

Center for robotics
Physics-Mathematics Lyceum №30

Engineering book of
Competition First FTC

Team
PML30 (φ)

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Содержание

1	Engineering section	5
1.1	Concept of robot	5
1.1.1	Construction	5
1.1.2	Autonomous period	5
1.1.3	Driver-controlled period	5
1.2	Strategy	6
1.2.1	Autonomous period	6
1.2.2	Driver-controlled period - main part	6
1.2.3	Driver-controlled period - final	6
1.3	Planned steps for creating of robot	7
1.4	Team meetings	8
1.4.1	29.09.14	8
1.4.2	06.10.14	11
1.4.3	07.10.14	12
1.4.4	08.10.14	14
1.4.5	10.10.14	16
1.4.6	11.10.14	18
1.4.7	13.10.14	20
1.4.8	15.10.14	22
1.4.9	16.10.14	23
1.4.10	17.10.14	25
1.4.11	18.10.14	26
1.4.12	20.10.14	28
1.4.13	21.10.14	29
1.4.14	22.10.14	31
1.4.15	24.10.14	33
1.4.16	25.10.14	34
1.4.17	27.10.14	36
1.4.18	28.10.14	37
1.4.19	01.11.14	38
1.4.20	03.11.14	40
1.4.21	04.11.14	41
1.4.22	08.11.14	42
1.4.23	10.11.14	44
1.4.24	11.11.14	45
1.4.25	12.11.14	47
1.4.26	14.11.14	49
1.4.27	15.11.14	50
1.4.28	16.11.14	51
1.4.29	17.11.14	52
1.4.30	18.11.14	54
1.4.31	19.11.14	55
1.4.32	20.11.14	56
1.4.33	21.11.14 (Competition)	57
1.4.34	22.11.14 (Competition)	59
1.4.35	23.11.14 (Competition)	61
1.4.36	25.11.14	63

1.4.37	29.11.14	. . . . .	65
1.4.38	30.11.14	. . . . .	67
1.4.39	01.12.14	. . . . .	68
1.4.40	05.12.14	. . . . .	70
1.4.41	06.12.14	. . . . .	71
1.4.42	08.12.14	. . . . .	73

1 Engineering section

1.1 Concept of robot

1.1.1 Construction

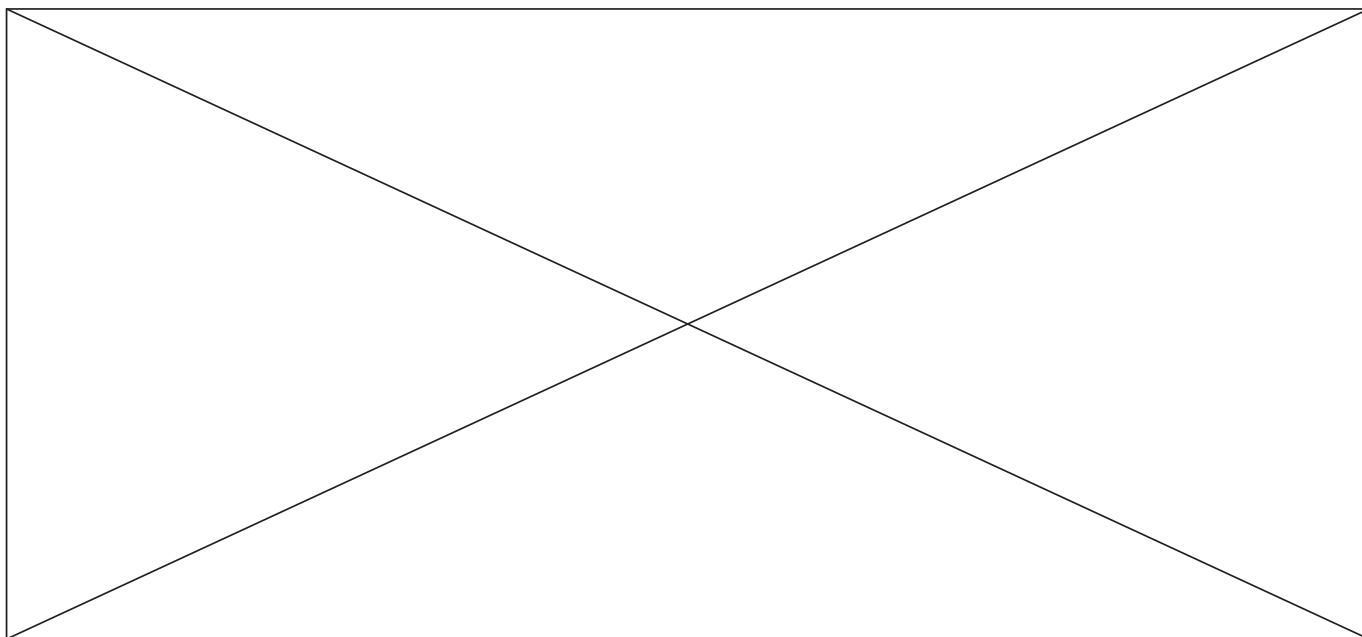
- Robot should be mobile, move quickly, and if it is possible in each of four direction.
- Robot should own four sensors of angle (encoder) to use it in the autonomous period.
- Robot should be compact and doesn't fill too much space, because it shouldn't hinder to ally.
- Robot must be able to monitor the five (5) goals simultaneously.
- The robot must own special device for moving the movable baskets.
- If possible, the robot should be lightweight. It will be easier to carry.
- Construction of robot should let us to change some elements quickly.

1.1.2 Autonomous period

- Robot should own some different versions of the autonomous period and use it, depending on possibilities of the ally, place of starting and others conditions.
- The program in an autonomous period should be simple.

1.1.3 Driver-controlled period

- Controlling of the robot should be simple and convenient
- One operator is fully responsible for the movement of our robot, second - for all another functions.
- Some steps in the controlled period may be implemented independently, to help operator.
- Operator should control speed of robot, because robot should perform precise manipulation.



1.2 Strategy

1.2.1 Autonomous period

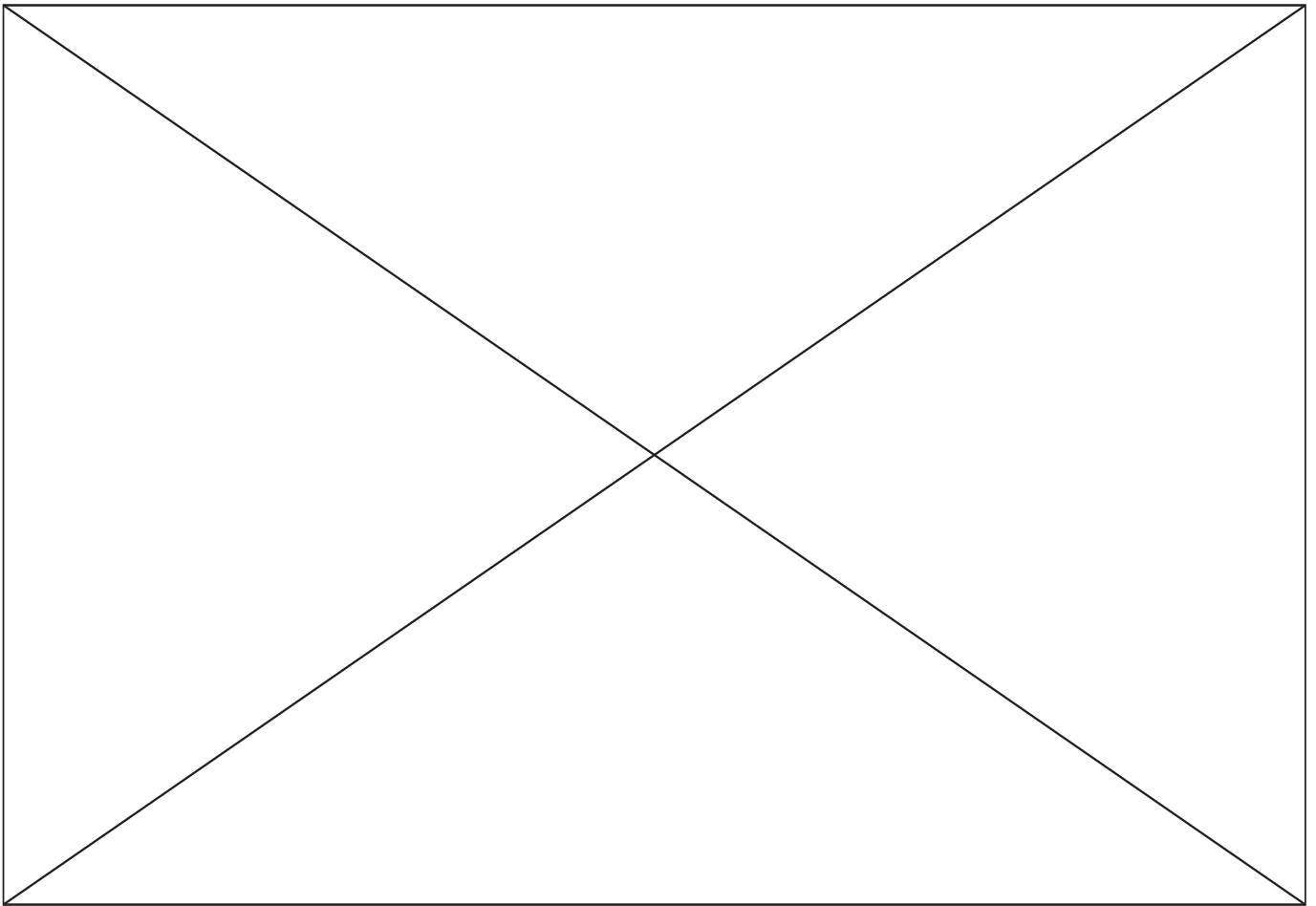
1. Put two autonomous balls in two different baskets.
2. Take the maximum number of mobile baskets and replace them to the parking area.
3. On the way to the parking area it should set in motion mechanism of release balls.

1.2.2 Driver-controlled period - main part

1. Let to our ally free access to the moving baskets. But, at the same time, it should carry one basket, because we should save the time.
2. First, fill balls 90-cm basket, then - 60-cm and 30-cm .
3. Avoid collisions with ally and opponents, because of vaste time .

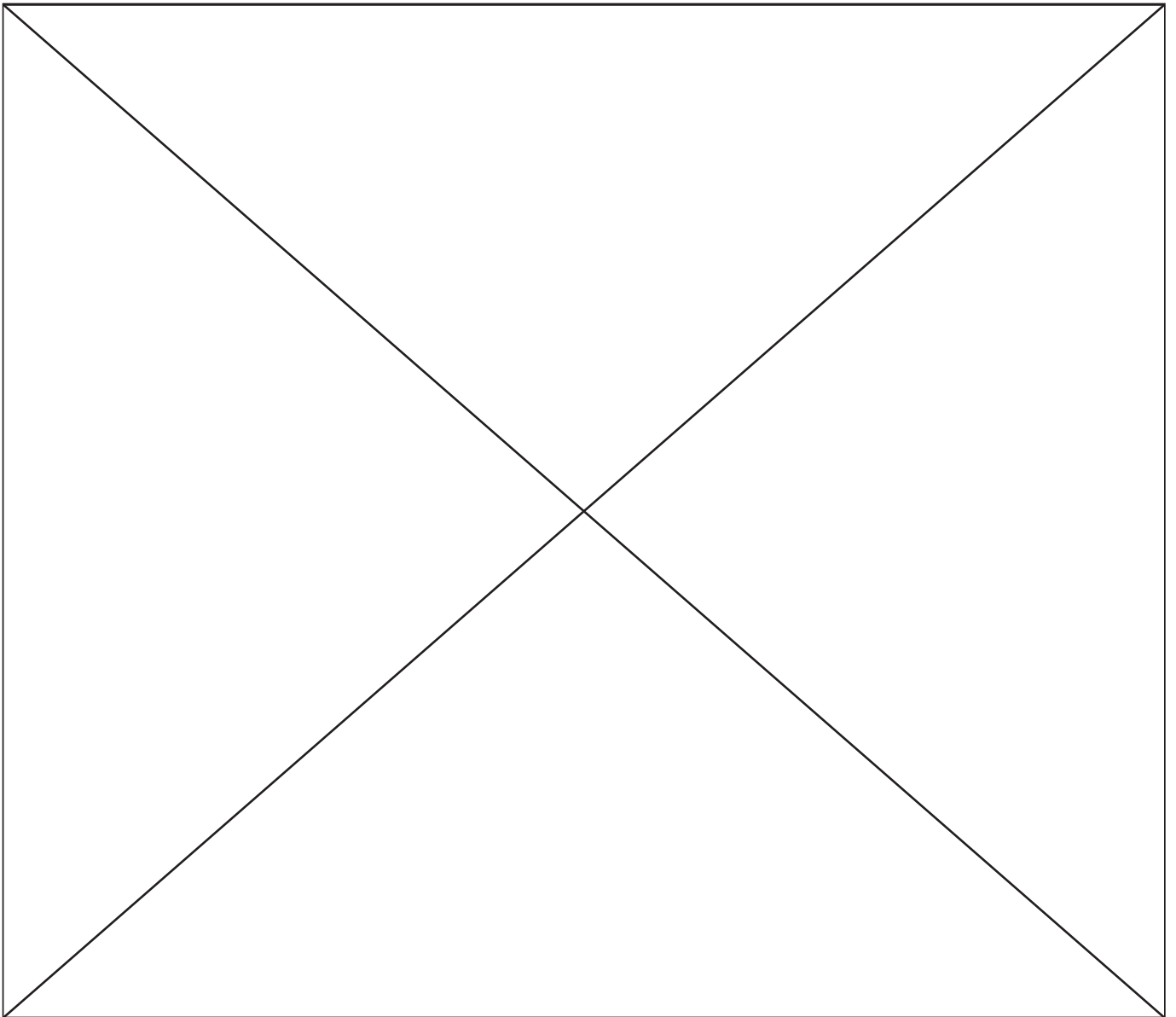
1.2.3 Driver-controlled period - final

1. Fill the central basket with balls.
2. Replace maximum possible number of the mobile baskets on the ramp.
3. Call the robot on the ramp.



1.3 Planned steps for creating of the robot

1. Creating a wheel (or track) base of the robot.
2. Writing a program for controlling the wheelbase through one (1) joystick.
3. Creating a system of control goals.
4. Writing a programm for control robot through two(2) joysticks.
5. Writing programm for the autonomous period.
6. Creating additional decorative elements.
7. Installation on the robot protection elements to prevent damage during an accidental collision.
8. Trainings (alone or with another robots).
9. Making improvements on the basis of first competition.



1.4 Team meetings

1.4.1 29.09.14

1. The time of beginning and ending of the meeting: 18:00 - 21:30
2. Purposes of the meeting:
 - 2.1. Discuss the rules of FTC Cascade Effect.
 - 2.2. Discuss the main aspects of robot's construction.
 - 2.3. Elaborate strategy of our team's play.
3. Work, that has been done
 - 3.1. Was discussed in part 2 of rules.
 - 3.2. During the discussion of construction of robot there have been several ideas:
 - 3.2.1. Dimensions of the robot:
 - 3.2.1.1. Body of robot must be compact enough. Body and gripper for balls must fit at the regulated dimensions.
 - 3.2.1.2. Robot must be compact not to bother alliance partner.
 - 3.2.1.3. Body of robot shouldn't be too small, otherwise it will be unstable when the lift is raised to maximum height (120cm)
 - 3.2.2. Wheel base:
 - 3.2.2.1. Construction with four standard wheels from set Tetrix. This system can move in a straight line and turn on the spot very good. A minor defect of this construction is that when the robot is turning wheels jump and robot shakes.
 - 3.2.2.2. Construction with two caterpillars. This construction's advantage is that it can move in a straight line and turn on the spot. The disadvantage of this system is that caterpillar can get off. Otherwise there is no caterpillars in Tetrix set so we have to make to their ourself.
 - 3.2.2.3. Construction with four omni wheels from Tetrix set fixed at angle of 45 degrees to the body of robot. The advantage of this construction is that it can move to any direction and can turn very fast but it move badly in a straight line. That could adversely affect the Autonomous period.
 - 3.2.2.4. Construction with four mecanum wheels that fixed as standard wheels. Advantages: good moving in a straight direction, fast turning, possibility of moving to any direction. Disadvantages: they have low accuracy when turning we have to buy this wheels separately from the set.
 - 3.2.3. System of control of balls:
 - 3.2.3.1. Basket for balls is fixed to the system of retractable slats that are interconnected with help of servomotors. Advantages: the absence of a line that can tear. Disadvantages: the complexity and low reliability.
 - 3.2.3.2. Basket for balls is fixed to system of retractable slats that are fixed to body of robot. DC-motors reel up the line and extract the lift. Advantages: this construction is simple and reliable (except the line). Disadvantages: line can tear.
 - 3.2.3.3. Basket for balls is fixed to system of retractable slats that are fixed to DC motor so it can rotate slats in the vertical plane. Advantages: opportunity of extracting in horizontal position that relieves the load from the line. Disadvantages: line can tear.

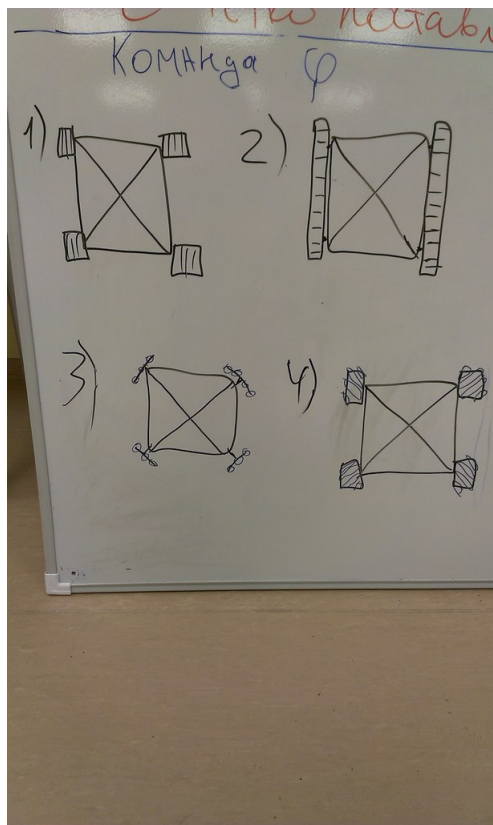


Рис. 1: Ideas of wheel base: 1) Construction with four standard wheels 2) Construction with two caterpillars 3) Construction with four omni wheels from Tetrax set 4) Construction with four mecanum wheels

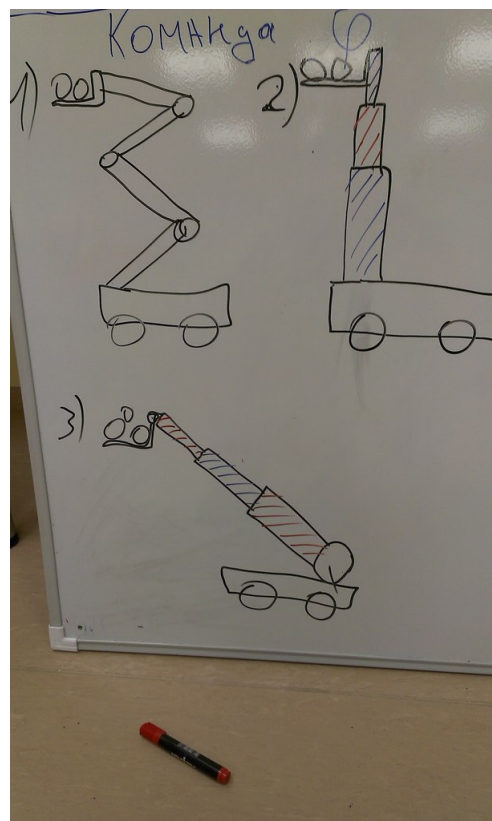


Рис. 2: Ideas of the lift 1) Construction №1 2) Construction with stationary slats 3) Construction with slats that fixed to DC motor

3.2.4. System of fixing the moving basket (for more accurate throwing of balls to basket and for moving it):

- 3.2.4.1. Π -shaped gripper with two servomotors fix basket between the beams. Servomotors are located at DC motor that can rotate them in vertical plane. Advantages: opportunity of raising basket. Disadvantages: takes a lot of space.
- 3.2.4.2. The hooks that can capture basket for small holes in it's base are used in the same gripper. Advantages: more compact than previous variant. Disadvantages: it could be difficult to get the hooks into the holes

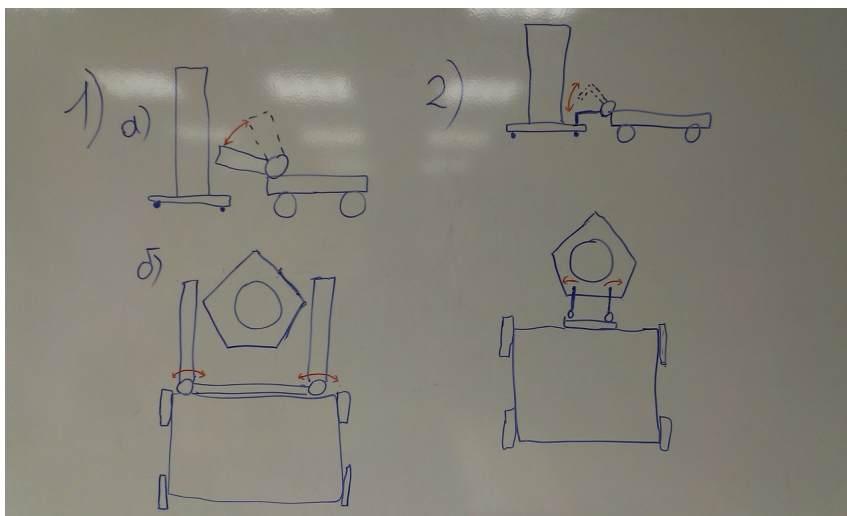


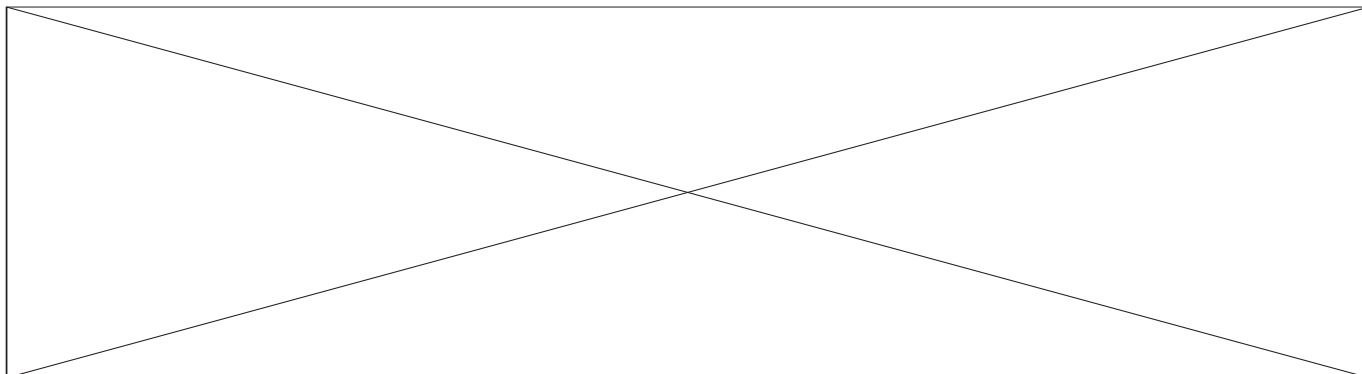
Рис. 3: Ideas of fixing of moving baskets: 1) Gripper shaped Π
2) Gripper with hooks

4. Results:

4.1. As the result of discussion were generated ideas that described in sections "Concept of robot" "Strategy" and "Planned steps for creating of the robot".

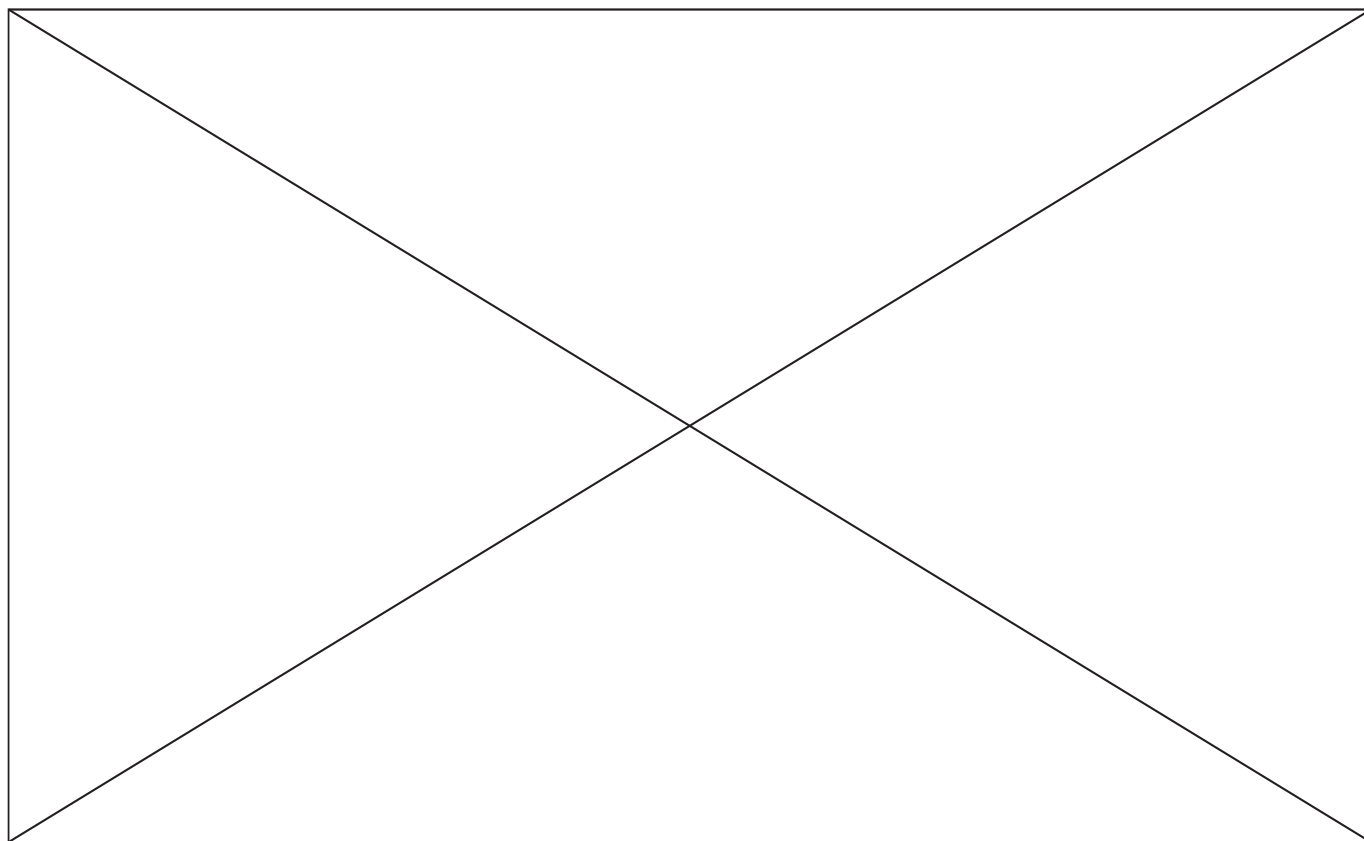
5. Tasks for the next meetings:

- 5.1. To choose the wheels base.
- 5.2. To choose the optimal sizes of robot.
- 5.3. To choose the best system of control of balls.
- 5.4. To choose the most effective way of fixing of moving basket.



