I. INTRODUCTION

Base on Cambodian Institute for Cooperation and Peace (CICP), Phnom Penh city in 2006 generated about 906 tons of waste per day during dry season and 875 tons per day during rainy season with 37% of it left uncollected and another 63% ended up only in landfill while so little got recycled. And scientist believe that by 2050 there will be more rubbish than fish in the ocean if there is no real effective solution toward this problem. This uncollected trash, landfill and recycling problems are continuing to skyrocket and become the most concern problem for environment. After consulting with a few expertise, take their advices, We Bin Tech Cambodia today with an invention of new technology smart bin that surely can make people contribute to develop our city environment.

II. PROBLEMS STATEMENT

Waste build up is such a major issue for cities in a developing like Cambodia. The population in the main city of Phnom Penh is continuing to grow along with the amount of trash that generated by people make trash management become a major issue effecting both health and environment. As we can see the current trash management system is collecting trash via a designed schedule which some route has more trash than the capacity of the truck to handle while some others route doesn't have any trash at all, this kind of inconvenience cost a lot of money because of the unnecessary waste of time, energy, emission and work force. Moreover, since in Cambodia not many people concern about their trash in which they throw away let alone recycle, the challenge to change Cambodian people's mindset toward recycling is necessary to tackle, because this behavior has cost tax payer's a fortune every year to clean up all the mess and wasted us ton of potential resources from recyclable materials as well.

III. OBJECTIVE OF THE INNOVATION

Our objectives of this project are:

- Use technology to optimize the best trash collecting route for trash collector
- Encourage people to recycle with smart bin by awarding them
- Spread the awareness of the environmental problems through smart phone app
- Improve city environment
- Increase recycling rate
- Decrease amount of trash and recyclable trash that will end up in landfill

IV. INNOVATION NATURE OF THE PROPOSAL

The main innovative nature of the proposal would be the ability to utilize the technology to involve in trash management system. With the current technology of social media, smart phone, internet and its popularity, we could definitely be able to create a great impact on spreading the information and new about the environment to people quicker than ever. Data collection would be an amazing use to creates a new and better trash management system also create data base for future analysis and usage. On the other hand, smart bin uses different types of sensors to detect trash which tell if peoples are actually recycle in the right way or not to be able to reward them correctly and effectively. The point on the other hand could be anything from promotion to real money that can be practice according to sponsors. Last but not least, is the encouragement people get by reward from smart bin that will help people trying to make our city a cleaner place for everyone. Overall, innovation nature of smart bin proposal would be the

technology that we use to create the new trash management system, the function to be able to differentiate trash and recycle them and lastly is the awarding system that will make people recycle with smart bin.

V. ADVANTAGES

When everything around the world is shifting itself to technology, then why not the dustbin? Dustbin is an essential part of the cleanliness mission and thus need to be looked after well. The present methodology being followed for waste collection has many flaws in it, so an immediate step has to be taken before it breaks down the whole system. Adding a bit of smartness to our dustbins will solve most of our problems and the smart-bin has a lot of advantages. The product which is designed to make every dustbin smart is very handy as it can put to work just by placing the sensor and GSM integrated model in the bottom of closing lid of dustbin. The first major advantage of it is that it will stop overflowing of dustbins along roadsides and localities as smart bins are managed at real time. The filling and cleaning time of smart bin will also be reduced thus making empty and clean dustbins available to common people. Using the prediction and route algorithm it will smartly find the shortest route thus reducing the workforce, the number of trucks required to clean, the amount of fuel consumed by trucks and thus can save a large amount of tax payer's money as well. It also aims at creating a clean as well as green environment, as it will reduce the fuel consumption and in return reducing the pollution in the air. Moreover, these solutions would create such positive side-effect like the reduction of the number of overfilled trash bin, increase trash collection coverage for trash collector. Also awarding people to recycle will increase the recycling rate while develop a good behavior for people, which is recycle, to the next generation as well as save us tons of potential resources of recyclable materials and less trash being dump in landfill as well. As it is being said that the technology which goes parallel with environment is the need of an hour. Our project is a step towards such green technology.

