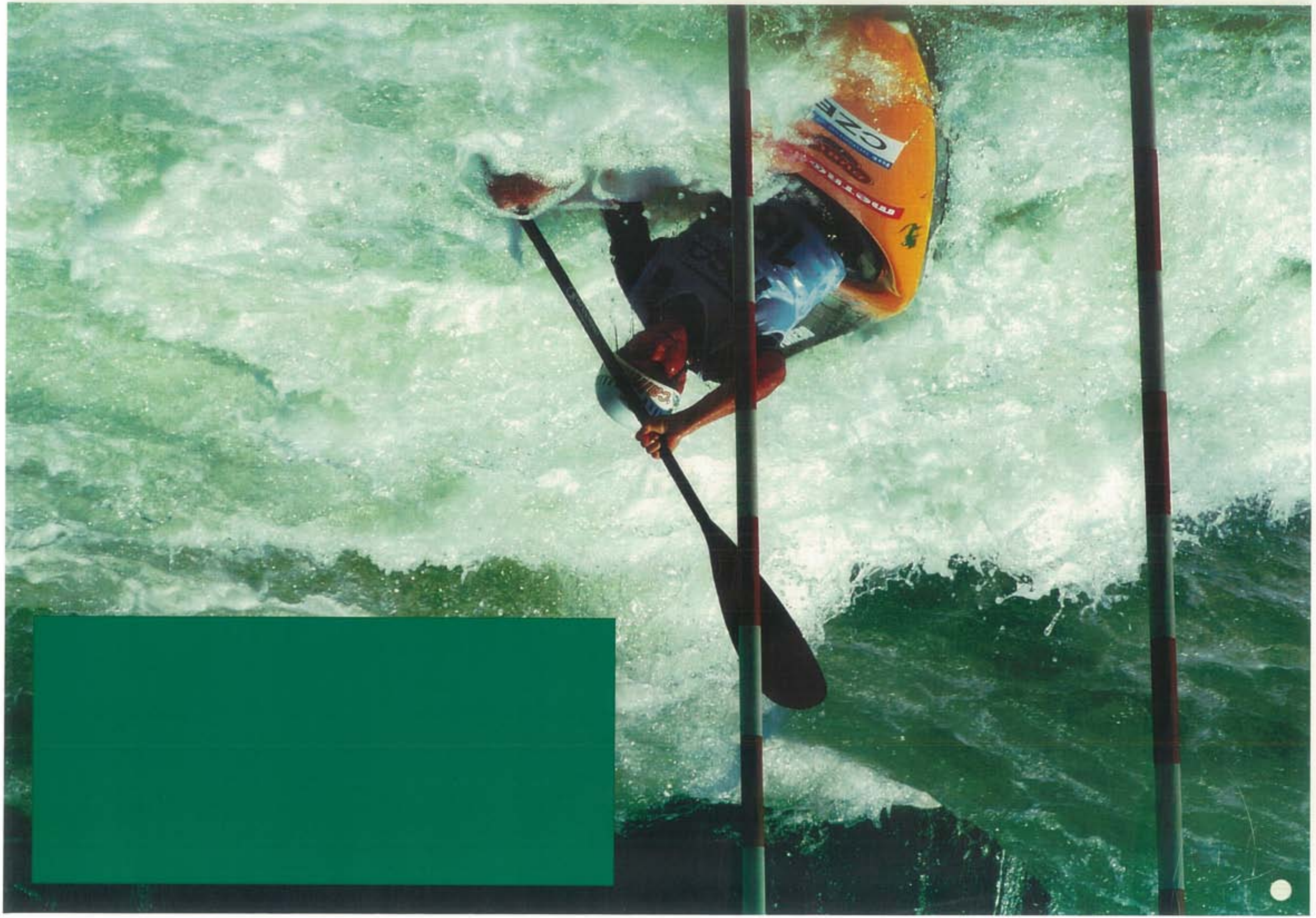
EDEXCEL

GCE Design and Technology: Product Design (A2) (Resistant Material Technology)

EXEMPLAR MATERIAL 2

Title: Kayak Camera Mount

UNIT: 6RM04



Contents

Brief

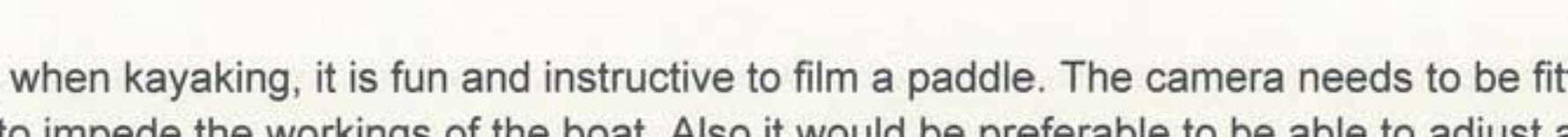
Problem

Occasionally when kayaking, it is fun and instructive to film a paddle. The camera needs to be fitted to the deck of the kayak in a way not to impede the workings of the boat. Also it would be preferable to be able to adjust and lock into position. It is often difficult to mount a camera to the front of a kayak because it often involves a homemade method with are not that secure. One existing solution to position a camera is to tie straps round the boat so it stays on. The problem with this is that it may work loose and move and hard to adjust. Also you are unable to change the direction of the camera while moving.

Brief

I would like to design a unit that can fit to the deck of a kayak and will include a fitting for a waterproof case, this will allow non waterproof camera to be used which will increase the market. The unit must easily fit to the kayak, not impede the function or damage it. The unit must be easy to fit and adjust and any mechanism must also be able cope with getting wet (including salt water) and it must be robust to take the knocks of adventurous kayaking. It must also be able to pivot 360º while paddling but must lock into position and not slip when moving I want to design this unit so that it can improve your paddle style for feedback and also to get interesting footage of a journey.

Client



My client is going to be a member of Tonbridge Canoe Club who is very experienced with kayaks he also takes A level DT as well so he also experienced with designing and making. His main concern with the unit is that the unit is vulnerable to falling off if he were to capsize and that the weight of the unit could affect the speed and handling of the kayak. However he says that there would be a good market especially to the white water kayakers who can get some good shots of the paddle.

Analysis

Waterproof Mountable Camera Case

Form

- The unit must be able to cope with hot and cold conditions e.g. in cold fast moving water
- The unit must have a smooth and sleek construction
- The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras
- Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position
- The unit must be able to fit onto any type of kayak deck
- The unit must be easy to clean out by having no small gaps to trap debris

Scale of Production and Cost

- The unit will be batch produced keeping costs down e.g. batches of 1000
- The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view
- The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good

Performance Requirements

- The unit must be strong to withstand adventurous kayaking. This will give shock loading and withstand what must be absorbed
- The unit has to be reliable even if the boat capsizes an it must have a safety line fixed to it
- The unit has to have enough space for a camera to be inserted into the case
- The unit must be lightweight as to not impede the kayaks performance or stability
- The unit must be able to point in sure direction with ease but not slip/move
- The unit must be able to rotate 360° so it can get full view of you and the surroundings
- The unit must not cause any lasting damage to the kayak

Function

- It has to have a waterproof case to fit a camera
- It has to fix onto the deck of a kayak so the paddler or journey can be filmed
- It has to be able to rotate while mounted then locked into position
- It must be able to cope with adventurous kayaking e.g. being hit by large waves
- It must keep the camera secure and comfortably
- It must be easy to fit needing few special tools and skills
- You must be able to loosen the unit to rotate it while paddling

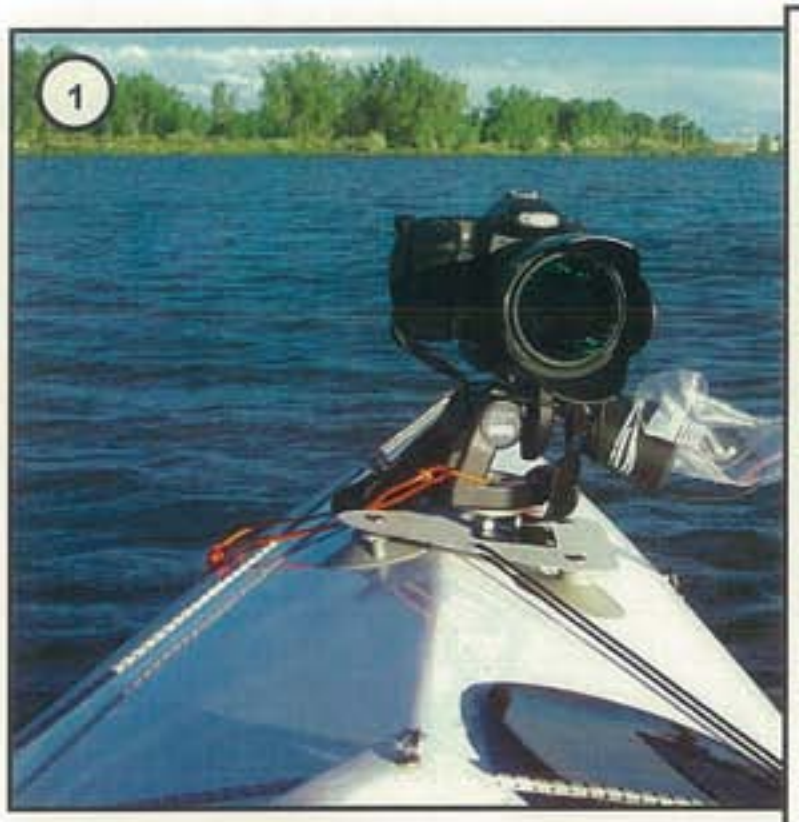
User Requirements

- The case has to store easy by being small and compact
- The camera must fit into the case with ease
- The unit must be able to disassemble easily
- You must be able to fix the unit to the kayak with few specialist tools
- You must be able to press the shoot button while paddling

Material Requirements

- The case must not be affected too much by water/saltwater
- The material must be sustainable to cope with years of adventurous paddling and rough treatment
- The case needs to be transparent so you can take a clear photo through it
- The case must be watertight and robust
- The fixtures must not be effected by water/saltwater

Research



This camera mount for a kayak, is held on by 3 suction cups making it very stable,

Advantages

- There is no need for cables round the boat preventing wear.
- Also the camera will remain safely on the boat as the suction should not be lost if wet.
- It is made from solid aluminium so it is very strong and ideal
- There is little plastic used so there is not much need for oil extraction
- The metal should stay in good condition

Disadvantages

- There is no way to absorb the shocks while paddling
- There is no case for the camera to go in so you would have to have a waterproof camera to attach on.
- The aluminium would make it very heavy
- Metal is more difficult to work with as the construction methods are harder

This design is similar to design 1 so the camera however it only has 1 suction cup

Advantages

- There is no need for cables round the boat preventing wear.
- Also the camera will remain safely on the boat as the suction should not be lost if wet.
- The unit can rotate and face any direction
- The parts are aluminium it is strong
- It does not have any plastic so there is no need for oil extraction
- It should stay in good condition and be reusable when discarded

Disadvantages

- There is no case for the camera to go in so you would have to have a waterproof camera to attach on,
- Only having 1 suction cup will make it very wobbly and it can easily lose suction and fall off
- It has no way of absorbing sudden shocks
- The aluminium would make it very heavy

This solution to fixing a camera is very bad because it is a cable tie with a piece of foam as a base,

Advantages

- It has a nice base for support meaning it can cope with any sudden jolts
- The cable ties should hold it quite securely.

Disadvantages

- The cable ties may not stop the camera slipping out of the side
- It would be difficult to mount onto the kayak.
- Another problem is that there is no case for the camera to go in so you would have to have a waterproof camera to attach on.
- All materials used are plastics so they are oil based cause extraction and damage to the environment
- The unit will not biodegrade cause large environmental impacts

This design is held onto the boat by Velcro straps

Advantages

- It is very small and simple
- It can also be easily adjusted while paddling.
- It is quite secure and is not affected by water
- It is very durable
- It has the ability to stretch and move

Disadvantages

- It is very close to the deck it cannot escape any knocks while paddling.
- The fixing the other end of the Velcro can be difficult
- Velcro is not as secure as some of the other designs
- There is no case for the camera to go in so you would have to have a waterproof camera to attach on.
- Velcro is made from nylon so when it is discarded it has to be burnt producing harmful gases

Research

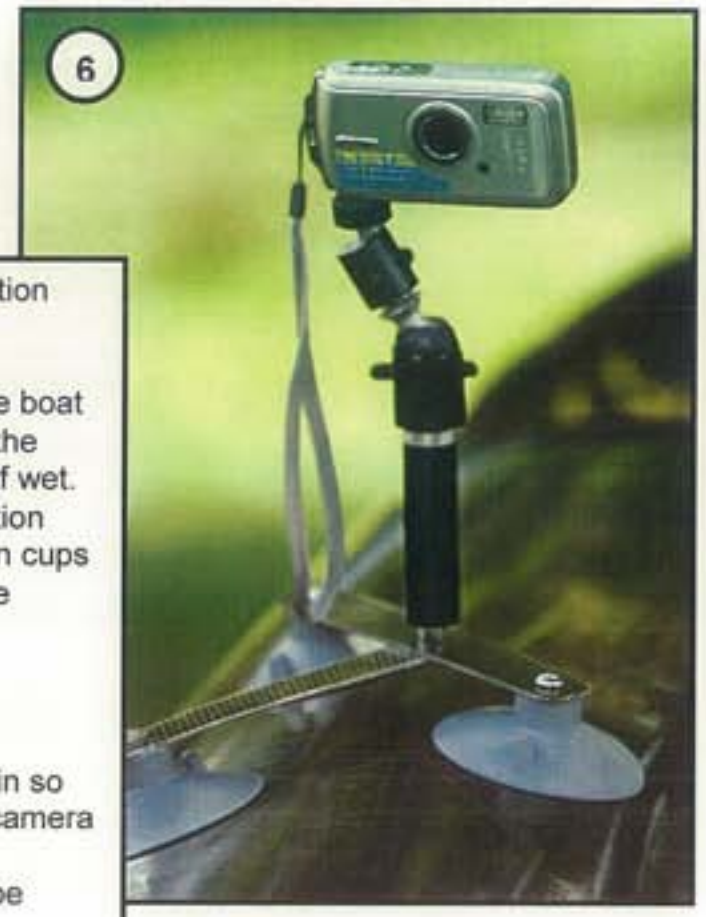
This design is held onto the boat by Velcro straps with a soft case

Advantages

- It is well protected
- There are no straps round the boat
- The Velcro straps are strong and not affected by water

Disadvantages

- It cannot be adjust easily while paddling
- It is not as secure as some the other designs
- It cannot face any other direction without taking the whole thing off
- Velcro is made from nylon so when it is discarded it has to be burnt producing harmful gases
- There is no case for the camera to go in so you would have to have a waterproof camera to attach on.



