TEAM REPORT

WORLD ROBOT OLYMPIAD 2011

ABDULLA CONTRACTOR
ABHIJITH RAMALINGAM
KAIVALYA GANDHI

INDEX

TEAM MEMBERS

ABDULLA ASLAM CONTRACTOR

MAJOR TEAM ROLES: DESIGNER / TECHNICIAN / MARKETING & PUBLICITY / PRESENTER

SPECIALITIES AND ROLE PLAYED: Skilled in Visual Arts, Graphic Design, Construction & Problem Solving - Played a vital role in developing the logo and posters, and contributed in the technical sessions and development of the robot and provided significant inputs on the designing and construction of the model.

ABHIJITH RAMALINGAM

MAJOR TEAM ROLES: TECHNICIAN / DEVELOPER / PROJECT MANAGER / PRESENTER

SPECIALITIES AND ROLE PLAYED: Skilled in Programming, Construction Idea Formulation & Troubleshooting - Played a major role in developing the dual-pin cartridge and other components of the model and contributed greatly in the technical sessions for major developments in the robot, coordinating the team and evaluating the progress made, and leading the construction of the model.

KAIVALYA NIRANJAN GANDHI

MAJOR TEAM ROLES: DESIGNER / PROJECT MANAGER / MARKETING & PUBLICITY / PRESENTER

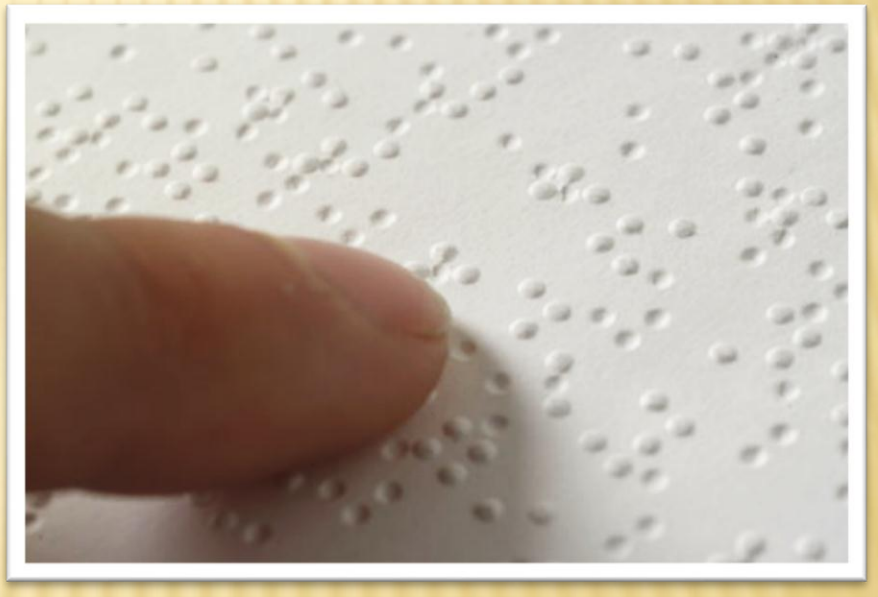
SPECIALITIES AND ROLE PLAYED: Skilled in Visual Arts, Marketing Strategies, Construction, Programming and Idea Formulation & Troubleshooting - Played a leading role in developing the logo, posters, and the compilation of textual and visual matter for the report and other collateral. Also provided significant contributions in the technical and brainstorming sessions during the development and programming of the robot, providing key ideas on the designing and construction of the model.

INTRODUCTION

We represent the future of human development.

With the basic goals of life improvement in mind, we have designed and developed a unique and practical integration of robotics in a model which contributes to the betterment of society.

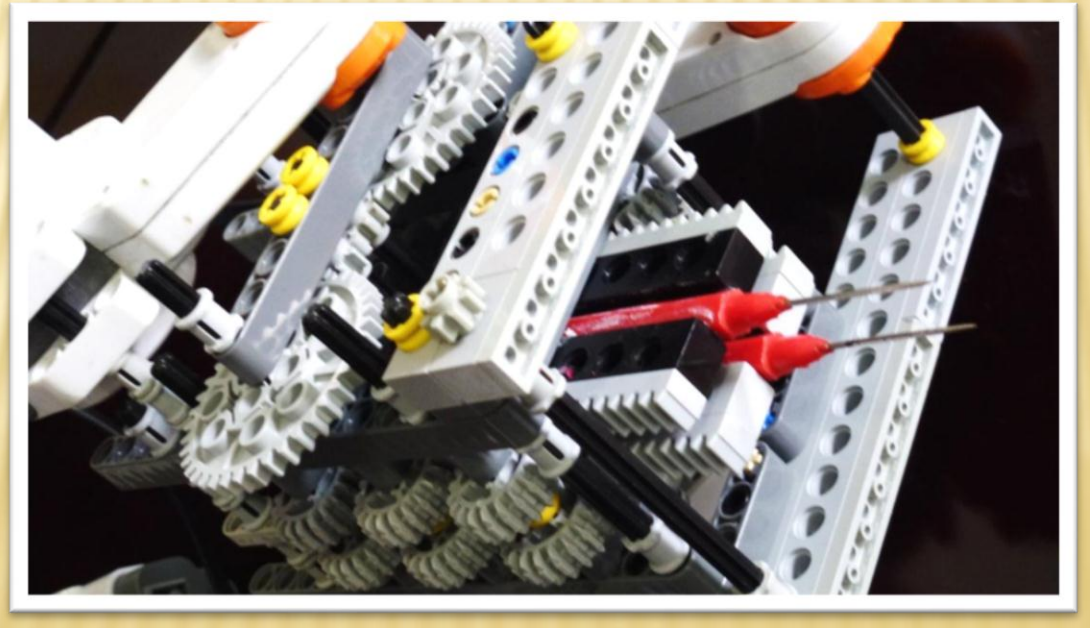
As a part of the next generation of human beings we believe that it is our duty to try and help all kinds of people enjoy their life to the fullest, and the physically disabled are no exception. Every day, in the world around us, we see a lot of suffering, but clearly it is the physically disabled who face the hardest challenges. This is why instead of only simply improving the lives people who are already well off; we decided to come up with a solution that would target the visually impaired people in society, and help them read in the special script of Braille.



WHY OUR ROBOT?

After a lot of brainstorming, we decided to build a relatively unique implementation of robotics… that of a printer capable of writing in the Braille language. Our semi-autonomous, fully functional, user-friendly Braille printer helps those who are unfortunately deprived of the gift of sight.

The model uses a simplistic yet sophisticated design similar to that of an actual industry-line printer mechanism. The advanced and suitable engineered printer pricking cartridge underwent a lot of testing and redesigns before its final version. A wheel system enables the movement of the paper along one axis, while the cartridge itself moves along the other axis.



WHY OUR ROBOT?

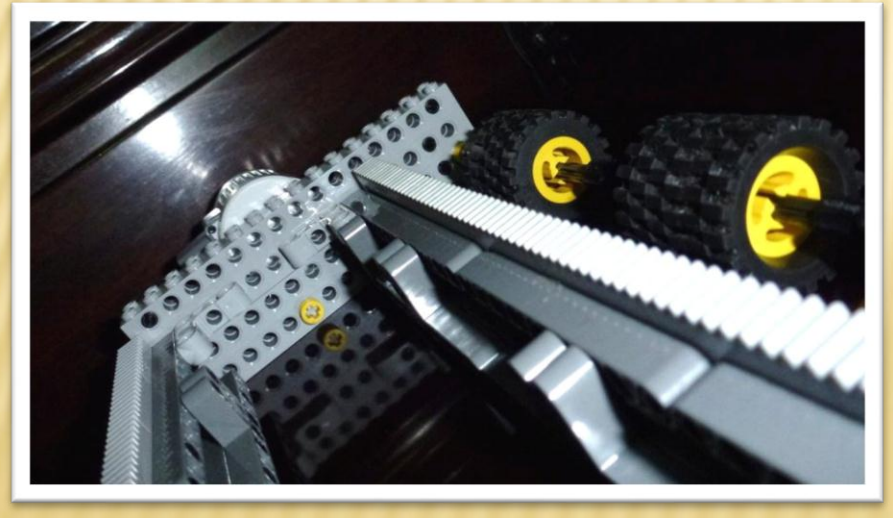
Even a person with absolutely no knowledge of braille can easily use this robot to print sentences and paragraphs in braille. This robot strives to include the visually impaired in society without them having to face as much difficulty in normal day to day tasks requiring reading and written scripts. Our main aim was to create a robotic device which aids the visually impaired, and helps them to explore and discover the world of literature, or just communicate with people by reading just like everyone else.

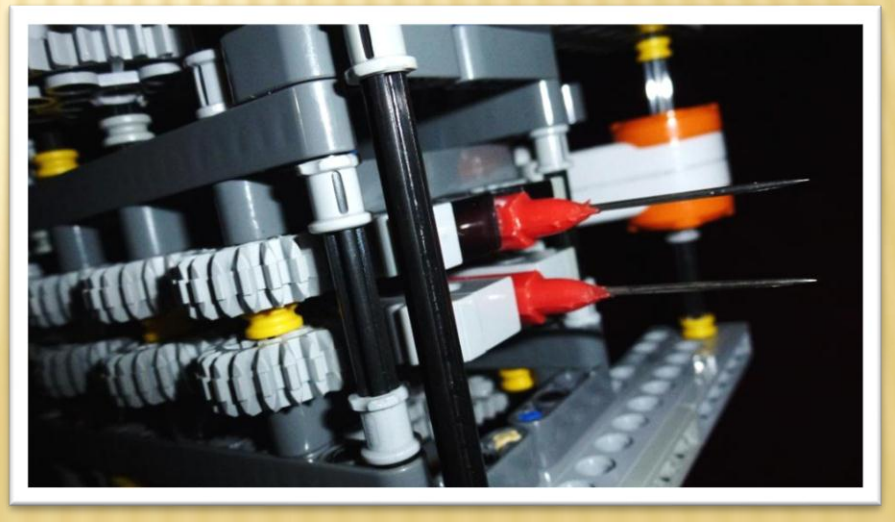
Our intuitive portable modular design enables the robot to be set up instantaneously within a few minutes and provide instant printing of Braille characters with a pre-programmed advanced Bluetooth communication system and input device.

