**Pipe Navigation Robot for Leak Detection Purposes**

Final Report

**G.M. Thomson**

12075672

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Study leader: Dr. le Roux

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| **Description of Product** |

This report describes work carried out on the design of a pipe navigating robot, with the objective of detecting elbows and branches in a pipe network. Once elbows and branches had been detected the robot was required to automatically transition from a horizontal to a vertical pipe and vice versa.

From the literature it was deduced that a wall-press wheel type hybrid robot was one of the more effective designs for pipe navigating robots in a network with vertical segments. The chassis of the robot was design from first principles in SolidWorks. The robot was designed to apply a unilateral force with the use of a scissor mechanism (controlled with a rotary actuator) to the walls of the pipe to hold its weight in a vertical pipe. The chassis was designed to allow the robot to rotate about its z-axis in the pipe to re-position itself relative to an elbow or a branch in a pipe network efficiently. The unique robot design was mathematically analyzed to verify the validity of is functions, such as navigating up a vertical pipe as shown in **Error! Reference source not found.** (a). The proximity sensors were designed from first principles and used light based technology to detect the elbows and bends in the pipe network. The controller chosen for this project was the Pic32 and was enhanced with analogue MUX’s to expand the number of available I/O pins. The Pic32 represented the central control of the robot and was used to obtain sensory data and control the rotary and driving actuation. The robot was controllable with an android application via Bluetooth.

The robot was capable of traversing a horizontal and vertical straight pipe at a faster rate than specified. The proximity sensors were able to accurately detect branches and bends perpendicular to the robot whilst moving, consequently improving the automation of the system. The robot was capable of automatically transitioning from a horizontal to a vertical pipe and vice versa through a bend. The operator had full control over the robot per the instruction list, see section **Error! Reference source not found.**. Additionally the robot was capable of passing over contaminants with a height of 8mm within a 200 mm pipe.

The unique design of a pipe navigating robot had the ability to navigate through simple pipe networks. Navigation through a branch with adequate grip presented a challenge for the robot due to the required rotation about the z-axis in the pipe and as such would require further investigation and experimentation.

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| Project records |

# System block

# Systems level description of design

# Block diagrams of modules

## Block diagram of module 1

# Description of modules

## Description of module 1

# Description of interfacing with other modules

# Complete circuit diagram

# Description of circuit

# Circuit diagrams of modules

## Circuit diagram of module 1

# Description of circuit diagrams

## Description of module 1 circuit

# Timing diagrams

# VHDL code

# PC board layout

# Components placement on the board

# Wiring diagram of the product mounted in the enclosure

# Mechanical design

# Acceptance test procedure

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# User guide

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