Tracking and Data Collection of Moving an Object
Project Closeout

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8/6/2021

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Tracking and Analysis of Moving Objects Design Impact Statement

Introduction:

The point of this impact statement is to analyze possibly any possible impacts that the system might subject the outside environment to, as well as impacts on social and cultural variable not directly related to the systems purpose. Another key aspect of this is to examine any possible negligible impacts the system may have on the environment. This system will be traveling through multiple geographical locations, and all safeguards should be taken in order to alleviate any negative impacts the system has on outside variables. Specially there will be an in-depth analysis of the lithium-ion battery, and components used to make the system.

Public Health, Safety, and Welfare Impacts:

The direct impact on other people is a critical concern for all engineering projects. As this system is intended to travel through the mail, there is a valid concern as to how many different environments that the system will be traveling through. Public health one main concern for this project. As this system utilizes lithium-ion batteries there is an inherent risk to public health if the system were to experience a failure and be exposed to the outside world. One of the most critical concerns with lithium ion is in its extraction. Both the soil and the air experience serious contamination from the extraction of lithium ion. In countries where lithium ion is extracted there is always a concern about poisoning the local water supply. This is a concern for lithium-ion extraction insofar as ensuring that the seller of the raw mineral will be doing the extraction responsibility, without poisoning the environment and threatening local life. This has been a concern in Nigeria for many years and continues to be an issue where lithium ion is extracted from low GDP countries. there is internet risk when pulling material from the soil, especially when the substance is poisonous. This data comes from the NCBI In a study regarding the health implication of heavy metals found in the food and water of the Nigerian people

Cultural and Social Impacts:

This project uses a neo7 GPS and gy9250 IMU, along with a microcontroller. The use of multiple silicone-based chips has many impacts on society and culture through the world. In an article written by CNBC it is outlined how the over consumption of electronics components has caused a major chip shortage throughout the world. Due to this shortage, prices have never been higher. As we in America, and larger countries, continue in our pattern of overabundance, there is a direct negative impact on the rest of the world. These materials and devices are no longer feasibility obtainable for those who live in a more impoverished society- making these devices almost impossible to obtain: cellphones, electronic hardware, etc. due to the fact that technology helps to make life easier on society, there is the inherent risk here that it can also be determinantal to those who struggled to obtain the materials- yet now cannot feasibility obtain them due to the shortage in materials, and the rising cost.

4.0 Environmental Impacts

Environmental impact factors for this system are wide ranging, especially in regard to obtaining the raw resources- the news has been littered with negative impacts of lithium ion on the environment. In 2016 there were multiple dead aquatic life within the river near a lithium mine. The Guangzhou mine is one of the worlds largest contributors to lithium. There were also dead mammals found along the river, promoting a closing of the mine in late 2013, which did help to alleviate some of the stress on the environment and local wildlife. Just as frightening is the post life of lithium-ion batteries, in which many large dumps have caught fire, poisoning the air and groundwater. There has been an attempt to circumvent these issues through recycling- which has proven difficult due to the intercultural property rights companies have when making batteries, not all of them can be recycled the same.

5.0 Economic Factors

In regard to economics, lithium ion has done much to help alleviate some of the negative impacts put on the world economy. In a report put out by the UN in 2021, some of these benefits are outlines. highlighting the positive impact that lithium-ion batteries have over more tradition acidic batteries. One of the critical points is the reduction in greenhouse gases, due to the elevation on persons to not use fossil fuels to power their devices- namely vehicles. Buses, storage, electrical powers on and commercial vehicle ownership has exploded exponentially since 2015 to now. The next aspect to look at it how lithium ion is helping to eliminate the dependency on non-green energy sources. Lithium-ion battery systems have allowed the expansion of green energy (solar, wind, hydro, thermal), due to their great capacity to store a charge for an extended amount of time. Overall, the impacts of lithium ion economically are astounding positive.