1.4.2 06.10.14

1. The time of beginning and ending of the meeting: 21:00 - 21:30
2. Purposes of the meeting:
 - 2.1. Begin to write a program to control the robot by joystick.
3. Work, that has been done:
 - 3.1. It was written two programs for test the wheel base: moving in a straight direction and turning around. It showed good results during driving in a straight direction. During the turning around robot highly shakes. It is due to the high coefficient of friction between the wheels and floor. So the wheels could not slip on the floor and jumped up and down. In general it does not affect the accuracy of turning.
 - 3.2. As a result of the discussion it was choosen the type of lift - sliding rails, the base of which are rigidly fixed to the frame of the robot. This design is most reliable and the easiest to implement.
4. Results:
 - 4.1. Type of lift was choosen.
5. Tasks for the next meetings:
 - 5.1. To buy furniture slats to create lift.



1.4.3 07.10.14

1. The time of beginning and ending of the meeting: 17:00 - 21:30
2. Purposes of the meeting:
 - 2.1. Writing a program to control the robot by joystick.
 - 2.2. Beginning of creating the lift.
3. Work, that has been done:
 - 3.1. Today control of the robot by joystick was implemented. Motor control was carried out by the left stick. During the tests it was found that when a small current was supplied on motors, they could not be rotated and too much loud have been to motors. In this regard it was decided to put a limit to the supply of too small signal.
 - 3.2. In order to raise the basket to 120 cm, it was decided to assemble two guides each of which consists of four furniture rails: two by 30 cm and two by 35 cm. Thus the lifting height is 130 cm. The guides were installed on the robot.

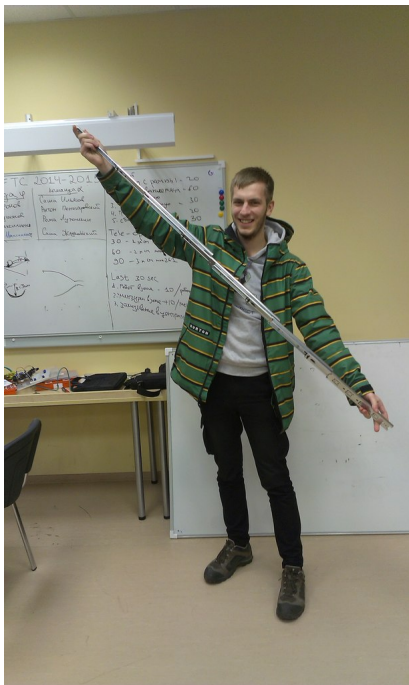


Рис. 4: Guides for the lift

- 3.3. It was decided to install a lift in the central part of the robot. Electronics was installed in the rear part and protected from damage by the lifting mechanism. Some space was left for the bucket in front of the robot.
- 3.4. Bucket is lowered inside the robot so this position is protected from the collision. But in this case, the question how the balls will get into the bucket arises if it will be located inside the robot. It was decided to increase the distance between the floor and the bottom of the front frame of beam to 7 cm so that a big ball could go. This has been achieved by turning the motor around in their mounts. In addition, the decision to increase clearance is increased the stability of the robot.

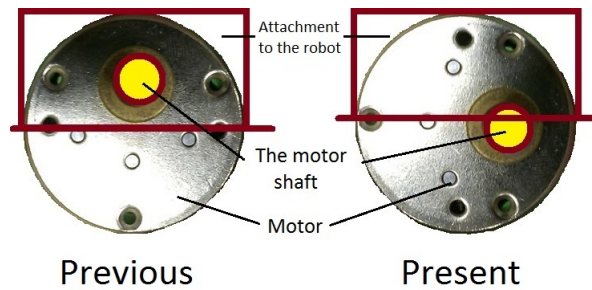
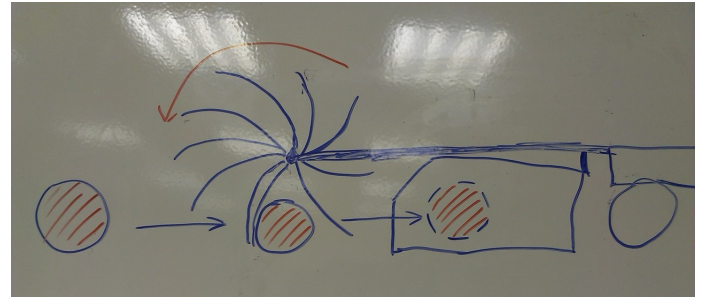


Рис. 5: Increase clearance

3.5. In front of the robot it was decided to install a soft brush, such as those installed on the snow machines that will rotate and capture balls. In the case when the robot has collected a maximum number of balls, the operator can stop the rotation of the brushes so other balls will not accidentally get into the bucket.



appearance



The principle of operation

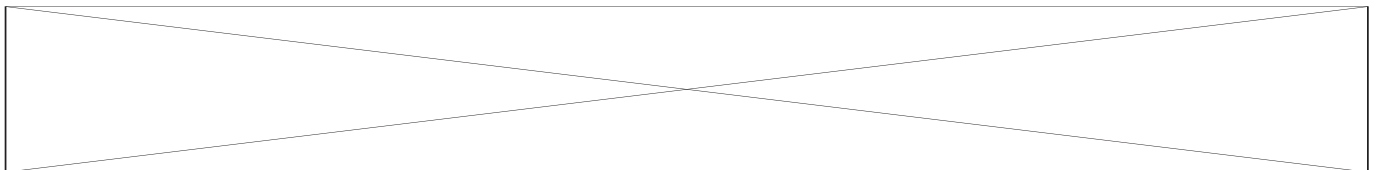
Рис. 6: The idea to capture balls

4. Results:

- 4.1. It was implemented a simple program to control the robot.
- 4.2. It was created and assigned rails for the lift.
- 4.3. Battery and motor drivers are properly fixed on the robot. NXT block has not been fixed, as it requires periodically to removed for battery replacement.
- 4.4. Clearance of the robot has been increased.

5. Tasks for the next meetings:

- 5.1. To finish the program of the robot control.
- 5.2. To implement control of the robot by Bluetooth.
- 5.3. To create a mechanism for moving apart guides.



1.4.4 08.10.14

1. Time of beginning and ending of meeting: 18:30 - 21:40.
2. Purposes of meeting:
 - 2.1. Making the programme of control of robot via Bluetooth.
 - 2.2. Choosing of the optimal way of extracting the lift.
3. Work, that has been done:
 - 3.1. Programme of control of robot was changed. Limit was set so that when joystick's deviation is small the robot doesn't move. It allowed to avoid heavy load from the motors.
 - 3.2. It was carried out connection to robot via Bluetooth.
 - 3.3. The test of programme was successfull. We couldn't make the programme of autonomous period because we didn't connect encoders to drivers of motors. But we'll need encoders in a competition.
 - 3.4. We tested the ability of robot to climb to inclined plane. Robot can climb to hill with a slope angle of 30 degrees.
 - 3.5. We decided to use the construction with the eight transverse axes for extracting of the lift (hereinafter they will be called as crossbars). They fixed between the slats. One crossbar is at the bottom of slate and one crossbar at the top of slat. In this case the line that is fixed at the bottom crossbar and thrown through the top crossbar extracts slat during the reeling of it.

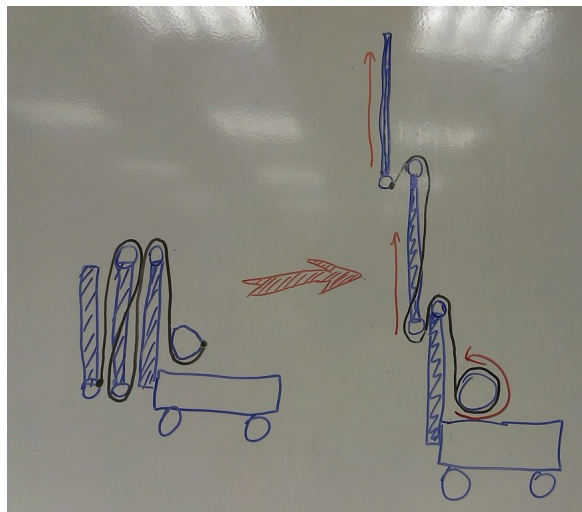
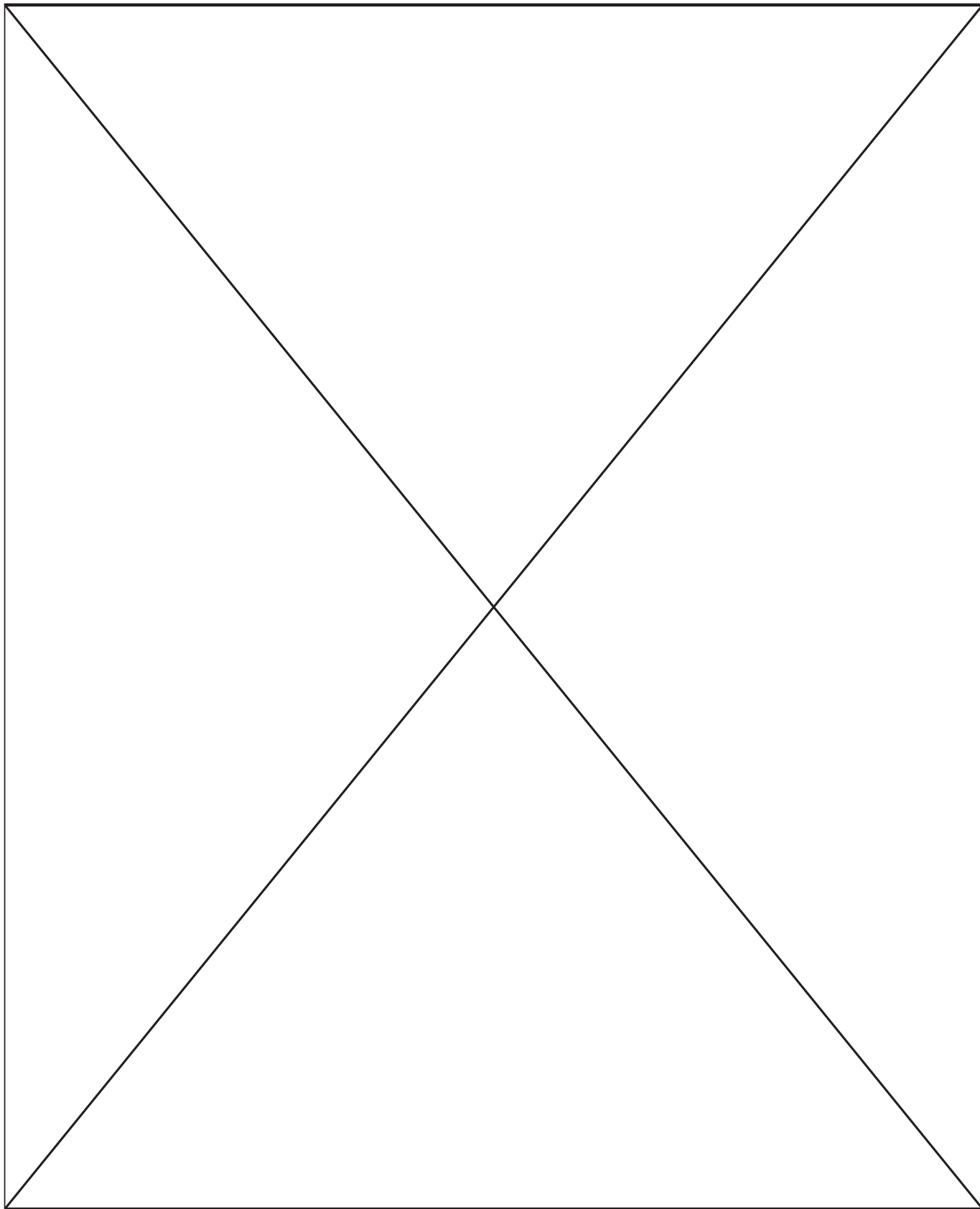


Рис. 7: Mechanism of extraction of the lift

- 3.6. It was decided to use the belt instead of the line because it is more strong and it can't entangle.
4. Results:
 - 4.1. It was made the programme of control robot via Bluetooth
 - 4.2. It was elaborated the concept of mechanism of extraction of lift.
5. Tasks for the next meetings:

5.1. To buy the belt for extracting of the lift.

5.2. To buy the aluminum profile for making the mounts of crossbars.



1.4.5 10.10.14

1. The time of beginning and ending of the meeting: 18:30 - 21:40
2. Purposes of the meeting:
 - 2.1. To choose the optimal diameter of the crossbars.
 - 2.2. To cut the aluminum profile into segments of desired length. To drill the holes in the segments and to install them between the rails.
3. Work that has been done:
 - 3.1. The belt for extracting the lift was bought.



Рис. 8: Belt

- 3.2. It was bought aluminum strip with dimensions 200 x 5 x 0.2 cm for creation mounts of crossbars.
- 3.3. It was reviewed 2 variants of crossbars: cylindrical rollers 15 mm diameter and axis diameter 5 mm from the Tetrax set. It was decided to use the axles because they are more compact.
- 3.4. The axis of the smaller diameter has a cut edge. It could prevent the movement of the belt. So it was decided to impose the sleeve on the axis. Preliminary tests demonstrated the viability of the idea.
- 3.5. After that it was decided to take action:
 - 3.5.1. The guides of the lift were previously disassembled.
 - 3.5.2. Aluminum strip was cut into 6 pieces: 2 to 30 cm and 4 to 35 cm.
 - 3.5.3. When we were drilling details some troubles appeared. All drills were ground off. It was decided to buy a new drill.

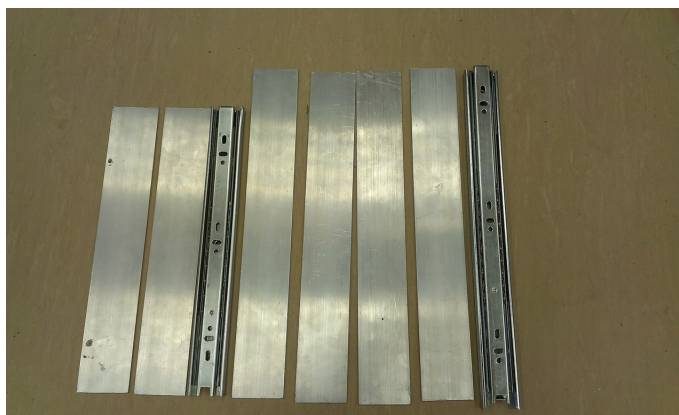


Рис. 9: Aluminum strip was cut into 6 portions

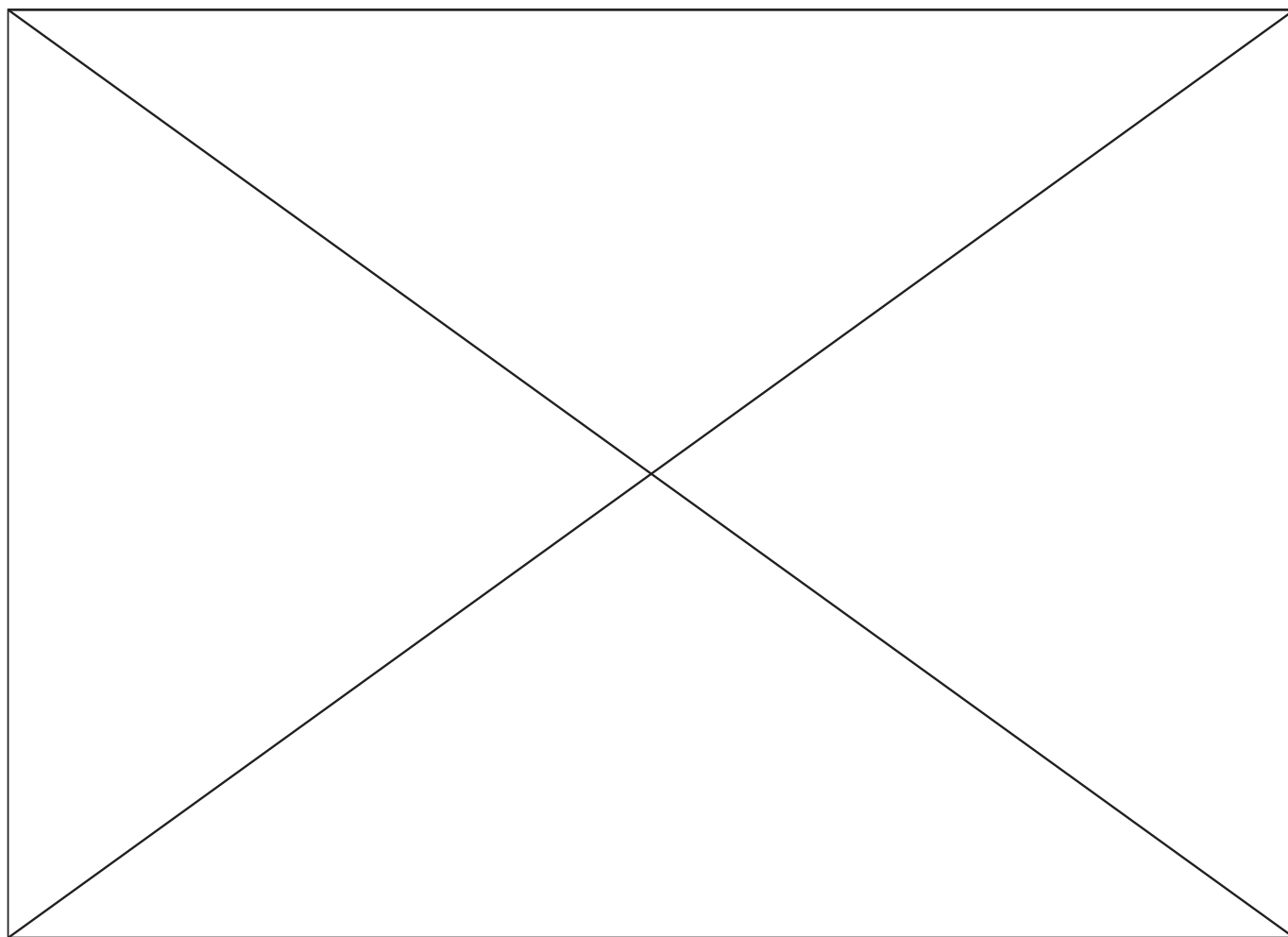
4. Results:

4.1. Tracks for the lift were choosed.

4.2. Beam have sawed into segments of desired length.

5. Tasks for the next meetings:

5.1. To buy the new drill for metal.



1.4.6 11.10.14

1. Time of beginning and ending of meeting: 16:40 - 21:40
2. Purposes of meeting:
 - 2.1. To make the holes in the mounts of beams in the lift.
 - 2.2. To assemble the guides of lift with new mounts.
 - 2.3. To install guides at robot.
3. Work that has been done:
 - 3.1. All mounts were finished and installed to slats.
 - 3.2. During the installation mounts for crossbars it turned out that screws have bothered movement of slats. It was decided to whittle away the screws.

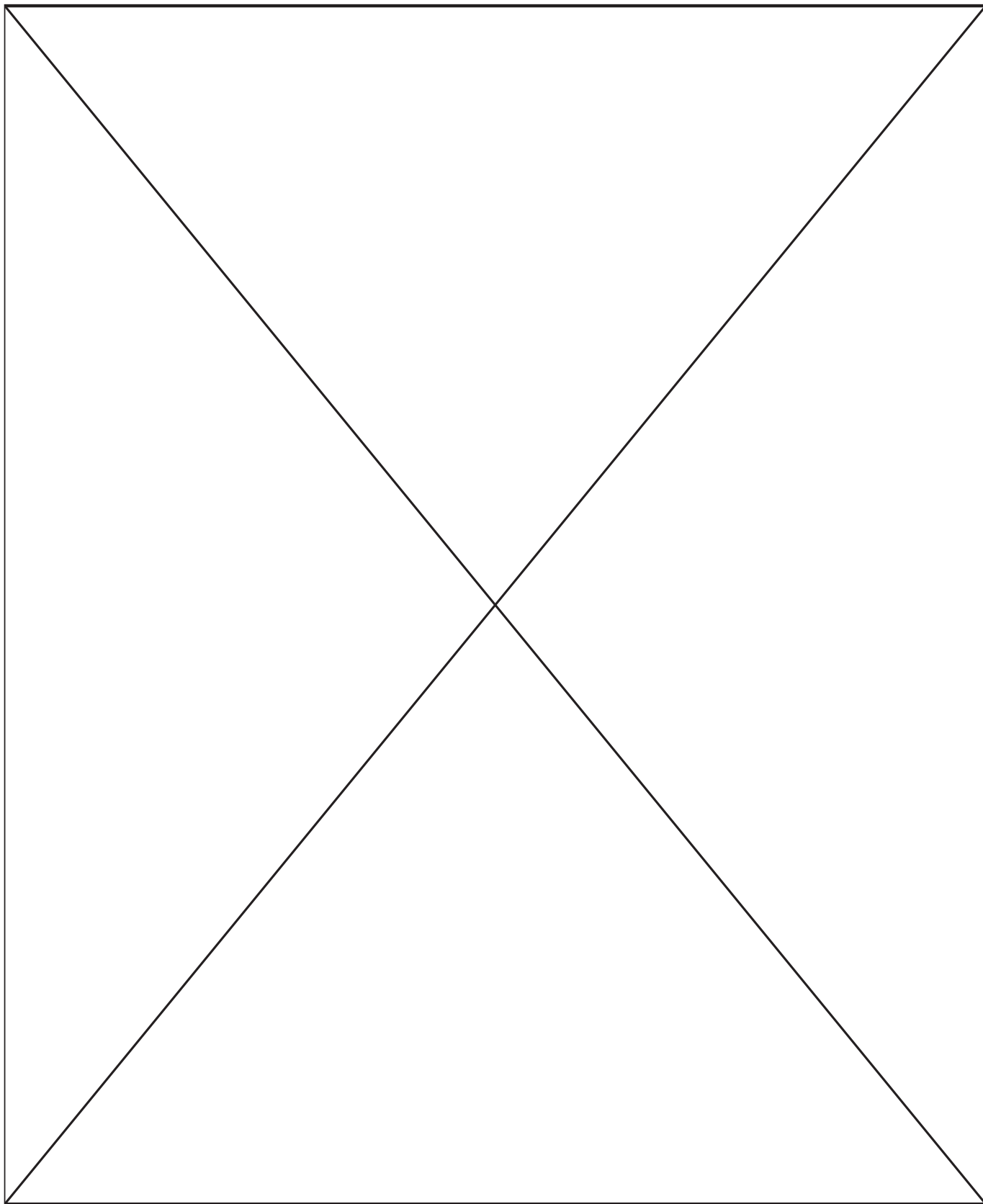


Рис. 10: Slats with mounts for crossbars

4. Results:
 - 4.1. Guides of the lift were assembled but weren't installed at robot.

5. Tasks for the next meetings:

5.1. To install guides, assemble the lift and test it.



1.4.7 13.10.14

1. Time of beginning and ending of meeting: 21:00 - 21:30
2. Purposes of meeting:
 - 2.1. To install guides at the robot.
 - 2.2. To elaborate concept of throwing of balls to baskets.
3. Work that has been done:
 - 3.1. It was decided to install axle around which rotates bucket with the balls on the top guide because our strategy is to carry movable basket behind the robot. There is tube which diameter is slightly larger than the diameter of big ball at the top of the bucket. The bucket rotates and the balls rolls to the basket.

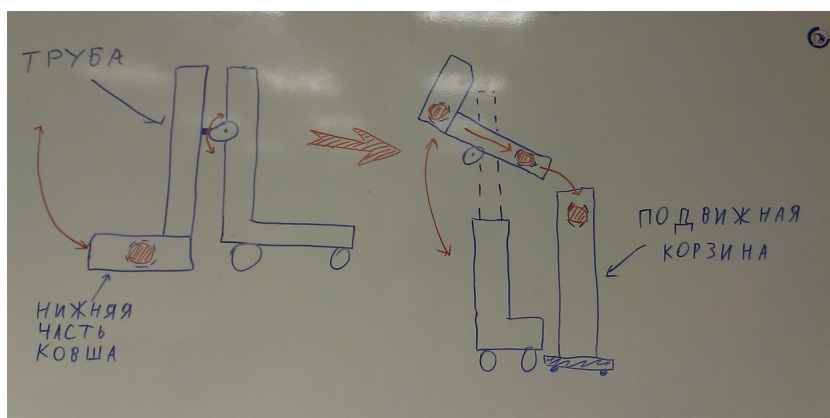


Рис. 11: Idea of the bucket

- 3.2. It has been estimated that optimal location of the axil around which will rotate the bucket is 20cm from the bottom of guide. Additional lifting height allowed to refuse from the one pair of slats. So three slats left.
- 3.3. The guides were installed to the robot.
- 3.4. It was decided to test the working of the lift after installation of the guides. The belt coped with this task but the axles bended. It was decided to install the more strong axles. In addition pairs of slats extracted to the different heights. So it was decided to connect the pairs of slats rigidly.

