WaterMainia

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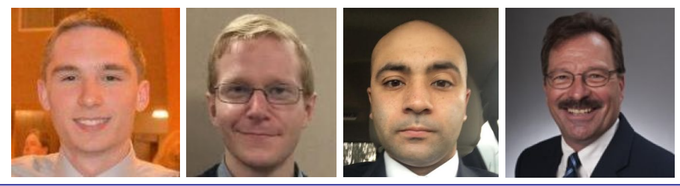
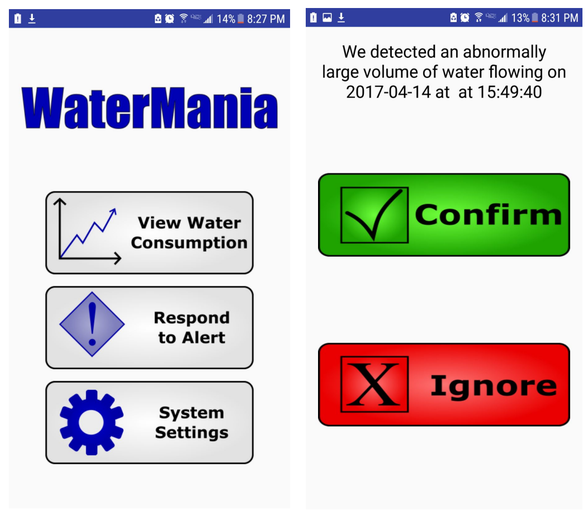


Abstract

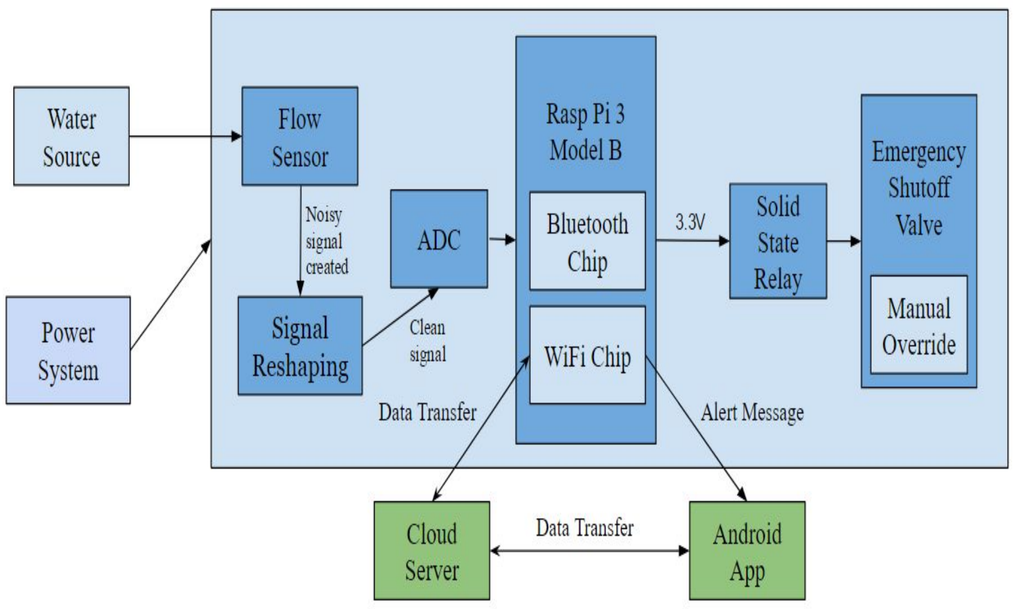
WaterMainia is a flow detection and data analysis device aimed to prevent catastrophic home flooding due to burst pipes, and to conserve water through leak detection. Watermainia also allows user to see their water consumption data in minute time increments. The system is composed of a hall effect sensor, proprietary software on a single board computer, and an emergency shutoff valve. It is being prototyped on a home plumbing simulation. When WaterMainia detects a water flow rate indicative of a leak it will notify the end user via an Android application and shut off water to the home if the leak is severe enough

Android App

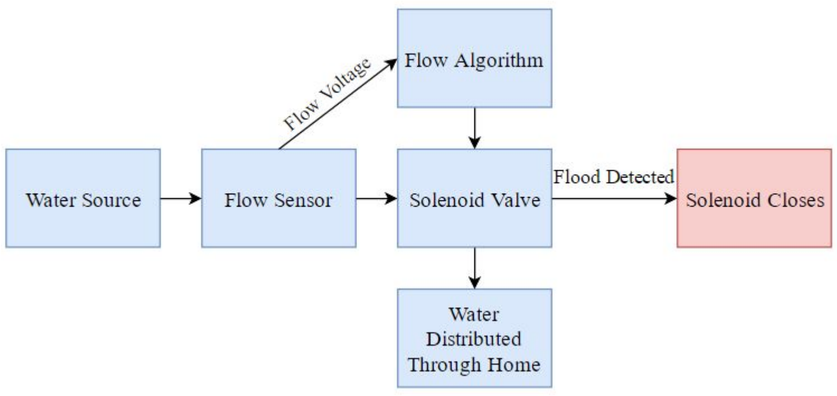
- **Alerts Users of leaks and provides options**
- **Displays water consumption on 3 different graph styles and tables**
- **Enables user to toggle system settings from within app between 2 modes and 2 parameters**



