Magnetic Induction Communication Access Control

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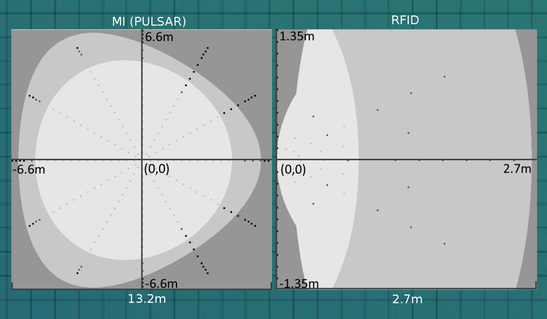
Abstract

Current personalized access control systems utilize either Bluetooth or NFC technology to automate private residence access. Our project, title Phone-Key, instead endeavors to borrow from Magnetic Induction Communication (MIC). MIC is conducted through magnetic fields generated by large inductors to enable communication within a controllable, localized area and through mediums which do not propagate standard EM radio waves. The Phone-Key system utilizes MIC on a personal smart phone to add an additional layer of security and usefulness to a private residence access control system through more controllable and well defined proximity detection and higher penetration through a wider range of materials.

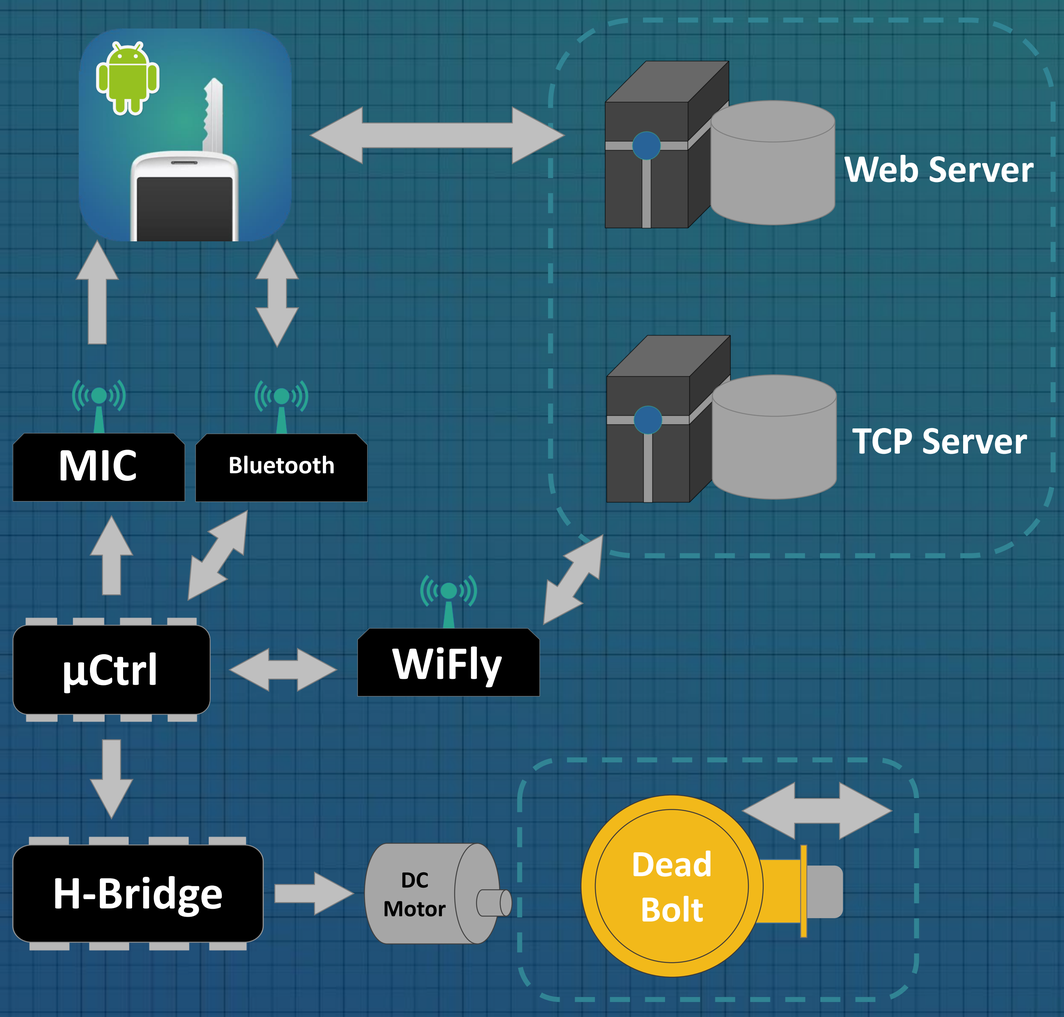
Motivation

In addition to superior penetration through barriers such as walls and human bodies, magnetic wave power dissipates more quickly than electromagnetic waves. Research has shown proximity detection between dedicated MIC devices to provide both higher resolution and more consistent proximity regions.

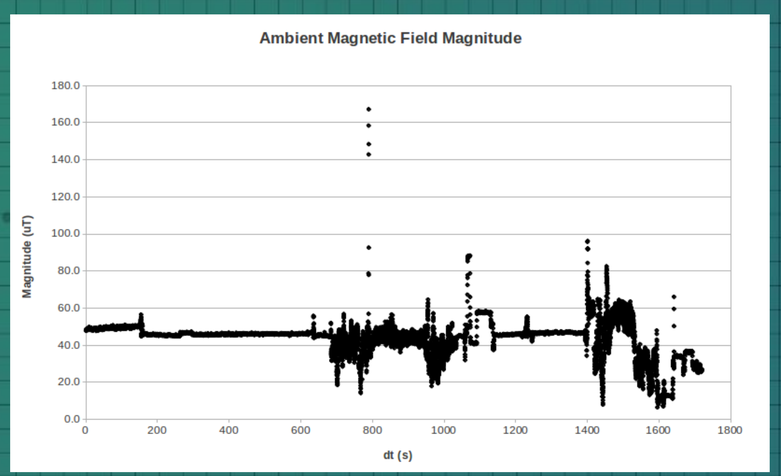


Proximity region from MIC and RFID proximity detection methods. Light regions indicate high signal clarity, grey regions indicate uncertain signal clarity, and dark regions indicate minimal signal clarity.[1]

System Design



Experiments



Measuring ambient magnetic field magnitude using the magnetometer. Nominal value of ~40µT led to technical specification for magnetic transmitter.