This design is held onto the boat by 3 suction cups that can be adjusted

Advantages

- There are no need for cables round the boat
- Also the camera will remain safely on the boat as the suction should not be lost if wet.
- The unit can rotate and face any direction better than other designs with 3 suction cups
- It should stay in good condition and be reusable when discarded

Disadvantages

- It has no way of absorbing shocks
- There is no case for the camera to go in so you would have to have a waterproof camera to attach on.
- The stand is small and thin so it wont be secure
- All materials used are plastics so they are oil based cause extraction and damage to the environment
- The unit will not biodegrade cause large environmental impacts

This design is held onto the boat by using a GorillaPod wrapped round the boat

Advantages

- It can be wrapped round the front of the boat with no cables or anything needing to stick to the boat
- It wont damage the boat
- It could fit on most boats

Disadvantages

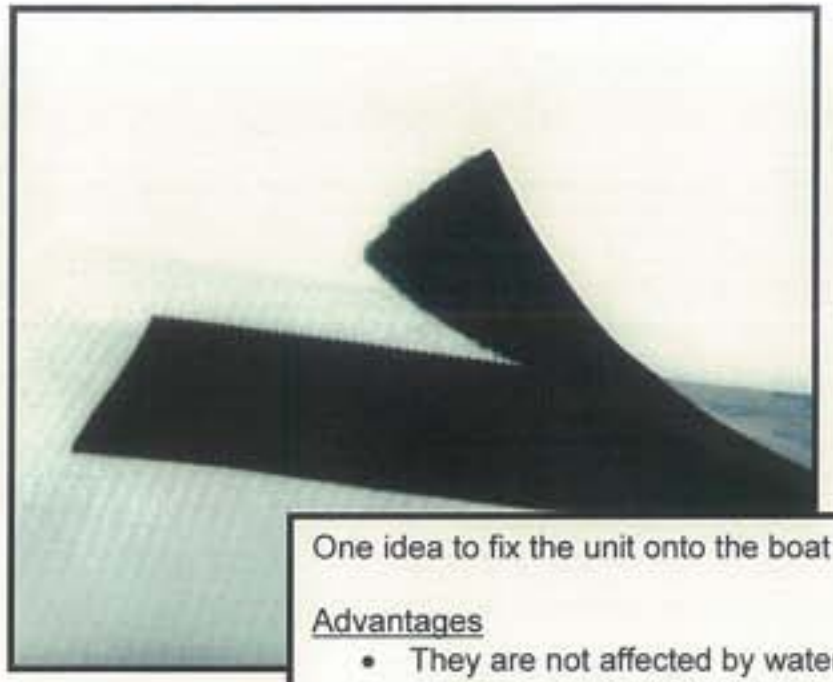
- There is no case for the camera to go in so you would have to have a waterproof camera to attach on.
- It is not very well protected
- It is not as secure as other designs
- It could scratch the boat
- It would not handle well against sudden shocks
- It is made from rubber and a thermoplastic so making these materials is made for the environment
- When discarded, the unit would have to be melted causing pollution

I like a lot of these designs however they each have certain aspects that make them unique. Design 1 will stay on the boat very well and will be very difficult to remove unless wanted. Design 2 is able to absorb some of the shocks while paddling. Design 3 can rotate to any direction and Design 4 is very small and compact and looks good. Design 5 will keep the unit very well protected. Design 6 is quite similar to design 1 but it is adjustable so it can fit onto boats better but may not be as strong. Design 7 is unique to all the other designs as it just ties on with nothing sticking to the boat.

My favourite design out of all of them is design 1 because it would be very secure, stays low on the boat and looks quite good.

Each design has a certain key aspect that I wish to combine to one design to make it all good in all areas but all of these 7 designs don't have one feature which I think is a feature that I want in my design. No of them have the ability to take a non-waterproof camera and put it into a case which will take the shots without any danger of damaging the camera so I think that this will be a very key part of my unit.

Research



One idea to fix the unit onto the boat is by using Velcro straps;

Advantages

- They are not affected by water
- They are quite strong when pulled parallel to the strap
- They are very small and not that noticeable
- They can mould to the shape of the deck
- They will not damage the boat
- Can be fixed to anywhere on the deck
- It is very durable
- It has the ability to stretch and move

Disadvantages

- They are not strong when pulled perpendicular to the boat
- Alternative ideas could be stronger and more reliable
- Velcro is made from nylon so when it is discarded it has to be burnt producing harmful gases
- The fixing the other end of the Velcro can be difficult

One of my ideas is using suction cups-similar to the handle you fix onto glass sheets;

Advantages

- They are very strong
- They are very reliable
- They are not affected by water
- It will not damage the boat
- It can be fixed onto anywhere to the boat

Disadvantages

- It is quite bulky
- It cannot fit to a rounded boat easily
- All materials used are plastics so they are oil based cause extraction and damage to the environment
- The unit will not biodegrade cause large environmental impacts

Another of my ideas is using magnets with one side on the deck and the other underneath, inside the kayak;

Advantages

- It will be quite strong
- It is quite small
- It will not damage the boat
- It is not affected by water
- It is made from solid metal so it is very strong
- It does not have any plastic so there is no need for oil extraction
- It should stay in good condition and be reusable when discarded

Disadvantages

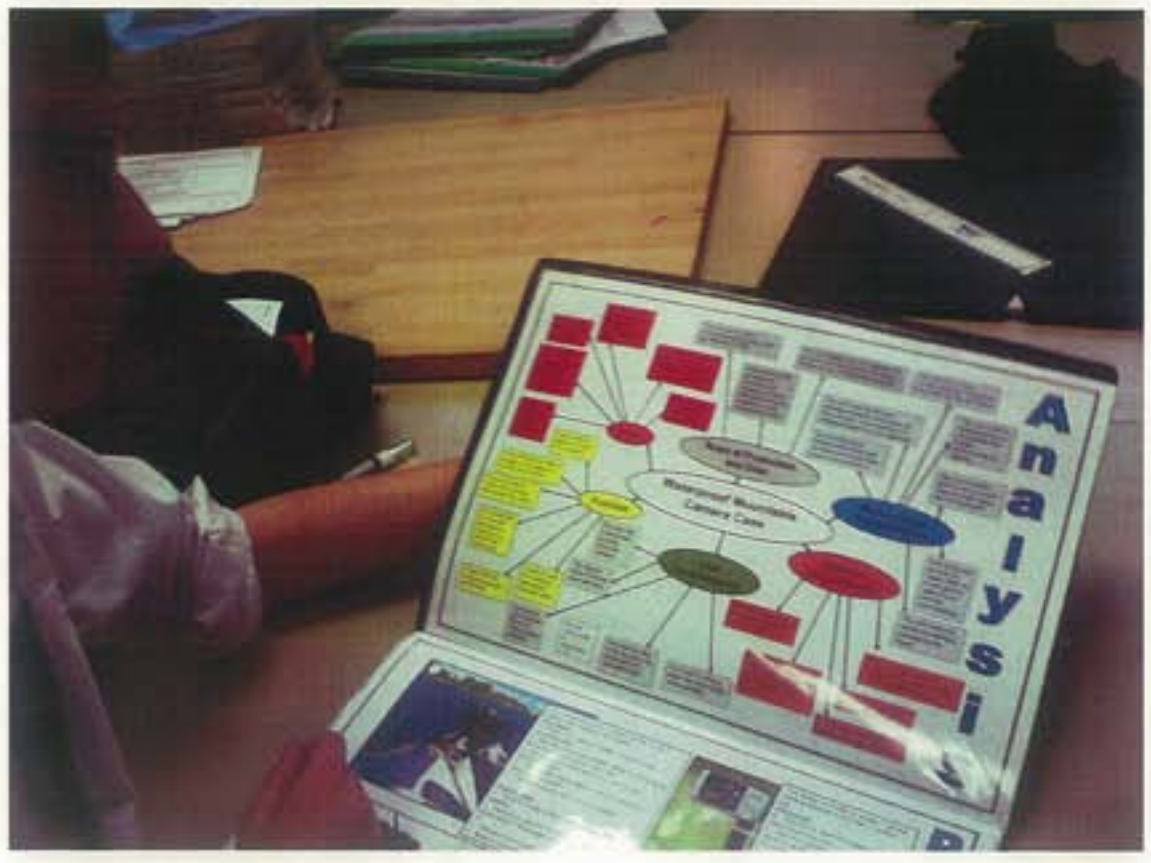
- It is not as strong as alternative ideas
- It cannot fit to a rounded boat
- It would be very hard to fix to the front of the boat
- The metal would make it very heavy

My favourite idea for fixing the camera to the boat is the Velcro straps because they are very small and compact, they can be quite strong but one of the best advantages to them is that they can mould to any boat shape which other cant. I will need to see how well each meets my criteria in tests

Client

My client who has extensive knowledge of kayaking looked through my analysis and highlighted they key points and other things that he think should be added. The main points are relating to the fact it maybe hindering the performance of the kayak or preventing you from reaching your full potential. The main concerns of the unit is it being too heavy which would hinder the kayaks performance as dead weight and also the kayak must not be too big or too tall as a lot of kayaks are slim and having the kayak tall will increase the centre of gravity and greatly increase the risk of capsizing.

Other key feature is that he wants it to look good on a boat; he suggested a neutral colour to finish it with that will match any style and colour of boat. As long as the unit will be able to take a good shot of your technique or the surroundings easily then the market for the stand is very good as a lot of people want to improve or take films of the surroundings



Specification

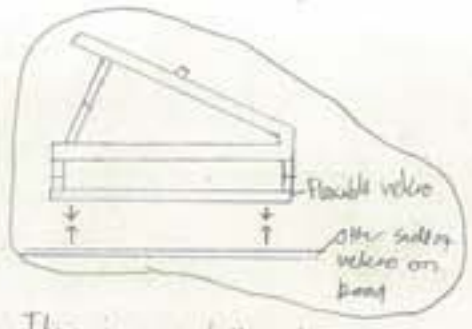
	Specification Point
Form	The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position The unit must be able to cope with hot and cold conditions with the materials not being affected by the weather The unit must have a smooth and sleek construction by using quality materials and having a smooth finish The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras The unit must be easy to clean out by having no small gaps to trap debris increasing the life of the unit
Function	The unit must be able to hold a digital camera allowing all types of camera to be used increasing the market potential The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong The unit must be able to rotate when needed but must stay locked when not needed this will be done by the fixture able to move freely to any angle but lock in place The unit must be able to cope with adventurous kayaking with the camera not taking any water damage and for it to be protected against knocks The unit must be able to keep the camera safe and secure but is still able to take photos clearly The unit must be able to fit easily with few tools/skills increasing the market in who can use it
User Requirements	The unit has to store easy by being small/ light and compact The camera must fit into the case with ease by not being to tight and to fit any type of camera but still manages to absorb shocks You must be able to loosen the unit to rotate it while paddling so you are able to look at the surroundings and to look at your technique The unit must be able to disassemble easily otherwise it can be annoying to the user You must be able to fix the unit to the kayak with few specialist tools/skills so it can be used by anyone You must be able to press the shoot button while paddling which means a slot for you finger has to be added but still keeping the unit watertight
Material Requirements	The case/fixtures must not be affected too much by water/saltwater this could be done by a sealed container and with non rusting materials The material must be sustainable to cope with years of adventurous paddling and rough treatment by having a protective finish The unit must be sustainable and can be recycled when disposed
Performance Requirements	The unit must not cause any lasting damage to the kayak by not having to drill into the kayak The unit must be able to rotate 360° so it can get full view of you and the surroundings. The unit must be able to point in sure direction with ease but not slip/move which must be done at the joint to let the top half move The unit must be lightweight as to not impede the kayaks performance or stability by not being too heavy or too big The unit has to have enough space for an average camera to be inserted into the case but still able to take videos The unit must be strong to withstand adventurous kayaking, this can be achieved by quality materials used and a quality finish The unit has to be reliable even if the boat capsizes, this could be done with a safety line attached to the camera and the boat
Scale of Production and Cost	The unit will be batch produced keeping costs down e.g. batches of 1000, this means that the unit can be made to order and not a continuous production The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good as it is not too expensive The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view this will be achieved by full rotation of the devise
Size, safety and quality	The unit must not be too big on the boat as this will affect the performance of the kayak, this can be done by making the unit low on the boat and using light materials The unit must be made with quality materials meaning the unit will be strong, light and not corrode over time The unit must not have any finger traps which can be avoided with covered moving parts

My client looked at my specification and he highlighted what are the key points that need to be addressed in my design. I will try and concentrate on these points as they are the most crucial in the making of my unit

I plan to make the unit out of ABS plastic because it is ~~strong~~, has a ~~high~~ impact resistance. It is resistant to water. It can be manufactured in many colours. It can also be ~~vapour~~ moulded

