schivaTO

OBSTACLE AVOIDANCE SYSTEM

ELECTRONIC SYSTEMS ENGINEERING

PROF: PASERO EROS

DESIGNED BY:

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PROJECT SPECIFICATIONS

Design a small, low power and precise obstacle avoidance system for various applications.

The system is in charge of detecting obstacles in range of a predefined sensing distance. Collected data are then sent via Bluetooth Low Energy to an external application.

Use-case scenarios

Work with extreme precision.

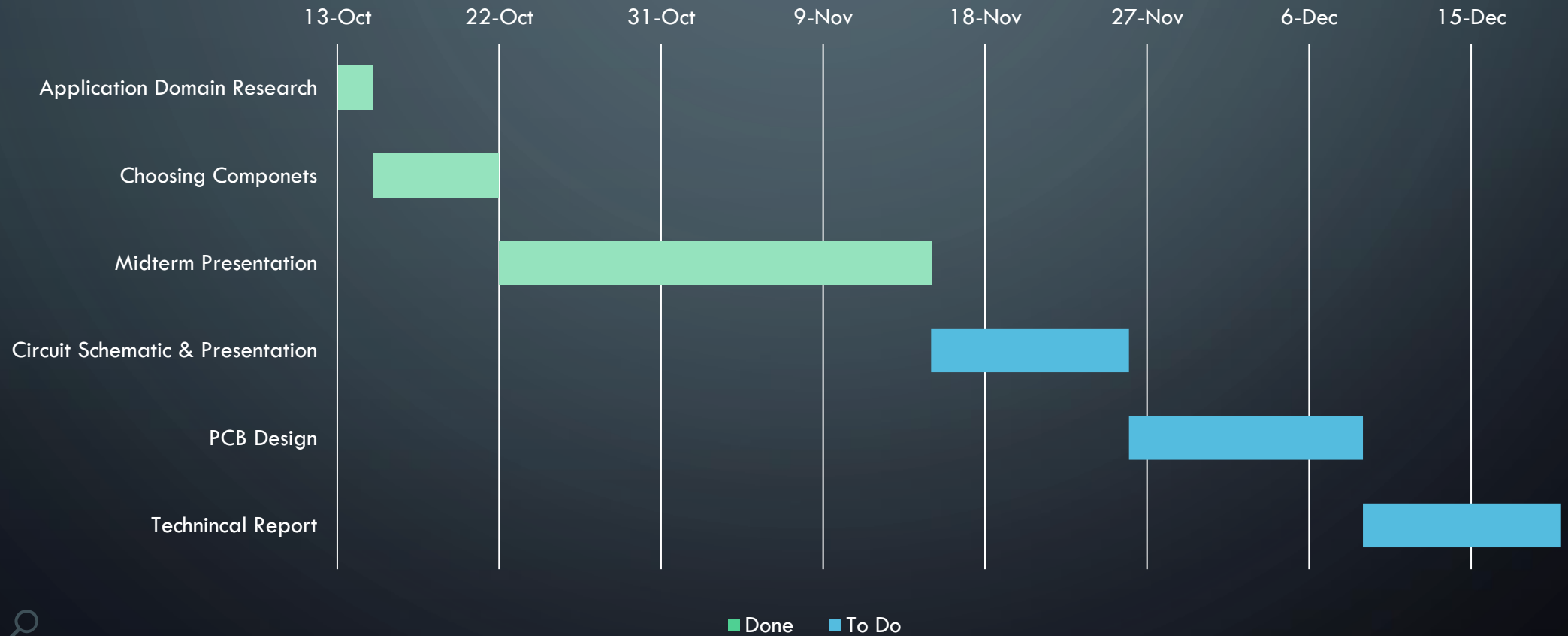*Avoid obstacles. Avoid house-works.*

