EyeEmpower Requirements
To enable the blind and visually impaired to shop

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1   Electronics and Robotics Lab Requirements

1.1 Raspberry Pi4 Development Boards (3 units)

· **Purpose**: Run AI algorithms (YOLOv10, OCR) & system control.

· **Specs**:

> · RAM: 8GB · CPU: ARM Cortex-A72 (quad-core, 1.5GHz) ·
>
> Connectivity: Dual-band Wi-Fi, Bluetooth 5.0

6,200.00 EGP Original price was: 6,200.00 EGP. 5,800.00 EGP Current price is: 5,800.00 EGP.

Lowest Price in Egypt: Around 5,800 EGP on MicroOhm-EG.

5800 * 3 = 17400

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YSt4fV_lpS3aq_zLjbNMahZcpTbiIPcLgj84fhoCcJoQAvD_BwE&ohost=www.google.com
&cid=CAESVeD2P2M21Zn2G3bG7zQ1SDIUCPKQmx0x8NhFwSHZowNqKX9ei1akNQ-
6J5wz4acFq_ZetsUz7NRpTV0un3TbbSy0LUi0-
nF211u8QdMizF_vN4J5kzo&category=acrcp_v1_40&sig=AOD64_3HUVeLTdSSTWdM
QuP1EhrU6cjUuA&ctype=5&q=&nis=4&ved=2ahUKEwjozoXprv6OAxW8nf0HHT0VPL4
Q9aACKAB6BAgEEAw&adurl=

1.2 High-Resolution Cameras(3 units)

· **Purpose**: Product image capture for object recognition.

· **Specs**:

> · Resolution: 5MP
>
> · FOV: 120ř (wide-angle for shelf scanning)   **450 * 3 = 1350**
>
> · Auto-focus: For varying distances (10cm2m)

The lowest price for a 5MP Raspberry Pi camera module in Egypt appears to be around 400-500 EGP.

Several online retailers, such as Amazon.eg and Kanbkam, offer these modules within that price range. Some listings on Amazon.eg show prices around EGP 480, while Kanbkam has a listing for a similar module at EGP 558.88. Another retailer, Future Electronics Egypt (Arduino Egypt), offers a 5MP camera module for LE 295, but this might be an older version or require additional components.

1.3   IMU Sensors (BNO055) (3 units)

· **Purpose**: Head movement tracking & spatial navigation.

· **Specs**:   · 9-axis (gyro + accelerometer + magnetometer)
                      · Precision: ś0.3ř orientation error

. **Use in EyeEmpower:** Tracks head movement and orientation for Visual SLAM

navigation. Automatically adjusts the camera angle when the user moves their head to

keep products in frame.

. **Importance:** Without this, the system cannot detect where the user is looking, making

navigation and object capture less accurate.

Current price is: 3100 EGP.   3100 * 3 = 9300

https://store.fut-electronics.com/collections/inertial- vibration?

srsltid=AfmBOopQNAphSdokRBrec0ocvZ6qkq0G-7kqryIHN0zOhi5eWMxUz9JE

1.4   Bone Conduction Speakers (3 units)

· **Purpose**: Audio feedback without ear obstruction.

Specs: Bluetooth 5.0,8-hourbattery life, lightweight.

Use in EyeEmpower: Deliversvoice instructions (product info, navigation, payment
 guidance) privatelywithoutblocking environmental sounds.

Importance: Ensuressafetybyallowing users to hear surroundings while following the
system's instructions
                           .

LowestPrice in Egypt: Around 600–850 EGP for entry-level bone conduction headsets.

https://www.amazon.eg/-/en/Eacam-Wireless-Computer-Conduction-

Speakers/dp/B0B918DSC8

750 * 3= 2250

1.5   Haptic Feedback Motors (3 units)

· **Purpose**: Tactile feedback in the wristband.

· **Specs**:

  · Type: Linear resonant actuators (LRA)

  · Intensity Control: PWM-based (5 levels)

  Use in EyeEmpower: Provides vibration alerts in silent mode for example, a short buzz = product found, a double buzz = turn right

  . **Importance:** Allows discreet interaction without sound, which is especially useful in quiet environments or crowded places where audio may be impractical.