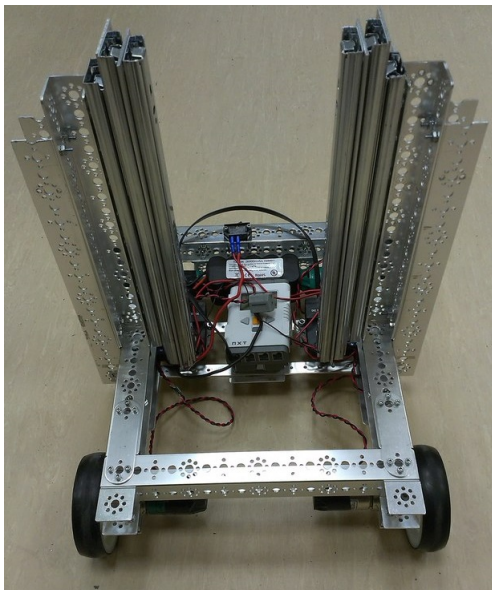


Рис. 12: Robot with installed guides

4. Results:

4.1. Guides was installed to the robot.

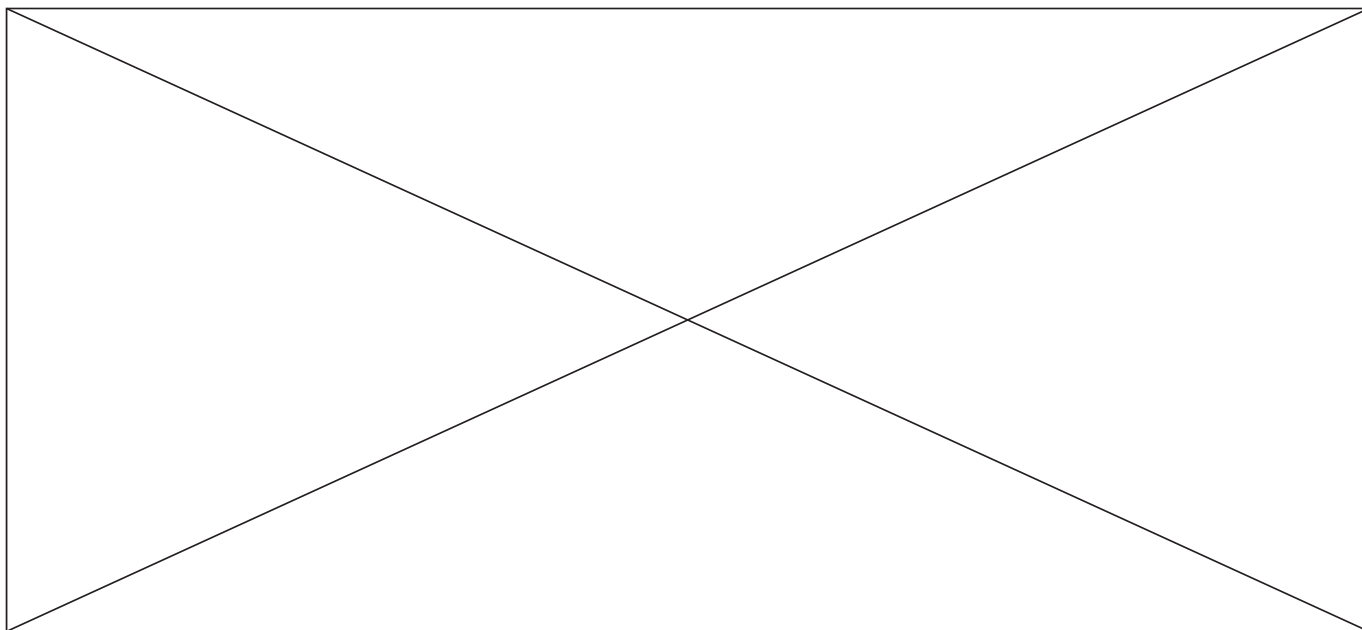
4.2. It was elaborated concept of the throwing balls to the baskets.

5. Tasks for the next meetings:

5.1. To assemble device that will rotate the bucket.

5.2. To buy the more strong axles.

5.3. To buy the aluminium profile for connection guides.



1.4.8 15.10.14

1. Time of beginning and ending of meeting: 17:00 - 21:30
2. Purposes of meeting:
 - 2.1. To change the crossbars at more strong.
 - 2.2. To connect the guides of lift for good extracting.
3. Work that has been done:
 - 3.1. We didn't buy aluminium profile for improvement of the lift. So it was decided start elaboration gripper for balls.
 - 3.2. It was installed servomotor of the free rotation with axle at the front of robot. On this axle it was decided to fix the the brush. Screeds will be use as the bristles of this brush.

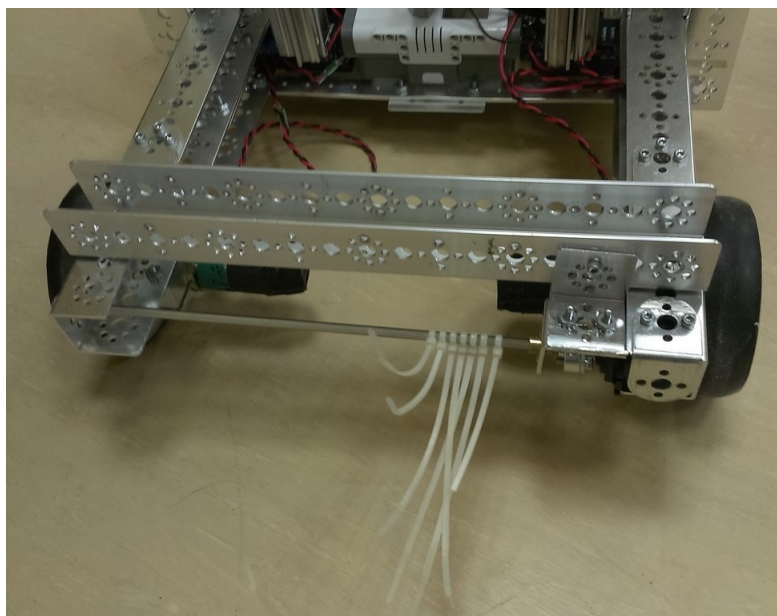
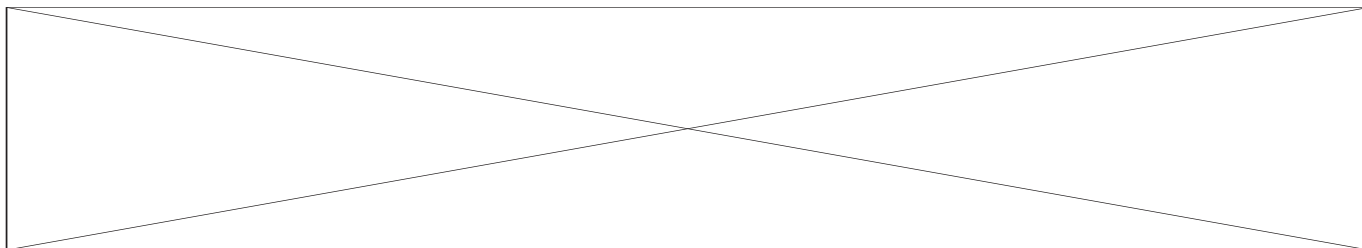


Рис. 13: Gripper for the balls

4. Results:
 - 4.1. It was started creating of gripper for balls.
5. Tasks for the next meetings:
 - 5.1. To buy materials for improvement of the lift.
 - 5.2. To finish creating of gripper for balls and to write the programme of control it.



1.4.9 16.10.14

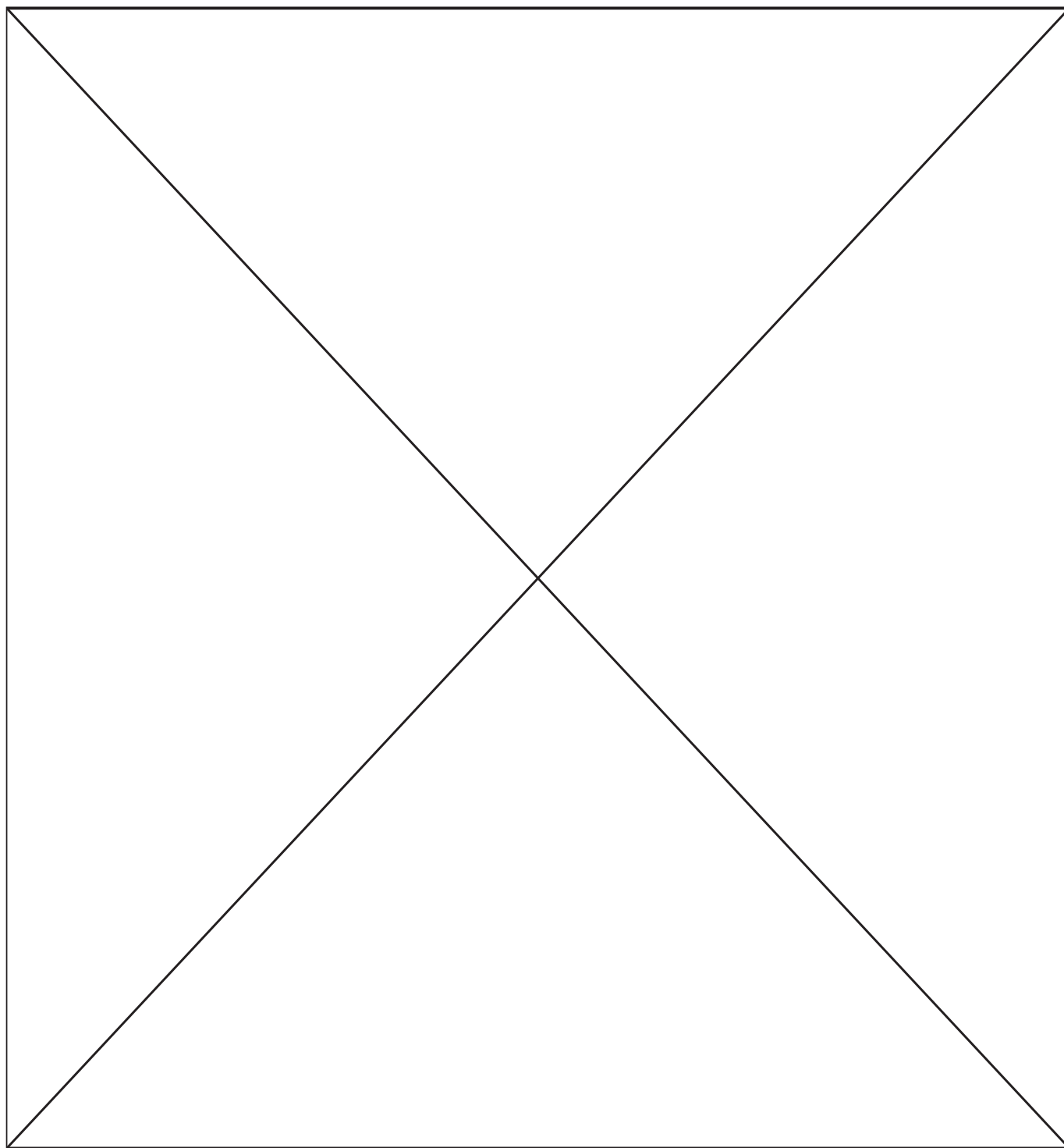
1. Time of beginning and ending of meeting: 17:00 - 21:00
2. Purposes of meeting:
 - 2.1. To connect controller for servomotors and link servomotor that rotates gripper for balls to it .
 - 2.2. To include to the programme of control robot control gripper for balls.
 - 2.3. To improve the lift.
3. Work that has been done:
 - 3.1. To date it was bought aluminium strip 100 x 4 x 0.3cm for creating transverse beams for connection guides of the lift and aluminium axle length 100 cm and a diameter 8 mm for creating crossbars.
 - 3.2. Strip was cut at 4 segments with needed length. It was decided to buy L-shaped profile and cut to it on the corners of needed size for installation transverse beams to guides.
 - 3.3. Axle was enough for 4 crossbars of the required 6. Two axles were installed to lift with help of elements from Tetrax set. They were made holes for another one axis but it wasn't installed to the lift. It was decided not to install the last crossbar for the top pair of slats because we have not yet figured out how to do it and it would make difficult the improvement of lift.
 - 3.4. Controller for servos was installed and it was connected to servo of continuous rotation. This servo rotates gripper of the balls.



Рис. 14: Crossbars that were installed to robot

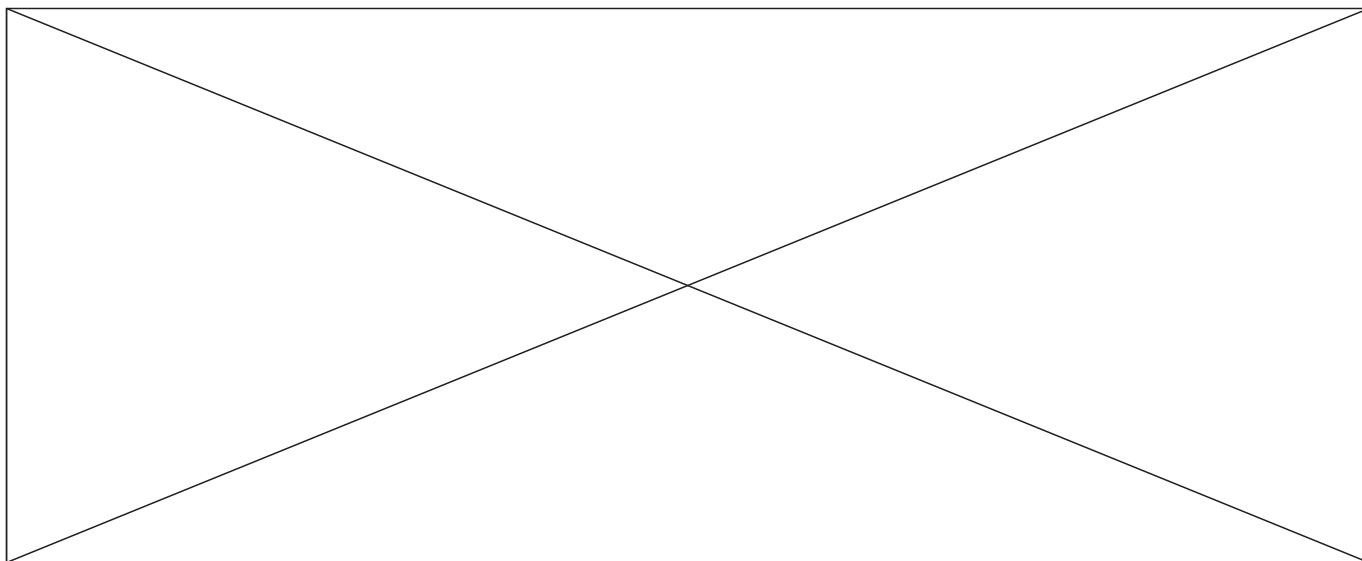
4. Results:
 - 4.1. Controller for servo was installed.

- 4.2. The programme of control servo wasn't wrote.
- 4.3. Aluminium strip was cut at the beams with needed length.
- 4.4. Axle was cut at crossbars.
- 5. Tasks for the next meetings:
 - 5.1. To buy another one aluminium axle and make the rest of crossbars.
 - 5.2. To buy L-shaped profile and to cut it into the corners for fixing beams to the lift.



1.4.10 17.10.14

1. The time of beginning and ending of the meeting: 17:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To write a program of control the gripper and include it to the robot control program.
3. Work that has been done:
 - 3.1. Program of servo control was wrote. Servo rotates by pressing the button. It stops after the operator removes his hand from the button. During the tests it turned out that it uncomfortable for operator. All commands are served from one joystick at the moment. But later the first operator will be responsible for only traffic control and everything else will make by the operator №2.
 - 3.2. During the tests of gripper on banks (balls we haven't at that time) it turned out that it instead of capturing them repels them. We understood that ties are fixed on the contrary.
 - 3.3. It was decided to relocate the front crossmember further from the axis so that it does not prevent the movement of the brush-ties.
 - 3.4. It was decided to fix ties on the axis by a hot-melt adhesive. But we didn't have a hot-melt adhesive on this meeting so it was decided to make it on the next meeting.
 - 3.5. It was turned out that the travel stops furniture racks can not withstand weight of lift. It was decided to strengthen the stops.
4. Results:
 - 4.1. A simple program of control the capture has been written.
 - 4.2. Gripper was tested in action. They was developed ideas to improve it.
5. Tasks for the next meetings:
 - 5.1. To create a final version of gripper.
 - 5.2. To change management program for the gripper of more convenient.
 - 5.3. To strengthen the travel stops furniture racks.



1.4.11 18.10.14

1. Time of beginning and ending of meeting: 16:30 - 21:40
2. Purposes of meeting:
 - 2.1. To create the finished version of gripper for balls.
 - 2.2. To change the programme of control of gripper to more comfortable.
3. Work that has been done:
 - 3.1. Screeds were located at the axle in 4 rows through every 90 degrees and fixed by the hot-melt adhesive.

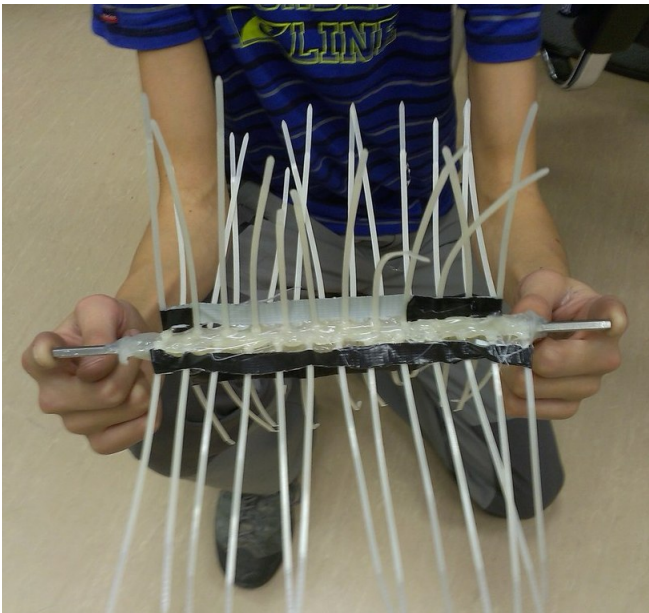


Рис. 15: Brush of gripper

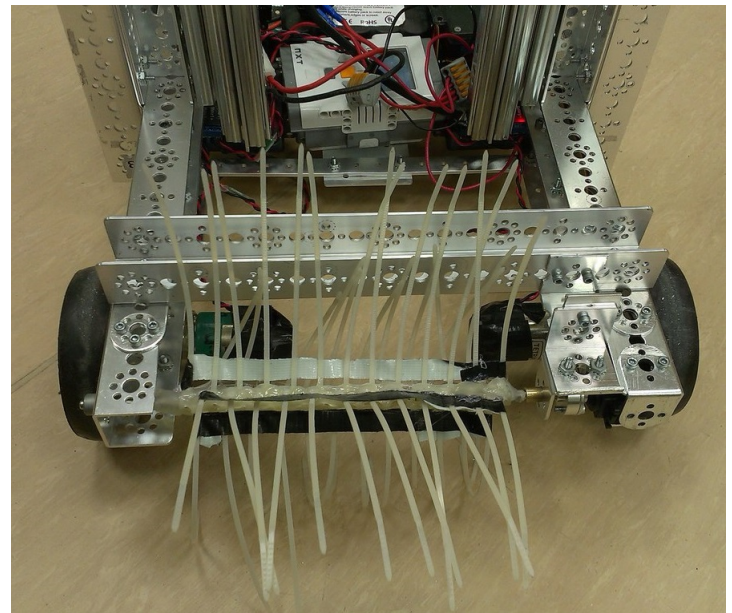


Рис. 16: The finished version of gripper for balls

- 3.2. Programme of control of gripper was changed. Now servo changes state (stop or running) by pressing the button. It allows to operator don't distracted to maintaining of gripper at working condition.
- 3.3. Gripper was tested on two balls from NXT set diametr 5cm. Robot can to capture balls at the open space and near the walls. There was one problem: brush locates only at the center of robot and for capture of ball it need to aim to it. We planned to install on each side of the gripper beams located like a funnel (hereinafter they will be called as slopes) for solving this problem. It allows to balls to roll to gripper.
- 3.4. It was turned out that when servo is stopping it try to keep angle,so it rattles. This needs to be corrected.
- 3.5. It was turned out that robot stop to shake when it turns around. It happened because a large part of it's mass was concentrated in the back part of robot. So the front wheels slipped freely.
- 3.6. In addition the start tasks it was made mechanism of overturning bucket.

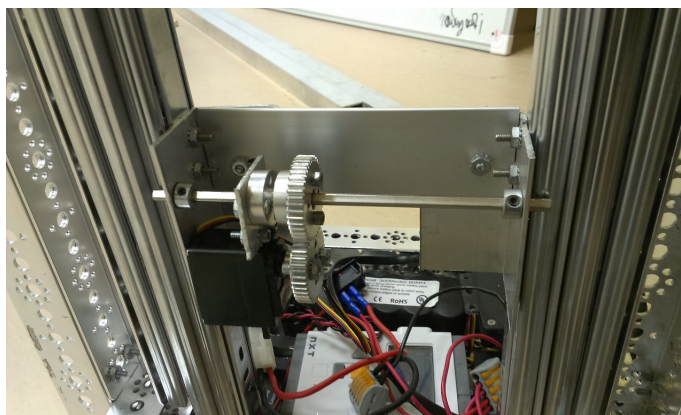


Рис. 17: Mechanism of overturning bucket

4. Results:

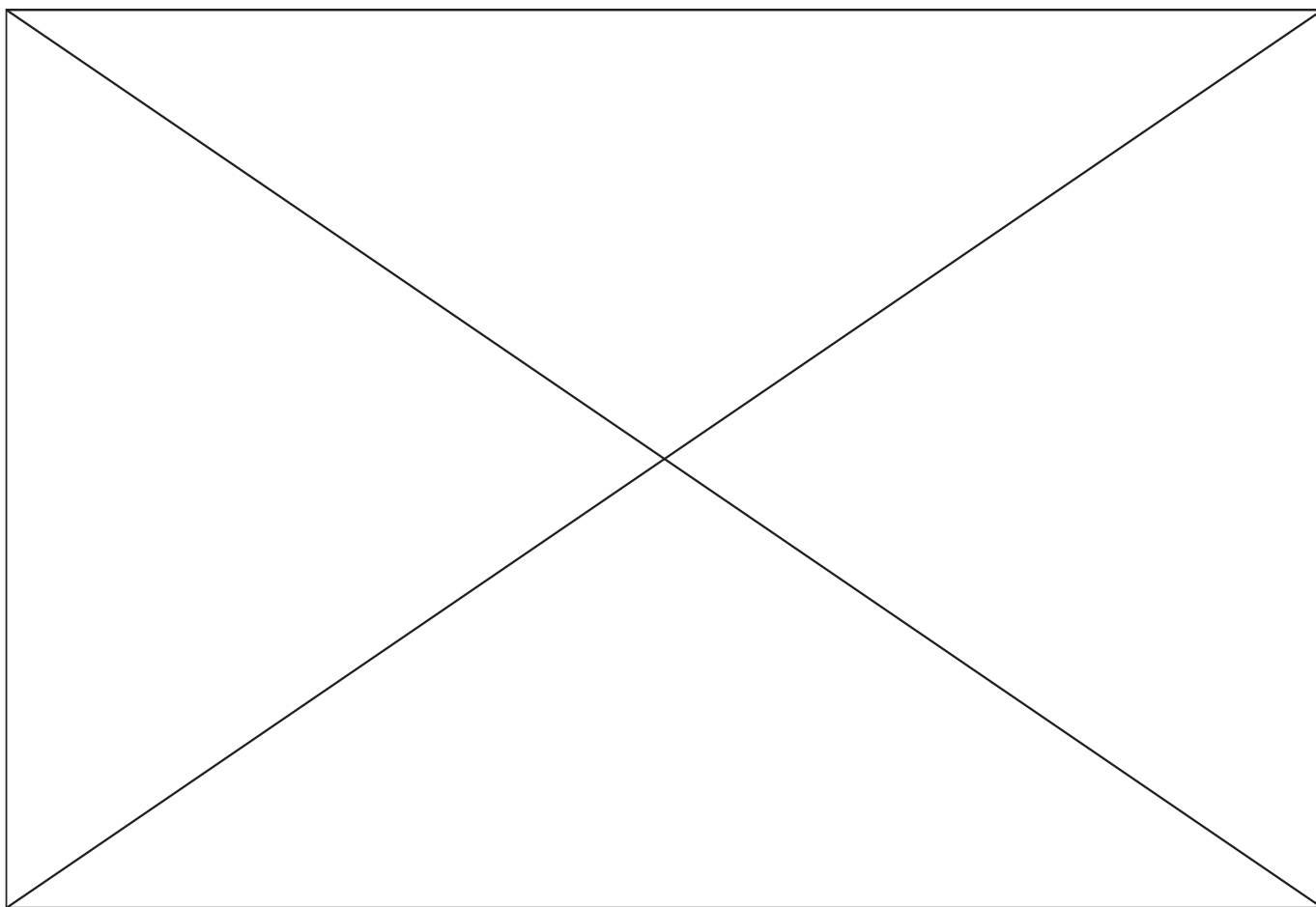
4.1. The gripper was finished.

4.2. It was created more comfortable programme of control the gripper.

5. Tasks for the next meetings:

5.1. To correct the problem with servo.

5.2. To install the slopes.



1.4.12 20.10.14

1. Time of beginning and ending of meeting: 20:30 - 21:30
2. Purposes of meeting:
 - 2.1. To correct the problem of servo.
 - 2.2. To fix transverse beams at the lift.
3. Work that has been done:
 - 3.1. We tried to make that before stop it slightly rotate to back for correction of problem with servo. But it wouldn't work.
 - 3.2. L-shaped profile was cut on corners of needed length.
 - 3.3. Transverse beams were made. One from their was installed at robot.



Рис. 18: Transverse beams

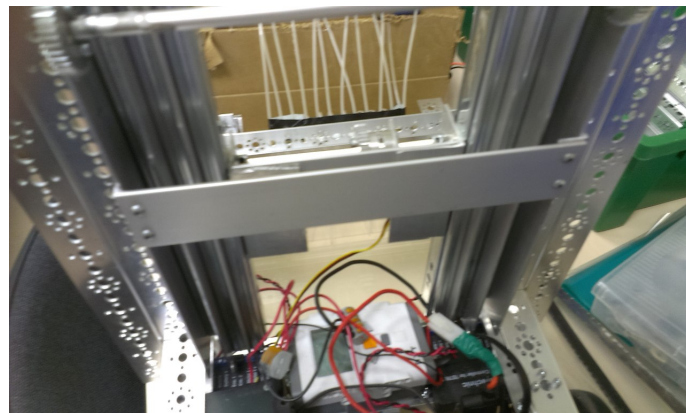


Рис. 19: Transverse beam that was installed at robot

- 3.4. Today we learned that 21 - 23 of November will be the competition FTC in Sochi. It was decided that our team will take part in this competition. Until the next meeting every participants of team will have to give an answer, will he be able to go to Sochi.
4. Results:
 - 4.1. Problem with servo not corrected.
 - 4.2. All ready to fixing of transverse beams to guides.
 - 4.3. One transverse beam was installed.
5. Tasks for the next meetings:
 - 5.1. To finish fastening transverse beams to guides of lift.
 - 5.2. To correct the problem with servo.
 - 5.3. To decide who can go to Sochi.



