DESIGN AND MANUFACTURE OF RECONFIGURABLE ROBOTS FOR RESCUE EARTHQUAKE VICTIMS

IR. UDINK AULIA M.ENG

IR. SYAHRIZA M.ENGSC

DR. IR. MUHAMMAD DIRHAMSYAH MT

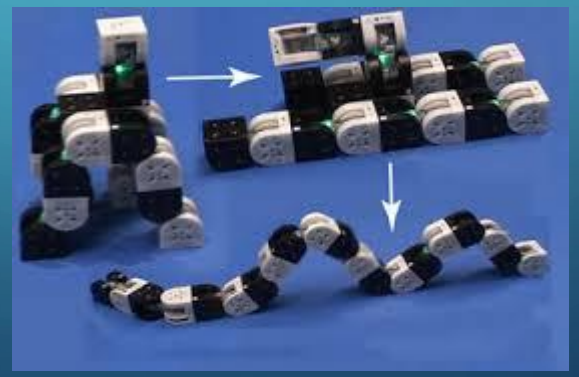
MECHANICAL ENGINEERING DEPARTMENT
ENGINEERING FACULTY SYIAH KUALA UNIVERSITY
2018

COLLAPSE BUILDING

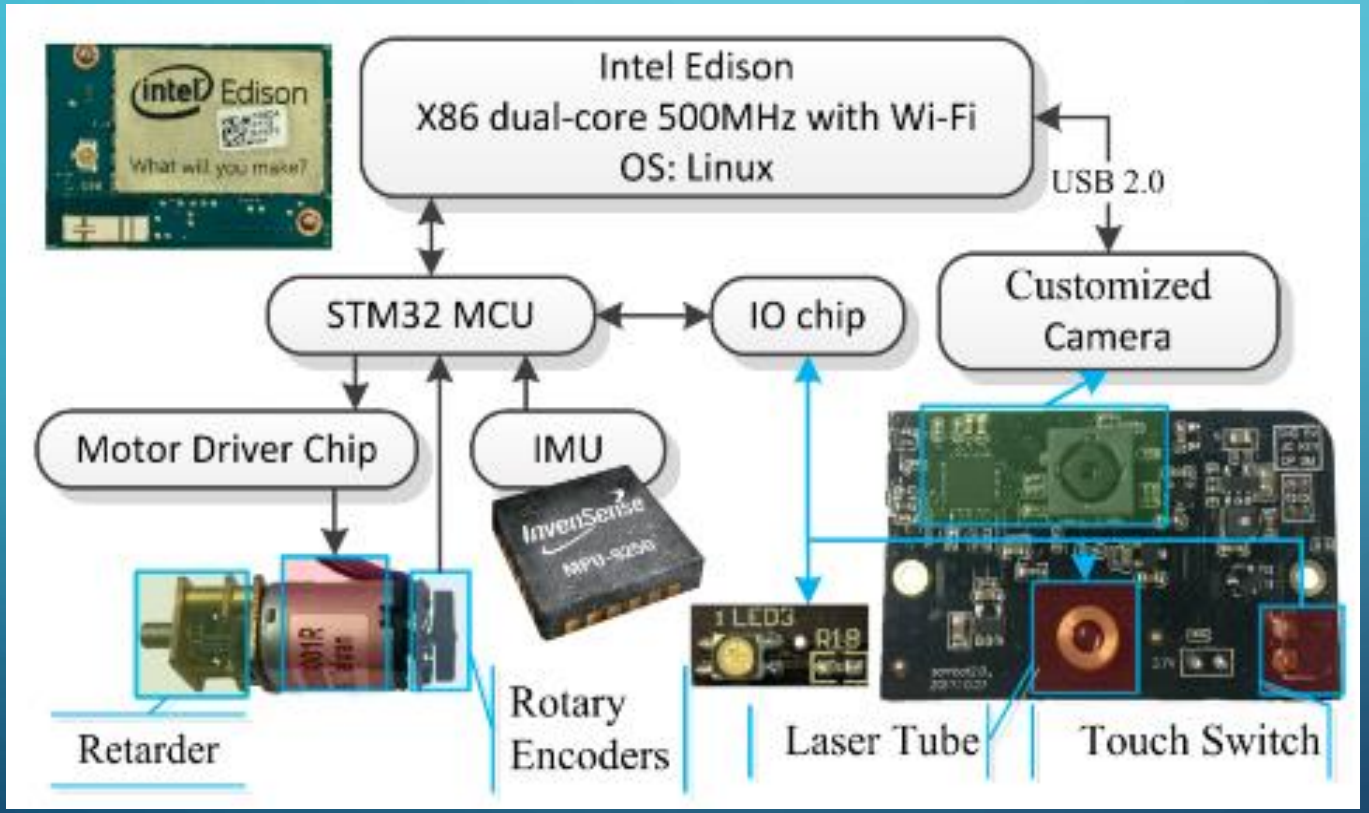
TECHNOLOGY TO HELP RESCUE WORKER

- Snake robot

