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Smart Screen Mirroring Prism System Using Total Station

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Abstract: *Surveying plays an essential role in civil engineering, particularly in the accurate layout and positioning of construction elements. Although modern instruments like total stations provide high precision, the traditional stake-out process still depends on manual communication between the operator and the prism holder. This often leads to delays, miscommunication, and reduced efficiency in fieldwork.*
The project "Screen Mirroring Prism" introduces a smart solution to overcome these limitations. It involves attaching a display screen to the prism rod, which receives real-time data from the total station through wireless communication such as Bluetooth. This allows the prism holder to directly view movement instructions like left, right, forward, and backward, along with distance information.
The system works by transmitting directional data from the total station to the display unit, where it is shown in a simple and understandable format. The prism holder follows these visual instructions to accurately reach the required point without repeated guidance from the operator. This reduces dependency on verbal communication and minimizes human error.
The proposed system improves accuracy, saves time, and enhances overall productivity in surveying operations. It is also cost-effective compared to advanced robotic systems, making it suitable for small and medium-scale projects..

Keywords: Surveying, Total Station, Stake-out Operation , Screen Mirroring Prism , Wireless Communication, Real-time Guidance, Directional Display System , Accuracy and Efficiency , Error Minimization, Cost-effective Innovation

I. INTRODUCTION

Surveying plays a crucial role in civil engineering projects, particularly during construction, layout, and monitoring activities. Modern surveying relies heavily on total stations for accurate measurement and stake-out of points using predefined coordinates. However, despite technological advancements in total stations, the stake-out process still depends largely on manual communication between the instrument operator and the prism holder. This paper presents an innovative prism-mounted guidance display system that improves stake-out efficiency by providing real-time visual guidance directly to the person holding the prism.

II. PROBLEM STATEMENT

During stake-out operations, previously surveyed points often need to be relocated using stored coordinates, even when original station points and physical reference objects such as trees, boulders, or markers no longer exist. The total station stores previously surveyed coordinates in its internal memory. In current practice, the total station operator guides the prism holder using walkie-talkies, hand signals, or verbal instructions while looking on the screen of total station. This method is slow, prone to misunderstanding, and dependent on visibility, terrain, and communication skill.

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The lack of direct feedback to the prism holder leads to repeated corrections, reduced accuracy, and increased field time.

III. METHODOLOGY

The methodology ensures accurate real-time guidance during surveying operations.

1. System Design and Components Selection

The system is designed using the following components:

Microcontroller (e.g., Arduino/ESP32): Acts as the main processing unit

Bluetooth Module (HC-05/HC-06): Enables wireless communication

Display Unit (LCD/OLED): Shows real-time instructions

Power Supply (Rechargeable Battery): Ensures portability

Prism Rod Mount: Holds the display system securely

The design focuses on compactness, durability, and ease of handling in outdoor conditions.

2. Communication Setup

A wireless communication link is established between the total station and the prism unit:

The total station sends positional data such as **angle deviation and distance to target**

The Bluetooth module receives this data at the prism end

A stable connection is maintained within a specific range for uninterrupted operation

3. Data Acquisition

The system continuously collects data from the total station, including:

Horizontal direction (left/right deviation)

Vertical or forward/backward movement

Distance to the required point

This data is transmitted in real time to ensure continuous guidance.

4. Data Processing and Algorithm

The microcontroller processes the received data using a programmed algorithm:

If deviation is towards left → display “Move Left”

If deviation is towards right → display “Move Right”

If distance is more → display “Move Forward”

If position exceeds → display “Move Backward”

If target is reached → display “Stop”

Threshold values are set to ensure precise positioning and avoid unnecessary movements.

5.Display Interface Design

A simple and clear interface is designed for easy understanding:

Direction arrows (← → ↑ ↓)

Text instructions (Left, Right, Forward, Backward, Stop)

Optional indicators like LEDs or buzzer for confirmation

The display is optimized for visibility in sunlight and field conditions.

6. Hardware Integration

All components are assembled and mounted on the prism rod:

Secure fitting to avoid vibration or damage

Proper wiring and insulation

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Compact arrangement for easy portability

7. Field Implementation

The system is used in real surveying conditions:
The operator sets the target point in the total station
The prism holder moves based on instructions shown on the display
Real-time updates guide the prism holder to the exact location
Final position is confirmed when the display shows "Stop"

IV. CONCLUSION

The Screen Mirroring Prism project effectively improves traditional surveying methods by solving the problem of manual communication between the total station operator and the prism holder. It provides real-time visual guidance directly on a display attached to the prism, allowing the prism holder to move accurately without relying on verbal instructions. This reduces errors, saves time, and increases overall efficiency and productivity in fieldwork. The system is also cost-effective (around ₹2500), simple to use, and compatible with existing surveying equipment, making it suitable for both small and large-scale applications. Additionally, its design allows for future enhancements such as better display systems and advanced technologies, making it a practical and innovative step toward modernizing surveying operations.

V. ACKNOWLEDGMENT

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Articles on modern surveying techniques and robotic total stations.

6. Project Development Sources

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Practical field observations and testing during surveying operations.