Report - Scientific Calculator

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Module: Design and Simulation of Circuits and Embedded Systems

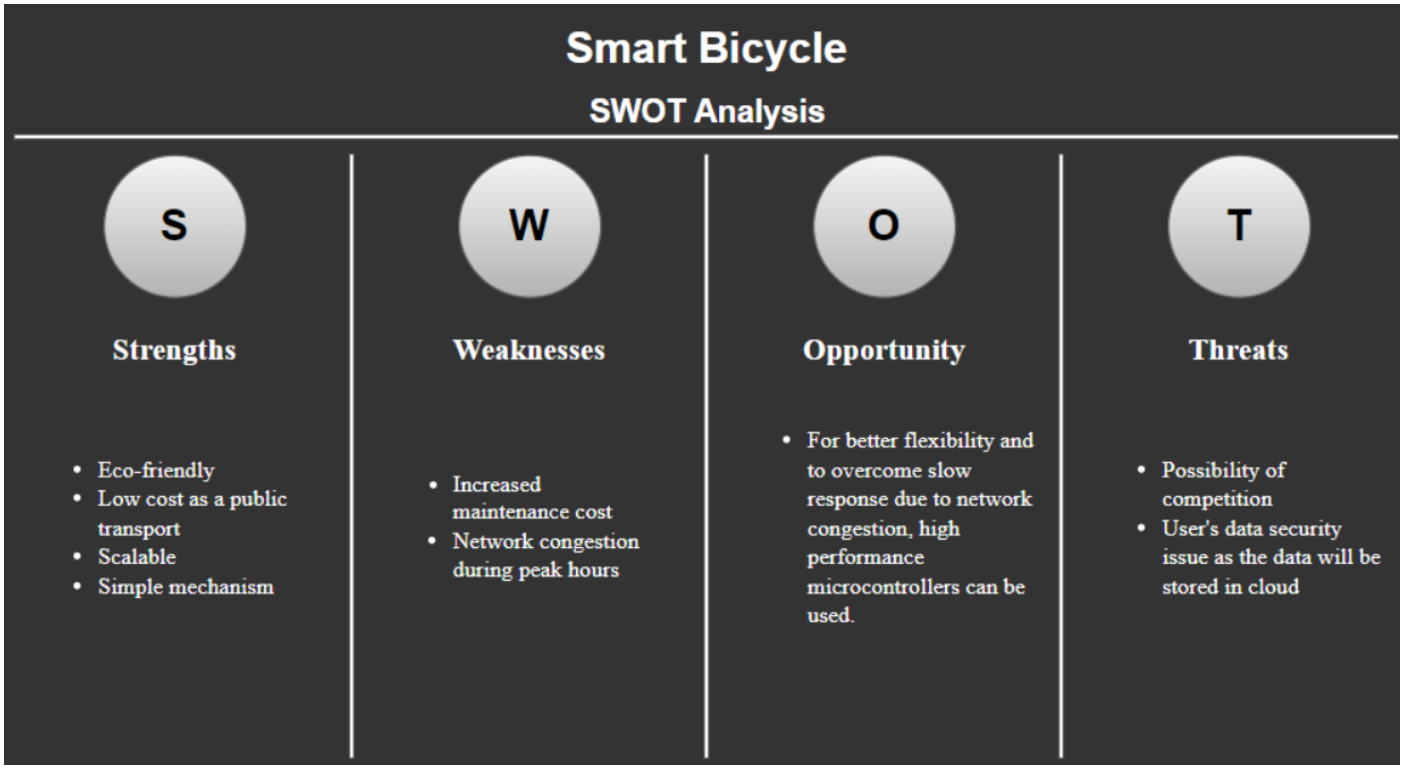
Introduction

This project aims to add on features like distance sensors and centralised locking system to make bicycles smarter and setup a reliable renting system. This re-designed bicycle infrasturcture is aimed towards making it user-friendly and cost-effective. The work in this project is driven towards deployment of sensors on bicycle and parking station.