Idea evaluation 2

Most canvas have a 1/4" diameter 20 ~~words~~ per inch Screw hole in the bottom allowing it to be fixed to a keypad. I plan to use this to fix the canvas to the unit



There is one bottom layer made from velcro which is attached to the rest of the unit. The other side of the Velcro is attached to the board with an adhesive

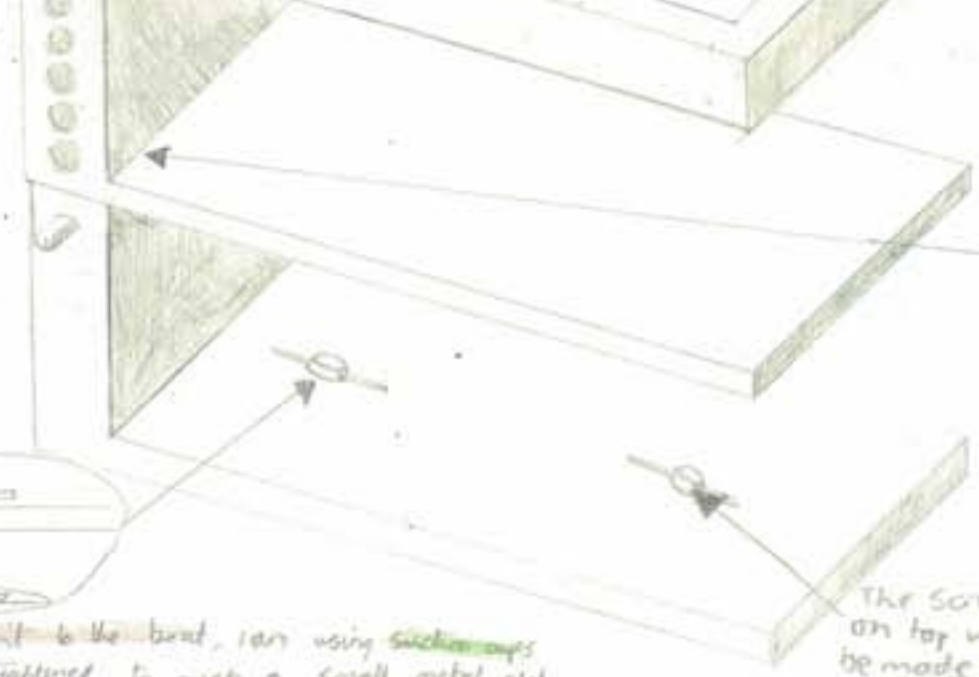
The mechanism for my design is to have two tubes sliding into each other which is regulated by a spring and is tightened by a Screw on the top

I will make these parts from brass which is very strong and can easily be worked with especially on a lathe

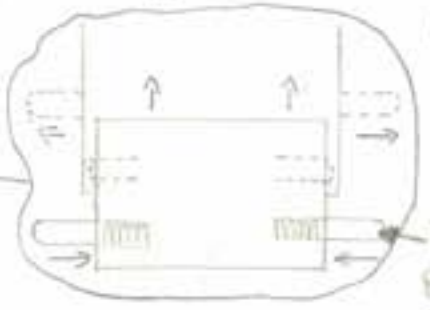
The spring will be inside the inner tube

The canvas will slot into the top and sit on the middle layer

I am going to make the unit out of ABS plastic, this is because it is ~~strong~~, has a ~~high impact~~ resistance. It can be made to different colours and it is ~~rigid~~ mouldable



Cross section of the side



These small parts will be made from brass as it can easily be casted to be mass produced

My mechanism for securing the unit is to press in the two buttons and sliding the unit until the buttons spring back into a hole

To fix the unit to the board, I am using suction cups which are tightened to push a small metal plate down, forcing the air out and creating a light vacuum to keep it on the board

The screws on top will be made from brass so that it can be casted and easily manufactured

I plan to have a simple spring system in order to absorb any sudden shocks that may occur while paddling. This will be done by one tube sliding into another

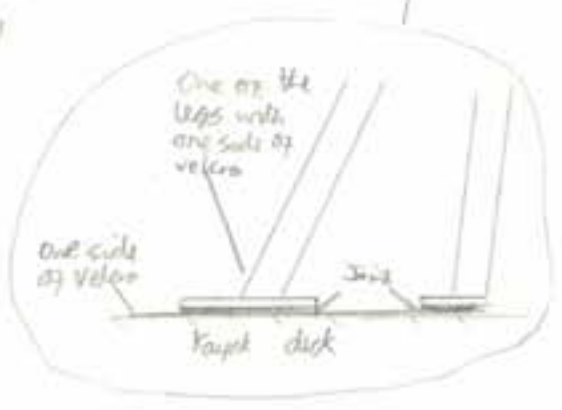
Idea evaluation 1

I plan to make the unit out of ABS plastic because of its key properties, it is very strong has an high impact resistance, it is resistant to water can be made to different colours and can be ~~vapour~~ moulded

I plan to use the 1/4" diameter screw hole to secure the canvas to the unit

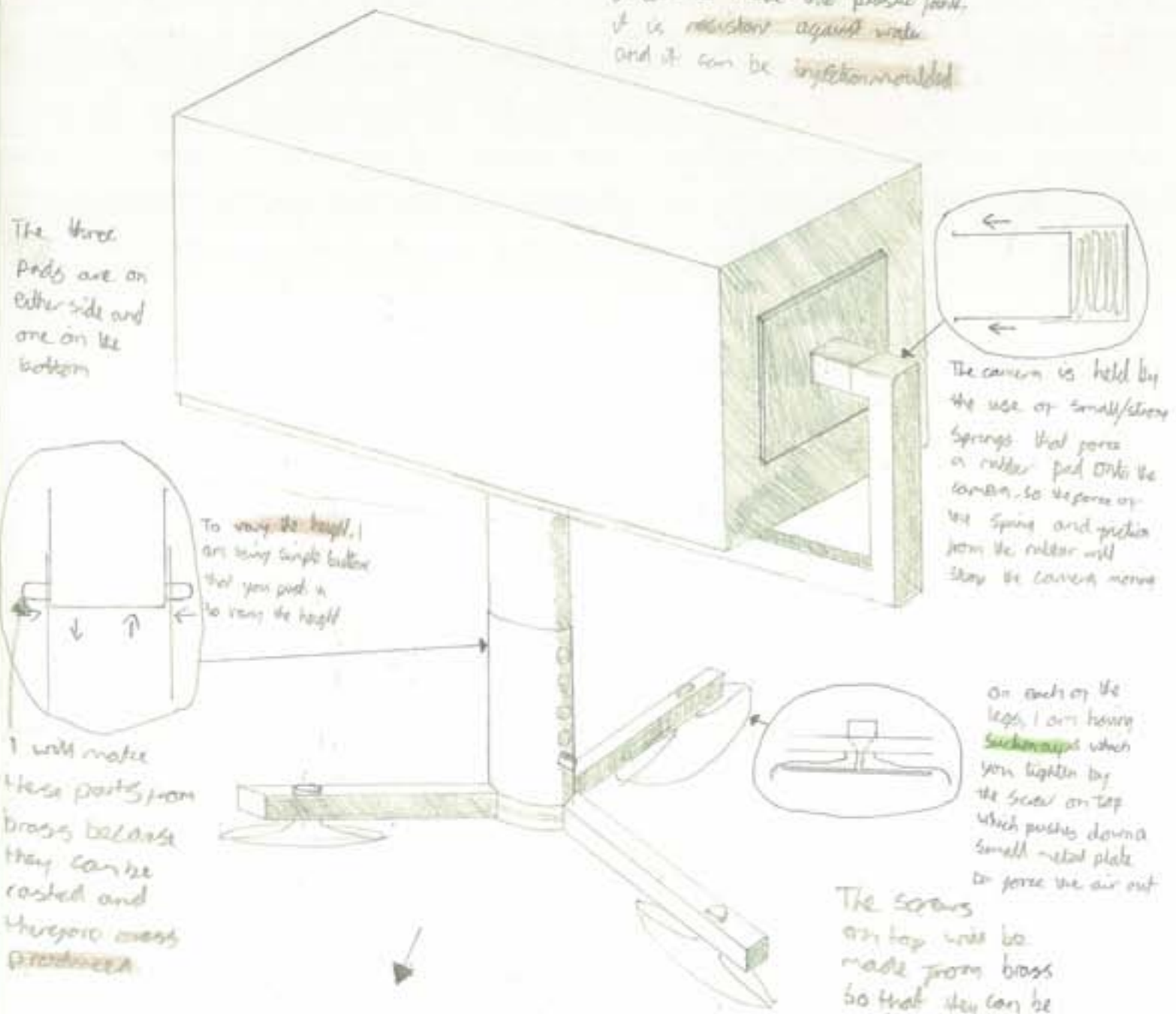
I will make this screw from stainless steel so it won't snap off and it can be topped

I plan to make the legs out of polypropylene in four different sections because PP is stackable plastic



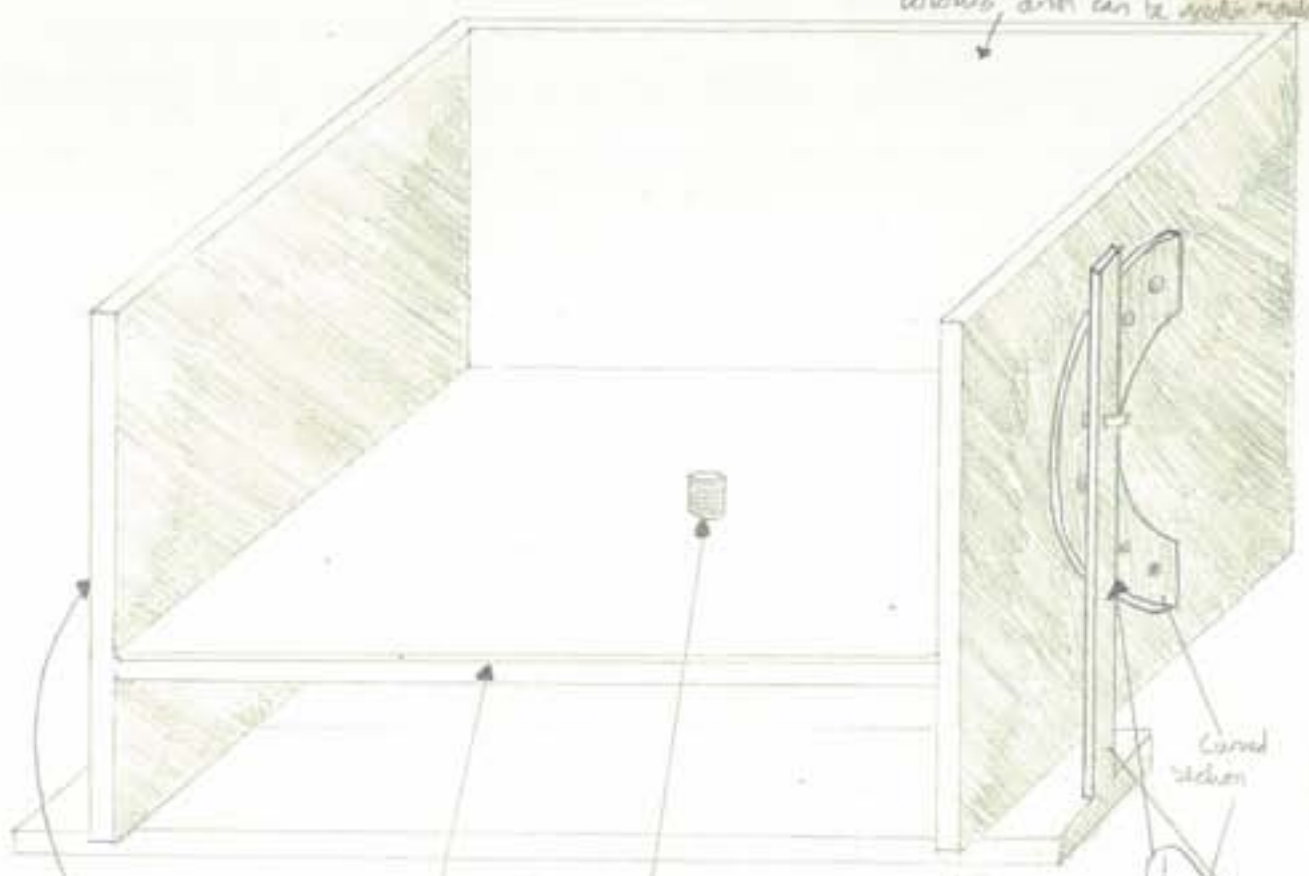
To secure the unit to the kayak, I plan to have a seperate piece of velcro that will permantly glue on by an adhesive. This means that the unit can be in different places and different angles

I plan to make the design out of polypropylene because it is hard, has good impact resistance, it can be made into plastic joints, it is resistant against water and it can be injection moulded



This cross section of my design shows how I am going to fix the camera into place. I will have 3 rubber pads that are spring held and friction will stop the camera sliding

I plan to make this design out of ABS plastic because it is very strong, has high impact resistance, it is resistant to weather, it can be made to different colours, and can be injection moulded



My idea for this side is for a piece on the stand will remain permanently in the curved 'C' piece. However, in that piece, it is allowed to move and not fall off

The camera will fit onto the standard 1/4" diameter, 20 threads per inch screw to allow the camera to fit on

I intend to move the whole unit apart from the stand to vary the angle. I will do this by a curved 'C' piece on both sides. This piece will have holes on one side with a screw to hold in place, where on the other side, the stand remains attached yet free to move the main unit

I plan to have a the removable layer with the screw hole on. This means you can put the camera on easily then you secure that piece on with the magnets on each side