How does the robot work and what does it do? (Summary)

The BrailleStorm is a fully functional, semi-autonomous robot which uses a simplistic yet sophisticated design similar to that of an actual industry-line printer. It employs 3 NXT bricks in the inputting and printing of the characters. A gear-grooved track runs along one axis, and the paper, with the help of a roller mechanism, along the other.

The pricking cartridge, moves along the track, and uses a gear train mechanism for moving the pin along the third axis, to prick the paper. A highly complex program enables the user to input a character from the menu, using the touch sensors. On receiving the selected character, the pin pricking mechanism accurately makes indentations on the paper, which can be easily interpreted by the user.





HOW DOES THE ROBOT WORK AND WHAT DOES IT DO? (DETAILED)

- The user-friendly control device or the Input NXT brick allows a person to select up to 10 characters for printing in the Braille script, through a simultaneous input program, with the help of a four-touch sensor data feed structure.
- The paper moving NXT, also the Master NXT brick constantly receives Bluetooth messages from the input brick, and stores the character choices to be printed.
- On completion of the character inputs for one line, the master brick transfers the control to the belt and pricking mechanism, which is controlled by the Belt NXT brick.
- It prints the 10 selections character by character, and transfers the control back to the Master NXT, which now awaits new inputs for the next line.
- This process continues and the program loops for the maximum number of columns on the paper, providing the Braille imprinted printout in the matter of a few minutes.

HOW DOES IT FIT INTO THE THEME?

Our model aims at achieving one major task, that of improving life by strengthening the position of the visually challenged in today's world. When one thinks of robots improving human life , he thinks of robots which "reduce man's workload" or " improve safety conditions". Though these are practical applications of robots, we decided go beyond the common perceptions of a robots role in today's increasingly mechanized world. We decided to make a robot which makes a difference. A robot which provides the gift of being able to read and communicate in literary form... **A robot which helps to improve the lives of the visually challenged**.

For those who are unfamiliar with the term "Braille", it is the official script of the blind. In the 1700s when Louis Braille invented Braille script, he revolutionized the helpless perceptions towards the blind by providing a medium of communication. He empowered the blind to live a life slightly similar to a normal human. . Keeping this in mind, BrailleStorm intends to "re-revolutionize" the world of script.

In keeping with the 21st century trend of mechanization, our robot helps in improving the life of the visually challenged, by providing them with a printer which can immediately translate English into Braille. This thereby gives them more of an equal standing in real life situations, thus bridging the social divides in society regarding physically challenged people.

How did we come up with the idea?

During our brainstorming, we came across the question - What is the best way to improve life? Is it helping those who are already well off and don't really need help, or is it targeting those who would actually value the support given to them? What about those who are physically impaired? Everyone would surely agree that these people are the ones who actually face the hardest challenges in daily life. Society has erected a mental barrier between them. We rely mostly on our eyesight for doing everything in our life, and yet don't realize the importance of the sensation of sight.

This brought us to "BrailleStorm", a relatively unique implementation of robotics… that of a printer capable of writing in the Braille language. With the help of our innovative model, we look to overcome this challenge and improve the lives of those without the gift of sight. This bridges the gap between the blind and gives them a chance to live like normal human beings, allowing them to do work activities and other day-to-day actions which require reading or communication by print language as such.

HOW IS IT UNIQUE AND INNOVATIVE?

The BrailleStorm, is a fully functional semi-autonomous robot with a wireless input system using a simplistic yet sophisticated design similar to that of an actual industry-line printer mechanism. Despite the drawbacks of the NXT software and the limitations of LEGO Mindstorms technology, the BrailleStorm prints the Braille script at almost complete accuracy, printing up to 32 different characters (including special braille characters for common words like ‘and’, ‘for’ and ‘the’). We believe it is truly innovative in its own league

The BrailleStorm is indeed unique in its own ways:

- The BrailleStorm is a relatively unique implementation of the LEGO software and components. Made completely out of LEGO pieces and parts, except the pin pricking cartridge and the thermocol soft base, the BrailleStorm comprises of almost exclusively LEGO components. This amazing achievement brings the versatility and innovation of LEGO components to a whole new level.

- Another main feature is its portability and cost effectiveness.

HOW IS IT UNIQUE AND INNOVATIVE?

- As an alternative to actual Braille embossers, costing more than 2000 USD, this simple yet sophisticated solution enables accurate embossing of characters and gives quite precise results for LEGO standards.

- Its modular design allows it to be assembled and dismantled on the spot within a few minutes, and brings portability of such printers to a whole new level.

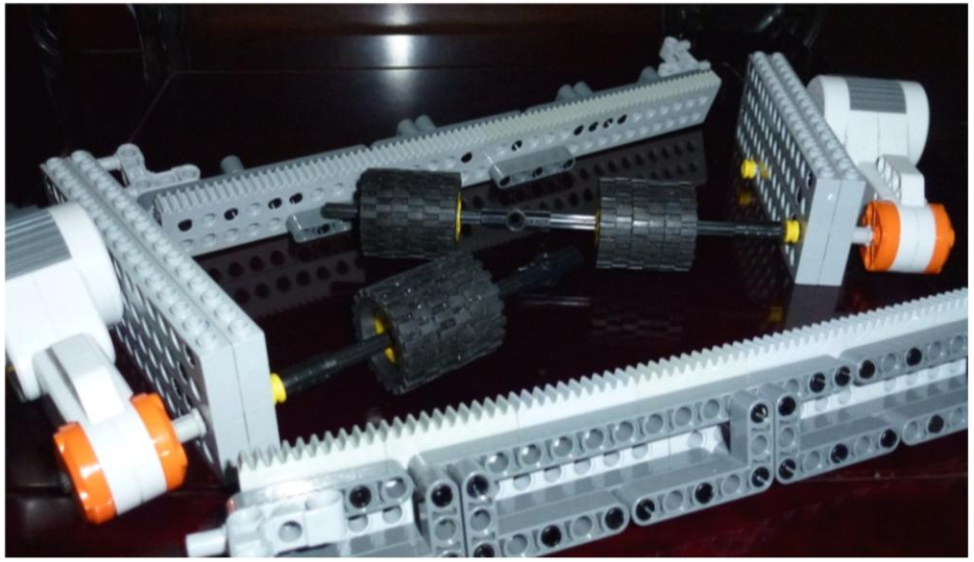
- The intricate and complex dual-pin mechanism allows fully accurate embossing of characters, in multiple axes, reducing the time taken for each character and increasing efficiency.

- The model highlights and targets a section of society providing technological advancements to the community of the visually impaired. This relatively unexplored avenue of robotics aims to uplift and promote the script and those who use it.

How does our robot exhibit good design and engineering?

- Our model uses a majority of LEGO Mindstorms' parts and components in its base and other functional structures. The BrailleStorm applies gear mechanics like never before. After thorough testing and design as well as programming modifications, we have found our BrailleStorm robot has attained exceptional accuracy levels, and delivers maximum possible precision with LEGO components, ensuring no hassles for the user in identifying and interpreting the Braille character.

- Another main feature of the BrailleStorm is that each component can be easily detached and easily assembled in less than five minutes, making it portable and easy to use anywhere.



HOW DOES OUR ROBOT EXHIBIT GOOD DESIGN AND ENGINEERING?

- Another engineering feat in the BrailleStorm is the fact that it consists of 68 different types of gears in the whole model, for a smooth printing operation. The gears play different roles in the different components, allowing for reversing the direction of motion, increasing torque and rotational speed, and for allowing 3-axis movements in the model, while optimizing the number of motors and movement sources required.

- Symmetry being the key in any good design, we kept that in mind during the construction and model redevelopment phases, striving for equal distribution of components, and adhering to alignment and symmetry in all ways possible, for almost all the various components. The dual pin cartridge, updated dual paper moving mechanism and the paper indentation, along with the base gear track of the printer all adhere to these engineering principles, in our effort to make a model of industry standards.

WHAT PROBLEMS DID WE ENCOUNTER & HOW DID WE OVERCOME THEM?

Building our robot and including within itself such complex programming proved to be a daunting task at first. In the BrailleStorm numerous problems were encountered during the process of programming. After experimenting on numerous robotic programming languages like LeJOS and NI-Labview we decide that the NXT-G software was ideal for this project due to its ability of performing concurrent programming and efficient Bluetooth communication code.

