Car Counting system

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1.Design Impact Statement

1. **Public Health, Safety, and Welfare Impacts**

   1.1 Problem of privacy

   When we think about the impact of the license plate recording problem, our team will be concerned about the privacy issue. The community where our device will be set up will also care about privacy problems. In many communities people again set the camera in the public place because they think they are offended, they worry that their privacy will be taken by those people who want to use these to do some bad things, and it results in them feeling unsafe. Therefore many communities will have people who secretly destroy facilities or complain directly to the community. And it will create many conflicts. As to whether it is illegal to record a license plate, after doing the research on the internet, it shows there is no law that clearly makes it illegal to install a license plate recorder in a neighborhood[1]. As a result, there has been a great deal of controversy between the two views, which still cannot be resolved successfully.

   From our research "Can Someone Really Steal Your Info From Your License Plate?" inform that unless you are a police officer or government official, you really can't get any personal information from someone's license plate[2]. So the neighbors' detailed information will not be revealed. But he does have the potential to create a lot of conflict in the community.

   1.2 Solution

   What the team can do is to try to find the stakeholders, and then explain to them, introduce the aim and advantages of the project and persuade them to agree to it, and ask for their approval as much as possible.Try to satisfy their needs and find a balance to achieve the goal.

2. **Cultural and Social Impacts**

   2.1 Problem of Cultural and social policy

   Car plate reader presence is always controversial in different countries, in different states, the related policies are also different. For example in China, the car plate reader device can be easily found in any parking area and they will record the car plate number and ask for the parking fee. According to the article "Things to Know Before Your Neighborhood Installs an Automated License Plate Reader", it introduces several problems and conflicts in the community, for example a similar case has appeared in a community. In order to maintain the community's safety, the Homeowner's Association (HOA) and Neighborhood Association decided to install license plate recognition and recording devices in the community[3]. When a criminal event happens, hundreds of vehicles in the license plate record will be suspected, even for some people who are just passing by[3]. It causes troubles and intensifies conflicts between neighbors. If the license plate recognition has recorded the wrong number, it may cause more trouble. Fewer people in some communities are reluctant to reveal their whereabouts, and they feel disgusted with setting a device like these. In the U.S , with the widespread implementation of this technology, many U.S. states now

issue misdemeanor citations of up to $500 when a license plate is identified as expired or on the incorrect vehicle.

2.2 Solution

From the research, car plate readers can be used for many purposes, such as charging the parking fee, assisting the police to keep the community safe, record the number for academic research or other experiments. Different communities and organizations will have different aims for using the car plate reader. But there is one thing, before the orgenization sets the device in public, they need to announce it to others and show their aim for using these and ask for other people's permission. Our team will also follow these requirements and we decide to set a notice board for mentioning to other people the road has been recorded for an academic project. And we promise that we will not use them for profit purposes and we will delete the data after a month.

3. Environmental Impacts

3.1 Problem 1: road damage and solution
Environmentally friendly design is the other important factor for our team considered. Before we started to design our project, after we did some research, we found that the most useful way is to place the ground induction coil in the road according to the "Self-triggering license plate identification method based on virtual coil".[4] However, we change the design to the Motion sensor and place them on the road sides, because the ground induction coil needs to be buried in the ground, and this will break the road surface and destroy the environment. The adertanage of using the motion sensor is because it is more cheap and convenient for setting up. And it will not do damage to our environment.
3.1 Problem 2: environmentally friendly design and solution
Another environmental impact our team considered is choosing the environment friendly battery. We decided to use the solar panel for the battery system, because we want to be environmentally friendly, we don't want to waste resources and pollute the environment and save cost. According to the article "6 Incredible Benefits of Solar Battery Storage for Your Home', we can easily find the benefits for using the solar system, the installation of solar cells in the machine can reduce the useage of electricity and reduce the carbon dioxide footprint of the household to a certain extent. Besides, unlike other generators, it is silent and very friendly to the environment, and the battery power supply capacity has been extended, which is a very good choice for saving the cost and resources. What's more, it doesn't create noise, and when we install it in the community, it doesn't create noise pollution, therefore the design doesn't cause trouble for the neighbors.

4. Economic Factors

4.1 Problem of maintenance fee

From the description of our project partner, we know that his purpose is to calculate how much responsibility for the road maintenance fee. Because he thinks he has a very small percentage of the road in front of his house. According to the article "Who is responsible for the maintenance of a private road?", we know that it is unfortunate that , "at common law, the owner of land subject to a private right of way ("the servient owner") is under no obligation to maintain it [5]. If someone with a right to use the roadway ("the dominant owner") wants it mended, it is up to them.", therefore although our project partener knows how many other people use the road, if he wants to repair the road, he still needs to pay all the maintenance fee.