  Price in Egypt: Around 600 EGP per unit from local electronics stores .

  https://www.amazon.com/haptic-motor/s?k=haptic+motor   **600* 3 = 1800**

1.6   Li-ion Batteries (3 units)

  · Purpose: Power system for 8+ hours.

  · Specs:

  · Capacity: 1000mAh

  · Charging: USB-C PD (18W)

  Use in EyeEmpower: Powers the Raspberry Pi, camera, IMU, speakers, and haptic feedback motors for over 8 hours of continuous use.

   Importance: Essential for all-day operation during shopping tripswithout the need for recharging.

  Price in Egypt: Around 500 EGP depending on supplier   **500 * 3 = 1500**

   https://www.amazon.com/Liter-energybattery-Battery-Rechargeable-Connector/dp/B09FLW3LF4

   https://store.fut-electronics.com/products/solar-usb-charger-for-lithium-batteries-lipo-rider?variant=1016434015&utm_source=chatgpt.com

  160 * 3 = 480

1.7   PCB Design & Testing Equipment (2 units)

· **Purpose**: Prototype and validate custom PCBs.

· **Tools**:

  . Oscilloscope: 100MHz bandwidth (for signal debugging)

  . Multimeter: Auto-ranging (voltage/current/resistance)

  . Soldering Station: Temperature-controlled (for SMD components)

2 AI Lab Requirements

2.1 High-Performance Computing Workstation ·

Purpose: Training deep learning models (YOLOv10, CNNs). ·

Specifications:

- GPU: NVIDIA RTX 4090 (or equivalent for parallel processing).
- RAM: 64GB DDR5.

Continuation of Specifications:

- · CPU: Intel Core i9-13900K / AMD Ryzen 9 7950X.
- · Cooling: Liquid cooling for sustained heavy loads.

2.2 Large-ScaleDatasetStorage

· **Purpose**: Store +100,000 annotated images of Egyptian retail products (for object detection and OCR).

· **Specifications**:

- · Capacity: 10TB NVMe SSD (e.g., Samsung 990 Pro).
- · Backup: RAID 1 configuration for redundancy.
- · Data Pipeline: Support for TFRecords/COCO dataset formats.

2.3 Audio Processing Equipment

· **Purpose**: Develop voice interaction and sound recognition (e.g., Arabic speech commands, environmental sounds like cashier beeps).

· **Specifications**:

- · **Hardware**:
  - · High-fidelity MEMS microphones (e.g., Knowles SPH0645).
  - · Audio interface (e.g., Focusrite Scarlett 4i4).
- · **Software**:
  - · Tools: Tacotron 2 (Arabic TTS), PyAudioAnalysis, SoundNet.
  - · Noise-cancellation algorithms (RNNoise).

2.4 Additional Requirements

· **3D Printer (Optional)**: For prototyping wearable components (glasses/band frames).

- Model: Prusa i3 MK3S+ (for precision).
- Filament: Lightweight PLA/PETG.

3   Engineering Design Lab Requirements

3.1 CAD Design Workstations

· **Purpose**: 3D modeling of smart glasses and haptic band. ·
Software:

  · SolidWorks (for mechanical design and stress analysis).

  · Fusion 360 (for iterative prototyping and collaboration).

· **Hardware**:

  · GPU: NVIDIA RTX 5000 (for real-time rendering).

  · RAM: 32GB minimum (for complex assemblies).

3.2   Ergonomic Testing Equipment

· **Purpose**: Validate comfort and usability for extended wear (8+ hours).

· **Tools**:

  · Anthropometric Kits: Measure head/arm dimensions for custom fit.

  · Pressure Mapping Sensors: Test weight distribution (e.g., Tekscan system).

  · User Feedback Stations: Record pain points during trials.

3.3   Prototyping Materials

· **Purpose**: Functional prototypes for field testing.

· **Materials**:

  · Frames: Aerospace-grade aluminum (lightweight, <100g).

  · Wearable Components: Flexible TPU/PLA (3D-printed for rapid iteration).

  · Waterproofing: Silicone gaskets (IP65 compliance).

Key Design Deliverables

3.3.1   *SmartGlassesDesign*

· Weight: <100 grams (including battery/camera).

· Battery Life: 8+ hours continuous use.

