Technical Description Paper

Team Information

Team Name:	Ghost Hunters
Country / Region:	Russia/ Krasnoyarsk city
The Participants Name and their Technical Role:	
Member 1:	*Maiia Kefer*, scenario of performance, creating a script for music and video, programming and participation in the design of robots
Member 2:	Vladislav Lizunov, programming and participation in the design of robots
Member 3:	Andrei Matveev, programming and participation in the design of robots
Member 4:	Victoria Kefer, mentor

Technical Information

Overview:

In the project "The Show Must Go On", the robots Guitar, Drums, Microphone symbolize rock musicians performing on stage in a huge hall and giving a concert for the public. Robots dance to music, attract attention; create a light and video show. The main idea of the show: "When people completely leave the stage and only robots remain, then The Show Must Go On!"
Project involves 6 robots: *Guitar, Drums, Microphone, Ramp, Screen, Camera.*

Mechanical Innovation:

To ensure that robots were stable, relying on the classical laws of physics, we located the centers of gravity of all mobile robots in the lowest part of the structures. Uniformity of the load is provided by distributing the mass of all elements of the robots over the surface of the platform. Smooth movement of robots is achieved with the help of program code.

Special Material:

- *Plywood.* For the outer part of the robot body, "Guitar", "Drums" used plywood to reduce weight, and improved their appearance.
- *Aluminum profiles.* The profiles from the "Tetrix" set are used for the moving part of the robots "Guitar, Drums, Microphone" to reduce weight and create sturdy structures.
- *Polypropylene tubes.* Used for the stand and moving part of the robot "Microphone" to reduce the weight of the structure.
- *Wooden slats*. Used to reduce the weight of the robot body "Screen".
- *Tulle*. Used to reduce the weight of the robot body "Screen".
- *Foam cardboard*. Used to reduce the weight of the moving part of the robot "Screen".

Micro-controller:

- Arduino Uno, Arduino Nano
- Arduino Pro Micro (analog Arduino Leonardo)
- Raspberry Pi
- GoGo board
- EV3

Sensors:

- Line tracking sensor (Arduino)
- Light sensor (GoGo)
- Ultrasound sensor (EV3) Ultrasound sensor (Arduino)
- Infrared sensor (Arduino)
- Color sensor (EV3)

Self-made Electric Parts:

- To control the motors and LED strip Arduino platform, we developed a connection scheme using the L293D driver.
- For motors and LEDs, a power supply of 12 volts is required, and for microcontrollers Arduino and GoGo, as well as sensors, 5 volts are required. Therefore, to dilute the power supply from the batteries, we had to use down-converters.

Wireless Communication:

- Bluetooth

Battery:

- Pitsco TETRIX Rechargeable Battery Pack (NiMH, 12V, 3000mAh)
- Education EV3 Rechargeable Battery DC (Lithium-Ion, 9V, 2050mAh)
- SANYO 18650 rechargeable battery (Lithium-Ion, 3.7V,2500mAh)
- LGEAS 18650 rechargeable battery (Lithium-Ion, 3.7V,2200mAh)
- Accumulators AA (Ni-MH, 1,5V, 3000mAh)

Programming Language:

- Arduino-C
- Piton
- Logo
- EV3

Performance Information

The Highlight:

The main characters of the show "The Show Must Go On" are robot musicians who, during the performance, interact with a person and with each other through numerous sensors of color, light, light changes, ultrasound range finders and others.

Robots demonstrate the ability to autonomously move and stop under certain conditions, turn lighting on and off, and also conduct video recording and transfer footage to the screen for viewers.

This project shows that robots can create an interesting show without directly interfering with people and thus proves the theatrical truth "The Show Must Go On".

Robot-Human Interaction:

The person interacts with the robots "Guitar", "Screen" and "Camera" by affecting the line tracking sensors. After that, these robots interact and start the programs of other robots ("Drums", "Microphone", "Ramp").

Robot-Robot Interaction:

After a person brings a color card to the line tracking sensor - two programs of movement and glowing "Guitar", installed on two Arduino platforms, are simultaneously launched. Right after that, the Arduino "Guitar" robot sends a signal via the Bluetooth connection to start the other robots, they turn on and go to the standby mode.

"Guitar" moves towards the robot "Ramp 1" and, at the same time, lights up to the music. At a certain distance from "Ramp 1", "Guitar" stops and continues to play color music, and on the "Ramp 1" the rangefinder works and the LED strip on all "Ramps" 1,2,3 turns on.

The "Drum" movement program installed on the Arduino platform, after waiting, starts moving at a certain musical moment. It also has a glow program on the GoGo-board, which is triggered by a photoresistor, to which a beam of light from the flashlight is directed.

"Drum" moves towards the robot "Ramp 3", while losing color music. At a certain distance from the "Ramp 3" robot "Drum" stops and continues to lose color.

The program of the robot "Screen" is triggered by a line tracking sensor located on the EV3. Next, "Screen" transmits a signal via Bluetooth channel to the EV3 motion program on the "Microphone" robot.

"Microphone" moves towards "Ramp 2" and stops at a certain distance from it thanks to an ultrasonic sensor.

As soon as the "Microphone" departs from the "Screen", then the range finder works on it and launches the program of movement of the "Screen" elements. "Screen" moves apart and becomes two times wider.

With the help of another ultrasonic rangefinder, the Arduino program is launched on the "Microphone", the RGB LED strip lights up, and the microphone stand rotates in the rhythm of the music.

At the very end of the show, a camera connected to Raspberry Pi is turned on. Then the camera takes a video from the stage of the auditorium and transfers the image through the laptop to the projector.

