Solar Powered Trash Collector on Land and Water Surface to Maintain Aquatic Ecosystem

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Abstract-Water is essential for our life, and there is no life without water on earth. It is important to maintain its cleanliness as it is the basic need for all living organisms on Earth. Water gets polluted due to many reasons such as waste from industry, garbage waste, sewage waste etc. This makes water unfit for drinking and other human activities. All urban water bodies in India are enduring a direct result of contamination and this results in scarcity of clean water. We have to incorporate technology such that cleaning work is done efficiently and effectively. This project helps in reducing pollution of water bodies thereby serves as a helping hand in removing scarcity of clean water. The main aim of our project is to collect trashes from water bodies together with purification of water. The system is made as a floating apparatus, when powered, it starts to float through water body and collect trashes. Along with trash collection a considerable amount of water is purified using filters. To make the boat selfsustainable, two solar panel are used which would charge the battery. When the Microcontroller is powered, it will drive the DC motors; motor for conveyer belt mechanism and motor for purification. Ardupilot, an open-source unmanned vehicle Autopilot software suite is used for autonomous vehicle control. Finally, a Wi-Fi module is used for visualising the status of microcontroller working. Thus, by incorporating this technology water scarcity and water purification can be overcome.

INTRODUCTION

The key point of the proposed scheme is to optimally direct the power and resources of the distribution system through persistent display of data as IoT-based communication system. At proposed scheme, every home device is interconnected using data acquisition module with an internet protocol (IP) address, which generates an enormous wireless network of working devices. For encouraging improved demand response for the distribution system to take care of energy, IoT-based communication system is utilized. To simply treat energy, optimal load requirement forecast and energy control processes are deal with SMACA system. In addition, the optimal utilization of the available resources and flexibility of these networks is provided and prolonged with IoT-based distribution system[1]. The substances could be categorized as good and bad and it can be determined in three states of matter; either in the form of solid, liquid and gas. These three major forms of substances may carry damage to condition particularly to environments and to human as well. The most common pollutions known are air, land and water pollution. Aside from these infamous pollutions, there are different kinds of pollutants including noise pollution, light pollution and plastic pollution. As can be alluded to reference [1], it is said that any sorts of pollutions consistently have negative effects on the surrounding environment; to wildlife and frequently human wellbeing and prosperity. In reference to [1], the pollution may also be caused by natural events. The events could be occurring due to forest fire and active volcanoes.

Water is the basic need for all living organisms and is the most essential resource, yet water pollution is one of the most serious environmental threats that we face today. More than70% of the fresh water in liquid form of our country is converted into being unfit for consumption. So that it is important to maintain the cleanliness of water. Almost every river system in India is now polluted to a considerable extent. As assessed by the scientists of the National Environmental Engineering Research Institute (NEERI) Nagpur, nearly 70% of water in India is polluted. This project helps to get rid of pollution of water bodies thereby reduces scarcity of clean water. Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids, and gases from water. The goal is to produce water fit for specific purposes. Several methods are used for this; which include physical processes such as filtration,

sedimentation, and distillation; biological processes such as slow sand filters or biologically active carbon; chemical processes such as flocculation and chlorination; and the use of electromagnetic radiation such as ultraviolet light. The innovative system that we propose, offers a unique way to tackle water pollution by collecting the waste accumulated on the surface of water bodies along with purification of a considerable amount of water using filters. This system is made autonomous using ArduPilot which is programmed using mission planner and is also remote-operated which is controlled by an RC remote. DC pumps are attached to the microcontroller for the trash collection and purification. To make the boat self-sustainable we have implemented two Solar panels which would charge the battery.

