Designing and Development of a QR Code-Based Wayfinding System for Tertiary Care Government Teaching Hospital: A Case Study of King George's Medical University, Lucknow

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Abstract—**Background: Large tertiary care hospitals often have complex campus layouts, leading to navigation difficulties for patients and visitors. Traditional signage-based wayfinding systems are frequently insufficient in extensive medical campuses.**

Objective: To design, develop a QR code–based digital wayfinding system integrated with Google Maps for King George's Medical University (KGMU), Lucknow.

Methods: A descriptive and applied research study was conducted at KGMU, a tertiary care medical university with a campus area of approximately 7 km² comprising around 149 buildings. Major clinical, academic, and administrative facilities were geolocated using Google Maps. Department-specific and a unified "common" QR code were generated to provide navigation routes. Usability was assessed through observation and user feedback.

Results: A comprehensive list of key hospital facilities was mapped and linked through Google map link. Scanning the QR code enabled users to access real-time navigation routes via Google Maps. The system reduced dependency on information desks, improved navigation efficiency, and demonstrated high usability among smartphone users.

Conclusion: QR code–based wayfinding is a cost-effective, scalable, and user-friendly solution for large hospital campuses. The model developed at KGMU can be replicated in other tertiary healthcare institutions to enhance patient experience and operational efficiency.

Index Terms—**Wayfinding, QR code, Digital health, Hospital navigation, Google Maps, Smart hospital**

I. INTRODUCTION

King George's Medical University (KGMU), Lucknow, established in 1906, is one of India's largest tertiary care teaching institutions. The university campus spans approximately 7 square kilometres (1,730 acres) and includes about 149 buildings housing 77 academic and medical departments. Thousands of patients and visitors access these facilities daily.

There is too many wayfinding systems are working in different institutions some of them are as under-

Table-1

S. No.	Wayfinding System	Description	Examples	Advantages	Limitations
1	Static Signage-Based System	Fixed signboards with arrows, symbols, and department names	OPD →, Emergency ←	Low cost, simple, no technology needed	Limited detail, language barriers
2	Color-Coded Wayfinding System	Uses colored lines, walls, or signage for different zones	Blue line → ICU	Easy to follow, good for elderly	Color blindness, maintenance

3	Map-Based Wayfinding System	Printed or displayed floor maps with "You are here"	Hospital layout maps	Gives overall view	Requires map reading skills
4	Digital Kiosk-Based System	Touchscreen kiosks with interactive directions	Self-service kiosks	Multilingual, interactive	High cost, power dependent
6	Mobile App–Based System	Hospital-specific apps for navigation	Hospital mobile app	Personalized guidance	App download required
7	RFID / Beacon-Based System	Indoor navigation using BLE/Wi-Fi/RFID	Indoor turn-by-turn guidance	High accuracy	Very expensive, complex
8	Human-Assisted Wayfinding	Information desks, volunteers, guards	Help desk guidance	Personalized help	Manpower intensive
9	Hybrid Wayfinding System	Combination of multiple systems	Signage + kiosk	Most effective & inclusive	Needs coordination

Due to the vast and dispersed campus layout, first-time visitors often face difficulty locating departments and service areas. This results in anxiety, delays in care, congestion at help desks, and increased workload for hospital staff. Conventional static signage systems have limited adaptability and are insufficient for large, evolving campuses.

Advances in smartphone usage and universal access to Google Maps provide an opportunity to integrate digital navigation solutions into hospital environments. QR (Quick Response) code–based wayfinding systems bridge physical signage and digital navigation, offering real-time, location-specific guidance.

As a high-volume tertiary care institution, KGMU faces challenges related to crowd movement and navigational confusion. Implementing a digital wayfinding system aims to:

- Improve patient and visitor navigation.
- Reduce dependency on hospital staff for directions.
- Decrease delays in accessing services.
- Enhance patient satisfaction.
- Align with national "Smart Hospital" and "Digital Health" initiatives.

II. AIM AND OBJECTIVES

Aim
To design and implement a QR code–based wayfinding system for King George's Medical University, Lucknow.

Objectives
1. To identify and geolocate major clinical, academic, and administrative facilities within KGMU.
2. To develop a common QR interface providing navigation to multiple facilities.