1.4.13 21.10.14

1. The time of beginning and ending of the meeting: 17:00 - 19:00
2. Purposes of the meeting:
 - 2.1. To rethink the strategy of autonomous and final periods and, if necessary, be amended.
 - 2.2. To complete the installation of transverse beams on the rails lift.
 - 2.3. To set the lower limit for furniture slats.
3. Work that has been done:
 - 3.1. Transverse beams had been installed on the lift.
 - 3.2. Travel stops furniture racks were strengthened by hot melt adhesive.

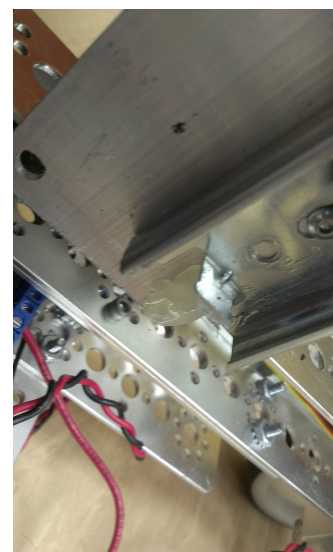
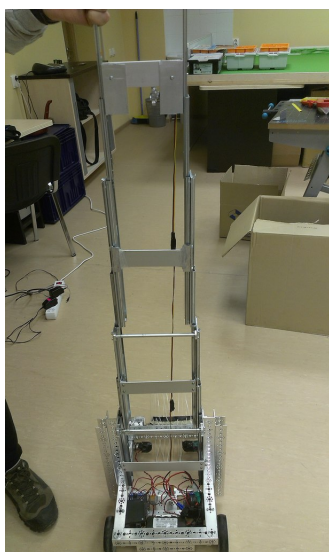


Рис. 20: The transeverse beams had been mounted on the robot

Рис. 21: Travel stops furniture racks reinforced with hot melt adhesive

- 3.3. At the end of the meeting there was a breakdown of the one furniture rack. It needs to be corrected.



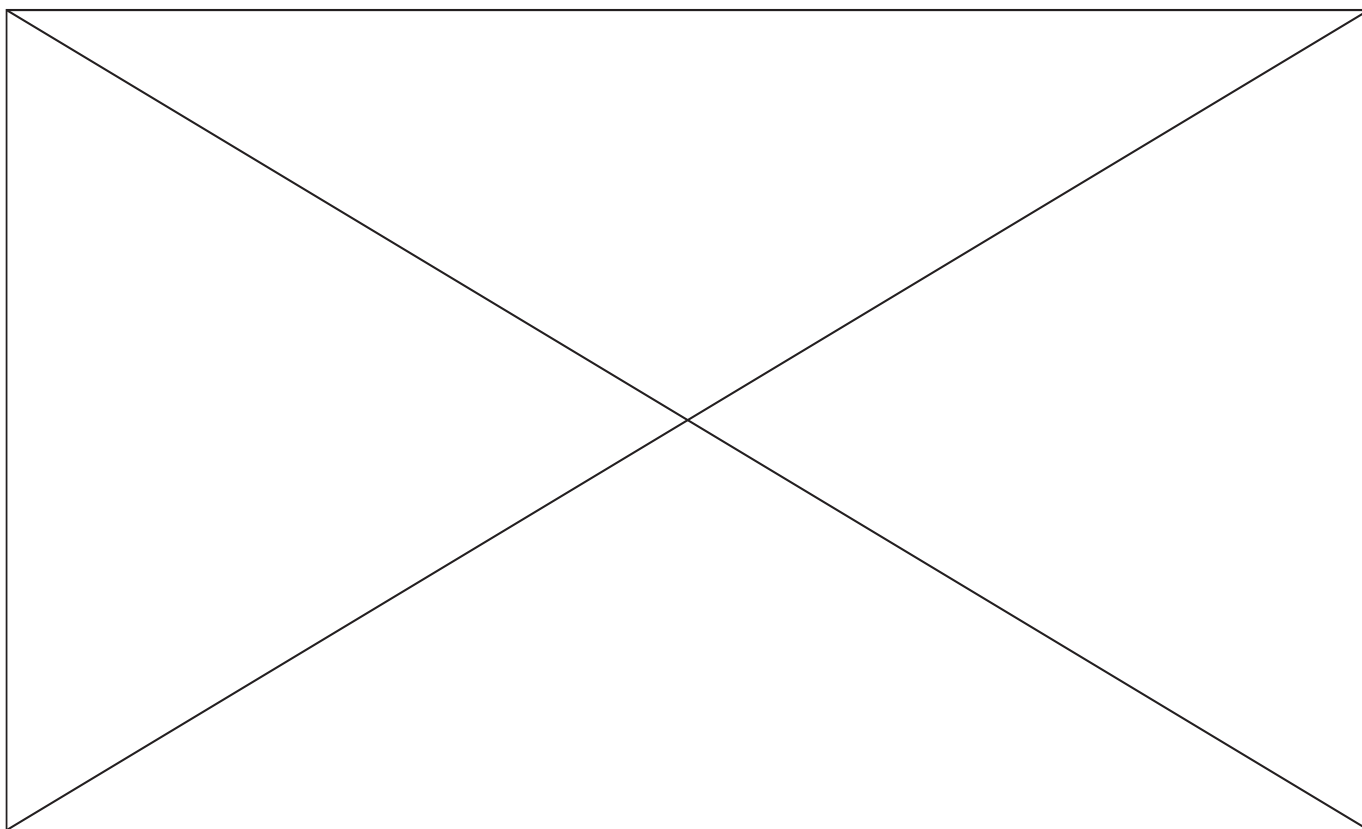
Рис. 22: Broken furniture rail (right)

4. Results:

- 4.1. All transeverse beams have been installed.
- 4.2. The travel stop of furniture slat was strengthened.

5. Tasks for the next meetings:

- 5.1. To correct damaged slats to understand what the cause and how to avoid it in the future.



1.4.14 22.10.14

1. Time of beginning and ending of meeting: 18:00 - 21:40
2. Purposes of meeting:
 - 2.1. To understand what causes the breakage of the guide.
 - 2.2. To repair the guide.
 - 2.3. To undersnand how to prevent this failure in the future.
3. Work, that has been done:
 - 3.1. After research of construction of the lift it was found that failure happened due to the excessive voltage. This voltage is creating by the transverse beam. It was decided to increase the distance between the guide and beam.
 - 3.2. Repair the slat failed so that it was replaced.

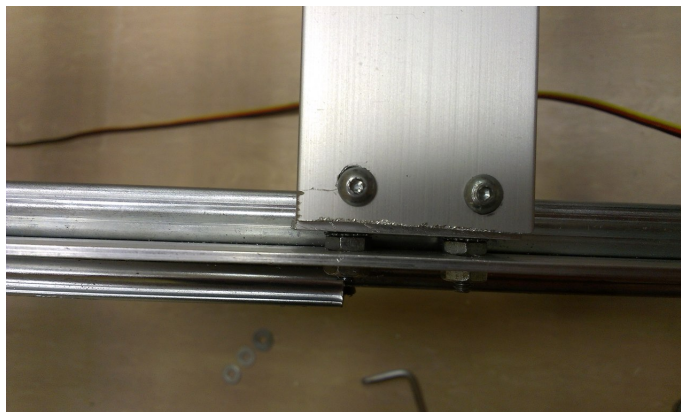


Рис. 23: Layer between beam and guide

- 3.3. It was decided to buy spare slats because it is impossible to repair broken rakes.
- 3.4. In addition it was created the mount for the last crossbar.

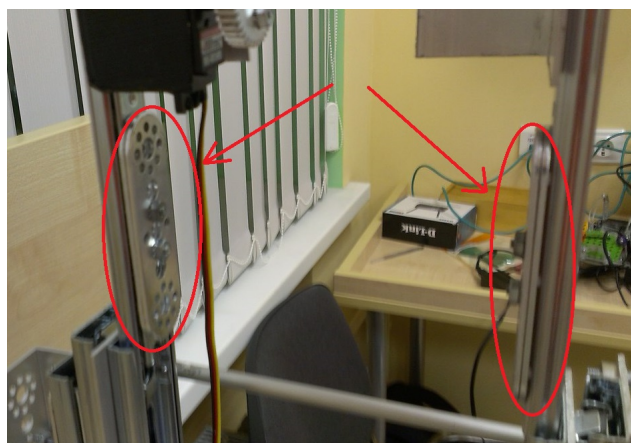
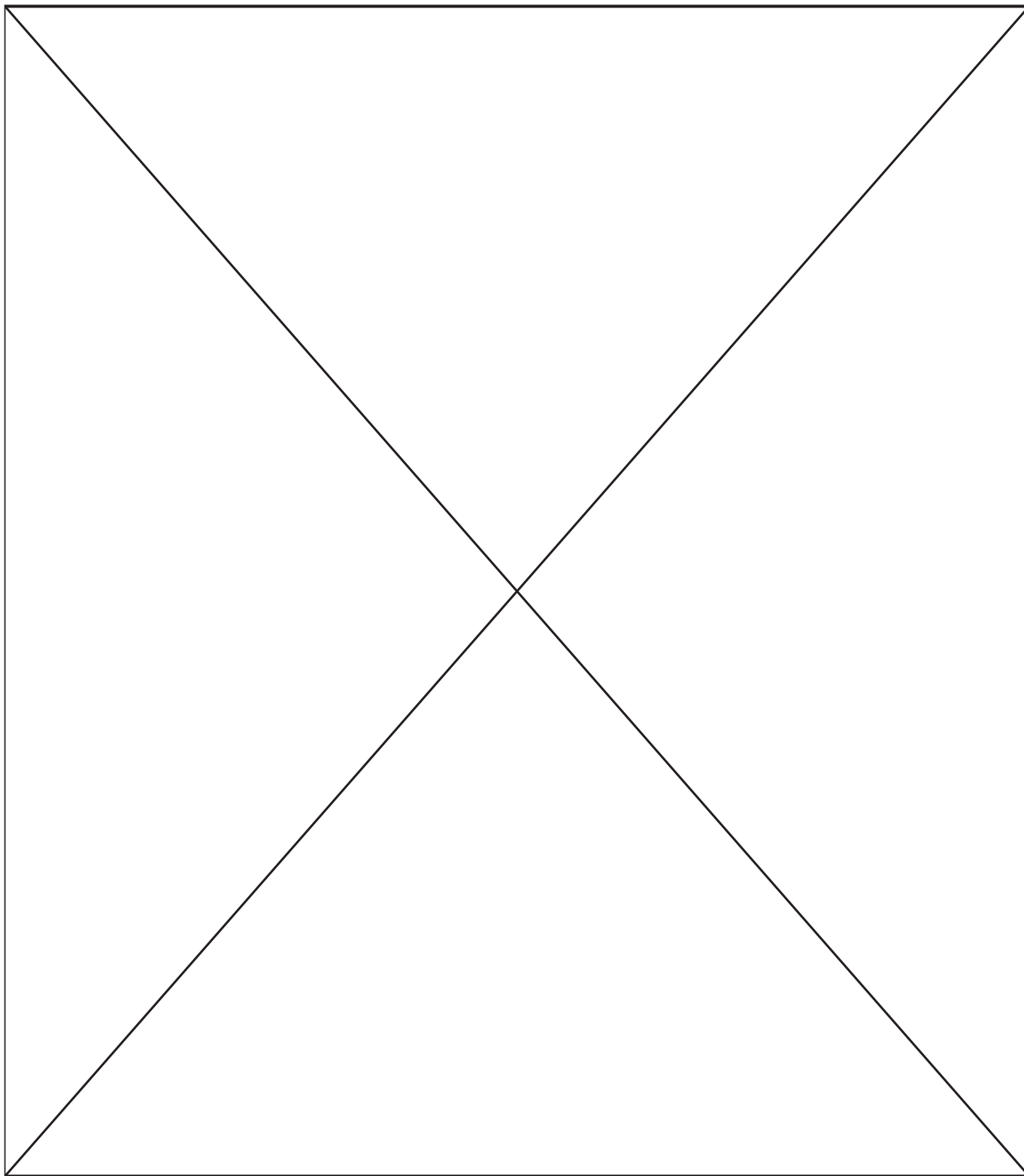


Рис. 24: Mount for crossbar

4. Result:

- 4.1. Repair of lift completed.
- 4.2. It was created the mount for top crossbar.
- 5. Tasks for the next meetings:
 - 5.1. To buy the spare furniture slats.



1.4.15 24.10.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To correct the problem with servo that rotates gripper for balls.
 - 2.2. To make the slopes for ball and install their at the robot.
3. Work, that has been done:
 - 3.1. Problem with servo was corrected. This problem appeared because after stopping servo rotated with low speed and can't to overcome elastic force of screeds. It happened due to the wrong value servo's position in the programme (value where servo stops - 127 instead of 135 that was in our programme).
 - 3.2. Aluminium sheet was sawn to strips of needed dimentions.
 - 3.3. Slopes were installed to robot and tested. The result is positive.
 - 3.4. It was seen that slopes bends when they faces with a rigid obstacle. They were installed stops that made of the aluminium strip for prevent this situation.

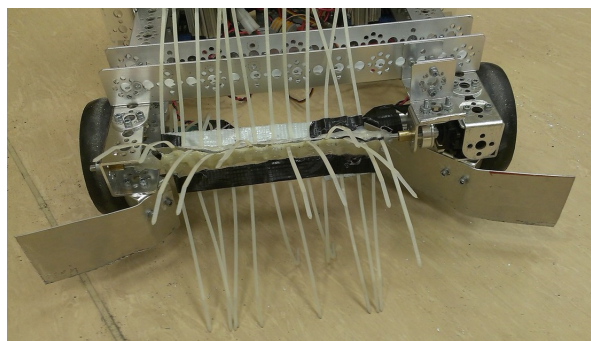


Рис. 25: Gripper with slopes

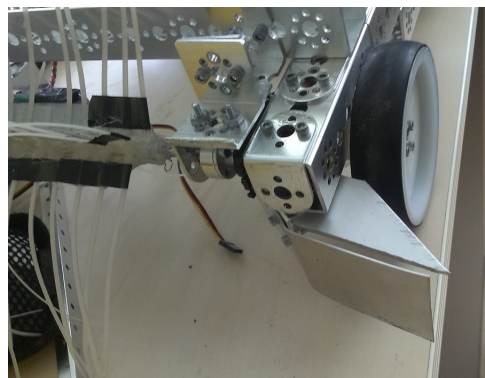
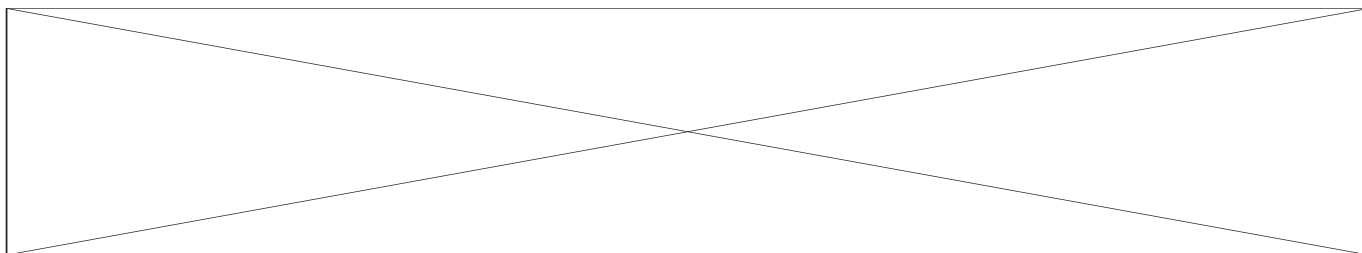


Рис. 26: Slopes with stops

- 3.5. The holes for installation of the remaining pair of crossbars at the lift were prepared.
4. Results:
 - 4.1. Problem with servo was corrected.
 - 4.2. Slopes for balls were installed to robot.
5. Tasks for the next meetings:
 - 5.1. To elaborate and create the mechanism of capture movable baskets.



1.4.16 25.10.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To elaborate and create the mechanism of capture movable baskets.
3. Work that has been done:
 - 3.1. They was considered 2 options of mechanism capture movable baskets (hereinafter it will be called MCB):
 - 3.1.1. Servo with the beam. When servo rotates beam turns and lowers.
 - 3.1.2. The furniture slat which connected with servo by the fishing line is fixed to the rear edge of robot. When servo rotates slat lowers.

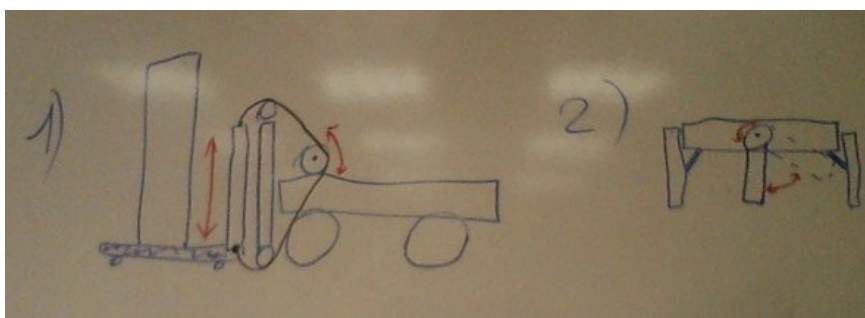


Рис. 27: Ideas of MCB 1)Slat 2)Servo with beam

- 3.2. It was decided to make MCB with slat because this variant more compact.
- 3.3. The furniture slat was sawn for reduction it's length.



Рис. 28: Shortened furniture slat(the sawn part is hatched)

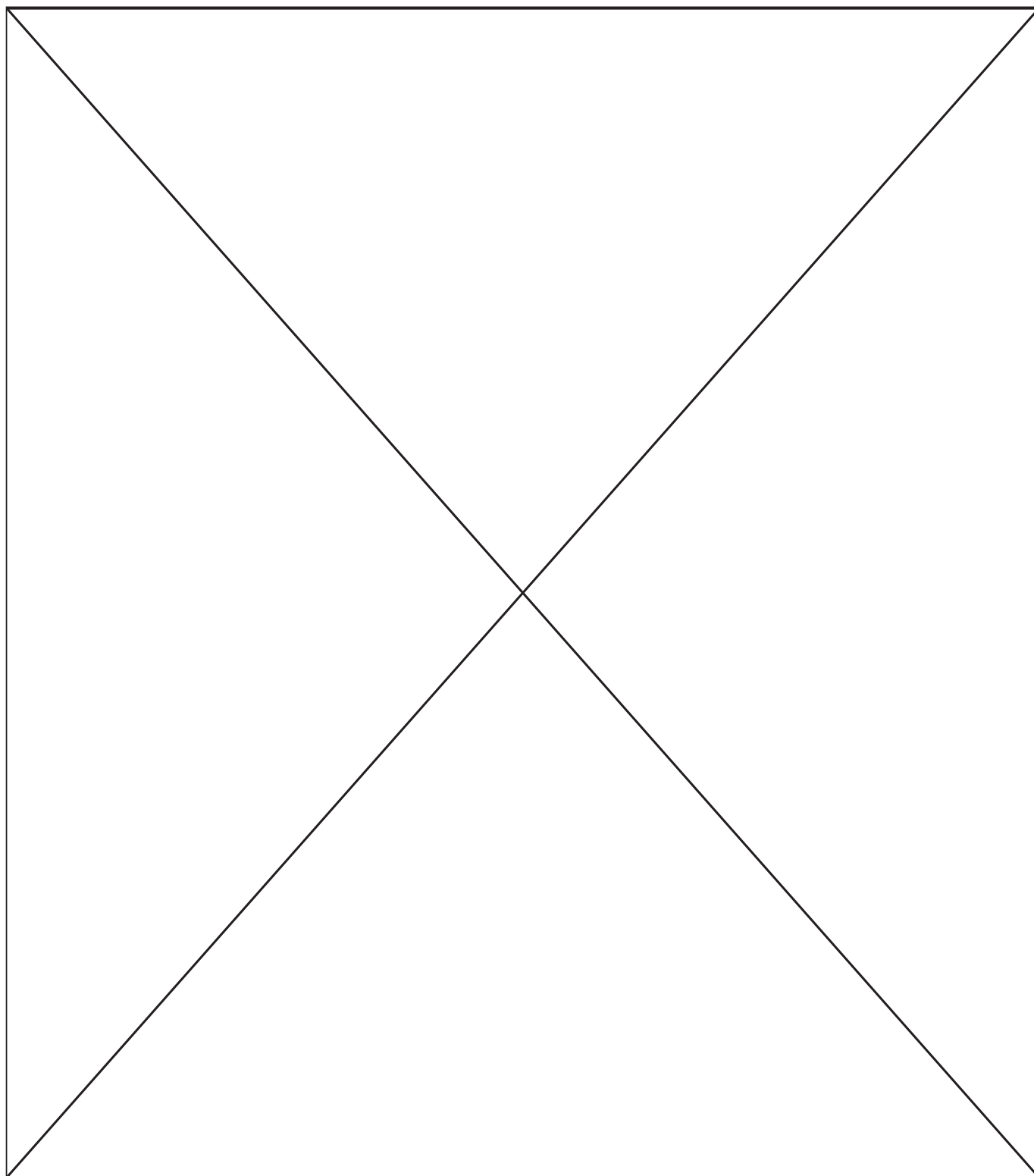
- 3.4. They were marked location for drilling holes for mounts on the slat. The holes weren't drilled because we didn't have the drill.

4. Results:

4.1. MCB was elaborated but didn't installed.

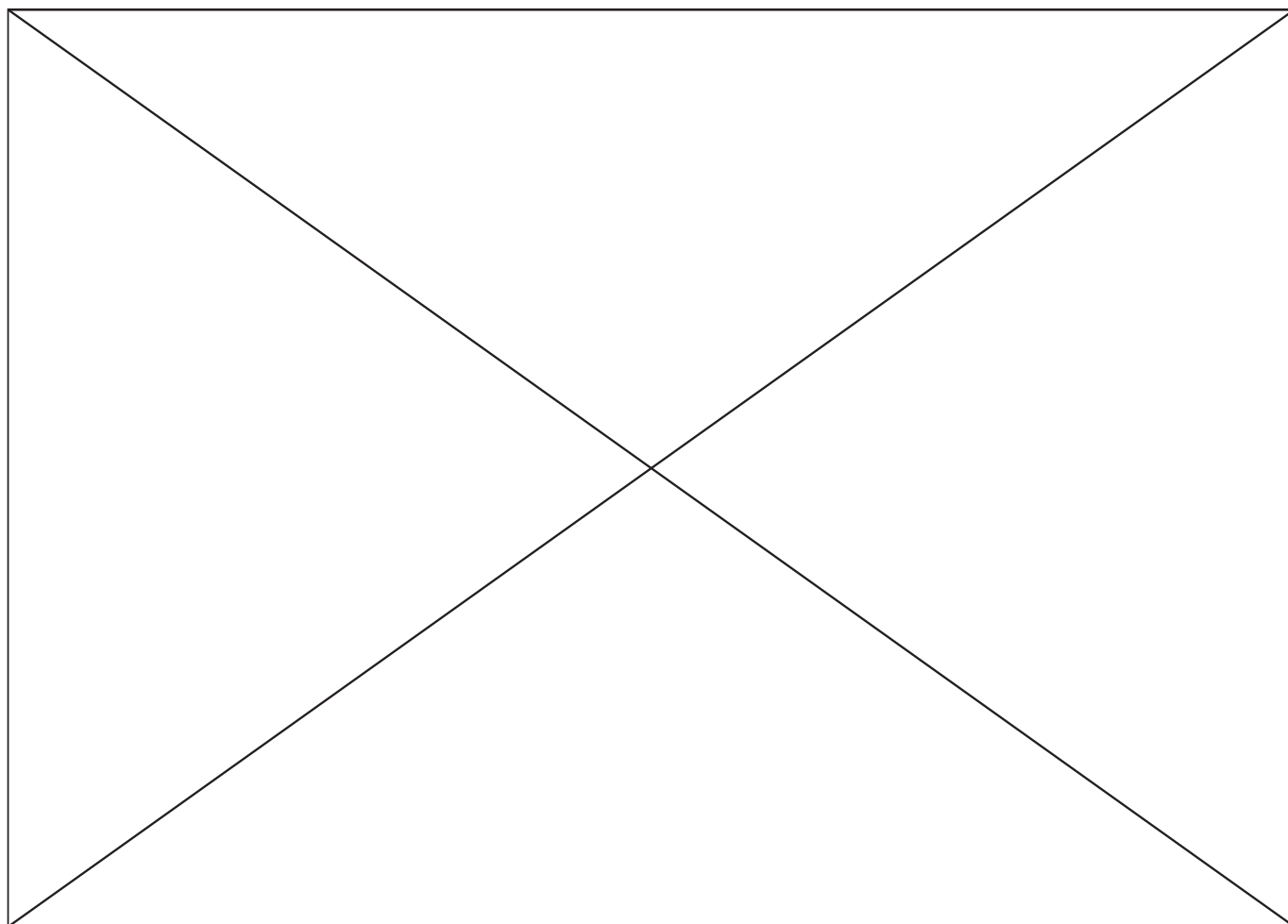
5. Tasks for the next meetings:

5.1. To finish creating of MCB.



1.4.17 27.10.14

1. The time of beginning and ending of the meeting: 18:00 - 19:00
2. Purposes of the meeting:
 - 2.1. To finish MCB.
 - 2.2. To discuss the engineering book, make corrections.
3. Work that has been done:
 - 3.1. It was decided to refuse from MCB with furniture slat due to complexity of this construction and the need understatement clearance (for lowering of the slat it need to install axle through which will go fishing line in the bottom part of robot).
 - 3.2. The engineering book was discussed and correction was made.
4. Results:
 - 4.1. It was decided to change MCB.
 - 4.2. They were made needed corrections in engineering book.
5. Tasks for the next meetings:
 - 5.1. To finish MCB.



1.4.18 28.10.14

1. The time of beginning and ending of the meeting: 17:00 - 19:00
2. Purposes of the meeting:
 - 2.1. To finish MCB.
3. Work that has been done:
 - 3.1. Servo which rotates the beam must be fixed as low as possible for maximum accuracy of capture.
 - 3.2. It was decided to fix servo in the following way: make hole diameter as the shaft of the servo. It need for location the servo so that it doesn't go beyond the robot's body (otherwise the robot did not meet in regulated dimentions) and able to rotate freely.
 - 3.3. The hole was made.

