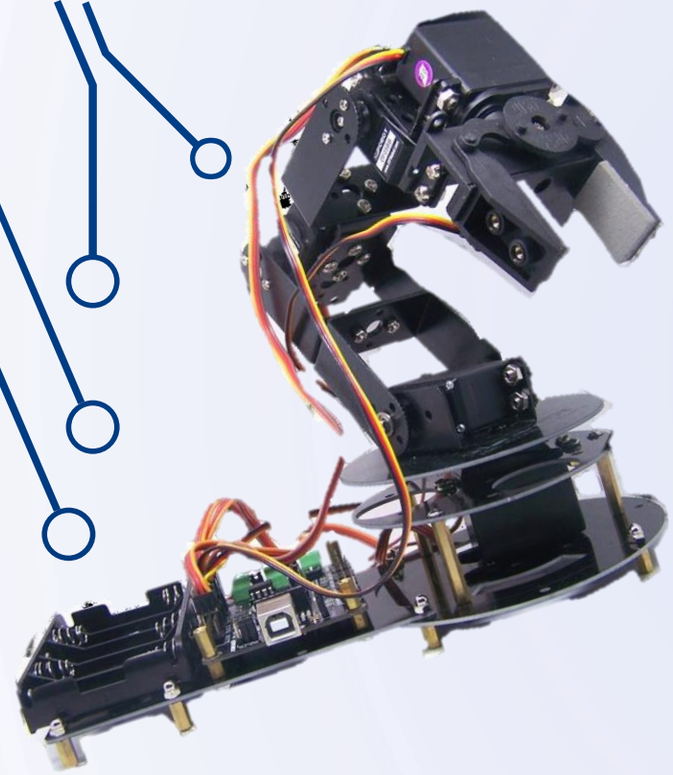

ROBOTIC ARM KIT

ADITYA SEHGAL

ENROLMENT NUMBER 04

IGCSE MAJOR PROJECT 2014

GUIDED BY MERVYN LONG

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SITUATION

IN TODAYS DATE STUDENTS IN SCHOOLS DO NOT LIKE TO STUDY THEORETICALLY ALL THE TIME, THEY WOULD WANT TO SEE A LOT OF DEMONSTRATIONS, IT IS OFTEN TOUGH FOR STUDENTS TO LEARN ABOUT ELECTRONICS AND GEAR MECHANISM, WITH DEMONSTRATIONS STUDENTS CAN ALSO GET TO USE THE PRODUCT THEMSELVES TO UNDERSTAND IT PERSONALLY AND NOT ONLY BY SOMEONE ELSE MAKING THEM UNDERSTAND, THIS IS IMPORTANT BECAUSE I FEEL THAT FEELING THE PRODUCT HELPS A LOT IN LEARNING ABOUT IT,

DESIGN BRIEF

I AM GOING TO DESIGN AND MAKE A ROBOTIC ARM KIT FOR STUDENTS TO BUY SPECIFICALLY IN INDIA,
THIS WILL INCLUDE A MINI DO IT YOUR SELF KIT WHICH CAN BE USED TO BUILD A MINI ROBOTIC ARM, I AM CHOOSING INDIA SPECIFICALLY BECAUSE IN INDIA THERE ARE VERY FEW KITS LIKE THESE TO KEEP THE STUDENTS INVOLVED IN THEIR SUBJECTS,
THIS WILL SOLVE THE PROBLEM BECAUSE SCHOOLS IN INDIA WILL BE ABLE TO BUY A ROBOTIC ARM FOR A VERY LOW COST TO DEMONSTRATE TO THEIR STUDENTS, SINCE IT WILL BE CHEAP SO THE STUDENTS INTERESTED WILL ALSO BE ABLE TO BUY IT FOR THEM SELVES,

THE DEADLINES

TOPIC	week number														
	1 TO 2	2 TO 3	3 TO 4	4 TO 5	5 TO 6	6 TO 7	7 TO 8	8 TO 9	9 TO 10	10 TO 11	11 TO 12	12 TO 13	13 TO 14	14 TO 15	15 TO 16
SITUATION															
DESIGN BRIEF															
MATERIALS															
TARGET MARKET NEEDS															
EXISTING PRODUCTS															
ERGONOMICS															
MANUFACTURING TECHNIQUES															
RESEARCH TECHNIQUES															
MOODBOARD															
QUESTIONAIRES AND FINDINGS															
DEVELOPMENT OF BUSY IDEAS															
BUSY IDEAS 4															
BUSY IDEAS 5															
DESIGN EVALUATION															
FINAL DESIGN 4															
FINAL DESIGN 5															
FINAL DESIGN 6															
MODELING															
PRODUCTION PLAN															
MODIFICATIONS															
TESTING															
CONSUMER EVALUATION															
PROPOSED MODIFICATIONS															
FINAL EVALUATION															
INDUSTRIAL PRACTICES															
QA/QC/TQM															

ADITYA SEHGAL
ROBOTIC ARM

MOOD BOARD


KIT CONTAINS
HOW IT WORKS
build it yourself
ROBOT ARM
Gripper
Wrist Motion
Elbow Motion
Base Motion
control box
Search Light
Base Rotation
Long Nose Pliers
Diagonal Cutter
Screwdriver (+)
Tools you may need


ROBOT ARM
wired control robot arm kit


STRIKER

MOOD BOARD ANALYSIS

JUST LIKE IN THIS PICTURE THE ARM HAS A VACUUM PUMP AND SO WILL MY PRODUCT HAVE A VACUUM PUMP

JUST LIKE THIS MODEL I HAVE GOT IDEAS TO ADD MOVEMENT TO THE ARM.

I HAVE CHOSEN A WATERMARK LIKE THIS BECAUSE SYMBOLIZES ELECTRONICS AND ROBOTICS.

THE TRANSFORMERS CHARACTER "BUMBLE BEE" HAS BEEN CHOSEN FOR INSPIRATION BECAUSE THE CHARACTER ITSELF IS A ROBOT.

I HAVE NOTICED THAT THE MOST COMMON COLOURS USED ARE BLACK AND YELLOW.

I HAVE GOT A LOT OF INSPIRATION FROM THESE KIND OF PICTURES.

THIS PICTURE OF THE GEAR SYMBOLIZES ELECTRONICS AND MECHANICS.

I HAVE SEARCHED FOR A LOT OF GRAPHICS LIKE THIS ONE.

THESE KIND OF PICTURES HAVE GIVEN ME INSPIRATION FOR INNOVATION.

RESEARCH STARTING POINT

RESEARCH PLAN

Topic of research	Why would I research on this topic	How would I research of this topic
Target Market	To design according to the right age group.	Surveys, Ask other manufacturers about who they aim.
Materials	To choose the right materials to build out of.	Testing, Prototyping, Judging properties of the different materials.
Functioning	To choose the right circuits and codes.	Try different circuits, Look online for different sorts of schematics.
Aesthetics	To appeal to the target market.	Surveys, Go through color psychology articles.
Price	To choose the right prices.	Surveys, Go through other manufacturers prices.
Ergonomics	The controller should comfortable in the hand.	Go through books on ergonomics of human hands.
Manufacturing techniques	To manufacture using the right machinery.	Ask seniors,proffesionals, try different methods of manufacture.

SURVEYS

Name- _____ Grade/Occupation-_____ Gender- _____

I am Aditya Sehgal and I am conducting this survey to get answers to a few questions which would help me continue with my IGCSE DT project.

Instructions-

-Please fill out all the questions asked.

-Return the answers in a week of giving the survey to you.

Q1. On what basis do you buy a product? (Please circle)

Colour Looks Functioning Capabilities of the product Price Brand

Q2. How much time do you spend on a project? (Please circle)

0 to 1 hr 2 to 3 hrs 4 to 5 hrs 6 hrs or more

Q3. Do you like to build your own projects?

Yes [ ] No [ ]

Q4. Are you interested in robotics?

Yes [ ] No [ ]

Q5. Would you want to learn about robot arms?

Yes [ ] No [ ]

Q6. Would you be interested to buy a robotic arm kit?

Yes [ ] No [ ]

Q7. How much would you pay for a robot arm kit?

0 to 500Rs 501 to 1000Rs 1001 to 2000Rs 2001 to 3000Rs 3001+ Rs

Q8. What do you like the most about robotics?

_____

Q9. What colour combinations would you prefer?

_____

Q10. If you had a robotic arm how would you mostly use it?

_____

Q11. If you got a chance, would you program it according it to your needs?

_____

Any other feedback you would like to give me?

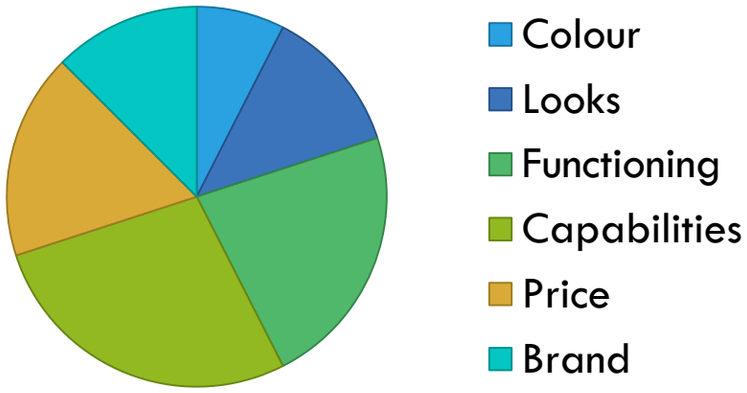
_____

_____

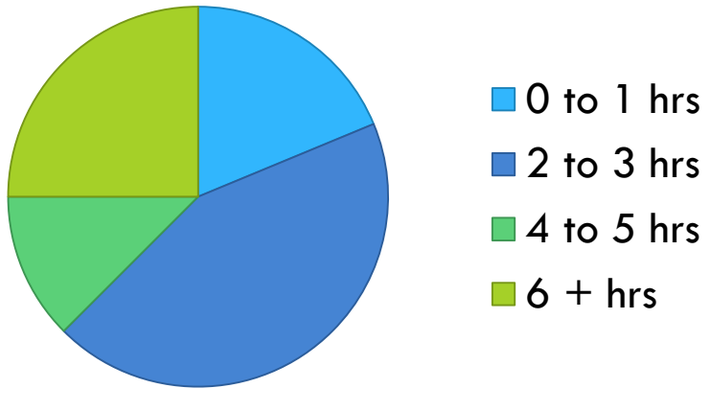
I HAVE DECIDED TO SURVEY 10 STUDENTS AND 5 TEACHERS. I HAVE CHOSEN 15 PEOPLE BECAUSE I THINK THESE AMOUNTS WOULD BE MORE THAN ENOUGH TO HELP ME ANALYSE THE MARKET AND WHAT THE NEEDS ARE OF THE POTENTIAL CUSTOMERS.

