Anti Bicycle Theft

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Practical Course on Wireless Sensor Networks
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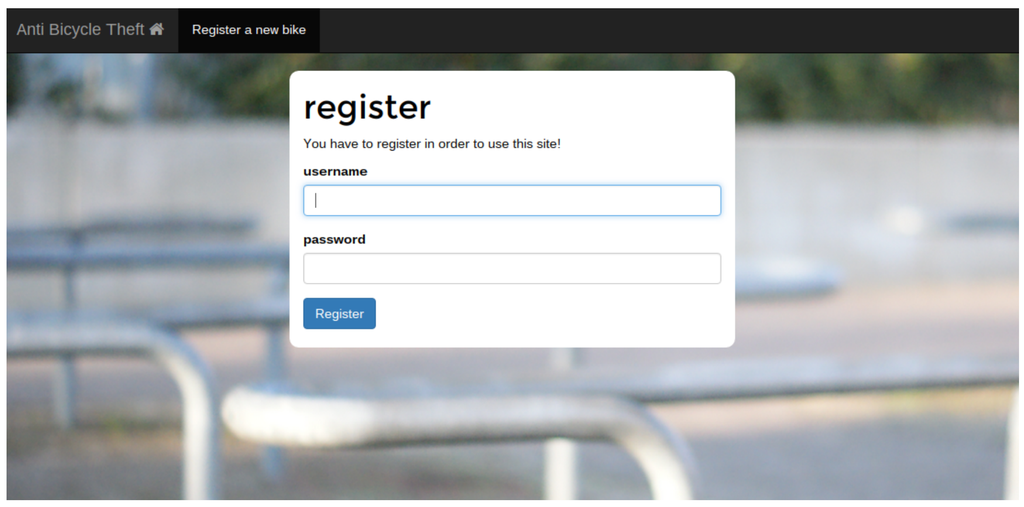
Introduction

Bicycle theft is a major problem in many cities, especially university towns. Our aim was to create a system that enables a bike owner to track a stolen bike. While other systems already on the market are trying to accomplish this by using GSM modules we tried to use a minimalistic approach:
A tracking GPS module that can be turned on after a bike has been stolen, tracks positions and retransmits them to the user via a short distance wireless interface and represents them on an easy-to-use web interface.



Used Software

1. Linux with TinyOS
2. NodeJS with Express
3. MongoDB
4. TinyOS Protocols (Dissemination & Collection [4])

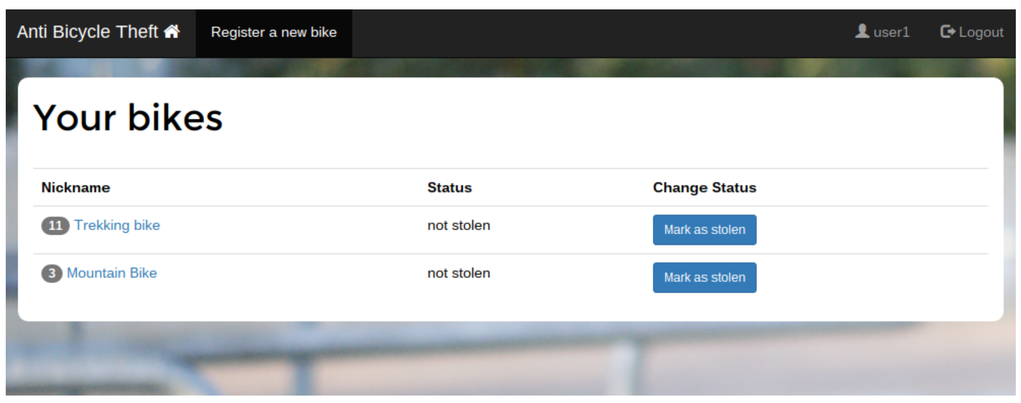
Used Hardware

1. Webserver with TinyOS, e.g. Raspberry Pi
2. IRIS motes
3. USB gateway (connected to the server)
4. MTS420cc sensorboard including GPS antenna