These two natural events may create all the three pollutions, to air, water and land pollution. Not to mention by human as well, the pollution may occurred as a result of human activities such as deforestation and coal mining which consistently lead to land and air pollution. Above all those pollutions, plastics pollution has been become the greatest threat ever faced by the world nowadays. According to reference [2], plastics were initially being used in the year of 1284. It was in England by Horners Company. They used tortoiseshells for natural plastic production. As mentioned in [3], the term tortoiseshells was invented in 1601 and it can be addressed to as “thermoplastic” or “natural plastic” due to its properties. Dated back in 1600 BCE, a ritualistic “ballgame” was used by the Pre-Columbian Civilizations in Mesoamerica. The ballgame was made from natural rubbers; cast from horns and shells. Authors from reference [2] stated the rubber was then improved with an addition of sulfur and became vulcanized rubber by Charles Goodyear in 1839.

A similar research has been studied by a German physicist which later turning the vulcanized rubber into successful and helpful materials. On the same year, Polystyrene (PS) was also invented by the German scientist which is mostly used for protection in packaging for nowadays used. Thirty-three years after that, Polyvinyl Chloride (PVC) was discovered by Eugen Baumann. The PVC was then fully commercialised and become well-known in United States in 1920s and due to its advantageous, the PVC can act as flame retardant. In reference to [4], figure 1 shows the graph of countries which has contributed to the plastic pollution to the ocean.

LITERATURE REVIEW

As stated earlier in the introduction of this study, the most common type of pollutions can be categorised into three; Land pollution, Water pollution and Air pollution. These pollutions have become the major factor that caused destructions to the surrounding environment which mainly created by human activities. Apart from this, the pollution may also occurred by natural causes. According to [5], the pollutions always concentrated in the metropolitan cities and suburban areas due to large number of population resided in the area. On the other hand, the rapid growth of industrialization at that time had caused the pollution becoming a universal problem. Pollution has been always an issue in China [6]. The most common problem is water pollution. A recent study had shown that over half of the river sections in remoted areas in China are rated as hazardous for human contact. In reference to [7], there are several risk valuations been made. One of the risk valuation is as illustrated through pollution case in Guangxi province of China. The problem was caused after an enormous dump of garbage. This happened in September 2016 where a quarter size of a whole shipment loaded with household garbage was dumped into the river.

However, this situation was captured and noticed by nearby villagers. After some reports made, an instant action had been made by the local department of environmental protection by launching an emergency water quality monitoring of the river. The Guangxi Environmental monitoring centre had also conducted a thorough investigation through the monitoring data after identification of water damage in the river. Another case study was taken from reference [8], where synthetic material such as the disposal of plastic has been seen as a threat to the surrounding and its widespread throughout the environment has caused the destruction of Anthropocene; an act of human activities which has an influence on the environmental impact hence the future of the earth system.

A recent study has been conducted according to [8] that in 2010, there was an estimation between 4.8 and 12.7 million tonnes of land-based plastic which was not properly managed and mishandled had been insinuated to the oceans. Due to this case scenario, it has been noted that the plastic pollution had delivered an obvious unfavourable effects on the organisms, ecosystems, human health and socioeconomic factors including aquaculture, tourism and navigation. The latest

evaluation made from reference [8], at least 5 trillion plastic debris was recorded drifting on the surface of the ocean. This Marine Plastic Pollution (MPP) had been extended to five subtropical ocean gyres as well as the Arctic Ocean; accumulation at the convergence zones. The accumulation of large scales of marine plastic was the result of aftereffect of the wind flow, the currents of the ocean as well as the thermohaline circulation. Thermohaline circulation can be defined as a flow of heat fluxes and freshwater across the sea surface and the interior mixture of heat and salt [9]. Apart from this convergence zones, there is comparable concentration in the subtropical gyres. It has been recorded that this was the result of the heavily populated areas in the Mediterranean Sea, South China Sea, Gulf of Mexico and Bay of Bengal.

