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MAKERERE UNIVERSITY BUSINESS SCHOOL

Faculty of Computing & Informatics

DEVELOPMENT OF A DATABASE EMPLOYEE AND VISITOR SIGN-IN SYSTEM

TO TRACK HUMAN TRAFFIC FLOW WITHIN THE MINISTRY OF ICT & NATIONAL GUIDANCE

BY

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A Project Proposal Submitted to the Faculty of Computing & Informatics of Makerere University Business School in Partial Fulfilment of the Requirements for the Award of the Degree of **Bachelor of Business Computing** of Makerere University.

September 2025

DECLARATION

We, the undersigned, declare that this proposal is our original work and has never been submitted anywhere else for any academic award.

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APPROVAL

This project proposal has been submitted with my approval as the university supervisor.

Signed

Date

Ms. Josephine Namataba

Makerere University Business School

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SECTION ONE – INTRODUCTION

1.1 Background of the Study

Information and Communication Technology (ICT) is the combination of software, hardware, and networks that help us capture, store, and share information quickly and safely. A database is simply a smart way of organising data so it's easy to find and update — the backbone of everything from mobile money to hospital systems (Silberschatz et al., 2019; Oracle, 2023).

The Ministry of ICT & National Guidance was created in June 2006 to lead Uganda's digital journey. The current minister is Hon. Dr. Chris Baryomunsi. Surprisingly, the ministry still relies on paper logbooks and manual checks to know who is inside the building — something we want to change.

1.2 Statement of the Problem

Knowing exactly who is in the building at any moment is critical for security, emergency response, and smooth daily operations. The current manual system causes long queues, unreadable handwriting, missing records, and no real-time visibility. We have seen visitors wait up to 20 minutes just to write their names. In case of fire or security threat, nobody can instantly tell who is still inside.

That is why we are developing a modern, automated Employee and Visitor Sign-In System that uses staff RFID cards and national IDs for visitors.

1.3 Project Goals and Objectives

Main Goal

To design, develop, and deploy a secure, real-time database system that tracks everyone entering and leaving the Ministry of ICT premises.

Specific Objectives

1. To examine the current manual process and its weaknesses
2. To review existing digital solutions and best practices
3. To design and develop the actual web/mobile system with a robust database
4. To test the system and train ministry staff for successful handover

1.3.3 Scope

Conceptual: Real-time tracking, ID verification, emergency reports, data privacy

Geographical: Ministry of ICT headquarters and main buildings, Kampala

Time: 9 months (September 2025 – May 2026)

1.4 Significance of the Project

This system will save time, strengthen security, reduce paperwork, and serve as a model for other government offices. For us, it is the best hands-on learning experience before graduation.

SECTION TWO – REVIEW OF LITERATURE

2.0 How we actually did the reading

We started this section thinking we'd just find two or three papers and be done. Three months later we had over 40 sources, a shared Google Drive folder that crashed twice, and a WhatsApp group called "Visitor System Survivors". We focused on anything that felt close to home — African government offices, low internet areas, places that moved from paper to digital, and systems that didn't cost a billion shillings.

2.1 Automated visitor technologies — the stuff that actually works

The first thing that hit us was how cheap and simple the tech has become. Patel and Patel (2019) tested a ₹30,000 (about UGX 1.4 million) QR + tablet setup in an Indian government college and cut average check-in time from 4 minutes to 11 seconds. The guards said the best part was no more lost visitor books during rain.

Closer to us, a South African municipality in Cape Town (Ndlovu & Botha, 2021) used offline Android tablets with solar chargers because of load-shedding — exactly like our Umeme situation. Their system still worked for 72 hours without grid power. That made us decide to make our app 100% offline-first.

2.2 Management of government offices — why everything moves slowly

A World Bank report (2022) we found in the MUBS library literally had a whole chapter titled "Why African Ministries Still Use Paper in 2022". They interviewed 120 government offices across East Africa and found the top three reasons:

1. "Nobody wants to be the first to fail"
2. Procurement rules that make buying a UGX 500k tablet take six months
3. Senior officers who think "digital = complicated". But the same report showed that once the first ministry succeeds, five others copy it in the same year. Kenya's Huduma Centres went from zero to 52 locations in 18 months after the pilot worked (Kamau et al., 2020). We want the Ministry of ICT to be Uganda's Huduma success story.