Data transmission tests showed large error rate in transmission due to the low resolution of the phone magnetometer. Various error correction techniques were employed to reduce the error rate by more than half.

Error Rate Before Correction	Error Rate After Correction	Burst Data Transmission Speed	Bulk Data Transmission Speed
67.2%	29.4%	12.5 bytes/second	2.55 KB/minute

Results

- Developed an Android application utilizing the built in magnetometer to receive magnetic field transmission.
- Successful encrypted transmission from inductor to phone magnetometer via magnetic field at 12.5 bytes per second and 29.4 percent error.
- Demonstrated transmission of data through materials which block typical EM radio waves.
- Web server implemented to allow user remote administration of door lock, including emergency disable feature.
- TCP server implemented to request statuses from and push update to all active Phone-Key lock systems.
- Phone-Key hardware automatically connects to TCP server through specified wireless internet access point.

Conclusion and Future Work

The Phone-Key system demonstrates the feasibility of proximity detection using as a means of adding an additional layer of security to access control systems. Our system demonstrates the feasibility of secure access control utilizing MIC.

Future work includes:

- Construction of dedicated MIC transmitter/receiver for increased transmission range.
- Implementation in secure doors/vaults with no exterior facing locking mechanism.

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Acknowledgements:

Liang Cheng William Haller

Basel Alnajjab Ted Bowen