

CanSat Leader Training Program (CLTP) Report

October 12, 2012 UN/Japan Nano-Satellite Symposium



Hironori Sahara Department of Aerospace Engineering Tokyo Metropolitan University





OKYO METROPOLITAN UNIVERSITY

首都大学東京



In November 1988 at the University Space Systems Symposium (USSS) held in Hawaii, Prof. Bob Twiggs (Stanford University Space Development Laboratory) proposed "CanSat" concept.

The CanSat provides an affordable way to acquire the students with the basic knowledge to many challenges in building a satellite. Students will be able to design and build a small electronic payload that can fit inside a soda can. The CanSat is launched into high altitude by rockets, balloons and/or aircrafts; and experiments are performed during descent by parachute, simulating the satellite operations in space. Post launch and recovery data acquisition will allow the students to analyze the cause of success and/or failure.











- Established in 2010 to contribute to capacity building in space technology and improve teaching methods based space engineering education
- CLTP provides a training course to experience whole cycle of CanSat development that involves
 - Design , Fabrication, and Launch by a model rocket or a captive balloon
 - Lectures on space engineering and nano-satellite development
- The participants will be expected to make a textbook in their own language for preparing education in their home countries.
- CLTP opened for <u>Academic researchers and educators belong</u> <u>to the University or Research Institute from outside Japan</u>, who wish to learn the hands –on space engineering education methods using CanSat.





LTP1

History



Date: February 14 -March 20, 2011 Venue: Wakayama University, Japan Organized by:



Attendee:12 participants from 10 countries (Algeria, Australia, Egypt, Guatemala, Mexico, Nigeria, Peru, Sri Lanka, Turkey, Vietnam)

CLTP2



Date : November 14-December 14, 2011 Venue : Department of Aerospace Engineering, Nihon University, Chiba, Japan Organized by:



日本大学 Attendee:10 participants from 10 countries (Ghana, Indonesia, Malaysia, Mongolia, Nigeria, Peru, Singapore, Thailand, Turkey, and Vietnam).

University Space Engineering Consortium



CLTPB



Date: July 17 - August 20, 2012 Location: Tokyo Metropolitan University, Hino, Tokyo, Japan Organizers:



TOKYO METROPOLITAN UNIVERSITY

首都大学東京



Supported by:

The 3rd CanSat Leader Training Program July 17- August 20, 2012 Tokyo Metropolitan University, Hino, Tokyo, Japan

CLTP3 CLTP3 CLT

METI

Cabinet Office

Ministry of Foreign Affairs of Japan Ministry of Education, Culture, Sports, Science and Technology Ministry of Economy, Trade and Industry Japan International Cooperation Agency

Cooperated by:



Noshiro Space Event Council

CanSat Launch Experiment have been conducted on the occasion of 8th Noshiro Space Event.





CLTP3 Attendee:

10 participants from 9 countries (Brazil, Egypt, Israel, Lithuania, Mongolia, Namibia, Nigeria, The Philippines

and Turkey). They formed 3 teams.





Sahara Laboratory **Tokyo Metropolitan University**



TOKYO METROPOLITAN UNIVERSITY DEPARTMENT OF AEROSPACE ENGINEERING



CLTP3 Support Members LIST

Hironori SAHARA (Associate Professor) [Supervisor] Winston Churchill says "Success consists of going from failure to failure without loss of enthusiasm." It is very applicable to what we engineers do.



Masachika A. KIJIMA (Assistant Professor) [Assistant] This is sonna be an event to remember!!



Yasuo ARAI (1st year of M.E.) [Support Member] I'm honored to have a chance to participate in CLTPS. Let's make CLTP3 better together! (^o^)



Ryo KAWAHATA (1st year of M.E.) [Support Member]





Shutaro NISHIKIZAWA (1st year of M.E.) [Support Member] Hello. I'd like to see you soon and develop the CanSat together! Let's have a good time in CLTPS!



Mitsuhiro MASUDA(1st year of M.E.) [Support Member] I'll do my best effort and enjoy such a wonderful event, CLTPS!



Keita WATANABE (1st year of M.E.) [Support Member] Hi, I'm looking forward to seeing you, all the CLTP3 participants. Let's enjoy developing the CanSat!



