Work Progress Report

Project Period: 2015/02/16 ∼ 2015/08/18

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Title

Developing an experimental platform for Human Robot Interaction based on human motions

1 2015/02/15-2015/02/21

Date	Content	Problems/Remarks
2015/02/15	• Arrival in Japan	-
2015/02/16	• Project discussion with professor. • Showed demo of ALVAR toolkit, CMT (Consensus based matching and Tracking) toolkit. Demo based on PC webcam. • Received Kinect V2 sensor.	-
2015/02/17	• Play with Kinect sensor SDK samples. • Setup Point cloud library environment. • Undergraduate presentation. • Welcome party.	• Problem with acquiring Kinect data and displaying in PCL viewer.

Date	Content	Problems/Remarks
2015/02/18	• Fixed the PCL Kinect Grabber problem (Signal for PCL point type PointXYZRGBA has not been registered in OpenNISegmentTracker) • Tried to make 3D model of smartphone to be able to track using PCL tracker.	• PCL tracker could not be used using reference point cloud. Under investigation (postponed)
2015/02/19	• Started integrating ALVAR,CMT to be used with the Kinect Stream • It needs custom build of OpenCV. OpenCV v2.4.10 does not support OpenNI2. So had to build the latest version of OpenCV.	-
2015/02/20	• Setting up new PC (VS2010, VS2013, PCL, Kinect SDK)	-

Date	Content	Problems/Remarks
2015/02/21	• Continue PC setup (Aldebaran Softwares, Intel XE composer 2015) • Start custom build of OpenCV (v3.0.0). Fixed many issues related to building the software. • Build of OpenCV (version 20150221) successful	-

2 2015/02/23-2015/02/27

Date	Content	Problems/Remarks
2015/02/23	• ALVAR tookit build • Glut32, FreeGlut build • OpenNI2 + Kinect Driver V2 build and Test (http://youtu.be/nhNPri5Aees) • Contacted Paolo Coletta of Eyesweb team and asked about how Kinect V2 is integrated in Eyesweb	-
2015/02/24	• ALVAR tookit Kinectv2 capture plugin build	• Problem encountered while capturing the Kinect Color frame
2015/02/25	• Started writing C#.NET Wrapper for libCMT (Consensus based Matching and Tracking library). After completion and testing will open source the library.	-

Date	Content	Problems/Remarks
2015/02/26	• Kinect calibration and Marker tracking using ALVAR library complete (http://youtu.be/ypb3T9BUipQ). A 7.5 × 7.5 cm marker tracking range is ∼ 3 m. • Wrote Kinect Video capture plugin and integrated with CMT.	• CMT → Very slow. And the tracking was not very robust.
2015/02/27	• Started again with PCL Tracker. • Modified OpenNI2 Kinect2 driver (Driver Initialization and Kinect Device setProperty) • Started exploring BLORT toolkit (http://www.acin.tuwien.ac.at/index.php?id=290&L=1) • Preparation to import 3D model of Nao Head	• Kinect2 device takes approximately 3 seconds to initialize properly ! • Particle filter tracking was very slow. Still not successful (need to be studied systematically) • Building BLORT in windows was very painful.

3 2015/03/02-2015/03/08

Date	Content	Problems/Remarks
2015/03/02	• Continue with BLORT toolkit build • Marker based wrist tracking (tested with ALVAR library) • Made a simple cube to place over Nao robot's head with markers on it's sides. • ROS setup in Virtual machine	Found that BLORT has dependencies with NVIDIA stuff. Figuring out a way to fix this.
2015/03/03	• Started with TrackerQt (successor of BLORT) (Advances in Real time object tracking - http://users.acin.tuwien.ac.at/tmoerwald/?site=4, http://users.acin.tuwien.ac.at/tmoerwald/?site=3#tracking). • Tried to set up Chilitags as well • Made the marker cube to put on top of Nao robot's head • Ported dummysim example in Nao Simulator sdk v 1.14 to sdk v2.1.	• Trying to evaluate BLORT, TrackerQt and Chilitags in Ubuntu in virtual machine (will use some monocular camera supported by OpenCV to test). If the results are promising will try to setup in windows.