Avoid cars too.
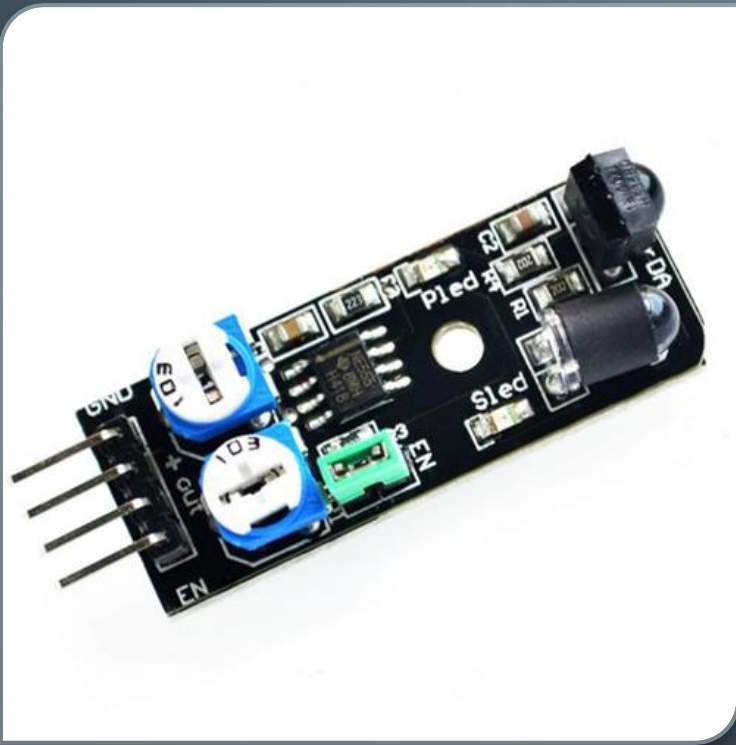
DEVICE SPECIFICATIONS

- Low cost device

- Low power consumption

- Self-contained power source

- Small to medium distance detection (range between 2cm and 40cm)

ELECTRONIC COMPONENTS
IR KY-032 OBSTACLE AVOIDANCE SENSOR

- **Working voltage:** 3.3V – 5V DC

- **Working current:** ≥ 20mA

- **Working temperature :** -10°C – 50°C

- **Detection distance:** 2cm – 40cm [0.79in – 15.75in]

- **IO interface:** 4-wire interface (-/+/S/EN)