- Modular Self reconfigurable Robot

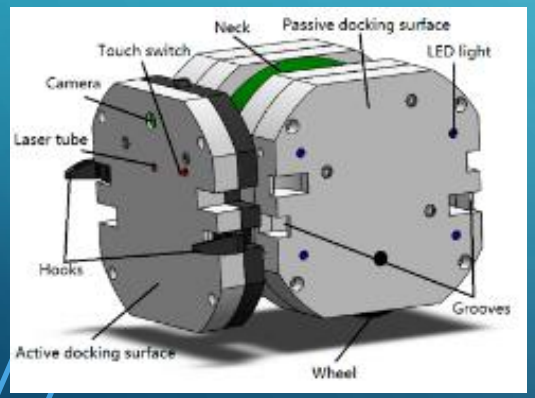


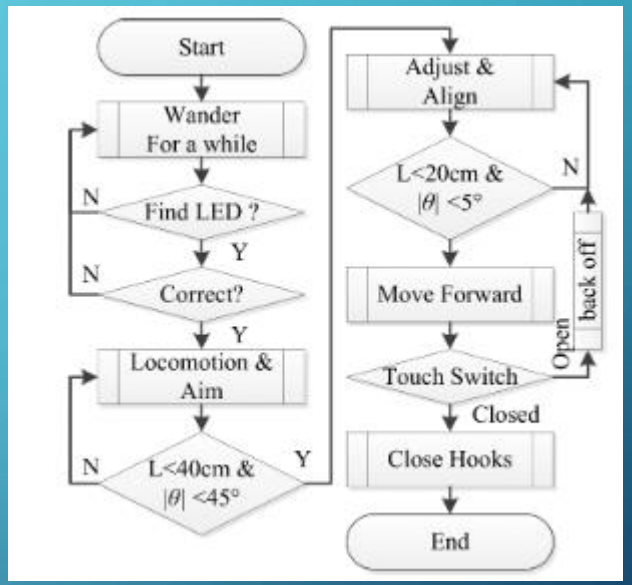
CONTROL


Intel Edison
X86 dual-core 500MHz with Wi-Fi
OS: Linux
USB 2.0
STM32 MCU
IO chip
Customized Camera
Motor Driver Chip
IMU
Retarder
Rotary Encoders
Laser Tube
Touch Switch

DOCKING PROCEDURE

1. wandering and searching phase;
2. position and angle adjustment phase; and,
3. docking phase