Takehiro OHIRA(Senior Student) [Support Member] I hope we all make skill up together through making CanSat. Let's talk a lot with us. I'd like to see you soon!!







The more I learn, the more I realize I don't know. The more I realize I don't know the more I want to learn



Kenji NAKAJIMA (Senior Student) [Support Member] I'm glad to participate in CLTPS and meet you. Let us enjoy learning about CanSat and making it. I hope you'll have a good time!!

Kentaro NISHI (Senior Student) [Support Member]

I'm looking forward to seeing you. Let's have good days in CLTP3!



RVOSUKE ISHII (2nd year of M.E.) [Adviser]

I'm glad to have a chance to see you, and to study aerospace technology with you. Let's enjoy the life in Japan.

Yoshihide UCHIDA (2nd year of M.E.) [Adviser]



I'm looking forward to meeting you all! Let's eniov CLTPS!!



Kazuhisa YOODA (2nd year of M.E.) [Adviser]

I would appreciate it if you enjoy both CanSat development and everyday in Japan. I expect you feel close to educational space engineering with us.



Yusuke WAKABAYASHI (2nd year of M.E.) [Adviser]

Hi, welcome to our Tokyo Metropolitan university.

Let's enjoy everything!



Special Lecture for International Understanding for TMU students conducted by UNISEC (Mav 11)



Hideki OGURO (Senior Student) [Support Member] Hello. I'm really happy to have a chance of making CanSat together. Let us have a good time in Japan. I can't wait for CLTP3!!

TOKYO METROPOLITAN UNIVERSITY

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Schedule of CLTP3-Overview

Period	Contents
Before CLTP3	 Distribution text namely "Lesson 0" which introduced the Outline of CanSat, its development of environment, basic electronics and tools for CanSat development CLTP3 Briefing (Jul.16)
First Week Jul 17-21	 Inauguration Ceremony(Jul.17) CLTP Basic Course – Lecture Series #1-5
Second Week Jul 22-28	 Akihabara Tour and the 10th UNISEC General Assembly (Jul. 22) CLTP Basic Course – Lecture Series #6-10 Group work on fabrication of an electric circuit system and discussion about CanSat mission
Third Week Jul 29-Aug 4	 Fabrication and testing of FM of CanSat Documents making
Fourth Week Aug 5-11	 Field Test of CanSat by Balloon (Aug.10) Post launch meeting
Fifth Week ^{Aug 12-20}	Field Test of CanSat by Model rocket on the occasion of the 8 th Noshiro Space Event held in Akita, Japan



Schedule of CLTP3-Before CLTP3

Period Contents

Before
CLTP3Text distribution namely "Lesson 0" which introduced the Outline of
CanSat, its development of environment, basic electronics and tools
for CanSat development

LESSON 0

1. Introduction

Before the start of CLTP3, we introduce outline of CanSat and its development environment. We recommend you to read and understand them by your arrival at Japan. As for the versatile products, you can find their information in detail on the corresponding websites.

2. Outline of CanSat in CLTPS

Participants in CLTPS divide into 3 teams, that is, each team consists of 3 or 4 members and has one chance to haunch a representative CanSat with a model rocket in Nochiro Space Event (NSE). Before NSE, each participant has 1 or 2 chances of his/her own flight test by using a balloon in Tokyo Metropolitan University (TMU) or somewhere.

CanSist developed by the participant in GLTP3 is batically defined as a basic combination constitution of one-board computer (OBC), GPG, transmitter (NATR), memory (EEPROM), and ground station (GS) as shown in Fig. 4, and we call it Racic System. Indeet the number of components in Racic System is a few, but their perfectly-harmonized operation is very difficult, and the participants are expected to aim the perfect operation as first priority. NOTE that the members in a team develop a commody/designed team CanSist and all of them are integrated to the team CanSist as a whole system. This style is in common with actual satellite development or project management. If you have surplus time, you may install your team's own mission (MISW) into the team's CanSist. Once again, the participant's first priority is to complete the perfectly harmonized operation of Basic System.