- **Adjustment method:** multi-turn resistance adjustment

- **IR pulse frequency:** 38kHz

- **Effective angle:** 35°

- **Board Size:** 1.6cm x 4cm

- **Weight:** 9g

ELECTRONIC COMPONENTS
TEXAS INSTRUMENTS MICROCONTROLLER CC2640F128RSMT
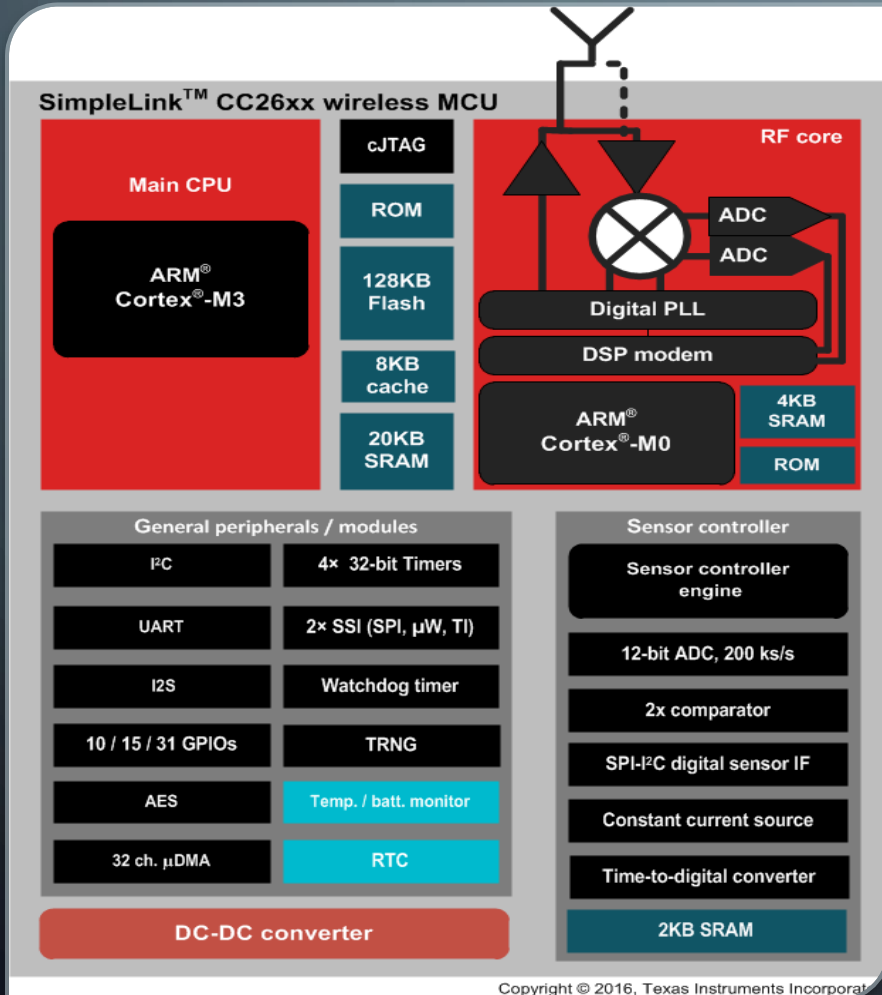
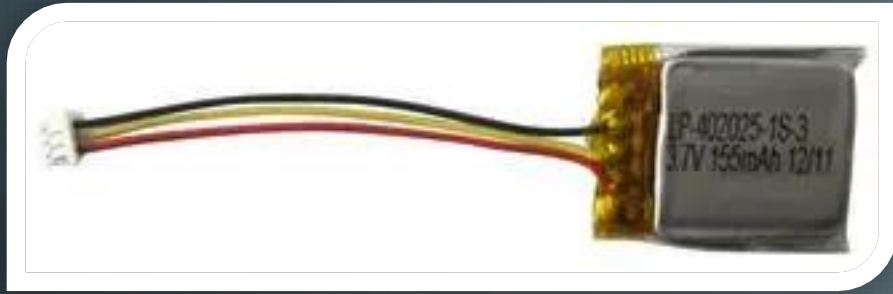- **Number of Pins :** 32