III. METHODOLOGY

The study was Descriptive and applied research study. Conducted in King George's Medical University, Lucknow, With Total duration of 8 weeks. All clinical, non-clinical, and administrative buildings within KGMU campus were included in the study while Residential buildings of KGMU were excluded from the study.

Data Collection-
Data were collected using-
- On-site verification of department locations.
- Recording latitude and longitude using Google Maps.
- Cross-verification of navigation routes.

Tools and Technologies used-
- Google Maps
- QR code generators
- Smartphones (Android/iOS)
- Microsoft Excel
- Printed and laminated QR display boards

IV. OBSERVATION AND DISCUSSION

The QR code–based wayfinding system effectively integrates digital navigation into the physical hospital environment. Compared to traditional signage, the system offers real-time updates, multilingual potential, and minimal infrastructure costs. While indoor navigation within multi-story buildings remains a limitation due to GPS constraints, the system performs well for outdoor and inter-building navigation.

The Data were collected using Google Map and a list of Departments and Facility were made and tabulated with their respective google link as under-

Table 2:

Way Finding system Design		
Sr. No.	Name of facility	Google location link
	Shatabdi Hospital (Phase-2) / शताब्दी अस्पताल (चरण-2)	Shatabdi Hospital (Phase-2) - Google Maps
	Shatabdi Hospital (Phase-1) / शताब्दी अस्पताल (चरण-1)	Shatabdi Hospital (Phase 1) - Google Maps
	Trauma Centre, KGMU / ट्रॉमा सेंटर, केजीएमयू	Trauma centre - Google Maps
	Kalam Centre, KGMU / कलाम सेंटर, केजीएमयू	Kalam Centre (Modern Teaching Block) - Google Maps
	Badi Pathology – Department of Pathology / बड़ी पैथोलॉजी – पैथोलॉजी विभाग	Department of Pathology - Google Maps
	Dean Office, KGMU / डीन कार्यालय, केजीएमयू	Dean office KGMU - Google Maps
	Department of Microbiology / सूक्ष्मजीवविज्ञान विभाग	Microbiology building- 01 - Google Maps
	Department of Physiology / शरीर क्रिया विज्ञान विभाग	Department of Physiology - Google Maps
	Department of Biochemistry / जैव रसायन विभाग	Department of Biochemistry - Google Maps
	Department of Community Medicine & Yellow Fever Vaccination Centre / सामुदायिक चिकित्सा विभाग एवं येलो फीवर टीकाकरण केंद्र	Department of Community Medicine - Google Maps
	Vice Chancellor (VC) Office / कुलपति कार्यालय	VC Office - Google Maps
	Research Cell, KGMU / अनुसंधान प्रकोष्ठ, केजीएमयू	Rsearch Cell King George's Medical University, Lucknow, Uttar Pradesh 226003 - Google Maps
	Registrar Office, KGMU / रजिस्ट्रार कार्यालय, केजीएमयू	Registrar Office KGMU - Google Maps
	Central Library, KGMU / केंद्रीय पुस्तकालय, केजीएमयू	Central Library, KGMU - Google Maps
	Indian Bank / इंडियन बैंक	Allahabad Bank - Google Maps
	Post Mortem House / Mortuary, KGMU / पोस्टमार्टम हाउस / शवगृह, केजीएमयू	Post Mortem House KGM Lucknow - Google Maps
	Department of Anatomy / शरीर रचना विभाग	Department Of Anatomy - Google Maps
	Department of Forensic Medicine & Toxicology / फॉरेंसिक मेडिसिन एवं टॉक्सिकोलॉजी विभाग	Department of Forensic Medicine & Toxicology - Google Maps
	Department of Medicine / मेडिसिन विभाग	Department of Medicine - Google Maps
	Department of Pediatrics / बाल रोग विभाग	Department Of Pediatrics - Google Maps
	CT Centre / सीटी केंद्र	C T Scan Centre - Google Maps
	Department of Ophthalmology / नेत्र विज्ञान विभाग	Department of Ophthalmology - Google Maps
	New Dental Block / नया डेंटल ब्लॉक	Prof C V Govila Dental Block - Google Maps
	Amrit Pharmacy, KGMU / अमृत फार्मेसी, केजीएमयू	Amrit Pharmacy Kgmu - Google Maps
	KGMU New OPD Building / केजीएमयू नया ओपीडी भवन	KGMU New OPD Building - Google Maps
	KGMU Old OPD Building / केजीएमयू पुराना ओपीडी भवन	Old OPD - Google Maps