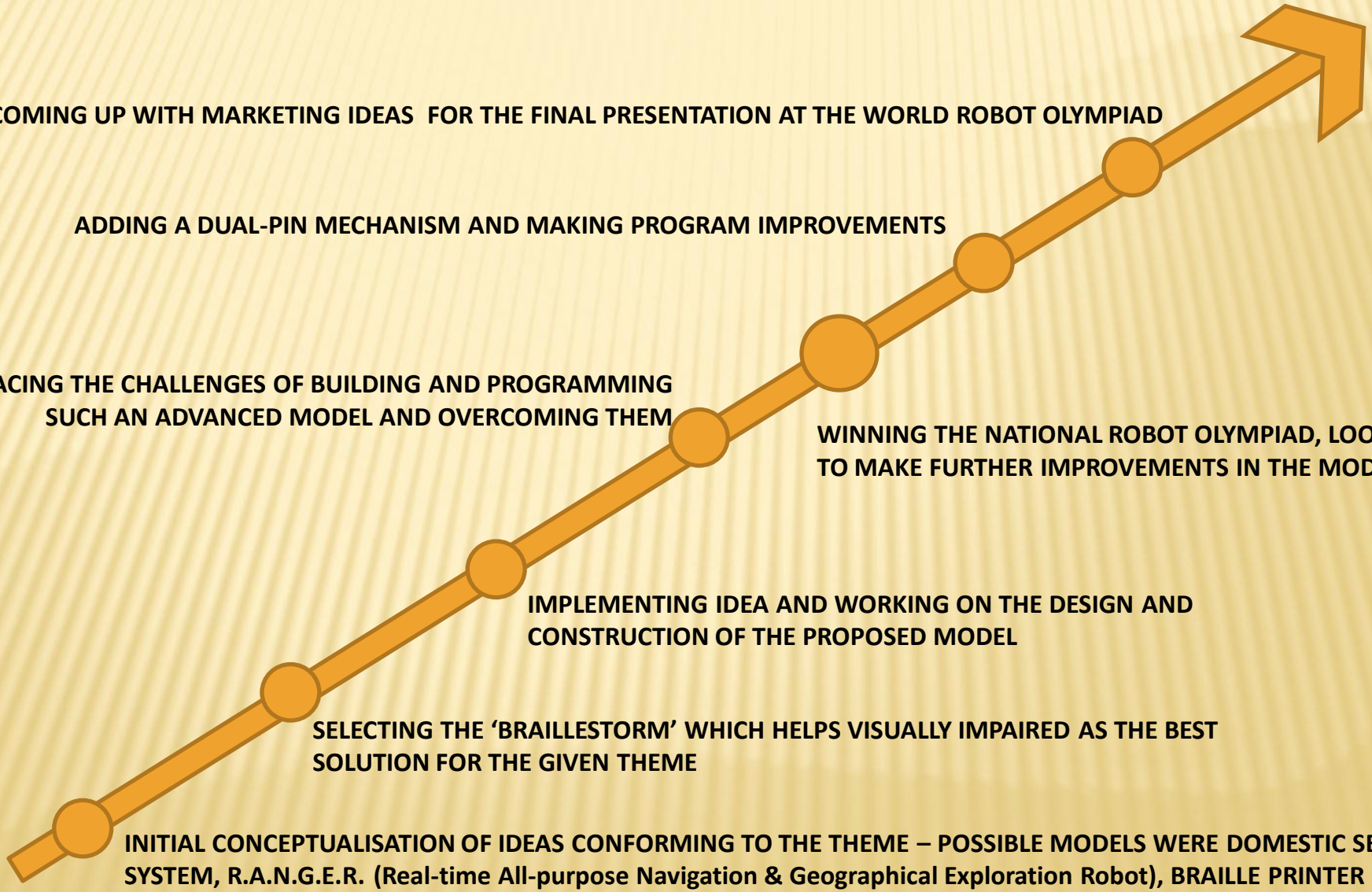
Our first problem we faced was fitting our pin pricking mechanism on the gear track. Under the guidance of our team coach, we came across a fix consisting of an alternate beam and axle design, we managed to make our robot move on the track we had made for it. The next problem we faced was the inaccuracy of the pin pricking mechanism. To combat this problem we used multiple gears while extending the size of our pin to make a gear train to ensure the pin does not move in any other directions during pricking.

WHAT PROBLEMS DID WE ENCOUNTER & HOW DID WE OVERCOME THEM?

The next predicament we found ourselves in was that the paper stuck to the pin after it pierced the paper. We solved this by building a set of beams on the gear track and also by lowering the height of the gear track. But after lowering the height, we were met with a new challenge. Due to continuous additions to the pricking cartridge, the weight of it inhibited the paper's movement, as the gear track was forced downwards and obstructed the free movement of the paper. This led us to come up with a solution of changing the orientation and streamline the size of the BrailleStorm, which led to reprogramming all the characters to match with the change of design.

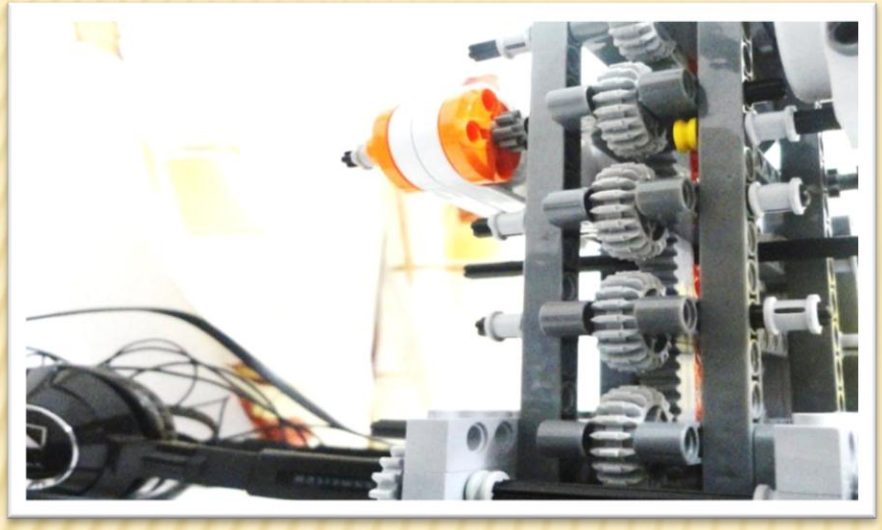
Programming the robot was definitely no easy task. We faced endless errors with synchronizing the Bluetooth communication, but ultimately we managed to overcome the problems in the communication segment. On our input device the program branches out to such an extent that adding an additional block of program actually causes a file error on the NXT brick. Separately programming all the 32 characters was tedious and required an immense amount of testing. The program was changed innumerable times to keep overcoming the various problems faced by it, but with continuous testing and drawing board analysis sessions, we managed to make a consistent program code for the model.