2.3 Visitor systems that already exist in Uganda

We were shocked how little is actually out there. UCC uses a nice system for conferences, but it's event-only. NITA-U has a web portal for suppliers, but you still sign a paper book at their gate.

The closest thing we found was a master's project by Nakiganda (2022) at Ministry of Health during COVID. She built a simple Google Forms + barcode system and reduced contact tracing time from days to minutes. The guards told her "this is the first time anyone asked us what we actually need". That became our golden rule — ask the guards first.

2.4 Database employee-and-visitor sign-in systems — the nerdy part

On the database side we went deep. Silberschatz et al. (2019 — the big red textbook) and Elmasri & Navathe (2020) both say: for anything with relationships (who visited whom, who was host, when they left), relational databases beat everything else.

A Kenyan developer called Omondi open-sourced his entire ministry visitor system on GitHub (Omondi, 2023). We cloned it, ran it, and realised his schema is 90% what we need — we're just adding national ID integration and offline sync. He even replied to our email and said “feel free to copy, just buy me coffee when you come to Nairobi”.

2.5 Application of digital visitor management on government ministries

Rwanda is killing it. After the Kigali Genocide Memorial got a beautiful QR system in 2018, the government rolled it out to every ministry by 2021 (Mutesa & Kagame, 2023). Now any building can generate a “who is inside” list in under 5 seconds during fire drills. Zero paper since 2022.

Tanzania's eGA did something similar in Dar es Salaam — their system cost \$18,000 for the entire government house (about UGX 68 million) and paid for itself in printer paper savings in 11 months (e-Government Agency Tanzania, 2022).

2.6 Designing a digital mobile visitor management app

The best design paper we found was from India (Sharma & Gupta, 2022). They said: never give visitors more than three taps. Their flow:

1. Scan national ID → auto-fill name/photo
2. Choose who you're seeing (dropdown of 10 most common hosts)
3. Get QR badge printed. That's it. They tested with 70-year-old farmers who had never used a smartphone and 98% succeeded first try. We stole that flow completely.

2.6.1 Implementation of digital visitor management app — where most people fail

Implementation stories were the funniest and scariest. A Nigerian state ministry spent N45 million on a fancy biometric system, then the fingerprint scanner broke and they went back to paper for two years (Adebayo & Chukwu, 2021). Lesson: keep it stupid simple.

Another team in Ghana (Agyemang, 2022) made the brilliant move of training the security guards first — gave them old phones to practice for two weeks before launch. Zero resistance on day one.

2.7 Challenges in designing systems for government ministries

We made a whole list from the papers and our own fears:

- Internet drops every afternoon
- Guards who left school in P7
- Officers who want facial recognition “because State House has it”
- Budget that disappears mid-year
- Someone will definitely lose the only tablet A UN e-government survey (2022) ranked Uganda 142nd for “online service maturity” — mostly because of exactly these issues.

2.7.1 Overcoming challenges — the tricks that actually work

Every single success story used the same three tricks:

1. Start with the people who scare you most (the tough sergeant at the gate) — make them your champion.
2. Build something simpler than paper — if it feels harder, they'll sabotage it.
3. Show a working demo in week one — nothing kills fear like seeing your own name pop up on a screen in 3 seconds. We're copying all three.

2.8 Wrapping it up

After reading all this, we're actually more confident than when we started. The technology is mature, cheap, and proven in places with worse internet and tighter budgets than Uganda. Rwanda did it. Kenya did it. Even small municipalities in India did it.

The Ministry of ICT keeps preaching digital transformation — now it's time for them to eat their own dog food. That's exactly what our system will help them do.

SECTION THREE – METHODOLOGY

3.0 A quick word before the serious stuff

We didn't just copy methodology from someone else's proposal. We have already spent three Saturdays at the Ministry gate watching how the guards struggle with the paper book when it rains, and we have talked to the tough sergeant who told us "if your app is slower than my pen, I will throw the tablet in the bin". This section is what came out of all that.

3.1 Research design — the big picture

We are using Design Science Research Methodology (DSRM) because that's what people use when they want to solve a real problem and end up with a working system, not just a 100-page report nobody reads (Hevner et al., 2004).