- **Clock Frequency :** 48 MHz

- **Interfaces :** I2C, SPI, UART

- **Operating Temperature Range :** -40°C - 85 °C

- **Max Supply Voltage :** 1.7 V - 3.8 V

- **Number of GPIOs :** 10

- **Dimensions :** 4mm x 4mm x 1mm
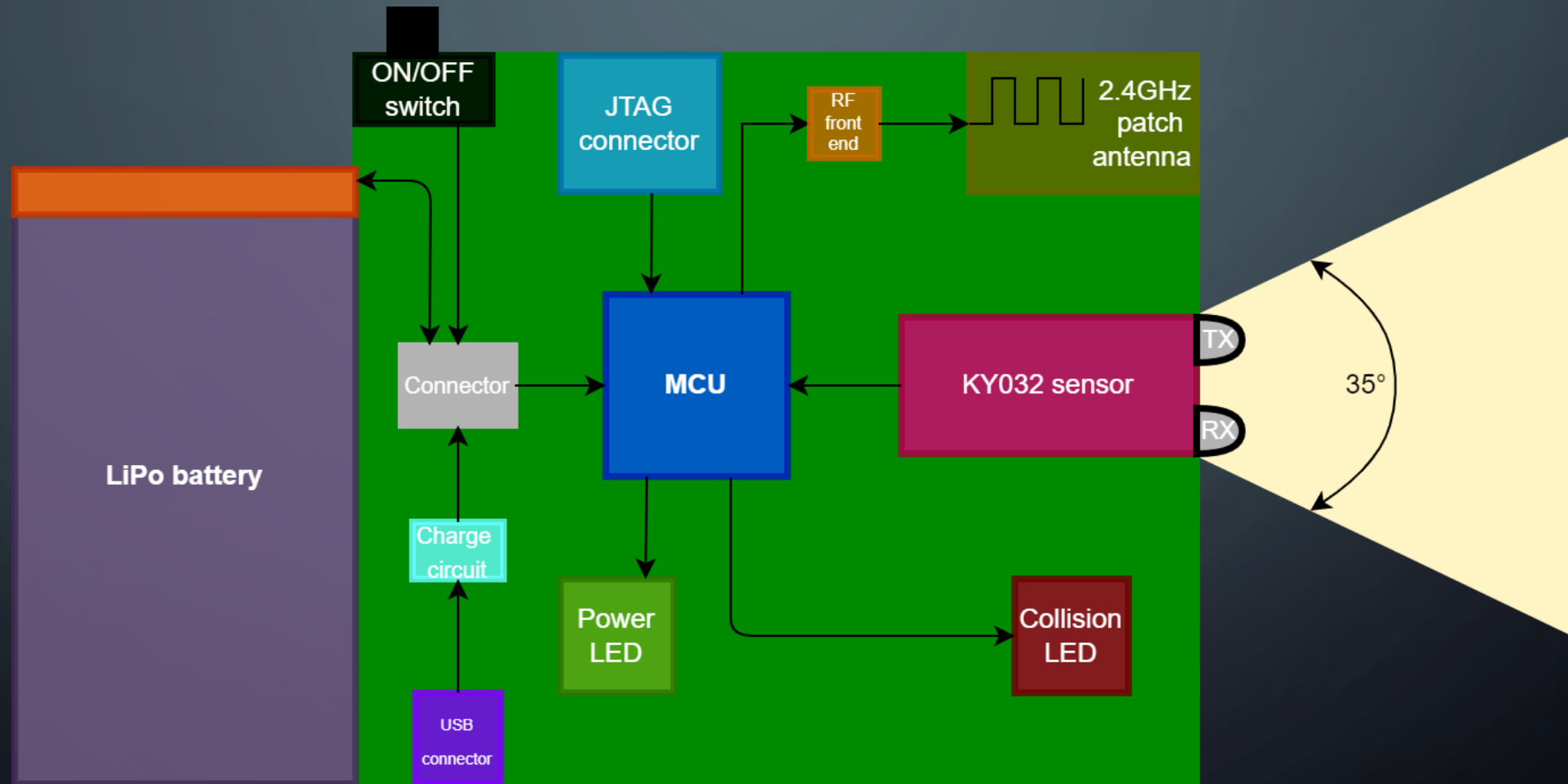
ELECTRONIC COMPONENTS
LIPO BATTERY LP-402025-IS-3

- **Nominal Capacity(0.2C) :** 165 mAh (typical)

- **Nominal Voltage :** 3.7 V (0.2C discharge)

- **Charging Voltage :** 4.2 V

- **Maximum Charging Current :** 155 mA

- **Maximum Continuous Discharge Current :** 310 mA

- **Dimensions :** 20 mm x 26 mm x 3.8 mm

- **Weight :** 4 g

BLOCK DIAGRAM

CHOSEN APPROACH

- The module is thought to work both powered by the LiPo battery or from an external power source. So that, the battery can be unplugged in favor of the external power lines.

- The ON/OFF switch has been added in order to reduce the power consumption during idle periods.

- Power & Collision LEDs have been introduced to notify the status of the system.