WHAT PROCESSES WE WENT THROUGH IN DEVELOPING THE ROBOT

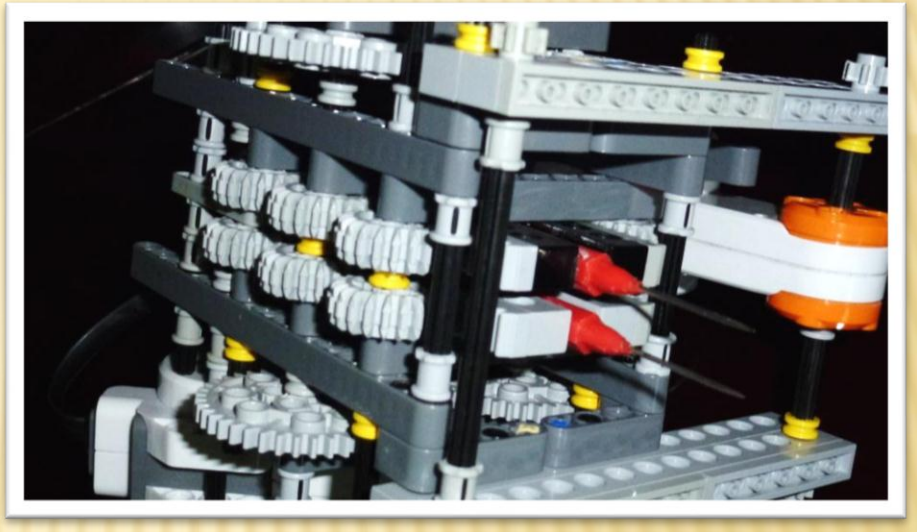


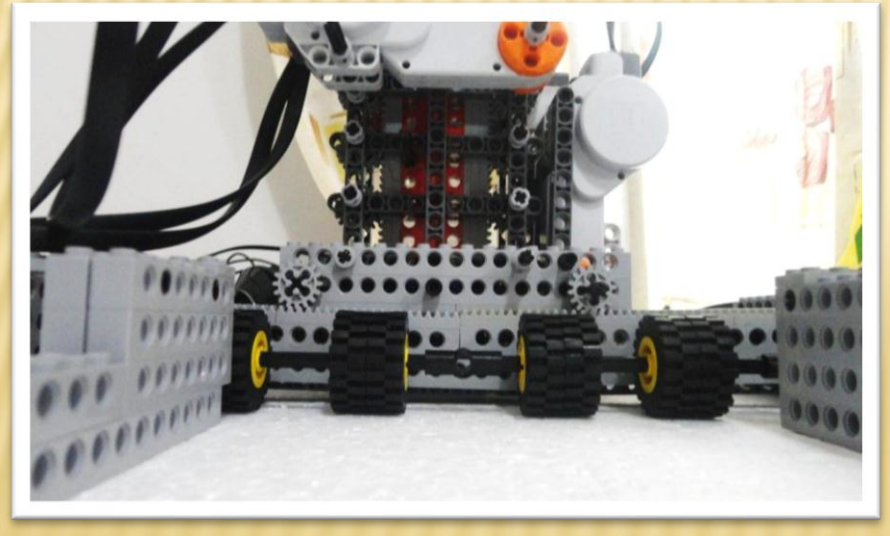
VISUAL COMPARISION OF BRAILLESTORM

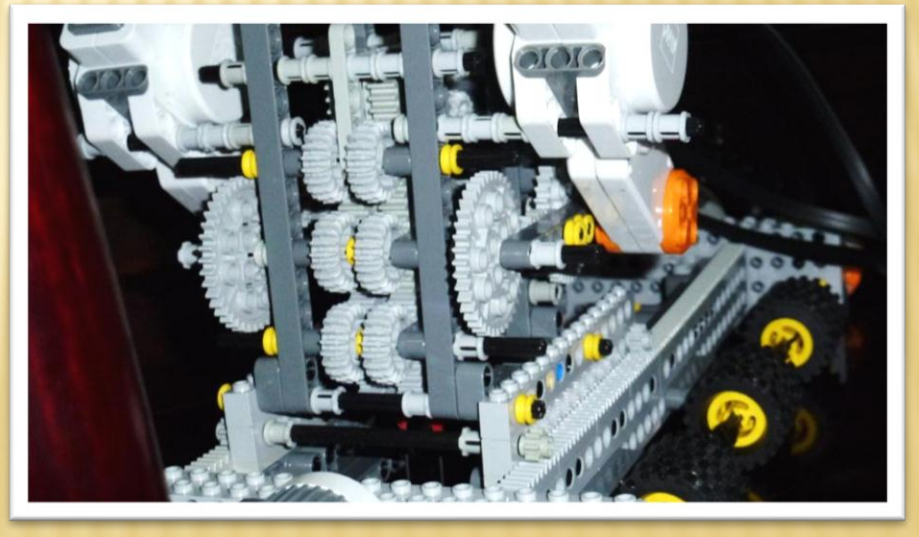
BRAILLESTORM 1.0

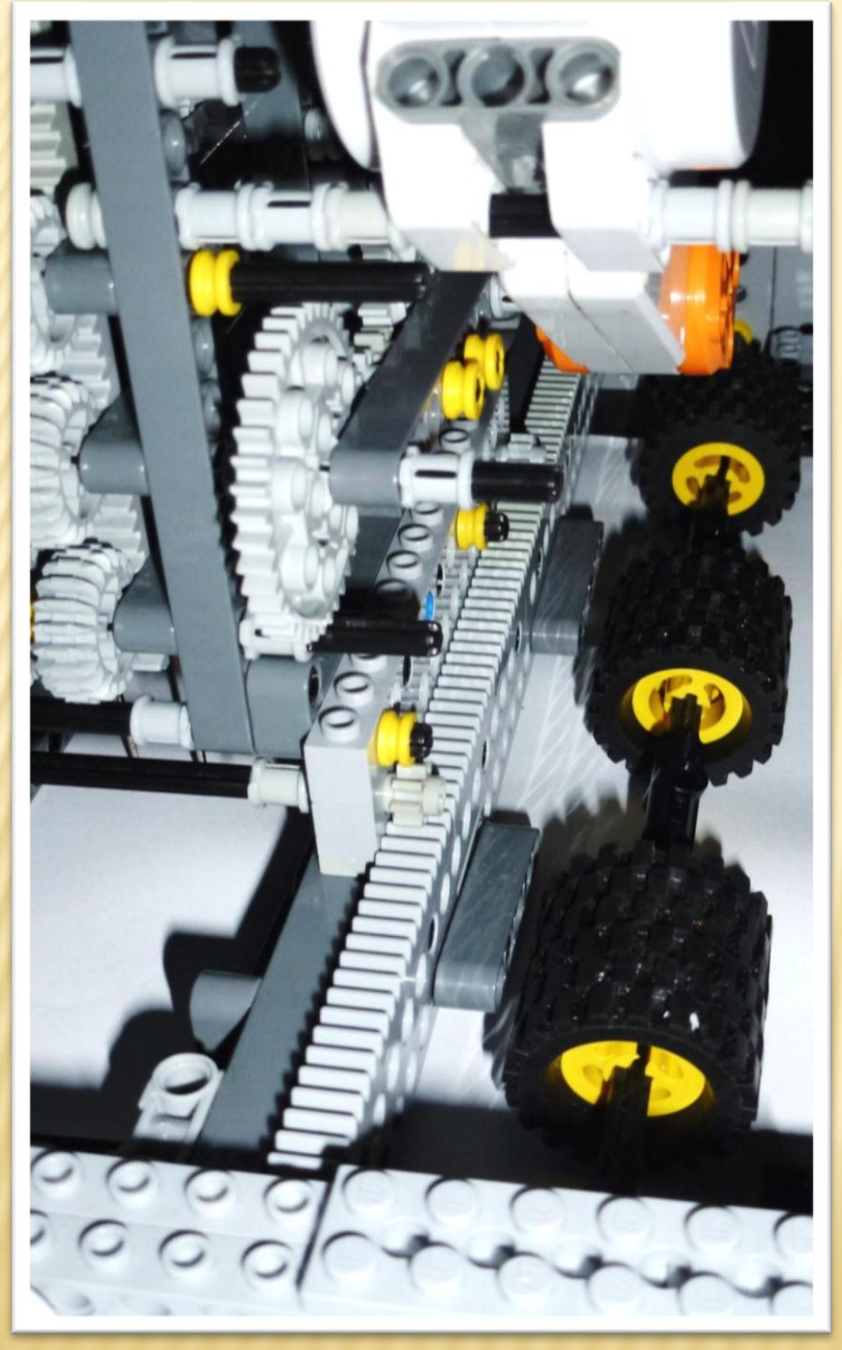


BRAILLESTORM 2.0









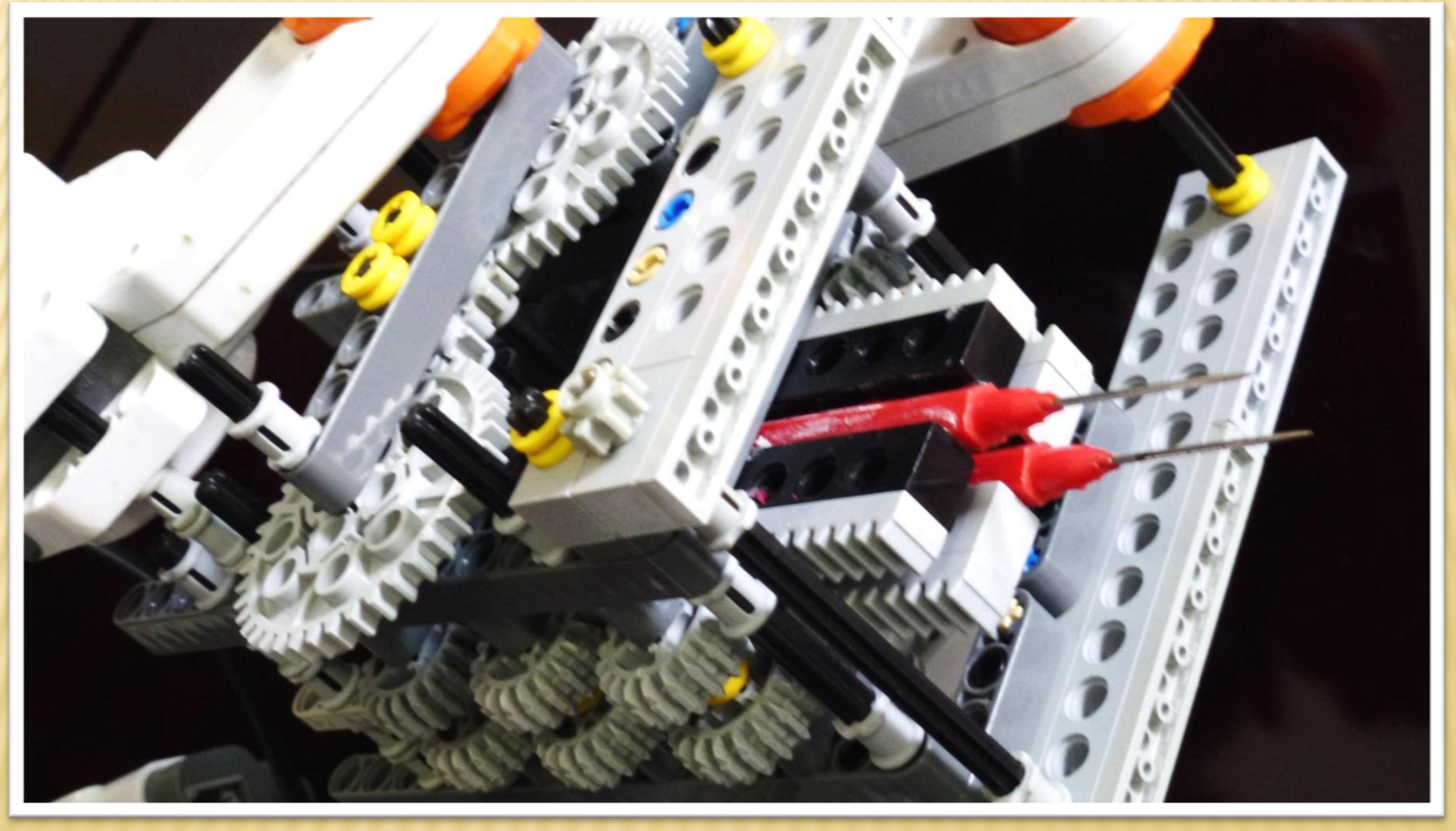
PICTURES
&
CLOSE-UPS

BRAILLESTORM 2.0

Three-axis movement

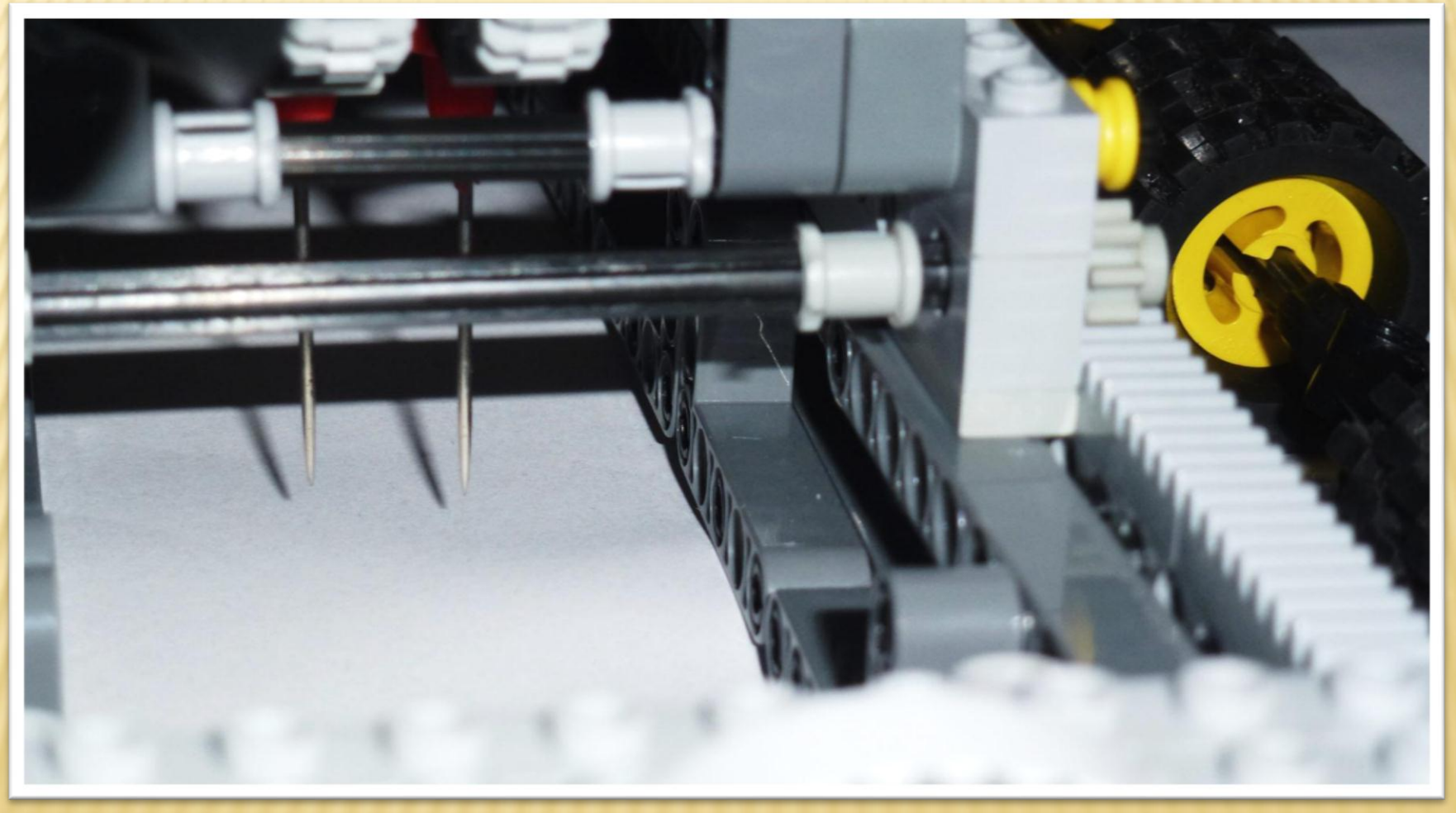