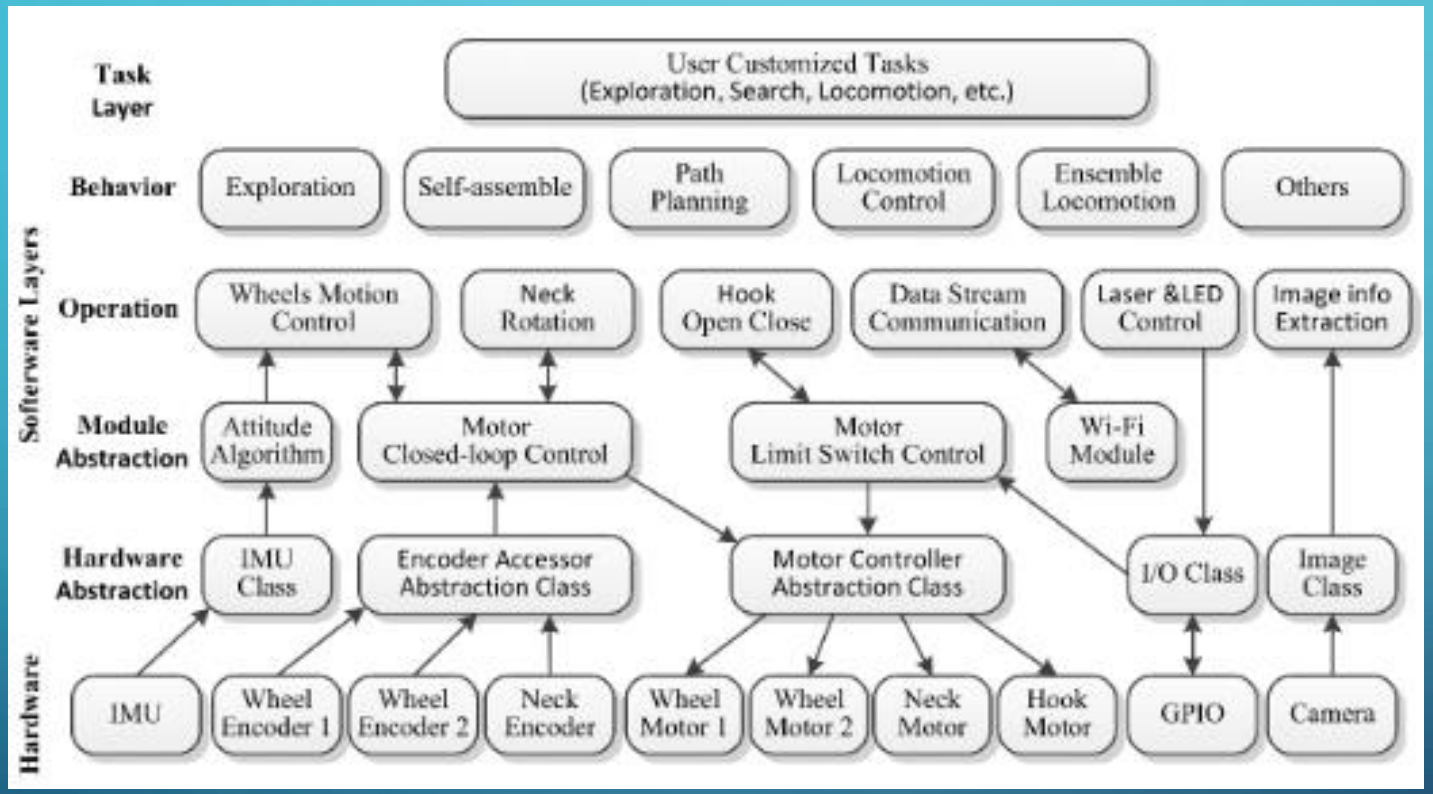


In this step, the active robot wanders under a certain strategy to explore and search for the correct passive docking surface whose LED lights formed a specific pattern. After finding the target passive docking surface, the robot will enter the next phase

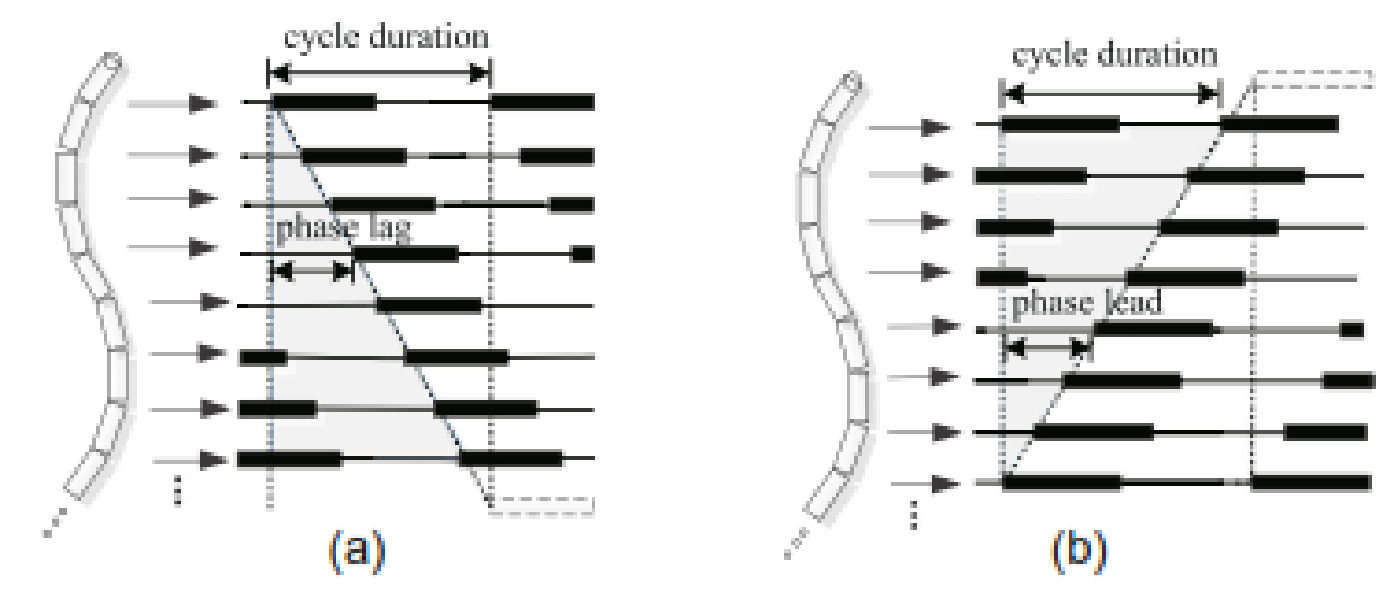
During this phase, a series of adjusting movements need to be performed. In each adjusting
movement, the active robot rotates at first to adjust its orientation and then moves forward to adjust its
position.

