MIDDLE EAST TECHNICAL UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE 494-DESIGN STUDIO 2

CURRENT STATUS & PLANS

revolusys

Company Name: Revolutionary Systems Inc.

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Group Members: **Onur Akdeniz**

Doğukan Atik

Ozan Berk Boyraz

Ahmet Demirdaş

Mert Eyüboğlu

1. The Current Locations and the Communication Tools of Team Members

The current location of the team members are as follows:

Ahmet Demirdaş : in Kayseri

Doğukan Atik : in Ankara

Mert Eyüboğlu : in Ankara

Onur Akdeniz : in Trabzon

Ozan Berk Boyraz : in Tokat

All the group members have their own smartphones. Although two of the members' internet connection in their home are weakly supplied, it can be said that the group has the video/audio conferencing capability. The Skype environment is tested and found suitable for the purpose.

2. A Brief Summary of the Current Status of the Project

The current status of the project is reported below for each subsystem.

2. a) Communication Subsystem

Currently, the designed circuit successfully transmits sentences between two Arduino devices. However, it sends the entire data in one packet and error correction is not implemented yet. Additionally, in the final product, we are going to communicate between a Raspberry Pi and Arduino and for that the circuit needs to be tested by using Raspberry Pi, too. Finally, instead of sentences, photo transmission should also be tried.

2. b) Transportation Subsystem

Our vehicle is capable of going back and forth between two obstacles(which correspond to the terminals) using two ultrasound sensors when powered by the power supply. (Without the rails)

2. c) Image Acquisition and Reconstruction Subsystem

Up to now, following tasks are completed in image acquisition & reconstruction subsystems. An image is taken by Raspberry Pi camera module, where the command for the initiation of the image taking process is given via keyboard. Upon receiving image, it is stored in the JPEG format and resized. A byte array is obtained from resized image. This byte array is separated to 500 arrays where each of these arrays represents the one unit of data chunk. Each of these 100 data chunks are to be sent at one time. These arrays are sent from Raspberry Pi 3 to Raspberry Pi 0 successfully using UART pins. The image is reconstructed at the receiver part and displayed.

3. Incomplete Tasks In the Project

3. a) Communication Subsystem

Under the light of the section 2.a of the report, we can summarize the tasks to be done as follows:

i) The serial communication protocol and error correction should be implemented.

Regarding this, we have already made some progress in the implementation of the serial communication protocol. Right now, we can successfully send a photo between two Raspberry Pi devices with their serial ports connected to each other with cables. In principle, we can build up the entire communication software by using two Raspberry Pi devices. Therefore, we believe that the software part of the communication system can be implemented by individual assignments and Skype meetings. However, we can not be sure of the reliability of the end product due to the fact that we are using cables instead of the photodiode circuit. The circuit is discussed below.

ii) The circuit should be tested with photos and its design should be finalized. Additionally, the circuits should be duplicated for use in multiple terminals and in the car.

In order to test the circuit, we have to acquire an oscilloscope. However, even then, we will need to gather up as a group in order to analyze and discuss the circuitry. Otherwise, given the current conditions, only one group member needs to take the entire hardware implementation and therefore, we don't see it feasible. Yet, considering the worst case scenario, we still assigned these tasks to the group members assuming that we have an oscilloscope and access to our locker in E block basement.

3. b) Transportation Subsystem

First of all, we will start to power up the car by a dedicated battery instead of the power supply in the shortest time. Other than that, the biggest missing part of the transportation subsystem is the construction of the rails. After the construction of the rail system further testing and fine tuning of the speed and braking distance of the vehicle will be done. However, as department stores are closed due to the ongoing coronavirüs pandemic, at the moment we can't search for and purchase the appropriate hardware for the construction of the rails.

3. c) Image Acquisition and Reconstruction Subsystem

It is planned to implement a GUI which will interact with the user so that the user can take a nice photo of himself.

The integration of the communication and image acquisition & reconstruction subsystems is not completed yet. The communication between receiver and transmitter side is done via cables, not by the photodiode circuit. This integration is described in the following subsection in more details.

3. d) Operational Integration

As the first step, communication and image acquisition & reconstruction subsystems will be integrated. This requires adding an Arduino Mega to communication path between Raspberry Pi 3 ad Raspberry Pi 0, therefore it is necessary to implement communication between Raspberry Pi and Arduino. After implementation, it is necessary to transfer an image, which is mentioned in the section 3-a in this report.