Pictures & Close-ups – Braillestorm 2.0

Dual-pin pricking mechanism



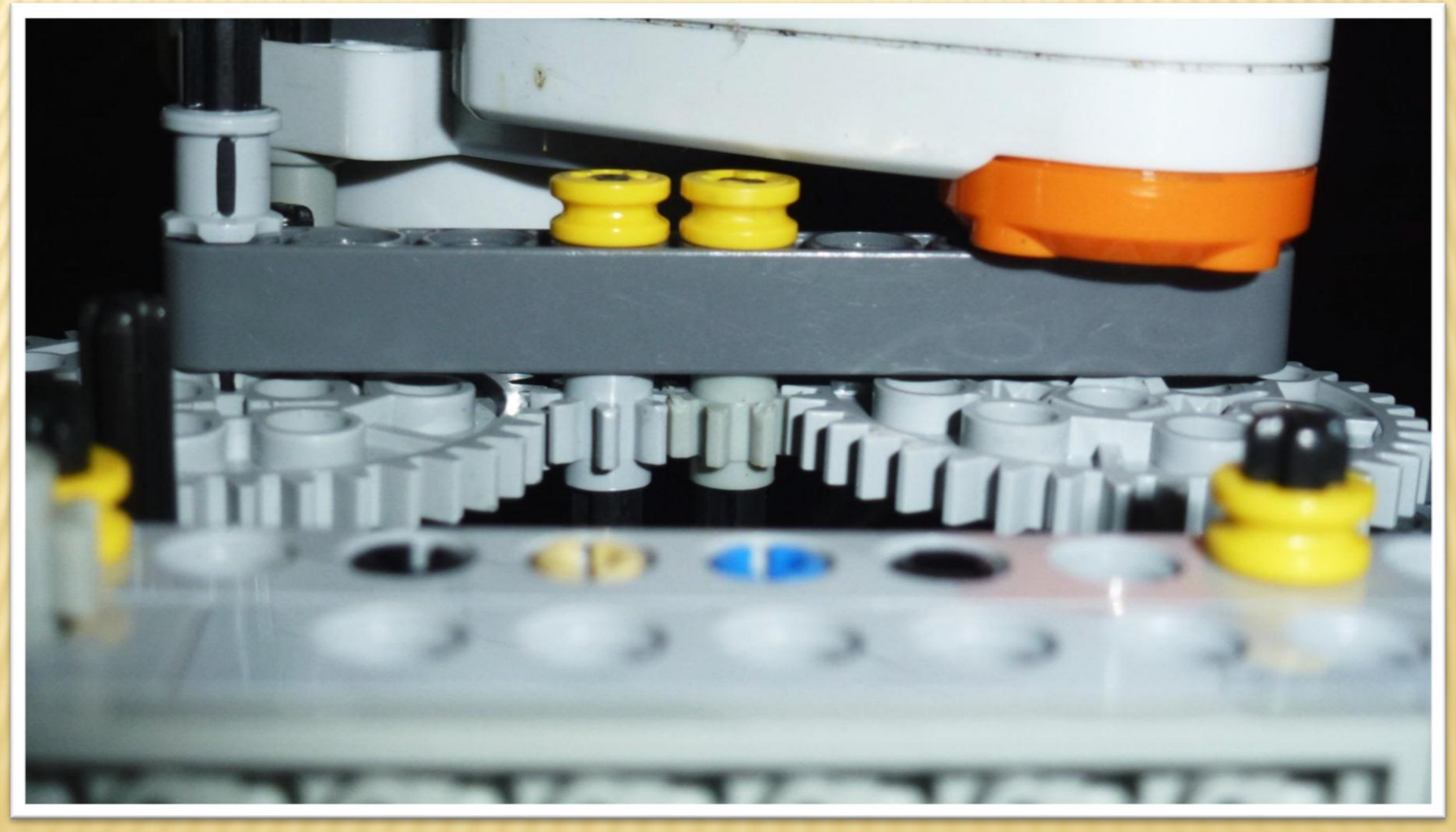
Pictures & Close-Ups – BrailleStorm 2.0

Enhanced view of the pin during pricking



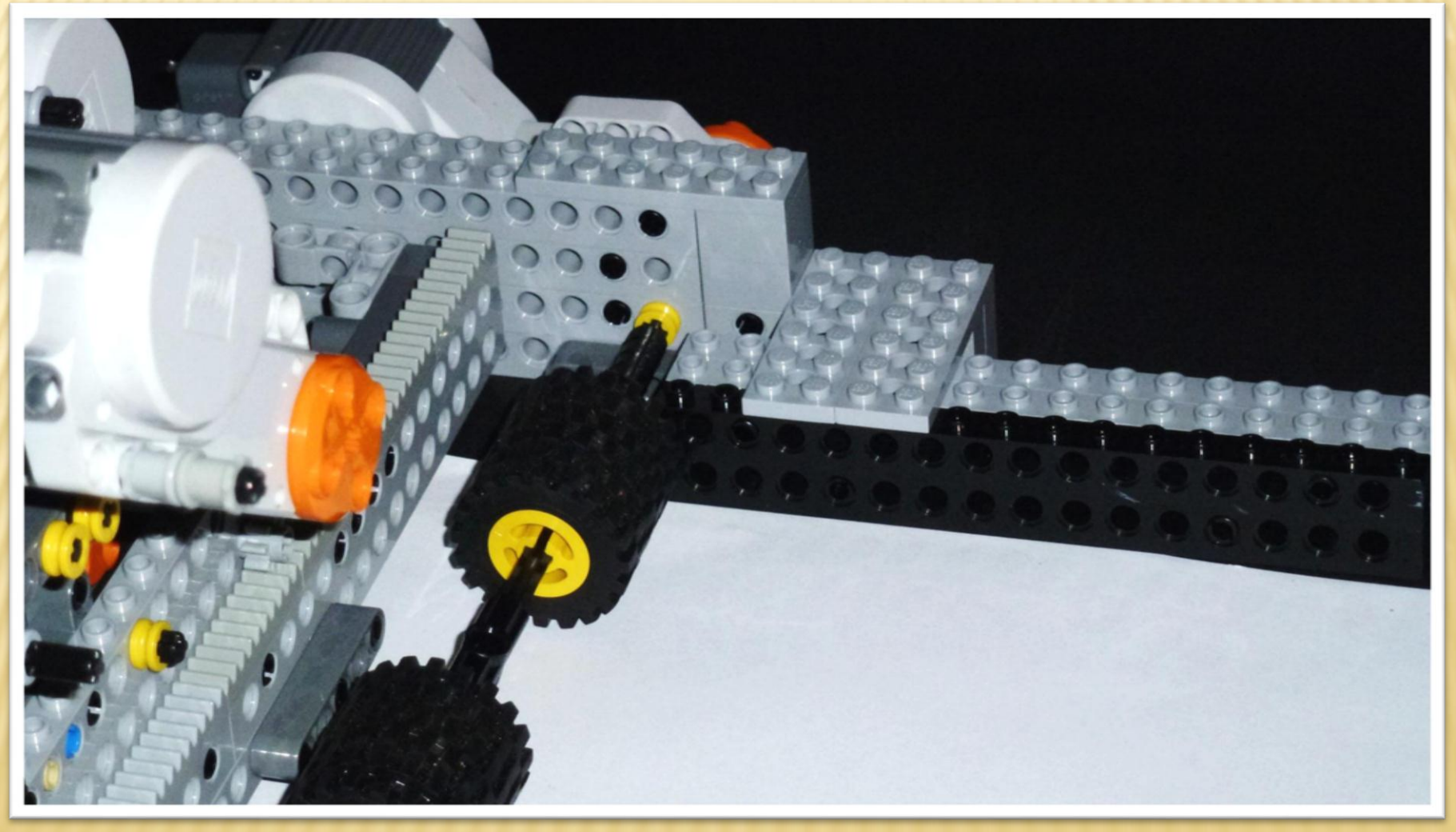
Pictures & Close-Ups – Braillestorm 2.0

Enhanced view of the direction inversing quadra-gear system



Pictures & Close-Ups – Braillestorm 2.0

Side view of the inner robot edge with paper indentation and paper moving wheel system