As indicated by [8], the biological pathway of living marine organism that had ingested the marine plastic cannot be reversed and stopped as it has a noteworthy impact in the worldwide dispersion of plastic particles. Factually demonstrated that this plastic served as an effective substrate for sessile species; Tube Worms, Bivalve Mollusks and Barnicales just as for motile life forms. Apart from that, it additionally affirmed that plastic could host very harmful viruses, microbial communities and bloom species which also known as "Plastisphere". Beside this, the marine plastic could act as a vector to transport the alien species which is invasive [8]. Regardless of the little size of the plastic, every particle has the ability to convey living organisms and to re-disseminate destructive substances which may alter ecosystem composition and its functionality as well as changing their genetic diversity. The plastic has become rapidly in use since the end of Second World War due to its durability as well as its lower cost of production [10]. Since then, plastic has been on production and currently its production exceeds 280 million tonnes per annum. Based on the same reference, it is believe that estuaries are the main source of transporting the plastic to ocean and of course due to other factors such as industrial outlets and recreational fishing activities. There has been a research made in South Africa that the marine debris is the source of foods by seabirds in the mid of 1980s.

From the reference [11], the plastic pollution has been greatly produced and the source of input to the marine environment have drastically increased. The reference is also once again express that the marine debris such as plastics are being ingested by the marine animals resulting in direct mortality and range of sub-lethal effects such as laceration and gastrointestinal blockage. Estimated over 260 species of animals have been reported to have ingested the plastic debris [11]. Studies from [12] stated that the Marine Plastic Pollution (MVP) composed of macro and microplastic was considered severe as the authorities have limited resources and services on the island of Caribbean and Atlantic Ocean. Beside tourism, fisheries and shipping are another contributing factors of plastic marine debris. Reference [12] has identified that Henderson Island as the most severely polluted in the world.

METHODS

Sentaurus is a TCAD software, developed by Synopsys, which solves the diffusion and transport equations, to modeling the structural properties and electrical behavior of semiconductor devices. All leading semiconductor companies use Synopsys TCAD tools throughout the technology development cycle. TCAD tools allow engineers to explore new design alternatives, test the quality of passivation layers, varying the lifetimes of charges executing simulations. Also is possible to evaluate, characterize, and optimize the process. Wind, water, tides, sunlight biomass and geothermal heat are some of the renewable energy sources. Solar power is the most developing alternate energy source because of its availability in abundance and zero emission. The process of conversion sunlight into electric power needs the use of solar or photovoltaic cell. This photovoltaic cell comprise of the slices of the semiconducting materials (silicon and germanium are most widely used). The solar cells are connected in a huge electric network of solar panels and are mounted over the surface leading to a huge electrical network called photovoltaic system. We also used a 2 Relay Module to switch higher voltage and current loads. A Propeller and a Conveyer belt are used for establishing vehicle movement. Finally, for the filtering we have used a normal filter along with sediment and carbon filters.