The second step will be integration of communication subsystem and transportation subsystem. The operation states of the vehicle will change in coordination with communication subsystem.

The third step is integrating all subsystems, i.e. transferring a photo using visible light communication and moving vehicle.

As mentioned in 3-a, an oscilloscope will be necessary for all steps of operational integration. The physical meeting of team members is necessary and social isolation makes the completion of tasks harder in first and second steps of operational integration but physical meeting is a must for the third step of operational integration therefore it is not possible under social isolation conditions.

3. e) Physical Integration

If all subsystems can be completed properly, there will be 3 main bodies to be integrated: Transmitter terminal, vehicle terminal and receiver terminal (Physical structure of the terminals are incomplete.) All of them must be aligned on the same physically guided track (i.e. rail). At that point, alignment of the LED's on the transmitter with the photodiodes on the vehicle is very important for the accuracy of the communication. Same situation is valid for the other end of the vehicle and receiver terminal. To obtain full alignment, all of the bodies must be produced appropriately. We experienced (while assembling the vehicle) that a lot of production errors and alignment mistakes can occur (for example in laser-cutting) . Also, for some processes, we do not have enough equipment for cutting, drilling etc. Overall system tests and optimizations must follow the physical integration and it is one of the critical point of the project. This process needs at least 2 group members to bring vehicle and terminals together.

4. Proposal Plan for the Remaining Tasks

Revolusys Inc. has planned the project's remaining tasks and assigned them individually to its members. Below presented the tasks and the related members.

Checksum Error Checking method implementation (assigned to Ahmet)

This task is consistent with part i of section 3-a of the report.

UART Protocol implementation and optimization for efficient communication (assigned to Doğukan)

This task is again consistent with part i of section 3-a of the report.

Duplication of receiver and transmitter circuitries (assigned to Doğukan and Mert)

This task is consistent with the part ii of section 3-a of the report.

Writing code for serial communication between Raspberry Pi and Arduino (assigned to Onur)

Tests to be conducted for capturing and transferring a whole photo (assigned to Doğukan and Mert)

This task is consistent with the part ii of section 3-a and section 3-c of the report. However, for this task and for the duplication of the receiver and transmitter circuitries task, an oscilloscope and access to the group locker is required since all of our components and our circuit is in it. Furthermore, we believe that several face to face meetings are essential for these tasks of the project. However, in the worst case, we will do the best we can separately assuming that we have obtained an oscilloscope from the university and we have access to our locker.

Power supply units for both receiver and transmitter terminals (assigned to Ahmet)

Voltage regulator search and implementation (assigned to Ozan and Onur)

Graphical User Interface for the screen at the transmitter terminal (assigned to Doğukan and Ozan)

Ozan will code the GUI for the photo taking terminal and then send the codes to Doğukan for the testing and optimization. This is because the Raspberry Pi is in Ankara, with Doğukan.

Vehicle's state machine implementation for transportation and communication integration (assigned to all group members)

Power supply unit for the vehicle (assigned to Mert)

Terminals and rail implementation (assigned to Mert)

Test for vehicle on rail (assigned to Mert)

5. Conclusion

In conclusion, the tasks that are not completed yet can be roughly separated into two as only software related tasks such as the implementation of the error correction code or implementation of the GUI and tasks that also contain hardware operation such as the tasks of the communication subsystem that involve the VLC circuitry. We believe that we can accomplish the only software related parts successfully without having any of the members meet. However, handling the hardware related tasks individually seems to be challenging for us. Only the group members in Ankara can actively work on those tasks and the testing and debugging of these systems without having an oscilloscope is making it even more challenging. Also, going out and buying some hardware is required which not possible in the current situation. In addition to all these, the integration of the subsystems without any group meetings is even harder. We are aware of the fact that some problems are awaiting for us in the integration of the subsystems task and debugging and solving those problems individually is a demanding job to complete. Although we can make conferences via Skype the efficiency and effectiveness of those meetings are not the same with our previous real life meetings. While we are aware of those challenges, we have presented a possible proposal plan to follow considering we won't be able to meet in person anymore. We will do our best to stick with this plan and complete the project as we have promised until a new term schedule is announced by the DS coordinators.