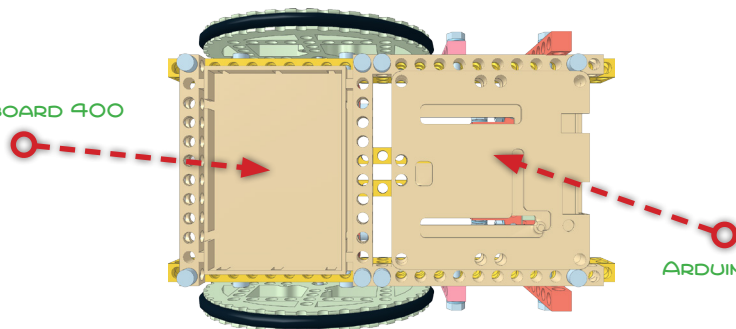


THE CONSTRUCTION OF A MOVABLE ROBOT FROM
AN OPEN SOURCE 3D PRINTED KIT BITBEAM.
ARDUINO UNO R3 IS USED AS A CONTROLLING
PROGRAMMABLE MICROCONTROLLER.

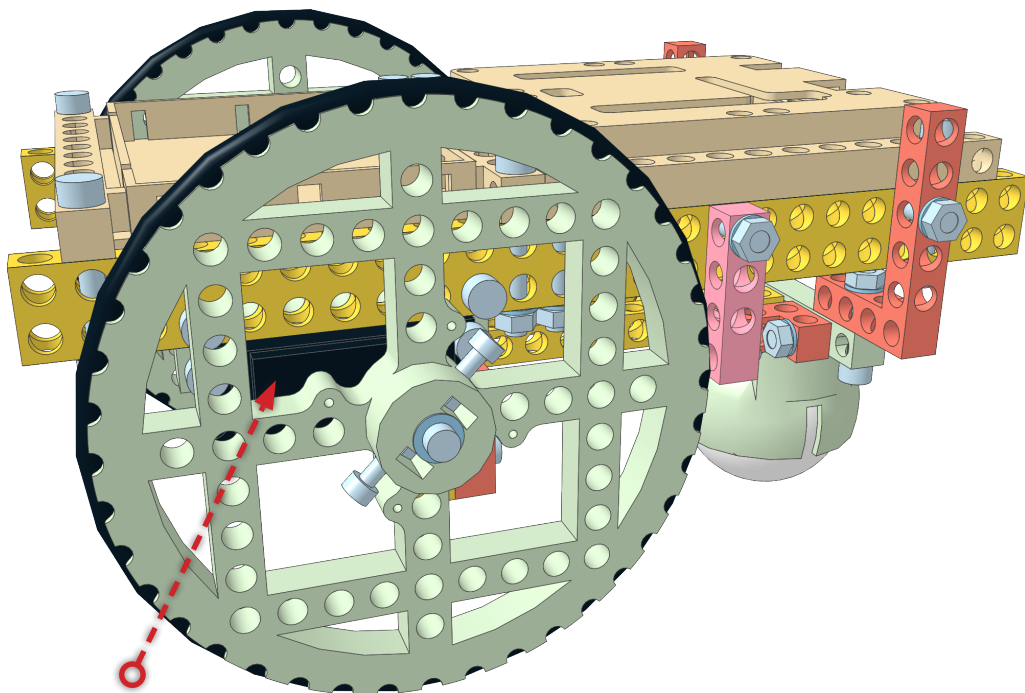
ROBOT FERDA

VERSION 1.1 BETA

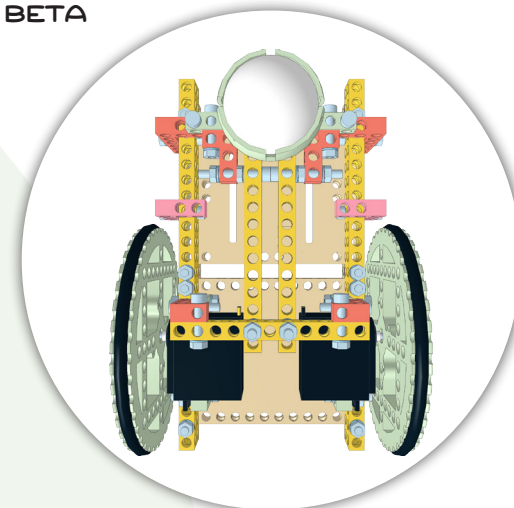
SOLDERLESS BREADBOARD 400



ARDUINO UNO R3



CONTINUOUS SERVOS



LO7 - FERDA

YOU CAN SHARE THIS PDF FILE FREELY!

This document was created, based on the experience in child education (10 – 14 years) in JAOS, the programming and robotics education club (www.policka.evangnet.cz/roboti).

I'd be glad if this document would get to everybody who could benefit from it in some way. It doesn't have to be just teachers and robotics club leaders. It could be anybody who builds the **m-Bitbeam** kit and programmes with **Arduino**...

You can share the file via internet or any data carrier. You can also put a download link onto your website or server. The only condition is, that the file must always be complete and completely free for download. The file must be downloadable, without the duty of registration on your website.

THE USAGE OF THIS MATERIAL ISN'T FREE, IT IS NECESSARY TO CARRY OUT A FEE...

The conception of this material is valued by many hours of work. If you would use this material please carry out the fee for using this digital material **2 €**. Your financial contribution will be used to create more education material which will also be free for everyone.

If you are still a child and can't pay the fee via internet, please get help from your parents. If you can't pay the fee for some reason don't worry and use it anyway. I believe that when you get older, you will pay me it.

If you want to use it as an education material for your students in school or a club, please pay the fee for each student.

More info about **m-BITBEAM** and the payment at:

<http://www.tfsoft.cz/m-bitbeam>

You will also find a summary of all the material there.

- If you want to put the file for download onto your website, please inform me.
I will tell you when the new version of the manual is ready.
- The file is prepared for paper A4. If you would print this material onto a different size of paper don't forget to:
set the specific size readjustment (for example in Adobe Reader: Size Options -> Fit)
- Please do not change the PDF file. If you find a mistake please inform me and I'll sort it out.

You think it is just “playing with a kit”?

*With a construction and programmable kit
it is never just “playing”...*

This applies to an open source Bitbeam kit even more! That's why we began using Bitbeams with children in the education club, JAOS.

Working with the kit encourages logic thinking, systematic attitude and technical abilities. When doing more complicated things, work with this craft encourages teamwork. The kit itself encourages not only fine movement but also patience, fantasy and work with any kinds of manuals (the understanding of text, pictures, graphs, etc.).

There is also math and physics at all time (frequently even more life sciences). Children also get a specific knowledge of programming.



Tomáš Feltl

skolniprojekty@gmail.com

At the moment I am dealing with modern technology education. For example laboratory systems (such as PASCO, VERNIER,...), smartboards, voting equipment, LEGO Mindstorms, Bitbeam kits, Arduino, Mobile phones... As a lector specialised in interactive education I cooperate with some organisations and schools.

The robot “Ferda” is revealing...

This robot was developed based on the experience in child (10 – 14 years) education in the educational club JAOS.

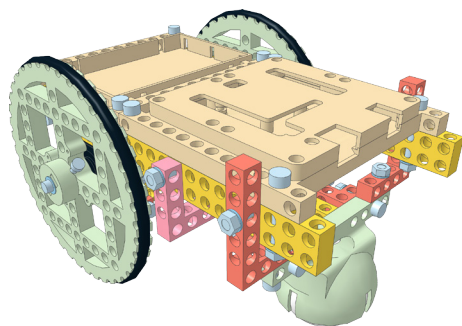
(www.policka.evangnet.cz/roboti).

When dealing with various tasks and problems, it is appropriate to think of your own robot specified for the concrete task. The solution is mainly “construction solution” of the robot. Sometimes the situation requires only software changes. And here comes the universal robot FERDA...

You can use FERDA to:

- ride (mainly on flat surface),
- draw onto the surface (the option of attaching a pen to the rotation axis of the robot);
- combine various sensors depending on your needs (modular system, quick module connection);
- easily disconnect any sensor;
- gradually tilt the module with the light sensor
- change the batteries without taking the robot apart
- attach something in the front part (for example your own original module);
- ride and drive with IR remote control;
- ride and drive with your smartphone.

The universal robot FERDA can also be used as an explorer of a room ☺.



What is BITBEAM?

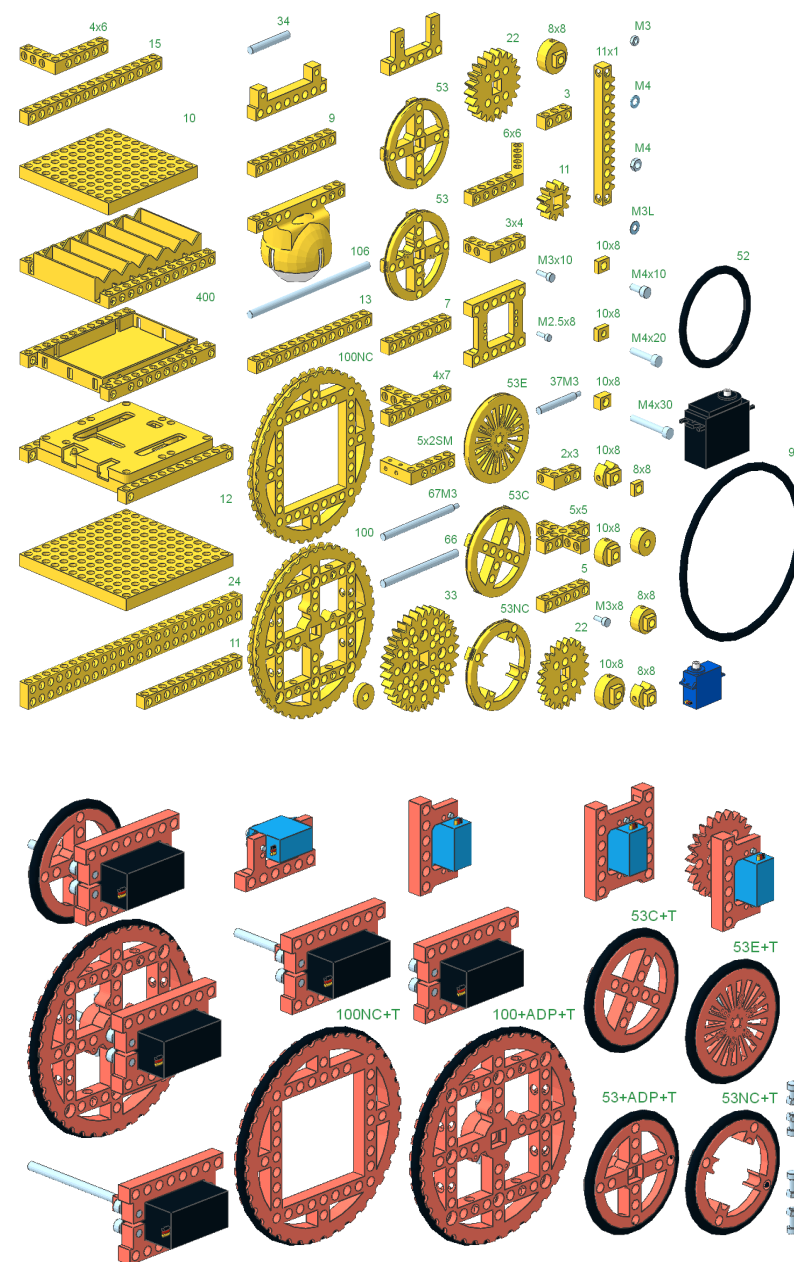
Bitbeam is a construction and prototyping kit available for free (Open Source). The size fits with LEGO Technics/Mindstorms, so it is possible to combine both kits. All Bitbeam parts are designed so that they can be made at home from various materials with various technology (3D printing, CNC, laser cutting). System Bitbeam is an interesting and cheap alternative to various commercial and construction kits, especially in combination with 3D printing. More info:

www.bitbeam.org.