Block Diagram



System Overview



1. **Detect water flow**
2. **Interpret waterflow data**
3. **React appropriately based on system settings**
4. **Alert user**

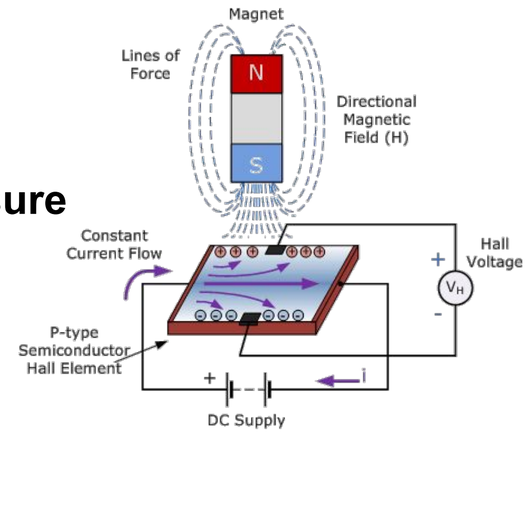
Specifications

- **System: Hall effect sensor, raspberry pi, emergency shut off solenoid**
- **Android Application**
- **Server: Storage for water consumption**

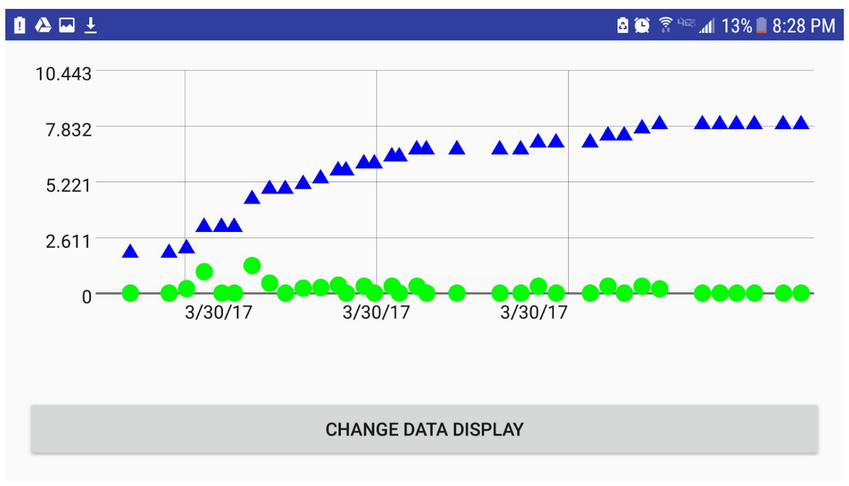
System

Hall Effect Sensor:

- **10mA current draw**
- **5V operating voltage**
- **1.75MPa maximum pressure**
- **<1 L/min -45L/min Flow Range**