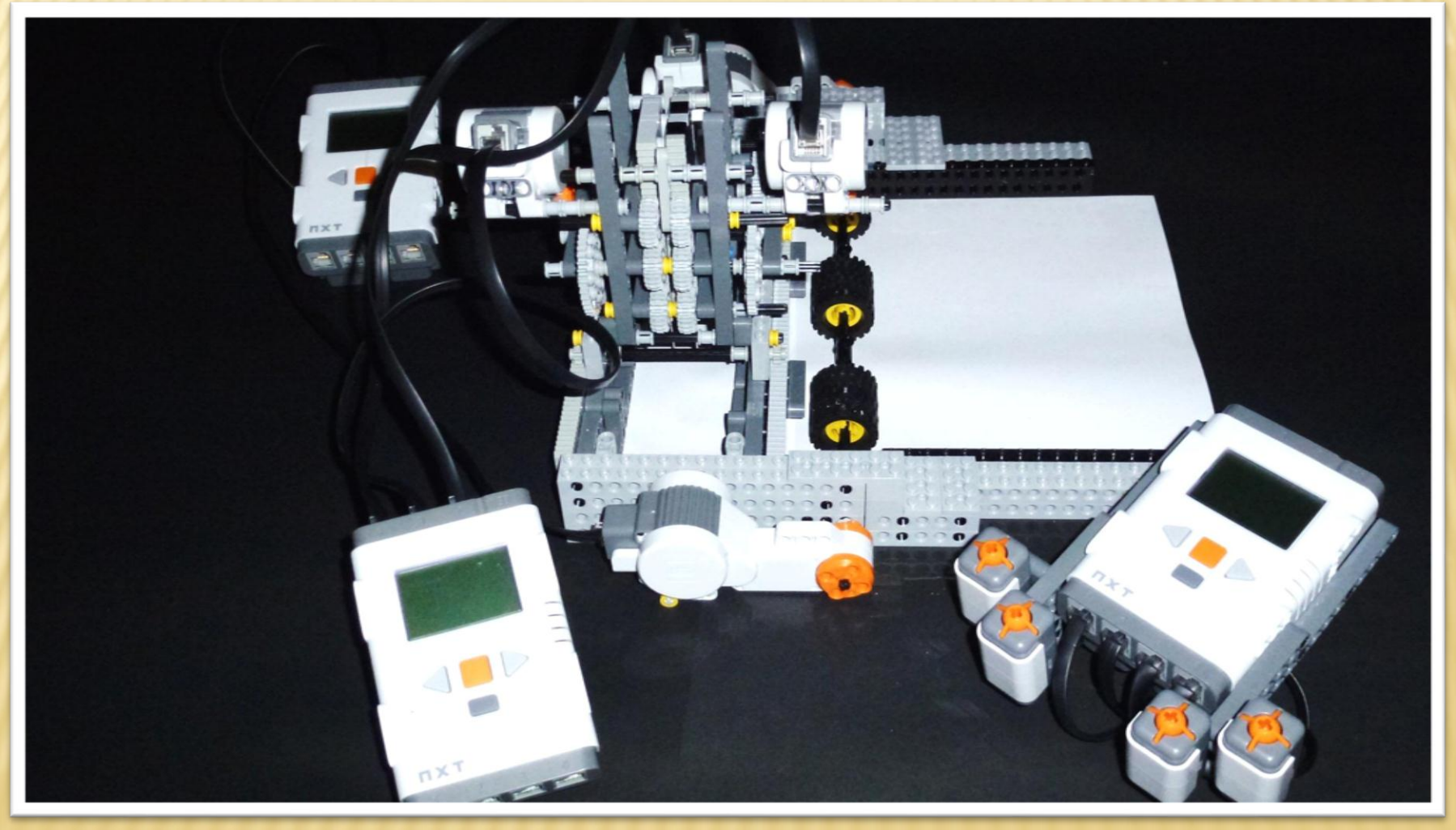


Pictures & Close-Ups – BrailleStorm 2.0

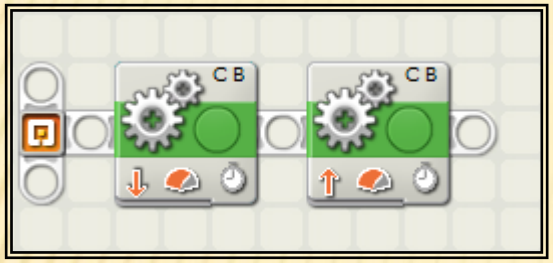
Bluetooth character input system

Pictures & Close-ups – BrailleStorm 2.0

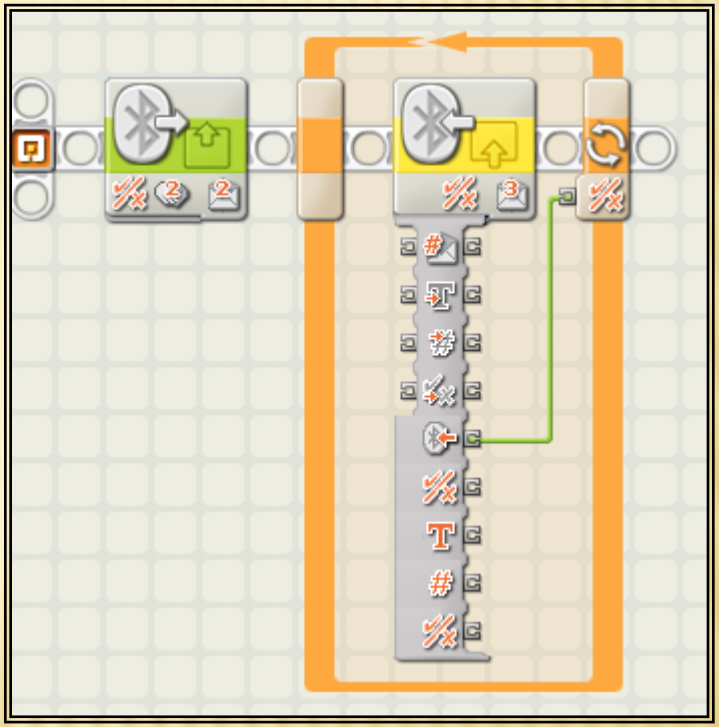
Complete model set-up



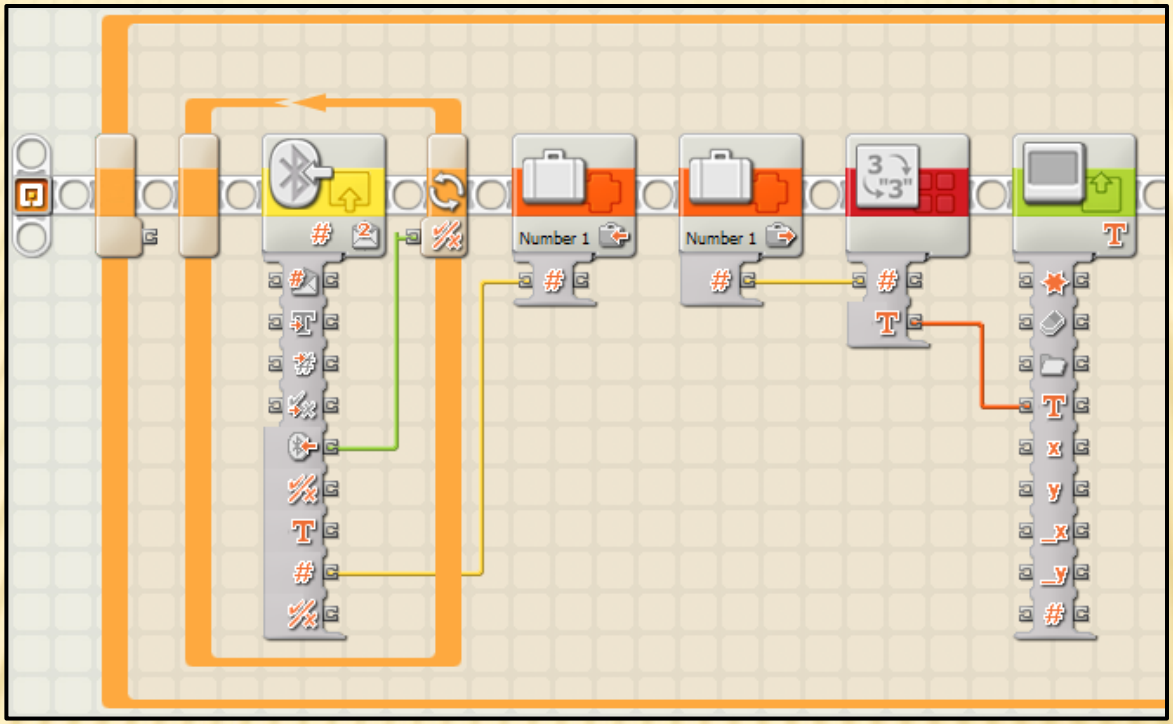