4.2 Solution

The best way for him is to talk with the neighbour or the community and find out a balance method based on those people 's usage percentage data to try to discuss and persuade them about paying the road maintenance fee. But it can still be hard to get a good result. And because of these economic factors, the community might have people who don't want to set the device on the road or they might didn't trust the data that our project partner gets. All of these need to have a discussion with all the related people before setting the project and placing the device.

2.Project Timeline

Course deadline	Project goals	Member	Task	Benchmarks
November 12	Project Charter Project Partner Update for Week 7	Team	Complete Assignment	Complete assignment through rubric guidelines
November 17	Be able to take picture on ESP 32	Ben	Receive ESP32 with camera and wire it. Take a few pictures to test.	ESP32 is able to take a picture and save it to the SD card which can be viewed on a computer/phone

November 18	Instructor System Architecture Meeting Teamwork Reflection Paper Instructor System Architecture Meeting	Team	Complete Assignments	Complete assignment through rubric guidelines
November 18	Biweekly Progress Video	Team	Record each team members updates	Complete assignment through rubric guidelines
November 18	Test	Zan	Find a useful Improvement	Prove the detect method works well
November 18	Sensor/PCB	Earth	Choose a type of sensor will be used to sense if a car is coming. Design a possible PCB for tech demonstration	Approval from Project Partner
November 18	Improve visualization	Yang	Plan web page structure and improve font size.	Improve styling
November 25	Block Diagram Engineering Requirements	Team	Complete Assignments	Complete assignment through rubric guidelines
November 25	Sending email function	Yang	Design sending email interface, to achieve manual input of mail content and send.	The user was able to receive the email successfully from numberplate@163.com
November 25	program	Zan	Make the program automatically run	Show the works

			And Decide the method we gonna use to transform the data between yang's block	
November 25	ESP wifi setup	Ben	Write code for server that hosts the images the ESP32 will take	Be able to connect to server with ESP32
December 2	Biweekly Progress Video Project Partner Update Block Validation	Team	Complete Assignments	Complete assignment through rubric guidelines
December 2	Technical Demonstration Preparation	Ben	Make sure a server is available to send the pictures the ESP32 camera takes to	Must be able to see a list of the pictures the camera took and automatically uploaded.
December 3	Technical Demonstration	Earth	Complete Technical Demonstration to T.A showing power and sensor	Complete Demonstration from TA and receive feedback
December 3	Technical Demonstration	Zan	Complete Technical Demonstration to show the automatically recognition process and store the useful information in order to prepare for the next step data connection	Get feedback Decide to use which version.
December 3	Technical	Yang	Complete all	Ensure that all

	Demonstration		functions of the web page	functions of the web page work successfully
December 3	Technical Demonstration	Ben	Demonstrate ESP32 and camera and server.	Complete demonstration according to guidelines.
2021 January 21	Block Validation1	Team	In this process, timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	Each member of the group completes his own block.
January 30	Block Check-Off 1	Team	In this process, timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	Each member of the group completes his own block.
February 11	Block Validation2	Team	In this process, timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	Each member of the group completes his own block.
February 21	Block Check-Off 2	Team	In this process, timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	Each member of the group completes his own block.
February 28	Block	Team	In this process,	Each member

	Validation3		timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	of the group completes his own block.
March 14	Block Check-Off 3	Team	In this process, timely discuss with the team members and ensure that the follow-up connection can be carried out smoothly.	Each member of the group completes his own block.

April 3	Test Wifi Distance
April 10	Solder headers to PCB
April 24	Check size for initial system testing Finish Email automation for checkoff Prove camera works for checkoff
May 1	Ben and Earth connect for physical components for testing
May 22	Ben and Yang test POST request together Optimize camera and PIR for computer vision (angle, distance etc.) Testing for pictures sent through system
May 29	Initial full system check Finish anything that is not done and put it together
June 5	Fix anything that went wrong during initial system check
June 10	Finish all testing and be ready to present work!

3.Scope and engineering requirements summary

Scope

The device will be able to take pictures in 2 directions of one lane, interpret the license plate or store the picture on a server, last a month without charging in average conditions, and send an email to the client. The project will not necessarily work late at night and may not last an entire month during extremely inclement weather preventing solar charging.

Engineering Requirements Summary

1. **Short Name**：Abnormal Cases
   Project Partner Requirement (PPR):*The machine can deal with the unclear image*
   Engineering Requirement (ER): The system will store pictures and display them via the internet when the license plate cannot be read.

2. **Short Name**：Cameras
   Project Partner Requirement (PPR):*There will be cameras to take pictures of vehicles.*
   Engineering Requirement (ER): The system will record cars coming from both directions on the roadway.

3. **Short Name**：Car Speed
   Project Partner Requirement (PPR):*The device needs to be able to tell when a car passes.*
   Engineering Requirement (ER): The system will identify cars moving at a speed of 15 mph 90% of the time.