VI. PROJECT SEQUENCE

We started our project since the start of the Techno Innovation challenge and up until now it's about 3 months. For the first 4 week on the Techno Innovation Challenge Cambodia, With the help of mentors we were able to develop great idea for our smart bin that fit and could solve the problem we are focusing effectively. During that time, we also create and update our prototype frequently until it become a workable prototype that is able to detect types of trash and generate point, data to server and forward to user mobile application. However, the prototype is not 100% working smoothly so after the event up until now we were able to create progress which is create a mobile app that is functioning and improve our smart bin and for the next 2 months, our aim for technical member is to make server and technology to work 100% smoothly also create a function and downloadable mobile app for testing with user while other member could develop a marketing strategy to spread the news of the smart bin to public. Moreover, these next two month, we would also trying to make partner, gain recognition, get donation and investment toward our project too, so after then Techno Innovation Challenge we wear able to partner small world, a community of business startup, to train and help up with our start up plan, marketing strategy, business plan, customer map and more, also a potential investment from small world in the future if we could implement this project to work. We get to become an impact hub member that

taking part in training by Youth Eco labs which sponsor by US embassy to get more knowledge on how to start a business startup properly and effectively. We also got our smart bin project to show in STEM festival 2018 which really gain us some recognition and interest from people toward our project both from the public and potential partner. And by doing so we were able to find a company that interested in our project that want our proposal for their consideration and another team call GO Green Cambodia App that is working in the same goal, which is to improve trash management system to want to collaborate with us. On top of that, we got a list of potential partner, investor or sponsor which already interested in our project such as:

- Phnom Penh Saart
- Go Green Cambodia
- InSEDD Cambodia
- Somram Project (ZAMANU)
- Monsne café, La pop, Brown café
- Cocacola, Vital, Smart Company

VII. LIST OF HARDWARE COMPONENTS

- Arduino Microcontroller
- Ultrasonic Sensor
- GSM Module SIM800L
- LCD 128x64
- Voltage Regulator
- Keypad
- RFID Reader and Card
- Capacitive Sensor
- Inductive Sensor
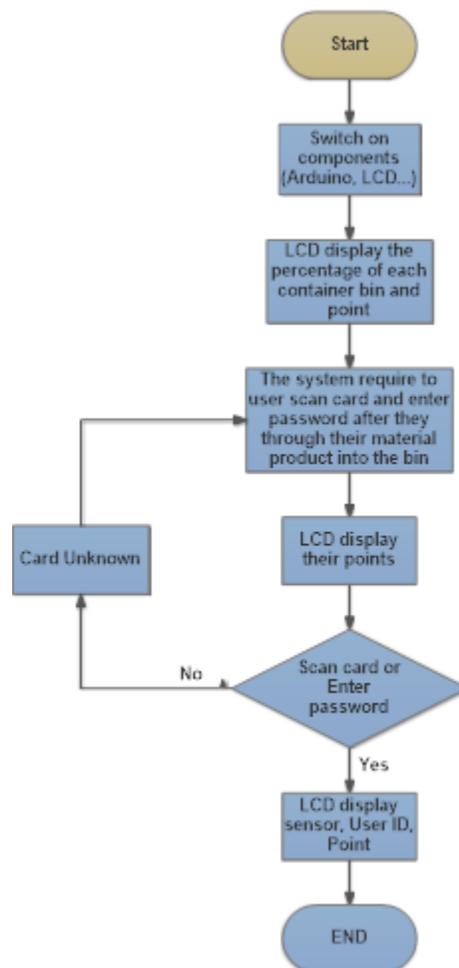- Solar Panel
- Battery