Ideas

Ideas Evaluation 1

	Specification Point	Met/ Can it be altered	How can it be altered?
Form	1. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 2. Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position 3. The unit must be able to cope with hot and cold conditions with the materials not being affected by the weather 4. The unit must have a smooth and sleek construction by using quality materials and having a smooth finish 5. The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras 6. The unit must be easy to clean out by having no small gaps to trap debris increasing the life of the unit	Needs to be altered	• The unit does not have a container to fit any type of camera in. I could achieve this by having a clear case that the camera can sit in • The unit also has some small places for dirt to get trapped in. I could prevent this by covering the mechanisms • This design meets all the other specifications
Function	7. The unit must be able to hold a digital camera allowing all types of camera to be used increasing the market potential 8. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 9. The unit must be able to rotate when needed but must stay locked when not needed this will be done by the fixture able to move freely to any angle but lock in place 10. The unit must be able to cope with adventurous kayaking with the camera not taking any water damage and for it to be protected against knocks 11. The unit must be able to keep the camera safe and secure but is still able to take photos clearly 12. The unit must be able to fit easily with few tools/skills increasing the market in who can use it	Needs to be altered	• The unit cannot rotate to look in different directions. This could be achieved by a mechanism to loosen the unit then twist it • The design meets all other design specifications
User Requirements	13. The unit has to store easy by being small/ light and compact 14. The camera must fit into the case with ease by not being to tight and to fit any type of camera but still manages to absorb shocks 15. You must be able to loosen the unit to rotate it while paddling so you are able to look at the surroundings and to look at your technique 16. The unit must be able to disassemble easily otherwise it can be annoying to the user 17. You must be able to fix the unit to the kayak with few specialist tools/skills so it can be used by anyone 18. You must be able to press the shoot button while paddling which means a slot for you finger has to be added but still keeping the unit watertight	Needs to be altered	• The design cannot freely rotate to look in different directions. This could be achieved by a mechanism to loosen the unit then twist it • There is no way to press the shoot button while paddling, this could be achieved with a line to press the button while moving • The unit does not have a container to fit any type of camera in. I could achieve this by having a clear case that the camera can sit in • The design meets all other specification points
Material Requirements	19. The case/fixtures must not be affected too much by water/saltwater this could be done by a sealed container and with non rusting materials 20. The material must be sustainable to cope with years of adventurous paddling and rough treatment by having a protective finish 21. The unit must be sustainable and can be recycled when disposed	Met	
Performance Requirements	22. The unit must not cause any lasting damage to the kayak by not having to drill into the kayak 23. The unit must be able to rotate 360° so it can get full view of you and the surroundings. 24. The unit must be able to point in sure direction with ease but not slip/move which must be done at the joint to let the top half move 25. The unit must be lightweight as to not impede the kayaks performance or stability by not being too heavy or too big 26. The unit has to have enough space for an average camera to be inserted into the case but still able to take videos 27. The unit must be strong to withstand adventurous kayaking, this can be achieved by quality materials used and a quality finish 28. The unit has to be reliable even if the boat capsizes, this could be done with a safety line attached to the camera and the boat	Needs to be altered	• The design cannot freely rotate to look in different directions. This could be achieved by a mechanism to loosen the unit then twist it • The unit doesn't have a safety line to secure it in an accident; this could be achieved with a line that can go around the hull. • The design meets all other specification points
Scale of Production and Cost	29. The unit will be batch produced keeping costs down e.g. batches of 1000, this means that the unit can be made to order and not a continuous production 30. The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good as it is not too expensive 31. The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view this will be achieved by full rotation of the devise	Met	
Size, safety and quality	32. The unit must not be too big on the boat as this will affect the performance of the kayak, this can be done by making the unit low on the boat and using light materials 33. The unit must be made with quality materials meaning the unit will be strong, light and not corrode over time 34. The unit must not have any finger traps which can be avoided with covered moving parts	Needs to be altered	• The unit is quite tall which will affect the centre of gravity, I need to make the unit smaller to perform better • The unit also has some small places for dirt to get trapped in. I could prevent this by covering the mechanisms • The design meets all other specification points

My clients main opinions with this design is that it is too big and it will affect the performance of the kayak. However, he thinks it looks good and has some aspects that are very good such as how it fits onto the boat. He thinks that there are some other designs that are better than this one

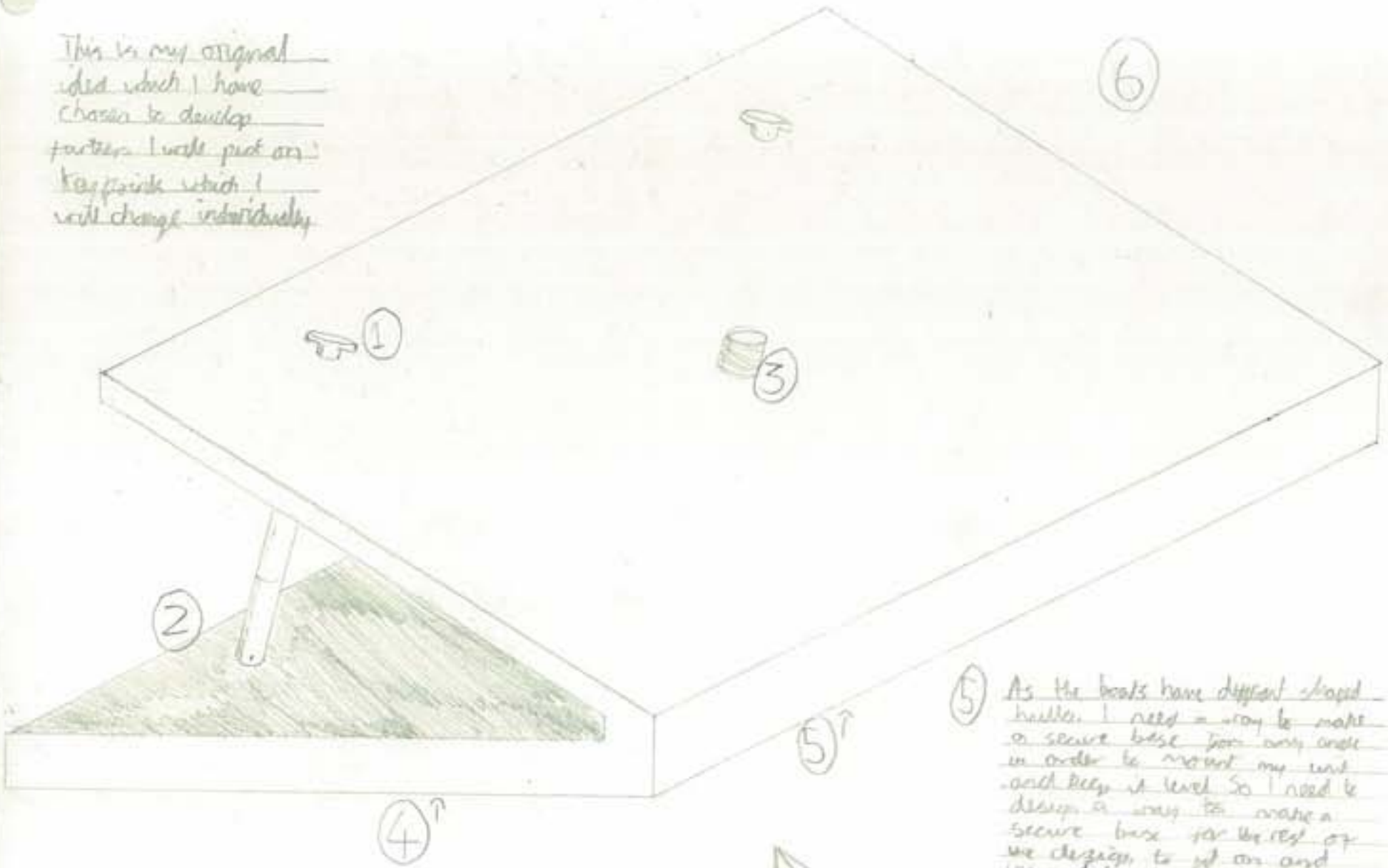
Ideas Evaluation 2

	Specification Point	Met/ Can it be altered	How can it be altered?
Form	1. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 2. Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position 3. The unit must be able to cope with hot and cold conditions with the materials not being affected by the weather 4. The unit must have a smooth and sleek construction by using quality materials and having a smooth finish 5. The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras 6. The unit must be easy to clean out by having no small gaps to trap debris increasing the life of the unit	Needs to be altered	• The unit does not have a container to fit any type of camera in. I could achieve this by having a clear case that the camera can sit in • This design meets all the other specifications
Function	7. The unit must be able to hold a digital camera allowing all types of camera to be used increasing the market potential 8. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 9. The unit must be able to rotate when needed but must stay locked when not needed this will be done by the fixture able to move freely to any angle but lock in place 10. The unit must be able to cope with adventurous kayaking with the camera not taking any water damage and for it to be protected against knocks 11. The unit must be able to keep the camera safe and secure but is still able to take photos clearly 12. The unit must be able to fit easily with few tools/skills increasing the market in who can use it	Met	
User Requirements	13. The unit has to store easy by being small/ light and compact 14. The camera must fit into the case with ease by not being to tight and to fit any type of camera but still manages to absorb shocks 15. You must be able to loosen the unit to rotate it while paddling so you are able to look at the surroundings and to look at your technique 16. The unit must be able to disassemble easily otherwise it can be annoying to the user 17. You must be able to fix the unit to the kayak with few specialist tools/skills so it can be used by anyone 18. You must be able to press the shoot button while paddling which means a slot for you finger has to be added but still keeping the unit watertight	Needs to be altered	• The design can look in one plane of direction however it may be better to have it able to look in other directions • There is no way to press the shoot button while paddling, this could be achieved with a line to press the button while moving • The unit does not have a container to fit any type of camera in. I could achieve this by having a clear case that the camera can sit in • The design meets all other specification points
Material Requirements	19. The case/fixtures must not be affected too much by water/saltwater this could be done by a sealed container and with non rusting materials 20. The material must be sustainable to cope with years of adventurous paddling and rough treatment by having a protective finish 21. The unit must be sustainable and can be recycled when disposed	Met	
Performance Requirements	22. The unit must not cause any lasting damage to the kayak by not having to drill into the kayak 23. The unit must be able to rotate 360° so it can get full view of you and the surroundings. 24. The unit must be able to point in sure direction with ease but not slip/move which must be done at the joint to let the top half move 25. The unit must be lightweight as to not impede the kayaks performance or stability by not being too heavy or too big 26. The unit has to have enough space for an average camera to be inserted into the case but still able to take videos 27. The unit must be strong to withstand adventurous kayaking, this can be achieved by quality materials used and a quality finish 28. The unit has to be reliable even if the boat capsizes, this could be done with a safety line attached to the camera and the boat	Needs to be altered	• The design can look in one plane of direction however it may be better to have it able to look in other directions • The unit doesn't have a safety line to secure it in an accident; this could be achieved with a line that can go around the hull. • The design meets all other specification points
Scale of Production and Cost	29. The unit will be batch produced keeping costs down e.g. batches of 1000, this means that the unit can be made to order and not a continuous production 30. The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good as it is not too expensive 31. The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view this will be achieved by full rotation of the devise	Met	
Size, safety and quality	32. The unit must not be too big on the boat as this will affect the performance of the kayak, this can be done by making the unit low on the boat and using light materials 33. The unit must be made with quality materials meaning the unit will be strong, light and not corrode over time 34. The unit must not have any finger traps which can be avoided with covered moving parts	Needs to be altered	• The unit is quite tall which will affect the centre of gravity, I need to make the unit smaller to perform better • The design meets all other specification points

My client like this design a lot, he thinks it works a lot better than the previous one, with a lot more of the specification points being met. His only critisizm of the design it that it can look up and down but not side to side and this could be adressed. His main concern of this whole project is that it could affect the performance of the boat by being too big/too heavy but this design has not done this. We both agree that this design should be be the one to use to build

Development

This is my original idea which I have chosen to develop further. I will put on a key guide which I will change individually



(1) My first issue with my original design is the fact that the screw that will be used to tighten the mechanism to change the angle, is in the way this could create problems when fixing the camera down to the unit as it may hit the camera or scratch it. Another issue with the screws is the fact they are small they will be hard to grip. This means they will be hard to tighten causing problems. I intend to answer this problem in my next design

(2) Another problem with my design is the method to change the angle. I feel my original method using screws to pull a spring down may become worn over time. I also think that the two pieces may dislodge regardless the whole design or they may break due to the stresses the spring is under and the thickness of the pieces being small and flimsy

(3.) Another issue with my design is the method of fixing the camera down to the unit. I feel that physically turning the camera will be awkward and there is a simpler solution to use the same screw hole, but a similar method of using it

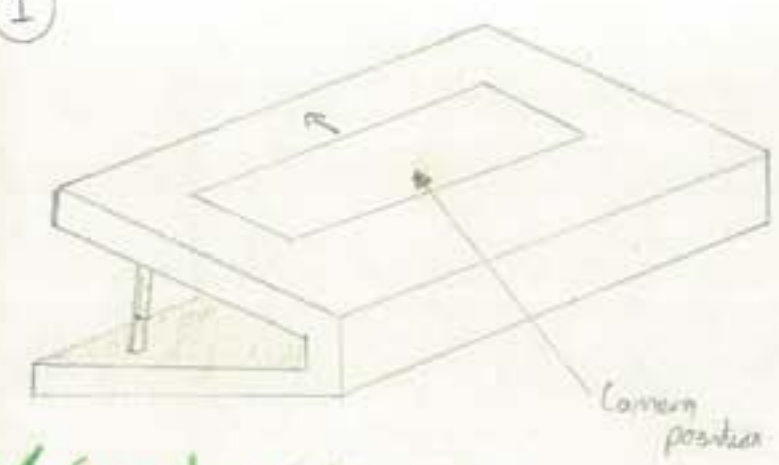
(4) I have designed my unit to vary in angle for the height of paddler but I have not thought about varying the side to side angle. I think that this would give my design a lot more potential because you would be able to see yours and another person technique as you paddle.