	Department of Pharmacology / फार्माकोलॉजी विभाग	Department of Pharmacology - Google Maps
	Centre for Advanced Research (CFAR) / उन्नत अनुसंधान केंद्र (CFAR)	Centre for Advanced Research (CFAR) - Google Maps
	Department of Urology / यूरोलॉजी विभाग	Department of Urology - Google Maps
	Department of Respiratory Medicine, KGMU / श्वसन चिकित्सा विभाग, केजीएमयू	Respiratory Medicine Department Kgmu Lucknow - Google Maps
	Kasturba Gandhi Chest Hospital (KCH) / कस्तूरबा गांधी चेस्ट अस्पताल (KCH)	Kasturba Gandhi Chest Hospital - Google Maps
	Department of Radiodiagnosis / रेडियोडायग्नोसिस विभाग	Department of Radiodiagnosis - Google Maps
	ENT Department / ईएनटी विभाग	ENT Surgical Ward 4 - Google Maps
	Surgery Ward / शल्य चिकित्सा वार्ड	Surgical ward-1 kgmu - Google Maps
	Department of Anaesthesiology / एनेस्थीसियोलॉजी विभाग	Anesthesiology Department - Google Maps
	Department of Surgery, KGMU / शल्य चिकित्सा विभाग, केजीएमयू	Deapartment Of Sugery KGMU.... - Google Maps
	Department of Paediatric Surgery, KGMU / बाल शल्य चिकित्सा विभाग, केजीएमयू	Department of Paediatric Surgery, KGMU - Google Maps
	Department of Plastic Surgery / प्लास्टिक सर्जरी विभाग	Department ofPlasticSurgery - Google Maps
	Department of Neurology / न्यूरोलॉजी विभाग	Department of Neurology Kgmu - Google Maps
	Gandhi Ward / गांधी वार्ड	Gandhi Ward KGMU - Google Maps
	Department of Dental Surgery, KGMU / दंत शल्य चिकित्सा विभाग, केजीएमयू	Department Of Dental Surgery, KGMU - Google Maps
	Gynaecological Oncology Department, KGMU / स्त्री रोग ऑन्कोलॉजी विभाग, केजीएमयू	Gynaecological Oncology Department, KGMU - Google Maps
	Queen Mary Hospital / क्वीन मैरी अस्पताल	
	College of Nursing, KGMU / केजीएमयू कॉलेज ऑफ नर्सिंग	KGMU College of Nursing - Google Maps
	CTVS Department, KGMU / कार्डियो-थोरेसिक एवं वैस्कुलर सर्जरी विभाग	دل کی سرجری کا شعبہ Heart Surgery Department, CTVS Deparemt, KGMU - Google Maps
	Psychiatry Department, KGMU / मनोचिकित्सा विभाग	मानसिक चिकित्सालय - Google Maps
	LARI Cardiology / लारी कार्डियोलॉजी	Lari Cardiology Centre, KGMU - Google Maps
	Department of Geriatric Mental Health / जेरियाट्रिक मानसिक स्वास्थ्य विभाग	Dept Of Geriatric Mental Health वृद्धावस्था मानसिक चिकित्सा विभाग - Google Maps
	Department of Orthopaedic Surgery / अस्थि शल्य चिकित्सा विभाग	Department of Orthopaedic Surgery, IDH Campus, OSSB - Google Maps
	Department of Physical Medicine & Rehabilitation (DPMR) / शारीरिक चिकित्सा एवं पुनर्वास विभाग (DPMR)	KGMC Department Of Physical Medicine Orthopaedic - Google Maps
	Paediatric Orthopaedics, KGMU / बाल ऑर्थोपेडिक्स विभाग, केजीएमयू	Paediatric Orthopaedics, KGMU - Google Maps
	Department of Rheumatology, KGMU / रूमेटोलॉजी विभाग, केजीएमयू	Department of Rheumatology KGMU - Google Maps
	Sankramak Rog Hospital (IDH) / संक्रामक रोग अस्पताल (IDH)	Sankramak Rog Hospital - Google Maps