Why m-BITBEAM?

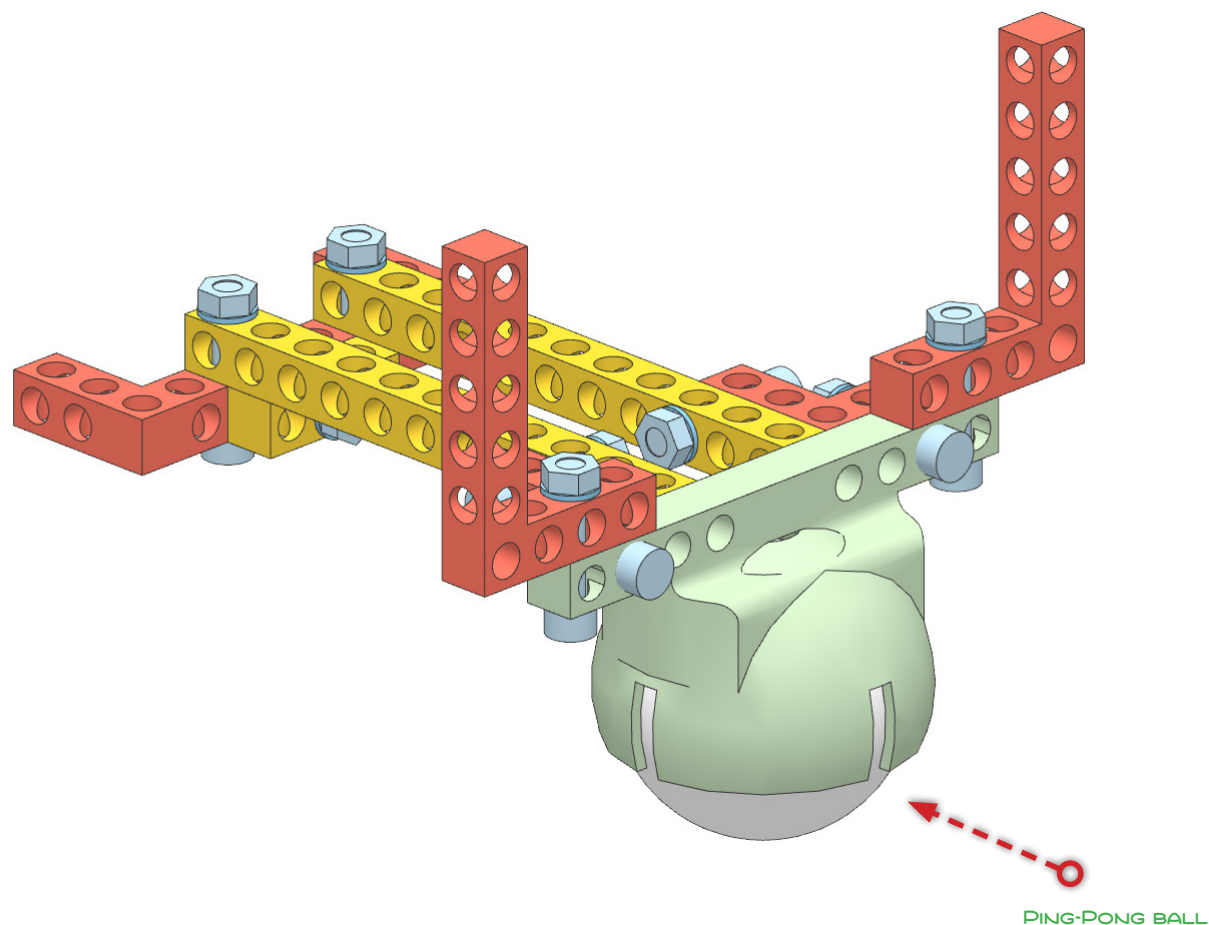
m-Bitbeam is a 3D printed construction kit, based on the Bitbeam concept adding some special parts like wheels, holders, boxes, etc. The electronic and programmable part of the kit is based on Arduino and its large “ecosystem” of various modules and sensors.

There are three main reasons for which m-Bitbeam exists. The first reason is the high price of the universal programmable kits like LEGO Midstorms. Thanks to the low price, m-Bitbeam is available for everyone (every child has its own kit at home). The second reason is much larger variability of Arduino for example sensors, motors, expanding modules etc. In that way they reveal unknown options and their projects can be not just more interesting but also reach into real life and praxis. There is nothing easier to go on the internet and see what is powered by Arduino today (3D printers, CNC machines, security systems, regulation systems, measuring systems, satellites, ...). The last reason is to spread knowledge about another technology – 3D printing. After absorbing the basics of 3D modelling with children, they can easily design their own construction parts exactly for the needs of their project.

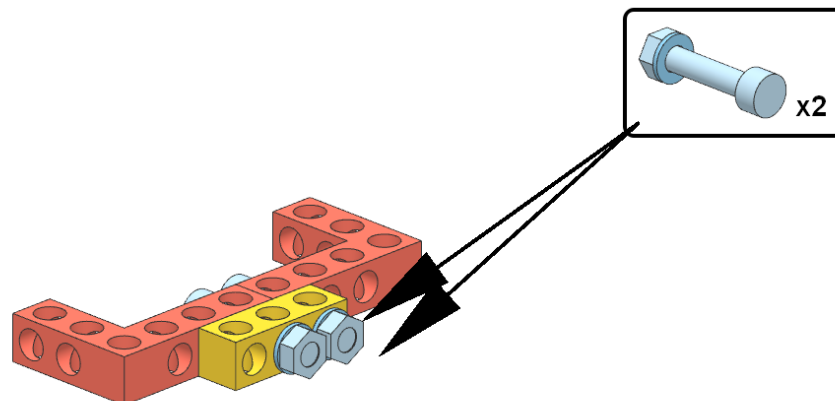
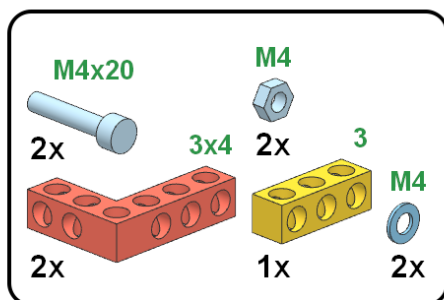


Repository of 3D models in STL format (for 3D printing): https://github.com/e-Mole/m-Bitbeam_Parts_for_3Dprint
 Repository of 3D models in DAT format (for preparation instructions, for example in MLCad + LPub): https://github.com/e-Mole/m-Bitbeam_Parts_for_LDraw

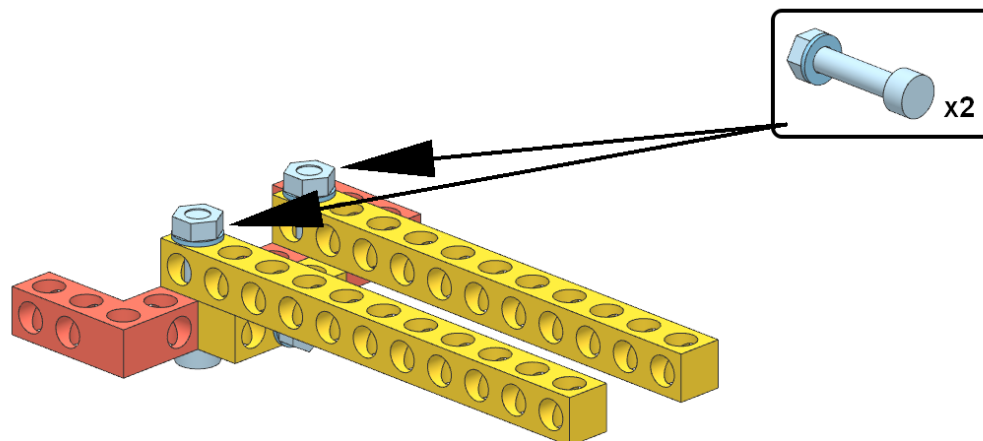
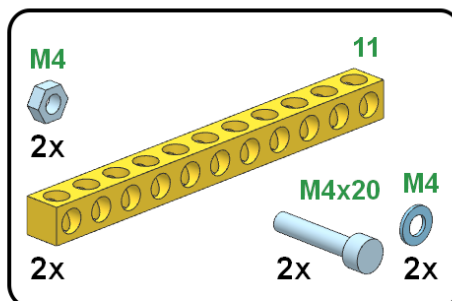
BEGIN WITH THE BOTTOM PART, IT WILL LOOK LIKE THIS WHEN DONE:



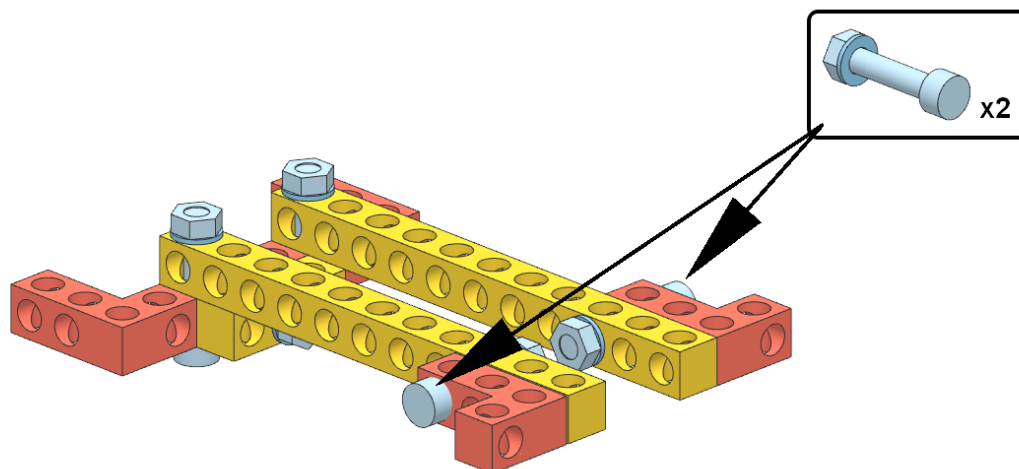
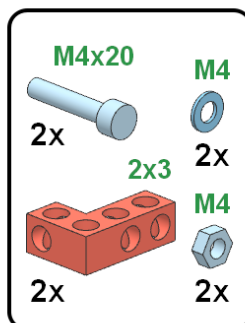
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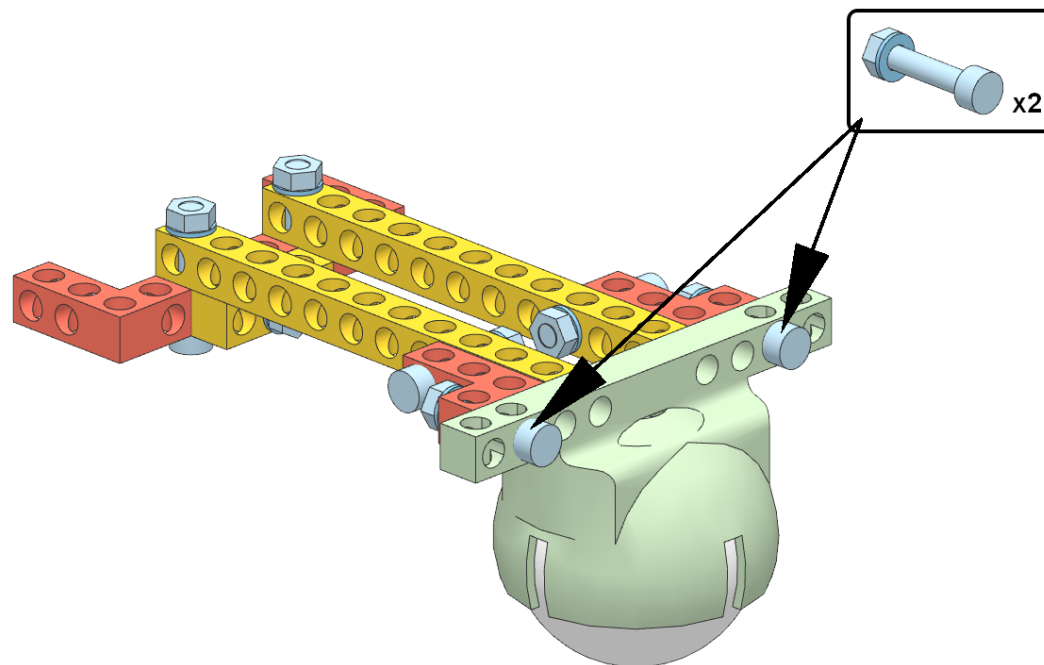
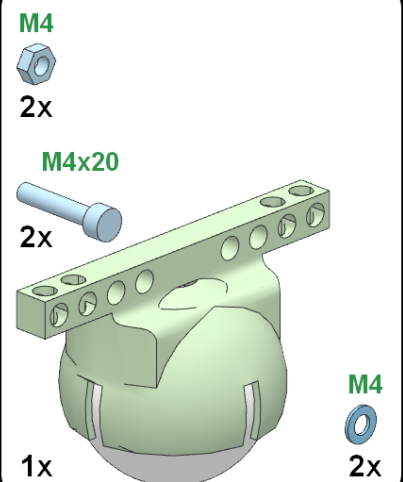
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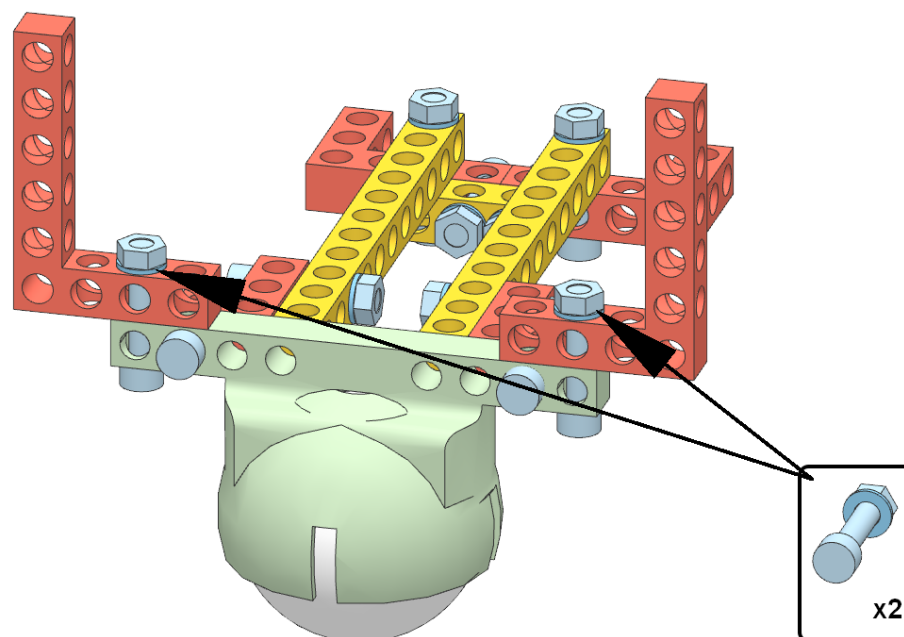
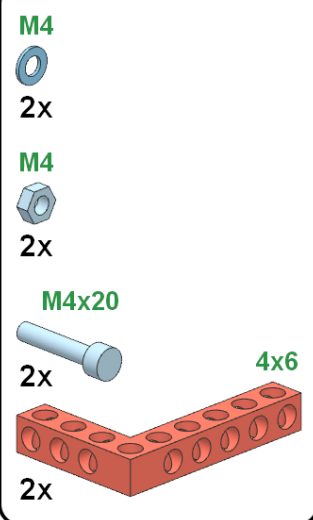
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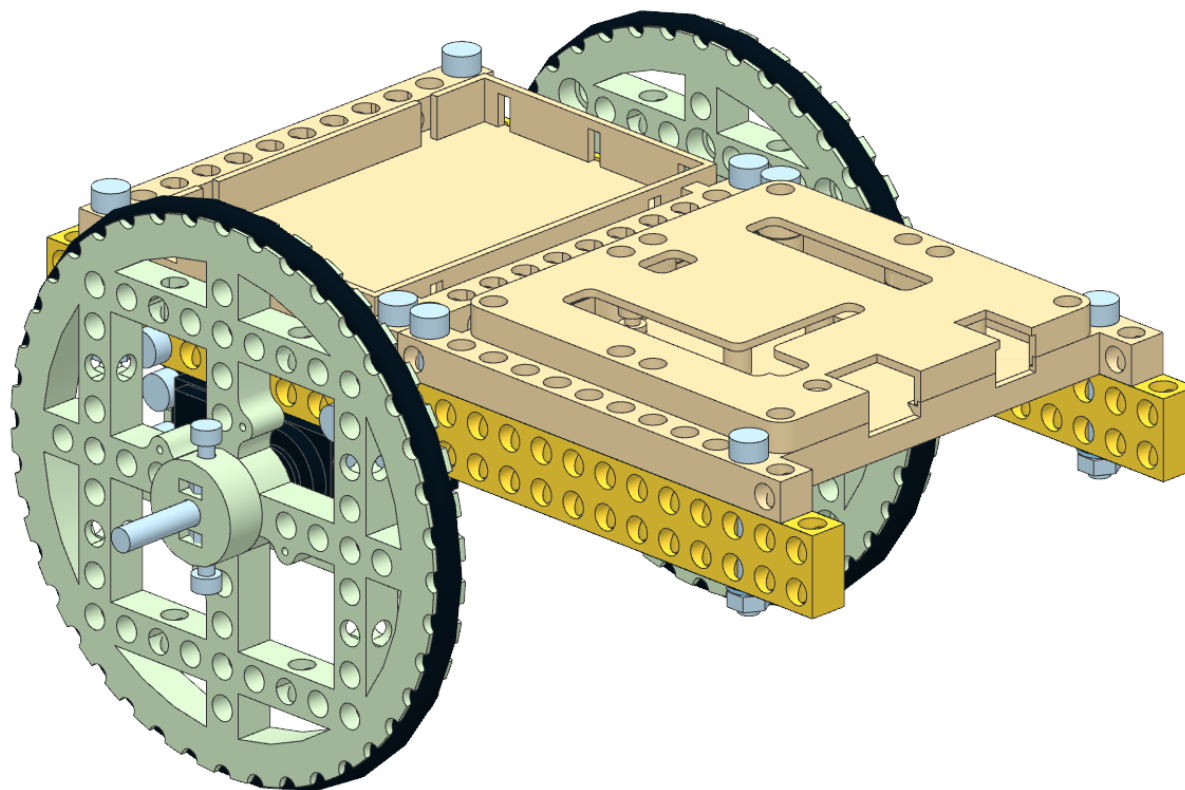
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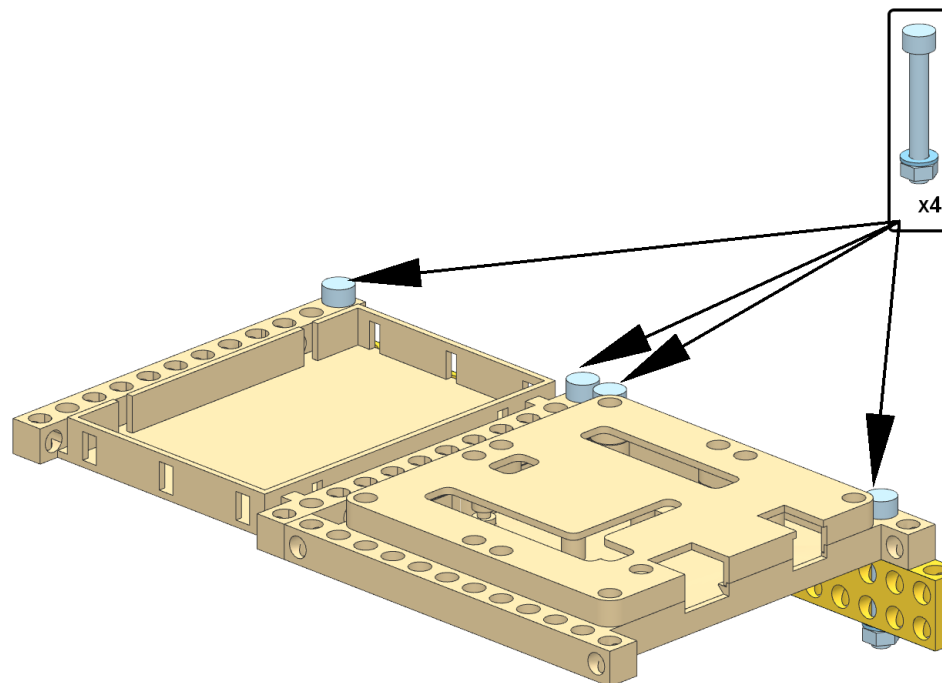
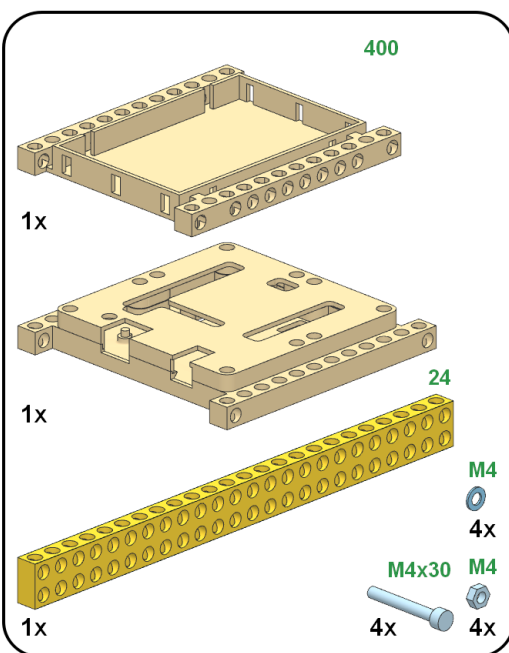
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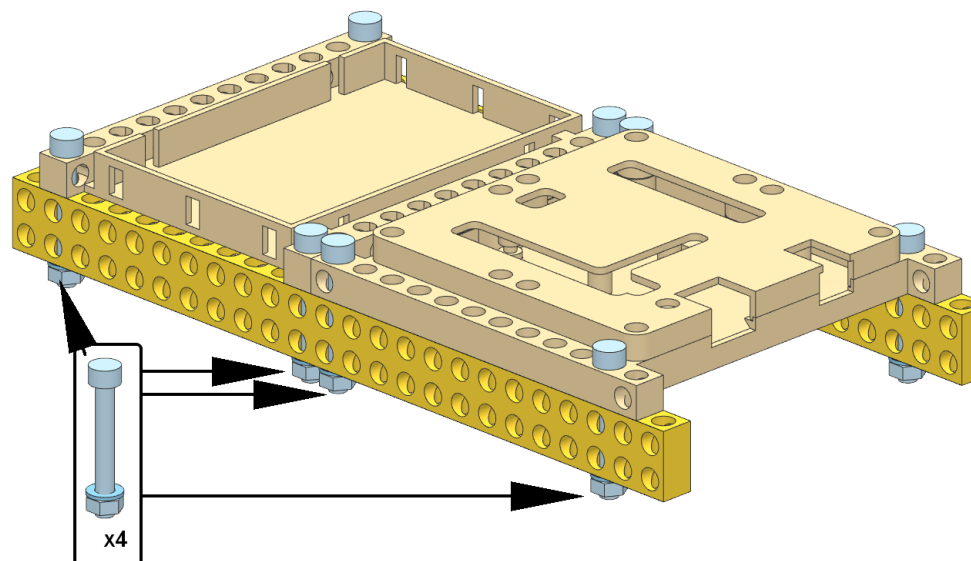
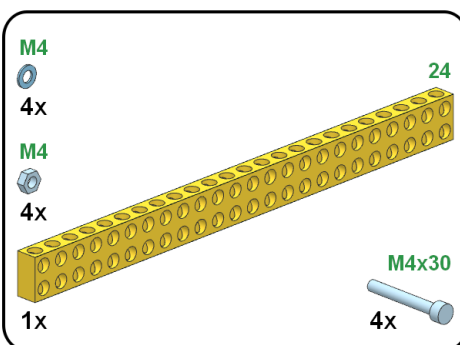
CARRY ON WITH THE TOP PART, IT WILL LOOK LIKE THIS WHEN DONE:



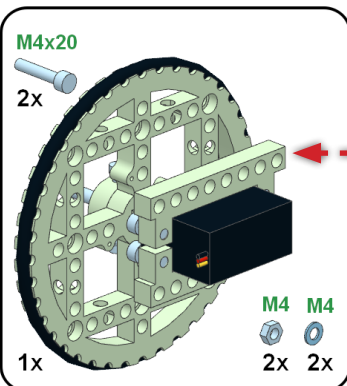
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2

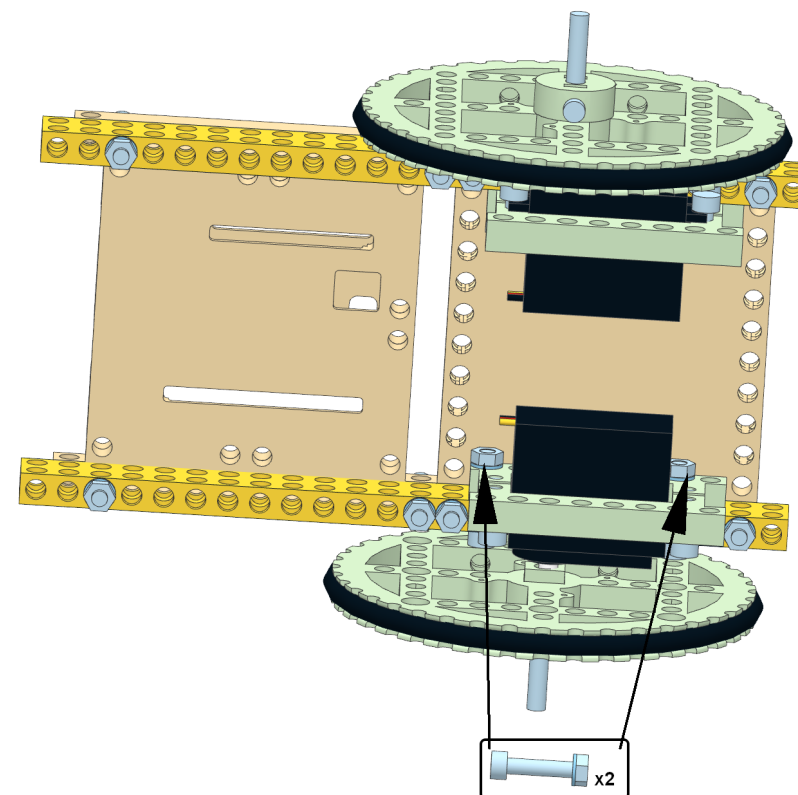
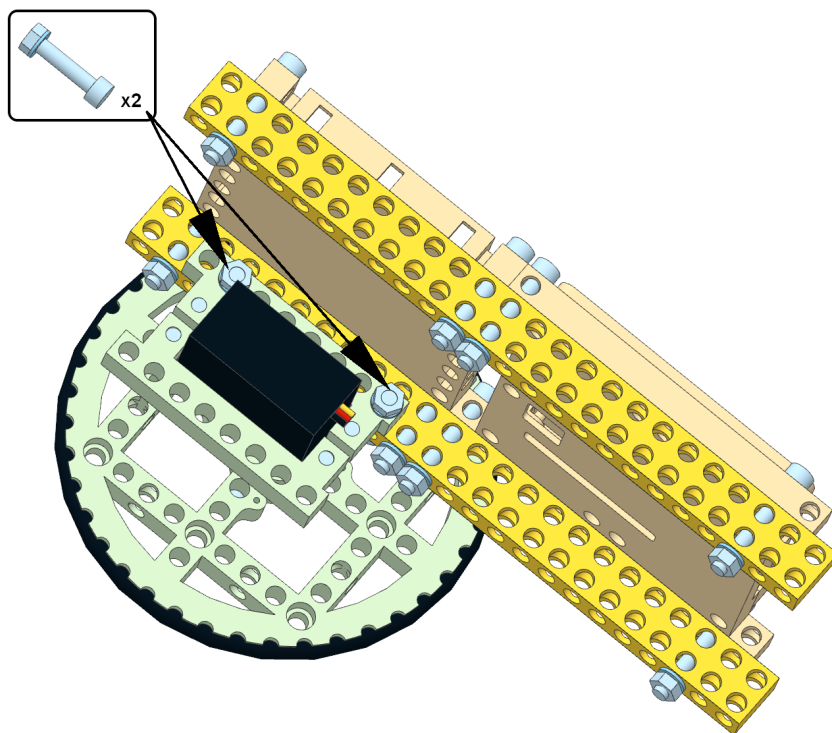
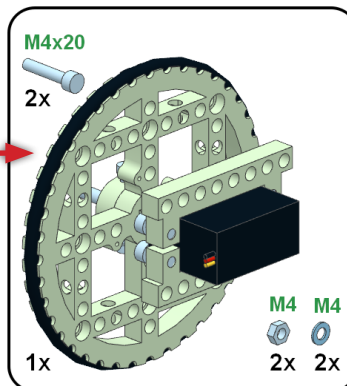


