Sri Lanka Institute of Information Technology

PROJECT REGISTRATION FORM

The purpose of this form is to allow final year students of the B.Sc. (Hon) degree program to enlist in the final year project group. Enlisting in a project entails specifying the project title and the details of four members in the group, the internal supervisor (compulsory), external supervisor (may be from the industry) and indicating a brief description of the project. The description of the project entered on this form will not be considered as the formal project proposal. It should however indicate the scope of the project and provide the main potential outcome.

PROJECT TITLE (As per the accepted topic assessment form)	Train robot to climb stairs
RESEARCH GROUP **(as per the Topic assessment Form)**	Robotics & Intelligent Systems
PROJECT NUMBER	(will be assigned by the lecture in charge)

PROJECT GROUP MEMBER DETAILS:

	STUDENT NAME	STUDENT NO.	CONTACT NO.	EMAIL ADDRESS
1	Jayawardana J.T.H	IT18216974	0753481647	it18216974@my.sliit.lk
2	Dilshan H.V.V	IT18217100	0713025880	it18217100@my.sliit.lk
3	Wijethilaka R.G.K.H	IT18220834	0717580125	it18220834@my.sliit.lk
4	Balasooriya T.D	IT18212150	0766409604	it18212150@my.sliit.lk

SUPERVISOR, CO_ SUPERVISOR Details

SUPERVISOR Name	CO-SUPERVISOR Name
Mr. Samantha Rajapakshe	**Mr.S.M.B.Harshanath**
Signature	**Signature**
Attach the email as Appendix 1	Attach the email as Appendix 2
16/07/2021	**16/07/2021**

PROJECT DETAILS

Brief Description of your Research Problem:

The purpose of creating robots is to help humans by perform difficult tasks or to facilitate human tasks. In doing so, some robots need to move from one place to another place without the help of humans. In such a case, the robots have to walk on a flat surface, a rough surface, or climb stairs. This makes it very difficult for robots to maintain their balance on climb stairs.

[1] J. Luo *et al.*, "Robust ladder-climbing with a humanoid robot with application to the DARPA Robotics Challenge," *Proc. - IEEE Int. Conf. Robot. Autom.*, pp. 2792–2798, 2014, doi: 10.1109/ICRA.2014.6907259.

[2] D. Aguilera-Castro, M. Neira-Cárcamo, C. Aguilera-Carrasco, and L. Vera-Quiroga, "Stairs recognition using stereo vision-based algorithm in NAO robot," *2017 Chil. Conf. Electr. Electron. Eng. Inf. Commun. Technol. CHILECON 2017 - Proc.*, vol. 2017-Janua, pp. 1–6, 2017, doi: 10.1109/CHILECON.2017.8229674.

[3] S. Oßwald, A. Görög, A. Hornung, and M. Bennewitz, "Autonomous climbing of spiral staircases with humanoids," *IEEE Int. Conf. Intell. Robot. Syst.*, pp. 4844–4849, 2011, doi: 10.1109/IROS.2011.6048209.

[4] S. Caron, A. Kheddar, and O. Tempier, "Stair climbing stabilization of the HRP-4 humanoid robot using whole-body admittance control," *Proc. - IEEE Int. Conf. Robot. Autom.*, vol. 2019-May, pp. 277–283, 2019, doi: 10.1109/ICRA.2019.8794348.

Description of the Solution:

In the solution we are proposing robot could climb stairs without help of human. By considering how the humans climb steps and the biological changes of their body, we expect to implement new stair climbing system.

The identification of human movement is the main source to implement the system. Vision is the most important part to identify objects. Human has eyes to identify objects, view of human is 3D so that could identify depth and get an idea about the move speed. Other than that, humans have 4 main senses: hearing, smell, touch and taste. Our sensors include the ears, nose, skin and tongue. Additional sensors include temperature sensors, body position sensors, balance sensors and blood acidity sensors.

As a result of that the humanoid robots are made with cameras and some sensors.

Using that cameras robot can identify objects like human. There is different type of sensors, that are specialization for a task. As an examples light and ultrasonic sensors are like eyes to vision, sound sensors are like ears to hear, touch, temperature and pressure sensors are like skin to sense touch.

The system firstly identify staircase, then take measurements of that staircase. Such as height of the step and width of the step. Finally, according to those inputs, it generates whole body climbing trajectory. That measure how much legs want to move, speed of the movements and how the body should behave. This system maintains body stability by considering the center of mass.

Main expected outcomes of the project:

Robots walk everywhere by identifying the environment objects. So that, according to this research robot need to clearly identify staircases. If not, the robot may fall down or stop its movement, because robot do not know it is a staircase, so it tries to walk same as the flat surface.
As an example, when robot bring some foods to a customer, if there is a staircase to reach the customer, the robot could not move to relevant location.

The main part of this research is to take the stair dimensions. because all these calculations depend on the dimensions.
The need to take the dimensions of the stairs is that when considering the stairs, they have their own height, width, and range. It is therefore imperative to calculate the dimensions of each staircase separately.