4. **Short Name**：Connectivity
   Project Partner Requirement (PPR): The device needs to be able to send pictures to a server.
   Engineering Requirement (ER): The system will output a summary of the cars seen, a representative image for each car, and a collection of images for cars that can not be identified via the

internet when the camera sub-system is at least 100' away from the router.

5. **Short Name** : Identify License Plate
   Project Partner Requirement (PPR): When the photo contains a clear license plate image, the license plate number can be recognized and recorded.
   Engineering Requirement (ER): The system will identify at least 90% of license plates with no more than 1 character wrong.

6. **Short Name** : Informing the Client
   Project Partner Requirement (PPR): System will send an email with the data.
   Engineering Requirement (ER): The system will send an email at a rate specified by the user, containing the recent summary of cars and links to any unidentified pictures.

7. **Short Name** : Power Supply
   Project Partner Requirement (PPR): The device needs to last at least a month without charging.
   Engineering Requirement (ER): The system will last not less than 30 days before needing to be pulled out and recharged.

8. **Short Name** : Size
   Project Partner Requirement (PPR): The device should fit in a standard mailbox.
   Engineering Requirement (ER): The system must be less than 19 inches long by 6½ inches wide by 8½ inches high except for the solar sub-system.

4.Risk register

Summary of the top three risks, they are R1,R2, and R3.
R1 is highly considered as an important risk impact and has a risk probability of 50%, which said there might be invalid connection between the parts completed by engineering students and those completed by computer science students. And in order to reduce the risk the team will have a frequency of communication under student Ben, Yang and Zan's push.

R2 is as important as R1, and the risk impact is median, which said the product might not work normally due to the influence of night or bad weather. And Student Earth and Zan will be responsible for following the weather forecast and recording the frequency of errors. In order to reduce the risk we are trying to negotiate with users to reach a consensus that the product cannot be used at night.

R3 is also important for our counting system, and the risk impact is median which said the sensor goes off too much. In order to reduce the risk, Ben will test more and finally find a suitable location for the sensor placement.

Part I

Risk ID	Risk Description	Risk category	Risk probability	Risk impact
R1	There is no feasible interface between the parts completed by engineering students and those completed by computer science students.	Technical, Internal	50%	H
R2	The product cannot work normally due to the influence of night or bad weather.	Technical, Environmental	50%	M
R3	Sensor goes off too much	Technical	50%	M
R4	In the process of development, conflicts	Internal, Communication	30%	M

	and contradictions occur between teams.			
R5	Camera draws too much power	Technical	30%	H
R6	The final product exceeds the open budget.	Cost, External	25%	M
R7	The law or neighbors may no longer allow private cameras to be installed around public roads.	External, Environmental, legal	15%	H
R8	Finally, the customer may not approve the final project due to insufficient accuracy, improper product appearance and size, etc.	Customer, Quality, Technical	10%	H
R9	The development team failed to develop the product within the prescribed time.	Timeline, Technical, Internal	10%	M
R10	Incompatible Interface between Camera and Code	Technical	10%	H
R11	The camera supplier failed to supply the goods as promised / damaged during transportation.	External	5%	S

Part II

Risk ID	Performance indicator	Responsible party	Action Plan
R1	Frequency of communication and handover	Student Ben, Yang and Zan are responsible for reminding team members to keep in touch during the development process and to introduce their work without reservation.	Avoid. The unified development language is defined before the development project. Increase the number of meetings per week. Report the progress of work in time.
R2	Light factor, camera pixel , sweather channel	Student Earth and Zan are responsible for following the weather forecast and recording the frequency of errors.	Transfer. Negotiate with users to reach a consensus that the product cannot be used at night. And the product damage caused by natural disasters, the loss will be borne by users.
R3	Testing	Student Ben	Reduce. Test more and find a suitable location for the sensor placement.
R4	The atmosphere of chat and discussion.	Student Zan is responsible for mediating the conflicts between the team members.	Reduce. Decrease the probability of conflict between team members and share their ideas and opinions in a calm way.
R5	Will have to test power draw consistently	Student Earth responsible for battery selection and power consumption control.	Reduce. The power consumption of the camera.
R6	Price change, Shop quotation	Student Zan will monitor and calculate the material cost and find the lowest supplier.	Reduce. List the materials needed in the development process and find the cheapest supplier. Calculate the budget.
R7	Regulatory body	Student Ben will remind	Reduce. Design the