Challenges and Difficulties:

1. An important problem that we had to work on is the lack of power supply for robots, since LEDs consume a lot of energy. We were looking for ways to make power supplies such that they were both not heavy and sufficient in terms of current. We made several separate battery assemblies and solved this problem. One such solution is the disassembly and reuse of batteries from old laptops that have served their time.
2. The search for materials to ensure that the robot designs were light and strong, is also another important topic of our research that we conducted during the project. As a result, we used plywood, aluminum profiles, polypropylene pipes, tulle, wooden slats and foam board.
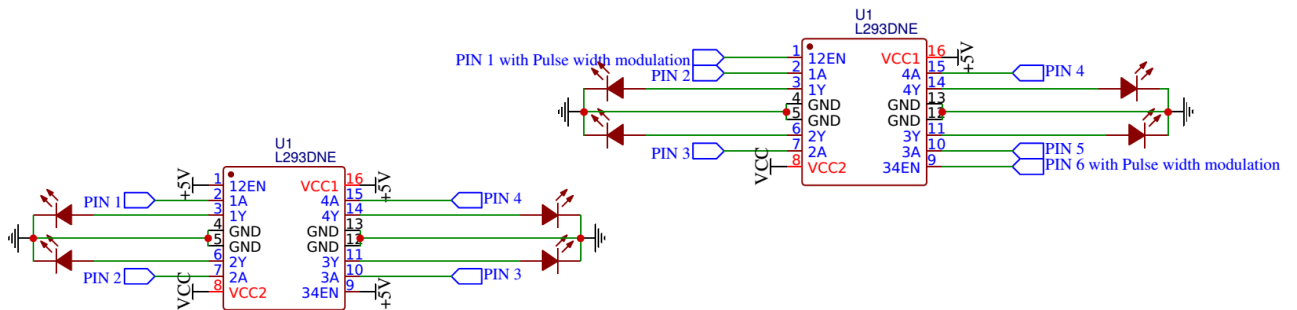
Collaboration:

Yes, we are happy to share with other members of the RoboCup OnStage community our solutions. We will gladly share our own scheme for connecting motors and LED tape to the L293D drivers.
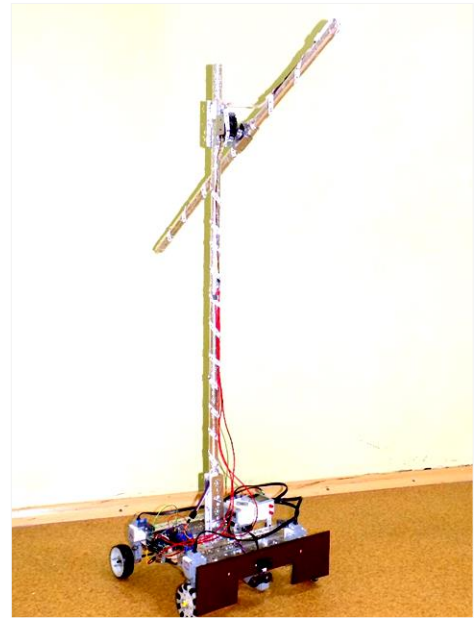
Photos and Images of the robot(s):

Team Ghost Hunters and Heroes of the show

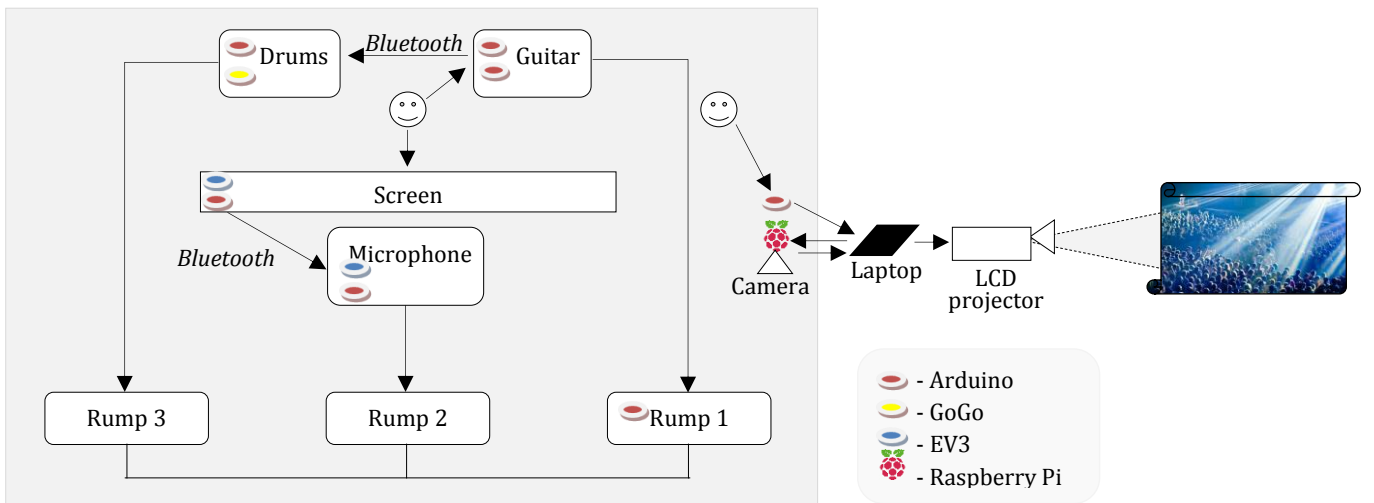**Schemes for connecting motors and LED strips to the L293D driver**

Guitar

Microphone

Maiia constructs the robot "Drums"

Drums

The scheme of interaction of robots and humans

Working together with the UGO team from Taiwan in the SuperTeam competition on RoboCup Asia-Pacific' 17

Team "Hunters" took 2nd place at RoboCup Asia-Pacific' 17

Team Ghost Hunters on RoboCup Russia Open' 18