



Azarbaijan Shahid Madani University, IR. Iran
Vice Rector for Research and Technology

Joint Research Project Application Form

Application Form

General Data

Project Title:

A Feasibility Study and Design of an Indoor Visible Light Positioning System for Healthcare Application

Project Duration (months):

12

Scientific Disciplines:

Telecommunication Engineering

Applicant Details

Personal data Iranian coordinator:

Academic Degree(s):	Ph.D., Assistant Professor
Other Academic Degrees or Title(s):	
First Name:	Hamed
Surname:	Alizadeh Ghazijahani
Sex (M/F):	Male
Date of Birth (DD-MM-YYYY):	06-04-1988
Nationality:	Iranian
Position:	Faculty member

Iranian university/Institution

Name of the Institution:	Azarbaijan Shahid Madani University
Faculty/Unit:	Faculty of Engineering
Address:	35 Km Tabriz- Azarshahr Road, Tabriz, Iran
ZIP Code:	53714-161
City:	Tabriz
Phone:	+98- 4131452460
E-Mail:	Intl_office@azaruniv.ac.ir
Website:	http://en.azaruniv.ac.ir/

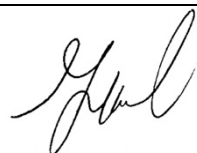
Personal data foreign coordinator:

Academic Degree(s):	Ph.D.
Other Academic Degrees or Title(s):	Chief Technology Officer
First Name:	Hossein
Surname:	Nejati
Sex (M/F):	Male
Date of Birth (DD-MM-YYYY):	
E-Mail:	hossein@kronikare.ai
Nationality:	Iranian
Position:	co-founder and CTO of KroniKare

Foreign Institution:

Name of the Foreign Institution:	KroniKare Pte. Ltd
Faculty/Unit:	Research and Development
Address:	75, #03-19 Ayer Rajah Crescent
ZIP Code:	139953
City:	Singapore
Phone:	+65 6873 0167
E-Mail:	info@kronikare.ai
Website:	Kronikare.ai

Project Team: (Other supervisors, advisors, students, other partners)

	Full Name	Position and Academic Rank	Type of Involvement	E-mail address and Phone Number	Partner's Signature
1	Hamed Alizadeh Ghazijahani	Ph.D. Assistant Professor	Main executer	Hamed.aligha@gmail.com +98-914 305 0134	
2	Mina Mahdinezhad	M.Sc.	Partner	mina.mahdinezhad70@gmail.com +98-991 864 9066	
3	Hossein Nejati	Ph.D. CTO and co-founder KroniKare	Foreign Partner	hossein@kronikare.ai +65-8480 2894	

Part A: Concept and quality of the Project

(Please write directly in the field under the respective heading. Part A must not exceed 6pages.)

Proposal Abstract (max 300 words):

The combination of an aging population and nursing staff shortages implies the need for more advanced systems in the healthcare industry. Many key enablers for the optimization of healthcare systems require the provisioning of location awareness for patients, nurses, doctors, and assets. Besides, robot navigation and visiting people way-finding inside the hospital buildings are of today's world essential needs.

On the other hand, as the Global Positioning System (GPS) cannot provide satisfying performance in indoor environments, indoor positioning technology, which utilizes indoor wireless signals instead of GPS signals, has grown rapidly in recent years. Meanwhile, visible light communication (VLC) using light devices such as light-emitting diodes (LEDs) has been deemed to be a promising candidate to use in indoor positioning systems (IPs). As visible light does not cause electromagnetic interference and has stronger anti-interference ability, it is suitable for use in RF-sensitive areas, such as hospitals.

In this research, we will investigate the application of indoor visible light (VLP) in hospitals. According to the hospital constraints and conditions, the challenges will be identified. Considering the VLP technology the solutions for each current challenge will be simulated and reviewed technically and then a suitable solution will be provided.

Key Words: Indoor Localization, Visible Light Communication (VLC), Visible Light Positioning (VLP)

Objectives and project description

(Suitability of the planned activities and timetable in line with the local, institutional and scientific needs and demands)

The aim of this research is to analyze the VLP potential challenges in a hospital environment. Some main challenges that play a substantial role are:

- Appropriate optical channel model
- Handoff problem in indoor VLP due to multiplicity of rooms and corridors in a hospitals
- Operation of VLP under night mode
- impact of ambient light noise
- impact of multipath fading and shadowing

To present an appropriate channel model for hospital, first, we will install some LED panels in some dedicated points of hospital rooms and then scan the intensity of light in various points using lux meter. Then, using the recorded data we can reform the presented general channel model for hospital applications.

An appropriate framework based on existing solutions for challenges will be provided. Ultimately the optimum package for smart hospitals will be given.