FINDINGS FROM SURVEYS

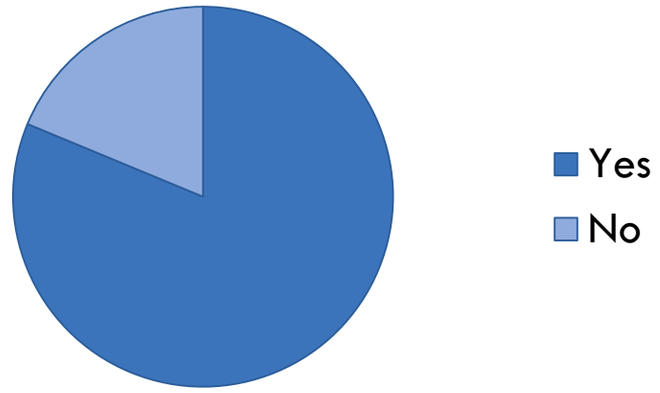
Question 1



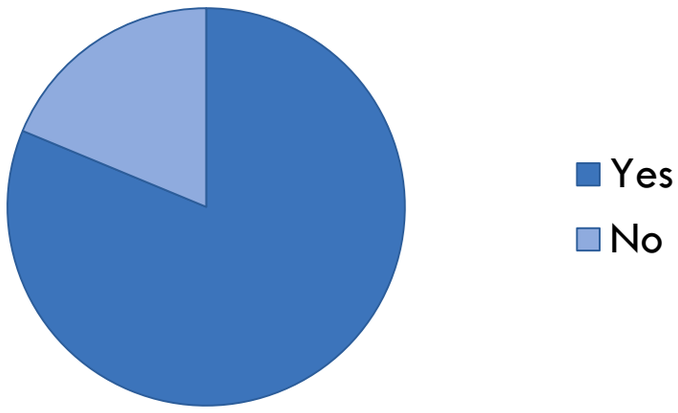
Question 2



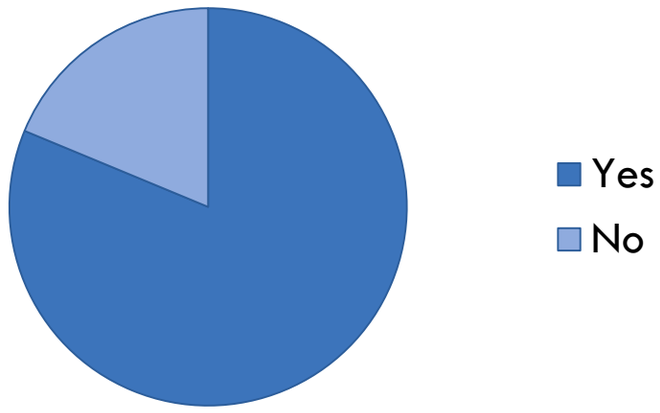
Question 3



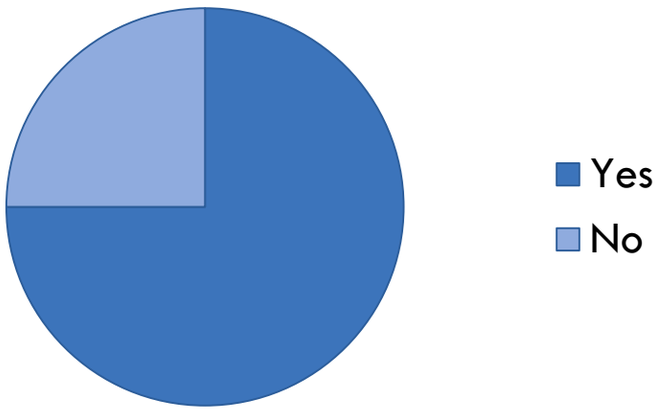
Question 4



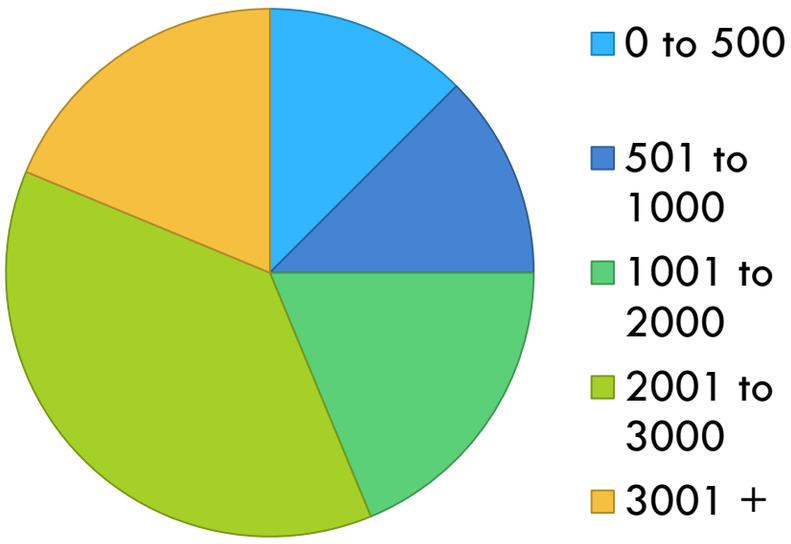
Question 5



Question 6



Question 7



AFTER THE ANALYSIS OF THESE ANSWERS I HAVE COME TO KNOW THAT PEOPLE WOULD BUY ANY PRODUCT BASED ON THE CAPABILITIES, WOULD PAY FROM 2000 TO 3000 RS. MOST PEOPLE WOULD ONLY WORK ON A PROJECT FOR NO MORE THAN 4 HOURS. MOST PEOPLE ARE ALSO INTERESTED IN ROBOTICS AND WOULD BE INTERESTED IN BUYING A ROBOT ARM FOR THEMSELVES. SINCE QUESTIONS 8 TO 11 ARE SUBJECTIVE, THEY CAN NOT BE ANALYSED AND REPRESENTED IN THE FORM OF A CHART OR TABLE. DUE TO THIS ISSUE I HAVE COME TO COMMON CONCLUSIONS OF THE FUNCTIONALITY OF THE ARM, THE COLOURS USED SHOULD BE BLACK AND YELLOW, USED AS A MONOTONOUS WORKER AND SHOULD BE PROGRAMMABLE.

EXISTING PRODUCTS ANALYSIS

TYPE OF ARM	PROS	CONS
	• IT IS MADE OUT OF ALUMINIUM AND SO IT IS STRONG • THE CLAW CAN ROTATE	• IT COSTS OVER RS 12000. • THE WIRING IS ALL OPEN
	• THE LOOKS ARE FUTURISTIC • IT CAN MOVE BECAUSE IT HAS WHEELS	• IT COSTS ABOUT RS8000(IT IS EXPENSIVE) • IT DOES NOT HAVE A LOT OF FUNCTIONS
	• IT IS VERY CHEAP(RS 5000) • IT IS FULLY PROGRAMMABLE	• IT COMES PREBUILT(STUDENTS DON'T GET A CHANCE TO GO DEEP INTO IT.
	• THE CLAW SHAFT ROTATES • IT CAN PICKUP MILDLY HEAVY OBJECTS	• IT COSTS RS21000 • THE SHAFT MIGHT BREAK DUE TO VERY HEAVY OBJECTS LIFTED

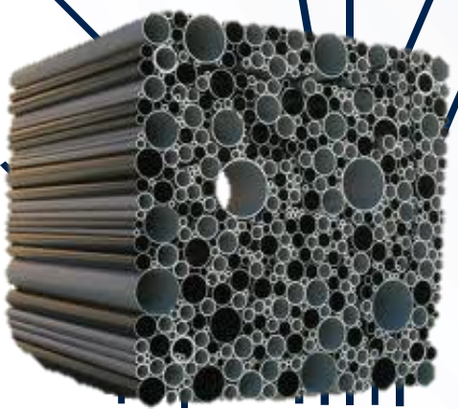
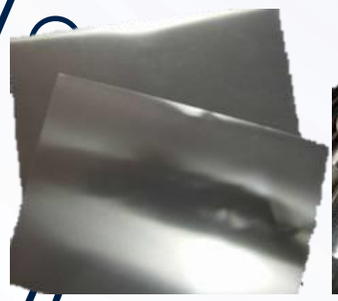
SINCE THERE WERE VERY FEW ROBOTIC ARM ITS AVAILABLE IN INDIA, THIS ANALYSIS GOT EXTREMELY EASY FOR ME TO COMPILE.
SINCE MOST OF THESE KITS WERE IMPORTED INTO INDIA, THE PRICES WERE EXTREMELY HIGH, AND ALL OF THEM HAD A MECHANICAL GRIPPER IN COMMON.

MATERIAL SELECTION

THE MATERIALS I THINK SHOULD BE APPROPRIATE FOR THIS PROJECT ARE MDF (MODERN DENSITY FIBREBOARD), ACRYLIC, ALUMINIUM, STAINLESS STEEL, PVC (POLYVINYL CHLORIDE), BRASS

	Material	weight	ease of cutting	colour availability	ease of colouring
	MDF	very heavy	easy	no colours available	very easy
	ACRYLIC	light	very easy	many clours available	no need to colour
	ALUMINIUM	mildly light	easy	only one colour available	can be coloured
	STAINLESS STEEL	heavy	hard	only one colour available	can not be coloured
	PVC	very light	very easy	many clours available	no need to colour
	BRASS	heavy	a bit hard	only one colour available	hard to colour
	LEAD	very heavy	easy	only one colour available	can not be coloured
	NYLON	very light	very easy	only one colour available	can be coloured

THE MATERIALS I HAVE FINALLY CHOSEN AFTER ANALYSING THE SHORTLISTED MATERIALS ARE ACRYLIC, MDF, NYLON AND PVC.
ACRYLIC WOULD BE USED FOR THE ENTIRE BODY AND THE CONTROLLER.
PVC WOULD BE USED FOR ANY CABLE MANAGEMENT AND TUBING FOR THE VACUUM PUMP INLET AND OUTLET. MDF WILL BE USED FOR THE BASE.



OTHER COMPONENTS

THERE ARE ALSO OTHER MISCELLANEOUS COMPONENTS USED TO BUILD THE PRODUCT WHICH ARE -

→ WIRES FOR CIRCUITS AND CONNECTIONS.

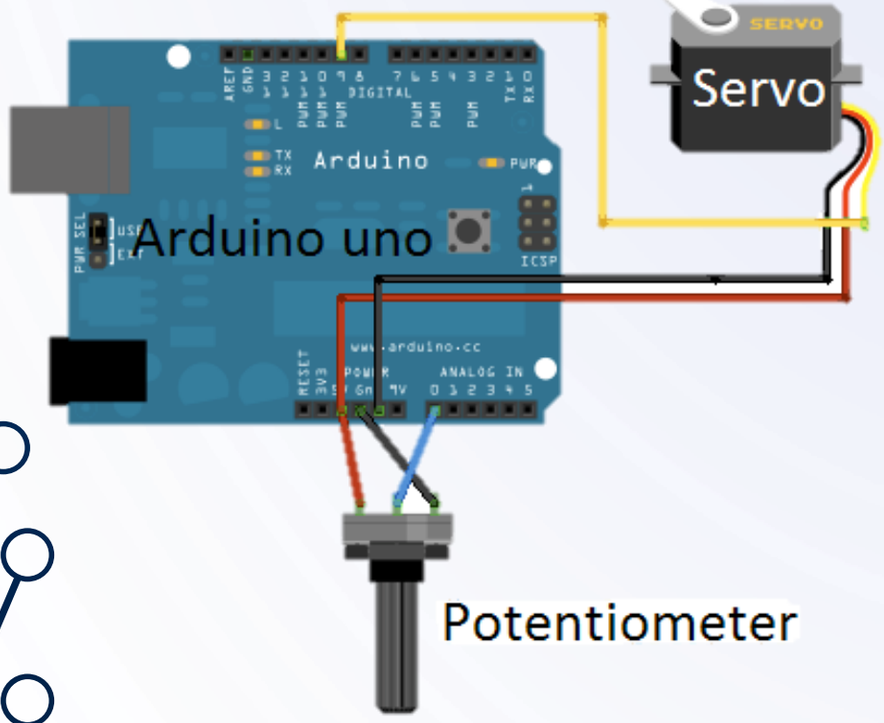
→ GEARED MOTORS AND SERVOS FOR ROTATIONS AND MOVEMENT.

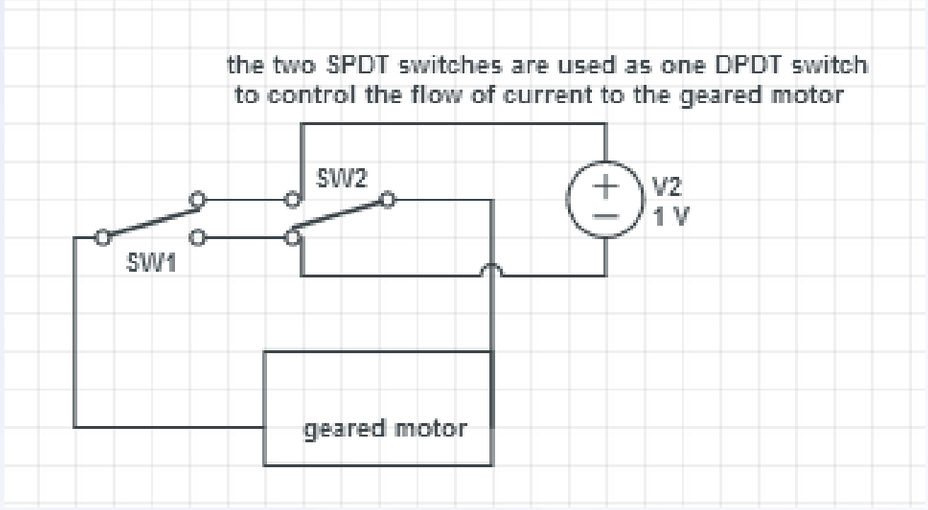
→ A MINI VACUUM PUMP TO PICK UP THINGS.

→ GENERAL ELECTRONICS COMPONENTS TO COMPLETE THE CIRCUITS.

→ AN ARDUINO UNO TO CONTROL THE SERVO USING A POTENTIOMETER.