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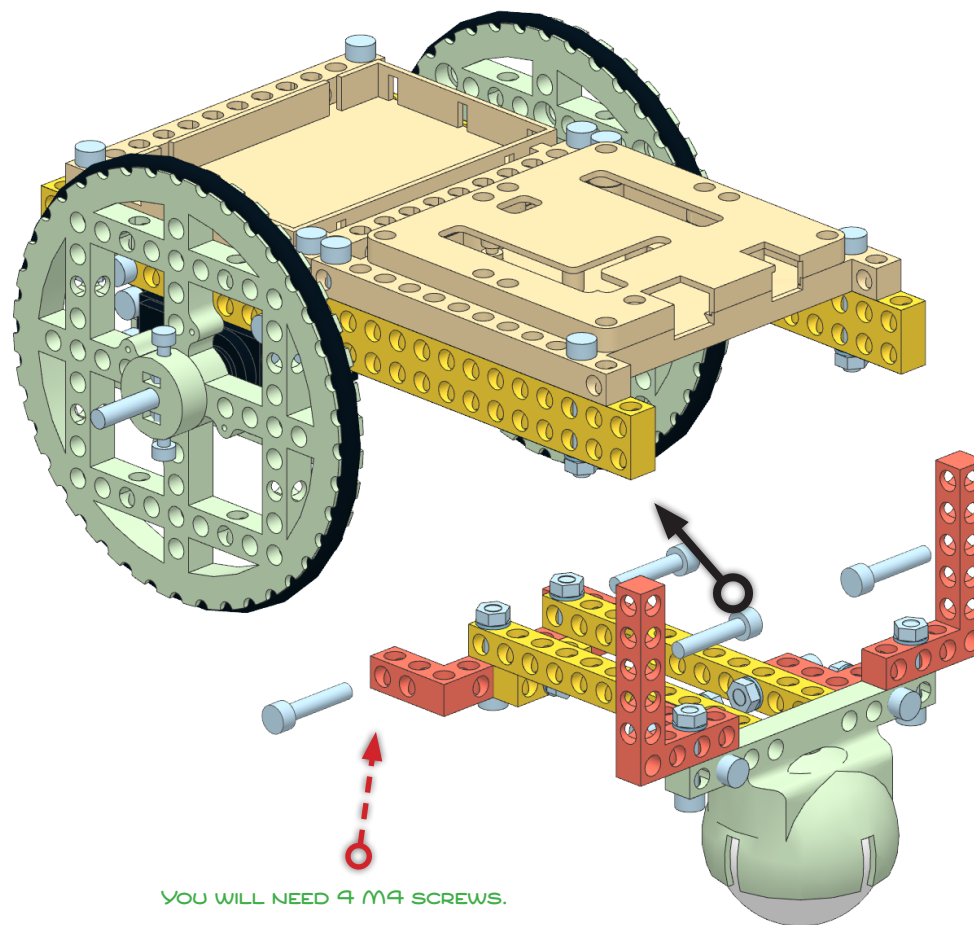


PREPARE THE PART WITH THE LEFT AND RIGHT WHEEL IN ADVANCE (THE WHEEL, O-CIRCLE, SERVO-WHEEL ADAPTER, AXIS, SCREWS, CONTINUAL SERVOMOTOR, 2 x SERVOMOUNT – SCREW IT TO EACH SERVOMOTOR).
YOU WILL FIND SPECIFIC INSTRUCTIONS TO BUILD THE SERVO AND WHEEL SET ON PAGE 17.

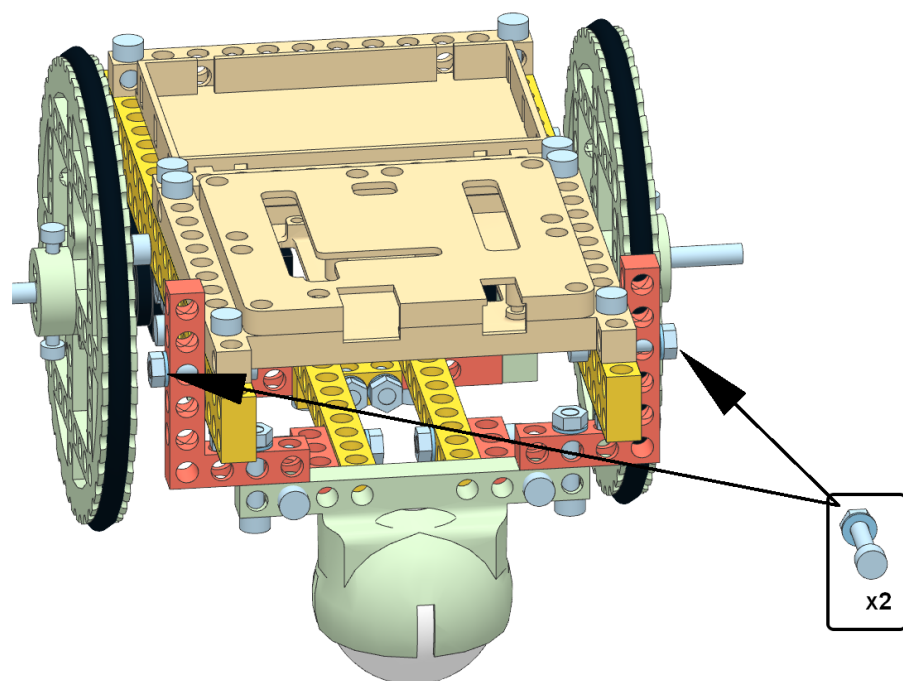
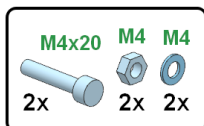
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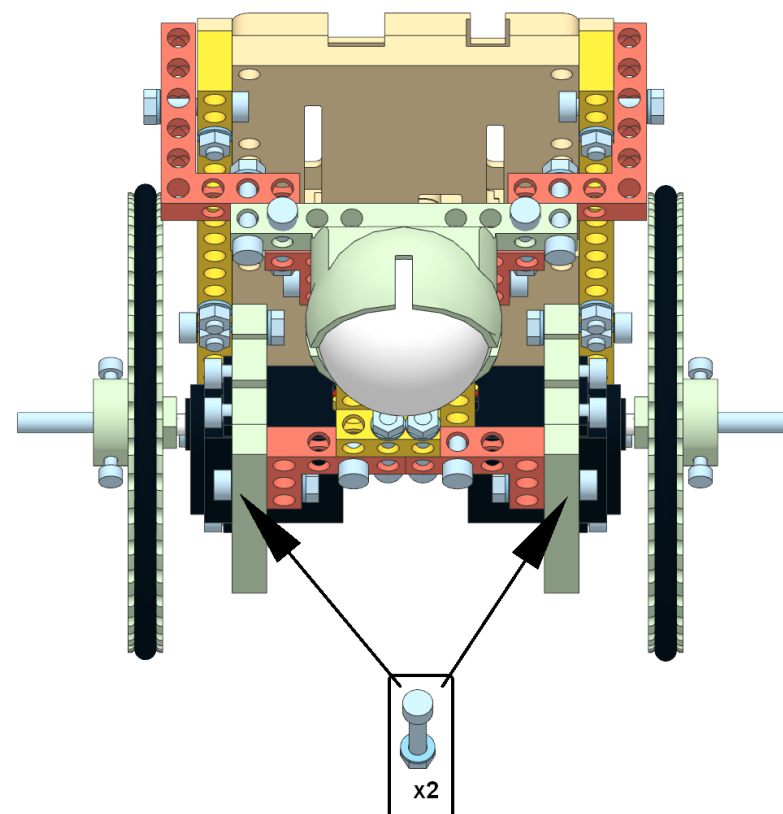
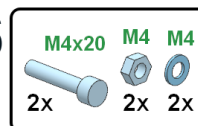
FINALLY, WE WILL CONNECT TO TOP AND BOTTOM PART:



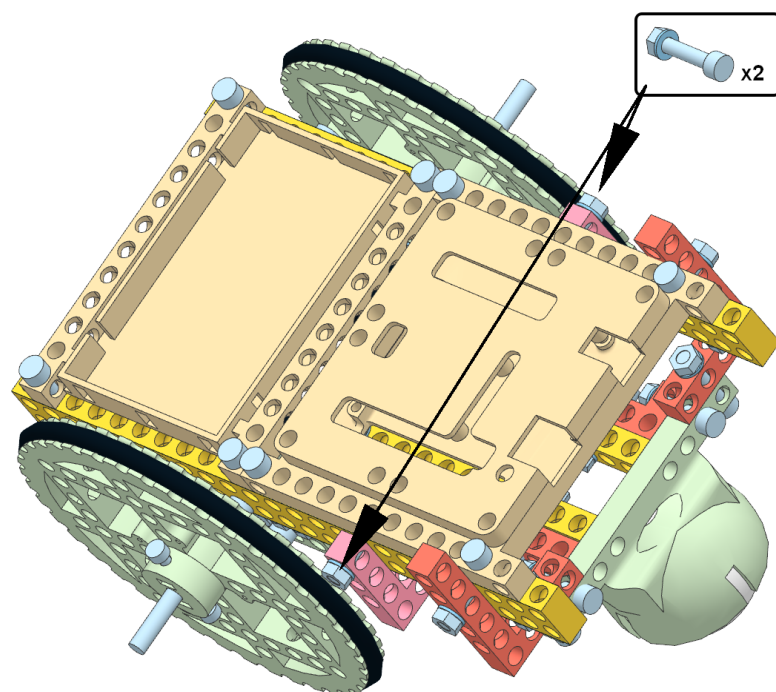
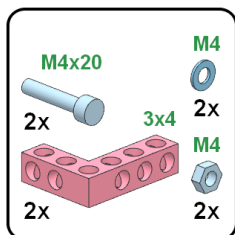
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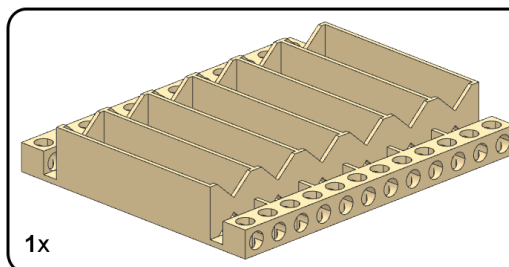
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7