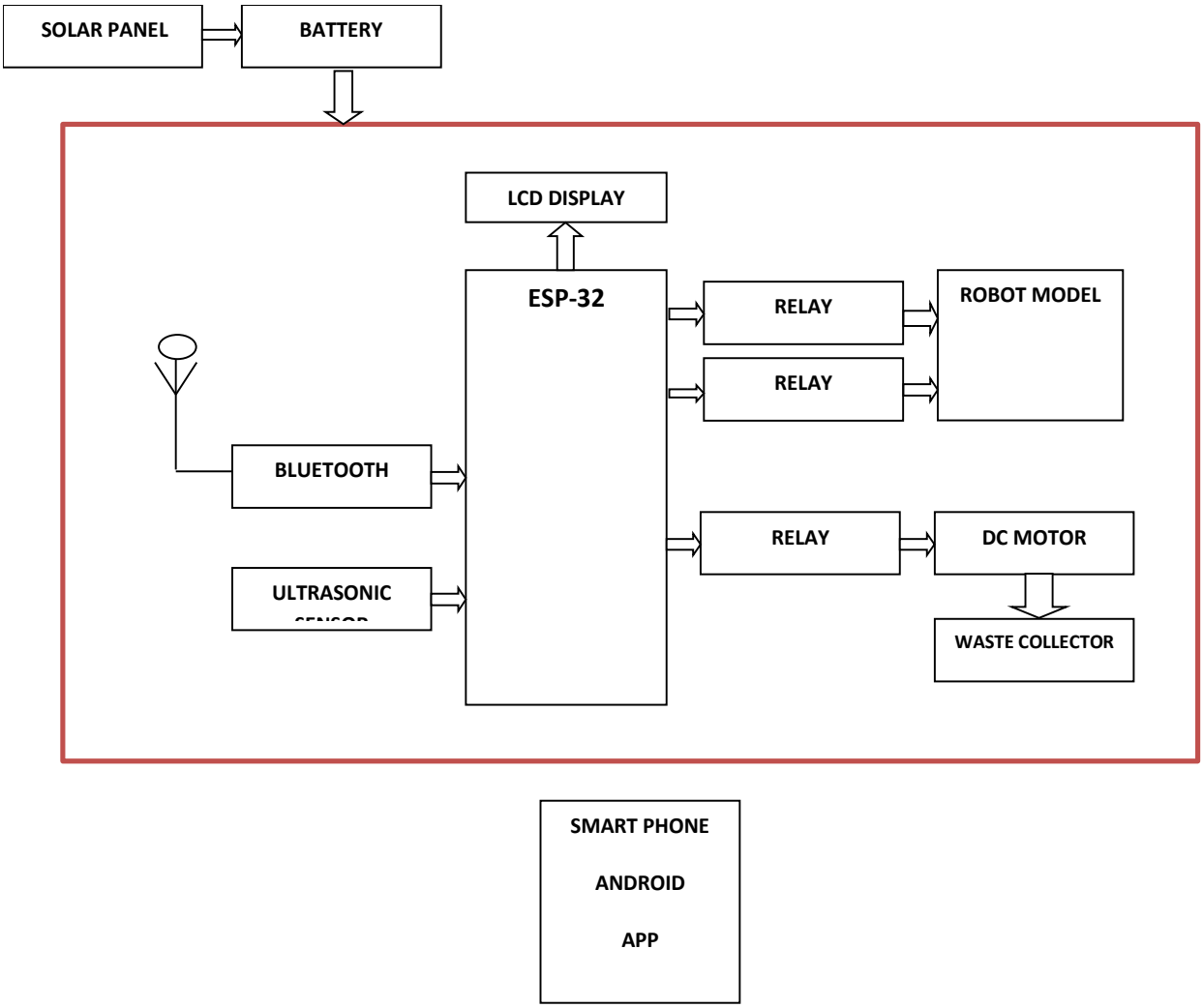
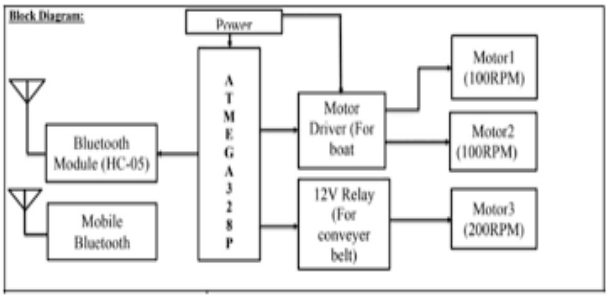


Fig 1: PROPOSED BLOCK DIAGRAM

Inorder to control the speed of boat, Potentiometer, Stepper motor, ESC are the components used. Library file for server motor is used, and initialise the values for ESC (pin number and max-min values of PWM). It is necessary to initialise the required variables like potentiometer. The readings from the potentiometer vary from 518 to 1023. The required input for the ESC is between 0 to 180, so that we need to map the values from the potentiometer to 0 to 180 (which means maximum phase width (0) and minimum phase width (180)). Maximum phase width, which the motor can run in full speed and for minimum phase width, which runs in low speed. In this system we have used two Propeller, so that by varying the speed of motors, the vehicle can be directed to left or right and at the same time gives forward movement.