VIII.   CIRCUIT DIAGRAM

Figure 1: System Flowchart

IX.   SOFTWARE AND ANALYSIS

The container is divided into percentage of garbage being collected in it. With its continuous use the levels get filled up gradually with time. Every time the garbage crosses a level the sensors receives the data of the filled level. This data is further send to the garbage analyzer as instant message using GSM module. Every message which is received at the garbage analyzer end is being saved as data which is further used for the process of analysis and predictive modelling. The data received at real time is used by the application interface for better viewing of the filled level. The data received is saved in the database keeping all its attributes intact as time and date. A history of data collected in months is used by the department of data analysis for prediction and report making. The application interface shows the real time level to the garbage analyzer and using that it directs its team of garbage collector to collect the garbage to avoid overflow. The prediction model is designed to predict the time in which every level of container will be filled in future. This helps in saving time; resources of the waste department and work is

then performed in more efficient manner. Moreover, the system for encourage people of trash recycling is exchange between point by recycling with smart bin and money. They must be scan card or enter the password ID for getting the points, and we also have app smart bin for android and iOS phone for free download, so the user need to refresh on their smartphone, so the points will increase. For the future vision we update product to QR code and scan with android and iOS application.

X.   REAL TIME INTERFACE

The real time view of the filled level of every container is shown on LCD display. Every level the dustbin gets filled up is received at the interface end using message service. This message received is taken in the form of text files which is connected to the application on smart phone showing the filled level of every container and the location of the smart-bin. SMS received from the GSM modules of our dustbin is taken in the form of text files. The text file in connected to database. The updated values of the dustbin level are taken to form the real time report.

The map of the city will be used in the application interface and these widgets marking the level of dustbin filled will be put in the location in map exactly the way dustbins are placed throughout the city. This will help the garbage analyzer to keep a track of dustbin filled in exact location. Thus, our application will help the garbage analyzer to keep a check on every dustbin throughout city at real time. It will help him taking accurate decision and avoid the overflow of dustbins and use the resources more efficiently. These multiple smart bin model can be applied to any of the smart cities around the world. A waste collecting team which is deployed for collection of garbage from the city can be guided in a well manner for collection. The application will serve as a central application for the person responsible for monitoring the waste status across the city. The model interface in an application on smart phone is made as shown below, it is completely dynamic in nature and is well connected with the respective dataset generated by the bins.

The smart-bin designed will be sending data about the levels of garbage collected in different parts of the university or city/town. The dataset created can be analyzed to gain lots of insights. The collected data set over a period of time will create a historical data set. The dataset contains different variables of which "ID", is the unique ID of a bin, and is the primary key. Our smart-bin sends us the message which contains the updated level of garbage along with the Date and Time stamp.
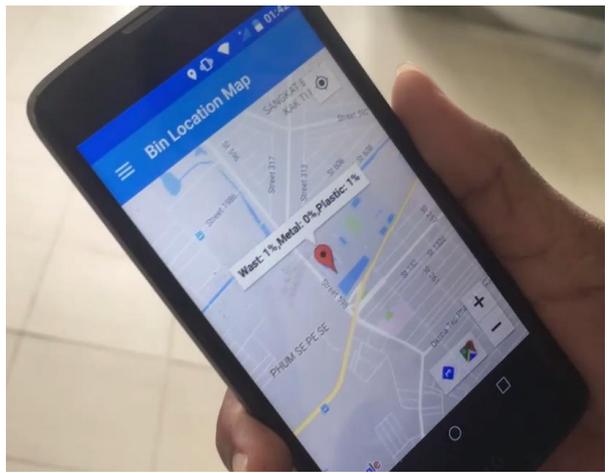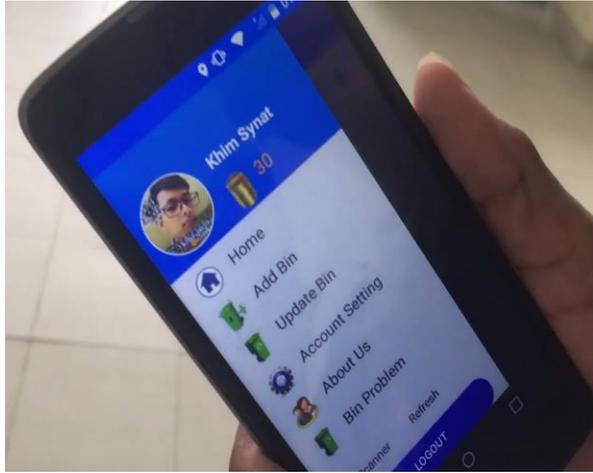
XI.   COST ESTIMATION