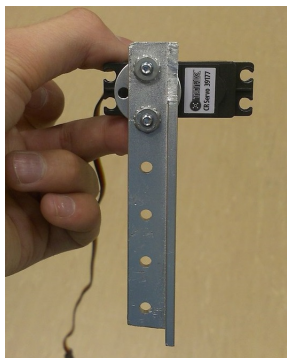


Рис. 29: Servo

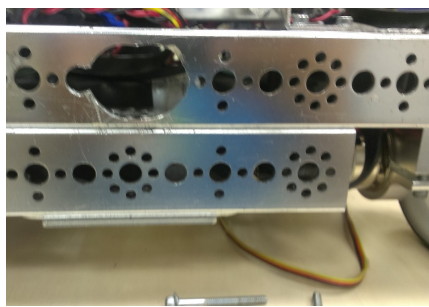


Рис. 30: Hole for servo

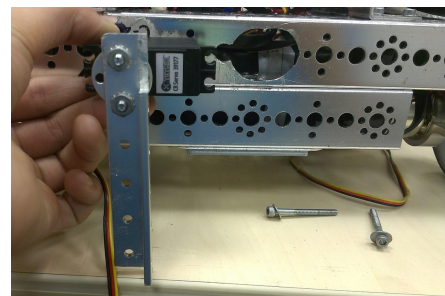
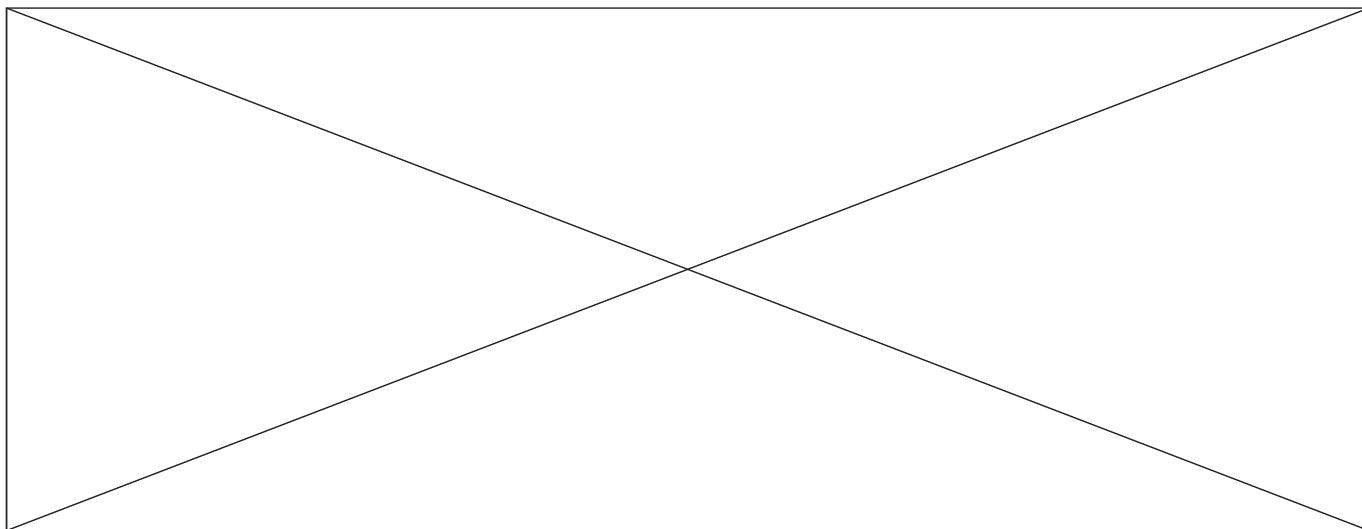


Рис. 31: Planned mount

4. Results:
 - 4.1. It was elaborated and partially implemented plan of fixing servo that rotates MCB.
5. Tasks for the next meetings:
 - 5.1. To finish MCB.



1.4.19 01.11.14

1. The time of beginning and ending of the meeting: 16:00 – 21:40
2. Purposes of the meeting:
 - 2.1. To fix rib of rigidity that was broken on the last lesson.
 - 2.2. To set up two axes on the lift.
 - 2.3. To fix the belt on the lift.
 - 2.4. To test the lift.
3. Work that has been done:
 - 3.1. It was decided to fix the rib with bolts because it is more fixedly than hotmelt.
 - 3.2. Two other crossbars were fixed in holes and fixed with hot melt.

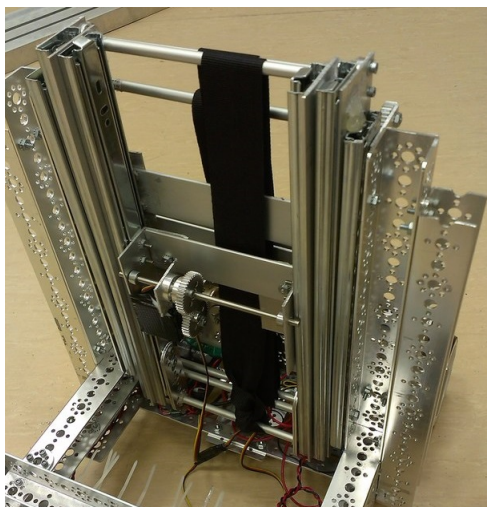


Рис. 32: Lift is finished

- 3.3. Lift was tested by pulling the belt by hands. It was found that extracting of the lift demands some efforts. 2 drives must cope with this task. Inner pair rails did not fall under their own weight during the lowering. It was decided to increase their weight and reduce friction.
- 3.4. On the robot were installed mechanism of extracting the lift (hereinafter it will be called as MEL).

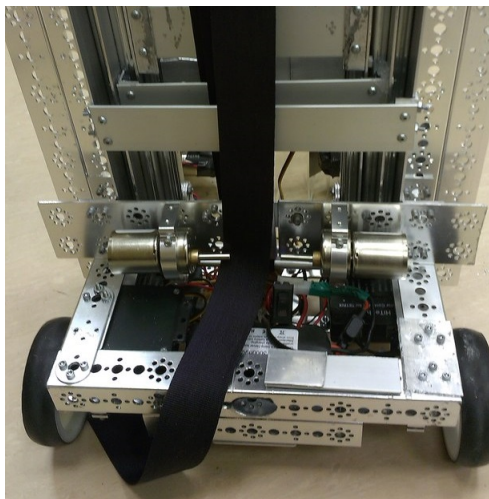


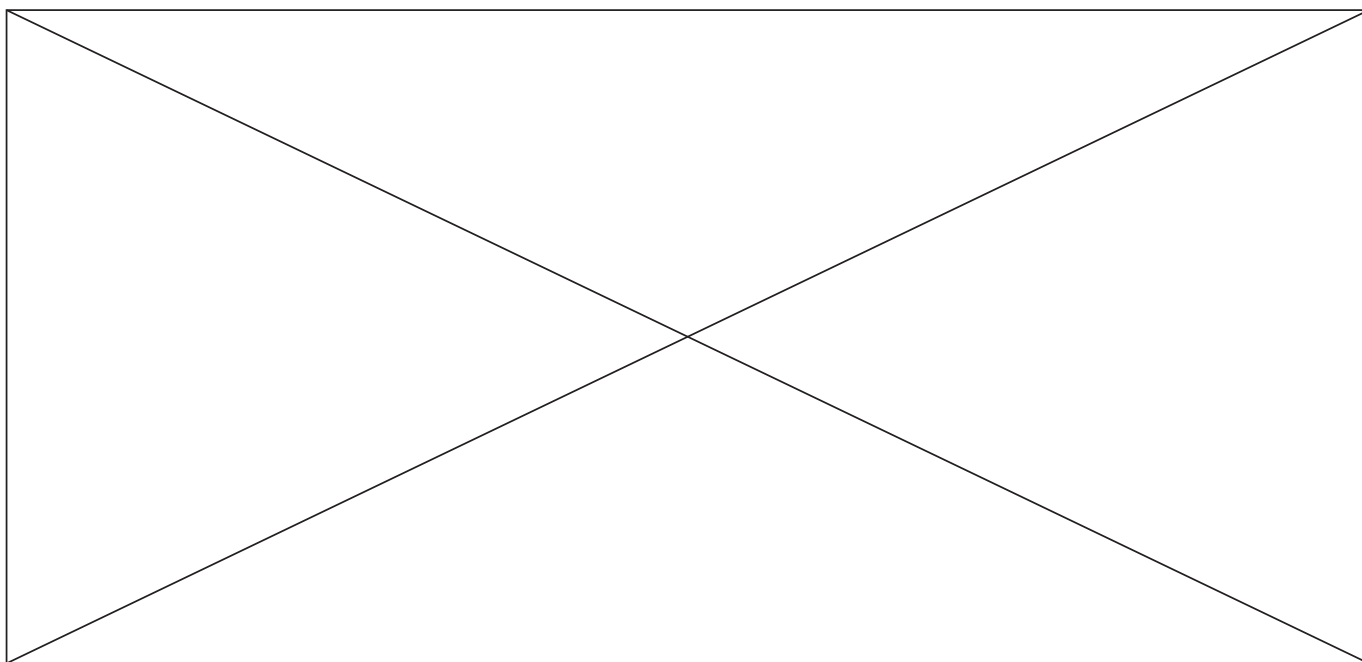
Рис. 33: Drives for moving lift

4. Results:

- 4.1. The rib was installed.
- 4.2. MEL was done.
- 4.3. The lift was tested.
- 4.4. Installation of the MEL was started.

5. Tasks for the next meetings:

- 5.1. Finalize the mechanism winch.
- 5.2. Install the drivers for the winch.
- 5.3. Fix the belt with thread.
- 5.4. Replace NXT-brick.



1.4.20 03.11.14

1. The time of beginning and ending of the meeting: 14:00 – 21:40
2. Purposes of the meeting:
 - 2.1. To finish the MEL.
 - 2.2. To install the drivers for MEL.
 - 2.3. To write a program to control MEL.
 - 2.4. To fix the the belt by threads.
3. Work, that has been done:
 - 3.1. Driver has been installed on the robot.
 - 3.2. Actuators were interconnected by a shaft where is reel the belt.
 - 3.3. The belt was sewn from one side to last axe and on the other to the shaft of MEL.

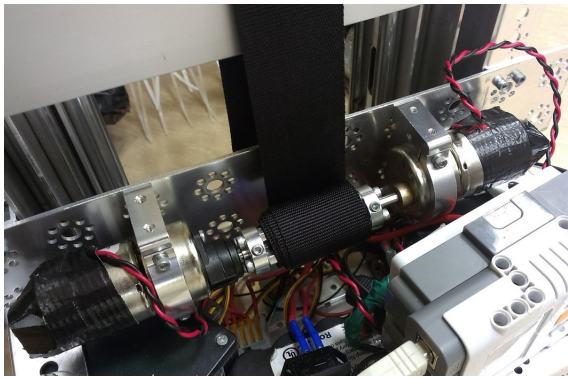


Рис. 34: Lift

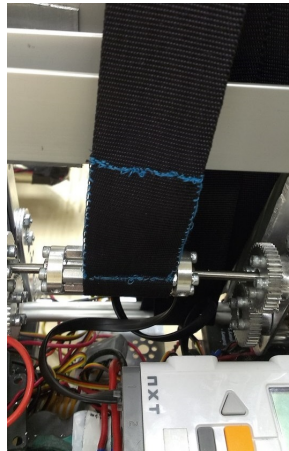
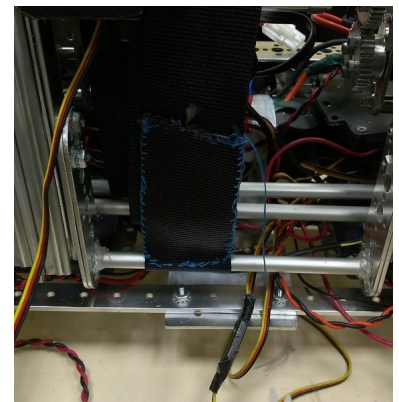


Рис. 35: Belt was fixed



- 3.4. It was wrote a simple programm that can rotate the MEL with a maximum speed in each direction or stand still. The movement of the MEL was monitored by the right analog sensor.
- 3.5. It has been found that the drive shafts are not arranged coaxially So the construction staggered. It was decided to change the design of the MEL so that the spool will be locate on a separate axe. Motors will be connected with spool by the gears with a gear ratio of 1:1. This will eliminate the problems with non-coaxial arrangement of motors.
4. Results:
 - 4.1. The drivers have been installed on the robot.
 - 4.2. Belt is securely fastened to the MEL.
 - 4.3. MEL has been tested. Two drives have enough power for extracting the lift.
5. Tasks for the next meetings:
 - 5.1. To alter the design of the MEL so that it will be reliable.
 - 5.2. To connect the encoder to one of the drives.

1.4.21 04.11.14

1. Time of beginning and ending of meeting: 14:00 – 20:30
2. Purposes of meeting:
 - 2.1. To change the construction of lift.
 - 2.2. To connect encoder to one of motors which moves lift.
 - 2.3. To add to programme of control of the lift stopper of it's moving.
3. Work, that has been done:
 - 3.1. Construction of the lift was changed.
 - 3.2. Encoder was installed to left motor of the MEL.

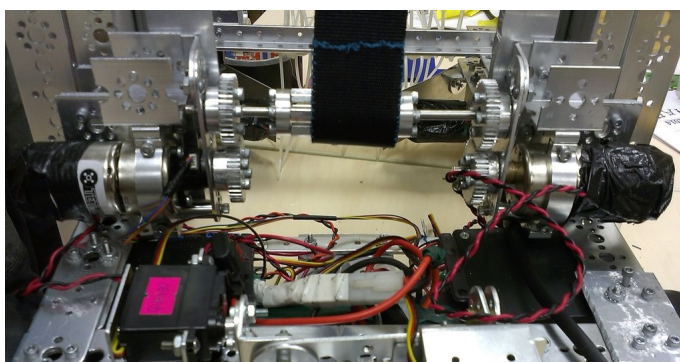


Рис. 36: The finished version of the MEL

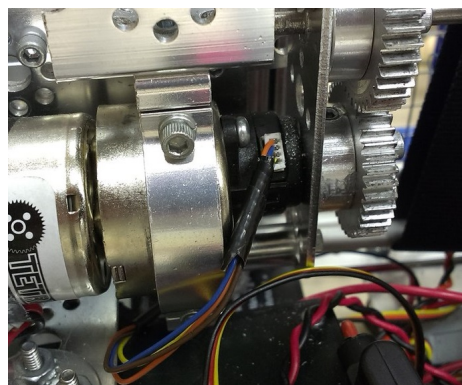
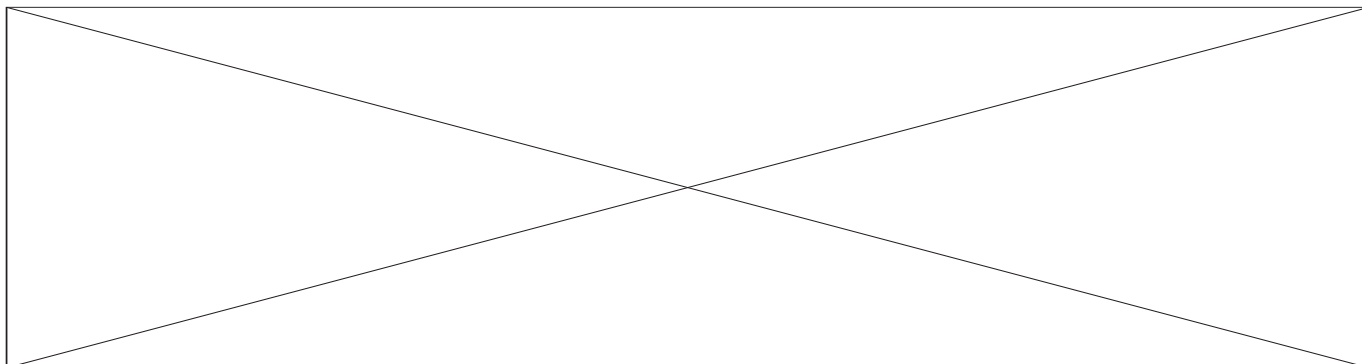


Рис. 37: Encoder

- 3.3. Stopper of moving of the lift was added to programme. If encoder's readings exceed the allowable value lift stops.
 - 3.4. Tests of the lift were successful. The new construction has no problem with extracting lift.
4. Results:
 - 4.1. The lift was finished.
 - 4.2. Tests of the lift were successful.
5. Tasks for the next meetings:
 - 5.1. To continue working on mechanism of overturning bucket and MCB.



1.4.22 08.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To elaborate new ideas for MCB.
 - 2.2. To start creating MCB.
3. Work that has been done:
 - 3.1. Ideas of the capture mechanism's construction:
 - 3.1.1. Mechanism that consist of two vertical rails that can turn. Then beams move apart in hand and pumps on the base of basket. Pluses: compact and easy assembly. Minus of this construction is that it can capture only one basket (it is not profitable in the autonomous period and in the final). Also it will need to aim for capture basket.
 - 3.1.2. The mechanism that consists two beams that can fall on both sides of the movable baskets. Then the basket base compress between the two beams. Pluses: beams may additionally lengthen so robot will be able to capture two baskets. This mechanism is simpler because it does not need to aim carefully. Minuses: uncompact, heaviness.

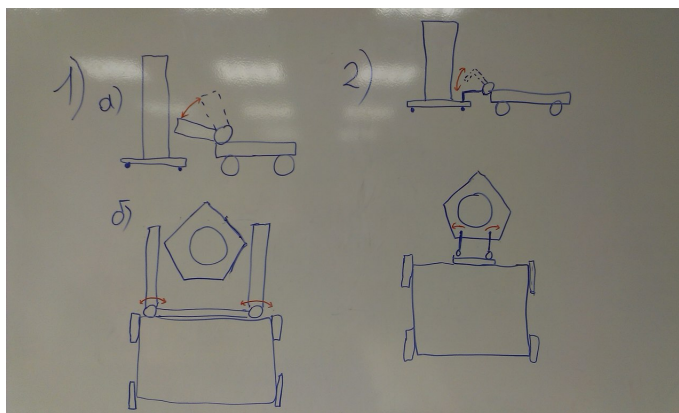


Рис. 38: Ideas of capture of movable baskets: 1)Two beams
2)Vertical slats

- 3.2. Assembly of MCB is not started because we didn't choose it.
- 3.3. It was decided to use the hole for servo for power button.

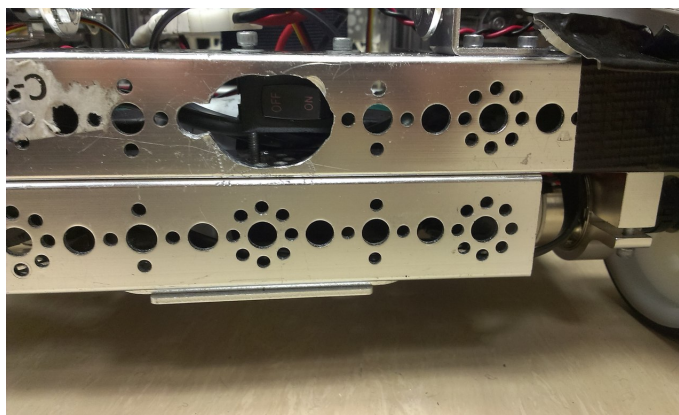


Рис. 39: Button of power

4. Results:

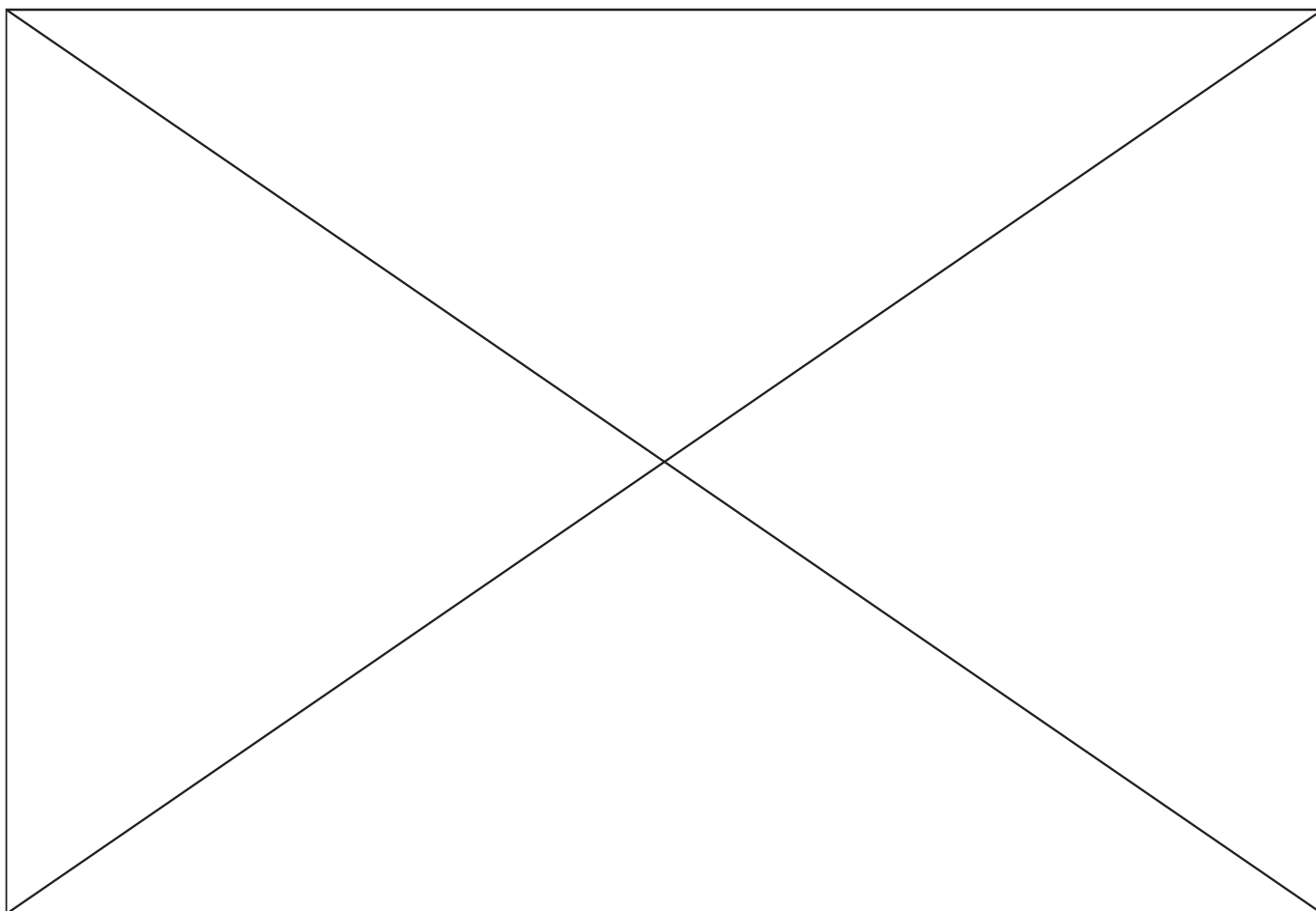
4.1. Three ideas of design have been suggested.

4.2. The MCB is not implemented.

5. Tasks for the next meetings:

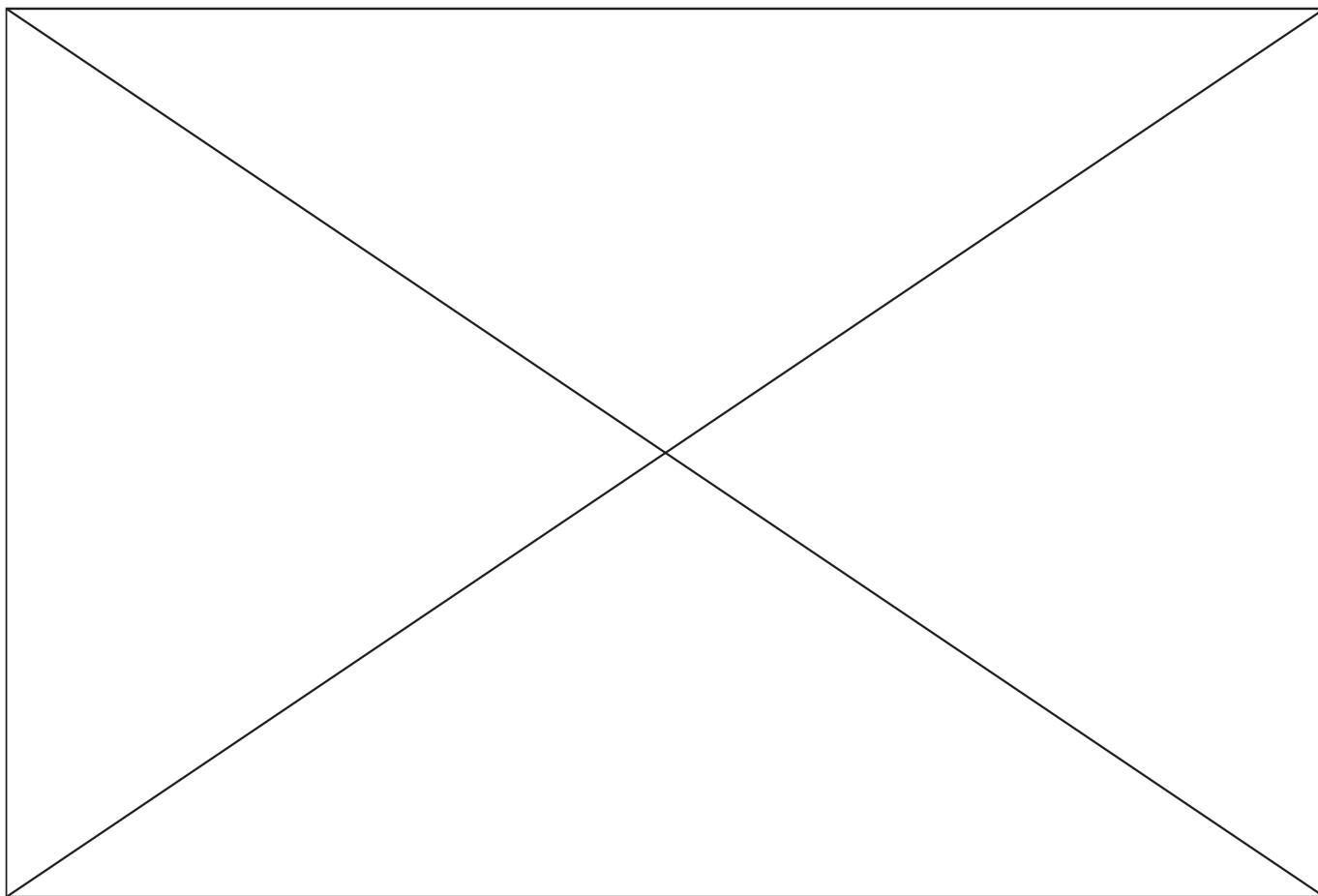
5.1. To choose the optimal variant of MCB.