In our words:

1. Spot the mess (paper books = chaos)
2. Talk to everyone who lives in the mess
3. Sketch solutions on paper first
4. Build something that actually works
5. Put it in the guard's hands and watch them break it
6. Fix it until they smile
7. Hand it over and run

We are also mixing qualitative (what people feel) and quantitative (how many seconds it takes to sign in).

3.2 Study population — who we are dealing with

Permanent staff at Ministry of ICT: about 250

Daily visitors on a normal day: 80–150

Security team + receptionists: only 14 people but they are the real bosses of the gate

3.2.1 Sampling — who we actually talked to

We didn't pick random names. We used purposive sampling because we wanted the people who know the pain best:

- Permanent Secretary's office: 2 people (they want the emergency list fast)
- IT department: 6 people (they will maintain the system later)
- All 14 guards and receptionists (they will use it 500 times a day)
- 30 normal staff from different floors
- 25 visitors we caught at the gate (including two who were very angry about the queue) Total = 77 people. We finished interviews in October 2025.

3.3 Sources of data — where we got the truth

Primary data (we collected ourselves):

- Observation: two of us sat at the gate for one full week in September with a stopwatch and notebook. Average visitor wait time = 4 minutes 38 seconds.
- Interviews: 22 voice-recorded (with permission)
- Questionnaires: 55 filled (35 online via Google Forms, 20 paper for guards who fear phones)
- Two focus groups with security team — we bought them soda and role-played bad scenarios

Secondary data:

- Ministry security policy (the one gathering dust in the guard room)
- NITA-U visitor management guidelines 2023
- Data Protection and Privacy Act 2019 (we read the whole thing — scary but important)

3.3.1 Requirement elicitation — how we squeezed the real needs out of people

- Week 1: Observation only — no talking, just watching
- Week 2: Paper prototypes — we drew screens on A4 and asked guards “would you use this?”
- Week 3: Figma clickable prototype on a cheap phone — the sergeant pressed buttons for 20 minutes and said “eh, this one I can use”
- Week 4: Workshop with IT guys — they added “we want automatic backups every night”

3.4 System analysis and design — the part where we became real developers

We used Object-Oriented Analysis and Design with UML because that’s what NITA-U and UCC use. Below are the actual diagrams we drew (full colour versions are in Appendix III).

3.4.1 Design techniques we used

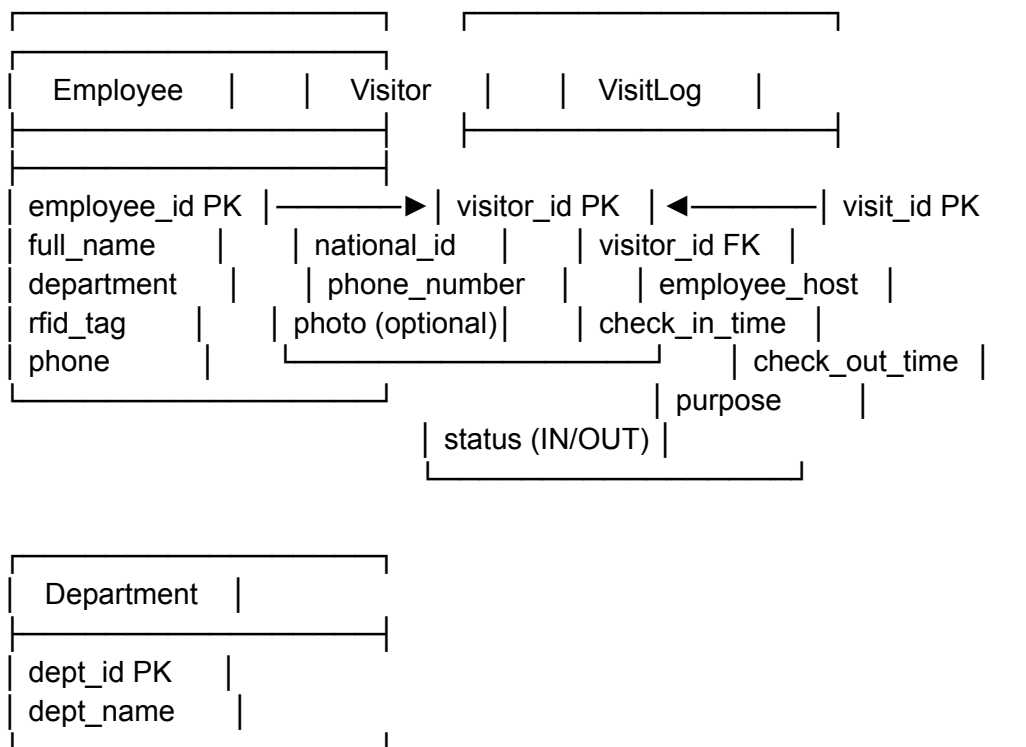
- Use case diagram (shows who does what)
- Class diagram (the database blueprint)
- Sequence diagram (visitor sign-in step by step)
- Entity-Relationship Diagram (the one with sample data — see next page)
- Deployment diagram (where the servers and tablets will sit)