(5) As the boats have different shaped hulls, I need a way to make a secure base for any one in order to mount my unit and keep it level. So I need to design a way to make a secure box for the rest of the design to sit on and incorporate it with clamps it to the boat

(6) I am not happy with the shape of my design. I think that it is very simple and boring. I think that a design that would fit with a boat design would look a lot better and it would more appealing

Development

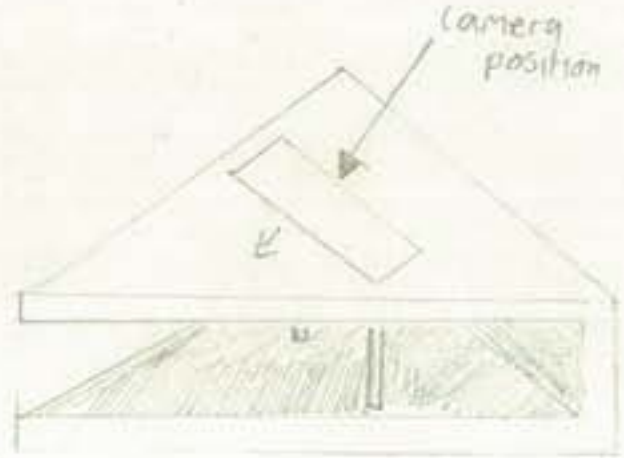
1



✓- Good points
- Simple
- Easy to build
- Fits shape of camera
- Not much wasted space

X- Bad points
- Very boring
- Not nice to look at
- Doesn't suit shape of boat

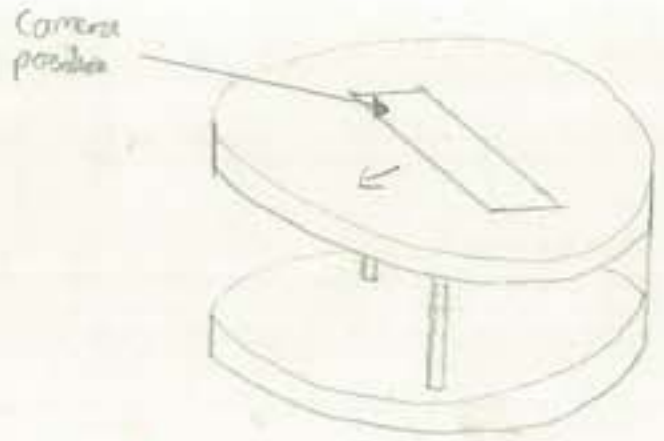
2



✓- Good points
- More exciting design
- Fits shape of boat better
- Relatively simple

X- Bad points
- Lots of wasted space
- Harder to construct

3

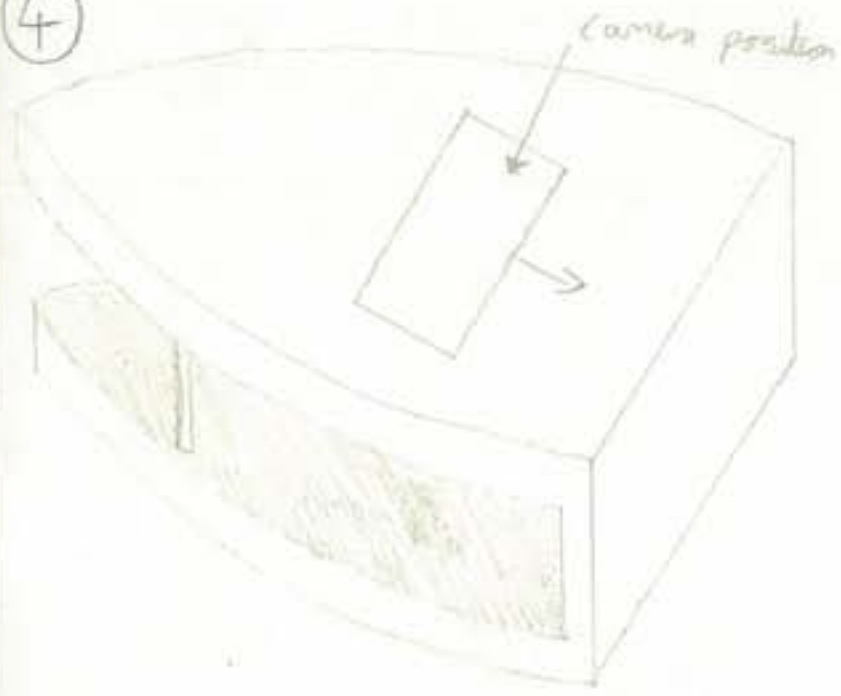


✓- Good points
- More exciting shape
- Matches boat better

X- Bad points
- Too complicated
- Hard to build
- Lots of wasted space

I was looking at alternative shapes for my design. I think the best idea is design 4 as it matches the boat style well and it looks the best. I will use the texture features from my previous design but not the shape

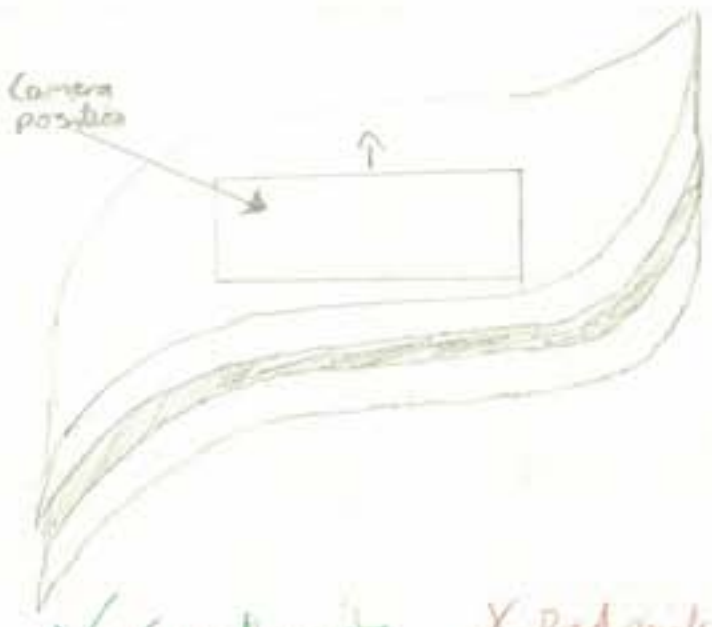
4



✓- Good points
- Fits boat shape excellently
- Looks very good

X- Bad points
- Lots of wasted space
- Harder to build

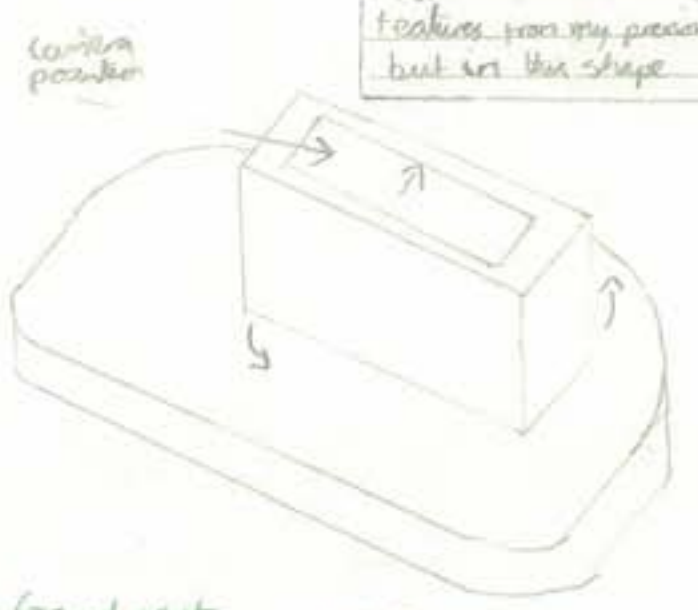
5



✓- Good points
- Looks very nice
- Not too much wasted space

X- Bad points
- Hard to build
- Doesn't match boat shape

6



✓- Good points
- Fits shape of the boat better

X- Bad points
- Highly impractical
- Over complicated
- Does not meet specification
- Hard to build
- Not nice aesthetically

Development - Testing

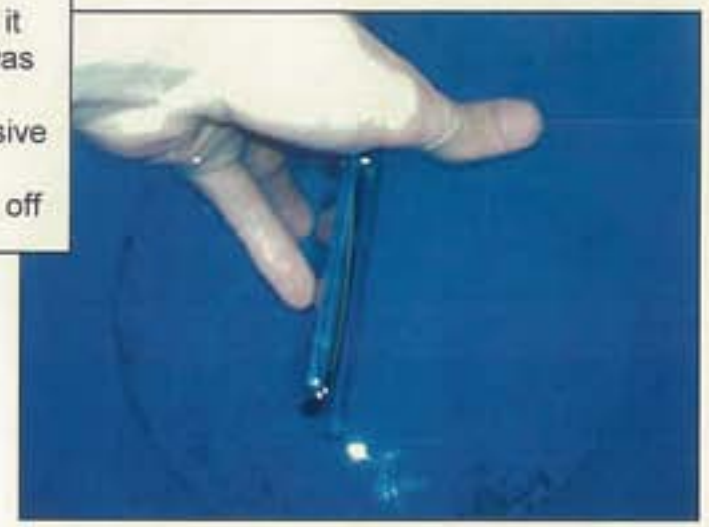
For my design, I wish to fix the unit to the boat, to do this I need a good fixing to the boat and another good fixing to put it. My initial idea was Velcro, Velcro's hook and loop strips would be ideal for my unit as it can mould to the shape of any boat and it is very thin so it won't take up a lot of space. I wanted too see the strength of the adhesive of the back of the strips, to see it would react when sliding force is applied and to also so the same but when the Velcro is wet. To do this I bought some Velcro that had an adhesive backing and I cut some acrylic to fix the Velcro to, I also screw wood to the back of them to make it easier to fix to a vice. I made three of these testing units in case they were to break

1

This is my first test I did on my Velcro. I wanted to see its sliding capabilities. I did this by drilling one hole in the Velcro and hanging a weight off it which stuck to the other side of the Velcro which was secure to a vice. I started with 2kgs but I thought that they Velcro could hold a lot more some I increased the weight to 38kgs when I run out of weights and space to put it on. I wanted to see if the Velcro would wear after repeated use. I managed to put 38kgs again on the Velcro but this time I did come off which does show that it will wear over time but this is due to the extreme weights it was under.

The Velcro I have has an adhesive backing on the other side; I wanted to see how well this would perform when wet as I didn't want the unit sliding off when it gets a little damp. I did this by submerging the Velcro underwater and keeping it under a running tap while I tried to pick it off, I was unsuccessful I doing this as I could not get underneath it. This proves how strong my adhesive backing is and as long as it has been applied correctly with no air bubbles, it should not come off

2



3

Due to the whole unit being in a water environment, I wanted to see if the Velcro would react differently when wet, to do this I did the same as the other weight test by drilling one hole in the Velcro and hanging a weight off it which stuck to the other side of the Velcro which was secure to a vice only this time, the Velcro was wet and water was applied to the gap between the Velcro during the test. I managed to get the weight to 34kgs until it broke, it was 4kgs less than the dry test but still performed excellently, well above what I had expected.

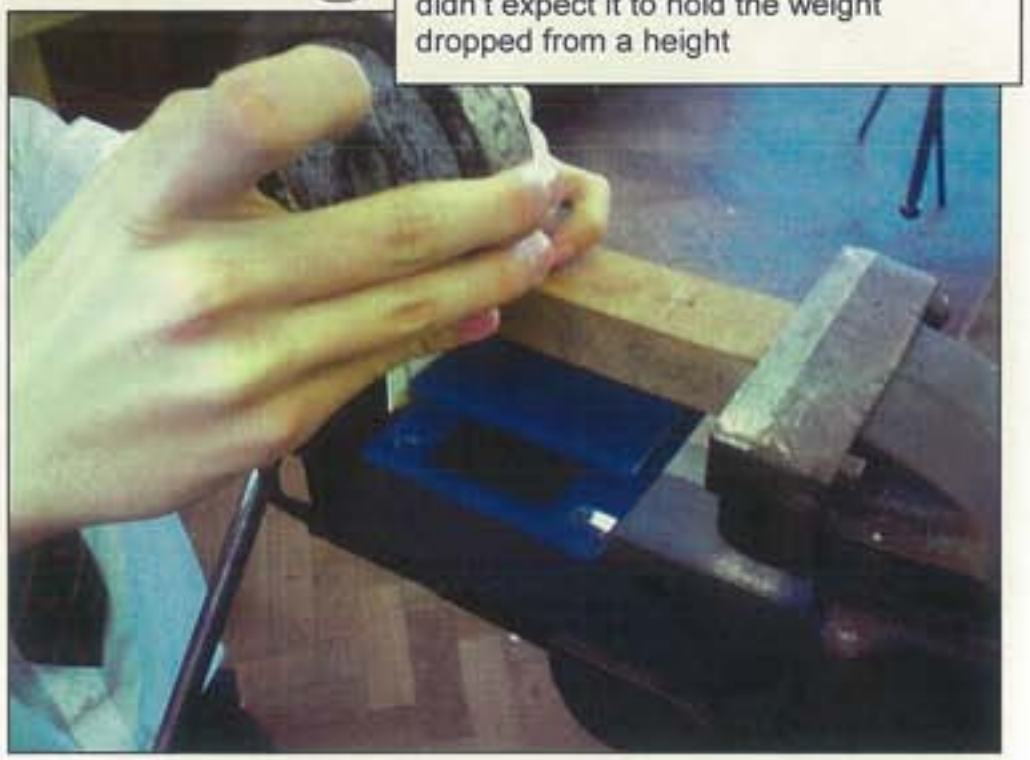
Development - Testing

4

Another one of my test was to measure the Velcro's strength perpendicular to the plane it is stuck on. I feel that this is a crucial point to test for my design. I carried out this test by drilling four holes on each corner on one side of the acrylic with Velcro. This was stuck to the other side of Velcro with was attached to a vice. I then hung weights on these four corners and added weights to each corner at the same time. I added weights by the 100g to each corner until the total weight was 5.6kgs. I ran out of space to put the weights on but when gentle force was applied, the bottom piece came off so it would not have held much weight. This shows the change in strength when weight is applied in different directions.