DEPARTMENT OF AFRONPACE ENGINEERING









CLTP3 Briefing at TMU (Jul 16)



Schedule of CLTP3-First Week

Period	Contents
First	Inauguration Ceremony (Jul.17)
Week	
Jul 17-21	





Schedule of CLTP3-First Week

Period Contents

First	CLTP Basic Course – Lecture Series #1-5 (Jul.17-20)
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- Week 1.Introduction to and Overview of CANSAT
- Jul 17-21 2.CANSAT System and Subsystems and Preparation before CANSAT Development

Shinichi Nakasuka, The University of Tokyo Tuesday July 17 9:00~12:00



3. Mission Subsystem

Hironori Sahara, Tokyo Metropolitan University Wednesday July 18 $9:00 \sim 10:30$

4. Structure and Accessary Devices

 Hiraku Sakamoto, Tokyo Institute of Technology
 Thursday July 19 9:00~10:30

5.How to Organize the Project and Design Reviews Seiko Shirasaka of KEIO University Friday July 20 $9:00 \sim 10:30$





Schedule of CLTP3-Second Week

Period

Contents

Second Week Jul 22-28





 ◆ CLTP Basic Course – Lecture Series #6-10 (Jul.23-27)
 6.RF Communication Subsystem and Ground Station System Seiji Kuroki, Professor Emeritus, Soka University Monday July 23 13:00~14:30

7.Sensors and Actuators

Masahiko Yamazaki, Nihon University Tuesday July 24 $9:00 \sim 10:30$



Schedule of CLTP3-Second Week

Period	Contents						
Second Week Jul 22-28	8.Command and Data Handling (C & DH) subsystem and Power System Shinichi Kimura, Tokyo University of Science Wednesday July 25 $9:00\!\sim\!10:30$						
	9. Ground Test and How to Feedback Yasuyuki Miyazaki, Nihon University Thursday July 26 $9:00 \sim 10:30$						
	10.Ground- Field Test and Safety Standards Hiroshi Hirayama, Kyushu University Friday July 27 9:00~10:30						



Schedule of CLTP3-Second Week

Period Contents

Second Week

- Group work on fabrication of an electric circuit system and discussion about CanSat mission
 - Tasks to participants by Dr. Sahara are ...
 - Communication with XBee on PC,
 - Let's try to communicate with each other via Xbee
 - GPS experiment on PC, Let's see your path with positioning.
 - XBee adapter fabrication
 - TOP board fabrication
 - GPS connector change to the one of EH style
 - Harness between TOP and MDL fabrication
 - Then, completion of PIC board needing soldering of surfacemount package. Then, your CanSat will be completed as for





Schedule of CLTP3-Third Week

Period	Contents
Third Week Jul 29-Aug 4	 Fabrication and testing of FM of CanSat Documents making by team in order to share an awareness of the development of a system and confirm soundness of the system