Date	Content	Problems/Remarks
2015/03/04	• Fixed the OpenGLSL errors in BLORT (GLSL Frag and Vert file errors). Both BLORT and TrackerQt requires GPU. Confirmed with Thomas Morwald (developer) • Checked chilitags with webcam in ubuntu (14.04) environment. It is not as reliable as ALVAR toolkit. Also there are memory leaks. • Ported robot_description sample from Nao Simulator sdk 1.14 to sdk 2.1.2 (for exporting urdf file of the robot model) • Setup PWP3D tracking library (Need CUDA GPU) • Naoqi setup in Ubuntu • Setting up openrave environment (thinking of use it as a simulation environment. put both robot and human in openrave simulator - don't know if it is good idea. But will give it a try)	-

Date	Content	Problems/Remarks
2015/03/05	• Experiment with Jean (Reflective marker tracking on subjects head. Captured video using kinect studio). Also checked the marker tracking by putting the marker on Nao robot's head and made a video (http://youtu.be/VB0LHJM0dwI). Marker tracking affected by lighting. • Setup ROS nao and openrave build. • Investigated if VREP could be used as simulation environment (It has a nao model but it is old. it has to be updated) • Serial kinematic chain model for the case when Marker is put on Nao's head. (has to be checked after implementation and experimentation)	

Date	Content	Problems/Remarks
2015/03/06	• Computing the pose of top of the marker cube when one or more of the markers are detected (if more than one quaternion slerp is used to find the best estimate) • Setting up openrave • Prepare Nao meshes and conversion of Urdf to dae (wrote a simple ros node to do this)	• Openrave build unsuccessful. • Dae conversion unsuccessful
2015/03/07	• Kinematic model design and implement implement in Python-sympy (for quick checking) • Visited Mujin bot office (www.mujin.co.jp). They do some impressive work in the field of industrial robotics	-
2015/03/08	• Continued with openrave setup	-

4 2015/03/09-2015/03/15

Date	Content	Problems/Remarks
2015/03/09	• Openrave setup complete • Collada export using collada_urdf exporter	collada_urdf exporter not working with Ubuntu 14.04 and ROS indigo. Have to try with ROS Hydro
2015/03/10	• Studied usage of VisualGestureBuilder tool. Tried generating simple hand wave gesture • Made a sample application to test the generated gesture database	• With both Left and right hand gestures available, only one of them is detected properly. Debugging to understand the problem
2015/03/11	• Fixed the bug in the gesture recognition sample. The sample video is uploaded at http://youtu.be/7E8TgLbQ4a8 • Kinect V2 setup guide documentation • Nao Robot collada model export successful - Finally !!! (Possible with ROS Hydro in Ubuntu 12.04 virtual machine)	-

Date	Content	Problems/Remarks
2015/03/12	• Optimizing the 3d collada model of Nao	
2015/03/13	• Investigated the possibility to use Protobuf as interprocess communication exchange format • Minor changes to the Experimot • Try openrave-2013 build • Joint data acquisition of Nao robot when Tai-chi motion is performed.	-
2015/03/14	• openrave-2013 build successful • Protobuf build • Decided to use Protobuf messages used in Gazebo to be used for the platform I am developing	-

Date	Content	Problems/Remarks
2015/03/15	• Created a custom marker cube for Nao pose detection (Cube bought from - http://www.amazon.co.jp/dp/B0049EVGC4/ref=pe_492632_159100282_TE_item) • Imported Gazebo messages from repository and wrote an automatic script to export the headers and source files from *.proto files. • Tested the export script and static library creation	-

5 2015/03/16-2015/03/22

Date	Content	Problems/Remarks
2015/03/16	• Seminar: Symptoms of being alive and shared life at Keio University – Talks on life, emerging new organisms, non-verbal communication in human robot interaction, life and turing machine, di-chronic study using coral atolls, human chimpanzee interaction, animals perception of life. • Observations relevant to my project – Using ethics to interact may give the impression that the thing is living. – The manner in which an agent/robot spends its idle time will have a greater impact on its liveliness. -	

Date	Content	Problems/Remarks
2015/03/17	• The joint values of the tai chi pose of Nao collected last week is used to simulate the Nao robot in openrave environment - Successful! • The video is uploaded at http://youtu.be/aFECThEAivk	-
2015/03/18	• Boost ASIO and ZMQ setup. • Seminar	-
2015/03/19	• Created kinect Video playback tool (http://youtu.be/vUdm8QeylP4) • Boost ASIO and ZMQ client/server development • Meeting	