6.0 Additional Impacts

As with all evolutions in technology there is a give and take, there is some aspects of the world that will suffer, yet ideally, we continue moving towards a net positive result. This is highlighted in the case of battery technology, its culmination can be very detrimental to geographical locations, and life there, yet can be done properly- with regulation. The overall positive impact of lithium ion has been the major pushing for green energy sources, allowing countries worldwide to turn away from fossil fuels. Lastly there are the unforeseen consequences of our engineering design choices. Not only for the protection of the world around us, but also to safeguard our employers from having to make costly redesign choices that negatively impact the entire project. For example, in the article regarding environmental impacts of lithium, written by the institute fort energy research, it was highlighted how a simple design oversite could cause not only financial concerns, but the direct safety of the consumer. In this article it speaks about a federal probe into the safety of Chevrolet's new electric car, powered by lithium-ion battery cells- the Bolt. At the end of 2019 this investigation was opened into manufacture due to multiple reported, unexplained, battery fires. Over seventy-seven thousand of the vehicles had to be inspected to ensure the safter of the purchase, and environment – quit a costly engineering oversite. It is our duty as engineering to analyze our engineering solution from every angle

7.0 Conclusion:

By ensuring that the modules used for this system are, in easily available, green in their manufacturing, and utilizing lower energy usage materials, we are able to lower the detrimental impact of our system onto the outside world and environment. Conscious choice must be made in the selection of materials, and also what will happen to the system once the project is completed. Utilizing newer energy technologies are guaranteed way to limit negative impacts. As engineering we have an inherent moral obligation to design inclusive, harm free, technologies that have the ultimate goal of limiting unforeseen effects that the system might have on the environment

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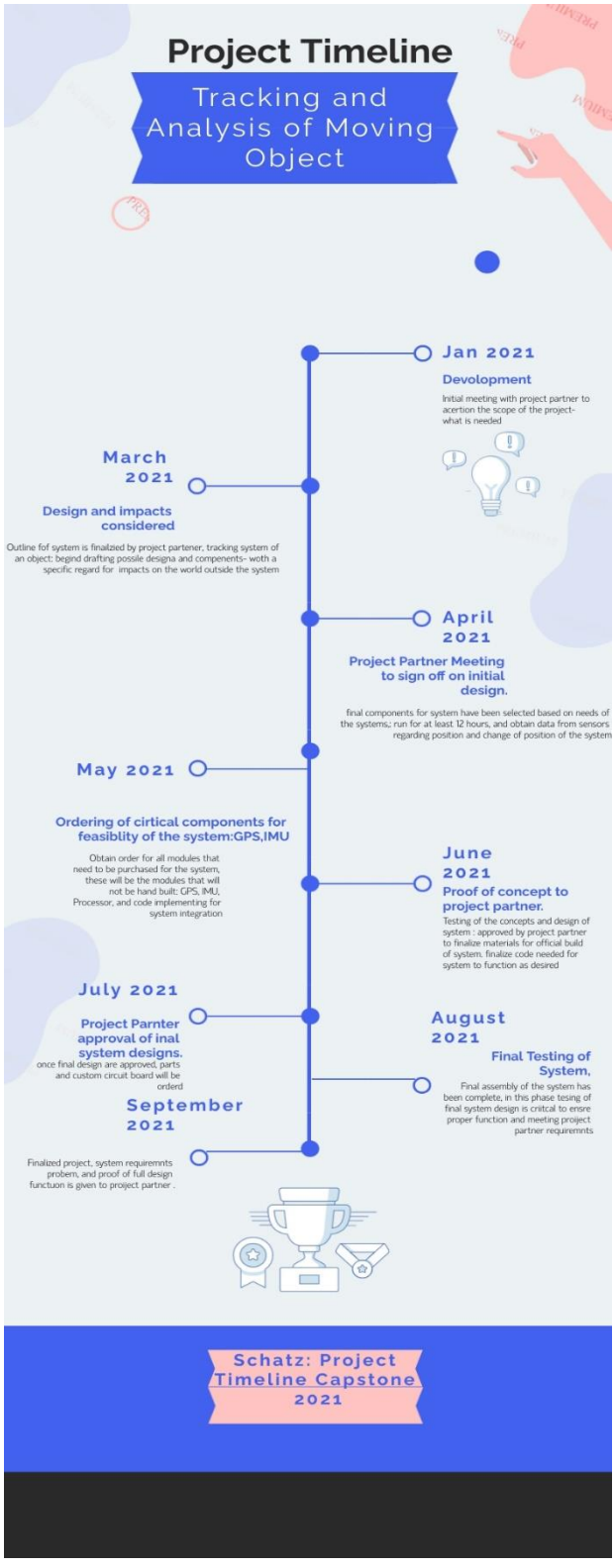
Project Timeline:



Scope and Engineering Requirements Summary:

Name:	Project Partner Requirement:	Engineering Requirements	Summary
Data Retrieval	Need to be able to get data off the system.	The system will output data in a CSV format and will report max and min values for each sensor type.	Data manipulation and subsequent organization and storage for later retrieval will be done by python coding to integrate all systems
Force Detection	The system will detect shock to itself	The system will report force applied to the package, within .01Gs of accuracy	Force Detection will be done via an IMU, code will ensure that there will be at least .01Gs of accuracy for saved reading
GPS	The system will detect its position	The system will report its latitude and longitude, or no signal, every 5 minutes for 12 hours	System will report at least every 5 minutes with information regarding the latitude and longitude of the system: coding to process data
Orientation Sensing	The system needs to be able to detect tilt	The system will be able to detect orientation changes in all directions, up to 180 degrees	The IMU will work in tandem with coding to detect changes in its rotation.

Risk Register

RISK ID	Risk Description	Risk Category	Risk Probability	Risk Impact	Performance Indicator	Responsible party	Action Plan	Lessons learned
R1	Vendor Delay	Timeline	80	H	Covid-19 and possible effects on shipping of components	Matthew	Reduce	Shipping delays were indeed very common, it was critical to ensure ample time for parts to arrive.
R2	Incompatible hardware	Technical	50%	H	Inability to connect hardware via code	Matthew	Reduce	Utilizing open-source operating systems, and substantial testing, allowed for seamless information of all hardware systems
R3	Code Incompatibility	Technical	20%	M	Hardware specific coding requirements	Matthew	Reduce	Choosing an objected oriented scripting language, python, allowed for easy integration and communication between various systems
R4	Battery Life and failure to meet system goals	Technical	80%	M	Wattage use of sensors	Matthew	Retain	Understanding of low power level modes, and limiting overall usage of superfluous systems allows

								for exponentially higher battery life of the system
R5	**Shipping concerns**	**Cost**	**30**	**L**	**Price Change**	**Matthew**	**Retain**	**Weight and size of the system should have better planned out to reduce shipping concerns, possibly using a nonlithium ion battery would also make this aspect of the system cheaper for the consumer to use**

Other Risk Discovered

Risk ID	New Risks	Effects on project	Possible Resolutions
R6	**Mental health concerns for members of the team due to covid 19 isolation: team dynamic and health**	The effects of location on all members of the team were a direct determinant to meeting timelines set down by project partner	Team bonding, an attempt to spend time, outside of the project, to participate in activities together- building a sense of cohesion and command- helps to bring support to others
R7	**Communication between all echelons of the project was difficult during covid**	There is an inherent difficult when working remotely, without the ability to meet with team members, and project partners. Played a large roll slowing the project, and forcing an inherent ambiguity on the project that made it difficult to	Having more frequent meetings in order to ascertain the health of not only the project, but the members working toward its completion.
R8	**Proper workspace without OSU workspace available during Covid**	Inability to have a sheltered, safe place, to work on the project was detrimental to the project timeline	

Future Recommendations:

Increase the system life by 7 days:
Currently the system can operate with all sensors, for just over 14 hours. This is well beyond the initial goal of 12 hours, but this improvement is necessary if the system is to be utilized for longer duration tracking missions. Most packages traversing long distances via post, will be there within 7 days (with proper shipping urgency purchased).
Recommendation
When designing the system, special care should be taken within the initial phase of development, with the goal of limiting wattage usage as much as possible. Utilizing a smaller micro controller, with less superfluous elctrincal systems, would increase the lifespan of this system (with a 2000mA battery capacity), the capacity to up to 62 hours (with a microcontroller utilizing about 80mA draw. Furthermore, shutting down all non-essential systems is critical (HDMI, LEDS), turning off all wireless activity, and video/audio outputs would help lower the overall usage o