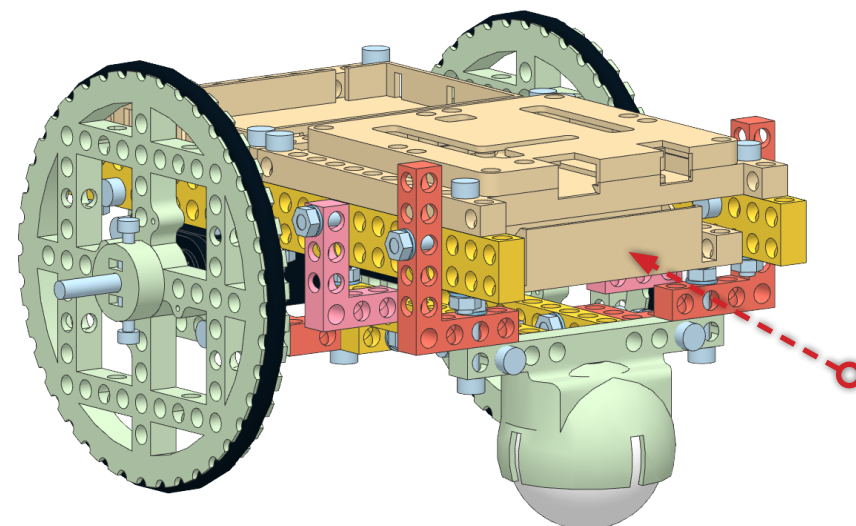


8

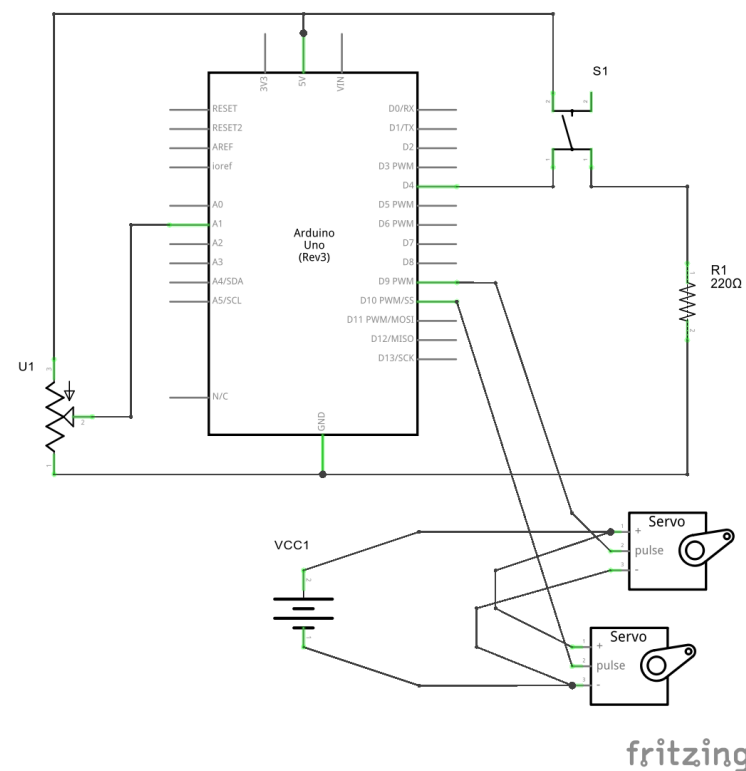
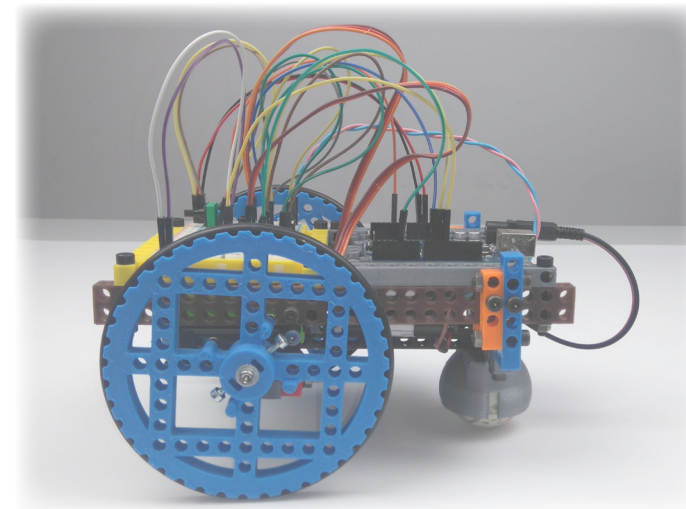
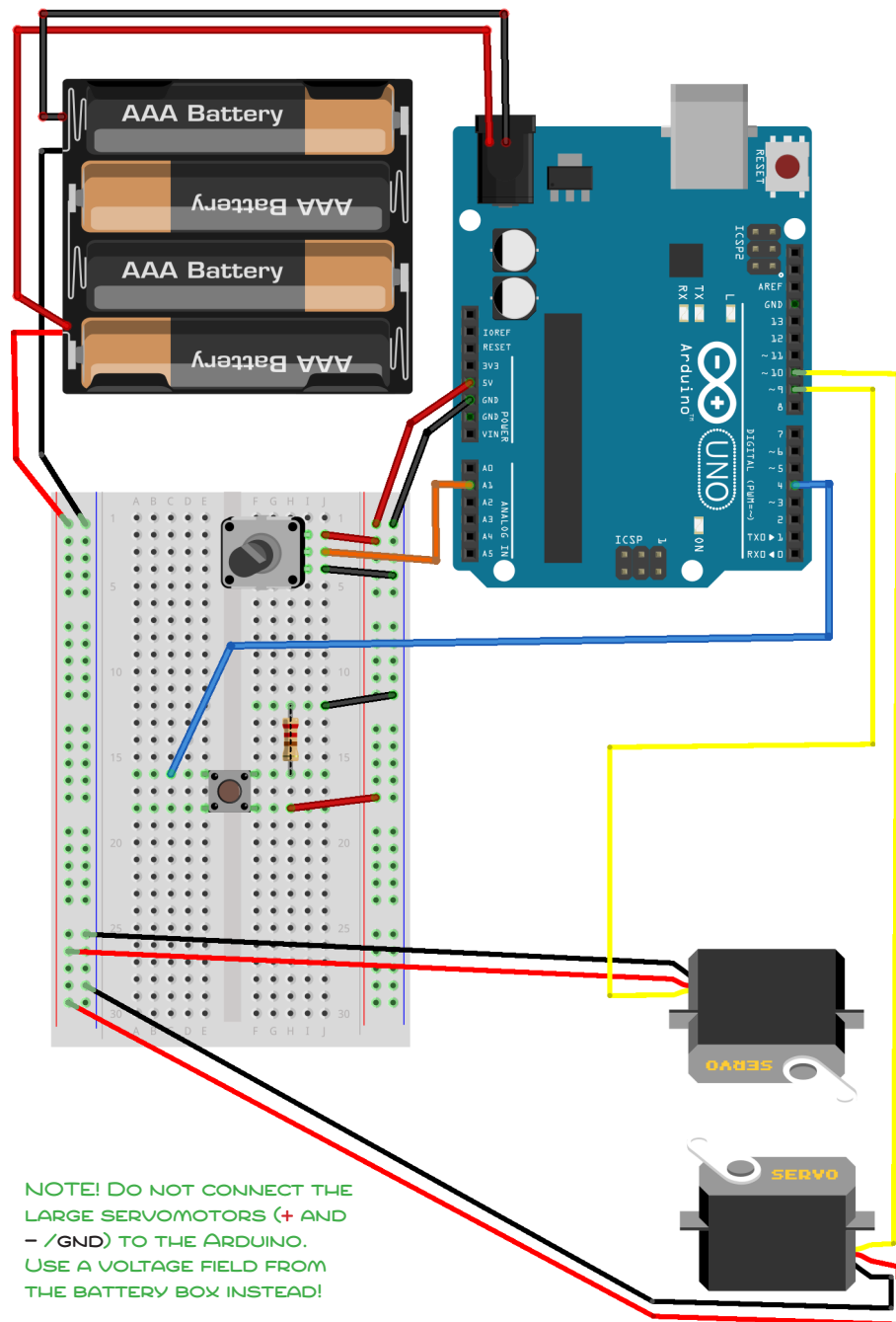


YOU CAN ALSO USE
A DIFFERENT THAN 3D PRINTED
BATTERY HOLDER.