Date	Content	Problems/Remarks
2015/03/20	• Successfully got protobuf and zeromq working together • Tested the joint value simulation using client server architecture • Also tried with the python publisher. Inter-process communication works as expected.	-

6 2015/03/23-2015/03/29

Date	Content	Problems/Remarks
2015/03/23	• Improved Kinect XEF File Playback tool (File Open, Display Body Index Frame etc.,) • Auto generation of C# classes from .proto files. Created the C# library containing the generated messages • Tested the IPC between the C# application and OpenRave client application - Works perfectly! • Kinect body information publication/subscription test	Kinect Playback Tool - The way to read the skeleton information from the event stream is still unknown. Have to figure it out.
2015/03/24	• Kinect body information display in openrave environment alongside Nao robot. - Works well • Real time Nao robot simulation in OpenRave environment (http://youtu.be/wUgRbslD6jk) • Absolute localization based on markers - test started	• -

Date	Content	Problems/Remarks
2015/03/25	• Integration of localization module in the framework (experimot_localization) • Kinect Playback tool IR stream support added	-
2015/03/26	• Integration of localization module. Developed nao Marker frame forward kinematics module and tested against openrave forward kinematics.	
2015/03/27	• Major refacoring of localization module • Unit testing • Localization IPC setup	-

Date	Content	Problems/Remarks
2015/03/28	• Bug fixes • Complete communication flow test (Localization, Robot-interface, Skeleton-tracking, Simulator)	• Need to fine tune localization. Position looks good. Orientation is a concern (TODO Item : Modify the way in which the torso frame is computed.) • Coordinate frames has to be synchronized.
2015/03/29	• Quartz scheduler - Feasibility study (Looks promising)	-

7 2015/03/30-2015/04/05

Date	Content	Problems/Remarks
2015/03/30	• Nao localization test. Fixed the torso frame calculation bug.	The pose computation is still sometimes strange. The frames of reference are not perfectly synchronized. Need more test.
2015/03/31	• Fixed bugs in the Nao pose estimation. • Added the color stream support in the kinect playback tool. • Investigation on how to extract skeleton data from raw buffer in XEF file	• The raw format used by Microsoft for color stream was Yuy2 (4 bytes for 2 pixels). The conversion from Yuy2 to RGB was implemented in Kinect Playback tool • The skeleton buffer was 6288 bytes. I tried decoding the skeleton values from the byte stream. Still cannot figure out how the data structure is aligned while serializing.
2015/04/01	• Fixed Experimot studio startup problem. • Scheduler design. Written core classes that will compose the Context of the scheduler.	-

Date	Content	Problems/Remarks
2015/04/02	• Schedule core classes design • Localization reference frame problem debugging	
2015/04/03	• Localization reference frame problem fix • Testing	-
2015/04/04	• Bug fixes in the localization	• The camera frame considered by ALVAR was (x-right, y-down and z-forward). However for KINECT it was (x-right, y-up and z-forward). So basically I had to invert the y-axis position values after computing the Torso pose. • *TODO*: Weighted pose estimation depending on the marker detection confidence.

8 2015/04/06-2015/04/12

Date	Content	Problems/Remarks
2015/04/06	• Lab meeting • Application bootstrapper - Modified XML schema to support node parameters. In the process of supplying the node parameters as a command line arguments to the individual nodes during startup.	-
2015/04/07	• Application bootstrapper support - Extended the xml config file to support global and local parameters. global Parameter overriding, support the new configuration information in the individual nodes. • Testing the supported nodes.	

Date	Content	Problems/Remarks
2015/04/08	• Node startup enable/disable support • Integration of Gesture recognition and Skeleton tracking and supported start up of this node from configuration information. • Application context information management support. Auto subscription of all the published messages. Under test	-
2015/04/09	• Migration from clrzmq to NetMQ .NET library for ZeroMQ • Parameter server and Context synchronization from all publishing nodes - Multi-threading support • UI update of current pose from the context	

Date	Content	Problems/Remarks
2015/04/10	• Tried serializing the kinect body to cross check with the raw buffer size • Kalman filter implementation started • Fixed bugs in the localization module and testing	- Walking on the floor mat was not good. So will test once again on the room 452 next week
2015/04/11	• Target Drives Means (TDM) Framework client python script development - To make the localization data available to the TDM framework	
2015/04/12	• Target Drives Means (TDM) Framework client python script development & Testing - Works fine • Will organize a meeting with Mr.Vincent Berenz next week and prepare for the initial integration test for the scenario of Nao robot walking to and fro between two locations.	