Once the robot identified the height and the width of stairs according to the range, it would do some calculations regarding how much the legs should move. Using motion controller.

There is an upright pose controller to allow robot to walk stably by preventing tilting of the robot during walking on uneven floor. In order to for us to do that we need to calculate the global inclination of the floor is a key factor. it can be measured by A 2-axis accelerometer, and it is installed in the inertial sensor.

WORKLOAD ALLOCATION

MEMBER 1	**Detect the staircase**

The main characteristic of a stair is that it has rigid form with periodic patterns. In the vision-based techniques detected stairs from monocular images by looking for concurrent lines, low texture regions satisfying some simple geometrical rules.

Therefore, robot need to learn using some data set. That data set includes different views of a staircase model. These approaches can be grouped based on the sensors and algorithms used.

The identified images from the image sensors could get as an input. Those images can analyses using the supervised learning (Convolution Neural Network) method in deep learning, because there is a data set. The Convolution Neural Network are frequently used in image classification due to their high accuracy. Based on that the robot will learn to classify staircases.

MEMBER 2	**Get dimension of staircase**

If robots recognize environmental objects as stairs, then a state transition algorithm for intelligent path planning of the robot is suggested. Further, a stereo vision module with a line laser is considered, in order to detect the stair dimensions.

MEMBER 3	**Move robot's legs on the staircase**

It would do some calculations regarding how much the legs should move after robot use real-time control and predict motion control to go to next step of staircase.

Real time controller approach dimension of staircases and motion controller use go to next step of staircase.

MEMBER 4	**Maintain stability of robot**

There is an upright pose controller to allow robot to walk stably by preventing tilting of the robot during walking on uneven floor. In order to for us to do that we need to calculate the global inclination of the floor is a key factor. It can be measured by A 2-axis accelerometer, and it is installed in the inertial sensor.

DECLARATION

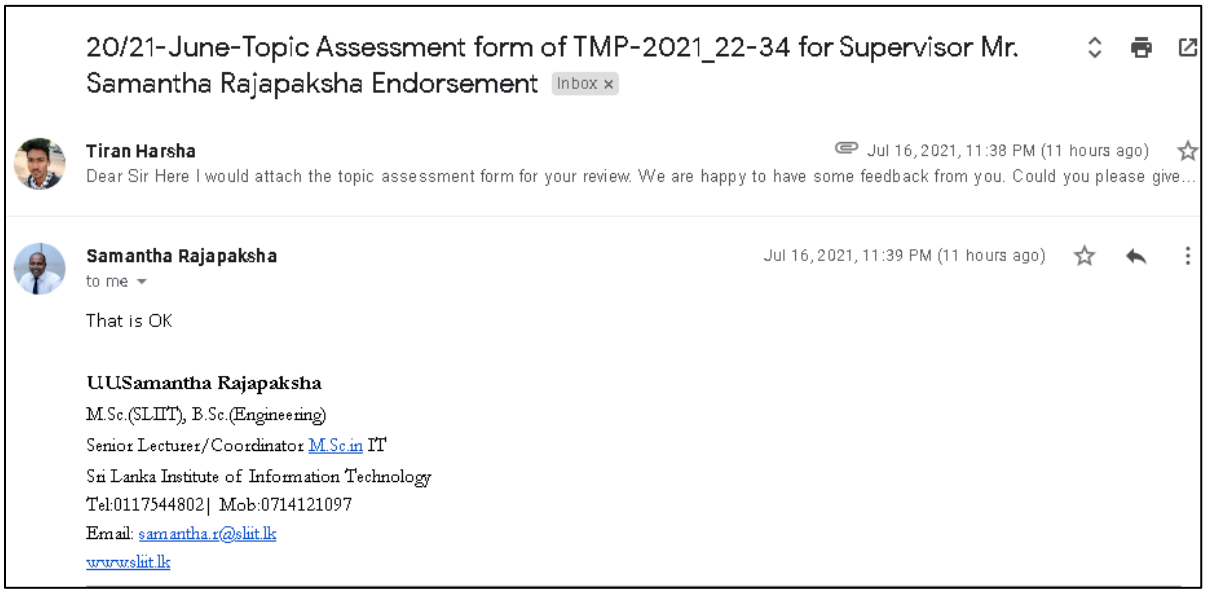
"We declare that the project would involve material prepared by the Group members and that it would not fully or partially incorporate any material prepared by other persons for a fee or free of charge or that it would include material previously submitted by a candidate for a Degree or Diploma in any other University or Institute of Higher Learning and that, to the best of our knowledge and belief, it would not incorporate any material previously published or written by another person in relation to another project except with prior written approval from the supervisor and/or the coordinator of such project and that such unauthorized reproductions will construe offences punishable under the SLIIT Regulations.

We are aware, that if we are found guilty for the above mentioned offences or any project related plagiarism, the SLIIT has right to suspend the project at any time and or to suspend us from the examination and or from the Institution for minimum period of one year".