5

I wanted to see how strong the Velcro was when sudden impact was applied so I designed an experiment to test this, I was going to drop a 1kg weight from a height of 2cm above the Velcro. I did this test 3 times and each time the Velcro broke off on the side it was dropped on but it stayed attached on the other side. This shows that the Velcro is not very good under sudden impact however it was only a small piece of Velcro that actually held it on (5cm by 5cm) so I didn't expect it to hold the weight dropped from a height



I think that the Velcro is a remarkable piece of material, it has managed to hold extreme weights with so little of it, I think that it would be ideal to use in my design

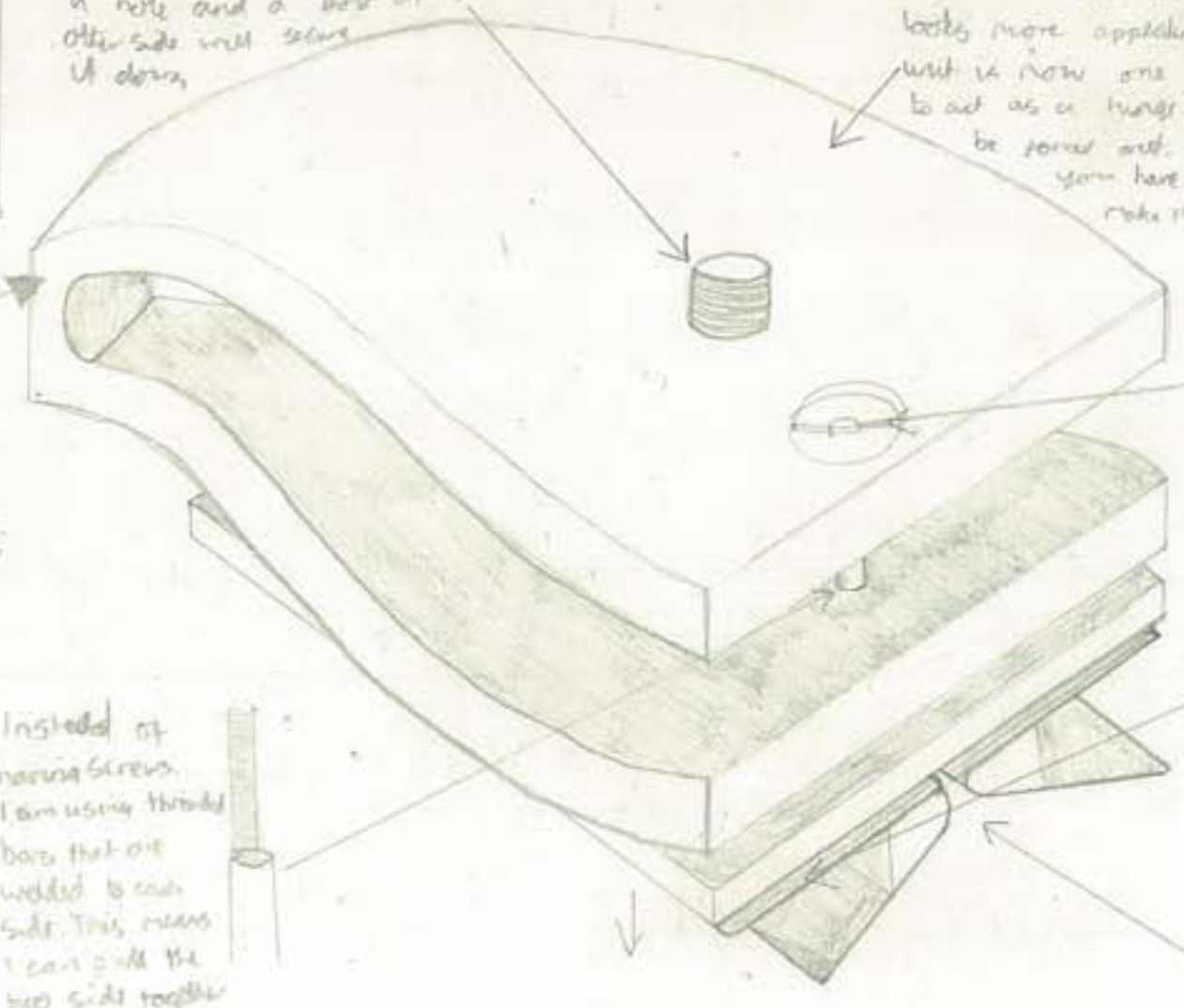
Development

In order to change my design, I am going to change each aspect that I pointed out from the first design and I will change the shape accordingly to what shape suited my needs best. By changing all of this I will have it together as my next design

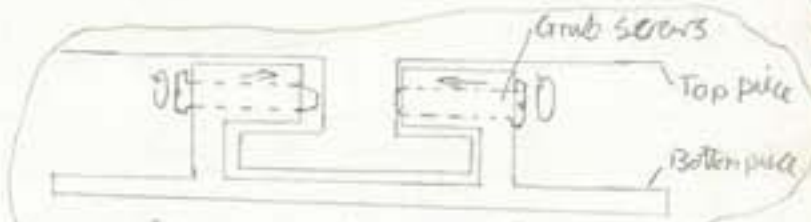
In order to fix the camera to the boat. The thread for the camera to screw onto will be removed and this will be screwed on post. Then the thread will be inserted through a hole and a bolt on the other side will screw it down.

I have changed the overall shape of my design. I have changed it to be more of an iron shape. I feel this matches the boat shape better and it looks more appealing. Also the whole unit is now one piece that is bent to act as a hinge. The two sides will be joined and at the ends, however you have to squish it to make the two sides level

I have decided to make it out of stainless steel rubber or plastic. This means it is strong, will keep its shape better and it will look better. This also means I can die cast the product to give a great result if it was volume manufactured

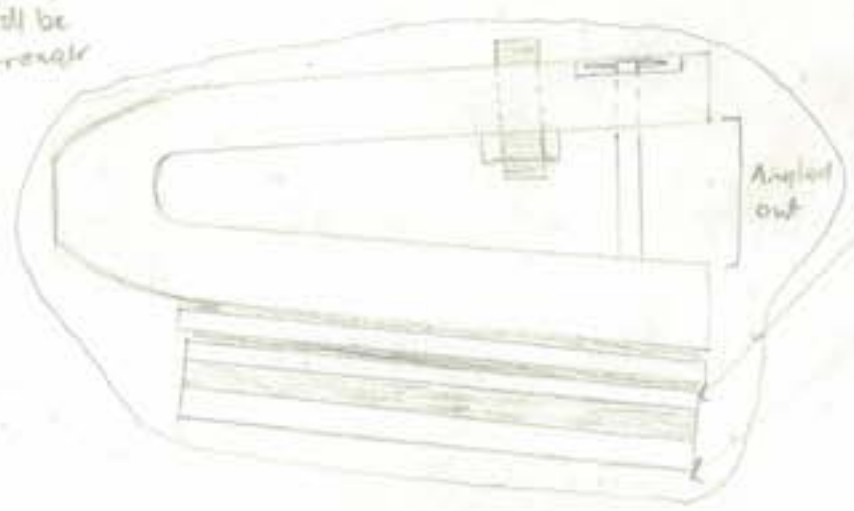


To make the screws flush I am going to cut hollows through the top side for the screw to fit in. This means that the screws will not have and part sticking out which can catch where the camera is placed

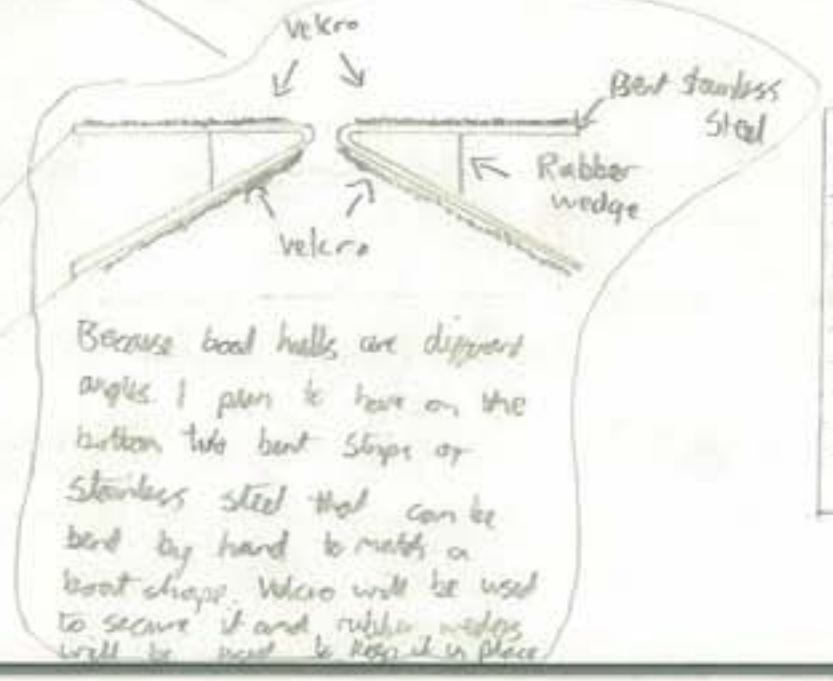


My idea for being able to twist the idea is to have the bottom piece secure and not moving. Then I will have the top piece able to rotate freely. I will then use grub screws to hold the bottom piece in place

Instead of having screws I am using threaded bars that are welded to each side. This means I can fill the two sides together and it will be much stronger



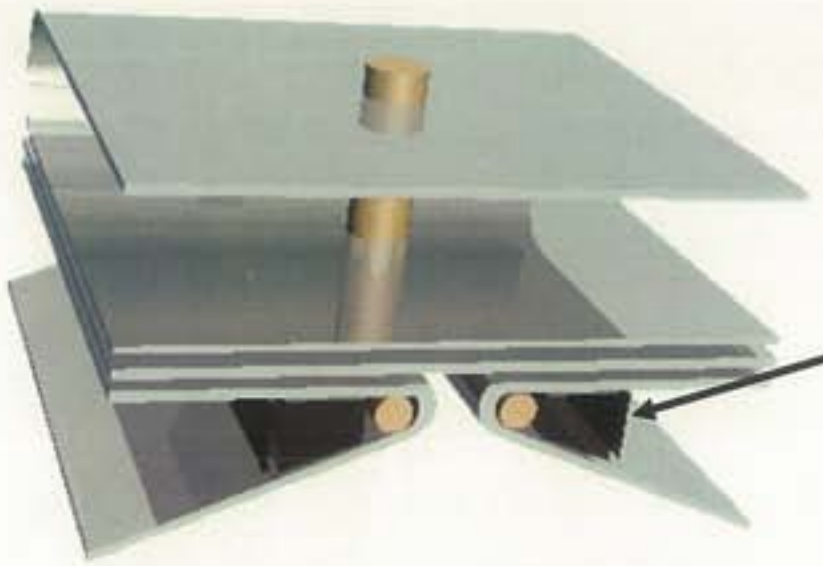
The velcro I am using should be more than enough to keep the unit on the boat as I proved with my testing. The velcro will be on the bottom of the unit and on the boat to hold it



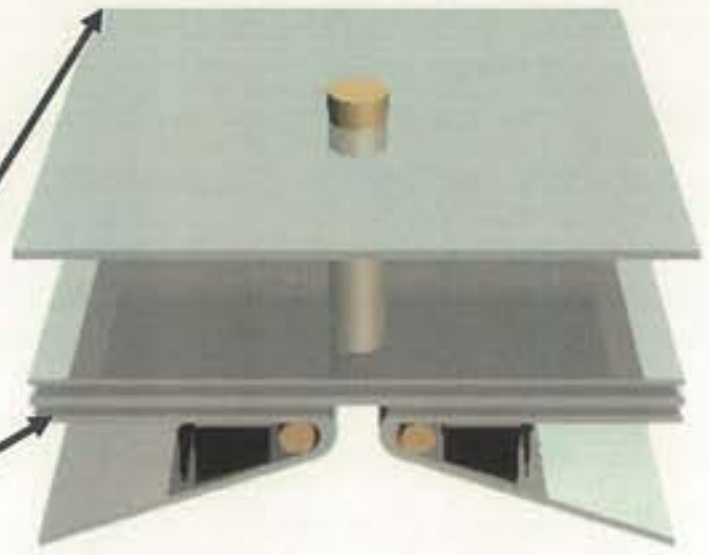
Because boat hulls are different angles I plan to have on the bottom two bent strips of stainless steel that can be bent by hand to match a boat shape. Velcro will be used to secure it and rubber wedges will be used to keep it in place

I am pleased with this design. I think it looks very appealing, all parts from the 1st design have been answered. I think that I'm nearly there in my design but I feel some mechanisms need slightly altering and the shape may need slightly changing as there is some wasted space with my current design