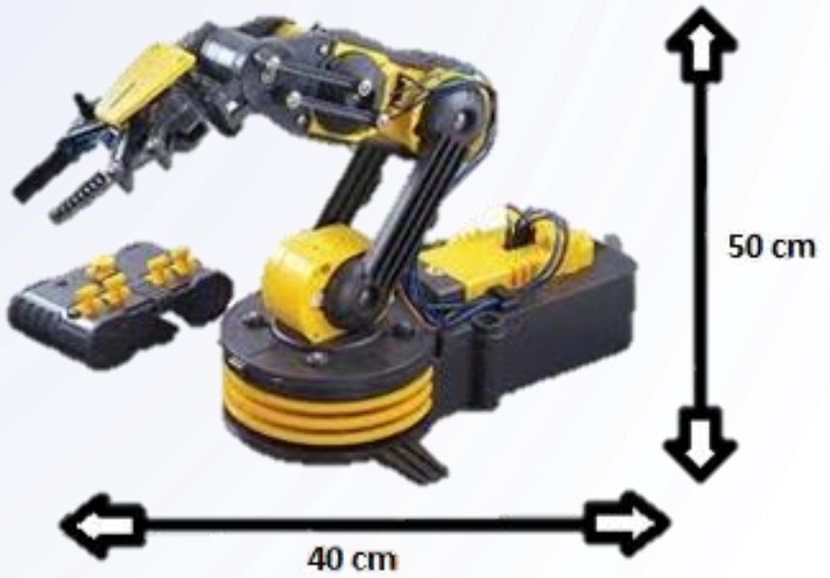
→ SPDT SWITCHES TO CONTROL THE CURRENT FLOW TO THE GEARED MOTOR





ERGONOMICS

THE ROBOTIC ARM SHOULD NOT BE ANY HIGHER THAN 50 CM AND SHOULD NOT BE LOWER THAN 25 CM. THE LENGTH OF THE ARM EXTENDED TO THE MAX SHOULD NOT BE ANY MORE THAN 40 CM. THE LENGTH OF THE BASE SHOULD NOT BE MORE THAN 20 CM. THE WIDTH OF THE BASE SHOULD BE ABOUT 10 TO 15 CM. THE LENGTH OF THE CONTROLLER SHOULD BE 15 CM AND THE WIDTH OF THE CONTROLLER SHOULD BE ABOUT 3.5 CM. THESE RANGES ARE CHOSEN SPECIFICALLY BECAUSE THESE ARE NOT TOO BIG FOR A KIT AND THE CONTROLLER'S DIMENSIONS ARE AN AVERAGE FOR THE HUMAN HAND, SO THAT THE CONTROLLER IS COMFORTABLE IN EVERY HAND.



MANUFACTURING TECHNIQUES

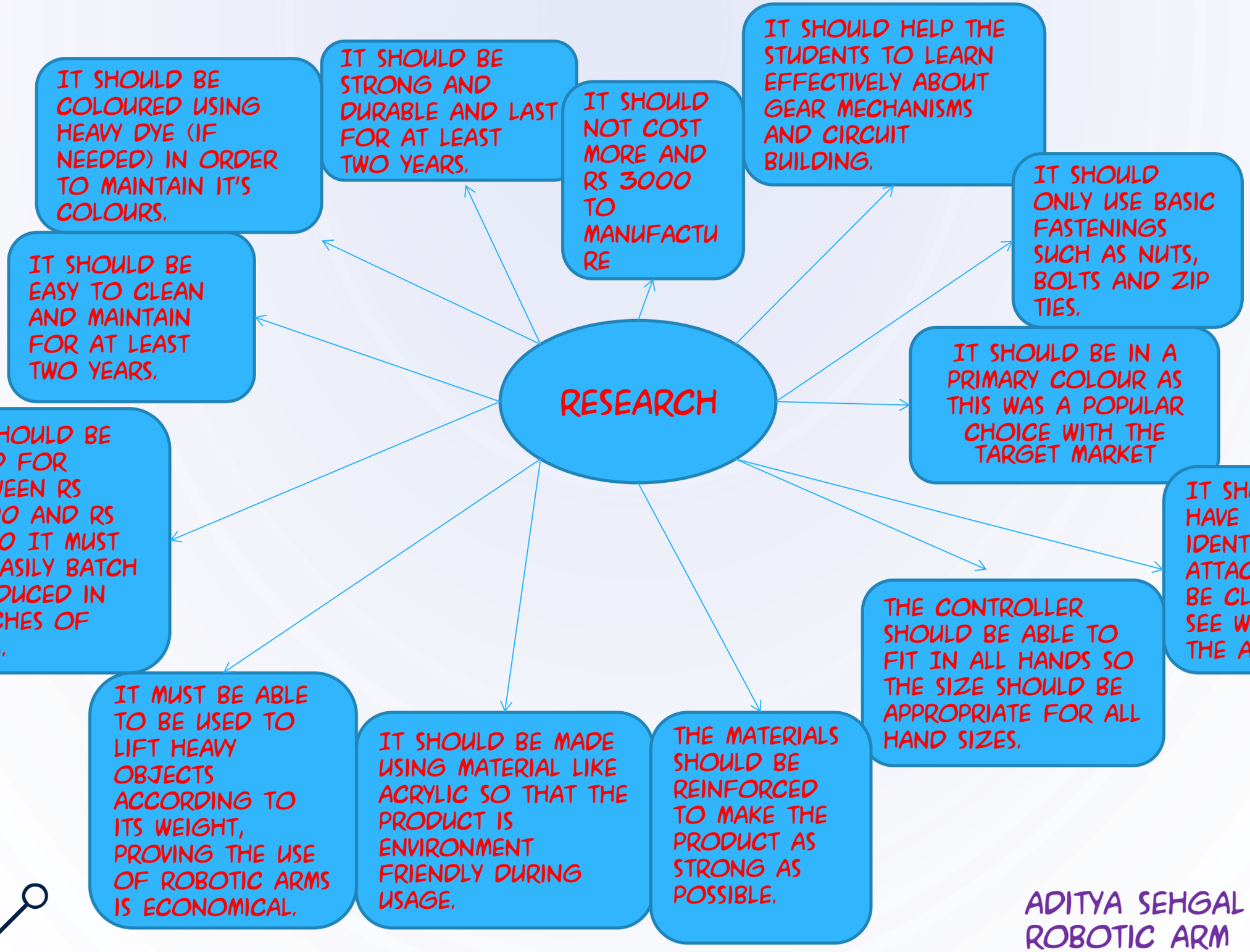
METHOD	PROS	CONS
LASER CUTTING	• VERY EASY • FAST • CHEAP	• PRODUCES HARMFUL GASES DUE TO SOME MATERIAL • CONSUMES A LOT OF POWER
VACUUM FORMING	• FAST FOR REPETITIVE WORK • GIVES PRECISE DETAILS OF THE MOULD	• REQUIRES A MOULD TO BE MADE • THINS THE THERMOPLASTIC BEING USED.
3-D PRINTING	• MAKES THE ENTIRE PRODUCT AT ONCE • VERY FAST	• LIMITED SIZE RANGE • CAN NOT DO THE CONNECTIONS • LIMITED MATERIAL
SOLDERING	• SECURELY BOND THE CONNECTIONS • GIVES GOOD CONDUCTIVITY	• CONTAINS LEAD • RELEASES HARMFUL GASES
LATHE	• GIVES EVERY MINOR DETAIL • CAN BE USED WITH A VARIOUS NUMBER OF MATERIALS	• CAN ONLY BE USED WITH RODS AND BARS • REQUIRES A LOT OF ATTENTION WHILE WORKING ON IT

TARGET MARKET

MY TARGET MARKET IS INDIAN SCHOOLS OR UNIVERSITIES AND STUDENTS WHO WOULD BE WILLING TO WANT A PRODUCT TO DEMONSTRATE TO THEMSELVES AND OTHERS ABOUT HOW ROBOTS WORK, GEAR MECHANISMS, VACUUM, AND MICRO-ELECTRONICS

MY TARGET MARKET NEEDS WOULD BE TO LOOK FOR A DIY (DO IT YOURSELF) KIT WHICH IS NOT VERY EXPENSIVE AND IT SHOULD NOT ALSO TAKE A LOT OF SPACE TO CONSTRUCT. CONSUMERS WOULD ALSO LOOK FOR IF THE KIT IS ACTUALLY BENEFICIAL TO BUY OR NOT.

ANALYSIS OF RESEARCH



ANALYSIS OF MANUFACTURE

INDUSTRY MANUFACTURING TECHNIQUES

THE ARM SEGMENTS WOULD BE CUT ON THE LASER CUTTER OR WOULD BE MADE USING INJECTION MOULDING.

BASE WOULD BE MADE OF ANY HARD AND HEAVY PLASTICS AND WOULD BE FORMED USING INJECTION MOULDING.

THE CONTROLLER WOULD BE MADE INTO TWO HALVES AND EACH HALF WOULD BE MADE FROM INJECTION MOULDING.

THE SUCTION PLATE WOULD ALSO BE MADE BY INJECTION MOULDING.

MANUFACTURE

MATERIALS

I WILL BE USING MATERIALS LIKE ACRYLIC, NYLON AND MDF.

WORKSHOP MANUFACTURING TECHNIQUES

MY ARM SEGMENTS WOULD BE DESIGNED ON 2D DESIGN AND THEN CUT ON THE LASER CUTTER .

THE BASE WOULD BE MADE FROM MDF AND THEN VACUUM FORMED TO GIVE IT A SIMILAR FINISH TO THE REST OF THE ARM.

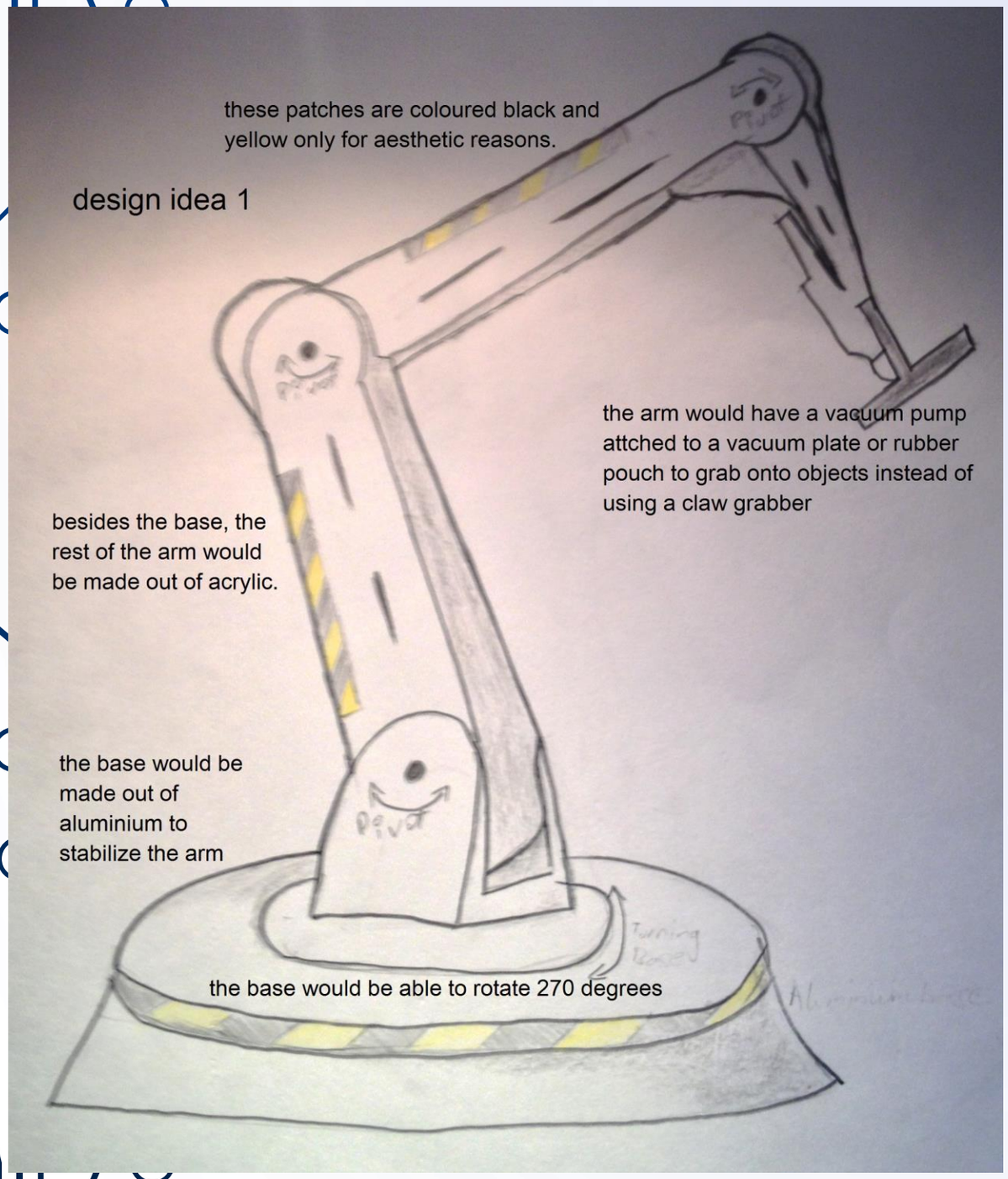
THE CONTROLLER WOULD EITHER BE VACUUM FORMED OFF OF AN EXISTING CONTROLLER OR WOULD BE CUT ON THE LASER CUTTER WITH LAYERING.

