Motivations And Goals
- To create an easily accessible and affordable heart monitoring bracelet for fatal heart malfunction detections.
- Technological goal will consist of systemizing database library for heart malfunction, creating an algorithm for a potential heart malfunction and creating a threshold variable for system application.

Introduction: ZnO Films And Nanostructures For Sensing
- ZnO is Multifunctional: piezoelectric, semiconducting, optical, transparent conductive

Advantages
- Small dimensions
- Controllable operating frequency by varying Mg composition
- Low power consumption
- Can be integrated with Si-based electronics
- Wireless frequency range

Directly applied voltage to ZnO biosensor contact region to obtain its bandwidth region

Bio-Sensor Quality Test
- Apply 3 different inputs
- Record data through an oscilloscope
- Create a filter that can reduce signal noise on MATLAB

Calculate total reaction time
Calculate average Rise time and Recovery time
Find Q, R, S Points

Input Noise Filtering
- FIR1 filter with order 25 and rectangular window outputted best noise cancellation result.

Filtering Result

Q,R,S Detection
- Q point is a minimum voltage location before R point.
- S point is a minimum voltage location after R point.
- R point is a maximum voltage location.

Q,R,S Detection Result
- average rise time is 0.027568 seconds
- average recovery time is 0.00363 seconds
- average total reaction time is 0.031198 seconds

3 different inputs
- Sudden Pressure, Sustained Pressure, and Repeated taps at 2Hz.

Human Pulse Detection
- Placed the bio-sensor under a wristband and connected to the oscilloscope.
- Applied 3 different inputs
- Average Beat-to-Beat Interval (R-R Interval) is 0.9468 sec
- Pulse Rate is 1.0562 Hz
- Experimental Subject Condition: Healthy

Human Pulse Noise Filtering
- Convolved input signal with 5Hz Low Pass Filter

Data Collection
- Data from [http://www.physionet.org/]
- Data contains detailed analysis about patients’ information, number of isolated beats, noise, Arrhythmia type.
- 150 ECG data from Arrhythmia patients and healthy test subjects.

Theoretical Algorithm
- Arrhythmia Detection
  \[ T \{
  N \text{Normal}} \quad \text{if } \frac{\sum_{i=1}^{N} Y_i}{N} \leq \text{threshold}
  \]
  Arrhythmic(1) \quad \text{if } \frac{\sum_{i=1}^{N} Y_i}{N} > \text{threshold}
- \( Y_i \) = Input signal
- Threshold value is set during synchronization process

Heart Attack Detection Software
- Actual Patient Data During Normal Condition
- Actual Patient Data During Tachycardia

Step 1: Take the mean value of the R-R intervals in the normal condition R-R_average
Step 2: Take the standard deviation of the R-R intervals in the normal condition R-R_STD_Normal
Step 3: Take the standard deviation of the R-R intervals in a moving time window R-R_STD_T(t)

See Boustany et al, 2000 (June 13) for more information.

Conclusion
We combined the ZnO nanosensor-based biosensors with cardiac arrest symptoms detecting software to create a complete system. This is an easy to use, low power consuming device. Since it is Si based, it can be offered to anyone at an affordable price. This will help to lower number of heart related deaths because of its usability and price.