OTTER RFID ANTENNA SYSTEM

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Introduction

- Recent increase of otter population
- Fish hatchery owners concerned
- Track and study otter movement
Objectives

- Identify and log otter movement
- Data easily accessible to researchers
- Develop a low cost, energy efficient system
RFID Antenna System

PIR Motion Sensor

PCB Power Supply

PCB

MOSFET Switch and RS-232

PIR Motion Sensor

RFID Receiver Unit

12V Battery
PCB

- 32 mil wire traces
- Test points
- PIC programmable interface
PIC Clock Speed Testing

\[ f = 4\text{MHz} \]

\[ \Delta X = 250.00\text{ns} \quad \frac{1}{\Delta X} = 4.0000\text{MHz} \quad \Delta Y(1) = 0.00\text{V} \]
PIR Motion Sensor

- Minimal power consumption
- Switches power with movement detection
- Provides information on movement direction
## Motion Sensor Power Consumption

### 5V Supply

<table>
<thead>
<tr>
<th>Sensor State</th>
<th>Current (mA)</th>
<th>Power (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>0.120</td>
<td>0.6</td>
</tr>
<tr>
<td>Active</td>
<td>19.68</td>
<td>98.4</td>
</tr>
</tbody>
</table>

### 3.3V Supply

<table>
<thead>
<tr>
<th>Sensor State</th>
<th>Current (mA)</th>
<th>Power (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>0.119</td>
<td>0.3927</td>
</tr>
<tr>
<td>Active</td>
<td>2.563</td>
<td>8.4579</td>
</tr>
</tbody>
</table>
RFID Receiver Power Supply Unit

- 12V car battery
- Solar panel charges it
- A switch is used to manually switch power
Solar Panel

- Charges and maintains the voltage of the battery
- Built-in overcharge protection and blocking diode
- Faces South, about 40° from the horizontal (latitude)
**Solar Panel Efficiency**

- Solar panel Rating $= 0.3A \times 4.2h \times 7\text{days}$
  $\approx 8.82\text{Ah/week}$ (4.2 hours of sunlight per day)

- Receiver Unit battery usage
  $= 310mA \times 0.58\text{hours/week} \approx 0.543\text{Ah/week}$
MOSFET and Op-AMP

- **MOSFET**: Turns on the CTL module only when motion is detected.

- **Op-amp**: Increases input voltage of the gate of the MOSFET.

\[
\frac{V_{out} - V_{in}}{V_{in}} = \frac{R_b}{R_a} = \frac{15k}{33k} = \frac{3}{7}
\]

\[V_{out} = 4.8 \text{V}\]
Block Diagram of Switching Circuit

12 V

12 V Voltage Regulator

From RFM module

CTL-MB2B Control module

5V Voltage Regulator

MAX 232N

33k-ohm

15k-ohm

3.3v

4.8v

OP Amp

Switching Circuit

MOSFET

D

G

S
TI RFID LF 134.2 kHz Antenna

- Reads the Passive Integrated Transponder (PIT) tags
- Uses inductive coupling to provide power to the PIT tags
- The antenna sends the unique ID to the RFM/CTL module
- Has inductance of 27 µH at 134.2 kHz
PIT Tags
RFM/CTL Module

- Provides power to the antenna
- Radio frequency module that controls the antenna
- Demodulates and decodes signal from the antenna
- Outputs the decoded signal in RS-232 format
RS232 Output from the RFM/CTL Unit

ASCII code for 'L' = 01001100

13.75V

200 µs
MAX232 Output of the Signal

4.375V

200 µs

0 0 0 0 0
PIT Tag IDs
Real Time Clock

- Uses the inbuilt RTCC module in the PIC microcontroller.
- Uses external 32.768 kHz clock crystal for stabilization.
- Calibration Range: +/- 2.64 seconds error per month.
Project Results

- Switching circuit successfully implemented
- PIT tags successfully read by the antenna
- Real time clock provides accurate timestamp
Further Work

- Develop code to write data directly to SD card
- Develop a program to read the data off the card
- Integrate individual code together