9 2015/04/13-2015/04/19

Date	Content	Problems/Remarks
2015/04/13	• Lab meeting • Python client preparation for Mr.Vincent Berenz to access localization information from my platform • Bug Fix: Refreshing the simulation window when no Kinect body is detected • In order to enhance the pose estimate, I plan to consider the depth information of the detected markers as well. To do this, I started integrating the PCL Grabber with Localization module.	-

Date	Content	Problems/Remarks
2015/04/14	• Made a python client sample plotting the pose of the robot on the plane using matplotlib • Meeting with Mr. Vincent Berenz about the TDM framework. We agree d to develop a description of the world to communicate information between Experimot and TDM • Continue implementation of Marker pose improvement taking into account of the kinect information. • Median filter implementation	
2015/04/15	• Kinect data integration for improved pose estimation	• Point cloud organization caused lot of issues and creating problems by crashing the application. Found the source causing the problem and fixed the issue. However the Pose estimation using kinect is still not successful.

Date	Content	Problems/Remarks
2015/04/16	• Modified the point cloud generation using MapColorFrameToCameraSpace method of coordinate mapper. The Pose estimation is not stable and sometime the depth information is noisy and it give INFINITY for the depth value which crashes the localization module • Started with the presentation • Tried three.js to be used as the 3D viewer of the web site (trying the possibility of providing the web based monitor for human robot interaction)	
2015/04/17	• Three.js robot loading verified. Refactoring the project structure • Motion/Behavior modules registration mechanism implementation • Made sample python script for calling the behavior installed in the robot • Python node parameter retrieval support - ongoing	-

Date	Content	Problems/Remarks
2015/04/18	• Python node parameter retrieval support - complete • Fixed the bugs in the robot behavior registration	
2015/04/19	• Prepare mid-term presentation	

10 2015/04/20-2015/04/26

Date	Content	Problems/Remarks
2015/04/20	• Mid-term presentation • Prepare Ubuntu-64 bit virtual machine. Bios option : Enabling Intex VT-x virtualization • Checked the ZMQ client in Ubuntu machine while the server is running in window machine • Prepare Naoqi sdk and Choregraphe in Ubuntu virtual machine • Begin to Embed web server	-
2015/04/21	• Try to improve localization • Behavior module modification • Gesture trigger message added and communication link is established with the server • Gesture trigger to behavior execution cycle is tested :)	

Date	Content	Problems/Remarks
2015/04/22	• Studio Ghibli Demo preparation • Embedded webserver setup using Nancy web framework and check the Nao asset loading. Works fine.	• Nao fell down when I was setting up demo. The Nao cpu is getting heated up quickly and shuts down for safety. Have to check if there is some problems with cooling system
2015/04/23	• Web server integration - Jquery ui • TDM module from Vincent integration test. – A router has to be used to connect the robot with the host computer – The virtual machine network setting has to be set as NAT – With these settings, the virtual machine was able to connect to the host and also to the robot. The module working has been verified. However there are some ambiguities in the way data has been decoded at TDM side.	• Nao shut down once due to over heating.

Date	Content	Problems/Remarks
2015/04/24	• Continued with web integration • World description : Human management, Gesture associated with each human management.	
2015/04/25	• Simulation of the robot in the web renderer. Works decently well	
2015/04/26	• Tried integrating JointJS for modeling of the scenario but without success.	

11 2015/04/27-2015/05/03

Date	Content	Problems/Remarks
2015/04/27	• Read papers on improvement of marker pose. Particle filter approach implementation check • Made modification of localization to just send (x,y,heading) to the TDM client • Tried making Playback tool with new approach but still not successful	-
2015/04/28	• Fixed bugs in the Kinect Playback tool - Now works perfectly without losing frames. • Particle filter implementation using BFL (Bayesian Filter Library). Experiencing problem in getting it running successfully.	
2015/04/29	• Localization particle filter test. • TDM module walking test not successful. • Helped Katsumata with setting up the Datalogger acquisition	• The way the coordinate values are interpreted in TDM is still unclear.