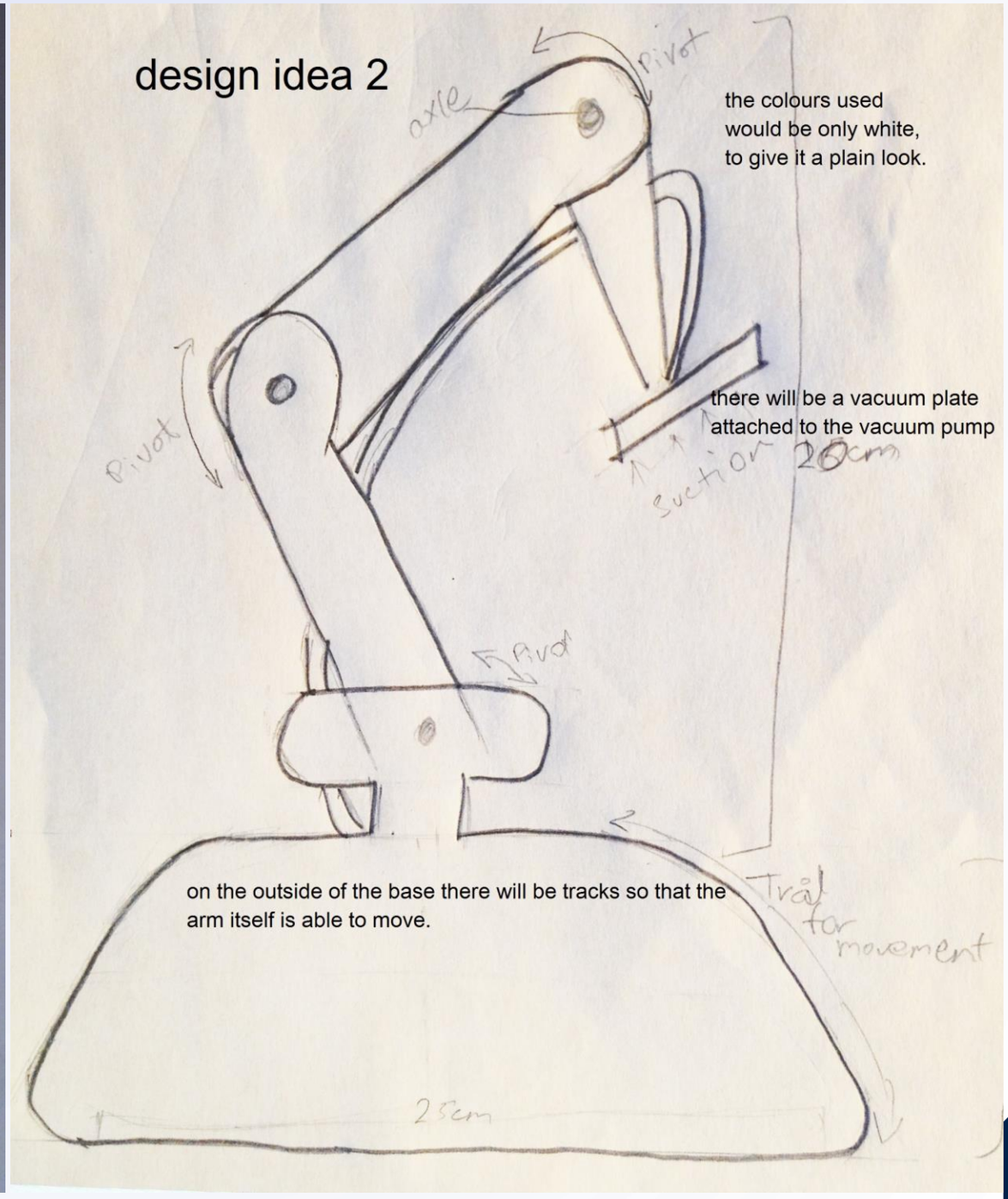
THE SUCTION PLATE WOULD BE MANUFACTURED ON THE LATHE.

DESIGN SPECIFICATIONS

FORM WHAT WILL IT LOOK LIKE? WHAT MATERIALS WILL YOU USE? WHAT SIZE WILL IT BE? WHAT ARE ITS SPECIAL FEATURES?	THE FINAL PRODUCT WOULD LOOK LIKE ANY ARM OF A ROBOT. I WOULD USE ACRYLIC AND ALUMINIUM. THE PRODUCT WOULD BE UNDER 50 CM TALL AND UNDER 40 CM WIDE. IT CONSISTS OF A VACUUM PUMP TO GRAB ONTO THINGS INSTEAD OF USING A REGULAR CLAW.
FUNCTION WHAT IS THE PURPOSE OF THE PRODUCT? WHAT WILL IT DO? HOW WILL IT DO THIS?	THE PRODUCT IS MADE TO HELP STUDENTS LEARN ABOUT ROBOTICS USING IT. IT WOULD TEACH STUDENTS ABOUT ROBOTICS AND ELECTRONICS BY USING THE ARM TO SIMPLY PICKUP OBJECTS. IT WILL BE ABLE TO DO THIS BY BEING CONTROLLED BY AN ARDUINO MICRO CONTROLLER.
USER WHO IS THE PRODUCT FOR? WHAT DO THEY WANT THIS PRODUCT TO DO? WHERE/WHY WILL THEY USE IT?	THE PRODUCT IS MADE FOR THE SCHOOL STUDENTS I INDIA AND ALSO FOR SCHOOLS IN INDIA. THEY WANT THE PRODUCT TO BE ABLE TO TEACH THEM IN A VERY INTERACTIVE METHOD. THEY WOULD BE ABLE TO BUY THESE KITS AT ANY TOY STORES, AND WOULD BUY IT IF THEY ARE INTERESTED IN ROBOTICS.
COSTS HOW MUCH WOULD THE PRODUCT COST TO MANUFACTURE? HOW MUCH WOULD IT BE SOLD FOR? HOW MUCH PROFIT WOULD BE MADE ON EACH PRODUCT? WHAT IS THE SCALE OF PRODUCTION?	THE PRODUCT SHOULD COST ABOUT RS2500 TO MANUFACTURE. THE PRODUCT WOULD BE SOLD FOR ABOUT RS3000. THE PROFIT MADE ON EACH PIECE SOLD WOULD BE APPROXIMATELY RS500. AT THE BEGINNING THE PRODUCTION WOULD BE ABOUT 10 PIECES PER DAY BUT THEN GRADUALLY INCREASE