5.2. To assemble MCB.



1.4.23 10.11.14

1. The time of beginning and ending of the meeting: 17:30 - 20:30
2. Purposes of the meeting:
 - 2.1. To choose the best option of design a capture mechanism basket.
 - 2.2. To begin creating the capture mechanism basket.
3. Work, that has been done:
 - 3.1. Preference was given to the design with vertical rails as the most simple and compact.
 - 3.2. It was decided to use two servos: one will be on the stand to lower the rack baskets, and the second - to push the two rails. Assembling of a capture mechanism basket was started but not completed.
4. Results:
 - 4.1. The design of the MCB was selected.
 - 4.2. MCB was partially assembled.
5. Tasks for the next meetings:
 - 5.1. Complete assembly MCB.
 - 5.2. To write a program to control the capture mechanism basket.



1.4.24 11.11.14

1. Time of beginning and ending of meeting: 17:00 - 20:30
2. Purposes of meeting:
 - 2.1. To finish MCB.
 - 2.2. To add to programme of control of robot control of MCB.
 - 2.3. To write the programme of control of robot with two joysticks.
3. Work that has been done:
 - 3.1. MCB was finished.

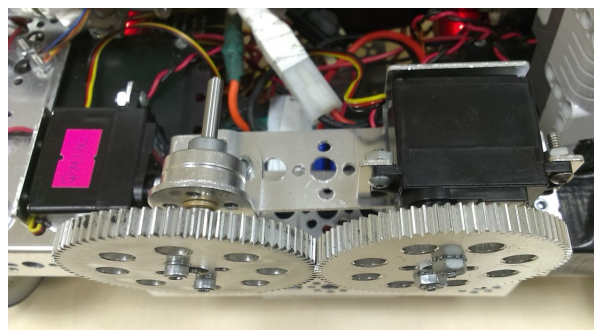
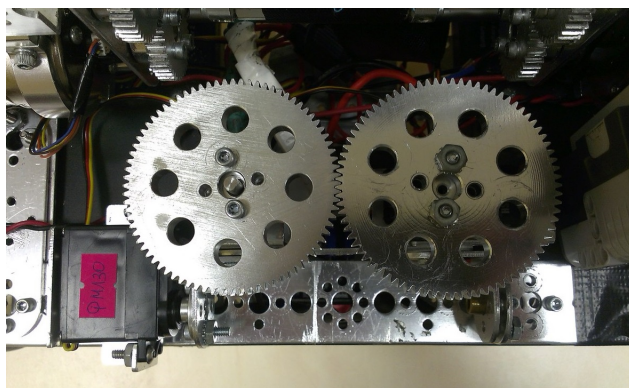


Рис. 40: Finished MCB

- 3.2. Programme of control MCB is not implemented.
- 3.3. Today it was chosen the place for NXT. Now it was fixed by scotch but we planned to fix it more reliable.

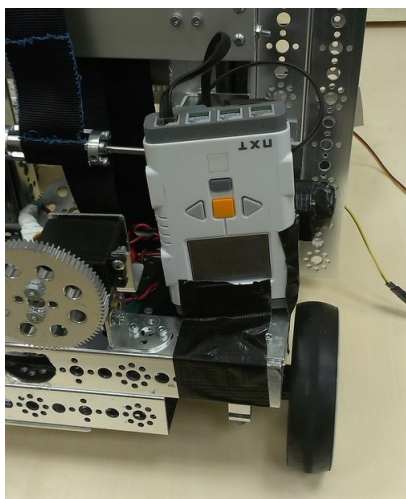


Рис. 41: Place for mount of NXT

- 3.4. We noticed that the wire of servo that overturns the bucket touches the floor when lift is folded. It can to prevent of bucket's moving. It was decided to create special coil that works

as the roulette and uncoil wire when it is not in tension or fix the wire in several places at the guides of lift.

- 3.5. It was decided to create a special programme which allows to us control one of the nodes of robot by NXT's buttons without control with joystick because we often needs to test some one node.
- 3.6. The programme of control with two joysticks was created but wasn't tested. In the new programme the first operator responsible for everything except moving and the second responsible for moving.
- 3.7. It was elaborated the mechanism of the churning stops and releasing balls in autonomous period: servo of continuous rotation at which will fixed two chains of beams from set Lego-NXT. Every two beams connected by one pin. When it folded this construction doesn't take up much space. When servo starts rotation it will be straight. So for churning stops it will enough to get in the distance of action mechanism. It more easy than write programme of finding stop by IR sensor.

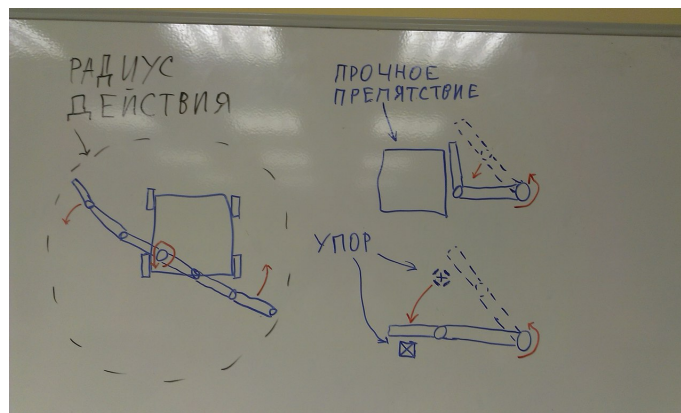


Рис. 42: Idea of mechanism of churing the stop

4. Results:

- 4.1. MCB was almost finished.
- 4.2. Programme of control MCB wasn't implemented.
- 4.3. Programme of control robot with two joysticks was created.
- 4.4. NXT was fixed at the robot.
- 4.5. It was elaborated concept of mechanism of churing of the stops.

5. Tasks for the next meetings:

- 5.1. To test programme of control robot with two joysticks.
- 5.2. To include to the programme of control robot the control MCB.
- 5.3. To fix the wire of servo, that turn bucket (hereinafter it will call STB) so that it doesn't prevent to moving of lift and bucket.
- 5.4. To make the programme of control nodes of robot by buttons of NXT.
- 5.5. To create and test the mechanism of churing of the stop.

1.4.25 12.11.14

1. The time of beginning and ending of the meeting: 19:00 - 20:30
2. Purposes of the meeting:
 - 2.1. To test program of the robot control by two joysticks.
 - 2.2. To include in the program of the robot control program of management MCB.
 - 2.3. To replace the gears in the MCB into smaller.
 - 2.4. To choose materials for bucket for balls.
3. Work that has been done:
 - 3.1. MCB takes up too much space because there were the large gear on the second servo. So it was decided to replace them to smaller ones. It was decided to remove two small gears that were used to mount for crossbar since all small gears have been used. It was created special attachment instead of the gears.



Рис. 43: Mount for crossbar was changed

- 3.2. Gears in the MCB were replaced to smaller ones.

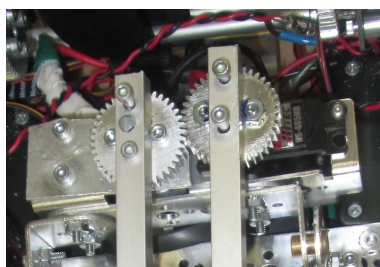


Рис. 44: Smaller gears

- 3.3. It was decided to use metal mesh with small cells for creation a ball's bucket. It has sufficient rigidity and it bends easy. Also the grid has a low weight. That is important because it will be rise to 120 cm. Additionally we'll can see how much balls are in the bucket through the grid cell.
- 3.4. Program of the control MCB has not been written.

3.5. Program of the robot control by two joysticks has not been tested.

4. Results:

4.1. The MCB was finished.

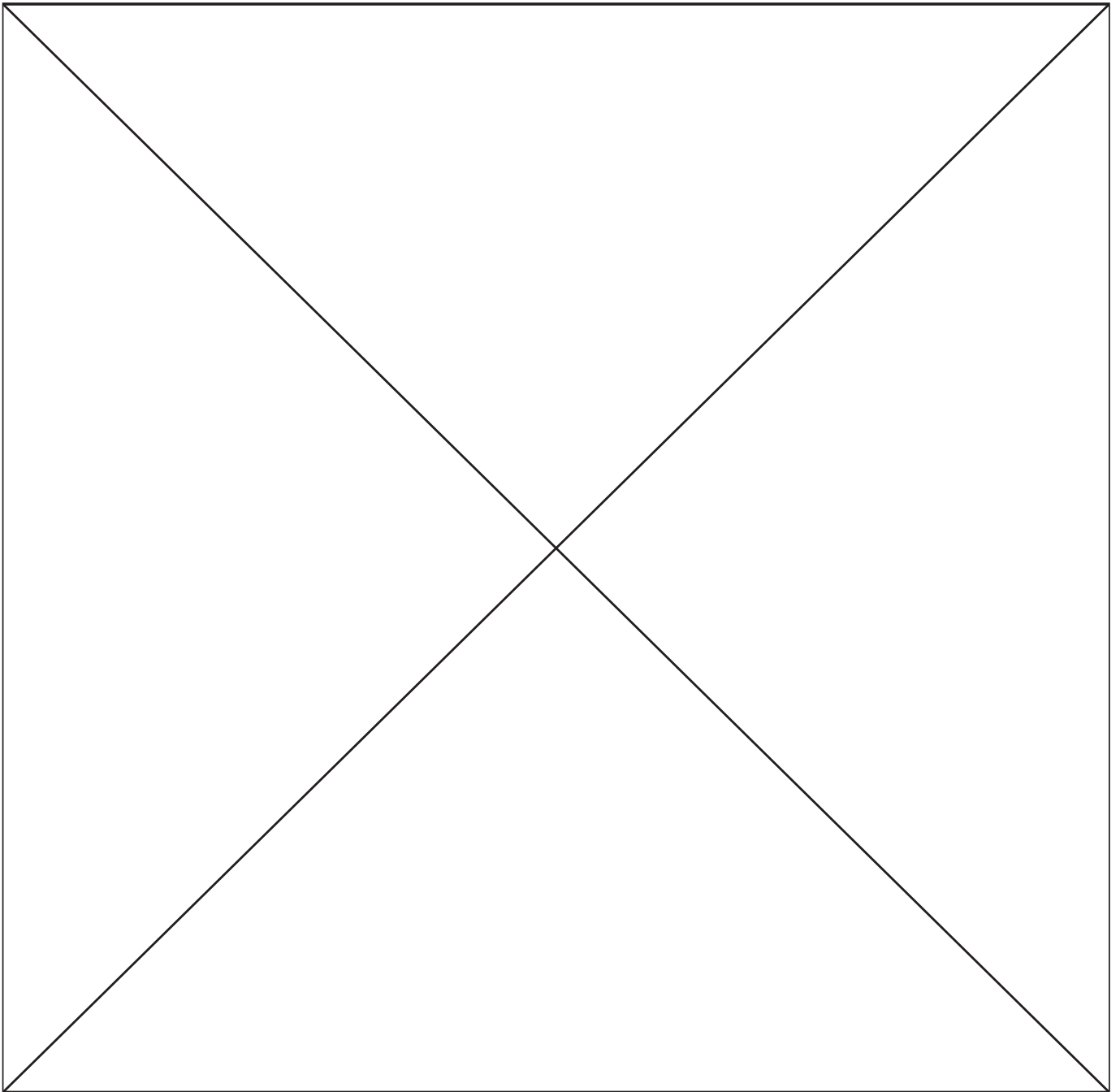
4.2. Programme of control MCB wasn't wrote.

4.3. Program of the robot control by two joysticks wasn't tested.

5. Tasks for the next meetings:

5.1. To add to program of the robot control program of the management MCB.

5.2. To test program of the robot control by two joysticks.



1.4.26 14.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:30
2. Purposes of the meeting:
 - 2.1. To test the programme of control robot with two joysticks.
 - 2.2. To start working on the bucket.
3. Work, that has been done:
 - 3.1. Programme of control robot with two joysticks was tested. Result positive. Control from two joysticks allowed share the responsibility in the control between two operators. It contributed to the increase of efficiency of working of the robot. In order to show good results in competitions it will need trainings to develop teamwork of the two operators.
 - 3.2. It was purchased metal mesh with sizes of cells 14 x 14mm and thickness of wire 0.9 mm. It was created framework for the bucket.

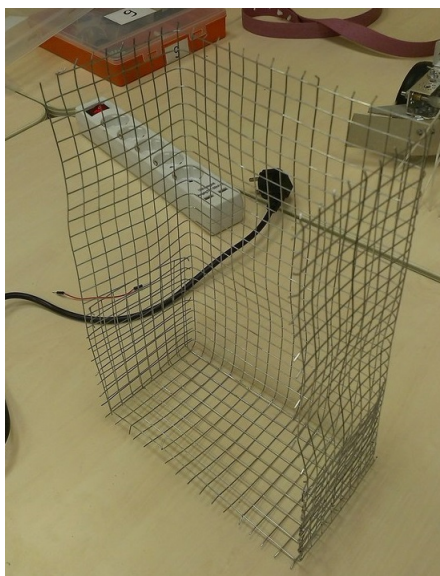
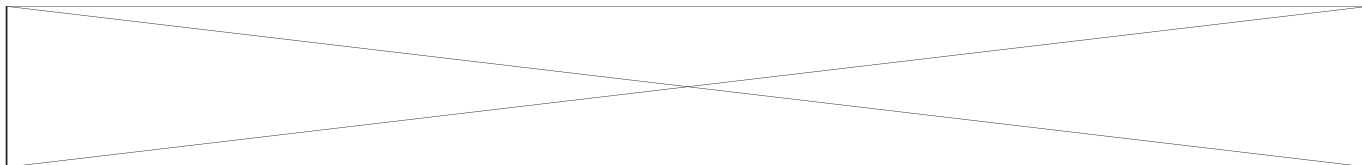


Рис. 45: Preparation for the bucket

4. Results:
 - 4.1. Programme of control from two joysticks was tested. Result positive.
 - 4.2. It was created preparation for bucket.
5. Tasks for the next meetings:
 - 5.1. To finish the bucket.
 - 5.2. To test working of mechanism of overturning bucket (hereinafter it will be called as MOB).



1.4.27 15.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To finish MCB.
 - 2.2. To fix MOB.
 - 2.3. To add to programme of control robot control of MCB.
3. Work, that has been done:
 - 3.1. It was decided use aluminium beams for MCB.
 - 3.2. Beams were fixed at servo.
 - 3.3. It was decided cut the beams to the desired size at the competition because the dimensions of the basis of rolling goal do not specify in regulations. Due to this it impossible to choose optimal length of beams.
 - 3.4. MOB was fixed with help mount for servo from set Tetrax and hot melt adhesive.

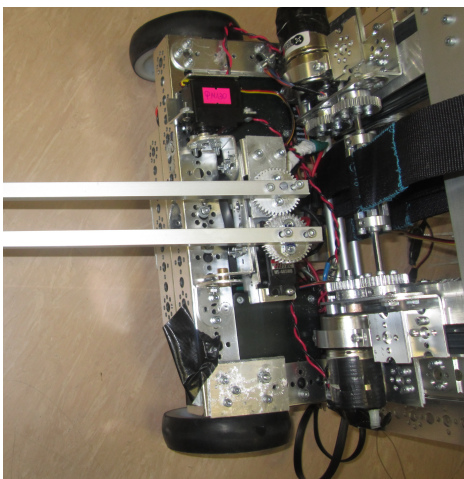


Рис. 46: Beams at MCB

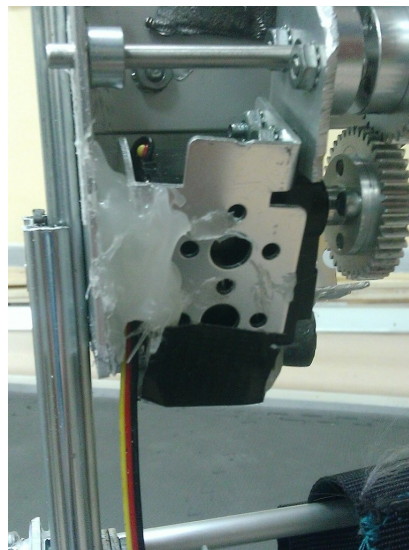
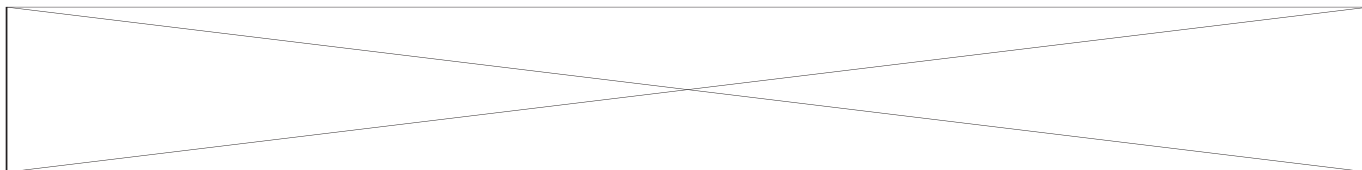


Рис. 47: Mount for MOB

4. Results:
 - 4.1. MCB was almost finished.
 - 4.2. MOB was fixed.
5. Tasks for the next meetings:
 - 5.1. To finish working on the bucket.



1.4.28 16.11.14

1. The time of beginning and ending of the meeting: 19:00 - 20:30
2. Purposes of the meeting:
 - 2.1. To finish working on the bucket.
 - 2.2. To fix the bucket on MOB.
3. Work, that has been done:
 - 3.1. Framework of the bucket was changed: it's top part was bended so that it formed pipe. The balls will roll on this pipe during overturning the bucket. The bottom part wasn't changed.
 - 3.2. It was decided to fix plastic bottle inside the tube. It will allow to the balls to slide over the pipe easier. We couldn't make it today because we didn't have the bottle.
 - 3.3. Bucket was fixed at MOB.
 - 3.4. It was found that transverse beam in front part of robot prevents to lowering the bucket to maximum bottom position. So that this beam was changed on a more subtle which doesn't prevent to moving of bucket.

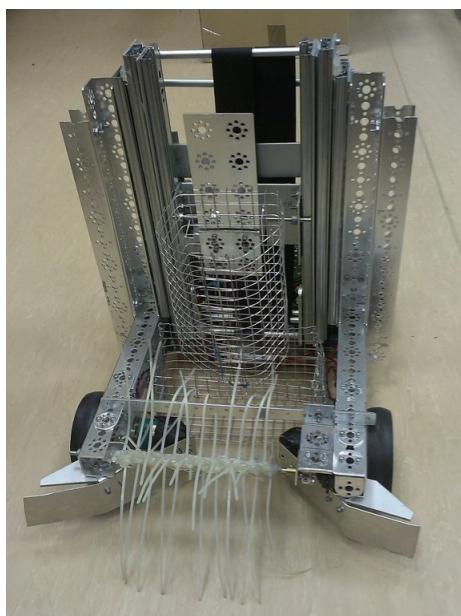


Рис. 48: Bucket in a start position

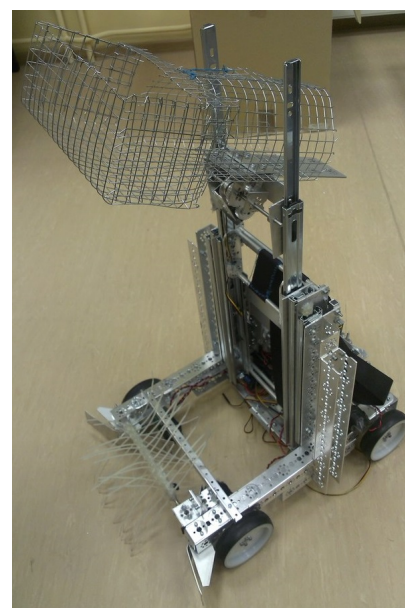


Рис. 49: Bucket in the overturned position

4. Results:
 - 4.1. Framework of bucket was created and installed to robot.
5. Tasks for the next meetings:
 - 5.1. To improve the bucket's construction.
 - 5.2. To test the bucket.

1.4.29 17.11.14

1. The time of beginning and ending of the meeting: 18:00 - 20:40
2. Purposes of the meeting:
 - 2.1. To improve the construction of bucket.
 - 2.2. To test the working of bucket.
3. Work, that has been done:
 - 3.1. Bucket was improved:
 - 3.1.1. Inside the tube was placed plastic bottle. Tube was extended by another one bottle for more accuracy of throwing the balls into the basket.
 - 3.1.2. They were fixed plastic stripes at the bottom part of bucket. They will help to balls to enter the pipe and not get stuck.
 - 3.1.3. The bottom of bucket was bended as a boat. It allowed to balls doesn't fall outside the bucket during the raise of it.
 - 3.1.4. It was left only hole at center of bucket for hit the balls inside. It also allows to reduce risk of falling balls outside the bucket during the rise.

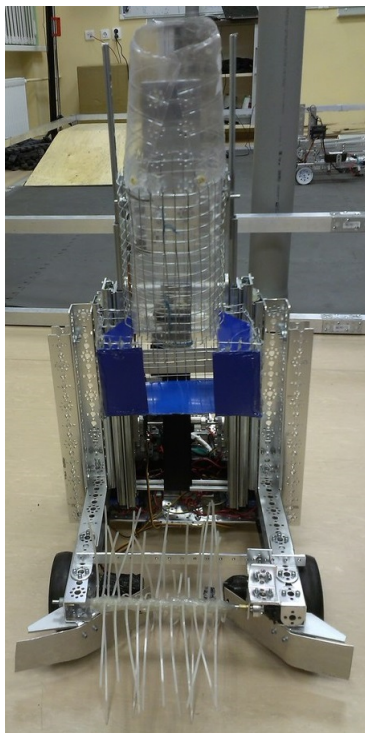


Рис. 50: Bucket in vertical position

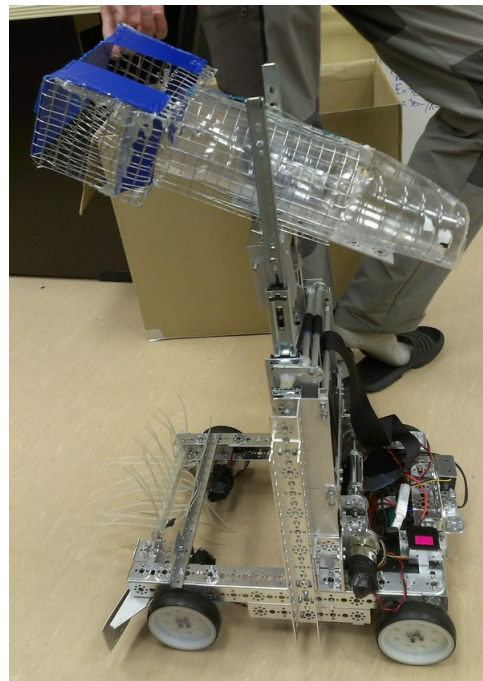
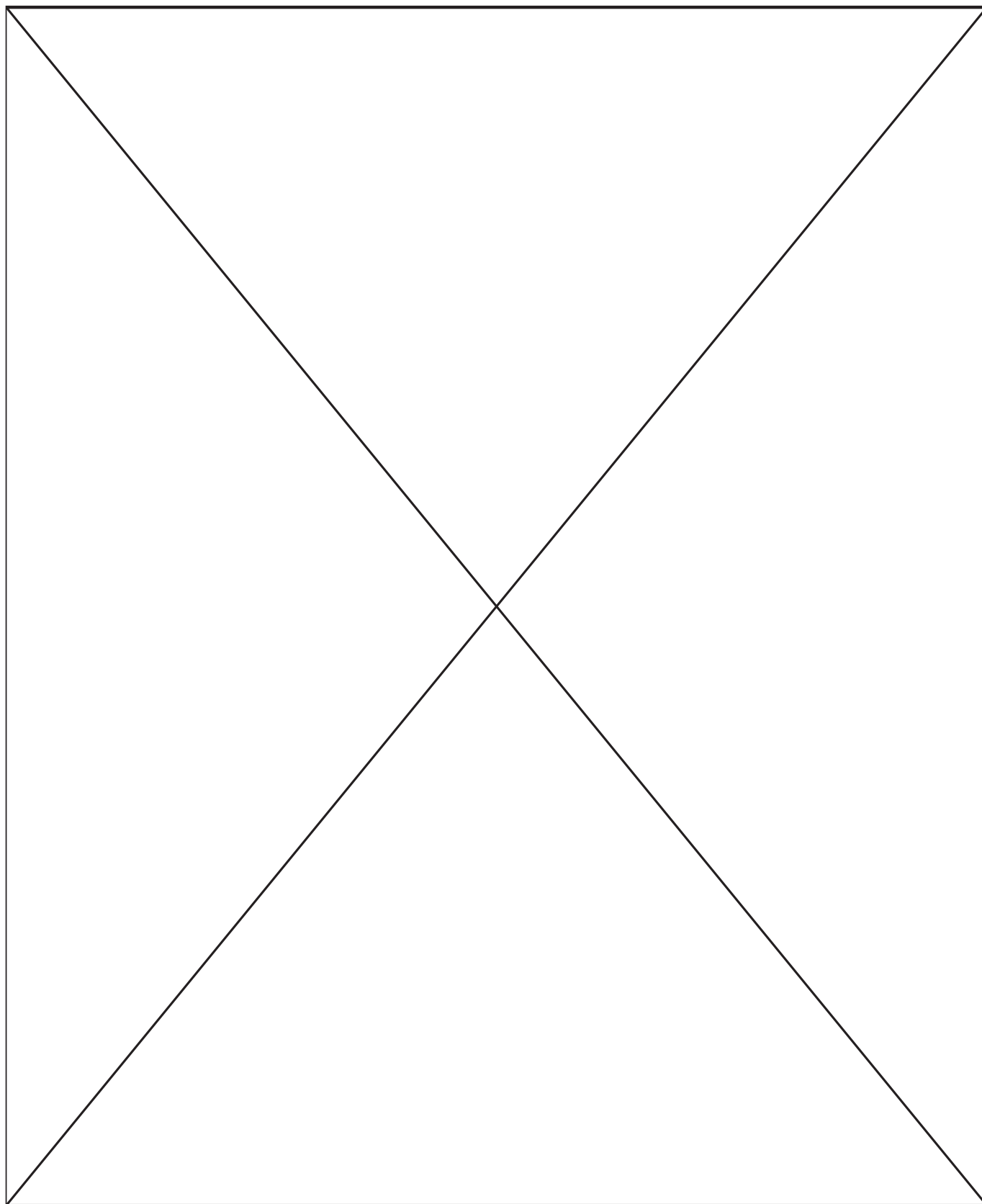


Рис. 51: Bucket in overturned position

- 3.2. The bucket was tested manually. Bucket can fill 2 big and 3 small balls. It is enough because at every big ball there is 3 small. Balls doesn't fall outside the bucket during the rise.
4. Results:
 - 4.1. Construction of the bucket was finished.
 - 4.2. Problems weren't detected during the tests of bucket.