In this phase, the robot opens its hooks and moves forward until it contacts the passive docking

SOFTWARE ARCHITECTURE



PHASE RELATIONSHIP IN ADJACENT JOINT OF A SNAKE ROBOT



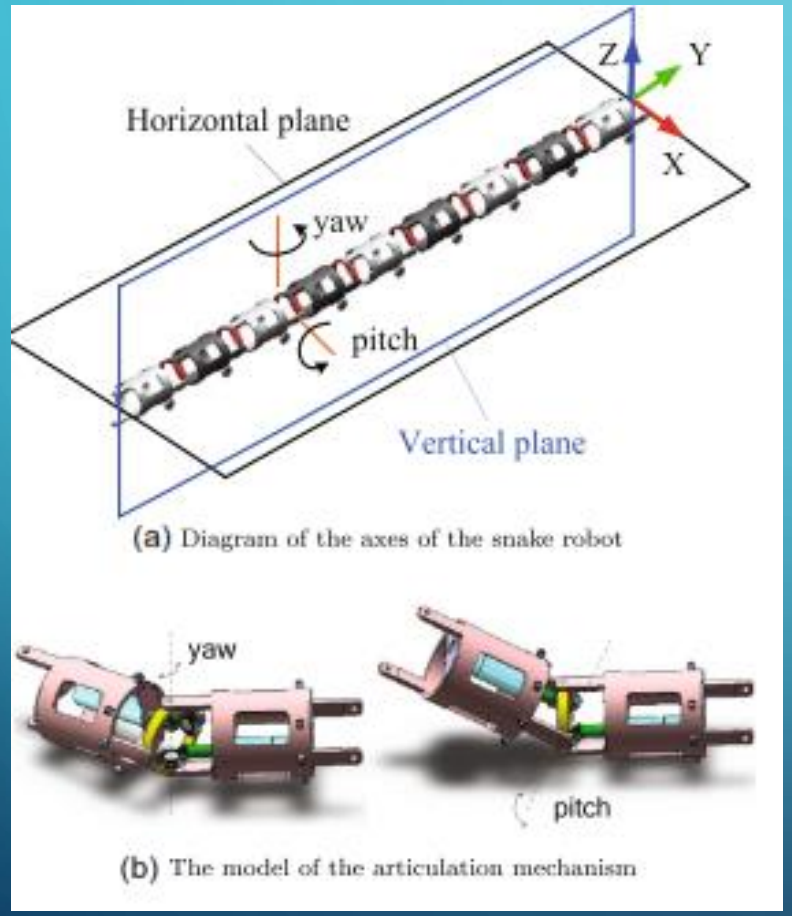
a a phase lag between neighbor segments during forward serpentine locomotion

b a phase lead between neighbor segments during backward serpentine locomotion.