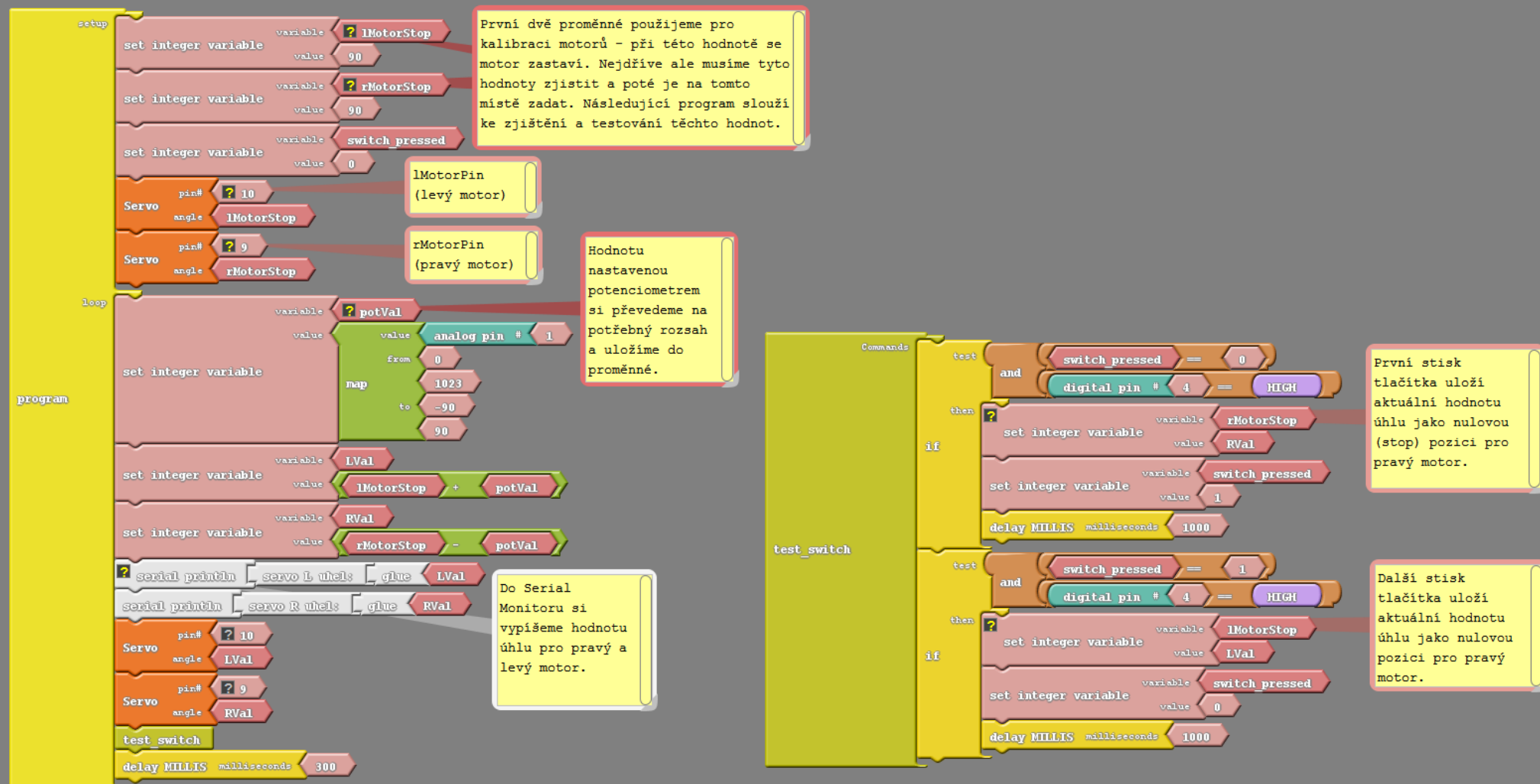
1x



BASIC CIRCUIT



PROGRAM NO. 1 (ARДУBLOCK) – SETUP AND TESTING



PROGRAM NO. 1 (ARДУBLOCK GENERATED CODE)

```

#include <Servo.h>

Servo servo_pin_10;
Servo servo_pin_9;

int _ABVAR_1_lMotorStop = 0 ;
int _ABVAR_2_rMotorStop = 0 ;
int _ABVAR_3_switch_pressed = 0 ;
int _ABVAR_4_potVal = 0 ;
int _ABVAR_5_LVal = 0 ;
int _ABVAR_6_RVal = 0 ;

void test_switch();

void setup()
{
  pinMode( 4 , INPUT);
  servo_pin_10.attach(10);
  servo_pin_9.attach(9);
  Serial.begin(9600);
  _ABVAR_1_lMotorStop = 90 ;
  _ABVAR_2_rMotorStop = 90 ;
  _ABVAR_3_switch_pressed = 0 ;
  servo_pin_10.write( _ABVAR_1_lMotorStop );
  servo_pin_9.write( _ABVAR_2_rMotorStop );
}

void loop()
{
  _ABVAR_4_potVal = map ( analogRead(1) , 0 , 1023 , -90 , 90 ) ;
  _ABVAR_5_LVal = ( _ABVAR_1_lMotorStop + _ABVAR_4_potVal ) ;
  _ABVAR_6_RVal = ( _ABVAR_2_rMotorStop - _ABVAR_4_potVal ) ;
  Serial.print(„servo L uhel:");
  Serial.print( _ABVAR_5_LVal);
  Serial.println();
  Serial.print(„servo R uhel:");
  Serial.print( _ABVAR_6_RVal);
  Serial.println();
  servo_pin_10.write( _ABVAR_5_LVal );
  servo_pin_9.write( _ABVAR_6_RVal );
  test_switch();
  delay( 300 );
}

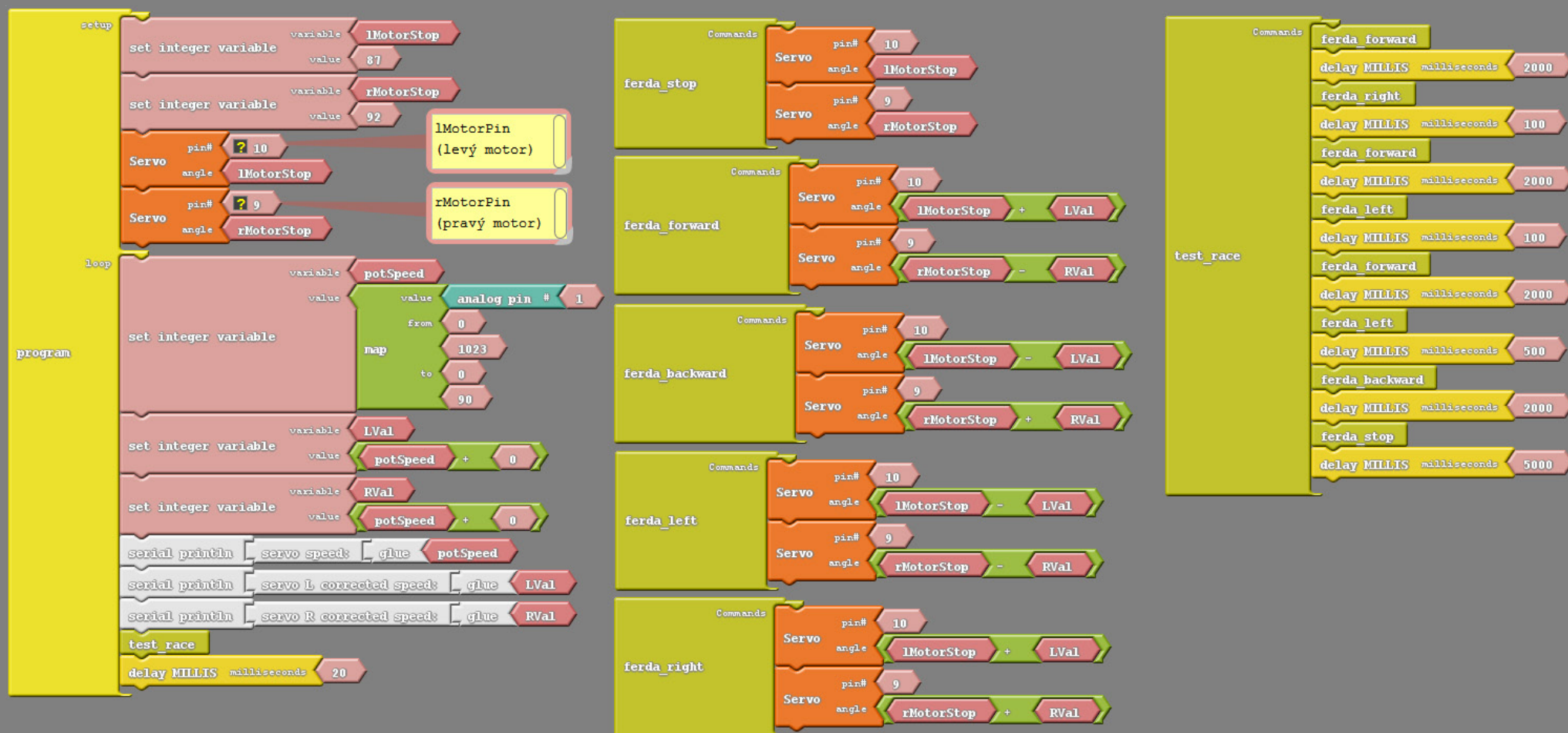
```

```

void test_switch()
{
  if (((_ABVAR_3_switch_pressed) == (0)) && ((digitalRead(4)) == (HIGH))))
  {
    _ABVAR_2_rMotorStop = _ABVAR_6_RVal ;
    _ABVAR_3_switch_pressed = 1 ;
    delay( 1000 );
  }
  if (((_ABVAR_3_switch_pressed) == (1)) && ((digitalRead(4)) == (HIGH))))
  {
    _ABVAR_1_lMotorStop = _ABVAR_5_LVal ;
    _ABVAR_3_switch_pressed = 0 ;
    delay( 1000 );
  }
}

```

PROGRAM NO. 2 (ARДУBLOCK) - DRIVING WITH FERDA



PROGRAM NO. 2 (ARДУBLOCK GENERATED CODE)

```

#include <Servo.h>

Servo servo_pin_10;
Servo servo_pin_9;

int _ABVAR_1_lMotorStop = 0 ;
int _ABVAR_2_rMotorStop = 0 ;
int _ABVAR_3_potSpeed = 0 ;
int _ABVAR_4_LVal = 0 ;
int _ABVAR_5_RVal = 0 ;

void ferda_right();
void ferda_forward();
void ferda_backward();
void test_race();
void ferda_left();
void ferda_stop();

void setup()
{
    servo_pin_10.attach(10);
    servo_pin_9.attach(9);
    Serial.begin(9600);
    _ABVAR_1_lMotorStop = 87 ;
    _ABVAR_2_rMotorStop = 92 ;
    servo_pin_10.write( _ABVAR_1_lMotorStop );
    servo_pin_9.write( _ABVAR_2_rMotorStop );
}

void loop()
{
    _ABVAR_3_potSpeed = map ( analogRead(1) , 0 , 1023 , 0 , 90 ) ;
    _ABVAR_4_LVal = ( _ABVAR_3_potSpeed + 0 ) ;
    _ABVAR_5_RVal = ( _ABVAR_3_potSpeed + 0 ) ;
    Serial.print( „servo speed:” );
    Serial.print( _ABVAR_3_potSpeed );
    Serial.println();
    Serial.print( „servo L corrected speed:” );
    Serial.print( _ABVAR_4_LVal );
    Serial.println();
    Serial.print( „servo R corrected speed:” );
    Serial.print( _ABVAR_5_RVal );
    Serial.println();
    test_race();
    delay( 20 );
}

```

```

void test_race()
{
    ferda_forward();
    delay( 2000 );
    ferda_right();
    delay( 100 );
    ferda_forward();
    delay( 2000 );
    ferda_left();
    delay( 100 );
    ferda_forward();
    delay( 2000 );
    ferda_left();
    delay( 500 );
    ferda_backward();
    delay( 2000 );
    ferda_stop();
    delay( 5000 );
}

void ferda_forward()
{
    servo_pin_10.write( ( _ABVAR_1_lMotorStop + _ABVAR_4_LVal ) );
    servo_pin_9.write( ( _ABVAR_2_rMotorStop - _ABVAR_5_RVal ) );
}

void ferda_right()
{
    servo_pin_10.write( ( _ABVAR_1_lMotorStop + _ABVAR_4_LVal ) );
    servo_pin_9.write( ( _ABVAR_2_rMotorStop + _ABVAR_5_RVal ) );
}

void ferda_left()
{
    servo_pin_10.write( ( _ABVAR_1_lMotorStop - _ABVAR_4_LVal ) );
    servo_pin_9.write( ( _ABVAR_2_rMotorStop - _ABVAR_5_RVal ) );
}

void ferda_backward()
{
    servo_pin_10.write( ( _ABVAR_1_lMotorStop - _ABVAR_4_LVal ) );
    servo_pin_9.write( ( _ABVAR_2_rMotorStop + _ABVAR_5_RVal ) );
}

void ferda_stop()
{
    servo_pin_10.write( _ABVAR_1_lMotorStop );
    servo_pin_9.write( _ABVAR_2_rMotorStop );
}

```

ADDITION (THE COSTRUCTION OF THE SERVO-WHEEL SET)

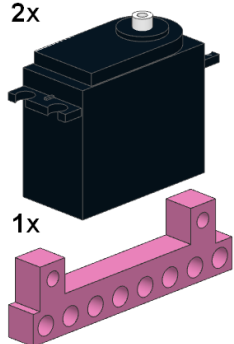
1

M4x10

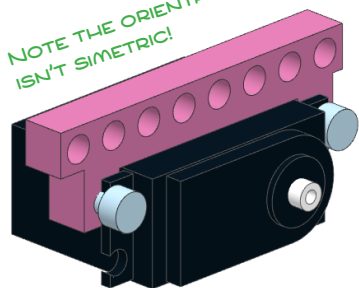
2x

1x

1x



NOTE THE ORIENTATION, THE PART ISN'T SIMETRIC!