5. Tasks for the next meetings:

5.1. To test the bucket with help programme.



1.4.30 18.11.14

1. The time of beginning and ending of the meeting: 16:00 - 1:00
2. Purposes of the meeting:
 - 2.1. To train on the control of robot.
3. Work, that has been done:
 - 3.1. The first tests of the robot showed the failure of the idea installation inside the tube plastic bottle. It reduced internal diameter so the balls stuck in the pipe. It was decided to remove the bottle. It solved this problem but now the length of tube is too small for throwing of balls to baskets.
 - 3.2. It was turned out that MOB can't turn the bucket when it filled with balls. It was installed fishing cargo mass 100g on the top part of bucket. So this problem was solved.

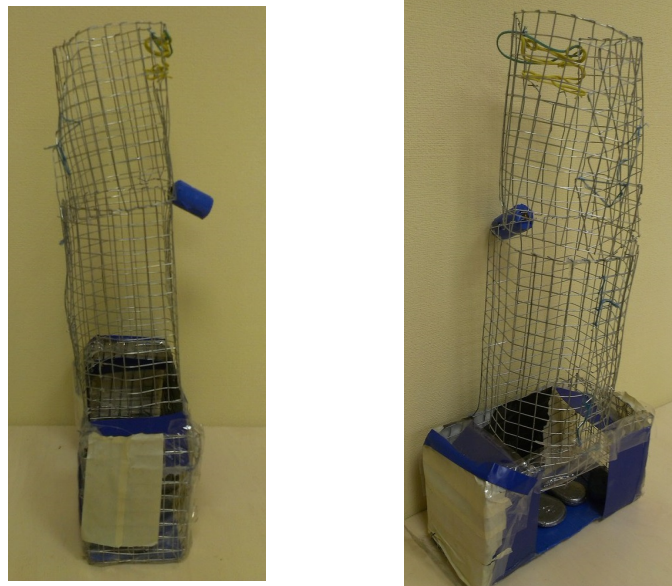
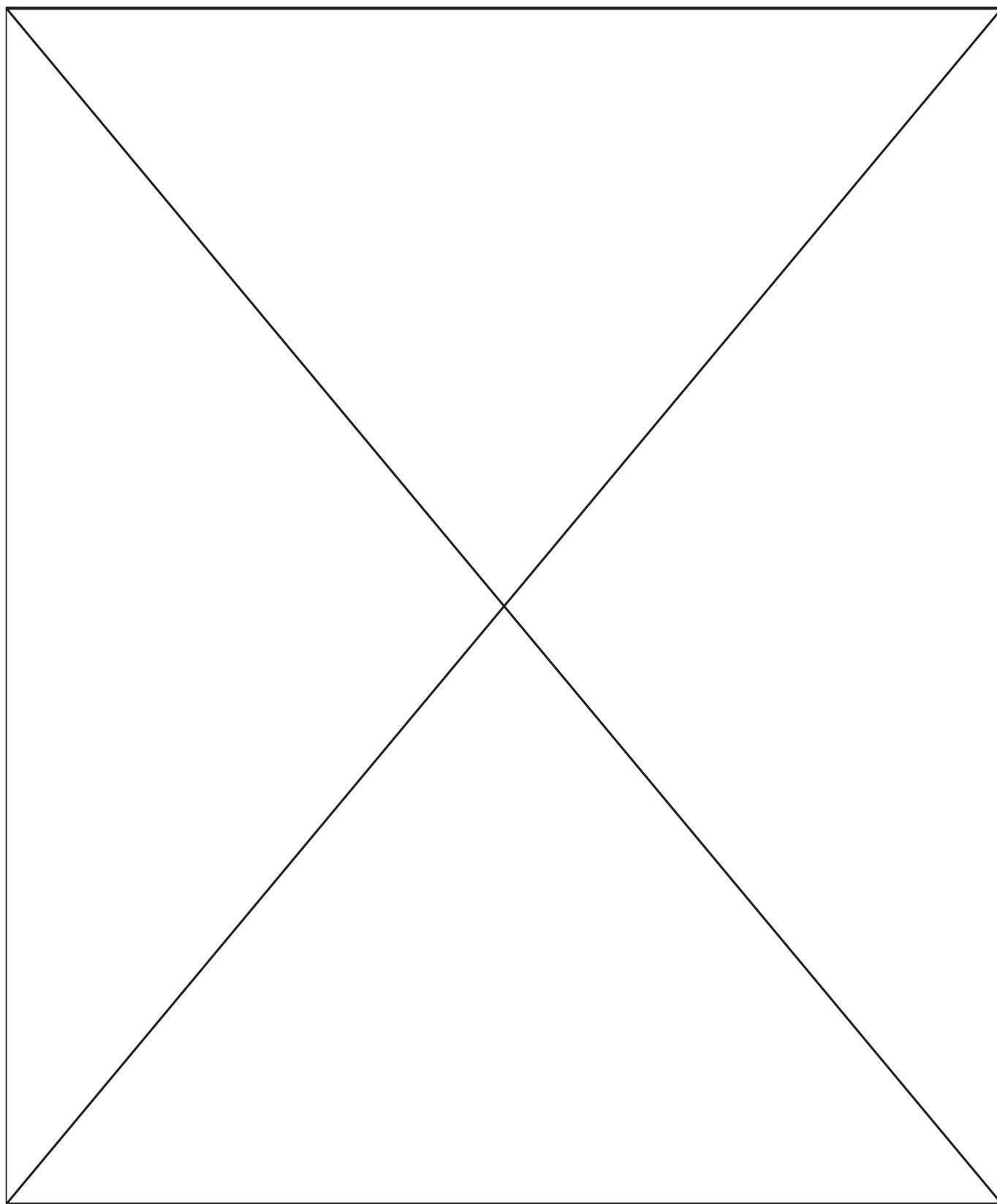


Рис. 52: Fishing cargo on bucket

- 3.3. Also it was turned out that two motors can't extract the lift. Fuses are heated and unlock the chain so the operator loses the control of lift. It was decided install transmission with the gear ratio 1:2 for reducing of load to motors .
- 3.4. Motors copes with extracting the lift after installation of transmission but sometimes the lift was jammed. It happens due to the clamping of the belt between top crossbar of the lift and bottom slat and bottom crossbar of the second slat. It was decided to install limiters that will not allow to bottom crossbar of the second slat raise too highly.
4. Results:
 - 4.1. Plastic bottles were removed from the bucket.
 - 4.2. It was installed transmission with the ratio 1:2 on the motors which extracts the lift .
 - 4.3. It was installed the cargo for normaly working of MOB.
5. Tasks for the next meetings:

- 5.1. To install the limiters of moving of crossbar at the lift.
- 5.2. To extend the tube of bucket for throwing of balls to baskets.
- 5.3. To train on the control of robot.



1.4.31 19.11.14

1. The time of beginning and ending of the meeting: 18:00 - 22:00
2. Purposes of the meeting:
 - 2.1. To install limiters of movement of the crossbar.
 - 2.2. To fix NXT-brick at the robot.
 - 2.3. To train on the control of robot.
3. Work, that has been done:
 - 3.1. It was installed limiters of crossbar's movement.
 - 3.2. It was turned out that metal mesh can to hook a lift and interfere with it's movement. The bucket was covered by tape. It allowed make it's surface smooth.
 - 3.3. NXT-brick was fixed at the robot stationary. The new place is better than previous because now it locates higher and it will be harder to damage it in the event of a collision.

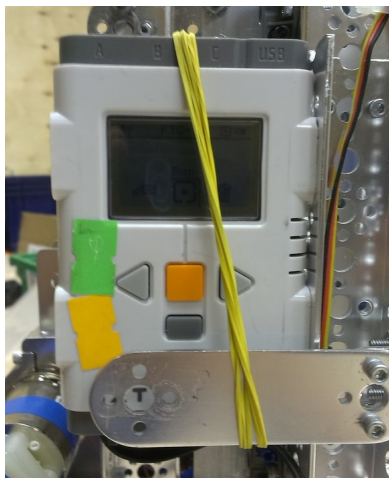


Рис. 53: Fixed NXT-brick (there is more last version at the photo)

- 3.4. We couldn't train on the control robot due to working on robot's construction.
4. Results:
 - 4.1. Trainings at the control of robot were not conducted.
 - 4.2. NXT-brick was fixed on the robot.
 - 4.3. It was corrected the problem with hooking of bucket during the lift.
 - 4.4. Limiters of crossbar's movement was installed on the lift.
5. Tasks for the next meetings:
 - 5.1. To continue the trainings on the control of robot.



1.4.32 20.11.14

1. The time of beginning and ending of the meeting: 16:00 - 22:00
2. Purposes of the meeting:
 - 2.1. To train on the control of robot
 - 2.2. To connect the encoders for orientation of robot in the autonomous period.
 - 2.3. To extend the tube of the bucket for throwing balls to baskets.
 - 2.4. Packaging robot for transportation to the competition "Robofest-South".
3. Work, that has been done:
 - 3.1. It was turned out that some balls don't get into the bucket and stay in the inner space of the robot. So the slopes was extended to reach the bucket. So balls get into the bucket.
 - 3.2. Encoders were connected to the motors that move two back wheels. Programme of autonomous period wasn't made.
 - 3.3. Tube of the bucket was extended. Now we can throw the balls to baskets.

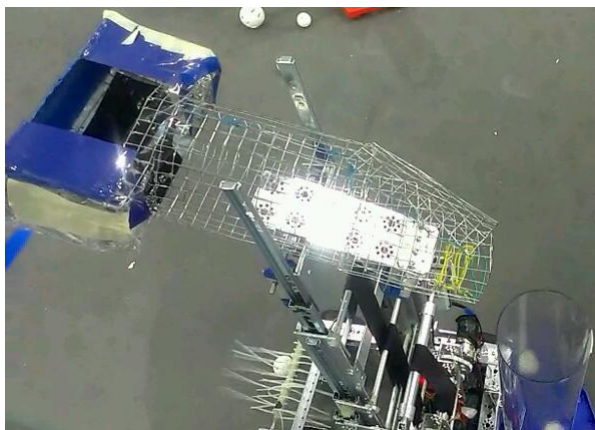


Рис. 54: Changes in the construction of the bucket

- 3.4. Robot was packed into the box for transportation it to the place of competition in the Sochi.
4. Results:
 - 4.1. Slopes were improved. Now all balls reach the bucket.
 - 4.2. Encoders were connected to the back wheels.
 - 4.3. Tube of the bucket was extended.
 - 4.4. Robot is ready to the transportation.
5. Tasks for the next meetings:
 - 5.1. To gain experience during performances at competitions.



1.4.33 21.11.14 (Competition)

1-nd day of competition "Robofest-South"

Today there was training matches.

Improvements that were done:

1. It was turned out that robot loses clutch with the floor when small ball gets under the wheel. It was installed protection of wheels from the balls.

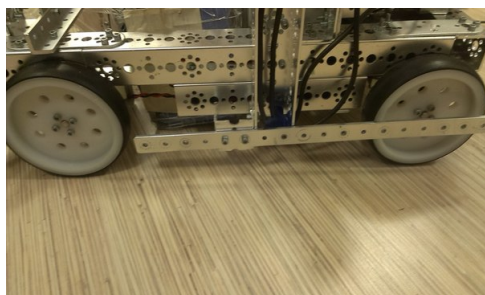


Рис. 55: Protection of wheels from the balls

2. It was turned out that base of rolling goal does not pass under the bottom of the robot. It doesn't allow to bring the goal to the robot as close as possible. It was decided to increase clearance of back part of robot.
3. Beams on the MCB was sawed to desired length and were fixed. But MCB was changed due to problems with second servo that bursting with beams. Faulty servo was removed and beams were fixed rigidly.

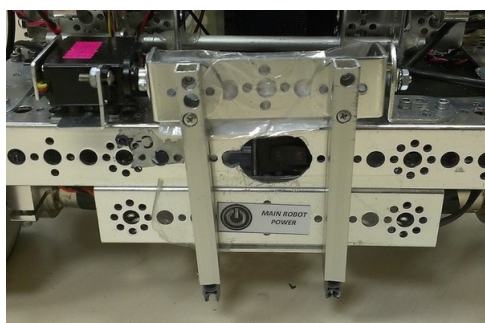
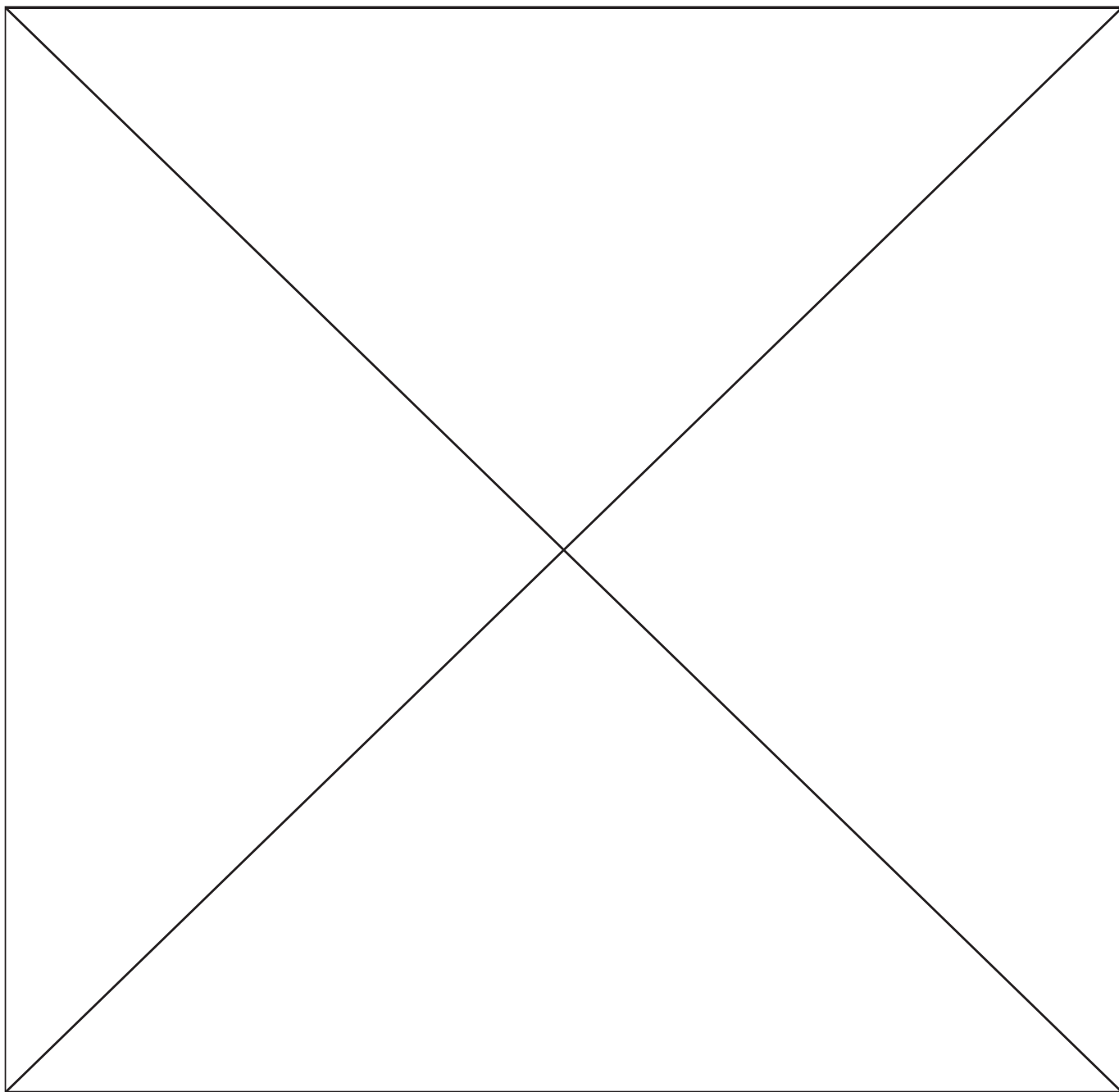


Рис. 56: Changed MCB

4. It was installed Samanta-module and it was conducted one training match on the field for competitions.



Рис. 57: Mount of Samanta



1.4.34 22.11.14 (Competition)

2-nd day of the competition "Robofest-South".

Today there were qualifying matches and protection of engineering books.

Results of matches: 2 wins from 4.

Results of protection of engineering books still unknown.

Main problems identified during matches:

1. There is low accuracy during throwing balls to the rolling goal. This was due to we didn't give enough time to trainings.
2. The wire of MOB often hooked to slats and torned. Due to this it was impossible throw balls to baskets.

Improvements that were done:

1. It was wrote programme of autonomous period that includes exit from the ramp and throwing autonomous balls to 60cm rolling goal.
2. It was wrote the programme that allows to control the lift by buttons of NXT. This programme convenient if we need to extract the lift for working on the construction of robot.
3. Also it was wrote the programme of autonomous period from the parking zone. It allows to knock down the fence when it is in the one position from three.
4. One crossbar bended due to the high loads. So it was strengthened by the metallic tube from set Tetrax. It corrected this problem but it was decided to replace aluminium crossbars to steel.



Рис. 58: Metallic tube on the crossbar

5. There was installed on MCB the slopes of the tie-rods for alignment rolling goals. In the future we planned to replace the screeds to plastic strips because they often brokes.

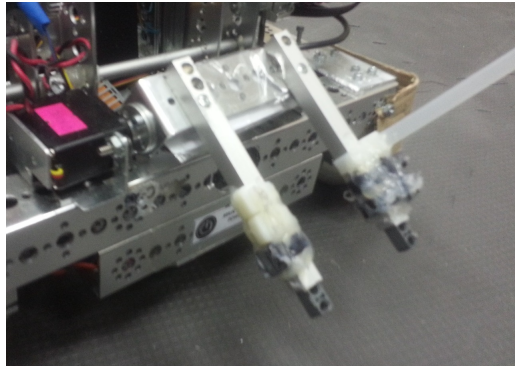


Рис. 59: Slopes for alignment of rolling goals.

6. Protection of wheels was improved . Now there is a cardboard protection but we planned make to it metallic.

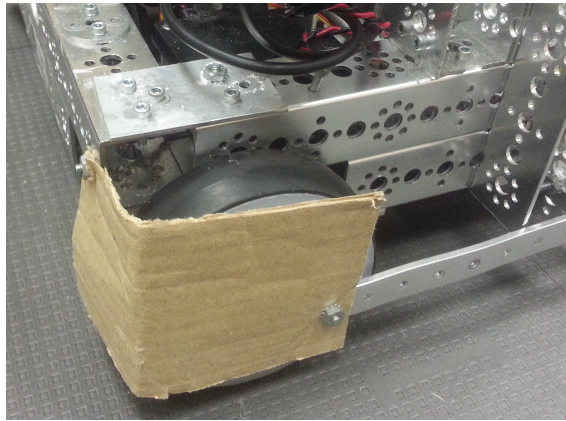


Рис. 60: Protection of wheels

7. During the one match NXT-brick fell off from the robot. So we fixed it as effectively as possible.

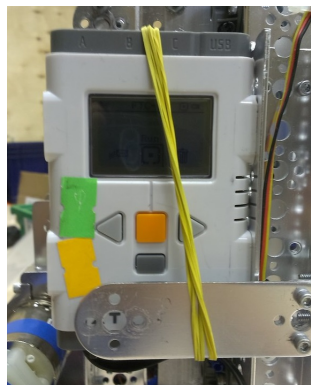


Рис. 61: Improved fixing of NXT

8. It was turned out that during extracting the lift the top pair of slats rises on the last. It doesn't allow to overturn the bucket up until the lift wasn't extracted fully. We must to extract the lift fully and then to lower this to needed heigh for throwing balls to any goal. We waste a lot of time so it was decided to correct this problems after returning from the competition.



1.4.35 23.11.14 (Competition)

3-nd day of competition "Robofest-South"

Today there were final matches.

Results of competition:

1. We didn't hit to "top 4" by the results of qualifying matches.
2. We didn't take part in the final matches because we communicate with other team too little.
3. We won in the nomination "The best engineering book".

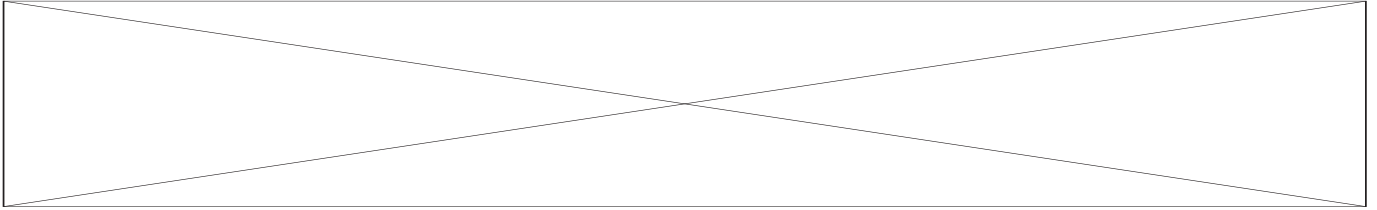
Improvements that were done:

1. It was started programme of autonomous period that include exit from the ramp throwing the autonomous balls to 60cm goal and moving it to the parking zone. But it was turned out that robot can turn to angle that bigger than a threshold but can't turn to smaller. We need to solve this problem after returning.

Results:

1. Successfully of performances on the competition:
 - 1.1. We didn't take the prizes by the results of matches.
 - 1.2. We took the first place in the nomination "The best engineering book".
2. Useful ideas that we took from another teams:
 - 2.1. One of the team had a fixture that resemble a folding basketball basket that directs balls vertically. It allows much increase accuracy of throwing balls to the goals.
3. Our mistakes and disadvantages of construction:
 - 3.1. We did not spend enough trainings. It need to train more.
 - 3.2. We communicate with other team too little. It didn't allow to us to agree with other team on accession to the alliance.
 - 3.3. It was turned out that it hard to knock down the fence and mechanism that we planned to make doesn't cope with it.
 - 3.4. We decided to refuse from installation mechanism wheels because robot with mechanism wheels has a lot of problems with riding to the ramp.
4. Tasks for the next meetings:
 - 4.1. To improve the programmes of autonomous period.
 - 4.2. To move the MOB to the top of the slat in order to we can overturns the bucket when the lift is in any position.
 - 4.3. To install mechanism that will direct balls vertically. It will increase the accuracy of throwing balls to goals because balls will fall straightly.
 - 4.4. To install 4 motors instead 2 on the mechanism of extracting the lift (hereinafter it will call MEL).

- 4.5. To improve the gripper for balls: change the couplers to something that captures the balls more securely and less fragile (a lot of couplers were broke during the competition). For example pieces of plastic bottle.
- 4.6. To practice the skills of effective control of robot.
- 4.7. To unravel the wires of power of motors and controllers and to hold their more gently.



1.4.36 25.11.14

1. The time of beginning and ending of the meeting: 17:00 - 21:00
2. Purposes of the meeting:
 - 2.1. To unravel wires and hold to their by the most accurate way.
 - 2.2. To increment count of motors, which move the lift, from two to four.
 - 2.3. Remove the transmission from the mechanism of extracting lift.
3. Work, that has been done:
 - 3.1. The wiring has been redone so wire doesn't mixed and not fills too much place inside the robot and doesn't prevent to change of battery.

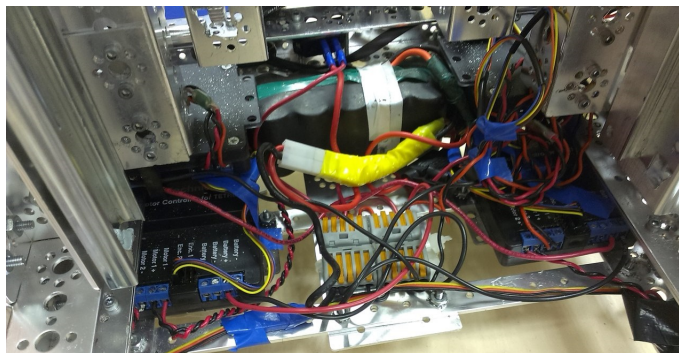


Рис. 62: The inner space after optimize the wiring

- 3.2. It was started alteration of MEL.
- 3.3. We add to construction two motors. So it was need to install another one driver of motors for control their. It was installed driver instead of the servo controller. Servo controller was installed to more available place. It will be easier to connect additional servos.
- 3.4. All drivers of motors were connected to NXT-brick to the port 1. Servo controller was connected to port 2. Initialization of controllers was changed in all programmes.