- The KY-032 sensor can be reproduced directly onto the PCB thus removing the additional costs introduced by buying an external module (see Market Analysis).

POWER CONSUMPTION ESTIMATION

The estimations rely upon the datasheets of each component.

- **Texas Instruments MCU :** Supposing 30% idle mode and 70% active mode power consumption is given by: 0.3*550 µA + 0.7*(1.45 mA + 48MHz*31µA/MHz) = 2.2 mA

- **Obstacle Sensor :** Value taken from the datasheet reports minimum supply current >= 20 mA

As a result, the total supply current required is around 22.2 mA. Given that the current requirements are particularly low, we can choose a small capacity LiPo battery in order to have a duration of around 4.5 hours.

MARKET ANALYSIS (COTS)

Analysis done with KY-032 sensor as a component off the shelf.

COSTS ESTIMATION FOR 1000 SchivaTO pieces:

- IR KY-032 OBSTACLE AVOIDANCE SENSOR   2000 €

- Charge controller MAX1555   1250 €

- Regulating charge pump MAX1759   3600 €

- TEXAS INSTRUMENTS MICROCONTROLLER CC2640F128RSMT   2170 €

- LiPo battery LP-402025-IS-3   8900 €

Total (1000 pieces)	17,920 €
Total (1 piece)	17.92 €

MARKET ANALYSIS (NO COTS)

Analysis done with KY-032 sensor directly reproduced on the PCB.

COSTS ESTIMATION FOR 1000 SchivaTO pieces:

- Resistive Trimmer (5kΩ and 10kΩ)   780 €
- NE555 Timer   198 €
- S0038B3VM – IR Receiver   545 €
- IR333-A – IR Diode transmitter   58 €
- Charge controller MAX1555   1250 €
- Regulating charge pump MAX1759   3600 €
- TEXAS INSTRUMENTS MICROCONTROLLER CC2640F128RSMT   2170 €
- LiPo battery LP-402025-IS-3   8900 €

Total (1000 pieces)	17,551 €
Total (1 piece)	17.55 €

MARKET COMPARISON

ZLL SG906 Laser
Obstacle Avoider
36,11€
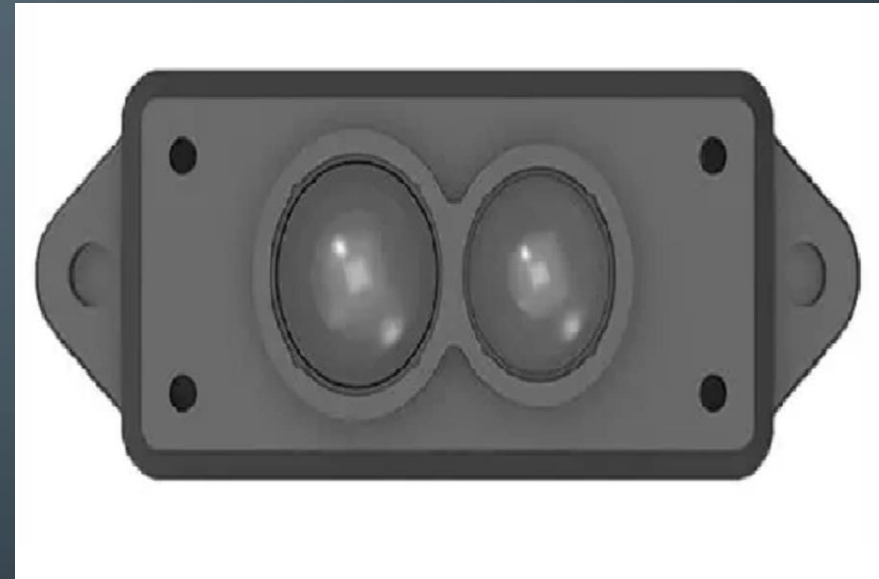
Tfmini LiDAR Module
Obstacle Avoider
49,15€

Our device guarantees a profit margin of at least 15€