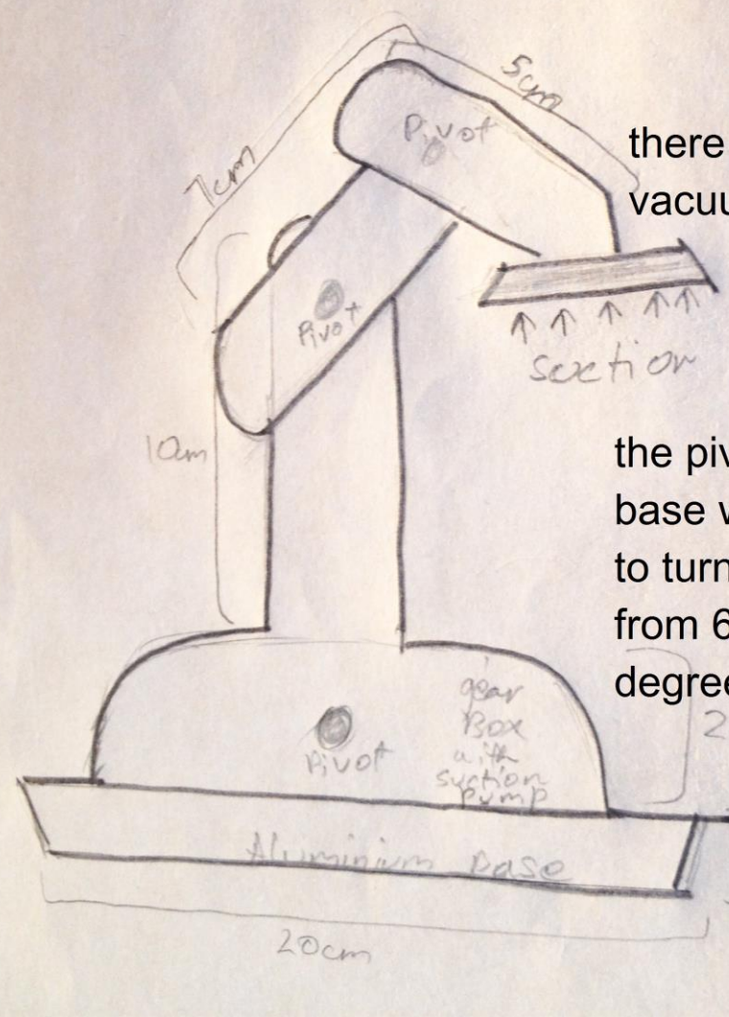
DEVELOPING IDEAS





DEVELOPING IDEAS

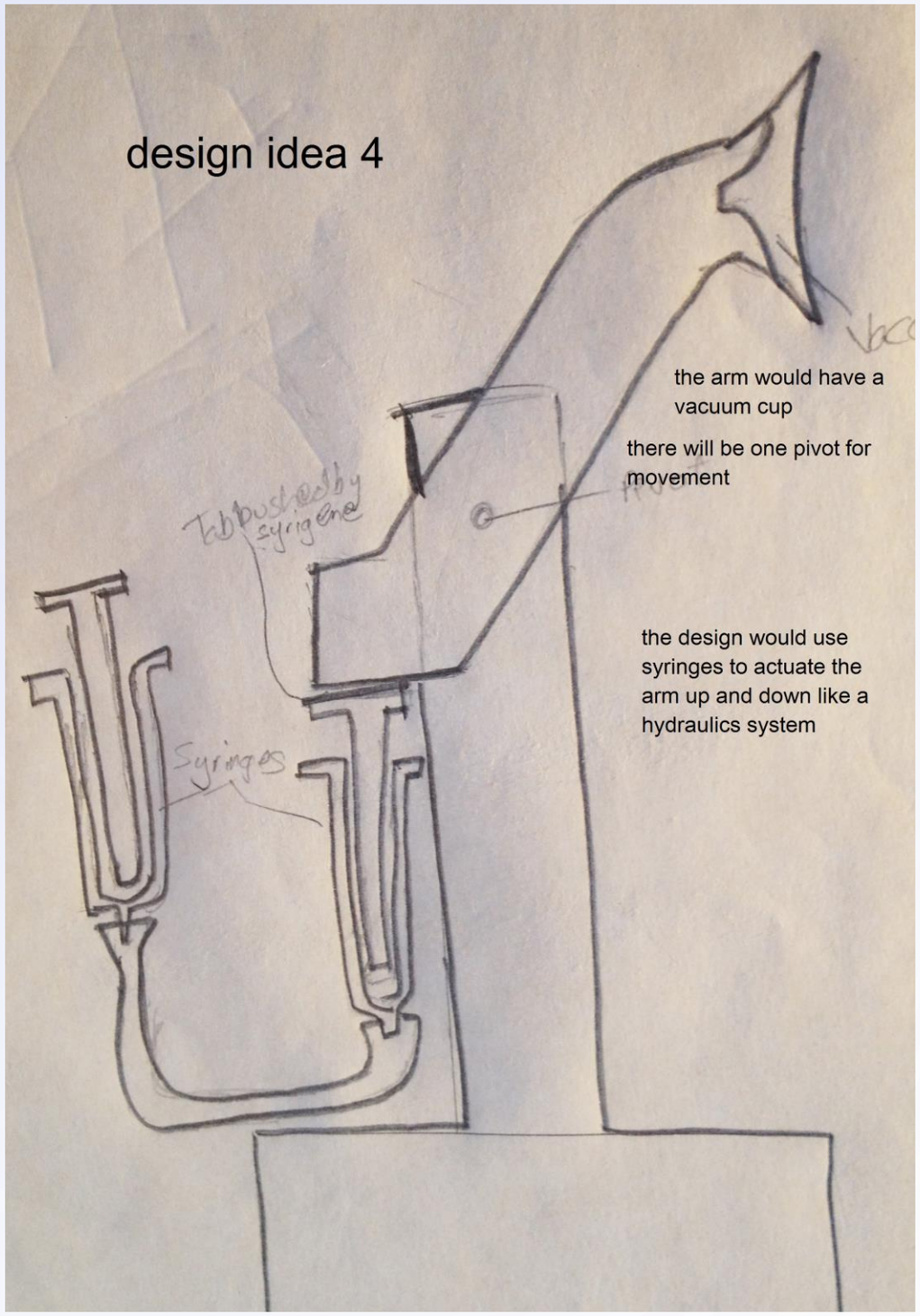
design idea 3



there will be a vacuum plate

the pivot in the base would be able to turn the arm from 60 to 120 degrees

design idea 4

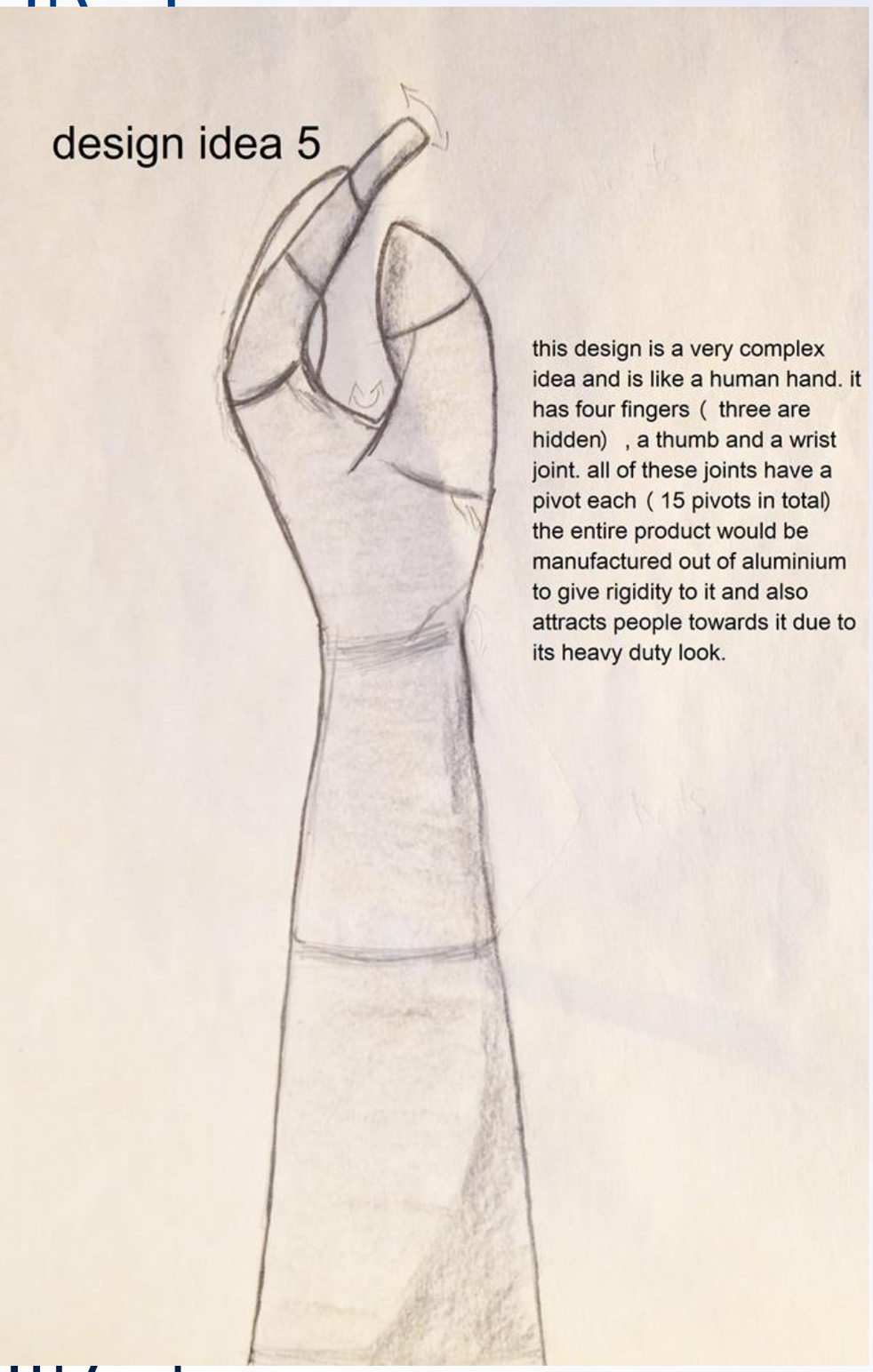


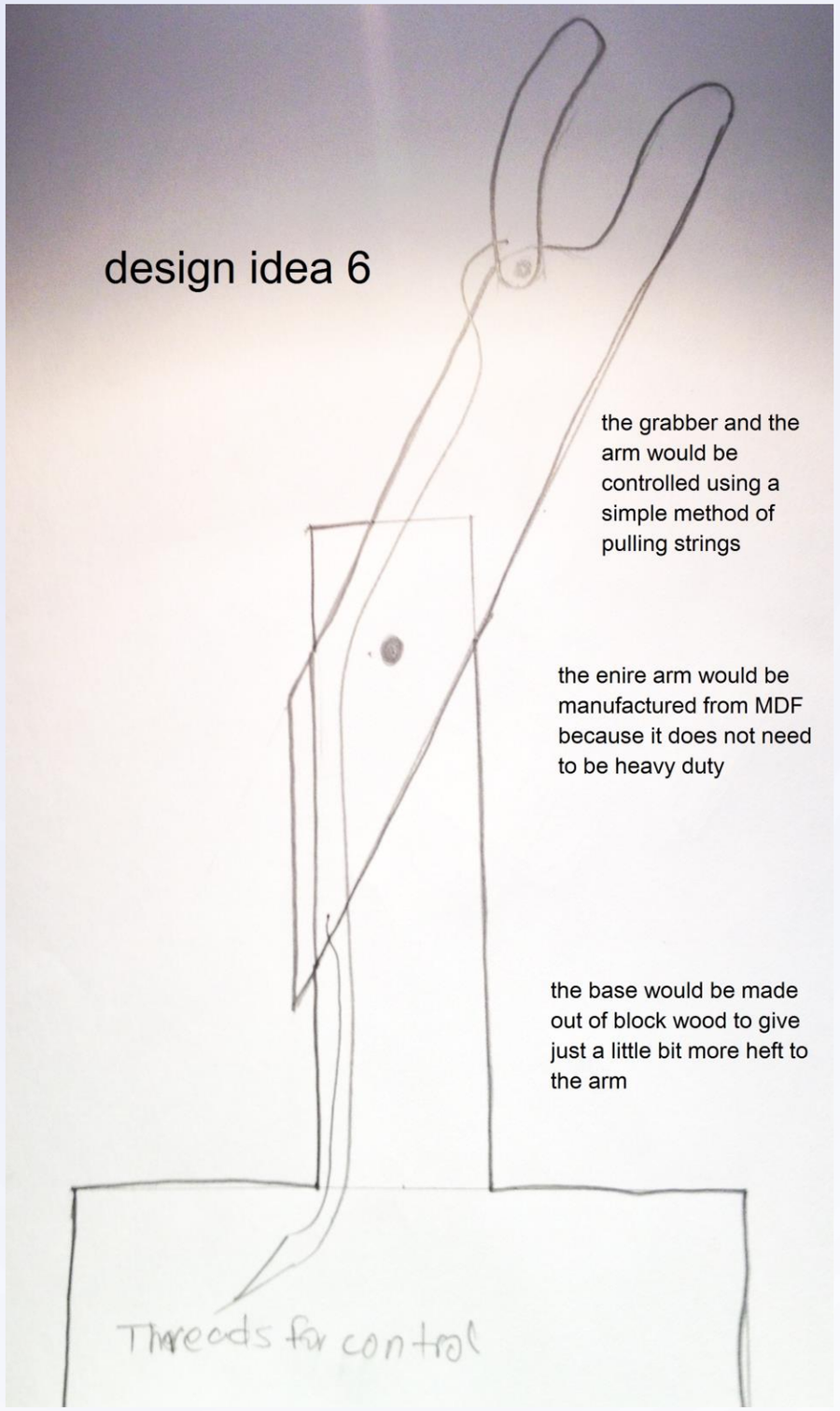
the arm would have a vacuum cup

there will be one pivot for movement

the design would use syringes to actuate the arm up and down like a hydraulics system

