

# Bio-Sensing Chip

## An Implantable Solution for Disease Detection

### Introduction

The Bio-Sensing Chip was inspired by rheumatoid arthritis. Rheumatoid arthritis is a disease which attacks the synovium of joints and other internal organs. There is no cure for the disease, but upon detection the symptoms of the disease can be managed. Early detection of diseases like rheumatoid arthritis are crucial for the millions of people diagnosed yearly. Early diagnosis means less damage to a person's body and allows for an improved quality of life.

The Bio-Sensing Chip is an early-warning system designed to optically detect diseases in the initial stages. The device is a proof of concept project, that upon miniaturization and further development, might eventually be implanted into the human body to alert the patient to seek medical attention before the disease fully develops.

### How it Works

The Bio-Sensing Chip is designed to detect disease by identifying and binding microspheres to biomarkers. Biomarkers develop in the body as a result of disease and can be used to determine the degree to which a disease has advanced.

Escherichia coli (E. coli) acts as a stand-in for biomarkers since the binding method is similar. The E. coli attach to magnetic and fluorescent microspheres that can be manipulated with a magnetic field. This manipulation allows the device to optically determine if the biomarker is present.



Magnetic and fluorescent beads suspended in solution.



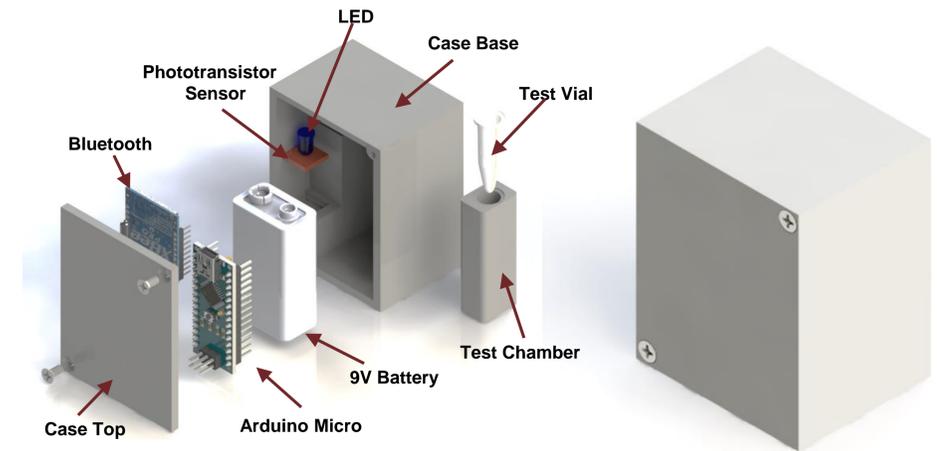
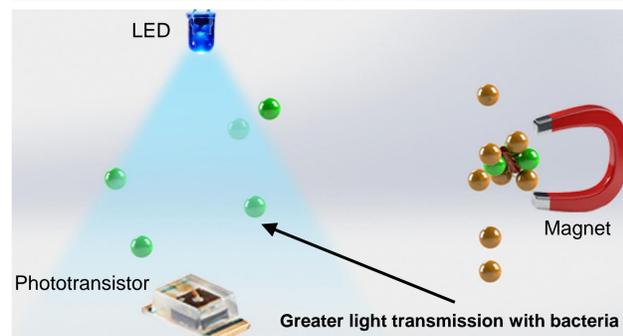
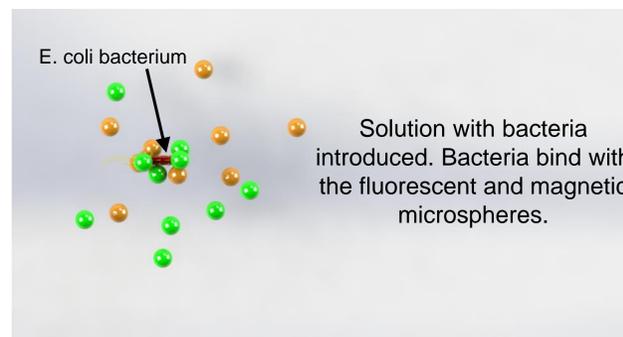
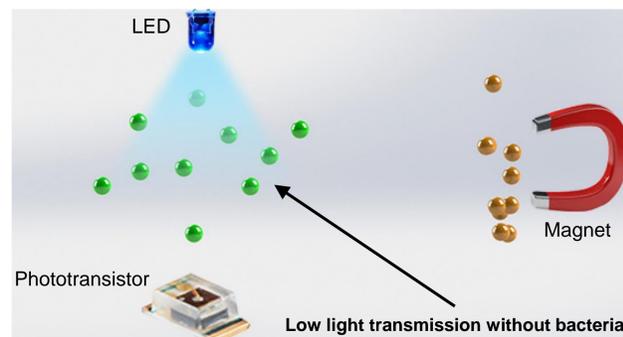
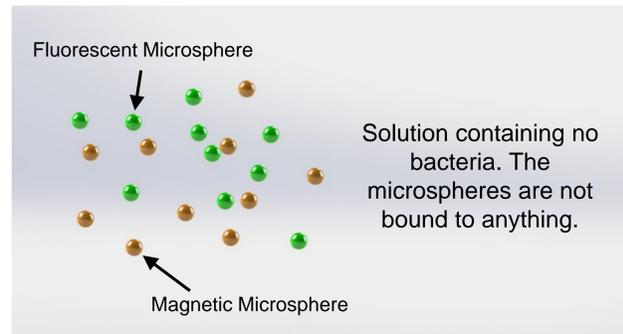
Magnetic and fluorescent beads bind to bacteria when it is introduced.