PROGRAM SCREENSHOTS

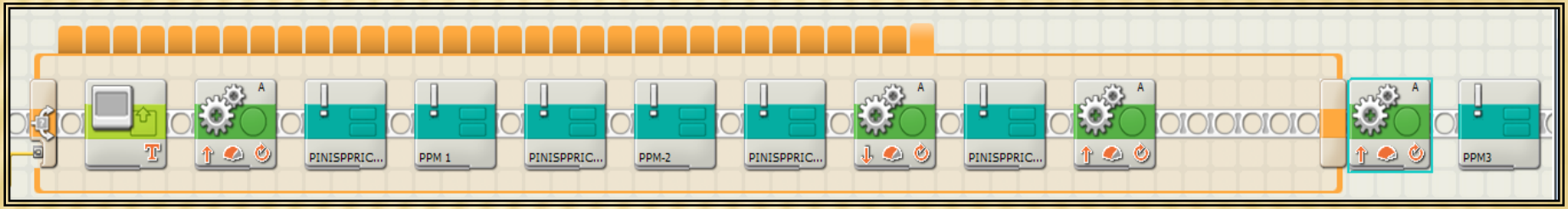


Pin Pricking

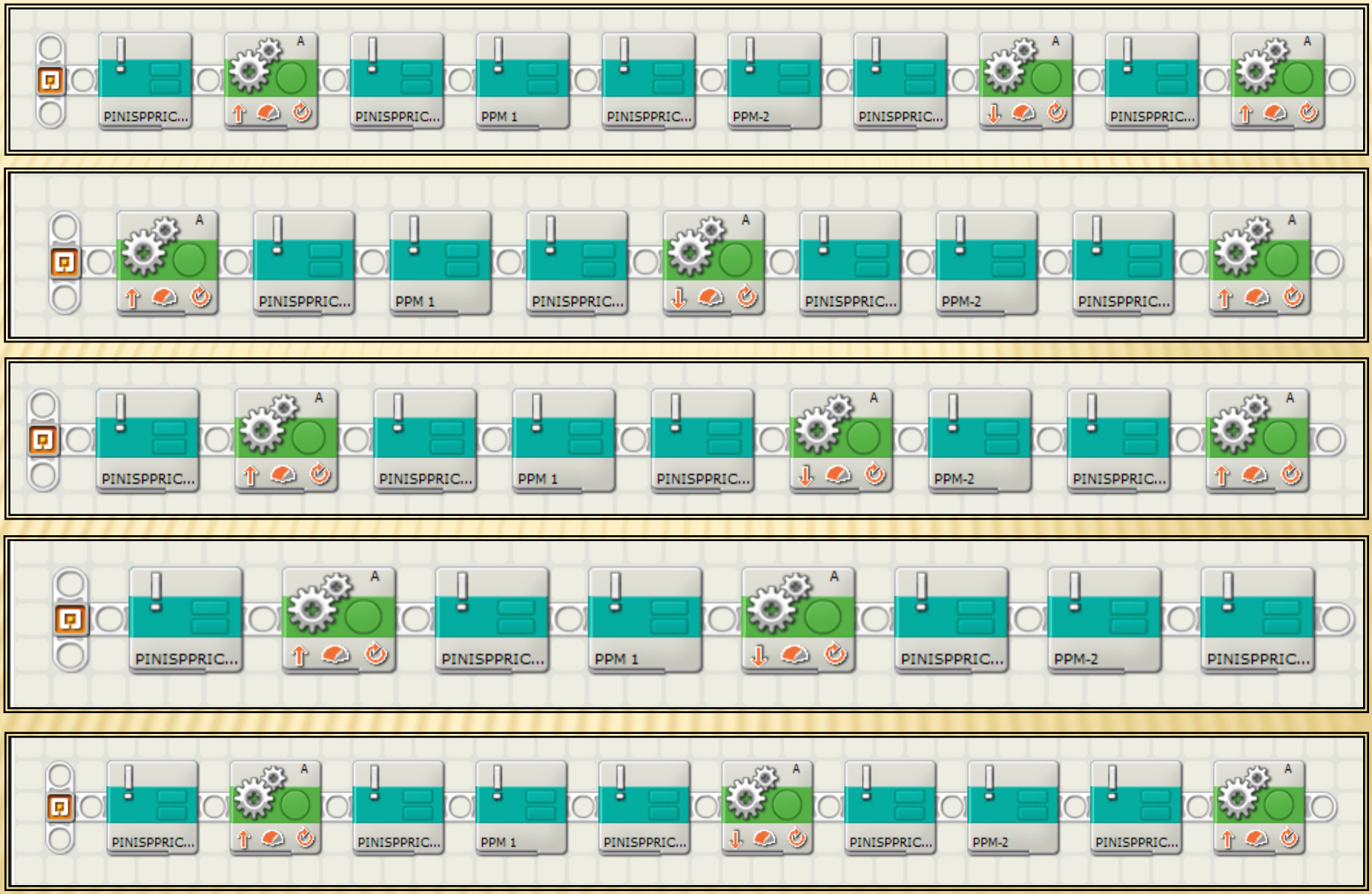


Bluetooth Sending

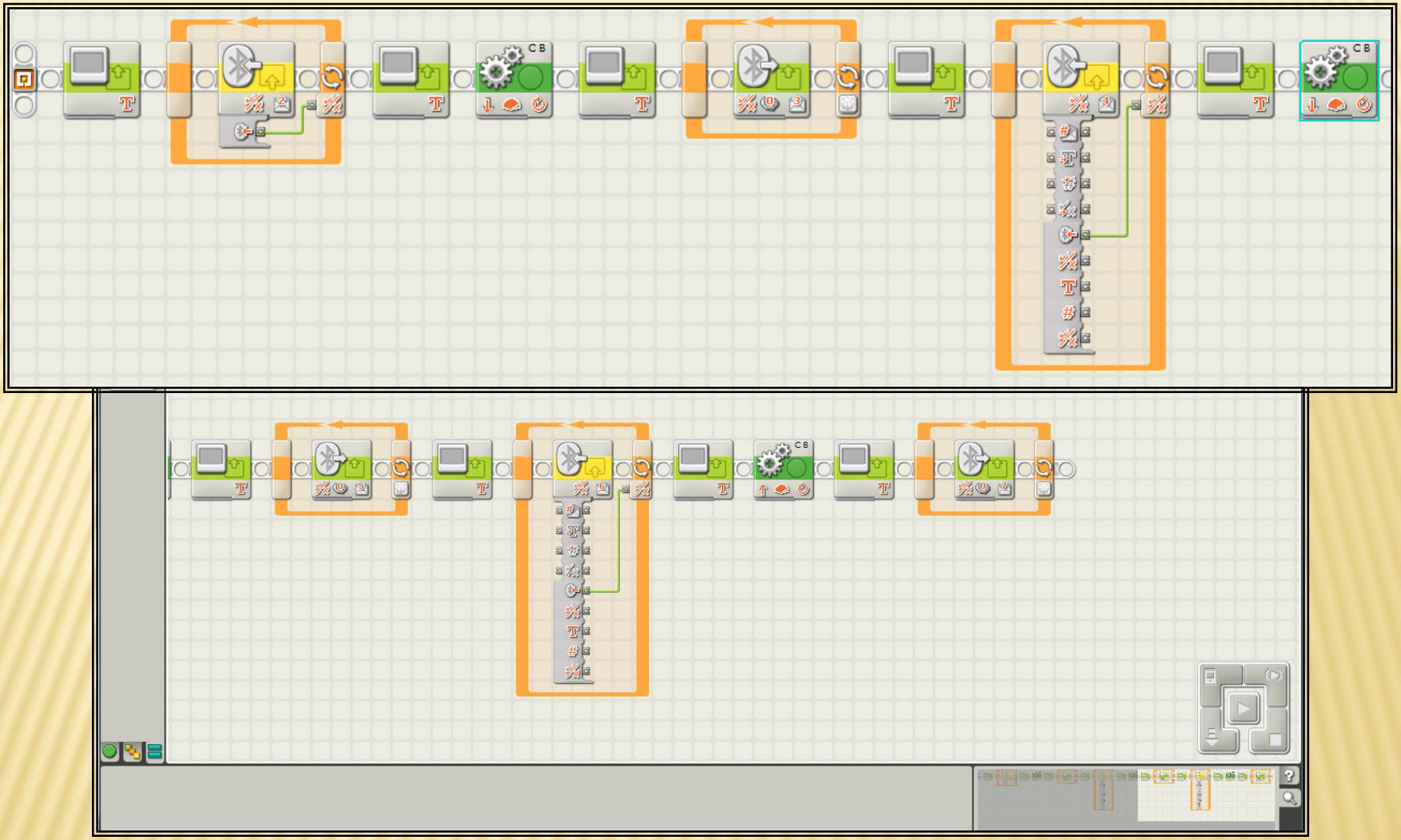




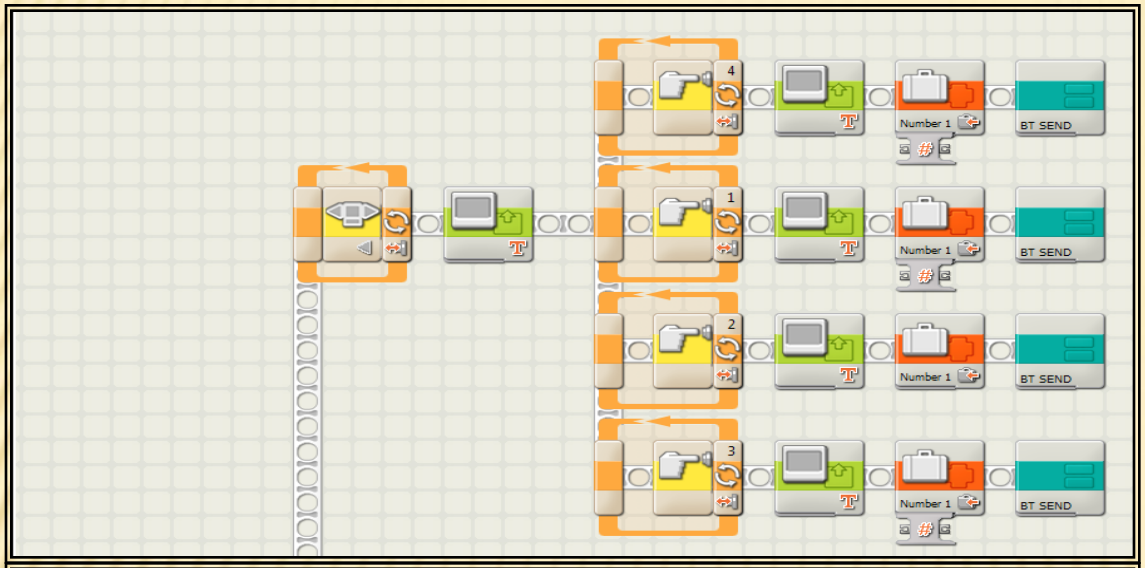
The entire belt program along with the 32 switch statements

