MK02-BEAMstiquito (“The Insect”) Walking Robot

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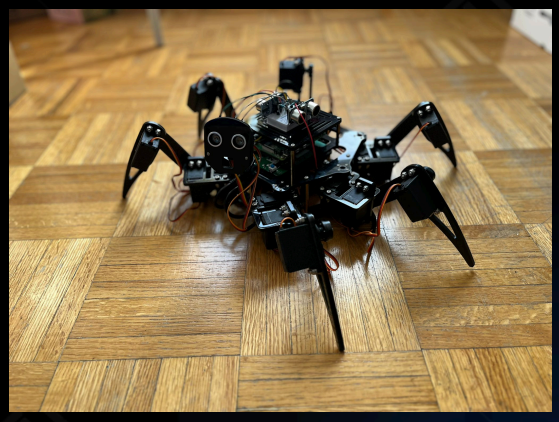
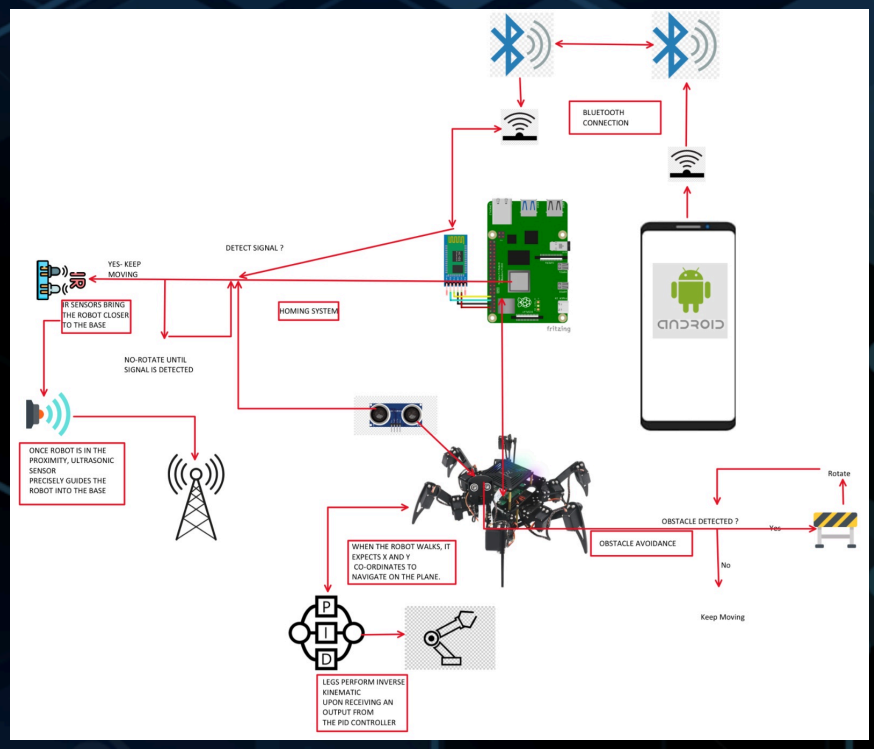


OBJECTIVE AND PURPOSE

In today's increasingly complex environments, our proof-of-concept BEAM insect/spider robot (45cm x 38cm x 10 cm) is capable of performing tasks such as implementing a complex walking kinematics, obstacle avoidance using software and bridging it with sensors, autonomous homing using Ultrasonic and Infrared sensors and base detection algorithm, and more, all using a simple touch on a phone. From navigating challenging terrains to scouting in hazardous areas, its unique abilities provide a promising purpose in tasks such as search and rescue operations,accessing hazardous environments, surveillance, etc. where accessibility of humans is restricted. By bridging the gap between human intervention and autonomous functionality, it brings a new era of efficiency and safety in diverse real-world scenarios.

DESIGN CHALLENGES

- Walking kinematics: Enable a robot with 6 legs and 18 degrees of freedom to move around in a flexible way. With so many possibilities of motion, how do we find a reasonable and effective solution?
- Obstacle Avoidance: Understanding sensory technology and how to process its data to help robot avoid simple obstacles.
- Wireless Communication: Decide the most efficient and suitable communication protocol that can be used for this project and develop an application that implements Socket programming for the selected protocol to work.
- Homing System: Develop a signal matching system that when performs a handshake, enables the robot to execute an autonomous home guidance algorithm.



APPROACH

To realise the design challenges of this project, the following approach for the respectives tasks was taken:

- Research was done on typical methods for controlling a hexapod. After making design considerations, a physically accurate 3d model of the robot was created and the robot movement was simulated on computer software. The code was then translated onto the physical robot and fine tuned to account for real world differences.
- Various sensory technologies and obstacle avoidance algorithms were studied. The algorithms were filtered out based on complexity and limitations of the selected sensor data. A simple avoidance strategy was implemented by testing and utilising the movements based by honouring threshold distance.
- Bluetooth remains to be the most suitable communication protocol for this project as it provides low latency and does not require IP. We started by developing a sample test application to gain experience and over the Winter semester, developed an app that implemented Bluetooth-Socket programming.
- After multiple design analysis, we came up with a home detection system where the robot detects a IR sensor transmitted signal which when received, starts moving towards it. If the path is obstructed, it will rotate and re-detect the signal until it reaches its destination.

DEVELOPMENT ENVIRONMENT

- Communication System: Java - Android Studio IDE
- Robot Movement Simulation: WeBots, Blender
- Obstacle and Collision Avoidance: piOS - Raspberry Pi 4B+
- Homing Mechanism: Arduino Bootloader (C/C++)

CONCLUSION

Our team was successfully able to meet the design challenges as mentioned above. However, the homing mechanism was implemented but not integrated with the project due to time constraints.

DEMONSTRATION




ACKNOWLEDGEMENT

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