



# Gait Analysis Using Motion Sensors on Smartphones

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## Introduction

- Walking is an important part of life for most people, yet many people have difficulty with walking
  - 1 in 3 adults 65 and older fall each year[1]
  - ~12 million visits to doctor's office for knee related problems[2]
- Care is based largely around costly doctors visits
  - Doctors can't easily gait "real" walking data from patients
  - Clinical gait analysis is very expensive, and there are not many labs
- Prevention of gait-related injuries provides more utility than treating problems that arise

## Motivation

- Laboratories are expensive to build and run
  - Constrains research to lab environments
- Most recording methods require fixed-environments
- Historically MEMS require securing multiple sensors on subject, reducing psychological acceptability

## Our Approach

- Cell phones are inexpensive relative to gait analysis laboratories
- People are used to carrying cell phones around - high psychological acceptability
- Cell phones are MEMS with communication abilities and powerful processing abilities
- Data can be easily collected in home, work, or other environments

## System Design

- Develop a program to collect accelerometer (linear acceleration) and gyroscope (angular velocity) data on Android phones
- The program can also determine whether gait is "normal" or "abnormal"

## Design Principles

- Final design should be user-friendly
- It should not interfere with normal phone activity
  - Emphasize power conservation
- The system should be extensible

## Architecture

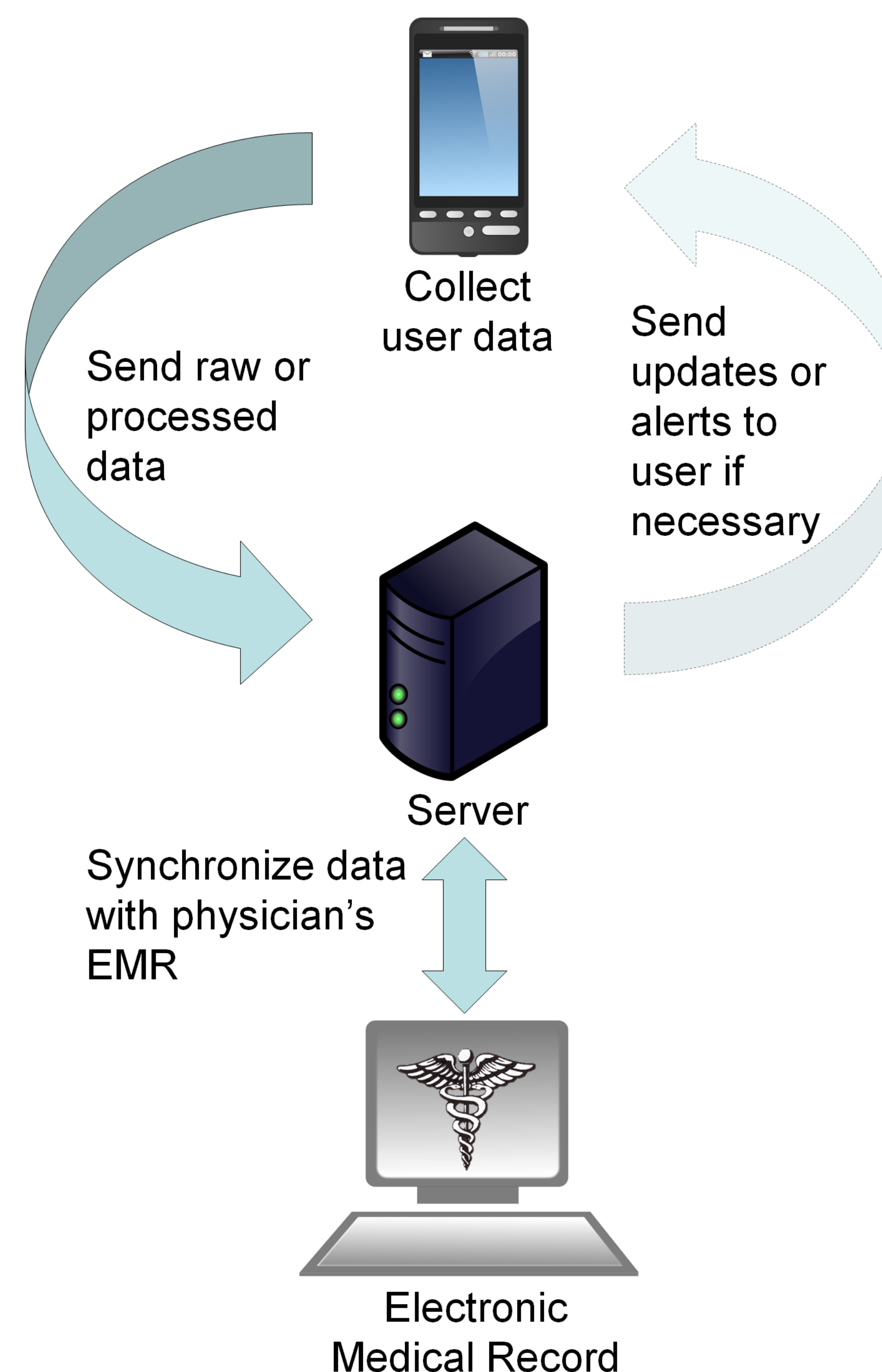


Figure 1: Prototype system architecture

## Process

- Write program to collect data
- Collect data using Samsung Nexus S smartphone
- Data analysis **(Current step)**
  - 2.1 Develop feature(s) based on knowledge of gait
- Add ability for program to classify gait
  - 4.1 Either in real-time or by sending the data to a server
- Add more features to make the system more robust
  - 5.1 Function in more locations (e.g. different pockets)
  - 5.2 Collect data from any orientation
  - 5.3 Integrate with Electronic Health Record systems

## Future Work

- Continue process
- Collect more comprehensive data – use multiple phones, many more subjects, more samples per subject
- Investigate more specific diagnostic capabilities
- Investigate viability in research lab and outpatient environments

## Conclusions

- Success in this field could save millions of dollars, greatly expand availability of care, and provide new data for a variety of research
- Extensively explore human resources in research

## References

- [1]<http://www.cdc.gov/homeandrecreationalafety/falls/adultfalls.html>
- [2][http://orthoinfo.aaos.org/topic.cfm?topic=A00130&return\\_link=0](http://orthoinfo.aaos.org/topic.cfm?topic=A00130&return_link=0)

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