Base on the table-2 a final list of the facilities was made as under-

Table-3
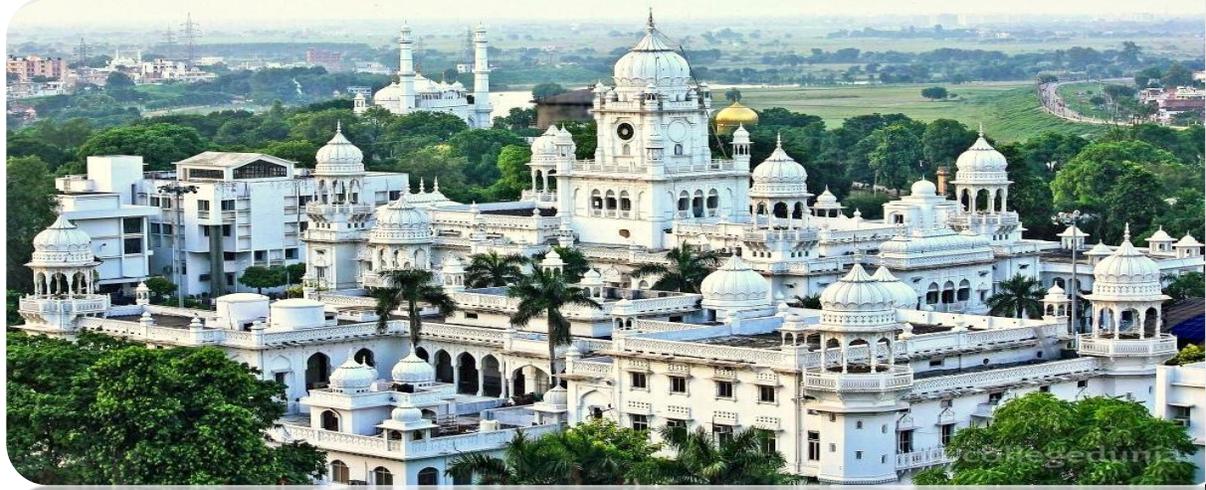
King George's Medical University, Lucknow

"SARATHI"

To find the way please click on the link bellow रास्ता खोजने के लिए कृपया नीचे दिए गए लिंक पर क्लिक करें।
KGMU New OPD Building / केजीएमयू नया ओपीडी भवन
KGMU Old OPD Building / केजीएमयू पुराना ओपीडी भवन
Badi Pathology – Department of Pathology / बड़ी पैथोलॉजी – पैथोलॉजी विभाग
Trauma Centre, KGMU / ट्रॉमा सेंटर, केजीएमयू
Blood Bank KGMU/ब्लड बैंक, केजीएमयू
LARI Cardiology / लारी कार्डियोलॉजी
Queen Mary Hospital / क्वीन मैरी अस्पताल
Gandhi Ward / गांधी वार्ड
Shatabdi Hospital (Phase-2) / शताब्दी अस्पताल (चरण-2)
Shatabdi Hospital (Phase-1) / शताब्दी अस्पताल (चरण-1)
Kalam Centre, KGMU / कलाम सेंटर, केजीएमयू
Dean Office, KGMU / डीन कार्यालय, केजीएमयू
Department of Microbiology / सूक्ष्मजीवविज्ञान विभाग
Department of Physiology / शरीर क्रिया विज्ञान विभाग