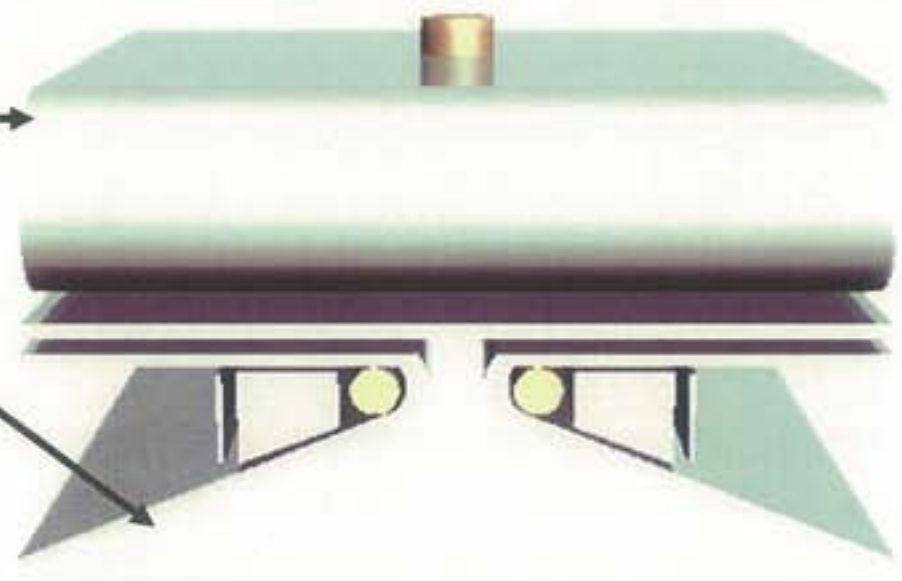
Development

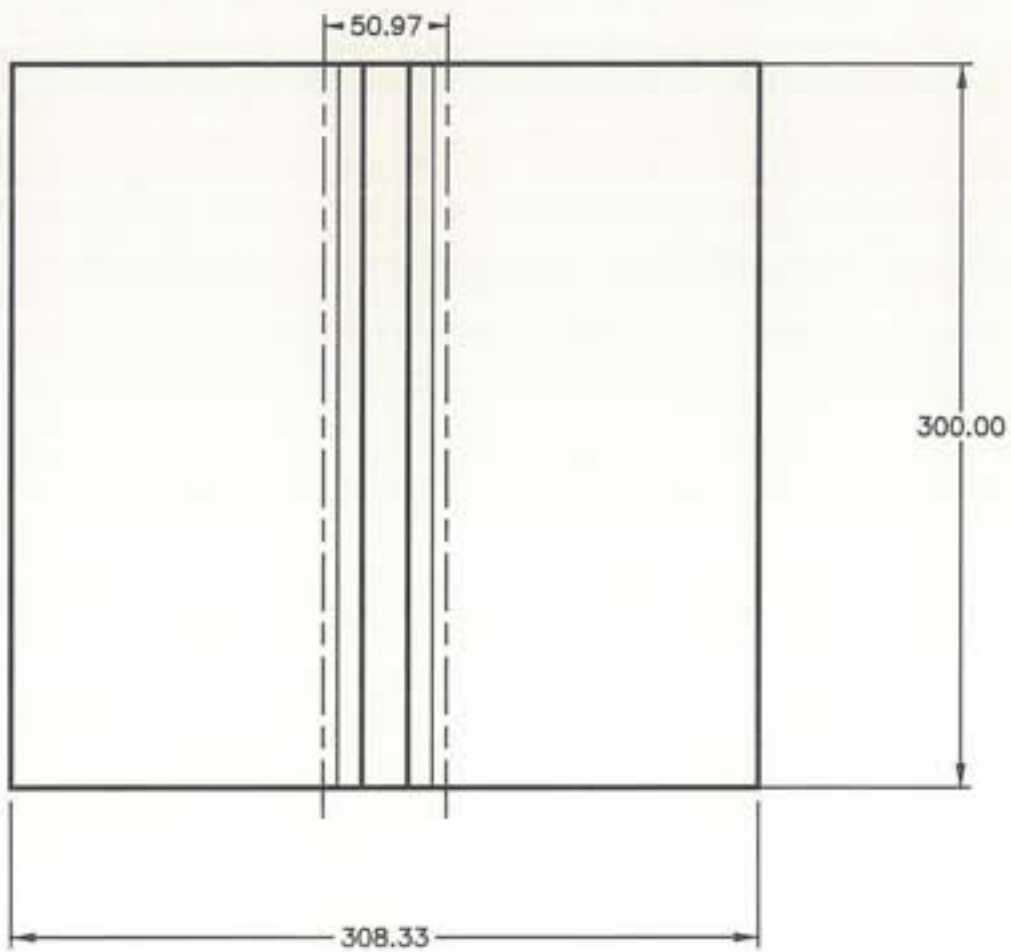


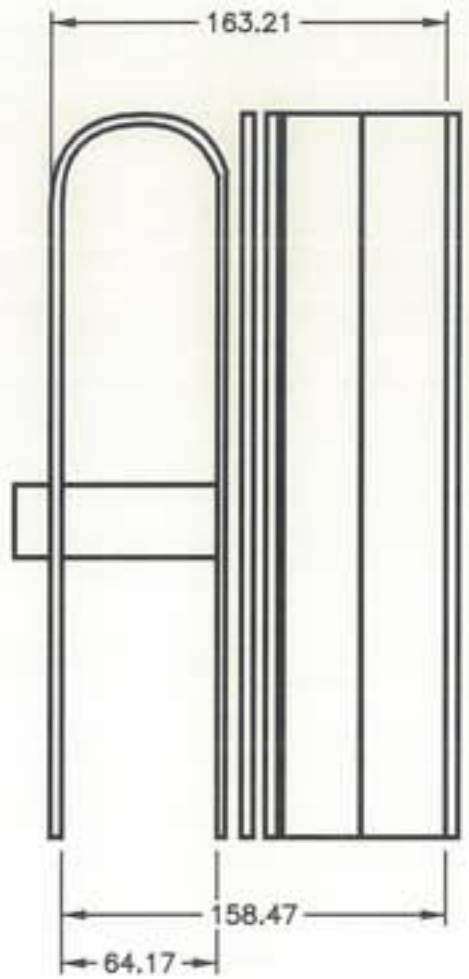
This is my final stage of development. I have altered the mechanism to fit it to a boat and it now is screwed it to pull a piece towards the bend to increase the angle. I have changed the shape once more to make it simpler and I have added in one more layer that has Velcro on it so that the top piece can be placed to any angle you want and you adjust it by ripping it off the Velcro and turning it.

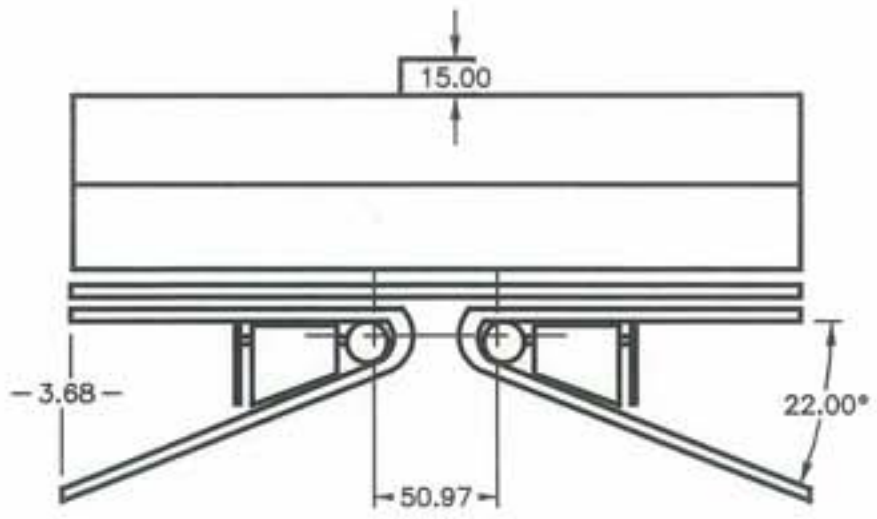


This final design has all the same aspects as my last stage apart from the points mentioned above. It will be made from stainless steel with some of the parts made from brass that I can make on a lathe. It will have Velcro on the underside to fit onto a boat I have all the dimension of my design on the next page









REV	DESCRIPTION	BY	DATE

TITLE

	SCALE	DATE
	DRAWN BY	
	CHECKED BY	
	APPROVED BY	
PROJECT NUMBER	DRAWING NUMBER	

Development Evaluation

	Specification Point	Met/ Can it be altered	How can it be altered?
Form	1. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 2. Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position 3. The unit must be able to cope with hot and cold conditions with the materials not being affected by the weather 4. The unit must have a smooth and sleek construction by using quality materials and having a smooth finish 5. The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras 6. The unit must be easy to clean out by having no small gaps to trap debris increasing the life of the unit	Design now meets	• The unit does not have a container to fit any type of camera in. I am not going to include this in my design as I feel that it would be too difficult to build a waterproof transparent case that all cameras can fit in and the case isn't necessary as water does not splash up the front of the boat • The unit does not have any small space that dirt can get trapped in • This design meets all the other specifications
Function	7. The unit must be able to hold a digital camera allowing all types of camera to be used increasing the market potential 8. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 9. The unit must be able to rotate when needed but must stay locked when not needed this will be done by the fixture able to move freely to any angle but lock in place 10. The unit must be able to cope with adventurous kayaking with the camera not taking any water damage and for it to be protected against knocks 11. The unit must be able to keep the camera safe and secure but is still able to take photos clearly 12. The unit must be able to fit easily with few tools/skills increasing the market in who can use it	Design now meets	• The unit can now look in any direction by putting the top in a different direction when needed • The design meets all other design specifications
User Requirements	13. The unit has to store easy by being small/ light and compact 14. The camera must fit into the case with ease by not being to tight and to fit any type of camera but still manages to absorb shocks 15. You must be able to loosen the unit to rotate it while paddling so you are able to look at the surroundings and to look at your technique 16. The unit must be able to disassemble easily otherwise it can be annoying to the user 17. You must be able to fix the unit to the kayak with few specialist tools/skills so it can be used by anyone 18. You must be able to press the shoot button while paddling which means a slot for you finger has to be added but still keeping the unit watertight	Design now meets	• The unit can now look in any direction by putting the top in a different direction when needed • You are unable to use the camera while paddling however the camera needs to be at the front of the boat to look at all of you so you wont be able to reach • The unit does not have a container to fit any type of camera in. I am not going to include this in my design as I feel that it would be too difficult to build a waterproof transparent case that all cameras can fit in and the case isn't necessary as water does not splash up the front of the boat • The design meets all other specification points
Material Requirements	19. The case/fixtures must not be affected too much by water/saltwater this could be done by a sealed container and with non rusting materials 20. The material must be sustainable to cope with years of adventurous paddling and rough treatment by having a protective finish 21. The unit must be sustainable and can be recycled when disposed	Met	
Performance Requirements	22. The unit must not cause any lasting damage to the kayak by not having to drill into the kayak 23. The unit must be able to rotate 360° so it can get full view of you and the surroundings. 24. The unit must be able to point in sure direction with ease but not slip/move which must be done at the joint to let the top half move 25. The unit must be lightweight as to not impede the kayaks performance or stability by not being too heavy or too big 26. The unit has to have enough space for an average camera to be inserted into the case but still able to take videos 27. The unit must be strong to withstand adventurous kayaking, this can be achieved by quality materials used and a quality finish 28. The unit has to be reliable even if the boat capsizes, this could be done with a safety line attached to the camera and the boat	Design now meets	• The unit can now look in any direction by putting the top in a different direction when needed • The design meets all other specification points
Scale of Production and Cost	29. The unit will be batch produced keeping costs down e.g. batches of 1000, this means that the unit can be made to order and not a continuous production 30. The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good as it is not too expensive 31. The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view this will be achieved by full rotation of the devise	Met	
Size, safety and quality	32. The unit must not be too big on the boat as this will affect the performance of the kayak, this can be done by making the unit low on the boat and using light materials 33. The unit must be made with quality materials meaning the unit will be strong, light and not corrode over time 34. The unit must not have any finger traps which can be avoided with covered moving parts	Design now meets	• The unit does not have any small space that dirt can get trapped in • The design meets all other specification points

My client is happy with my developed design, his main issue with this original design of it not rotating has now been addressed and it can be placed to any angle and will be on there tightly. Some small points that he did not address like dirt getting in have also now been sorted and

Plan of Manufacture

Part	Plan	Time	Manufacture Process	Volume Manufacture	Quality Control Checks	Safety Checks	Pictures
	I will write a cutting list of all the materials I need for my project	5 minutes Total: 5 minutes	-	-	I will measure out each part twice using a ruler so that I will have less work to do later		      
Curved metal pieces x2	My first part is to bend the piece	10 minutes Total: 15 minutes	I will put each piece in a vice and bend it by hand, I will also use a hammer to make it even	I could use a machine with a jig to get it exact and to do it a lot quicker	I will use a protractor to make sure the angle was precise and even	I will secure the metal in a vice to stop it slipping	
	I have to file down the metal	10 minutes Total: 25 minutes	I will put the metal in a vice and use a file to smooth down the sides	-	-	I will be sure not to touch the metal as it is sharp	
Brass rods x2	I have to make a brass rod to go in the curved metal. In order to do this I have to divide the rod into 3 pieces	20 minutes Total: 45 minutes	I will put the rod in a vice, measure it out and use a hacksaw to cut it	I could use a CAM machine to do it for me	I will measure out the length I need two time with a ruler	I will wear safety goggles to stop metal shavings getting into my eye	
	With the smaller rod pieces, I have to machine them to all interlock with each other but allowing them to freely rotate	60 minutes Total: 105 minutes	I will put each piece in the lathe and face all the sides. With two of the three pieces, I will drill a hole down the middle while with the other, I shall cut the end smaller to fit into these holes	I could use a CAM lathe to do the work for me in quicker time and high standard	I will use a set of veneer callipers to ensure I have the right measurements	I will wear safety goggles to stop metal shavings getting into my eye	
	With the middle piece of the rod, I have to put another piece of brass onto it so I will drill a hole for it to fit into	10 minutes Total: 115 minutes	I will secure the brass in a hand clamp and use a pillar drill to make the hole	I could use a CAM machine to speed it up and always give high standards	I will use a set of veneer callipers to ensure I have the right measurements for the hole	I will wear safety goggles to stop metal shavings getting into my eye	
	I will have the smaller piece of brass already cut to fit into this new hole but it need to have a thread on it	20 minutes Total: 135 minutes	I shall use a tap with the brass in a vice to make a thread	-	-	-	
	With the threaded brass, I will now be able to weld the two together	30 minutes Total: 165 minutes	I will inserted the two brass pieces and weld them together	-	-	I will wear blacked out goggles and heatproof gloves to avoid me injuring myself	
	Now that the bar is ready, I will be able to weld the bar onto the steel	30 minutes Total: 195 minutes	I will place the brass in the right position but still allowed the middle to move freely when inside and weld it together	-	-	I will wear blacked out goggles and heatproof gloves to avoid me injuring myself	
Nylon Rods	I have to have a piece that I could pull in to increase the angle of the mechanism. I used nylon for this which was pre-	10 minutes Total: 205 minutes	I will secure the nylon in a hand clamp and use a pillar drill to make the hole	I could use a CAM machine to speed it up and always give high standards	I will use a set of veneer callipers to ensure I have the right measurements	I will wear safety goggles to stop nylon shavings getting into my eye	