Results

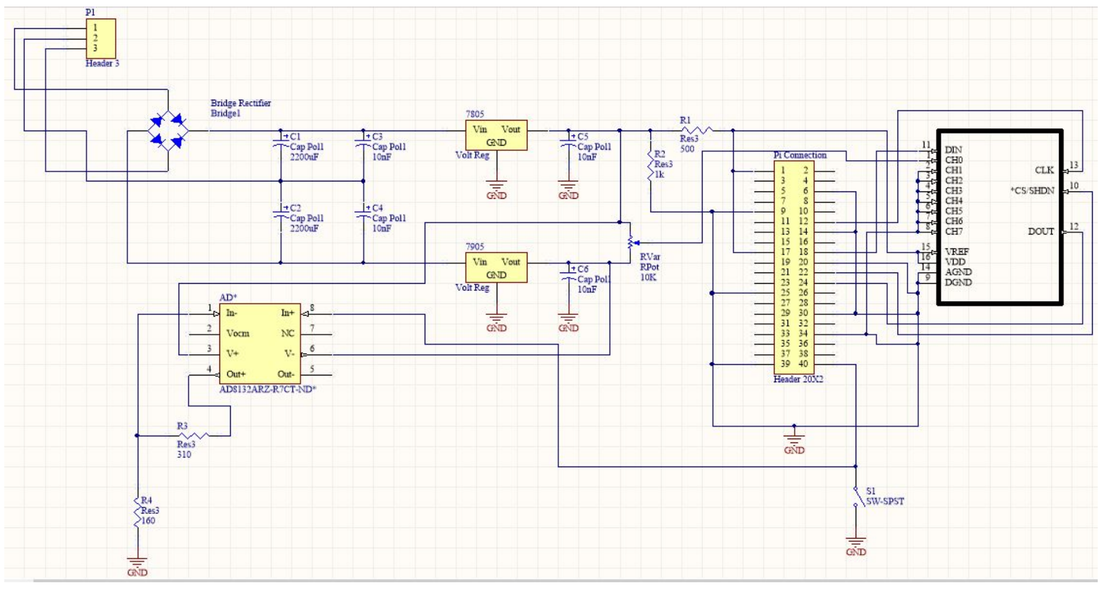


- **34W power consumption**
- **Tabulated and saved accurate water consumption data**
- **$301.87 system cost**
- **Timely reaction to bursts**
  - **During vacation mode testing 2-3 seconds until valve closure was witnessed**
  - **During At Home mode user is able to change valve state within one fetch cycle which is set to 1 min**

Acknowledgement

Special thanks to our faculty advisor Prof. Christopher Hollot. We would also like to recognize our evaluators, Profs. Mario Parente and Zlatan Aksamija, as well as Professor Ron Selines.

Power Supply



- System supplied by 5V/3A power supply

Contingency

- In the event of a power outage, the solenoid valve will snap shut by default if the system is in vacation mode and notify the user
- For At-Home mode, the user can opt to turn on the automatic valve closing in the event of a power outage
- At any point where the device shuts off the water the user can choose to immediately override the command and reopen the valve

Cost

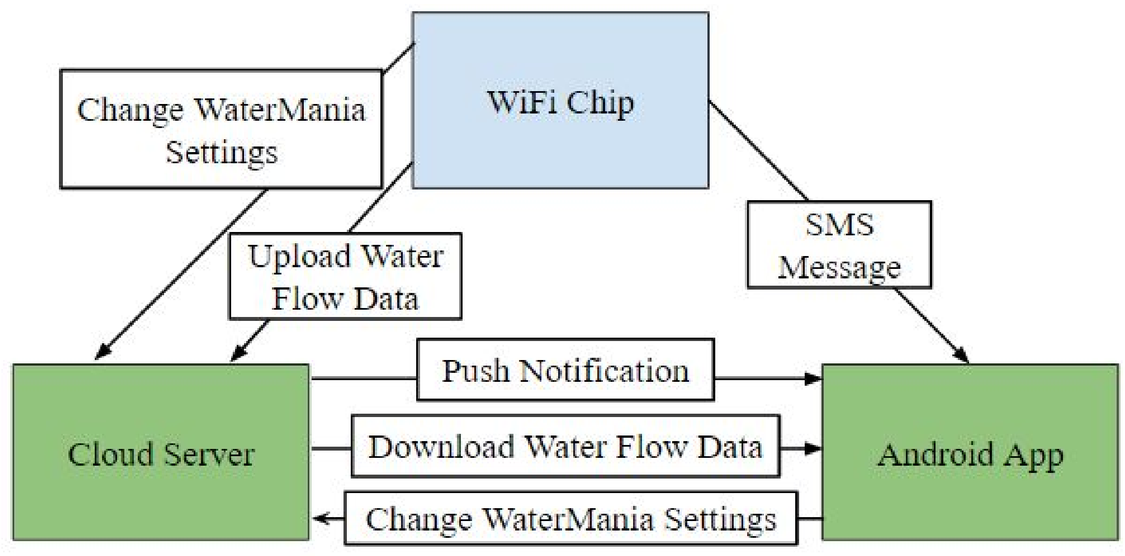
Component	Quantity	Prototype Cost	Production Cost
Micro SD Card	1	$20.99	$20.99
Server	1	$25.00	$25.00
Transformer	1	$16.56	$10.22
Power System Parts	1	$43.06	$25.64
PCB	1	$78.00	$39.00
Raspberry Pi 3	1	$41.99	$41.99
Solenoid Valve	1	$26.99	$26.99
Hall Effect Sensor	1	$10.00	$10.00
PEX Pipe Fittings	-	$28.00	$28.00
Solid State Relay	1	$11.28	$11.28
Total		$301.87	$239.11

Device Modes

- Device functionality is split into two modes, At-Home Mode and Vacation Mode
- Vacation mode is a binary mode that will shut off water flow from the water main if the sensor detects any water flow
- The user will be alerted via SMS when the device halts the flow of water
- At-Home Mode detects and records all water usage
- The user can set thresholds for total water usage over certain periods of time
- The system will alert the user when set thresholds have been exceeded

Software

- Output Signals from the sensor are sent to the Raspberry Pi
- Square waves converted to flow data by proprietary software
- Periodically, the device will save the data locally as well as send the data to a cloud server so that it can be retrieved by the user via an Android Application
- The device will connect to Wi-Fi but even in the event that Wi-Fi is unavailable will still be able shut off water in the event of a flood



Experiment

All prototyping was done on a mock-up system consisting of a sump pump pumping water through a system of 3/4” pipe where our sensor would read data so as to simulate water flowing into a typical residence.