### Device Design

An LED is used to shine light through the microsphere/bacteria solution. The interaction of microspheres with bacteria alters the amount of light that can be transmitted through the fluid. A phototransistor is used to detect small changes in light which makes bacteria detection possible. The test results are then wirelessly transmitted to a user's cell phone via bluetooth, alerting them of the results.

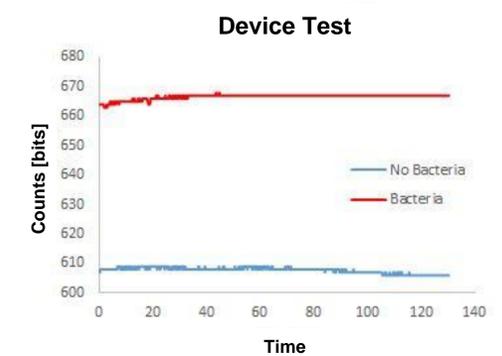
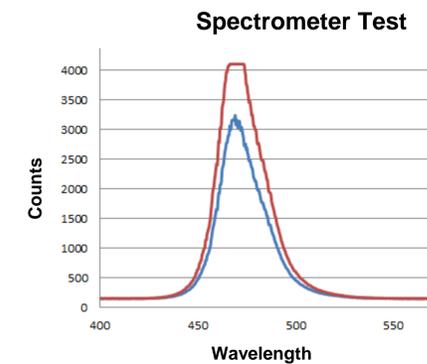
### Detection Method

The device uses magnetic and fluorescent microspheres to optically determine whether or not bacteria is in the solution.



### Results

A distinct change in the amount of light transmitted through the solution can be seen using a spectrometer. A similar change can be seen using a small, inexpensive phototransistor. This change allows the user to be notified of a change in their condition.



### Possibilities

Future devices like this could potentially revolutionize medicine. Diseases that people are genetically predisposed to could be detected in the very early stages. Annual testing for genetic diseases would be a thing of the past. Patients could be notified instantly of an advancing disease. Millions of people annually could be diagnosed earlier saving their quality of life and drastically reducing medical costs.

### Future Work

In its current state, the device is suited to bacteria detection. With further refinement the optical detection method could be extended to disease detection. The bio sensing chip will need many more years of research, development, and testing to go before there is a possibility of implantation. The design must be made smaller, the material biocompatible, and suitable for the detection of various biomarkers.