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ELECTRONICS AND COMMUNICATION ENGINEERING

U24EC203-SENSORS AND ACTUATORS

Submitted by

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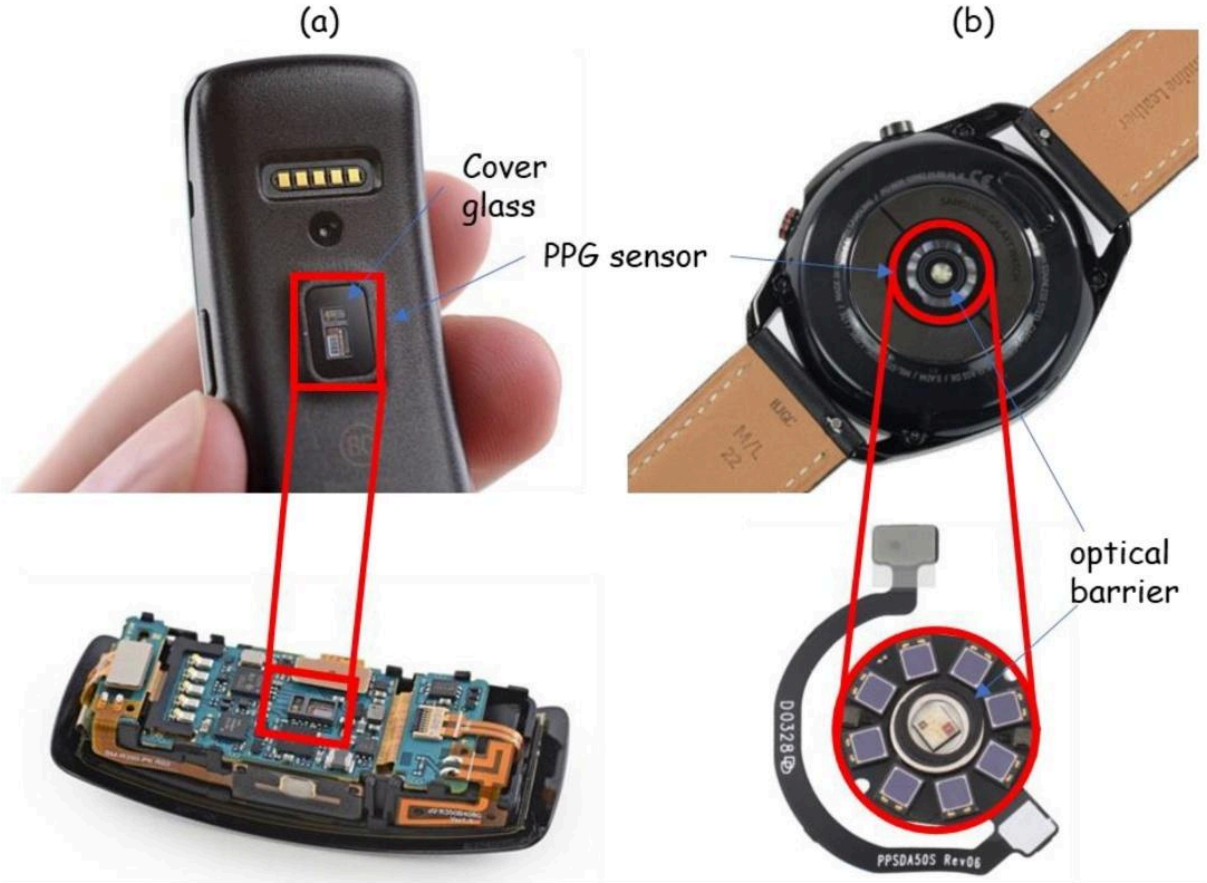
II year B Section

Case Study :1

PPG Sensor

Abstract

Photoplethysmography (PPG) is a non-invasive optical technique used to measure blood volume changes in human tissue. In this project, a PPG optical sensor (LED + Photo diode) is used to detect pulse waveform and calculate heart rate. The output of the sensor is processed using a microcontroller to extract BPM (Beats Per Minute). This system can be used for heart rate monitoring, stress monitoring and fitness tracking.



Introduction

PPG is widely used in smart watches, pulse oximeters and medical devices because it is simple, low power and easily wearable. A PPG sensor emits light (usually green or IR) into the skin and measures how much light is reflected back. When blood flow increases, more light is absorbed — this creates a rhythmic waveform. From this waveform, heartbeat and SpO2 can be obtained. This makes PPG suitable for continuous health monitoring.

Objective

• To measure heart rate using PPG sensor
• To record the optical pulse waveform
• To monitor cardiac activity in a simple and low-cost method

Methodology

1. LED light is passed into the skin (usually finger).
2. Blood absorbs the light based on heart pumping.
3. Reflected light is collected by photodiodes in the PPG sensor.
4. Analog signals are amplified and filtered.
5. The microcontroller converts it to BPM.
6. Heart rate value is displayed on the monitor / LCD.