Date	Content	Problems/Remarks
2015/04/30	• Stanford Natural Language Processing Integration successful. Still have to think how to use it. • Added required messaging proto files for motion recognition and robot behavior (schema change) • Human pose computation and implementation. Plane composed of torso, shoulder left and right is considered to compose the torso frame.	
2015/05/01	• Google Blockly seems to be a good choice for visual programming. So read about it. • Started to integrate Blockly with the client application	
2015/05/02	• Restructuring the web inerface and managed to include threejs viewer and blockly in the app.	

12 2015/05/04-2015/05/10

Date	Content	Problems/Remarks
2015/05/04	• Managed to load properly the robot model into restructured client application • Made custom blocks for Robot behaviors, triggers, actions and priorities. Tried sample code generation from blocks • Improved code editor	-
2015/05/05	• Main program generation using APScheduler and tested for simple gesture to behavior workflow. APScheduler does not work for immediate triggers • Started trying out scriptcs which will enable running csharp programs as scripts. Made sample program. Need to incorporate automatic generation of code from the blockly program • Minor improvements and refactoring	

Date	Content	Problems/Remarks
2015/05/06	• Scriptcs - Main program generation. Made individual scripts for helper classes • Tested auto generation for a given Gesture-Behavior mapping and confirmed the execution. Works well	
2015/05/07	• Blockly csharp code generation bug fixes • Automatic code generation from the blockly. • The blockly block information is sent as JSON string to the server and the server parses the string to dynamically generate the program. Works pretty well • Support for multiple behavior execution in sequence :) • Start and Stop program from the web client • First important milestone reached :)	

Date	Content	Problems/Remarks
2015/05/08	• Created a more sleek behavior definition block. • NetMq pre-release install. Better performance and no exception occurs while application exit • Simulation of robot in the new web interface using the real joint values. Added necessary AJAX interfaces to access the joint values • Tested the behavior execution workflow with the real robot. Works just fine :) • Prepared presentation	
2015/05/09	• Localization information logger node development and testing. CSV export of the collected pose data.	
2015/05/10	• Plotting the collected localization log. Need to collect more data and perform more tests.	

13 2015/05/11-2015/05/17

Date	Content	Problems/Remarks
2015/05/11	• Lab meeting and Meeting with Mr. Vincent Berenz • Implemented Planar pose logger • Started consolidating bibliographic references for ICSORO 2015	-
2015/05/12	• Improvements to Localization module • Multiple behavior each triggered by different gestures support. Adopted Blockly xml format instead of my JSON format. Wrote XML parser to retrieve information about the behavior description	

Date	Content	Problems/Remarks
2015/05/13	• Relative localization visualization on a plane • Added motion based behavior task - meaning while executing the behavior the latest information about the human position and orientation will be considered • Client side - UI modification to enable loading saved behaviors.	
2015/05/14	• Localization parallax error debugging - still without success. • Client Side - Load/Save/Clear program.	
2015/05/15	• Documentation	

14 2015/05/18-2015/05/24

Date	Content	Problems/Remarks
2015/05/18	• Lab meeting • Documentation for conference paper • Prepare for demo	-
2015/05/19	• First year students Lab visit • Behavior description improvement. (Adding gesture counter to be used for various purposes)	
2015/05/20	• Behavior definition block modified to make it flexible • Behavior Program Parser modification. • Expression evaluator added to evaluate an expression dynamically (say boolean trigger for starting and conditional termination of a behavior)	

Date	Content	Problems/Remarks
2015/05/21	• Gesture counter support • Main program modification to support Startup/Gesture Driven/Exit Behavior • Support for execution termination logic (execute once/until a conditon/forever)	
2015/05/22	• Code Refactoring • Documentation • Skeleton display support in the web interface started	
2015/05/23,24	• New blocks added to support sample scenarios for the paper • Conference paper update	

15 2015/05/25-2015/05/31

Date	Content	Problems/Remarks
2015/05/25	• Thesis Documentation start	-
2015/05/26	• Global Symposium on Scientific Breakthroughs • Thesis Documentation	
2015/05/27	• NaoBehaviorModule execution principle modified. Capability to add parameters while calling a behavior • Testing	
2015/05/28	• KinectEx library integration which includes joint smoothing. added joint angle field to the kinect body message • Tried imitating the elbow roll angles with Nao robot by scaling the joint values • Prepare the ros environment for Turtlebot	