· Durability: IP65-rated (dust/water-resistant).

· AR Display: Optional waveguide lens for visual cues (for low-vision users).

3.3.2 HapticBandDesign

· Touchpoints: 20 distinct zones (for gesture control).

· Feedback: Graded vibrations (e.g., short/long pulses for confirmations).

· Battery: 12-hour lifespan (200mAh Li-Po).

· Comfort: Hypoallergenic silicone strap (adjustable sizing).

3.3.3 UI/UX Design

· **Principles**:

  ˙ One-Hand Operation: Large tactile buttons with Braille labels.

  ˙ Minimalist Interface: Voice-first, with fallback to physical controls.

  ˙ Fail-Safes: Undo/emergency stop gestures (e.g., triple-tap).

4 Additive Manufacturing Lab Requirements

4.1 FDM 3D Printers

· **Purpose**: Printing glasses frame & haptic band prototypes.

· **Build Volume**: 300Œ300Œ400mm (for full-scale parts).

· **Materials**:

  · PLA: Structural components (cost-effective). ·
  PETG: Glasses frame (durable, lightweight). ·
  TPU: Haptic band (flexible, skin-safe).

4.2 Resin Printer (SLA)

  Purpose: High-detail/complex parts (e.g., electronics housings).

  Resolution: 0.01mm layer height.

· **Materials**:

  · Standard Resin: Precision components.

  · Flexible Resin: Hinges/ergonomic features.

4.3   Post-Processing Tools

· UV Curing Station: For resin part hardening.

· Sanding/Filing: Surface smoothing (80400 grit sandpaper).

· Chemical Smoothing (Optional): Acetone vapor for PLA/PETG.

Prototypes to Print

4.3.1   Glasses Frame (5 units)

· **Material**: PETG (impact-resistant, <100g).

· **Variants**:

  · 3 ergonomic designs (adjustable nose pads/temples).

  · 4 colors (user preference testing).

4.3.2   Haptic Band (5 units)

· **Material**: TPU (shore hardness 70A for comfort).

· **Sizes**: S/M/L/XL (based on anthropometric data).

· **Features**: Modular slots for electronics.

4.3.3   Electronics Housings (10 units)

· **Material**: PLA (rapid prototyping).

· **Design**:

  · Waterproof gasket channels (IP65 compliance).

  · Cable routing holes (labeled for sensors/battery).

4.3.4   Mounting Parts (20 units)

· **Materials**: Mixed (PLA for brackets, TPU for joints).

· **Features**:

  · Snap-fit connectors (tool-free assembly).

  · Hinges with 180ř rotation (durability testing).

5   VR & XR Lab Requirements

5.1 Spatial Audio Development Setup

· **Purpose**: Developimmersive3Daudiofornavigationcuesandenvironmentalfeedback.

· **Hardware**:

  · Audio Interface: Focusrite Scarlett 18i20 (8-channel) for multi-directional sound design.

  · StudioMonitors: KaliAudioLP-6(pair)+subwooferforaccuratefrequencyresponse.

· **Software**:

  · Spatial Audio SDKs: Microsoft Spatial Sound, Oculus Audio SDK.

  · Plugins: Ambisonic Toolkit for Unity/Wwise.

5.2   3D Audio Recording Equipment

· **Purpose**: Capture real-world product/environment sounds (e.g., cashier beeps, store ambiance).

· **Tools**:

  · Binaural Mics: Neumann KU 100 (dummy head recording for lifelike playback).

  · Ambisonics Recorder: Zoom H3-VR (4-channel 1st-order Ambisonics).

  · Field Kits: Windshields, portable preamps for market recordings.

5.3 AR Development Workstation

· **Purpose**: Build audio-centric AR navigation (for low-vision users).

· **Hardware**:

  · GPU: NVIDIA RTX 4080 (real-time ray-traced audio rendering).

  · Headset: Meta Quest 3 (passthrough AR testing).

· **Software**:

  · Game Engines: Unity 2022 LTS (with AR Foundation), Unreal Engine 5 (Meta-Sounds).

  · SDKs: ARCore/ARKit, Phonon 3D for acoustic modeling.

Total Cost = 35280 + Additional expenses for reserve (4720) = 40,000 EGP