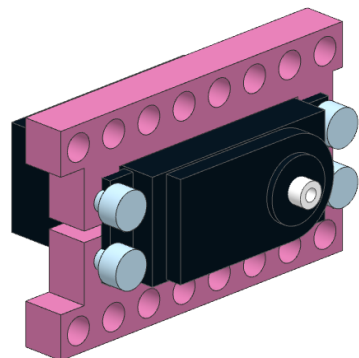
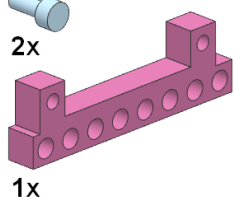


2

M4x10

2x

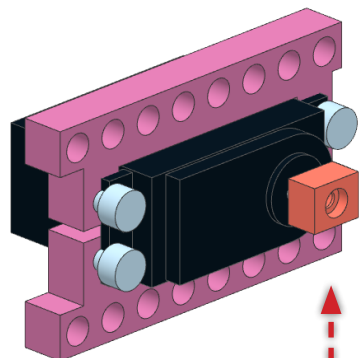
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3

10x8

1x



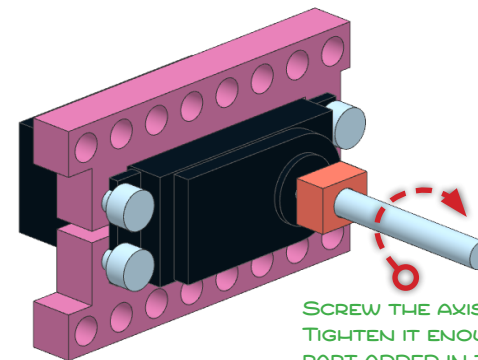
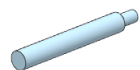
IT IS NECESSARY TO WARM THE PART (FOR EXAMPLE WITH A LIGHTER) AND ATTACH IT TO THE METALLIC, FLUTED SERVO AXIS, SO THAT IT DOESN'T MOVE. IT IS ALSO POSSIBLE TO GLUE IT BECAUSE THE PART IS USED UNIVERSALLY WITH M-BITBEAM AND CAN STAY ON THE SERVO FOR EVER.



4

37M3

1x

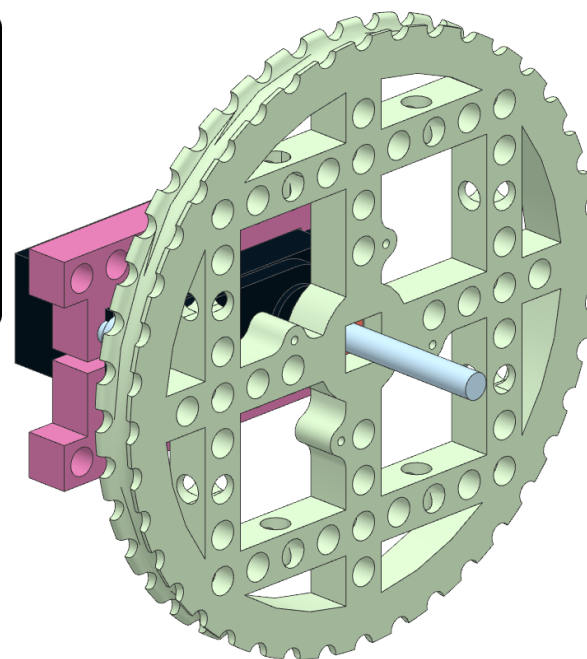
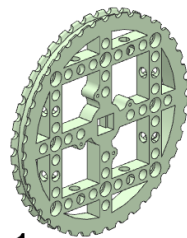


SCREW THE AXIS INTO THE THREAD. TIGHTEN IT ENOUGH TO FIXATE THE PART ADDED IN THE PREVIOUS STEP.

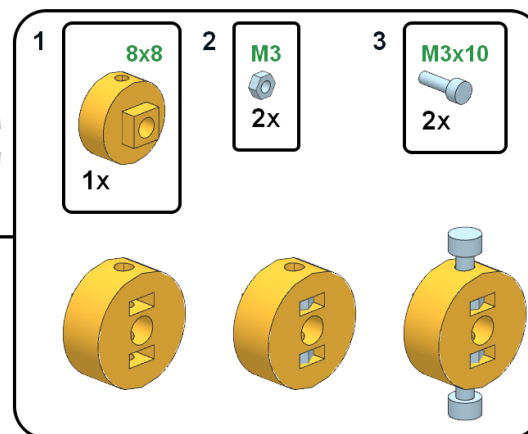
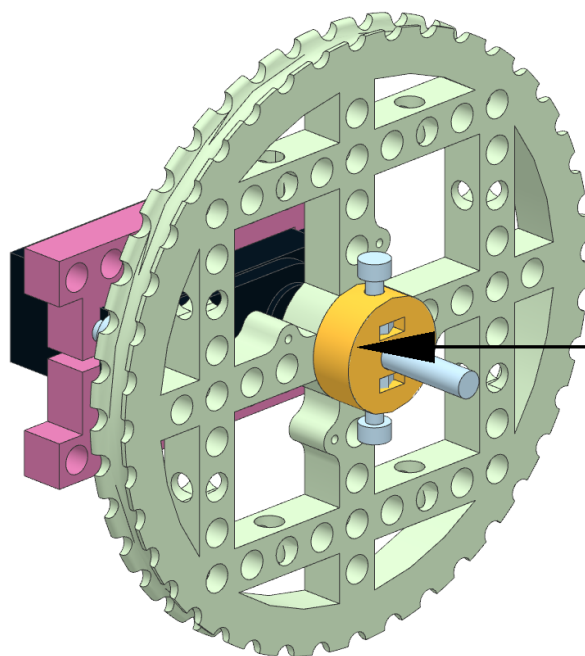
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100

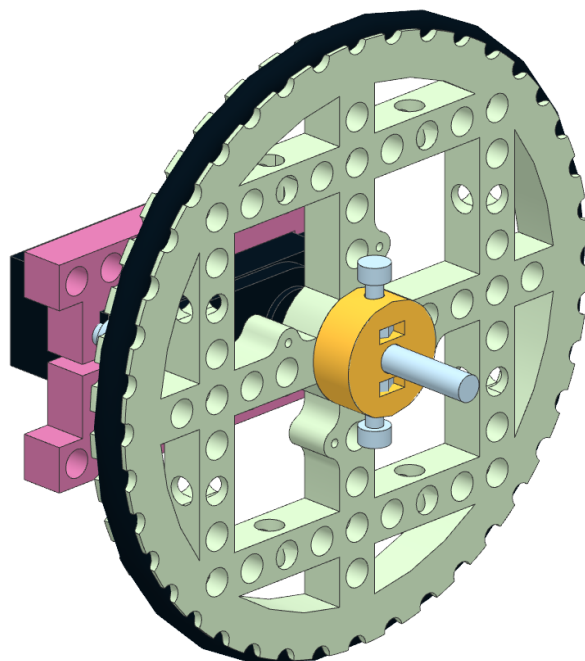
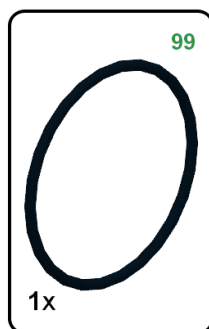
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6

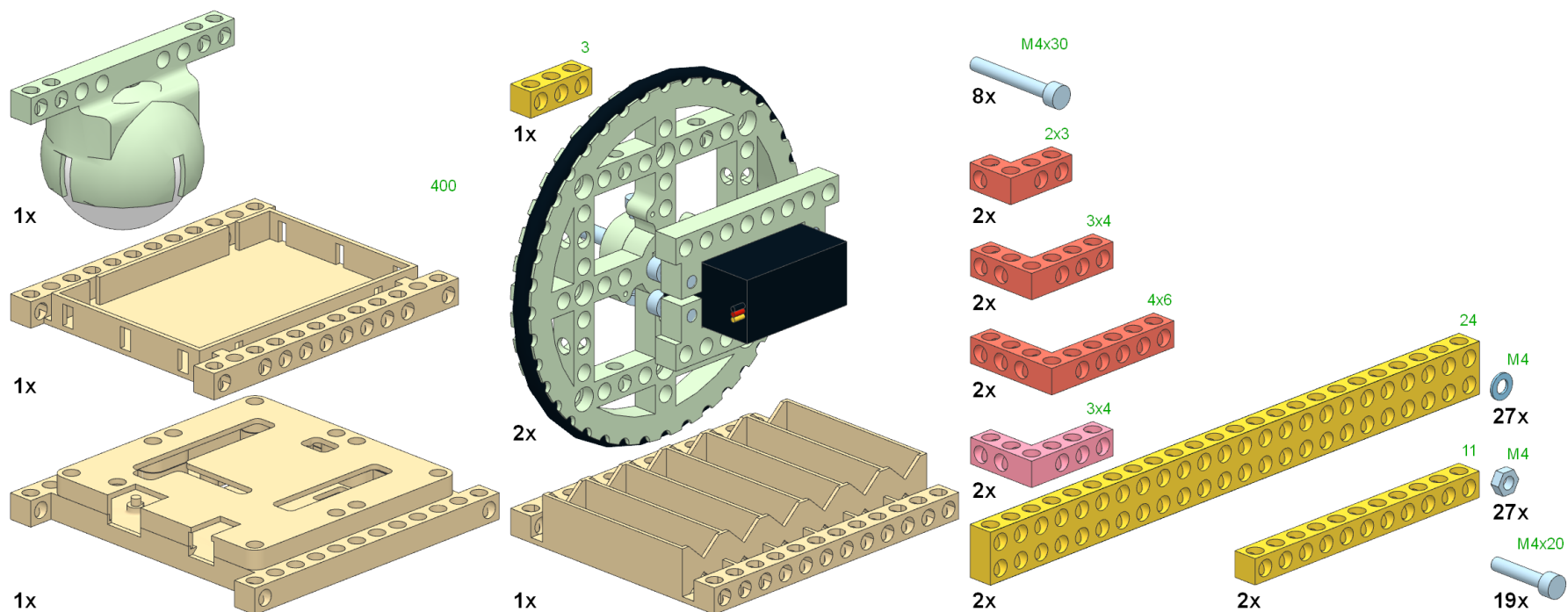


7



CONSTRUCTION MANUAL L07 - FERDA

The list of the parts is the same as the 3D printed kit m-Bitbeam Education Base set (basic education set).



This construction manual was created using free SW tool: **MLCad** (<http://mlcad.lm-software.com>), **LDView** (<http://ldview.sourceforge.net>) and **LPub** (<http://lpub.sourceforge.net>)..
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