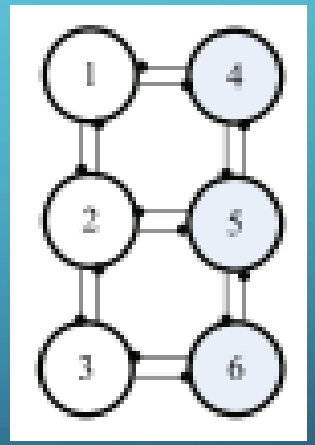
SNAKE LOCOMOTION

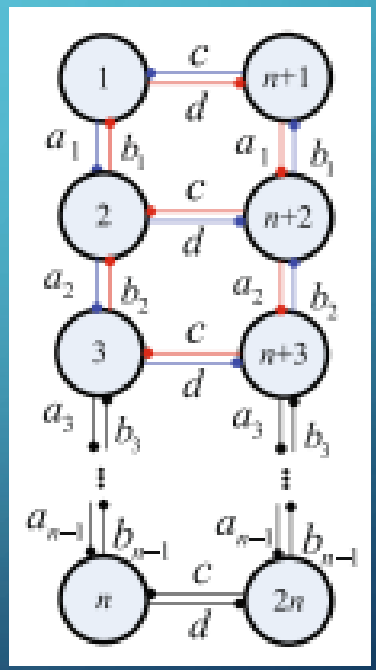
- Snakes use a wide variety of gaits such as serpentine locomotion, inchworm-like locomotion and sidewinding locomotion that make them survive with high adaptability in complex environment.

CPG (CENTRAL PATTERN GENERATOR) CONTROLLER



A simulated model of a snake





Topological structures with six coupled Hopf oscillators: **a** two-way double chain

MAIN PARAMETER SNAKE ROBOT

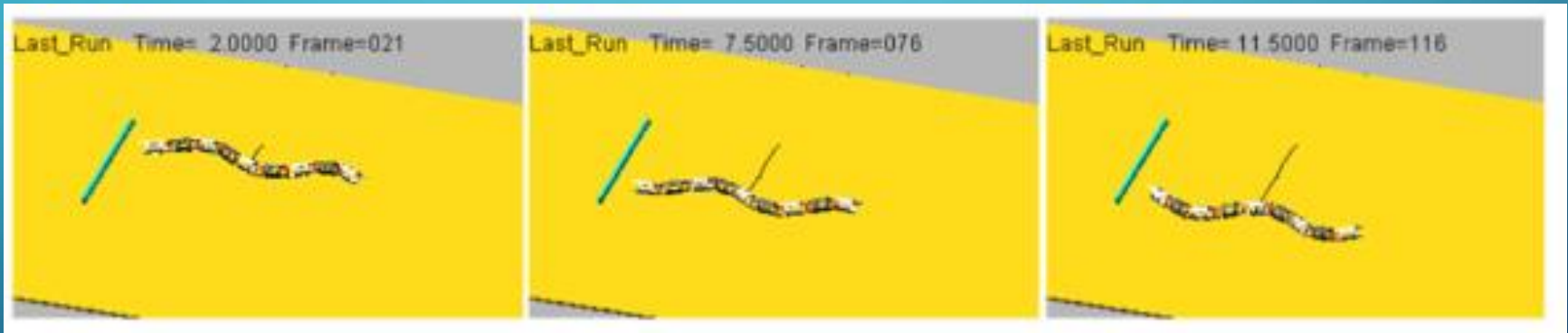
Table 1 Main parameters of the snake robot

Parameters	Values
Snake Unit	10
DOF of a joint	2
link length(m)	0.18
link radius(m)	0.08
Joint torque(N.m)	0.96
Motion range of pitch angle(°)	[-40,40]
Motion range of yaw angle(°)	[−40,40]

Table 2 CPG parameters to generate rhythmic output during the serpentine locomotion

Parameters	Values
ω_i(Hz)	1
ρ_L(rad)	$\pi/6$
ρ_R(rad)	$\pi/6$
δ(rad)	$\pi/5$
φ(rad)	$\pi/2$
a	0.4
b	1
c	0.9
d	1
λ	0.75
k_{min}	4

SIMULATION OF SIDEWINDING GAIT



The screenshots of the simulated snake robot during the sidewinding gait on ADAMS. Main parameters are ω =1Hz, ρ = p/6rad, ρR= p/36 rad, φ = p/2rad, d = 3p/10 rad
L

Thank you