Documents created by CLTP3 participants



ast Up	dated on August 01	8, 2012.							
unba	Anormaly	Occurrence Time	Site of Occurrence	ef Occurrence	Cause	Influence	instrament for Detecting Anomaly	Provision to Avoid Anomaly	Handling when Anomaly Detected
1	Connectans got ung@iggand	Anytime	A consectors	Mporte	faled to make sure the attachments are secure enough	Corresponding signal or electric communication (set	Defect an Internetry Iterve caused by the failure of concerned companents plang the lines of the way logged commodar	 Plate sure to secure attactivents by more than one member Bond the connectors with Cametine X one day before jeanch Confirm the attactivent with work toms memory within the latest the security 	Connect the connector firmly and confirm its soundness with a tester and televiery items
2	Wires/Connectors got unplugged	Azyūre	A connectors	LOW	Vibration caused by Juncher	Corresponding signal or electric communication list	Defect an inferentry items caused by the failure of concerned components aging the lose of the unplugged connector	found the connectors with Cemedine X one day before launch	If there is an apportunity for a second bunch, do to provisions written in W1 before the second bunch.
,	CarGat main switch is OFF	Night before k unch	Switch on TOP board	490	Nalled to respect launch procedures	All function and communication dead	Cannot obtain takenetry: Carnera did not turned 8%	Hate a check bit or documentation of launch procedure and respect it during installation to procedure with the	Turn on the switch, then confirm that the LED is aminated
4	Dattery worl Ocal	AnyOra	Bettery, 175	MEOLE	faled to charge the battery during pre-leanch dates (at leasts day before the leanch date)	All functions and communication dead	Connell obtain takenetiy	Noise a check (at an documentation of pre-Jourch presentary and respect Autority pre-Jourch-dates (at least a day before Jourch date).	Ourge the bullery
5	Supervition switch	CanSul Deployment	Separation corrector	LOW	The metal part on the switch	Communication is dead	General obtain takenetry	Check connection of the SEP connector before \$gt4-	Norver CarSat and check SEP connector-
4	Perachute felled ta	Peredistic	hrechute	NIDOLE	Parischule was not folded	Carsiat will tree to	visually detected after deployment of Canilat.	Propely fail the parachute. Check failing during	After segaration we can do nothing.
,	Paradhute party digitiyutitimangkima of the paradhute	Parachute deployment	Necture	MIDDLE	fanachate was not folded property.	Cantial will free full or have an uncertail edite	Vasally detected after deployment of CanSat	Property fall the parachula, Check faking during installation to carrier and jounds weight	After separation we can do nothing.
,	Demoped and shart-circuited califies	During Battery recharging, maintenance	t lectronic hardware	Mbout	Midhand ing of the Cardiat during fearcation, testing, or maintenance.	CanSalt malfunctioning or will get damaged.	Varial and destriculated ting.	Handle the Cardial property during all stopes of design.	Regisce demoged part or cable,
,	canual drifted too far envay due to strang	Laureh day	Ballom or Canaat Forschulte	Mbore	Minty weather,	May cause jourch abortion or, if Cantat is already dealeyed, it way be drifted too for away.	Youl observation during lounds	Heasare wind speed us ground prior to leach and suspend leavch if wind speed is cutoble of the solety margin.	Track GPS class to help recover Cardial,
50	tis came attacks	ofter separation fram	Cardat	LOW	Separation did not occur	Cannot receive to wantry data Sympany in and CPS and Intel	No data is received during descent.	he sum the SBP connector can be released at second loss instant	Recover Cardial and check SEP contectors
11	OPS mallunctioned	layire	Cantor	LOW	Carnel accure satellies signals; 198 fore other readule	Cannot acquire CanSat position,	Test 075 signal reception in the Dound Station,	Check its integrity before burnch (Ta/Na bell with Klock, Search for EW searces and figure out how to	Check its integrity before journ's (Turka test with X0ee); Search for DM sources and figure out how
12	franszvitter antenna on CanSat and/or on Graund Station is	AnySte	CanSat or Ground Histon	MDOLE	Mishanding: fall off	Attee module damaged	Visal checking the antenna; full is establish communication.	nimente there. Handle the Xites motules carefully.	In Invalid Care, Owce If a connection between Carliet and Erour station can be established. If has not successfe whethan the demaged wherea or the Xibes me
13	Contait is domaged due to the shock when the participate s, dentities and s.	Separation	Cardat structure	NIDOLE	Cecessive shock load due to the drag force.	Rape ring might broke; destronic circuitry can be damaged; CanSat might drop who feel	Visally detected during descent or other recovery	Propelly design of the parachute system bills dure and parachute itself)	There is nothing we can do during descert, Reco the CarSoL identify cause of the problem, and o A in the next design.
14	Prenature unglugging of the separation switch	Launch Wade	teparation plug on the bottom of the can	1851	Rectext vibrations accidental pressing during the Banch mode beaking for GPS starting)	E will make the Cardial onter the descard mode before auth	The ground station will start to receive to emotry detec	Handle the Canital carefully after tarning on the main switch.	Shert circuit again the SEP plug by preveng it. We seconds to guarantee that camera turns off, fram Cardet main switch. Then, you can restart the accordure.
15	lattery failure	Anytive	Auwer System - Tebery	LOW	Sischarge: Helf-Inclining.	The whole subtern can not be furned as an it will not work	System daes not turn on, System mail and landining. 1009 Junt is faint	Reasys check the battery charge - should be around Regulator Viti-SMO1 = 4,2V	Change up the kattery; if it is not enough, considionate the bettery;
16	SD Card Intel RS 184	Baard/Satellite	Battom Board	LOW	SD Card was not inserted	Carnera will not work/recent-	Comors does not start to record when the command is given by QAC.	Be sure the SD Card is properly inserted in the carnets metals also.	Nontrive speciars that block the sligt IF necessary? Heart the SD Cart propeds.
17	Did not inset the SD Card balling assembly of Camera	Battern Baard/Satellite	Bellom Board	LOW	forget to insert the SD-Card before assembly.	Carriera will not work/recent-	Common does not start to record when the commond is given by OBC.	Be sure the SD Card is already inserted before secondly of the camera module.	Remove spacers that block the slat and insert the Card propeds.
18	Demoging the parts shalling subleting	Dourds assembly	tours.	LOW	Wahard ha of the parts or order into	Demage of the part or the bound	Vaal checking circuit malfunctioning	Handle the parts, the board and the adder into preprise	Substitute the part or the beant.
19	Demage of the bellety during	Satalite assemble/maintenary	falloy/Carwis notip	MIDDLE	felloy damaged the overcharge	Sattery-demagnic heating. ooglistice, fire-	Bellery heats las marks	Manage check the carriers mediateled binking during the recharging. Once it has slapped, remove the	Substitute botters-
20	esufficient sattery of the lastop cantoo ing the processisation	Launch	taptagiGraand Station	LOW	United lattery time for the leptop	Oreand statters will be turned off, stagging the receiving of data via XBee Life,	Crecklaping Lattery.	Assess that there is a ways a power supply source and high to feed the grand station gave during a the earch, descent and recovering process.	Get a power supply-
21	Wring cannot an of para during programming	Programming	OPC BOANSMately Seand	LOW	Fir orden tajlected.	Nay damage the ODC.	Can well communicate to the computer.	iss careful when plugging the programmer - pay ettention to the pins order.	Formary programmer connector and to the connecton property. Check If the CBC was not demografy.
22	Certaphy pits during programming the OBC	Propanning	09C Buansi Mittele Board	LOW	Wrong contraction; wrong power level calection during programming	ORI camaged, unders-	true during programming. OBC does not work the way it was designed by code.	the careful often all agging the programmer - pay attention to the pinc order.	Substitute the OEC (the part lise) or the ordina of boards.
23	Failing to match the camera and the camera hole as the can after maintaining the Cantax or recharging the battery or removing the SD	Siructure americally	Carlie	LOW	Watte of the spacers structure: Convex hale on the can was not well mate,	Camera sight is totally ar partially blocked.	Visual checking.	Heasawa carefully the position of the carson laws before damp the hole: Do the hole after conclusion the bottom based assembly, evolvion do estim- read finations in the spaces structure after the can hole is done.	Try FL the spacers structure in a different way: succeed. Use a new car,
24	Card Directed pin slats	During the	Slots on the CanSat	Mboug	Same ditt or small parts may block the pin-skits	The connection calles we had	Finanting a cable is too hard, the pin sists may team because	Work en Candiel in dean (desidered) environment	name of the stat or the small part spectrug the sides. Fit is not possible the pert with the pin side