After done many research, we can estimate our actual price. For our software development we could spend from 35$ up to 40$ and hardware development is possibly spend from 25$ to 30$ so the actual price of smart bin cost only around 65$. And if we create our product more with a large amount, the price will be decrease because we purchase a lot of materials at the same time. Our product will be placed first at ITC to test our business model.

If it works, we will consider enrich our product to other places like university, supermarket, park, or many public places. So, all ITC's students consider as our first target customer. Our reward system to encourage people is exchange between point by recycling with smart bin and money. The exchange is 10 points equal 200riel therefore students can do exchange payment at cantine through smart phone with appropriate reward with their point. There are around 3000 students in ITC and 75% of them use plastic bottle and other recyclable container, so if they support using our product, we could earn 25000-30000 riel a day. On the other hands, we could also make profit by selling our recyclable trash to recycling company, add advertising material that put on our bin or sell our product directly to customer with maintenance service.

XII.   THE EFFECTS OF INNOVATION

Our invention of Smart Bin contains numerous effective to our target customer. First and foremost, purpose of this invention is to motivate people to use and recycle waste more by changing their throwing trash behavior. As we have invented a new technology recently to detect the kind of trash in the right category, if people put trash in wrong category our bin will alert itself showing that they throw trash into wrong place. Also, we allow consumer to flow out all liquid waste of their drink before throwing plastic container into the bin. This is not only how we contribute to improve people's behavior of throwing trash but also to prevent our environment to consumers from dirty smell. If people contribute by doing so we will award them points. Furthermore, by using smart bin people will love and learn more how to do trash recycle since   every time they throw trash in the right category they will get points which is generated by using our smart bin to their account in app on smart phone and they can do exchange their point to appropriate thing such as a bottle of water, coffee, ice cream. People's awareness of waste management is absolutely necessary. By realize so, we decide to put advertising material to share more environmental educations, problems caused by waste, importance of recycling trash and more in order to develop people's awareness of trash issue and enjoy as entertainment as well. Moreover, our advertising material can be used as business material for customer who want to promote their business too. It is also the way we can earn income. Another amazing effectiveness of smart bin to customer is easiness of finding the location of smart bin and check the quantity of waste in each bin through smart bin's app on smart phone. This benefit is to save time, money, gasoline of trash collector. Simply meaning is trash collector can come and collect trash on the time without the bin being overfilled.

XIII. METHODOLOGY OF TEAMWORK

In order to work effectively on a project especially inventing a thing like ours, with no team's commitment, hardworking, unity and discussion seem not possible to us. Everyone in Bin Tech Team is university students some of us have part time job and work while studying and caring about a big challenging in study field; however, we still keep in touch and work closely to make this invention appear. To work smoothly and efficiently, we divide and share task to each other in team to work with individual skill. The combination skills of our team are variety. Two members of us study Computer science so our responsibilities are to develop app, web and database. And other two of us is Business student and engineering so we responsible for marketing research, market survey, customer development… and another one is student of electronic engineering so he responsible hardware development.

Moreover, we always motivate each other to move on updating our work whenever anyone in team start to feel of losing motivation and we always find way to see possible goal to make it happen. On the other hands, we work with each other honestly. We give feedback in thing that need more improvement and admire on accomplishment. Our mindset is one for all and all for one. We will make it happen with hard working and commitment.