Even Distribution of workload:
Ensuring that the project workload is split evenly among team members is paramount. This led to, in this project and others, the dissolving of team cohesion, and general moral of members of the team. Ensuring that each member is doing an equal amount of work is critical- this also comes with its own issues though. Helping to manage the team framework setting would yield itself well to the project staying on time, and keeping the team working towards a common goal- raising the likelihood of the project being finished on time
Recommendation
From initial development phase of the project, ensure each team member is equally providing information and help to the project. Use this time to ascertain strengths and weaknesses in the team members- it is often difficult to speak up if one is struggling with a specific aspect of the project they are working on- ultimately leading to members of the team not putting forth adequate effort to master the skills necessary to complete the project on time. Spread the load of work and have team members work together to share their strengths, to teach, so that others can learn. In this way the team can grow together as a cohesive unit- keeping project on track

Fast Track Building phase:
Currently we saw many issues during the design of the circuit layout, and ensuring a working PCB arrives on time. A failure to properly analyze deficiencies in the modules will lead to a massive loss of time, and ensure the project does not meet the timeline
Recommendation
I would recommend extensive testing for each module that is being developed. Ideally it would be perfect to simulate the design- and ensure all components are working as intended

Proper Management and Support of all members of the team:
Repeatedly we saw issues where members of the team were not willing to speak up when they are struggling, which is a guaranteed during the pandemic isolation. This forces a distance between the team members, and a grind all communication to a halt.
Recommendation
Bolstering an atmosphere of trust, and empathy is key. If this is done from the start, each member of the team will feel more at ease speaking up if they are struggling. It needs to be made abundantly clear that your team, at least for the duration of the project, is there for each other. This will help to ensure that when a member is struggling, they will speak up. This will allow other members of the team to be able to ensure that the project timeline is not sacrificed.

Ensuring Team Workspaces and Meeting times:
During pandemic a proper meeting place, in person or online, is paramount to the success of the project. Having a set meeting place helps to speed along the development of the project, but more importantly it ensures that if one module or aspect of the project is falling behind, then the rest of the team will be notified of it in a timely manner- speeding up the timeline.
Recommendation
At the start of the project, ask all teammates times and days that work best for them to meet. This may also include possible meeting places that are preferred (discord, school, etc.). having at least two meetings a week will give flexibility to team members if they have to miss a day, they can come later in the week and catch up the rest of the team. These meeting also play a large part in keeping moral high, and the project on track to be completed within the set time

Extensive Code Testing- Debugging as a group:
The software aspect of the project is one of the most challenging. If there is a focus on team debugging the likelihood of there being serious coding errors down the road decrease dramatically. This is twofold, one part technical and the other managerial. Having a single member struggle on their own, for an extended amount of time, is detrimental to the project. Involve the entire group in an effort to tackle the problem together
Recommendation:
Make it apart of the weekly meeting that there is will a discussion of the code, and issues that may arise- specially edge cases. Debugging the code as a team helps to get multiple viewpoints of the problem- yielding a solution to the problem much quicker than if the group member was alone. Check values of all critical values as you step through the program in a debugger. This will ensure that small coding issues do not become a detriment to the project timeline.

Obtain multiple backups of critical electrical components (if financially feasible)
This project to assemble our system faced many hardware setbacks. Every single time an electronic component was purchased, there was inevitable a failure of that component at some point- often when the item is brand new.
Recommendation:
If financially feasible order 3-4 backups of each critical electrical component, especially smaller comments meant to read sensory data. This will ensure that when one of them fails, there is no downtime that threatens the project timeline. Lastly, it is paramount that each component is tested before it is fully integrated into the system as a whole- they often bad out of the box.

Managing expectations to keep project on track:
Having a concrete way of communication, wirelessly, to ensure distance from campus is not an issue, is key to maintaining accountabilities for all. Ensuring agreed upon expectations for the project and what each individual is going to do will keep the project on track, and the workload even for all members of the project. There were instances where expectations were never laid down for our project, which led to a loss of team cohesion, trust, and moral – risking the project as a whole
Recommendation:
A combination of expectations, and check-ins helps to keep the team baseline, in regard to what each person needs to do, within the standard norm. without laying down fundamental expectations at the very start, there will be significance interpersonal conflict. Each member of the team has their own culture, wants, needs, strengths, and weaknesses. Speak with the team as a whole and set up basic expectations all will follow. Lastly having a secondary communication pathway, specially for checking in regarding the progress each member of the team has made. Something informal here is perfect, discord/text/messaging service (that everyone agrees on), will help to ensure that each member does not feel a “pressure” by the rest of the team. It is an informal check in, where each member speaks to their aspect of the project, and if they believe they are on track