Block Diagram

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Finger → PPG Sensor → Amplifier/Filter → Microcontroller → Display
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Result

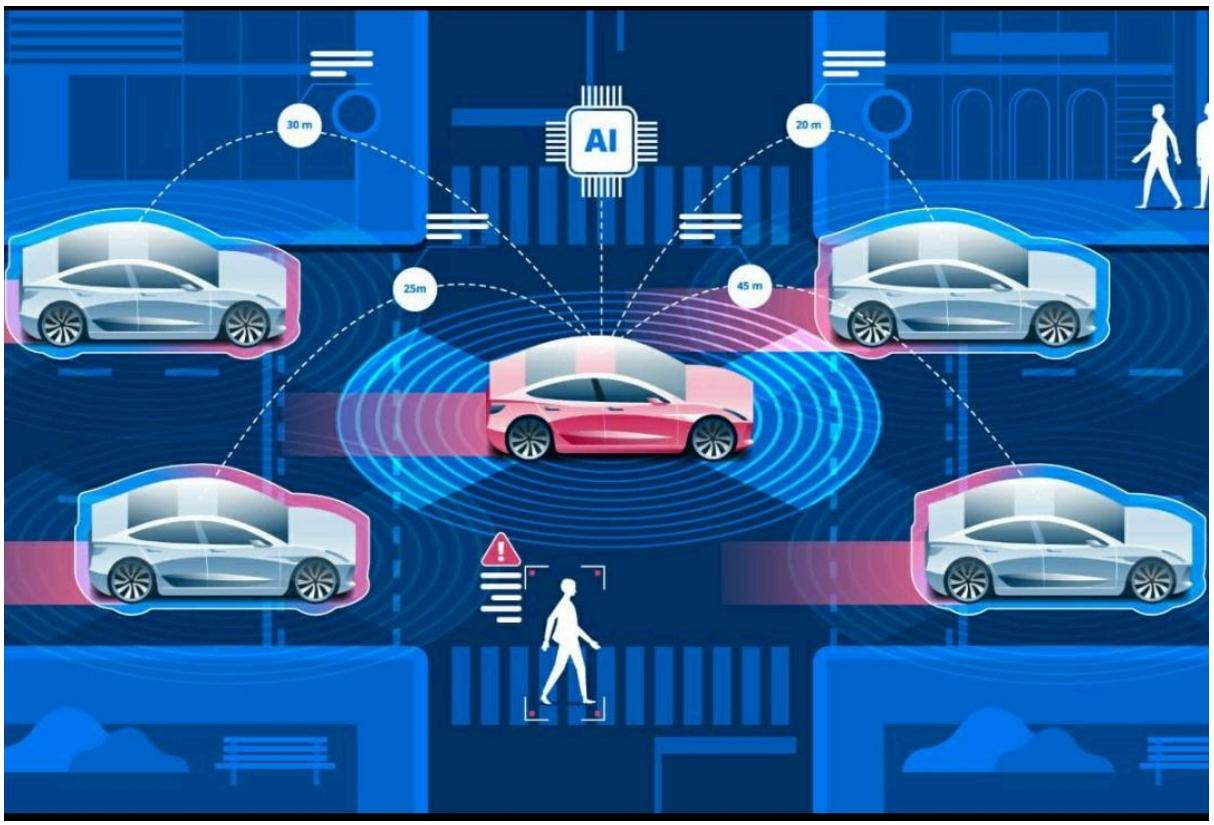
PPG output waveform was successfully captured. From the waveform peaks, heart rate was calculated. The system can continuously monitor heart rate in real-time and can be used for fitness and medical applications.

Case Study :2

LiDAR Sensor

Abstract

LiDAR (Light Detection And Ranging) is a distance measurement technique using laser pulses. In this project, LiDAR is used to scan surroundings and measure the distance of objects. The reflected laser light time-of-flight is processed to generate accurate distance mapping. This system can be used in obstacle detection, autonomous vehicles and robotics.



Introduction

LiDAR transmits laser pulses and calculates the distance by measuring the time taken for the reflected pulse to return. Because light travels very fast, LiDAR gives highly accurate distance information even in long ranges. LiDAR is used in self-driving cars, drones, 3D mapping, industrial automation, warehouse navigation etc. It works in day/night conditions and gives 360° scanning capability when used with rotating modules.

Objective

• To measure distance using LiDAR module

• To detect obstacles in real-time
• To show how LiDAR can help in autonomous navigation systems

Methodology

1. LiDAR emits laser pulses.
2. The laser hits the object and reflects back.
3. The sensor measures the time taken by the laser to return.
4. Microcontroller converts ToF → distance value.
5. Display / mapping software shows the environment.

Block Diagram

LiDAR Unit → Microcontroller → Processing Algorithm → Display / Map Output

Result

LiDAR sensor successfully detected obstacles and calculated distance with high accuracy. The system provides fast real-time mapping which is suitable for robotic navigation and automotive safety applications.