Background information

(regional, national, institutional, scientific context)

In recent years, several techniques are proposed to enhance the VLP accuracy performance from theoretical to practical. In this way, the researchers utilize both classical and machine learning methods. On the other hand, one can put the proposed VLP techniques into two classes from the receiver's point of view. Some of them use a photodiode (PD) at the receiver side as a receiver sensor which is sensitive to the light level. The others are camera-based receivers that measure the receiving light swing using the built-in camera sensor, especially in smartphones. In PD-based methods, the RSS information is first detected by a PD, and then the distance between the transmitter and receiver is calculated based on trilateration triangulation algorithms. To distinguish the signals for RSS measurement, the LEDs generate high-speed pulses with unique frequencies or unique codes. The methods choose the smartphone as a VLP receiver, in addition to the camera use the other built-in sensors such as gyroscope and ambient light sensor (ALS) to extend the accuracy of indoor localization.

Innovative approach

(in terms of theoretical, interdisciplinary, methodological and educational aspects)

Medical care environments, including hospitals, have special conditions regarding light level, architecture, decor, medical equipment, etc., which distinguish them from other environments. Providing a suitable proposal for a hospital-specific VLP by considering the specific conditions and existing limitations can improve the VLP's performance in this environment.

To the best of our knowledge, all the proposed VLP systems are for general budlings. This motivated us to specifically address the application of the VLP in healthcare and provide a suitable design with useful performance. This research will cover the main challenges of VLP in a hospital and solutions.

Expected results, planned activities, time table (work schedule)

(Alignment of the expected results with the objectives and the planned activities.)

The expected results can be outlined respectively as below:

- A full examination of each challenge regarding VLP application in healthcare
- A survey of potential solutions for each challenge
- A complete study on a hospital condition and constraints
- Proposing an appropriate channel model for a hospital by practical measuring
- Proposing a complete package for optimal use of the VLP in the hospital

Part B: Contribution to and additional benefit for the universities' internationalization (Optional).

(Please write directly in the field under the respective heading. Part B must not exceed 4 pages.)

Relevance of the proposed activities for the internationalization of the university/research institution

Correlation between the universities' or research institutions' strategy and the respective project proposal

Support and strengthening of institutional capacity of the partner university/research institution

Increase in integration in international scientific networks

Part C: Results and sustainability

(Please write directly in the field under the respective heading. Part C must not exceed 4 pages.)

Potential impact for the beneficiaries

(local, institutional, regional/ national level)

This is a novel study on one of the most high-tech and new topics in the field of communication engineering jointly with healthcare equipment. Research on the VLP will result in powerful scientific publications for both beneficiaries. Besides, reach to such advanced technology helps both institutes to broaden their world-class experience and to be known in the world.

Part D: Research Timeline Table:

	activities	Duration of the activity (each cell represents two months)											
1	Primary studies	x	x	x									
2	Challenges identifying			x	x	x	x						
3	Channel modelling					x	x						
4	Simulating potential solutions						x	x	x				
5	Finalization of the proposed package									x	x		
6	Documentation and publish results										x	x	x

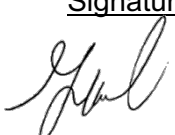
Part E: Budget Details:

Summary of funding	
Institution/ University	Funding
Azarbaijan Shahid Madani University	1200 \$
KroniKare Pte Ltd.	10000 \$
Total	11200 \$

List of Expenses					Cost (amount in Rials)
Research Personnel and Partners' Compensation	Name		Hours required		
	1- Hamed Alizadeh		120		90/000/000
	2- Mina Mahdinezhad		120		42/000/000
	Subtotal:				132/000/000
Equipment and instruments (non expendable)	Equipment and Model No.		Manufacturer	Quantity	
	1- Lux Meter		Metrix LM76	1	75/000/000
	2- LED Panel		KPL 60*60	5	30/000/000
	3-				
Subtotal:					105/000/000
Travel	Destinations		Transport Mode	Number of People Travelling	Number of trips
	1- Tehran		Airplane	2	2
	2-				
	3-				
	4-				
Books, Copy and Print					18/000/000
Communication (phone, web, etc)					15/000/000
Other Expenditures	1-				
	2-				
Grand Total:					350/000/000

Additional funding
Is the project funded through other sources as well? No If yes, name the funding agency/organisation and the amount of funding.
Has the same proposal been submitted to other funding agencies/organisations? No If yes, name the funding agency/organisation.

Project Manager(s) Affirmation:

<u>Full Name</u>	<u>Signature</u>	<u>position</u>	<u>Date</u>
1- Hamed Alizadeh Ghazijahani		Main executer	06-10-2022
2- Hossein Nejati		Foreign executor	08-10-2022