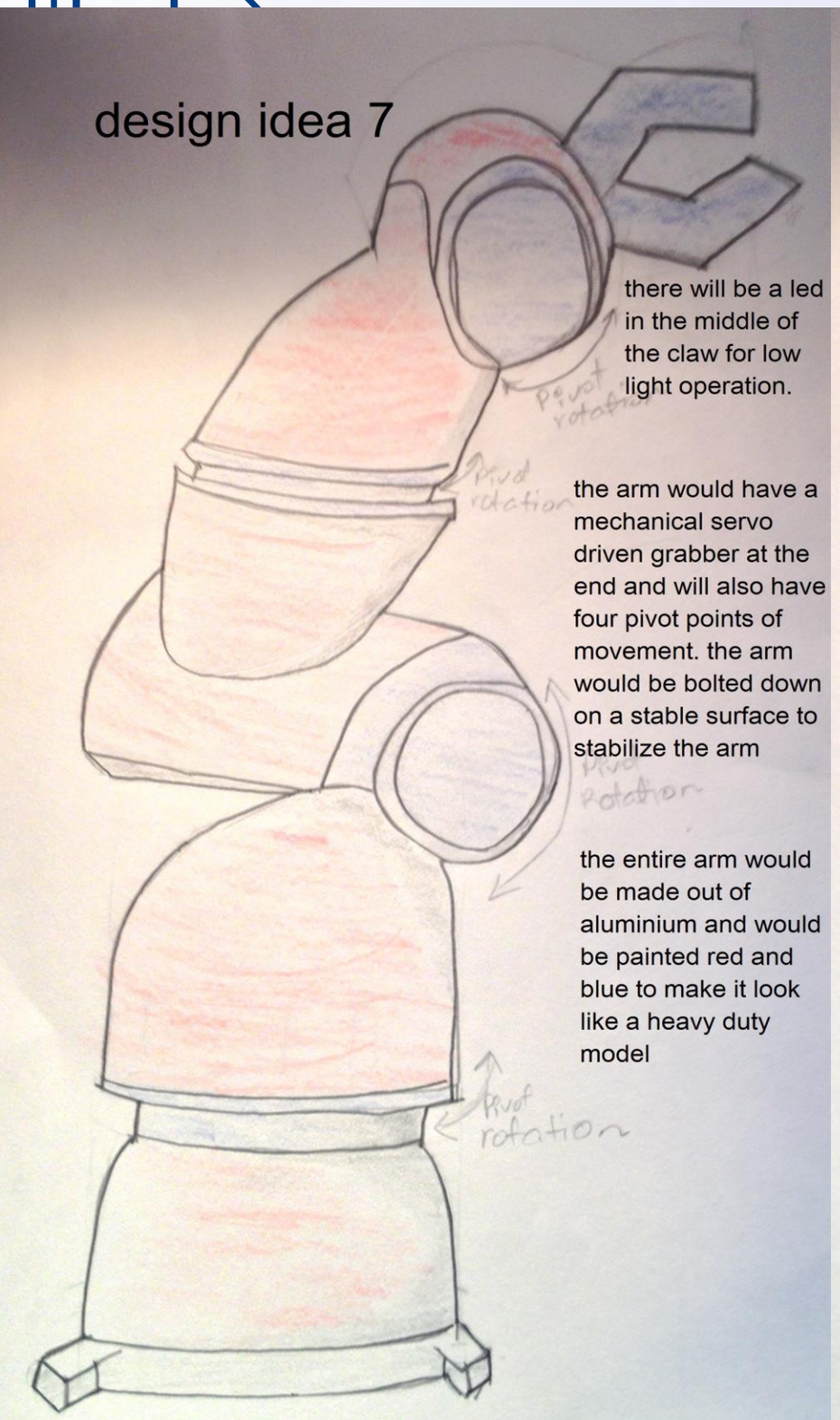
DEVELOPING IDEAS





DEVELOPING IDEAS

design idea 7

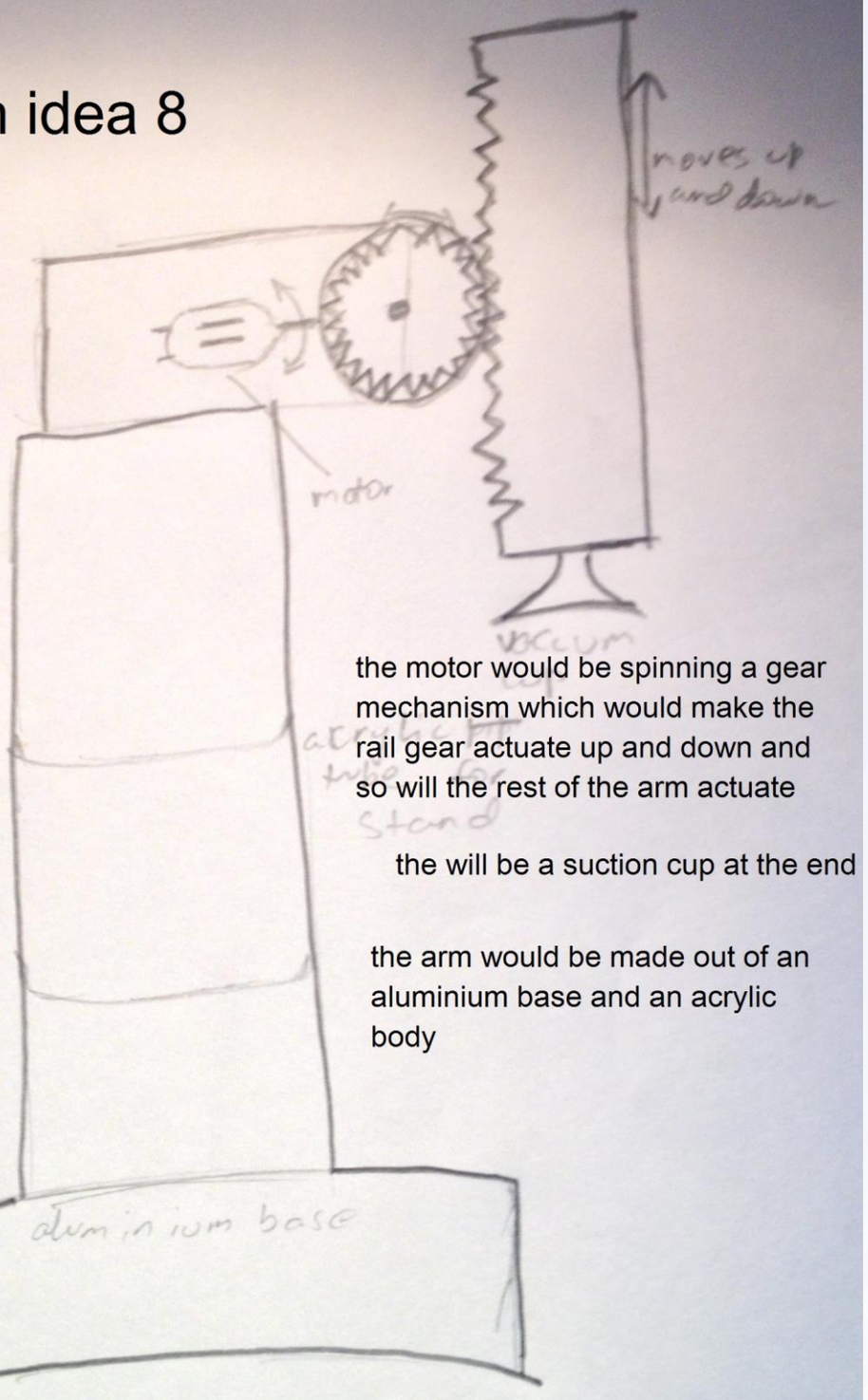


there will be a led in the middle of the claw for low light operation.

the arm would have a mechanical servo driven grabber at the end and will also have four pivot points of movement. the arm would be bolted down on a stable surface to stabilize the arm

the entire arm would be made out of aluminium and would be painted red and blue to make it look like a heavy duty model

design idea 8

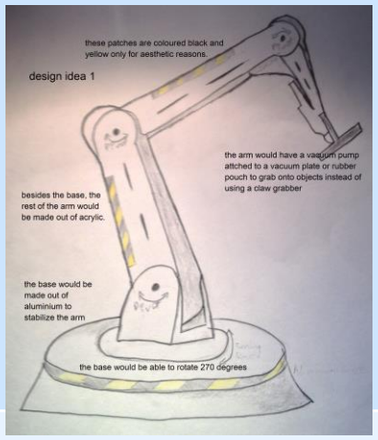
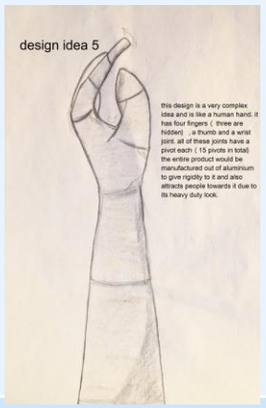
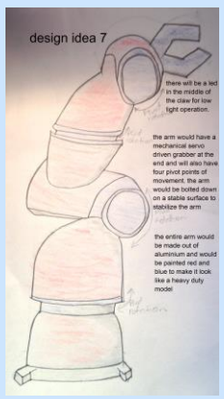


the motor would be spinning a gear mechanism which would make the rail gear actuate up and down and so will the rest of the arm actuate

the will be a suction cup at the end

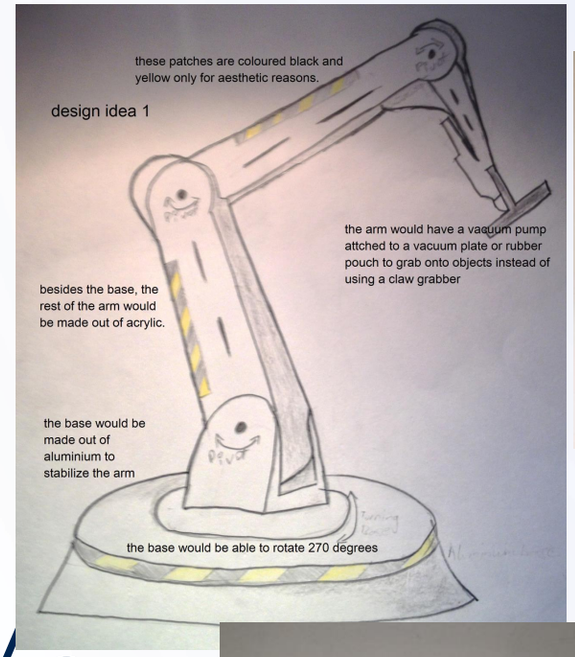
the arm would be made out of an aluminium base and an acrylic body

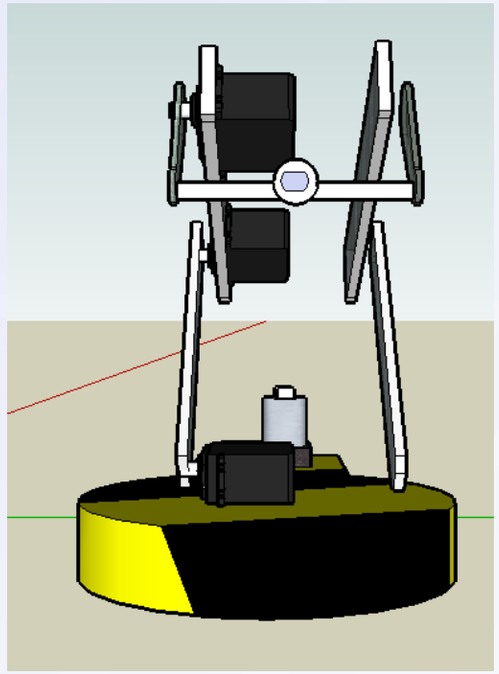
THREE DEVELOPED IDEAS

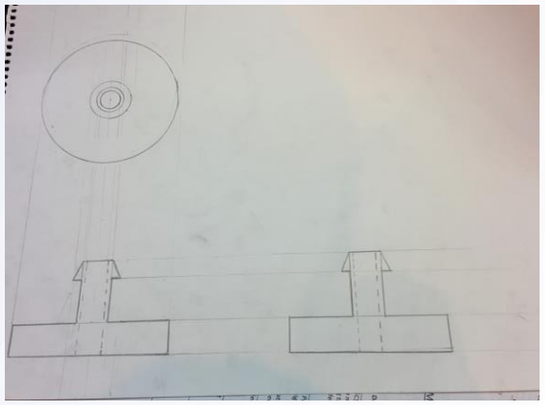
Idea chosen	Pros	Cons
IDEA 1 	• It is a very easy design. • Does not require a lot of materials. • Has a very basic colour combination. • The entire can rotate on the base. • It has a unique feature of having a vacuum pump.	• The vacuum pump may not be able to suck onto objects too heavy. • It is a very lean design so it might break. • It does not have a lot of functions. • The vacuum pump creates a lot of noise.
IDEA 5 	• It resembles the human hand to an extent. • It has a lot of mobility in terms of rotation. • It is all round so there are no sharp edges to cause cuts. • It looks like some kind of professional equipment.	• Since it is made of aluminium, it is very heavy. • It is too complicated for a student to learn from. • Since there are 15 pivots, too many motors would be needed. • Students may not be bale to assemble this sort of a kit.
IDEA 7 	• it is very flexible due to the amount of pivots. • The grip is very strong onto objects due to the mechanical claw. • It is stabilized due to the aluminium build. • It may be used by professionals to handle delicate objects.	• The base needs to be bolted on to make the arm steady. • The aluminium build would be too expensive. • Shaping aluminium is too hard. • It is too complex for a student to learn from • Students might not be able to assemble this kind of a kit.

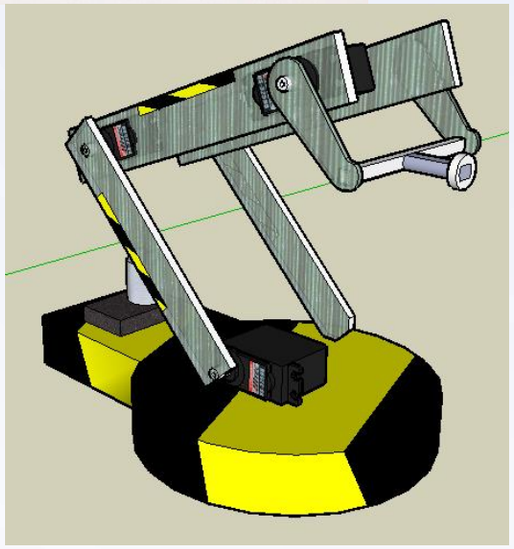
FINAL DESIGN

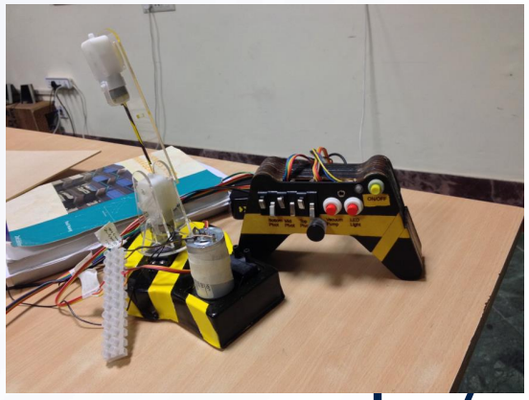
I HAVE CHOSEN DESIGN IDEA 1 BECAUSE I BELIEVE WHILE PRODUCING A KIT LIKE THIS FOR STUDENTS TO ASSEMBLE, IT SHOULD BE ABLE TO TEACH STUDENTS AND ALSO IT SHOULD BE AN EASY PROJECT FOR STUDENTS TO ASSEMBLE.
WHILE KEEPING THESE IN MIND I WAS ALSO THINKING OF MOBILITY OF THE ENTIRE ARM AND THE COST OF PRODUCTION.
ALSO THE ROBOT ARM KIT I'M MAKING HAS A UNIQUE FEATURE OF A VACUUM PUMP REPLACING THE OLD MECHANICAL GRABBER. THIS IS DONE FOR STUDENTS TO GET TO KNOW ABOUT SOMETHING NEW LIKE VACUUM AND HOW VACUUM PUMPS WORK.











PROTOTYPING

I HAVE MADE THREE PROTOTYPES OF THE ROBOTIC ARM TO COMPARE AND JUDGE DIFFERENT MATERIALS AND TEST THE APPEAL OF THOSE DIFFERENT MATERIALS TO THE CUSTOMERS.
THESE THREE PROTOTYPES WERE MADE FROM CARDBOARD, ACRYLIC AND MDF. THESE MATERIALS ARE CHOSEN BECAUSE THEY ARE THE EASIEST TO WORK WITH AND THEY APPEALED TO ME AS A DESIGNER.

Material used	Pros	Cons
MDF	• EASY TO CUT • EASY TO PAINT • CAN BE CUT ON THE LASER CUTTER	• MIGHT BURN ON THE LASER CUTTER • MAY RETAIN BURN MARKS
ACRYLIC	• CAN BE CUT ON THE LASER CUTTER • MANY COLOURS AVAILABLE	• MAY RESEAL ON THE LASER CUTTER • MAY SHATTER • MAY GET SCRATCHED
CARDBOARD	• EASY TO CUT • EASY TO PAINT • DIFFERENT THICKNESSES AVAILABLE	• MAY BEND • CAN NOT HOLD HEAVY WEIGHTS • MAY TEAR IF IT GETS WET

PRODUCTION PLAN

ROBOTIC ARM KIT

I STARTED WITH DRAWING ROUGH SKETCHES AND IDEAS FOR THE ROBOTIC ARM.

THEN I CHOSE THREE BEST IDEAS AND EVALUATED THEM.

FROM THOSE THREE CONCEPTS I CHOSE ONE FINAL IDEA.

THEN I CHOSE THE MATERIALS TO WORK WITH LIKE ACRYLIC AND NYLON.

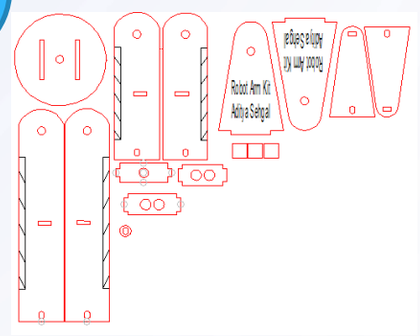
THEN I DESIGNED A PROTOTYPE MADE FROM ACRYLIC, MDF AND CARDBOARD

AFTER MAKING THREE PROTOTYPES , I EVALUATED THEM AND CHOSE ACRYLIC AS THE MOST SUITABLE MATERIAL.