Mission Plan

Contingency Plan

System Specification





Schedule of CLTP3-Fifth Week

Fifth Week Aug 12-20

Period

 Field Test of CanSat by Model rocket on the occasion of the 8th Noshiro Space Event held in Akita, Japan





Contents

21:20:21 91/80/2102







Japanese Culture Program – Tea Ceremony kindly organized by citizen volunteers



Awarding Ceremony on the occasion of The 8th Noshiro Space Event <image>

Certificate of Completion



Comments on CLTP3 and Vision for future by participants



Brazil

The following topics give an overview of the future activities I am willing to implement:

1 – Organize workshops in my university to spread the knowledge about the CanSat program;

2 – Attract students (grad and undergrad) from several engineering course (mostly electrical and mechanical) to start teams focused on develop their own CanSats from scratch;

3 – Set up an internal competition in the engineering school of USP;

4 – Gather people to form teams to the international competitions.



Egypt

I plan to contribute to CanSat Training Programs (CTP's) in my country. I hope I and my students could develop new ideas for the CanSat.

I hope this program grow further to making Cube-sat. This could be the second level for successful participants of Can-Sat.





I hope I will be able to run such a program in Israel.

Lithuania

Establish some sort of UNISEC in Lithuania and propagate space engineering for students who's studying electronic and electrical Engineering;

Making CanSat and Open class competitions in Lithuania and participate in foreign country competitions; and

Extend Avionic study program implementing space engineering subjects



I want to learn more features to develop my Cansat and also to educate more number of capacities from my country to support national space education development program, studies, practical activities and scientific research centers. Final vision to be launched Mongolian satellite if possible in near future. And also to develop capacity of the Mongolian university students in satellite technology by conducting similar training and mentor students to participate in local, national and international projects.