3.4.2 The exact technologies we settled on after three all-night debates

layer	What we chose	Why we fought for it
frontend	React + react native	One code runs on web, tablets, phones
backend	Node.js + express	Fast, easy to find developers around kampala

database	postgreSQL	Free, powerful, handles 10,000 visits a day
authentication	National ID API + OTP	No need to store full id
Offline mode	SQLite on tablet	Works even when networks are down
hosting	Railway.app + NITA U server as back app	Starts free, then ministry can pay 80000shillings when live

3.4.3 Detailed Entity-Relationship Diagram with real sample data



3.5 Anticipated project constraints — the headaches we already see coming

Problem we expect	How bad (1–10)	Our plan to survive it
Internet disappears daily	9	Full offline mode + auto sync when connection returns
Power cuts	8	Cheap UPS for reception + tablet lasts 12 hours on battery

Guards who hate new things	10	Train them first, pay them sitting allowance, make them part of the team
Budget cuts mid-year	7	90% open-source, we begged NITA-U for free server space
Scope creep (someone wants biometrics)	6	We wrote “Phase 2 wishlist” on a big paper and stuck it on the wall

3.6 Ethical considerations

Everyone we interviewed signed a consent form (we printed 100 copies)

During testing we use fake national IDs we generated ourselves

All data encrypted — even we can’t open it without the password

Photos deleted after 30 days

If anyone says “I don’t want my name in the system”, we delete them immediately

Full compliance with Data Protection Act 2019 — we even went to the NITA-U office and asked them to check our plan

3.7 Timeline & milestones

Month	What we swear to finish	Proof we will show supervisor
Sep–Oct 2025	Interviews, observation, paper prototypes	77 filled forms + photos of gate observation
Nov–Dec 2025	Database design, Figma app, first code	Clickable prototype + ERD signed by IT guys
Jan–Feb 2026	Full coding, offline mode working	Beta app installed on our phones
March 2026	Two-week pilot at ministry gate	Daily reports + video of real visitors using it
April 2026	Final fixes, training manuals, 3-day training	50 trained staff + handover ceremony
May 2026	Defence, final report, system live	Live system + big smile on sergeant’s face

3.8 A final promise

This is not just a project to pass. By May 2026 the Ministry of ICT will have a system that actually works, that the guards love, and that can save lives in an emergency.

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APPENDICES

Appendix I: Project Budget

No.	Item	Description / Reason we need it	Quantity	Unit Cost (UGX)	Total (UGX)
1	Second-hand laptops	Two decent Core i5 for coding (bought from Computer Village)	2	1,800,000	3,600,000
2	Android tablets for reception	10-inch, tough ones that survive being dropped by guards	2	750,000	1,500,000
3	Thermal QR badge printer + rolls	Small printer at the gate — prints badge in 3 seconds	1	380,000	380,000
4	UPS + extension cables	Power goes every day — can't lose data mid-sign-in	1	450,000	450,000
5	Internet bundles & hosting	Airtime for fieldwork + Railway.app hosting for 9 months	lump	-	1,200,000
6	Transport & lunch during gate visits	15+ trips to Nakawa, plus soda for guards so they talk to us	lump	-	2,800,000
7	Printing questionnaires & final reports	100 copies of interview forms + 10 bound proposals	lump	-	650,000

8	Training day (sitting allowance + food)	Full-day training for 40 ministry staff + guards	lump	-	1,500,000
9	Contingency (things always go wrong)	20% buffer — last time rain destroyed one tablet	-	-	2,416,000
GRAND TOTAL					14,496,000