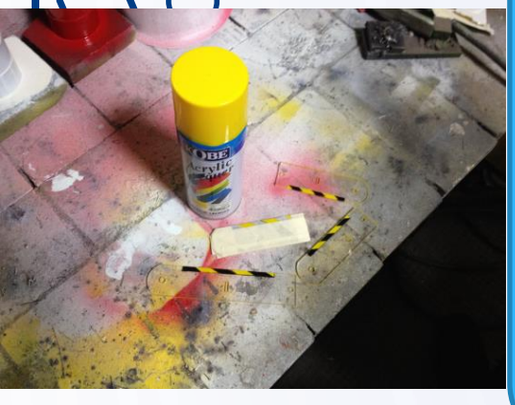
THEN I DESIGNED THE ENTIRE ROBOTIC ARM ON 2D DESIGN CAD SOFTWARE TO GET THE PARTS CUT ON THE LASER CUTTER.

AFTER GETTING ALL THE PARTS TOGETHER I CUT OUT THE BASE USING MDF USING A SCROLL SAW.

THEN I VACUUM FORMED THE BASE TO COVER IT WITH THERMOPLASTIC TO GIVE IT A THE SAME FINISH AS THE REST OF THE ARM.

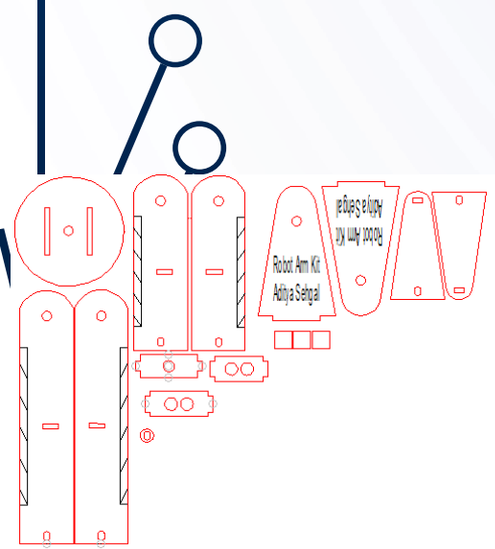


PRODUCT ION PLAN



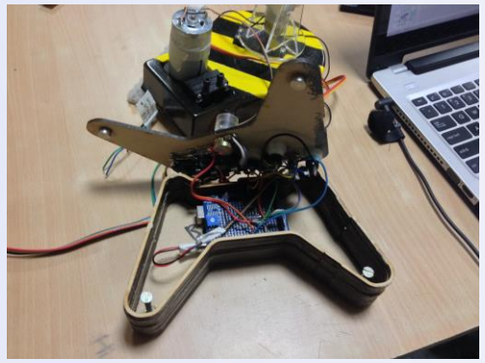
THEN I PAINTED THE BASE AND THE AM PARTS WITH BLACK AND YELLOW SPRAY PAINT.

I THEN GLUED AND SCREWED THE VACUUM PUMP, SERVO AND GEARED MOTORS RESPECTIVELY

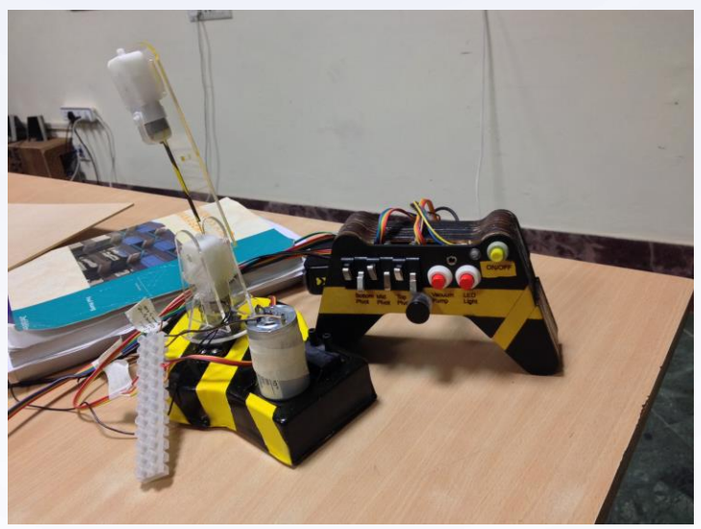


THEN I DESIGNED, CUT ON LASER AND ASSEMBLED THE CONTROLLER AND THEN PAINTED IT.

THEN I PAINTED THE CONTROLLER AND CONNECTED THE WIRES TO THE REST OF THE ARM.



THEN I TESTED THE ROBOTIC ARM AND EVALUATED THE ROBOTIC ARM KIT



cutting list for robotic arm kit

Part	Qty.	Width(mm)	Length(mm)	Thickness(mm)	Diameter(mm)	Material
1	1	450	600	3		clear acrylic sheet
2	1		30		4	steel rods
3			50		45	circular nylon bar
4	3	130	150	10		mdf blocks
5	2	450	600	3		mdf sheets
6	1	400	250	2		styrene sheet
						Aditya Sehgal

MODIFICATIONS MADE

- THE BASE WAS SUPPOSED TO BE MADE OUT OF ALUMINIUM, BUT MDF WAS USED BECAUSE MDF IS EASIER TO WORK WITH AND GIVES MORE WEIGHT TO THE BASE.
- THERE IS A COMPARTMENT ADDED TO THE BACK OF THE BASE TO STORE THE VACUUM PUMP AND THE ELECTRONICS.
- THE SPIGOT WAS MADE USING NYLON AND WAS TRIED TO BE MADE OUT OF ACRYLIC, BUT ACRYLIC SHATTERED.
- THERE IS NOW AN LED LIGHT ON THE END OF THE ARM NEAR THE SPIGOT.
- INSTEAD OF USING DPDT THROTTLE SWITCHES I HAVE CHOSEN TO USE 3 TERMINAL MICRO SWITCHES FOR THE CONTROL ON THE MOTOR BECAUSE MICRO SWITCHES WERE FOUND TO BE EASILY USABLE. INSTEAD OF USING INLAYS IN ACRYLIC TO GIVE AN INDUSTRIAL LOOK, PAINT WAS USED DUE TO THE WASTAGE OF ACRYLIC CAUSED BY USING INLAYS.
- INSTEAD OF VACUUM FORMING A CONTROLLER TO MAKE MY OWN CONTROLLER, I HAVE CHOSEN TO LASER CUT MULTIPLE LAYERS OF MDF TO MAKE THE CONTROLLER OUT OF.
- I HAVE CHOSEN TO USE A WALL AC/DC 12 VOLT CONVERTER FOR POWER THE ARM.

TESTING

TESTING WAS AN EASY PROCEDURE WHERE I HAD TO WORK WITH THE ROBOTIC ARM AND HAD TO EVALUATE HOW IT WORKS.
WHILE TESTING I FACED A PROBLEM OF THE ARM COLLAPSING DUE TO THE WEIGHT OF THE GEARED MOTORS WHICH THE BOTTOM PIVOT WAS NOT ABLE TO HOLD IN ONE POSITION. THIS ISSUE COULD BE SOLVED BY ADDING TENSION SPRINGS OR USING SERVOS INSTEAD OF GEARED MOTORS.
WHILE USING THE ARM, THE CONTROLLER IN HAND FELT A BIT TOO THICK AND BIG AS WELL.
WHEN I USED THE VACUUM PUMP, IT CREATED A LOT OF NOISE AND VIBRATED TOO MUCH LEADING THE ENTIRE ARM TO VIBRATE AND MOVE ALONG THE SURFACE.

CONSUMER EVALUATIONS

Survey

Name - _____ Grade/occupation - _____ Gender - _____

I am aditya sehgal and I am conducting this survey to get consumer suggestions and evaluations to complete my IGCSE D.T project.

Instruction –

- Please answer all the questions asked.
- Please return the survey within a day or two.

Q1. After using the robotic arm were you interested in buying the arm?
Yes [ ] No [ ]

Q2. Did you like the overall design of the robotic arm?
Yes [ ] No [ ]

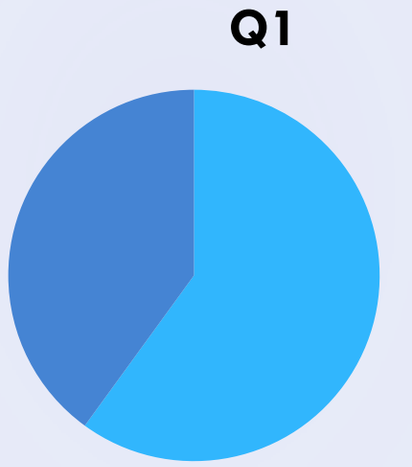
Q3. Would you be interested to build a robotic arm like this on your own?
Yes [ ] No [ ]

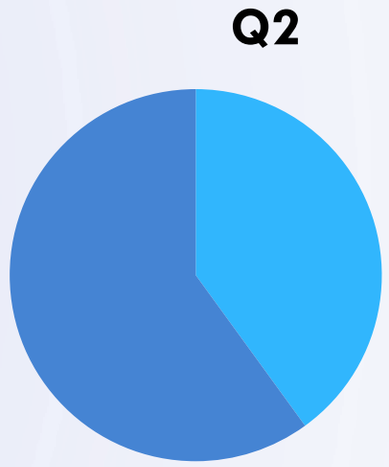
Q4. What do you feel about my project?
Impractical [ ] Useful [ ] Makeshift work [ ]
Well thought of [ ]

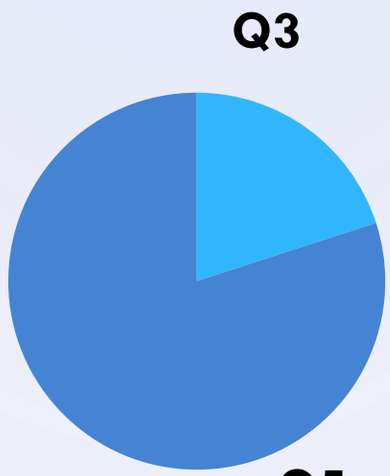
Q5. How was your overall experience with the arm?
Very bad [ ] Bad [ ] Neutral [ ] Good [ ]
Very good [ ]

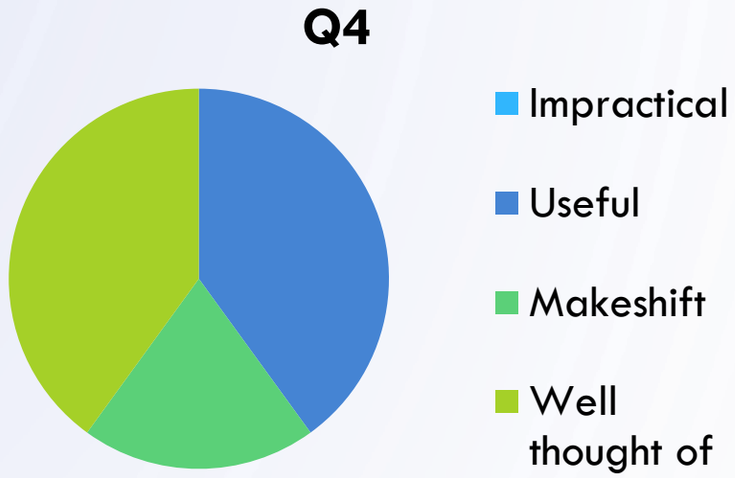
Q6. Any improvements you would like to suggest?

_____
_____









I ASKED FIVE USERS AND EVALUATED THEIR ANSWERS.
I HAVE REALIZED THAT MOST USERS WERE INTERESTED IN A PROJECT LIKE THIS BUT WOULD WANT IT PREASSEMBLED. I ALSO REALIZED THAT MOST PEOPLE WERE SATISFIED WITH THE ROBOT ARM. MOST PEOPLE ALSO FIND MY PROJECT USEFUL.

PROPOSED MODIFICATIONS

I HAVE THOUGHT OF SOME MORE MODIFICATIONS WHICH COLD BE MADE TO MAKE THE ROBOTIC ARM A MUCH BETTER PRODUCT.

- INSTEAD OF USING GEARED MOTORS, SERVOS COULD BE USED FOR BETTER CONTROL ACCURACY AND PREVENT COLLAPSING OF THE ARM
- SINCE THE VACUUM PUMP CAUSED THE ENTIRE ASSEMBLY TO VIBRATE, STICKY RUBBER FEET SHOULD BE USED INSTEAD OF SIMULATING RUBBER FEET USING GLUE FROM A HOT MELT GLUE GUN.
- SINCE THE VACUUM PUMP WAS NOT AS EFFECTIVE AS I THOUGHT, IT WOULD BE PREFERRED TO USE A MECHANICAL CLAW.
- INSTEAD OF MAKING THE BASE OUT OF MDF AND THEN VACUUM FORMING IT, A HEAVY PLASTIC COULD USED AND HEAVY STEEL BLOCKS COULD BE EMBEDDED INTO IT TO MAKE IT HEAVIER.
- INSTEAD OF LAYERING THE CONTROLLER FROM MDF, IT CAN BE MADE FROM VACUUM FORMING AN EXISTING CONTROLLER.
- INSTEAD OF USING AN ARDUINO, A CUSTOM PRINTED CIRCUIT CAN BE USED TO REDUCE THE COST OF PRODUCTION AND ALSO TO REDUCE THE THICKNESS OF THE CONTROLLER.