Features

- Features:
    - Installed with ultrasonic sensor to measure distance and alert the rider of any object/vehicle in close proximity of the bicycle.
    - Parking stations installed with solenoid locks.
    - Locking and unlocking system with RFID (RFID can be used in smaller areas such as university campus where all staff and student possesses their ID cards but for larger areas such as public transport fingerprint reader would be more efficient and user-friendly).
    - Location tracking using GPS.
    - Connection with central server to collect informations like distance travelled, location, time of locking and unlocking the bicycle etc.

SWOT Analysis



High Level Requirements

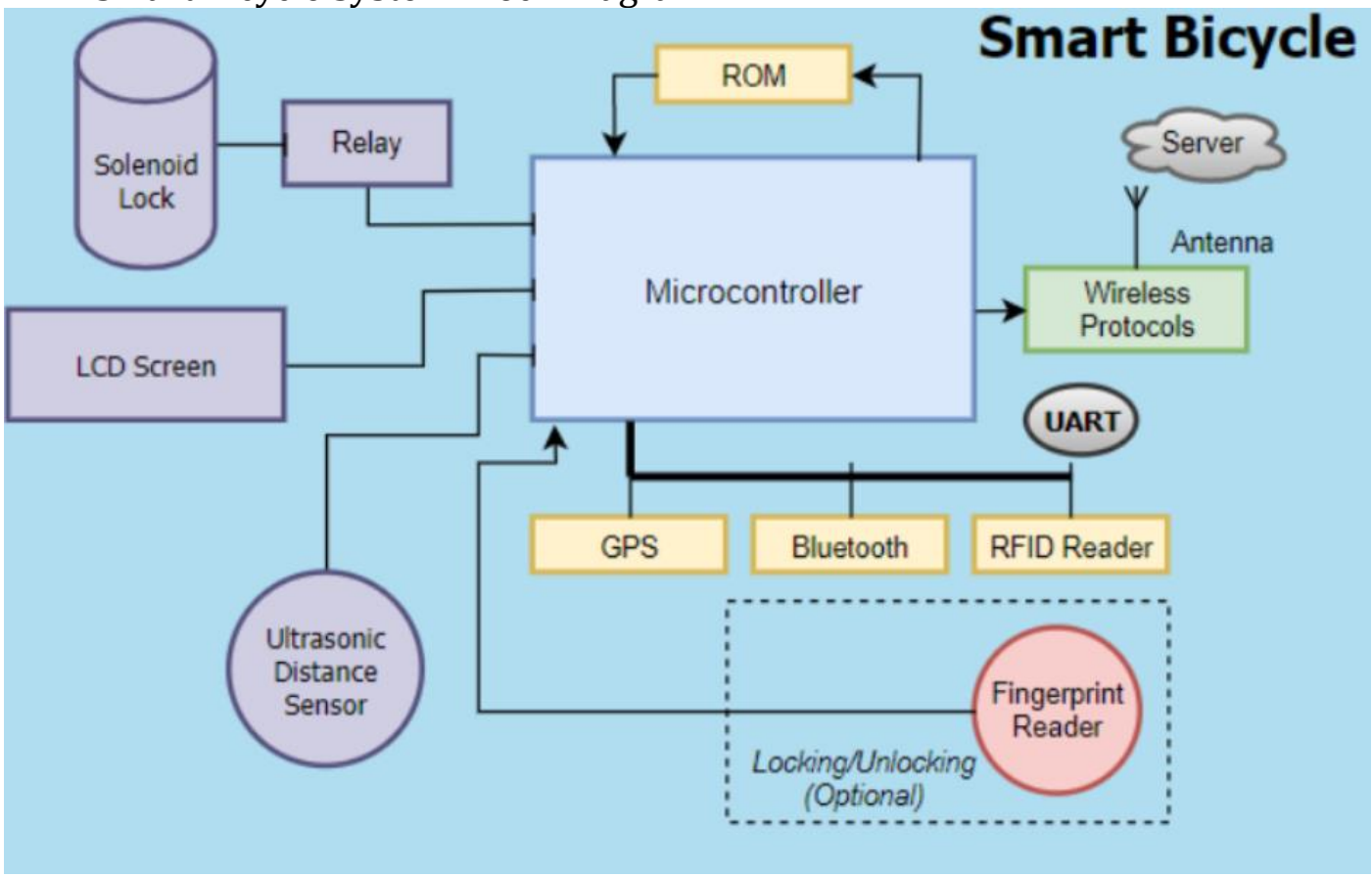
ID	Description
HR01	Should be aware of natural surroundings and obejcts near by
HR02	Should be able to generate travel history
HR03	Should be able to lock/unlock bicycle using RFID (or fingerprint reader)
HR04	Should be able to collect, read and store data of the bicycle and the rider
HR05	Should be durable to withstand less than than ideal conditions