	meeting, proposed government changes	customers during the project and ask them to ask their neighbors for permission. And Ben will pay close attention to the relevant laws.	product as small as possible to prevent interference with neighbors or violation of the law.
R8	Customer	Student Ben will pay attention to keep close contact with the project partner and modify the scheme according to the user's requirements in time.	Avoid, in the initial stage, the project requirements will be carefully discussed with the customer. After the project requirements are determined, the customer will not change it at will and sign the relevant contract.
R9	Development progress.	Student Yang will strictly follow the schedule and urge the team members to complete the assigned projects on time. All team member should be responsible for accomplish their task on time	Reduce. When the task process lags behind the timeline, it should be adjusted in time to speed up the completion progress.
R10	Check if camera is programmable	Student Earth or Ben	Reduce
R11	Manufacturer inventory, logistics company cargo transportation information.	Student Earth will pay attention to confirm the delivery time with the manufacturer and pay close attention to the express information.	Avoid. Confirm the inventory with the supplier before placing an order for the camera. After getting the camera, check the quality of the camera in time.

5.Future Recommendations

	Recommendation
1	**Add Night mode function** In our project we only achieved the goal for recording the car in a day,however because of the time we abandoned the night mode function, it required a high quality camera and the lighting system. The system also needs to deal with the impact of severe weather on visibility and the problem of the reflection of light. **Recommendation** We need to choose a more expensive camera and deal with the night mood, also beside the road we need to have something to light up in order to deal with the unexpected bad weather.
2	**Increase the system life to 90 days.** In our project we aim to make the device running for 30 days without charging and although we finished it, We use solar energy to achieve our goals, however, we believe that by simplifying and upgrading the design structure again, the life of the system should be extended. **Recommendation** When designing, plan for a slightly larger battery, but also pack the components on the PCB more tightly to allow more battery space. I plan to place the microcontroller on my own PCB,
3	**Add App Version** Our project only has the web version and it allows the user to log in on the web or check the email. However in the future we can add the app version. **Recommendation** In order to make a portable version of an app whether on IOS or Android. The app version can have the same function or simple function for the user to quickly overview the database.
4	**Decrease the device size** Our project is a little big and although it reaches the requirement, there still can be a lot of improvement. **Recommendation** The system structure can be simplified, and also the battery can be decreased a lot.
5	**Not just license plate recognition**, also can do color and vehicle type

	Our project only can record the car plate number and the photo of them. Actually we can also make it to record the color and the vehicle type to make the device more smart. **Recommendation** Add the color recognition and the vehicle type recognition function, whether by exploring the API we use or writing our own one. When we record more clearly, the rate of making mistakes will reduce and the data we collected can be more accurate.
6	**The frequency of the license plate is shown to the user in descending order** Our project only displays the car plate number by time. However this makes the database a little bit of mass and it is not very friendly for the user to check. **Recommendation** THe email function and the database can add the sorting function, Sorting by frequency and report on it to the user. And has the function of displaying on webpages through time or frequency sorting.
7	**Add Search Features** Our project only displays the car plate number. However, in future, the user might want to know how many times a specific car passes by. The user needs to search that car plate number in the database through our web, or app. And then our design will not be suitable for the user. **Recommendation** We need to add the function of researching by plate number or selecting function by frequency to make the database and our web more smart to use. And this needs to add a selecting and searching function in our code. But here is something I need to pay attention to is the privacy law in the local community.
8	**Alarm functions** Our system can do nothing to protect itself, and because it is located beside the road and outside the door. There will be some bad situation that happens and the user doesn't know. So we need to add the alarm function to our device. **Recommendation** The use of the alarm function is applicable to when the machine or system fails, it should send a message or alarm to inform the user that the equipment is abnormal, also can prevent the phenomenon of theft and damage.

References:

[1] "YOU ARE BEING TRACKED." [Online]. Available: https://www.aclu.org/issues/privacy-technology/location-tracking/you-are-being-tracked. [Accessed: April. 17, 2021]..

[2] G. DeSantis, "Can Someone Really Steal Your Info From Your License Plate?," Aug. 27, 2020. [Online]. Available: https://www.motorbiscuit.com/can-someone-really-steal-your-info-from-your-license-plate /. [Accessed: April. 17, 2021].

[3] J. Kelley and M. Guariglia, "Things to Know Before Your Neighborhood Installs an Automated License Plate Reader," Sep. 14, 2020. [Online]. Available: https://www.eff.org/deeplinks/2020/09/flock-license-plate-reader-homeowners-associatio n-safe-problems. [Accessed: April. 17, 2021].

[4] "Self-triggering license plate identification method based on virtual coil," Available: *https://patents.google.com/patent/CN101833859A/en*, 2010. [Accessed: April. 17, 2021].

[5] M. Loveday, "Who is responsible for the maintenance of a private road?," 23-Aug-2019. [Online]. Available: https://www.thetimes.co.uk/article/who-is-responsible-for-the-maintenance-of-a-private-ro ad-s8nhhqqxb. [Accessed: April. 17, 2021].