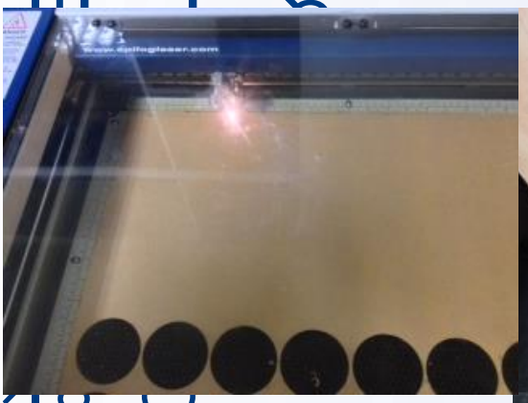
FINAL EVALUATION

- THE ENTIRE PROJECT WENT REALLY WELL AND I AM SATISFIED WITH MY FINAL OUTCOME, EVEN THOUGH IT COULD HAVE BEEN BETTER IF THE PROPOSED MODIFICATIONS COULD HAVE BEEN IMPLEMENTED BEFORE.
- ACCORDING TO ME, MY PRODUCT HAS MET MOST OF MY SPECIFICATION POINTS
- THE ARM IS QUIET EASY TO USE BUT THE CONTROLLER MAKES IT DIFFICULT TO HANDLE.
- IT DOES NOT FUNCTION AS WELL AS IT WAS SUPPOSED TO DUE TO THE WEIGHT THE MOTOR CAN NOT HOLD BUT THIS ISSUE CAN BE RESOLVED BY IMPLEMENTING A MODIFICATION LIKE USING TENSION SPRINGS.
- THE BIGGEST ADVANTAGE OF THE DESIGN CHOSEN IS THAT MOST PEOPLE WHO ARE AWARE OF ROBOTIC ARMS IS AWARE OF THE DESIGN CHOSEN
- THE BIGGEST DISADVANTAGE IS THAT THE VACUUM PUMP CREATES TOO MUCH NOISE.
- I WAS NOT ABLE TO STAY WITHIN THE BUDGET MAINLY BECAUSE OF THE EXPENSE OF THE VACUUM PUMP AND ARDUINO.
- THERE ARE NO SUCH SAFETY ISSUES WITH MY PRODUCT BUT THERE ARE EDGE WHICH ARE SHARP AND MAY CAUSE CUTS AND BLEEDS.
- THE ARM ITSELF IS NOT MADE OUT OF ECO FRIENDLY MATERIAL DUE TO ACRYLIC, BUT IT DOES NOT HARM THE ENVIRONMENT DURING USE.
- IT CAN BE MASS PRODUCED AND THE TECHNIQUES USED COULD BE INJECTION MOULDING AND LASER CUTTING.
- IT IS EASILY TRANSPORTABLE TO DELIVER BUT ONLY IF IT IS NOT ASSEMBLED.

INDUSTRIAL PRACTICES

- THE ROBOTIC ARM COULD BE MASS PRODUCED REALLY EASILY BECAUSE IT WILL BE PACKED INTO A BOX AND WOULD NOT BE NEEDED TO BE ASSEMBLED.
- THE BOX FOR THE ROBOTIC ARM KIT WOULD PRINTED USING OFF SET PRINTING PROCESS. BECAUSE IT IS THE MOST COMMON PRINTING PROCESS USED TO PRINT CARDBOARD BOXES
- SINCE THE ENTIRE ARM IS MADE OUT OF ACRYLIC WHICH CAN BE CUT OUT ON LASER CUTTER, A CAD SOFTWARE LIKE 2D DESIGN COULD BE USED TO DESIGN THE PARTS WHICH NEED TO BE CUT OUT.
- THE BASE WOULD BE MANUFACTURED BY INJECTION MOULDING, AND THE REST OF THE ARM WOULD BE CUT OUT ON THE LASER CUTTER.
- THE ONLY ENVIRONMENTAL ISSUES CAUSED ARE DURING MANUFACTURE, WHICH IS THE GASES FORMED WHEN ACRYLIC IS CUT ON THE LASER CUTTER
- IT WILL BE DELIVERED IN A CARDBOARD BOX WITH A FOAM INLAY PROTECTOR TO GIVE EXTRA PROTECTION TO ALL THE COMPONENTS INSIDE OF THE BOX.
- ONLY SOME PARTS WOULD BE TESTED LIKE THE VACUUM PUMP, GEARED MOTORS AND THE SERVO BECAUSE THESE ARE ELECTRONICALLY DRIVEN COMPONENTS WHICH NEED TO BE TESTED BEFORE DELIVERY.

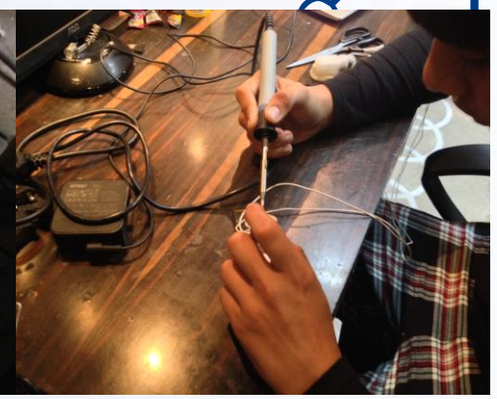
PICTURES OF THE PROCESS



GETTING THE SEGMENTS COLLECTING THE PIECES, CUT ON LASER.

TURNING NYLON ON THE LATHE FOR THE SUCTION PLATE.

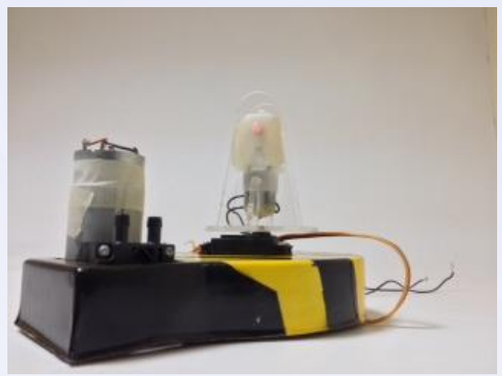
SPRAY PAINTING THE SEGMENTS.



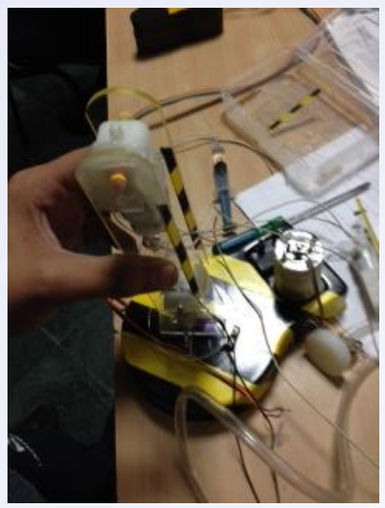
SOLDERING WIRES TO THE MOTORS.

GLUING THE MOTORS.

CUTTING THE SHAFTS.

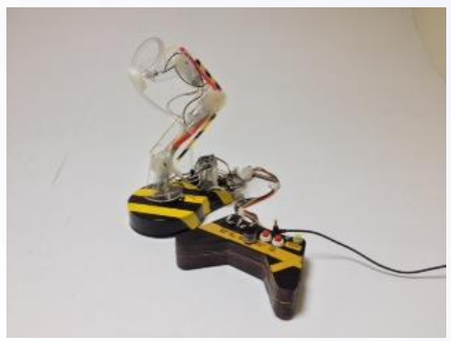


ASSEMBLING THE ARM.



ASSEMBLING THE ARM.

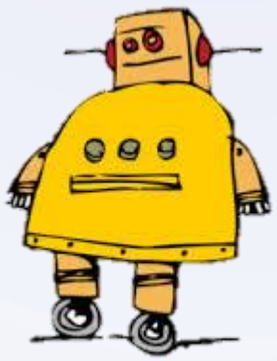
ASSEMBLING THE ARM.

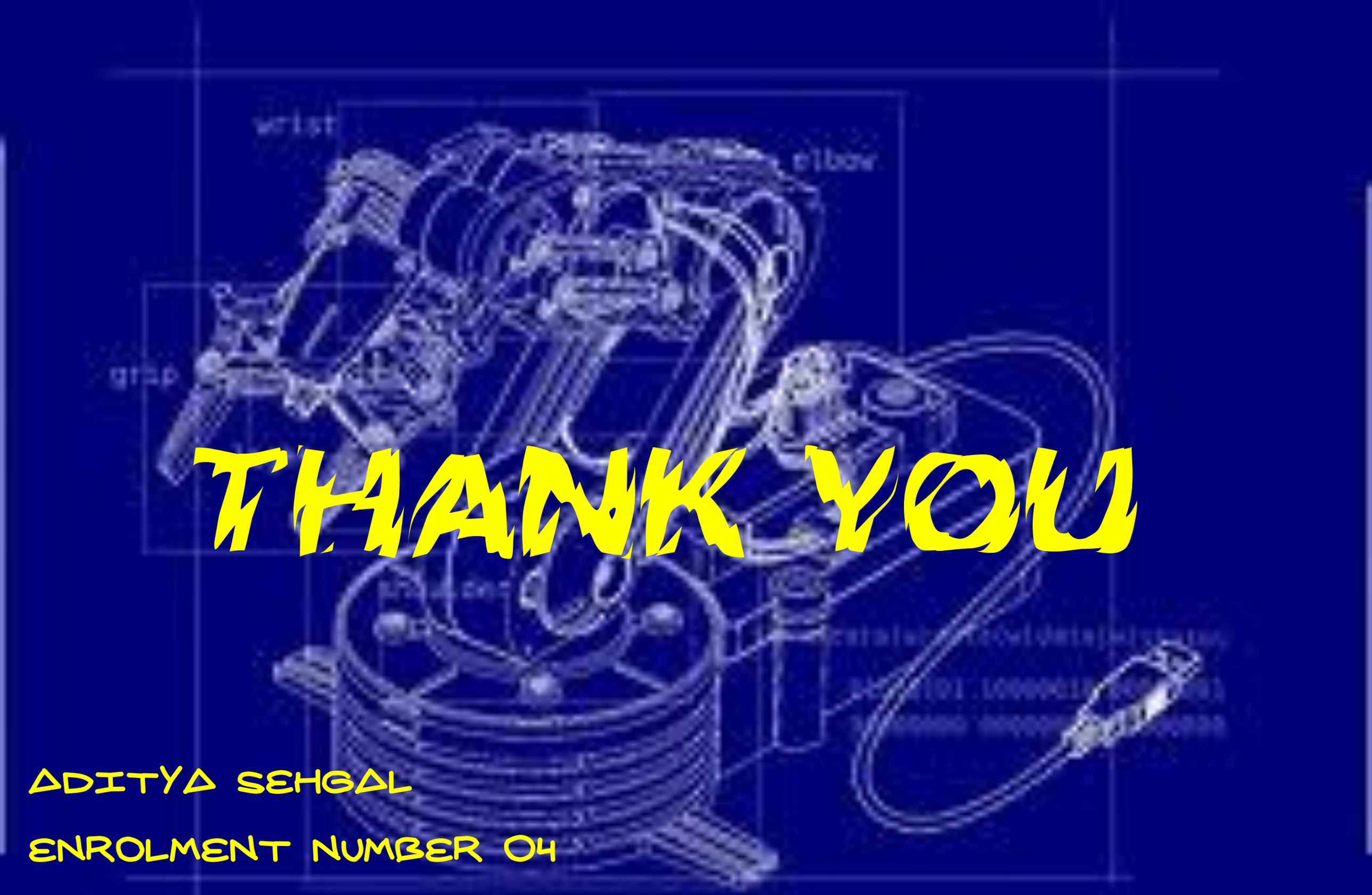


THE FINAL PRODUCT.

CITATION

IMAGES-
ALL THE IMAGES USED ARE TAKEN FROM WWW.IMAGES.GOOGLE.COM AND WWW.INSTRUCTABLES.COM
THE 3D CAD MODEL-
THE 3D CAD MODEL IS A MODIFICATION BUILT ON TOP OF ANOTHER MODEL AVAILABLE ON THE OFFICIAL GOOGLE SKETCHUP WEBSITE HTTP://SKETCHUP.GOOGLE.COM/3DWAREHOUSE/ , THE LINK FOR THE MODEL IS-
HTTP://SKETCHUP.GOOGLE.COM/3DWAREHOUSE/DETAILS?MID=E3CF3947751075F28FD244AD5F0757C2





THANK YOU

ADITYA SEHGAL

ENROLMENT NUMBER 04

MAJOR IGCSE PROJECT 2014

GUIDED BY MR MERVYN LONG