	STUDENT NAME	**STUDENT NO.**	**Signature**
1	Jayawardana J.T.H	IT18216974	
2	Dilshan H.V.V	IT18217100	
3	Wijethilaka R.G.K.H	IT18220834	
4	Balasooriya T.D	IT18212150	

Appendix 1

Supervisor reply email



20/21-June-Topic Assessment form of TMP-2021_22-34 for Supervisor Mr. Samantha Rajapaksha Endorsement Inbox ×

Tiran Harsha Jul 16, 2021, 11:38 PM (11 hours ago)

Dear Sir Here I would attach the topic assessment form for your review. We are happy to have some feedback from you. Could you please give...

Samantha Rajapaksha Jul 16, 2021, 11:39 PM (11 hours ago)

to me

That is OK

U.U.Samantha Rajapaksha
M.Sc.(SLIIT), B.Sc.(Engineering)
Senior Lecturer/Coordinator M.Sc.in IT
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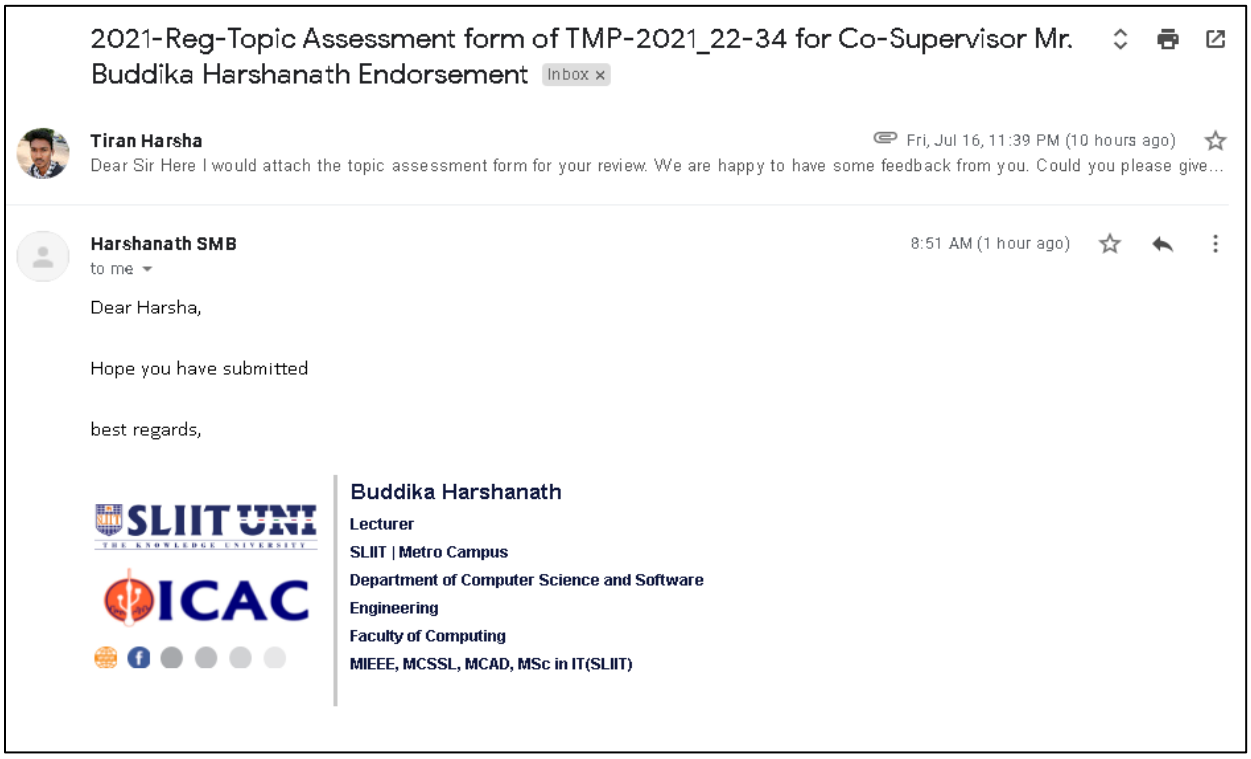
Appendix 2

Co-supervisor reply email



2021-Reg-Topic Assessment form of TMP-2021_22-34 for Co-Supervisor Mr. Buddika Harshanath Endorsement Inbox ×

Tiran Harsha Fri, Jul 16, 11:39 PM (10 hours ago)

Dear Sir Here I would attach the topic assessment form for your review. We are happy to have some feedback from you. Could you please give...

Harshanath SMB 8:51 AM (1 hour ago)

to me

Dear Harsha,

Hope you have submitted

best regards,

Buddika Harshanath
Lecturer
SLIIT | Metro Campus
Department of Computer Science and Software Engineering
Faculty of Computing
MIEEE, MCSSL, MCAD, MSc in IT(SLIIT)