Plan of Manufacture

	cut to size, I have to drill a hole inside for the threaded bar to go through						
Brass nuts x2	I have to make nuts to go on the end of the threaded bar. I have the brass cut to size but it has to have a hole through it and faced/cut on the outside	6o minutes Total: 265 minutes	I will put the brass in a lathe, face all the sides and then cut one side to have a smaller diameter for better grip and then I will drill a hole right the way through it	I could use a CAM lathe to do the work for me in quicker time and high standard	I will use a set of veneer callipers to ensure I have the right measurements	I will wear safety goggles to stop metal shavings getting into my eye	
	I need a thread on the inside on the hole I have just cut in the nuts	15 minutes Total: 280 minutes	I shall secure the brass in a vice and then tap the inside to form a thread	-	-	-	
	Finally to the nuts, I have to make them easier to grip so I will give the nuts three sides to grip onto	30 minutes Total: 310 minutes	I will secure the brass tightly and file the brass down to give it 3 sides instead of a curved surface	-	I will measure out the length of sides to make sure they were equal	I will wear safety goggles to stop metal shavings getting into my eye	
Separating sheet	I have a sheet of metal between the fixture to the boat and to the piece to put the camera on. I have this piece cut to size but I will have to smooth down the sides	10 minutes Total: 320 minutes	I will have the metal in a vice and I use a file to smooth down the sides	-	-	I will be sure not to touch the metal as it is sharp	
Camera bar/nut	To fix the camera down, I have to make a bar that was threaded to screw to a camera. I have the bar but it has to be threaded	15 minutes Total: 335 minutes	I will secure the brass in a vice and then tap the inside to form a thread	-	-	-	
	In my design, a nut has to be placed onto the threaded camera bar to stop it falling off, I will make a second nut as I need it later on	60 minutes Total:390 minutes	I will put the brass in a lathe, face all the sides and then cut one side to have a smaller diameter for better grip and then I will drill a hole right the way through it	I could use a CAM lathe to do the work for me in quicker time and high standard	I will use a set of veneer callipers to ensure I have the right measurements	I will wear safety goggles to stop metal shavings getting into my eye	
Top piece/bar	I now have to make the top piece of my design which the camera will sit on. I have a sheet of stainless steel that I need cutting to shape	30 minutes Total: 420 minutes	I will cut the steel in a guillotine to make it slimmer at the bend to make it easier to bend and look better	I could use a CAM machine to cut the metal out for me	I will mark out on the steel where I need to cut and double check my measurements	I will never put my finger near the blade of the guillotine even when not cutting	
	As I will use the guillotine, it will make it very sharp which is a safety risk so I have to file it down	20 minutes Total: 440 minutes	I will put the metal in a vice and I use a file to smooth down all the sides	-	-	I will be sure not to touch the metal as it is very sharp	
	With the metal in shape,	30 minutes	I will mark out where the	I could use a CAM	I will use veneer	I will make sure that	

Plan of Manufacture

	I need to drill holes in it for a mechanism and the other for the camera bar to fit through	Total: 470 minutes	holes are needed, centre punch the centre of them and use a pillar drill to make the hole	machine to do it for me to high precision and speed	callipers to get the right size hole, I will use a ruler to double check I had the holes in the right place	the sheet of stainless steel was very well fastened down. I also will wear safety goggles to stop metal shavings	
	For this top piece, I need a bar that I can pull down to vary the angle the camera looks at. I have the bar already and cut to size but I have to put a thread on the outside of it	15 minutes Total: 485 minutes	I will secure the brass in a vice and then tap the inside to form a thread	-	-	-	
	I will now have to weld the bar onto the top piece, it will have to be in the exact spot for it to go through one of the holes	30 minutes Total: 515 minutes	I will mark out exactly where I need the bar to be then I will weld the bar to the top piece	-	I will double checked my measurements to make sure the bar would fit by using a ruler	I will wear blacked out goggles and heatproof gloves to avoid me injuring myself	
	With the bar in place, I will have to assemble the top piece together	5 minutes Total: 520 minutes	I will bend the top piece by obtaining a spare pipe and bend the work over it to make it even and make sure the bar went through the hole. I will then use the other nut I have made earlier to keep it down	-	-	-	
Final Assembly	I have to clean up all my work	30 minutes Total: 550 minutes	I will have to clean up all my work by using sandpaper to get rid of scratches and marks	-	-	-	
	I will need a finish for my design so I will use black barbeque paint as it is waterproof, scratchproof and gives a nice matt finish	10 minutes x4 (+ 60 minutes drying time between coats) Total: 590 minutes	I will go outside and apply the paint to my design so that it covered all the surfaces but no drip marks	It could be done by doing multiple units at a time using one large machine to spray them all in	-	I will do it outside so that I didn't inhale the paint	
	Finally, I have to put on the Velcro onto the respective sides of work and assemble the unit	20 minutes Total: 610 minutes	I will measure out the Velcro with a ruler and then cut it out using scissors, I will then apply the Velcro with the self adhesive backing already on it	-	I will double check all my measurements so I didn't waste any Velcro	-	

Evaluation

	Specification Point	Has it met this point?
Form	1. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 2. Finger traps should be avoided. This may occur when fixing the camera on or adjusting the cameras position 3. The unit must be able to cope with hot and cold conditions with the materials not being affected by the weather 4. The unit must have a smooth and sleek construction by using quality materials and having a smooth finish 5. The unit must be able to hold a waterproof camera case that will accommodate a range of common cameras 6. The unit must be easy to clean out by having no small gaps to trap debris increasing the life of the unit	1. My unit is able to fit onto any kayak shape due to the mechanism I have on the bottom of the unit 2. There are no finger traps in my unit that people could hurt themselves on 3. Due to the unit being made from stainless steel and a barbeque paint finish, it can cope with any weather 4. My stainless steel have given a good finish and looks sleek on the boat 5. The unit can accommodate any type of camera that has the standard 1/4in screw on the bottom 6. All small gaps are easily accessible if you had to clean it out
Function	7. The unit must be able to hold a digital camera allowing all types of camera to be used increasing the market potential 8. The unit must be able to fit onto the deck of any kayak type and shape, I will do this by the fixtures to the boat being able to mould to shape but still remaining strong 9. The unit must be able to rotate when needed but must stay locked when not needed this will be done by the fixture able to move freely to any angle but lock in place 10. The unit must be able to cope with adventurous kayaking with the camera not taking any water damage and for it to be protected against knocks 11. The unit must be able to keep the camera safe and secure but is still able to take photos clearly 12. The unit must be able to fit easily with few tools/skills increasing the market in who can use it	7. The unit can accommodate any type of camera that has the standard 1/4in screw on the bottom 8. My unit is able to fit onto any kayak shape due to the mechanism I have on the bottom of the unit 9. The unit has Velcro on it that means it can be moved to any angle you wish as film anywhere you want 10. The units Velcro can easily accommodate to any knocks and the unit being small reduces the risk of it being damaged 11. The unit can accommodate any type of camera that has the standard 1/4in screw on the bottom 12. No tools are needed to use the product
User Requirements	13. The unit has to store easy by being small/ light and compact 14. The camera must fit into the case with ease by not being to tight and to fit any type of camera but still manages to absorb shocks 15. You must be able to loosen the unit to rotate it while paddling so you are able to look at the surroundings and to look at your technique 16. The unit must be able to disassemble easily otherwise it can be annoying to the user 17. You must be able to fix the unit to the kayak with few specialist tools/skills so it can be used by anyone 18. You must be able to press the shoot button while paddling which means a slot for you finger has to be added but still keeping the unit watertight	13. The unit is very small and light so it doesn't impede the kayaks performance 14. I decided not to build this in my design as it is too difficult to build, it wouldn't look good and it is not highly necessary 15. The unit has Velcro on it that means it can be moved to any angle you wish as film anywhere you want 16. The unit can be disassembled from the boat in seconds 17. The unit needs no tools to mount to the kayak 18. I decided not to include a way to use the camera while kayaking because that means I would have to mount it further forwards and not get as good a shot
Material Requirements	19. The case/fixtures must not be affected too much by water/saltwater this could be done by a sealed container and with non rusting materials 20. The material must be sustainable to cope with years of adventurous paddling and rough treatment by having a protective finish 21. The unit must be sustainable and can be recycled when disposed	19. Stainless steel will not rust over time or when exposed to water so it will work with years to come 20. The barbeque paint finish will give another additional layer to protect it from water 21. Stainless steel can be recycled or reused when disposed of
Performance Requirements	22. The unit must not cause any lasting damage to the kayak by not having to drill into the kayak 23. The unit must be able to rotate 360° so it can get full view of you and the surroundings. 24. The unit must be able to point in sure direction with ease but not slip/move which must be done at the joint to let the top half move 25. The unit must be lightweight as to not impede the kayaks performance or stability by not being too heavy or too big 26. The unit has to have enough space for an average camera to be inserted into the case but still able to take videos 27. The unit must be strong to withstand adventurous kayaking, this can be achieved by quality materials used and a quality finish 28. The unit has to be reliable even if the boat capsizes, this could be done with a safety line attached to the camera and the boat	22. The unit will not need to harm the kayak in any way 23. The unit has Velcro on it that means it can be moved to any angle you wish as film anywhere you want 24. The Velcro will not let the camera change direction at any time unless you want it to 25.The unit is small and lightweight so it will not affect the kayaks speed or stability 26. I decided not to build this in my design as it is too difficult to build, it wouldn't look good and it is not highly necessary. However any type of camera can be attached 27. The units Velcro can easily accommodate to any knocks and the unit being small reduces the risk of it being damaged 28. I have not attached a safety line to my design as I can rely on the strength of the Velcro which I tested underwater and it still performed well
Scale of Production and Cost	29. The unit will be batch produced keeping costs down e.g. batches of 1000, this means that the unit can be made to order and not a continuous production 30. The unit needs to be competitive and be good value for money. My client thinks a price of £20 would be good as it is not too expensive 31. The unit would be aimed as an accessory for kayakers; it could help give technical feedback or just photographic view this will be achieved by full rotation of the devise	29. As the unit is made from stainless steel, in future production, I could cast the product to make it quicker and still to a high standard. 30. If it were to be batch produced by being casted then I could easily sell it for £20 as it wouldn't it wouldn't be expensive to make 31. The unit can be used for both technical feedback for serious racers or people wanting to film a journey
Size, safety and quality	32. The unit must not be too big on the boat as this will affect the performance of the kayak, this can be done by making the unit low on the boat and using light materials 33. The unit must be made with quality materials meaning the unit will be strong, light and not corrode over time 34. The unit must not have any finger traps which can be avoided with covered moving parts	32. The unit is very small and light so it doesn't impede the kayaks performance 33. Stainless steel will not rust over time or when exposed to water so it will work with years to come 34. There are no finger traps in my unit that people could hurt themselves on

Evaluation

This is me tightening some of the screw on my design to have the angle suited to the

I decided to test out my mounts strength by spinning the kayak round with it still attached; it was still standing when I flipped it back up

Here are some of the photos of my camera on the kayak using my mount

I tested the mount of multiple shaped kayaks

Evaluation

Overall, I am happy with my design, there are a few imperfections which could be sorted out and other parts to it I would do differently if I had to build another. I think that I have made it well and it works which is the main thing, I have made it to fit onto the front of the boat so it is out of the paddler's way but at a very good angle to shoot him.

My finished product looks directly like my working CAD drawing and final stages of development which I am pleased of except I decided to change the same to make it easier to bend and look a bit better. I managed to create what I intended and did not set goals that were unable to achieve. My design is not too big and the colours I have used are neutral so it looks good with any sort of boat.

I have a few criticisms with my design that I could have changed while planning or done differently when making, firstly I am not pleased with some of the nuts on my project, some of them are a bit stiff and I would have liked to design a different mechanism for it.

I was so confident in my design that I was sure that the camera could be suspended upside down and still hold so I tried it out and it held perfectly, the camera is able to work on every boat I have tested and given some great shots, I have been using it myself to try and help my own kayaking abilities and it make it a lot easier

I did another test on my unit to test its strength on the boat. I placed the kayak on the boat and then spinned the kayak in the water so the mount was submerged. I then bought it back to the surface and the mount was still in the exact same position as before (see page before)

My client's opinions were that the projects looks good on the boat and it is not too heavy. Another good feature it has is that it is not too tall and stops it from having a high centre of gravity-affecting the performance. One of his criticisms is that the some of the nuts are hard to tighten and another solution would have been better but overall he likes the design a lot