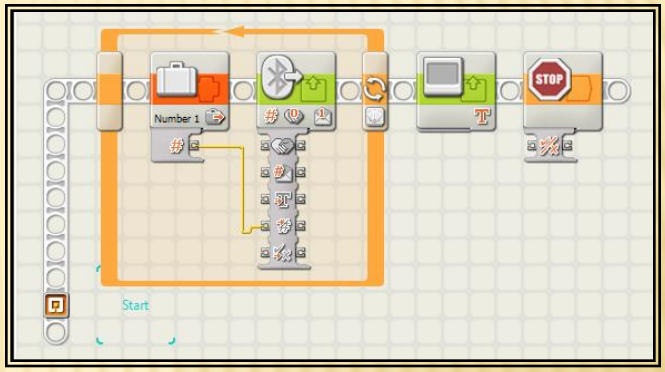


Program for just the letters P,Q,T,N

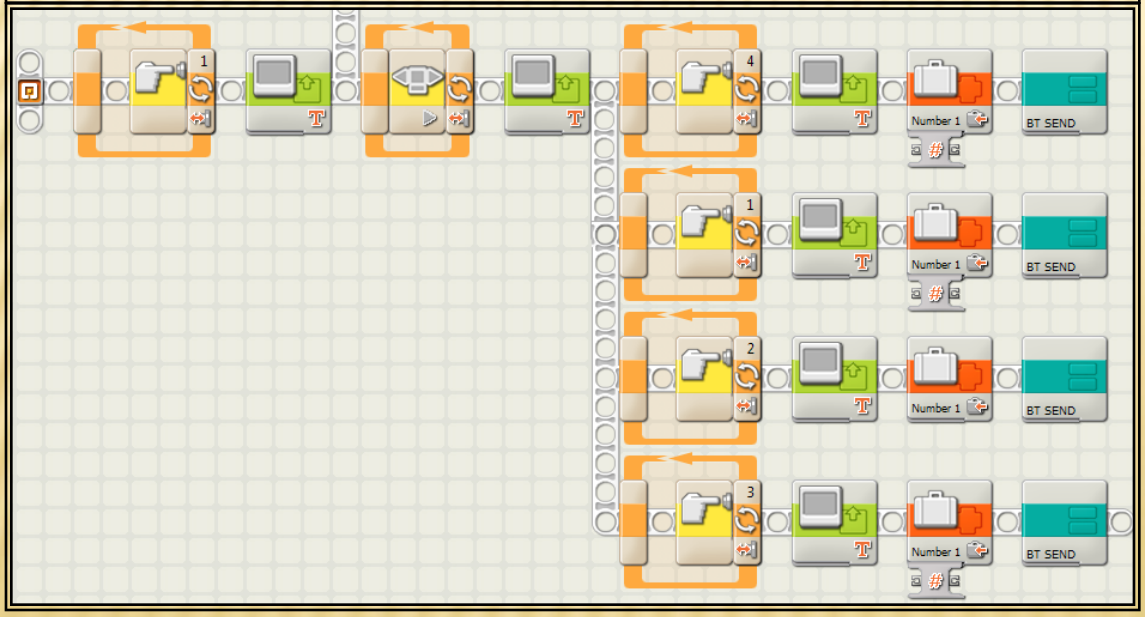


Entire program for the Paper moving mechanism

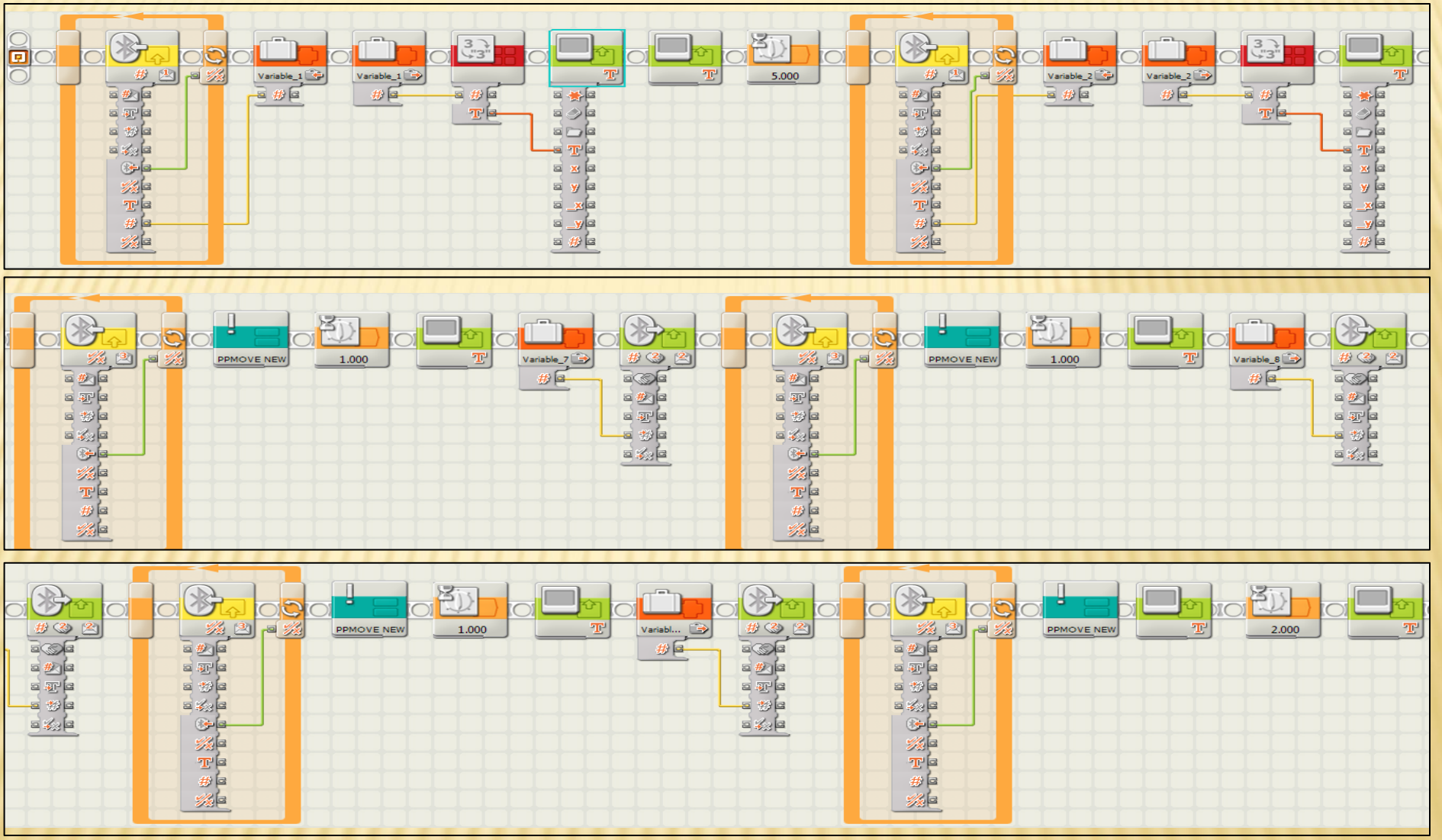




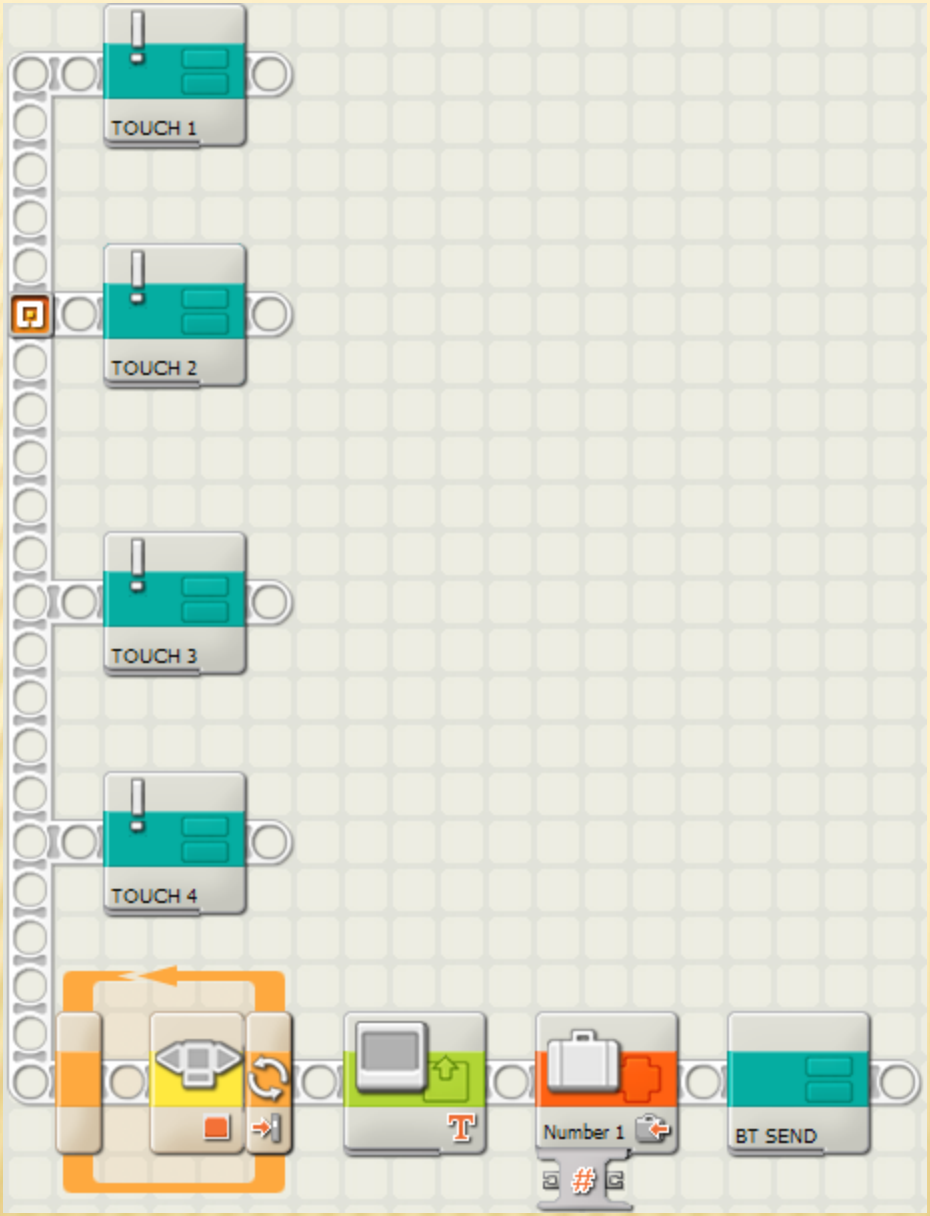
Bluetooth for the Keyboard



The My block for Keyboard



Program segments for the Main Control NXT and Belt Program



Keyboard character input segment with MyBlocks for simultaneous feed monitoring

ACKNOWLEDGEMENTS

We would like to firstly thank our teachers and parents for their continuous support and effort. We also greatly appreciate the help and enthusiastic support of our peers and school technical and IT staff, who have provided us with all the resources which we needed with full cooperation. We would also like to mention a special note of thanks to a few of our senior students who had helped us in the initial stage for the preparation for the competition, providing various insights and ideas and suggestions, giving us a taste of what to develop upon.

We would also like to thank the WRO organizers for providing a platform for robotics, and giving an incentive for robotics development around the world. We have greatly enjoyed and benefited from the experience of preparing and facing the challenges the Open Category has to offer.