Date	Content	Problems/Remarks
2015/05/29	• Nao Imitation module complete flow checked. Automated the joint values scaling and angle computation for each target joint in Nao. Still the sign of the angles are not correct. Need to check and fix.	
2015/05/30,31	• Conference paper update • Thesis documentation	

16 2015/06/01-2015/06/07

Date	Content	Problems/Remarks
2015/06/01	• Conference paper discussion and correction • Crated new gestures needed for therapy experiment • Modified the gesture recognition module to support new gestures.	-
2015/06/02	• Approach behavior modification (test with simulator a dummy walk) • World frame support added in order to find the relative orientation of Nao and human.	
2015/06/03	• Worked on Approach behavior methodology • Fixed lot of bugs in the behavior program execution • Testing	

Date	Content	Problems/Remarks
2015/06/04	• Behavior simple block added • Expressive say with an argument support • Therapy scenario support start	
2015/06/05	• Modified main program execution to support therapy scenario • Fixed the bugs in the ”expressive say with arguments” • Performed the experiment for the ”Therapy facilitator scenario”	
2015/06/06	• Museum scenario - Choregraphe program added • Approach behavior modification	
2015/06/07	• Approach behavior as a combination of pure rotation and translation motions • Museum scenario experiment	

17 2015/06/08-2015/06/14

Date	Content	Problems/Remarks
2015/06/08	• Conference paper update	-
2015/06/09	• Conference paper update • Speech recognition module integration (Microsoft speech platform). Added speech recognition node.	
2015/06/10	• Conference paper update and submission	
2015/06/11	• Behavior description method redesign • Speech recognition Japanese language test	
2015/06/12	• Thesis documentation	

18 2015/06/15-2015/06/21

Date	Content	Problems/Remarks
2015/06/15	• Thesis documentation • Changing behavior description	-
2015/06/16	• Completely changing the way behavior program is defined • Added new run time behavior execution engine and direct code generation from the block description	
2015/06/17	• (Blockly definition $\rightarrow$ C# code generation $\rightarrow$ Dynamic execution) - Implementation and test (ongoing)	

Date	Content	Problems/Remarks
2015/06/18	• Speech Trigger implementation and test • Speech response wait function - added new block, implementation and test • Parallel task execution block - added, implemented • Approach behavior migration to new execution engine	
2015/06/19	• Thesis documentation	

19 2015/06/22-2015/06/28

Date	Content	Problems/Remarks
2015/06/22	• Thesis documentation • Questionnaire discussion	-
2015/06/23	• Thesis documentation • First year students : Choregraphe Lesson	
2015/06/24	• Thesis documentation	
2015/06/25	• Implemented asynchronous robot task execution • FSM for execution of tasks in the robot side and the application side • Fixed priority based premption implementation and test	

Date	Content	Problems/Remarks
2015/06/26	• Thesis documentation • Fixed priority premption test • Parallel task execution test	
2015/06/27	• Software update on GVLab Nao and TagawaLab Nao • Fixed priority premption test in real robot • Parallel task execution test in real robot	
2015/06/28	• Thesis documentation	

20 2015/06/29-2015/07/05

Date	Content	Problems/Remarks
2015/06/29	• Thesis documentation • Questionnaire update • Preparation for user study	-
2015/06/30	• Thesis documentation • Handout preparation	
2015/07/01	• Check approach behavior and fixed bugs • Integrate questionnaire to the application	
2015/07/02	• User study experiment	

Date	Content	Problems/Remarks
2015/07/03	• Thesis documentation • Questionnaire Japanese translation • User test with multiple robots • Integration of IMU with platform	
2015/07/04	• Thesis documentation	

21 2015/07/06-2015/07/12

Date	Content	Problems/Remarks
2015/07/06	• Humanoids 2015 manuscript preparation • Speech recognition using normal microphone • Tuned timing for speech recognition	-
2015/07/07	• Conducted user study with first year students • Humanoids 2015 manuscript preparation • Experiment	
2015/07/08	• Humanoids 2015 manuscript preparation • Thesis documentation	
2015/07/09	• User study experiment	

Date	Content	Problems/Remarks
2015/07/10	• Thesis documentation • Questionnaire Japanese translation • User test with multiple robots • Integration of IMU with platform	
2015/07/11	• Thesis documentation	