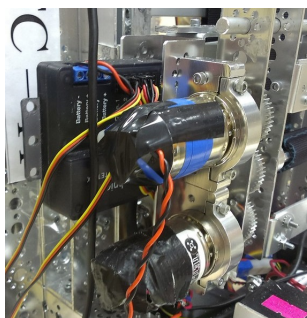
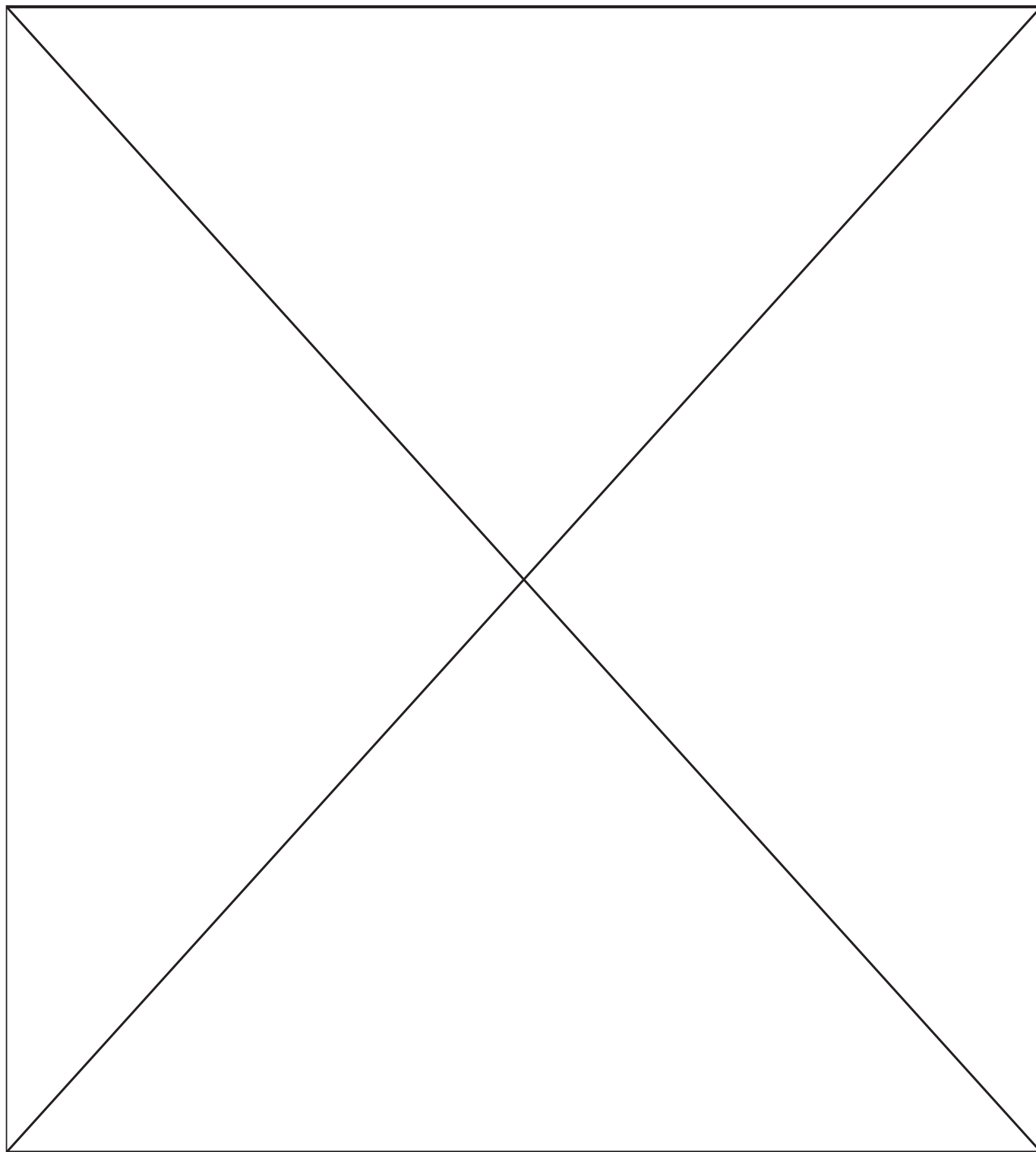


Рис. 63: Servo controller

4. Results:
 - 4.1. Wiring was optimized.
 - 4.2. Driver of motors was installed.

- 4.3. Servo controller was installed on more available place.
- 4.4. It was started alteration of mechanism of extracting of the lift.
- 5. Tasks for the next meetings:
 - 5.1. To finish the alteration of MEL.
 - 5.2. To elaborate concept of the new gripper for balls.



1.4.37 29.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:10
2. Purposes of the meeting:
 - 2.1. To finish the alteration of MEL.
 - 2.2. To elaborate concept of the new gripper for balls.
 - 2.3. To test the MEL.
3. Work, that has been done:
 - 3.1. MEL was finished. Now it moves by four motors with gear ratio 1:1.

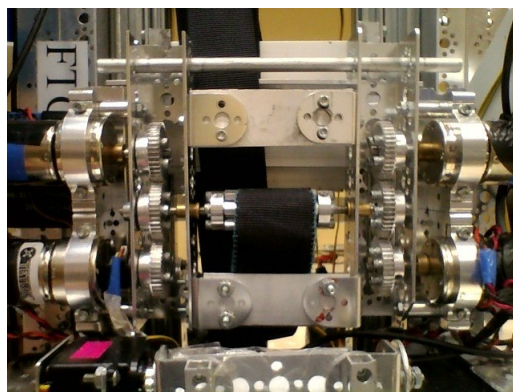


Рис. 64: Changed MEL

- 3.2. MEL was tested. Speed of extracting increased twice. Motors not experiences undue stress during the working.
- 3.3. Ties has too small stiffness and not always captures balls and often break. It was decided use blades that cut from the plastic bottle. It was designed that optimal count of blades - 3. In addition it was decided to improve the bucket so that the bucket has a ramp 7cm in hight in the front part. It will allow to us capture 5 big balls. Also the balls will not fall from the bucket. It was created schematic drawing of gripper and bucket.

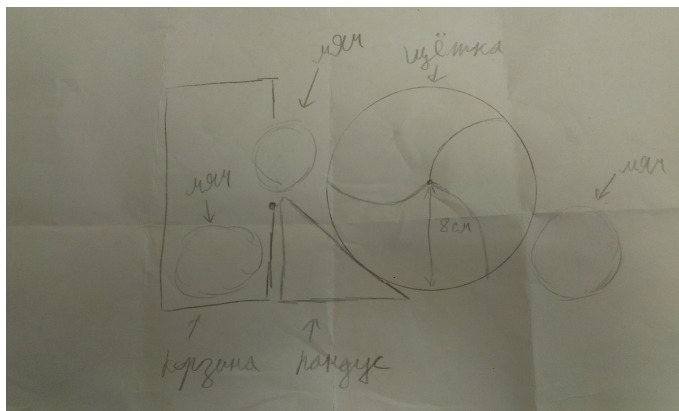
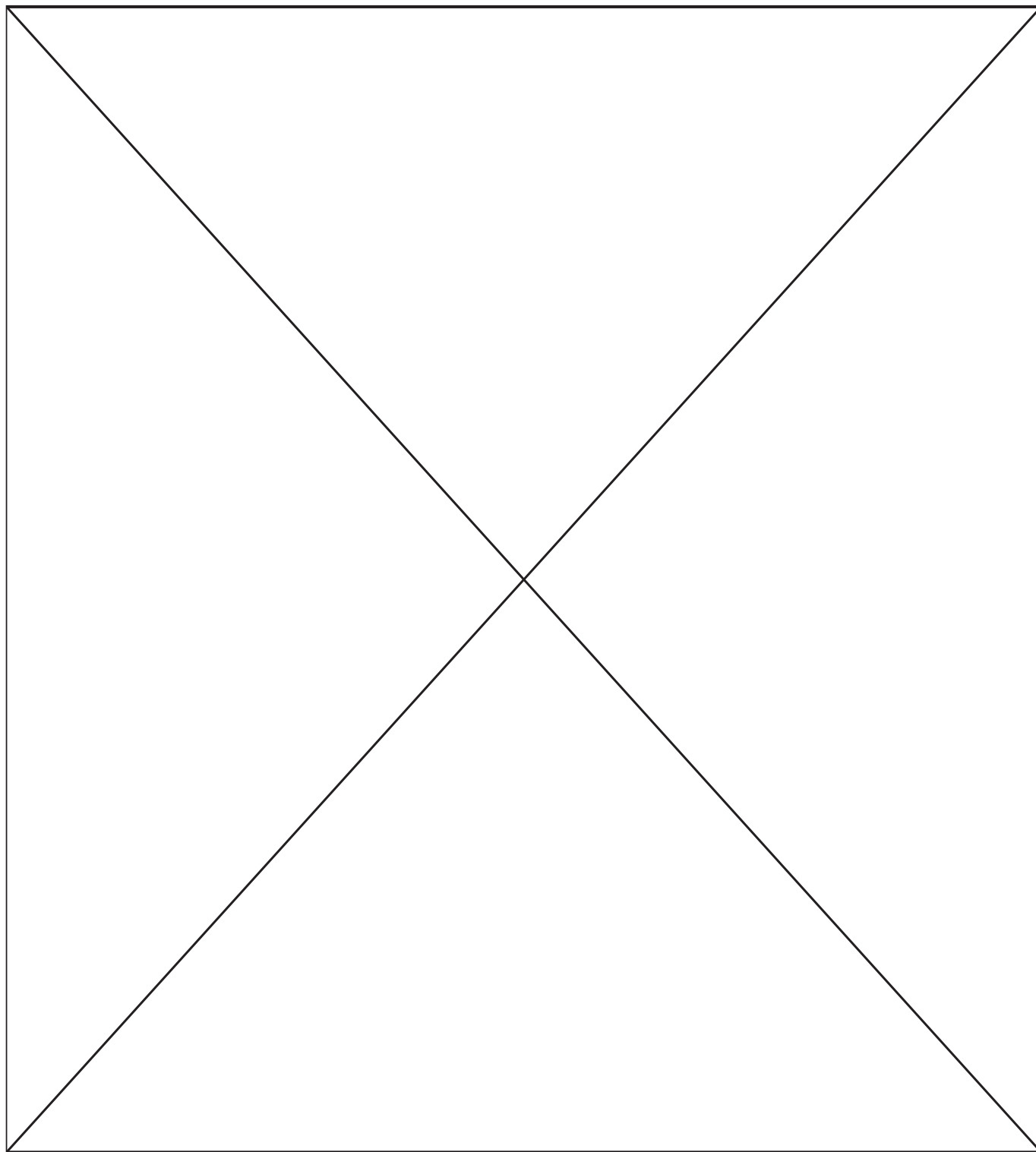


Рис. 65: Drawing of gripper and bucket

4. Results:

- 4.1. The alteration of MEL was finished.
- 4.2. MEL was tested. The speed of rising increased twice.
- 4.3. Construction of new gripper for balls was elaborated.
- 5. Tasks for the next meetings:
 - 5.1. To change the gripper for balls.



1.4.38 30.11.14

1. The time of beginning and ending of the meeting: 14:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To change the gripper for balls.
 - 2.2. To test the new gripper.
3. Work that has been done:
 - 3.1. They were installed plastic blades on the axle.

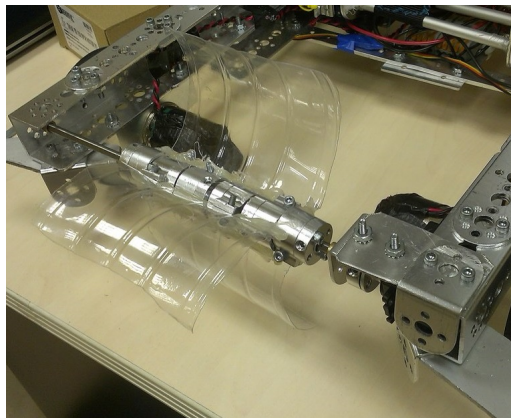


Рис. 66: The new gripper for balls

- 3.2. Tests.
- 3.3. The transverse beam prevented to working of gripper because blades more stiffness than ties. So the beam was removed. It was decided to install Π -shaped rib of rigidity. Horizontal crossbar of it will locate higher and will not prevent to working of the gripper.
- 3.4. The axle of gripper was located too low. So it was decided to increase clearance of front wheels. After incrementation of clearance gripper hasn't any problem with capture of big balls.
4. Results:
 - 4.1. Gripper for balls was changed.
 - 4.2. Clearance of front wheels was increased.
 - 4.3. Gripper was tested. Result positive.
 - 4.4. Transverse rib of rigidity was removed.
5. Tasks for the next meetings:
 - 5.1. To move the MOB to top of the last slat.
 - 5.2. To install Π -shaped rib of rigidity.
 - 5.3. To start elaboration of concept of the new bucket.

1.4.39 01.12.14

1. The time of beginning and ending of the meeting: 15:30 - 19:00
2. Purposes of the meeting:
 - 2.1. To move the STB to the top of the last slat.
 - 2.2. To install Π -shaped rib of rigidity.
 - 2.3. To start elaboration of concept of the new bucket.
3. Work, that has been done:
 - 3.1. MOB was moved to the top of the last slat.

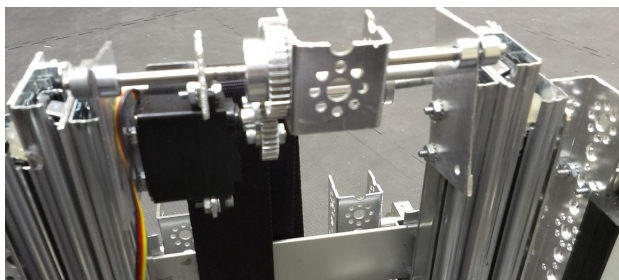


Рис. 67: STB

- 3.2. Π -shaped rib of rigidity wasn't installed.
- 3.3. It was decided to create the bucket so that: on the bottom of the bucket there is pallet 7cm in height. Ramp fix on a front part of it. Then there is part that open on the front. It needs for getting balls into the bucket. Then the bucket starts to narrow and at the top there is the hole with sizes of big ball. Uniform narrowing doesn't allow to balls stuck inside the tube. After the bucket there is gutter that fixed on the top pair of slat so that balls falls from the overturned bucket to a goal. The gutter ends by a folding element that directs to balls vertically.

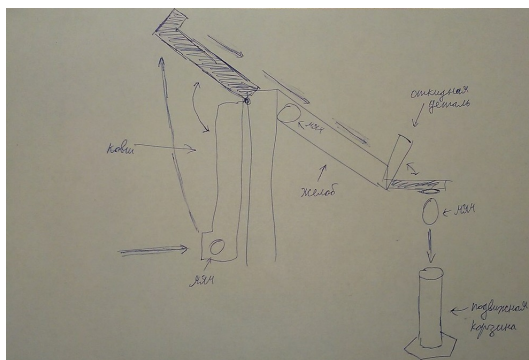


Рис. 68: Concept of the bucket

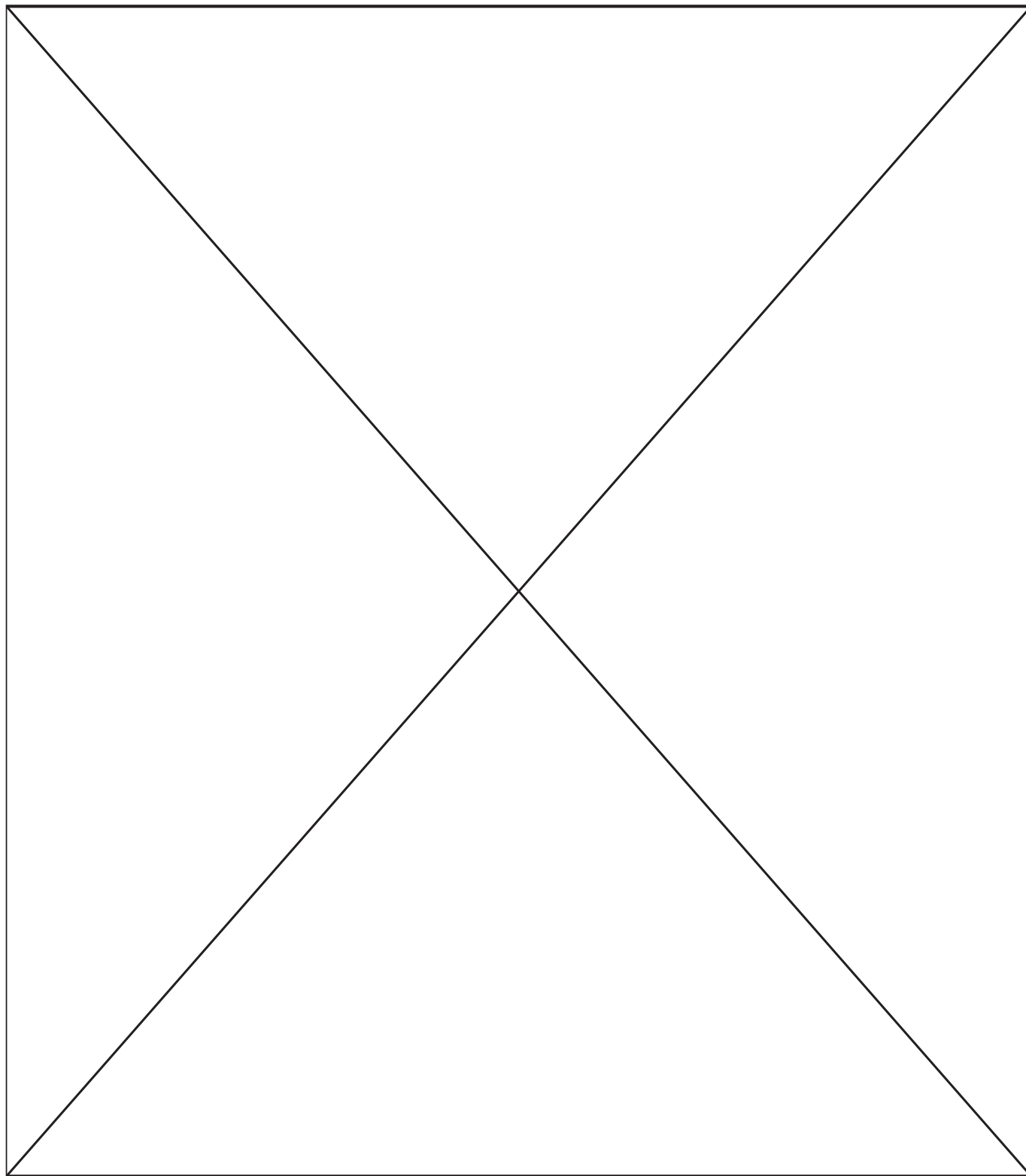
4. Results:
 - 4.1. MOB was moved to the top of the last slat.
 - 4.2. Rib of rigidity wasn't installed.

4.3. It was elaborated concept of the bucket

5. Tasks for the next meetings:

5.1. To install Π -shaped rib of rigidity.

5.2. To start implementation of the bucket.



1.4.40 05.12.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
 - 2.1. To install Π -shaped rib of rigidity.
 - 2.2. To measure the inner space of robot and choose optimal sizes of bucket.
3. Work, that has been done:
 - 3.1. Π -shaped rib of rigidity was installed.

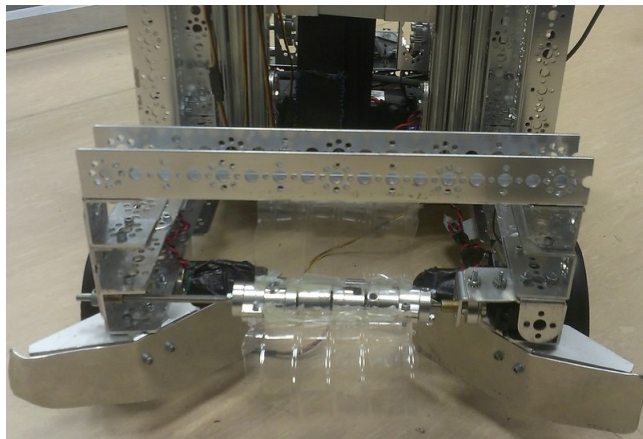
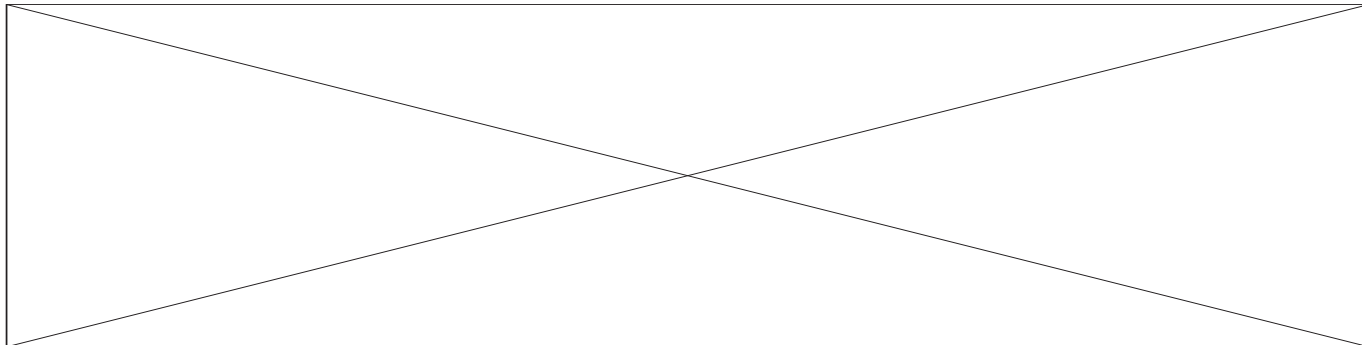


Рис. 69: Π -shaped rib of rigidity

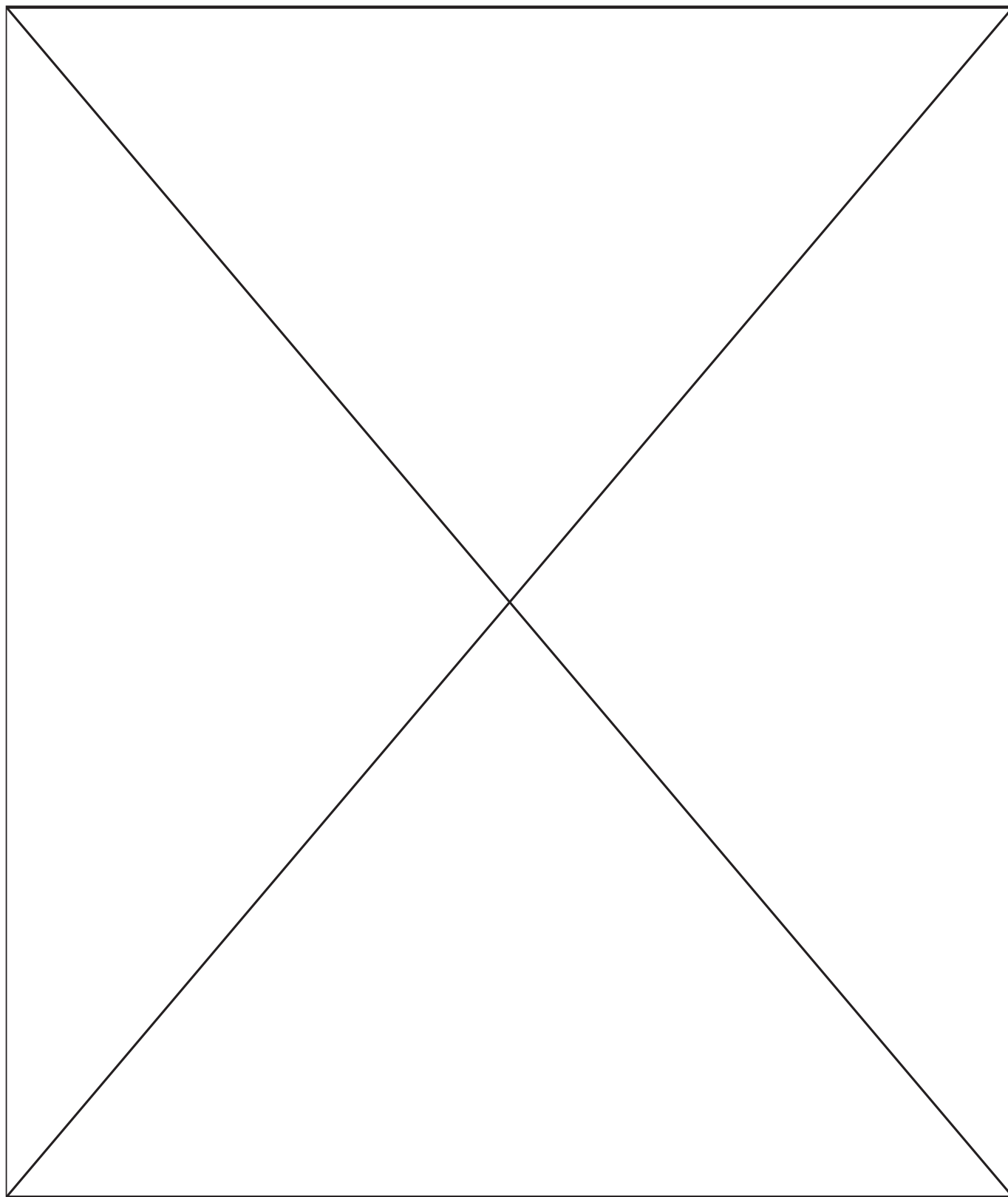
- 3.2. We measured the space allocated for bucket. Optimal sizes of bucket were choose.
 - 3.3. Programme of autonomous period was improved. Function that convert reading of encoder to centimeters was removed. It allowed solve the problem with turning to parking zone.
4. Results:
 - 4.1. Π -shaped rib of rigidity was installed.
 - 4.2. Programme of autonomous period was improved.
5. Tasks for the next meetings:
 - 5.1. To create the drawing for new bucket.
 - 5.2. To choose and buy the material for bucket.



4.3. MEL was strengthened.

5. Tasks for the next meetings:

5.1. To make a new bucket.



1.4.42 08.12.14

1. The time of beginning and ending of the meeting: 17:00 - 20:30
2. Purposes of the meeting:
 - 2.1. To make the new bucket.
 - 2.2. To test the new bucket.
3. Work that has been done:
 - 3.1. We use as a material for bucket packaging of PET because we couldn't buy list of PET.
 - 3.2. Projection of bucket was cut out. Bucket was fastened by duct tape. We planned to strengthen it by superglue.

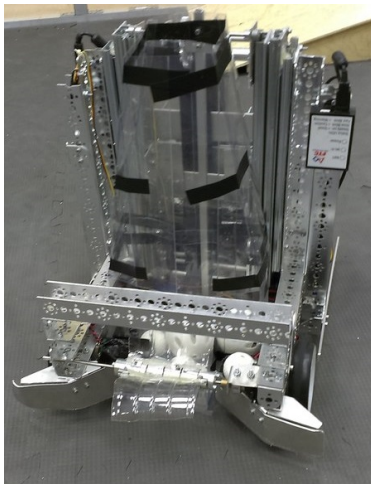


Рис. 72: New bucket

- 3.3. Bucket was tested for picking up balls. In most cases balls gets into the bucket. Some balls gets to the side and stuck on the robot. It was decided to make slopes which will prevent to balls get to side. Some balls doesn't leave the gripper and throws outside. It was decided to install limiters which prevent to balls move outside. Balls doesn't fall from the bucket after getting to it.
- 3.4. It was turned out that small balls can get under the bottom of robot due to the increase of clearance. So the slopes were fixed lower.
- 3.5. Bucket was bended due to the weight of balls. So it was fixed aluminium profile to back part of bucket. After that bucket stop to bend.
4. Results:
 - 4.1. Bucket was created and installed on the robot.
 - 4.2. Tests of bucket were successful.
 - 4.3. Slopes were fixed lower.
5. Tasks for the next meetings:
 - 5.1. To test MOB with the bucket.
 - 5.2. Install limiters that will prevent to balls move outside the bucket.

2 Thanks and prospects

We liked to do interesting and custom project that include engineering part and working with new people.

Our team planned to continue to do robotics. It is our first year when we take part in FTC so we will do it in a next year. We'll correct all our mistakes and we will much better.

We don't know what we'll do in a future but we shure that this time will not be a waste.

We are thankful to company FIRST for organizing of this competition.

Also we thank our sponsors: company PTC and it's Russian representative "Irisoft" and charitable foundation "Finist" for support. Also we thank Physics-Mathematics Lyceum №30 and it's director Alexey Tretyakov for providing comfortable conditions for preparation to competition.

Team PML 30 φ