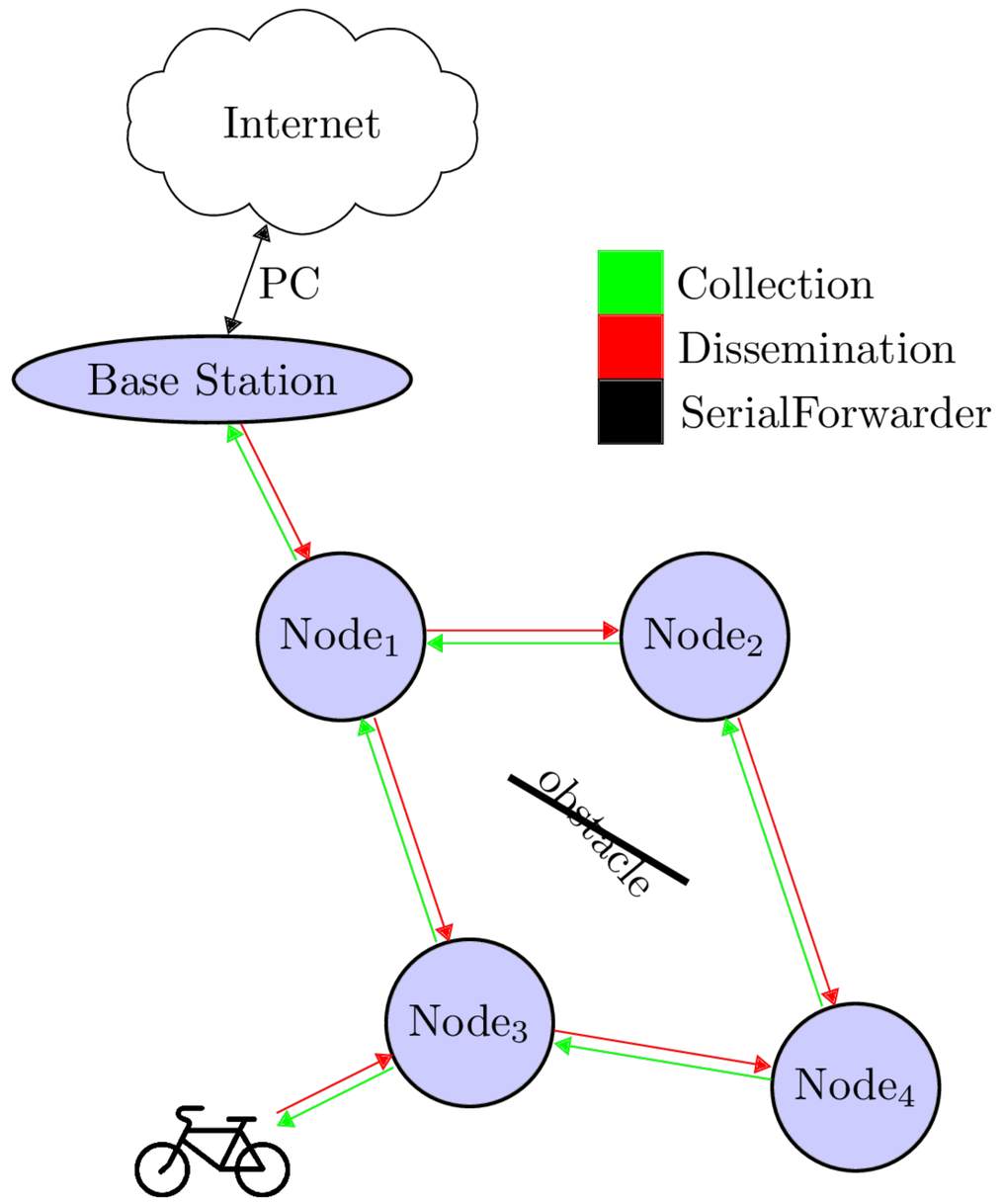
(pictures according to previous enumeration numbered from left to right)

System Description

The system consists of a computer running a webserver, an IRIS mote connected to the it via USB, a set of relay IRIS motes and so called bicycle IRIS motes. The process begins after a user marked his bike as stolen using the system's webapplication using an `ID`. The webserver will relay this `ID` to the basestation which broadcasts it to all relay motes via dissemination[4]. When a bike passes a relay mote it establishes a connection and checks whether its `ID` is being disseminated. If this is the case the bicycle mote will turn on its GPS module and start recording its position in combination with a timestamp.
The next time the bike passes a relay mote the position data is transfered, collected[4] at the base station and made available to the user on the webapplication.



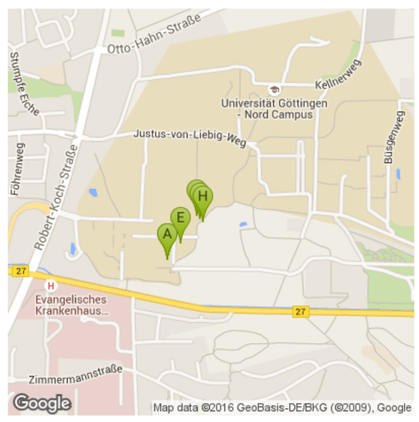
Topology



Conclusion

The system we proposed an implemented prototypically allows a user to remotely turn on a location tracking device, collect data over extended periods of time. This works even if his bike is not in range of a network after it has been activated. Using an easy-to-use webinterface bicycles are able to be quickly reported as stolen. Gathered location data can be conveniently displayed on a digital map.

Time	Latitude	Longitude	Marker
22.01.16 13:28	51.55638	9.948045	A
22.01.16 13:28	51.55638	9.948045	B
22.01.16 13:28	51.55638	9.948045	C
22.01.16 13:28	51.55638	9.948045	D
22.01.16 13:32	51.556785	9.948606	E
22.01.16 13:36	51.557424	9.949393	F
22.01.16 13:38	51.55752	9.949286	G
22.01.16 13:39	51.557344	9.949528	H
22.01.16 13:41	51.557488	9.948853	I
22.01.16 13:44	51.557452	9.949545	J
22.01.16 13:45	51.557636	9.949868	K



Future work is needed to determine how battery usage can be minimized (e.g. by replacing GPS with WiFi positioning) and whether a sufficient relay network can be established at reasonable costs.

References

[1] Bundeskriminalamt. Polizeiliche Kriminalstatistik (PKS) 2014 - IMK-Bericht (barrierefrei). [last visited 27th January 2016].
[2] Andreas Donath. GPS-Modul gegen Fahrradklau. [last visited 27th January 2016].
[3] Cycle Leash Pty Ltd. Leash It. [last visited 27th January 2016].
[4] TinyOS Stanford wiki. Network Protocols of TinyOS. [last visited 27th January 2016].