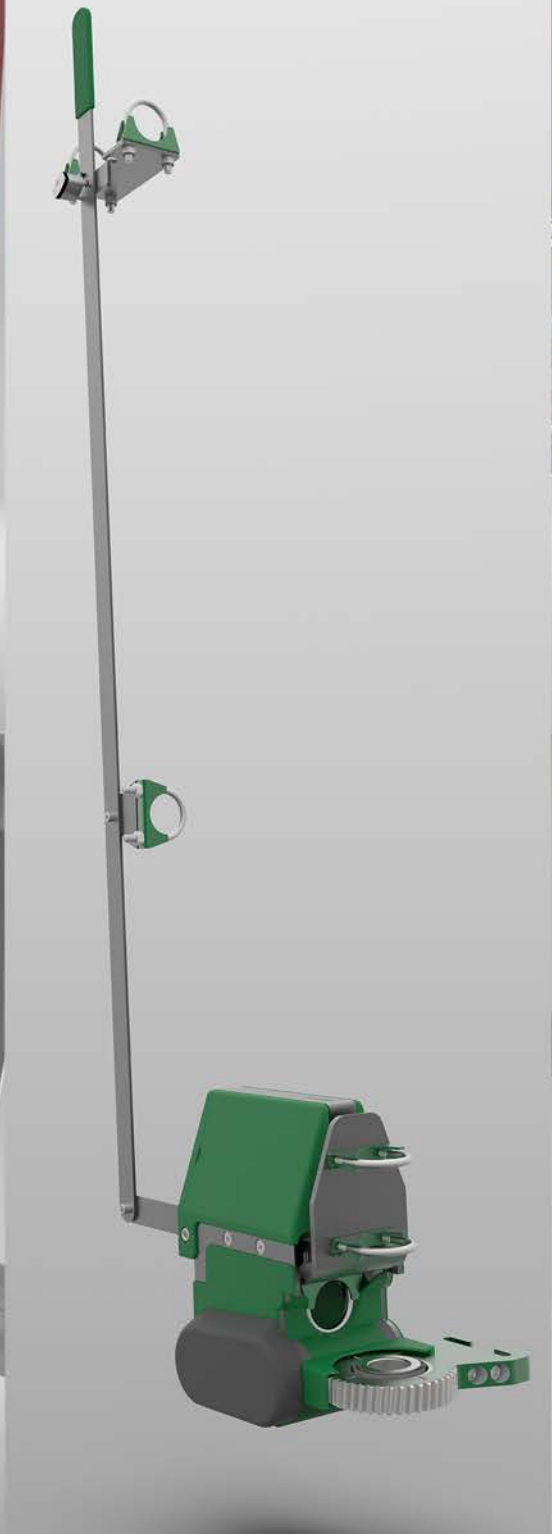
Manual Override

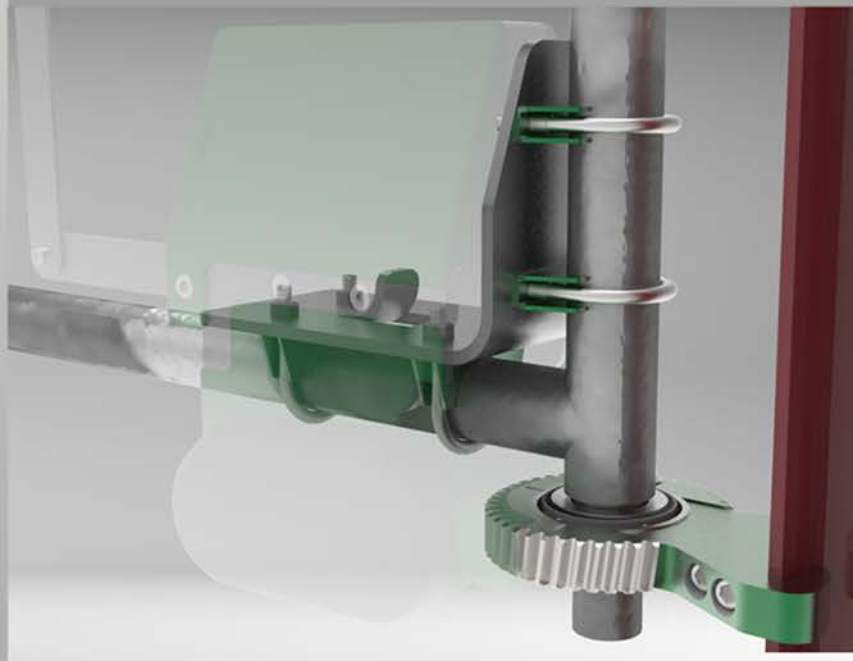


Self locking



2 Year Battery life





Fits All Standard Gates


AGRID
Meadow Gate
Status: Open
Tap AGRID To close


AGRID