Turkey

I am planning to extend the information and experience I gained in the program both to our students and in the near future to the highschool science teachers and students in order to increase the awareness on space technology in the public

Nigeria

To add more features to my Cansat and participate in the Nigerian homemade satellite to be launched in Nigeria by 2030. To develop capacity of the Nigerian University students in satellite technology by conducting similar training in Nigeria and mentor the students to participate in international projects.

The Philippines

My vision is to use CanSat as a starting point to build the capacity of the Philippines in space engineering especially micro/nano satellite development.

I am looking forward to promoting and capacity building Space engineering, and Space technology applications in Namibia. Encourage my students to participate in international competitions and setting up UNISEC NAMIBIA.









Activities of alumni after completing CLTP

These are the Alumni's activities after returning to their home countries.

Activity Progress Report from Egypt (May 2012)

CanSat Training Seminar and lectures have been held by Cairo University, Egypt as below



CTP1: First Can8at Training Program July 20 - 1 August 1, 2011



EED: Egyptian Engineering Day, First Place Award for the Best Mechanical Engineering Project, September 6-8, 2011



CTP2: Second Can8at Training Program Jan 25– February 5, 2012

Through Dr. Khali's efforts, the CTP2 students (2nd CanBat Training Program in Egypt) won the first place of famous student competition during a research conference in Egypt organized by the American University in Calico and titled "Entrepreneurship and innovation: Shaping the Future of Egypt". The paper title was "National e -commerce Rescue from Internet-cut off crisis using Nano-stallate Constellation".



The first CanSat Training Program was held in Mongolia (May 2012)



Netional University of Mongola and Mongolari University of Science and Technology have conducted shortterm Central training originary from April 19-23. They will hold the 2nd program around the model of December co-agenetas by UNESCO.

News from Indonesia 2011

Cansat Training Program (CTP 2012) has started



Openig Bessions by Dr. Agrianto Eko Putra (CLTP2 participant)

Censel Training Enginemi (CTP 2012) for 3 months for students has stated since. Jan 11, 2012 In Aerospace and Empedded Explorituals Research group (AEROS) (Dect. of Computer Solenze and Electronical Statuly of Methematics and Natural Eclences, <u>Universities Gardian Masie</u>, Yogyekarta, Indonesia. Click <u>have</u> for Dr. Pulyes Bips.

Recent Activity Information from Ghana 2011

The first conference on Space and Satellite technology was held



http://www.cltp.info/activities.html



CLTP4 First Announcement



The 4th CanSat Leader Training Program (CLTP4)

First Announcement



Autumn 2013, Japan

What is CLTP?

The CanSat Leader Training Program(CLTP) was established in 2010 to contribute to capacity building in space technology and improve teaching methods-based space engineering education.

Education using CanSat will be available in more than half of nations (about 100 nations) in the world by the year 2020.

History

1^a CLTP : Feb 14-Mar 20, 2011/94/akayama Univ 2^{ad} CLTP : Nov 14-Dec 14, 2011@Nihon Univ 3^{ad} CLTP : Aul 17 -Aug 20, 2012@Dfokyo Metropolitan Univ

Expected Participants

Academic Researchers beiong to the University or Research Institute from outside Japan Applicant eligibility Requirements

What is CanSat?

The CanSat provides an affordable way to acquire the students with the basic knowledge to many challenges in building a satellite. Students will be able to design and build a small electronic payload that can fit inside a soda can. The CanSat is launched and ejected from a rocket or a balloon. By the use of a parachute, the CanSat slowly descends back to earth performing its mission while transmitting.

telemetry.

Post launch and recovery data acquisition will allow the students to analyze the cause of success and/or failure.







Further Information including Participation Faces and Application Submission details will be available on the 2nd announcement to be made soon.

CLTP Office c/o University Space Engineering Consortium(UNISEC) E mai: dtp-officeBunisec.jp URL: www.ctp.into Further Information including *Participation Fees and Application Submission details* will be available on the 2nd announcement to be made soon.

File program is granted by the layer Code/of the Hermotics of Ginese (GR)/Hermotic Harding Program for World Landing Interactive HECon Education Technology (FHET Program)," instanted by the Exact Technology PRES (File).

Thank you very much!

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