Low Level Requirements

ID	Description	HRID
LR01	Should have a ultrasonic distance sensor	HR01
LR02	Should have a display screen for informations' display to rider	HR01, HR03
LR03	Should be able GPS enabled	HR02
LR04	Docking station should be installed with RFID scanner and user must have RFID tags	HR03
LR05	Should be accurate when reading fingerprint	HR03
LR06	Should be able to communicate with the server and store essential data	HR04
LR07	Should undergo a regular maintainance	HR05

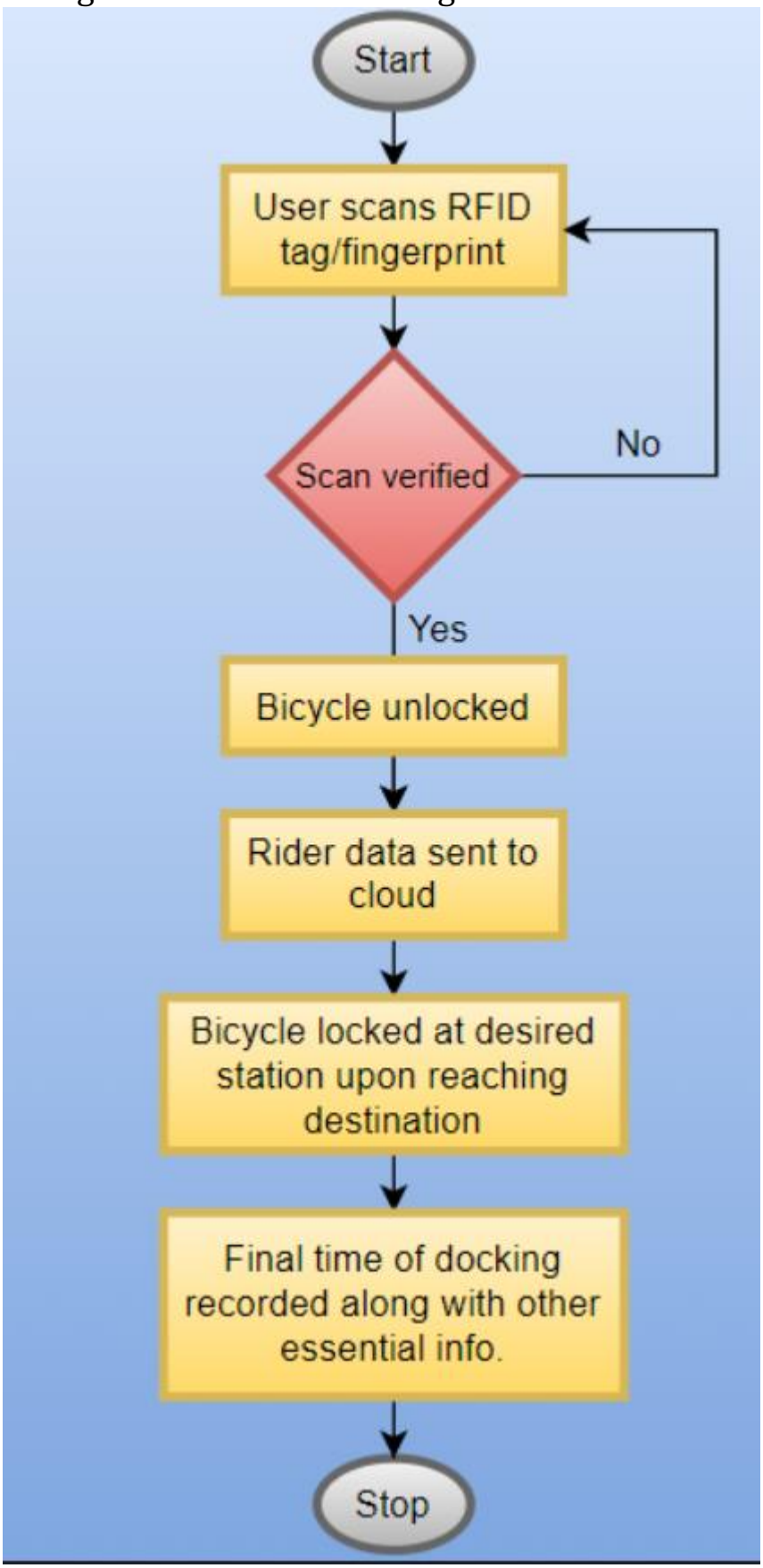
Architecture

- Smart Bicycle System Block Diagram

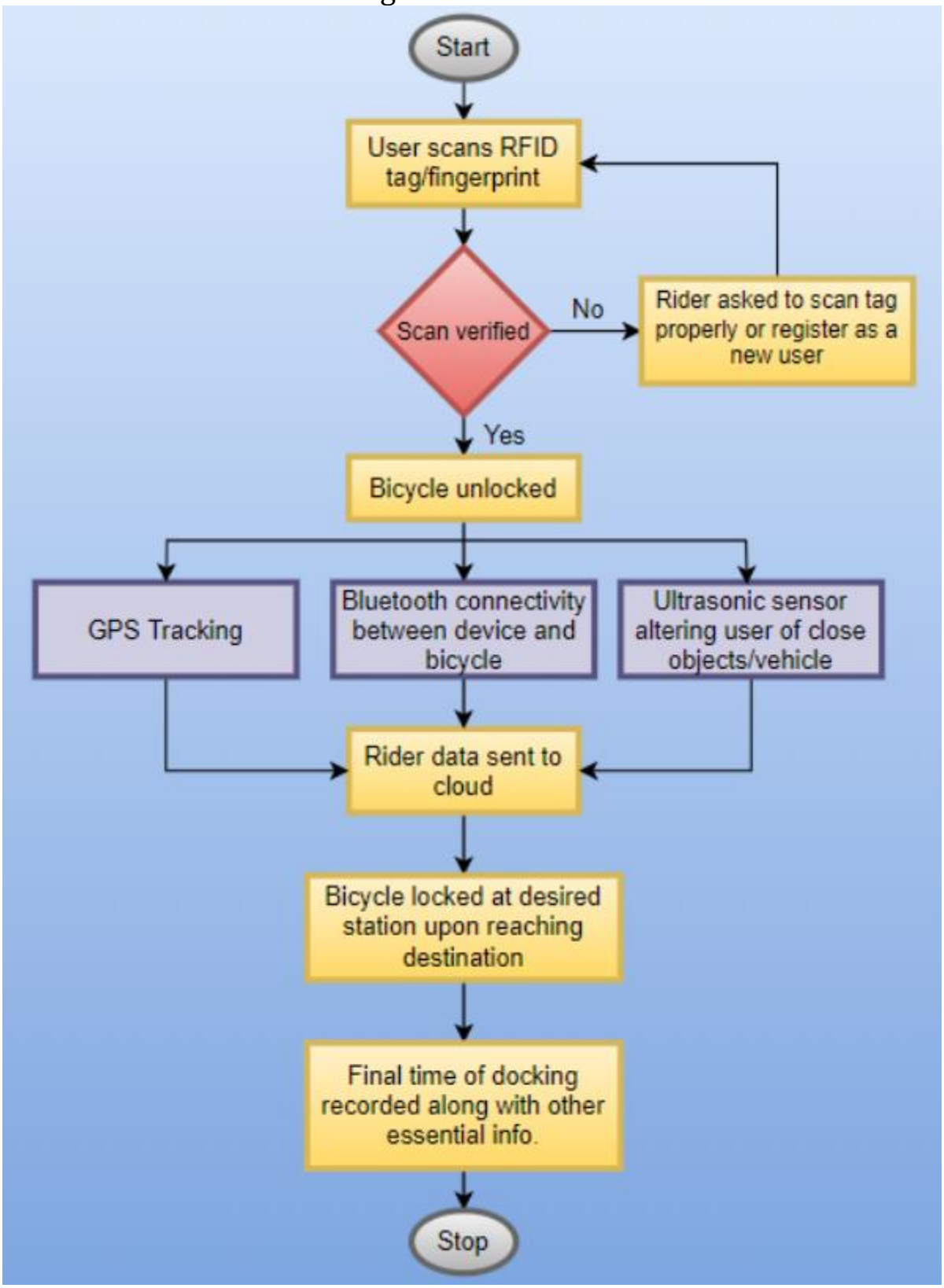