Department of Biochemistry / जैव रसायन विभाग	
Department of Community Medicine & Yellow Fever Vaccination Centre / सामुदायिक चिकित्सा विभाग एवं येलो फीवर टीकाकरण केंद्र	
Vice Chancellor (VC) Office / कुलपति कार्यालय	
Research Cell, KGMU / अनुसंधान प्रकोष्ठ, केजीएमयू	
Registrar Office, KGMU / रजिस्ट्रार कार्यालय, केजीएमयू	
Central Library, KGMU / केंद्रीय पुस्तकालय, केजीएमयू	
Indian Bank / इंडियन बैंक	
Post Mortem House / Mortuary, KGMU / पोस्टमार्टम हाउस / शवगृह, केजीएमयू	
Department of Anatomy / शरीर रचना विभाग	
Department of Forensic Medicine & Toxicology / फॉरेंसिक मेडिसिन एवं टॉक्सिकोलॉजी विभाग	
Department of Medicine / मेडिसिन विभाग	
Department of Pediatrics / बाल रोग विभाग	
CT Scan Centre / सीटी केंद्र	
Department of Ophthalmology / नेत्र विज्ञान विभाग	
New Dental Block / नया डेंटल ब्लॉक	
Amrit Pharmacy, KGMU / अमृत फार्मेसी, केजीएमयू	
Department of Pharmacology / फार्माकोलॉजी विभाग	
Centre for Advanced Research (CFAR) / उन्नत अनुसंधान केंद्र (CFAR)	
Department of Urology / यूरोलॉजी विभाग	
Department of Respiratory Medicine, KGMU / श्वसन चिकित्सा विभाग, केजीएमयू	
Kasturba Gandhi Chest Hospital (KCH) / कस्तूरबा गांधी चेस्ट अस्पताल (KCH)	
Department of Radiodiagnosis / रेडियोडायग्नोसिस विभाग	
ENT Department / ईएनटी विभाग	
Surgery Ward / शल्य चिकित्सा वार्ड	
Department of Anaesthesiology / एनेस्थीसियोलॉजी विभाग	
Department of Surgery, KGMU / शल्य चिकित्सा विभाग, केजीएमयू	
Department of Paediatric Surgery, KGMU / बाल शल्य चिकित्सा विभाग, केजीएमयू	
Department of Plastic Surgery / प्लास्टिक सर्जरी विभाग	
Department of Neurology / न्यूरोलॉजी विभाग	
Department of Dental Surgery, KGMU / दंत शल्य चिकित्सा विभाग, केजीएमयू	
Gynaecological Oncology Department, KGMU / स्त्री रोग ऑन्कोलॉजी विभाग, केजीएमयू	
College of Nursing, KGMU / केजीएमयू कॉलेज ऑफ नर्सिंग	
CTVS Department, KGMU / कार्डियो-थोरेसिक एवं वैस्कुलर सर्जरी विभाग	
Psychiatry Department, KGMU / मनोचिकित्सा विभाग	
Department of Geriatric Mental Health / जेरियाट्रिक मानसिक स्वास्थ्य विभाग	
Department of Orthopaedic Surgery / अस्थि शल्य चिकित्सा विभाग	

Department of Physical Medicine & Rehabilitation (DPMR) / शारीरिक चिकित्सा एवं पुनर्वास विभाग (DPMR)
Paediatric Orthopaedics, KGMU / बाल ऑर्थोपेडिक्स विभाग, केजीएमयू
Department of Rheumatology, KGMU / रुमेटोलॉजी विभाग, केजीएमयू
Sankramak Rog Hospital (IDH) / संक्रामक रोग अस्पताल (IDH)

V. RESULTS

After A comprehensive list of major facilities including OPD buildings, diagnostic centers, specialty departments, administrative offices, and hospitals successfully mapped, a common QR code ("KGMU SARATHI") was developed bilingual to provide access to multiple destinations from a single interface. The QR code Generated was as under-

"KGMU SARATHI"

"केजीएमयू सारथी"

System Workflow-

The system demonstrated:

- Improved navigation efficiency
- Reduced crowding at help desks
- High usability among smartphone users
- Easy scalability for adding new departments

Advantages of the System

- Cost-effective and low maintenance.
- No need for custom mobile application.
- Easy scalability.
- Eco-friendly (reduces printed maps).
- Supports digital literacy.

Limitations

- Requires smartphone and internet access
- Limited accuracy inside multi-story buildings
- Dependent on GPS signal strength

VI. CONCLUSION

The QR code–based wayfinding system developed for KGMU demonstrates a practical, scalable, and user-friendly solution for large hospital campuses. It significantly improves visitor navigation and supports the transition toward smart healthcare infrastructure.

VII. RECOMMENDATIONS

- Expand QR coverage to all hospital blocks
- Integrate QR codes into appointment slips and hospital websites
- Conduct awareness and training sessions
- Introduce indoor navigation using Wi-Fi or Bluetooth in future phases

VIII. FUTURE SCOPE

- Development of indoor navigation systems
- Integration with AI-based virtual assistants
- Offline navigation capabilities
- Integration with hospital information systems (HIS)

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