RC remote is programmed to control the working of propeller, conveyor belt, vehicle movement and speed and pumping mechanisms in water purifier. Here 4 sets of ESCs are used,2 for movement of vehicle, 1 for conveyer belt, 1 for propeller and the other for pumping and purification. Initially, the values and pin numbers for each component is set with the help of library files. The analog value from the Potentiometer is connected to the

analog pin of the Microcontroller and data gets transmitted through NRF module. In the receiver section, the received potentiometer values are mapped to the required range of values by varying the PWM signal. The variation in pulses helps in controlling the speed of motors. This is the same concept that is used in Conveyer belt, Propeller and in the Pumping and Purification process.

RESULT ANALYSIS

Several designs and projects have been conducted throughout the world on handling the plastic pollution. It ranges from autonomous, mechanical and human-based computation designs. All the designs were created in the hope of reducing the plastic pollution especially those plastics found on the water surface; water body and ocean. After several research and observations made, we have subsequently developed an idea and led to produce another proposed design. The design itself can be illustrated in figure 5. Like other designs and projects, the proposed design shown in figure 5 and 6 is a result after numerous number of discussions and considerations. It was chosen due to its novelty in terms of functions and aesthetic design. It is also a fully autonomous robot vessel which was designed to collect different kinds and sizes of floating plastics and other types of marine plants on the surface of water.

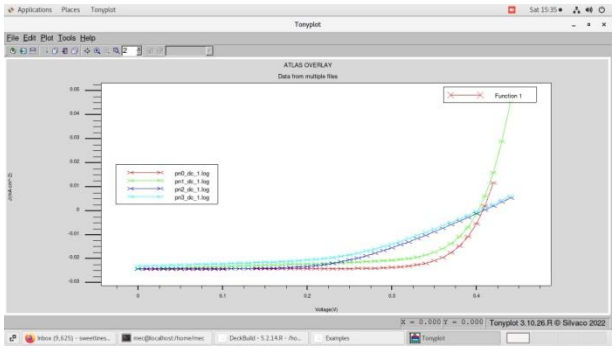


Fig 3: Overlay

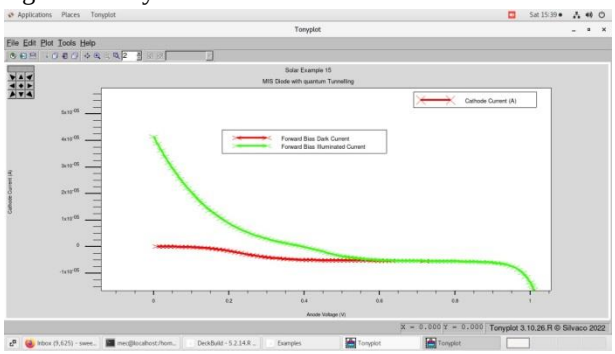


Fig 4: MIS Diode

Solar cells have shown great rise within the photovoltaic industry for over few decades. Many research and development within this direction has changed the pathway of the photovoltaic industry and leads to a new era where efficiency and cost are the most standard concern. This paper is an effort towards the basic understanding of dependency of the yield of photovoltaic system over the electrical and optical parameters. Using a single layer of crystalline silicon solar cell with optimised thickness and choosing the right parameters leads to the reduction in the cost of the solar cell.

CONCLUSION

The aim of the study was to investigate the main contributor to plastic pollution. It was found that the main sources of plastic pollution were mainly caused by huge dump of garbage as well as the result of tourism activities. Amongst the negative impacts of plastics pollution includes the destruction of anthropocene, unfavourable effects on the organisms, ecosystems and human health. A number of countries have carried out various initiatives to reduce plastic pollution. These initiatives include Automatic Trash Collection Boat which is currently being established in China, Solar-powered Water Wheel Project which is carried out in Baltimore, a SeaVax from United Kingdom and many more. Although there are several initiatives that have been already practiced around the world, the demand of reducing plastic wastes on the water surface keeps on increasing as this plastic pollution is still a threat to human, living creatures and environment. Hopefully with the new proposed design, it could help to scale down the amount of plastic wastes. Apart from this, the new proposed design was created and produced so that it is applicable to be used anywhere and more importantly, it was designed to suit for the Bruneian context. However, the main important steps that need to be taken is to create awareness among the world population of the negative impacts of plastic pollution.

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