Component	Description
Relay	To interface with solenoid lock for locking and unlocking
LCD Display	Displays information like distance of any object/vehicle from bicycle
Solenoid Lock	To lock the bicycle in parking station
Ultrasonic Distance Sensor	To sense and alert user of any object/vehicle in close proximity
GPS	To enable location tracking
Bluetooth	To enable wireless link between user's smartphone and the smart bicycle
RFID	To enable docking and undocking of bicycle. The cycle will be unlocked if user is in close proximity and will be locked if not
ROM	To store data memory and program memory
Wireless Protocol	To enable communication with central server which will store informations like distance travelled, location, time of locking and unlocking the bicycle etc
Fingerprint reader	Enables docking and undocking of bicycle from parking station. It is optional since this obejctive can be achieved from RFID as well. But, for larger scale fingerprint reader is suggested given that many user might not be carrying their RFID tags (say adhaar card or driving licence) all the time
UART	To transmit and receive serial data

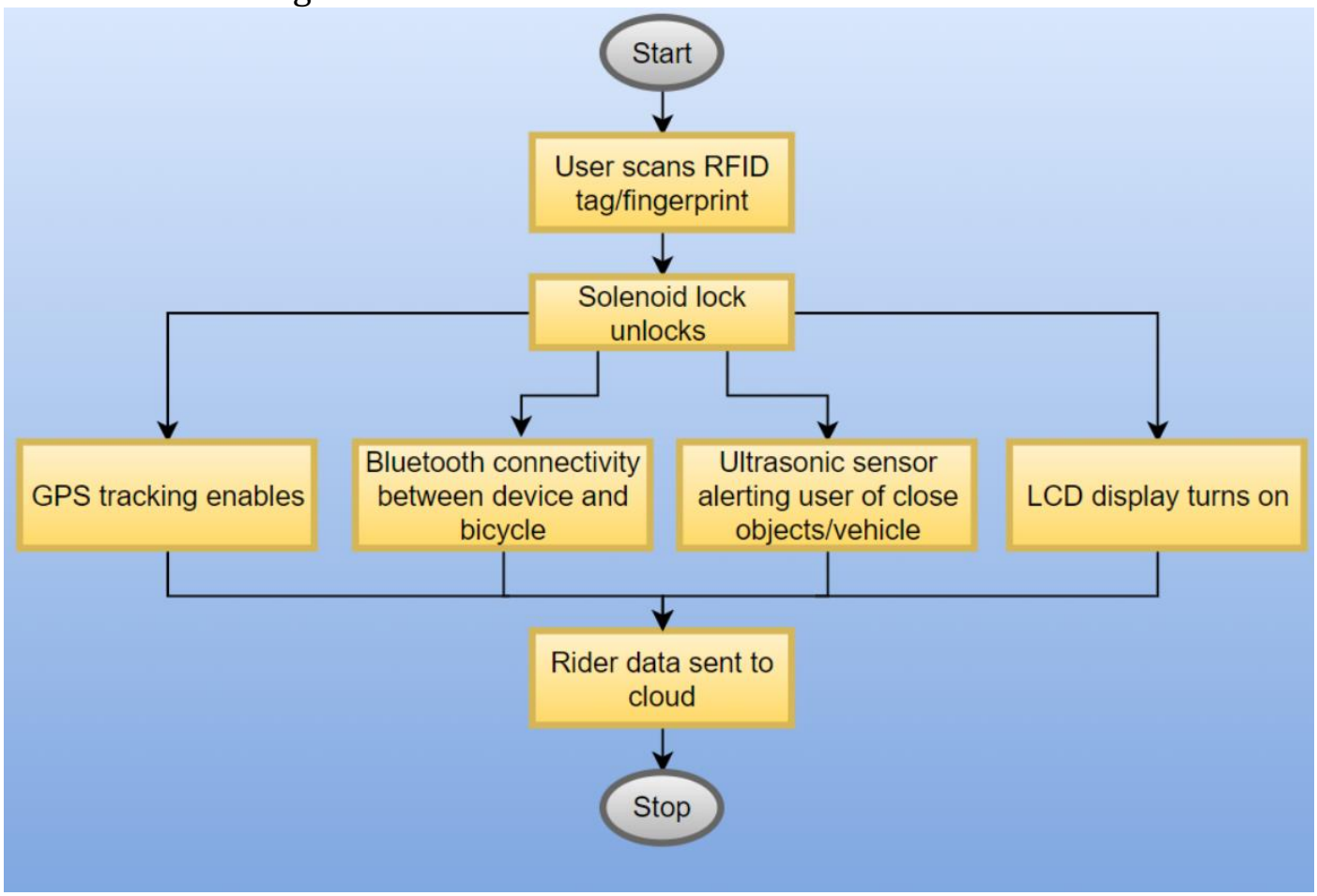
- Behavorial Diagram:
  - High Level Flow Chart Diagram:



- Low Level Flow Chart Diagram:

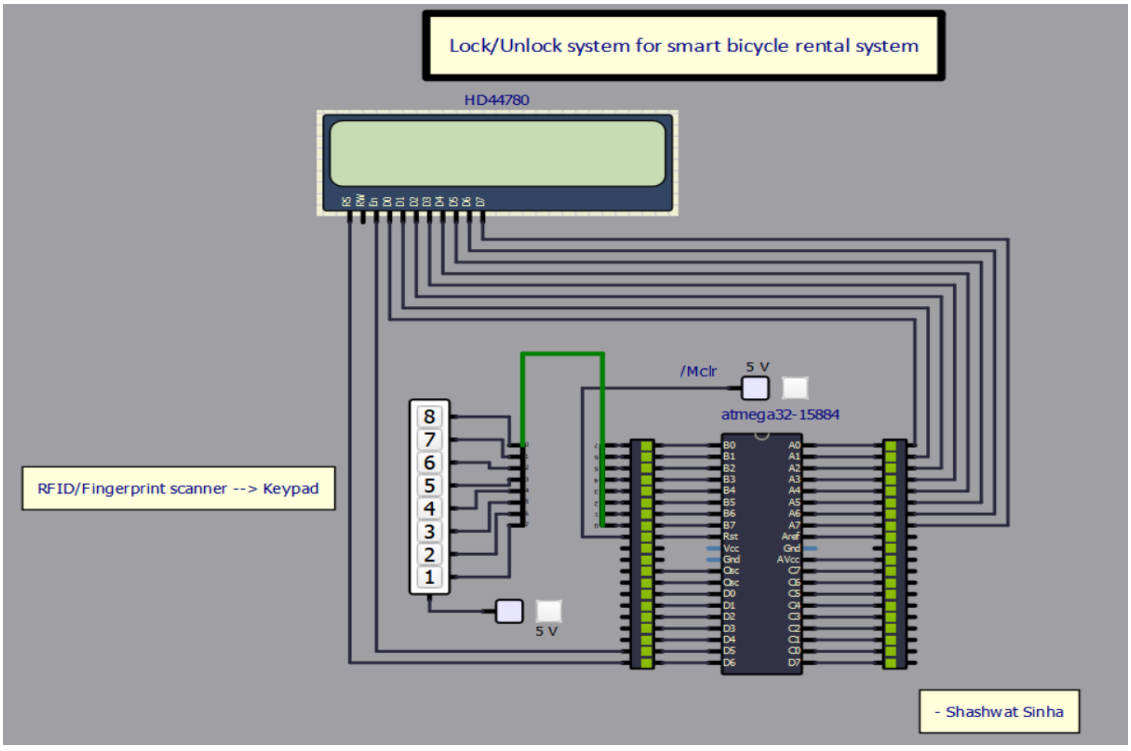


- Use Case Diagram:

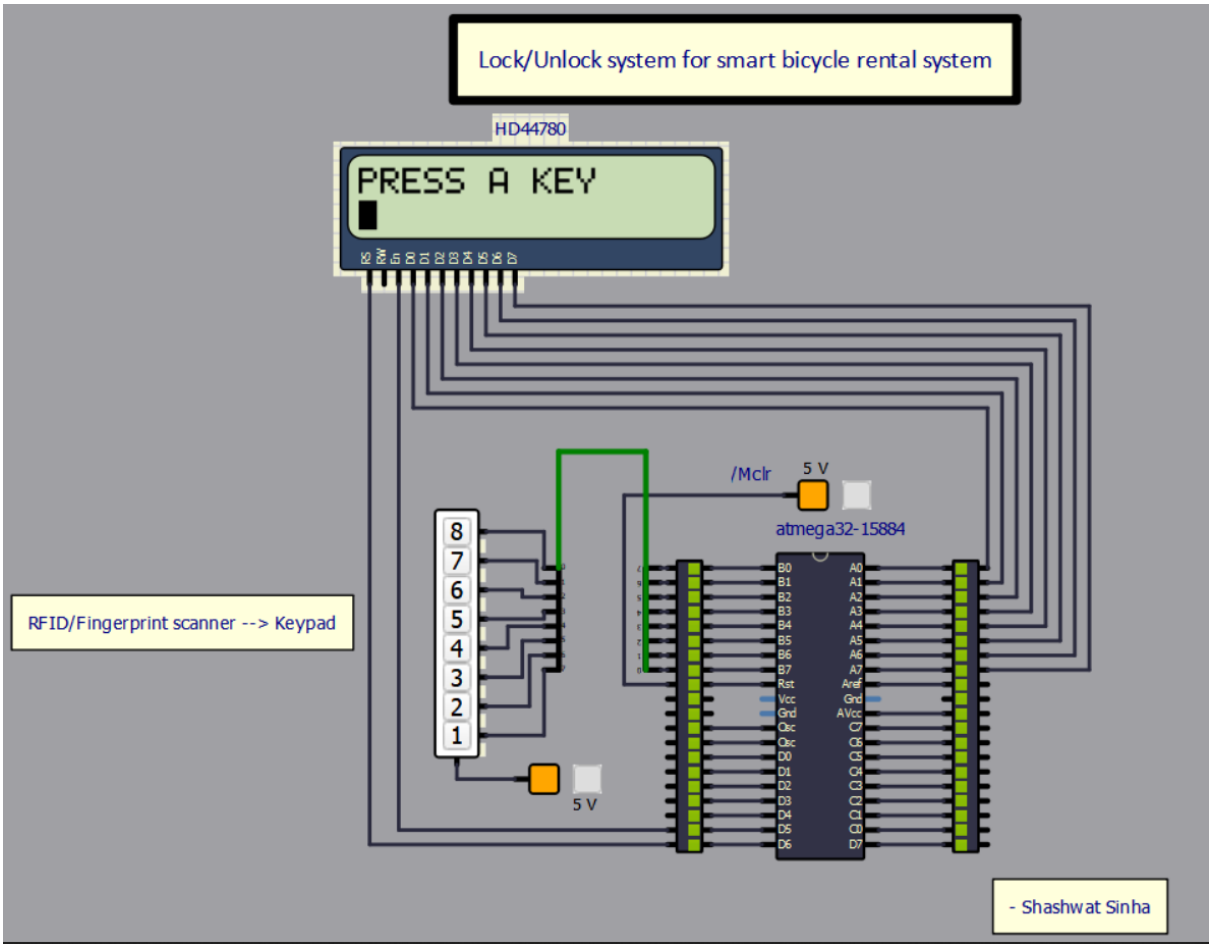


Images and videos showcasing project outputs

➔ **Scanner in idle mode:**



➔ **Scanner during reading user input:**



References

1. ATmega32 Datasheet
2. An IoT Based Smart Campus System
3. Embedded System NPTEL modules