1. **EXECUTIVE SUMMARY**

In this era, we are all aware of that accessing to information has a crucial importance, but the more important and challenging part is how to transfer that information. Although RF transmission has been the conventional mean of data transmission up to these days, due to the increasing mobile data transmission RF technologies started to struggle on resolving our needs. In addition to the highly occupied bandwidth RF technologies suffer from speed, security and power efficiency problems. The best way to accomplish these problems is using a revolutionary method: visible light communication.

As Revolutionary Systems we will design an image transmission platform where VLC is combined with data transportation by a vehicle. The system will consist of two end terminals that can receive or transmit an image as data packets while a vehicle rushes between these terminals to handle the long-distance transmission of the data. While combining communication and transportation the main purpose is to transfer an image as accurately as possible in the shortest time. For achieving this goal, the main tasks and our solutions approaches can be listed as:

* Data Compression and Division into Data Packets
* Compression of image data to enable faster transmission
* Division of the image data into smaller matrices to get smaller data packets
* Visible Light Communication
* Sending and receiving light signals by LEDs and photodiodes
* Modulation of the original signal for communication
* Filtering in order to cancel noise
* Use of preamble signals for handshaking between receivers and transmitters
* Data Transportation by Vehicle
* Control of the vehicle on physically guided tracks
* Distance detection by ultrasound sensor
* Transceiver unit placed and memory chunk on the vehicle

Even though handling all these tasks require knowledge from a diversity of electrical engineering areas, our team contains engineers specialized in the areas of communication, computer, electronics and control. Thus, a correct division of labor between us enables us to handle this big task as smaller and manageable problems and come up with a competitive product build upon the skills of each member.

Our company aims to build up a fast and accurate system for the minimal cost while taking physical robustness and the immunity of the system to variable conditions into account. The project is planned to be finished in 4.5 months with a total budget of about 130$.

As the end product, a vehicle that is moving on a physically guided track with a transceiver on it and two end terminals which are a transmitter and a receiver will be delivered. In addition to these, a camera to take the photo and a display will be supplied to the customer with a user manual and two years of warranty.

This document is a critical design report of the described product which contains detailed technical information on how the product will be developed.

1. **INTRODUCTION**

Radio spectrum is used to transmit data wirelessly for an enormous amount of daily services including but not limited to TV and radio broadcasting, mobile phones, Wi-Fi communications, GPS and radar. The global mobile data traffic has increased by 71 percent in 2017 according to the yearly report of CISCO[1] .In addition, the increasing device connectivity because of IoT also puts more load on RF bandwidth. Hence, the ever-increasing demand for huge amount of information, faster communication and higher quality data, it is crucial to note that the usable radio spectrum is a scarce source where exponentially growing demand surpasses the supply. Apart from the narrow and already highly occupied bandwidth problem, some other issues with the convenient communication systems can be explained as security problems, power inefficiency and interference.

A recently developed communication method which is known as VLC (visible light communication) has a potential to solve these problems. Since VLC uses visible light, the bandwidth is increased tremendously, it is in between 430 THz to 790 THz[2] . Also, since the VLC receiver receives the signal only if the transmitter and the receiver are in the same room, it is more secure than RF communication. What is more, since a visible light source can be used for both illumination and communication, it saves extra power when compared to RF communication.

Although, there are existing communication architectures, they suffer from the aforementioned inefficiencies. A need exists for new communication methods. The design possesses a physically guided vehicle and a VLC system. The goal is to transport a picture from one terminal to the other terminal as fast and accurate as possible while keeping the cost minimal.

The professors of Electrical and Electronics Engineering in METU has requested from us to design a system which can transfer data via two complementing technologies, transportation and communication. From then on, the company have worked solidifying the technical approach on the project. By means of weekly meetings and R&D work conducted at Design Laboratory, currently, Revolusys can modulate the communication signal via OOK (On-Off Keying) and receiving the data packets with the rate of 20 kbps at 5-10 cm distance. Tests for communication, image acquisition and reconstruction and transportation submodules were also done by company.

This report contains the technical details of subsystems, critical algorithms for the flow of the project, requirement analysis of the subsystems, test plans, signal interfacing and integration of the overall system. The interaction of the subsystems and project parts like cost analysis, 3D drawing and power analysis will also be given.

By accomplishing this project, we will prove that a VLC system integrated with a transportation vehicle is implementable and this, in turn, will lead to a widespread use of the visible light spectrum. This will allow us to operate on a completely empty frequency band which will increase the amount of data transmission to a greater extent. Therefore, the entire society will reap the benefit of increased and more reliable data transmission and live in a more connected world.